BIODIVERSITY, CONSERVATION, AND ENVIRONMENTAL MANAGEMENT IN THE GREAT LAKES BASIN

Edited by
Eric Freedman and Mark Neuzil

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Biodiversity, Conservation, and Environmental Management in the Great Lakes Basin

The Great Lakes Basin in North America holds more than 20 percent of the world's freshwater. Threats to habitats and biodiversity have economic, political, national security, and cultural implications and ramifications that cross the U.S.–Canadian border. This multidisciplinary book presents the latest research to demonstrate the interconnected nature of the challenges facing the Basin.

Chapters by U.S. and Canadian scholars and practitioners represent a wide range of natural science and social science fields, including environmental sciences, geography, political science, natural resources, mass communications, environmental history and communication, public health, and economics. The book covers threats from invasive species, industrial development, climate change, agricultural and chemical runoff, species extinction, habitat restoration, environmental disease, indigenous conservation efforts, citizen engagement, environmental regulation, and pollution. Overall the book provides political, cultural, economic, scientific, and social contexts for recognizing and addressing the environmental challenges faced by the Great Lakes Basin.

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Preface

Eric Freedman and Mark Neuzil

As the editors, the two of us approached this project from multiple vantage points. As scholars, we've researched how the media covers environmental issues in the Great Lakes Basin. As professors, we've taught environmental journalism and environmental communication to university students. As professional journalists, we've explained the latest scientific discoveries to the public and reported on topics ranging from air pollution to natural resource policy to public land conflicts to leaking landfills to endangered birds. As photographers, we've shot lighthouses, kayakers, wildlife, fish, rural cemeteries, vineyards, and sand dunes. As long-time residents of the Basin, we've canoed its rivers, hiked and cross-country skied its trails, swum at its beaches, biked its back roads, and camped at its parks. As authors, we've written books about its canoe heritage, its pioneering settlers, its forests, and its outdoor recreation opportunities.

We also saw a need for an in-depth look at a cross-section of key scientific, policy, and public administration research that will help shape the Great Lakes Basin's future as ecologically unique and economically vital. Thus this book provides multidisciplinary perspectives on an array of environmental, biodiversity, and conservation issues through the work and insights of U.S. and Canadian researchers, practitioners, policy-shapers, and scholars from a wide range of disciplines, including biology, fisheries and wildlife, forestry, chemistry, political science, economics, journalism and communication, community sustainability, and geography.

Figure 1.1 Map of the Great Lakes Basin.

Source: Council of Great Lakes Governors, inc.

1 Introduction

Examining the terrain

Eric Freedman and *Mark Neuzil*

The St. Clair River marks a 40-mile (64-kilometer) stretch of the U.S.–Canada border, connecting Lake St. Clair with the southern end of Lake Huron between Port Huron, Michigan, and Sarnia, Ontario. It boasts the largest freshwater delta in North America, shelters at least six shipwrecks, and supplies water for drinking and agriculture to communities on both sides of the river. It is home to 40 percent of Ontario's fish species and a major Great Lakes Basin wetland system. Geese fly low over the water. A riverside trail entices joggers, bicyclists, and dog-walkers. Beavers have returned. A shoreline restoration project on the Canadian side has improved habitat for aquatic wildlife. Pleasure boats cruise by. Bald eagles nest on a small island across from Guthrie Park in St. Clair Township, Ontario, watching to prey on fish and ducks.

But looks can be deceiving. Across from the park stands an oil refinery. Nearby is a cargo ship fueling station with high levels of mercury and polychlorinated biphenyls (PCBs) on the river bottom under its dock, contaminants that migrated downstream from a polluted industrial facility. The city of Sarnia is the location of "Chemical Valley," with its assemblage of petroleum refineries, chemical manufacturing facilities, and other heavy industries. Cargo vessels use the St. Clair River as a shipping channel. Under the Great Lakes Water Quality Agreement, the river has been designated as one of 43 Areas of Concern in the Great Lakes Basin since 1987 because of the history of industrial and urban uses along its shores. Thus several "beneficial uses" are classified as impaired, including eating fish and game, drinking water, and dredging. Scientists are still assessing other possible impairments, such as fish tumors, reproductive problems and deformities among birds and animals, and degraded wildlife and fish populations.

At the same time, there has been significant ecological progress along the river due to collaborative work by public agencies in both countries, local First Nations, environmental nongovernmental organizations, and industry, including heightened environmental compliance and regulation, removal of severely contaminated sediments, restoration of wildlife habitat, stronger spill prevention plans, and reduction of combined sewers that collect both sewage and stormwater runoff during heavy rainfalls.

We see a similar spectrum of environmental concerns in more remote, less-populated areas of the Basin. If you sail about 204 nautical miles (378 nautical kilometers) from Sarnia, Ontario, and Port Huron, Michigan, to the northern

Figure 1.2 Invasive phragmites threaten cattails and native grasses along the St. Clair River shoreline.

Source: Carin Tunney

end of Lake Huron, you'll arrive at Mackinac Island. Once a strategic military, fur trading, and missionary post, it is now a popular resort destination anchored in the Straits of Mackinac connecting Lake Huron and Lake Michigan as a single hydraulically linked system. Motor vehicles other than emergency vehicles are banned on the 3.8-square-mile (9.8-square-kilometer) island, so transportation for residents, visitors, and workers is by horse, bicycle, and foot.

Evidence of the island's history is long and deep, with prehistoric fishing camps found by archaeologists. Native American legend tells how the Great Spirit, Git-chi Man-i-tou, created the island (Gringhuis, 1970). European settlement followed. In 1695, French explorer-commander Antoine de la Mothe Cadillac wrote to a government minister about his ability to defend what was what New France called Michilimackinac Island – now Mackinac: "It is important that you be informed in case you are not, that this village is one of the strongest that there is in all of Canada. There is a fine palisaded fort, a highly disciplined garrison of elite soldiers" (Peyser and Brandão, 2008: 103). France, Britain, and eventually the fledgling United States vied for control of the island.

Development soon followed. By 1823, as Dunnigan (2008: 164) noted, "The island was crisscrossed with roads and trails . . . and visitors moved with relative ease as they toured natural and historical sites." By the mid-1820s, the U.S. Army established what is now the Mackinac Post Cemetery near Skull Cave, which was a burial site for Native Americans. Nineteenth-century geologists arrived to study the island's mineral potential. Its natural beauty attracted more and more visitors, such as a U.S. Army captain who described this scene in 1842: "This autumn time

had clad the forests with a thousand hues . . . Between the crimson-leafed maple, the purple and gold ivy and beech, and the green eternal cedar . . . the naked rocks start out" (Dunnigan, 2008: 239). Vacation homes and hotels followed, as did souvenir stores, fudge shops, bars, bike rental and horse-drawn carriage businesses, and boutiques. Only about 500 residents live on the island year-round.

Although much of the island remains relatively pristine with heavy woods, geologically distinctive formations, and historic structures, the island and its environs in the Straits of Mackinac are not paradise. Despite stringent environmental protection laws, there is a risk that freighters and tankers passing through the straits may carry invasive species in their ballast water or may accidentally discharge fuel or other contaminants. The safety of the controversial Line 5 pipeline, commissioned in 1953 to carry crude oil and natural gas under the straits, is heatedly debated. The roughly 850,000 to 1 million visitors arriving at the island annually – most of them by high-speed ferry – put pressure on the infrastructure of the island and its gateway communities in Michigan's Upper and Lower Peninsulas. As a natural barrier, the straits isolate populations of wildlife, such as the bobcat, from the two peninsulas, thus impairing genetic diversity.

The setting

Superior. Michigan. Ontario. Erie. Huron.

Straddling the U.S.–Canadian border, the Great Lakes of North America – the Laurentian Great Lakes – are stunning, overwhelming, sprawling, awe-inspiring, vibrant, troubled, troubling, frustrating, threatening, threatened, enriching,

Figure 1.3 Ship passes under the Blue Water Bridge between Port Huron, Michigan, and Sarnia, Ontario.

Source: Pat Lambert

challenging, and reassuring. Ice Age legacies and symbols of the future. Repositories of incalculable natural wealth and targets of exploitation. Treasured for their cultural and economic value and abused through greed and ignorance. Sources of water essential for drinking, for farming, for industry, for transportation, for recreation, for shipping, for wildlife.

These lakes are the world's largest freshwater surface system. They dramatically influence climate. They provide water tainted with mercury, with PCBs. They offer invasion routes for hostile non-native species. Their storms pummel shoreline sand dunes and send ill-fated cargo ships and pleasure craft to the deep.

They are eyed with envy by thirsty parts of the continent. They are eyed with promise as sites for offshore wind farms. They are eyed with hunger for the wealth of their fisheries – even after years of heavy fishing pressure.

Encompassing the lakes themselves and covering far more territory, the Great Lakes Basin incorporates land in eight states and two provinces, covering roughly 297,000 square miles (770,00 square kilometers). Toronto, Windsor, Detroit, Toledo, Chicago, Buffalo, and Milwaukee are in the Basin, which spans 850 miles (1,400 kilometers) west–east and 725 miles (1,200 kilometers) north–south. Their dunes "wrought of glacial magic," as Elfont and Elfont (1997: 7) put it, are the largest that border freshwater in the world. An estimated 33 million people live in the Basin, alongside more than 75 other mammal species. "Which mammals occur here, where they live, and how they survive and reproduce is the result of a never-ending interplay between the living and nonliving components of the Great Lakes ecosystem" (Kurta, 1995: 3). The same is true, of course, of invertebrates, insects, birds, plants, and other flora and fauna.

Environmental and conservation challenges

As the St. Clair River and Straits of Mackinac examples illustrate, major ecological challenges confront the Great Lakes Basin. They include threats from invasive species, development and sprawl, climate change, agricultural and chemical runoff, air emissions, dependence on fossil fuels, energy exploration and hydraulic fracturing, wildlife and human diseases, poaching and illegal wildlife trafficking, and chemical contamination. These challenges to habitat and biodiversity have economic, political, national security, and cultural implications and ramifications that cross the U.S.–Canadian border.

We can trace the environmental impacts of settlements to the earliest days of cities along the Great Lakes and the St. Lawrence River, including Chicago, Montreal, Toronto, Rochester, Buffalo, Milwaukee, and Duluth. We can trace the environmental impacts of mega-projects that have irreversibly changed the very landscape, from the St. Lawrence Seaway to the Erie Canal to networks of superhighways. We have literally reversed the Chicago River's direction of flow.

Some species in the Basin have already gone extinct, including the eastern elk, the blackfin cisco, and most famously, the passenger pigeon. There are no precise figures on the number of critically endangered, endangered, and vulnerable

Figure 1.4 Boaters and spectators under the Blue Water Bridge where the St. Clair River meets Lake Huron.

Source: Dorothy Alexander

species remaining in parts or all of the Basin, but lists compiled by U.S. and Canadian government agencies are long. While a few are familiar iconic species, including the Canada lynx and the gray wolf, most are little-known to the general public, such as the copperbelly water snake, northern long-eared bat, Kirtland's warbler, Karner blue butterfly, dwarf lake iris, pitcher's thistle, and piping plover. The International Union for the Conservation of Nature (IUCN), which maintains the world's most comprehensive database of species' status, the IUCN Red List, cites reasons for that information gap, such as the fact that many species have not been fully evaluated.

These and other factors contributing to potential eco-devastation led a Lake Superior State University biologist to ask the audience at a local library where he was giving a public talk, "Are we at the beginning of the sixth mass extinction?" (Nolan, 2016).

Why should we worry about extinction? Doesn't it sound, well, abstract and distant, like the demise of dinosaurs and mastodons? Can't endangered species on the cusp of extinction be protected and bred in zoos and wildlife refuges? Can't science resurrect those that have already disappeared through cloning? What does it say about a society that lets species go extinct out of carelessness, callousness, avarice, or ignorance? The conservationist, philosopher, and wilderness advocate

Aldo Leopold once observed that humans could live comfortably without songbirds and wildflowers that lack "economic value" and whose disappearance and demise "would likely go unheralded." Leopold certainly would have agreed with environmental journalist Jason Mark's assessment that "species' instrumental value to humans shouldn't matter" because they have "an *intrinsic* value. They have a worth in and of themselves, even if it appears that they're good for nothing" (Mark, 2015: 85).

Can't government, businesses, science, and citizen action provide effective conservation management and environmental health protection for people, flora, and fauna in the Basin?

Overview of the book

The interplay of geography, hydrology, climate, biology, economics, politics, culture, history, and human emotion sets the stage for this book, which has three major aims:

- Illuminate the interconnected nature of habitat, biodiversity, and species extirpation and extinction challenges in the transborder Great Lakes Basin, which holds more than 20 percent of the world's freshwater.
- Highlight recent research into those challenges from multiple disciplines in the natural and social sciences.
- Provide political, cultural, economic, and social contexts for recognizing and addressing those problems and challenges.

We organized the book by four closely connected themes: (1) Habitat, Conservation, and Restoration; (2) Extinction and Survival; (3) Pollution, Climate Change, and Invasive Species; and (4) Public Policy.

Under Habitat, Conservation, and Restoration you'll read about the impact of dam removal projects on native and invasive fish species, the state of irrigation in the Great Lakes Basin, and the construction and restoration of reefs to provide safe harbors and enhance recreational fisheries. Chapters in the Extinction and Survival section explore efforts to protect habitat for at-risk turtle species, social attitudes toward the passenger pigeon as reflected by media coverage of the centennial of its extinction, the interaction of white-tailed deer and gray wolves, and patterns of movement by black bears and wolves. Chapters in the Pollution, Climate Change, and Invasive Species section highlight research on toxicants and chemicals of emerging concern; interactions among nutrient pollution, invasive species, and climate change; and efforts to save black ash as a Native American cultural resource from the destructive invasive emerald ash borer. The final theme, Public Policy, looks at U.S. congressional legislation about the Great Lakes, the role of conservation authorities in Ontario, public engagement and "citizen science" with the region's natural resources, and principles for environmental collaboration with Indigenous and non-Indigenous groups

Several threads connect these chapters, much like geology, hydrology, and geography connect the Great Lakes, the rivers flowing into them, and their watersheds. The first thread is the insignificance – at least to the forces of nature – of political borders between the two countries and among their states and provinces. Water flows, air moves, and wildlife travels easily across artificial lines on maps.

Another commonality is the complexity of the Basin's environmental and conservation management challenges from both a scientific and a public policy standpoint. There is no end in sight to the arrival of non-native flora and fauna that disrupt habitats and food supplies for native species. There is no end in sight to the creation of new chemicals whose short- and long-term health and environmental effects are unknown. There is no end in sight to population growth and to development pressures on fragile ecosystems and on limited natural resources. There is no end in sight to demands from water-hungry parts of the United States to "share" – in reality, to divert water from the Great Lakes. There is no end in sight to the threat of species extinction. And there is no end in sight to changing global climate that will impact lake levels, agricultural patterns, wildlife migration, human and animal health, economic activity, and outdoor recreational opportunities.

Borders do have political and diplomatic significance, however. What entities of government will take what legislative, regulatory, remedial, and protective steps to safeguard the region's natural resources? And who will pay for those measures? Thus another shared thread is the need for credible public and nongovernmental mechanisms and institutions to resolve environmental disputes. Researchers at Michigan Technological University and Northwest Indian College explained that a "multijurisdictional, multiscale system of governance" has evolved to address transborder problems of toxics such as mercury, PCBs, pesticides, and industrial chemicals that bioaccumulate in food chains. Scientists, they argue, can play important roles in connecting "various jurisdictional scales of governance" by monitoring atmospheric concentrations of such toxics and by "modeling their fate and transport" (Gorman et al., 2016: 443). Several such entities already exist, including the International Joint Commission and the Great Lakes Fishery Commission. In addition, environmental law enforcement and regulatory agencies collaborate and cooperate in investigations ranging from toxic discharges to trafficking in animals parts that cross state, province, and national borders.

Of course, it's impossible to cover all aspects of the Great Lakes Basin's environmental management, biodiversity, and habitat destruction and restoration in a single volume. That is why we, as editors, had to omit a number of relevant topics that also are the subject of fascinating research with potential practical impact, such as microplastics in the waters of the region, landfills and recycling capacity, mass transit systems, harbor dredging, zoning, and the role of nonprofit conservancies in protecting land and waters that government agencies cannot or will not protect.

Conclusion

This book underscores how complicated environmental issues are in the Great Lakes Basin, how difficult it is to make decisions based on a complex mix of science, economics, public opinion, and realistic policy alternatives – and how high the stakes are. "The one constant in the evolution of the Great Lakes since the arrival of Europeans is surprise," observed David Dempsey, a former environmental policy advisor for the International Joint Commission. He continued:

> No government and few individuals foresaw the collapse of fish stocks, the invasion of the sea lamprey, thousands of deaths from typhoid and cholera, the sudden fall of Lake Erie. And while individuals successfully pressed governments to undo these disasters, there was always a great cost. In the twenty-first century, the greatest cost may result from failing to act in advance of disaster.
>
> (Dempsey, 2004: 227)

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