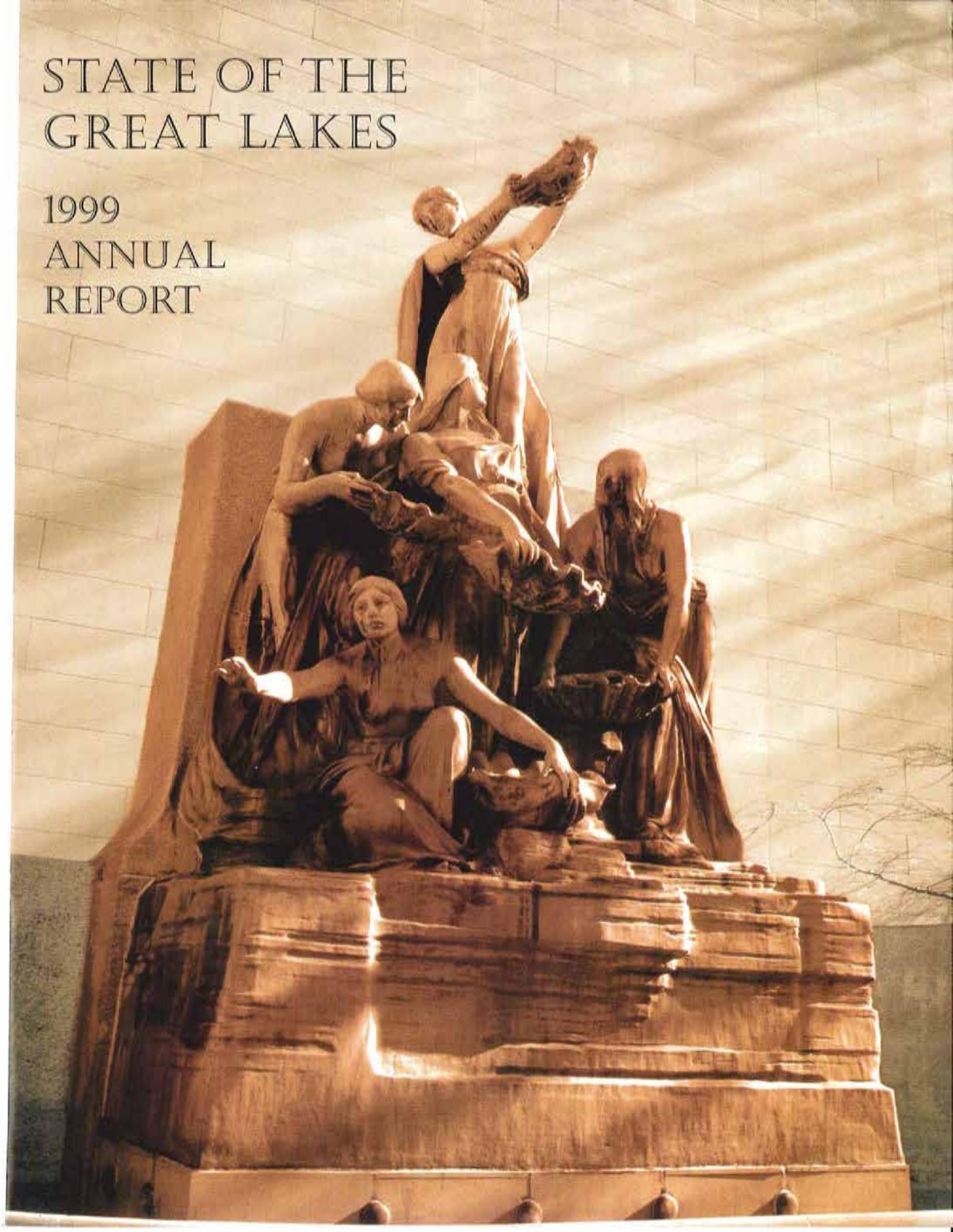


STATE OF THE GREAT LAKES

1999
ANNUAL
REPORT



The Fountain of the Great Lakes, (1913) by Lorado Taft (1860 - 1936), sits in the south wing of the Art Institute of Chicago. The fountain depicts five female figures grouped together so that water flows from the shells they hold in the same way it passes through the Great Lakes system. Superior, at the top, and Michigan empty their water into the basin held by Huron, who sends her stream on to Erie. Ontario receives the water and gazes off as it flows into the ocean.

1999: A Year of Accomplishment

A Message from the Governor

As we pause to assess the state of the Great Lakes and Michigan's environment, which are inextricably linked with one another, I am gratified by the accomplishments over the past year.

In October, I announced the successful sale of Michigan's first series of \$97 million in Clean Michigan Initiative (CMI) bonds – over the Internet in fact!

The CMI, which I proposed and the voters approved in 1998, provides \$675 million to insure long-term funding for Michigan's environmental protection and recreational needs, including brownfield cleanups, waterfront redevelopment, water quality monitoring, remediation of contaminated sediments, and control of polluted runoff. I have signed a supplemental budget bill committing CMI funds for the cleanup of 90 contaminated sites in 29 counties. I will continue to push for speedy deployment of CMI dollars for the benefit of our communities and the environment.

The CMI and other state dollars will also allow Michigan to leverage \$129 million in federal funds to create Michigan's Conservation Reserve Enhancement Program (CREP) which encourages environmentally-sound practices on agricultural lands to improve water quality and wildlife habitat.

Protecting and improving Michigan's water quality is essential. This multifaceted approach – CMI and CREP – will help ensure that our vital water resources are properly protected for the long term.

This year I was also very pleased to announce that Michigan came into compliance with all federal clean air standards. These standards cover six "criteria" pollutants: carbon monoxide, lead, nitrogen dioxide, ozone, particulates, and sulfur dioxide

This is a tremendous accomplishment. Michigan is a populous – and prosperous – industrialized state. Achieving compliance of these demanding environmental standards is a tribute to the cooperative efforts of business, municipalities, and state government.

The mutual self-interests of environmental and economic concerns are nowhere more evident than in Michigan's recreation and tourism industry. "Great Lakes – Great Times."





No wonder Michigan leads the nation in the number of public golf courses, ranking third. Tourists and Michigan's own estimated 1.2 million golfers make the state's golf course industry worth \$94 million annually.

So, I was happy to showcase the Turfgrass Environmental Stewardship Program, a cooperative effort of state government, Michigan State University, and the Michigan Turfgrass Foundation. This voluntary program will certify golf courses for good environmental stewardship, as well as responsible golf course design and construction to avoid situations that compromise the environment. To date we have 152 courses enrolled with 18 already certified.

Throughout 1999, I continued to work with my fellow Great Lakes Governors to formulate a sustainable water diversion policy for the 21st Century. I can now report that at our 17th annual leadership summit this fall, all eight governors pledged to develop a new agreement to more closely plan, manage, and make decisions for the protection of the waters of the Great Lakes, including a new common standard against which water projects will be reviewed. Moreover, they renewed their efforts to secure funding for an effective water use database to facilitate decisions.

Over the last 15 years, the Great Lakes Governors have abided by a set of principles when managing the waters of the Great Lakes. These principles have guided us in developing, maintaining and strengthening the regional management regime for the Great Lakes ecosystem.

I will continue to exercise my authority, along with my fellow Great Lakes Governors, to address any attempt to export Great Lakes water. I aim to strengthen the authority of those who govern the resource on a day-to-day basis. I will work to keep control of these essential resources in the hands of the Great Lakes states.

Michigan has learned that the economies of the states and provinces in the Great Lakes Basin are interdependent with the ecology of the vast natural resources we steward. I am proud of the fact that our water and air are cleaner than they've been since monitoring began. But there is more to be done. In the year ahead, I intend to build upon the success of 1999 to ensure Michigan remains an environmental leader in this new century.


John Engler
Governor

Looking Toward the Millennium

Although the actual millennium begins next year, it would be churlish not to join in the general good cheer and exuberance which characterized the end of 1999. Of course, attempting to assess the state of resources as massive and complex as the Great Lakes requires a millennial mindset no matter when the exercise is undertaken.

In August of 1999, Regis Philbin, congenial host of ABC's "Who Wants To Be a Millionaire," had an encounter with the Great Lakes. According to the Associated Press, Regis told contestant David Honea, a doctoral student in computer engineering, that he incorrectly answered a question on which of the five Great Lakes is the second largest in area after Lake Superior. Honea said Lake Huron. Regis's computer said Lake Michigan.

Ultimately, the show's executive producer admitted that Honea was right! Lake Michigan is second largest in volume but Lake Huron is second largest in surface area. Remember ABC is in the same part of the country where folks wanted to call Lake Champlain a Great Lake.

Technology continued its triumphant march into the millennium. Click on www.britannica.com and type in the Great Lakes. Presto! All the information you once had to pay for, in the hard-copy version of Encyclopedia Britannica, is now absolutely free on line. Among the many interesting things you will learn is that, in the United States and Canada, "It is a source of pride for both countries that there are no fortifications or warships along the boundary." Amen to that.

Heraclitus, an ancient Greek philosopher, said that all is flux. That about sums it up for the millennium. But one thing that won't change is the price for this year's *State of the Great Lakes 1999 Annual Report*. It's still free. So don't be fooled if you happen to be surfing on Barnes & Noble's web site and stumble across our 1997 and 1998 annual reports priced, respectively, at \$15 and \$20. This is not a joke. An enterprising publishing house, DIANE Publishing Company, evidently reprints free government publications with a big mark-up.

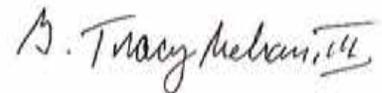
The Great Lakes is, indeed, a dynamic ecosystem. Change is inevitable. However, the Office of the Great Lakes, with all due respect to Heraclitus, worked mightily to keep the quality and content of this year's report unchanged, i.e., of the highest standard in terms of insight and usefulness.





The caliber of the many people whose professional lives center on the Great Lakes continues to impress us. Their work and commentary is offered here for the reader's continued enlightenment and edification.

Finally, our readers are encouraged to consult a companion document, prepared by our office, *Great Lakes Trends: Into the New Millennium*. This updated report documents changes in the chemical, physical and biological components of the Great Lakes ecosystem. It may be accessed on our website at: www.deq.state.mi.us/ogl



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

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As the Millennium Changes

The State of the Great Lakes at the End of the Millennium

by Harvey Shear, Ph.D.

As we approach the end of the millennium, it is timely to reflect on the state of the Great Lakes, and the progress made by a partnership of stakeholders led by the governments of Canada and the United States on cleaning up and preserving this most precious resource.

European settlement was attracted to the Great Lakes basin because of the apparently limitless supply of fresh clean water (20% of the world's supply of fresh surface water). The Lakes provided a trade route to the interior of a vast continent, and the water attracted industry and agriculture on a large scale. The 350-year history of this development, however, has been one of environmental abuse; largely out of ignorance of the effects of human activity on the complex ecosystem that is the Great Lakes basin. Much of the southern part of the Basin was clear cut for agriculture, great cities grew along the shoreline, pollutants were discharged untreated into the waters, non-native species, both terrestrial and aquatic, became established, excessive harvest of the seemingly limitless fishery resources soon brought many species to the brink of extinction, and in one case (the blue pike in Lake Erie) to actual extinction.

The two national governments as early as 1909 saw the problems that uncontrolled development had had on the water resources of North America, and signed the Boundary Waters Treaty. This Treaty was very far sighted, because it took into account the need to deal with transboundary pollution. It was this Treaty that allowed the governments, in 1972, after extensive studies of the effects of excessive nutrients on Lakes Erie and Ontario, to sign the Great Lakes Water Quality Agreement (the Agreement). The governments of all jurisdictions in the two countries have been working diligently for 27 years to achieve the purpose of the Agreement which is "restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem."

So, how have we done as a society in striving to achieve this lofty purpose? The governments, as part of their reporting responsibilities under the Agreement, established a



biennial reporting process known as State of the Lakes Ecosystem Conference (SOLEC). SOLEC held its first meeting in 1994 and its most recent in 1998. The locations alternate between Canada and the United States. The next SOLEC is scheduled for October 2000 in Hamilton, Ontario.

SOLEC has reported on a number of key environmental and societal aspects of the Great Lakes Basin, including changing land use patterns, human health, the state of the economy, aquatic community health, toxic chemicals, nutrients, near shore terrestrial and aquatic community health, and coastal wetlands and aquatic habitats.

It is difficult to give an overall assessment of the health of the Great Lakes Basin Ecosystem because the system is so large and complex. Nevertheless, the information presented at SOLEC gives a clear signal about a number of important elements of the system:

Toxic Chemicals

Trend analysis shows that toxic chemical concentrations in fish and wildlife continue to decline at the same rate as seen since the early 1970s. The Canadian Wildlife Service data on contaminants in herring gull eggs show this clearly. Control programs to restrict or eliminate these chemicals have had a demonstrable effect.

Nutrients

Excess levels of nutrients in the Lower Lakes (Erie and Ontario) in the 1960s was the immediate impetus for the signing of the Agreement. Since 1972, both countries have spent some \$10 billion (U.S. Dollars) on building and/or upgrading sewage treatment facilities to ensure that nutrient levels in the Great Lakes are at or below agreed to targets to avoid problems associated with excess nutrients. This program has been very successful as one can see in *Figure 1*.

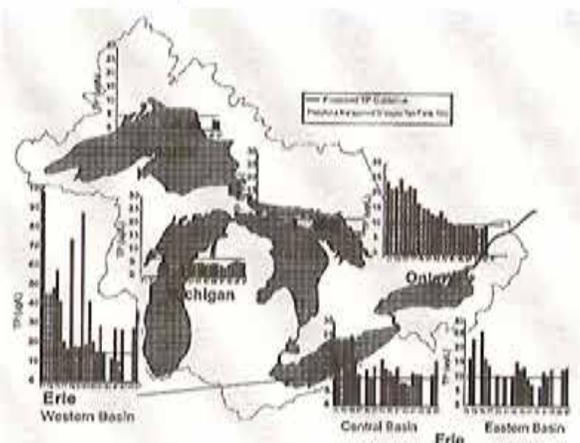


Figure 1
Total spring open lake phosphorus trends in the Great Lakes 1971-1997.

Source: Environment Canada (Environmental Conservation Branch) and USEPA (Great Lakes National Program Office)

Human Health

It is difficult to in humans, assess the effects of living in the Great Lakes basin, given the number of factors that affect human health (lifestyle, genetics). Despite these limitations, SOLEC has looked at some of the trends in chemicals that may affect human health. Analysis has shown that the levels of these contaminants in humans are continuing to decrease from levels measured in the 1960s-70s (Figure 2). Human health experts have concluded that living in the Great Lakes Basin poses no greater overall threat to human health than living in any other industrialized part of the world. Having said this, there are some populations that are at higher risk from environmental contaminants, such as the very young, the elderly, pregnant women, and people who consume above average amounts of Great Lakes fish.

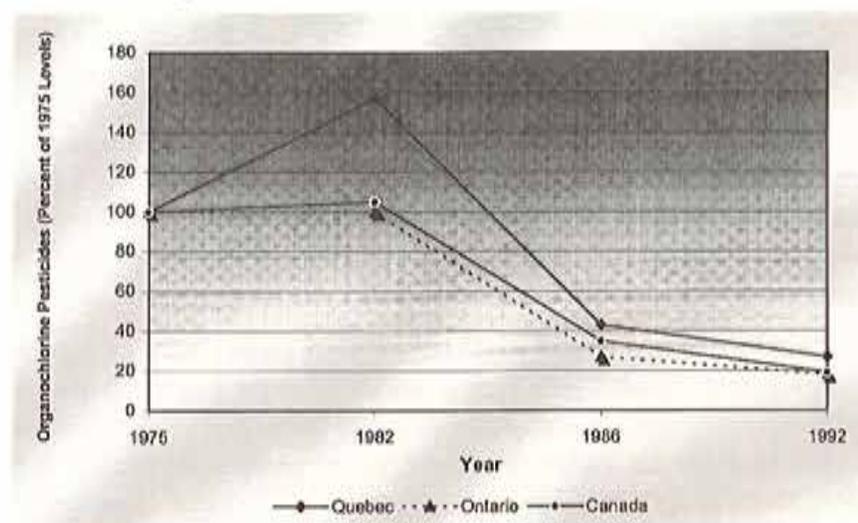


Figure 2
Mean concentrations of 7 organochlorine pesticides in human breast milk 1975-1992.

Source: Craan and Haines, 1998

Aquatic Communities

Both the offshore and nearshore aquatic communities have undergone major changes in species composition and numbers over the past 350 years. Seventeen species of fish, for example, have become extinct, have been eliminated from one or more of the lakes, or have been severely depleted. Many of these species have been replaced with hatchery-reared imports, or with species accidentally introduced. The impact of zebra mussels has been catastrophic on the aquatic food chain, especially in Lake Erie. Other non-native species have the potential to disrupt the food web even further. Despite the best efforts of governments to prevent new arrivals of non-native species, they continue to come, often in the ballast tanks of foreign ships. The latest arrival, *Cercopagis pengoi*, is a small, planktonic (free-swimming) animal with a very long tail



containing numerous little hooks. This creature can reproduce asexually and very prolifically. The animal is capable of fouling fishing nets and other gear, and it is likely to compete with other zooplankton for food. The impacts are potentially very significant.

Land Use

Land use policies and practices in the Great Lakes Basin have favored urban sprawl and low density development in recent years. In many cities the old, high-density urban core has been abandoned and development has looked to the "limitless" expanses of farmland surrounding these cities. A couple of often quoted examples: From 1970 to 1990 the six county area of northeast Illinois grew by 4.1 percent in population, but the consumption of land increased by 46 percent. In Michigan, between 1980 and 1990, farmland was converted to some other use at the rate of 10 acres an hour! Land conversion in southern Ontario is following a similar pattern, although no figures are available. Poor land use practices such as urban sprawl lead to increased use of cars, more roads, more air pollution, greater consumption of water (for all those suburban gardens), and loss of wildlife habitat. These poor practices now constitute the single greatest threat to the health of the Great Lakes.

Nearshore Terrestrial

The Great Lakes Basin possesses some unique nearshore terrestrial communities. Many of these communities are only found in other locations hundreds or thousands of miles from the Great Lakes. The moderating influence of the Great Lakes has allowed these communities to develop and flourish. The assessment of the health of these communities is universally bad. They are all under threat from human encroachment of one form or another. Urgent action is required to preserve these unique areas, and through SOLEC a concept known as Biodiversity Investment Areas (BIAs) has been developed. These BIAs are unique assemblages of plants and animals that are a key component of the healthy functioning of the Great Lakes ecosystem, and that need protection. BIAs have been proposed for terrestrial communities, coastal wetlands, and aquatic communities.

Coastal Wetlands

The same story can be told for coastal wetlands. Over 80 percent of the wetlands in the southern part of the Basin have been lost to development since the late 1700s. Filling, dredging and dyking have all led to the demise of coastal wetlands. Despite our considerable knowledge about these important areas, the loss continues. Every wetland saved has been the result of a hard fought battle of concerned citizens against some form of development.

So, where are we in our fight to “restore and maintain the chemical, physical, and biological integrity of the water of the Great Lakes Basin Ecosystem”? Well, as you have seen, we have made great strides in some areas, but we have a ways to go in others. Nothing should be taken for granted as we move into another millennium. The pressures on the Lakes from 33 million people will continue. Population projections for southern Ontario indicate another 2 million people by 2020, so the demand for land, water and adequate sewage treatment will accelerate. Governments and the general citizenry of the Basin will need to be ever vigilant if they want their Lakes to survive.

Harvey Shear is the Regional Science Advisor for Environment Canada's Ontario Region. He serves on numerous committees including Canadian Chair of the State of the Lakes Ecosystem Conference and the International Joint Commission's Council of Great Lakes Research Managers.



Globalization and the North American Environment

by Janine Ferretti



The age of globalization is a harbinger of what the next millennium will bring in terms of challenges and opportunities for the North American environment. The opening-up of trade and investment regimes and rapid technological changes are likely to have a substantial effect on the environment. While globalization can promote the more efficient use of resources, it can also contribute to increased pressure on natural resources and increased pollution. One of the key challenges for North America is to ensure that there are adequate environmental institutions and strong environmental programs and policies, including effective enforcement of environmental legislation, in place to respond to these pressures. Without these "equalizers," the environmental challenges we face will increase in enormity. Here is a projection of just a few of them:

Global demand for wood is expanding at a rate of 1 to 2 percent annually, despite improvements in efficiency and recycling. Old growth habitat in many Canadian and U.S. temperate and boreal forests is still being clearcut, and in Mexico logging continues to clear land for crops and grazing. While post-harvest replanting efforts may be stabilizing the quantity of forest cover in parts of North America, the conversion to monoculture plantations is degrading forest quality. Forests are becoming increasingly fragmented, biologically impoverished and stressed.

While North America is blessed with a significant share of the world's fresh water, water is not evenly distributed and water scarcity will become a reality in more places. Already the withdrawal of water from aquifers for various farming needs is increasing and pumping exceeds natural recharge in the High Plains Aquifer System of the United States, California's Central Valley, the southwestern United States, and Mexico City and the Valley of Mexico. In some regions of the United States, water tables have fallen by up to 120 cm a year.

Gains in urban air quality in Canada and the United States over the past 20 years could be offset by increased urban sprawl, and growth in the number of motor vehicles and in distances driven threaten to overturn gains made. Serious air

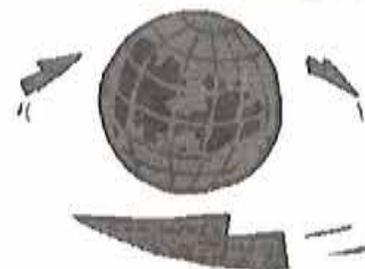
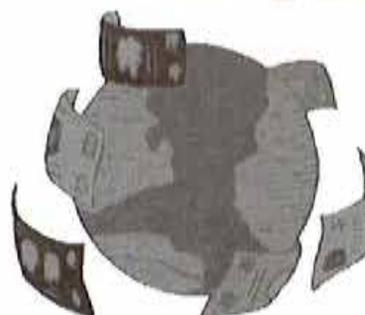
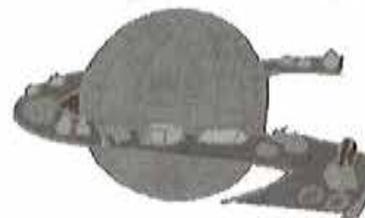
quality problems persist in many of North America's largest cities such as Mexico City, Denver, and Toronto. Air pollution is emerging as a key contributor to some respiratory and cardiovascular diseases that are impairing health and killing vulnerable populations of North Americans.

The United States and Mexico are among the top 19 countries with the greatest number of threatened species and half of North America's most diverse ecoregions are now severely degraded. Habitat change is the greatest threat, but invasive species including plants, animals, insects and even viruses are emerging as a new and difficult challenge. Increased transportation associated with booming trade of goods, and the expansion of aquaculture provide insidious opportunities for many more exotic species to be introduced into North America, threatening the biodiversity of native ecosystems.

If current patterns of fossil-fuel use remain unchanged, CO₂ emissions are expected to double from pre-industrial levels by the year 2050, and may increase the Earth's average surface temperature by 1 to 3.5 degrees C by 2100, a rate of change faster than any observed over the last 10,000 years. Hotter temperatures and higher evaporation rates will cause drought and desertification in some areas and heavier rainfall and flooding in others. Forest and agricultural zones may shift, pests and diseases may inhabit new territories, sea levels may rise and the frequency and intensity of storms and fires may increase.

These examples, drawn from the CEC's upcoming State of the Environment Report for North America, lay out some of the serious challenges facing North Americans in the new millennium. But there are also opportunities. Through great changes in technology, we are able to access and analyze information in ways that revolutionize our ability to understand, communicate and respond to environmental issues. In this global information age people are empowered to take action to protect their local community or take part in efforts to protect ecoregions and species thousands of miles away. As economic ties draw Canada, the United States and Mexico close together, a sense of a North American community and an understanding of North America as connected ecoregions, air and water sheds is emerging. People are able to reach out across cultural and political boundaries and work together to address environmental problems of common concern.

North Americans, as they enter the new millennium, know from experience that environmental issues cut across political boundaries, and that there is mutual benefit in having strong environmental institutions and programs in



“Think Globally, Act Locally AND Globally” – This, I believe, is the prescription that the Great Lakes community must adopt if we are to successfully meet the environmental challenges of the new millennium. The issues of invasive species, the air deposition of persistent toxic substances, biodiversity decline and climate change, some of the basin’s most serious environmental threats, all have significant global dimensions. Not only must we take actions within the basin to address these issues, but we must be more engaged internationally to influence world-wide action.”

Gary Gulezian, Great Lakes National Program Office, U.S. Environmental Protection Agency

place in all three countries. There is no doubt that through effective North American cooperation we can protect the environmental underpinnings of our well being into the next millennium.

Janine Ferretti is Executive Director of the Commission for Environmental Cooperation, which looks at North American environmental issues from a continental perspective, with a particular focus on those arising in the context of trade liberalization, and fosters collaborative efforts by Canada, Mexico and the United States to address them.

Environmental Bond Dollars Going To Work In Communities Statewide

by Russell J. Harding

Translating the Clean Michigan Initiative (CMI) from a ballot-box concept into tangible local results is a main thrust of the Department of Environmental Quality (DEQ).

Since CMI's overwhelming passage in November 1998, Governor John Engler and the Legislature remain focused on putting environmental bond dollars to work in communities statewide. Implementing much of this effort is the DEQ, whose programs account for more than \$500 million of the overall \$675 million bond.

Voter approval of the governor's initiative also signaled a vote of confidence in the state's ability to ensure that CMI lives up to its promise. It's a trust not being taken lightly by the Governor, Legislature or involved state agencies.

CMI continues to be a source of genuine enthusiasm among agency staff. Many funding proposals under the bond are based on their recommendations, since field staff are on the front lines of environmental protection. Their firsthand knowledge of environmental challenges, coupled with strong partnerships at the local level, ensure the most effective use of bond dollars.

CMI dollars are already at work from Detroit to the Upper Peninsula. The state was actually able to start getting bond dollars out the door in July when Governor Engler signed a Fiscal Year 1999 budget supplemental bill designating \$143 million for statewide environmental cleanup, redevelopment and pollution prevention projects. In October the Michigan Department of Treasury sold \$97 million in the first series of CMI bonds.

The breakdown under the spending bill is as follows:

- The largest single appropriation of more than \$64 million is going for brownfield cleanup and redevelopment projects. Returning contaminated sites to productive use presents communities with a healthier environment and stronger jobs base. The largest portion of this funding – nearly \$48 million – is being used to clean up 90 contaminated sites in 29 counties. Another \$12.6 million is earmarked for corrective actions to address releases from leaking underground storage tanks in 64 counties. Grants designed to encourage local governments to meet their



responsibilities for remediating solid waste landfills on the federal National Priority List total \$2 million. An additional \$2 million supports the Brownfield Grant and Loan Program. The first CMI brownfield redevelopment grant totaling \$721,000 was issued to Ontonagon County for development of the White Pine Industrial Park on the former Copper Range property.

- In August, 13 communities received grants totaling \$19 million to revitalize waterfront properties. Ridding these sites of old buildings and contamination allows for greater public access to urban waterfronts, and creates more appealing locations for recreation and business. Waterfront grant awards under the second round of funding will likely be made in early 2000.

- Contaminated sediment cleanup work has been initiated through agreements with either the U.S. Environmental Protection Agency, U.S. Army Corps of Engineers or state contractors at six sites. The \$4.3 million is addressing needs at the Black Lagoon on the Detroit River; Pine River Impoundment in St. Louis; Ruddiman Creek near Muskegon Lake; Tannery Bay on White Lake; an unnamed tributary to Wolf Creek in Montcalm County; and Deer Lake in Marquette County. Remediation is under way in the Pine River Impoundment. Assessments are completed in the Black Lagoon and Tannery Bay and are nearly complete at Deer Lake. Assessments at Ruddiman Creek and the unnamed tributary to Wolf Creek are slated for completion in 2000.

- The DEQ is reviewing 52 grant applications submitted for nonpoint source pollution prevention grants that were submitted by the July 14 deadline. Awards are to be made when program rules are promulgated. A second grant cycle is anticipated in early 2000.

- CMI also provides funds necessary to further emphasize the state's commitment to pollution prevention, as well as to develop and promote a science-based environmental education curriculum.

Our work is just beginning. Shaping, refining and implementing CMI is a massive undertaking. While the bond's remaining aspects continue to undergo legislative discussion, the department and administration are joining lawmakers to ensure that program integrity – as well as the trust of Michigan voters – is upheld.

Russell J. Harding is Director of the Michigan Department of Environmental Quality.



Pine River Dredging Project

The St. Lawrence Seaway at 40

by David L. Knight

When the St. Lawrence Seaway opened in 1959, proponents of the massive, \$1 billion project predicted that it would change things forever in the Great Lakes. And indeed it has.

First and foremost, the Seaway has served as a key outlet for the agricultural bounty of the North American breadbasket, and as a highly efficient conduit for the raw materials that feed the mid-continent's basic industries. Cost studies have consistently demonstrated that it is significantly less expensive to ship bulk cargoes to and from major Midwestern markets via the Great Lakes/Seaway system than by routing them through East Coast or Gulf ports.

Over two billion metric tons of cargoes have been transported on the Seaway over its first four decades, primarily grain, iron ore, imported steel, stone and coal. Access provided by the Seaway to iron ore mines in Quebec and Labrador, and to imported raw steel in the form of coils, slabs and billets, helped make the Great Lakes states the leading steel producers in the country.

Without the bulk transportation efficiencies allowed by the Seaway and the domestic Great Lakes shipping industry, it is questionable whether the region's heavy manufacturing sector would have survived the recession of the early 1980s to become as globally competitive as it is today.

From an agricultural perspective, the Seaway is a primary export route for about 13 million to 15 million tons a year of grain and other agriproducts of the U.S. and Canadian prairies. Grain shipped on the St. Lawrence, which comprises about a third of all Seaway cargo, travels to markets all over the world, providing producers with a cost effective transportation option for their export commodities.

Seaway commerce today is based on a delicate equation: iron ore and steel move upbound, and grain moves back down. While there are many other types of cargo moved on the Seaway, this two-way traffic in the major commodities promotes maximum vessel efficiency, lower freight rates and a more sustainable trade pattern for the entire system.

Culturally, the St. Lawrence Seaway helped the Great Lakes region develop not only a greater prominence on the global stage, but also a broader world view of its own. With the



official dedication of the Seaway on June 26, 1959, by President Dwight Eisenhower and Queen Elizabeth II, Great Lakes ports such as Duluth, Detroit, Cleveland, Milwaukee and Toronto literally became seaports overnight, a distinction that carried both status and opportunity.

When the Seaway opened the Great Lakes to the world, however, not everything that came through the gateway was expected, or necessarily welcome. Ballast water of ocean vessels trading in the Lakes is believed to have introduced a number of non-native species that have altered the Lakes' ecological balance.

In recent years, ballast water management has become a high priority issue in the Great Lakes. Interesting new coalitions have brought together the research community, shipping interests and public policy makers to search for solutions. Some of the resulting research initiatives in the Lakes have attracted international attention, as the problem of invasive species grows as a concern for ports, harbors and other sensitive aquatic systems all over the world.

Environmentally, the Seaway has offered benefits too. A 1993 study by the Great Lakes Commission found that vessel transportation on the Great Lakes/Seaway system uses considerably less fuel, produces fewer emissions and is less prone to pollution-causing spills than if the same cargoes were transported by either truck or rail.

Due to a lock infrastructure too small to handle modern container ships that dominate non-bulk shipping today, the Seaway will likely never attain its design capacity of 60 million tons of cargo a year. But as it begins its 41st season in 2000, the Seaway will be riding the momentum of six years of relative stability. A strong North American economy has kept cargo volume levels relatively steady at the 40 million-ton mark, 50 million if additional tonnage on the Welland Canal between Lakes Erie and Ontario is counted.

After 40 years, the St. Lawrence Seaway remains a remarkable engineering feat, a valuable asset to the U.S. and Canadian economies, and a permanent part of the geography of the Great Lakes.

David L. Knight is editor of Great Lakes/Seaway Review, a quarterly magazine covering the Great Lakes/St. Lawrence Seaway system.



One of the U.S. Seaway locks in Massena, New York

90 Years Under the Boundary Waters Treaty

The Great Lakes are unique as an example of international cooperation in the successful management of shared resources. The tradition of binational cooperation, across the border of the United States and Canada, derives in large part from the Boundary Waters Treaty signed on January 11, 1909.

The opening paragraph of the Treaty sets out its ambitious goals for the longest undefended border in the world:

The United States of America and His Majesty the King of the United Kingdom of Great Britain and Ireland and of the British Dominions beyond the Seas, Emperor of India, being equally desirous to prevent disputes regarding the use of boundary waters and to settle all questions which are now pending between the United States and the Dominion of Canada involving the rights, obligations, or interest of either in relation to the other or to the inhabitants of the other, along their common frontier, and to make provision for the adjustment and settlement of all such questions as may hereafter arise, have resolved to conclude a treaty in furtherance of these ends...

The Boundary Waters Treaty established the International Joint Commission (IJC) to prevent and resolve disputes over the use of shared waters and to provide independent advice on other transboundary environmental issues.

The IJC has developed water quality objectives for, and monitored the restoration of, the Great Lakes and other watersheds along the common boundary. It also oversees the operation of several hydropower projects that affect water levels and flows across the boundary and alerts the two countries to transboundary air quality issues of concern.

The Treaty has been hailed as the first binational environmental agreement. It has led to many efforts to restore the health of the common waters, including more detailed agreements such as the Great Lakes Water Quality Agreement.

Canadian Prime Minister Jean Chrétien saluted 90 years of achievement under the Treaty by declaring that: "...people take 5,000 miles of shared boundary for granted but... it takes an organization such as the IJC to prevent and resolve disputes over the use of shared waters between the two countries."

***"WATER! WATER!
WATER!***

***Definitely our region
will need a clear-
headed management
of that resource.
Until further notice,
no diversion, no
exportation and no
'unmastered
additional public
consumption.'***

***A precise and well
documented
description of the
levels of the waters
should be offered to
the public with a
deflated view of
catastrophic
innuendos.***

***The maintenance and
the improvement of
the Seaway's
infrastructures are
also a must for both
governments (United
States and Canada)."***

**Dr. Hugues Morrissette,
General Director of the
St. Lawrence
Development Secretariat
of the Gouvernement du
Quebec.**

The IJC is now joined by the Great Lakes Fishery Commission, another international organization, as well as interstate organizations on the American side such as the Council of Great Lakes Governors and the Great Lakes Commission. These latter two bodies have now admitted the Provinces of Ontario and Quebec as associate members. This sustained commitment to international and intergovernmental cooperation finds its origins in the Boundary Waters Treaty of 1909.



Boundary Waters of the Great Lakes Basin

Biochemistry and the Great Lakes **Persistent Toxic Substances** **and Health Effects in the** **Great Lakes Basin**

by Christopher T. DeRosa, Ph.D.

The Great Lakes Basin (GLB) is vulnerable to the accumulation of pollutants released as byproducts of commerce and industry. This accumulation is, in part, accounted for by the fact that less than one percent of the Great Lakes volume exits via the St. Lawrence seaway on an annual basis.

The International Joint Commission (IJC), established by treaty between the United States and Canada to oversee the water quality of the GLB and other boundary waters, has identified 362 pollutants in the water, sediments, and biota of the Great Lakes. With such an overwhelming number of substances of concern, the issue of establishing priority is significant. Recognizing this, the IJC identified eleven persistent toxic substances (PTS) that include some of the usual suspects of concern in the environmental public health practice. These PTSs, such as dioxin, PCBs, dibenzofurans, organic forms of mercury and lead, PAHs, and pesticides are persistent materials and many are lipophilic so that they bioaccumulate in biota and biomagnify at successive levels of the food web.

Findings of Wildlife Biologists

Each of these PTSs has been addressed by the Agency for Toxic Substances and Disease Registry (ATSDR) toxicological profiles which document, among other deficits, the neurodevelopmental deficits associated with exposure to these substances. In the GLB, concerns were first raised about neurodevelopmental effects based in part upon the findings of wildlife biologists. Reproductive and developmental deficits, disrupted endocrine function, compromised immune competence, as well as cancer, in a wide range of phyletic categories, including birds, fish, reptiles, and mammals have been established. Canadian researchers reviewing this range of findings coined the word "GLEMEDS," referring to the Great Lakes Embryonic Mortality Edema and Deformity Syndrome, a very characteristic suite of effects associated with the findings of wildlife biologists, particularly as they relate to avian species. In this syndrome, the developing young have a bloated, distended appearance.



They have mandibles that are of unequal length and characterized by crossed bills, supernumerary digits, club feet, and enlarged thyroids to the extent that researchers at the University of Guelph reported that 100 percent of 2-4 year old salmon stocks that they encountered had grossly distended thyroids. Additionally, there is an overall feminization and demasculinization of the populations, resulting in same sex pairings. There is also an indication of disrupted ontogeny in which the normal downy feathers of the young are not evident, but instead young hatchlings exhibit the feathers characteristic of adults. These findings have significant implications for human health, given the National Academy's view of animals as sentinels of human health. They set the stage for the early human epidemiologic studies conducted in the GLB.

Early Epidemiologic Findings

One of the epidemiologic studies in the GLB was the Jacobsons' Michigan Maternal Cohort study. This prospective longitudinal study involved 242 mother-infant pairs; the mothers had consumed contaminated fish in excess of 12 kilograms per year six years prior to and during pregnancy. Perinatal effects reported by the Jacobsons included a reduced gestational age, a decreased birth weight and a decreased head circumference. The Jacobsons and their coworkers also reported behavioral deficits exhibited in children. These included a reduced responsiveness to stimuli throughout the study, and, when tested at seven months and four years of age, they were three times more likely to have low normal IQs, two times more likely to be two years or more behind in their reading comprehension, and they exhibited both reduced short and long term memories as well as attention deficits. Although the Jacobsons controlled for 37 specific confounders, including alcohol, tobacco, and maternal age, there are limitations that have been noted regarding this study.

Findings Outside the Basin

When one looks across and beyond the GLB, there is an emerging convergence of findings. One example is the North Carolina Breast Milk and Formula Project, which was a study of over 800 mother-infant pairs exposed to background levels of PCBs. When tested after birth, these children exhibited behavioral deficits that were similar to those reported by the Jacobsons. However, these were somewhat lower levels of PCB exposure and, at three years of age, the deficits were no longer evident.

A second study outside the Basin was the New York Occupational Study of mothers exposed occupationally to PCBs. In this case, the investigators reported a reduced

gestational age on the order of 6.6 days as well as a reduced body weight on the order of 150 grams – very consistent with those perinatal effects reported by the Jacobsons. In addition, the Taiwan and Japanese poisoning incidents involving rice oil referred to as Yusho and Yucheng disease, respectively, also reflect the potential impacts of PTS on development as a result of in utero exposure. These children exhibited deficits in IQ as well as some morphological alterations including hyperpigmentation and abnormal growth of epidermal tissue.

The Seveso incident, based on an industrial accident in Seveso, Italy, is reminiscent of some of the findings of the wildlife biologists reflecting an overall demasculinization and feminization of the population. The typical sex ratio expected at birth is 106 males to 100 females. In contrast, following the industrial incident in Seveso in the late 70s, the ratio of children born to mothers exposed during that incident was remarkably skewed (i.e., 26 males and 48 females). In a series of studies in Europe, Koopman-Esseboom and her colleagues have reported exposure effects associated with maternal levels of both dioxin and PCBs during in utero development. Effects noted by the Dutch researchers included altered thyroid status of both the mothers and the children, reduced scores on psychomotor tests that were evident at three months, and hypotonia and hyperflexia that parallel some of the findings of the Jacobsons in Michigan and Dr. Walter Rogan in North Carolina.

The convergence of these findings suggests that the studies conducted should be viewed as the lenses of microscopes that are focused on slightly different slides or populations at different points in time. As a consequence, the variation that is seen from one study to another is not so striking as the remarkable convergence of findings derived across the different epidemiologic studies as well as the findings of the wildlife biologists.

Recent Epidemiologic Findings in the Great Lakes Basin

The questions raised by and about the Michigan maternal-infant study prompted Congress to authorize ATSDR to fund a series of epidemiologic studies. One of these studies, conducted by Dr. Helen Daley and her colleagues at the University of Oswego in New York, represents a replication and extension of the prospective longitudinal study conducted by the Jacobsons in the early 80s. This study involved 536 mother-infant pairs. Like the Jacobsons' study, the mothers consumed fish six years prior to and during pregnancy on the order of 40 pounds per year. Importantly,



Fish eating birds, such as this osprey, are particularly susceptible to bioaccumulative toxic substances.



the Oswego research team controlled for in excess of 100 potential confounding variables in the broad areas of demographics, delivery, and other substances. When tested one and two days after birth, the infants exhibited abnormal reflexes, less mature autonomic reflexes, and they were easier to startle. This last finding indicates a reduced ability to habituate to mildly noxious stimuli. Importantly, the Oswego research team, in a satellite bioassay involving rodents fed rat chow derived from salmon contaminated with environmentally relevant levels of PCBs, found the rats exhibited the same inability to habituate to mildly noxious stimuli. Remarkably, when the offspring of these rats who were exposed in utero to PCBs were tested, they, too, reflected an inability to habituate to mildly noxious stimuli, suggesting a transgenerational impact of such exposures.

A second study funded by ATSDR and conducted by Dr. John Vena of the University of Buffalo, involves a cohort of 11,000 sport fishermen and their partners. Findings reported by these investigators included a delay in the time to pregnancy, a reduced length of menstrual cycles on the order of 1.1 days, and an increased risk of infertility for those who consumed more than one fish meal per month. The reduction in menstrual cycles is significant, in part, based on the findings reported by the Endometrial Association of America, indicating that a reduction in the length of menstrual cycle represents a two-fold elevation in the risk for developing endometriosis. This disease has increased dramatically in the world in the last fifty years. Prior to 1900, only five cases of endometriosis had been reported. However, since that time, the rate of endometriosis in the United States alone has risen to about five million cases per year. Undoubtedly, part of this difference is due to differential diagnosis; however, that is inadequate by itself to explain the dramatic increase in this condition.

Dr. John Dellinger and his colleagues at the University of Wisconsin studied a cohort of 541 people of the Chipewa tribe of the Ojibway people. They found an increased incidence of joint pain, liver disease, diabetes, and memory loss. Significantly, there was a reduced performance deficit observed in pegboard tests linked to both memory and motor skills in this cohort. Dr. Jane Courval of Michigan State University undertook another study of 625 couples of reproductive age. These researchers reported a suggestion of a delay in the time to pregnancy associated with fathers' exposure, and not mothers', to contaminated fish. These findings parallel those of the University of Buffalo research team outlined above.

Conclusions

In summary, it is clear that despite very significant successes in reducing levels of PTS in the GLB, health concerns remain for at risk populations by virtue of physiologic sensitivity and/or elevated exposures. The PTS such as PCBs, dioxins, and dibenzofurans appear to be particularly important in this regard. In terms of effects, these PTS have been associated with a range of reproductive and developmental effects that include deficits in cognitive development and delays in time to pregnancy as well as impacts on fertility. Such findings raise significant questions. One such question was posed at a recent conference examining the weight of evidence for the potential health impacts of persistent organic pollutants on human health. That question was: "Has the fetus become the mining canary of the 90s?" Are PCBs and other PTS the tragic environmental health story effects of lead on child development all over again?

Given the significant implications of such findings, the critical importance of primary prevention is apparent. This entails both pollution prevention as well as the model of disease prevention as key strategies to interdict the exposure pathways. Key elements of the model for disease prevention include:

- Surveillance for patterns of morbidity and mortality in at-risk populations by virtue of elevated exposure and/or physiologic sensitivity;
- Evaluation of the factors underlying the patterns of morbidity and mortality observed at the population level, and, importantly;
- Interventions or control strategies that are strategically targeted to at-risk populations including health education and risk communication so that individuals can take steps to reduce their exposure and that of their families; and, finally
- Infrastructure development at the state and local levels to implement such a model of disease prevention which is coupled to:
- Impact assessments to assure that the interventions undertaken actually serve to improve health status of at-risk populations.

Examples of where this model has been successful are described in studies by Fitzgerald and Schantz of fishing populations in the GLB in which body burdens were elevated two to four fold for some of the persistent organic pollutants identified earlier. Concern regarding these body burdens resulted in a number of health risk communication efforts



Appropriate methods of cleaning and preparing fish, as well as knowing what fish to eat from what bodies of water, can reduce human health risk.

working through the gatekeepers to the communities including the midwives and spiritual leaders as well as the political leaders of these communities. Based on these strategically targeted interventions, the elevated body burdens in these populations were reduced to background levels within a six-year period of time without sacrificing fish as a nutritionally important component of this population's diet. Instead, appropriate methods for preparing fish as well as what fish to eat from what bodies of water were identified as key messages. The resulting alteration of the communities' behavior accounted for a fundamental enhancement in health status. This illustrates the importance of putting science to service in terms of public health practice.

Fully referenced, peer reviewed material, summarized in this paper, can be obtained by contacting ATSDR's Information Center at 404-639-6300, FAX: 404-639-6315, or by email at: <http://atsdr1.atsdr.cdc.gov:8080>

Dr. DeRosa serves as Director of ATSDR's Division of Toxicology, responsible for the Agency's Substance Specific Research Program, toxicological profiles, as well as emergency response and consultations.

The Endocrine Disruption Issue Revisited

by Tim Zacharewski, Ph.D.

This article revisits the issue of endocrine disruptors, which was previously covered in a forum in the "State of the Great Lakes 1996 Annual Report."

The endocrine system is comprised of all the glands and organs within an animal that are involved in the production, secretion and response to hormones. It serves essential roles in normal development, behavior, and reproduction, as well as in the general well being of an animal. There has been increasing concern that chemicals and complex mixtures may interfere with the normal functioning of the endocrine system in humans and wildlife by mimicking the activities of endogenous hormones such as estrogen and androgen that occur naturally within an animal. Exposure during gestation and lactation, at the time when the developing organism is most susceptible, is the greatest concern due to possible predisposition to adverse health consequences as an adult. These health risks include hormone-dependent cancers and compromised reproductive fitness. Although it is undisputed that exposure to hormonally-active compounds at high concentrations can affect human and wildlife health, the extent of harm resulting from exposure to these compounds at concentrations commonly encountered in the environment is highly controversial and fiercely debated with the scientific community. As a result, endocrine disruption has become a highly charged political and economic issue.

Hormonally active chemicals, commonly referred to as endocrine disruptors, are found throughout the environment. They have been detected in human and wildlife tissue and also in food, air and drinking water. Endocrine disruptors include pharmaceuticals, environmental pollutants, industrial chemicals, natural products produced by plants and endogenous hormones excreted by animals. Most endocrine disruptors are typically 10,000 to 100,000 times less potent than the endogenous hormone. Despite the weak activity of endocrine disruptors, some epidemiological studies have reported that exposure to these compounds during development may contribute to the increased incidence of reproductive tract abnormalities and hormone-dependent cancers of the breast, prostate and testes, and decreases in sperm counts in humans. Results from field studies also suggest that endocrine disruptors may contribute



to developmental abnormalities and compromised reproductive fitness in some wildlife species such as fish, birds, reptiles and amphibians.

In response to public concern, the Food Quality Protection Act (FQPA) and Amendments to the Safe Drinking Water Act (SDWA) were passed in 1996. This legislation requires the United States Environmental Protection Agency (EPA) to develop a screening program, using appropriate validated systems and other scientifically relevant information, to determine whether certain substances have an effect in humans that is similar to an effect produced by a naturally occurring estrogen or other such endocrine effect. This has subsequently been extended to include androgen and thyroid effects as well as potential effects on wildlife. In 1996, the EPA formed the Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC) which included stakeholders from government, academia, industry and public advocacy groups. EDSTAC was charged with providing advice on how to design a screening and testing program for endocrine disrupting chemicals. The EPA is currently using the report as a framework for their program as part of a coordinated international effort to identify and assess the potential adverse effects of endocrine disruptors on human and wildlife health.

At the request of the EPA, the U.S. Department of the Interior, the U.S. Centers for Disease Control and Prevention, and the U.S. Congress, an independent study was initiated by the National Research Council (NRC) in July 1995 to: (1) assess the status of the endocrine disruption issue, (2) identify substances, geographic areas, and sources of concern as well as human and wildlife populations at risk, and (3) if possible and warranted, suggest general approaches for identifying and mitigating toxicological problems. The much-awaited report entitled "Hormonally Active Agents in the Environment" was finally made available in July 1999. It provides a comprehensive review of the available literature, but fails to present a consensus opinion on the most controversial endocrine disruption issues such as decreasing sperm counts in men. Limitations and uncertainties within the available data lead to different judgements among committee members, which made completing the charges difficult. Although clear effects were identified in some wildlife species, there was no consensus on the evidence of endocrine disruption in humans. Due to exposure to complex mixtures and the lack of understanding of how endocrine disruptors elicit their effects, the committee was unable to identify any causative compounds. This lack of consensus is not confined to the NRC committee, but reflects the ongoing debate within the scientific community at large.

"Public understanding and support form the basis for addressing all current and future environmental challenges. The most pressing environmental challenge will be to insure that people throughout the basin become more knowledgeable about the ecosystem and how the impacts of human activities can ripple through the ecosystem."

**Thomas Baldini,
Chairman, U.S. Section,
International Joint
Commission**

Overall, the report highlights significant knowledge gaps and makes specific research recommendations that need to be undertaken in order to fully assess the effects of endocrine disruptors. Many of these research priorities are currently being investigated as part of an international effort to identify and assess the potential health consequences of exposure to endocrine disruptors on human and wildlife health.

Dr. Tim Zacharewski is an Assistant Professor in the Department of Biochemistry and the National Food Safety & Toxicology Center at Michigan State University. His teaching and research efforts have focused on identifying and assessing the effects of endocrine disruptors on human and wildlife health. He is also a consultant to the Science Advisory Board of the U. S. Environmental Protection Agency.

Exotic Species

Vanquishing Exotic Species in the Great Lakes

by Sandra Zellmer



The International Joint Commission sponsored a workshop on exotic species policy during its 1999 biennial meeting. A White Paper distributed at the workshop detailed the adverse effects of exotics and assessed various control methods. It suggested that economic measures, particularly taxation, could best prevent discharges of infested ballast water, a primary vector for introducing aquatic invasive species into the Great Lakes. As a workshop participant, I took the position that regulation under the Clean Water Act (CWA) could control ballast water discharges in United States waters more effectively.

The CWA Applies to Ballast Water

The "discharge of any pollutant" from a point source is prohibited by the CWA, 33 U.S.C. sections 1251, *et seq.*, unless a permit is obtained from the U.S. Environmental Protection Agency (EPA) or an authorized state. However, EPA's regulations exclude ballast discharges from the CWA permit program. The Pacific Environmental Advocacy Center (PEAC) recently petitioned EPA to rescind the regulation, arguing that vessels which discharge ballast water are explicitly included in the CWA's definition of a point source, and that exotic species are "biological materials" included within the definition of pollutants. EPA's initial response acknowledged that ballast discharges could be covered by the CWA, and indicated that it would "explore options" for regulating ballast water.

Not only the plain language of the CWA but also the statute's objectives and legislative history support, if not compel, the regulation of ballast water discharges. The CWA, like the United States-Canada Great Lakes Water Quality Agreement, is intended to restore and maintain the chemical, physical, and biological integrity of aquatic ecosystems, and to ensure that water quality supports fisheries and other designated uses. It is well-documented that invasive species, no less than other pollutants, have had tremendous effects on Great Lakes' water quality and native biodiversity.

The subsequent enactment of the National Invasive Species Act (NISA) does not preclude regulation of ballast water. While NISA directs the Coast Guard to regulate ballast

exchange in Great Lakes' waters, NISA expressly states that it does not supersede any requirements or prohibitions regarding ballast discharges under the CWA. In addition, a 1999 Executive Order requires all federal agencies to "use existing programs and authorities to prevent introduction of invasive species." The Coast Guard, whose mission is primarily safety at sea, should support the efforts of the EPA, an entity with substantial expertise in pollution control.

The CWA Permit Program is Effective

Pollution has been greatly reduced under the CWA's permit program. Prior to the Federal Water Pollution Control Amendments of 1972, the federal government relied largely on economic incentives to stimulate improvement in water quality, to no avail. When technology-based effluent limitations were finally imposed in conjunction with permit requirements, pollution loadings dropped and measurable abatement occurred for the first time in years, without significant losses in employment or industrial growth.

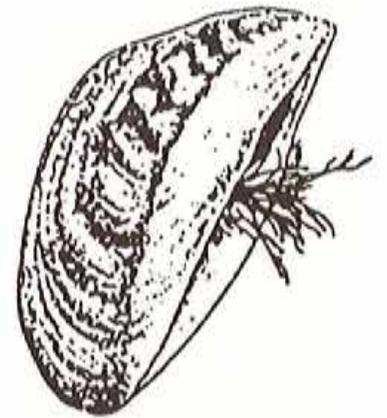
Many states have been delegated the authority to administer the CWA permit program, and therefore have some flexibility in implementation. However, EPA's national effluent limitations for industrial categories and subcategories impose a floor below which neither individual nor jurisdictional efforts may sink. Uniform standards level the playing field by requiring all facilities within an industrial class to meet a minimum threshold of cleanliness, making social dislocation and forum shopping between geographical regions – the "race to the bottom" – less likely.

Strong enforcement provisions, particularly citizens' suits, make the CWA permit program all the more effective. Absent vigorous enforcement, even the most stringent regulations have a tendency to become "paper tigers" in the face of marketplace pressures; noncompliance results in economic benefits (the free use of waterways for waste disposal) while compliance results in economic costs (expensive pollution removal treatment) and competitive disadvantage.

Opponents of regulatory regimes argue that basing pollution levels on current assessments of technology chills further innovation; industry will be reluctant to research new control methods, knowing that costs increase as standards based on the best technology are ratcheted up. However, economic strategies, such as taxation, can lead to the same results, unless the tax rate accurately reflects and exceeds the costs of making additional reductions and is routinely revised when new technology or information comes to light.

Implementation

Regulation of ballast discharges through the CWA has



The Zebra Mussel has spread to at least 119 inland Michigan lakes since its introduction to the Great Lakes, probably through ballast water, in the 1980s

several advantages compared to NISA. The CWA would apply to fully laden vessels declaring "no ballast on board" (NOBOBs), because the vessel itself is the regulated point source, regardless of the quantity of ballast. At present, NOBOBs are virtually unregulated. In addition, CWA effluent limitations, based on the "best available technology" (BAT) economically achievable, would require improvement beyond NISA's salinity standard, which reflects roughly 83-85 percent exchange by volume. In setting BAT, EPA would consider the exchange capacity of the best performers, which appears to be 90 percent or better, according to the Coast Guard, as well as the potential for alternative treatment technologies: ultraviolet light; micro-ozonation; biocides; temperature (heat); and filtration.

In implementing the program, EPA could opt for an individual permit requirement or a general or regional permitting approach. Either way, performance would improve. Both individual and general permits allow for public participation and require EPA to focus on the problem and to revisit the issue on a regular basis. In comparison, exemptions, such as EPA's current ballast regulation, tend to drop out of sight, "into a pool of inertia." *NRDC v. Costle*, 568 F.2d 1369 (D.C. Cir. 1977).

Establishing emission controls for ballast discharges under the CWA will, no doubt, pose a challenge, because ships, as mobile sources, are quite different than traditional sources of pollution – wastewater discharges emitted from industrial pipes. Nonetheless, courts have repeatedly held that administrative difficulties are no excuse for regulatory avoidance. In the end, EPA, in cooperation with the Coast Guard and Canadian regulatory bodies, and with International Joint Commission input and support, must regulate ballast water discharges under the CWA. The real challenge is not whether to regulate, but how to do so as quickly and as effectively as possible, given the myriad interests at stake.

Professor Sandra Zellmer teaches environmental law courses at the University of Toledo College of Law, and is a faculty member of the Legal Institute of the Great Lakes. A more detailed version of this article will be published in an upcoming issue of the "Toledo Journal of Great Lakes Law, Science and Policy."

Some Short, Simple, and Obvious Points about Exotics and Ballast Water

by Eric Reeves

I'd like to give what J.R.R. Tolkien called a good "Hobbit Speech." Short, simple, obvious, and to the point. Here are some very simple and obvious observations about the problem of exotic species in ballast water. Also, because my experience has been that I have difficulty maintaining more than three clear thoughts in my head at one time (on my best days), I'll restrict myself to the three most important things to say about exotics and ballast water.

To begin with a dumb question, wasn't this supposed to have something to do with how clean the water is?

We recently held a workshop on the subject of "Exotic Policy" at the 1999 Great Lakes Water Quality Forum in Milwaukee, attended by representatives of all levels of government, the marine industry, environmental groups, and academics. As you might expect, we had a great deal of disagreement about many issues. But there was one basic thing that almost everyone did agree on, emphatically. That is the obvious need for a valid standard for the allowable discharge of ballast water.

Don't we have a standard? Well.... Maybe this is where it's a little less obvious. There is a standard, in a sense, in that the National Invasive Species Act of 1996 (and the previous legislation) said that alternative means should be as good as the ballast exchange established as the primary option by the legislation. However.... We know very well, from extensive testing done by the Canadians, that high levels of live exotics are present in tanks that have been exchanged under the current regime. And, yes, the U.S. Coast Guard also has a regulatory standard based on salinity. However...The U.S. Coast Guard has already pointed out, in a public regulatory proposal, that the salinity standard is unreliable. We know for a fact that there are many vessels which begin with tanks so saline that they need not do more than pretend to conduct an exchange in order to pass the regulatory test. But this, as everyone should be clear on by now, does not mean that the water is safe. We know that many organisms dangerous to the lakes can survive that temporary immersion. In the meantime, we continue to promote exchange, without any of the obvious changes to ship design that could make it safe



and effective, and have not even seriously considered promulgating standards for the construction of new ships which will be in service for decades to come. Can anyone really argue that there isn't something wrong with this picture?

And what about those NOBOB things?

One might assume that our regulatory regime for controlling ballast water in the Great Lakes would apply to most, if not all, of the vessels carrying in contaminated water and sediment. One might. But one would be mistaken. A large majority of the vessels coming into the lakes each year report themselves "no ballast on board" or "NOBOB," and pass without meeting any requirement. But they do in fact carry contaminated slop and sediment in their tanks, a good percentage of which is later pumped out into the lakes during intra-lake cross-ballasting. There is, indeed, no legal exemption for these vessels under the National Invasive Species Act of 1996 (or the previous legislation, for that matter, although the 1996 legislation clarified the applicability of the law, just in case anyone was really wondering). However... Nothing is being done about them. Can anyone really argue that there isn't something wrong with this picture?

The drive-a-supertanker-through-it "safety exemption."

In the Great Lakes, under the original version of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, the U.S. Coast Guard established a reasonable exemption to the open ocean exchange requirement by regulation. The regulation says, in essence, if you can't exchange safely on the open ocean, let us know, we'll talk, and we'll decide what else you need to do to deal with the problem instead. No one in the U.S. Coast Guard, the Canadian maritime agencies, or anyone else in this field wants to break ships in half. This reasonable safety exemption in the regulations was specifically referred to as a model to be followed in the national regime during the consideration of the National Invasive Species Act of 1996. Sounds fine, doesn't it? However... At the last minute, in floor action without any hearings or reports, Congress changed the ground rules at the request of the marine industry. The new safety exemption, written into the law, says that any ship which cannot safely conduct a high seas exchange is specifically and absolutely relieved of any other requirements that the U.S. Coast Guard might try to impose in order to protect against its contaminated water. In other words, if you have an unsafe ship, you have an absolute right to dump dirty water. Also, that puts an artificial premium on the value of the older and more decrepit vessels which

cannot safely conduct an exchange (because they don't have to bother to do anything), thus increasing the ultimate danger to mariners from unsafe ships. Would this concept be acceptable as public policy in any other area of environmental protection? Would we tell someone who is dumping toxics to clean it up if they can, but not to worry about it if they have to spend any money in order to do it safely?

That should be quite enough for you to think about.

Eric Reeves is a retired commander in the U.S. Coast Guard. He was responsible for the administration of the US ballast water regime in the Great Lakes 1993-1998, and has recently worked on the issue as an independent researcher for the International Joint Commission. He has a JD and is currently working on his Ph.D. in political science at Carleton University in Ottawa.



Sustainable Business in West Michigan – A New Paradigm for the Next Millennium

by William A. Stough



What do business leaders like John Browne, Group Chief Executive, BP Amoco; Edgar Woolard, Chairman, E.I. duPont de Nemours and Company; William Clay Ford, Jr., Chairman of the Board, Ford Motor Company; and Tachi Kiuchi, Managing Director, Mitsubishi Electric all have in common with a growing number of West Michigan businesses?

They are executives of some of the leading global companies that have come to understand that the current rate of industrial metabolism is fast approaching the non-negotiable limits of the ecological system upon which present commerce is based. They are not environmental zealots; they are fierce competitors out to increase their market share by using the principles embodied in sustainable development. Companies like them that have adopted sustainability as a strategic driver believe the very nature of our overall system of commerce is changing dramatically. Many of these companies are rapidly positioning themselves for survival and prosperity in the future by the mercenary integration of sustainability into their core business mission.

Sustainable Development Principles

Sustainable development has been defined as development that can be kept up over time because it does not erode its natural resource base and the natural environment in which it must take place. From a business perspective, I define sustainable development as "businesses that adopt strategies and activities that allow the enterprise and its stakeholders to realize their profit goals and improve their quality of life in ways which protect, sustain, and enhance earth's life support systems."

A sustainable business system consists of four major elements:

1. **It uses renewable inputs.** A sustainable system of commerce relies on renewable inputs of energy and materials (natural income) without drawing down natural capital by relying on nonrenewable inputs or using renewables faster than they can be replaced.

2. It depends on cyclical, highly efficient material flows. Material flows within a sustainable system of commerce result in extremely efficient use of resources and mimics the cyclical flows of natural systems. The non-product output of one process becomes the input for another process. Nothing is wasted.

3. It is nontoxic. A sustainable system of commerce does not produce or use long-term, persistent toxic materials that harm earth's life support systems.

4. It is socially equitable. A sustainable system of commerce is equitable and broadly defined takes into account the needs and basic rights of the current generation, future generations, and other living things.

Trends in Sustainable Commerce

A recent Business for Social Responsibility research project found that among leading companies that have adopted sustainable development principles, the following trends are emerging:

There is a growing awareness of the business value of sustainability practices. Whereas eco-efficiency is seen by companies as providing "bottom-line" cost savings, sustainability is viewed as having the potential to expand the "top line" through the creation of new products, enhanced market share, asset retention, and other means of value-creation.

Companies increasingly are extending their sustainability efforts upstream and downstream to involve their suppliers (and sometimes their suppliers' suppliers) as well as their customers.

Many stakeholder groups are beginning to explore the social side of sustainability and are looking for leadership companies where they can make investments.

A Local Model

The West Michigan Sustainable Business Forum was created in 1994 to provide a source of information and expertise about business sustainability to its 50 members (see www.sustainable-busforum.org). It is a partnership between the West Michigan business community and the West Michigan Environmental Action Council in which both sides focus on winning strategies that have a positive effect on the economy and the environment. Through monthly meetings that now attract internationally known sustainable business experts, the Business Forum provides unparalleled networking opportunities among member businesses and provides a forum through which the latest sustainability information, tools, techniques, and case studies can be delivered.

"The most pressing challenges we face are (1) how to clean up the ecological wreckage of the past and (2) how to make the transition to clean production – that is, how to change our design and consumption of products to achieve ecological sustainability. We need a much more finely tuned understanding of our interactions with this ecosystem (as opposed to hindsight or end-of-the-pipe decrees like "don't eat the fish"), and we need new economic policies, informed by our understanding of the true life-cycle costs of any product – from raw material to disposal."

Margaret Wooster,
Executive Director,
Great Lakes United, an
international coalition
dedicated to restoring
and conserving the
Great Lakes – St.
Lawrence River
ecosystem.

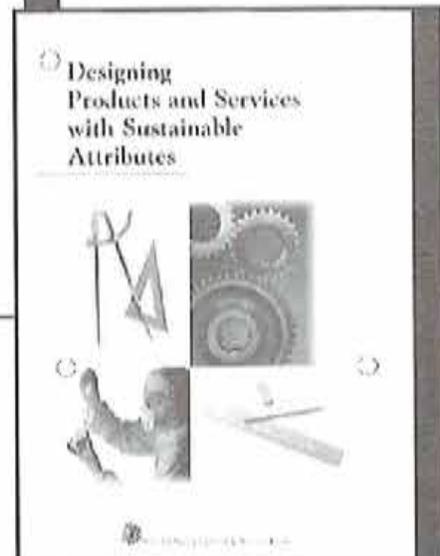
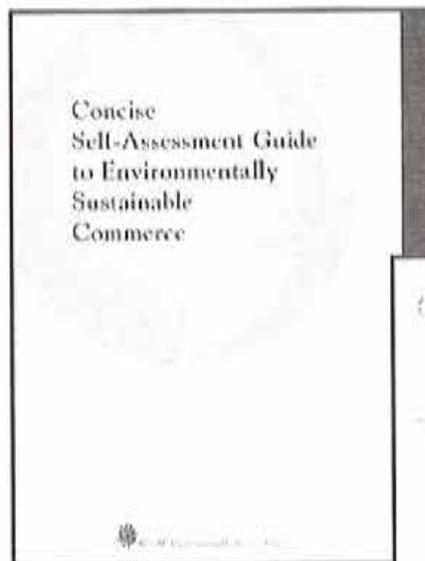
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Wolverine World Wide, Inc.
Yamaha Musical Products

With financial support from the Joyce Foundation and contributions from member companies, the Business Forum developed several highly regarded sustainability tools including a self-assessment guide to sustainable commerce and a design guide to sustainable products and services. Amory Lovins, CEO of the Rocky Mountain Institute and author of *Natural Capitalism*, is currently working with six participating West Michigan companies to incorporate his principals of Natural Capitalism into their operations to help reduce their ecological footprint and increase resource efficiency.

The West Michigan Sustainable Business Forum holds great promise as a model for other regions to drive economic vitality, product innovation, and environmental quality.

William A. Stough is a vice president with BLDI Environmental & Safety Management. He is a founder of the West Michigan Sustainable Business Forum and is working with Rocky Mountain Institute on the Natural Capitalism project in West Michigan.



Integrating Economics into Environmental and Natural Resources Policy

by Dr. Eileen O. van Ravenswaay

One of the most profound lessons that ecology teaches is that we dwell in a complex ecosystem where everything is interconnected. A change in one part of the system eventually affects all the other parts, although these effects may appear much later in time. Therefore, human actions often have unintended and unwanted consequences as well as intended ones.

Economics teaches a similar lesson. An economy is a complex system. A change in one part of the system often results in unanticipated, unintended and unwanted consequences elsewhere. For example, what at first appears to be a common sense approach to environmental and natural resource policy may turn out to be ineffective, inefficient, or even counterproductive.

Wise policy choice requires a deep understanding and appreciation of the complexity and ripple effects in both eco and economic systems. However, most environmental and natural resource policies ignore or exclude economic analysis. Even when it is included, economic analysis is often limited to predicting the initial effects of a policy, not its ripple effects.

Most economists believe that our environmental and natural resource policies could be more effective and less costly if economic analysis was included in the policymaking process. For example, economic analysis can identify which policies are most efficient or cost-effective for achieving environmental and natural resource goals. Economic analysis can identify innovative policy approaches based on knowledge of how economic actors make decisions in response to incentives or disincentives. It can also identify the type of data that needs to be maintained in order to analyze the benefits and costs of environmental and natural resource policy alternatives.

Economists also believe that simply changing environmental and natural resource policies is not the only way or even the best way to achieve environmental goals. Other types of public policies need to be changed, too. For example, a policy intended to spur economic development may worsen the very same damage that environmental and



"The challenges for the next millennium must recognize that the Great Lakes ecosystem will continue to change and that there will likely be an increase in competing demands for Great Lakes resources. Key issues such as water quality, exotic species and contaminants will remain, and new issues will continue to surprise us. Complex management decisions and wise use of the Great Lakes will require a much better, science-based understanding of the Great Lakes at the ecosystem level and the development of new institutional arrangements and partnerships that allow for proactive and flexible ecosystem management and true integration of science and policy."

**Dr. Stephen B. Brant,
Director of the National
Oceanic and
Atmospheric
Administration's Great
Lakes Environmental
Research Laboratory**

natural resource policies work to prevent. This is like the left hand of government not knowing, and thus undoing, what the right hand has done.

One of the reasons economic policies may unintentionally work in direct opposition to environmental policies is that tradeoffs between economic development and ecosystem health are not always explicitly considered. For example, the economic input-output models widely used to assess the economic impacts of public policies do not account for ecosystem impacts. One of the major reasons for this oversight is that our economic accounting systems only provide information about production and consumption of goods and services traded in markets, but environmental goods and services are not traded in markets.

Over the past thirty years, a small number of environmental economists have been developing methods for valuing environmental goods and services. These methods are beginning to be used by private and public sector managers, especially in many European countries. Under guidance from the United Nations and the World Bank, many countries are beginning to establish environmental accounting systems so that policy decisions can be made using both market and nonmarket information.

Another important lesson of ecology is that ecosystem change is constant. To survive and thrive, all life forms must be able to detect and adapt to change. Therefore, resilience is an important characteristic of ecosystems.

Economics teaches this lesson, too. Change is constant in economic systems. There are changes in population size and demographics. Weather changes. Technology changes. Competition changes. To survive and thrive, economic institutions should be designed so that producers and consumers can accurately detect and adapt to change.

The importance of system resilience is one of the reasons economists typically favor market-based and incentive-based policies. Markets are resilient. They allow decentralized production and consumption decisions, and, thus, better adaptation to local conditions.

A third important lesson from ecology is that ecosystem output, such as net primary production, depends on the stock of biotic and abiotic factors. Too much or too little of a factor can limit or retard growth even if all other factors are at optimum levels of support. Sustainable growth requires that the stock of biotic and abiotic factors be maintained.

The counterpart lesson in economics is that economic output, or net domestic product, depends on the stock of capital available to produce output. For example, economic

output decreases if worn out transportation, utilities, and communication infrastructure are not replaced or new generations of workers are not educated. Thus, sustainable output requires investment in the stock of capital. That investment requires forgoing some current consumption to ensure future consumption.

Since the economic system obtains resources from the ecosystem, increases in economic output may come at the expense of ecosystem output. Unless this tradeoff is explicitly considered, both economic and environmental sustainability are threatened. Both economic and ecosystem data need to be considered together to ensure sustainability. This will require new data and better knowledge about linkages between the economy and the environment.

Michigan has taken a leadership role to encourage environmental economics research at the state level. Last year, the Michigan Great Lakes Protection Fund (MGLPF) requested proposals for research to improve the economic efficiency of environmental and natural resource policy affecting the Great Lakes basin. Funded projects include benefit-cost analysis of innovative environmental policies such as air emissions trading, watershed effluent trading, wetlands banking, and marketable land development rights. Other projects examine how property taxes, financial responsibility requirements, and shoreline development policies affect environmental protection. MGLPF expects to fund more environmental economics research in the future.

What we choose to measure ultimately determines how well we manage. Physical measures of environmental quality and natural resource stocks help us decide *what* needs to be managed better. Economic measures help us decide *how* to manage better. A true systems approach to environmental and natural resource policy requires coordinated analysis of both eco and economic systems.

Dr. Eileen van Ravenswaay is a Professor in the Department of Agricultural Economics at Michigan State University. She teaches courses and conducts research on ecological and environmental economics. She serves on the Michigan Environmental Science Board and as Chair of the Technical Advisory Board of the Michigan Great Lakes Protection Fund.

The Automobile and Environmental Sustainability?

by Gregory A. Keoleian



Environmental sustainability of a product such as an automobile can be measured ultimately by its impact on the planet's life support system. This support system can be characterized in terms of natural resource endowments and environmental quality for current and future generations. Life cycle assessment (LCA) is an analytical framework that provides a variety of metrics that can help us assess environmental sustainability. LCA evaluates the material and energy input and outputs related to a product throughout its material production, manufacturing, use/service and retirement stages. While the automotive industry has offered society many benefits including personal mobility and employment (7.5 percent of the total US employment), there are significant costs as well. Consider in this article several key environmental sustainability issues relating to each stage of the automobile life cycle.

Materials Production

The materials composition of an average 1998 domestic automobile with a weight of 3261 pounds is approximately 54 percent steel, 11 percent iron, 6.7 percent aluminum, 7.5 percent plastics (and composites), 4.3 percent rubber, 2.9 percent glass, 1.4 percent copper, 6.1 percent fluids and lubricant and 5.1 percent other materials (Figure 1). The automotive industry use represents at least one-third of the overall U.S. consumption of iron, lead, platinum and synthetic and natural rubber. Original Equipment

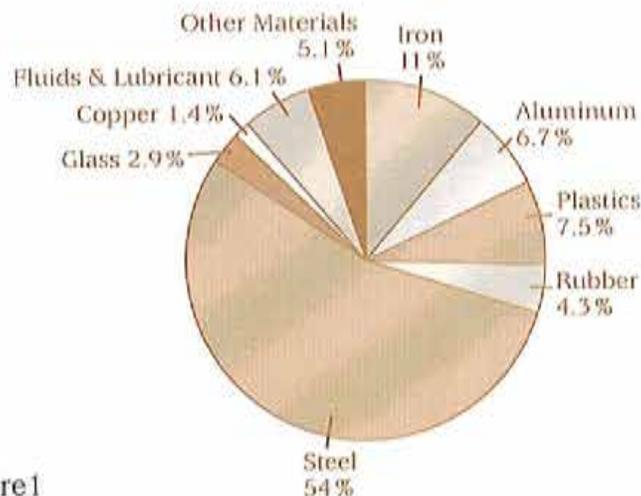


Figure 1

Manufacturers (OEMs) and suppliers face many challenges in reaching environmental goals while also meeting performance, safety and aesthetic design requirements. For example, substitution with lightweight materials represents an important strategy for achieving significant improvements in fuel economy. Ultra-light steel, aluminum, magnesium, titanium and plastics offer the potential to reduce the weight of new vehicles. With the exception of steel, however, virgin production of these materials is generally energy intensive. For example, recycling aluminum saves 95 percent of the energy required to produce it from ore. A challenge for environmental sustainability is to continue to increase the recycled content of vehicles with an emphasis on closed loop recycling into the same product.

Manufacturing

This stage encompasses parts fabrication (over 20,000 for a single vehicle), component manufacturing and vehicle assembly. In 1991, the Big Three OEMs (Chrysler, Ford, and General Motors) and the state of Michigan (on behalf of the Great Lakes States and the U.S. Environmental Protection Agency (EPA)) initiated the Great Lakes Automotive Pollution Prevention Project. A major focus of this project was to track Great Lakes Persistent Toxics (GLPT) and identify mechanisms to reduce their release. The OEMs have implemented dozens of projects to reduce or eliminate VOCs, heavy metals and other GPLT. Despite these efforts the industry has reported that 23 million pounds of GLPT were released in 1994; these data do not include the emissions related to automotive suppliers and off-site energy production. The environmental sustainability challenge is to realize zero persistent toxic emissions and zero material wastes in vehicle production. Total vehicle remanufacturing may also become an important strategy in the future. OEMs would periodically take back and upgrade old vehicles (e.g., after 100,000 miles) by refurbishing parts and components and replacing certain vehicle systems such as an interior.

Use

Almost 90 percent of the total life cycle energy is consumed in this stage. The average EPA fuel economy of new 1975 cars and light trucks was 15.8 mpg and 13.7 mpg, respectively. For model year (MY) 1999 this increased to 28.1 mpg for cars and 20.3 mpg for light trucks. Fuel economy improvements of automotive manufacturers, however, have been offset by increases in the vehicle miles traveled (VMT) by consumers from 1,040 trillion miles in 1970 to 2,352 trillion miles in 1997. Consequently, fuel consumption has actually increased; compare 80,133 million gallons in 1970 with 119,237 million gallons in 1997. The role of consumers in realizing environmental sustainability is critical. More





“The automobile is one of the most recycled products in the United States.”

recently the combined car and light truck fuel economy of new vehicles has decreased due to a dramatic purchasing shift by consumers towards sport utility vehicle and other light trucks (these vehicles account for almost half of the total market). The combined new light duty vehicle (cars and trucks) EPA fuel economy was 15.3 mpg for MY 1975 and then peaked in 1987/1988 at 25.9 mpg compared to 23.8 mpg for MY 1999. Motivation by consumers to purchase more efficient vehicles is weak. Gas and oil costs for vehicle operation (6 cents/mile) contribute only 11 percent of the total operating costs for a current vehicle (54 cents/mile). Without effective economic incentives current trends away from environmental sustainability will continue.

The auto industry has realized major reductions in vehicle air pollutant emissions over the last three decades. The one exception is carbon dioxide from combustion of gasoline that accounts for a significant fraction of greenhouse gas emissions in the U.S. Automobiles in use are responsible for approximately 17 percent of the total U.S. carbon dioxide emissions, not including vehicle production and supporting infrastructure. President Clinton’s Climate Action Plan in 1991 to stabilize greenhouse gas emissions to 1990 levels by 2000 has been ineffective. Total emissions in 1990 were 1632 million metric tons of carbon equivalents (MMTCE) and increased to 1814 MMTCE in 1997.

The Partnership for a New Generation of Vehicle (PNGV) is a collaborative research and development program between the U.S. government and U.S. Consortium for Automotive Research to dramatically improve fuel economy. The goal for this program is to achieve a production prototype by 2005 with a fuel economy of three times the 1994 mid-sized vehicle or approximately 80 mpg. OEM’s are developing hybrid vehicles and fuel cell vehicles to meet this target. It is also expected that hydrogen will replace petroleum as the primary fuel in the first half of the 21st century as it offers many environmental benefits and it can be produced using electricity generated from renewable sources.

End of Life

The automobile is one of the most recycled products in the United States. The infrastructure is well developed for recovery of metallic components of the vehicle. Currently, approximately 75 percent of the vehicle is recycled at end of life through dismantling, shredding and materials separation processes. Many components including alternators, engines and pumps are dismantled from retired vehicles and remanufactured for reuse. The OEMs have set goals to reduce the non-recyclable fraction which includes plastics, glass and rubber. The material and/or energy recovery from the

"automotive shredder residue" (ASR) represents a significant challenge. Interestingly, while the ASR receives much attention, a large percentage of the life cycle solid waste generation associated with the automobile occurs in other stages: vehicle production (67 percent) and use/service (25 percent).

Conclusion

The responsibility for the environmental sustainability of the automobile lies with consumers, automotive manufacturers and suppliers, and policy makers. Policy makers need to address major environmental issues related to fossil fuel use by developing stronger greenhouse emissions and renewable energy policies. Policy mechanisms are also required to curb consumption and accelerate the implementation alternative technologies being developed by OEMs.

The innovative potential of the American automobile industry is tremendous. Most of this talent is focused on vehicle performance and amenities instead of environmental sustainability. I have collaborated with many dedicated and committed champions and leaders of environmental sustainability in the automotive industry. Stockholders, however, demand short-term financial performance rather than a focus on long term economic welfare and ecological health. Dramatic changes both in vehicle production and the underlying values that shape consumption are necessary before we can imagine a sustainable automobile system, particularly given anticipated increases in demand for the automobile by developing countries.

Gregory A. Keoleian is Co-Director of the Center for Sustainable Systems, and an Associate Research Scientist in Industrial Ecology with the School of Natural Resources and Environment and the College of Engineering at the University of Michigan.

Wildlife in the Great Lakes Region

Recovery of Bald Eagles within the Great Lakes Basin

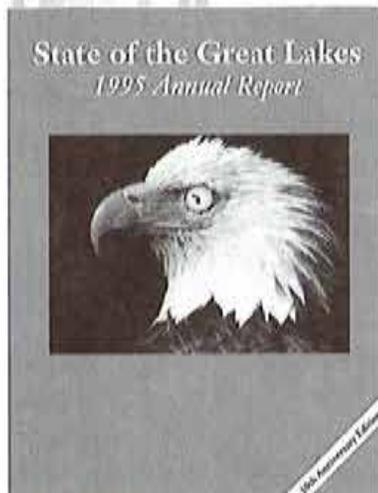
by Dr. William Bowerman



The bald eagle population nesting within the Great Lakes Basin, as well as across the continental United States, is well on the road to recovery. The announcement by President Clinton on July 4, 1999, that the bald eagle population had recovered, and the subsequent proposal to remove it from the Endangered Species List by the U.S. Fish and Wildlife Service, is the capstone of over 50 years of eagle protection and monitoring. It was through the efforts of a retired banker, Charles Broley of Toronto, who conducted banding studies of eagles in Florida in the 1940s and 1950s, which first alerted us that there was a problem with bald eagles and their ability to reproduce. His studies were among the first that related the spraying of DDT to the decline in the eagles in North America.

The decline in numbers of breeding pairs of eagles resulted in the start of the continental bald eagle project by the National Audubon Society in 1960-61. Sergej Postupalsky, whom anyone who has ever been involved with eagles in Michigan knows well, began the Michigan bald eagle survey in 1961, with this coming year being his 40th field season. Because of his efforts and those of many others, a long-term bald eagle database exists in Michigan. One can virtually go back 40 years and know nearly every reproductive outcome for nearly every single nesting pair of eagles in the state. Because of this and other long-term projects, the ability to track the progress and determine the reasons behind the decline and subsequent recovery of the eagle are well known.

Three primary actions have resulted in the recovery of the bald eagle population in North America: management of and protection of nesting habitat; public education and the lessening of human related mortality including deaths due to gunshot, incidental trapping, poisoning, and decreasing collisions with manmade objects; and, most importantly, the banning of DDT and many other organochlorine compounds in the early 1970s in the U.S. and Canada.



The "State of the Great Lakes 1995 Annual Report" focused on the reclassification of the bald eagle nationally from "endangered" to "threatened." The report included numerous eagle images and facts.

Within a few years of the banning of these compounds, the numbers of nesting pairs and the success rate of nesting attempts both increased. It is very interesting when one looks at how the eagle population recovered in the Great Lakes Basin. The recovery has shown a west to east pattern. Refuge populations of eagles in interior Minnesota and Wisconsin, from areas that were not as affected by DDT and other compounds, appear to be the primary source of the Midwest recovery. These birds produced great numbers of offspring which occupied most of the potential nesting territories, and eventually, through density dependent factors, caused emigration to other available habitat. By the mid-1980s, eagles were beginning to repopulate the shorelines and islands of 4 of the 5 Great Lakes (Lake Ontario is still without nesting eagles). Those eagles nesting along the Great Lakes, however, still had impaired reproduction in comparison to those nesting in areas remote from the Great Lakes.

This pattern holds true today. Abandoned eggs from areas along the Great Lakes still have concentrations of many compounds above the thresholds known to impair their ability to hatch. This leaves us with a bit of a dilemma, where, while the actual number of breeding pairs of eagles has increased in the state above our recovery goals, the continued effects of environmental toxicants from the Great Lakes food web both impacts the reproduction of eagles living along the coastlines, and potentially threatens interior nesting pairs should fish ladders be built along hydroelectric dams allowing anadromous fishes to migrate from the Great Lakes into clean, interior areas.

However, because so much is known about the eagle, and the eagle has been chosen as a biosentinel species for the temporal and spatial distribution of persistent organic compounds and mercury, our continued vigilance in Michigan should ensure that the eagle, once recovered, does not decline and require the protection of the Endangered Species Act again in the near future.

Dr. William Bowerman is an Assistant Professor of Wildlife Toxicology at Clemson University, a member of the Northern States Bald Eagle Recovery Team, and a member of the International Joint Commission's Great Lakes Science Advisory Board.

"There now are in the Great Lakes many successes including species recoveries and rebuilt fisheries. Sound science has been vital in our understanding of how these large aquatic systems respond to human-induced changes. Adherence to science and support for research will continue to provide a foundation for the management challenges of the future. Nevertheless, we will never have a complete understanding of the ecosystem. While striving to push the limits of our knowledge we must always remain steadfast to our stewardship responsibility and not fall victim to technological arrogance."

**Dr. Burton Ayles,
Chairman, Great Lakes
Fishery Commission**



Gray Wolf Recovery in the Upper Great Lakes States

by Charlie Wooley

After near extinction, gray wolves (*Canis lupus*) in the Upper Great Lakes states have rebounded, and their future in this part of the country looks bright, due in large part to the Endangered Species Act.

Even though state law in Wisconsin and Michigan already protected wolves before 1973, the year the Endangered Species Act was passed, those state provisions took effect too late. Wolves were extirpated in Wisconsin by the time they were given state protection in 1957. Michigan gave wolves state protection in 1965 when only a few wolves remained in the Upper Peninsula and an isolated population existed on Isle Royale. In Minnesota, a bounty on wolves continued until 1965. Between 1965 and 1974, Minnesota had an open season on wolves and the state's Department of Natural Resources killed them under a Directed Predator Control Program. Approximately 250 individuals were taken in Minnesota each year. The wolf population in Minnesota was considered stable to declining and was estimated to number about 450 to 700 animals.

The Endangered Species Act required that a Recovery Plan be prepared. The plan identified conservation actions needed to establish a healthy wolf population that would no longer need Endangered Species Act protection. The Recovery Plan enabled conservation agencies and organizations to focus time, money, and energy on the most important conservation actions.

Along with protection from uncontrolled killing and implementation of the Recovery Plan, wolves rebounded because their primary prey, white-tailed deer, flourished. White-tailed deer herds in Minnesota, Wisconsin, and Michigan increased through the 1980s and early 1990s because of mild winters and timber harvests that created prime habitat.

Wolf numbers in northeastern Minnesota increased and Minnesota wolves were reclassified from endangered to threatened in 1978. At the same time, the gray wolf expanded into other parts of its former range. Wolves now live in all areas of "presumed" suitable habitat in Minnesota and are moving into areas previously thought unsuitable.

Wolves also moved back into Wisconsin and Michigan and occasionally disperse into North and South Dakota.

Currently, the wolf population in the Upper Great Lakes states is healthy, increasing in number, and expanding in range. At the end of the 1997-98 winter, gray wolf numbers were to be about 2,450 in Minnesota. At the end of the 1998-99 winter, they numbered approximately 197 in Wisconsin and 174 in the Upper Peninsula of Michigan. An isolated population of 25 additional gray wolves inhabited Isle Royale National Park, also in Michigan.

The wolf population increase and expansion has been so successful that the U.S. Fish & Wildlife Service (the Service) is working on a proposal to change its status under the Endangered Species Act.

Previously, the Service developed a proposal to delist (that is, remove from federal protection) the gray wolf population in the Upper Great Lakes states - Minnesota, Michigan, and Wisconsin - as well as wolves dispersing westward into North and South Dakota. The proposal was developed with the understanding that Minnesota, Wisconsin, and Michigan would develop state management plans to protect the existence of gray wolves if federal protection was removed. Development of state management plans is not required by the Endangered Species Act before a species can be delisted, but those plans would give the Service strong assurances that the species would be managed and conserved in the foreseeable future.

The Service is now considering new options for reclassifying, rather than delisting, the gray wolf in the Upper Great Lakes states. The Michigan Department of Natural Resources developed their wolf management plan in 1997 and the Wisconsin Natural Resources Board recently approved the plan for their state. Unfortunately, during their 1999 session, the Minnesota legislature failed to agree on a wolf management plan for Minnesota. Because of this, the Service is reluctant to propose delisting the Upper Great Lakes wolf population. Without an approved management plan for Minnesota, the state containing the Midwest's core wolf population, it is impossible to evaluate future threats to Minnesota wolves or to insure that this animal will continue to do as well as it is currently. Therefore, in the absence of a state management plan for Minnesota, the Service is considering retaining the current classification of threatened for Minnesota wolves and reclassifying wolves from endangered to threatened in Michigan and Wisconsin, and possibly North and South Dakota. Such a reclassification proposal would retain federal protection of wolves throughout the Midwest, but would provide Wisconsin and



“Currently, the wolf population in the Upper Great Lakes states is healthy, increasing in number and expanding in range.”

Michigan with additional flexibility to deal with the growing problem of wolves preying on domestic animals. In effect, this reclassification would equalize the Act's classification and protection of wolves throughout the Upper Great Lakes states -all would be treated as threatened, with a provision allowing government removal of wolves that kill livestock or pets. If Minnesota does adopt a sound management plan for the gray wolf, it is likely that we would then prepare a proposal to delist the gray wolf in the Upper Great Lakes states.

The remarkable comeback of the gray wolf to the northwoods of Minnesota, Wisconsin and Michigan is a testimonial to the Endangered Species Act and the numerous people, groups, and state agencies that have worked for the wolf's recovery.

Charlie Wooley is Assistant Regional Director, U.S. Fish and Wildlife Service in Minneapolis, Minnesota



“Michigan gave wolves state protection in 1965 when only a few wolves remained in the Upper Peninsula and an isolated population existed on Isle Royale”

Conservation of Landscapes and Natural Systems

Local Land Trusts working to protect the Great Lakes

by Glen Chown

Local land trusts are one of the fastest-growing segments of our nation's conservation movement and are emerging as key players in efforts to protect the Great Lakes ecosystem.

Between 1994 and 1998, the number of land trusts in Michigan grew from 28 to 38. And, Michigan's land trusts are having a tremendous impact; during those same four years the number of permanently protected acres grew from 70,783 to 105,015—an increase of nearly 50 percent. Every single one of these acres was protected through the work of Michigan land trusts.

Fueling this rapid growth in land trusts *and* protected land is the realization by many Michigan residents that land trusts are a way for them to have a stake in shaping the future of their local communities. The effects of urban sprawl and unmanaged growth can no longer be ignored and are felt by every one of us, even in the most remote regions of our state.

One of the strengths of local land trusts is their ability to work with private landowners to protect priority parcels of land using cost-effective and proven tools, such as conservation easements. Land trusts also provide tax incentives to land donors and build grassroots support through membership and outreach activities. In addition, land trusts play a much-needed role in helping units of government work with the Michigan Natural Resources Trust Fund, which uses oil and gas revenues from state land to support the acquisition of property with outstanding natural and recreational values.

Land Trusts and the Great Lakes Watershed

Given the importance of maintaining and improving water quality within the Great Lakes basin, Michigan conservancies are focusing more resources than ever before on building comprehensive watershed protection programs. This comprehensive watershed approach requires a significant commitment of resources toward land protection, land restoration, resource stewardship, and public education.

Traditionally, land trusts have put almost all of their emphasis on land protection. However, in the Grand Traverse Bay Watershed of northwestern Lower Michigan, the Grand Traverse Regional Land Conservancy is forging strong alliances with other organizations in



Boardman River
photo by Steve Largent,
Director of Boardman
River Restoration and
Protection Project

The Nature Conservancy's New Blueprint for Conservation Action in Michigan and the Great Lakes

by Helen Taylor

For 20 years the Michigan Chapter of The Nature Conservancy has been protecting the wild, the rare and the beautiful of our state. The biological diversity of Michigan—from wildflowers to neotropical migratory birds, from wolves in the Upper Peninsula to remnant prairies along the Ohio-Indiana border, from flowing inland streams to the sheltered bays of the Great Lakes themselves—is incomparably rich and varied, and key to the health of the Great Lakes ecosystem.

We are at a new juncture in the Michigan Chapter, and to achieve our mission of protecting biodiversity in this Great Lakes state and beyond, we must be even more ambitious and far-reaching in our conservation agenda. This means no longer focusing solely on protecting the rare and endangered species and natural communities, but also the declining, vulnerable and even common elements of the diversity of life. Historically, the Conservancy's emphasis has been on terrestrial places, but we now have the tools and expertise to broaden our work equally to aquatic systems. Across the country and overseas, the Conservancy is reassessing its priorities to—for the first time—have a comprehensive picture of what conservation success will look like. We are prioritizing our work within ecoregions, such as the Great Lakes, to be as efficient and effective as possible in the next ten years.

In Michigan we have many opportunities for globally important conservation. Through comprehensive planning within ecoregions that cross into Michigan, we have a blueprint for conserving the diversity of life in Michigan's lands and waters over the long-term. Sites and landscapes—the shoreline of northern Lake Huron, the Keweenaw Peninsula, the headwaters of the Shiawassee and Huron River and the prairie savannas of West Michigan, just to name a few—present enormous conservation opportunities, and challenges. These places take on even greater significance as we consider Michigan's central role in the preservation of the Great Lakes ecosystem, in the protection of migratory



**High priority habitats
in Michigan.**

“Understanding and addressing the linkage between land use and water quality is a major challenge for the next decade and beyond. Urban and suburban sprawl, loss of farmland and open space and ill-advised development in coastal areas collectively compromise the health and integrity of our natural resources and, ultimately, our economic and social well-being. We need to move the notions of ‘watershed-based management’ and ‘sustainability’ from rhetoric to reality. And, we need to develop intergovernmental and public/private sector partnerships to address the land use/water quality linkage.”

**Dr. Michael J. Donahue,
Executive Director,
Great Lakes Commission**

species in North America, disappearing natural habitats, the world’s largest freshwater ecosystem and other features found nowhere else on Earth.

The Michigan Chapter has identified more than 300 sites as high priority conservation areas—including both terrestrial and aquatic priorities (see map); up until now, the Michigan Chapter’s attention has focused on fewer than 100 sites. This new vision of conservation prioritizes the best and most viable examples of diverse flora and fauna in the Great Lakes region, and was developed with many of you and other experts in the region. Now, we are in the process of determining how most quickly and effectively our partners and we can work together to protect these places.

We cannot and will not be doing this alone. The key to our conservation work in the 21st Century will be innovative collaborations with public and private partners at all scales—local, state, regional, national and international. Partnerships with agencies, decision-makers, leaders and corporations in Michigan and elsewhere will be key to forming high-leverage strategies for large-scale conservation. For many of our sites identified as conservation priorities, our partners are better poised to carry conservation forward, and our role may be to ensure that they have our support and resources to take conservation action. We are eager to share our new vision with others. We’d like to think that our new understanding of priority places can serve as a common bond among our partners who are dedicated to wildlife preservation, open space, land-use planning, free-flowing rivers and clean water and air.

The climate is right for such large-scale conservation. Both favorable public opinion about conservation and public wealth is high; the will and the way are there. Conservation is becoming a unifying concept, not a divisive one. People are drawn to conservation and the protection of biodiversity for many reasons—be it recreation, open space, the economic value of natural resources or the next medicinal cure. With our long tradition of working collaboratively with diverse interests to protect our natural heritage, the Michigan Chapter of The Nature Conservancy hopes to use our new vision for catalyzing conservation throughout the state during this tremendous time of opportunity. The conservation of biodiversity in the Great Lakes is important to *everyone’s* interests in this new millennium.

Helen Taylor is the new State Director of the Michigan Chapter of The Nature Conservancy. She was Director of the Conservancy’s Great Lakes Program for the last three years and has worked in Great Lakes issues and environmental policy for 12 years.

Acknowledgements

Guest Contributors

Dr. William Bowerman, Clemson University
Glen Chown, Grand Traverse Regional Land Conservancy
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David L. Knight, "Great Lakes Seaway Review"
Eric Reeves, U.S. Coast Guard (retired)
Dr. Harvey Shear, Environment Canada
William A. Stough, BLDI Environmental & Safety Consultants
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Charlie Wooley, U.S. Fish and Wildlife Service
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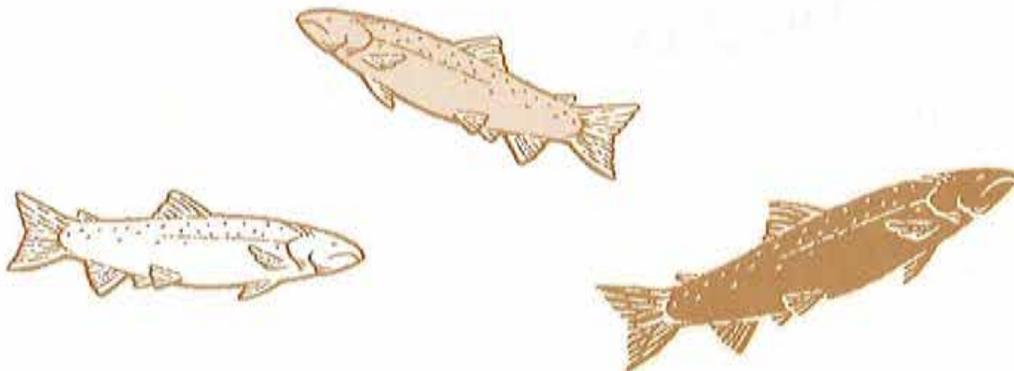
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Pursuant to Public Act 128 of 1985 for Governor John Engler

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