

# State of the Great Lakes 1997 Annual Report

## Lake Huron: the "Forgotten" Lake?



## In Memoriam

The Office of the Great Lakes dedicates this *State of the Great Lakes 1997 Annual Report* to the memory of Gary K. Hurlburt. On October 22, 1997, Gary lost his battle with cancer. Gary was employed by the Michigan Department of Natural Resources/Environmental Quality for over 23 years as a toxicologist. He was hired as the Department's first toxicologist to assess the impacts of toxic substances on the environment from a human health perspective. For the last 15 years, Gary had supervised the Hazard Assessment Unit in the Great Lakes and Environmental Assessment Section. Gary was involved in the development of the Great Lakes Initiative (GLI), an effort by the U.S. Environmental Protection Agency (EPA) and the Great Lakes states to develop consistent water quality standards in the Great Lakes basin. For his development of human health water quality criteria, he was awarded special recognition by EPA in 1992, and the Director's Award for Outstanding Professionalism by the Department in 1994. Gary was a co-principle investigator for a project titled, "Defining Persistent, Bioaccumulative and Toxic Great Lakes Contaminants," funded by the Michigan Great Lakes Protection Fund, Office of the Great Lakes. The purpose of the project is to improve Michigan's relative risk ranking ability and identify high priority persistent, bioaccumulative and toxic Great Lakes contaminants. His colleagues in Michigan and all the Great Lakes states will miss working with Gary Hurlburt.

*Cover illustration adapted from a 1755 map of the Great Lakes  
by French mapmaker Jacques N. Bellin.*

# Working for Generations Not Yet Born

Over the past and current years, I have launched several initiatives which will place Michigan at the forefront of protecting our Great Lakes. I am determined to pass on to future generations, not yet born, the bounty of our "sweetwater seas."

Looking at the Great Lakes watershed as a whole, I have proposed the Clean Michigan Initiative, a bond issue amounting to *half a billion dollars*, to meet several important challenges. In particular, I am seeking \$325 million for Brownfield Redevelopment to renew old industrial sites and retard urban sprawl and the paving over of "greenfields."

I am seeking \$50 million to combat nonpoint source pollution — runoff from farms, parking lots, construction sites and golf courses — which is now the single biggest cause of water quality impairment. Building on my work as Chairman of the blue-ribbon National Forum on Nonpoint Source Pollution, convened by the National Geographic Society and The Conservation Fund, I aim to maintain our state's leadership on this environmental priority.

As a means of furthering the toxic cleanup of Great Lakes Areas of Concern, and implementing their Remedial Action Plans, I am also calling for \$25 million for the remediation of contaminated sediments, remnants of historic misuse of chemicals of concern such as PCBs and mercury.

The Great Lakes fishery is the most immediate manifestation of the bounty of the Great Lakes to our citizens. The \$4 billion resource is the primary measure by which they judge our success, or lack thereof, in exercising stewardship over the entire basin.

With this in mind, I have budgeted \$18 million for rehabilitation of Michigan's fish hatcheries and an additional \$3 million for sea lamprey control efforts in the St. Marys River which accounts for the production of more lampreys than all other Great Lakes tributaries combined! Moreover, I continue

to urge the federal government to follow our example and appropriate the full \$15.1 million necessary to carry out the complete sea lamprey program proposed by the Great Lakes Fishery Commission.

These efforts are complemented by the ballast technology control project, which I started under the auspices of the Council of Great Lakes Governors, designed to address the broad threat of exotic species introduction by international shipping. Meanwhile, the Office of the Great Lakes continues to implement our state plan to reduce the introduction and spread of the alien intruders throughout Michigan.

Believing that sound science is the basis of sound environmental policy, I have sought the advice of the Michigan Environmental Science Board (MESB), chaired by Michigan State University's Dr. Larry Fischer, on questions involving both directional drilling along the Great Lakes shoreline and the proposed use of fish consumption advisories for fish contaminated by PCBs. Relying on the advice of the MESB, drilling will be banned within 1,500 feet of the shore and near other sensitive areas. We are offering strict guidelines for fish consumption by women and children, due primarily to the extreme sensitivity of unborn children, while recognizing the health benefits of eating fish for the general population, e.g., males and women beyond child-bearing age.

My plan of action is ambitious, but it is also necessary if we hope to maintain the glory of the Great Lakes for our grandchildren. I invite every Michigan citizen to join me in this exciting quest for a fully restored ecosystem.



John Engler  
Governor





# Working Through the Issues One at a Time

Theologians define humility as the virtue "that keeps a person from reaching beyond himself." It is opposed to pride and to self-denigration which fails to recognize one's gifts or abilities. Very simply, humility requires acceptance of the truth.

Humility is foremost in our thoughts as we try to comprehend the dynamics of resources as vast and complex as the Great Lakes, much less manage them. This is not the counsel of despair but of realism in the face of uncertainty or incomplete information. There are plenty of instances where this is the case: the decline of the perch fishery in Lake Michigan; the nature and extent of global climate change; the impacts, if any, of hormone-disrupting chemicals on the child in the womb; the amount of water in the Great Lakes over the long term; and the impact of long-range air pollution.

There are, of course, those areas of human endeavor where scientific knowledge and political will have come together, say, to reduce the loadings of persistent, bioaccumulative toxics into the environment or to restore a Great Lakes fishery decimated by pollution, over-fishing, exotic predators and habitat destruction.

What strikes me about the selection of articles in this year's *State of the Great Lakes 1997 Annual Report* is the interplay of opinions, in a kind of contrapuntal movement, working through the issues one at a time.

I am edified by the level of this discourse, proud to offer it to our readers as they come to terms with these pressing issues with the humility necessary to complex subjects.

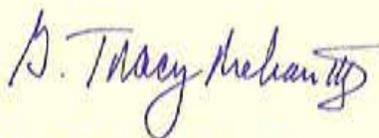
This year's annual report highlights Lake Huron, "the forgotten lake," in the hope of elevating it as a concern for policy makers in the region. Lakes Michigan, Erie, Ontario and Superior all have their comprehensive lakewide processes. It is time for similar attention to be directed to

Lake Huron, with an emphasis toward habitat restoration and control of exotic species, especially the sea lamprey.

The staff of the Office of the Great Lakes dedicates this annual report to the memory of Gary Hurlburt, an esteemed colleague,

a friend and a man who did more than his share to restore the Great Lakes in the face of historic toxic contamination. He was the department's first toxicologist and trained many others who came up through the ranks. Gary's death last year was a tremendous loss to the region, the state, and, most particularly, his family for whom we continue to pray. Gary embodied Theodore Roosevelt's view of how life should be lived: "Far and away the best prize that life offers is the chance to work hard at work worth doing."

*Requiescat in pace.*



G. Tracy Mehan, III  
Director  
Office of the Great Lakes





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# State Demonstrates Ongoing Commitment To Great Lakes Protection

*By Russell J. Harding, Director, Michigan Department of Environmental Quality*

The year 1997 stands out as a notable period in Michigan's tradition of protecting and enhancing water quality in the Great Lakes Basin.

Michigan became the third state in the region to implement the Great Lakes Initiative (GLI). The GLI was a joint effort between the U.S. Environmental Protection Agency and the Great Lakes states to establish a consistent level of environmental protection for the Great Lakes ecosystem regarding toxic pollutants.

Significant progress was made in the cleanup of surface water sites with contaminated sediments. Remediation efforts on the River Raisin, Willow Run Creek, Manistique River, Newburg Lake and Evans Products Ditch resulted in the removal of over 600,000 cubic yards of sediments contaminated with PCB. These sediments had served as an ongoing source of PCB contamination to surface waters. The remediation project at Monguagon Creek also was completed by removing 30,000 cubic yards of sediment contaminated by various organic chemicals from historical industrial activities.

Though directional drilling has been occurring since the early 1980s, Governor Engler asked the Michigan Environmental Science Board to examine any potential risks associated with the practice. The board concluded that directional drilling poses virtually no risk to the Lakes, but offered suggestions for protecting the shoreline. The key recommendations, such as establishing a 1,500-foot setback zone from the shoreline and prohibiting new infrastructure in critical or sensitive areas, were immediately adopted by the Department of Environmental Quality (DEQ).

Significant recent water permit reissuances included the city of Detroit and Dow Chemical in Midland. The new permit contains provisions for minimizing toxic pollutants and for controlling industrial discharges. In addition, the permit continues the implementation of the city's combined sewer overflow (CSO) control program. Compliance with these CSO requirements is expected to cost more than \$1 billion.

At Governor Engler's request, the Michigan Legislature has appropriated an additional \$500,000 to the DEQ's Surface Water Quality Division to implement a portion of a new statewide water quality monitoring strategy. The DEQ continued to implement the Lake Superior Binational Program signed by Governor Engler in 1991. Consistent with the commitment made by the governor, administrative rule revisions were published to designate all water in the Lake Superior Basin as Lake Superior Outstanding International Resource Waters. The special designation is intended to minimize or eliminate new or increased discharges of nine specified bioaccumulative chemicals of concern.

Our 1997 record is one in which all Great Lakes stakeholders can take great pride. The ultimate test is whether we can sustain that positive momentum in this new year and into the next millennium. It's a challenge we're committed to meeting.



# Moving Toward Sustainable Fisheries

by K. L. Cool, Director, Michigan Department of Natural Resources

During the summer of 1965, millions of alewives washed up on the beaches of Lake Michigan. The mass die-off of fish coincided with the peak of the tourist season. Beaches were closed. Front-end loaders, bulldozers and specially designed heavy equipment were deployed to gather up and bury the fish. Researchers were reporting that 95% of the fish biomass of the Great Lakes was composed of non-native prey fish, principally alewives and smelt. Sea lamprey, which had invaded the Great Lakes via the St. Lawrence Seaway project, had all but eliminated the key predator fish of the Great Lakes. Recreational fishing was nearly nonexistent. Commercial fishing was on the ropes. To make matters worse, massive blooms of algae were fouling the beaches in southern Lake Michigan.

The message was clear: the Great Lakes region had to develop a sustainable approach to economic development, sustainable meaning one that did not sacrifice the integrity of our ecosystem. The response by the people of the Great Lakes region was immediate and remarkably effective. Municipal and industrial wastewaters were cleaned up. Discharges of phosphates, which fueled the algae blooms, were controlled. Toxic chemicals and persistent chemical contaminants, such as DDT and PCBs were banned in the Great Lakes watershed. Sea lamprey control was perfected and implemented. Predator fish were stocked to control the overabundant smelt and alewives. The lakes quickly became a national destination for salmon and trout fishing. By 1990, the fisheries of the Great Lakes were valued at \$4 billion annually. We have come a long way in only 30 years.

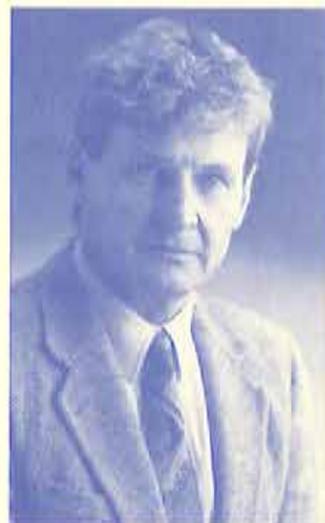
But the Great Lakes, as barometers of the health of our environment, are telling us there is still much to do. Their fisheries still require two "life support systems": sea

lamprey control and stocking. If we relax either of these programs, the fisheries would collapse.

When sea lamprey control and restocking of trout and salmon began, the expectation was that lake trout would quickly become self-sustaining again.

The same was thought of walleye re-introductions in Saginaw Bay and elsewhere in Lakes Huron and Michigan. Lake trout, in fact, are now sustained by reproduction in Lake Superior. This lake has nearly been weaned of hatchery support. Yet, after 30 years of stocking, lake trout are still not reproducing at significant levels in Lakes Michigan or Huron. And walleye are still largely dependent on stocking in these waters. This tells us we still have a long way to go before recovery of these lakes can be considered complete.

Stocking is costly. Operating costs, alone, of Michigan's hatcheries are \$6,700,000 annually. Michigan's fish hatchery system as we know it today is largely a product of the restocking effort of the 1960s. The facilities are aging and some are nearing the end of their working lives. In 1997, therefore, Governor Engler proposed the spending of \$18 million for maintenance of the state's hatchery facilities. This investment will assure the future productivity of Great Lakes fisheries. The investment was required principally because salmon, trout and walleye were not reproducing in Lakes Huron and Michigan as expected. Why weren't they?



Great Lakes ecosystems are complex. In complex systems, an array of factors can be expected to work in concert to produce a particular result. In this case, the principal factors are barriers (dams) and loss of spawning habitat, contaminants and pollution, over-fishing, and sea lampreys: *the same factors that led to the collapse of the Great Lakes fisheries in the first place.* Barriers continue to block walleye, salmon, trout, sturgeon and other species from reaching historically important spawning grounds. Contaminants such as PCBs, combined with diets composed of non-indigenous species like alewives, are causing early mortality syndrome in salmon and trout. Sediment from runoff waters continues to bury spawning reefs needed by walleye and lake trout. Over-fishing, both recreational and tribal commercial, of lake trout continues to confound rehabilitation efforts. Sea lamprey control has been frustrated by lack of funding. And new, unwelcome invaders from outside the Great Lakes watershed continue to colonize the lakes through navigation seaways.

Fortunately, research has revealed that cost-effective advances in lamprey control are within reach. The only impediment to containment of lamprey now appears to be funding. For this reason, Governor Engler and the State Legislature appropriated \$1,000,000 per year for the next three years to help with the lamprey control effort in the St. Marys River. I hope this state contribution will stimulate both Canada and the United States to fully fund the lamprey control program. With fully funded lamprey control, numbers of adult, spawning age lake trout would almost double in northern Lake Huron and would increase substantially in Lake Michigan. The prospects for reproduction of lake trout would be greatly enhanced.

Much of the habitat needed to support reproduction of Great Lakes fish is buried behind dams. Dams also block fish passage to high quality spawning habitats in upper reaches of tributary streams. Over 1,600 miles of prime fish spawning and nursery habitat is blocked by dams across rivers

that flow into Michigan's Great Lakes. For example, it is estimated that removing or providing fish passage around the lowermost dams on the Muskegon River would result in enough salmon reproduction to support most of Lake Michigan's chinook salmon fishery. Almost all of Michigan's prime spawning sites for lake sturgeon (a state Threatened Species) in Lake Huron tributaries are blocked or buried by dams.

It is my sincere hope that Michigan's costly reliance on stocking to sustain Great Lakes fisheries will soon come to an end. In the future I see hatcheries playing a role in supplementing and diversifying inland and Great Lakes fisheries, but they would no longer act as "life support" for aquatic ecosystems and economic benefits they derive. I hope that in another 30 years it will not again be necessary to invest in a complete renovation of our current hatchery capability. But no single action will take us to that future. We must integrate a full lamprey control program with invasive species prevention, effective harvest controls, continued vigilance in control of aquatic contaminants, selective dam removals, fish passage improvements, and improved control of sediment losses from our lands. As costly as stocking is, until all those elements are in place, we must continue to rely on our hatcheries to maintain ecosystem health and viable fisheries.



*A lake is the landscape's most beautiful and expressive feature. It is the earth's eye; looking into which the beholder measures the depth of his own nature.*

Henry David Thoreau, Walden

## Lake Huron – Is It the Forgotten Lake?

### The Forgotten Lake

Lake Superior has its Bi-national Program. Lakes Michigan and Erie have their Lakewide Management Planning

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*Lake Huron — “lake of the shaggy-haired tribe” (named after the first French explorers’ impression of the area’s native residents)*

Source: Great Lakes United

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processes, and Lake Ontario has its Toxic Reduction Strategy. Millions of dollars are being spent on the Lake Michigan /Green Bay Mass Balance Study and everyone is celebrating the success of the phosphorus reduction efforts in Lake Erie. Even Lake St. Clair is getting attention. What about LAKE HURON? Have we forgotten about LAKE HURON?

Lake Huron may not be getting the attention other Great Lakes are getting from government agencies and other organizations, but maybe that's not all bad. The charter boat captains aren't complaining. Coho, chinook, and walleye fishing have been great over the last several years. Eagles don't seem to be complaining, their brooding success rate has increased and pairs of bald eagles have returned to nest along the Lake Huron shoreline.

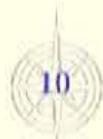
However, there is a complacency regarding Lake Huron. As the 'lake-in-the-middle', both geographically and in environmental quality, it is a lake without high-profile issues or advocacy groups to

focus attention. It has relatively good water quality and wetlands, except in the Areas of Concern. The fishery is relatively healthy except for the lamprey threat to the lake trout fishery from the St. Marys River. Nonetheless, the problems are real and there is a need to identify what most needs to be protected and restored.

The U.S.-Canadian border divides Lake Huron almost in half. The Canadian portion of the lake, including Georgian Bay, is within the Province of Ontario. The U.S. portion is located within the state of Michigan. Lake Huron has the longest shoreline of the Great Lakes and has more islands than any other lake in the world. The lake is the third largest freshwater lake in terms of area and the sixth largest in volume. Lake Huron has the largest island, Manitoulin, of any freshwater lake on Earth.

### *General Lake Huron Facts*

Length .....	206 miles
Breadth .....	186 miles
Average Depth .....	195 feet
Maximum Depth .....	750 feet
Volume .....	849 cubic miles
Water Surface .....	23,000 sq. miles
Watershed Area .....	4,800 sq. miles
Shoreline length (w/islands) .....	3,180 miles
Retention Time .....	22.6 years
Total Population .....	2,694,151
Michigan .....	1,502,687
Ontario .....	1,191,464
Islands .....	more than 30,000
Source: Environment Canada/U.S. Environmental Protection Agency, 1996	



### Lake Huron Land Use

Forest .....	66%
Agriculture .....	22%
Residential/Industrial .....	10%
Other .....	2%

Source: Environment Canada/U.S. Environmental Protection Agency, 1996

Both sides of Lake Huron have low human population densities, with the southern portion of the watershed developed to a greater degree than the northern. In the past 20 years there has been increasing pressure for seasonal land uses, especially recreational cottages. The trend over the next 20 years will likely be for more permanent homes and year-round recreational cottage use.

### Lake Huron Birds

Compared to the other Great Lakes, Lake Huron has the highest number of fish-eating birds that breed along the shoreline. Most populations of fish-eating birds (cormorants, caspian terns, and osprey) are increasing, with caspian terns and osprey no longer showing adverse effects of contaminants. Loss of shoreline marshes and wetlands have been moderate compared to the other lakes except in Saginaw Bay. However, continuing loss of wetlands is a serious threat to habitat, including loss of resting and feeding areas for migratory waterfowl. Saginaw Bay, a rich biological resource and largest freshwater coastal area in the United States (1,143 square miles) continues to provide essential habitat for both fish and wildlife with more than 3 million waterfowl migrating through the area annually.

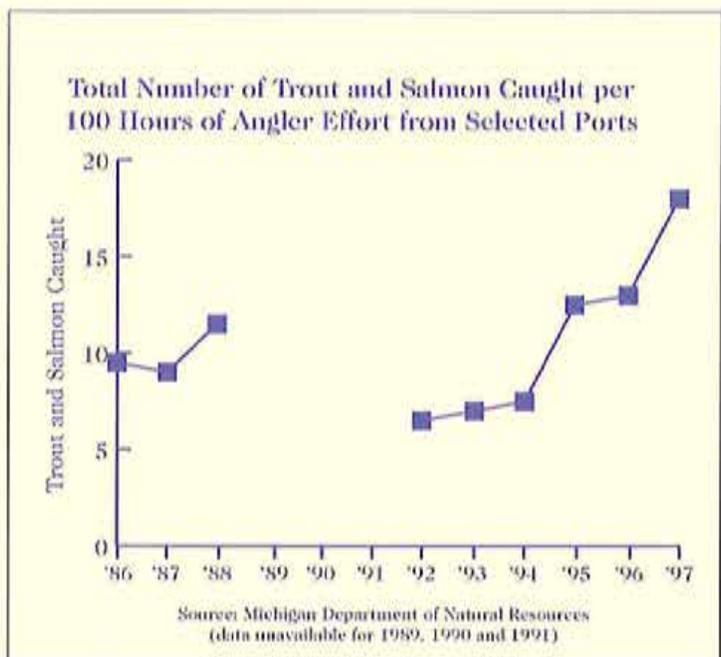
### Lake Huron Fish Community

Lake Huron's aquatic community health and biodiversity are relatively good, at least in contemporary terms and

in comparison to the other Great Lakes. The fish community in Lake Huron is recovering, but remains unstable after decades of being over-harvested and subjected to the effects of nonindigenous species. Modest numbers of stocked lake trout are reproducing in the lake, and populations of whitefish are more abundant than at any other time in this century. Walleye and yellow perch are once again abundant. Rainbow smelt and alewife populations are currently stable, but have been reduced in comparison to former peak levels in the 1970s.

Both United States and Canadian fisheries managers, through the Great Lakes Fisheries Commission, developed fish community objectives for Lake Huron. They are committed to protection and restoration of the lake's fish community. The fish objectives rest on a set of ecological principles (i.e. stability, balance, and sustainability) tempered by social values. The objectives reflect the understanding that natural systems are dynamic and provide some latitude in adjusting management approaches to different conditions.

In Lake Huron major areas of contention and opportunity are: habitat management, sea lamprey control,



introduced exotics, public demands, monitoring and research requirements, and judicious stocking. The major Fish Community Objectives for Lake Huron are:

- *Salmon/Trout*: establish a diverse community with lake trout the dominant species.
- *Walleye/Perch*: reestablish and/or maintain populations.
- *Northern Pike/Muskellunge/Channel Catfish*: maintain as prominent predators.
- *Lake Whitefish/Ciscoes*: maintain diversity and restore lake herring.
- *Sturgeon*: increase abundance to remove it from its threatened status in U.S. waters.
- *Sea Lamprey*: obtain a 75 percent reduction by 2000 and 90 percent by 2010.
- *Species Diversity*: recognize and protect the array of other indigenous fish species because of their ecological significance; intrinsic value; and social, cultural and economic benefits.
- *Genetic Diversity*: maintain and promote genetic diversity.

- *Habitat*: Achieve a no net loss of productive capacity of habitat, rehabilitate degraded habitats, and support the reduction/elimination of contaminants.

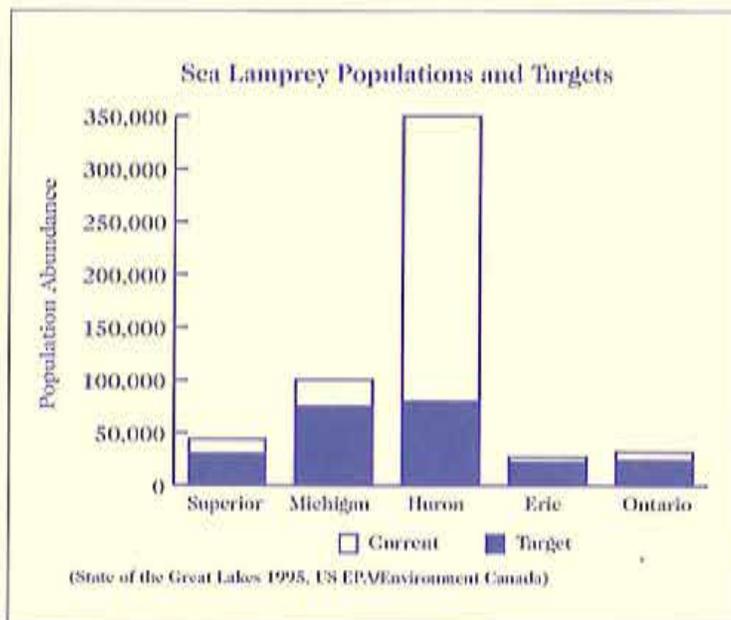
## Lake Huron Sea Lamprey

Rehabilitation of the Lake Huron fisheries has not been as successful as in other areas of the Great Lakes principally because of the sea lamprey. Without question the sea lamprey problem in northern Lake Huron, associated with increased production from the St. Marys River, is the most severe impediment to a healthy fish community in the lake. By the 1990s the St. Marys River was producing more young sea lamprey than all other spawning tributaries to all of the Great Lakes, on either side of the international border, combined. Although sea lamprey control efforts on all Lake Huron tributaries, excluding the St. Marys, are comparable with other Great Lakes, there are more sea lamprey in Lake Huron than in the other lakes combined. Cost-effective sea lamprey control on the St. Marys, once thought to be impossible, may now be within reach because of a special program developed by biologists and research scientists working under the direction of the Great Lakes Fisheries Commission.

With respect to other exotic species causing stress in Lake Huron, zebra mussels, purple loosestrife and the zooplankton such as the spiny water flea pose major threats.

## Lake Huron Water Quality

Historically, phosphorus has been a significant problem in the Great Lakes. To a great extent, this has not been the case in Lake Huron, with the exception of Saginaw Bay and the Ontario shore of the southern portion of the lake. The Great Lakes Water Quality Agreement identified target loads for all the lakes to prevent phosphorus-related problems



(over enrichment), and Lake Huron has generally maintained loadings less than the target loads. With the exception of 1982 and 1985, loadings have been below the target since 1981. Some localized nutrient problems still persist in Saginaw Bay and on the Canadian side (Severn Sound, Collingwood and Spanish Harbours).

Originally, there were five Great Lakes areas of significant environmental contamination or Areas of Concern (AOCs) in Lake Huron. Lake Huron boasts the only AOC that has been cleaned up and delisted to date — Collingwood Harbour, Ontario. The St. Marys River area was originally designated as an AOC because of contaminants. Control of industrial sources is progressing and pollution loads are being reduced. The two other Canadian AOCs, Spanish River and Severn Sound are responding well to remedial actions and showing recovery.

From the late 1970s to the early 1990s, persistent, bioaccumulative substances such as PCB, DDT, dieldrin, dioxins, and furans concentrations declined significantly in Lake Huron lake trout. However, PCB concentrations have not declined significantly since the mid 1980s. DDE trends in Lake Huron Herring Gull eggs show a marked decrease in concentration since the mid 1970s. As with other trends, the concentrations decreased significantly in the late 1970s but have remained relatively the same since. Continuing sources of contaminants are primarily from sediments of historic discharges, airborne deposition and land runoff.

In comparison to Lakes Michigan, Erie, and Ontario, contaminant concentrations are relatively low. Nevertheless, public health advisories exist

### Lake Huron Trends

Top Predator Fish	Long-term Trends	Recent Trends
DDT	Declining	Continuing to decline
PCBs	Declining since mid 1980s	Leveling off, hasn't declined significantly
Dieldrin	General decline	
TCDD & TCDF	General decline	
Mercury	General decline	Leveling off, if not increasing
Herring Gull Eggs		
PCBs	Declining	Leveling off
DDE	Declining	Leveling off

Source: Environment Canada/U.S. Environmental Protection Agency, 1997

regarding the consumption of trout from the open lake and all four AOCs. Advisories with respect to amount and frequency of consumption are in effect in Lake Huron for chinook salmon, coho salmon, brown trout, steelhead, walleye pike, and yellow perch. As in other lakes, advisories differ by species, size, and location, so it is important to check advisories in effect for the appropriate state or provincial jurisdiction.

### Lake Huron – What's Next?

Lake Huron, at least at this time, is a lake without high-profile issues or advocacy groups focusing attention on it. However, with continued habitat destruction, the leveling off of the declining toxic concentrations, a continued sea lamprey threat, and a fishery that is at its peak but probably not sustainable at current levels, there is a need to continue to challenge the federal, state, and local decision-makers. Decisions made today in the Lake Huron watershed will impact the lake tomorrow.

# Lake Huron, Magnificence Challenged

By Dr. Gail Krantzberg

Lake Huron, including Georgian Bay, is the second largest Great Lake and the third largest freshwater lake in the world in area. Despite its size, Lake Huron has not been immune to urbanization and industrial proliferation. The shore line which extends more than 6,150 km (3,813 mi), is characterized by shallow, sandy beaches and the rocky shores of Georgian Bay. Lake Huron's drainage area is relatively large compared to the other Great Lakes. With a watershed more than twice the size of Huron's approximately 57,800 km<sup>2</sup> (22,542 mi<sup>2</sup>) surface water, and a retention time of 22 years, the lake is particularly susceptible to adjacent land-use activities. While the northern portion is lightly populated and extensively forested, the Saginaw River basin is intensively farmed and contains substantive metropolitan areas.

Lack of attention to habitat destruction, continued sewage and stormwater discharges, and the proliferation of exotic species bodes poorly for the future of the splendor that is Lake Huron.

While bans on toxic substances such as DDT and mirex have resulted in declining concentrations of toxins, atmospheric deposition is an increasingly significant source of toxic chemicals to the lake. Toxic pollutants are carried from sources well outside the Great Lakes basin. Binational and international cooperative efforts to remove these chemicals from production and use is essential to enhance and sustain healthy fish and wildlife populations, human well being, and human uses of the lakes such as fish consumption. In specific zones, contaminated sediment continues to be an active and important source of contaminants such as PCBs. Obstacles to cleaning up contaminated sediment, such as regulatory complexity and lack of explicit decision making tools continue to hamper the recovery of this Lake from historic abuse.

The Lake Huron biotic community is imbalanced due to the proliferation of exotic species such as zebra and quagga mussels, ruffe, goby, carp and white perch. These species change food web structure thereby

altering the movement of energy and contaminants through the trophic levels. An important consideration is the change in nutrient availability for native species. For example, carp and zebra mussel represent huge bottlenecks for energy translocation from benthos or plankton to predatory species. The fish community is also threatened by the growing source of lamprey from the St. Marys River. There is cause for concern over whether current levels of walleye are sustainable, with growing populations of lampreys and the unknown food chain impacts resulting from zebra mussels.

Exotic species also pose a challenge to sustaining the competing interests of commercial and sport fisheries. In addition to invertebrates and fish, uncontrolled spread of Eurasian milfoil and purple loosestrife threaten nearshore and wetland habitats, important spawning, nursery, rearing and feeding zones for many littoral and profundal species. The future biotic community will adjust to these invaders, but in a manner irreverent of human desires or uses. Economic and recreational repercussions are inevitable.

Despite these stressors, Lake Huron and Georgian Bay offer some of the most pristine and spectacular vistas of the Great Lakes. Lake Huron has the highest number of fish-eating birds that breed along the Great Lakes shoreline due to the



diversity and areal extent of habitat. Populations of the fish-eating breeding birds such as cormorants, Caspian terns, osprey, and bald eagles have returned to nest along the Lake Huron shoreline.

Cottagers and boaters derive pleasure from the beauty and crisp oligotrophic waters of the Lake. However, with substantial increases in second home developments and the construction of more and larger marinas, the nearshore zones are increasingly suffering from septic seepage and discharges of grey and black water from pleasure craft. Shorelines are being hardened, nearshore vegetation removed, and habitat lost.

In some of the more agricultural reaches, stream banks are denuded, erosion has become severe, and large volumes of fertilizers, pesticides and fecal material are washed into the lake.

To reverse this trend requires aggressive, land-owner contact programs, that educate and remediate local site conditions. Successes are possible. The inclusive cooperation of the farming community in the Severn Sound Remedial Action Plan provides evidence of such success. Demographics, however, forecast more growth northward, linked to the Detroit and Toronto metropolitan areas. Incremental and continued degradation of green belts and natural heritage systems is an immediate problem.

Lake Huron was the unwelcome host to four Areas of Concern until Collingwood

Harbour was delisted in 1994. Saginaw River in Michigan, and Severn Sound and Spanish Harbour in Ontario continue to strive towards fully restoring environmental quality. Collingwood Harbour, Spanish Harbour and Severn Sound are clear indicators that progress is achieved with a strong vision for the future, broad community engagement, and a cooperative, partnership approach. As of 1997, due to industrial and municipal investments to abate discharges, and community investments to voluntarily reintroduce muskellunge, the Spanish Harbour Remedial Action Plan is fully implemented. As with Collingwood Harbour, however, it will not be possible to remove fish consumption advisories, since the sources of mercury or PCBs are not within the geographic boundaries or watersheds of these Areas of Concern. Only a regional, lakewide or broader approach can restore this attribute.

Herein lies the greatest dilemma. There is currently no initiative to launch the development of a Lakewide Management Plan for Lake Huron. There is a danger of complacency for Lake Huron. It is the lake without high-profile issues, with the fewest Areas of Concern, and with no central community voice. Nonetheless, the problems are real and insidious. At the 1996 State of the Lakes Ecosystem Conference, participants in the Lake Huron break-out session looked forward to declaring regions of Lake Huron Areas of Excellence. Those who work on, live by, swim in, drink from, and share a love for this magnificent jewel need to press for special designation of those areas relatively untouched by human intervention, and raise the need to halt and reverse the impacts of human sprawl in this wondrous and dynamic place.

*Dr. Gail Krantzberg is an ecotoxicologist currently responsible for Environment Ontario's Great Lakes programs, including the restoration of 17 Areas of Concern. She is also president of the International Association for Great Lakes Research.*



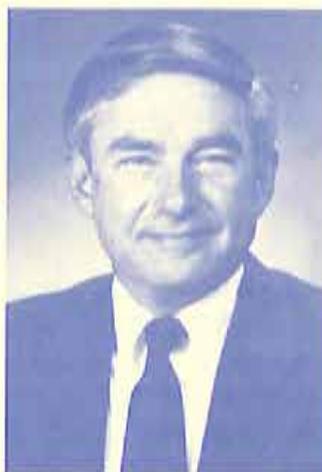
*Cottagers and boaters derive pleasure from the beauty and crisp oligotrophic waters of the Lake.*

# Communities and Business Partner for Saginaw Bay Stewardship

by Jerold E. Ring and Elizabeth J. Cisur

Within the heart of Michigan's booming farm and industrial economies lies one of America's greatest natural treasures — its largest contiguous freshwater coastal wetland. Blanketing the shores of the Saginaw Bay, this wetland system and the 8700 square-mile watershed that supports it, provide vital habitat for a vast array of plant and animal species. Of particular significance is the Bay's role as an oasis for migrating song birds and waterfowl on the Central Flyway. The Bay and the natural resources within the watershed also provide critical resources for Michigan's economy. The watershed drains about 15% of the state, and is home to some of its most significant agricultural and industrial resources.

Communities, conservationists, foundations, and businesses have come together in the last year to create a unique partnership to enhance the Saginaw Bay watershed and to create a more sustainable future for all its inhabitants. Under the leadership of the Dow Chemical Company citizens from communities around the watershed have launched the Saginaw Bay Watershed Sustainable Communities Initiative.



Based on models developed by the President's Council on Sustainable Development, and with help from The Conservation Fund, a national, non-profit land and water conservation organization, the Initiative identifies issues, sets priorities, and then tackles projects designed to address concerns with tangible, on-the-ground solutions designed to steward natural resources, strengthen local economies, and support watershed communities. For example, the Initiative has identified and funded a series of projects intended to nurture the region's growing nature-based tourism industry by improving birding opportunities in the watershed. The projects integrate habitat protection, improvement of birding facilities, and promotion of watershed birding opportunities on the Internet. Most importantly, communities within the watershed are working together to complete the projects.

Because we only protect what we understand and appreciate, one of the fundamental missions of the Initiative is to help residents and visitors cooperatively develop a shared sense of identity for the Saginaw Bay watershed as a sustainable community. The Initiative is creating



opportunities to enhance understanding of sustainability by connecting people, ideas, resources, organizations, and programs through regional networks of local projects.

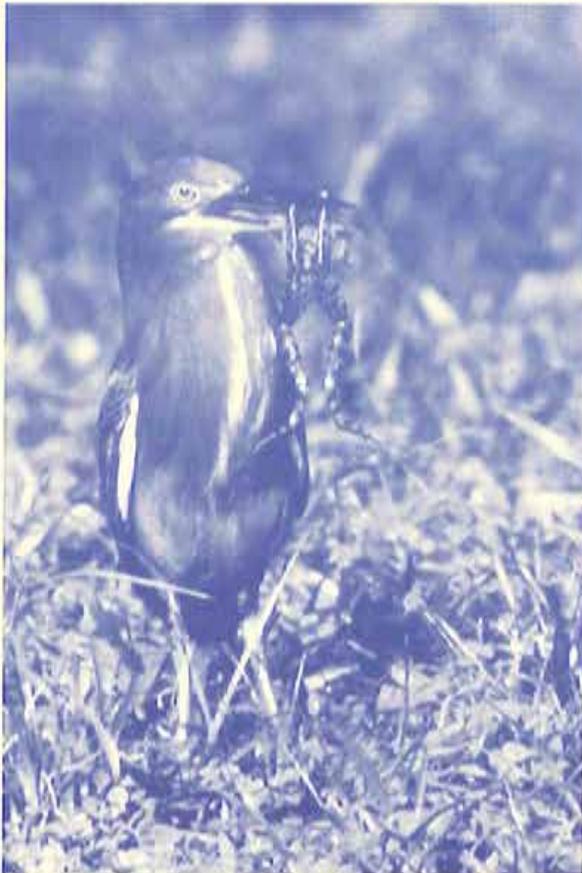
One of the most innovative aspects of the Initiative is the creation of a network of foundations which includes community and private foundations from around the watershed. Based on our research, this is the first time a group of foundations has come together to support a comprehensive sustainable communities effort focused on a natural resource. The Network has created an initial "seed" fund of over \$500,000 to support projects recommended by the Initiative.

In the coming year, the Initiative will be developing projects relating to land use, agriculture/pollution prevention, and continuing birding and nature-based tourism projects. What makes the Initiative work is the knowledge and experience of its people. Farmers participate in the agriculture task

group, birders and tourism experts serve on the birding task group, and city planners and developers serve on the land use task group. By involving people who know what needs to be done and how to do it, the Initiative develops viable, "real world" projects that demonstrate that sustainable alternatives make sense. This grass-roots approach also helps insure that projects reflect local concerns.

Through the Saginaw Bay Watershed Sustainable Communities Initiative, business, community, and conservation leaders are reaching out to watershed residents to encourage a more holistic approach to natural resource protection, economic development and community revitalization.

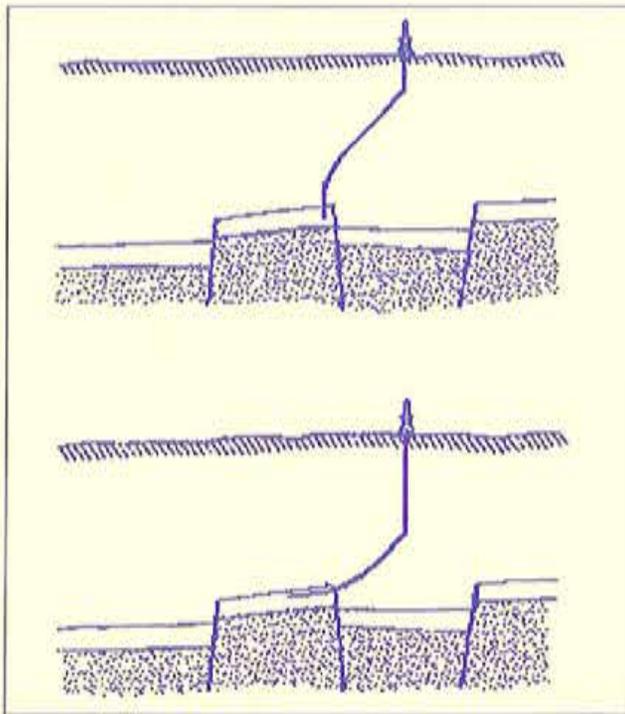
*Jerry Ring is Director, Global Contributions and Community Programs for the Dow Chemical Company. He is also Executive Director of the Dow Chemical Company Foundation. Elizabeth Cisar is Director of the Great Lakes Office of The Conservation Fund, a national, non-profit land and water conservation organization.*



*A Green Heron*

# Directional Drilling for Oil and Gas Below the Great Lakes

Directional drilling is a technique whereby a well bore is intentionally deviated at controlled angles to reach a selected subsurface target (see figure below). Directional drilling became fairly common in Michigan in the 1970s, and made it possible to reach oil and gas reservoirs by drilling from remote surface locations.



*Directional (upper) and horizontal (lower) well paths.*

The 1982 PA 69 (MCL 322.428) regulated directionally drilling under the Great Lakes. It states in part: "A person shall not conduct drilling operations for the removal of oil or gas from under the beds of the Great Lakes or connecting or connected bays, harbors, or waterways, unless all drilling operations originate from locations above and inland of the ordinary

high-water mark and are conducted pursuant to the terms of a written lease obtained from the Department of Natural Resources."

Great Lakes bottom lands are owned by the state, and the mineral rights are managed by the Department of Natural Resources (DNR). A lease must be obtained from the DNR before a permit to drill can be granted. A drilling unit—a tract of land that can be effectively drained by one well—must be established when a permit to drill is issued.

Ten wells have been directionally drilled under Lake Michigan, and three wells have been drilled beneath Lake Huron and Saginaw Bay. Most recently, Newstar Energy applied for two permits to drill with targets under Lake Michigan north of Manistee. Additional applications from Newstar are expected.

The risk of contamination or disturbance of the Great Lakes from directional drilling under the bottom lands is immeasurably small. At the point where the well bore crosses under the shoreline it is typically several thousands of feet deep. The oil and gas reservoirs under the lakes are sealed by impervious rock layers; otherwise, the oil and gas would have long ago leaked away. If any oil or gas were to escape, it would follow the path of least resistance—up the well bore to the surface (indeed, this is the intent of drilling the well). The construction of the well prevents even the remote possibility of oil or gas migrating out of the well bore and into a shallower formation where it could reach the surface.

Directional drilling does increase the risk of mechanical problems in drilling, but this does not translate to an increased risk of environmental damage. The main element of risk at any oil or gas well is

from spills or leaks at the wellhead on the surface. For this reason, special attention must be given to choice of the wellhead location and to spill prevention and containment.

In 1997, Governor John Engler requested that the Michigan Environmental Science Board (MESB) evaluate the state's regulatory procedures pertaining to directional drilling under the Great Lakes. In its report of October 1997, the MESB concluded "that there is little to no risk of contamination to the Great Lakes bottom or waters through releases directly above the bottom hole portion of directionally drilled wells into Niagaran Reef and deeper reservoirs. There is, however, a small risk of contamination at the well head." However, the ecological impacts can be minimized by prohibiting surface development in highly sensitive and unique areas, and by using appropriate technical and siting criteria in areas where drilling is allowed.

The Department of Environmental Quality (DEQ) developed an action plan to implement the science panel's recommendations including the establishment of a 1,500 foot setback zone from the shoreline and prohibiting new infrastructure in critical or sensitive areas, e.g., dune areas. Moreover, the well and surface facility sited cannot be visible from the shoreline, or from areas maintained for public recreation contiguous to the shoreline. Permittees may satisfy this condition through natural topographic barriers, berming or vegetative screening.

The DEQ and DNR also put into policy the MESB's recommendation that lease sales specifically prohibit the construction of infrastructures within the setback zone and limit oil and gas development to areas where existing infrastructures are already available.

The only disagreement between the two departments and the MESB related to the state's leasing criteria. The MESB suggested that the leasing process deal with environmental land use impacts and conflict

analysis, and that the oil and gas permit process focus more on the technological impacts of directional drilling to the environment. Applicants that cannot obtain a lease due to an inadequate or unacceptable environmental analysis should not proceed to the oil and gas permit process. The agencies believed the permitting process which requires an Environmental Impact Assessment provided sufficient controls.

# Industry Meets the Challenge

By Frank L. Mortl

The Great Lakes provide the residents of Michigan and surrounding states with a valuable resource for commercial and recreational purposes.

Michigan is also blessed with large hydrocarbon resources underlying portions of the Lower Peninsula and the Great Lakes. Over 50,000 wells have been drilled in Michigan since 1925. The oil and gas industry, represented by the Michigan Oil and Gas Association, has paid over \$916,000,000 back to the citizens of Michigan in the form of royalties, rentals and lease sale bonuses on state owned lands from the 1,340 oil wells and 3,263 gas wells drilled on state lands.

A small number of wells drilled within the last 20 years have bottom hole locations under Michigan waters of the Great Lakes. Thirteen holes (6 gas wells, 2 oil wells, and 5 dry holes) drilled since 1979 have bottom hole locations ranging from 30' to 3,750' from shore. These wells were all drilled with directional drilling technology, which allows placement of surface locations away from environmentally sensitive areas.

In 1997, Newstar Energy USA applied for and was granted a permit by the Geological Survey Division, Department of Environmental Quality (DEQ), to drill a well with a bottom hole location under Lake Michigan. Additional permit applications by Newstar caused concern among special interest groups regarding directional drilling under the Great Lakes. Newstar and all other companies requesting permits to drill wells in Michigan are subject to stringent regulations administered by the DEQ.

As a result of special interest group concerns regarding directionally drilled holes under the Great Lakes, Governor John Engler, requested that the Michigan Environmental Science Board (MESB) address the risk of contamination of Great Lakes waters, evaluate the potential

impacts of directionally drilled holes and review the existing and potential permit conditions for adequacy in protecting the shoreline usage focused on social/aesthetic inconsistencies between

recreational and drilling operations. The MESB recommended environmental planning and communication. Other considerations addressed involved permitting streamlining, uses of existing infrastructures and drilling cuttings storage.

In November 1997, Russell J. Harding, Supervisor of Wells, signed Supervisor Instruction 2-97 outlining changes in permitting, drilling and operating wells directionally drilled under the Great Lakes waters. Significant changes include provisions prohibiting surface locations and new access roads closer than 1,500 feet from the high water mark of the Great Lakes. Wells drilled in areas primarily used for recreation or residential uses shall not be visible from the shoreline. Wells, surface facilities and new roads shall not be located in environmental, high risk or critical dune areas. Wells shall not be located in floodwater areas if there is an alternative. Excavated pits shall not be used for disposal of drilling muds and cuttings.

The evaluation by the MESB and the resulting Supervisor's Instruction will ensure that Michigan's Great Lakes waters and shorelines will be protected for enjoyment and use by its citizens, visitors and future generations.



*Frank L. Mortl has been president and CEO of the Michigan Oil and Gas Association (MOGA) since 1971.*



# Let's Not Drill in the Wrong Direction

By Keith Schneider

What makes the colorful, rough, and wild northern Lake Michigan coast one of the world's truly superb landscapes is that the tension between industrial development, housing, recreation, and environmental protection has gradually been resolved.

In the spring of 1997, however, that thoughtful balance between competing interests threatened to crumble. Newstar Energy, a Canadian company, proposed tapping oil and gas reserves 4,000 feet beneath Lake Michigan and up to a half a mile offshore by installing new wells on the shoreline using directional drilling technology. The Michigan Department of Natural Resources (DNR), sold the company the necessary bottomland leases. The Geological Survey Division, a unit of the Michigan Department of Environmental Quality (DEQ), proposed to approve the drilling permits.

But as word of the plan filtered out of Lansing, the company's proposal received a different reception. Lake front property owners wanted to know whether Newstar's wells would lead to oil spills. Conservation groups urged the state to take a closer look at the effect the new wells, and other industrial infrastructure would have on

communities and the sensitive shoreline environment. Local government officials criticized the internal administrative decision-making process and called for much greater public involvement in reviewing and overseeing

Newstar's shoreline wells and those planned by other companies.

Faced with escalating public dissent that attracted national and international attention, Governor John Engler intervened. In August, he asked the Michigan Environmental Science Board (MESB), a panel of state-appointed experts, to review the issues and render a conclusion.

In October, the panel did just that. It issued a strong statement of concern for the effects of drilling, and the industrial infrastructure that accompanies it, on the shoreline ecosystem. The panel emphasized the importance of reducing the shoreline land use conflicts by requiring comprehensive environmental planning and increased communication between all stakeholders before the state issues drilling permits.

To achieve those goals, the MESB made these specific recommendations:

- Prepare an "aggressive" environmental impact study before state minerals are leased.
- Establish setbacks from sand dunes, wetlands, and other coastal resources.
- Use the state's data gathering expertise to both determine environmentally sensitive areas that should not be



developed, and already-industrialized areas that should.

- Invite the public and local governments to participate in deciding where drilling is appropriate, and where it is not.

In short, the MESB produced the most complete and clear-headed plan for developing energy reserves in sensitive areas in nearly 20 years. Not since 1980, when the Milliken Administration, Shell Oil and the conservation community reached agreement on how best to explore for oil and gas in the Pigeon River Country State Forest, has such a rational and workable land use plan for energy development been officially proposed in Michigan.

It is now up to Governor Engler and his environmental advisors to put the scientists' recommendations into effect. Several useful steps have been taken in that direction. The governor has embraced the MESB's proposals, as has the director of the DEQ. In December, moreover, the DEQ leadership warily invited five prominent conservation groups to collaborate with senior state officials in preparing a land use plan for shoreline energy development that focuses on protecting natural resources.

The conservation groups, including the Michigan Land Use Institute, are taking the invitation very seriously. Our goal is to ensure that the state establishes new public policy that is consistent with the MESB recommendations and existing state and federal environmental laws.

It's somewhat understandable why the DEQ is nervous about handling the Great Lakes drilling issue outside of the internal administrative process. Public input can be messy. It takes time to cooperate with local governments and to hold public hearings. And it forces the state to consider more alternatives.

But that's just the point. The state's top environmental scientists have laid the foundation for a workable and effective program of natural resource protection and industrial development. When considering

drilling for oil and natural gas in one of the most ecologically and economically valuable ecosystems in world, time and forethought must be taken to do it right.

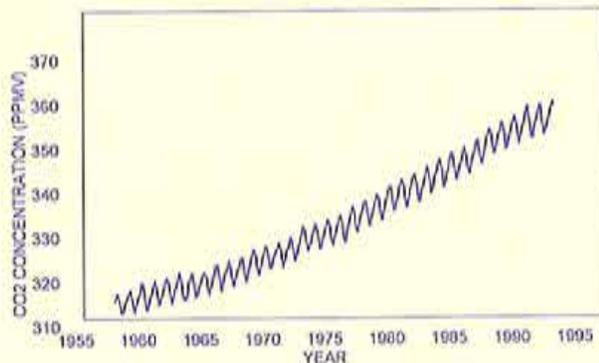
*Keith Schneider is Executive Director of the Michigan Land Use Institute in Benzonia, Michigan.*

# Potential Effects of Climate Change on the Great Lakes Basin

by Frank H. Quinn

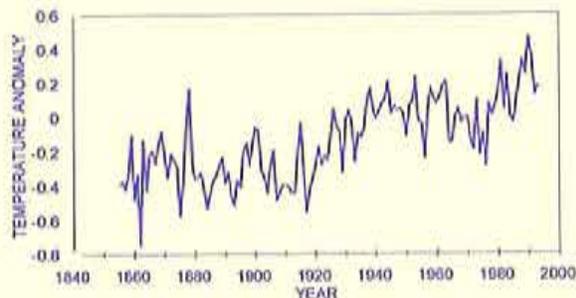
## The Greenhouse Effect

The recent climate change convention in Kyoto, Japan, and the resulting proposed climate treaty have increased the interest in the potential impacts of climate change on the Great Lakes basin. The primary issue is the accumulation of greenhouse gases<sup>6</sup> in the atmosphere and their effect on our climate system. The rapid increase in atmospheric carbon dioxide (CO<sub>2</sub>) concentrations over the past 50 years is shown below. Other greenhouse gases have



*Carbon Dioxide concentrations at Mawna Loa, Hawaii (Keeling and Whorf, 1994)*

also increased significantly. The increase in CO<sub>2</sub> as well as other greenhouse gases, over the past century is believed to have



*Global average temperature anomalies (°C), 1855-1993 (Jones, Wigley, Briffa, 1994)*

resulted in a significant rise in global average temperature of between 0.3 and 0.6°C. Air temperatures in recent years were

the warmest since 1860 in the period of the instrumental record and perhaps as warm as any other century since about 1400 AD. While global implications are important, significant impacts will also be felt in regional areas, including the Great Lakes basin.



## GCM Climate Change Scenarios

To assess the impact of climate change we need scenarios of potential climate that contain increased concentrations of greenhouse gases. These scenarios are not forecasts of what will happen, but rather, plausible scenarios representing future climates. These scenarios are developed using General Circulation Models (GCMs). The GCMs represent the complex interaction of physical processes that link the radiation processes of the atmosphere and surface to global atmospheric circulation and the hydrological cycle. Although these models are very complex, they are still a very crude representation of the real climate system and are limited by our knowledge of climate processes and feedback mechanisms. GCMs can capture the important large-scale features of the global climate system, but their poor regional resolution leads to an inadequate representation of regional climate. For example, large inland water bodies such as the Great Lakes are not represented in the GCM models used in these studies.

However, double carbon dioxide ( $2\times\text{CO}_2$ ) equilibrium response GCM experiments can be used to measure the sensitivity of the climate system to increased greenhouse gas concentrations and provide a useful assessment of the future state of the climate.

For these scenarios, the GCM is run in two modes: current conditions ( $1\times\text{CO}_2$ ) and  $2\times\text{CO}_2$  conditions. In the  $1\times\text{CO}_2$  simulation, the average global  $\text{CO}_2$  concentration is set at the present level and the model is run until a stable climate is attained; this represents "current" climatic conditions. In the  $2\times\text{CO}_2$  simulation the carbon dioxide gas component of the GCM is doubled from its present level and the model is run again until it reaches a new equilibrium. The difference between the  $1\times\text{CO}_2$  and  $2\times\text{CO}_2$  estimates the sensitivity of the climate system to a doubling of carbon dioxide.

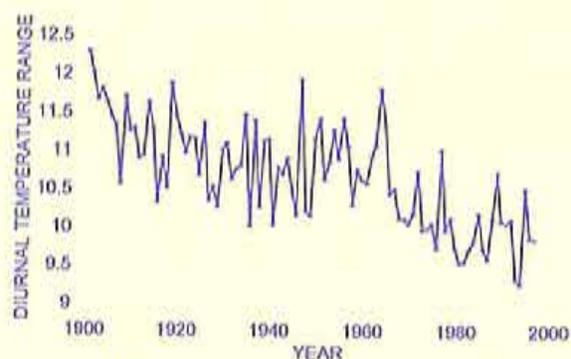
## Impacts

The potential impacts of these climate change scenarios are significant. They indicate, in general, a warmer climate with either more or less precipitation depending upon the GCM used for the scenario. The modeling results also indicate that the potential exists for major changes in the hydrologic water balance in the Great Lakes; the supply of water to the Great Lakes decreases although precipitation increases throughout large portions of the basin. The warmer air temperatures and higher rate of evaporation and evapotranspiration increases moisture loss, decreases runoff, and leads to a decline in lake levels. The warmer climate would also indicate increased water surface temperatures and changes in the temperature structure in all of the lakes leading to potential changes in ice cover and habitat. In addition, the potential for decreased turnover could decrease oxygen in several of the lakes' bottom waters. In some scenarios the lake level decreases are quite significant, for example, Lake Michigan-Huron and Lake Erie levels drop

more than 1 meter. Water level declines of this magnitude have important impacts on wetlands, fisheries, and human use of the shoreline.

## Comparison with Present Conditions

While there are major impacts of climate warming in other areas of North America, the only indicator consistent with climate change in the Great Lakes basin is a general decrease in the diurnal temperature range, with night-time minimum temperatures increasing more than daytime maximum temperatures. (see figure below) Average annual air temperatures have either been relatively constant or have shown a slight decrease over the past 50 years. We are also in the midst of a high precipitation regime that began in the mid 1960s, and because of this we have observed two periods of record high lake levels and one period of near record levels.



*Diurnal temperature range at Ann Arbor, Michigan.*

To put climate change in the Great Lakes basin into perspective, we must remember that the climate system is not linear, with rapid and large changes in both averages and in variability occurring in the past. As is stressed in stock market analysis, past performance/climate does not guarantee future performance/climate.

*Frank H. Quinn is the Head, Physical Sciences Division of the Great Lakes Environmental Research Laboratory in Ann Arbor, Michigan. GLERL Contribution #1081*

# Global Climate Changes And The Great Lakes Basin

by George H. Kuper

Global Climate Change (GCC) has been referred to as the “mother of all environmental issues.” It could fundamentally alter the way industry operates both in the Great Lakes region and worldwide, as well as permanently alter the landscape of international trade.

A key issue in the U.N. Framework Convention on Climate Change (FCCC) negotiations, even after the Kyoto agreement of December '97, is the commitments to be made by Annex 1 (industrialized) countries and non-Annex 1 (developing) nations. The large percentage reductions in emissions demanded by non-Annex 1 nations and their resistance to call for universal implementation is seen by the Great Lakes region's industry as a major effort to fundamentally shift the cost structure of industrial activity in favor of developing countries. For instance, it has been pointed out that with either a carbon tax or CO<sub>2</sub> production caps to achieve 1990 emission levels by 2012, roughly 20-30% of the U.S. energy-intensive basic chemical industry would move to developing countries in the next 15 to 30 years. As U.S. firms build new plants abroad and domestic plants lose markets to foreign producers; the study estimates that accompanying U.S. job losses will be as high as 200,000.

The U.S. response has not been constructive. The Great Lakes Region's industrial leadership is concerned that the absence of a strong scientific consensus on the nature and cause of GCC problems has allowed the U.S. Administration to energize emotional arguments over rational analysis and orderly action. This emotion has led us to make two critical policy errors:

- making the inaccurate *assumption* that technology deployable within a decade

will bring about control of CO<sub>2</sub> emissions and provide alternative sources of energy. The idea that we can *painlessly* reduce our

level of fossil fuel consumption and meet international emission reduction commitments relatively quickly while maintaining our current quality of life is fantasy.

- Failing to recognize that most models anticipate a doubling of CO<sub>2</sub> in the earth's atmosphere over the next 40–60 years. That doubling will occur even if we could get all the world's industrial activities to below 1990 levels today! Although the climatic effects of that doubling are subject to debate, it inevitably demands greater focus on ensuring adaptation by all CO<sub>2</sub> affected systems, as well as temperature affected systems. Timely research and innovative technology development — along with major changes in the habits of all our citizens — are the only viable routes to reducing GHG emissions without ruining our economy. Most technologies require 7–15 years to develop (after the science) plus up to 30 years to incorporate those technologies into the capital stock. This means we need long term — not 10–14 years — policies to make the shifts we're discussing.

One start toward ameliorating international political pressure is to change the nature of CO<sub>2</sub> reduction targets from gross emissions to emissions per unit of output. As citizens of all nations want



products that they perceive increase quality of life, the objective should be to reduce CO<sub>2</sub> per unit of output — continuing to give market advantage to the most efficient producer.

Another modification to the U.S. position ought to focus on what NAFTA's North American Commission for Environmental Cooperation calls upward harmonization of technology and capability. As countries increase their industrial capabilities, they do so with more energy efficient, less GHG emitting technologies.

The timing of objectives is critical. The pace of reduction targets will determine the economic impact felt by the Great Lakes region. A recent study published by Argonne National Laboratory examined impacts of 1990 targets by 2012 on basic chemicals, iron and steel, petroleum refining, aluminum, paper and allied products, and cement industries. Highlights include:

- U.S. steel shipments would fall 30%, with job losses of roughly 100,000.
- All primary aluminum plants in the U.S. would close by the year 2010 losing 18,000 jobs, if fuel price increases are applied to hydro- and thermal-based electricity.
- Domestic paper and pulp producers would realize "serious negative employment and output effects" with no ability to absorb energy price increases absent "a major technological breakthrough."
- Petroleum industry output would drop 20%, with Northeast and Gulf Coast refiners most severely affected.
- Approximately 17 to 26 million metric tons of cement clinker capacity would be shut down in the cement industry, causing the loss of 9,700 to 5,800 jobs, primarily in small communities. Imports would displace domestic production between 37% and 46% of total consumption by 2010.

Cost impacts on the region are not unique to industry. A fall '97 study reported

by Prof. Stephen S. Fuller, George Mason University, points out that the City of Detroit's energy bill would increase by 55% if we achieved 1990 levels of GHG by 2010. Paying for it would require the equivalent of a 34% increase in property tax rates, or cutting 6% of the city's workforce.

As one would expect in an issue of this complexity, industry in the Great Lakes region is not concensed on the impacts of GCC policies to the region's economy. Some industries, which are less fossil fuel intensive in their processes, or less greenhouse gas emitting, will like aggressive reductions because they will see new market opportunities. (e.g. fuel cells).

Some Great Lakes industrial organizations have already complied and achieved CO<sub>2</sub> emissions levels of 1990 or lower. (e.g. Chemical company that won't talk publicly about their significant accomplishments; a mining company that has lowered its electrical energy consumption by an average of 26%/yr. for the last 6 years!) Some will face dramatic shifts and/or closing down entirely as a general result of lowering GDP (utilities; much worse than the oil shock of the 70s). Several have excellent solutions for CO<sub>2</sub> reduction but implementation is beyond their individual firm's ability to bring it about (e.g. cement).

With time and proper incentives, industry will adapt new GHG reducing methodologies in the interest of improving the productivity of all resources utilized. The ability of our citizens to change behaviors will remain problematic without serious incentives. Therefore, in addition to sponsoring research, our region's public policy ought to be aimed at persuading the Federal government toward: (1) fixing the treaty process including the terms of reference for the debate to get a more sensible international agreement aimed at CO<sub>2</sub> adaptation as well as reduction and energy efficiency, universally applied within reasonable time frames; and, (2) public investment in adaptation strategies to respond to doubled levels of CO<sub>2</sub> in the atmosphere.

The region's policy ought also to be aimed at gaining increased state and federal governments' interest in working with industry on amelioration technologies and strategies including the modification of existing constraints and laws to encourage adoption of new technologies; honoring past accomplishments, and incorporating those accomplishments in achieving targets/goals; and, providing reasonable time and incentives to do the right thing (rather than further constraints and higher costs). Also we should be aiming towards further developing and supporting a region-wide strategy. This strategy would mobilize the region's considerable assets behind a major coordinated effort to position ourselves in the forefront of GCC competitive technologies. For the region's industry, this strategy to date has four major components:

- better identification of concepts and technologies that will respond to GCC challenges — both greenhouse gas reduction/energy efficiency and adaptation to CO<sub>2</sub> doubling — and be economically competitive;
- a more efficient matching process of innovative products and potential sponsors (both financial and market routes);
- reducing governmental and other infrastructure barriers to the commercialization of new concepts; and,
- the increased regional dialogue and consensus around these issues and possible responses. The Council of Great Lakes Industries, together with technical support from the Wright Technology Network and the U.S. Department of Energy, plans to create (in 1998) and maintain a forum for Great Lakes Regional Networking in support of implementing energy efficient technologies.

*George H. Kuper is president and CEO of the Council of Great Lakes Industries.*

# How a "Climate Change" Treaty Might Affect the Auto Industry

by Patrick L. Anderson

According to the terms of the Kyoto Protocol, the United States would be required to reduce its "greenhouse gases" emissions seven percent below 1990 levels.

The ultimate effects of a treaty would depend on U.S. policies to implement and enforce it. Carbon dioxide — a natural product of combustion, as well as a byproduct of photosynthesis in plants and respiration in humans and animals — is one greenhouse gas. To reduce these and other emissions to comply with the Kyoto agreement, the U.S. government would likely raise the cost of combustion through taxes on carbon-based fuels, such as coal, gasoline, fuel oil and other petroleum products. A supplementary gasoline tax would also be likely, to curb driving and encourage fuel efficiency.

Such measures would substantially increase costs to the automobile industry and its consumers, with three negative effects: the direct cost increases, the reduction in consumer demand and the substitution effect away from profitable models.

When auto manufacturing companies are required to expend more of their revenue on energy — either through direct taxes or through indirect taxes embedded in the price of goods — they are forced to reduce expenditures in other areas. With likely increases in electricity prices of 20 to 30 percent, employment in the industry would clearly suffer as resources were devoted to these tax burdens.

The Kyoto agreement would require improvements in automobile mileage beyond those already expected. Super "green cars" would require more expensive catalytic converters with electric pre-warming functions, hydro-carbon trapping filters, expensive low-weight materials and lower

performing engines. While these cars are possible with technology that is available today, they are much more costly. Recent product announcements by domestic and Japanese

manufacturers indicate that the price of producing a super "green car" would be 25 to 75 percent higher than the automobile meeting today's strict emissions standards. Consumers who purchase such vehicles, or taxpayers who subsidize them, will pay a stiff price premium.

Finally, domestic automakers would suffer a loss of profitability as consumers shift away from profitable vehicles such as sport-utilities, towards economy cars. While domestic manufacturers dominate the market for larger vehicles and trucks, they are not as competitive in economy cars.

The Kyoto agreement would have some benefits, especially if market incentives were allowed to drive the environmental improvements. Debate about the Kyoto agreement will hopefully produce sound discussion of the actual costs of pollution, and the best methods for continuing the improvements in emissions that have characterized the automobile industry for the past two decades.

*Patrick Anderson is president of Anderson Economic Group, a consulting firm in Lansing, Michigan, specializing in public policy and environmental economics.*



# Climate Change: Controlling our Economic Destiny with Alternative Fuel Vehicles

by Lana Pollack

It's only one degree Fahrenheit, hardly enough to make us give up our down jackets and warm gloves, but the scientific jury has issued its verdict on global warming. The world community made clear at Kyoto they were taking the matter seriously. Especially in a highly integrated global economy, it makes no economic sense for us to deny this warming or ignore the massive fuel switching that will be a consequence of this global phenomenon. We are all entitled to our own opinions, but not our own facts.

Michigan's economy will hang or be hung on the Big Three's capacity to move rapidly beyond the internal combustion engine.

At the 1998 Auto Show in Detroit, the Big Three showcased plans to build alternative fuel cars, but their alternative fuel vehicles are still years away. It's clear that Japanese and European competitors are positioning themselves to capture a major market share of alternative fuel vehicles, hoping to beat Detroit's automakers in engineering and marketing.

Those who oppose changing our industrial and vehicular fuels claim we cannot afford to make changes on the basis of incomplete information. But these are the same people who said we couldn't afford to implement environmental laws that took the lead out of gas, the CFCs out of aerosols, the acid out of rain and the filth out of Lake Erie. If Detroit's automakers fail to make the technology shift, the loss of market share will make their massive drop in sales during the 1970s look like a mere tie on the balance sheet.

Vehicles account for 30 percent of carbon dioxide emissions, with electric utilities at 36 percent and industrial emissions at 22 percent. With impending utility deregulation, market share is a major concern for our biggest energy companies.

It's also an excellent opportunity to craft incentives and subsidies for alternative fuels to cushion the changes that will inevitably be imposed when global warming

drives the energy sources toward lower carbon content fuels. Unlike Texas or Alaska, we aren't dependent on carbon extracting industries. We can control our economic destiny, but success depends on smart and timely decisions. The Big Three do not peddle oil. They sell cars, and cars can be engineered to run on alternative fuels.

Other economic outcomes of global warming are less certain. Agricultural yields could be boosted if, as preliminary evidence indicates, spring comes a week earlier. Plants may grow faster in a carbon dioxide-rich environment, but may have less nutritional value. Faster evaporation from warmer lakes and oceans could lead to more severe droughts and flooding. Spring tourism could be helped and fall travel diminished if Michigan loses its spectacular sugar maples.

Kyoto is only the beginning. Michigan's auto industry will have to shift a substantial percentage of its fleet to low/no carbon dioxide emission vehicles. Following a reactionary and domestically focused political route will only put all our industries further behind. Not even the Big Three and the energy companies can beat the laws of physics, and soon they won't be able to beat the laws of economics either.



*Lana Pollack is president of the Michigan Environmental Council.*

# Lake St. Clair: A Changing System

Nestled between two countries in southeast Michigan, serving as the gateway to the upper Great Lakes, is Lake St. Clair. It is the smallest and shallowest lake in the Great Lakes system. Occasionally referred to as the "sixth" Great Lake, Lake St. Clair has earned a reputation as one of the most dynamic ecosystems in Michigan. This reputation has evolved over many centuries, beginning with French explorers' description of the Lake as a "sea of grass." Prior to European settlement of the region, Lake St. Clair was a vast wetland of grasses and marsh. Early market hunters harvested waterfowl by the millions, pushing their punt boats through the intricate maze of vegetation. Over time human encroachment replaced these vast wetlands with open water, shoreline development, and agriculture. Modern day observers witness a very different Lake St. Clair.

By 1994, Lake St. Clair was besieged by unusual weather patterns and fluctuating currents. Heavy rains caused sewage overflows.<sup>1</sup> Large masses of plants were uprooted and washed ashore, trapping bacteria while beach closures became the norm. The presence of zebra mussels appeared to exacerbate the situation. The outcry of public officials gave the Governor pause to consider a state of emergency. In an aquatic plant management investigation, the Army Corps of Engineers concluded that plant expansion occurred along the lake perimeter and in the open water, with a major portion occurring along the western shore where the highest levels of coliform bacteria were detected. The Corps recommended that a master plan be developed to serve as a guide in the preservation, conservation, and restoration of the natural and manmade resources of the lake.

In 1997 the Macomb County Board of Commissioners established the Blue Ribbon Commission on Lake St. Clair because the degraded state of water quality was having a severe economic impact on the county. The Blue Ribbon Commission convened on March 19, 1997. The objective was to develop an action plan within 180 days and assess discharges into the Clinton and St. Clair Rivers; run-off from agricultural, commercial, industrial, and residential land uses; sewage treatment capacity and capabilities, including stormwater concerns; biological problems; and contamination. Subcommittees were formed and final reports issued on each topic. It became clear the problems and solutions for a clean and vibrant Lake St. Clair are complex but manageable. Monitoring, education, voluntary action, regulation and enforcement are the four key elements identified as part of the Blue Ribbon Commission's final report. However, budget limitations and lack of priority were identified as major obstacles to achieve the common goals.

Measuring the overall condition of the lake is difficult. The problems affecting Lake St. Clair go beyond the borders and control of Macomb County. The watershed is part of two countries, one First Nation, one state, one Canadian province, and several counties. While progress has been made in reducing pollutants to the lake, much remains to be accomplished. Closed swimming beaches and fish consumption advisories underscore the need for heightened awareness and action by all stakeholders.

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<sup>1</sup> "Lake St. Clair 1994 Beach Closings", *State of the Great Lakes 1994 Annual Report*, Office of the Great Lakes, pp. 38-40.



# Lake St. Clair: Resource Renaissance

by Robert C. Haas

During the thirty years that I have been observing Lake St. Clair, some amazing changes have occurred. A number of exotic organisms have successfully colonized the lake, some remain at high population levels (i.e. zebra mussel and round goby), while others eventually declined to very low levels (white perch and tubenose goby). None of the exotic organisms has been proven to have negatively impacted the native fish community of Lake St. Clair. In addition, visually dramatic ecological changes have occurred in the lake which were widely misinterpreted by numerous people from the scientific community, the press, and the public. During the summer of 1994, Lake St. Clair made headline news daily due to nuisance levels of floating vegetation and high levels of *E. coli* at public beaches. The nuisance plant problem has not occurred again, but the *E. coli* pollution has. Public displeasure, primarily riparian, over the 1994 situation resulted in the 1996 appointment of a Macomb County Blue Ribbon Committee to address pollution problems and the ecology of Lake St. Clair. Their Blue Ribbon Report was issued in 1997. This report is valuable because it directs public attention to severe problems with storm runoff and sanitary sewage in tributaries that drain densely populated Macomb and Oakland counties. However, the blue ribbon report erred in generalizing

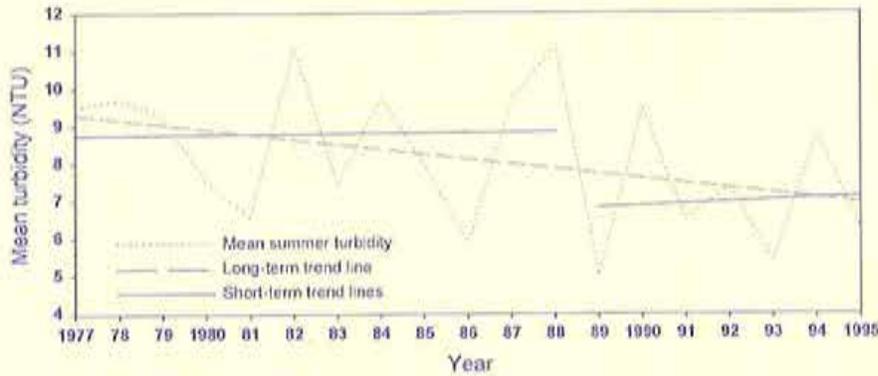
this "polluted situation" to Lake St. Clair which actually has very low levels of domestic contamination. Public recreation declines when pollution conditions are misinterpreted. It is very sad that many anglers have recently been turned off to fishing in Lake St. Clair because of the mistaken notion that the lake is polluted.



The nuisance plant problems probably result from a succession of unusual environmental conditions which do not occur frequently. High *E. coli* levels at beaches in 1994 resulted from sewage contamination of tributaries and relatively small inshore zones. This problem is unrelated to growth of submerged vegetation. Turbidity and lake levels are related since lower levels favor growth of rooted plants which in turn may act to stabilize sediments. Also, drought conditions cause less runoff which means lower turbidity because of less sediment and nutrients entering the lake. Both turbidity and water level have demonstrated a slightly downward trend since 1977 (see figure on top of page 32). However, when the longer 19 year period is broken down into two shorter periods, 1977-1987 and 1988-1995, slightly upward trends are apparent. One plausible explanation is that the severe drought of 1987-1988 reset an otherwise mildly increasing trend to a much lower level in 1988. This lower level produced the appearance of a slight downward trend when averaged over the 19-year period. In addition, high amounts of sunlight during the first half of the 1994 growing season produced an unusually



### Anchor Bay of Lake St. Clair June - August turbidity



Data courtesy of the New Baltimore Water Department

muskellunge provide more evidence that fish habitat has improved as a result of better ecological conditions.

We would all choose not to have zebra mussels if given that option. While they may be involved to a limited extent in the ecological changes in Lake St. Clair, they are not the

dense growth of rooted plants. Exceptionally low sunlight during July-August of that year probably encouraged early plant die-back and sloughing. Large amounts of loose vegetation coupled with unusual wind directions and speeds caused rafting along the west shore of Lake St. Clair.

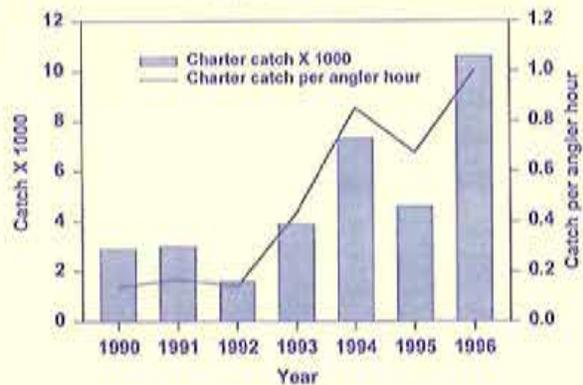
During the past ten years, there has been an overall improvement in the fish community of Lake St. Clair. For instance, today Lake St. Clair produces some of the finest sport fishing opportunities in the world for native predator fish species including muskellunge, smallmouth and largemouth bass, northern pike, and yellow perch. Much of the credit for these improvements should be attributed to ecological changes, namely the increased visibility of the water and increased growth of submerged rooted plants. High water levels in 1998 will favor lower plant growth and higher turbidity which may begin to reverse the overall improvement in the fish community. There has been steady improvement in the yellow perch fishery as evidenced by success in the charter fishery where total catch and catch per angler hour have dramatically increased since the early 1990's (see figure at right). Another even more impressive indicator of improved fish community is the dramatic increase in the number, size, and catch per effort of great lakes muskellunge in the sport fishery. These positive changes in perch and

driving force. Many Great Lakes aquatic scientists predicted in the early 1990's that zebra mussels would cause declines in valuable fish populations of Lake St. Clair. The opposite situation actually occurred. I believe zebra mussels can better be described as just another participant in an aquatic community that has benefited from ecological change.

Although not considered to be one of the "Great Lakes," Lake St. Clair proves to be as complex an ecosystem as any of the others.

*Robert C. Haas works in the research section of the Fisheries Division of the Michigan Department of Natural Resources and supervises fish population studies on Saginaw Bay, Lake St. Clair and Lake Erie.*

### Michigan Lake St. Clair Charter Fishery Yellow Perch



# The Islands of the Great Lakes: Unique and Globally Significant

by Karen E. Vigmostad

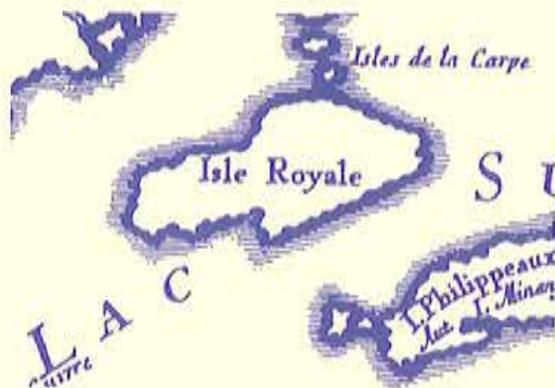
As critical components of a rare freshwater coastal ecoregion, the 35,000 islands of the Great Lakes hold *exceptional natural biological diversity* found no where else on Earth. Superlatives such as unique, special, magnificent, and rare all apply to these islands. Islands can be thought of as *living organisms* whose boundaries expand and contract with the forces of wind and wave. Each island has its own natural history and biological integrity; yet ironically *islands are not "islands."* While they appear separate and disconnected, islands are intimately connected to near and distant lands. For example, islands are closely connected to the mainland through wind patterns as well as to Central and South America by the migration of warblers and Monarch butterflies. Some islands, such as the Thousands Islands of eastern Lake Ontario, form intimate geological and vegetative "stepping stones" for living species between the mainlands of New York and Ontario. Other islands are part of interconnected groupings of islands known as archipelagos. The Les Cheneaux islands form a significant Lake Huron archipelago — so significant that The Nature Conservancy is working with local communities to find ways to protect this

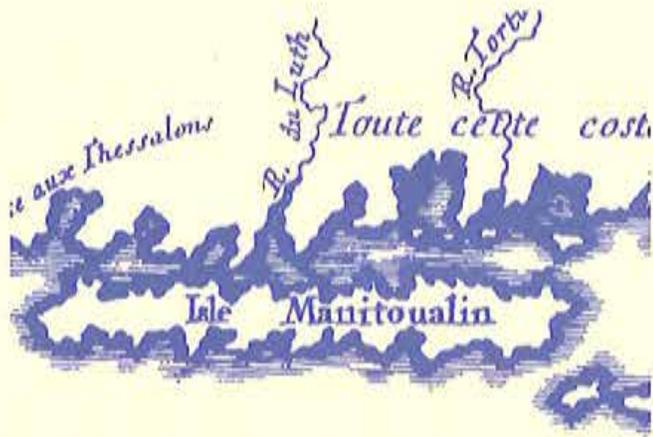
national treasure using landscape or ecosystem conservation. The three most pressing threats to Great Lakes biological diversity are certain agricultural practices, the water levels of the lakes, and development.



## Michigan's Great Lakes Islands

Michigan is home to close to 600 Great Lakes islands, about half in public and half in private ownership. We have two types of islands. We have *towering perched dune* islands resting on glacial deposits like the Fox Islands of Lake Michigan. We also have *limestone or dolomite bedrock* islands like Isle Royale of Lake Superior. What makes Michigan's Great Lakes islands special is that they have a disproportionately high number of occurrences of "endangered, threatened or rare species, exemplary natural communities...and other special natural features." The Michigan islands known to have more than 10 of these occurrences are Isle Royale and other nearby islands, Drummond, Beaver, Bois Blanc, South Manitou, Belle, Sugar, Harsens, South Fox, High, Grosse Ile, Thunder Bay, and Manitou island off the Keweenaw Peninsula. Michigan islands have 933 of these occurrences which is over ten percent of the state's total, despite islands accounting for only one percent of the land area. Every Michigan coastal endangered species is found on a Great Lakes island.





This is due to three factors: the isolation of the islands which protects them from disturbance, a unique moderated climate, and being the preferred nesting sites for piping plover and other colonial waterbirds.

## What Michigan is Doing to Protect these Treasures

The purchase and protection of Great Lakes islands is of high importance in Michigan. Following a long tradition of outstanding natural resource protection, the state of Michigan has taken the basin-wide lead on Great Lakes island research, management, and protection. The Michigan Coastal Management Program has supported many projects that benefit islands including funding island inventories that help us understand the value of these islands. The Michigan Natural Resources Land Trust Fund is slated to purchase North Fox Island in Lake Michigan.

Still more can be done. Support can be made available to islanders to help them understand and preserve the treasures they call home. Resource managers can find ways to protect the special nature of islands during day-to-day management. Public ownership of land, particularly Great Lakes islands, continues to be a viable option because of their globally significant natural values. In this way our grandchildren will be able to say that we not only funded

research that revealed the special global significance of Michigan's Great Lakes islands, but we took special steps to protect and conserve them.

*Karen E. Vignstad has served as director of the Rouge River Watershed Council, senior policy specialist in the Office of the Great Lakes, and Great Lakes specialist for the Michigan Sea Grant College Program. She is currently a doctoral candidate in Resource Development at Michigan State University and director of the U.S.-Canada Great Lakes Islands project.*

### *Lake Huron Islands*

*The vast majority of the 35,000 islands of the Great Lakes are in Lake Huron's Georgian Bay. Lake Huron holds some of the most incredible islands on Earth such as the world's largest freshwater island, Manitoulin. Manitoulin Island is in the Canadian waters of Lake Huron and is 100 miles long by 25 miles wide and is entirely privately owned. Manitoulin is one of many Great Lakes islands that are of special spiritual importance to Native Americans, and about half the islanders are aboriginal.*

*Information taken from the "State of the Great Lakes Islands" proceedings from the 1996 U.S.-Canada Great Lakes Islands Workshop by Susan Crispin and Dr. Judith D. Soule.*

# The Michigan State Waterways Commission: 50 Years of Extraordinary Accomplishments

In 1997, the Michigan State Waterways Commission celebrated 50 years of extraordinary accomplishments.

To understand the magnitude of their accomplishments, you have to visualize the perils of traveling the Great Lakes prior to the establishments of the Commission in 1947. The following passage is quoted from a Port Huron sea captain in the Waterways Commission's first biennial report.

"In all of my sailing days I have never seen two more unfriendly coasts than portions of Lake Superior and Lake Huron. These are spots where there are stretches over 100 miles without harbor or shelter for a small vessel . . . Even with a well-founded and well-engined vessel, he [a motor botaman] can, on the average, make about 10 miles an hour. To make it in 60 miles, it would take six hours or an average day's run. In that time these lakes can swing from beautiful, calm blue water to the full raging fury of storm and squalls. Without a harbor of refuge, this dangerous coastal area stops our commercial and pleasure craft as truly as any desert."

But citizen leaders of "1940" knew that the Great Lakes did not have to be a marine desert. They had a clear vision for the marine potential of the Great Lakes. They envisioned a great marine highway supported by protected harbors of refuge. Their vision spoke of partnerships between the federal and state governments and local communities. And they believed that this vision should be achieved by boaters paying their own way.

Communities, Congress, citizens and the Governor shared the same vision and goals. And so today, because of the power of that vision, the Great Lakes are home to the world's greatest marine highway. From New Buffalo in the southwest to Bolles Harbor in the southeast, a boater is never more than 15 miles from a protected harbor. In many

areas that vision has been expanded to assure that a protected harbor is within seven miles. Harbor communities have found these protected harbors of refuge to be springboards for economic development or redevelopment. Michigan's renown Great Lakes sportfishery could not have developed without this marine highway, nor would today the state of Michigan have the largest number of registered watercraft in the nation. The boaters have made this all possible by agreeing from the very beginning to pay their own way. Not a penny of the state's general fund has been used to support these extraordinary accomplishments!

While the Michigan State Waterways Commission has extraordinary accomplishments to celebrate, they are also looking to the challenges for the future.

Many of the facilities are aging. Built thirty plus years ago, we are seeing the need for overall upgrades and improvements to the electrical and fuel systems, restroom/shower office building improvements and bubble system installation to protect our investments from ice damage.

With fifty years of powerful leadership, the Michigan State Waterways Commission stands ready to ensure that its next fifty years are equally as productive.



*Presque Isle Harbor, Lake Huron*

# Great Lakes Water Levels

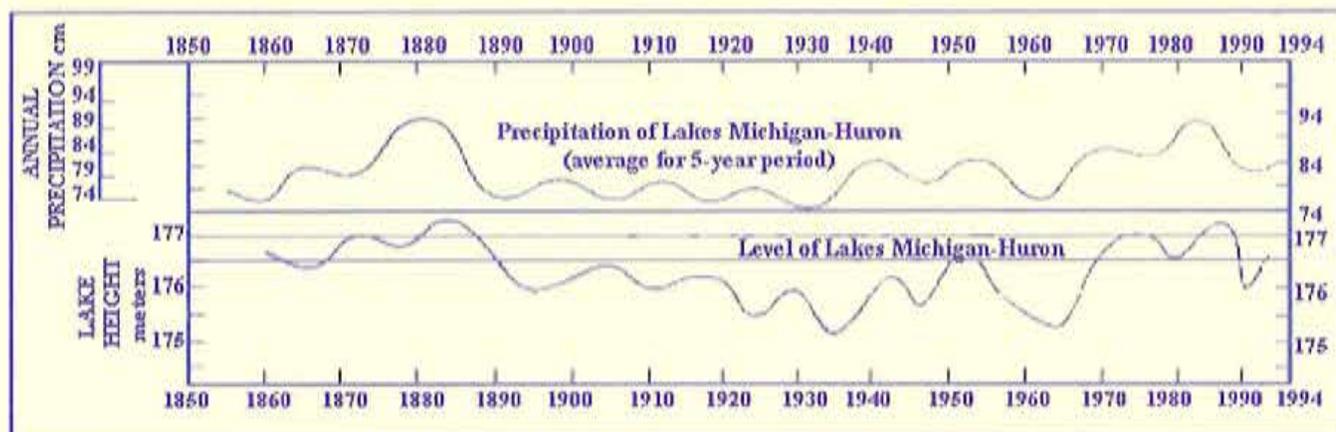
Great Lakes water levels have fluctuated since their creation and these fluctuations are directly related to climatic conditions affecting the basin. Many of the extreme lake level changes that occurred in the geologic past related to advance and retreat of glaciers in the Great Lakes basin. Since final retreat of the glaciers from the basin, water levels have continued to fluctuate. Scientific evidence shows that around 5,000 years ago lake levels were approximately 21 feet higher than today. Within the past 500 years, water levels have been as high as 8 feet above current recorded average. Actual measurements of lake levels began in the 1850s with accurate measurements since 1918. The recording of these data provides evidence that in the late 1800s water levels exceeded the 1986 record highs.

A number of natural factors effect water levels. Some of the major factors include precipitation falling directly on the water surface, inflow from upper lakes, runoff from land, groundwater, evaporation from the surface of the lakes, and outflow from the lower lakes. Artificial factors also effect lake levels and include regulation of outflows; diversions of water into, between and out of the lakes; dredging; and

consumptive uses. Natural factors have the greatest impact on lake levels, although human impacts continue to increase. Evidence of natural influence is provided by comparing lake level fluctuations to precipitation falling in the Great Lakes basin from the 1850s to 1994. The figure below shows a direct relationship between water level and precipitation with a slight delay in water level changes following changes in precipitation. Water level rise in 1997 resulted from annual increases in precipitation during 1995, 1996, and during the first three months of 1997.

Increases in water level renew concern over erosion damage and increases interest in placing shore protection structures.

As long as there is variability in climatic conditions there will be fluctuations in Great Lakes water levels. Assuming that interest in living along the Great Lakes shoreline continues, there will be property owners wishing to place shore protection to protect their property from erosion. The DEQ continues to assure that placement of shore protection is done in the least damaging way to preserve natural resources and protect nearby property owners from adverse impacts associated with placement of shore protection.



*Precipitation & Lake Level changes for Lakes Michigan-Huron  
(modified from Changnon, 1997)*

# Air Toxics Deposition to the Great Lakes – What Have We Learned From the Great Waters Program?

By Joy Taylor

The “Great Waters Program” is a unique requirement of the 1990 amended Clean Air Act (CAA) that requires the U.S. Environmental Protection Agency (EPA) to assess the input and sources of hazardous air pollutants (HAPs) to the “Great Waters.” The Great Lakes, Lake Champlain, Chesapeake Bay and select coastal waters constitute the Great Waters. The Program also requires that research be conducted to determine if any adverse effects to public health and the environment exist from HAPs and whether any water quality standards are exceeded from HAP deposition. Additionally, EPA is charged with determining if additional regulations that go beyond what the CAA already requires are necessary to “prevent serious or widespread environmental effects, including such effects resulting from indirect exposure pathways.” EPA is required to report to Congress on their progress and

results of the Program every two years.

Since the inception of the Great Waters Program, two Reports to Congress have been submitted; one in May 1994 and most recently in June 1997. The second report is intended to be an update of any research findings and other activities that have occurred since the release of the first report to Congress. The following is a summary of the findings of the first report to Congress:



## *Great Waters' HAPs*

Cadmium & cadmium compounds  
DDT/DDE  
Dieldrin  
Hexachlorobenzene  
α-Hexachlorocyclohexane  
Lindane  
Lead & lead compounds  
Mercury & mercury compounds  
PCBs  
Polycyclic Organic Matter  
TCDD  
TCDF  
Toxaphene  
Nitrogen compounds

- Atmospheric deposition can be a significant contributor of toxic chemicals to the Great Waters.
- Adverse effects such as cancer and developmental effects associated with Great Water's HAPs in wildlife and humans are fairly well understood, although data is insufficient to establish the link between atmospheric deposition of these pollutants and their related effects.
- Many sources and source categories of the HAPs have been identified, however identification of specific sources that are contributing to atmospheric deposition is difficult because sources can be local, regional and even global.
- Exceedances of water quality criteria have occurred for certain HAPs.
- Adverse effects on wildlife and human health have been observed from exposure to persistent pollutants that

bioaccumulate, primarily via fish consumption.

- Ecological impacts to animal populations from the HAPs can be significant. Such effects include immune function impairment, reproduction problems and neurological changes that affect survival. Sometimes these effects can be so subtle that they are often missed.

EPA's general policy conclusion was that the science justifies reasonable actions to reduce atmospheric loadings to the Great Waters even though uncertainties still exist. Federal actions include implementing the regulatory provisions of the CAA, using an integrated multimedia approach to reduce the release of the HAPs and continue to support research to fill in the many data gaps that still exist.

The second report to Congress reaffirmed the findings in the first report, and further concluded that recent air monitoring suggests that atmospheric levels of some of the HAPs are slightly declining or leveling off, but remain a significant concern in the Great Lakes.

Additional activities to further our understanding on Great Waters issues are identified in the second report, some of which include:

- Continue research on deposition and air monitoring efforts to track progress.
- Improve modeling efforts to better estimate the loadings of HAPs to the Great Waters.
- Improve source identification both from local and long-range transport and investigate the impact from HAPs that continue to recycle within the environment.
- Continue to promote pollution reduction efforts locally, regionally, nationally, as well as coordinate international efforts.
- Assess economic costs and benefits associated with reductions of the HAPs to the Great Waters and identify economic impacts associated with exposure and such effect indicators as

fish advisories, habitat decline and diminished species diversity.

EPA released its draft determination that stated no additional regulations that go beyond the existing CAA provisions are necessary to "prevent serious adverse human health effects and serious or widespread environmental effects as a result of atmospheric deposition of HAPs emitted by domestic stationary sources."

The Great Lakes Basin will benefit from the continued emphasis on research including continued air monitoring sampling, emission inventory development and source identification, provided resources are annually dedicated to this important program. Successfully eliminating HAP loadings to the Great Lakes will also require local, regional, national and international efforts. Michigan will continue to be involved in many activities both on a local, regional, national and international scale. One such international effort includes the countries of Canada, the United States, and Mexico.

*Joy Taylor, Air Quality Division, Michigan Department of Environmental Quality, served on the Michigan Mercury Pollution Prevention Task Force.*

# Ecological Implications of Impervious Surfaces

by Chuck Hersey, Steve Perry and Andrew Schmidt

Impervious surfaces can have a significant negative impact on water quality because the degree of imperviousness affects the amount of runoff from precipitation and pollutant loadings to surface waters, including the Great Lakes. Current trends indicate that the amount of impervious surface in the Southeast Michigan region is and will continue increasing.



*Chuck Hersey*



*Steve Perry*



*Andrew Schmidt*

## What Is Imperviousness?

Imperviousness is a surface's degree of permeability. The level of imperviousness is related to land use because land use impacts infiltration of water through soil. Land use types such as forests and agriculture represent a 2% imperviousness with commercial, institutional and central business districts representing between 56.2% - 76.3% imperviousness, and shopping centers and malls representing 80% imperviousness. Imperviousness is a very useful indicator in measuring impacts of land development on aquatic systems.

There are three categories of stream response to impervious runoff. Sensitive streams are those that contain stable channeling with good water quality and good stream biodiversity. Impacted streams begin showing unstable channeling with fair water quality and fair stream biodiversity. Non-supporting streams have highly eroded stream banks resulting from unstable channeling. These streams frequently have very poor water quality and stream biodiversity. Categories derived by to evaluate water quality are indicated in the figure on page 40.

## Importance of Imperviousness

Natural land cover allows precipitation to infiltrate, providing water for plants and animals and recharging aquifers while precipitation on developed land cover runs off, carrying with it accumulated surface debris and pollutants. The degree of imperviousness is a good indicator of water quality because it creates a stress on surface waters during wet weather events. Increases in imperviousness are closely associated with development characteristics, including additional housing units, more roads and more parking lots.

## Methodology (Calculating imperviousness)

Estimates of imperviousness for Southeast Michigan were derived from a study conducted by Wayne County's Rouge River National Wet Weather Demonstration Project. The Rouge Project Office (RPO) collected about 300 samples throughout the watershed to determine the degree of imperviousness associated with various land uses. The land use categories were based on those used in the Michigan Resource Information System.

Once a level of imperviousness was developed for each land use category, the



degree of imperviousness and associated water quality impacts could be estimated using existing land use data. Future levels of imperviousness were estimated based on those changes in land use associated with implementing generalized community master plans. While the actual implementation of all local plans is not likely, this procedure provides a starting point for identifying areas of concern. This procedure needs to be applied to watersheds and subwatershed areas.

## Results

Between 1995-2020, the region's projected population growth is 8%, while urbanized land will increase 40%. As a result, the region's degree of imperviousness is expected to increase from 11% in 1995 to 20%, assuming that local land use plans are fully implemented.

## Implications of increasing imperviousness

Implications of increasing levels of imperviousness are significant for both the surface waters of both Southeast Michigan and the Great Lakes. Major fiscal investments are being made in Southeast Michigan to clean up and maintain surface waters. At the same time that existing problems are being cleaned up, levels of imperviousness are increasing significantly. Unchecked, the consequences are that progress in restoration and maintenance of water quality will be difficult, slowed and, in some cases, reversed.

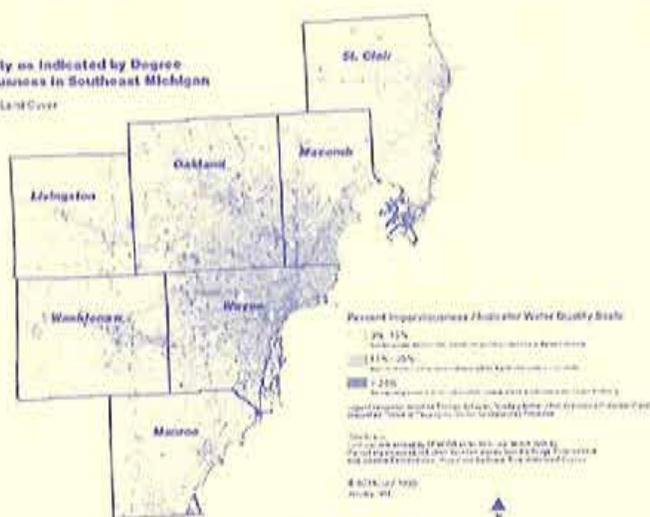
There is still a chance to be proactive in addressing the imperviousness issue. Some increases projected by 2020

can be avoided through more thorough planning that accounts for the negative consequences of increased impervious surface. A watershed approach to water quality initiatives can identify measures that prevent and/or mitigate expected increases in levels of imperviousness. Local governments and developers need tools they can apply to minimize the amount of impervious surface associated with various types of development. More importantly, they need to be provided with an understanding of the economic and environmental benefits of implementing measures limiting increases in impervious surfaces.

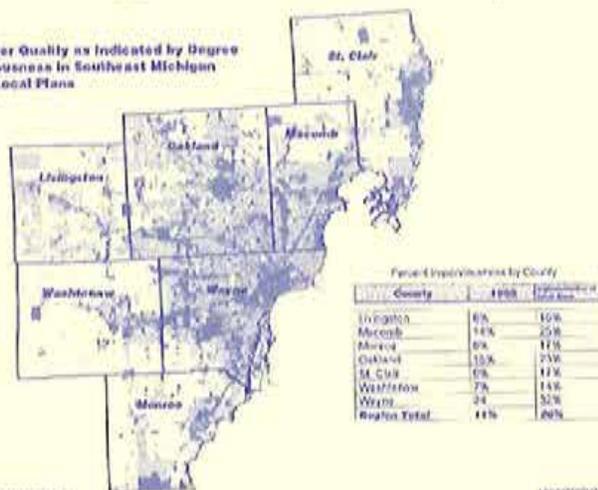
*Chuck Hersey, Steve Perry, and Andrew Schmidt are members of SEMCOG's Environmental Programs staff.*

Figure 1

Water Quality as Indicated by Degree of Imperviousness in Southeast Michigan  
1995 Land Use / Land Cover



Future Water Quality as Indicated by Degree of Imperviousness in Southeast Michigan  
Based on Local Plans



# 1997 Great Lakes Fishery in Review

Diligence is the term that best describes 1997 Great Lakes fishery activities, with progress made on many fronts. The Lakes continue to respond positively to changing environmental conditions brought on by declining contaminant trends, sea lamprey controls, "run-of-the-river" dam controls, and the on-going dialogue between the Great Lakes states, tribes, and province of Ontario. Highlights of 1997 include:

## Strategic Great Lakes Fishery Management Plan

Senior federal, state, provincial and tribal members convened in 1997 under the auspices of the Great Lakes Fishery Commission for the signing of an updated Joint Strategic Plan for Management of Great Lakes Fisheries. The document, first signed in 1980, articulates a shared vision for fisheries restoration in the Great Lakes Basin and is widely viewed as one of the world's best examples of cooperative, ecosystem-based fishery management. The 1997 revisions were intended to strengthen the Plan based upon a review of progress made and by applying lessons in implementing the original Plan. At the same time, the Plan recognizes the constitutional and other legal responsibilities of the management agencies to manage their respective fishery resources. The Plan is designed to be a very practical tool for coordinating efforts of environmental management or natural resource offices and fishery agencies to provide mutual benefits and protection of the Great Lakes aquatic system.

## \$18 Million Hatchery Renovation and \$3 Million Sea Lamprey Control Pledge

In June Governor Engler pledged \$18 million for state hatchery renovation and \$3 million to help battle the continued invasion of sea lamprey in Lakes Huron and Michigan. The Governor's proposal includes complete renovation of the Oden hatchery near Petoskey, partial renovation of the Platte River hatchery near Traverse City, improvements to rearing water quantity and quality at Marquette and Thompson hatcheries, improvement to effluent management methods at Thompson, Harrietta and Wolf Lake hatcheries, and improvements to the education and interpretive centers. The Department of Natural Resources has stocked Michigan's lakes, rivers and streams with more than 160 million fish since 1990. The \$18 million commitment will enhance and safeguard Michigan's \$2 billion annual sports fishery.

The Governor also declared war on sea lamprey infestation of northern Lakes Huron and Michigan from the St. Marys River, and challenged government officials in both Canada and the United States, as well as other Great Lakes states and Ontario, to match Michigan's financial commitment to the battle. The three-year \$3 million commitment will deliver an integrated control program including both chemical spot treatments and enhanced sterile male release. An estimated 350,000 sea lamprey migrate down the St. Marys River into Northern Lake Huron each year, and currently kill one-half of the adult lake trout population annually. Controlling the large population of sea lampreys produced in the St. Marys River remains one of the biggest challenges in the Great Lakes.



## Sturgeon Tracking and Rehabilitation on Lake St. Clair

Fisheries experts and researchers from the Department of Natural Resources (DNR), the University of Michigan, and the U.S. Fish and Wildlife Service were aboard the DNR's research vessel, The Channel Cat, during the first two weeks of June to implant radio and sonic transmitters into sturgeon from the St. Clair River. This long-term research study will focus on sturgeon and their habitats. Researchers hope to unlock mysteries surrounding sturgeon behavior such as determining spawning sites, feeding habits, and overall population health. Sturgeon were once abundant in all of the Great Lakes but nearly wiped out as a result of commercial fishing, habitat degradation and pollution.

## Yellow Perch Update

In 1997 yellow perch abundance in Lake Michigan continued a decline in Wisconsin, Illinois, and Indiana waters while showing only minimal recruitment in Michigan waters. Significant numbers of yellow perch larvae are not surviving well to the young-of-the-year stage, which implies that aging adult populations are not being replaced readily by new generations of perch in Lake Michigan. Scientists are not sure of the cause of the yellow perch decline, although predation by alewives and impacts due to other non-native species are suspected. There is agreement that the fish are not surviving to a harvestable age. A lakewide tagging study began in 1997 to investigate yellow perch movement and homing to spawning sites. On a brighter note, increased stocks of yellow perch in Lake Erie warranted a 72% increase in allowable catch, from 4.3 million pounds in 1996 to 7.4 million pounds in 1997 for Michigan, Ohio, Pennsylvania, New York and Ontario.

## Tribal Fishing Issues

On March 28, 2000, a settlement termed "Entry of Consent Order" expires between three Michigan Tribes, State of Michigan, U.S. Department of the Interior, and various sportfishing organizations. The order went into effect in May 1985 to allocate fishery resources fairly and reduce social conflict between tribal and white commercial fishermen and recreational anglers, while maintaining valuable fish stocks. A mechanism to resolve disputes arising from the Agreement was established by the formation of a five-member Executive Council which is comprised of the three Tribal Chairmen, a state, and a federal representative. The agreement divided treaty waters into geographic zones, designating some areas as state zones, some as tribal zones, and some areas as lake trout refuges or rehabilitation zones to promote natural lake trout reproduction. The Agreement remains the backbone for sustaining Great Lakes fisheries in Michigan. While disputes can and do arise with some regularity, the Agreement provides the vehicle to reach common ground among the interested parties. In 1997, DNR Director K. L. Cool entered discussions aimed at resolving conflicts while working toward a new agreement. There is consensus that early, constructive dialogue is the key to maintaining an agreement into the new millennium.



# Waterfront Re-Development

Visit any community or state park along Michigan's 3,200 miles of coastline and you will enjoy the benefits of the Coastal Management Program. Michigan's program provides more than \$1 million in grant funds each year to local governments, non-profit groups, tribal communities and state agencies for a wide variety of coastal related work. Planning and zoning, site design and engineering, natural features studies, restoration of historic structures, and public access construction are examples of eligible projects. An important component of the Coastal Management Program is funding and technical assistance to encourage waterfront redevelopment. Many communities have utilized this funding source to rebuild dilapidated waterfront sites, remove or restore structures, and develop plans for revitalizing urban shorelines. Following are a few examples of recent accomplishments.

## Detroit River Greenway Initiative

The city of Detroit conceived the idea of a Greenway System to create a permanent, linked greenway of public and private open spaces throughout the metropolitan area including the Detroit riverfront.

Three projects in support of the Greenway Initiative received funding assistance in 1997. Michigan State University/Sea Grant Extension received a grant to help build a collaborative partnership agreement process between communities involved in the Greenway Initiative. The Rails-to-Trails Conservancy received a grant to prepare a master plan for a five-mile long greenway trail that follows the Detroit River. The Rivertown Business Association received a grant to promote the resources of the Detroit River through the development of a riverfront guide, including maps of the area.

## City of Houghton Waterfront Pathway and Park System

The city of Houghton developed a pathway and park system along four miles of its waterfront on the Portage Canal, which bisects the Keweenaw Peninsula. The paved pathway, constructed over the course of several years and with grant assistance from the Coastal Management Program, is very popular with bicyclists, in-line skaters, runners, and sightseers. In winter, the pathway can be used by snowmobilers and skiers. The most recent segment of the pathway development was at the site of an old pier that had been used for loading cargo ships. With funding assistance from the Coastal Management Program, the site is being transformed into a small park with a link to the waterfront pathway, transient boat mooring and shorefishing structures.

## Elberta – Frankfort

In a true partnership project, the village of Elberta is using Coastal Management Program funds to complete a redevelopment plan for the 26-acre Ann Arbor Marine Terminal Yard located on Betsie Bay. Redevelopment of the site as "mixed use" as well as a Village Park will be the result of the cooperative efforts of the village of Elberta and the Michigan Departments of Transportation, Environmental Quality, and Natural Resources.

The Coastal Management Program offers funding opportunities for diverse coastal projects. Waterfront redevelopment has been a national priority for coastal areas since the passage of the federal Coastal Zone Management Act in 1972. Since Michigan's Coastal Management Program was officially adopted in 1978, waterfront redevelopment projects have been a high priority for funding.



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