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GREAT LAKES FISHERIES ECOLOGY AND MANAGEMENT: A PRESENTATION TO THE CANADA-U.S. LAW INSTITUTE

William W. Taylor†

INTRODUCTION

I am pleased to be here. Henry King, thank you for inviting me and thank your for adding a biologist to the group. Henry and I strategized about having a lawyer with us in case we needed one. So, Tracy Dobson, thank you for all the work you have been doing as well.

I have been living in the Great Lakes region since I was born, originally near Lake Ontario. Then, I left to go to college. I returned to the Great Lakes in 1980 as an assistant professor at Michigan State University. I have had the great pleasure of working with many colleagues on the Great Lakes, and I need to acknowledge a few of those today. George Costaris, Mary Lynn Becker and Dennis Moore of the Canadian Consulate General’s Detroit office have been friends of mine for many years with our Canadian Studies Center. I appreciate all the support that they have given in understanding the Great Lakes fishery ecosystem from a U.S. and Canadian prospective. Chuck Krueger, who is the science advisor for the Great Lakes Fishery Commission, has been a long-term friend. He helped prepare some of the slides and gave me access to the information I needed. I also acknowledge many of the graduate students that I worked with on the Great Lakes who not only taught me about Great Lakes ecology and management, but they also (and most importantly) taught me about myself. I appreciate their help in learning about life in general and fisheries systems in specific. Furthermore, there are the many management agencies that I have had the good fortune to interact with both in the U.S. and Canada. In particular, I want to mention John Robertson, former Chief of Fisheries Division in the Michigan Department of Natural Resources. He helped me better understand and appreciate the Great Lakes management agencies and their inner workings.

Now, it is particularly fitting that I have a friend in the room – Dr. Joe Koontz, Chair of the Case Western Reserve University Department of

† Chairperson and Professor, Department of Fisheries and Wildlife, Michigan State University, East Lansing, Michigan. B.A., Hartwick College; M.S., West Virginia University. Ph.D., Arizona State University. Additional biographical information available at xvii.
Biology. I am in good company. Koontz has worked extensively on the Great Lakes. We used to joke about Cleveland and the fire on the Cuyahoga River in the late 1960s, which created the first article in Time magazine's environmental section.1 I searched for a picture of that fire. It was famous, in my mind and probably in the minds of other ecologists, but, lasting only fifteen minutes, no one took a picture. It caused only about forty thousand dollars worth of damage.2 In defense of the Cuyahoga, there were many fires in the Great Lakes basin during the 1950s. One of these was captured on film. The fire was huge and caused millions of dollars worth of damage,3 but nobody really cared because the U.S. and Canada were striving for economic prosperity.

Throughout this talk, we are going to see the evolution of the perspectives, the values of the people in the decisions made concerning the Great Lakes ecosystem.

I lived two houses away from Lake Ontario in the 1950s and 1960s. Dead alewives floated on the surface of the lake and eutrophication was widespread. We never would have given a cent to reclaim Lake Ontario. There was no way we were going to use Lake Ontario for fishing; for that, we went to the Finger Lakes. My parents, in their wisdom, substituted Lake Ontario with a technological fix. They built an in ground, heated swimming pool. That was how we dealt with the problem of an ecosystem in distress. Luckily, there were people in both the U.S. and Canada there that changed our perspectives as to what we expected out of the environment and how we could improve the Great Lakes for the benefit of all.

The Great Lakes are magnificent, complex and diverse. They heavily reflect the activities of humans. Fish integrate the biological, physical, chemical and the social environments to which they are exposed.

I am going to give you an overview on the ecological side of the equation, and Tracy Dobson and Henry Regier will talk about governance. I hope that we can show some of the lessons we have learned and hopefully learn from the lessons ignored.

One interesting note is that those who are small lake or river biologists look at people who study the Great Lakes and they think we are nuts. After all, who can possibly work with such a large system? However, if you go to the marine biologists, they think what we do is easy because we work with such a small amount of water, only 20 percent of the surface fresh water of the world. The Great Lakes ecosystem and our management of that system is a microcosm that mimics the issues that society in both of our nations have in

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3 *TIME*, supra note 1, at 41.
balancing human and environmental goals. Many of the issues that I heard
the last day and a half are also reflected in the Great Lakes, whether it is
Artic National Wildlife Reserve conflicts over drilling for gas and oil,
interbasin water transfers, First Nations’ rights, aquatic nuisance species and
their impact, health, contaminants, fish diseases and waterborne pathogens.

GREAT LAKES ECOSYSTEM GOVERNANCE

There are eight states and one province (Ontario) in the Great Lakes
proper. There is one other province downstream on the St. Lawrence River
(Québec), which also engages with us. There are two federal and several
tribal or First Nations governments that are involved in Great Lakes’
fisheries management. We really are discussing a co-managed system,
where the diversity of ecosystems and where the multitude of societal and
individual beliefs and values are not in harmony. At one time, I counted over
640 municipalities that affected the water quality in the Great Lakes that, in
turn, affected fish production in these systems.

I will concentrate on a couple of species to give examples of what we do,
and then talk about how we manage the Great Lakes ecosystem in general.

Lake Trout

Lake trout (Salvelinus namaycush) was a species that was important to the
commercial fishery and to the livelihood of people in the Great Lakes.

Lake Superior, in 1848, was an aboriginal fishery. A scientist named
Agassiz made the first descriptions of the different forms of fish.⁴ In all the
Great Lakes at that time, there were different variants of lake trout and vast
numbers of other fish species.

Stresses

As more people immigrated to the upper Great Lakes from the East Coast
and Europe in the 1860s, commercial-scale fishing operations began using
pound nets for catching fish. Additionally, the land use patterns changed
dramatically due to lumbering, rock quarrying, agriculture and citification of
the Great Lakes basin. The impact was drastically altered water quality and
quantity throughout the basin.

As the massive influx of people coming into the Great Lakes Basin
required large amounts of food for sustenance, we over fished the lakes by
the early 1900’s. After the First World War, we experienced a major change

⁴ Louis Agassiz, Lake Superior: Its Physical Character, Vegetation and Animals,
 Compared with Those of Other and Similar Regions (1850).
in fishing technology with the introduction of gas and diesel powered tugboats. It is true that these new ships were safer. However, the new boats could go farther out into the lake exploiting populations distant from their home ports. Furthermore, a boat and its crew did not did not have to be a part of the local community.

Gill nets, another method used for catching fish, were originally made of hemp but they were not very efficient and were replaced by cotton in the 1930s. The multifilament nylon nets introduced in the 1950s were extremely efficient, as the new nets were much thinner, stronger and more effective in catching fish compared to their predecessors.

People think about sport fishing as having a great impact on the Lakes, but sport fishing was not really a significant component of most of the Great Lakes fishery before the 1960s. There were areas like Saginaw Bay and Green Bay that had large stock of perch and walleye but, for the most part, the sport was a limited and local phenomenon, not something that most people had time or money to do. However, in the tributaries of the Lakes, there was plenty of sport fishing activity.

Another event that placed more stress on the Great Lakes ecosystem was the introduction of aquatic nuisance species. The most infamous of these was the sea lamprey (*Petromyzon marinus*). They had a significant impact on our fish populations, particularly the lake trout. They were first spotted in the Erie Barge Canal in the 1800s. The sea lamprey swam through to Lake Ontario in 1819. Nobody knows for sure whether they were there historically or whether they migrated in through the canal.\(^5\) By 1921, the sea lamprey was spotted in Lake Erie and in 1932 they were found in Lake Huron. They were first seen in Lake Michigan in 1936, and in Lake Superior in 1946.\(^6\)

The sea lamprey spawns in the streams, living there from four to seven years. For about 18 months, they swim out into the lakes. They attach to fish using their rasping suction-cup mouth that makes a hole and slowly kills the fish. They became abundant. Since lake trout take many years to mature, between the overfishing by humans and the infestation by the sea lamprey, they were not able to stay alive long enough to reproduce. Hence, the natural reproduction of lake trout failed in Ontario, Erie and Michigan. Lake trout were virtually eliminated in Lake Huron, and the stocks in Superior’s eastern basin started to decline by the 1950s.\(^7\)

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\(^6\) Id.

In addition to lake trout, many other species, i.e. chubs, were also impacted by human activity, whether it be through overfishing, sea lamprey introduction or environmental degradation. I told you that I once lived on Lake Ontario, and we did not care. After all, we did not think we could do anything different. There was a lack of awareness of alternatives. The lack of public environmental concern combined with high fishing mortality and increasing environmental degradation resulted in multiple problems for the Great Lakes ecosystem, including collapsing fish stocks, eutrophication and chemical contaminants which resulted in fish reproductive problems and congenital deformities. Additionally, we channelized our river resources, altered the hydrology, impeded the migration of fish and altered the coastline. Whole schools of alewives (an exotic allowed into the Great Lakes through the canal system, washed up dead on the beach, causing massive degradation to beachfront property.

As the fishery collapsed, those who fished for a living suffered through hard times. Fishing communities simply vanished because the people who lived in them could not find employment when there were no fish to catch. Fish managers were saying the opposite of “Eureka!,” because no one knew how to control the degradation. One of the lessons we learned from this experience is that we do not tend to be concerned about the environment until the conditions are bad and we are forced into restoring or rehabilitating the ecosystem. There is a famous Pogo cartoon from the early 1970s that says, “Yes, son, we have met the enemy, and he is us.”

Recovery Strategies

Canada and the U.S. responded by embarking on a fishery rehabilitation program, focusing on lake trout. Because it was a species that takes a long time to mature, the fisheries managers knew it was going to take a long time to rehabilitate, perhaps as long as 25 years. At the time, 1955, the cost was estimated to be about $30 million dollars, but it turned out to be much more.

We felt that healthy lake trout systems translated into overall ecosystem health. Historically, lake trout were very diverse, filling a broad niche in the Great Lake ecosystem. They could be found in both near and offshore habitats, had diverse feeding habits, and were of significant cultural value to the people of the basin.

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Our fisheries management strategy included three elements: fishery regulations, the stocking of lake trout, and environmental protection. We closed the commercial, lake trout fisheries and stocked millions of lake trout over the past fifty years. We enacted the Great Lakes Water Quality Agreement\(^\text{10}\) and the Clean Air Act,\(^\text{11}\) both of which were important legal tools that helped achieve the desired water quality.

The Great Lakes Fishery Commission was created in 1955. We attempted to create such a commission in the U.S. and Canada several times before this, but no one had the willpower to do it until disaster struck. The Great Lakes Fishery Commission has no management authority, but the Commission does have coordination authority; principally the management of the sea lamprey control program. The Commission uses many different techniques to control the sea lamprey from an integrated pest management perspective, using lampricide, a chemical to sea lamprey barriers and sterile male release. Between stocking fish and controlling lamprey, the Great Lakes were on life support.

So, how did the lake trout respond? They increased in numbers, but not much natural reproduction was taking place. There were many different explanations as to why this occurred. Some of the reasons included unsuitable spawning grounds,\(^\text{12}\) inadequate numbers of spawners; infertile eggs either because of contaminants;\(^\text{13}\) a diet of alewives that contained thiaminase, an enzyme that adversely impacts reproductive success;\(^\text{14}\) predation by other fish on eggs and larva;\(^\text{15}\) and an inadequate genetic composition of the stocks.\(^\text{16}\) Unfortunately, at the time we began our restoration programs and started stocking fish, we did not recognize the importance of genetic diversity. We had a limited pool of fish that were available for us to use, so we primarily stocked one genetic type referred to as the lean lake trout. Recent studies indicate that this strain of lake trout does not perform as well as other genetic strains.


\(^{11}\) Air Pollution Control ("Clean Air") Act, 42 U.S.C.A. §§ 7401-7671 (West 2002).


\(^{13}\) Id. at 14. However, the contaminant levels are much lower now than in the 1980s. Id. at 19.

\(^{14}\) Id. at 5.

\(^{15}\) ESHENRODER, supra note 12, at 21.

\(^{16}\) Id. at 11.
Current Status

In Lake Superior, we were able to implement sea lamprey control and rehabilitation efforts very quickly, and we now considered the lake rehabilitated. Lake Huron is doing much better, although there are concerns regarding the number of lampreys being produced in the St. Mary’s River and about the level of fishing mortality from the Native Americans and recreational fisheries. In Lake Michigan, we have had little or no reproductive success as such this lake is still undergoing rehabilitation. In Lake Erie, no reproduction has been detected and in Lake Ontario, there has been evidence of natural production but it has been limited. For the last several decades some people claim that the lake trout is coming back, but the effort and cost has been enormous. Additionally, for a long-lived species such as lake trout, it takes a long time for meaningful recovery. In human terms, this equates to several generations of professional biologists. Many U.S. and Canadian citizens are tired of spending large amounts of money and effort without tangible results.

What are the lessons we have learned? First, it takes a long time to rehabilitate systems, especially for a long-lived species. Second, non-native species, such as sea lampreys and alewives, can seriously impede restoration. Third, fishing mortality must be controlled. Fourth, genetics are important. The key word here is diversity. Fifth, species are easier to restore in ecosystems that are the least disturbed. Sixth, we must find mechanism that allows the seamless transfer of fundamental information from science to management agencies. Lastly, management agencies must have enough flexibility to be able to quickly adapt to ecosystemic change.

CONCLUSION

Bertrand Russell said it best: “The central problem of our age is how to act decisively in the absence of certainty.” How do we act decisively when we do not know everything? I often tell people, do not let what you cannot do interfere with what you can do. For instance, in the early 1970s, Henry Regier wrote a paper with Bill Hartman that was published in Science that said that Lake Erie was dead. The lake was not worth anything because of the increasing eutrophication and the dying fish. Because of efforts by people such as Henry Regier, today, we have a productive walleye fishery in Lake Erie. It recovered because people started recognizing that the environment was important, and the research and management agencies

17 BERTRAND RUSSELL, AN INQUIRY INTO MEANING AND TRUTH (1940).
responded and worked to that end. If you had a fire in the Cuyahoga today, you would have a much bigger reaction to it than you did in 1969; it would simply not be acceptable today.

In conclusion, we must have a vision that can be transferred to others. This is happening through the Great Lakes Fishery Commission and throughout the Great Lakes community due to the dedicated efforts of many individuals, communities and institutions in both the U.S. and Canada.

Thank you.