TESTIMONY OF

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"Invasive Species: Their Impact and Our Response"

Preface

My name is Jeffrey M. Reutter. I have been doing research on Lake Erie and the Great Lakes, studying this wonderful resource, and teaching about it since 1971. I am the Director of the Ohio Sea Grant College Program (part of NOAA), the F.T. Stone Laboratory (the oldest freshwater biological field station in the country), the Center for Lake Erie Area Research (CLEAR), and the Great Lakes Aquatic Ecosystem Research Consortium (GLAERC). I have held these positions since 1987.

I am here today to speak to you about aquatic invasive species. While much of my focus will be on the Great Lakes, it is important to note that this is indeed a national problem, and I am pleased that the National Sea Grant College Program has been able to provide so much leadership to efforts to address this issue. Since 1993 Ohio Sea Grant has published four reports documenting the work of all 30 Sea Grant programs in addressing the invasive species problem, and we are currently working on a fifth report. Our last report was published in 2000 and contains important information on Sea Grant research and outreach projects on 22 invasive species from 24 coastal states. This report is available on the Ohio Sea Grant College Program web site at www.sg.ohio-state.edu.

The take home message from my talk this morning is very simple: the invasive species problem is one of the most important issues we face. I chair the Research Needs and Priorities Subcommittee for the Council of Great Lakes Research Managers of the International Joint Commission, and they have designated invasive species as one of the top five research issues facing the Great Lakes region. Invasive species impact coastal ecosystems, habitats, native species, our economy, and human health. We have not closed the door to their introduction, more are on the way, and we have not been able to develop adequate technologies to control and eradicate those that are already here. Furthermore, we have found their impact to be much broader than originally estimated. We must invest in research to develop new technologies that both close the door on future introductions and control those that are already present. And, finally, the Great Lakes must be included in marine and oceanic activities and treated as this country's fourth coastline by all agencies.

Introduction

Whether they are called *aquatic nuisance species*, *invasive species*, *exotic* species, or *nonindigenous species*, all of these terms describe the same problem—non-native plants and animals that are invading our coastal and aquatic resources. Since the 1800s, more than 140 exotic aquatic organisms of all types—including plants, fish, algae and mollusks—have become established in the Great Lakes. As human activity has increased in the Great Lakes watershed, the rate of introduction of exotic species has increased. More than two-thirds of the organisms have been introduced in the past 40 years, a surge coinciding with the opening of the St. Lawrence Seaway. In their native habitats invasive species may be harmless, but when transplanted to other areas, they compete with indigenous animals and plants for food and habitat. Invasive species are causing significant ecological and economic problems throughout the Great Lakes and may constitute the largest single threat to the biological integrity of the world's largest freshwater system. Species such as zebra mussels, quagga mussels, sea lampreys, purple loosestrife, and round gobies, to name a few, are drastically altering aquatic ecosystems, harming human health, and interfering with business and recreational pursuits.

Invasive species are frequently transported by human activities such as the dumping of ballast water from transoceanic ships, transporting species via recreational boats, and emptying unwanted bait. Research has produced effective control methods for zebra mussels that have helped industries and drinking water facilities save millions of dollars in control and monitoring. Public-awareness of invasive issues has increased through conferences, information clearinghouses, newsletters, and web sites. These efforts have impacted hundreds of thousands of people in the region by providing current research results and educational information to inform, combat, and prevent the spread of invasive species. But, the problem is far from being solved.

On 6 June 1990, leading scientists and managers in the Great Lakes region met in Detroit to develop a plan to address the problem. They formed the Great Lakes Nonindigenous Species Coordinating Committee. On 29 November 1990, the Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA) passed in the United States. As a

result of this act, the National Aquatic Nuisance Species Task Force was formed, and the Great Lakes Nonindigenous Species Coordinating Committee became the Great Lakes Panel on Aquatic Nuisance Species. This Panel reports to the Task Force. The National Invasive Species Act (NISA) passed in 1996 and efforts are currently underway to reauthorize the act. Unfortunately, implementation of the National Invasive Species Act falls far short of national needs to effectively protect the region's coastal resources from expensive and environmentally damaging invasions by invasive species, e.g. invasive species are still appearing in the Great Lakes at the rate of about one per year.

Regional Identification of Research/Monitoring Needs and Priorities

The Coordinating Committee met in Columbus, Ohio on 4 December 1990 as part of the first zebra mussel research conference. The Committee developed six main focus areas for research and management to address aquatic nuisance species throughout the Great Lakes region. These research categories were adopted nationally and internationally and are still in use today. Current and accurate information is needed in each of these areas for every invasive species.

- Biology and Life History
- Effects on Ecosystems
- Socio-Economic Analysis: Costs and Benefits
- Control and Mitigation
- Preventing New Introductions
- Reducing the Spread

The Lake Erie Experience

Today I would like to provide you with some specific information about invasive species impacts in Lake Erie and some suggestions that would improve our ability to address the problem. These are clearly illustrative of invasive species impacts in other locations. However, to enhance your understanding, I must first tell you a little about Lake Erie, and, we must recognize that Lake Erie may be a model for many other bodies of water in this country, and we must transfer the knowledge we gain from this lake to prevent the same thing from occurring in other locations in this country.

The Great Lakes hold 20% of all the freshwater in the world and 95% of the freshwater in the United States. The US shoreline of the lakes is longer than the Atlantic Coast, Gulf Coast and Pacific Coast, if we leave out Alaska. Approximately 30% of the US population lives around these lakes.

Lake Erie is the southernmost and shallowest of the Great Lakes. As a result, it is also the warmest. It also provides drinking water to 11 million people each day. The other Great Lakes are all in excess of 750 feet deep, and Lake Superior is 1,333 feet deep. The deepest point of Lake Erie is 212 feet in the eastern basin, off Long Point. As a result, Lake Erie is the smallest of the lakes by volume, and Lake Superior is 20 times larger than Lake Erie. The watersheds around the other four Great Lakes are all dominated by

forest ecosystems. The watershed around Lake Erie is the home to 14 million people and is dominated by an agricultural and urban ecosystem. As a result Lake Erie receives more sediment and more nutrients than the other Great Lakes. Now, if Lake Erie is the southernmost, shallowest, warmest, and most nutrient enriched of the Lakes, we should expect it to be the most productive of the Great Lakes. It is. In fact, we often produce more fish for human consumption from Lake Erie than from the other four lakes combined. As you will see in a minute, this biological productivity has also made Lake Erie a "zebra mussel heaven."

Scientists divide the Lake into three basins based on significant differences in shape and depth. The Western Basin is the area west of Sandusky and has an average depth on only 24 feet. The Eastern Basin is the area east of Erie, Pennsylvania and contains the deepest point in the Lake. The Western and Eastern Basins have irregular bottoms with a lot of variation in depth. The Central Basin is the large area between Sandusky and Erie. The average depth of this basin is between 60 and 80 feet and the bottom is very flat. Unfortunately, it is this shape that causes this basin to develop an anoxic hypolimnion when phosphorus levels are too high.

Lake Erie has gone from being the poster child for pollution problems in this country to being one of the best examples in the world of ecosystem recovery. A little over 30 years ago, 1969, the Cuyahoga River burned and Lake Erie was labeled a dead lake. Nothing could have been further from the truth. In reality the Lake was too alive. We had put too many nutrients into the Lake from sewage and agricultural runoff. These nutrients had allowed too much algae to grow, and that algae, when it died and sank to the bottom, had used up the dissolved oxygen in the water as the algae was decomposed by bacteria. This sequence is a natural aging process in lakes called eutrophication, but man had accelerated the process by 300 years by putting in too much phosphorus. It is very similar to what we are seeing today in the Gulf of Mexico, but the problem in salt water is nitrogen.

To reduce the amount of algae in the Lake, we needed to reduce the amount of the limiting nutrient. By "limiting nutrient," I mean the essential nutrient that is in the shortest supply. Without this nutrient algae cannot grow and reproduce. In freshwater this nutrient is phosphorus. In 1969, we were loading about 29,000 metric tons of phosphorus into Lake Erie each year. Our models told us that in order to keep dissolved oxygen in the Central Basin, we needed to reduce the annual loading of phosphorus to 11,000 metric tons. This was accomplished and the recovery of the Lake has been truly remarkable. The walleye harvest from the Ohio waters jumped from 112,000 in 1976 to 5 million in 1988 and the value of this fishery exceeds the value of the lobster fishery in the Gulf of Maine. Small businesses associated with charter fishing increased from 34 in 1975 to about 900 today, and Lake Erie became the "Walleye Capital of the World." We are concerned now the invasive species may be reversing all of our previous gains.

While extensive literature reviews are certainly the correct way to begin every research effort, we must also recognize that invasive species may behave differently in different

environments. For example, when the zebra mussel invaded Lake Erie, we first reviewed the European literature. This is an example of what we have observed.

Biology and Life History

Europe	Lake Erie
Spawn at 3-5 years	Spawn at 11 months
Lay 50,000 eggs	Lay 1 million eggs
Larvae drift for 11 days	Larvae drift for 33 days
Will attach to any hard surface	Attach to hard surfaces but have also spread over 1000s of acres of soft substrate

We also learned that zebra mussels have a fat content about ten times the level in native clams. As a result they can accumulate fat-soluble contaminants like PCBs at ten times the level in native clams.

Effects on Ecosystems

The zebra mussel is a filter feeder. Each one filters about 1 liter per day. We observed the first zebra mussel in Lake Erie at Stone Laboratory on 15 October 1988. Recognizing the significance of this find, we initiated the first zebra mussel research project in this country one month later. One year later, 15 October 1989, the zebra mussel density in the Western Basin of Lake Erie reached 30,000 per square meter. Zebra mussels also cover all of the artificial reefs we have created including those we created with the rubble from old Cleveland Browns Stadium. Water clarity increased about 600%, rotifer densities fell 80%, and planktonic diatom densities fell 90%. The Lake Erie walleye population is about 1/3 of what it was before the zebra mussel invasion, and the economic value of the walleye fishery has fallen from over $600 million to about $250 million.

In the mid-1990s we began seeing blooms of *Microcystis*, a form of blue-green algae that produces the toxin microcystin. We believe these blooms were caused by zebra mussels releasing phosphorus and removing the forms of algae that compete with *Microcystis*. This species can cause human health problems and problems for fish and wildlife and is blooming in the Western Basing of Lake Erie as we speak.

In the mid-1990s the round goby invaded Lake Erie and rapidly became the most abundant bottom species. In the Central and Eastern Basins it replaced the mottled sculpin and is rapidly preying on bass eggs in their nests. We also noticed that gobies were eating zebra mussels, and they in turn, were being eaten by smallmouth bass, and transferring the contaminant burden from the zebra mussel to the bass, thereby creating a new pathway for contaminants to reach humans.

Phosphorus levels in Lake Erie fell from the 1970s to 1995. Since 1995 they have been on the increase. Phytoplankton and zooplankton densities have also increased, and, if the trend continues, within 3 years we will be back to the levels of the 1970s when Lake Erie was the poster child for pollution problems in this country. This has caused a return of

the problems of the 1970s including an anoxic hypolimnion in the Central Basin. This problem is being exacerbated by a transition from zebra mussels to quagga mussels, another invading species. In 1993, in the Western Basin, zebra mussels made up 99% of the mussel population and quaggas made up 1%. Today quaggas make up 90% and zebras make up 10%. Both zebra mussels and quagga mussels appear to change the way phosphorus cycles through the Lake and quaggas appear to release more phosphorus than zebra mussels. Thus, they are hypothesized to be exacerbating the problem of anoxia. Global arming and reduced water levels are also making this problem worse.

I believe Lake Erie is the sentinel and we should develop models to extrapolate our results to other bodies of water that contain mussels so they can be prepared for the problem and take preventative action before it occurs.

Recommendations

- Support and strengthen the National Invasive Species Act.

- Treat the Great Lakes as this country's fourth coastline. Some, but not all, agencies and programs include the Great Lakes in marine and oceanic programs, e.g. National Sea Grant College Program and the National Association of Marine Laboratories. However, it is often difficult to determine whether the Great Lakes are included, and if they are included on an equal footing. For example, NOAA is currently conducting strategic planning sessions in all coastal regions. Their planning session for the Great Lakes is in Boulder, Colorado. To correct this, they added a session that will be less than half as long and occur after they have met to draft the strategic plan. This sends a very poor message to our constituents. It appears that the same is true of NSF's oceanic and Great Lakes Programs where little funding reaches this region. Without their support, it is hard to address any of this region's most important issues including invasive species.

- All Sea Grant Funding should be based on merit. Currently, the National Sea Grant College Program awards about 2/3 of its total support to the 30 individual state programs in a fashion that is not based on merit. This is considered that program's base funding and it is critical to the operation of every program—allowing the program to plan for the research, education, and outreach activities to be conducted locally to address national needs. Within most state programs, these dollars are awarded on a very competitive basis. However, the awards from the National Program to the individual programs are based on historical funding rather than merit. In Ohio we have a superior program, but one of the smallest based on dollars received. As a result, we are less able to support students, businesses, faculty, and coastal issues (e.g. invasive species) from Sea Grant in Ohio than in most other states. All Sea Grant funding should be based on merit and the process should be transparent.

- It appears that earmarking within the National Undersea Research Program is hindering the program's ability to address issues in the Great Lakes. Currently NURP has 6 regional centers, but half the funding must go to the two centers on the west coast. Furthermore, the Great Lakes are lumped with the Northeast Regional Center in New England making it very difficult for dollars to reach the region. This support could be very helpful in documenting the expansion of mussels onto soft substrates.

- Support for equipment and facilities at marine laboratories within NSF is woefully inadequate.