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THE IMPACT OF AQUATIC INVASIVE SPECIES ON THE GREAT LAKES

(110–14)

HEARING

BEFORE THE

SUBCOMMITTEE ON
WATER RESOURCES AND ENVIRONMENT

OF THE

COMMITTEE ON
TRANSPORTATION AND
INFRASTRUCTURE
HOUSE OF REPRESENTATIVES

ONE HUNDRED TENTH CONGRESS

FIRST SESSION

March 7, 2007

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March 2, 2007

SUMMARY OF SUBJECT MATTER

TO: Members of the Subcommittee on Water Resources and Environment

FROM: Subcommittee on Water Resources and Environment Staff

SUBJECT: Hearing on the Impact of Aquatic Invasive Species on the Great Lakes

PURPOSE OF HEARING

On Wednesday, March 7, 2007, at 2:00 p.m., in Room 2167, Rayburn House Office Building, the Subcommittee on Water Resources and Environment will receive testimony from representatives of the U.S. Environmental Protection Agency, the State of Michigan, the Great Lakes Commission, the City of Racine, Wisconsin, the Great Lakes and St. Lawrence Cities Initiative, the Little Traverse Bay Bands of Odawa Indians, academia, environmental groups, port facilities, and the power sector on the impact of aquatic invasive species on the Great Lakes.

BACKGROUND

Aquatic Invasive Species in the Great Lakes

The Problem: As a result of the increasing globalization of trade, speed of maritime travel, volume of cargo shipments, and tourism, the probability of accidental introductions of aquatic invasive species in the United States has increased in recent decades. The Great Lakes region has been negatively impacted by aquatic invasive species in part because of its location as a center of population and trade. Of the estimated 230 non-native aquatic species that are now found in the United States, at least 70% - over 162 species – can be found in the waters of the Great Lakes. These invasive incursions have already had profound environmental, economic, and public health impacts on the region. Without additional federal, state, or local action, the numbers of aquatic invasive species – and the costs to the American public, businesses, and environment - are expected to increase over time.

Aquatic invasive species consist of fish, plants, mollusks, invertebrates, insects, algae, and micro-organisms that are not native to an aquatic ecosystem. Because aquatic invasive species do not have natural predators, they can quickly become established and disrupt many ecosystems. Not only can aquatic invasive species displace and degrade native species and ecosystems, they can also cause serious damage to water infrastructure. While aquatic invasive species have been brought into the waters of the United States since colonial times, the Great Lakes were first impacted on a major scale in the 1950s.

The Great Lakes are one of the most important water resources on Earth. All five lakes combine to contain around 20% of the total global fresh surface water. The region surrounding the Great Lakes (both the U.S. and Canada) has a population of around 40 million people. As home to some of the major industrial centers in the United States and Canada, the Great Lakes region is a major manufacturing, transportation, and trade hub. The lakes have, from the earliest human settlement, provided a convenient and effective means for transporting natural resources and manufactured goods around the region. In addition, the lakes support the largest freshwater fishery in the world – consisting of both commercial and recreational fishing. Because so much commerce relies and is centered on the lakes, a healthy Great Lakes ecosystem is critical not only for the economic health of the region, but for the nation as a whole.

Aquatic invasive species first disrupted the Great Lakes ecosystem on a large-scale in the 1950s. The sea lamprey is an eel-like fish from the coastal north Atlantic that attaches to other fish and drains them of blood and other bodily fluids. The sea lamprey entered the upper Great Lakes through the Welland Canal around Niagra Falls. By the 1950s, the top native predatory fish – the lake trout – was already in decline due to over-fishing and habitat degradation. This led the sea lamprey to become a dominant predatory species and begin to decimate other native Great Lakes fish populations. Moreover, in the absence of the lake trout as a predator, another invasive species – the common alewife – began to overpopulate. By the 1960s alewives were so populous that they outstripped their food sources and began dying in huge quantities. Billions of starved, dead alewives washed up on the shores of Lake Michigan. Lakeside municipalities along Lake Michigan had to expend considerable tax resources to clean up the dead alewives. In order to control the alewife populations, fishery managers introduced salmon to Lake Michigan - a non-native species to the Great Lakes – in the mid-1960s. The salmon were so successful in containing the alewife population that they, too, ended up outstripping this food source and washing up, themselves, on the shores of Lake Michigan. Today, fishery managers now must try to achieve a delicate balance between these two non-native species by stocking Lake Michigan with alewives as a food supply for the salmon (which are now fished by both recreational and commercial fishermen).

In 2001, scientists estimated that 162 aquatic invasive species of all varieties had taken up residence in the Great Lakes. Some researchers have found that figure now tops 170 aquatic invasive species. Researchers also estimate that a new invasive species will be discovered at a rate of one every eight months. The U.S. Geological Survey (USGS) has found that the largest group of aquatic invasive species in the Great Lakes is aquatic or wetland plants, followed by fish, then algae. Assorted other species, including mollusks, invertebrates and micro-organisms, combined for 22% of the total aquatic invasive species listed in the USGS survey.[1]

[1] http://biology.usgs.gov/s+t/noframe/x185.htm (accessed 26 February, 2007)

The following is a listing of some of the many aquatic invasive species that inhabit the Great Lakes and negatively impact the ecosystem and economy.

- **Zebra Mussel:** Small, opportunistic filter-feeding crustaceans from eastern Europe. Scientists believe that zebra mussels were introduced into the Great Lakes through contaminated ballast water in the late 1980s. They reproduce rapidly and consume very large amounts of microscopic plants and animals, depriving native species of food. While zebra mussels are individually very small, densities of over 1 million zebra mussels per square meter have been found in Lake Erie. The sheer mass of zebra mussels can clog and potentially overwhelm water-related infrastructure, such as fresh water intake pipes used for drinking water. While zebra mussels can improve water clarity, their feeding also dramatically impacts and depletes the food chain in the ecosystems the mussels have invaded. Researchers have also associated the presence of zebra mussels with toxic algal blooms that foul drinking water supplies.

- **Sea Lamprey:** An eel-like fish from the coastal north Atlantic that attaches to other fish and drains them of blood and bodily fluids. Scientists believe that the sea lamprey entered the Great Lakes through the Welland Canal in 1921. A single adult sea lamprey can kill as much as 40 pounds of fish in a 12- to 20-month period. This species has caused the extinction of three species of whitefish and the decline of several other major native fish species (including lake trout), resulting in negative impacts on commercial and recreational fisheries.

- **Quagga Mussel:** Small, opportunistic filter-feeding crustaceans from eastern Europe. Researchers believe that they entered the Great Lakes through ballast water around 1989. They reproduce rapidly and consume very large amounts of microscopic plants and animals, depriving native species of food. Very similar impacts to the zebra mussel.

- **Round Goby:** Aggressive fish from eastern Europe first discovered in the Great Lakes region in 1990. Scientists believe it probably arrived via contaminated ballast water. It has decimated the small-mouth bass population by consuming their eggs.

- **European Ruffe:** The European ruffe is native to northern Europe and Asia. Researchers believe that it probably entered the Great Lakes through contaminated ballast water in the early 1980s. The ruffe can compete for food and habitat with native Great Lakes fish such as yellow perch. They also consume large amounts of the eggs of commercially important native fish such as lake whitefish.

- **Viral Hemorrhagic Septicemia (VHS):** An infectious viral disease that affects fish. Originally a virus found in salt water, it has been a problem in Europe for many years. The virus made its first appearance in the Great Lakes region in 2005. Fishery managers believe that VHS was introduced through contaminated ballast water. The virus poses no human risk, but has been linked to several fish kills and is of increasing concern in the Great Lakes region. It causes internal bleeding in fish, destruction of internal organs, and can manifest itself with external tumors. National Oceanic and Atmospheric Administration (NOAA) researchers have found that VHS has been responsible for several large fishkills in the Great Lakes. They also believe that nearly 50 Great Lakes fish species are susceptible to the virus, including several commercially important ones.

- **Whirling Disease (*Myxobolus cerebralis*):** A pathogenic protozoan parasite from Europe that affects the nervous systems of trout. Researchers believe that the parasite entered the United States through contaminated trout in 1955. The parasite attacks the fish cartilage and has devastated some trout populations. It is a severe problem in rivers and streams in western states, but has been primarily confined to fish hatcheries where close fish proximity makes transmission easier.

- **Purple Loosestrife (*Lythrum salicaria*):** An ornamental, wetland plant from Eurasia that is displacing cattails and other native wetland vegetation. Scientists believe it was brought into the United States in the early nineteenth century. Purple Loosestrife has no value as a food source for native wildlife and is less suitable as habitat than native wetland plant species.

Sources: Aquatic invasive species incursions are, in part, a function of human population migrations and increasing global trade. Increases in the number of people traveling, and the speed and methods of travel and trade have all played a part in increasing the rate of introduction and survival rates of non-native plants, animals, and micro-organisms into the Great Lakes.

Non-native species have a greater chance of surviving and then establishing themselves in new habitats when they come from a region that is similar to the ecosystem they are introduced to. For example, aquatic invasive species from northern and eastern Europe, Korea, northern China, and Japan may have an easier time establishing themselves in new habitats in the Great Lakes than species from, for example, south-east Asia. The NOAA's Great Lakes Environmental Research Laboratory reports that the most successful invasive species to take hold in the Great Lakes are from eastern Europe – specifically from the Black, Caspian, and Azov Seas. Species from the coastal North Atlantic Ocean are the second most established aquatic invasive species. They have not, however, been as effective at establishing new habitats as eastern European species.

Aquatic invasive species in the Great Lakes come from a variety of sources. In general, any untreated material (water, wood, soil, etc.) can serve as a possible pathway for aquatic invasive species. Among the most prevalent pathways, however, are cargo ships. The vectors can include a vessel's ballast water, anchor chains, and hulls. The recreational boating industry is also of concern because many invaders, such as zebra or quagga mussels, can survive for long periods of time in bilge water or while attached to the exterior of water-craft during transport. For example, California officials recently found quagga mussels in Lake Havasu near the Arizona border. They believe that a recreational boater unknowingly brought the mussels into the lake after returning from a trip to the Great Lakes and failed to adequately clean and dry the boat. Some non-native species – such as salmon – were introduced to the region to suppress other aquatic invasive species. Some of these now serve a central function in supporting recreational and commercial fisheries.

Impact of Aquatic Invasive Species on the Great Lakes

Environmental Impacts: Invasive species can have significant environmental impacts because they can disrupt ecosystems. Because non-natives often have no natural predators they can dominate ecosystems very quickly. Not only can their population skyrocket, they can compete for food

supplies, introduce new pathogens that can decimate native species populations, and consume native species. The environmental impacts of aquatic invasive species in the Great Lakes have included:

- The loss of the native lake trout population due to the sea lamprey;
- Zebra mussels improving water clarity, while at the same time disrupting the food chain of native species;
- The disappearance from Lakes Michigan, Huron, Erie, and Ontario of a small shrimp-like invertebrate called *Diporeia* – part of the native ecosystem food chain. NOAA scientists believe that the zebra mussel may be out-competing *Diporeia* for algae, a food source shared by both species ;
- Native clam and mussel population decreases due to competition from the zebra and quagga mussels;
- Declining health of the lake white fish – a commercially valuable Great Lakes fish. This is likely due to the disappearance of *Diporeia* – the lake whitefish's primary food;
- Declines in the yellow perch population in Lake Michigan. This is likely due to the increased frequency of toxic algal blooms associated with zebra mussels.

Economic Impacts: While estimating the exact economic costs of aquatic invasive species is difficult, the financial burden placed on the nation is very large. A 2000 study by Cornell University in the scientific journal, *BioScience*, placed the damage costs to the entire country at $138 billion annually. A 2001 study attributed national net economic losses due to invasive fish at approximately $1 billion per year.

In the Great Lakes, zebra mussels have cost, according to some sources, an estimated $5 billion over ten years for cleaning infrastructure such as water intake pipes, filtration equipment, and power generating infrastructure. The annual eradication program for sea lampreys costs between $10 million and $15 million. The spread of the purple loosestrife – an invasive aquatic plant common to the Great Lakes – results in costs of $45 million per year due to forage losses and control costs, according to Cornell University researchers.

Costs are incurred across a whole spectrum of economic activities. These include:

- The municipal, power, and industrial sectors: Facilities must clean intake pipes of mussels and other organisms that impede the flow of water. For example, zebra mussel control efforts can place huge costs on municipalities and industry. One source cites average annual costs for large municipalities at approximately $360,000. The U.S. Geological Survey cited average annual control costs for hydro-electric plants at $83,000, fossil fuel plants at $145,000, and nuclear power plants at $825,000;
- The tourism industry: Beaches are closed due to algal blooms, and recreational fish-stocks are reduced due to competition from aquatic invasive species. Boat engines and steering equipment can become jammed and ruined with non-native plants, such as hydrilla or water

hyacinth, and zebra and quagga mussels can clog engine water intakes. In 1993, the congressional Office of Technology Assessment determined that $100 million per year was spent on invasive aquatic weed control;

- Commercial fisheries: Valuable commercial fisheries, such as the lake whitefish, are declining due to habitat and food supply competition, as well as aquatic invasive species (such as the European ruffe and the round goby) eating their eggs. A 1999 study from Cornell places costs to fisheries from invasive species at $1 billion annually. The fishhook waterflea adds to the costs for the fishing community because it clogs fishing nets;

- Home-owners and communities: Homes adjacent to water bodies are valued substantially higher than those located farther away from water. However, waterfront values can decline if the water body is impaired. For example, water bodies that are choked with aquatic invasive plants, or have had their recreational fishing stocks decimated by aquatic invasive pathogens or competing fish may result in the values of adjacent properties declining;

Finally, state and municipal finances are impacted from the decrease in tax revenues from the impact of aquatic invasive species on activities that are state revenue sources, as well as on expenditures to mitigate the effects of aquatic invasive species (clean-up, eradication, population controls, public education, etc.).

Public Health Impacts: Aquatic invasive species in the Great Lakes can also cause public health impacts. This is very important for residents of the region, as the Great Lakes are the only coastal waters of the United States used for drinking water. These public health impacts include harmful algal blooms, deterioration in drinking water quality, and beach closures.

- **Harmful Algal Blooms:** NOAA Great Lakes Environmental Research Laboratory researchers have found a relationship between the presence of zebra mussels and harmful algal blooms in the Great Lakes. Some harmful algal blooms can jeopardize human health, as well as destroy the ecosystems where they are located by depleting the surrounding water of oxygen. Algal blooms develop when certain conditions, such as high nutrient or light conditions, cause the algae to reproduce rapidly. Some algal blooms are harmless, but some, such as *microsystin*, produce toxins that are harmful to humans, fish, and Great Lakes habitats. These harmful algal blooms can produce neurotoxins, liver toxins, cell toxins, and skin irritants. The symptoms produced by ingestions of these toxins by humans can include nausea, vomiting, acute liver failure, muscle cramps, paralysis, skin irritations, rashes, and respiratory failure.

- **Deterioration in Drinking Water Quality:** NOAA Great Lakes Environmental Research Laboratory researchers have found a relationship between the presence of zebra mussels and harmful algal blooms in the Great Lakes. Algal blooms may cause smell and odor problems in water. In addition, researchers have determined that several virulent micro-organisms develop within toxic blue-green algal blooms. These micro-organisms are included on the U.S. Environmental Protection Agency's Candidate Contaminant List of dangerous micro-organisms and chemicals, required under the Safe Drinking Water Act Amendments of 1996.

- **Beach Closures:** After the dramatic increase in the population of the non-native common alewife in the 1960s, billions of dead alewives began to wash up on shore due to starvation. In order to make the beaches safe for humans, bulldozers were needed in some areas to clean the shoreline of the massive quantities of dead fish. The need to clean Great Lakes beaches have declined in recent years, however, because of declining alewife populations.

- In 2004, 13% of the monitored U.S. Great Lakes beaches were closed 10% of the time. This is an increase from 1998, when only 9% of the beaches were closed at least 10% of the time. The reasons for these beaches closures have varied – but include algal blooms and the presence of bacteria such as *E. coli* or *Enterococci*.

- Finally, communities increasingly find themselves expending resources to clean the shells of dead zebra mussels from local beaches.

WITNESSES

PANEL I

U.S. Environmental Protection Agency
Honorable Benjamin H. Grumbles
Assistant Administrator for Water

Little Traverse Bay Bands of Odawa Indians
Honorable Frank Ettawageshik
Tribal Chairman

City of Racine, Wisconsin
Honorable Gary Becker
Mayor
Also testifying on behalf of:
Great Lakes and St. Lawrence Cities Initiative

Michigan Office of the Great Lakes
Mr. Ken DeBeaussaert
Director
Also testifying on behalf of:
Great Lakes Commission

PANEL II

Notre Dame University
Dr. David Lodge
Department of Biological Sciences

Duluth Seaway Port Authority
Mr. Adolph Ojard
Executive Director

National Wildlife Federation
Mr. Andy Buchsbaum
Director, Great Lakes Office
Also testifying on behalf of:
Healing Our Waters - Great Lakes Coalition

New York Power Authority
Mr. John Kahabka
Manager of Environmental Operations

HEARING ON THE IMPACT OF AQUATIC INVASIVE SPECIES ON THE GREAT LAKES

Wednesday, March 7, 2007

HOUSE OF REPRESENTATIVES,
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE,
SUBCOMMITTEE ON WATER RESOURCES AND ENVIRONMENT,
Washington, DC.

The subcommittee met, pursuant to call, at 2:00 p.m., in room 2167, Rayburn House Office Building, the Honorable Eddie Bernice Johnson [chairman of the committee] presiding.

Mr. COSTELLO. [Presiding] The Subcommittee will come to order. I want to welcome all of our witnesses here today, and thank you for being here.

The Chair of this Subcommittee, Eddie Bernice Johnson, is on the Floor managing a bill right now. So as soon as she is finished, I think there were three amendments that they were debating to the bill. As soon as she completes her work on the Floor, I would expect that we will have votes in the next 15 minutes or so. We will come back and she will be in the chair at that time.

So at this time, I would ask unanimous consent that the full statements of both the Chairperson of this Subcommittee, Eddie Bernice Johnson, and my statement be included in the record, and any other opening statements that members would like to submit for the record.

Hearing no objection, so ordered.

I want to welcome our witnesses here today. The first panel is seated, and we will proceed to recognize you in order. We will be under the five minute rule. As we proceed under the five minute rule, we would ask our witnesses to summarize their testimony within five minutes and then we will recognize the other witnesses and there will be time for questions as well.

We are very pleased to have a very distinguished panel of witnesses on our panel here this afternoon. First, we have the Honorable Benjamin H. Grumbles, the Assistant Administrator for Water for the United States EPA. Next we have the Honorable Frank Ettawageshik, the Tribal Chairman of the Little Traverse Bay Band of Odawa Indians. Next we have the Honorable Gary Becker, the Mayor of the City of Racine, Wisconsin. He is also testifying on behalf of the Great Lakes and St. Lawrence Cities Initiative. Finally, we have the Honorable Ken DeBeaussaert, Director of the Office of the Great Lakes for the State of Michigan, and also testifying on behalf of the Great Lakes Commission.

So before we go to our witnesses, I would recognize at this time Dr. Ehlers, sitting in for the Ranking Member of this Subcommittee.

Mr. EHLERS. Thank you very much, Mr. Chairman. It is a pleasure to be here. I have spent a lot of time on invasive species issues, including sponsoring several bills on that. I appreciate your taking this issue up.

Also, I am filling in for the Ranking Member. For those who are not familiar with political nomenclature in the Congress, Ranking Member does not mean the most rank member——

[Laughter.]

Mr. EHLERS.—but rather the highest ranking Republican. So I am filling in for Mr. Baker, who has to be on the Floor for a short period of time. He has a statement that he has presented and rather than read it, Mr. Chairman, I will just move that his statement be entered into the record.

Mr. COSTELLO. Without objection.

Mr. EHLERS. Thank you very much. I reaffirm my pleasure at being here. As the sponsor of several bills, the sooner we can act on this, the better.

I might also express my pleasure at the panel selected. I know all of them personally, I have worked with all of them on this issue, and I am sure we are going to hear words of great wisdom from all of them.

With that, I will yield back.

Mr. COSTELLO. Thank you, Dr. Ehlers.

I understand that, Mr. Grumbles, you have to leave at 3:00 o'clock, is that correct? What we will do then is we will ask you to present your testimony first. After you conclude, I will ask Subcommittee members if they have questions for you. So before we go to the other witnesses, we will let you give your testimony, and then we will have an opportunity to ask questions at that time.

So if you will proceed, and again, thank you for being here.

TESTIMONY OF THE HONORABLE BENJAMIN H. GRUMBLES, ASSISTANT ADMINISTRATOR FOR WATER, UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Mr. GRUMBLES. Thank you, Mr. Chairman, and Congressman Ehlers, in particular, I want to thank you for your leadership over the years on the Great Lakes. And Congressman Salazar, thank you as well for your leadership on this important Subcommittee and for convening this hearing on one of the most pressing and important environmental, ecological and economic threats to the Great Lakes, and to the Country, and that is invasive species. The Great Lakes is a vast but fragile ecosystem, and the focus of this hearing is appropriate, it focuses on one of the greatest threats, invasive species.

On behalf of Administrator Steve Johnson of EPA and also the Great Lakes Interagency Task Force, I am delighted to present testimony describing important actions that are underway and additional actions that are needed to respond to this great challenge.

The first thing I would say, Mr. Chairman, is that the President's Executive Order in May of 2004 did several things, one of which was to establish an interagency task force. Another was to

support the important work of a regional collaboration. This regional collaboration was an impressive fusion of ecology and democracy to bring together groups, government, non-governmental groups from all levels to work on the challenges to the Great Lakes. One of the highest and most important priorities has been to make further progress in reducing the spread and preventing the introduction of invasive species. Seven of the 48 near-term actions that the Administration agreed to in the context of the follow-up to the executive order and the regional collaboration specifically focus on invasive species.

As you know, and all of the folks in this room know, who are here to celebrate and also recommit to the importance of the Great Lakes know, that invasive species are one of the greatest challenges. There are approximately 180 aquatic invasive species that have been introduced over the years into the Great Lakes, an average of one every eight months, a new invasive species is introduced. We all know that this is an environmental and an ecological threat, and a very significant one at that. Some of the estimates are that the costs for the treatment and control of zebra mussel impacts on industrial and municipal facilities are estimated at $100 million to $200 million annually, just in the Great Lakes. And of course, there is the ecological damage beyond the economic damage, the ecological damage and disruption of the food chain, as well as the potential spread of different type of viruses and diseases that can affect birds and fish and people.

Another one of the menacing species knocking at the door of the Great Lakes is the Asian carp. The Asian carp can grow rapidly to over 100 pounds. They can breed so fast that Australians have named them river rabbits. They could have a devastating impact on the Great Lakes by out-competing native fish for plankton. That is why we feel it is so important to continue to make progress on a sustainable approach of physical barriers, such as the Asian carp, or the electrical barriers preventing the introduction of carp to Lake Michigan, as well as many other steps.

Mr. Chairman, I want to focus on some of the important actions to date. The testimony goes into great detail. EPA is strongly supported by agencies such as the U.S. Fish and Wildlife Service, various councils and task forces and resource groups. The basic point is, we all recognize, working with our State and local and non-governmental partners, we need to do more, we need to do much more in terms of the invasive species threat. Some of the specific things that I would like to comment on are the agreement that EPA has with the Coast Guard. We are a cooperating agency in an extremely important effort that the Coats Guard has underway, and that is to propose ballast water treatment standards. We think it is extremely important for Congress to act on this issue of invasive species in the Great Lakes and beyond. We think that there are many important tools to use, such as NAISA and reauthorizing and strengthening that statute. We think it is important to move beyond just exchange to treatment. That is why we support strengthening of the overall standards and framework for regulating ballast water.

And Mr. Chairman, I would be delighted to answer questions at the appropriate time. Thanks very much for the opportunity to testify.

Mr. COSTELLO. Thank you, Mr. Grumbles.

Let me recognize at this time Dr. Ehlers.

Mr. EHLERS. Thank you, Mr. Chairman.

First of all, Mr. Grumbles, you commented several times about the ecological and economic threat we face. I think it is more than a threat, it is an ecological and environmental disaster. The costs that we are incurring with this is just outrageous, just in Michigan alone, when you look at the figures for dealing with the zebra mussel and some of the other species coming in.

And I am just getting awfully frustrated with the slow pace at which we are addressing this. It is typical Government action. I know I am part of the Government. But there is always this dispute about who is supposed to do what. Take for example, the electronic barrier to keep the Asian carp out of the Great Lakes. I have been beating people up on that for years. But they says, well, the Corps of Engineers has to do it. The Corps says, well, we don't have the money to do it. Then it comes to the problem of maintenance, who is going to maintain it afterwards. The Corps doesn't have maintenance money. The local communities aren't sure they have enough money. And it is just going on and on. If that Asian carp ever gets through there into the Great Lakes, we are talking at least a $6 billion a year cost, all because we don't have the money to put a few million dollars into electronic barriers.

A specific question on the ballast water standards, I appreciate that the Coast Guard is finally getting into action on that. They were given responsibility by the Congress in the early 1990's to address this and never have. So now they are setting ballast water standards. I appreciate that they are setting ballast water standards. But again the point is, where is the research that says what the standard should be? Where is the research that is trying to define the basic standards or the basic processes that should be used in determining the standards? Is it going to be ballast water exchange? If that doesn't do it, what about the sediments? How do you deal with that? I haven't seen any answers on that yet. At the same time, I have introduced a bill on that for a number of years, just to do the research. And I fault the Congress as much as I do anyone in the Administration on this. It still is not in law, there is still not good research being done by university level researchers telling us exactly what the pathways are, how things get in here, what we have to do to achieve, to really stop them in every way possible.

So I don't want to vent on you, Ben, because you have been a hero in a lot of this. But it is extremely frustrating that these problems have been there for years now. I have been in the Congress 13 years, and they were here before I started. And we are still spinning our wheels on something as simple as ballast water standards, preventing the little critters from getting in, or the big critters. I am especially disturbed at the length of time it is taking to get that electronic barrier in. If Asian carp ever gets in, there is going to be recriminations on every newspaper in the Great

Lakes States, condemning the Government in round terms for not having installed that and stopped them.

Enough sermons. But I would appreciate any comments and advice you have to offer.

Mr. GRUMBLES. Congressman, thank you. I think the key is prevention and technology and also awareness of the economic as well as the ecological damage that is occurring. I fully agree with you, it is not just a threat, it is a current problem. But it can get worse if we don't all work together to be more proactive.

In terms of the economics, EPA is working with other agencies on developing and using bioeconomic tools to really get a better number. We think it is important to do that, to help increase awareness, and that will help lead to more action.

In terms of technology, I think it is important to continue to push more and more for more information to pursue more science to develop those technologies. EPA's environmental technology verification program is an important component of that. We have entered into a memorandum of agreement with the Coast Guard. We expect that there will be protocols specifically for environmental technology verification testing being validated. What we are looking at is a final draft of the protocols being validated by Coast Guard and Navy, at Navy's testing facilities, which has been recently enhanced to support ballast water technology testing and verification.

So I fully appreciate the spirit and also the substance of your comments about moving ahead more quickly and accelerating the pace on ballast water, not just addressing exchange issues, but also getting at treatment and identifying real and practical and effective technologies to treat the spread of invasives and to stop it.

Mr. EHLERS. Are you doing the research that guides the Coast Guard?

Mr. GRUMBLES. EPA is doing some of the research. I think it is truly, as the Interagency Invasive Species Task Force and Council would tell you, it is a multi-agency effort. I can tell you that our research office within EPA, which you are very familiar with, is aware of the need for continued work on the technologies and research and the tools for combating invasive species.

Mr. EHLERS. I know they are aware of the need, but are they doing the research, are they identifying pathways?

Mr. GRUMBLES. Yes. My understanding is that there is research being done. We also, in coordination with other organizations and consortia, are carrying out research. There is also an awareness of the need for more research and technology deployment.

Mr. EHLERS. Let me just also add in the tiny bit of time I have left, this is an international problem. I was very disappointed with the last international conference where we tried to strengthen the standard in the international agreements. The other countries showed very little sympathy for our efforts and very little understanding of the problem we face here, probably because they have so many different invasive species in all their harbors, they have given up hope.

But I think if we can't get international agreement on this, we just have to go ahead and do our own thing. We cannot afford to

let more invasive species in. It is an incredible expense for our Country.

With that, Mr. Chairman, I will yield back.

Mr. COSTELLO. Thank you.

At this time I will recognize Mr. Salazar for five minutes for questions of Mr. Grumbles.

Mr. SALAZAR. I do appreciate this.

Mr. Grumbles, I think you have listed six invasive species, which are fish, plants, mollusks, invertebrates, insects, algae and microorganisms. Which one would you say is the biggest threat, not only to the Great Lakes, but to other waterways in this Country?

Mr. GRUMBLES. Congressman, from a policy perspective, from a scientific perspective, I would be very constrained to identify any one single one as the biggest threat. The inattention to the overall need is the biggest threat, because in many ways, invasives are a silent threat, because you don't know, like drought, you don't really know it until you are upon it.

But I think one of the important efforts at the Federal interagency level is linking the terrestrial invasive species group with the aquatic invasive species group, recognizing that there is a strong linkage there. Also just from the aquatic perspective, we are very much aware, our Great Lakes National Program Office at EPA is very much aware of the many different types of threats that the mussels, it is not just the Asian carp or those celebrated invasives. There are others that can pose a greater ecological threat.

And this is a great subject, not just for the Great Lakes, but for the whole Country, whether it is in bays and watersheds in the east or west coast or in the middle section. But particularly in coastal regions, it is one of the greatest challenges, as well as viruses. It doesn't have to be fish or shellfish. There are also viruses that are invasive species.

Mr. SALAZAR. And the reason I asked you this is because yesterday, I had the Army Corps in my office and we were talking about two big invaders that have been introduced in Colorado, within the Colorado River and the Arkansas River. One of them is the salt cedar, or the tamarisk, which not only is big and uses a lot of water along our waterways, but also contaminates the soil, because it actually leaves an area of very salty soil where nothing grows after you remove them.

Now, the Army Corps is in charge of removing some of those species along portions of the Colorado River. You mentioned a little bit ago about the plan the President put forward to coordinate all the agencies together. How effective do you think that is and who is going to be taking the lead in addressing these issues?

Mr. GRUMBLES. Of course, I was referring to the Great Lakes Interagency Task Force. On that, pursuant to President Bush's executive order, EPA chairs that task force with respect to the Great Lakes ecosystem. There are other executive orders that have been issued relating to other challenges, the invasive task force that is not limited to the Great Lakes, Executive Order 13112, the National Invasive Species Council, which I believe Department of Interior is the primary agency on.

But for us, specifically in the Great Lakes, invasive species, there is a need for a strong Federal role. We feel that in addition to EPA, Interior and Agriculture and Coast Guard and Army Corps and Commerce are extremely important agencies, using existing tools they have, which often rely on, it can be chemical, physical barriers, but also taking steps working with our colleagues to ensure a healthy habitat. Because oftentimes when habitats are unhealthy, they are most vulnerable to invasive species.

Mr. SALAZAR. Thank you. Thank you, Mr. Grumbles, thank you, Mr. Chairman. I yield back.

Mr. COSTELLO. Thank you, Mr. Salazar.

The Chair recognizes the Ranking Member of the Subcommittee, Mr. Baker.

Mr. BAKER. Thank you, Mr. Chairman.

I want to try to get a better assessment, Mr. Secretary, of our procedural circumstance. As I understand the district court case, Northwest v. EPA is now on appeal, pending a determination of whether the incidental discharge question can be reinstated or not. Concurrent with that, I understand there are existing MOUs between EPA and Coast Guard relative to establishing a workout plan for deployment of new technologies and other perhaps innovative control mechanisms.

Assuming the best circumstance and outcome, from today looking forward, what kind of time frame is it going to take to get some substantive deployment in place? Will it require perhaps a final legal determination of the pending court matter? Will the MOU be the operative lever from which the Coast Guard takes the next step? Help us understand, if we are just taking a snapshot today, what are we going to look like two years from now?

I read with disturbing interest that the estimate is a new invasive species every eight months. How many more are we going to have before we get an answer?

Mr. GRUMBLES. Thank you, Congressman. Those are really some of the key issues that need to be discussed, in Congress as well as in the agency hearing rooms.

You mentioned the court case. I know folks are very familiar with this. This was the decision in September, 2006, where a district court in California issued an order vacating a longstanding regulatory exclusion from permitting under the Clean Water Act for discharges incidental to the normal operation of a vessel, including ballast water exchanges.

Mr. BAKER. That doesn't include, for example, a bilge pump on a 16 foot ski boat?

Mr. GRUMBLES. I believe so. I think our estimates and those of others, if left undisturbed, that decision could lead to a Clean Water Act permit for 13 million recreational vessels, 81,000 commercial fishing vessels, 53,000 freight and tank barges.

The important point is that because we respectfully disagree with that decision, we are appealing that decision. An even more important point, though, Congressman, is that we recognize that important actions need to occur to continue to combat the spread of invasive species. You mentioned the Coast Guard. From our perspective, a key way to proceed with other agencies is to provide support to the Coast Guard to use their existing authorities for

their ballast water discharge standard regulation that they are going to be working on, but also to provide technical support to you and your colleagues in Congress to move forward with a stronger and reauthorized national invasive species act legislation that addresses this issue of——

Mr. BAKER. You may not be comfortable in addressing this, since it is a question of another agency's authority, but do you believe, from your perspective, the Coast Guard has the regulatory platform from which to make judgments and regulate this problem?

Mr. GRUMBLES. From my perspective, I believe that the framework of the NANPCA 1990 legislation and the 1996 amendments from NAISA, that provides the regulatory framework and the primary lead agency, the Coast Guard. An important addition to that, though, is to clarify from a Congressional standpoint the role of the Clean Water Act in the EPA permitting process. We continue to believe that the Coast Guard has the overall tools, but that it would be beneficial for Congress to strengthen the NAISA and to provided for a uniform standard for treatment.

Mr. BAKER. Since my time is about to expire, let me interrupt one more time. It would be your view, then, that the Coast Guard has the ability and authority to move forward, absent any appellate decision on the EPA litigation, they could in your view take whatever steps they believe to be adequate to begin addressing this problem, notwithstanding the legal status of the EPA at this time?

Mr. GRUMBLES. Well, I think they do have the authorities to continue to move forward under their existing tools. We think it is important for Congress to strengthen their tools, to provide a uniform standard for treatment. An important point is that right now in EPA, there is an order by the judge for us to vacate our exemption before October 1st, 2008, September 30th, 2008.

Mr. BAKER. Which is a whole new set of problems. That complicates our circumstance, but it doesn't address the invasive species issue.

Mr. GRUMBLES. Right.

Mr. BAKER. I thank you.

Ms. JOHNSON. [Presiding] Mr. Kagen.

Mr. KAGEN. Thank you, Madam Chairwoman, and thank you, Mr. Grumbles, for coming here today and educating us. Thank you also to other members of the EPA for bestowing on me a national award for studying the environment and making it more friendly for children and patients I took care of for many years.

Through your testimony you did mention that there is a collaborative research program that has been supported by NOAA, the Coast Guard and the EPA. I am wondering if you could share with us some of the results of the Great Lakes Environmental Research Lab and also the Smithsonian Environmental Research Group. Do you have those results available to share with us, particularly as it relates to the ballast and the introduction of invasive species into the Great Lakes?

Mr. GRUMBLES. I thank you for your excellent question. I don't have the specifics or the details. I would be happy to provide those to you and your colleagues on the Committee. It is important, though, to re-emphasize the need for working together through

both the Smithsonian Institution, all the work that NOAA is doing and other research agencies on this threat.

Mr. KAGEN. Thank you very much. I would appreciate the data, since my background is in science and I like data. It is less political when you have numbers.

[Laughter.]

Mr. KAGEN. I don't mind working with anybody if it means we can help to reduce not just the number but the introduction of additional invasive species.

But since I am also new here and I am beginning to sort of feel my way around, are you willing to take full and complete blame for any other additional invasive species that come into the Great Lakes? And if it isn't you or your organization, who do we look to to address the issue?

Because I think the real question is not to prevent the Asian carp from coming in, they are going to get in, and then what do we do when they get here? Who do we look to to blame?

[Laughter.]

Mr. GRUMBLES. I think agencies at the Federal level, State and local level should be held accountable for decisions and being proactive. I think—it is hard to——

Mr. KAGEN. It is hard to put a rope around the neck of an agency. It is a lot easier to get someone who is front of us at a microphone.

[Laughter.]

Mr. GRUMBLES. I certainly will accept part of the blame, or for the success. I think we appropriately focus on oftentimes the glass that is half empty. We also need to keep in sight that there is progress, there are some important collaborations and actions that are occurring, there is a commitment to do more, on the issue that Congressman Ehlers raised, on the Chicago Sanitary and Ship Canal, working to iron out those issues surrounding the Asian carp barrier.

There are good things, there are actions that are occurring, not just in the Federal agencies. But Congressman, we need to be focused on prevention and being held accountable, and that includes me, to take steps to help, practical, aggressive steps to reduce the likelihood of continued increases of the spread of invasive species.

Mr. KAGEN. The other thing I am impressed with here in Congress is the good will of everyone, because everyone in the room and everywhere beyond has great intentions. It is rather the speed at which these intentions are executed and the programs funded and the research done. I will just remind you of our stewardship that we all share, the stewardship of the Great Lakes, which represents 90 percent of the fresh water in the United States, and 20 percent for the entire planet. So this is a tremendously important role that Congress plays and the EPA as well.

Would you agree with me that the primary reason we have seen such a rapid rise in the number of invasive species throughout the Great Lakes has to do with global trade and the introduction of these species through the shipping process?

Mr. GRUMBLES. I think that is the reality. That is definitely one of the major factors, the maritime trade.

Mr. KAGEN. The zebra mussel that I step in in the Fox River in Appleton, Wisconsin, doesn't come in by air. It was delivered by some boat and the ballast water. So you would agree with me that that is the route of travel and that ought to be then the top priority of your organization and of Congress, is that right?

Mr. GRUMBLES. I think, and as I have talked with the head of the Maritime Administration, and as we have worked, collaborated with the Coast Guard, Maritime Transportation, global transportation, ought to be one of the priority, not the sole, but one of the priority areas of focus.

Mr. KAGEN. I look forward to working with you throughout my career in Congress.

Mr. GRUMBLES. Thank you.

Ms. JOHNSON. Mrs. Miller.

Mrs. MILLER. Thank you, Madam Chairman. I want to commend you for holding this hearing today.

I have been involved in politics for about 30 years, and a principal advocacy of mine throughout all of that has been protecting our magnificent Great Lakes, which as my colleague pointed out, is fully 20 percent, one-fifth of the fresh water supply on the entire planet. In fact, Mr. DeBeaussaert and I have worked together on the blue ribbon commission for Great Lakes projects many more years than we probably want to talk about.

But this issue of invasive species, let me be very blunt. When I came here, I thought, what is the big deal? Why can't we do something in Congress or the agencies about invasive species? It is well documented the kind of havoc that they are wreaking economically on the Great Lakes Basin, as well as the damage that they are doing to such a delicate ecosystem. As a Nation, we have not had the political will to do so. That is the brutal reality.

In regard to the shipping that comes in and brings all these critters along with them, we are only talking about a couple of hundred, maybe several hundred at the most, boats. Because the ones that are inside the basin, never go out, so who cares? Right? They are not bringing any critters in. But the other ones that are coming internationally do, as they are coming into the St. Lawrence Seaway. If the Country of France came over and dumped their nuclear waste in Wyoming, would the EPA think that maybe we should do something about that?

But yet here you have these international vessels coming into the Great Lakes, dumping these critters all over the place, and you can't do anything? Honestly. Why not?

Mr. GRUMBLES. We think we can, and we think that we use our statutory tools and responsibilities and look to the agencies and the statutes that are best, most appropriately suited to be proactive and to deal aggressively with that. I recognize your leadership on this issue. I feel honored to sit on the table with folks who have been so much, particularly Ken, who helped chair the regional collaboration on invasives, the strategy team on that.

Congresswoman, as you know, it involves different authorities and agencies. EPA is committed to working with Coast Guard, working with Congress to help strengthen that underlying statutory framework and approach. We think the Clean Water Act is one of the most successful environmental statutes in the Nation's

history. One of the questions is, how do you use the tools under that statute in the most appropriate way. From our perspective, over the last 30 years, we interpreted the statute with Congressional acquiescence, essentially, that it wasn't viewed that EPA, as opposed to Coast Guard under other authorities, would be requiring Clean Water Act permits under the Federal Clean Water Act for vessels.

Mrs. MILLER. OK, I am going to run out of time here, so if I could interrupt you. That is not the correct answer, although I appreciate your answer.

Could you give me, at a later time here, a briefing on why you think the EPA does not have the proper tools, from a regulatory process, regulating policy to do something about that? And my other question, for the minute and a half I have left here, because we can't get the EPA to do anything or because the Congress is not acting fast enough, Ken DeBeaussaert and others, our Governor, our State legislature, has actually tasked our own piece of legislation in Michigan, so that if you are an ocean freighter and you come in, we make sure that you have done your spit and swish, and that you have done your ballast water discharge, to our own negative economic impact. Because we are a State that is trying to stand up and do the right thing, they are just going to go to Ohio or somewhere else. We are very concerned that we are going to be economically disadvantaged because we are trying to do the right thing.

I have introduced a piece of legislation to make that uniform amongst the Basin, and I hope that happens. But did you have any comments on what Michigan did in that case?

Mr. GRUMBLES. First of all, I want to just say that absolutely, positively, EPA wants to be part of the solution. We are taking steps and we are working with other Federal agencies and coordinating with Coast Guard. We also developed a rapid response protocol. We are one agency, and it requires a team to deal with this. We do truly recognize this as a threat, and we want to use the appropriate tools and work with Congress to strengthen the NAISA statute.

With respect to the efforts of Michigan, I think is important that States have the ability to take additional steps and develop approaches that are within the overall constitution and framework. We think the beauty and attractiveness of the Great Lakes Regional Collaboration that the President has been encouraging over the years is that it brings together the Federal agencies, but also the States and tribes and local governments. Individual States may have approaches, whether it is a NOBOB challenge, which we agree is an extremely important and serious challenge that needs to be confronted with action.

Btu we are committed to working with all of the States and with the other agencies to make progress with respect to ballast water and also on the NOBOB challenge.

Mrs. MILLER. Thank you, Madam Chairman.

Ms. JOHNSON. Thank you very much.

The Chair now recognizes Mr. Oberstar.

Mr. OBERSTAR. Thank you, Madam Chair. I thank our panel of witnesses. I understand that Mr. Grumbles does have another com-

mitment and has to leave earlier. Ms. Johnson and I have both been on the House Floor on a major piece of legislation from our Committee to provide funding to build sewage treatment facilities.

I have read your statement with interest, Mr. Grumbles, and I have one question. Is there a technology that EPA has identified that can be effective in eliminating from ballast water non-indigenous species of the kind that we are concerned about here, these invasive species? There may be other ways in which they enter, as attached to the exterior hulls in the salties that enter the Great Lakes. But I am considering just the Great Lakes at the moment. But there is ballast water discharge on the west coast and the east coast, and the Gulf coast. In fact, all of those coastal port authorities are concerned about it coming from the East China Sea, from the eastern, or we would call it the western Pacific Rim.

We have had studies for year about invasive species. We know what they do. What we need to do is get them out of the water column and eradicate them before they get into the water column. Is there something in EPA, a technology, a treatment, that EPA said, this will do it?

Mr. GRUMBLES. First of all, Congressman, Mr. Chairman, I would say I want to get back to you for the record with much more specifics. In terms of the answer, I think we believe there is not a silver bullet technology. There are promising technologies. There are technologies that are more effective and implementable than others.

I would also say that EPA is one agency with others, such as NOAA and USDA, that are very much involved with the Coast Guard on developing the standards and providing support to the Coast Guard as they develop a ballast water treatment standard, which will rely on performance based approach.

Mr. Chairman, I would say that I look forward to providing you with more detail, and before doing that, coordinating with the other agencies on what are the most promising technologies to get the invasives out of the water column.

Mr. OBERSTAR. I appreciate that very much. I think Mrs. Miller, with whom I have had extensive discussion on the subject matter, would appreciate it, and Mr. Ehlers from Michigan, our resident scientist on the Committee. We are at an end of patience with studies. There is a good deal more that needs to be evaluated, studied, researched and so on, but there are things that we need to do now to prevent the next lamprey eel, spiny echinoderm, zebra mussel, round eyed goby, European milfoil, all those that have entered in ballast water into the Great Lakes and destroyed the water column and the native species.

We may never be able to get the zebra mussel out. We don't want to import the diving duck from the Black Sea that is its natural enemy, because then who knows how quickly that creature will proliferate, with no natural enemies for it? We need both control mechanisms for those that are already in the water column in the Great Lakes, in the saltwater parts and a means of preventing it from getting in, species from getting into our water column, treating the ballast water for starters.

So I would welcome your follow-up and any indication other agencies are actively working with EPA in this process.

Mr. GRUMBLES. Yes, sir.

Mr. OBERSTAR. I yield back the balance of my time.

Ms. JOHNSON. Thank you, Mr. Chairman.

Any other questions for Mr. Grumbles?

Hearing none, thank you very much.

Mr. GRUMBLES. Thank you very much.

Ms. JOHNSON. We will see you next time.

I would like to welcome now Chairman—Ettawageshik?

Mr. ETTAWAGESHIK. Ettawageshik.

Ms. JOHNSON. I just speak Texas English, that's why I don't do it well.

[Laughter.]

Ms. JOHNSON. From the Traverse Bay Band of Odawa Indians. Thank you for being here.

I also welcome the Honorable Gary Becker, Mayor of the City of Racine, Wisconsin. We look forward to your testimony as well. And Mr. DeBeaussaert.

Mr. OBERSTAR. DeBeaussaert. [Phrase and greeting in French.]

Ms. JOHNSON. Our Chairman is multilingual, and I appreciate it, because I am not.

We will now recognize you, Mr. Chairman.

TESTIMONY OF THE HONORABLE FRANK ETTAWAGESHIK, TRIBAL CHAIRMAN, LITTLE TRAVERSE BAY BANDS OF ODAWA INDIANS; THE HONORABLE GARY BECKER, MAYOR, CITY OF RACINE, WISCONSIN; KEN DEBEAUSSAERT, DIRECTOR, MICHIGAN OFFICE OF THE GREAT LAKES

Mr. ETTAWAGESHIK. Madam Chair and members of the Committee, my name is Frank Ettawageshik, Tribal Chairman for the Waganakising Odawak, otherwise known as the Little Traverse Bay Bands of Odawa Indians in Michigan.

As Chairman, I also serve as the tribal representative to the Chippewa Odawa Resource Authority, otherwise known as CORA. That is a coalition of five Michigan tribes that oversees the management and regulation of treaty-based fishing rights in the upper Great Lakes. CORA also oversees implementation of a consent decree entered in the year 2000, a negotiated settlement of a longstanding Federal court case among the five tribes, State of Michigan and the Federal Government. The consent decree governs the allocation and management of the fishery resources and the 1836 treaty-ceded waters of the upper Great Lakes.

With the approval of the CORA board, I speak on their behalf today with respect to the issue of aquatic invasive species, an issue we consider of great importance for our fishing rights as well as the continued successful implementation of the consent decree.

Our ancestors, who signed the 1836 Treaty of Washington with the United States Government, had the wisdom to ensure that future generations could continue utilizing the fish resources of the Great Lakes for sustenance and income, and many tribal families continue to depend on fishing today. While we were preparing our written testimony, we consulted with the Great Lakes Indian Fish and Wildlife Commission and also the Haudenosaunee Environmental Task Force, with the staff of these organizations. Together

with CORA, we represent many of the tribes throughout the Great Lakes, from one end to the other of the Great Lakes Basin.

As tribal nations, we often speak, and we are being taught to consider the impact of our decision on through to the coming seventh generation. While this teaching causes us to take the long view in our planning, there are times within this long view that we find ourselves needing immediate action in order to protect the needs of those coming generations, in order to meet our sacred duty and working to protect all of creation and the beings with whom we share it. Today is one of those times we call for immediate action.

Commercial fishing is one of the oldest industries in the Great Lakes, if not the Nation. Historically, the Great Lakes supported a vast, vibrant, profitable commercial fishing industry. Sadly, today, commercial fishing on the Great Lakes, particularly tribal fishing, is on the verge of collapse. Under the various environmental and market forces, the direct and indirect impacts of aquatic invasive species stand out as the leading cause for the precipitous decline in treaty-based commercial and subsistence fishing activity.

Our primary concern is the continued, steady and destructive invasion of aquatic invasive species into the Great Lakes, with their primary vector for entry being ballast water discharge from transoceanic shipping. To state it bluntly, the transoceanic shipping industry, through ballast water exchange practices and construction of canals, has severely impaired and threatens to destroy the treaty-based commercial and subsistence fishing industry.

The tribes understand that foreign shipping into the Great Lakes provides economic benefits to the United States. However, we submit to you that any economic benefits derived from Great Lakes foreign shipping, that those benefits pale in comparison to the economic costs resulting from damages caused by aquatic invasive species. We have heard many people talk about that today, both in the questions and various statements.

One of the things that we are concerned about is with these various species that have been there, but the recent discovery of a serious new fish virus in Lakes Ontario, Erie and Huron, which is believed responsible for large fish dieoffs in the spring of 2005, has greatly raised the level of concern. Although it has not yet been determined how viral hemorrhagic septicemia, VHS, found its way into the Great Lakes, ballast water discharge is implicated. This is just another example of the costs associated with this.

Unfortunately, history has proven that once an aquatic invasive species is introduced to the Great Lakes, it can't be stopped. Therefore, prevention is the only viable approach to combating aquatic invasive species. The means by which aquatic invasive species enter the Great Lakes must be stopped, and the ballast water vector should be the first priority. We have heard other people speak to that today.

It is really saddening to realize that most of the costs and environmental damages wrought by AIS could have been prevented. And all costs for those that are being introduced today, all of those costs could have been prevented. So while the solutions may be expensive, we believe that they pale in comparison to the true eco-

nomic costs. So not only is this a Great Lakes issue, but these species that come in and end up working their way throughout other ecosystems throughout the area, we have heard recently some reports of the zebra mussels moving their way into other waterways. We think that this is a very serious concern.

On any given day, any given ballast water discharge from a transoceanic vessel can carry an organism that could inflict as much or even more economic and environmental damage as the sea lamprey or zebra mussels or the pathogen VHS. We believe that immediate action is necessary. We support the actions that are being done, we support the actions of those on the Committee that have been taken, and others. And I would be glad to answer any questions.

Ms. JOHNSON. Thank you very much, Mr. Chairman.

I now recognize the Mayor of Racine, Wisconsin.

Mr. BECKER. Thank you, Madam Chairman. Good afternoon, members of the Subcommittee.

I also serve as vice chair of the Great Lakes St. Lawrence Cities Initiative, a coalition of mayors of some 39 member cities and an additional 50 participating cities. Great Lakes mayors are extremely fortunate to be managing cities and towns located along a resource as incredible as the Great Lakes Basin. At the same time, however, Great Lakes mayors must deal with the problems of the Great Lakes on a daily basis, whether it is making sure that the water intakes are clear from zebra mussels, dealing with beach closings, unreliable water quality standards, operating wastewater treatment plans, or managing stormwater, the people that work for me, like mayors across the Basin, must make sure things are done right. These are very real issues for me and my fellow mayors and the people who live in our cities.

Invasive species are a key issue for Great Lakes mayors, causing extensive biological damage and resulting in billions of dollars of costs across the Country and in the Basin. Over 180 different species have come into the Great Lakes already and they continue to arrive at the rate, as has been mentioned, about one every six or seven months. Some of the most notable, of course, have been the sea lamprey and zebra mussel.

Ballast water in ships is the most common pathway for entry into the system. Additionally, they are very close to entering the Great Lakes, there are several varieties of the Asian carp already in the Chicago Sanitary and Ship Canal, less than 50 miles from the Great Lakes.

Cities have dealt with the zebra mussel problem for many years, with the clogging of drinking water intake structures being the primary concern. In my own City of Racine, we have spent nearly $1.4 million in 1995 for a new chemical feed system, chemical lines and diffusers to address the situation. In addition, it has increased our annual operating costs at the water utility between $30,000 and $40,000 per year, and we are one medium-sized city along the Lakes.

The tragedy of the situation is that much of the invasive species problem could have been prevented. If action is not taken quickly, though, things will get worse, as we all know. Man of the issues we deal with on the Great Lakes are the results of mistakes we

made in the past. And now we are paying the price. Rarely do we have the opportunity to prevent future damage by taking action now. This is one situation where we have that opportunity, and it would be a mistake not to take full advantage of it.

Comprehensive invasive species legislation on a national level is essential if we want to deal with the problem effectively. This legislation does not need to cost taxpayers a large amount of money. In fact, the lack of strong laws is costing taxpayers much more already. The Federal Government needs a strong program to restrict ballast water discharges and control other pathways for invasive species. Costs incurred in controlling the flow of invasive species should be absorbed by the responsible businesses and consumers of the products they produce and transport.

An additional problem with not having comprehensive Federal laws is that States, as Michigan was mentioned, and local governments are finding it necessary to move ahead on their own. Having a program in one of the Great Lakes States and potentially different programs in others will cause problems for States and for the shipping industry.

One other action by Congress needed in the very near term is authorization and appropriation to complete construction and fund the operation of the electronic barrier on the Chicago Sanitary and Ship Canal. Mayors and many others in the Great Lakes region such as Governors, business groups, environmental organizations and members of Congress wish this could have been done several years ago. Each day it is not completed perpetuates the unnecessary risk to the multi-billion sport and commercial fishing industry on the Great Lakes.

Although the focus of today's hearing is on invasive species, it is important to recognize that there are many other serious threats to the Lakes. Discharges of untreated or inadequately treated sewage from combined sanitary sewer overflows are a major problem across the Basin. The infrastructure investments needed are in the billions of dollars, and only with significantly increased investments by Federal, State and local governments will the problems be solved.

Other key issues highlighted in the collaboration strategy, which the Great Lakes perceives as a blueprint for moving forward, were the toxics, habitat and wetlands protection and contaminated sediments. These are the priority issues from the perspective of Great Lakes mayors.

Thank you for holding this hearing and for the opportunity to provide testimony. Hopefully, we will not have our legacy as today's leaders to have future generations look back and ask, why did they not act when they knew it needed to be done? Thank you.

Ms. OBERSTAR. [Presiding] Thank you very much, Mayor Becker. We really appreciate your contribution today.

Mr. DeBeaussaert.

Mr. DEBEAUSSAERT. Thank you, Mr. Chairman, members of the Committee. My name is Ken DeBeaussaert, I am the Director of the Michigan Office of the Great Lakes. I am honored to speak today on behalf of the Great Lakes States and the State of Michigan's Executive leadership, our Governor, Jennifer Granholm, and

Lieutenant Governor, John Cherry, who is currently the chair of the Great Lakes Commission.

First to thank you, Mr. Chairman and members of this Committee, for the leadership that you have already demonstrated this session in advancing some important legislation and that I know you have acted on yet this afternoon. I want also to thank you for holding this important discussion about the impacts of aquatic invasive species on the Great Lakes.

Before I begin my remarks, I would also like the personal privilege of acknowledging the great efforts that our members from the Michigan delegation, Mrs. Miller and Congressman Ehlers, historically, on so many of these issues.

In the Great Lakes region we take seriously our stewardship responsibility, and for good reason. The Great Lakes constitute the largest surface freshwater system in the world. More than 35 million Americans receive the benefits of drinking water, food, a place to live, work and recreate and transportation from these Great Lakes. And our national economy depends on the Great Lakes. Great Lakes States account for 30 percent of the total U.S. gross domestic product, and the Great Lakes are a key national transportation network. Fishing, boating, hunting and wildlife watching generate some $53 billion annually in revenue in the Great Lakes Region, with boating alone supporting over 250,000 jobs.

We are especially appreciative of this Committee calling attention to the problem of invasive species in the Great Lakes, because curbing their introductions is really a priority once again in 2007. Unfortunately, as we have heard, the list of invasive species and the problems associated with them continues to grow. As of 2006 more than 188 species were established in the Great Lakes.

And they are not just impacting the health of our fishery. They are also impcating our economy. The cost of invasive species is estimated as high as $5.7 billion annually, and the cost of just one invader, the zebra mussel, estimated to cost city's power generators and others millions of dollars annually.

The impact of invasive species on the ecological health of the Great Lakes is equally alarming. We know that Lake Erie has developed a 3,900 square mile dead zone in the summer months and we know that in Lakes Michigan and Huron we have seen a dramatic decline in the health of fish stock that is believed to be linked to the change in the food web that you will hear later, in a later panel this afternoon.

Perhaps most alarming, though, is what we don't know. Our understanding of the extent of the damage continues to evolve as more species are introduced, as viruses are identified, like the VHS. And of course, we shudder to think of the potential devastation that the Asian carp could bring to our Great Lakes.

Unfortunately, we believe Federal action to halt introduction of invasive species via ballast water has been too slow. Frustration over that inaction led five Great Lakes States to join a lawsuit to try to force action by the EPA. And in 2005, as has been mentioned, with broad bipartisan and business support in Michigan, we adopted legislation requiring ocean-going vessels that visit Michigan ports to obtain a permit beginning in 2007. We currently have

12 vessels that are in the process or have obtained a permit under that law.

Individual State permitting, though, is far from being a perfect solution to this complex problem. But in Michigan, we are resolute in our determination that we cannot just sit by and watch the Great Lakes teeter on what some scientist describe as the tipping point of ecological meltdown. In fact, in addition to Michigan's law, ballast water legislation was introduced in several Great Lakes States. If Congress does fail to act, I think it is likely that those measures will continue to advance.

But the Great Lakes States continue to believe that the best solution is a Federal ballast water program, one that is uniform and consistent and protective of the Great Lakes. So Chairman Oberstar, we applaud and appreciate your recent statements, expressing your commitment to tackle this challenge in 2007. I recommend that while solutions to these problems are not simple, that you consider that a good deal of the work from our perspective may already have been outlined in the Great Lakes Regional Collaboration Strategy. One action alone, passage of a national aquatic invasive species act, similar to the one introduced by Congressman Ehlers and a similar bill in the Senate last session would be a monumental step forward. I would note that there was broad consensus in that process about the ballast water provisions of that legislation, and worth noting that consensus support included representatives of the region's maritime industry.

And finally, whether through a comprehensive NAISA bill or WRDA bill or through freestanding legislation, we would hope that this Congress would be able to act quickly to authorize and fund the Corps of Engineers' work to complete construction, operate and maintain the electrical barriers designed to prevent the Asian carp from invading the Great Lakes via the Chicago Sanitary and Ship Canal.

Mr. Chairman, the Great Lakes States pledge to you that we will continue to work together to develop solutions for stopping the spread of invasive species and we must work together to protect and restore this ecological treasure that we call the Great Lakes. That will be our legacy for future generations. We thank you again for your interest in this issue today.

Mr. OBERSTAR. Thank you very much for your testimony. Thanks to all three members. Chairman Ettawageshik, megwich.

Mr. Baker, do you have any questions?

Mr. BAKER. Thank you, Mr. Chairman.

Mr. Mayor, the Secretary earlier testified that he felt that in the current scheme of operations, notwithstanding pending litigation in California on ballast water discharge, absent any other action by the EPA, he viewed that the Coast Guard had the appropriate regulatory foundation from which they could properly act. Do you share that view, or do you see other obstacles to some sort of regulatory regime being put into effect that would minimize these problems?

Mr. BECKER. I am far from the expert on it, but I agree with Mr. Grumbles that the authority in law is there. I think one of the other things he did touch on is, does the Coast Guard have the capacity, do they have the resource, the number of ships, the number

of men to go ahead and enforce. I don't think on the Great Lakes the answer to that is yes. They are stretched from a number of different missions. But also as Mr. Grumbles said, probably some clarifying language, passage of law by Congress to reinforce and strengthen their authority would be helpful.

Mr. BAKER. Let me further clarify, the Coast Guard is involved in a process, as I understand it, designated as a NEPA process, to come to some conclusion about the most effective way to proceed. That has now been ongoing over a period of some number of years. If they have the authority to act, they are the party which seems to be agreed upon as the responsible entity to make some substantive progress, what do we need to do to draw this regulatory public comment period to some sort of conclusion and get a public policy produced? I can certainly understand the Chairman's frustration and members who enjoy the Lakes. I am on the other end of the tube down here. We have similar problems with other issues. But even in Katrina terms, this has been going on a long time.

Mr. BECKER. A lot of these issues have. I guess possibly through Congress, through Congressional legislation, set a date certain where this must be done. I don't know what other answer to get some of these agencies to move. I am not here to criticize the Coast Guard or EPA. But I have certainly found running a city that if there are not date certains that you give the bureaucracy to get things done, they have a tendency to not get done.

Mr. BAKER. Well, in your public policy position, then you believe there has been adequate vetting, public comment and review of the matter to adequately reach a conclusion?

Mr. BECKER. Personally, yes, and I would argue that on most issues. There has probably been enough discussion and I think on invasives or anything else, I think we have the science, we know what needs to be done. It is a matter of getting it done, whether through legislation or getting the bureaucracy to implement.

Mr. BAKER. Well, sometimes controversy breeds caution. I was advised by a senior statesman back home one time about pursuing a highway project too vigorously. He told me that surveys are a lot better for you than the construction. He said, if they think you are going to act, that is a good thing. Once you start acting, you are in real trouble. So maybe that is where we are.

[Laughter.]

Mr. BAKER. I yield back.

Mr. OBERSTAR. Mr. Hall?

Mr. HALL. Thank you, Mr. Chairman, and thank you all for your testimony. I am sorry I was late, I was double booked at a Veterans Administration hearing, and I am trying to cover everything.

I am curious, representing a district that spans the Hudson River, whether any of the panelists would be able to comment, I believe we have our fair share of invasive mussels and other aquatic species. In what ways are the strategies in use or that are being contemplated for the Great Lakes applicable to an estuary like the Hudson? What special challenges do you know of that a water body like the Hudson River present in addressing invasive species?

Mr. DEBEAUSSAERT. Well, we have found that a number of the invasive species that have spread throughout the United States have found their place first in the Great Lakes. The zebra mussel

is one, for example, that was first identified in Lake St. Clair in the mid–1980's and now has spread not only throughout the Great Lakes, but we have seen their advancement to Lake Mead recently.

So I think that the notion of preventing the introduction of invasives into our Great Lakes will have an implication for other bodies of water, and part of the recommendations of NAISA goes beyond just the simple matter of preventing the introductions, but also preventing the spread of current invasive species that are in our waters today. There is a whole series of recommendations that would be helpful there.

As it relates to the electrical carp barrier, as an example, that was first designed, as I understand it, to prevent some of the exotic species in the Great Lakes from getting into the Mississippi, the round goby in particular. Unfortunately, that did not occur before that round goby passed through. Now we are seeing it as a line of defense to protect the Great Lakes from the Asian carp.

So I think there are ways that these measures that are enacted do provide benefit beyond the Great Lakes States.

Mr. HALL. Are there any, and this is to any of you distinguished gentlemen, are there any invasive species hot spots in the Great Lakes? Do the species cluster in some areas more than others, or do harbors seem to be more susceptible than the rest of the lake?

Mr. ETTAWAGESHIK. I believe that because we are in a—it is large, but it is a contained system. It really is, we may find areas where we first find an invasive species. But the problem is that it eventually gets everywhere. So while we actually are working on a rapid response to the finding of aquatic invasive species and we have a plan through the Great Lakes Regional Collaboration and the implementation to devise methods for rapid response when we find something that has recently been discovered, the problem is that by the time we find it, the next problem is already in the lake and we don't know what it is yet, it is already there. It is going to cost us millions of dollars to deal with. But we don't know what it is yet, because we haven't found it yet.

That is the problem we have right now. The VHS is one that has been coming in, the viral hemorrhagic septicemia. This is something that is going to have a major effect. The people that I am here representing are fishermen. We are commercial fisherman as well as subsistence fishing. This is going to have a major impact, and we don't know for sure what that impact is yet, because we just know that it has spread.

Are there hot spots? The first time you identify a spot, I suppose that is a hot spot. We try to deal with it. But usually by the time we have found it, it is other places as well.

Mr. HALL. Thank you, Chairman. I just want to ask one more question. I guess this is sort of a ship management, hydromechanical question. Is water ballast necessary while navigating the Great Lakes, or is it necessary while out on the ocean, and something that could reasonably be expelled before entering the St. Lawrence? Maybe this question was answered before I got here, so excuse me if it is redundant. But I am just trying to understand, is there resistance from the shipping industry to clearing their tanks before they enter the system, or if so, why?

Mr. BECKER. No, they do expel the ballast before they enter into the system, generally. The problem is the amount of sludge in the bottom of the ship, you can't expel it all. So when they even, they come into the Basin and they reload the ballast water, then when they drop their freight, their load somewhere, and then they dump the ballast water, it's——

Mr. HALL. Rinsing it out.

Mr. BECKER. Good analogy, yes. So even though they have expelled the ballast water before they entered the basin, they pick up more in the sludge in the bottom of the ship. There are a lot of organisms down there, too.

Mr. HALL. Thank you. Thank you, Mr. Chairman

Mr. OBERSTAR. Mr. Ehlers.

Mr. EHLERS. Thank you, Mr. Chairman.

Mr. DeBeaussaert, I am not familiar with the status of the Michigan law at the moment. I would be interested if you could explain that. But also, I would like to raise a State's rights issue, not just with Michigan, but you would know what Michigan's attitude would be, and perhaps you can also enlighten me on what the other States would be. If we passed a Federal law on invasive species, whether it is ballast water or anything else, would the States, do you think the States would be happy with their own laws being preempted by the Federal Government? Or would they gladly accept our efforts?

Mr. DEBEAUSSAERT. I thank you for the opportunity to expand just a bit on the State law first. The law was passed in 2005 and it required by 2007 that the ocean-going ships obtain a permit. A process was developed over a period of time to develop a general permit opportunity to try to streamline that process. The Department of Environmental Quality identified four specific treatment technologies that they approved under our State law and also allowed the opportunity for individual ships to seek an individual permit if they wanted to use an alternative technology.

There is also, in Michigan's situation, the vast majority of ships would not be discharging ballast water in our ports, and they would be under permit and would be reporting, but would not be required to have that technology in place, so long as they weren't discharging. And as I said, as of a couple days ago when I left Michigan, I think we had 12 individual ships that either had obtained the general permit or were in the process of doing so. And we certainly hope and encourage others to follow that suit.

As to the second part of your question, about the reaction of States to preemption, I can tell you that last year, there was a bill that was introduced in the U.S. Senate, I think it was 363, and the Great Lakes Governors united in opposition to that letter. One of the reasons for their concern was the preemption of the ability of the States to act. There were concerns about many other provisions of that law as well.

Similarly, I think the attorneys general for many of the Great Lakes States signed a letter to the Congress, to the Senate in particular, outlining their concerns. One of the concerns was that preemption. So I think there is a reluctance to, at the outset, to say that the States would be willing to accept that preemption. It is something that has been identified both by the Governors and the

attorneys general as a major concern. I guess part of the major question would be what the whole overall package was, what the program was. Clearly, the bill that was introduced last year did not meet that test.

Mr. EHLERS. Was it because they didn't feel the law was strong enough? And if we did write a strong law that was stronger than all the State laws, do you think the States would still be concerned?

Mr. DEBEAUSSAERT. I think there will always be concern about the ability of the States to not be able to act under their authorities. But clearly in that case, there were specific concerns about the provisions of that bill that the States did not feel were adequate. I am not in a position to speak for all of the Governors in terms of how they might react to other legislation that might be introduced. But I know it would be a concern at the outset.

Mr. EHLERS. How many States have passed ballast water laws now?

Mr. DEBEAUSSAERT. In the Great Lakes States, Michigan is the only one that has passed the legislation. It was introduced in several States in the last session and did not meet the final signature into law. I know it has already been introduced in at least one State and I expect again, depending on the outcome of the activities here, that other States will consider moving forward as well.

Mr. EHLERS. What have you learned from the shipping companies so far? Do they seem perfectly willing to get the permits and work with the State, or are they simply going to bypass Michigan and go elsewhere?

Mr. DEBEAUSSAERT. Well, as I said, we already have 12 individual ships that are either under permit or in the process of doing so. We have had concerns raised about this process from others. In fact, some that had expressed concern about the practical ability within the current year to implement the technology. And there were discussions and provisions that were made to allow for, in the current year, some ability for those activities to continue under a consent order that would require rather than the full technology, the reporting requirements, some sampling that would occur as we move forward.

So there have been and there are ongoing discussions, I would say, with the industry on this issue.

Mr. EHLERS. What confidence do you have that the problem is really the ballast water, I should say solely the ballast water, as opposed to creatures attaching themselves to the hulls of the ship during the ocean voyage, then coming in?

Mr. DEBEAUSSAERT. Well, as you know, there are a number of vectors for introduction, and ballast water is identified as the primary for many of these issues. But clearly, the comprehensive approach of NAISA that attempted to address a number of the vectors really is what is needed. But as well, we wouldn't want to stand in the way of individual ballast water legislation, if in fact it was protective of the Lakes.

Mr. EHLERS. Thank you very much. Thank you, Mr. Chairman.

Mr. OBERSTAR. I thank the gentleman for his questions.

Mr. Kagen.

Mr. KAGEN. Thank you, Mr. Chairman, and thank you, all of you, for taking time to be here today, but more importantly, thank you for your advocacy and your hard work for trying to guarantee clean and healthy water for successive generations.

In listening to your testimony, Mr. Becker, about dates and time tables, I can tell you from being here for a few weeks, it is hard to agree to a time table for anything. But we are still working hard to get the job done.

With regard to the problem of ballast water and ships, it reminds me of the history in medicine, forgive me, as I am a doctor, I think that way, I look at invasive species much like it is an infectious disease. If my good friend, my colleague John Hall from New York had dirty hands, I would want him to wash his hands before he goes from one sick patient to the next. So in some respects, cleaning up the ballast water is a lot like washing your hands. In the very beginning of washing one's hands, as a physician, going from room to room or patient to patient, we didn't have really good techniques. So we developed better techniques. So it may not be the shipping industry's fault entirely for not knowing how to "wash their hands," but I would think that if that is the concern, whether the species are inside the tank or outside on the shell, so to speak, of the ship, we ought to as Government officials help them to develop a better technique so we can prevent further infections from these invasive species.

It is really a shame, I think, that you should have to sue your Government for them to do their job. I hope that era has ended with the last election.

Chairman Frank, I would ask you, would you agree with me that it might be really time to put our minds together to look not just at the invasive species issue, but isn't the invasive species in our Great Lakes, the occurrence of them, a symptom of a greater problem that we have failed to really secure and protect not just our surface water but our ground water? And wouldn't you think it might be time that we could all come together and move our standards up sufficiently to protect not just the surface water but our ground water?

Mr. ETTAWAGESHIK. The tribes have worked with each other and also with the Canadian first nations, the tribes in the Great Lakes Basin. We have a total of around 160 of the 185 tribes and first nations in the Great Lakes Basin that have signed an accord, the Tribal and First Nations Great Lakes Water Accord, that works on the very issues that you are talking about, that pledges to work together for the protection of both the quantity and quality of the water and work hard to assert our rights as both in jurisdiction and also our responsibilities to the protection of those waters.

We look at the water as a whole, not just the lake but the rivers, the streams, the ground water, all of this together as a package within the basin. And efforts that will work to protect that, we believe, are essential. So we have been working for many years to do this as part of our traditional teachings and it is something that we try to work on within ourselves. But also realizing that our best tools as tribal governments to get things done are to encourage those other governments around us to act on these issues as well.

So yes, I do think it is time to consider this as a package.

Mr. KAGEN. Well, success requires no excuses. So as I see some people with excuses, we have failed, everyone has failed somewhere along the way, as we have over 150 invasive species now.

I look forward to working with your tribe and other organizations to help guarantee our clean water. And I yield back the balance of my time.

Mr. OBERSTAR. Ms. Norton.

Ms. NORTON. Thank you very much, Mr. Chairman. I very much regret not being here earlier. This is a subject of considerable interest to me. I recognize that Mr. Grumbles of the EPA has left, so one question that I have may put the three of you at some disadvantage. Yet you may know about what has happened to other waterways. Those of us in this region of course also have one of the great wonders of the world, one of the great waterways, the Chesapeake Bay. We have focused, it seems to me, quite justifiably, on the Great Lakes.

How national a problem do you think we have here? When you consider how far in, well, it is according to how you look at it, the Great Lakes are, and that there are waterways that are closer to the oceans, one wonders how national, how much worse this problem may be or how much it is a matter of certain waterways?

Mr. ETTAWAGESHIK. I guess I will start. We look at the water throughout, all the water is connected. So all of our waterways, while I am here specifically talking about Great Lakes, when we try to figure out what is a sacred spot or how do we deal with that, for our way of thinking, the whole earth, all of creation is sacred and all of creation is interconnected. We are within one very large ecosystem with the planet. And how things affect the Great Lakes also affect everyone else.

As we heard earlier, when we were talking about where an invasive species may first show up and how it may spread, this issue is not contained just within one particular region of the Country. This has implications that are nationwide.

Ms. NORTON. I am regarding your testimony as a case in point, that is what is so troubling about this. I take it that that is your testimony, that while you know the Great Lakes best you believe this is a national phenomenon, equally found in other parts of the Country?

Mr. ETTAWAGESHIK. Yes.

Mr. DEBEAUSSAERT. If I could just add to that, we are obviously concerned about this unique freshwater ecosystem that we are blessed with living in and near. But the fact is that other States have, beyond Michigan, outside the Great Lakes, have enacted legislation dealing with ballast water issues, notably California, some of the other west coast States have also taken action to try to address this issue.

So we are here from the Great Lakes States, but we do believe that it is also an issue of national significance.

Ms. NORTON. I think it is today, Mr. Chairman, that we have on the Floor the Clean Water Act. If I could, within your expertise, bring up another issue that perhaps also you have seen in the Great Lakes. My family has lived in this region since the 1850's. Recently, in recent years, we have found in the Chesapeake Bay a phenomenon clearly, we believe, of the pollution of the water, of es-

sentially freakish species. You talked about invasive species, species that have no predator.

I wonder if in the Great Lakes you have seen, for example, fish with teeth or male/female changes in fish, something that also appears to be a new phenomenon, or at least our ancestors did not report such widely spread fish—I don't know quite what to call them, but species in our waterways. Have you seen such changes in your waterways and what would you have to tell us about them, if so?

Mr. ETTAWAGESHIK. One of the things that, the women from the tribes are the people that are keepers of the water. They spend considerable time teaching us and talking to us about these things. And they talk about mother earth weeping and crying. They talk about these things and the symptoms that we get from that. Those symptoms that they talk to us about are those very things that you are referring to, where things are not the way they were meant to be, and we have fish that have tumors, we have fish that are basically being both male and female at the same time. We have all different sorts of issues like that that occur. And these do occur primarily in hot spots of pollution and other issues. But these are the symptoms of nature responding to all of the abuse that we have given to her.

So these are things that we are taught that we need to try to fix, and we need to try to find ways to deal with them. That is our sacred duty and it is the duty of our governments to try to make that, help bring about those changes that will fix those problems.

Ms. NORTON. Do you foresee a situation—there are some rivers and streams that are known for certain kinds of fish, for example, unlike the Chesapeake Bay, where you may have this huge variety. Do you foresee any possibility in the near future where you could have a catastrophic elimination of fish in such rivers and stream where, as we know, there are no natural predators, and the predator embeds itself? And we are talking about, This is a trout stream or some particular fish that is particularly known for this particularly waterway?

Mr. ETTAWAGESHIK. We do have those cases. We have cases where there are places where we used to catch certain species and we no longer can. We have one example within, not just a stream, but within the Great Lakes, the lake trout virtually collapsed because of the introduction of the lamprey eel. The predation of this lamprey has, without controls that have since been brought into place, we would have no lake trout fishery at all.

As it is, we have done, there has been a significant amount of money, in fact, some of the things that we are asking for through the various pieces of legislation that we have been talking about today is money to help fund that lamprey control project, and to adequately fund it. Because as with everything, it has been cut back for a variety of different reasons. We are not able to control just that one species, that one invasive species that has had serious impact on our fishery.

But we have other varieties where there are different species that are in danger. That is of great concern to us.

Ms. NORTON. Does anyone ever introduce natural predators to get the predators out? What would you do if the predators have

embedded themselves, especially if it is a stream or river known for one or two kinds of fish? And you didn't catch them in time, what could we do? I guess this is my version of the ice caps melting, I don't think you can do anything about those.

But can you do anything about a situation where a predator has, as will surely be the case at some place, because some of these will be smaller streams, some of these will be streams or rivers where people don't have the funds or haven't recognized what has happened? Is there anything you can do about it?

Mr. DEBEAUSSAERT. Part of the comprehensive legislation, NAISA did include a rapid response component to try to find ways of addressing issues. Obviously the key is prevention, preventing these new species from being introduced. But if in fact we did see an introduction, some ways of addressing quickly and trying to stop the spread of those species. The one thing, to get to the earlier question and comment about the impact of a single species taking over, that is the concern that we have about the Asian carp. We need to have that electrical barrier in place, because if those carp did enter the Great Lakes, that is our fear, that they would overwhelm the native fishery.

We are also concerned about this new virus that has been mentioned, the VHS. We have seen significant mortality of fish populations where that virus has been found.

Ms. NORTON. Thank you very much, Mr. Chairman.

Mr. OBERSTAR. I thank the gentlelady for those very thoughtful questions, as always. What we are discussing today is just one part of a long chain of assaults upon the waters of the Great Lakes. When DDT was found to be destructive in the food chain, weakening the shells of eagle eggs, so that the young eagles did not form properly, and in the aftermath of Rachel Carson's book, Silent Spring, we went after DDT in the United States, and eventually phased it out.

But eagles were still dying and declining in the Great Lakes. In 1985, 1986, 1987 and 1988, I held hearings as chair of the Investigations and Oversight Subcommittee on water quality agreement between the United States and Canada. What we learned then was that it was DDT still adversely affecting the eggs, where was it coming from? We banned it in America.

But we allowed it to be exported to Central America, where it was used to control insects in the banana plantations. And the aerosols were caught up in the upper atmosphere from the movement from the Gulf up through the Mississippi flyway and deposited within 10 days of spraying on the Great Lakes. So we had to extend the reach of the Federal Government to companies that were exporting DDT into Central America. And then we had a witness, Dr. Henry Lickers, who was a Ph.D microbiologist, a member of the Akwesasne Tribe at the eastern end of the Great Lakes, also known as the Mohawks. And he testified before the Committee that for 2,000 years, his people had lived there and lived on fish. And they were extraordinarily healthy.

But all of a sudden, they were experiencing tremors in their joints, they were experiencing three times the national average of miscarriages, spontaneous loss of fetus and rare types of cancers. It was traced to the mercury in the fish and PCBs and toxaphene

that was being taken up by the fish that the people were eating. So the Akwesasne people had to change their eating habits.

And what did they do, I asked? Well, Dr. Lickers said, they switched to meat. And what were the health consequences of that? Now we have above average arteriosclerosis, heart attack, stroke and high cholesterol and diabetes, as we switched to other foods for the energy we once got from the fish.

So here we have this extraordinary chain of life in the Great Lakes. They are a total ecosystem. We have to be concerned about intra-Basin transfers, waters of Lake Superior that may be carrying species that is deposited in Huron or Erie, Ontario or Michigan. So you have made a great contribution to our fund of knowledge on the subject, and we continue this effort to protect this precious one-fifth of all the fresh water on the face of the earth.

Thank you for your contribution.

I will call the next panel, but Ms. Johnson and I both have to go to the House Floor to complete consideration of the Clean Water legislation that has been pending and suspended while leadership and others went to the White House on some other subject matter of far less importance.

[Laughter.]

Mr. OBERSTAR. We have panel two, Dr. David Lodge, from Notre Dame University, my son's school; Adolph Ojard, of the Duluth Seaway Port Authority; Andy Buchsbaum, from the National Wildlife Federation; John Kahabka of the New York Power Authority. I will ask Mr. Kagen of Wisconsin to assume the Chair.

Thank you very much, all the members of the panel. We are grateful for your contribution today. I read your statements late last night. I wish I could stay for the testimony, but I have to be over on the House Floor to complete consideration of the bill. I know that you will hear penetrating questions from Mr. Baker and from Dr. Ehlers.

Dr. Lodge, please begin.

TESTIMONY OF DAVID M. LODGE, PROFESSOR, DEPARTMENT OF BIOLOGICAL SCIENCES, UNIVERSITY OF NOTRE DAME; ADOLPH N. OJARD, PRESIDENT, AMERICAN GREAT LAKES PORTS ASSOCIATION, EXECUTIVE DIRECTOR, DULUTH SEAWAY PORT AUTHORITY; ANDY BUCHSBAUM, DIRECTOR, NATIONAL WILDLIFE FEDERATION'S GREAT LAKES OFFICE AND CO-CHAIR, HEALING OUR WATERS GREAT LAKES COALITION; JOHN M. KAHABKA, MANAGER OF ENVIRONMENTAL OPERATIONS, NEW YORK POWER AUTHORITY

Mr. LODGE. Thank you very much, Mr. Chairman and other members of the Committee. I thank you for the opportunity to participate in this hearing today. As you may know, I come to this issue from the perspective of having worked as a biological researcher for on the order of 24 years or so on this issue of invasive species, specializing in aquatic invasives in particular.

If I could have my Power Point up, I would appreciate it. Together with a number of colleagues, both at Notre Dame and other universities, I have collaborations going on addressing a number of issues of invasive species, including those involving ships and many other related issues.

I am a past chairman of the National Invasive Species Advisory Committee and also recently chaired a committee for the Ecological Society of America that published a set of recommendations for U.S. policy on invasives. That paper includes some consideration of ballast water.

I am a biologist, and the discussions we have had so far have been extremely helpful. But to my mind, it is helpful to get below sometimes the abstractions and think about real organisms. At least that is what biologists like to do.

So I want to tell you a story, if you will, involving three species. And I want to start with one, a reasonably small fish, the round goby, but a fish that has some large impacts. What I am illustrating here is the goby can be caught in the thousands, on the southern shore of Lake Michigan and unfortunately many other places in the Great Lakes, as illustrated by this map from the USGS, where you see in red that this goby, having been introduced by ballast water, has spread throughout the Great Lakes, and very importantly, not only within the Great Lakes, but as you will see, is traveling down the Illinois River, having had access to it through the Chicago Sanitary and Ship Canal, and is well on its way to colonizing not only the Illinois River but the Mississippi River and probably far beyond.

So one message I want to leave you with is that what happens in the Great Lakes does not stay there. The opposite may be true of various activities in Las Vegas, but it is not true of the Great Lakes. Unfortunately, the organisms that arrive in the Great Lakes will come to your Congressional districts before too long, whether they are in Oregon or California or Arizona or New York or wherever. The Great Lakes are a beachhead for invasions for freshwater ecosystems in North America. So wherever one is in North America, one has to care about what is going on in the Great Lakes.

Now, I have had the experience in southern Lake Michigan of fishing and catching nothing but small, useless round gobies where many people used to catch the very highly valued yellow perch and other species. So round gobies have damaged both commercial and recreational fisheries, and especially in concert with the impacts of other species, two others which I illustrate here, two species of mussels, the zebra mussel and the quagga mussel. We are seeing increasingly large impacts throughout the ecosystems of the Great Lakes.

Let me just quickly go through a few of these, some of which have already been mentioned. Many people are familiar with these very high, direct financial damages done to industrial facilities for zebra mussels. Those damages, a bare minimum estimate, as we have already heard, of $150 million a year that doesn't even begin to include the other sorts of ecosystem impacts that I am going to go on to describe, which include the loss of recreational and commercial fisheries, especially for whitefish in Lakes Huron and Michigan, where we see a very strong association between the increase in abundance of mussels and the decline in the native food for these very important whitefish. So that fishery has declined about 70 percent since the 1990's.

Round gobies themselves consume many mussels, from which they derive a number of dangerous compounds, including botulinum toxin, because the mussels create a great environment for the bacteria that produces this toxin. That toxin in turn is transferred to very valuable fishes, including those consumed by humans, like smallmouth bass. So not only do we see the transfer of some dangerous compounds up the food web potentially to humans, we also see increasingly, especially in Lakes Erie and Ontario, the loss of many fishes in recent years.

We see direct impacts on human recreation from these windrows of mussel shells. We see taste and odor problems in drinking water caused by the increasingly abundant blooms of harmful algae strongly associated with these mussels.

And I could go on and on with many species, as I summarized in the written testimony, could go on and on, because we know of over 180 species in the Great Lakes, which means that they are just like the other places that we know about, an increasing number of species. And in the Great Lakes we know that in recent years, about 70 percent of those species have come from ballast water, about 40 percent of the ship-borne alien animals cause the sorts of damages that I have talked about already.

And this again, to close with the same theme that I began with, this is not an issue limited to the Great Lakes. The zebra mussels, illustrated here, are a great example of this. The black dots are where they already are. They have spread down the Mississippi, and this invasion, like many other invasions, is not over. We have heard again that quagga mussels were recently discovered in the Colorado River and Lake Mead. We in fact predicted in a paper to appear in print shortly that this would happen. Unfortunately, that prediction has come true.

So we have to care about the ships that originally introduce organisms into the Great Lakes as the beachhead, and we have to care a great deal about what is going to happen from the Great Lakes as recreational boaters and other pathways disperse those species from the Great Lakes.

Thank you.

Mr. KAGEN. [Presiding] Thank you, Doctor.

Next we have Mr. Adolph Ojard, Executive Director of the Duluth Seaway Port Authority. Welcome, and thank you for being here.

Mr. OJARD. Thank you for having me.

Mr. Chairman, members of the Subcommittee, again, I am Adolph Ojard, Executive Director of the Duluth Seaway Port Authority, Duluth, Minnesota. I am also here today as the President of the American Great Lakes Ports Association, an organization that represents the 12 public port authorities on the U.S. side of the Great Lakes.

While I am here specifically on behalf of the Great Lakes port community, I can assure you that the views I express today are shared by the majority of the private maritime interests in the Great Lakes St. Lawrence Seaway system.

Although today's hearing focuses on the Great Lakes aquatic invasive species, I think we need to understand that this is both a national and an international issue. While various witnesses tes-

tifying today will offer different perspectives, we all agree on one thing: Congress must act quickly to enact national programs requiring the treatment of ships' ballast water.

The Great Lakes Seaway transportation corridor continues to develop as an essential component of our national transportation policy. This is the longest and most extensive deep draft waterway in the world, 2,342 miles from Duluth, Minnesota to the Atlantic Ocean.

Water-borne transportation is widely regarded as the safest, cleanest and least costly mode of commercial transportation. Ships emit one-tenth of the greenhouses gases of trucks and half that of trains. One maritime accident is recorded for every 14 rail accidents and 75 truck accidents.

Unfortunately, the emergency of aquatic invasive species has become our industries' Achilles heel. We stand ready to solve this problem and let me assure you that we will solve the problem.

The focus of this hearing is impact of aquatic invasive species on the Great Lakes, and for the Great Lakes shipping industry that impact is the fear of isolation and the fear of a growing patchwork of differing and conflicting State laws, each attempting to regulate ships engaged in interstate and international commerce. Since most Great Lakes vessels load and discharge in numerous jurisdictions, the potential for chaos is considerable.

Since the year 2000, the States of New York, Michigan, Illinois, Indiana, Minnesota, Wisconsin have all considered ballast water regulations. Many of these efforts have been misguided and reflect the lack of maritime experience at the State level. To date, only the State of Michigan has actually enacted a ballast water statute. That law requires all ships conducting port operations in Michigan ports to obtain a permit from the State. Further, it requires that a ship owner either certify that it will not discharge ballast in Michigan waters or that it will do so only after treating the ballast with one of four treatment systems. These systems are arbitrarily selected by the Michigan Department of Environmental Management. None of them have been scientifically tested and shown to prevent the introduction and spread of invasive species. Minnesota and Wisconsin also have bills pending.

So what is the impact on Great Lakes commerce? Well, if you can imagine four ports of call, four permit applications, four permit fees, application of an uncertified shipboard treatment system, countless opportunities for delay and disruption, and the question then really remains, will the ships and the vessels continue to call?

It is also important to note that the States do not want to get involved in the regulation of ballast water. Based on our experience, all branches of State Government recognize the negative consequences of their action. They understand the harm they inflict on their own citizens and their own economies by adding costs and isolating valuable Great Lakes maritime commerce.

Yet the continuing lack at the Federal level has driven States to attempt independent remedies. With minimal understandings of the intricacies of maritime industry, the legislation that is being developed is ineffective at best, impractical at most. Further complicating the issue is that State regulatory bodies have little or no knowledge of shipboard issues.

Therefore, when Federal standards are finally enacted, the U.S. Coast Guard must be the regulatory agency. Vessel operations are highly complex. The Coast Guard is the only agency with the knowledge, experience and skill to effectively regulate vessel operations.

The negative impacts of aquatic invasive species are not in dispute. The need for both the environment and the industry is for Congress to create a regulatory framework within which the private sector can begin making necessary investments to solve this problem. I believe we can protect the aquatic environment and maintain a healthy shipping industry. There is a win-win scenario, and it is not far out in terms of our ability to succeed.

So what is needed? We need to find enforceable Federal standards for ballast water treatment. A Federal preemption over State and local jurisdiction. Uniform national standards and regulations. Incentives to encourage vessel operators to begin early installation of ballast water treatment systems, and the authorization of the Coast Guard to exclusively regulate shipboard ballast operations.

Again, I thank the Subcommittee for hosting this hearing, for being sensitive to the need and for moving quickly on this legislation. I would welcome any questions. Thank you.

Mr. KAGEN. Thank you for your considered testimony and your opinions. Being a neighbor from Wisconsin, thanks for hiking in here today. Your accent was well appreciated.

Mr. OJARD. I appreciate that.

[Laughter.]

Mr. KAGEN. Next we have Mr. Andy Buchsbaum, Director of the Great Lakes Office of the National Wildlife Federation and also testifying on behalf of the Healing Our Waters Great Lakes Coalition. Welcome.

Mr. BUCHSBAUM. Thank you, Mr. Chairman. I would like to congratulate you on getting my name right the first time around. I don't know if you know any other Buchsbaums anywhere else, but it is a tough name.

The Healing Our Waters Coalition is a coalition of 90 organizations, State, regional, local and national, dedicated to protecting and restoring the Great Lakes. It was founded by generous support from the Wege Foundation, the Joyce Foundation, and we are very involved not only with the invasive species debate, invasive species issues, but also with Great Lakes restoration generally. I will get to that in a second.

You have already heard from many people today about the importance of the Great Lakes, the importance not only to the ecology of the region but to the economy of the region. You have already heard about the general problem of invasive species, so I am going to focus on a few things. One hundred eighty-three species so far in the Great Lakes that we know of, invasives, you have heard that, one every 28 weeks. About eight months, it is accelerating, one every 28 weeks comes in.

Let me follow up on something that Dr. Lodge was talking about, and that is one of the huge impacts, which involves a freshwater shrimp called diporeia. If I could have one of the slides called up, I have a few slides.

[Slide sown.]

Mr. BUCHSBAUM. Diporeia are tiny freshwater shrimp that form about 80 percent of the food at the bottom of the Great Lakes. Their population gets to about 10,000 organisms per square meter. This picture of Lake Michigan, all those dark blue spots are at the 10,000 per square meter level. As it lightens up, please give me the next slide.

[Slide shown.]

Mr. BUCHSBAUM. You can see, as it gets lighter and lighter, there are fewer and fewer of these things.

[Slide shown.]

Mr. BUCHSBAUM. And then finally, what you see here is a crash of this fundamental part of the Great Lakes food web. These tiny freshwater shrimp have virtually disappeared over large stretches of Lake Michigan. Advance it one more time.

[Slide shown.]

Mr. BUCHSBAUM. Ninety-four percent decline in 10 years. This is the basis of the Great Lakes food web.

Next, slide, please.

[Slide shown.]

Mr. BUCHSBAUM. Dr. Tom Nalepa is the person who did this modeling and who did the sampling to establish that. He is a NOAA scientist from the Great Lakes Environmental Research Lab. He began sampling for diporeia for other reasons back in the 1980's, found this phenomenon and then quickly began sampling other places.

For Lake Huron, he began sampling in the year 2000. Look at what has happened in just three years, a 57 percent decline.

When Congressman Ehlers said that this is an ecological disaster happening, this is one huge example of what he meant.

Next slide, please.

[Slide shown.]

Mr. BUCHSBAUM. Zebra mussels have been blamed for a lot of the decline of the diporeia. But the zebra mussels themselves are now declining, because quagga mussels have come in. Look at the increase in quagga mussels in the last 10 years. This is again from Dr. Nalepa's slides.

One more slide, I think that wraps it up.

[Slide shown.]

Mr. BUCHSBAUM. This is also the quagga mussels for Lake Huron.

Next, and we are done.

[Slide shown.]

Mr. BUCHSBAUM. This is massive. This is something that we featured, the slides you have in my testimony, it is much more lengthy. We featured some of this, Dr. Nalepa's work, in this report that you also have called Ecosystem Shock, which is something NWF did in 2004. I invite you to read through that and you will see some of the statistics and some of the descriptions in more detail.

Scientists have done another report, though, on the Great Lakes and released it just over a year ago. It was called Prescription for Great Lakes Protection and Restoration. Some of the region's leading scientists, joined by some of the Nation's leading scientists,

over 200 right now, issued this report. They concluded that the Great Lakes are suffering right now ecosystem breakdowns.

What I just showed you, the diporeia crash, is one of the leading breakdowns, but it is not the only one. You have heard some others today. They say the reasons for the breakdowns is because there is a combination of stresses that have injured the Great Lakes. They have injured, and you will appreciate this, Mr. Chairman, they have injured what they call its immune system, its ability to respond to stress, its buffering capacity.

Invasive species are among probably the lead of those stressors. Because how can a system reach equilibrium if once every 28 weeks another huge stressor comes in that it can't handle?

Because of this, the scientists actually recommended doing things not just to restore the Lakes but to stop the new stressors from coming in. They say we can't restore the Lakes properly unless these new stressors are stopped.

So the scientists and the Healing Our Waters Coalition and the Great Lakes Regional Collaboration, everyone who studies this problem says the top priority has to be a comprehensive approach to stopping invasive species like the National Aquatic Invasive Species Act that was introduced last week in the Senate, has been pending last year. It is comprehensive, because ballast water, although a huge cause, is not the only cause. There are others.

The other top priority is to stop the signature species, the signature threat, the Asian carp, from coming up the canal. Ten to twenty million dollars now will save tens to hundreds of billions of dollars later. We saw what happened with inaction with Katrina. We know that we can do better. There is a very easy solution out there. This one is not rocket science, Congressman Ehlers. This one is a lot easier than that, it is an electric barrier, electric current underneath the canal. We need to do that.

Then finally, if you will indulge me for 20 more seconds, we have to restore what we have lost. That is the purpose behind the Great Lakes Collaboration and Implementation Act, which Congressman Ehlers and others introduced yesterday and which they introduced last year. That will restore that immune system that we need. Because given the fact that these things are here to stay, we need to bolster the health of the Great Lakes so they can take care of themselves. We can't do it for them, but we can help them do it for themselves.

With that, I have a number of other comments that I can't get to which address some of what Congressman Baker said and others in terms of the EPA and Coast Guard role. But I will save that for questions. Thank you very much.

Mr. KAGEN. I appreciate your comments, and if we don't have time for questions because of the vote, I would certainly appreciate your written commentary from questions you would have expected us to ask.

And finally we have John Kahabka, the Manager of Environmental Operations from the New York Power Authority. You have the floor.

Mr. KAHABKA. Good afternoon, Mr. Chairman, and thank you.

My name is John Kahabka, I serve as the Manager of Environmental Operations for the New York Power Authority. The Power

Authority is the Nation's largest State-owned electric utility, with 18 generating facilities and more than 1,400 circuit miles of transmission lines. We own and operate our facilities without the use of tax dollars or State credit. We finance our operations with earned revenues from sale of electricity and through bonds and notes for capital projects.

In addition, for a number of years, I have also represented the American Public Power Association on the Aquatic Invasive Species Task Force of the interagency committee established by the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990. Among the electrical generation facilities owned by the Power Authority are two major hydroelectric facilities within the Great Lakes Basin, several small hydro facilities, a relatively large pump storage facility in the northern Catskills, a number of fossil-fired plants in New York City.

At the time when the zebra mussel first made its appearance, the Authority owned and operated two additional nuclear power plants, one located on Lake Ontario and the other one actually on the Hudson River. We have always considered that the impacts on our operations by aquatic invasives, especially Dreissena Polymorphia, the zebra mussel, to be critical to our continued economic operation.

Recognizing the need for immediate measures to address this problem, in 1990 we instituted a monitoring and mitigation program at all our facilities. In May of 1990, we installed a chlorination system at the 2,400 megawatt Niagara Hydro project in western New York. The initial system cost us over $100,000 and we are currently in the beginning phases of refurbishing that system. We expect those costs to be anywhere between $200,000 to $250,000 with annual control efforts ranging between $30,000 to $50,000.

At our St. Lawrence project, we have essentially a similar system. At our 1,000 megawatt pump storage project, Blenheim-Gilboa in the Catskills, we installed a state of the art, at the time, experimental copper ion generator in an effort to reduce our chemical discharges. At our Hinckley, Crescent and Vischer Ferry small hydro projects within the Mohawk drainage basin, we installed a filtration system and use mechanical cleaning.

The FitzPatrick plant, which is now owned by Entergy Nuclear, back in 1991 when we owned it, we installed a chlorination system at that facility that cost about $175,000 at that time. Conversations with Entergy Nuclear recently have indicated they are spending between $100,000 to $150,000 a year in maintaining that system.

At the Indian Point facility I referenced earlier, their annual operating costs are roughly about $350,000, just to control biofouling.

The use of Great Lakes water for power production is significant. The 2005 report by the Northeast-Midwest Institute calculated that there are some 535 power plants within the U.S. portion of the Great Lakes Basin with a combined generating capacity of over 50,000 megawatts. That comprises roughly 13 nuclear plants and 175 coal-fired power plants. By interfering with maximum effective operations of the power plants, they can jeopardize, zebra mussels, that is, or biofoulers, can jeopardize reliable supply of electricity.

The worst case impact from Dreissena in our facilities would be the loss of generation. Replacing our hydropower, which we sell typically at 1 to 2 cents per kilowatt hour, would force us to go out and by it on the market, anywhere from 5 to 10 cents a kilowatt hour. In 1995, Chuck O'Neill of Sea Grant reported on the economic impacts of zebra mussels. I want to just bring out that from Chuck's work, it was shown that the expenditure on zebra mussel control only at the nuclear power stations was around $786,000, and at fossil stations, about $146,000. All these expenditures included plant retrofits, chemical control and prevention projects.

The Power Authority to date has overcome a lot of these initial effects, but it has not been without impacts to our operations and our costs. The zebra mussel infestation has proved to be one of our more daunting environmental challenges and will continue to challenge us in the future.

The Power Authority supports the efforts of the State and Federal Government to regulate and control ballast water, as this is clearly the vector of choice for the movement of aquatic invaders. Continuing funding of the monitoring and control programs and research is essential. Without these, it is certain that additional invasives, as you have heard, of course, many times today, will affect the Great Lakes and their tributaries.

On behalf of the Power Authority, I want to express my appreciation for your taking the attention to hear my testimony. If there are any questions, I would be happy to answer them. Thank you.

Mr. KAGEN. Thank you very much for enlightening us, with no joke being intended.

Mr. Gilchrest, do you have any questions?

Mr. GILCHREST. Thank you very much.

I represent the Chesapeake Bay, and many of the problems that you are describing we have in the Bay area. It seems that the shrimp that you are talking about their decline is similar, but I think it is worse in the Great Lakes, to our oysters. We have lost in the last 100 years about 99 percent of the oysters, which was a form of the ecosystem, not at the bottom of the food chain, but they had an immense filtering capacity.

Can you specifically identify the water quality issue that is decimating these shrimp? Or is something else eating them?

Mr. LODGE. I will take a stab at it. I think the short answer is, the exact links are unknown. What is known is that wherever these mussels have become abundant, the diporeia, this little shrimp-like organism, has declined. I don't think anyone really understands exactly what is going on. I myself in the past have been something of a skeptic about this. But the pattern is absolutely compelling to me these days, as you saw from the maps.

Mr. GILCHREST. So the new mussels have also come in, likely in ballast water?

Mr. LODGE. Yes. Both mussels it seems clear came in ballast water. The difference between the mussels, I am almost inclined to say, are things that only a biologist can get excited about.

Mr. GILCHREST. But they are two different species, the zebra mussels and the diporeia is another mussel?

Mr. LODGE. No, the——

Mr. GILCHREST. The diporeia is a shrimp?

Mr. LODGE. The diporeia is a little shrimp. The two mussels are called zebra mussels and quagga mussels. They are two different species, and in fact, they do have some important ecological differences, with quagga mussel living quite happily more deeply in the Lakes.

Mr. GILCHREST. But the zebra mussels seem not to have an effect on the shrimp?

Mr. LODGE. No, I believe it is the case that both. And in fact, I think it may be the case that in the past in many surveys, these two mussel species have not been sufficiently distinguished from one another, because they are easy to mix up.

Mr. GILCHREST. Well, when you look at them, they look the same.

Mr. LODGE. If I had them here today, I would not be able to tell them apart.

Mr. GILCHREST. So as far as our assistance with you is concerned, this aquatic invasive species bill needs to get moving on the House side. There is a recognition, and I like the concept that the immune system has been degraded. I will start using that in my district. The immune system.

But it is an invasive species problem, it is general human activity and all that involves degrading nature's design, again, fundamentally. Part of this process, though, is an effort to restore habitat and water quality. So we will, Mr. Chairman, we will do all we can to move the type of legislation, hopefully in this Congress, on the invasive species, those kinds of pieces of legislation, do all we can before this thing is a foregone conclusion.

One last very quick comment. On top of all this lair of problems is global warming, which will have other effects that we are not quite sure of at this time. Yes, sir?

Mr. BUCHSBAUM. Congressman, a couple of things. First on global warming, there have been three studies that have come out in the last few months about the impacts of global warming on the Great Lakes that show that it is going to really exacerbate all the problems we are talking about. Apparently there is a study that just came out last week that shows that Lake Superior's water temperature has raised 4 degrees, which has enormous implications for the entire ecosystem and for the fishing and for everything else. Ice fishing has become an endangered sport in the northern climates now.

In addition to that, there is another study, it is not complete, but the information was leaked, apparently, it is coming out in April, that says that the lake levels of Lake Michigan and Lake Huron may decline up to five feet because of global warming, which would completely decimate everything, completely change everything. And then there is another study that came out a few months ago that predicts that Lake Erie may shrink by 15 percent.

So if we can't get our house in order before these things happen, we will have no chance of responding. That is why, as important as invasive species legislation is, that is the prevention piece. We also have to do the restoration piece.

Congressman Rom Emanuel today, in commenting on his bill at a press conference, said that he recognized that it is not just the Great Lakes that are facing these major restoration problems. He

specifically was talking about the Chesapeake Bay. So I think that in the future, we need to begin pooling our resources and knowledge, and also our political strategies to get these major restoration bills through. Because a lot of change has already happened, and we need to address that.

Mr. GILCHREST. Thank you very much. Thank you, Mr. Chairman.

Mr. KAGEN. Thank you very much for referring to the immune system, since I am immunologist. I used my fundraising capabilities as an immunologist to get here.

[Laughter.]

Mr. KAGEN. We are going to have to break and end the meeting, but I want to have all of you on record with regard to a question that comes up with regard to intra-lake shipping, as to whether or not this poses a threat for spreading an invasive species from one lake to the other. Would you all agree that the answer would be yes, that this is an issue, and that a ship, whether it is traveling intra-lake or from overseas should have the same rules applied to them?

Mr. LODGE. I would agree all the evidence would suggest that ships, lakers, so-called laker ships moving within the Great Lakes, are likely to be an important pathway by which species get spread around in a lake.

Mr. OJARD. Yes, the lakers will spread, but we are not going to introduce through the lakers. If we have good ballast water legislation, adequate systems onboard the ocean ships, we are going to significantly retard the influx of invasives into the system and there would be very little to spread around.

Ocean ships are moving throughout the Great Lakes, so they in essence are spreading as well as the lakers themselves.

Mr. KAGEN. Thank you. Andy?

Mr. BUCHSBAUM. Yes, the lakers definitely spread what is there. I think that it is unlikely that the standards you would use for lakers would be the same as the standards you would use for ocean-going vessels. I think the problems and solutions would be different. You could probably find some different solutions for lakers than you can for the ocean-going vessels.

Certainly, if we act quickly on the ocean-going vessels, then I agree definitely with Mr. Ojard, that you stop the influx. These things are going to spread through the Great Lakes regardless of whether the lakers are spreading them or not. So it is a question of how you reach equilibrium. Thank you.

Mr. KAGEN. The Subcommittee would be interested in your written recommendations pertaining to the lakers and the ocean vehicles.

John?

Mr. KAHABKA. I would agree with the panelists as well, that the movement will happen.

Mr. KAGEN. Thank you very much. This will end today's hearing. We appreciate very much your coming here and your hard work. It is well appreciated. Thank you.

[Whereupon, at 4:17 p.m., the subcommittee was adjourned.]

STATEMENT OF HON. RICHARD BAKER

HEARING ON
"THE IMPACT OF AQUATIC INVASIVE SPECIES ON THE GREAT LAKES"
COMMITTEE ON TRANSPORTATION & INFRASTRUCTURE
WATER RESOURCES & ENVIRONMENT SUBCOMMITTEE

March 7, 2007

Welcome to our hearing on the effects of invasive species on the Great Lakes.

The increased presence of invasive plant and animal species is a major environmental problem affecting the Great Lakes region, as well as other parts of our country.

- In the 1950s, the sea lamprey was introduced unintentionally into the Lakes and decimated trout fisheries. Today, there are at least 25 major non-native species of fish in the Great Lakes.

Zebra mussels damage natural resources, and invade and clog water intake pipes, costing water and electric generating utilities hundreds of million dollars a year in prevention and remediation efforts.

In addition, non-native plant species are displacing native aquatic vegetation.

There are more than 180 non-native aquatic species in the Great Lakes, many of which are invasive.

It is said a new aquatic invasive species is discovered every 6 to 8 months on average in the Great Lakes, as they are introduced through ship hulls and ballast water discharges, canals and waterways, recreational vessels, and trade of live organisms.

Once an exotic species establishes itself, it is almost impossible to eradicate and usually difficult to prevent from moving throughout the nation. We are finding that reducing the introduction and spread of aquatic invasive species is a difficult problem to solve.

Last Congress, when this Subcommittee held a hearing on the Great Lakes, one of our witnesses warned that the Great Lakes and their ecosystems are reaching an ecological "tipping point," beyond which environmental recovery could become increasingly difficult, or even impossible, to achieve. Invasive species in the Great Lakes are major stresses that are pushing the Great Lakes ecosystem towards such potentially irreversible changes.

In 2005, there was an estimated loss of $5.0 billion in economic activities in the Great Lakes region due to aquatic invasive species. Nationally, such losses are estimated to be $138 billion annually.

Preventing and controlling invasions of nonindigenous species in the Great Lakes and elsewhere is critical.

The Great Lakes Regional Collaboration strategy calls for preventing the introduction of new species, eradicating harmful aquatic invasive species, and controlling the spread of others, and provides specific recommendations for achieving this.

I look forward to hearing from the witnesses about how the various Federal, state, local, and nongovernmental entities plan to deal with the problem of invasive species in the Great Lakes, in light of the Great Lakes Regional Collaboration strategy recommendations.

STATEMENT OF
THE HONORABLE JERRY F. COSTELLO
SUBCOMMITTEE ON WATER RESOURCES AND ENVIRONMENT
HEARING ON THE IMPACT OF AQUATIC INVASIVE SPECIES ON THE GREAT LAKES
WEDNESDAY, MARCH 7, 2007 AT 2:00PM

Thank you, Madame Chairwoman, for holding this hearing on the impact of aquatic invasive species on the Great Lakes.

Madame Chairwoman, this Subcommittee has a long history of oversight on the ecological and environmental health of the Great Lakes. Over the past three decades, the Subcommittee has held numerous hearings on the Great Lakes, and has investigated and proposed legislation to address Great Lakes water quality impairment, contaminated sediments, and a wide variety of sources of pollution to the Lakes.

As a life-long resident of a Great Lakes state, I am well aware of the importance of these vital natural resources to the economic health and well being of our state. Whether as a source of drinking water for our largest cities, a major transportation

corridor for the movement of goods and services, or as a center for recreation, the Great Lakes are integral to the regional economies and livelihood of those states that line their shores.

The impact of invading species to U.S. waters has grown beyond simply reducing native fishing harvests to threatening the natural functioning of entire ecosystems and posing significant threats to human health. Aquatic invasive species spread through ballast water threaten local water supplies in many Great Lakes communities. Now is not the time to throw up our hands to the issue of controlling invasive species. Congress needs to establish a strict standard for controlling the spread of aquatic invasive species to prevent the next wave.

I am well aware of the concern about the costs associated with trying to control and prevent aquatic invasive species. I am also aware of the costs incurred across a whole spectrum of economic activities as a result of invasive species. Congress must

not avoid its responsibility to ensure a tough, new standard for the protection of the nation's waters. As we have seen in the Great Lakes, the cost of inaction is far too great.

Clearly, Madame Chairwoman, significant policy and funding challenges remain in this nation's efforts to protect the Great Lakes from invasive species. I am pleased that this Subcommittee continues to explore these issues. I welcome the witnesses here today, and look forward to their testimony.

TALKING POINTS FOR
THE HONORABLE EDDIE BERNICE JOHNSON, CHAIRWOMAN

SUBCOMMITTEE ON WATER RESOURCES AND ENVIRONMENT
HEARING ON
THE IMPACT OF AQUATIC INVASIVE SPECIES ON THE GREAT LAKES
WEDNESDAY, MARCH 7, 2007 AT 2:00 P.M.

I'd like to welcome today's witnesses to our hearing on the impact of aquatic invasive species on the Great Lakes. Today we will hear from representatives from federal, state, and local governments, from tribal communities and nations, academia, NGOs, port facilities, and the power sector.

These diverse perspectives will provide the subcommittee with a much broader perspective of the problems of aquatic invasive species in the Great Lakes – as well as a clearer understanding of what is at stake.

The Great Lakes are among the nation's most important resources. The lakes combine to hold around 20% of the entire supply of fresh surface water on the planet. The region surrounding the Great Lakes has a population of around 40 million people. As home to some of the great industrial centers of the world, the Lakes themselves are an important manufacturing, transportation, and commercial hub.

However, the high levels of commercial activity in the Great Lakes has also made the region susceptible to incursions by a variety of aquatic invasive species.

Aquatic invasive species in the Great Lakes come from a variety of sources. In general, any untreated material – whether it is water, wood, or soil – can serve as a potential source for their introduction. Among the most prevalent pathways, however, are cargo ships. Invasive species often enter our waters through vessels' ballast water.

The impacts of aquatic invasive species in the Great Lakes are many. They are already threatening the functioning of entire ecosystems, increasing economic costs on both the private and public sectors, and posing significant threats to public health.

We are currently facing a situation where many aquatic invasive species have found receptive homes throughout the Great Lakes – with few, if any, natural predators to control them. Not only can their numbers skyrocket, they also

introduce foreign diseases into ecosystems, and consume our native species.

For example, the zebra mussel has become a bane of communities, industry, and water resources managers throughout the Great Lakes and beyond. A small mollusk introduced to the Great Lakes in the late-1980s from contaminated ballast water, it has overwhelmed native ecosystems.

While each mussel is very small, they cluster in astronomical numbers. The result is that they alter ecosystems by disrupting the food chain, and clog pipes in water infrastructure and industrial facilities. Tens of millions of dollars are spent every year to control the zebra mussel populations.

These are costs that both government and the private sector must bear. And these are costs we as a nation cannot afford. And I want to stress that these are costs that could have been avoided were there an effective ballast water management system in place.

Just this week, US News & World Report ran a story about how political gridlock in previous congresses delayed the passage of legislation that would combat invasive species in the Great Lakes. I am proud to say that this subcommittee will move forward on addressing this dire problem.

Estimating the economic cost of invasive species is an inexact science. However, a Cornell University study puts the costs to the entire country at $138 billion annually. In the Great Lakes, aquatic invasive species threaten important commercial fisheries, damage vital cooling systems in power plants, and lower housing values.

Aquatic invasive species can also cause public health impacts. This is a very important issue for residents of the region because the Great Lakes are the only coastal waters of the United States that are used for drinking water.

Invasive species are associated with the fouling of drinking water supplies by making the water smell badly and taste poorly.

In addition, one of the most notorious aquatic invasive species – the zebra mussel – is associated with harmful blue-green algal blooms that can produce toxins that are harmful to humans.

In conclusion, the Great Lakes region has been negatively impacted by aquatic invasive species in part because of its location as a center of population, manufacturing, and trade. Unchecked growth in the types and numbers of aquatic invasive species will result in costs that the region and the nation cannot afford.

I welcome the witnesses to today's hearing, and I look forward to their testimony. They will better inform the subcommittee as to the nature of the problem of aquatic invasive species, and alert us all to their threats to the Great Lakes' economy and environment.

STEVE KAGEN, M.D.
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Washington, DC 20515–4908

Opening Statement
Honorable Steve Kagen, M.D.

Committee on Transportation and Infrastructure
Subcommittee on Water Resources and the Environment

"The Impact of Aquatic Invasive Species on the Great Lakes"

Madam Chairwoman, I am proud to take part in today's hearing on aquatic invasive species in the Great Lakes, and I would like to thank the Chairwoman and the Subcommittee for holding today's hearing as this issue is of special and serious concern to my district in Northeast Wisconsin, as I represent a large portion of the coastline of Lake Michigan.

The vital role that the Great Lakes play in our nation must not be underestimated. Not only is it the largest freshwater system in the world, has costal area greater than that of both the East and West Coast of the United States, it also is responsible for 30% of exports, and generates $3.8 billion dollars of our gross domestic product.

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As our highways become more crowded and our airspace is subject to weather delays, cargo ships and freight vessels remain vitally important to our nation's economy; they are a key element in domestic transportation and international trade. These vessels, however, are also the main culprits of carrying invasive organisms in their residual sediment water of their cargo holds or ballast tanks.

Despite highly reported compliance to mandatory ballast water management (BWM) in the Great Lakes, over 180 nonindigenous aquatic species having become established in the Great Lakes. It is clear that our current regulations and laws, particularly the sluggish implantation of NISA with regard to ballast water management, as well as the new challenge of "No Ballast on Board" (NOBOB) vessels, are ineffective and inadequate for handling this problem.

The impact of invasive species in the Great Lakes goes far beyond environmental damage. There are serious economic consequences and financial costs associated with attempting to manage and control these aquatic invaders. In the Great Lakes, it is estimated that roughly $5 billion in damages has been caused by the zebra mussel;

while the cost to the ecosystem of lost native species may never be known. There is also a huge recreational cost with associated with the loss of fish and wildlife in the Great Lakes.

My hope is that the committee, with the testimony and answers from this panel, will be able to create effective, realistic, and fast-acting solutions to deal with the present and future problems of invasive species in the Great Lakes. Thank you.

STATEMENT
THE HONORABLE JAMES L. OBERSTAR
SUBCOMMITTEE ON WATER RESOURCES AND ENVIRONMENT
HEARING ON
THE IMPACT OF AQUATIC INVASIVE SPECIES ON THE GREAT LAKES
WEDNESDAY, MARCH 7, 2007 AT 2:00 P.M.

Chairwoman Johnson, thank-you for holding today's hearing on the impact of aquatic invasive species on the Great Lakes. The control of aquatic invasive species is important to the economic and environmental health of not only the Great Lakes – but also the entire nation.

As you may know, I began work here at the U.S. Congress in 1963. Back in those days I was the clerk for the Subcommittee on Rivers and Harbors. Even then we knew about the dramatic impacts that aquatic invasive species were having on our own native species.

Just over ten years before I began here, in 1952, the lake trout fishery on the Great Lakes totaled over 3 million pounds, and some two and a half million pounds of white fish were caught in Lake Michigan. In the span of only one year, that figure had plummeted to just 300,000 pounds of the trout, and 250,000 pounds of the white fish.

While we weren't exactly sure what the cause was, we sure knew we had an environmental and economic disaster on our hands.

It turns out that the culprit for the devastation of these vitally important fisheries was a small aquatic invasive creature – the sea lamprey. This species attacks and latches onto other fish and parasitically feeds from them – consuming their fluids and tissues.

The sea lamprey likely first arrived in the Great Lakes in the 1820s – when the Erie Canal was first opened for commerce. It has since spread throughout the region through contaminated ballast water, and through the Welland Canal.

Now governments of the United States, of Canada, of the Great Lakes States, of cities and towns through the region spend millions of dollars, every year, to control the problem of lamprey eels – to correct our past mistakes.

Madame Chairwoman, even in the early days of domestic and international trade, ocean-going and inland-waterway shippers were the unwilling hosts for the importation of non-native species. Unfortunately, many of these invaders found receptive homes in the United States – with few, if any, natural predators to control their propagation in domestic waters, and ample sources of food and shelter to fuel their exponential growth.

Now we know that allowing the invasion of the sea lamprey to occur was not our only mistake in controlling aquatic invasive species in the Great Lakes. In the years that followed, numerous *additional* invaders have founds homes in the waters of the region, among these: the zebra mussel, the Eurasian milfoil, the European ruffe, and now the VHS virus.

In fact, researchers now believe there are at least 162 aquatic invasive species in the Great Lakes alone.

And this number is growing at a rate of over 1 new invasive species a year.

And what does that mean? It means that with each additional invader, our native environment suffers, that costs go up for commerce, for industry, and for taxpayers, and that the public's health is put increasingly at risk.

But this isn't just a problem for the Great Lakes. One thing I'm hoping that we can take away from today's hearing, Madame Chairwoman, is that an aquatic invasive species that first establishes itself in the Great Lakes can easily move to other parts of the country.

For example, earlier this year California officials found quagga mussels in Lake Havasu, near the Arizona border. Quagga mussels are one of the newest aquatic invasive species and are similar to zebra mussels – they reproduce very rapidly and can clog water infrastructure and harm the food chain. Prior to the discovery in California, we had all thought that quagga mussels were isolated in the Great Lakes. However, they can survive for long periods of time in bilge water, or attached to the *outside* of water-craft during transportation. We now think that a recreational boater unwittingly brought these quagga mussels from one of the Great Lakes to California after returning from a boating trip and failing to adequately clean and dry his or her boat.

The lesson I'm hoping all the members take away from this is that aquatic invasive species are not just a regional problem that are affecting the Great Lakes alone – it's a national problem.

Economic impacts in the Great Lakes cause ripple effects throughout the country – putting financial burdens on taxpayers and governments large and small, as well as raising the price of products. And given the ease with which some of these aquatic invaders can be transported – other parts of the country may suffer environmental impacts, too.

We've known for a long time – since I first started working here – that a major problem affecting the environmental and economic health of the Great Lakes, and the public health of the region's population are aquatic invasive species.

It's well past time to do something effective about them.

I look forward to today's hearing to learn about the extent of the problem and the nature of the impacts. Armed with this information, we can proceed to make good policy - policy that makes sense economically and environmentally – to save this precious region from the ravages of these aquatic invaders.

I am pleased that we have such a diverse range of experts on today's panel. I welcome each of the invited witnesses, and look forward to hearing their testimony.

For the record

Representative Thomas E. Petri
Statement For the Record
Water Resources and Environment Subcommittee Hearing
"Impact of Aquatic Invasive Species on the Great Lakes"
March 7, 2007

Chairwoman Johnson and Ranking Member Baker:

I would like to take this opportunity to congratulate you on holding this important hearing to examine the impact of invasive species on the Great Lakes. This is an issue that is very important to my state of Wisconsin as well as the rest of the United States.

The Great Lakes is a national treasure, containing 90% of the United States freshwater. More than 35 million people live in the Great Lakes basin and depend on its natural resources for many vital needs such as drinking water, energy production, and transportation. Furthermore, the Great Lakes provide resources to support millions of jobs, especially in the fishery and boating industries. According to the U.S. Fish and Wildlife Service, nearly $15 billion in recreational activities such as fishing, hunting, and wildlife watching occur annually in the Great Lakes region.

The migration of invasive species into the Great Lakes threatens to severely damage the aquatic environment and have a negative effect on the industries that depend on the Great Lakes. I am a cosponsor of several bills that have been introduced this Congress that would help prevent the spread of these species by detecting them early and establishing proven techniques to eradicate them.

I am encouraged that this Subcommittee will be examining this issue closely and look forward to working with my Committee colleagues to develop and support measures that will help restore and maintain the Great Lakes.

Opening Statement
Congressman John T. Salazar
T&I Subcommittee on Water Resources
Hearing on the Impact of Aquatic Invasive Species on the Great Lakes
March 7, 2007

Thank you, Madame Chair.

I appreciate the subject matter of today's hearing, because even though we are focusing on the impact that invasive species have on the Great Lakes and surrounding region, the larger problem of invasive alien species infiltrating our nation's waterways is something that affects each of our districts.

Invasive species are recognized as one of the leading threats to biodiversity and impose enormous costs to agriculture, fisheries and human health.

In Colorado, we are dealing with similar issues, as we have been invaded by a number of harmful exotic species.

Among the 6 invaders that have been introduced in Colorado, 2 have caused significant damage to my district.

The Salt Cedar, or Tamarisk, is a shrub that infiltrated the U.S. in the 1800s, originating from Eurasia.

The plant has a long tap root system, allowing it to reach deep into the local water supply.

Because of its reach, it deprives municipalities of much needed water, interfering with daily farming and domestic water use.

Some estimates show that this plant consumes approximately 163 billion gallons of water a year from the Colorado River Basin, roughly the same amount of water allotted to the state of Nevada.

The Russian Olive, which originated in Germany, is another invasive species that extends throughout western and central U.S.

Much like the Tamarisk, this shrub interferes with the natural plant ecosystem and taxes our water reserves.

These 2 species have negatively impacted the ecosystem and economy of my district.

They have single-handedly left many farmers and ranchers like myself with unworkable land and depleted water sources.

Clearly something must be done to address the problem of invasive species within our water systems.

We know the extent of the damage these species cause. We must explore options to prevent and limit future incidences of invasion.

I look forward to today's hearing. Thank you.

U.S. HOUSE OF REPRESENTATIVES

Committee on Transportation and Infrastructure
Subcommittee on Water Resources and Environment

TESTIMONY OF
The Honorable Gary Becker

Mayor, City of Racine, Wisconsin
and Vice Chair, Great Lakes and St. Lawrence Cities Initiative

March 7, 2007
Washington, D.C.

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U.S. HOUSE OF REPRESENTATIVES
Committee on Transportation and Infrastructure
Subcommittee on Water Resources and Environment

TESTIMONY OF
The Honorable Gary Becker
Mayor, City of Racine, Wisconsin
and Vice Chair, Great Lakes and St. Lawrence Cities Initiative

March 7, 2007
Washington, D.C.

Good afternoon Madam Chairwoman and members of the Subcommittee. My name is Gary Becker and I am the Mayor of Racine, Wisconsin. I also serve as Vice Chair of the Great Lakes and St. Lawrence Cities Initiative, a coalition of mayors from 39 member cities and 50 participating cites from the Great Lakes and St. Lawrence region in the United States and Canada. Mayor Richard M. Daley of Chicago is our Founding Chair and Mayor David Miller of Toronto is our current Chair. Thank you for the opportunity to testify before you today.

Great Lakes Mayors are extremely fortunate to be managing cities and towns located along a resource as incredible as the Great Lakes. The Great Lakes bring tremendous local and regional benefits in terms of economic development, trade, recreation, tourism and drinking water. At the same time, however, Great Lakes Mayors must deal with the problems of the Great Lakes on a daily basis. Whether it is making sure the water intakes are clear from zebra mussels, dealing with beach closings and unreliable water quality standards, operating wastewater treatment plants properly, or managing storm water, the people who work for me, just like those for all the other mayors across the basin, must make sure things are done right 24/7. These are very real issues for me, my fellow mayors, and the people who live in our cities.

Invasive species are a key issue for Great Lakes Mayors, causing extensive biological damage and resulting in billions of dollars of costs across the country and in the Great Lakes Basin. Over 180 different species have come in to the Great Lakes already, and they continue to arrive at the rate of one every six or seven months. Some of the most notable are the sea lamprey and zebra mussels.

Others very close to entering the Great Lakes are several varieties of Asian carp, already in the Chicago Sanitary and Ship canal less than 50 miles from Lake Michigan. Ballast water in ships is the most common pathway for entry into the system.

Cities have dealt with the zebra mussel problem for many years, with the clogging of drinking water intake structures being the primary concern. In my own City of Racine, we spent almost $1.4 million in 1995 for a new chemical feed system, chemical lines, and diffusers to address the situation. In operating expenses for chemicals and energy to fight the zebra mussels, the Racine Water Utility spends $30,000 to $40,000 annually.

The tragedy of this situation is that much of the invasive species problem could have been prevented. If action is not taken quickly, things will get worse. Many of the issues we deal with on the Great Lakes are the result of mistakes we made in the past, and now must pay the price. Rarely do we have the opportunity to prevent future damage by taking action now. This is one situation where we have that opportunity, and it would be a mistake not to take full advantage of it.

Comprehensive invasive species legislation on a national level is essential if we want to deal with the problem effectively. In fact, it is something we need to coordinate closely with our Canadian neighbors and make sure coverage includes the Great Lakes and St. Lawrence. It also needs to be done with full awareness of the actions recently taken by the International Maritime Organization. This legislation was introduced in earlier years, and never advanced to passage. This must be the year for action.

This legislation does not need to cost taxpayers a large amount of money. In fact, the lack of strong laws is costing the taxpayers much more already. The Federal government needs a strong program to restrict ballast water discharges and control the other pathways for invasive species. Costs incurred in controlling the flow of invasive species should be absorbed by the responsible businesses and the consumers of the products they produce and transport.

An additional problem with not having comprehensive federal laws is that states and local governments are finding it necessary to move ahead with their own efforts. The State of Michigan took a strong leadership role by passing legislation and implementing a program that took effect this year. Other states are also considering programs. Having a program in one of the Great Lakes states, and potentially different programs in others, will cause problems for states and for the shipping industry, The vast amount of legislative, administrative, and business time spent to deal with this could be avoided with strong Federal legislation.

Chicago has passed an ordinance to prohibit the sale of live Asian carp as another means of dealing with the problem. Although this is helpful, it cannot solve the problem we are facing with invasive species on a broader scale.

One other action by Congress needed in the very near term is authorization and appropriations to complete construction and fund operation of the electronic barrier on the Chicago Sanitary and Ship Canal to keep Asian carp out the Great Lakes.

Mayors, and many others in the Great Lakes region, such as Governors, business groups, environmental organizations, and members of Congress, wish this could have been done several years ago. Each day it is not completed perpetuates the unnecessary risk to the multi-billion dollar sport and commercial fishing industry on the Great Lakes.

In addition to passing comprehensive federal invasive species legislation, the Federal government could be doing more with legislation and regulations on the books already. In particular, the U.S. Department of Interior has authority under the Lacey Act to restrict the shipments of injurious species to prevent the expansion of a problem. The Interior Department has had petitions for listing the black, bighead, and silver carp for a number of years, and only recently proposed the listing of one of the species. Congress even considered legislation last year because of the lack of action by the Department of Interior. Mayors ask for your assistance in making sure that the Interior Department takes action promptly to list all three species as injurious.

The U.S. Coast Guard has regulations on ballast water that should be enforced strictly. With the expanded homeland security responsibilities of the Coast Guard, it is not clear whether they have sufficient resources to do this, or whether it is treated as a high enough priority. We would like to work with the Coast Guard to see what further actions might be possible.

Although the focus of today's hearing is on invasive species, it is important to recognize that there are many other serious threats to the Great Lakes. Discharges of untreated or inadequately treated sewage from combined and sanitary sewer overflows are a major problem across the Basin. The infrastructure investments needed are in the billions of dollars, and only with significantly increased investments by Federal, state, and local governments will this problem be solved.

Great Lakes Mayors appreciate the recent action by this Subcommittee and the full Committee to advance three key water infrastructure bills (H.R. 569, H.R. 700 and H.R. 720). We are hopeful that the House will pass these bills.

Other key issues highlighted in the Great Lakes Regional Collaboration Strategy, which the Great Lakes region perceives as the blueprint for moving forward, were toxics, habitat and wetland protection, and contaminated sediments. These are the priority issues from the perspective of the Great Lakes Mayors.

The Great Lakes Regional Collaboration Strategy of December 2005 did an excellent job of identifying the top priority problems on the Great Lakes and setting out the actions needed to solve them. Although some progress has been made under the Strategy, we need to accomplish much more. It is going to take a significant increase in time, management attention, and financial resources by all parties before we can advance in ways that will truly protect and restore the Great Lakes for future generations.

Thank you for holding this important hearing and for the opportunity to provide testimony. I would be happy to answer any questions you may have.

Testimony of Andy Buchsbaum
Director, National Wildlife Federation's Great Lakes Office and
Co-Chair, Healing Our Waters℠–Great Lakes Coalition

Before the House Committee on Transportation and Infrastructure's
Subcommittee on Water Resources and Environment

Hearing on the Impact of Invasive Species on the Great Lakes

March 7, 2007

Madame Chairwoman, Mr. Ranking Member, members of the Subcommittee, thank you for the opportunity to testify before you on a critically important issue: the impact of invasive species on one of our nation's greatest natural treasures - the Great Lakes. My name is Andy Buchsbaum and I am the director of the National Wildlife Federation's Great Lakes Office. NWF is America's oldest and largest conservation organization and has one million members and affiliated organizations in 47 states. I am also a co-chair of the broad-based Healing Our Waters–Great Lakes Coalition. The HOW Coalition is made up of over 90 national, regional, state and local organizations that are dedicated to the protection and restoration of the Great Lakes. These include Great Lakes state and regional conservation organizations such as the Alliance for the Great Lakes, Great Lakes United and the Ohio Environmental Council; national conservation organizations like Ducks Unlimited, the National Parks Conservation Association, Trout Unlimited, the Sierra Club, the Nature Conservancy and the Audubon Society; educational institutions such as Shedd Aquarium and Brookfield Zoo; and government representatives such as the County Executives of America. The Coalition's membership list accompanies this testimony as Appendix A.

As this subcommittee knows from hearings you have held, the Great Lakes are of national and worldwide importance. Yet, they have been severely damaged by numerous stresses, the most severe being invasive species. Unless actions are taken soon to protect the Great Lakes from new invaders and to respond to the damage that has already occurred, the Great Lakes face massive and irrevocable degradation.

My testimony today will focus on the impact invasive species are having on the Great Lakes. To help illustrate the threat to our region's way of life, I will first describe the importance healthy Great Lakes are to the nation. I will then outline the accelerating deterioration the Great Lakes are currently experiencing, in large part due to invasive species, and the urgency of congressional action to protect the Great Lakes from this threat. The bottom line is this: any further delay in congressional action to address invasive species will result in irreversible damage and dramatic changes to this national and global treasure.

The Great Lakes: A National Priority

The Great Lakes define the landscape of our nation and a way of life for a region of more than 42 million people. They mean more to us than places to swim or fish; more than places to hike through some of the world's most beautiful dunes and national lakeshores; more than a source of drinking water; more than the lifeblood of commerce and industry. For those of us who live here, they are part of our way of life. They define who we are, our past and our future.

When I was growing up near Chicago, the high points of my childhood each summer were trips to Lake Michigan's North Avenue Beach in Chicago, the Indiana Dunes, and the Warren Dunes in Michigan. My friends and I would play in the water, race down the dunes and watch the incredible sunsets over waters so vast you could not see the other side. Now my own family is reprising those wonderful times. The best part of my sons' summers are when we go to roam the shoreline of Lake Superior, swim in the bone-biting cold of its waters and watch the sun set under the horizon. The lakes create the memories that bind my family to millions of others, and link my generation with my parents' and my children's. They are the defining features of our physical world, our continuing constant.

So it is no surprise that the Great Lakes are a top priority for those of us who live there. A 2003 Joyce Foundation poll asked Great Lakes residents if protecting and restoring the Great Lakes is important. Ninety six percent said yes! This response shows how closely we identify with our home.

The health of the Great Lakes is important not to just those that live there, however, but to every American as well. These Lakes define our nation's geography and history. They constitute 95 percent of the surface freshwater in the United States. They have a coastline of 10,000 miles – longer than the combined U.S. coastlines of the Atlantic and Pacific Oceans. They supply the drinking water, shipping, recreation and economic lifeblood to millions of people in eight states. They constitute a 1,000-mile border between the U.S. and Canada. They are continental features that attract migratory birds from the Canadian Arctic to South America. Millions of migratory waterfowl breed in the Great Lakes and then fly to the eastern and southern U.S. to supply hunters and birdwatchers from New Jersey to Louisiana.

The Great Lakes are truly a national treasure. Tom Kiernan, President of the National Parks Conservation Association and co-chair of the Healing Our Waters Coalition, puts it this way: "The Great Lakes are national icons, a beautiful natural treasure you can see from space. Like the majestic Grand Canyon and Everglades, these inland oceans help define the soul of a region and the landscape of a nation." Their national importance has prompted 11 national organizations to actively participate in the Healing Our Waters Coalition to protect and restore them. Leaders from around the country – including those from the Chesapeake Bay, Restore America's Estuaries, Everglades and Coastal Louisiana, each of which also have pressing needs for restoration – understand the national importance of the Great Lakes and their need for protection and restoration:

"Like the Chesapeake Bay, the Great Lakes are resources of national significance. They

have helped shape our history as a nation and they have provided immeasurable recreational, economic, and cultural opportunities for our citizens. Unfortunately, they share a history of insufficient investment in their protection and restoration. National attention, national funding, and national commitment to the restoration of natural resources like the Chesapeake Bay and the Great Lakes is critical for us, as a nation, to ensure a legacy of clean water, abundant fisheries, and economic development for future generations." Roy A. Hoagland, Esq., Vice President, Environmental Protection and Restoration, Chesapeake Bay Foundation

"The Great Lakes are extraordinary resources of national importance, and they require national attention and funding to get back to health. Like the Great Lakes, many of our nation's Great Waters - such as Puget Sound, the Louisiana Coast, the Everglades or Chesapeake Bay -- are in grave condition. Investments in the restoration of these critical ecosystems will repay us many fold, and will benefit the nation as a whole." Mark Wolf-Armstrong, CEO of Restore America's Estuaries.

"The Great Lakes are of national importance. If we can't save Coastal Louisiana, we can't save the Great Lakes and vice versa. It can't be that we have to choose one place over another, or we'll be set up to fail everywhere. The consequences to the nation of inaction or delay are enormous. We cannot afford to wait, either here in Coastal Louisiana or in the Great Lakes." Mark Davis, Director, Coalition to Restore Coastal Louisiana

"As America's Everglades is a unique national treasure, so too are the Great Lakes. The people of the Great Lakes region support restoring the Everglades, and we support restoring the Great Lakes." – Everglades Coalition

Our Coalition appreciates their support and we support their efforts to protect these national resources as well.

The Great Lakes' economic importance to the Midwest and the nation is immense. The Great Lakes annually generate billions of dollars of economic revenue directly:

- Tourism in Ohio is a $7 billion industry sustaining over a quarter of a million jobs.
- In Michigan, tourism generates $16 billion annually, and in Wisconsin, $11.8 billion.
- Hunting, fishing and wildlife watching account for more than $18 billion annually in the Great Lakes states.

But the economic impact of the Great Lakes is far greater than this. Twenty-five million people rely on the Great Lakes for their drinking water. Industries such as auto, power, agriculture and steel depend on them to supply their industrial processes. Consumers and businesses throughout the region and the nation rely on them for the shipment of goods such as grain, steel and manufactured goods. The Great Lakes define not just the recreational and ecological footprint of the region; they drive the economic opportunities in the Midwest.

The economy of this region is vitally important to the nation. The Great Lakes region produces one-third of the nation's economic gross state product. The Great Lakes are the natural infrastructure that supports this productivity; their health is critical to economy of the Midwest and the nation.

The Healing Our Waters Coalition will be better able to demonstrate what we already know: investing in Great Lakes restoration and protection is good for our nation's economy as it is for our families and environment. We are partnering with the Council of Great Lakes Industries, the Great Lakes Cities Initiative and the Brookings Institution to produce an independent study of the ways in which investing in Great Lakes ecosystem restoration will support the economy of the region. We will be happy to share it with the Subcommittee when our work is complete later this year.

A Resource in Peril: "Ecosystem Breakdown"

Despite their vast size, the Great Lakes are fragile and need our nation's help. In recent years, the Great Lakes have been increasingly plagued by beach closings due to untreated sewage; invasions by harmful exotic species (on average, one new invasive species enters the Great Lakes every eight months); contamination of sport and commercial fisheries; and loss of habitat for wildlife. Each of these and other problems has been viewed as a separate challenge to be researched and addressed independently; few have tried to assess the condition of the Great Lakes as an ecosystem and design solutions on that basis.

In December 2005, over sixty of the leading scientists in the Great Lakes region issued an alarming report. In a paper titled "Prescription for Great Lakes Ecosystem Protection and Restoration"[1], the scientists concluded that the Great Lakes are experiencing an historic crisis (attached as Appendix B). Deterioration of large sections of their ecosystem is accelerating dramatically, and if not addressed now, the damage is likely to be irreversible. In their own words:

> "There is widespread agreement that the Great Lakes presently are exhibiting symptoms of extreme stress from a combination of sources that include toxic contaminants, invasive species, nutrient loading, shoreline and upland land use changes, and hydrologic modifications . . .. In large areas of the lakes, historical sources of stress have combined with new ones to reach a *tipping point*, the point at which ecosystem-level changes occur rapidly and unexpectedly, confounding the traditional relationships between sources of stress and the expected ecosystem response. *There is compelling evidence that in many parts of the Great Lakes we are beyond this tipping point. Certain areas of the Great Lakes are increasingly experiencing ecosystem breakdown*, where intensifying levels of stress from a combination of sources have overwhelmed the natural processes that normally stabilize and buffer the system from permanent change."[2] (Emphasis added)

Over 200 scientists from around the country, including from California, Hawaii and Tennessee, have endorsed the report.

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[1] http://restorethelakes.org/PrescriptionforGreatLakes.pdf

[2] http://restorethelakes.org/PrescriptionforGreatLakes.pdf, P.1

The scientists' report was a surprise to the public because to many, the Great Lakes and their tributaries seem to be improving. Due to fundamental policy shifts like the Clean Water Act, massive government investment in better sewers and responsible private initiatives, rivers no longer catch fire, Lake Erie has come back from the dead, the water often looks clearer and many pollutant indicators have improved. But such observations only scratch the surface and the scientists looked much deeper to find an ecosystem in crisis. They have documented:

- The destruction of the foundation of the Great Lakes food web in many of the Great Lakes. Populations of the basic food group for most fish, a freshwater shrimp called *Diporeia,* have declined from over 10,000 per square meter of lake bottom to virtually zero over vast stretches of Lake Michigan and the other Great Lakes. The scientists cannot be sure, but they believe the decline is linked to the infestation of the Great Lakes by an invasive species, the zebra mussel, which colonizes the lakebeds in thick mats of shells that extend for acres and leaves the surrounding lakebeds barren of life. The National Wildlife Federation produced a report describing the devastating impact that invasive species have had on the Great Lakes in a report titled *Ecosystem Shock* (attached as Appendix C).

- Lake Erie's so-called "dead zone," an area deprived of oxygen, has reappeared in central Lake Erie. Accompanying this anoxic zone is the return elsewhere in the lake of blue-green (toxic) algae blooms and episodic die-offs of fish and fish-eating birds from avian botulism. Scientists are seeing similar eutrophication problems in Lake Huron's Saginaw Bay and Lake Michigan's Green Bay.

- Many fish populations are showing signs of stress and decline in the Great Lakes. Scientists have found widespread decline in growth, condition and numbers of yellow perch, lake whitefish and other valuable fish species in Lake Michigan and portions of Lake Huron.

The scientists concluded that these and other large-scale ecosystem changes result from the loss of the Great Lakes' capacity to buffer themselves against sources of stress – essentially, damage to the Great Lakes immune system. Much of the buffering capacity for the Great Lakes comes from healthy near-shore communities and tributaries. As these areas are damaged by pollution, hydrologic modifications, invasive species and shoreline development, they lose their capacity to buffer the Great Lakes. Without that buffering capacity, each new stress – whether it is an invasive species or additional pollution – can set off a cascade of damage to the ecosystem that occurs rapidly and unexpectedly. In the scientists' words:

> "In the Great Lakes, nonlinear changes are no longer a future threat–these types of changes are taking place now. While in some areas some indicators of ecosystem health have continued to improve over the past decade, other large areas of the lakes are undergoing rapid changes where combinations of effects of old and new stresses are interacting synergistically to trigger *a chain reaction process of ecosystem degradation. The rapidness of this chain-reaction process, seen over the past five to fifteen years and*

involving sudden and unpredictable changes, is unique in Great Lakes recorded history."[3] (Emphasis added)

Invasive Species Role in the Breakdown of the Great Lake Ecosystem

Although it is hard to determine which problem is the largest cause of the ecosystem breakdowns now plaguing the Great Lakes, many scientists believe that it is invasive species. It is easy to see why:

- Scientists have found 183 aquatic invasive species in the Great Lakes thus far, making it one of the most invaded ecosystems in the world. They include:

  - Eel-like sea lamprey that attack lake trout and suck the blood out of them;
  - Zebra and quagga mussels that form thick mats of shells over vast stretches of the lake floors and beaches and disrupt the food chain;
  - A fish-killing virus called viral hemorrhagic septicemia that has spread to Lakes Ontario, Erie and Huron and caused multiple fish kills; and
  - Most recently, bug-eyed shrimp that feed on tiny zooplankton and phytoplankton that directly or indirectly sustain the Great Lakes native fish species was found in Lake Michigan.

- Since 1950, on average one new invasive species has entered the Great Lakes every seven months. Under such an onslaught it is impossible to conceive of how the Great Lakes ecosystem could possibly reach any sort of equilibrium, how aquatic life could recover or how scientists and managers could make decisions to help restore the lakes' buffering capacity.

- Invasive species are affecting every level of the Great Lakes ecosystem: the lake bottoms, the water column, the surface, the shorelines, the near shore and the open water, the zooplantkton, the forage fish and the fish at the top of the food web (like trout and walleye).

- The breadth, depth and frequency of these invasions are facilitating what some scientists call "invasional meltdown." Some invaders alter their new environment in ways that make it easier for subsequent invaders to thrive, making it even more difficult for native species to survive.

- The aquatic invaders are only one part of the invasives problem. Terrestrial invaders also are having devastating impacts on the Great Lakes ecosystem, making restoration more difficult and raising the costs. All along the coastlines and tributaries, the wetlands so important for the Great Lakes immune system are being taken over by phragmites and purple loosestrife. Lake Ontario is losing its native wetlands, which are based on sedge grasses. As we propose to spend billions of dollars on restoring

[3] http://restorethelakes.org/PrescriptionforGreatLakes.pdf, P.8

coastal wetlands, we need to protect the wetlands we have from these terrestrial invaders.

Virtually every ecosystem breakdown in the Great Lakes identified by the scientists – the Lake Erie anoxic zone, the declines and stresses in fish populations, and widespread food web disruption – are caused in large part by invasive species. The massive damage to the Great Lakes food web over the past 15 years is perhaps the most illustrative example of why invasive species are so devastating. Fully 99 percent of the foundation of the food web – the food available to fish in the sediments of the Great Lakes – is made up of four species: tiny shrimp-like creatures called *Diporeia*; fingernail clams; certain worms, and opossum shrimp. Of these, *Diporeia*, the tiny shrimp, dominate making up 80 percent of the available food.

Since about 1990, however, the *Diporeia* and fingernail clam populations have crashed over vast stretches of Lake Michigan, Lake Huron and other lakes. Attached to this testimony in Appendix C are two charts that illustrate the decline in *Diporeia* in Lakes Michigan and Huron. Dr. Tom Nalepa of NOAA's Great Lakes Environmental Research Laboratory, based on his research of the past two decades, produced these figures. They graphically show a 94 percent decline in *Diporeia* organisms in Lake Michigan over 10 years and a 57 percent decline of those organisms in Lake Huron in only 3 years. *Diporeia* populations have gone from 10,000 organisms per square meter to virtually zero in many areas. Scientists have also seen a parallel crash in the populations of fingernail clams, and are now concerned about the viability of the other major food source, the opossum shrimp.

Scientists believe that the cause of this collapse is zebra mussels. Zebra mussels colonize the lakebeds in thick mats of shells that extend for acres and leave the surrounding lakebeds barren of life. They are not completely sure, though, and are still searching for the mechanism that causes the disappearance of the *Diporeia*.

Ironically, zebra mussel populations are now declining in the Great Lakes. The invasive quagga mussel is crowding them out. The quagga mussel threatens to further depress the *Diporeia* populations in the Great Lakes, and even worse, decimate the remaining food sources in the lake sediments – particularly the opossum shrimp. Dr. Nalepa's studies have produced two other charts on the growth of the quagga mussel population, attached as Appendix D.

The damage to these foundation species is sending waves throughout the Great Lakes food web. We are seeing impacts on native perch, walleye and trout. Combined with the other invasive species that have invaded our region, the Great Lakes ecosystem is experiencing breakdown. As invasive species like zebra and quagga mussels overwhelm the Great Lakes, large stretches of the lakes that used to be teeming with life are now barren.

These rapid and dramatic changes to the Great Lakes food web are unprecedented in the recorded history of the lakes. And unless we take action now, the attacks on the lakes will only worsen. The damage to the food web done by zebra mussels, quagga mussels and other aquatic invaders will be very difficult to repair.

Unless we stop new invaders from entering the Great Lakes, however, restoring them will be impossible. The Great Lakes cannot even begin to recover when every seven months another invasive species enters the lakes and begins to wreak its own particular kind of havoc on the ecosystem. Scientists say they are falling farther and farther behind in even understanding the lakes because the system changes so dramatically due to these fresh invasions.

Potentially the worst aquatic invaders to the Great Lakes thankfully have not yet arrived. They are Asian and silver carp, large fish with voracious appetites that are only 50 miles from Lake Michigan. These fish can grow as large as 100 pounds and six feet in length and eat everything in their path. They were intentionally introduced to clean out catfish farms on the Mississippi, but escaped and migrated up the Mississippi River to the Chicago Sanitary and Ship Canal. In some areas of the Mississippi River, Asian carp have multiplied so rapidly that in less than a decade they make up 90 percent or more of the fish life. Scientists at the Illinois Department of Natural Resources have shown that native fish are suffering. The average weight of a 25-inch buffalo fish, a native and popular fish with locals in the Illinois River, has dropped from over 12 pounds to less than 9 pounds over five years.

The only thing standing between these monster fish and Lake Michigan is a temporary underwater electric barrier installed by the U.S. Army Corps of Engineers. Unfortunately, a permanent barrier has design problems and cannot be brought on-line without further investment and time, and the temporary barrier is not failsafe. Until the permanent barriers are operational and effective, the Great Lakes are at extreme risk. As a U. S. Fish and Wildlife officer explained to a newspaper, "If the Asian carp get into Lake Michigan, they will turn the Great Lakes into giant carp ponds."

Actions Needed To Stop Invasive Species From Entering The Great Lakes

The National Wildlife Federation's *Ecosystem Shock* report described the damage to the Great Lakes food web. It also provided the best summary of information (known at that time) of which invasive species were causing the most damage, where they had been introduced and when, where they originated and what should be done to stop them.

As the report showed, invasive species enter the Great Lakes from a number of sources. There is no single "silver bullet" that can protect the lakes, which is why our nation needs a comprehensive approach. We can start by addressing the biggest vector for invasive species to the Great Lakes: the ballast water of foreign ships. Ships from outside the Great Lakes system take on ballast water in their homeports and travel to the Great Lakes. When they put off and take on cargo in Great Lakes ports, they uptake and discharge that ballast water. Often the ballast tanks of these ships contain organisms not native to our region. Many of these organisms thrive in cold fresh water, reproducing and becoming yet another on a growing list of invasive species in the Great Lakes.

But ballast water is not the only source of invasive species in the Great Lakes. Other vectors include ship hulls, accidental and intentional releases and ship or barge canals. One of the worst invaders, the eel-like sea lamprey, which decimated the lake trout population throughout the lakes, migrated through the Lake Erie Canal and reached Lake Superior by 1938.

These multiple vectors for entry demand a comprehensive strategy to combat them – one that is integrated and national. Such legislation must have strong provisions that require effective standards that are defined, set and enforced for how ships manage their ballast water; supports information and education outreach programs to reduce the potential for aquatic invasive species introductions; creates a rapid response process for the containment, control, and eradication of initial invasions; screens live aquatic species for invasiveness before import; and authorizes additional research to ensure that proper methods are developed and used to prevent, control and eradicate aquatic invasive species.

Steps to combat the invasive species problem in a comprehensive manner have already begun in the Senate. The Healing Our Waters Coalition supports the bi-partisan, national approach taken by Senators Carl Levin and Susan Collins. They introduced S. 725, the National Aquatic Invasive Species Act (NAISA), on March 1. This legislation lays the foundation to control the invasion of aquatic species in the Great Lakes. Our Coalition looks forward to working with the bill sponsors to further enhance the enforcement and screening provisions of this legislation, which we hope is considered by Congress this year.

In addition to the actions proposed in S. 725, we also need to address the canals that connect the Great Lakes to other watersheds. The top priority must be the Chicago Sanitary and Ship Canal because of the close proximity of the Asian carp. The clear consensus of the Healing Our Waters Coalition members and our partners among the cities, states and business communities is that the top priority must be funding and completing the electric barrier that is currently keeping the Asia Carp from reaching Lake Michigan. For a relatively small investment – about $9.0 million – the permanent barrier can be brought on line in the next few months, thereby saving the Great Lakes and the nation from spending billions of dollars in response costs and lost jobs.

Stopping the entrance of new aquatic invaders must be the top priority, but it is not the only priority. The Great Lakes have sustained extensive damage such as food web disruptions from zebra mussels, quagga mussels, sea lamprey and 180 others. Restoration, not just protection, is required.

Scientists, policy-makers and the citizens of the region came together to make a single set of recommendations to restore the Great Lakes. They joined in a process called the Great Lakes Regional Collaboration, which involved all levels of government (federal, state, tribal, local), scientists, multiple stakeholders and citizens from the region in a 12-month planning effort. The result of that effort is a precedent-setting Great Lakes protection and restoration plan called the Great Lakes Regional Collaboration "Strategy to Restore and Protect the Great Lakes." The Strategy recommends a $20 billion in federal, state, local and private investment in the Great Lakes to restore wetlands, clean up toxic sediments, stop non-point pollution, and most importantly, to stop invasive species introduction by passing a new law like NAISA.

All of these investments are important to address the harm that invasive species have already caused the Great Lakes. As the scientists stated in their "Prescription" paper, the Great Lakes can recover their health and stabilize if their buffering capacity – their immune system –

can be restored. Restoring the health of lake sediments and shorelines can help restore the Great Lakes immune system, providing the lakes with the buffering capacity they need to heal themselves and repel new insults. So actions like cleaning up toxic sediments, softening shorelines, instituting buffer strips and restoring wetlands will help repair the damage that zebra and quagga mussels have caused.

For that reason, it must be a priority not only to pass laws that stop new invaders from entering the lakes, but also to invest the resources necessary to allow the lakes to heal themselves from existing invaders. The Great Lakes Collaboration Implementation Act was introduced last year to ensure that Congress addresses all of priorities at once and in an integrated way. This legislation addressed the key issues raised by the Great Lakes Regional Collaboration. Our Coalition urges this Subcommittee to consider the elements of that legislation when the bill is reintroduced this year. The longer we wait to clean up toxic harbors, protect wetlands or upgrade sewer systems, the more expensive and harder it becomes.

Conclusion

Although invasive species have plagued the Great Lakes for over a century, we are now at a tipping point. Because rapid action is so important for the health of both the Great Lakes and the region's economy, we are now seeing states begin to take matters into their own hands. Michigan, for example, passed a law in 2005 requiring ocean-going vessels that discharge ballast to install ballast-water treatment by the beginning of this year. Other states are considering similar laws. Even though no single state can solve this problem alone, they hope that by taking the initiative they can spark congressional action.

The Great Lakes are under attack. If we are going to be truly successful in stopping foreign invasions of species from far away places, Congress needs to pass a comprehensive law this year that ends the dumping of untreated ballast water, closes the door on the Asian carp and provides mechanisms to screen species being imported in our country and educate the public on the impact invasive species has on our environment and economy. The economic and ecological wellbeing of our region and a way of life are at stake.

We hope that this hearing is the beginning of that congressional action. Thank you again for the opportunity to testify before you today.

Appendix A: Members of the Healing Our Waters-Great Lakes Coalition

Appendix B: Bails, et.al. "Prescription for Great Lakes Ecosystem Protection and Restoration: Avoiding the Tipping Point of Irreversible Change" December 2005

Appendix C: National Wildlife Federation. "Ecosystem Shock: The Devastating Impacts of Invasive Species on the Great Lakes Food Web" October 2004

Appendix D: Diporeia declines in the Great Lakes

Appendix E: Quagga Mussels in the Great Lakes

Prescription for Great Lakes Ecosystem Protection and Restoration

Avoiding the Tipping Point of Irreversible Changes

December 2005

(Endorsements as of May, 2006)

Jack Bails, Vice President, Public Sector Consultants

Alfred Beeton, Ph.D., retired Director of Great Lakes Environmental Laboratory, Adjunct Professor, University of Michigan

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Note: Affiliations are listed for identification purposes only.

OVERVIEW

There is widespread agreement that the Great Lakes presently are exhibiting symptoms of extreme stress from a combination of sources that include toxic contaminants, invasive species, nutrient loading, shoreline and upland land use changes, and hydrologic modifications. Many of these sources of stress and others have been impacting the lakes for over a century. These adverse impacts have appeared gradually over time, often in nearshore areas, in the shallower portions of the system, and in specific fish populations. Factors such as the size of the lakes, the time delay between the introduction of stress and subsequent impacts, the temporary recovery of some portions of the ecosystem, and failure to understand the ecosystem-level disruptions caused by the combination of multiple stresses have led to the false assumption that the Great Lakes ecosystem is healthy and resilient.

Because it has taken the Great Lakes four centuries of exposure to these human-induced stresses to get to this point, some argue we have decades to control these and other sources of stress and promote the lakes' recovery.[1] From this perspective, protecting the Great Lakes is not particularly urgent and action can wait until we conduct more studies, while taking small corrective measures when the opportunity or need arises. However, if not addressed with great urgency, the Great Lakes system may experience further – and potentially irreversible – damage.

In large areas of the lakes, historical sources of stress have combined with new ones to reach a tipping point, the point at which ecosystem-level changes occur rapidly and unexpectedly, confounding the traditional relationships between sources of stress and the expected ecosystem response. There is compelling evidence that in many parts of the Great Lakes we are at or beyond this tipping point. Certain areas of the Great Lakes are increasingly experiencing ecosystem breakdown, where intensifying levels of stress from a combination of sources have overwhelmed the natural processes that normally stabilize and buffer the system from permanent change.[2]

Although the specific episodes of ecosystem breakdown have been unpredictable and alarming, few Great Lakes researchers are surprised by these occurrences. A number of papers were published in the 1980s describing stresses in various areas of the Great Lakes, including Lake Erie and shallow embayments in lakes Michigan, Huron, and Ontario. These papers described the symptoms of the Great Lakes ecosystem under distress, and laid the foundation for a conceptual ecological framework for understanding the changes that were occurring at that time. Rapport et al. (1985) discussed ecosystem self-regulating mechanisms (such as responses to invasive species) and the process by which stresses can give rise to early warnings, coping mechanisms, and ultimately lead to ecosystem breakdown if the overall stress is sufficiently prolonged and/or intense. The ecosystem adaptation syndrome discussed in the paper can be used to help formulate a systematic ecosystem approach to environmental management of the Great Lakes. This ecosystem breakdown concept helps explain the scope,

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[1] Great Lakes Interagency Task Force, Report to the President on the Implementation of the Great Lakes Executive Order, undated, available at: http://www.epa.gov/glnpo/collaboration/final_rttp_10282005.pdf

[2] This is analogous to discussions of resilience and catastrophic change in ecosystems as presented in Scheffer et al. (2001), whereby assuming alternative stable states are available, sufficient perturbation in any ecosystem can shift it to an alternative (and potentially "unwanted") stable state.

intensity, and speed of the ecosystem changes that have occurred in the Great Lakes since the 1980s.

Examples of ecosystem breakdown or major changes in the lakes include: (1) persistence of the anoxic/hypoxic zone in the central basin of Lake Erie and other stresses in the eastern and western basins; (2) continued symptoms of impairment (including eutrophication) in Saginaw Bay and Green Bay; (3) well-documented rapid disappearance of the once abundant amphipods in the genus *Diporeia* in sediments of large areas of all the lakes (except for Lake Superior), and concomitant food web disruptions; (4) recent declines in growth, condition and numbers of lake whitefish in Lake Michigan and portions of Lake Huron; and (5) elimination of the macrophyte (i.e. rooted plant) community and simplification of the benthic food web, in Sandusky Bay on Lake Erie and Cootes Paradise in Hamilton Harbour on Lake Ontario, due to sediment and other pollutant loads.

The major cause of ecosystem breakdown is the severe damage that has been done to the Great Lakes' self-regulating mechanisms. In the past, healthy nearshore communities and tributaries helped reduce the impact of many stresses on or entering the lakes. Over time, the combined effects of a whole suite of stresses from a variety of human-induced sources have overwhelmed the ecosystem's self-regulating mechanisms. This diagnosis suggests that it is appropriate and necessary to address multiple sources of stress in order to reverse the trend toward widespread ecosystem breakdown. The following is a list of Great Lakes management objectives based on this diagnosis.

- *Restore*

Restore critical elements of the *ecosystem's self-regulating mechanisms*. To the extent possible, reestablish natural attributes of critical nearshore and tributary communities so they can once again perform their stabilizing function. Where full restoration of natural attributes is not possible, improve desirable aspects through *enhancement* of important functions.[3]

- *Remediate*

Remediate abusive practices that create *sources of stress*. Reduce or eliminate physical habitat alterations, pollution loadings, pathways for invasive species, and other stressors or their vectors into the lakes.

- *Protect*

Protect the functioning portions of the ecosystem from *impairment*. Preserve those portions of the ecosystems that now are healthy, and those that can be restored or enhanced, through sustainable development practices within the Great Lakes basin.

- *Measure*

Building on existing efforts, measure ecosystem health through a set of agreed-upon integrative indicators that can serve to assess current conditions and monitor the progress of restoring the lakes.

[3] Establishment of restoration goals obviously needs to acknowledge ecological constraints (e.g., the presence of numerous invasive species – including introduced fish – that are currently important components of food webs) as well as consider other human use objectives (e.g., maintenance of sport fisheries that include introduced species) (see, for example, discussions in Kitchell et al., 2000; Mills et al., 2003; Sproule-Jones, 2003).

The conceptual model here indicates the importance of immediate and sustained action. It advocates using the principles of ecosystem-based management to restore and protect the Great Lakes. Without such action, the lakes could potentially suffer irreversible and catastrophic damage.

SYMPTOMS

Many of the changes the Great Lakes have experienced in response to sources of stress have been documented for decades. Examples of symptoms and sources of stresses to the lakes include:

- Extirpation or major declines in important native species (such as lake trout and deepwater ciscoes) due to overfishing and effects from aquatic invasive species (such as sea lamprey predation on lake trout, and competition with deepwater ciscoes by introduced alewives and rainbow smelt);
- Widespread reproductive failures of keystone, heritage, and other (both native and introduced) fish species, including lake trout, sturgeon, lake herring, coaster brook trout, and Atlantic and Pacific salmon;
- Fouling of coastlines, resulting in beach closings and loss of habitat for fish and waterfowl;
- Toxic contamination of fish, which threatens the health of people, wildlife, and some fish species themselves, and results in fish consumption advisories throughout the Great Lakes and inland lakes and rivers;
- Loss of coastal wetlands, including over 90% of the presettlement wetlands along the Lake Huron/Lake Erie corridor;
- More recent introductions of aquatic invasive species (e.g., zebra and quagga mussels, round gobies and predatory zooplankton such as *Bythotrephes cederstroemi* and *Cercopagis pengoi* (two species of water fleas)) leading to declines in valued/important native aquatic species (including certain plankton, unionid clams and certain native fish species);
- Decreased populations of benthic organisms in many locations, causing decreased health in lake whitefish and with the potential to impact other species; and
- General water quality degradation, associated algal blooms, Type E botulism in fish and waterfowl, and contamination of drinking water (e.g., Johnson et al., 1998; Beeton et al., 1999; IJC, 2000; IJC, 2002; IJC, 2004; Whelan and Johnson, 2004).[4]

[4] In some cases, policies designed to address these stresses have been effective. Most notably, the passage in the United States of the Clean Water Act in 1972 and subsequent amendments initiated the National Pollutant Discharge Elimination System for point sources and resulted in billions of dollars in investments by federal, state, and local governments to upgrade, improve, and extend wastewater collection and treatment systems directly tributary to the Great Lakes; similar scale investments were made in Canada. The ban on the use and manufacturing of certain toxic chemicals, and strict protections put on others, has helped allow key indicator species (eagles, herring gulls) to return to health. However, even with substantial investments over the past three decades, wastewater treatment plants and sewer systems are in need of substantial new capital expenditures for major repairs, upgrades and, in some cases, replacement, and it is clear that local funding alone will not be adequate to the task. In addition, though a subject of research and policy focus for a number of years, nonpoint source pollution – including urban runoff, agricultural runoff, air deposition, and contaminated sediments – continues to be a significant contributor of pollutants to Great Lakes waters.

Historically, these and other symptoms were attributed to six major anthropogenic or human-induced sources of stress to the ecosystems in each lake.[5] The symptoms may appear stepwise like a chain reaction or self-organize in a complex, ecologically degraded manner. Listed in no particular order are those anthropogenic sources of stress: (1) **overfishing** (i.e., extracting larger quantities of fish than the system can sustain naturally); (2) **nutrient loading** (i.e., addition of phosphorus and nitrogen in excess of natural levels, usually via human waste and urban and agricultural runoff); (3) the release of **toxic chemicals** (e.g., mercury, polychlorinated biphenyls (PCBs) and other chlorinated hydrocarbons), including many that are both persistent and bioaccumulative;[6] (4) increased sediment loading as well as other sources of stress associated with **land use practices** (e.g., physical changes including alteration of vegetative land cover, wetland filling, modification of shorelines); (5) introduction of invasive (nonnative) **exotic plant and animal species** (e.g., purple loosestrife, sea lamprey, and zebra mussel); and (6) **hydrologic alterations** in tributary and connecting waterways, diversion and/or alteration of flows through the construction of dams, channels, and canals, alteration of natural drainage patterns (e.g., leading to increased surface water runoff and stream flows in urban areas with increased imperviousness).

Many of the symptoms of stress on the Great Lakes are attributable to a combination of these six sources of stress. Fouling of coastlines and near-shore areas arises from sewage overflows and contaminated runoff. Historically, valued species of fish declined in number or disappeared as a result of overfishing and, to varying degrees, invasive species, lost habitat connectivity, and toxic chemicals. Presently, invasive species and concomitant food web changes as well as lost connectivity of tributary spawning habitat play a larger role in affecting fish populations. Toxic chemical contamination in fish, which also threatens the health of humans and fish-consuming wildlife, is a direct result of historical and current toxic chemical releases. The loss of coastal wetlands stems from changes in land use practices and hydrologic alterations. Changes in water quality are caused directly by toxic chemical, nutrient, microbial and sediment pollution, as well as through actions of some invasive species (e.g., zebra mussels). Invasive species are the most likely principal source of food web disruptions now occurring in the Great Lakes, and are implicated in reproductive failures of some fish species (e.g., walleyes, lake trout, yellow perch, and lake herring) (McDonald et al., 1998; Fielder and Thomas, 2005).[7]

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[5] Although we often speak of a "Great Lakes ecosystem," in most cases each lake basin has its own ecosystem, further divided into sub-basin ecosystems.

[6] In addition to chemicals that have been of longstanding concern in the Great Lakes, increasing attention is being directed at chemicals of emerging concern, including those found in products such as pharmaceuticals, personal care products, and flame retardants. Some of these and other chemicals may act as endocrine disruptors or otherwise alter regulatory systems in biota, and potentially add to the stress caused by toxic chemicals of principal focus in the region.

[7] One example of reproductive effects on salmonids involves the action of the enzyme thiaminase, which transforms the essential vitamin thiamine. In a recent study, lake trout fed diets with substantial amounts of thiaminase (either in bacterial form or with alewives (an introduced species with naturally elevated levels of the enzyme)) produce eggs more susceptible to embryonic early mortality syndrome (Honeyfield et al., 2005).

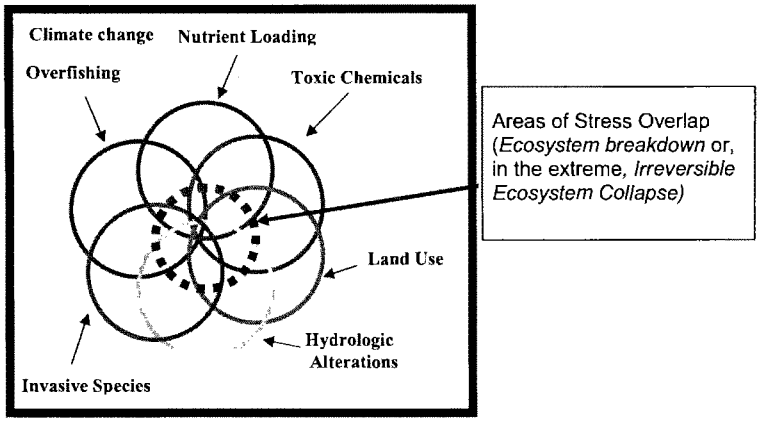
It should be noted that superimposed on these primary stresses are the broader, large-scale changes in global and regional climate. A recent analysis of the potential global warming and regional climate change impacts to the Great Lakes region included declining lake levels and the duration of winter ice, jeopardizing reproduction of some fisheries, and general lake warming that could negatively impact coldwater fish species, favor invasions of warm water nonnative species, and expand the duration of summer stratification and increase the potential for hypoxia ("dead zones") (Kling et al., 2003). These findings were generally consistent with earlier predictions for the Great Lakes in a scenario with a doubling of atmospheric carbon dioxide levels, although the researchers emphasized that the many complex interactions could lead to varied responses in individual ecosystems (e.g., thermal habitat changes in deep stratified lakes vs. shallow lakes and streams) (Magnuson et al., 1997). In addition to these potential compounding factors in the lakes proper, earlier ice breakup and earlier peaks in spring runoff will change the timing of stream flows, while increases in heavy rainstorms may cause more frequent flooding with potential increases in erosion, and additional water pollution from nutrients, pesticides, and other contaminants. While it is difficult to know how these changes will interact with the other six classes of stress identified above, there is little doubt that global warming will add yet another source of stress to the already perturbed Great Lakes ecosystem.

DIAGNOSING THE DISEASE

The Great Lakes ecosystem and the major human-induced sources of stress on it can be portrayed as a series of overlapping circles in a Venn Diagram, as shown in Figure 1 on the following page.[8] For areas where stresses act singly or jointly but not at intense levels, an ecosystem may change adaptively to an unhealthy state of diminished vigor and unpleasant aesthetics but not suffer major transformation to a disorganized critical state. Such a contrast could be analogous to a person feeling sick and redirecting vital efforts to recover at home rather than being taken to a crisis center for surgery or other intensive care. In an ecosystem in which only one stress acts intensely, positive (or reinforcing) or synergistic feedback loops can emerge, leading to a runaway or catastrophic breakdown process. However, such feedback loops are more likely to occur as the adverse effects of a number of stresses interact. The probability of disastrous ecosystemic breakdown appears to increase with the number of stresses acting on and interacting in the ecosystem. Thus, in this conceptual model, the probability of breakdown is likely to be highest at the center of the Venn Diagram where all types of stress act and interact to varying degrees. The prevention of this type of ecosystem breakdown should be the focus of attention in any restoration and protection efforts.

[8] The locations of stresses on the diagram is somewhat arbitrary, as the model is limited to working with stresses that are represented in two dimensions. It is possible that two or more stresses might interact in stronger ways (and others less coherently) that can be represented in the diagram.

Figure 1.



The magnitude (intensity), shape, and degree of overlap of the stresses have varied over time and space. For example, **overfishing** began in the late 1800s and continued into the 20th Century, while **invasive species** had signifieantly effected the ecosystem by the middle of the 20th Century. Other stresses have had significant effects more locally, such as **nutrient loading** in Green Bay, Saginaw Bay, and the western and central basins of Lake Erie, and **toxic chemicals** in the basin's industrial complexes such as along the Niagara, Detroit and Fox rivers (although due in part to diffuse loadings, many contaminants long ago become more widespread throughout the lakes themselves). In order to address these areas of overlap, there remains the need to better understand the salient features of these areas.

Conceptual Understanding of Ecosystem Stress Adaptation

The nearshore areas are important in the ecosystemic self-organization of the Great Lakes. Before the significant impact of humans (i.e., following European settlement), the nearshore areas were in equilibrium with surrounding areas. There was a healthy abundance and diversity of organisms interacting to various degrees with surrounding areas (from wetlands to offshore), and loads of nutrients and other constituents from land could be assimilated and/or transferred between communities without major disruptions to the functioning ecosystem. With development and industrialization in the Great Lakes, land use changes, increased pollution, and other factors have increased stress on these nearshore areas.

As the types and intensity of stress increased, two things happened. First, inflowing nutrients were shunted to the open waters of nearshore areas where photosynthetic energy fixation then erupted as plankton blooms. The blooms resulted in the loss of many valued, native species of nearshore communities and an increase in other species, native and nonnative, that favor open waters. Second, the entire ecosystem, including community abundance and composition, became unstable and began to undergo wider and more frequent fluctuations. Increased loadings of sediments from watershed runoff, toxic chemical inputs, oxygen depletion (following increased nutrient loads), hydrological alterations and other sources of stress

created a hostile environment to bottom dwelling, pollution-sensitive species and to the eggs of most Great Lakes fishes (Rapport et al., 1985; Steedman and Regier, 1987). Some of these changes were concomitant with or followed upon earlier changes to the upper portions of the food web due to a combination of introduction of aquatic invasive species (such as the sea lamprey, rainbow smelt and alewives) and overfishing, leading to extirpation or significant depletions of open water species such as lake trout and deepwater ciscoes (Eshenroder and Burnham-Curtis, 1999).

More recently, the invasion of zebra mussels in Lake St. Clair in 1988 and later arrival of quagga mussels have altered this nutrient flow dynamic in the Great Lakes yet again. Extensive colonization by zebra mussels in nearshore areas of the lower lakes has resulted in the reduction of nutrient and energy supplies to the open waters (Hecky et al. 2004). The extreme filtering capacities of zebra mussels for plankton has transferred energy from the water column to the nearshore benthic areas, and diminished the transport of nutrients via currents to the deeper waters. Also, quagga mussels colonize deeper waters and out-compete other organisms for food resources directly. The increased nearshore retention of nutrients along with clearer water has led to an increase in undesirable species of algae. Organic material filtered by mussels is transformed into biodeposits (pseudofeces and feces) that while serving in part as a food source for some organisms, are not utilized as a food source by many other benthic organisms (see below). In addition, the zebra mussels themselves are undesirable prey for most native Great Lakes fish species, but are readily consumed by invasive round gobies. The introduction and spread of zebra and quagga mussels has not only led to declines in native mussels (Nalepa et al., 1996) and other benthic species (see, for example, Nalepa et al., 1998; Dermott, 2001; Lozano et al., 2001), but has also facilitated the spread of other invasive species (Ricciardi, 2001).

With sufficient cumulative stress (including habitat loss, nutrient loadings, oxygen depletion, and invasive species), the capability of once healthy, resilient, and diverse coastal communities to buffer against natural and human perturbations can be overwhelmed. In essence, the health-sustaining system of the Great Lakes is seriously weakened. Once the resilient capabilities are exceeded the ecosystem organization abruptly and catastrophically changes, resulting in ecosystem breakdown. Under extreme circumstances where the suite of stresses become severely intense, the ecosystem adaptive responses in some cases move into another phase dominated by species that can tolerate and benefit from those sources of stress. The presence of surface scum, mats of fungi, strands of filamentous algae, and surface blooms of toxin-producing algae create this new phase in the water column. This surface association has appeared seasonally in certain bays and in the shallow waters of the Great Lakes, but has had adverse affects on both the nearshore and open water communities.

Scientists throughout the world are documenting the actual and expected damage that the loss of such ecosystem resiliency can cause. In March, 2005, the United Nations issued a final draft of a report endorsed by 1,200 of the world's leading scientists called the Millennium Ecosystem Assessment Synthesis Report (United Nations, 2005). One of the report's conclusions follows:

> **There is *established but incomplete* evidence that changes being made in ecosystems are increasing the likelihood of nonlinear changes in ecosystems (including accelerating, abrupt, and potentially irreversible changes), with**

> **important consequences for human well-being.** Changes in ecosystems generally take place gradually. Some changes are nonlinear, however: once a threshold is crossed, the system changes to a very different state. And these nonlinear changes are sometimes abrupt; they can also be large in magnitude and difficult, expensive, or impossible to reverse. (Emphasis in original, endnote omitted) (United Nations 2005)

The Millennium Ecosystem Assessment Synthesis Report conclusions are repeated in a "Scientific Consensus Statement for Marine Ecosystem-Based Management" recently adopted by over 200 scientists (Scientific Consensus 2005). The scientists signing the Consensus Statement on marine environments (as do the scientists endorsing this prescription paper) emphasize the need for a holistic, ecosystem-based management approach, including the dangers of managing only individual sources of stress or specific species:

> **Ecosystems can recover from many kinds of disturbance, but are not infinitely resilient.** There is often a threshold beyond which an altered ecosystem may not return to its previous state. The tipping point for these irreversible changes may be impossible to predict. Thus, increased levels of precaution are prudent as ecosystems are pushed further from pre-existing states. Features that enhance the ability of an ecosystem to resist or recover from disturbance include the full natural complement of species, genetic diversity within species, multiple representative stands (copies) of each habitat type, and lack of degrading stress from other sources. (Emphasis in original.) (Scientific Consensus, 2005)

While the same ecological principles cited for the world's oceans apply to the Great Lakes, the lakes may be less able to cope with stress than typical coastal marine environments. Ecosystems that have evolved in relatively unstable environments, such as those in the intertidal ocean communities that are exposed to frequent tidal movements and that have great diversity of species, are more likely to resist and/or recover from moderate human-induced stress. In contrast, the Great Lakes ecosystem is a relatively young (< 12,000 years), mostly oligotrophic system that has evolved in a relatively stable environment with a more limited number of species. The lakes represent a more closed system than coastal ocean waters, and respond more slowly to contaminant loadings (with longer hydraulic flushing times than coastal areas). Because of these differences, the lakes may be rapidly altered by even moderate stresses such as changes in water quality, system hydrology, or the introduction of invasive species (Rapport and Regier 1995). Thus, action to avoid the tipping point for irreversible ecosystem changes in the Great Lakes may be even more urgent than for coastal marine environments.

Great Lakes Ecosystem Response to Loss of Resiliency

In the Great Lakes, nonlinear changes are no longer a future threat – these types of changes are taking place now. While in some areas some indicators of ecosystem health have continued to improve over the past decade, other large areas in the lakes are undergoing rapid changes where combinations of effects of old and new stresses are interacting synergistically to trigger a chain reaction process of ecosystem degradation. The rapidness of this chain-reaction process, seen over the past five to fifteen years and involving sudden and unpredictable changes, is unique in the Great Lakes' recorded history. Some of the most significant changes observed include the radical food web disruptions occurring in Lakes Michigan, Huron, Erie, and Ontario; the reoccurrence of the anoxic/hypoxic zone in the central basin and other impairments (such as blooms of *Microcystis* cyanobacteria in the

western basin) in Lake Erie; and ongoing problems related to invasive species and other impairments in Lake Ontario. A profile of components of these potentially devastating ecosystem responses follows.

Profiles of Ecosystem Breakdown

Food Web Disruptions

Invasions of aquatic nonnative species in the Great Lakes have been a concern since the mid-twentieth century when sea lamprey, combined with other sources of stress, decimated populations of lake trout in the Upper Great Lakes. Facilitations between a series of invasive introductions have resulted in a synergistic effect leading to significant alterations of critical ecosystem processes in the Great Lakes. For example, reductions in lake trout and other predator species due to sea lamprey predation in Lakes Michigan and Huron paved the way for explosive increases in the populations of other invaders (e.g., alewife and rainbow smelt) which, in turn, competed with and preyed upon native forage species (Holeck et al., 2004).

More recently, researchers have documented a dramatic decline in abundances of the amphipod *Diporeia* in sediments of Lake Michigan. *Diporeia* is a critical component of the food web, important in the diets of many fish species. Historically, it has been the dominant food source for species such as slimy and deepwater sculpin, bloater, and lake whitefish. In the early 1980s average abundances of *Diporeia* in bottom sediments from Lake Michigan were as high as 12,200 individuals/m^2. However, *Diporeia* numbers began declining by the early 1990s, and by 2000 became severely depleted from sediment samples from Lake Michigan in much of the southern and northern portions of the lake, in some cases disappearing altogether (Nalepa et al., 1998; GLERL, 2003).

Populations of other macroinvertebrates have declined significantly in Lake Michigan as well. Oligochaete worms and fingernail clams showed declines in parallel with those of *Diporeia* in nearshore areas from 1980 – 1993 (Madenjian et al., 2002). While researchers have not been able to establish a direct link, they have associated the decline of *Diporeia* with increases in the abundance of the nonnative zebra mussel in Lake Michigan beginning in 1989. *Diporeia* and other benthic organisms depend on diatoms and detritus from other phytoplankton as a primary source of food, the same source of energy that zebra mussels utilize (Nalepa et al., 1998). Recent research indicates that the loss of amphipods is having serious consequences for the fish of Lake Michigan, including whitefish (Pothoven et. al., 2001), sculpin and bloater (Hondorp at al. 2005), and alewife (Madenjian et al., 2002). Evidence also indicates that similar food web disruptions are occurring or have already occurred in Lakes Huron, Erie and Ontario (e.g., Nalepa et al., 2003; Dermott and Kerec, 1997; Lozano et al., 2001).

Lake Erie: Re-emerging Problems and New Threats

For the Lake Erie ecosystem, cautious optimism about restoration was expressed in the early 1990s as the result of reductions in phosphorus loadings, improved dissolved oxygen levels in the bottom waters of the central basin, and increased fish populations (Markarewicz, 1991). However, while improvements have continued by some measures (e.g., increased water clarity, establishment of rooted aquatic plants), other impairments have persisted and/or increased in intensity in recent years. For example, recent data indicate that since the early 1990s springtime phosphorus concentrations have increased, summertime dissolved oxygen

levels in Lake Erie's central basin have decreased, and walleye numbers have begun to decline (IJC, 2004). Lake Erie nutrient loads and cycling, oxygen demand, dissolved oxygen levels and related issues have been the subject of a number of studies in recent decades, and it has been recognized that a combination of factors (including physical factors such as thickness of the bottom water layer, or hypolimnion) can affect deeper water dissolved oxygen levels.[9] Because of the number of factors involved, it is likely that no single factor explains the more recent periods of hypoxia (low oxygen conditions) in the central basin. Factors that could be influencing the persistent development of central basin summertime hypoxia include climate change and altered weather patterns (e.g., changes in temperatures and timing and intensity of storm events), changes in nutrient loadings (in particular from nonpoint sources – some data show increased phosphorus loadings from Ohio tributaries in the past decade), and altered internal cycling of phosphorus in response to the presence of zebra and quagga mussels (e.g., IJC, 2004; U.S. EPA and Environment Canada, 2004).

Avian botulism is another feature of the stress complex in Lake Erie (with cases also observed in Lakes Ontario and Huron), leading to episodic summertime die-offs of fish and fish-eating birds. The die-offs (which have included freshwater drum and birds such as common loons (*Gavia immer*) and red-breasted mergansers (*Mergus serrator*)) are linked to the generation of a neurotoxin produced by the anaerobic bacterium *Clostridium botulinum*. While the mechanisms leading to the outbreaks remain to be confirmed, the botulism toxin has been found in dreissenid mussels and invasive round gobies (a principal predator of zebra mussels), leading to the hypothesis that round gobies are transferring the toxin from zebra mussels to organisms higher in the food web (Domske, 2003; Ricciardi, 2005).

Another stress in Lake Erie is the return of blooms of the blue-green algae (or cyanobacteria) *Microcystis*. In addition to being a low quality food for other aquatic species, these algae can produce the microcystin toxin, which at sufficient levels can be harmful to fish, wildlife and humans. *Microcystis* are selectively expelled during feeding by zebra mussels, and thus zebra mussel colonization appears to be facilitating the re-emergence of these problem blooms (Vanderploeg, 2002). Another problem is the increasing frequency of algal mat development in nearshore areas (in particular in the eastern basin) by the filamentous green alga *Cladophora*. Blooms of this alga, which impair recreation and otherwise detract from beach aesthetic value, are linked to nearshore hypoxia/anoxia (U.S. EPA and Environment Canada, 2004).

Yet another significant potential threat to the ecosystem of Lake Erie and the other lakes is the presence of Asian carp in waters near the lakes. Several of these species have been imported to the southern U.S. to control unwanted organisms found in aquaculture facilities, and in some cases have escaped into the wild. While several individual Asian carp have been caught in Lake Erie, there are no established populations in Lake Erie or any of the other Great Lakes. However, at least two of the species have migrated up the Mississippi and Illinois Rivers and are within several miles of Lake Michigan. If the fish (which are planktivores and can range up to 40 kg) manage to breach barriers (such as the electric barrier on the Des Plaines River in Illinois), enter the Great Lakes, and become established, they could cause

[9] See for example Kay and Regier (1999) (and related papers in the State of Lake Erie volume) and Charlton (1987), Rosa and Burns (1987) and other papers in the same issue of the Journal of Great Lakes Research.

significant impacts on the ecosystem through competition with other fish that feed on plankton (U.S. EPA and Environment Canada, 2004).

Other emerging or ongoing symptoms of stress in Lake Erie include the continued presence of invasive species (including round gobies and quagga mussels), rising water temperatures, limited shallow water habitat due to hydromodified shorelines on the southern shore (in particular in the western basin), continuing presence of toxic chemicals (e.g., PCBs and persistent pesticides) leading to fish consumption advisories, and findings of pharmaceuticals, hormones and other chemicals of emerging concern in the Detroit River (IJC, 2004; U.S. EPA and Environment Canada, 2004).

Ongoing Impairments in Lake Ontario

Lake Ontario is also continuing to struggle with multiple sources of stress. While *Diporeia* declines have been reported since the 1990s following invasion by zebra mussels, as previously noted, the invasive quagga mussels have contributed to further alterations of the benthic community over broader areas in the lake. Other species that have invaded Lake Ontario in the past 10-15 years, with the potential to out-compete other native species, include the amphipod *Echinogammarus ischnus*, the New Zealand mud snail (*Potamopyrgus antipodarum*), and the predatory zooplankton *Cercopagis pengoi* (or fishhook water flea). The combination of a number of stresses over the past two decades (including oligotrophication, invasion by zebra and quagga mussels, fishery management practices, and climate change) has significantly altered the Lake Ontario fish community, with declines in alewife, native sculpin and whitefish, and increases in some native species associated with lamprey control (Mills et al., 2003). In addition, as with the other Great Lakes, numerous fish consumption advisories remain in place for Lake Ontario, including for PCBs, dioxins, mirex/photomirex and mercury (U.S. EPA, 2005; Ontario MOE, 2005).

PRESCRIPTION FOR RECOVERY

A number of management efforts (at local, state, national, and binational levels) directed at protecting and restoring the Great Lakes over the past three-plus decades have been developed and implemented, and there have been a number of successes. Sea lamprey control efforts starting in the 1950s have been relatively successful at controlling populations of this species, which has taken a significant toll on populations of lake trout and other native fish. Binational efforts following the signing of the Great Lakes Water Quality Agreement (GLWQA) in 1972 resulted in lowering of phosphorus loads to the lakes and improvements in a number of water quality indicators (in particular in the more heavily (nutrient) impacted lower lakes). Subsequent efforts under the GLWQA directed at toxic chemical contamination in Areas of Concern (AOC) (through Remedial Action Plans (RAPs)) have made some progress in addressing contaminated sediments, with two of 43 AOCs delisted. Implementation of Lakewide Management Plans (LaMPs) has also proceeded in recent years, with a number of efforts underway through the LaMP process in each lake to address numerous beneficial use

impairments.[10] Other efforts have been ongoing over the past decade to address specific problems in the lakes or basin, such as the Canada–U.S. Binational Toxics Strategy (addressing mostly persistent, bioaccumulative, toxic (PBT) chemicals) and the Great Lakes Panel on Aquatic Nuisance Species. In addition, the development of indicators of ecosystem health has been conducted through the State of the Lakes Ecosystem Conference (SOLEC) process.

The complexity of the jurisdictional management for the Great Lakes has long been recognized, involving management by two federal governments, eight states and two provinces, Native American and First Nation tribes, municipalities, as well as institutions such as the International Joint Commission, the Great Lakes Fishery Commission, and the Great Lakes Commission offering policy and management guidance. Challenges in implementing programs to protect the Great Lakes have been highlighted in recent reports, including a 2003 U.S. General Accounting Office (GAO) report. The report noted there were 148 federal (U.S.) and 51 state programs funding work on environmental restoration within the Great Lakes basin; a smaller number of federal programs (33) were focused specifically on the basin. The report also noted the lack of any overarching approach to coordinate program activities in support of Great Lakes restoration, as well as the lack of a coordinated monitoring program to determine basinwide progress toward meeting restoration goals (U.S. GAO 2003).

Indeed when faced with a particularly damaging human perturbation in the Great Lakes, our corrective response has generally been to focus on a particular cause of stress and not on the integrated sources of stress that allowed it to occur. For example, when excessive nutrients and associated algal blooms impaired Lake Erie, we focused on the major point sources of phosphorus that fed the algae and lead to oxygen depletion. For a short period, we dampened down that perturbation. However, now that similar degraded conditions have reappeared, we are uncertain if such conditions are due to insufficient control of excessive nutrients, are caused by invasive species, or the result of a combination of stress sources not effectively addressed when the problems were first identified. Compounding the issue, the Great Lakes ecosystem's adaptive responses, transforming into undesired, unhealthy states, seem to be increasing in a dramatic way, in particular due to the uncontrolled introduction of new invasive organisms that out-compete native species whose natural habitat has been severely degraded in a number of areas. In spite of some efforts at addressing invasive species introductions (such as ballast water exchange requirements in the Non-Indigenous Aquatic Nuisance Species Prevention and Control Act of 1990, which do not affect the large majority of ships entering the Great Lakes declaring "no ballast on board" but which in fact may contain residual ballast water), the rate of introduction of new aquatic invaders has remained high over the past 15 years, averaging over one new species every eight months since 1970 (Ricciardi 2001).

Two broad approaches for addressing Great Lakes problems by the policymaking and management communities are treating each symptom, or treating the disease. In addressing each perturbation individually, for example, one would look for approaches to control the spread of zebra or quagga mussels, approaches for reducing polluted runoff, and strategies for addressing existing contaminants and chemicals of emerging concern. Conversely, the Great

[10] For Lake Huron, the lakewide effort is the Lake Huron Binational Partnership, which is not nominally a LaMP.

Lakes community can address the unacceptable adaptive changes in the lakes by focusing attention on the multiple sources of stress that have led to wide-scale disruption of essential nearshore/tributary processes. While recognizing the difficulty in addressing a number of individual stresses (e.g., many years of efforts at suppressing sea lamprey populations), we believe focusing on the multiple sources of stress will lead to the best possible policymaking for and management of the Great Lakes ecosystem.

As we focus on multiple sources of stress, several critical ecosystem objectives should be maintained: (1) restore and enhance the self-regulating mechanisms of the Great Lakes by focusing on the health of key geographic areas. This includes major tributaries and key nearshore areas; (2) to the extent possible, remediate existing and prevent major new perturbations (e.g., stop the introduction of new invasive species and pollutants); (3) protect existing healthy elements by adopting sustainable land and water use practices in the basin that maintain the long-term health of the Great Lakes ecosystem and associated benefits; (4) better monitor ecosystem health and the progress of restoration and protection efforts.

Steedman and Regier (1987) outlined and defined a set of components for Great Lakes ecosystem rehabilitation and those definitions have been modified to formulate the following suggested four primary management objectives for the Great Lakes.

1. **Restore and Enhance Critical Nearshore Areas, Tributaries, and Connecting Channels**

   The ecosystem-based conceptual model should be applied to identify specific geographic areas where the combination of individual sources of stress have contributed or are likely to contribute to the degradation of the nearshore/tributary areas. These are areas where ecosystem breakdown is occurring or is likely to occur, and where action is most likely to restore resiliency to the Great Lakes. These consensus–targeted areas for coordinated restoration and protection efforts may well include those locations already identified as Areas of Concern by the International Joint Commission (expanded geographically to ensure they include the major sources of stress) as well as nearshore/tributary areas that are now showing symptoms or vulnerability to multiple sources of stress. This may require increased institutional focus (including increased emphasis within LaMP efforts) on these nearshore areas. The goal should be to reestablish the natural states critical to nearshore and tributary communities so they can once again perform their stabilizing function, or, if that is not feasible, enhance critical elements that play a role in stabilizing the communities.

2. **Remediate Basinwide Sources of Stress**

   Some of the major stress sources need to be managed through systematic, basinwide approaches. Impacts of stress are often lakewide, if not basinwide, and the remedies are not linked to a limited geographical area. Basinwide stress reduction recommendations include:

   - Support research on control of existing invasive species (e.g., round gobies, zebra and quagga mussels), and to the extent they are identified, implement any control measures
   - Prevent the introduction of new invasive species.

Mitigate existing negative impacts and prevent significant future human alterations of tributary hydrology and Great Lakes shoreline structure. This can include promoting connectivity of habitat (such as wetlands or free-flowing rivers) important for many species.

- Reduce loadings of nutrients, sediments/dredged material, toxic chemicals, and microbial pollution to the Great Lakes and tributaries from all sources, including addressing continued development pressures and potential for increases in polluted runoff.

Actions such as these will be critical in preventing new perturbations as well as enabling the recovery process. Addressing nonnative species introductions is a key issue. Unlike chemical pollution (except in extreme cases of local pollution), nonnative species, if established, can be extremely difficult to control and have the potential to engineer the ecosystem to a significantly altered state.

3. Protect Healthy Functioning Elements

Sustainable development practices within the Great Lakes basin are required to preserve those portions of the ecosystem that now are healthy, and those that can be restored or enhanced. Recovery of healthy nearshore communities and tributaries, once begun, must be maintained; the conditions that caused the impairments in the first place must be addressed. Watershed-based approaches to land use management provide the best opportunity to minimize negative impacts on the surface water and groundwater essential to the sustainability of the Great Lakes ecosystem. Actions should support and expand activities that employ holistic, watershed-based approaches to land and water use decisions.

4. Monitor Ecosystem Health

Monitoring the ecosystem response through an agreed-upon set of integrative indicators will be an extremely important part of any Great Lakes restoration effort. This effort should build on ongoing efforts such as the development and application of SOLEC indicators. Major changes in the ecosystem are occurring while many of the indicators that governments have traditionally used to measure Great Lakes health (water clarity, ambient water pollution levels, and certain contaminant levels in wildlife) are actually improving. Because nonlinear changes, such as those the Great Lakes are currently experiencing, may confound expected relationships between sources of stress and the lakes' response, traditional indicators may not be adequate descriptors of the health of the ecosystem and may not be useful in predicting future conditions. While some type of consensus on indicators is desirable, given the dynamic nature of the system and our understanding of it, flexibility must also be included in the development and use of indicators.

Certain features of the ecosystem appear to be particularly responsive to the seven sources of stress (including climate change) identified above. Emblematic species such as certain fish-eating birds and populations and reproductive health of key fish species (such as lake trout, lake herring, walleye, yellow perch, and lake sturgeon) as well as wetland sub-ecosystem complexes should clearly be part of any monitoring program. In addition,

monitoring should include a strong human health component, in particular involving tribal/First Nation communities and other populations heavily dependent on Great Lakes fisheries and other resources. There have been varying degrees of research on integrative indicators of ecosystem integrity with most effort focused on emblematic species and wetland complexes. Some evidence suggests smaller organisms at the bottom of the food chain respond more quickly to change, and thus monitoring micro- and macro-invertebrates might well reveal the earliest signs of ecosystem disruption and/or recovery (Odum, 1985).

A key issue for any monitoring network is the ability for rapid detection and identification of new threats, in particular aquatic invasive species. This is particularly important given the difficulty in controlling invaders once established, and the significant economic costs and ecological disruption nonnative species can cause (Pimentel et al., 2000). Use of predictive tools based in part on an understanding of existing invasions can assist in monitoring for potential invasive species (Ricciardi, 2003).

SUMMARY

The health of the Great Lakes ecosystem is in jeopardy. While a number of remediation and other activities have been pursued through the years to address Great Lakes problems, additional actions are urgently needed to restore system elements, particularly in critical nearshore/tributary zones where a chain reaction of adaptive responses to a suite of stresses may be leading to catastrophic changes: ecosystem breakdown and potentially irreversible ecosystem collapse. Without at least partial restoration of these areas, the negative symptoms being observed in the Great Lakes will likely intensify and could degrade irreversibly. Concurrently, actions are needed to control or eliminate sources of basinwide threats to the essential biological, physical, and chemical components of the Great Lakes' ecosystem stability and health. Finally, large areas of the Great Lakes basin waters remain relatively healthy and productive and they provide a wide range of benefits to the people of the region. Protecting the remaining areas from further stress is significantly more cost-effective than attempting restoration after damage has occurred. In summary,

- Historically, when faced with a particularly damaging ecosystem impact, policy responses have focused on particular symptoms and not on the integrated sources of stress that cause these symptoms.
- To increase the effectiveness of policy and on-the-ground restoration, sources of stress and, especially, interactions between those sources need to be explicitly considered.
- One way to prioritize efforts is to focus on specific geographic areas that have experienced ecosystem breakdown and develop efforts to address the multiple sources of stress that have contributed to these impacts.
- Some major sources of stress to the Great Lakes have broad implications and need to be addressed basin-wide since the sources (and their impacts) are not always limited to single locations.
- Watershed-based approaches offer the best opportunity to protect existing basin waters by establishing sustainable land and water use development practices.

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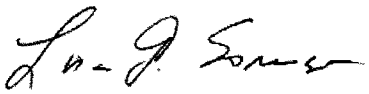

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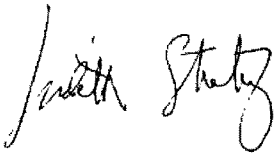

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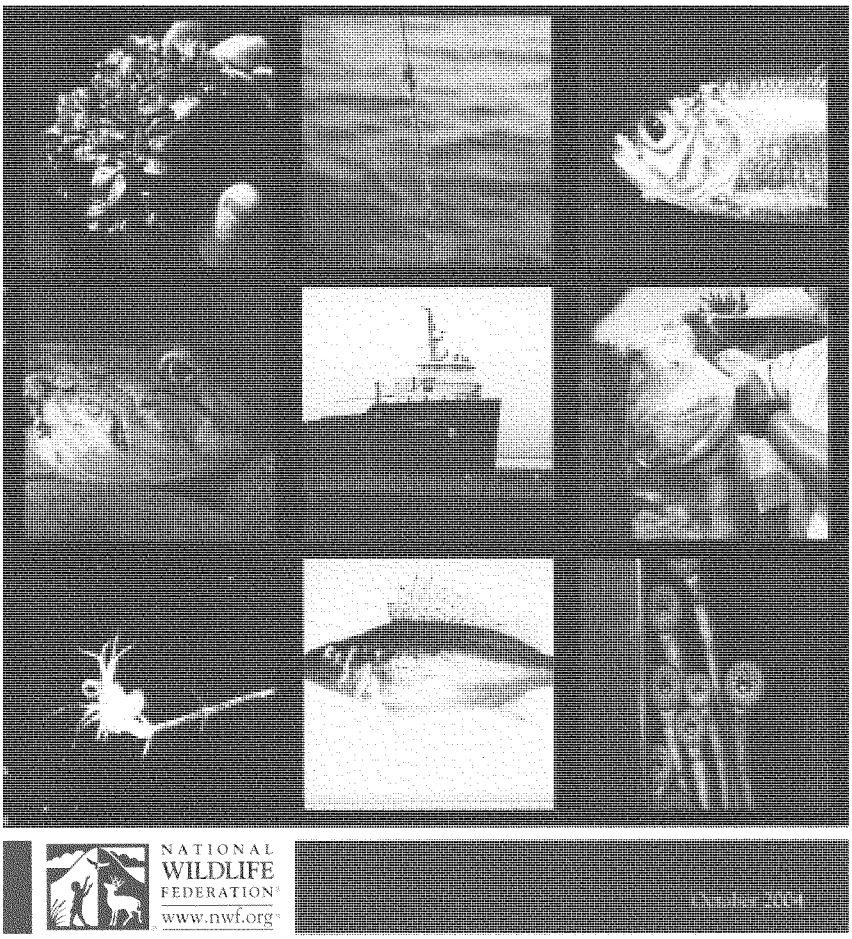

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Ecosystem Shock:
The Devastating Impacts of Invasive Species on the Great Lakes Food Web

Ecosystem Shock:

The Devastating Impacts of Invasive Species on the Great Lakes Food Web

October 2004

By Gwen White, PhD., Michael Murray, PhD., and Sara E. Jackson

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One report in a series on Great Lakes Restoration

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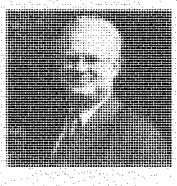
FOREWORD



One of the defining experiences of my life occurred on the shores of Lake Erie. I was young, and it was the first day of my family's summer vacation. I was excited to go fishing with my Dad. What promised to be a wonderful day, however, turned into a very painful one.

Standing on the waterfront, I looked out onto the lake and saw mats of dead fish floating in the water. I didn't know it at the time, but I was witnessing the actual extinction of a species – the blue pike of Lake Erie – and the near-death of the lake itself.

At that time, more than 30 years ago, chemical pollutants had poisoned Lake Erie. Wildlife perished. Scientists warned that the Great Lakes would die.

But they didn't.

That crisis led to the passage of the Clean Water Act, a ban on phosphate detergents, and a multi-billion dollar investment in wastewater treatment upgrades. Eventually the Great Lakes came back. Wildlife recovered. The rehabilitation of the Great Lakes became a conservation success story.

Now, however, the Great Lakes are again in a fight for their survival.

This time, the threat is not one of chemical pollutants (even though controlling chemical discharges remain an on-going priority). It is one of aquatic invasive species. Non-native organisms have entered the Great Lakes, out-competed native species for food and habitat and wreaked havoc on the ecosystem.

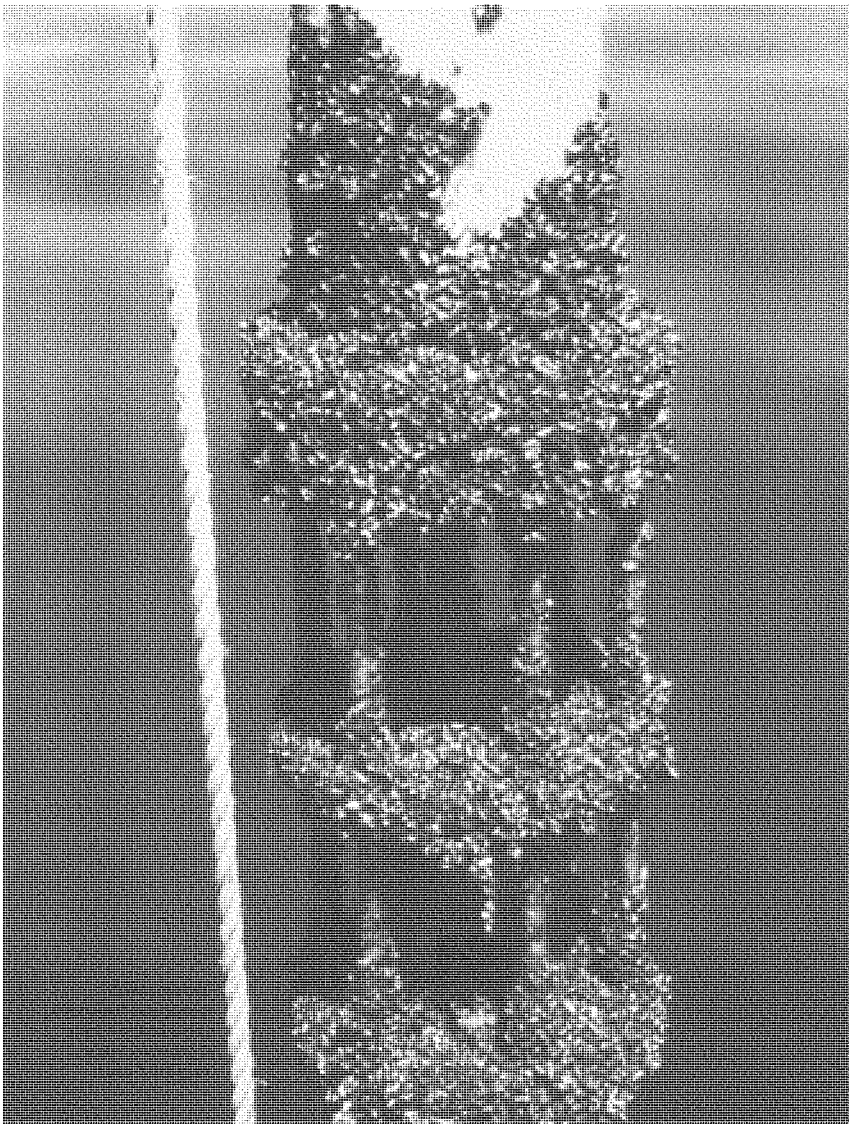
This report provides a comprehensive look at the devastating impacts that invasive species are having on the Great Lakes food web. Non-native species are harming fish at the top of the food web and decimating organisms at its base. The ecology of the lakes is profoundly changing before our eyes, and the repercussions can be felt by weekend anglers trying to reel in a decent catch and regional governments striving to meet the goals of the Great Lakes Water Quality Agreement.

The picture is grim. The prognosis is alarming. But solutions to this problem exist. And we still have time to act.

We hope that this report inspires legislators, scientists and industry leaders to work together to protect the Great Lakes and other U.S. waterways from the threat of invasive species.

For its part, the National Wildlife Federation is committed to shutting the door on invasive species. We are committed to protecting native wildlife and their aquatic habitat now so that they may be enjoyed now and for generations to come.

Larry Schweiger
President and CEO
National Wildlife Federation



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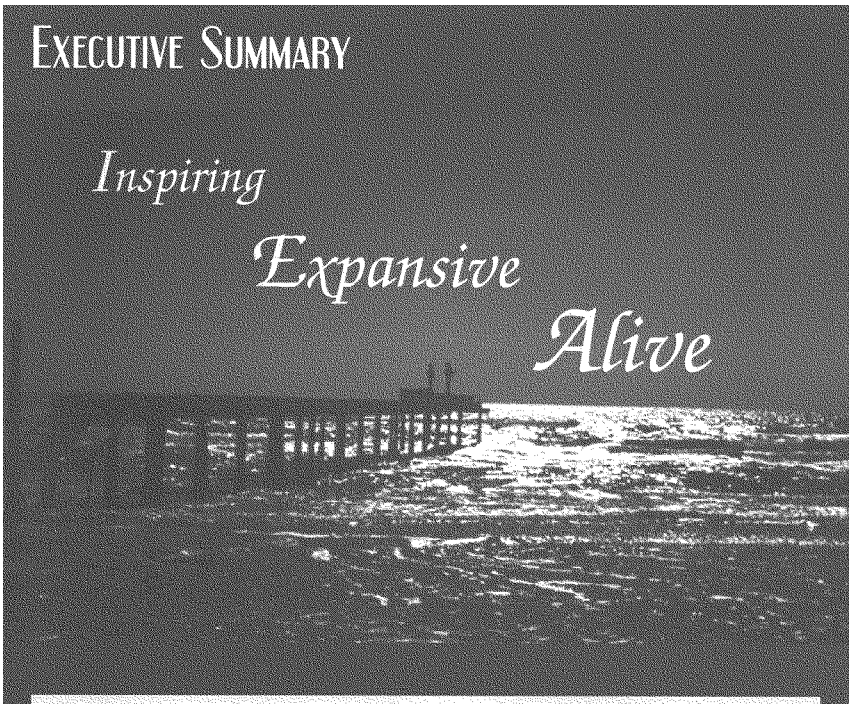
Executive Summary



Sometimes referred to as the "Sweetwater Seas," the Great Lakes contain an incredible 20 percent of the world's surface freshwater. Their coastlines stretch over 10,000 miles, as long as the Atlantic and Pacific coastlines of the United States combined. Imagine pouring the Great Lakes out over the continental U.S. - they would fill the Grand Canyon and the rest of the nation would be submerged under 9 feet of water. The ecosystems supported by these lakes are equally vast - from varied shoreline to deepwater habitats. In monetary terms alone, the Great Lakes fisheries generate almost $7 billion each year through both commercial and recreational means. The Great Lakes are truly a national and global treasure.

Inflicting damage on a system this vast seems as if it would be difficult. Indeed it is. Over the past few centuries, though, human population expansion and development has inadvertently caused several ecosystem-wide shocks to the lakes. The harvesting of forests and establishment of agriculture in the region led to extensive erosion that damaged fish spawning habitat. Overfishing in the 19th century led to the extinction of several fish species such as the deepwater cicso. In the 20th century, chemical pollution destroyed some species and harmed others.

Once damaged, a water system this huge is very difficult to restore. Over time, we have managed to address and, at least, partially mend many of these earlier ecosystem-shocks. For example, Lake Erie, once declared nearly dead due to chemical

pollution (in particular phosphorus), now is much cleaner. Though a number of problems with persistent toxic chemicals remain, pollution reductions have improved conditions for aquatic life and wildlife.

Now we are witnessing another wave of ecosystem shock. The entire food web – including the foundation of the vast Great Lakes ecosystem – is being disrupted by aquatic invasive species.

People who frequent the shores of the Great Lakes are becoming increasingly familiar with the side effects of some of these nuisance species invasions. They see the thousands of zebra mussel shells now covering the beaches. They stroll the shores and periodically notice hundreds of tiny invasive fish called alewives floating dead and rotting in the wave breaks. Curious about this sighting, they learn that groups of alewives tend to die off simultaneously causing potential human health hazards. Yet, these shoreline observations only hint at the full story.

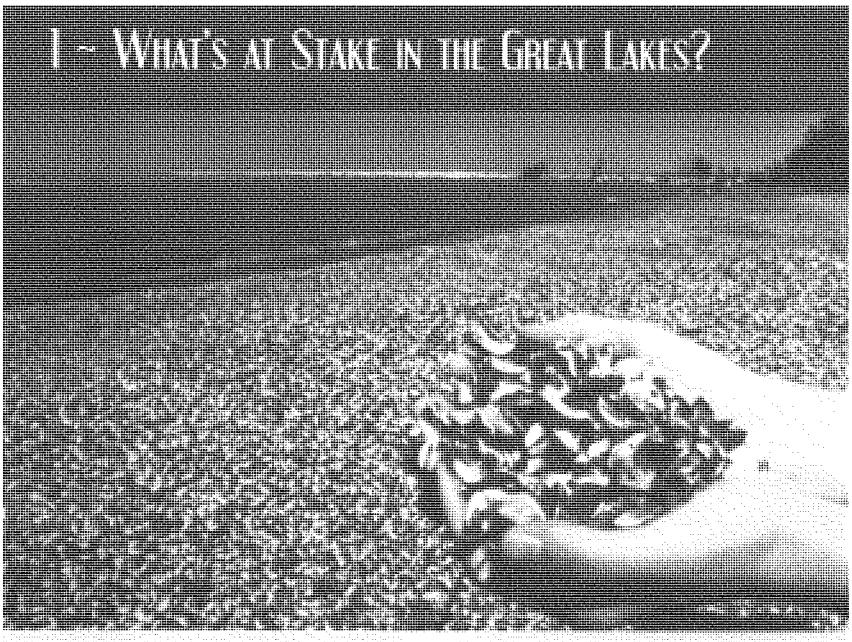
Alewife, sea lamprey, round goby, Eurasian ruffe, spiny water flea, zebra mussel and quagga mussel are some of the more devastating species to be introduced to the Great Lakes system. All have had extreme adverse affects on significant native aquatic species, such as the commercially important lake trout and whitefish. Individually, scientists have studied these nuisance creatures and brainstormed ways to attempt to eradicate their populations. At best, we have only been successful in figuring out ways to manage their populations and reduce their negative impacts. Meanwhile, additional potentially devastating invasive species, such as Asian carp, are already on the doorstep to the Great Lakes, threatening to enter.

Perhaps one of the most alarming discoveries in the study of the relationship between native and invasive species in the Great Lakes is the depletion of a tiny freshwater shrimp called *Diporeia*. *Diporeia* historically has constituted up to 80 percent of the living material in offshore lakebed areas and is critically important as food for fish, particularly juvenile fish. In some locations in the lakes, this shrimp has gone from populations of over 10,000 organisms per square meter of lake bottom to zero in just a few years. Such a rapid and complete decline in a foundation species is unprecedented in the recorded history of the Great Lakes. Scientists do not know for sure the reason for this decline, but many believe that the zebra mussel population is the likely culprit. Thick colonies of zebra mussels, sometimes acres in area, cover large sections of the lakes' bottom and once established, interfere with the ability of *Diporeia* and some other organisms to thrive and reproduce.

As additional invaders enter the lakes and take hold, they place the entire Great Lakes fishery at an even higher risk of collapsing. And once such invasions occur, our options for recovery are quite limited. The lakes will not clean themselves of invasive species as they can, to a certain extent, chemical pollution once pollution sources are reduced or eliminated. Nor can we restore the food web simply by stocking high-profile species like trout and salmon or by limiting their harvest. We must develop and implement new management tools designed specifically to examine and protect the entire ecosystem — not just individual species. We must investigate and better understand food web dynamics and how they are being disrupted. And it is absolutely imperative that we stop new, even more damaging species from entering the Sweetwater Seas.

Congress is currently considering two highly effective opportunities for action. The first is legislation that would restrict activities (like ballast water discharges) that are the primary entrance routes for invasive species. This bill, called the National Aquatic Invasive Species Act (NAISA), could prevent new harmful species from invading the lakes. It would not, however, address the damage that is being done by the invasive species already present. Fortunately, another set of legislative proposals would finance a Great Lakes restoration initiative designed to restore habitat and species that have already been harmed. The Great Lakes restoration bills would provide billions of dollars for these and other restoration purposes. It will take a combination of these effective programs to ensure the survival of a healthy and diverse Great Lakes ecosystem.

I ~ What's At Stake in the Great Lakes?



Zebra mussels on a Lake Erie beach.

The aquatic resources of the Great Lakes region contribute significantly to the economic development, culture, and recreation in the region, affecting eight states and two Canadian provinces. The Great Lakes and all of the connecting channels and rivers form the largest surface freshwater system in the world, containing nearly one-fifth of the world's supply of fresh surface water.[1] This abundant resource produces fish, attracts visitors to the region, and provides water for myriad additional uses of economic and recreational benefit. Sport fisheries support 75,000 jobs, while commercial fisheries provide an additional 9,000 jobs around the lakes.[2] Recreation and tourism in the region is valued at $15 billion annually with $6.89 billion annually related to the fishing industry.

The five lakes, though formed from the same processes of glaciation and following glacial retreat over the past 10,000 years, vary greatly in their physical settings and characteristics, from the relatively shallow and warmer Lake Erie (average depth of 62 feet) with its heavily developed shoreline in the south to the much larger, deeper and cooler Lake Superior (average depth of 483 feet) in the north. The land and climate around the lakes is also quite diverse, ranging from the colder climate, granite bedrock, and more heavily forested areas in the north to the warmer climate, more fertile soils, and intensive agriculture in the south. The forests and grasslands around the lakes have supported a diverse range of plants and animals, including moose, deer,

foxes and wolves, while many waterways and wetlands have supported beaver and muskrat. As many as 180 species of fish were indigenous to the lakes themselves.[3]

Over the past two centuries, the Great Lakes region has seen dramatic change in human populations, land use, and resource management approaches. Between the 1820s and 1900s, the human population around the Great Lakes nearly tripled.[4] The building of settlements, increased use of the lakes for transportation, and the expansion of commercial fisheries all affected the lakes.[5] Logging during the latter decades of the 19th Century was extensive in parts of the region, and though the overall affect on Great Lakes water quality was unclear (apart from observations on sawdust pollution)[6], it is likely that soil erosion, changes in runoff and streamflow, and tributary habitat and water quality were affected.[7] With industrialization came the alteration of waterways through the building of dams, breakwaters, wharfs and dikes, construction and dredging of channels, and the filling of wetlands.[8] Though commercial fisheries had been in place for some time, overfishing became an issue with the collapse of the lake herring fishery in Lake Erie in the 1920s.[9] The combination of phosphates in detergents, excessive nutrients from agriculture, and poor waste management led to eutrophication (i.e., algal blooms and other symptoms of excessive nutrients) in parts of the lakes during the 1960s, and subsequently awareness increased of the problems of widespread contamination of the lakes by persistent toxic chemicals.[10] Other emerging threats to the lakes include changing lake levels and climate change.[11]

While some changes in recent decades – such as slower population and industrial growth rates and greater environmental awareness – have contributed to improved water quality in the lakes[12], Great Lakes fisheries remain at risk, in particular from the threats of invasive species.[13]

In the midst of these challenges, residents of the region recognize the value of the Great Lakes as a binational and global treasure. Polling conducted throughout the region in 2002 indicated that Great Lakes residents are highly committed to protecting and restoring what they consider to be a defining part of their homes and lives. Overall, 94% agreed (67% agree "strongly") that each of them has a personal responsibility to protect the Great Lakes. Nearly all — 96% — agree (78% "strongly") that we "need to do more to protect Great Lakes habitats from pollution".[14]

Today the Great Lakes are experiencing an ecosystem shock which appears to be due in large part to the introduction of aquatic invasive species that have established themselves in the Great Lakes, out-competed local species for food and habitat, and profoundly altered the food web of these five freshwater seas. The potential challenges to the Great Lakes ecosystem from these invasive species is likely to be greater and longer-lasting than any of the disruptions we have witnessed over the past two centuries.

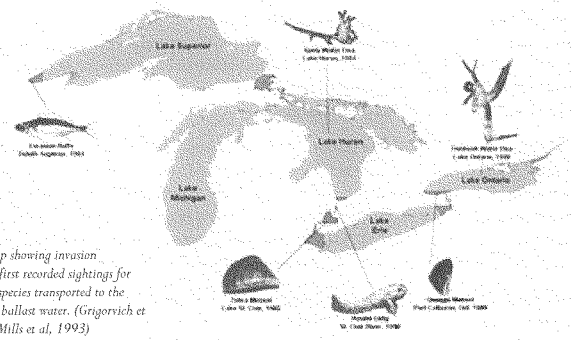
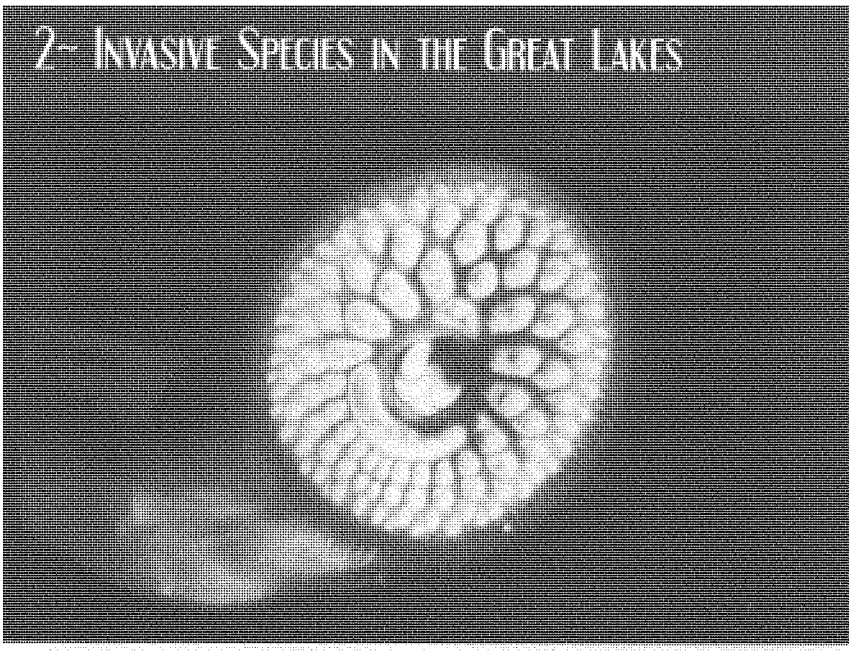


Figure 1: *Map showing invasion "hotspots" and first recorded sightings for select invasive species transported to the Great Lakes by ballast water. (Grigorvich et al, 2003 and Mills et al, 1993)*

2– Invasive Species in the Great Lakes



Sea lamprey mouth

Over the past two centuries, more than 50,000 foreign plant and animal species have become established in the United States. About one in seven has become invasive, with damage and control costs estimated at more than $137 billion each year.[15] Nationally, about 42% — 400 of 958 — of the species that are listed as threatened or endangered under the Endangered Species Act are considered to be at risk primarily because of predation or competition with exotic species.[16] Indeed, invasive species comprise the second-largest threat to global biodiversity after habitat loss.

The Great Lakes region has been similarly affected by exotic species, and continues to be threatened by existing and potential new species invasions. Since the 1800s, the introduction of over 160 exotic species has irreversibly altered the region's ecosystem, causing dramatic changes in biological relationships and natural resource availability.[17] The effects of some introductions have been particularly acute – for example, sea lampreys played an important role in the collapse of lake trout fisheries in the upper Great Lakes in the 1940s-50s.[18] In addition to worries about the effects of invasive species on individual species, a wider concern is potential effects on the broader food web (see Box 1 for brief overview of Great Lakes food webs).

Introduced species enter the Great Lakes basin by multiple pathways. As of the early 1990s, the breakdown of the routes of introduction for 139 known aquatic invasive species was shipping (41 new species), unintentional releases (40), ship or barge

canals, along railroads or highways, or deliberate releases (17), unknown entry vectors (14) and multiple entry mechanisms (27).[19] Unintentional releases can include unintentional fish stocking, aquarium release, and bait handling.[20]

About 70% of the 160 invasive species which have established themselves in the Great Lakes are native to the Ponto-Caspian region (a region of southeastern Europe and southwestern Asia that contains the Black, Azov, and Caspian Seas), with the second highest percentage originating from the Atlantic Coast of the United States.[21] An assessment of shipping patterns indicated that the Baltic and North Seas were the source regions for the majority of cargo-bearing ships — both number of ships and reported tonnage, for ships identified as no ballast on board, or NOBOB — entering the Great Lakes in 1997.[22]

The number of species invading from the Ponto-Caspian region surged beginning in the 1980s, primarily due to increased ship traffic, increased ship speed, and ballast water discharge. Factors such as extensive linkages of inland basins to the seas through canals and rivers, tolerance for wide-ranging salinities in many species, and transformations in the new environment that make habitat more suitable for additional exotic species coming from the same region all have contributed to increased numbers of invasions.[23]

Box 1

Great Lakes Food Webs

The adjoining sketch shows a very simplified food web analogous to what might be found in one of the Great Lakes. From a biological standpoint, the lake can be divided into free, open ("**pelagic**") waters and deeper ("**benthic**") zones near and including the sediments. While many species tend to remain in one or another of the zones, other species (e.g. some fish and aquatic insects) sometimes move between them. An important aspect of the food web is the transfer of energy (in the form of nutrients) between organisms. In this case, **phytoplankton** — suspended microscopic plants (algae) or photosynthetic bacteria — grow by processing sunlight through photosynthesis. Phytoplankton can be consumed, either in the water or after they have died and fallen to the sediments, by either **zooplankton** (small suspended animals with limited powers of movement) or by **macroinvertebrates** (small animals lacking a backbone) in the sediments. These organisms can in turn be eaten either by other small animals, such as aquatic insects, or **forage fish**, such as smelt or alewife, which then can be eaten by **predator fish** such as lake trout or Pacific salmon. Changes to the food web can occur in several ways – including "top down" with the introduction of a new predator fish, or "bottom up" with the introduction of species that effect populations of either plankton or benthic organisms. In real lake systems, food webs are more complex, with many interacting components. However, the potential for food web disruption by invasive species or other phenomena always remains.

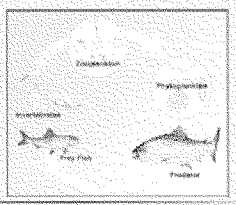
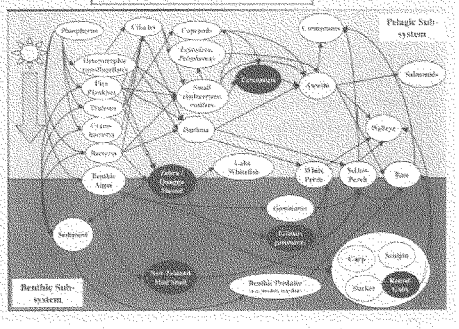


Figure 2: *Food web diagram (NOAA)*

Figure 3: *Sample food web (Mills, et al., 2003)*



Box 2

Exotic Species Can Have Economic Value

Since recorded time began, people have brought plants and animals with them for food and other uses. Many introduced species of plants and animals, such as varieties of corn, wheat, rice, and other food crops, and cattle, poultry, and other livestock, now provide more than 98% of the U.S. food system at a value of approximately $800 billion per year.[24] Some predatory fish species (such as Pacific salmon) originally introduced in the Great Lakes to control invasive fish species have since become popular in the multi-billion-dollar recreational fishing industry. However, these types of introductions can still potentially have costs in terms of broader ecological changes not initially foreseen.

The Rate of Introduction is Increasing

As the use of the Great Lakes as a transportation route for commerce intensified, the rate of introduction of aquatic nuisance species also increased. Since the opening of the St. Lawrence Seaway in 1959, 77% of the new organisms established in the Great Lakes are attributed to ballast water discharge.[25]

Figure 4 shows the relationship between increased shipping activity and the increased rate of successful aquatic species invasions. Figure 5 indicates the increase in the cumulative number of invasive species in the Great Lakes. The rate of increase in recent decades is the highest observed thus far. Nearly 30% of invasive and introduced species in the Great Lakes became established after 1959.[26]

Who are the invaders?

We know of at least 160 exotic species that have invaded the Great Lakes since the 1800s; but in reality, there are probably many more that we have not yet discovered. The invaders we know about represent a wide variety and type of organisms. Based on data through the early 1990s, most of these species include aquatic or wetland plants (42%), invertebrates (20%) fishes (18%), and algae (17%).[27] Although it is difficult to conclusively identify the most damaging invaders because we do not yet know the full extent of the harm they are causing, three broad categories of organisms have already caused dramatic alterations to the ecosystem: fishes, mussels, and zooplankton.

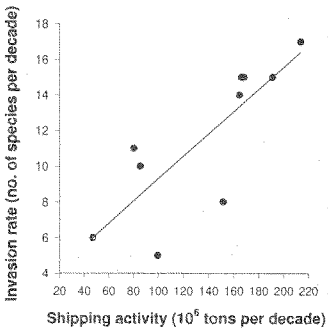


***Figure 4**: Increased shipping in the Great Lakes has led to an increased number of aquatic invasive species introductions -- as shown by the relationship between the invasion rate and shipping activity in the Great Lakes (reproduced with permission from Ricciardi 2001)*

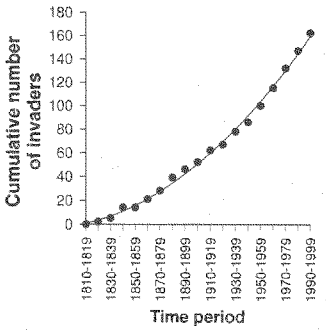
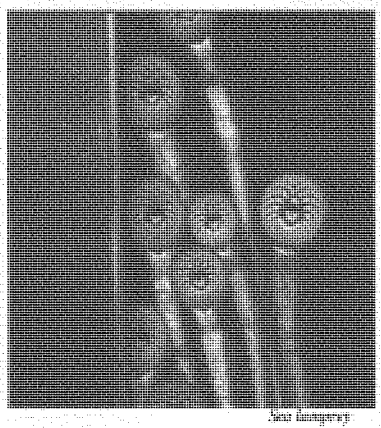


***Figure 5**: Cumulative number of nonindigenous invasive species established in the Great Lakes by decade (reproduced with permission from Ricciardi 2001).*

Invading nuisance fish degrade native fish species

A number of invasive fish species have taken hold in the Great Lakes, either as a result of deliberate introductions or inadvertent invasions. Examples of species or groups of species that have had a significant effect on the fisheries and/or the broader food web are presented below.

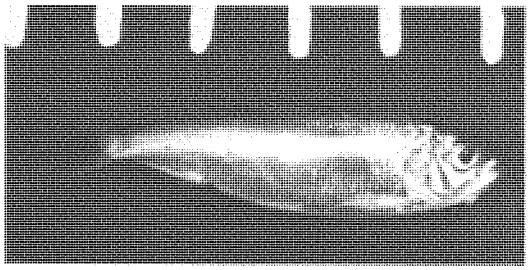


Sea lamprey

Sea Lamprey: The sea lamprey has most likely had the most significant impacts on Great Lakes fisheries of any invasive fish species. The lamprey was first identified in Lake Ontario in the 1830s, likely migrating west through the Erie Canal, although more recent genetic evidence indicates the species may be indigenous to Lake Ontario.[28] While the lampreys were not discovered in Lake Erie until 1921, they quickly spread to the upper three Great Lakes, reaching Lake Superior by 1938.[29] Lampreys affect the food web through habitat modification and, to a greater extent, through predation on fish.[30] The eel-like fish attaches to fish and drains them of blood and bodily fluids. An adult sea lamprey can kill up to 40 pounds of fish in 12-20 months. The combination of sea lamprey predation and overfishing led, to varying extents, to substantial declines or complete collapses of populations of lake trout, burbot, and lake whitefish in the middle of the 20th Century. Use of chemical control on sea lamprey larvae began in the late 1950s in Lake Superior and was extended to other lakes over the next three decades, and has eliminated spawning runs from a number of streams.[31] (See further discussion on populations of species affected by sea lamprey in Section 5).

Round Goby: Round gobies look and behave very similarly to the mottled sculpin, a fish native to the Great Lakes. However, these invaders are much more aggressive and out-compete the sculpins, as well as several other fish species, for food and habitat. First reported in the United States in the St. Clair River in 1990, they quickly spread, and now inhabit all five Great Lakes.[32] Once round gobies arrive in an area, a combination of aggressive behavior and prolific spawning allow the species to rapidly increase in abundance. They have been deemed responsible for local extirpation of mottled sculpins in Calumet Harbor, Lake Michigan, through competition for food sources, for space, and for spawning sites.[33] In addition, zebra mussels facilitate the introduction and establishment of round gobies by serving as a readily available food source for the non-native fish – round gobies are one of the few fish species that eat zebra mussels – and by creating habitat for small invertebrates that are the prey of small gobies.[34] The zebra mussel/ round goby relationship thus represents a case of invasional meltdown, the process by which a group of nonindigenous species facilitates one another's invasion in various ways, increasing the likelihood of survival, the ecological impact, and possibly the magnitude of the impact.

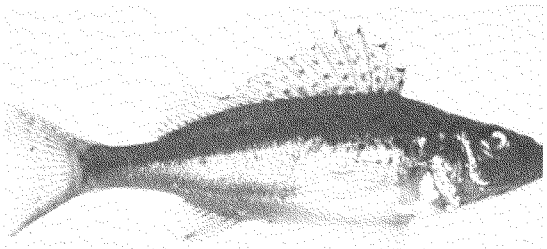
Round goby



Alewife

ALEWIFE: Alewives are indigenous to lakes and streams in watersheds along the East Coast of the United States. As was the case with sea lamprey, alewives were abundant in Lake Ontario by the late 19th Century, likely having migrated from East Coast basins through the Erie Canal. The opening of the Welland Canal allowed for migration to the upper lakes, although it was only in 1931 that alewives were reported in Lake Erie. They were reported in Lake Huron in 1933, Lake Michigan in 1949, and Lake Superior in 1954[35], and had a significant affect on the fish community of most of the lakes. Alewives were held responsible for population declines in a number of fish species, including emerald shiner, bloater and yellow perch during the 1960s, and also likely were responsible for low abundances of deepwater sculpin in Lake Michigan by 1970. Alewives also likely contributed to reductions in burbot abundance in Lakes Huron, Michigan, and Ontario. In addition, alewives have continued to hinder the recovery of lake trout populations due to both their predation on lake trout young and reversely through early mortality syndrome (a thiamine deficiency in lake trout offspring caused by the parent's consumption of non-native species such as alewife as opposed to more nutritious native species).[36] A further problem with alewives is that they swim in dense schools and often die off in large numbers, littering beaches with rotting carcasses, and posing health threats. Ironically, some species introduced in the 1960s to control alewife populations (e.g. chinook salmon) are now popular sportfish, and are dependent on adequate alewife populations.[37]

EURASIAN RUFFE: The Eurasian ruffe was first found in the St. Louis River, Minn. in 1986, probably introduced via ballast water.[38] Ruffe can tolerate a wide spectrum of environmental and ecological conditions, ranging from shallow to deeper waters and low- to high-nutrient waters, although their abundance increases with the latter. The fish spawn on a variety of surfaces, and in some cases, more than once per year. Adults feed on macro invertebrates on lake sediments, and their primary predators are pikeperch and northern pike. Since their introduction, they have become the most abundant fish in the St. Louis River estuary – by the mid-1990s, their densities were over 4 times greater than the next most populous species (spottail shiner and troutperch).[39] While research has not indicated any substantial fish community changes in response to the ruffe invasion in the St. Louis River,[40] their tolerance for wide-ranging conditions, potential for widespread distribution, and their diverse diet of organisms on bottom sediments could eventually lead to pressures on other fish populations with similar diets.



Eurasian Ruffe

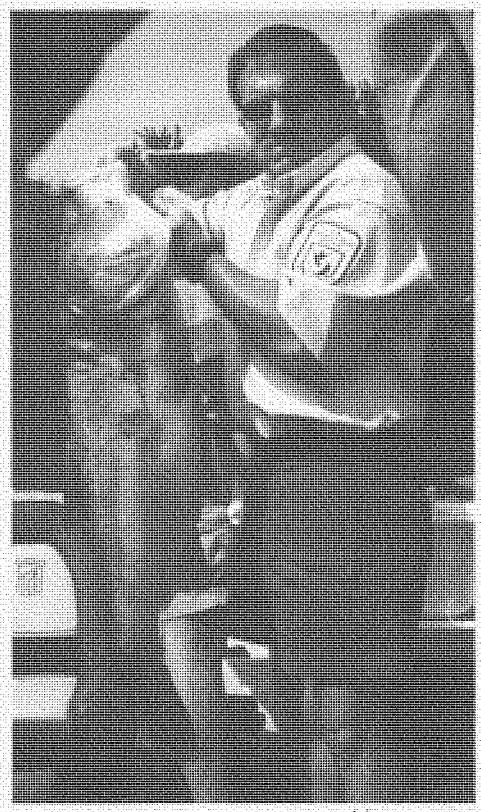
BOX 3

Asian carp jumping towards the Great Lakes

The closely-related bighead carp and silver carp (commonly referred to jointly as Asian carp) are a looming threat to the Great Lakes. Bighead carp are known to reach 90 pounds and silver carp 60 pounds. Because they are filter feeders that eat primarily plankton and they can attain such a large size, scientists suggest that these carp have the potential to deplete zooplankton populations. This can lead to reductions in populations of native species that rely on this food source, including all larval fishes, some adult fishes, and native mussels. Species of fish with high recreational and commercial value, including salmon and perch, are at risk from such competition in large rivers and the Great Lakes.

Asian carp likely escaped from catfish farms in the South during flooding in the 1990s or through accidental release. In less than 10 years they have spread up the Mississippi River system and have been collected in the Chicago Sanitary and Ship Canal only 25 miles away from entering Lake Michigan. In some of the big pools along the Mississippi River, Asian carp have multiplied so quickly that in less than a decade they make up 90 percent or more of the fish life. To stem the potential movement of fish between the Mississippi and Great Lakes waters, the Army Corps of Engineers has constructed an electrical barrier across the canal to repel fish in both directions. The barrier is not fail-safe and will require either backup generators or a second barrier for added security. A plan is currently in place to construct a second barrier.[41]

The silver carp have become infamous for their tendency to panic when they hear a boat motor, hurling themselves out of the water and into the path (or onto the deck) of passing vessels and personal watercraft. As dangerous as they may be to recreational boaters and anglers, they are even more perilous to the Great Lakes fishery. Despite some efforts by commercial anglers and state management agencies, no viable market for the large crop of carp has developed along the Mississippi River and its tributaries. If the Great Lakes are transformed into a "Great Carp Pond," there is no indication that a fishing industry would develop to replace losses to the current $6.89 billion industry.



Asian carp

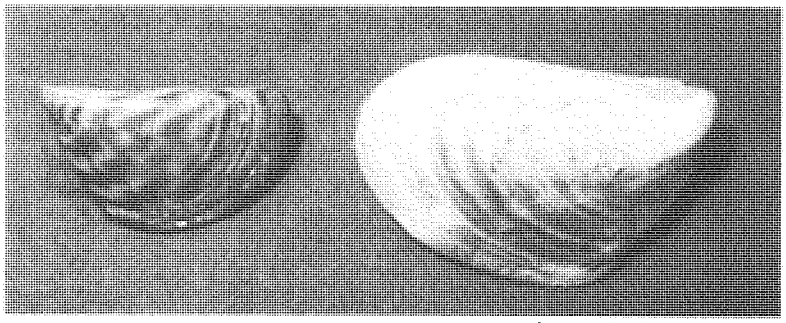
Exotic mussels re-make the bottom of the Great Lakes

Several invasive mussels have established themselves in the Great Lakes. The two most significant are the zebra and quagga mussels.

Zebra Mussel: The zebra mussel is a highly opportunistic mollusk that reproduces rapidly and consumes microscopic plants and animals from the water column in large quantities. Zebra mussels were first discovered in the Great Lakes in 1988 in Lake St. Clair, where they had been discharged in the ballast water from ocean-going vessels.[42] Because zebra mussels have a larval stage as plankton, they can easily be taken up in ballast water and passively distributed within a lake or downstream in rivers.[43] The adults can also attach to vessels and be transported to new water bodies as the boats enter them either directly or following overland transport. About the size of a fingernail, zebra mussels excrete a strong adhesive that allows them to attach to virtually anything, from rocks to municipal water intake pipes. The mussels can form thick colonies, acres in size, which cover the lakebed and occupy the habitat needed by native species. Even more damaging, zebra mussels are incredible filter-feeders, capable of consuming large quantities of microscopic aquatic plants and animals from the water column – and depriving native species of needed nutrients. Research indicates that zebra mussels remove suspended matter from the open water at a rate of up to 30 percent per day, and their filtering rate is over 10 times higher than that of native unionid mussels.[44] Such filtering fundamentally shifts the location of the food and energy in the Great Lakes, from the water column down into the sediments. While this shift has resulted in much clearer water in many parts of the Great Lakes, this clearer water means less nutrients for many fish species.

Scientists are just beginning to understand the impacts that zebra mussels are having on the Great Lakes. Researchers suspect that zebra mussels are a major factor in the collapse of a fundamental food source in the Great Lakes food web – the tiny, shrimp-like *Diporeia* (see Section 4). Scientists also believe the zebra mussel invasion has had negative impacts on a variety of fish species (see Section 5).

Quagga Mussel: A second mussel may be as damaging to the Great Lakes as the zebra mussel: the quagga mussel. Quagga mussels first appeared in the Great Lakes in 1989.[45] In size and appearance they are similar to zebra mussels, and like zebra mussels they colonize in thick mats over acres of lakebed. The major difference – and the one that alarms scientists – is that quagga mussels can colonize in deeper, colder water than zebra mussels. Zebra mussels thrive in the shallower and warmer lakebed areas along huge stretches of Lakes Michigan, Erie and Ontario, and Saginaw Bay. Now quagga mussels have begun to colonize additional lakebed areas, further decreasing the overall nutrients available to organisms important in the food web (see Section 4).[46]



A zebra mussel and quagga mussel

BOX 4

Zebra Mussels Contribute to Toxic Algae Blooms

An example of toxic algae bloom

Researchers have found that zebra mussels can promote the growth of a toxic algae that is responsible for human and wildlife health concerns and the fouling of drinking water supplies. *Microcystis* is one of a class of algae that produce toxins (termed microcystins) that can cause harm and even death in fish, wildlife and people – for example, 55 people in Brazil died following exposure to microcystins. Blooms of this type of algae were common in parts of the lower Great Lakes before phosphorus reduction measures were taken in the 1970s. However, recent research indicates that zebra mussels may be contributing to a resurgence of the blooms in areas such as Saginaw Bay and Lake Erie. Zebra mussels consume and break down some algae, but selectively reject *Microcystis*, which can contribute to blooms of the toxic algae. In addition to the potentially harmful consequences on wildlife and people, the blooms can also effect the food web – the low intake rates and poor nutritional quality of *Microcystis* lead to decreased survival of zooplankton (microscopic animals) consuming the algae, which can then affect fish consuming the zooplankton.[47]

Unpalatable zooplankton thrive in the water column

Zooplankton are tiny animals that float in the water and feed on small, usually microscopic, floating plants called phytoplankton. Zooplankton are a significant source of food for many fish at some stage of their lifecycle – especially young fish. Because of their small size, easing their entry into ballast tanks, and the phenomenon of "resting stages," some zooplankton can easily become invaders into new ecosystems. As was the case with exotic mussels mentioned above, recent invasions by exotic zooplankton species have indicated the potential for nonindigenous species to disrupt the Great Lakes ecosystem.

One type of zooplankton of significant importance in

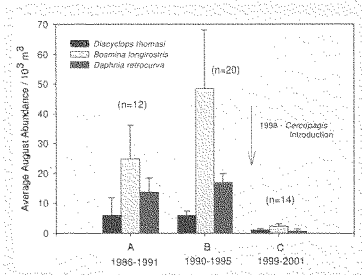
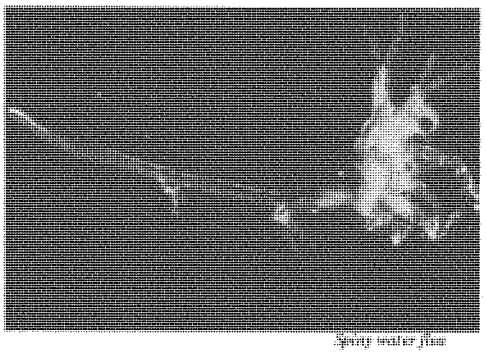


Figure 6: *Driven out: The introduction of the fishhook water flea in Lake Ontario in 1998 led to the dramatic reduction in three dominant zooplankton. (Reproduced with permission from Laxson, 2003.)*

freshwaters are cladocerans, also known as water fleas. Two recent zooplankton invaders of the Great Lakes come from this family – the spiny water flea and fishhook water flea. Both of these water fleas possess long sharply barbed tail spines that comprise upwards of 80% of the organisms' lengths. Many fish that otherwise eat zooplankton avoid both of these spiny creatures as prey and most of the smaller fish cannot effectively swallow them because of the long hooked tail spine. In addition, these larger zooplankton eat smaller zooplankton, competing directly with some fish for this important food source.

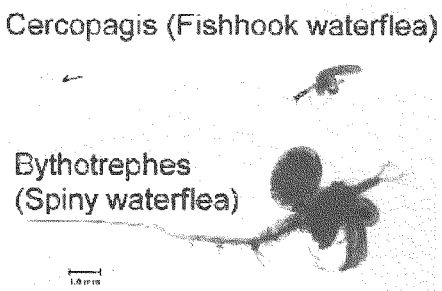


Spiny water flea

SPINY WATER FLEA: The spiny water flea native to northern Europe and Asia, was first found in the Great Lakes in Lake Ontario in 1982.[48] Over the next five years, this water flea was found throughout the Great Lakes and in some inland lakes in nearby states. Establishment of the spiny water flea in Lake Michigan was followed in 1987 by significant declines in abundance of three species of an important group of zooplankton, the Daphnia.[49] In a more recent study of smaller Canadian lakes, it was found that lakes invaded by the spiny water flea had significantly lower total amounts of the cladoceran zooplankton group, and on average 23 percent fewer of these species than the uninvaded lakes.[50]

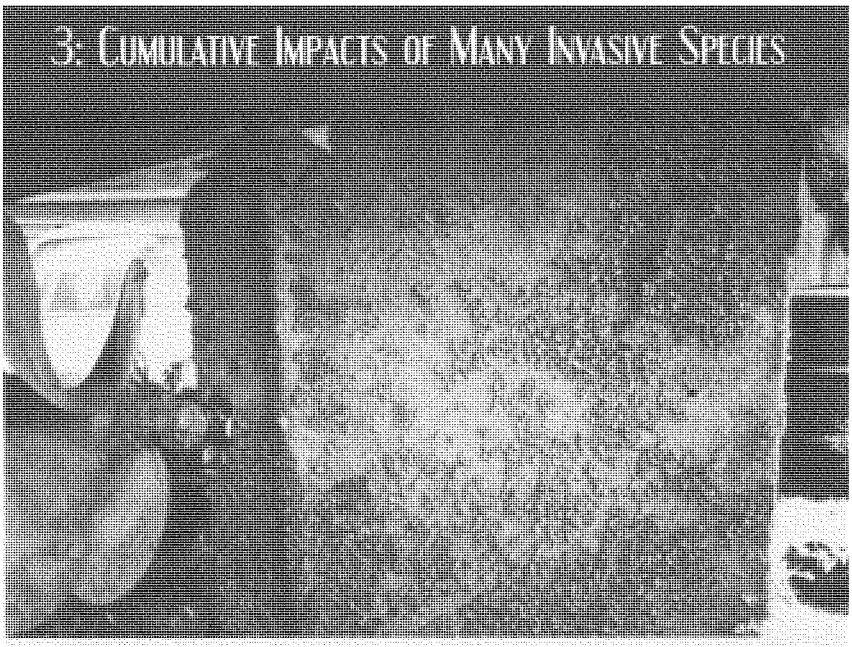
FISHHOOK WATER FLEA: The fishhook water flea is native to the Ponto-Caspian region (southeast Europe). It was first found in Lake Ontario in 1998 and quickly spread through lakes Ontario, Michigan, and Erie by 2001. The pattern this expansion took is consistent with the inter-lake transfer of ballast water; in addition, pleasure-craft are likely responsible for transfer from the Great Lakes to inland lakes.[51] Research on Lake Ontario indicated that the abundances of three dominant zooplankton declined dramatically after the introduction of fishhook water fleas in the lake (see Figure 6).[52]

GIANT CLADOCERAN: A third exotic zooplankton species, the giant cladoceran, is native to Africa, Asia, and Australia and most likely entered North America with African fish imported for the aquarium trade or to stock reservoirs.[53] Since 1995, it has been found in the Illinois River and a connecting channel to Lake Michigan through Chicago and now appears close to invading Lake Michigan; it was found in Lake Erie in 1999.[54] The giant cladoceran is much larger and has more numerous spines than similar native species making it difficult for young fish to eat; this could result in a reduction of food available in lakes, streams, and fish hatcheries where this zooplankter invades.



Fishhook waterflea and spiny waterflea

3: Cumulative Impacts of Many Invasive Species



Zebra mussels

Scientists estimate that about 10 percent of the aquatic species that have been introduced into the Great Lakes have caused significant ecological and economic damage.[55] While the impacts of some of these species are clear, the potential for other direct and indirect impacts remains to be determined. Scientists have, however, concluded that invasive species can affect multiple ecological levels. They influence various functional and behavioral factors for the native species, such as habitat use and foraging, abundance, distribution, food web relationships, and pathways for energy and nutrients.[56] They can alter the physical and chemical conditions of a habitat to an extent that the behavior, growth, and reproduction of native species are impaired. As the Great Lakes are invaded by increasing numbers of exotic species, scientists are discerning some disturbing patterns:

Profound alteration of the base of the food web. Over the past 15 years, invasions in the Great Lakes increasingly consist of tiny invertebrates. While they are important to their native food web, in the Great Lakes they are capable of accumulating in high densities and replacing native ecological equivalents. This dramatically reduces the amount of available nutrient for a number of native species in the system.[57] It also alters the way nutrients and contaminants travel through the food chain and ecosystems of the lakes.[58] (See discussion in next section).

Assault on the ecosystem on multiple fronts. A combination of multiple new species may make life even more

difficult for native species, especially if these invaders are affecting the ecosystem at several different levels.[59] For example, in addition to taking up food energy that would otherwise be in species more readily consumed by forage fish, zebra mussel shells increase the complexity of the lakebed, making it difficult for fish to find food, and thus affecting the way nutrients and energy flow through the food web. The spiny water flea then affects the water column, out-competing native zooplankton. Then the introduced Eurasian ruffe may compete with native species for the limited food resources, further diminishing the survival of natives in the ecosystem.[60]

Facilitation of invasional meltdown (accelerating invasion). Some invaders may alter their new environment in ways that could make it easier for subsequent invasive species to establish themselves, thus accelerating the increase of new species over time.[61] Since 1970 there has been an average of one invader recorded every eight months in the Great Lakes, with the number of species established per decade increasing over time. None of these species have ever successfully been eliminated.[62]

Increased pressures on commercial and sportfish species. As invasive species consume energy, food, and habitat resources, these necessities become less available to the native species that are useful to humans. This may stress sport or commercially valuable species enough that harvest has to be reduced to sustain the population. For example, the Ohio Department of Natural Resources began

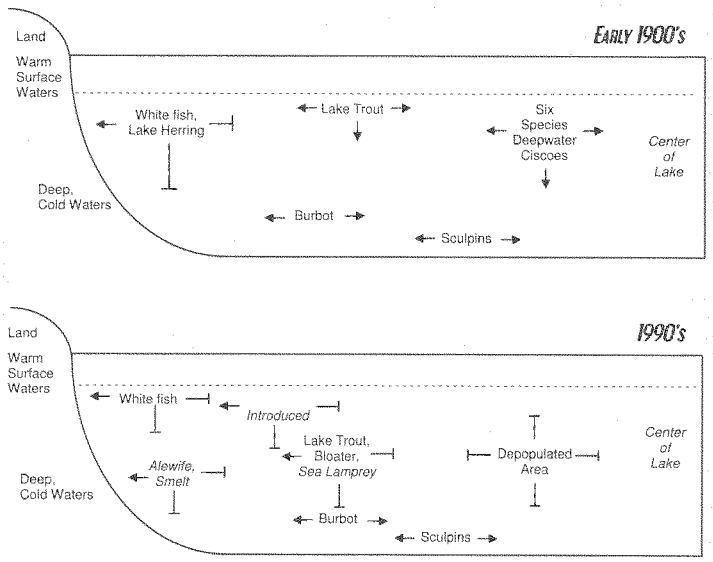
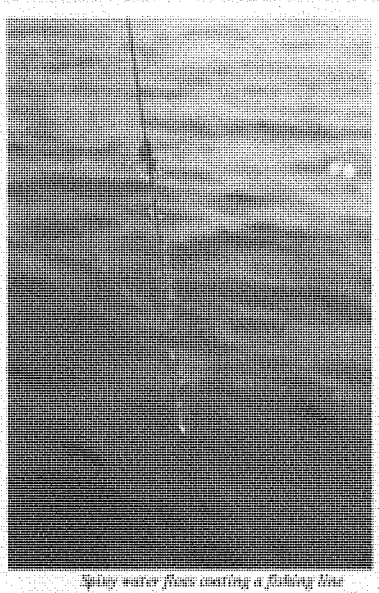


Figure 7: Changes in generalized distribution of offshore Great Lakes fishes from the early 1900s to the 1990s (adapted from Eshenroder and Burnham-Curtis, 1999).



Spiny water flea coating a fishing line

to prohibit the catching of smallmouth bass in Lake Erie during May and June after a long-term study showed that round gobies decimated the nests by consuming eggs in the absence of the male bass guarding the nest.[63] Additional states are considering similar modification of bag limits for recreational anglers to balance the impacts of aquatic invasive species.

Changes in the broader species distribution of fishes. The combination of extinction and depletion of native fish species and introduction of non-native fish has significantly changed the fish distribution in the Great Lakes over the past century, as indicated in Figure 7. Among the changes:

- Among forage fish, lake herring and deepwater ciscoes have been replaced by smelt and alewife (with the most dramatic changes in Lake Ontario);
- Average lengths among the forage fish have decreased substantially (e.g. Lake Michigan deepwater cisco averaged from 203 to 333 mm (about 8 to 13 inches) in length in 1930, while alewife and smelt averaged 66 and 109 mm (about 2 ½ - 4 ¼ inches), respectively, in 1987);
- Invasive forage fish (smelt and alewives) inhabit much shallower waters than the native fish they have replaced, and bloaters whose numbers have recovered in Lakes Michigan and Huron tend to be in shallower waters than before;
- Introduced salmonids (predator fish such as coho and chinook salmon, and steelhead and brown trout), while within the size range of the historically dominant native fish (the lake trout), are shorter lived species, about five years for the introduced salmonids vs. over 20 years for lake trout;
- The introduction of salmonids has been producing a fish community dominated by piscivorous fish (fish that eat other fish) that inhabit the upper waters of the lakes vs. a community historically dominated by piscivorous fish that fed in deeper waters (lake trout and burbot).[64]

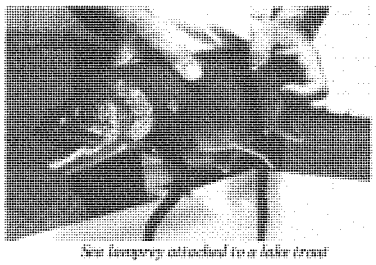
Section 5 includes more detailed discussions on impacts of invasive species on fish populations, as well as trends in commercial fish catches.

Extent of Great Lakes Food Web Disruption

Foundation Species	Fish
Diporeia	Lake Trout
Fingernail clams	Yellow Perch
Zooplankton (3 species)	Whitefish
	Smallmouth Bass
	Lake Herring
	Deepwater Ciscoes
	Slimy Sculpin
	Mottled Sculpin

Impacts have varied significantly between species - from near extirpation throughout a lake (e.g. for lake trout) to local depletions (e.g. mottled sculpin).

Figure 8



Sea lamprey attached to a lake trout

IMPACTS ON INFRASTRUCTURE AND BROADER ECONOMY CAN BE SIGNIFICANT

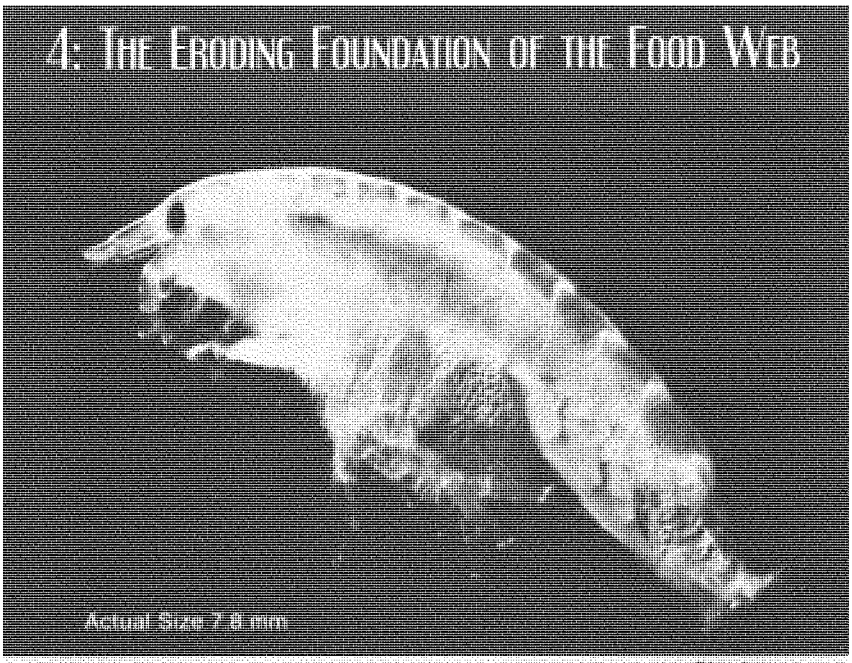
Invasive species introductions are a consequence of the economic welfare of our nation. Many species introductions, both intentional and unintentional, can be linked to economic activities, such as production, trade, and shipping.[65] The irony is that they are now impacting the economic prosperity.[66] Invasive species in general can affect the economy in a number of ways, including production, price and market effects, trade, food security and nutrition, human health and the environment, and financial costs.[67] Two ways that aquatic invasive species have affected infrastructure and the broader Great Lakes economy are indicated below:

Disrupting water infrastructure. Zebra mussels get inside water intake pipes and facilities, resulting in high costs to remove them. As they establish populations in more and more inland lakes in the Great Lakes basin (generally via private smallcraft transport), they put increasingly more water infrastructures at risk. In fact, University of Notre Dame researchers determined that it would be more cost-effective to spend $324,000 per year on efforts to prevent zebra mussel infestation on each inland lake associated with a power plant rather than pay the high costs of managing the negative impacts of zebra mussels on water withdrawals once populations were established in each lake.[68]

Imposing high unending control costs, if control is even feasible. The invasion of the sea lamprey had by the 1940s devastated populations of whitefish and lake trout and resulted in substantial economic losses to recreational and commercial fisheries.[69] From 1900 until trout population declines were caused by sea lamprey, the annual commercial harvests of lake trout exceeded 4.4, 6.3, and 5.5 million pounds annually for Lakes Superior, Michigan, and Huron respectively.[70] Control efforts were initiated in the 1950s, but by the early 1960s, the catch was only about 300,000 pounds. In 1992, annual sea lamprey control costs and research to reduce its predation were approximated at $10 million annually. Ongoing control efforts have resulted in a 90% reduction of sea lamprey populations in most areas, but now, resources spent on controlling these exotics are not available for other fisheries and resource management purposes. This earlier assessment found that the total value of the lost fishing opportunities plus indirect economic impacts in the Great Lakes could exceed $500 million annually.[71]

Lake trout with sea lamprey wounds

4: The Eroding Foundation of the Food Web



Diporeia

A healthy food web is a complex interrelationship in which each plant and animal benefits from and contributes to the success of the ecosystem. Typically the bottom of a food web begins with the tiniest creatures and their populations are endlessly bountiful. Moving up the food web, the animals become larger and their populations become fewer in number as they require more space and food. The top of the food web is very dependent on the health of all of the lower levels. When there is a disruption in the lower food web, negative effects ripple up through many populations and can be devastating.

A key part of the food web in the Great Lakes are macroinvertebrates (small animals without backbones) which link algae with fish communities. In particular in the deeper water of the lakes, four groups of organisms dominate the macroinvertebrate community — fingernail clams, certain worms (*Oligochaetes*), opossum shrimp (*Mysis*), and most significantly, a tiny shrimp-like amphipod called *Diporeia*. Together, these organisms constitute the vast majority of the deepwater food available to forage fish and other animals the Great Lakes, accounting for as much as 99% of the biomass available in the sediments.[72] Any changes to the sediment environment that affects these organisms therefore has the potential to greatly affect the fish and other predators reliant on this food source.

Diporeia

Diporeia

Diporeia, particularly compared to other invertebrates, are an especially important, high-energy food source for many fish.[73] In fact, most fish species feed on *Diporeia* at some stage of their life cycle.[74] In deeper water habitats, *Diporeia* consume nearly one-quarter (23%) of the total annual production of phytoplankton[75] and, in Lake Michigan, they consume over 60% of the spring diatom bloom (blooms of an algae rich in lipids, another nutrient),[76] making these nutrients available to move up the food web.

Yet *Diporeia*, a key component of the Great Lakes food web, has dramatically declined over the past 20 years – in some cases decreasing from over 10,000 organisms per square meter to virtually zero. The scale and short time frame of the declines are particularly disturbing; fish species reliant on *Diporeia* need to find other equally nutritious food sources in order to survive in areas where the amphipod is in steep decline. If some of those food sources are less easily digested or available, the species would not likely be able to evolve characteristics quickly enough to compensate (see discussion in Section 5 on impacts of *Diporeia* declines).

Box 5

Locking up production in the lakebed: expansion of mat-forming bacteria

At the same time that *Diporeia* disappeared in Lake Ontario, a bacterium called *Thioploca* began to form in unusually extensive mats and soon became the most dominant organism in the sediments of the upper lakebed. More energy began being used in the development of bacterial mats, leaving fish and other resources useful to humans deprived of nutrients.[77] While some exotic species such as alewife can be viable food sources for commercial and sport fish species, bacterial mats do not provide food or habitat for these species. As the mats developed, the lakebed community was reduced to a few species of worms and a few tiny clam species. Additionally, nitrate has doubled in Lake Ontario over the past several decades,[78] which may also support the spread of the bacterial mats. Prior to 1991, dense *Diporeia* populations (up to 16,000 individuals per square meter[79]) probably directly and indirectly — by keeping the lakebed more oxygenated — reduced the development of the bacterial mats on the lakebed.[80]

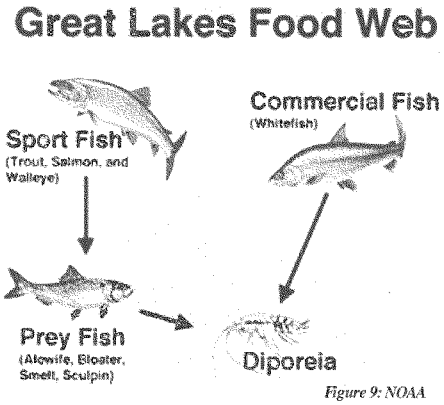
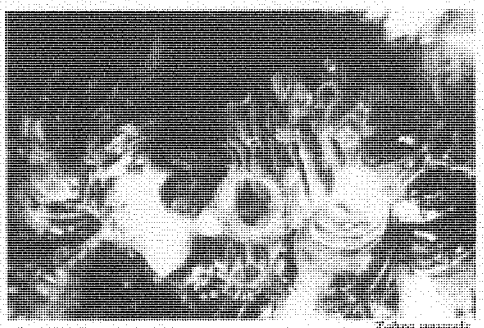


Figure 9: NOAA



Zebra mussels

Disappearance of high quality food coincides with the appearance of exotic mussels

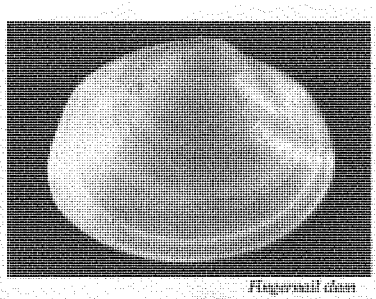
Since their discovery in the Great Lakes, zebra and quagga mussels have colonized a wide variety of underwater surfaces to depths of 130 meters[81] and have reached densities of up to 340,000 per square meter in some areas.[82] Zebra and quagga mussels are aggressive and efficient filter-feeders that consume large volumes of nutrients, dramatically decreasing suspended nutrients that are critical to other species.[83] In particular, this diversion of food resources may deprive *Diporeia* and other deeper water macroinvertebrates of food settling from the above water.[84]

Substantial declines in *Diporeia* populations, as well as that of fingernail clams, have been observed in several of the Great Lakes since the establishment of zebra mussels. Although the connection between zebra mussel invasion and significant *Diporeia* declines coincides in time, direct causal links have not been clearly established. Although other potential explanations for the declines have been proposed – including decreasing algal nutrient resources and indirect competition with zebra mussel colonies in shallow water – these alone cannot explain the total elimination of *Diporeia* from favorable habitats.[85] Other factors that may affect *Diporeia* include disease from pathogens[86] — though none have been reported in the literature, as well as additional factors — yet unknown.

As *Diporeia* disappears, the pressure will be greater on a less abundant food source, the opossum shrimp. If the opossum shrimp is susceptible to the same factors that are causing the degradation in *Diporeia*, few other alternatives are left to support many fish and other aquatic animals in deeper waters of the Great Lakes. Indeed, scientists have observed impacts on fish that depend on *Diporeia* as a food source:

- In Lake Erie, smelt stocks have declined since the loss of *Diporeia*;
- In Lake Ontario, slimy sculpin and young lake trout, species that also rely on *Diporeia*, have declined;
- In Lake Michigan, whitefish have shifted from eating *Diporeia* to the more abundant, but less nutritious zebra mussel, leading to leaner, smaller whitefish.[87]

Fingernail Clams: As devastating as the disappearance of *Diporeia* may be for the Great Lakes fishery, it may be only part of a broader decline near the bottom of the food web. Scientists have also discovered what looks like a parallel depletion in another species, the fingernail clams. These clams are found in the upper sections of sediments and feed on microorganisms in the water between sediment particles. Because some fingernail clams filter-feed directly on algae, zebra mussels can be in direct competition with them for food. Research in Lake Michigan revealed substantial declines in fingernail clams through the mid-1980s and into



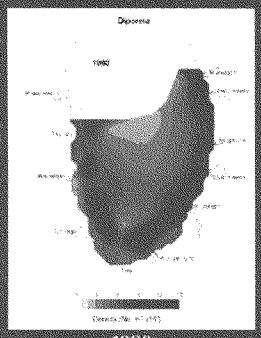
Fingernail clam

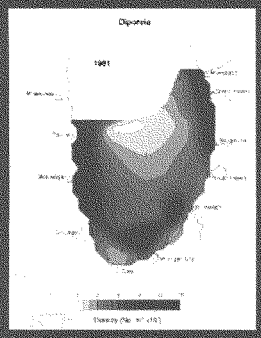
Figure 10: Changes in abundance of Diporeia in sediments of southern Lake Michigan from 1980-2000. By 1998, large sections of nearshore waters in the southern and southeastern portion of the lake were supporting few if any numbers of the shrimp-like organism. (Graphic from T. Nalepa, Great Lakes Environmental Research Laboratory, NOAA)

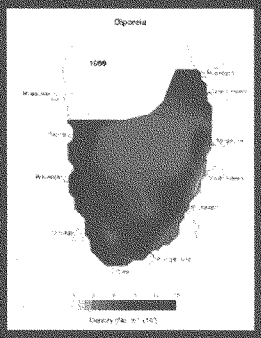
Diporeia in Lake Michigan: Examples of Declines in these Lakebed Food Resources

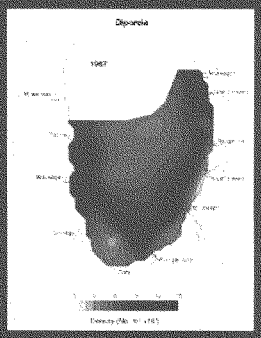
Diporeia numbers in southern Lake Michigan dropped slightly during the 1980s, but decreased much more rapidly beginning in the early 1990s following the introduction of zebra mussels to the lake in 1989.[88]

- The density of *Diporeia* at the Grand Haven, MI station dropped from 10,000 per square meter in the 1980s and early 1990s to 110 per square meter in 1999 after zebra mussels were discovered in the area in 1992 – a 99 percent decline.[89]
- The mean density of *Diporeia* off Muskegon, MI declined from 5,569 per square meter to 1,422 per square meter.
- By 1998, *Diporeia* declined in southern Lake Michigan and were rare or absent off Grand Haven, Saugatuck, South Haven, and St. Joseph out to depths of 70 meters.[90]



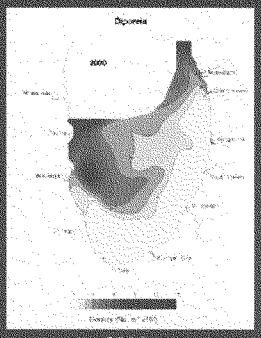




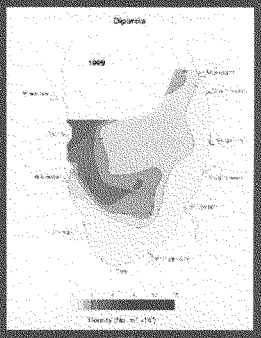


Similar changes in *Diporeia* populations have been observed in sampling of a number of sites in Lake Ontario:

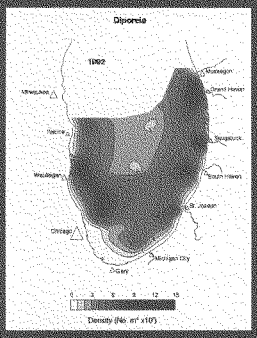
- Mean densities of *Diporeia* were at least 130 times greater in 1964 and 1972 than in 1997 after zebra mussel establishment.
- At locations where *Diporeia* was abundant, densities dropped to 15% of their former levels in three years (averaged 6,363 per square meter in 1994 and only 954 per square meter in 1997).
- The percentage of stations where no or very few *Diporeia* were found more than doubled from 40% in 1994 to 84% in 1997.
- A zone of very low *Diporeia* density (less than 4 individuals per square meter) extends as far as 16 miles (26 kilometers) off-shore and to depths of 656 feet (200 meters) over 40% of the total surface area of Lake Ontario soft sediments in 1997.



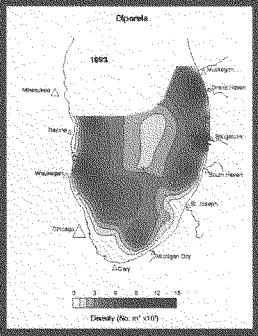
2000



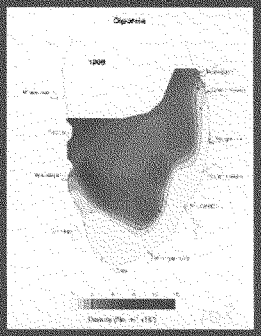
1999



1992



1993



1998

the early 1990s; yet the widespread nature of the declines – including beyond areas of zebra mussel infestation – suggested that zebra mussels may have had a more minor role, with nutrient reductions and declining primary productivity playing a larger role.[91]

However, in another study near Michigan City, Indiana, growth of zebra mussels on fingernail clams was observed, and the researchers hypothesized that zebra mussel colonization caused the significant declines in fingernail clams seen from 1992-1997, from a median of 832 to13 clams per square meter.[92] Similar results have been found in Lake Erie, where the clams declined significantly in areas where zebra mussels were abundant.[93] In western Lake Ontario, a significant increase in the population of zebra mussels was accompanied by a complete crash of two species of fingernail clams.[94] (See Figure 11).

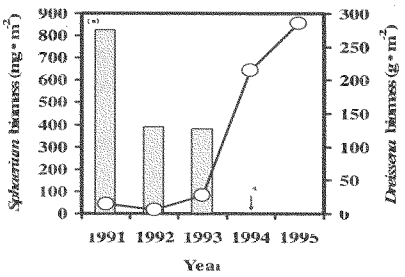


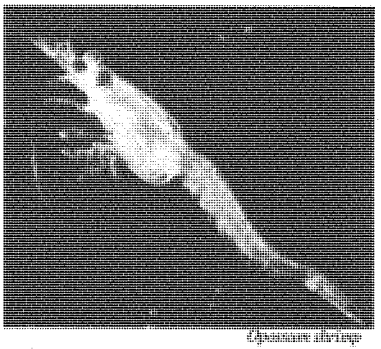
Figure11: *The introduction and expansion of zebra and quagga mussels (Dreissena) (open circles) near the mouth of the Niagara River corresponded with a steep decline in numbers of the native fingernail clam (Sphaerium) (bars) from 1991-1995.* (Mills et al., 2003)

Because fingernail clams can be important food sources for certain fish (for example, these clams were among the food items encountered most frequently in the diet of lake whitefish in southern Lake Michigan in the late 1990s),[95] reductions in their numbers could lead to additional foraging pressures on fish that consume them, in particular if zebra mussels are not eaten.

Another Species that May Be at Risk – Opossum Shrimp

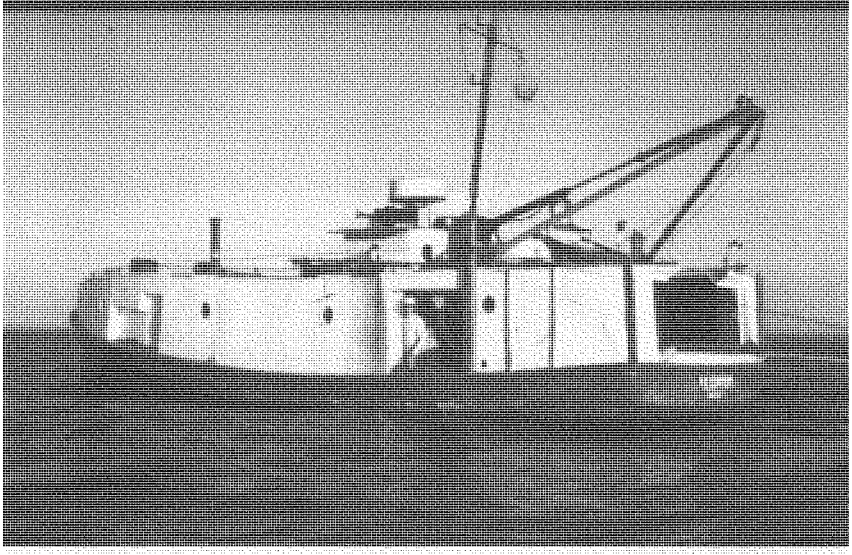
Another important component of the food web is the opossum shrimp. This organism, which can grow up to about 1.5 inches long, feeds on a variety of zooplankton, and can move up and down through the lower, cooler waters of a lake.[96] It is an important food source for a number of fish species in open lake waters, including forage fish such as deepwater sculpin, smelt, alewives, and bloaters, as well as lake whitefish.[97] Research off of Muskegon, Michigan in southern Lake Michigan found that as the percentage by weight of *Diporeia* in the diet of lake whitefish declined from 70 percent to 25 percent from 1998 to 1999-2000, the intake of opossum shrimp increased from four percent to nearly one-third of the total.[98] Although research has yet to find declines in opossum shrimp populations, increased predation by fish that would otherwise feed more on *Diporeia* could lead to substantial pressures on these shrimp populations.

The dramatic decline -- to the point of disappearance -- of these foundation species represents a sea-change in the food web and the entire Great Lakes ecosystem. Although the causes have not been conclusively proven, scientists believe that invasive species -- particularly zebra mussels -- are the likely culprits. Regardless of the causes, we already are seeing substantial damage ripple throughout the Great Lakes fishery, as discussed in the next section.



Opossum shrimp

5– Impacts on Fish Communities and Commercial Fisheries

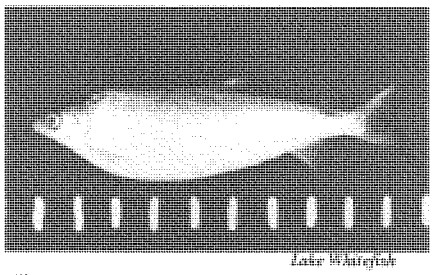


Fisherman trawling for smelt

The commercial fishing industry has adjusted to many dramatic changes in Great Lakes fish communities due to exotic species introductions – from around 60,000 metric tons annually around 1900, commercial fish harvests remained near 45,000 tons per year through most of the 20th Century.[99] In fact, recent restoration efforts have revealed positive results – for example, lake trout are again naturally reproducing in Lakes Michigan and Huron, and are apparently self-sustaining in Lake Superior; burbot populations have come back to some extent in the upper Great Lakes.[100] Restoration efforts must now address the possibility that there will be a loss of basic components in the food web; in particular, the disappearance of *Diporeia* may prove to be the most devastating result of invasive species to date, as well as one of the most challenging blows from which to recover.

The disappearance of *Diporeia* may destroy the link between the best food supply and the fish.[101] Following the zebra mussel invasion in Lake Ontario, alewives and rainbow smelt (which feed in part on *Diporeia* there), and juvenile lake trout moved to deeper water. Alewife and rainbow smelt, both fish that support trout and salmon stocks, used to obtained 40% and 11% respectively of their energy budget from *Diporeia*.[102] The shift of these species to deeper water has likely increased the importance of the opossum shrimp in their diets, although it has not necessarily led to increased growth rates in the colder water.[103] The relationship between this disruption in food levels and selected fish species is discussed below.

LAKE WHITEFISH: Lake whitefish are widely distributed in North American freshwater lakes. They are a staple of the Great Lakes commercial fishery and a mainstay of the traditional Native American diet. Great Lakes whitefish have been subject to at least two major declines, towards the end of the 19th Century, due to overfishing and drainage modification, and in the middle of the 20th Century, due in part to sea lamprey predation.[104] More recently, the average annual commercial lake whitefish harvest from 1995-1999 was over 50% of the total commercial catch in Lake Michigan each year.[105] But following the arrival of zebra mussels in 1989, the average length and weight of these fish decreased in southeastern Lake Michigan.[106] One measure of a fish's size is its condition factor, determined by calculating the ratio of its weight to its length cubed. A lighter, more emaciated fish has a lower condition factor. Figure 12 shows declines in condition factor of three age classes of lake whitefish in Lake Michigan since a population peak in 1992. While reduced growth rates in the 1990s may have been partly attributable to factors involving the density of the populations, the rapid decline starting in 1995 coincided with significant increases in zebra mussel density in northern Lake Michigan.[107]



Lake Whitefish

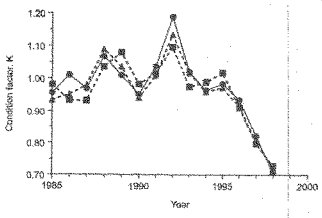


Figure 12: *Crash Diet: Following an explosion of zebra mussels in Lake Michigan during the 1990s and the near-disappearance of the water body's prized food source, Diporeia, lake whitefish experienced drops in weight in relation to their length – a measurement known as condition factor. Researchers assess the health of fish populations by tracking condition factor. Mean condition factor for age-4 (circles), 5 (triangles), and 6 (squares) lake whitefish from Lake Michigan, 1985-1998 (reproduced with permission from Madenjian et al. 2002.)*

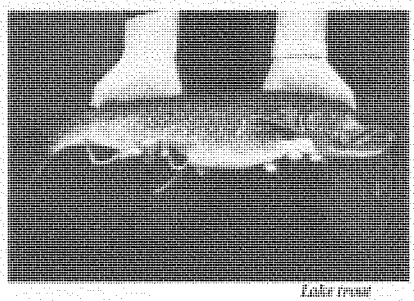
A very similar pattern is appearing 700 miles away on the eastern end of the Great Lakes chain. Lake whitefish from Lake Ontario's Kingston Basin supported 50% of Lake Ontario's total commercial harvest of all fish species in the 1990s.[108] Since 1993, whitefish body condition, decreased juvenile and adult abundance, poor survival, and reduced production have occurred as lake whitefish shifted to feeding on mussels.[109] Research into the health of Lake Huron lake whitefish in response to decreased abundance of *Diporeia* is underway.[110]

LAKE TROUT: Lake trout are native to the Great Lakes and historically supported a significant commercial fishery in all lakes but Lake Erie. As noted previously, the combination of overfishing and sea lamprey predation led to significant declines in lake trout populations. These included a complete collapse of lake trout populations in Lakes Michigan and Huron in the 1940s, and continued declines — that had begun prior to sea lamprey invasion — in Lake Superior. By the mid 1990s, lake trout were considered commercially extinct from all of the lakes except Superior. An additional insult to lake trout in at least one lake came from toxic chemicals: a retrospective assessment indicates that exposures to dioxin-like chemicals (including dioxins, furans, and certain PCBs) alone were sufficiently high to cause complete mortality in lake trout sac fry (i.e., young fish that have not completely absorbed the food sac) in Lake Ontario through the late 1970s.[111] The combination of chemical control on sea lamprey larvae and stocking

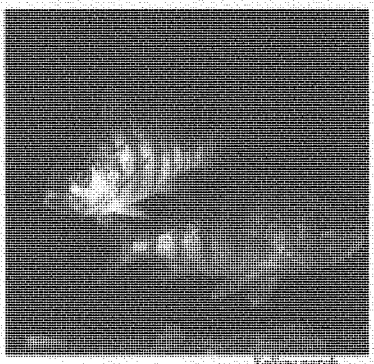
programs (and presumably declining levels of dioxin-like chemicals in Lake Ontario) have brought lake trout populations back to some degree, although only in Lake Superior are lake trout considered to be naturally reproducing at sustainable levels.[112]

In the past decade, the disappearance of *Diporeia* has imparted another blow to lake trout. Densities and body condition of lake trout dropped sharply in Lake Ontario's Kingston Basin after 1992, corresponding to the disappearance of *Diporeia* in those waters.[113] Juvenile lake trout eat *Diporeia*, and although adult lake trout do not depend directly on *Diporeia* for food, they do prefer to eat slimy sculpin in the summer months,[114] which rely on *Diporeia* for food.[115] In the past decade, densities of slimy sculpin have declined by as much as 95% in some waters of Lake Ontario.[116] In this same area, only a single specimen of *Diporeia* was collected from 18 lake bottom samples in 1997, where average densities of *Diporeia* had reached levels of 14,000 per square meter before the mussel invasion.[117] Scientists believe that drops in productivity through nutrient abatement and reduction in *Diporeia* may have negatively affected slimy sculpin populations,[118] with corresponding damage to lake trout.

In addition, zebra mussel colonies on shallow water reefs appear to inhibit successful lake trout spawning while other exotic species (carp, alewife, and round gobies) are potential predators of eggs and fry.[119] Recent research has indicated that an adult diet high in alewives has contributed to thiamine deficiency, which can also lead to mortality of lake trout fry.[120]



Lake trout



Yellow perch

YELLOW PERCH: Yellow perch have been important in the commercial fisheries in the four lower Great Lakes for decades, in particular in the past three or four decades in Lakes Huron, Erie and Ontario.[121] Declines in yellow perch in Lake Michigan in the 1970s were attributed to predation of larvae by the exotic alewives. Although populations rebounded in the 1980s, yellow perch recruitment (i.e., the increase in a fish population stock through reproduction, maturing, and migration) has been extremely poor since 1989,[122] for reasons that are still not clear.[123] Poor recruitment resulted in the lake-wide closure of commercial fisheries and reductions in bag limits for recreational anglers by the mid-1990s. In southern Lake Michigan, yellow perch survival and recruitment is closely tied to zooplankton abundance. Density of nearshore zooplankton had declined by a factor of 10 between 1988 and 1990 and remained low during 1996-1998, and may have contributed to yellow perch declines.[124] Although no firm evidence yet exists, it is possible that declines in *Diporeia* populations in southern Lake Michigan have also contributed to poor recruitment of yellow perch. Because they are also preyed upon by fish such as walleye, muskellunge, northern pike and burbot, yellow perch recruitment failures can affect a number of fisheries.

6~ Prognosis for the Great Lakes

Thirty years of pollution controls and fisheries management have driven a recovery process in the Great Lakes. However, as pointed out in the most recent State of the Great Lakes report, while a number of indicators are trending positive (e.g., meeting of phosphorus targets in all lakes but Erie, recoveries of bald eagle populations on Great Lakes shorelines), the introduction of non-native species has dramatically disrupted the Great Lakes ecosystem already, and threatens to grow worse.[125] The combination of invasive species and other threats to the ecosystem will make meeting the goals of the Great Lakes Water Quality Agreement that much more difficult. And a lack of sophisticated management tools combined with the complexity of the system will make management of the system challenging.[126]

Predicting Impacts

Predicting the impacts of new invasive species requires taking into consideration how the species will interact with the new environment as well as with other species, both native and non-native. Additionally, forces such as climate change may make determining the challenges of future Great Lakes system management even more challenging.[127] Sometimes the identification and management of new nuisance species may not occur for an extended period of time after initial exposure. Based on records of deliberate species introductions, it may take several years before the invader is detected in the system, depending on the speed of dispersal and type of organism.[128] This additional passage of time may obscure the linkage between the species and the damage it is causing, particularly since this link may not be direct or linear.[129]

Scientific predictions suggest that the Great Lakes and St. Lawrence River system will continue to receive new and potentially more damaging invasions from Eurasia.[130] As each new species becomes established, the ecosystem will respond to these new relationships. These changes will continue to challenge our innovative ability to adapt, especially in light of additional pressures on the Great Lakes ecosystem.

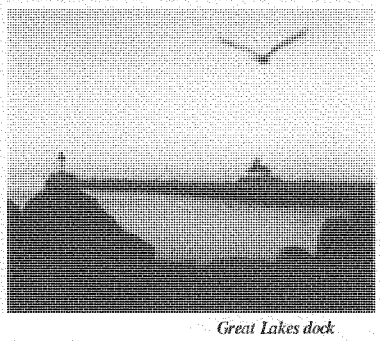
The Great Lakes Will Dramatically Change if We Don't Take Action

Unless additional action is taken quickly, the number of invasive species entering the Great Lakes will likely continue to dramatically increase. Researchers use considerations including potential donor regions with growing economies, trade patterns, attributes of species likely to facilitate invasion, and history of successful invasions in order to identify new species that could potentially invade the Great Lakes.[131] An important characteristic is examining species in regions from which successful Great Lakes species invasions have occurred. One study identified 56 fish species from the Ponto-Caspian region of Eurasia as potential invaders to the

BOX 6

Climate Change and the Great Lakes – Potential to Exacerbate Problems from Invasive Species

Climate change is being increasingly recognized as a serious problem for the Great Lakes. Computer models indicate that the climate in general could be as much as 7 degrees warmer by the end of this century. The models also indicate widely varying predictions on impacts of climate change on lake levels in the Great Lakes, ranging from as much as a 1.38 meter (4.6 ft) drop in Lakes Michigan and Huron by 2090 to a 0.35 meter (1.2 ft) increase in levels for the two lakes. The different predictions are generally due to difference in predicted precipitation levels and increases in air temperature. Other computer modeling predicts that the lakes would be warmer and more static for longer periods of the year (e.g. stratified with warmer water on top during warmer months), which could lead to reductions in nutrient cycling as well as lower penetration of oxygen to the deeper waters in the lakes. Though the potential food web repercussions of these changes are not clear, potential effects include reduced primary production (e.g., the production of algae), reduced generation times for most invertebrates, and reduced habitat for coldwater fish such as trout and salmon due to lower oxygen levels in deeper waters.[132]



Great Lakes dock

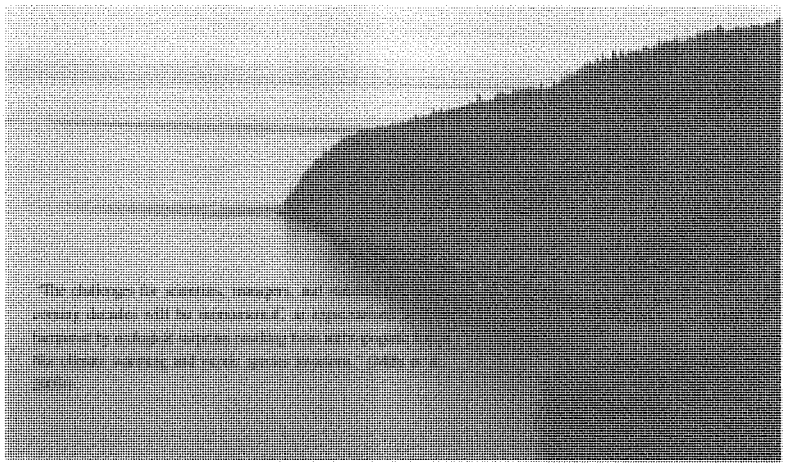
Great Lakes.[133] Two additional studies looked at invertebrate species; one determined that 16 species were "high risk" out of the 63 species[134] studied and the other identified 17 "high risk" species out of 59 species.[135] Similar studies have not yet been conducted for other groups of plants or animals.

Shutting the Door on Aquatic Invasive Species: An Ounce of Prevention is Worth a Pound of Cure

We have a greater chance of slowing the impact of invasions if we can determine ways of preventing their entry and by taking quick action to eradicate new populations before they are established. Determining which species pose the highest risks and then focusing prevention and control efforts on the pathways that bring those species may be the most effective strategy.

With advanced information on invasive and potentially harmful organisms, control measures such as quarantines and import restrictions could be established.[136] Additionally, resources could be better allocated to increase the chances of early detection and rapid response.[137] A process known as bioeconomical modeling uses a framework to evaluate the risks posed by invasive species to both economic activity and the environment and could be used to assist in identifying optimal management strategies.[138]

The Great Lakes ecosystem has been affected by invasive species and other stresses for over two centuries, and the fish communities have changed significantly during this time. Yet the potential for even more significant changes via an invasional meltdown of Great Lakes food webs is real.[139] Research is increasingly showing the potential for "mutualistic interactions" to occur—that is where two or more invasive species interact to mutual benefit for each involved. Acknowledging this threat means addressing ballast water introductions and other methods of invasive species transport. It means focusing on the benefits of educational programs. It means supporting research, technologies and regulations that control, reduce and prevent the spread of invasive species.



Great Lakes shoreline

7~ Recommendations for Action

Gerald Sim, Alberta

Our options for recovery once a nuisance species invasion has occurred in the Great Lakes are limited. The lakes will not clean themselves of invasive species as they can to some extent of chemical pollution; so stopping new inputs is not enough. Nor can we restore the food web simply by stocking high-profile species like trout and salmon or limiting their harvest. We must develop and implement new management tools designed specifically to protect the entire ecosystem and not just individual species. We must investigate and better understand food web dynamics and how these systems are being disrupted. Above all, it is absolutely imperative that we stop new, even more damaging invasive species from entering the Great Lakes. To accomplish this difficult but vital objective, we must attack the problem on multiple fronts: policy, research, funding, and public education. A number of initiatives have been taken to combat the threat of invasive species in the Great Lakes through containment, control and prevention. Efforts have achieved varying degrees of success.

Duluth, MN

Policy Actions

The invasion of the sea lamprey and ensuing crash of several commercial fish species led to the establishment of one of the most successful invasive species control programs – the sea lamprey control program – which has reduced lamprey populations by 90%, according to the Great Lakes Fisheries Commission, which manages the program in conjunction with the U.S. Fish and Wildlife Service, Army Corps of Engineers, and Fisheries and Oceans Canada. The program costs between $10 million and $15 million annually, and, its success notwithstanding, has underscored the challenge of mitigating the effects of invasive species in an environment in which they have already established themselves.

Great Lakes states have also enacted statutes to prevent the introduction and spread of invasive species. Through a patchwork of legislative initiatives, states have attempted to monitor and regulate the importation, transportation, stocking, possession, sale and release of non-native species such as fish and bait.

Recent efforts to combat invasive species have focused on preventing new non-native organisms from entering the Great Lakes through the primary pathway of entry – the release of ballast water from ocean-going vessels originating in foreign ports.

Under the Non-Indigenous Aquatic Nuisance Species Prevention and Control Act of 1990, ships entering the Great Lakes from the oceans are required to either carry no ballast water when entering the Great Lakes ("No Ballast On Board" vessels, or NOBOBs), or to exchange their ballast water at sea, in theory dumping any invaders into the ocean before they reach the Great Lakes.

But after extensive study, scientists have concluded that NOBOBs and ballast water exchange are not effective at stopping the introduction of new invasive species into the Great Lakes. Salt water may kill freshwater organisms. However, brackish water species such as crustaceans and algae may survive the exchange treatment.[140] Furthermore, despite their name, NOBOBs do contain residual ballast water and sludge that the pumps cannot remove. NOBOB vessels entering the Great Lakes typically carry between one to two hundred metric tons of unpumpable slop and sediment in the bottom of their tanks.[141] As the ships unload their cargo and take in Great Lakes ballast, the residual ballast mixes with the new water, resuspending non-native organisms and then releasing them when they take on and discharge ballast during their voyage through the lakes. Ballast water exchange at sea fares no better, for the same reason. Such exchanges cannot remove all organisms from ships' ballasts; so even after an exchange at sea, ships entering the Great Lakes can carry harmful organisms that they discharge as they travel through the lakes. And of course, ballast water exchange cannot address invasive species that attach to the hulls of ships.

Far more protection is needed. There are a number of immediate and important actions the federal government and regional leaders should take to address invasive species

to prevent further damage to the Great Lakes food web and fishery. These include:

National Legislation: Congress is considering comprehensive national legislation – the National Aquatic Invasive Species Act (S.525), or NAISA – that would regulate the most common routes of nuisance species introduction in the United States, including the nation's first implementation of standards for ballast water discharges. NAISA's enactment is a top priority; but it is also part of a long-term solution. The Great Lakes need even more rapid action than the bill would provide.

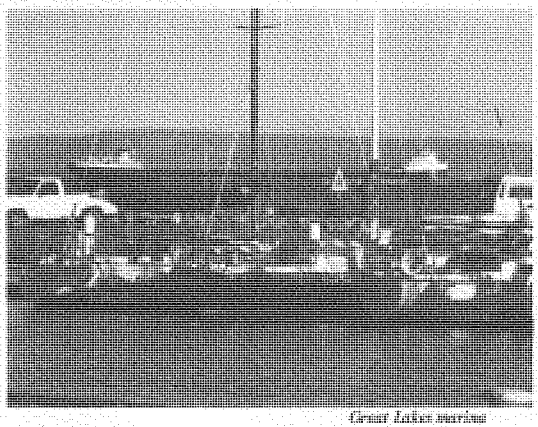
Voluntary action: The shipping industry has recognized its role in the introduction of aquatic invasive species. Recently, the International Maritime Organization (IMO) issued international ballast water standards for vessels. The IMO standards are weak and do not go far enough in protecting the Great Lakes. Those standards have also not been ratified by the necessary 30 nations representing 35 percent of world shipping tonnage. Nevertheless, the shipping industry does not have to wait for government action; it can take measures now to prevent the introduction of new harmful species. Over the past several years, ballast water treatment technologies have been tested to reduce the probability of invasive species introductions. Great Lakes carriers, ports and shippers can commit to developing and installing innovative and effective treatment technologies, rather than waiting for the public outcry and legal liability that could accompany a new infestation by a harmful invasive species.

Great Lakes Restoration: Congress also is considering pending legislation that would provide $4 billion-$6 billion to restore the Great Lakes. These funds would be spent in a number of areas, including invasive species control, clean up of contaminated sediments, prevention of additional water pollution, and habitat restoration. The funds may also be spent on research projects (including the research discussed below) that are critical to understanding and addressing the massive disruption of the Great Lakes food web.

Research Actions

Scientists have made strides in determining the extent of the disruption of the Great Lakes food web, the causes of that disruption, and its consequences. However, there are critical knowledge gaps that must be filled before we know how to restore the food web or at least minimize the damage done to it. More research is urgently needed to determine:

- The scope and severity of changes to the food web throughout the Great Lakes.
- The causes of the changes to the food web, including a better understanding of multiple interacting factors where identified.
- The impacts that food web disruptions have already had on other aquatic species, and the likely future impacts given current trends. Current impacts need to be measured directly to the greatest extent possible. Additional data gathering and computer modeling on food web interactions is necessary to identify potential



Great Lakes marina

Box 7

Getting a Handle on Invasive Species: The Challenges of a Coordinated, Effective Response

Jurisdictional management of resources in the Great Lakes drainage basin is complex – involving the federal governments of the United States and Canada, bureaucracies from two provinces and eight states, and Native American tribes.[142] Further, policy and management guidance is provided by the International Joint Commission and the Great Lakes Fisheries Commission.

U.S. government agencies at all levels have adopted programs to restore and protect the environmental quality in the Great Lakes region. In a 2003 report, the U.S. General Accounting Office (GAO), the investigative arm of Congress, found that within seven federal agencies there were 33 programs that were specifically designed to address environmental conditions in the Great Lakes through activities such as research, cleanup, or pollution prevention. The federal government spent $387 million in fiscal years 1992 through 2001 on these programs. During this same time, the Army Corps of Engineers spent $358 million on projects in the Great Lakes basin, as directed by Congress. And, according to the GAO, officials from seven states reported 17 Great Lakes specific programs that expended about $956 million in 1992 through 2001. In its assessment of these Great Lakes restoration efforts, the U.S. General Accounting Office found that there is no single agency in charge of the Great Lakes to coordinate various programs, resulting in a menu of Great Lakes programs that are often fragmented, uncoordinated and underfunded.

The GAO found that similar problems plagued national efforts to combat invasive species. In 1999 President Clinton signed an executive order to ramp up the government's response to invasive species and curtail the damage caused by non-native organisms to the environment, economy and health of the country. The executive order established the National Invasive Species Council (NISC) to provide leadership on invasive species initiatives – including responsibilities to ensure federal initiatives are coordinated and effective.

As part of this charge, the NISC crafted a federal management plan, issued in 2001, to coordinate the national effort to control invasive species among the 20 or so federal agencies that currently have jurisdiction in that area. In a study released in June 2003, the GAO found that the federal management plan for addressing invasive species included actions that would lead to the control of, monitoring and response to invasive species – though it lacked clear outcomes and measures of success. Further, the GAO found that implementation of the plan was slow due in part to lack of funding and staff to carry out he work. The 2003 study also identified other obstacles in combating invasive species, including gaps in existing legislation and lack of an effective ballast water standard. The report detailed major concerns by state officials, including a lack of federal funding, public education and outreach, and cost-effective management programs.[143]

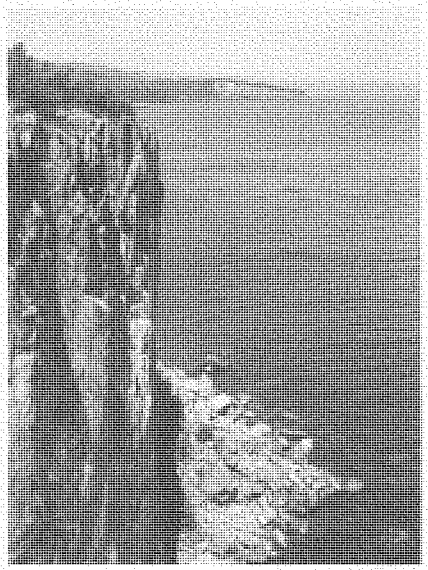
future impacts of food web disruptions in the Great Lakes.

- The design of new management tools to address the damage to the food web and its ripple effects throughout the lakes. Existing tools are inadequate.

In addition, since all potential invaders may not be prevented from entering the Great Lakes, research should be aimed at prioritizing threats, through means such as:

- Identifying potential donor regions and dispersal pathways of future invaders;
- Selecting potential invaders using biological criteria;
- Using invasion history as a predictive criterion;[144]
- Examining instances of failed invasions to identify limiting factors.[145]

While researchers have been addressing various aspects of these issues, it is clear that current research capacity and activity must increase to address these potentially serious changes to food webs. Significant additional funding is urgently needed, and state and federal fisheries agencies need to establish this research area as a top priority within their budgets and staffs.



Public Education

State funding will not be enough. According to the U.S. General Accounting Office, federal funds – especially new federal funding through Great Lakes restoration financing legislation currently pending in Congress are essential.

Policymakers and the public for years have heard about toxic pollution, water diversions and habitat destruction in the Great Lakes, and the general level of public understanding of these issues is relatively high. In the past few years, invasive species also have gained considerable notoriety. But few outside the Great Lakes scientific community understand the radical and harmful changes these problems have caused for the Great Lakes food web, fishery, and overall ecosystem. That limited awareness must change. The Great Lakes are in the midst of what may be an ecological meltdown – and the public and many policymakers do not yet know. The Great Lakes will not receive the attention they need in the time frame they need it unless public awareness of the problem changes dramatically.

A great number of mechanisms are available to bring about this change. A few include:

- Organized hearings, in Washington D.C. and in the region, to explore and highlight the problem.
- The convening of panels of knowledgeable scientists by conservation and business associations at regional and national meetings.
- State legislative and agency hearings.
- Priority-setting by regional organizations, such as the International Joint Commission, the Council of Great Lakes Governors, and the Great Lakes Cities Initiative.
- Continued education and outreach through state Sea Grant programs, and increased efforts by state extension programs.

Conclusion

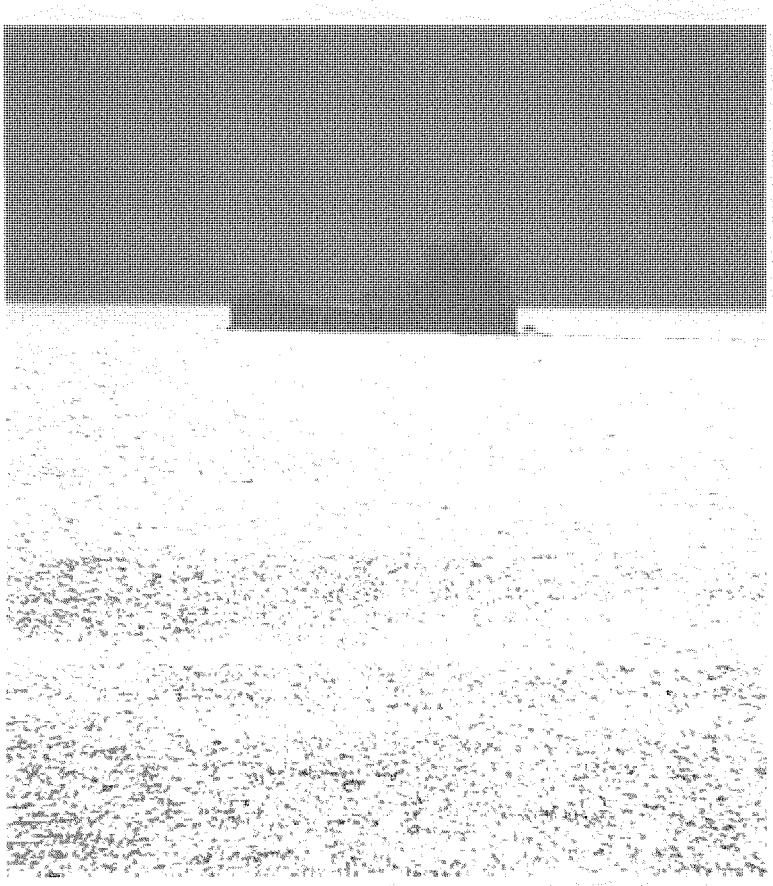
The Great Lakes right now are experiencing perhaps the most fundamental – and potentially devastating – changes in their recorded history. The Great Lakes food web is undergoing massive disruptions, primarily from the invasion of non-native aquatic species. We see the obvious effects of alewives washing up dead on the beaches, sea lamprey sucking the life out of lake trout, and zebra mussels clogging water intake pipes. But as damaging as these are, the research presented in this report indicates that they only scratch the surface of what's ailing the lakes.

The entire foundation of the Great Lakes food web is declining precipitously. The largest component of the base of the food web – *Diporeia*, a tiny shrimp-like organism – has nearly disappeared from large stretches of the lake bottoms. Other key components – fingernail clams and opossum shrimp – are beginning to experience similar declines. Although there is no conclusive evidence, most scientists believe that an invasive species, the zebra mussel, is the likely the culprit. And they worry that invasions by a similar species, the quagga mussel, will expand the damage to the remaining food web foundation, attacking deeper-water food sources.

The damage by invasive species is perpetual. Unlike pollution in the lakes, which can improve once new inputs are stopped, invasive species continue to reproduce and thrive even if no new species are introduced. The problem species we see now will

continue to get worse without action; and new invaders (an average of one every eight months) will continue to be introduced.

The lakes need action now. They need research to better understand the disruptions to the food web, the consequences to key species, and the best methods and places of intervention. They need federal and state legislation and voluntary action to stop the introduction of new invasive species. They need new management tools to address the invaders that are already in the lakes. And they need funding to accomplish these tasks – to restore the Great Lakes. Their future, and ours, are in the balance.



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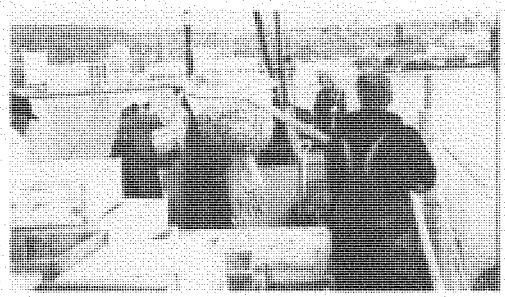

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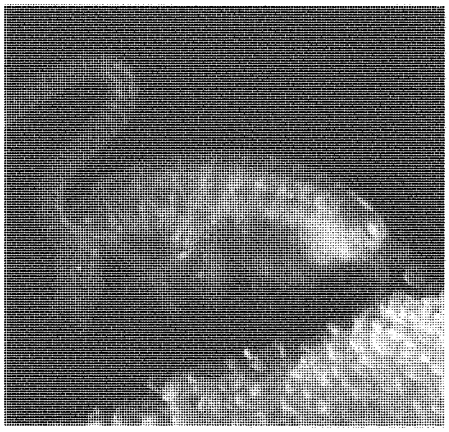

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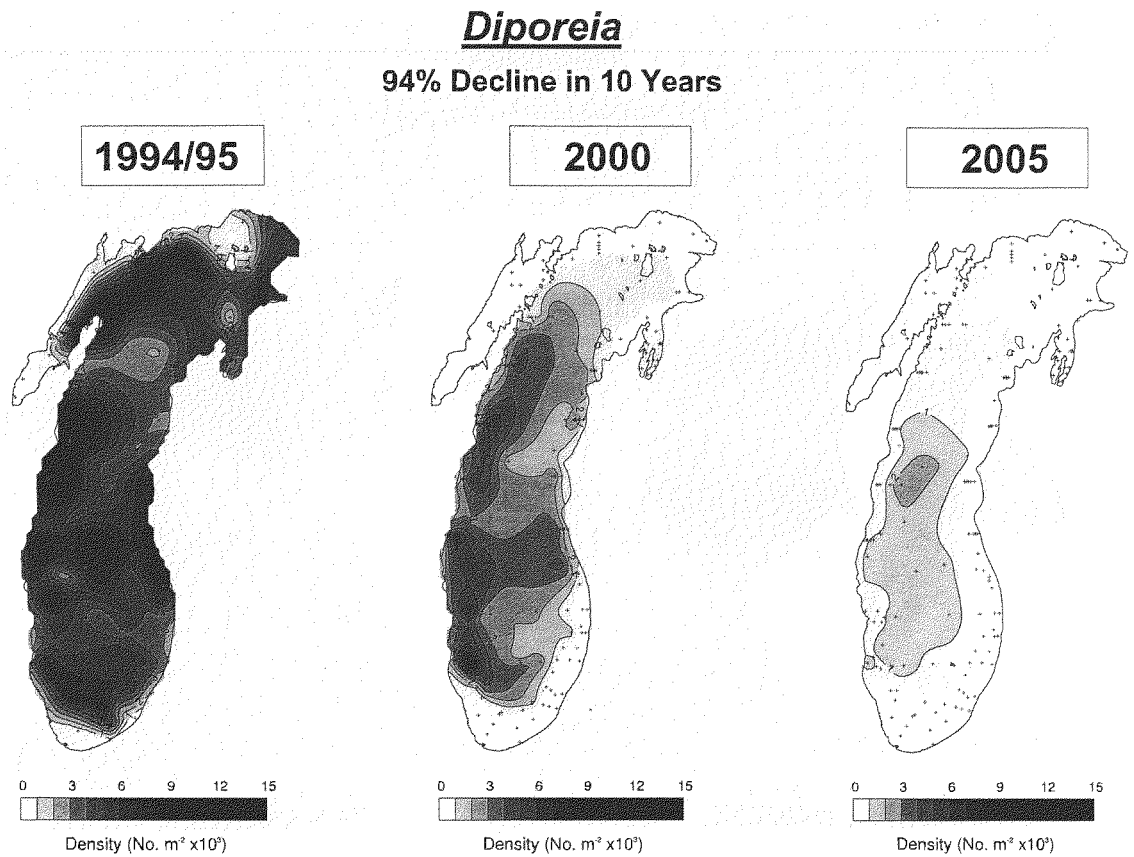
Diporeia
94% Decline in 10 Years
1994/95
2000
2005
0 3 6 9 12 15
Density (No. m⁻² x10³)
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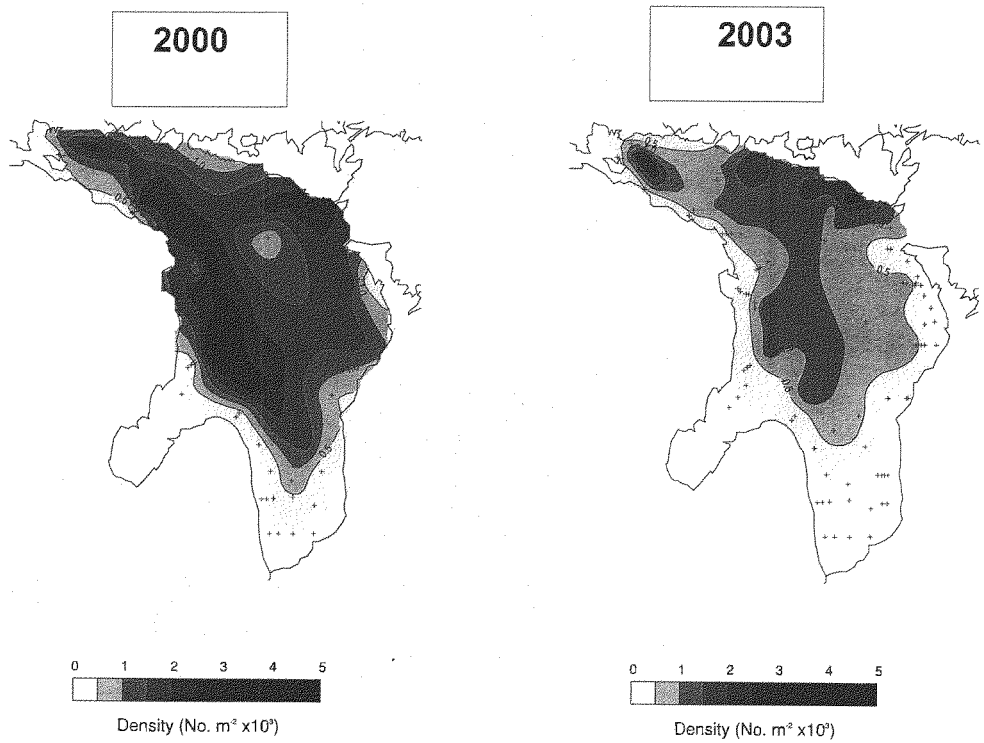
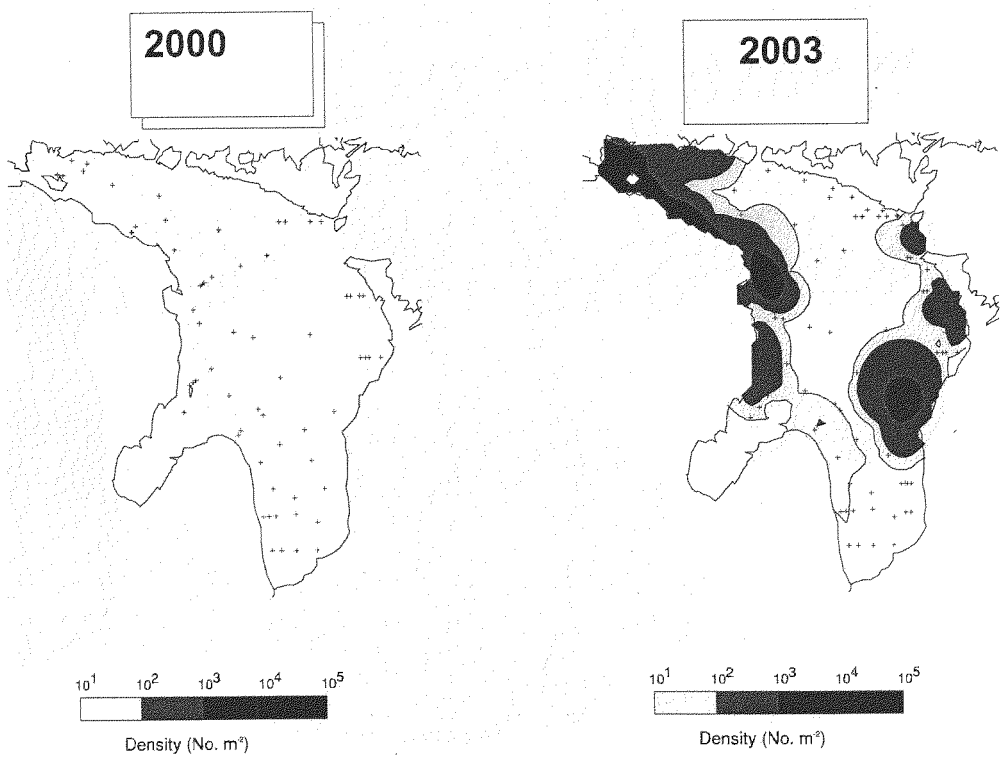
Density (No. m⁻² x10³)

Diporeia

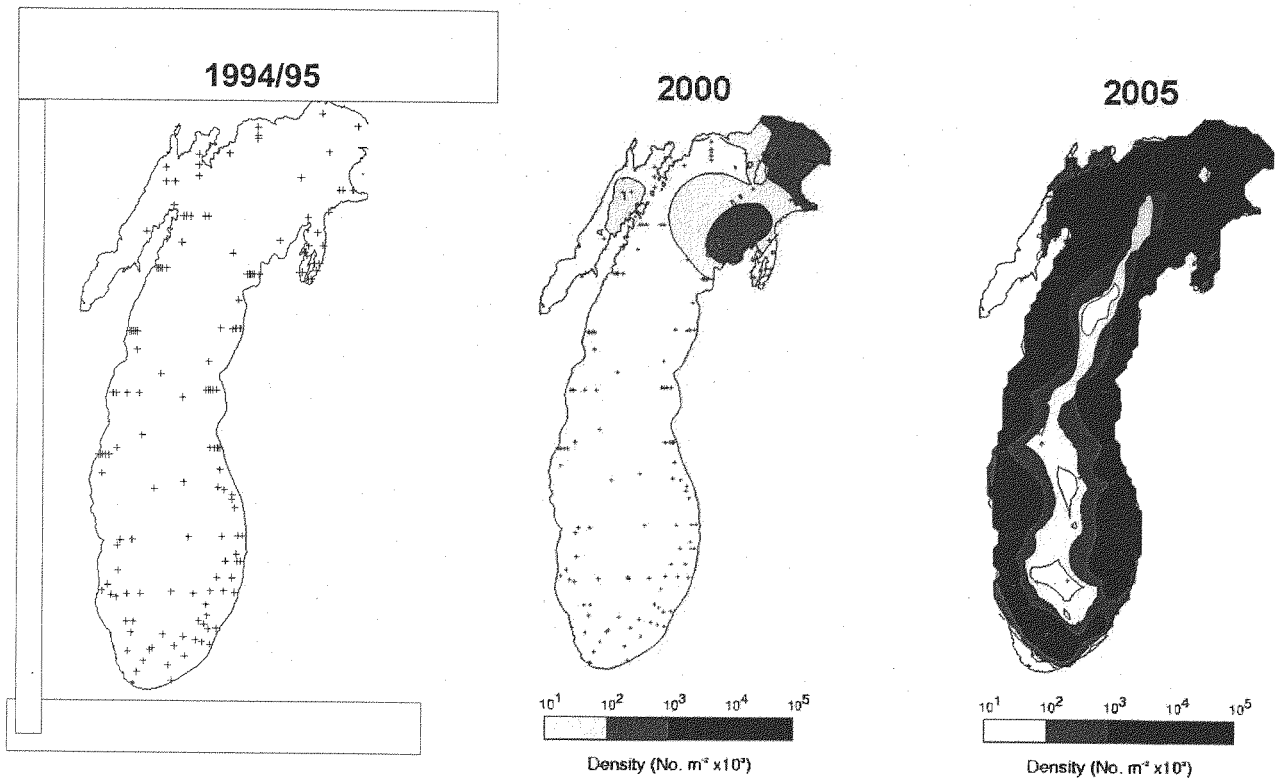
57 % Decline in 3 Years



Quagga Mussel



Quagga Mussel



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- Great Lakes Boating Federation
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- Indiana PIRG (INPIRG)
- Izaak Walton League of America
- John G. Shedd Aquarium
- John Ball Zoological Gardens
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- League of Women Voters of Michigan
- League of Women Voters of Ohio
- League of Women Voters of Wisconsin
- Michigan Council of Trout Unlimited
- Michigan Environmental Council
- Michigan Land Use Institute
- Michigan League of Conservation Voters
- Michigan Wildlife Conservancy
- Minnesota Center for Environmental Advocacy
- Minnesota Conservation Federation
- Minnesota Council of Trout Unlimited

- Minnesota Environmental Partnership
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- West Michigan Environmental Action Council
- Western Lake Erie Association
- Winous Point Marsh Conservancy
- Wisconsin Association of Lakes
- Wisconsin League of Conservation Voters
- Wisconsin PIRG (WISPIRG)
- Wisconsin Trout Unlimited

Testimony by

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517-335-4056

On behalf of the Great Lakes States
Before the
U.S. House Committee on Transportation & Infrastructure,
Subcommittee on Water Resources & Environment

March 7, 2007

Mr. Chairman and members of the Committee, thank you for the opportunity to appear before you today to discuss our shared efforts aimed at restoring the Great Lakes, and our concerns about the negative impacts of aquatic invasive species on those restoration efforts. My name is Ken DeBeaussaert and I am the Director of the Michigan Office of the Great Lakes. I come to you today from the Great Lakes state. I am testifying today on behalf of the Great Lakes States and the State of Michigan's executive leadership, Governor Jennifer Granholm, and Lt. Governor John Cherry, the current chair of the Great Lakes Commission.

I want to start by thanking you, Chairman Oberstar, for the support you have provided over many years for a long list of critical Great Lakes programs and initiatives. And, we applaud your leadership on national issues of importance to the Great Lakes region, including reauthorizing the Clean Water Act State Revolving Loan Fund at a significantly higher level than has been the case in the recent past. The loan fund is especially important to the Great Lakes States where these additional funds will aid our efforts to protect our drinking water and our beaches from sewage-contaminated pollution and runoff.

This problem – preventing pollution that contaminates drinking water and fouls our beaches – is one of the top priorities of the Great Lakes States. It is our priorities that bring us here today. Today is Great Lakes Day, a day when we ask Congress to listen as we ask for your help: to join with us in sharing the task of protecting our Great Lakes, of maximizing their value and importance as an economic engine for the region and in addressing the top priority problems facing the lakes and their residents.

We are more united than we have ever been regarding our shared agenda to protect and restore the Great Lakes. Attached to my testimony are the Great Lakes Commission's Great Lakes Program and a letter from the Council of Great Lakes Governors outlining our list of short-term actions for attention by Congress in 2007. Together, these reflect requests to Congress from the States to share in the investment we are making to protect and enhance the quality of our region's most valuable asset. The requests we submit are crafted to be realistic and achievable even in these times of tight budgets. Our requests are crafted to present to Congress the immediate actions that are needed to implement the Great Lakes Regional Collaboration Strategy – the blueprint that has been developed to protect and restore the Great Lakes.

This blueprint was developed over a 12-month period that was initiated by President Bush's Executive Order. The plan was released in December 2005. An unprecedented level of input – involving over 1500 people from federal, state, and local governments, industry, conservation groups and tribal interests – went into the plan. This plan reflects the best efforts of basin government leaders and stakeholders to organize and prioritize the allocation of resources to respond to the biggest challenges facing the Great Lakes. One of the key ingredients missing in this blueprint is critical to its success: increased support from Washington to help us put this plan into action.

We were pleased to work with Congress last year to pass the Great Lakes Fish and Wildlife Restoration Act of 2006, which increased the authorized funding for research projects and on-the-ground regional projects of significant merit to further enhance our restoration efforts for fish, wildlife,

and the habitats upon which they depend. We ask for Congress's support for critical programs like the state revolving loan fund and the Great Lakes Legacy Act to clean up contaminated sediments. We call on Congress to follow through on the promise of these important programs with the needed appropriations. At the same time, we note that even if these programs are fully funded, these efforts are simply not enough to address the critical problems we face.

Our region is united on what must be done this year to advance our efforts to protect and restore the Great Lakes. This unity is reflected in a one-page document, "Five Lakes – One Voice," that has been endorsed by a number of regional groups and is also attached to my testimony. We urge Congress to help us:

- Stop the inflow of aquatic invasive species by passing a National Aquatic Invasive Species Act, legislation (S. 770 as introduced in the 109th Congress) that authorizes comprehensive prevention and control programs, including construction and maintenance of the Asian carp barrier and critically needed regulations on ships' ballast water to prevent the introduction and spread of harmful aquatic invasive species, and appropriating $20.2 million to the Great Lakes Fishery Commission to control sea lamprey and to provide a unified forum for ecosystem-based management of the fishery resources of the Great Lakes basin.

- Clean Up Toxic Sediments by appropriating $54 million for the Great Lakes Legacy Act and restore Great Lakes "toxic hot spots."

- Restore Great Lakes Wetlands by appropriating $28.5 million to partner with the states in restoring 200,000 acres of valuable Great Lakes wetlands and $16 million for the Great Lakes Fish and Wildlife Restoration Act.

- Protect Water Quality by appropriating $1.35 billion for the Clean Water State Revolving Fund (CWSRF) to update sewerage systems, safeguard drinking water and protect coastal health in the Great Lakes. Reauthorize the CWSRF in order to provide additional funding in future years.

- Enact Great Lakes Restoration Legislation by authorizing the recommendations from the Great Lakes Regional Collaboration restoration strategy and funding coordinated implementation actions.

We are especially appreciative of this committee calling attention to the problem of invasive species in the Great Lakes. Tackling this problem – curbing the introductions of aquatic invasive species – is a top priority in 2007.

In the Great Lakes region, we take seriously our stewardship responsibility. You've probably heard some of the superlatives we often use to describe the Great Lakes and why they are a vital national treasure. The Great Lakes constitute the largest surface freshwater system in the world. More than 35 million Americans receive the benefits of drinking water, food, a place to work, live, and recreate, and transportation from the Great Lakes.

Our national economy depends on the Great Lakes. The Great Lakes States account for 30 percent of the total U.S. Gross Domestic Product. The Great Lakes are a key national transportation network. U.S.-flag vessels annually ship over 125 million tons of cargo between Great Lakes ports. Fishing, boating, hunting and wildlife-watching generate almost $53 billion in annual revenues in the Great Lakes region. One-third of all the boats registered in

the U.S. are in the Great Lakes States and boating alone supports over 250,000 jobs.

The special qualities of the lakes inspire bold leadership to protect them and to ensure that they are used wisely today so that future generations can enjoy their bounty. We boast that the Great Lakes are a living laboratory and that we are pioneers – global leaders in forging fresh water resource management and protection programs. In Michigan, we are proud of the fact that we banned the sale of DDT and PCBs before the rest of the nation banned these harmful chemicals in the 1960s and 70s. We took these actions because it was our duty as stewards of these Sweetwater Seas. We also banned these chemicals first in Michigan to spur the federal government into action.

We face a similar crisis in the region today because of the problem of invasive species. Unfortunately, federal action to halt introductions of invasive species has been too slow and the problems continue to mount. Frustration over this inaction led five Great Lakes states to join a lawsuit to try to force action by the U.S. Environmental Protection Agency (EPA) through provisions of the Clean Water Act. A federal district court decision requiring repeal of the exemption for ballast water from the Clean Water Act is now being appealed by the U.S. EPA.

In 2005, after years of waiting for federal action and requiring vessels to demonstrate that they were using best management practices, the Michigan legislature with support of the Michigan Chamber of Commerce and the Michigan Manufacturers Association and with only one dissenting vote in both chambers passed legislation requiring ocean-going vessels that visit

Michigan ports to obtain a permit beginning in 2007. Under provisions of the law signed by Governor Granholm, a ship operator must utilize one of four technologies that the state has identified through a general permit or an alternative method approved by the state to discharge ballast water from an ocean-going ship at a Michigan port.

Individual state permitting is far from being a perfect solution to this complex problem. We recognize, of course, that we cannot protect Michigan's Great Lakes waters from invasive species that could be introduced by ships discharging their ballast water in other parts of the lakes. But, we are resolute in our determination that we cannot sit by as we watch the Great Lakes teeter on what some scientists describe as the tipping point of ecological meltdown.

The problems caused by aquatic invasive species and the threat that they pose to our region is well documented. Unfortunately, the list of problems and the list of invasive species continue to grow. As of 2006, more than 180 aquatic invasive species have become established in the Great Lakes. These species are not just a threat to the health of our fishery - they are a threat to our economy. The estimated cost of invasive species is $5.7 billion annually. The cost of just one invader, zebra mussels, is estimated to cost cities, power generators and others $500 million annually.

The impact of invasive species on the ecological health of the Great Lakes is equally alarming. Perhaps most alarming is what we don't know; our understanding of the extent of the damage continues to evolve as more creatures are introduced and as the science catches up. Lake Erie has

developed a 3,900 square mile dead zone in the summer months. Although the causal mechanisms are not clear, it is suspected that the dead zone is linked at least in part to changes in the dynamics of the food web in Lake Erie that correspond to the proliferation of zebra mussels. In Lakes Michigan and Huron, the proliferation of zebra and quagga mussels, both non-native species that arrived here in the ballast tanks of ships, is thought to be responsible for the crash in populations of diporeia. This tiny freshwater shrimp has become the unlikely poster-animal that symbolizes the declining health of the Great Lakes fishery. Many species of valuable commercial and sport fish, including whitefish, perch, trout and salmon, are directly or indirectly dependant on diporeia for food. In some parts of the lakes, where zebra and quagga mussels have taken over, diporeia are virtually gone and the health of fish stocks is declining dramatically. One particular example is the severe decline in the population of Chinook salmon in Lake Huron since 2002. We believe this decline may be a result of changes in the transfer of energy throughout the food web brought on by quagga mussels. If, in fact, the basic food web has been disrupted by aquatic invasive species in Lake Huron, the probability of recovering the salmon population through stocking of more salmon is highly unlikely.

One year ago at Great Lakes Day, we urged action to combat invasive species and enact ballast water legislation. One year later we return with an even greater sense of urgency. Yet another invasive species has been identified and a new disease of fish – viral hemorrhagic septicemia (VHS) – is spreading throughout the Great Lakes at an alarming rate. Although we do not fully understand what VHS will do to fish populations in the Great

Lakes, the virus has already caused significant mortalities of many fish species in Lakes Huron, Erie, and Ontario.

The collapse of sport (salmon) and potentially commercial (whitefish) species that are likely related to the introduction of aquatic invasive species has already had a significant economic impact to the port communities in Michigan along Lake Huron, and to the commercial operations targeting lake whitefish (State and Tribal). That impact will be further exacerbated by VHS.

Fortunately, solutions to these problems, though not simple, have already been outlined. In the Great Lakes Regional Collaboration Strategy to Restore and Protect the Great Lakes, a straightforward suite of solutions is presented. I had the honor of co-chairing the Strategy Team that developed the Aquatic Invasive Species recommendations of the Strategy. As I noted earlier, our priority recommendations to Congress this year are built around this blueprint. One action alone, passage of a National Aquatic Invasive Species Act (NAISA), similar to S. 770 as introduced in the 109th Congress would be a monumental step forward in reducing the risks of future introductions and spread of invasive species. I would note that a NAISA bill was re-introduced last week by Senators Levin and Collins. We are now reviewing this bill.

If a NAISA bill similar to S. 770 as introduced in the 109th Congress becomes law, it would fulfill the first two requests on our list of short term actions. First, this bill would authorize the Corps of Engineers to complete the construction, as well as operate and maintain, the electric barriers

designed to prevent Asian carp from invading the Great Lakes via the Chicago Sanitary and Ship Canal. We are pleased to see funding for the barrier included in the President's budget recommendations for the Corps although we have concerns with the specific funding provisions. We hope that Congress will enact legislation that provides for stable, long-term federal funding for the operation and maintenance of both the temporary dispersal barrier and the permanent barrier that is still under construction. Another way to do this would be to pass H.R. 553 and S. 336—legislation to federally fund full construction, maintenance and operations of the barriers. The Great Lakes states have already contributed monies to overcome federal funding shortfalls, in addition to the significant amounts committed by the State of Illinois. The federal government must now do its part to ensure that the Great Lakes remain protected from Asian carp.

S. 770 as introduced in the 109th Congress also included the badly needed provisions to reduce the risk of future releases of invasive species from ships discharging their ballast water. During the development of the Great Lakes Regional Collaboration Strategy, there was broad consensus that the ballast water provisions of S. 770 would meet our immediate needs. It is worth noting that this consensus support included representatives of the region's maritime industry.

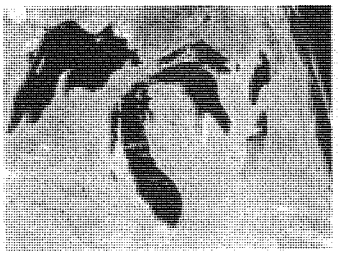
In addition to the recommendations of the Great Lakes Collaboration, I have attached a 2006 letter signed by the eight Great Lakes Governors, which outlined to members of the U.S. Senate their concerns about proposed legislation in the last session of Congress and outlining their view of key elements in any ballast water legislation.

We believe that the time to pass legislation to create a strong, protective uniform program to regulate ballast water discharges in the Great Lakes is now. We applaud your recent statements, Chairman Oberstar, expressing your commitment to tackle this challenge in 2007 and you have our pledge to work with you to craft a workable solution Toward that end, the Great Lakes States have continued a dialogue with representatives of Tribal and local governments, the maritime industry, conservation groups and others. Our goal continues to be to identify common interests in a federal solution to the problem of ballast water induced releases of invasive species. We continue to discuss many of the thorny issues that, if they could be resolved, might help you in your efforts to find a workable federal policy solution. We already have consensus on a number of general elements of a solution. We will be continuing our dialogue in the future and look forward to sharing with you the results of our ongoing discussions. One certainty is the strong consensus on one fundamental point: we all agree that a federal solution to this problem is needed and this need is urgent.

In addition to Michigan's enactment of ballast water permit requirements, ballast water legislation was introduced in several Great Lakes states last year. Already this year, a bill modeled after Michigan's was introduced in the Minnesota legislature. Clearly, a state-by-state approach creates challenges for our states, the maritime industry, and others. But, if Congress fails to act, it is likely that these state measures will proliferate. The Great Lakes states continue to believe that the best solution is a federal ballast water permit program that is uniform, consistent and protective of the unique qualities and characteristics of the Great Lakes.

In closing, Mr. Chairman and members of the committee, our pledge to you is that we will continue to work together to develop solutions for stopping the spread and introduction of invasive species. We also pledge to ensure that the investments that we ask Congress to make toward our list of short term priorities are put to good use.

We must protect and restore this ecological treasure. That will be our legacy for future generations. Thank you, Mr. Chairman.



Great Lakes Restoration: Five Lakes – One Voice

Regional Priorities for the Great Lakes

March 2007

The Great Lakes region is united in support of critical, near-term priorities to restore and protect the Great Lakes. These are consistent with the priorities of the governors of the Great Lakes states, are endorsed by the mayors of the Great Lakes and St. Lawrence Cities Initiative, and reflect recommendations from the Great Lakes Regional Collaboration Strategy to Restore and Protect the Great Lakes. We urge Congress to implement these specific actions to address urgent threats and implement high-value restoration opportunities:

- **Stop Aquatic Invasive Species:** Pass the National Aquatic Invasive Species Act and House and Senate legislation (H.R. 553 and S. 336) that authorize construction and maintenance of the Asian carp barrier to prevent the introduction and spread of harmful aquatic invasive species – such as the Asian carp – and appropriate $20.2 million to the Great Lakes Fishery Commission to control sea lamprey and manage fishery resources.
- **Clean Up Toxic Sediments:** Appropriate $54 million for the Great Lakes Legacy Act to clean up contaminated sediments and restore Great Lakes "toxic hot spots."
- **Restore Great Lakes Wetlands:** Appropriate $28.5 million to partner with the states in restoring 200,000 acres of valuable Great Lakes wetlands and $16 million for the Great Lakes Fish and Wildlife Restoration Act.
- **Protect Water Quality:** Appropriate $1.35 billion for the Clean Water State Revolving Fund (CWSRF) to update sewerage systems, safeguard drinking water and protect coastal health in the Great Lakes. Reauthorize the CWSRF in order to provide additional funding in future years.
- **Enact Great Lakes Restoration Legislation:** Authorize recommendations from the Great Lakes Regional Collaboration restoration strategy and fund coordinated implementation actions.

We are united as a region in asking for congressional support for these near-term Great Lakes priorities.

Chippewa Ottawa Resource Authority	Great Lakes Commission	Great Lakes and St. Lawrence Cities Initiative	Great Lakes Fishery Commission	Healing Our Waters Great Lakes Coalition®
www.1836cora.org	www.glc.org	www.glslcities.org	www.glfc.org	www.healthylakes.org

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March 2, 2007

The Honorable Carl Levin
269 Russell Senate Office Building
Washington, D.C. 20510

Dear Senator Levin:

As Governors of the Great Lakes region, we want to share with you our joint agenda for restoring the Great Lakes and ask for a significant improvement in federal investment to improve a watershed that is home to more than 30 million Americans.

In December 2005, the Governors joined with representatives of the Bush Administration, Congress, and regional mayors and tribes to unveil a strategy to restore and protect the Great Lakes. This Strategy was developed as a result of a Presidential Executive Order establishing the Great Lakes Regional Collaboration (GLRC), a process that included over 1500 stakeholders from across the spectrum. We are mindful of intense federal budgetary constraints and the need to address environmental concerns from coast to coast. However, we believe that further delays in true federal engagement will further imperil the lakes and exponentially raise long-term restoration costs.

Our list of near-term action priorities remains unchanged from last year. Our long-term goal remains to secure large-scale, long-term funding to implement the Strategy's recommendations and to enact management reforms to ensure that resources are efficiently used to address our highest-priority needs.

We continue to recognize that specific actions can and must be taken now to advance the GLRC Strategy. Therefore, we ask you to support the attached series of near-term actions to protect and restore the Great Lakes in FFY 2008, which include:

- Achieve broad, national protection against the introduction and spread of aquatic invasive species through Congressional passage of a *National Aquatic Invasive Species Act* (as reflected in S.B. 770, H.R. 1591 and H.R. 1592 as introduced in the 109th Congress.) In addition, authorize funding and direct the U.S. Army Corps of Engineers to spend such funds as are necessary to upgrade, complete construction, operate and maintain a permanent, two-dispersal barrier system in the Chicago Sanitary and Ship Canal at full federal cost in order to prevent the Asian carp and other invasive species from entering the Great Lakes.

- Appropriate funds in the amount of at least $54 million annually in support of the Great Lakes Legacy Act. Furthermore, the Legacy Act is expiring and needs to be reauthorized as soon as possible.

- Appropriate $28.5 million to begin restoration work immediately of 200,000 acres of wetlands in the Great Lakes Basin. The States remain committed to working with other non-federal partners to provide an additional $28.5 million cost-share toward this end.

We also want to ensure that existing and proven core programs, such as the Clean Water State Revolving Loan Fund; the Coastal Zone Management Program; and, the Great Lakes Fishery Commission's Sea Lamprey control program are fully funded. Continuing programs like these is critical to maintaining the gains made through past investments.

In the coming weeks you will be hearing and seeing much more from our States' constituents who believe the time for planning has passed, and that critical remedial and preventive actions are overdue. In partnership with your States, we hope you will consider the attached list of near-term action priorities we have assembled, and urge you to consult with our offices to address outstanding issues or concerns.

Sincerely,

Rod Blagojevich
Governor of Illinois

Mitch Daniels
Governor of Indiana

Jennifer M. Granholm
Governor of Michigan

Tim Pawlenty
Governor of Minnesota

Eliot Spitzer
Governor of New York

Ted Strickland
Governor of Ohio

Edward Rendell
Governor of Pennsylvania

Jim Doyle
Governor of Wisconsin

Attachment

COUNCIL OF GREAT LAKES GOVERNORS
GREAT LAKES RESTORATION AND PROTECTION
NEAR TERM ACTION ITEMS
FFY 2008

General

The Great Lakes Governors express strong support for the *Great Lakes Collaboration Implementation Act* (S. 2545 and HR 5100 as introduced in the 109th Congress), to implement the recommendations of the Great Lakes Regional Collaboration (GLRC) Strategy.

Aquatic Invasive Species

Aquatic invasive species (AIS) continue to pose one of the most serious threats to the Great Lakes ecosystem. An average of one new species is discovered in the Great Lakes ecosystem every eight months, and once present, eradication is often impossible. Prevention is vital to stemming ecosystem impacts from new invasive species. And, because AIS easily transfer from watershed to watershed, it is absolutely critical that comprehensive national action be taken to combat the spread of AIS.

Therefore, the federal government must move swiftly under its existing authorities to require improvement for ballast water management including practices for those ships declaring no ballast on board to forestall the introduction of new invasive species to the Great Lakes.

We continue to ask that injurious carp species be listed under the Lacey Act to limit the spread of the carp to the Great Lakes and other watersheds.

In addition, Congress should pass and the President should sign a *National Aquatic Invasive Species Act* (NAISA) that contains the components in S. 770, H.R. 1591 and H.R. 1592 as introduced during the 109th Congress. Enactment of such a NAISA is one of the key legislative objectives of the Great Lakes Regional Collaboration's (GLRC) Strategy. Passage of comprehensive federal legislation such as NAISA would address many of the key recommendations developed by the participants in the GLRC and is critical to our overall restoration goals.

To combat AIS, funds should be authorized and appropriated via the passage of the NAISA, the Water Resources Development Act or other legislation as follows:

- It is critically important that Congress authorize and direct the U.S. Army Corps of Engineers to spend such funds as are necessary for them to complete construction of the permanent dispersal barrier in Chicago Sanitary and Ship Canal, make permanent the temporary dispersal barrier, reimburse the Great Lakes States for the costs incurred to date associated with completing both, and maintain and operate both dispersal barriers at full federal cost.
- $8 million for Great Lakes State-specific management plans. It is vital that these funds be distributed to the States and Tribes to implement existing plans approved by the U.S. Fish and Wildlife Service.

- $11.25 million to prevent introduction of AIS by vessels (includes $6 million in support of the U.S. Coast Guard's Section 1101 program, $2.5 million for the U.S. Environmental Protection Agency's Section 1101 program, and $2.75 million to Task Force Section 1101).
- $1 million for model regional, State and local rapid response contingency strategies.

Coastal Health

Elimination of sewage overflows to the Great Lakes and their tributaries is a region-wide need and the most direct means of improving coastal health. Beach closures are one of the most obvious markers of degraded coastal conditions.

Combined Sewer Overflows (CSOs) and Sanitary Sewer Overflows (SSOs) are the greatest impediment to improving coastal health. The federal government, in cooperation with the States, should ensure that all CSO/SSO communities have completed a long-term control plan (LTCP) within the next four years and are making adequate progress in implementing these plans.

The cost of correcting CSOs and SSOs is burdensome to local communities and to ratepayers. The Clean Water State Revolving Loan Fund (SRF) has served as a critical tool for updating the sewerage systems in the Great Lakes. Unfortunately, recent and ongoing major cuts to this program have resulted in a loss of hundreds of millions of dollars for the Great Lakes States. It is essential that the historical full-funding of $1.35 billion again be appropriated in support of this program.

In addition, we again ask that an additional $2 million be provided under the Beach Act to enable Great Lakes States and Tribes to standardize, trial, and implement a risk-based approach to beach/coastal assessment. Beyond that, we seek to maintain current funding levels: $1.75 million for the Great Lakes States and $50,000 for eligible Tribes.

Areas of Concern

Passage of the Great Lakes Legacy Act provided for the first time a dedicated source of funding for remediation of contaminated sediments in the Areas of Concern (AOC). However, appropriations rarely approached the authorized levels during the life of this program. Therefore, at least $54 million should be appropriated for FFY 2008. Furthermore, the Legacy Act is expiring and needs to be reauthorized as soon as possible to address these ongoing problems.

Restoration of the AOCs is necessarily driven at the local level, through plans developed by States, Tribes, local officials, and concerned citizens. Unless this capacity is nurtured at the local level, progress on AOC restoration will be limited. While States and non-governmental organizations have continued to support Remedial Action Plan (RAP) groups, federal support has dwindled with negative effect. Accordingly, we again request that $10 million be appropriated to support State and local AOC/RAP programs in the Great Lakes States, an increase of $8 million over the current appropriation. We also request that USEPA's Great Lakes National Program Office (GLNPO) receive $1.7

million for program administration—an increase of $1.2 million over the current appropriation.

Toxic Pollutants

Progress in protecting and restoring the Great Lakes will only be achieved and maintained to the extent that toxic pollutants are controlled. Certain persistent toxic substances have been significantly reduced in the Great Lakes Basin ecosystem over the past 30 years but they continue to be present at levels that pose threats to human and wildlife health. These substances also warrant fish consumption advisories in all five lakes. More recently, researchers have documented the presence of additional chemicals of emerging concern that may also pose threats to the Great Lakes.

The federal government should restate its commitment to implement the Great Lakes Bi-national Toxics Strategy and should evaluate its implementation schedule for opportunities to accelerate its efforts.

We ask that the FFY 2008 budget include an additional $2 million to be distributed to the States to expand the toxics reduction program in the Great Lakes Initiative.

The Administration and Congress are asked to provide $1 million in FFY 2008 in ongoing funds to continue Tribal fish tissue contaminant analysis programs and related community education programs. Congress is again asked to appropriate an additional $100,000 in the FFY 2008 budget to facilitate Tribal participation in a mercury stewardship program.

Emerging chemicals of concern are little understood but pose a potentially serious threat to aquatic life and wildlife in the Basin. We ask that Congress provide $100,000 for monitoring these new chemical contaminants.

Habitat and Species

Protecting and restoring wetlands and Great Lakes tributaries can significantly advance the preservation of species diversity in the Great Lakes Basin. These activities are also key to the full implementation of international agreements on management of migratory birds and Great Lake fish.

The Great Lakes Governors applaud the reauthorization of the Great Lakes Fish and Wildlife Restoration Act of 2006. Fully funding this program would help address one of our greatest challenges--protecting and restoring fish and wildlife habitat. If fully funded, GLRC members will have increased capacity to implement specific recommendations of the GLRC Strategy. While specific project objectives may vary among jurisdictions, the composite results will help attain the regionally important Strategy goals. We ask that the fully authorized $16 million be appropriated for FFY 2008.

We also continue to ask that $28.5 million be provided to existing Fish and Wildlife Service programs to restore 200,000 acres of wetlands, toward the GLRC Strategy's goal of eventual restoration of 550,000 acres. States, local governments and NGOs would

raise an additional $28.5 million in non-federal matching funds.

To maximize the use of existing funding for wetlands protection and restoration, the GLRC strategy proposes that the Federal Interagency Task Force review all federal agencies' wetland management programs and develop a consolidated approach. We applaud the U.S. Army Corps of Engineers' new Great Lake Habitat Initiative and ask that the Great Lakes Federal Interagency Task Force complete a review of all federal agencies' wetland management programs to develop a consolidated wetlands restoration and protection approach.

Great Lakes tributaries are key spawning and nursery areas for Great Lakes fish. Species recovery plans are dependent on protecting existing high quality tributaries and restoring other tributaries with the potential to support targeted species. These activities are site-specific, based on watershed hydrologic and physical habitat needs. The GLRC Strategy set a near-term protection and restoration goal of ten tributary streams. We ask that Congress pass a Great Lakes River Restoration Act and direct $40 million in the FFY 2008 budget for Fish and Wildlife Service programs to be directed to key tributary stream restorations.

Nonpoint source pollution

Nonpoint source pollution impacts vary greatly in frequency and severity across the Great Lakes. Impacts have been particularly severe in coastal wetlands and tributaries that once buffered the Lakes from environmental damage.

Although there are existing programs to deal with sedimentation and nutrient enrichment, the current needs outstrip existing program capacity. We ask that the FFY 2008 budget include an additional $66 million to increase enrollment in buffer strip programs.

Urban streams are particularly vulnerable to nonpoint source pollution. We request $18 million in FFY 2008 for hydrologic improvement projects in urbanized areas where runoff from development directly affects natural waterways and their confluence with the Great Lakes or connecting waters.

Indicators and Information

Accountability demands that the Great Lakes restoration effort be able to determine baseline conditions and assess the results of restoration projects and investments. In addition, the capacity to assess trends is needed to observe long term change and detect the emergence of new issues (e.g. new exotic species).

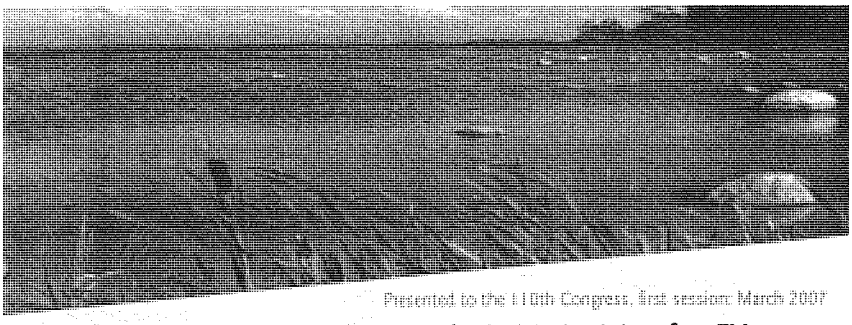
The SOLEC process to develop indicators should be completed for a full suite of 80 indicators, with particular attention to the use of indicators that will measure the success of the measures recommended in the GLRC Strategy. We ask that $800,000 be provided in FFY 2008 toward this end. We continue to believe that a "top ten" list of indicators should be developed and reported to the public on an annual basis.

The Great Lakes Federal Interagency Task Force should review monitoring programs among its member agencies to ensure effective and efficient gathering and reporting of data. The Task Force should coordinate with the States and Tribes to optimize the effectiveness of monitoring investments throughout the region.

Sustainability

The philosophy of sustainability overlays all the recommendations developed through the GLRC process. The positive result of investment in restoration projects can only be maintained over time if sustainable practices become more widespread. Many of the recommendations in the GLRC's Strategy reflect a sustainable approach.

In the near term, we suggest that federal agencies review prioritization formulas for brownfield grant and loan programs, and for State Revolving Fund loan programs, to determine whether projects that reflect sustainable practices or advance sustainable principles can be awarded a higher priority for funding or a more favorable interest rate.



Presented to the 110th Congress, first session March 2007

Great Lakes Commission Legislative Priorities for FY 2008

On behalf of the eight Member states of the Great Lakes Commission, we present the following legislative priorities to protect and enhance the quality of our region's environment and economy. The Commission thanks the members of the Great Lakes Congressional Delegation for their support of critical programs and funding and we are most eager to work with the delegation on the issues presented below.

The Commission's priorities are crafted to advance the conclusions and recommendations of the region's stakeholders as presented in the Great Lakes Regional Collaboration Strategy (www.glrc.us). The Commission endorses the recommendations to Congress from the Council of Great Lakes Governors; the recommendations herein complement the governors' requests. Finally, the Commission recommends funding for some core federal programs of importance to our region and Member states.

We urge Congress to address the following highest priority issues:

Aquatic Invasive Species

Comprehensive legislation is needed to curb introduction and spread of invasive species from all pathways, and funding is needed to maintain core programs, such as the Sea Lamprey Control Program. Action by Congress is essential to ensure that commercial vessels visiting ports meet uniform discharge requirements that protect our freshwater lakes from invasive species.

Dispersal Barriers:

Congress should pass legislation, the Great Lakes Asian Carp Barrier Act, to prevent the Asian Carp and other invasive species from entering the Great Lakes. The legislation would authorize the U.S. Army Corps of Engineers (USACE) to complete the construction of, and provide at full federal cost for the permanent operation of, two dispersal barriers in the Chicago Sanitary and Ship Canal. H.R.553 and S.336 would fulfill these recommendations. Appropriate $8.5M to implement this authority.

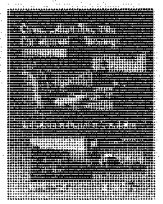
National Aquatic Invasive Species Act (NAISA):

Reauthorize the Act to achieve broad, national protection against the introduction and spread of aquatic invasive species, including provisions reflected in S.770, H.R.1591 and 1592 as introduced in the 109th Congress. The recent discovery of a new invasive shrimp and the spread of the fish virus VHS have heightened the urgency of ensuring that invasive species be curtailed.

Sea Lamprey Control:

Appropriate $20.2M to the Great Lakes Fishery Commission for its Sea Lamprey Control Program that protects a multibillion-dollar sport fishery.

Great Lakes Regional Collaboration Implementation



A significant increase in funding is essential to support protection, restoration and cleanup of the Great Lakes. The Bush Administration, federal agencies, and the states, cities, Great Lakes tribal governments and numerous stakeholder organizations jointly developed and signed the Great Lakes Regional Collaboration blueprint in December 2005. Funding from the federal government is needed to fulfill the promises in the blueprint and to match the significant investment of states, cities, local governments and private funds. Congress should pass legislation and provide funding to implement the restoration blueprint.

Great Lakes Legacy Act:

Reauthorize the Act and appropriate the fully authorized amount of $54.0M to the U.S. Environmental Protection Agency (USEPA) to remediate contaminated sediments in Great Lakes Areas of Concern (AOCs) and facilitate public involvement in sediment cleanup projects.

Restore Wetlands:

Appropriate $28.5M to the U.S. Fish and Wildlife Service (USFWS) to begin restoration of 200,000 acres of wetlands, toward the Great Lakes Regional Collaboration goal of restoring 550,000 acres. States, local governments and NGOs would raise an additional $28.5M in nonfederal matching funds.

Additional Priorities for Great Lakes

In addition to the highest priorities expressed on page 1, the Commission calls on Congress to support the following measures within the first year of the 110th Congress:

Aquatic Invasive Species

Congress should pass legislation to list Asian carp as injurious under the Lacey Act, and should appropriate funds for the following:

- $8.0M nationwide to the USFWS to support Great Lakes state-specific management plans;
- $11.25M for the Section 1101 program (Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990) to prevent the introduction and spread of aquatic invasive species from vessels and by other vectors, including $6.0M to the U.S. Coast Guard (USCG), $2.5M to the USEPA and $2.75M to the Aquatic Nuisance Species Task Force (ANSTF); and
- $1.0M to the ANSTF to support rapid response strategies.

Coastal Health

Beaches Environmental Assessment and Coastal Health (BEACH) Act:
Appropriate $1.75M to the BEACH Program for the Great Lakes states and $50,000 for eligible tribes to maintain current programs; and, in addition, $2.0M to enable Great Lakes states and tribes to standardize, trial-test and implement a risk-based approach to beach/coastal assessment.

Coastal Zone Management Act (CZMA):
Reauthorize and fully fund the Act to support existing Great Lakes state Coastal Zone Management programs, which are critical to maintaining the gains made through past investments.

Areas of Concern

AOC Cleanup Implementation:
Appropriate funds for three essential elements necessary for implementation of cleanup actions:

- $10.0M to the USEPA for distribution to the Great Lakes states and local advisory committees in the 30 U.S. AOCs to support development and implementation of Remedial Action Plans;
- $1.7M to the USEPA Great Lakes National Program Office for program administration; and
- $4.0M to the USACE for the Great Lakes Remedial Action Program to provide technical analyses and related support.

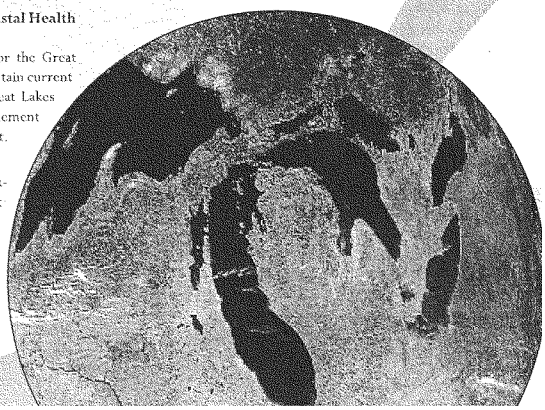
Toxic Pollutants

Appropriate $2.0M to the USEPA GLNPO to be distributed to the states to expand the toxics reduction program under the Great Lakes Initiative; $1.0M to continue tribal fish tissue contaminant analysis programs and related community education programs; $100,000 to facilitate tribal participation in a mercury stewardship program; and $100,000 for monitoring emerging new chemical contaminants.

Habitat and Species

Great Lakes Fish and Wildlife Restoration Act:
Appropriate $16.0M to the USFWS for grants to states, tribes and local governments to restore coastal wetlands.

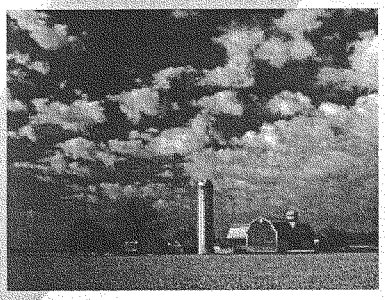
Riparian Restoration:
Pass legislation to authorize a Great Lakes Tributary River Restoration Act to provide cost-shared grants to locally managed restoration projects in priority watersheds and appropriate $40.0M to the USFWS for this program.



Protection and Restoration in FY2008

Nonpoint Source Pollution

Farm Security and Rural Investment Act:
Farm Bill conservation programs are a key mechanism for achieving the recommendations of the region's restoration blueprint. Reauthorize the Act to enhance conservation and improve water quality through soil erosion control, conservation and habitat quality enhancement programs.



Great Lakes Basin Program for Soil Erosion and Sediment Control:
Reauthorize this provision of the Farm Bill and appropriate $5.0M to the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service to provide grants to the states for soil erosion control projects through the Great Lakes Basin Program for Soil Erosion and Sediment Control.

Buffer Strip Programs:
Appropriate $66.0M to the USDA to increase enrollment in buffer strip programs for water quality improvement in Great Lakes tributary rivers and streams.

Section 319 Program:
Appropriate $84.0M to the USEPA for grants to Great Lakes states to address nonpoint source pollution controls.

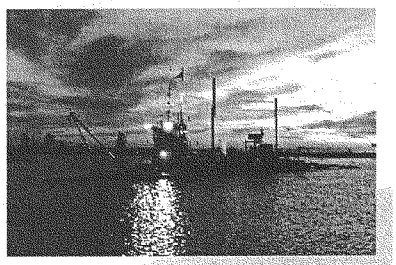
Indicators and Information

Monitoring Restoration Progress:
Appropriate $800,000 to USEPA for the SOLEC process to develop a full suite of 80 ecosystem monitoring indicators, including a "top ten" list of indicators which will be reported to the public on an annual basis.

Water Resources Infrastructure

Water Resources Development Act:
Authorize projects consistently supported by the Commission, including:

- St. Clair River-Lake St. Clair Comprehensive Management Plan;
- Hydrological study of the St. Clair River focusing on navigation, erosion of the river, and declining water levels in the river and in lakes Michigan and Huron;
- Construction of a second lock at Sault Ste. Marie, Mich., at full federal expense;
- Ongoing design and construction of sea lamprey barriers and traps in the Great Lakes;
- Dam removal or rehabilitation projects to improve environmental quality; and,
- Expanded use of dredged sediment for projects in the public interest.



Channel Maintenance Program:
Appropriate $125.0M to the USACE to maintain and repair Great Lakes channels, harbors and infrastructure for commercial and recreational navigation.

Sustainability

Water Act Reauthorization:
Reauthorize the Clean Water Act with provisions that the USEPA review prioritization formulas so that projects that reflect sustainable development practices or advance sustainable development principles can be awarded higher priority for funding or a more favorable loan interest rate.

Clean Water State Revolving Fund Loan Program:
Appropriate $1.35B nationwide for combined sewer overflows and sanitary sewer overflows, essential to updating sewerage systems and improving coastal health.

Priorities for Core Federal Programs and Research

Federal agencies contribute to the restoration, protection and use of Great Lakes water resources, which includes cooperative efforts with Canada. The Commission endorses the recommendation of the Great Lakes governors that federal monitoring programs be reviewed and evaluated to ensure effective and efficient gathering and reporting of data and to eliminate any duplication of effort. Maintaining and enhancing the efforts of federal agencies requires the following federal funding:

International Joint Commission:

$6.75M to the U.S. section to support projects associated with the Great Lakes Water Quality Agreement and Boundary Waters Treaty.

National Oceanic and Atmospheric Administration (NOAA)

- **Integrated Ocean Observing System:** Authorize the Ocean and Coastal Observation System Act and appropriate $150.0M annually to NOAA to implement this Act, with at least $4.0M dedicated to support of the Great Lakes Observing System.
- **National Sea Grant College Program:** $65.0M to support the national program with an appropriate distribution to the seven Great Lakes Sea Grant programs.
- **Great Lakes Environmental Research Laboratory:** $17.5M to continue high priority research including new habitat restoration and human health initiatives.
- **Center for Sponsored Coastal Ocean Research/ National Ocean Service Extramural Grants:** $28.0M to include support for research conducted by Great Lakes universities focused on invasive species, hypoxia, harmful algal blooms and climate change impacts.

U.S. Environmental Protection Agency

- **Great Lakes National Program Office:** $25.0M to continue high priority habitat protection and restoration programs, ecological monitoring and coordination of Lakewide Management Plans and Remedial Action Plan teams across the region.
- **Office of Research and Development:** $18.0M to continue research functions conducted by labs in Duluth, Minn., and Grosse Ile, Mich., particularly on toxic contaminant control, endocrine disruption and environmental indicators.
- **Persistent Toxins:** $4.0M to expand current efforts under the Great Lakes Air Deposition (GLAD) and Integrated Air Deposition Network (IADN) programs.

U.S. Geological Survey

- **Great Lakes Science Center:** $13.2M to support current programs, including additional deepwater fishery science and ecosystem research.
- **National Streamflow Information Program:** $17.0M nationally to expand the coverage to monitor chemical, nutrient and sediment loading to the Great Lakes.

Great Lakes Commission
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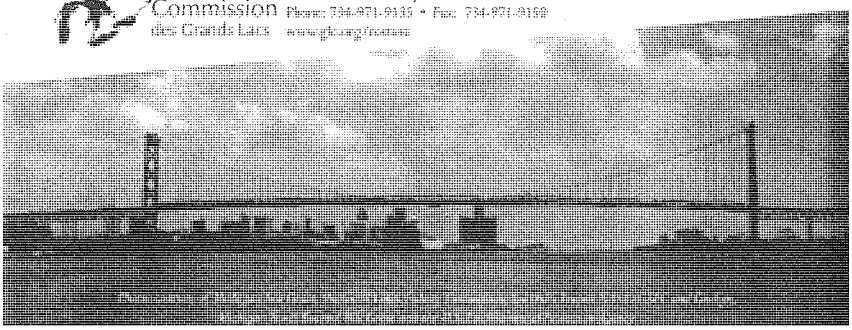

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September 12, 2005

The Honorable Daniel Inouye
United States Senate
722 Hart Senate Office Building
Washington, D.C. 20510

The Honorable Ted Stevens
United States Senate
522 Hart Senate Office Building
Washington, D.C. 20510

Dear Senator Inouye and Senator Stevens:

Thank you for your efforts to curb the introduction of aquatic invasive species (AIS) through ballast water management legislation. The future of commerce, recreation and the environment of our nation demands action. Already, some 162 species have harmed the Great Lakes. San Francisco Bay, Chesapeake Bay and other national waters have similar problems. Invasive species introductions cost the nation billions of dollars in damages each year.

As you know, the Great Lakes Governors remain deeply committed to halting the effects of AIS. One of our nine priorities for Great Lakes restoration and protection is to stop the introduction and spread of non-native aquatic invasive species. A key action toward this goal is to eliminate ship-mediated introductions of AIS, particularly via ballast water that has proven to be a well-established pathway for invasions. We strongly believe that the time has come to take decisive action to protect the nation's coastal waters, including one of the world's most outstanding natural resources, the Great Lakes.

As proposed by S. 363, ballast water management alone cannot adequately protect the Great Lakes and the rest of our nation's waters from AIS. That is why it is our strong preference to address the AIS issue comprehensively. Several critical components must be included in any Congressional action directed toward eliminating ship-mediated AIS introductions for it to be effective and have our support. The following provisions must be included in any effective Congressional bill that addresses this issue:

- Require the interim application of: 1.) best performing ship-board ballast water treatment; 2.) best residuals management practices for vessels that declare "no ballast on board;" and, 3.) best hull management methods for all ocean-going vessels. Ships should be required to meet an environmentally protective standard on a future date certain (within 5 years), but preventive measures must be taken in the interim;
- Establish incrementally tougher protective standards and require ships to meet those standards by a future date (between 2011 and 2014). The ultimate goal must be zero discharge of viable organisms;

- Maintain the possibility of using U.S. EPA's Clean Water Act authority to address ballast water discharges so that States can assure their publics that they and their resources will receive adequate protection from this threat even if the federal program fails to be implemented;
- Maintain the possibility of State action to improve on federal protections related to ships. While a uniform federal regulatory process is necessary, it should not preclude the States from strengthening these protections as needed;
- Review and implement best-performing ballast water management practices for non-ocean going vessels to address the spread of AIS already introduced into U.S. waters;
- Immediately and significantly expand the research, testing and evaluation of all treatment policies and technologies; and,
- Support information and education outreach programs to reduce the potential for AIS introductions.

Several provisions in S. 363 could significantly impede progress to provide meaningful AIS protection. Specifically, we are concerned with the following provisions:

- A State pre-emption clause that would preclude States from taking steps to protect against damage by AIS introduced through ballast water;
- A clause that the Act would supersede any provision of the Clean Water Act with respect to ballast water;
- Limited case-by-case review of treatments demonstrated to be substantially better than ballast water exchange; and,
- Locking-in the existing regulatory exemption for ships declaring no ballast on board until S. 363 standards are implemented ten years or later from the effective date of the legislation. Because these ships can be a significant vector for AIS and account for approximately 90 percent of the ships entering the Great Lakes, immediate interim steps must be taken.

The draft report of the Great Lakes Regional Collaboration issued on July 7, 2005 indicates the broad-based support for addressing this important problem. While State and regional actions against AIS remain critical to establishing a complete protective framework, we believe that a coordinated national approach is the preferred long-term means of stopping new invasive species from penetrating the Great Lakes. While reserving judgment on other specific bills, we urge you to support comprehensive AIS legislation incorporating the suggestions outlined in this letter as an alternative to S. 363 as currently drafted.

Please do not hesitate to contact David Naftzger, Executive Director of the Council of Great Lakes Governors, at 312-407-0177 if there are questions. We look forward to continuing to partner with you on this issue of national importance.

Sincerely,

Rod Blagojevich
Governor of Illinois

Jennifer M. Granholm
Governor of Michigan

George E. Pataki
Governor of New York

Edward Rendell
Governor of Pennsylvania

Mitch Daniels
Governor of Indiana

Tim Pawlenty
Governor of Minnesota

Bob Taft
Governor of Ohio

Jim Doyle
Governor of Wisconsin

cc: Great Lakes Congressional Task Force

TESTIMONY

OF

FRANK ETTAWAGESHIK

TRIBAL CHAIRMAN
OF THE
WAGANAKISING ODAWAK
(LITTLE TRAVERSE BAY BANDS OF ODAWA INDIANS)

Before the

HOUSE COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE
SUBCOMMITTEE ON WATER RESOURCES AND THE ENVIRONMENT

March 7, 2007

Frank Ettawageshik, Tribal Chairman
Waganakising Odawak (Little Traverse Bay Bands of Odawa Indians)
7500 Odawa Circle, Harbor Springs, MI 49740
231-242-1418

Testimony of Frank Ettawageshik, Tribal Chairman
Little Traverse Bay Bands of Odawa Indians

INTRODUCTION

Mr. Chairman and members of the Committee, my name is Frank Ettawageshik, Tribal Chairman for the Waganakising Odawak otherwise known as the Little Traverse Bay Bands of Odawa Indians (LTBB). As chairman, I also serve as the LTBB representative to the Chippewa/Ottawa Resource Authority (CORA), which is a coalition of five Michigan tribes that oversees the management and regulation of treaty-based fishing rights in the upper Great Lakes. CORA also oversees implementation of a Consent Decree entered in the year 2000, a negotiated settlement of a longstanding federal court case among the five tribes, State of Michigan, and the federal government, which governs allocation and management of the fishery resources in the 1836 Treaty-ceded waters of the upper Great Lakes.

With the approval of the CORA board, I speak on their behalf today with respect to the issue of Aquatic Invasive Species (AIS), an issue of grave importance to the Tribes' Treaty-based fishing rights, as well as the continued successful implementation of the federal-court ordered Consent Decree. Our ancestors, who signed the 1836 Treaty of Washington with the U.S. government, had the wisdom to insure that future generations could continue utilizing the fish resources of the Great Lakes for sustenance and income, and many tribal families continue to depend on fishing today.

While preparing for this testimony we consulted with the staff at the Great Lakes Indian Fish and Wildlife Commission and the Haudenosaunee Environmental Task Force. Together with CORA these three organizations represent Tribal Nations from one end to the other of the Great Lakes Region.

As Tribal Nations we often speak of being taught to consider the impact of our decisions on through to the coming seventh generation. While this teaching causes us to take the long view in our planning, there are times within this long view that we find ourselves needing immediate action in order to protect the needs of those coming generations, in order to meet our sacred duty in working to protect all of creation and those beings with whom we share it. **Today is one of those times we call for immediate action.**

Commercial fishing is one of the oldest industries in the Great Lakes, if not the nation. Historically, the Great Lakes supported a vast, vibrant, and profitable commercial fishing industry. However, due to many and various forces, the commercial fishery on the Great Lakes is but a fraction of its historical presence, giving way in many cases to governmental policies that

favor recreational fisheries. Today, the tribal treaty-based fishery remains one of the most significant commercial fisheries on all of the Great Lakes.

Sadly, however, commercial fishing on the Great Lakes, particularly Tribal fishing, is on the **verge of collapse.** Out of the various environmental and market forces, the direct and indirect impacts of **Aquatic Invasive Species (AIS)** stand out as the leading cause for the precipitous decline in Treaty-based commercial and subsistence fishing activity. I also note that AIS have resulted in major negative impacts to the recreational fishery among all the Great Lakes States.

Remediation of damages by existing AIS, and prevention of additional invasions is essential to the future of: 1) the Treaty-based fishery, 2) implementation of the 2000 Consent Decree, and 3) many other water-related industries and activities throughout the Great Lakes – and the nation. Our primary concern is the continued, steady, and destructive invasion of AIS into the Great Lakes, with their **primary vector** for entry being **ballast water discharge** from **transoceanic shipping.**

I. ECONOMIC AND ENVIRONMENTAL IMPACTS OF AQUATIC INVASIVE SPECIES

Despite the Tribes' strong involvement at all levels of inter-governmental resource management and related processes in the Great Lakes for nearly three decades, the Tribes have been forced to helplessly watch the Great Lakes resource, and their treaty-based fishing industry being shamefully attacked, eroded, and diminished by AIS, particularly species that entered via the ballast water vector. We are appalled as to how such an obvious and destructive activity is allowed to continue, virtually unabated, **while the federal government stands idle.**

The Tribes understand that foreign shipping into the Great Lakes provides economic benefits to the United States However, we submit to you, that any economic benefits derived from Great Lakes foreign shipping, pale in comparison to the **economic costs resulting from damages caused by AIS!** We also stress the fact that economic damage and remediation costs are cumulative and indefinite. That is, each time an AIS becomes established, the costs associated with minimizing the impacts of that AIS become an annual expense – forever. Probably the most renowned example of remediation for an AIS is the predatory sea lamprey, which invaded the upper Great Lakes through shipping canals in the 1930's. **Controlling sea lamprey, a responsibility of the Great Lakes Fishery Commission, currently costs the U.S. government $12.4 million per year – for a single AIS, with no end in sight.** Despite this control effort, sea lamprey damages to commercial and sport fisheries remain substantial, as are the impacts on inter-governmental management processes. Left uncontrolled, sea lamprey would essentially eliminate both commercial and sport fisheries throughout the Great Lakes in a very short time.

Numerous studies are ongoing to compare the economic benefits of transoceanic shipping into the Great Lakes, with the past and future costs associated with the AIS already in the basin, as well as those that undoubtedly will be dumped here. For example, anecdotal reports of the costs associated with removing zebra mussels from municipal water intake pipes throughout the Great Lakes range in the hundreds of millions per year – with no end in sight. Furthermore, AIS that have invaded the U.S. via the Great Lakes have already expanded into inland waterways, and **as this expansion spreads across the nation, the costs and damages will continue to mount.**

II. DIRECT AND INDIRECT IMPACTS OF AIS

AIS impacts are wide ranging including both direct and indirect impacts on the environment and management processes in the Great Lakes. Direct impacts include reduced fish abundance due to predation or competition from AIS (e.g. sea lamprey), damage to fishing gear requiring expensive repairs or destruction of the gear (e.g. zebra mussels), loss of income due to fouling of fishing nets that results in reduced fish harvests, and so on. Indirect, but equally as important, effects include altered lake ecology that results in changes in water clarity (fish distribution), expansive growth of net fouling algae (reduced harvests, damaged gear), loss of market value due to vastly reduced growth/condition of fish, and so on.

The combined direct and indirect impacts of AIS on the Great Lakes resource is resulting in **rapidly increasing costs to tribal fishing businesses**, coupled with declining marketability of fish that have be devalued due to AIS. Further exacerbating the plight facing the Treaty fishery industry is the increasingly contentious political and regulatory climate that arises between governments charged with managing a shared resource. **Ironically, nearly all the major points of inter-governmental contention involving the Tribes and State and Federal governments can be traced back to one or more of the cascading impacts of AIS introductions.** Even the 2000 Consent Decree recently required modification due to excessive sea lamprey abundance. Governments have continuously been required to re-negotiate and rewrite joint management plans, and change fishing regulations – not as a result of their own behavior – but rather due to the drastic ecological changes caused by a seemingly unending invasion of AIS.

To state it bluntly, **the transoceanic shipping industry, through ballast water exchange practices and construction of canals, has severely impaired, and threatens to destroy, the Treaty–based commercial and subsistence fishing industry.** We find it unacceptable that one industry has been allowed to erode, and threaten to destroy, another industry, particularly an industry that was presumed protected by the federal government through the 1836 Treaty of

Washington, and more recently in the 2000 Consent Decree - to which the federal government is signatory!

III. IMMINENT THREAT OF INTRODUCTION OF DANGEROUS PATHOGENS SUCH AS VIRAL HEMORRHAGIC SEPTICEMIA

Until recently, the Tribes, along with state and federal governments, have been mostly focused on invading plant and animal species. However, the recent discovery of a serious **new fish virus** in Lakes Ontario, Erie, and Huron, which is believed responsible for large fish die-offs in the spring of 2005, has greatly raised the level of concern. While it has not yet been determined how **Viral Hemorrhagic Septicemia (VHS)** found its way into the Great Lakes, ballast water discharge is implicated. Regardless of whether ballast exchange is the culprit with specific regard to VHS introduction, the discovery of VHS clearly and undeniably raises the concern that serious pathogens could find their way to the Great Lakes and U.S. via ballast water, **both fish and human pathogens.** We question how such a serious threat can be allowed to continue!

VHS provides yet another example of the **costs associated with AIS.** Since its discovery less than a year ago, governments across the Great Lakes have been scrambling to decide what actions should be taken within their respective jurisdictions, and in cooperation with other agencies. Many fish stocking programs are now threatened, included those conducted by the Tribes. Agency hatcheries now have to implement additional protections to prevent the virus from infesting the hatcheries. Governments, including the federal government (USDA-APHIS) are preparing to implement controversial policies to restrict the movement of certain fish species in an effort to slow the spread of the virus. Agencies have implemented VHS monitoring programs within their jurisdictions. All these costs, in money and time, are a consequence of a single new AIS, in this case a pathogen. We are asking that you address this situation immediately, before we must suffer from the introduction of another pathogen that results in a fish, wildlife, or human epidemic.

IV. PREVENTION IS IMPERATIVE, WITH THE BALLAST WATER VECTOR BEING THE FIRST PRIORITY

Unfortunately, history has proven that once an AIS is introduced in the Great Lakes, even in a geographically isolated area, its future spread cannot be stopped – it is too late. Therefore, **prevention** is the only viable approach to combating AIS. **The means by which AIS enter the Great Lakes must be stopped, and the ballast water vector should be the first priority!**

It is extremely saddening to realize that most of the costs and environmental damages wrought by AIS **could have been prevented.** Accordingly, all the costs and damages that will inevitably result if **additional AIS** are allowed to be introduced into the Great Lakes **can be prevented.** We believe the ballast water vector could have, and should have, been addressed two decades ago. The transoceanic shipping industry was well aware, as were governments and organizations within the U.S., that ballast water discharge was a "time bomb" regarding AIS. Yet, the federal governments of the U.S. and Canada implemented only weak and virtually meaningless ballast water exchange regulations. The ineffectiveness of these regulations is evidenced by the continued invasion of species that originate in Europe and Asia –major ports for transoceanic shipping to the Great Lakes.

V. FEDERAL LEGISLATION REQUIRED – GREAT LAKES REGIONAL COLLABORATION RECOMMENDATIONS

What can be done to stop the invasion before additional AIS cost our nation and the Treaty fishery even more damages in money, commercial, subsistence and recreational opportunities, and environmental and human health? Foremost, **federal legislation is essential.** This **legislation must be effective,** not simply window-dressing. Remember, the effectiveness of any regulations regarding AIS will be readily evaluated based on whether new AIS find their way into the system. We stress that even one species, such as sea lamprey or zebra mussels, can cost our nation billions, and threaten to destroy affected industries and opportunities – such as the Treaty-fishing industry.

Since the primary objective for AIS legislation must focus on prevention to be meaningful, we only support legislation that effectively meets that objective. House Bills 1591 and 1592 and the companion Senate Bill 770, with the modifications recommended in the final report of the Great Lakes Regional Collaboration (Collaboration) would be acceptable. However, we note that the modifications in the Collaboration recommendations were developed prior to the discovery of the pathogen, VHS, which only further demonstrates the urgent need for even more stringent ballast water discharge restrictions.

A second Bill introduced last year, **Senate bill S.363, would do little or nothing to prevent additional AIS from entering the Great Lakes for the foreseeable future. We do not support that bill!** First, S.363 does not require ship-board ballast technology for the majority of ships entering the Great Lakes until the year 2016. **That is far too late.** Effective regulation and control of ballast water should have been accomplished decades ago. Putting off effective measures for another decade will result in additional irreversible economic and environmental catastrophes. Based on the current rate of AIS invasion, there is every reason to

believe that the Great Lakes, and thus the entire nation, would be subjected to many damaging AIS by 2016. **All vessels entering the Great Lakes must meet an environmentally protective standard *immediately*.**

The Tribes applaud the State of Michigan for recently enacting a permitting system for ocean-going vessels that enter Michigan ports. While we greatly appreciate Michigan's legislation for ballast water regulation, Michigan is just a single Great Lakes state. A strong federal law is absolutely essential; however, the federal government has been completely ineffective in addressing this issue, and the "clock is ticking" for the Treaty fishery industry.

The Chippewa Ottawa Resource Authority was a signatory to a petition in a federal lawsuit intended to require EPA to issue and enforce ballast water discharge permits pursuant to the Clean Water Act. This lawsuit was successful, and EPA was ordered to implement the ballast water discharge permits as indicated in the Clean Water Act. However, Senate bill S. 363 would preempt any State laws regarding ballast water, and prevent regulation of ballast water through the Clean Water Act. With no immediately effective federal standards, S. 363 would thus actually exacerbate the AIS disaster.

SUMMARY OF THE AIS ISSUE AND TRIBAL CONCERNS

1) **Federal Responsibility.** We view the problem of AIS to be the responsibility of the federal governments of the U.S. and Canada. Only the federal governments could have prevented the economic and environmental damage that has been inflicted on the Treaty fishery and the respective nations. Only the federal governments can effectively eliminate future damages.

2) **Treaty fishing industry already severely damaged, and its very existence greatly threatened.** AIS, and particularly AIS introduced through ballast water, have severely damaged the Treaty commercial and subsistence fishing industry, and if left unregulated, threatens to completely destroy it. Similarly, non-treaty fishing activities (e.g. recreational fishing) have also been severely impacted. In both cases, the governing bodies for the commercial and recreational fisheries have to increase their expenditures to remediate impacts.

3) **Transoceanic shipping irresponsibility.** We find it shocking and appalling that the transoceanic shippers are allowed to enter the heartland of the U.S. (Great Lakes), dump their AIS infested trash from ballast tanks, and return home – thereby leaving U.S. governments and citizens to deal with the economic and environmental consequences.

4) **Economic and Environmental damages.** AIS issue is a profound problem with interrelated economic and environmental components. The economic costs to industry and governments inflicted by AIS already in the system are staggering – and more AIS enter each year. The environmental damage is just as large, and will continue to grow as AIS dumped in the Great Lakes eventually spread across the country.

5) **Pathogen introduction.** Whether the fault of ballast discharges or not, the recent introduction of a pathogen (VHS) clearly illustrates the urgent need for action in regulating transoceanic shipping and ballast water. On any given day, foreign pathogens, which could impact animal or human health, are being discharged into the waters of the Great Lakes. Most are likely benign, but it only takes one.

6) **Priority focus on prevention.** We stress the need to focus immediate attention on the transoceanic shipping industry, rather than sidetrack the discussion to the Great Lakes Fleet (freighters), or rapid response strategies. History has shown that once an AIS enters the Great Lakes system, it will spread throughout pursuant to its habitat requirements – and there is little governments can do to stop the spread.

7) **Ballast water vector is fixable.** The ballast water vector is readily curable; it will simply require ocean-going ships to spend the necessary funds to fix their problem. Unfortunately the shipping industry has stubbornly and shamefully refused to act, despite two decades of damage awareness. We believe they have had ample time to meet their responsibilities.

8) **Federal Trust Responsibility.** The federal government has a trust responsibility to the Tribes, which includes protecting the rights retained in the 1836 Treaty of Washington, and as signatory to the mutually negotiated 2000 Consent Decree.

9) **Other vectors for AIS introduction.** While we focused on the ballast water vector for AIS introduction, the federal government also needs to immediately address other vectors. Once an AIS is established, it doesn't matter how it was introduced. Currently, a vector of great concern to the Tribes is the potential invasion of Asian Carp through the Chicago Sanitary Ship Canal. Only a single electric barrier is preventing Asian Carp from invading the Great Lakes thereby presenting a situation that will be devastating for the native fishes of the Great Lakes. The proposed second barrier must be completed and fully funded on an annual basis.

10) **Great Lakes Regional Collaboration.** The Tribes participated fully in the Great Lakes Regional Collaboration, an effort initiated by President Bush in 2005. The final report from this massive Great Lakes-wide collaborative effort provides much detail and

documentation regarding AIS. As evidenced in this report, all governments and impacted user groups acknowledge and concur that AIS have been, and continue to be, one of the most significant threats to the health of the Great Lakes ecosystem, and its associated industries and activities.

11) **Immediate action required.** History has shown that AIS impacts can be massive, within both the fisheries and non-fisheries realms. The AIS issue can be summarized as simply as this: **on any given day, any given ballast water discharge from a transoceanic vessel can carry an organism that could inflict as much, or even more, economic and environmental damage as sea lamprey, or zebra mussels, or the pathogen VHS.**

CONCLUSION

We urge you, for the reasons discussed above, to immediately begin the process to enact meaningful, effective, and enforceable regulations that will ensure that the uncontrolled invasion of AIS through ballast water of ocean-going ships is stopped. The economic, health, and environmental consequences for all citizens of the nation and the Great Lakes Region are far too great to continue to ignore or downplay this problem. ***The need for immediate action is both obvious and essential.***

TESTIMONY OF
BENJAMIN H. GRUMBLES
ASSISTANT ADMINISTRATOR, OFFICE OF WATER
U.S. ENVIRONMENTAL PROTECTION AGENCY
BEFORE THE
WATER RESOURCES AND ENVIRONMENT SUBCOMMITTEE OF THE HOUSE TRANSPORTATION AND INFRASTRUCTURE COMMITTEE

March 7, 2007

Introduction

Good afternoon Chairwoman Johnson and Members of the Subcommittee. I am Benjamin H. Grumbles, Assistant Administrator for the Office of Water at the U. S. Environmental Protection Agency. Thank you for the opportunity, on behalf of Administrator Stephen Johnson and the Great Lakes Interagency Task Force, to discuss the ecological and economic threat of aquatic invasive species in the Great Lakes and the Administration's many efforts to confront this serious challenge. Federal agencies are working together through the Task Force, as well as with other State, local, and Tribal partners in the region, to restore and protect the Great Lakes, one of our country's most important environmental treasures. I am here today representing the Interagency Task Force.

President Bush's Great Lakes Executive Order of May 18, 2004 (E.O. 13112), which established the Interagency Task Force (IATF), has strengthened interagency coordination on a wide variety of issues, and the threat of aquatic invasive species is a prime example of where we are effectively working together to investigate issues, share information, and develop solutions to these difficult problems. The IATF uses a strategy developed by the Great Lakes Regional Collaboration (GLRC), as a guide in directing its invasive species activities. Seven of the 48 Near Term Actions committed to by the Interagency Task Force to help support the GLRC Strategy are invasive species-related. Federal Agencies are implementing these near term actions over the next two years.

Background

The Great Lakes ecosystem is a vast but fragile environment highly susceptible to the disruptive impacts of aquatic invasive species that are introduced via ballast water and other routes. Ecological effects have been far reaching and continue to imperil the lakes. The US Ocean Commission reported that the economic impacts of invasive species can be substantial. For example, just within the Great Lakes, between 1989 and 2000, zebra mussels alone are estimated to have cost between $750 million and $1 billion in losses to natural resources, and damage to infrastructure. The primary vectors for Great Lakes aquatic invasive species include maritime commerce, canals and waterways, aquaculture, organisms in trade, and recreational activities.

To date, we have identified over 180 aquatic invasive species in the Great Lakes, and new aquatic invaders are being introduced at the rate of about one every eight months. The impact of introduced aquatic invasive species already in the system, from the sea lamprey to the zebra mussel, serves as a harbinger of economic and environmental costs to come if this crucial threat is not better controlled and prevented. The Great Lakes Fishery Commission estimates that $12-15 million is spent per year for sea lamprey control activities. Costs for the treatment and control of zebra mussel impacts on industrial and municipal facilities are estimated at $100-200 million annually in the Great Lakes.

In addition to the economic damage they can cause, invasive species can severely impact the fragile aquatic ecosystem of the lakes by disrupting the food chain or helping to spread diseases. Quagga mussels have been implicated in the disappearance of *diporeia*, a tiny shrimp-like organism that is a key food source at the bottom of food chain for many Great Lakes fish.

Scientists suspect that round gobies and quagga mussels have a role in the spread of Type E avian botulism which has killed tens of thousands of water birds in the Great Lakes.

Viral hemorrhagic septicemia, or VHS, is an Ebola-like virus for fish. VHS is usually limited to saltwater fish. The strain killing Great Lakes fish is believed to be a mutation of a VHS virus found in saltwater fish off the coast of eastern Canada near Nova Scotia. It has not yet been determined how the mutated saltwater virus arrived in the Great Lakes. VHS is sweeping across the Great Lakes, killing large numbers of important fish species including muskie, freshwater drum, yellow perch, smallmouth bass, bluegill, crappie, and gizzard shad.

Another menace knocking at the door of the Great Lakes are species of Asian carp. These fish were brought to the U. S. from China in the 1970's to clean up algae in Arkansas fish farms along the Mississippi River. Many of them escaped the fish ponds during the extreme flooding in 1993 and 1995. Asian carp can grow rapidly to over 100 pounds, jump like tarpon, and breed so fast that Australians nicknamed them "river rabbits." They consume two or three times their weight in plankton every day. They could have a devastating impact on the Great Lakes by out-competing native fish for plankton, which is the food base for the early life stages of native fish. Right now, the only thing holding them back from entering Lake Michigan is an electric barrier that sends a current through the water and keeps them from swimming past it. I know this Committee is well aware of the importance of maintaining and enhancing this protective barrier, which is being completed and operated by the U.S. Army Corps of Engineers.

Invasive species can also impact our use and enjoyment of the lakes. In decades past, die-offs of introduced alewives fouled Great Lakes beaches before an adaptive management program was introduced. More recently, stinking mats of *cladophora*, a green algae, which had become just a bad memory after

phosphorus controls were enacted, have re-appeared on Great Lakes beaches due, in part, to impacts from zebra and quagga mussels.

The newest Great Lakes invader is the bloody red shrimp (*Hemimysis anomala*) most recently reported in Lake Ontario in May 2006, and in Lake Michigan by the National Oceanic and Atmospheric Administration's (NOAA) Great Lakes Environmental Research Laboratory in November 2006. Agencies are assessing the extent and impact of this invasion.

It is important to note that invasive species problems in the Great Lakes can leap-frog across the nation. The Great Lakes are the aquatic gateway to the heartland of America, and a hot spot for aquatic species introductions to major interior water bodies of the United States.

One need only examine the spread of the zebra mussel and the quagga mussels to understand this. Quagga mussels were recently found west of the Continental Divide in lakes Mohave and Havasu in Arizona, and Lake Mead in Nevada. In the Great Lakes quagga mussels are replacing zebra mussels throughout the basin. The quagga mussels occupy a greater depth range and are not restricted to hard substrates due to their shell morphology. Zebra mussels are now outside the Great Lakes - St. Lawrence River system as far west as eastern Oklahoma, as far south as the Mississippi delta below New Orleans, Louisiana, and east as far as the Hudson River estuary north of New York City. Zebra mussels have fouled industrial and municipal water intakes, which must now be chemically treated on a regular basis throughout the summer months to keep them flowing. Quagga mussels will continue to cause these same problems.

Actions to Date

Federal Agencies are taking many important steps to prevent and control the spread of aquatic invasive species. Some highlights include:

- Federal agencies, including EPA, continue to serve on the National Invasive Species Council established under E.O. 13112, and on the Aquatic Nuisance Species Task Force created by the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990. Regional efforts are coordinated through the Great Lakes Regional Panel on Aquatic Nuisance Species. Since 1991, the U S. Fish and Wildlife Service has provided operating expenses for this important forum. Many Great Lakes invasive species initiatives have originated or been fostered by the panel membership, which includes all U.S. and Canadian federal agencies, the eight Great Lakes States and the province of Ontario, tribal authorities, regional agencies, user groups, local communities, commercial interests, and the university/research community.

- Through the Midwest Natural Resource Group (MNRG), federal agencies have developed an effort to assess and control terrestrial invasive species in the Great Lakes basin. The MNRG senior managers signed a November 2006 invasive species MOA, and the member agencies are now implementing an action plan to address terrestrial invasive species in the basin. This plan recognizes that aquatic and terrestrial invasive species are linked, and that efforts to control both need to complement one another. The National Park Service is the current leader of this effort.

- The Federal Interagency Task Force has created a Federal Aquatic Invasive Species Rapid Response Subcommittee to serve as a central point of contact for information and activities related to invasive species rapid response efforts.

- In order to develop better methods for estimating economic costs associated with aquatic invasive species, in July 2005, EPA co-sponsored a Federal - non-Federal workshop of expert economists and ecologists to discuss conceptual frameworks and bioeconomic tools for developing

credible regional and national aquatic invasive species economic impact estimates. EPA is now, with NOAA Sea Grant and the U.S. Geological Survey (USGS), leading an interagency effort to develop and test a bioeconomic approach to estimating aquatic invasive species regional economic impacts.

- The Great Lakes Fishery Commission continues its crucial effort to control the sea lamprey. Controlling lamprey populations has cost over $250 million to date, or about $12-15 million per year.

- U.S. Army Corps of Engineers continues to operate the electric carp barrier on the Chicago Sanitary and Ship Canal. This barrier is our last chance to prevent the migration of the Asian carp and other invasive fish species from the Mississippi River watershed into the Great Lakes ecosystem. In addition to the Corps' strong leadership on this important project, several Federal Agencies have contributed to testing the barrier, including EPA, the U.S. Coast Guard, and the U.S. Fish and Wildlife Service.

- A collaborative research program initially supported by NOAA, EPA, and U.S. Coast Guard continues to address ballast water management issues in "No Ballast On Board" Vessels or NOBOBs. These vessels transport aquatic organisms in small, unpumpable compartments within ballast tanks. NOAA's Great Lakes Environmental Research Laboratory continues to work with researchers to study the effectiveness of ballast water best management practices.

- EPA and the U.S. Coast Guard entered into a Memorandum of Understanding to develop protocols for assessing new treatment technologies using EPA's Environmental Technology Verification (ETV) Program. This program is designed to accelerate the entrance of new

environmental technologies into the domestic and international marketplace. A final draft of the protocols is now being validated by the Coast Guard and the Department of the Navy at the Navy's testing facility which has been recently enhanced to support ballast water technology testing and verification.

- In August 2003, EPA entered into an MOU with the U.S. Coast Guard to collaborate in the development of an Environmental Impact Statement (EIS) for the Coast Guard's upcoming proposed rulemaking to establish a ballast water treatment performance standard. We are a cooperating agency on that EIS, which is currently under development, along with NOAA, the U.S. Fish and Wildlife Service, and, most recently, the Department of Agriculture's Animal and Plant Health Inspection Service.

We recognize that detecting and managing invasive species is a responsibility we share with State and Local governments, as well as industry, boaters, anglers and other users of the resource. Education and outreach continues to be an important component of our efforts to control invasive species. The information we provide includes:

- U.S. Fish and Wildlife Service's outreach initiatives to educate the public on how they can prevent the spread of aquatic invasive species.

- Educational experiences through the U.S. Forest Service's collaboration with the John G. Shedd Aquarium in Chicago to create a new permanent exhibit bringing the public face-to-face with major aquatic invasive species in the Great Lakes.

- Technical guidance, such as EPA's 2005 document providing an overview of EPA authorities that may apply to aquatic invasive species rapid response or control actions. Created for natural resource managers, this

document identifies the authorities that apply to aquatic invasive species rapid response or control actions, and the steps required to quickly and fully comply with those authorities. The document also provides case studies in which state and local natural resource managers successfully obtained emergency exemptions and special local need registrations for aquatic invasive species eradication or control actions under the Federal Insecticide, Fungicide and Rodenticide Act.

Lastly, as part of our environmental protection and natural resource management activities, federal scientists aboard Great Lakes research vessels, like EPA's Lake Guardian, are our "eyes on the water." While prevention is most important, early detection provides the best opportunity to respond to invasive species that are already here. Federal scientists are often responsible for the first detection of new invasive species.

Legislative Issues

You may be aware of litigation in which several groups filed a lawsuit in December 2003 in the U.S. District Court for the Northern District of California (*Northwest Environmental Advocates et al. v. EPA*, No. C 03-05760 SI). The lawsuit challenges the denial of a rulemaking petition the litigants had submitted to EPA and seeks revocation of the Agency's long standing exclusion of discharges incidental to the normal operation of a vessel from requiring a Clean Water Act (CWA) permit. In September 2006, the Court issued an order vacating that regulatory exclusion as of September 30, 2008. Because that order was not limited to just ballast water discharges, it potentially implicates a variety of other discharges incidental to the normal operations of vessels, not only for the thousands of larger ocean-going ships with ballast tanks, but also, for example, approximately 13 million recreational vessels, 81,000 commercial fishing vessels, and 53,000 freight and tank barges operating in U.S. waters. Because we respectfully disagree with that decision, the Government, on November 16, 2006, filed a notice of appeal with the U.S. Circuit Court of Appeals for the Ninth Circuit.

I want to stress that this does not reflect a dismissal of the significant impacts of aquatic invasive species. Rather, we believe the Clean Water Act does not currently provide an appropriate framework for addressing ballast water and other discharges incidental to the normal operation of vessels.

EPA supports enactment of appropriate legislation to strengthen the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, and the National Invasive Species Act of 1996 in order to ensure the establishment of environmentally-sound, uniform, Federal ballast water discharge standards and requirements. In particular, EPA believes that it is important that there is a strong framework in place for regulating ballast water in order to substantially reduce the threat of damaging invasions through the ballast water pathway. Although the ballast water discharge standards contained in the February 2004 International Maritime Organization's ballast water Convention are not as stringent as those sought by the U.S. during negotiations, at U.S. insistence the treaty preserves the ability of Parties to set more protective standards to better safeguard their waters against invasions. Because the structure and basic approach of the Convention in many respects reflect successful accomplishment of the United States' negotiating goals, we generally believe its basic framework and approach could serve as a useful model when considering additional domestic legislation.

Conclusion

In closing, Chairwoman Johnson, I would like to thank you and the Subcommittee for inviting me to participate in this hearing. The Administration looks forward to working with you and all of our partners to continue this important work. It is only through concerted, coordinated action that we will be able to solve the invasive species problem in the Great Lakes, and to protect and restore the lakes so that they are cleaner and healthier. I would be happy to answer any questions you may have.

UNITED STATES HOUSE OF REPRESENTATIVES

TRANSPORTATION AND INFRASTRUCTURE COMMITTEE

SUB-COMMITTEE ON WATER RESOURCES AND ENVIRONMENT

THE IMPACT OF AQUATIC INVASIVE SPECIES ON THE GREAT LAKES

John M. Kahabka

March 7, 2007

Good morning Mr. Chairman and distinguished members of the Subcommittee. My name is John Kahabka. I serve as Manager of Environmental Operations for the Power Generation business unit of the New York Power Authority (NYPA). I thank you for your attention to this issue and appreciate the opportunity to testify.

The New York Power Authority is the nation's largest state-owned electric utility, with 18 generating facilities and more than 1,400 circuit-miles of transmission lines. The Authority operates without the use of tax dollars or state credit, financing its operations with revenues earned from sales of electricity and through the sale of bonds and notes for capital projects. The Authority supplies electricity to government agencies, community-owned electric systems and rural electric cooperatives, private utilities and to private sector businesses and non-profit institutions in return for commitments to protect jobs. Our Mission is to provide clean, economical and reliable energy consistent with our commitment to safety, while promoting energy efficiency and innovation for the benefit of our customers and all New Yorkers.

My responsibilities, as Manager of Environmental Operations, include interaction with regulatory authorities, local governments, operations staff and consulting personnel to ensure that commitments related to a variety of programs at Power Authority facilities are maintained in an environmentally compatible manner.

For a number of years I have also represented the American Public Power Association (APPA) on the Aquatic Nuisance Species (ANS) Task Force, the interagency committee established by the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA, P.L.101-636) and chartered under the Federal Advisory Committee Act. One of the goals of this task force is to minimize the harmful effects of aquatic nuisance species already introduced into the waters of the United States.

Despite the best preventive efforts, new nonindigenous aquatic species are certain to be introduced into U.S. waters. Once an introduced species is identified as causing harm, or having the potential to cause harm, the ANSTF works to identify environmentally sound methods that can control further spread and minimize harm to public interests. In addition to developing species-specific control plans, other activities include the development of rapid response capabilities, survey and monitoring efforts,

review and approval of state management plans, Regional Panels and research and education specifically related to monitoring and control.

Among the electric generation facilities owned and operated by NYPA are two major hydroelectric facilities within the Great Lakes Basin, several small hydro facilities, a pumped storage facility in the northern Catskills, and fossil-fuel power plants in New York City. At the time the zebra mussel first made its appearance, the Authority also owned and operated two nuclear power plants, one of which was located on Lake Ontario. The Power Authority considers the impacts on its operations by aquatic invasive species, especially infestations by zebra mussels (Dreissena Polymorphia), to be critical to the continued economic operation of these facilities.

Recognizing the need for immediate measures to address this problem, in early 1990, the Power Authority instituted monitoring and mitigation programs at a number of our facilities throughout the state. Unfortunately, there are limited effective mitigation options for control of the zebra mussel. The most widely use control method entails the discharge of chemicals (either chlorine or mulluscicides) into the water supply system. In New York State, such discharges require approval from the Department of Environmental Conservation (DEC). This approval generally takes the form of an amendment to the facility's State Pollution Discharge Elimination System (SPDES) permit. Both the Power Authority and the DEC have closely monitored the effectiveness and impacts of these control options.

In May of 1990, we instituted a chlorination program at the 2,400-megawatt Niagara hydropower project in Western New York. The program chlorinates the service-type support systems of the plant, which include the fire protection system, the transformer cooling, and bearing cooling systems. The main flow system utilized for power production at the project is not chlorinated. The initial installation of this system cost over $100,000 and is currently in the process of being refurbished. Estimated costs to renovate the treatment system and associated controls are expected to approach $200,000. Annual control efforts are expected range in cost from $30,000 to $50,000. A similar chlorination system was also installed at the Authority's 800-megawatt St. Lawrence hydropower project.

To control zebra mussels at the Authority's 1,000-megawatt pumped storage facility at Blenheim-Gilboa in the Catskills, we installed a state of the art experimental copper ion generator in an effort to reduce chemical usage.

At our Hinckley, Crescent, and Vischer Ferry small hydropower facilities within the Mohawk River drainage, we installed both a filtration system for service water systems and use mechanical cleaning. While effective in controlling infestation of critical water systems at these locations, the methods are labor intensive and costly. Moreover, mechanical cleaning must be performed when the plants are shut down.

At the FitzPatrick Nuclear Plant on Lake Ontario, the Authority installed a chlorination system in 1991. This system is also used to treat the service water type support systems of the plant. The cost for implementing the initial chlorination technology was more than $175,000. Based upon conversations with Entergy Nuclear, the current plant owners, annual expended costs to control fouling from zebra mussels are in the range of $100,000 to $150,000. At another former NYPA plant now owned and operated by Entergy, Indian Point Unit No. 3 Nuclear Plant, similar control practices were implemented and now have annual operating costs approaching $350,000 annually.

Water is essential to the process of generating electricity. In hydropower plants, water is the fuel. In other facilities, water is used to produce the steam that power turbines or used as a coolant in the combustion processes.

The use of Great Lakes water for power production is significant. A 2005 report[1] by the Northeast-Midwest Institute calculates that there are some 535 power plants within the U.S. portion of the Great Lakes basin, having a combined generation capacity of over 50,000 megawatts. Thermal plants comprise about 90% of this generation and include 13 nuclear and 175 coal-fired units.

By interfering with the maximum effective operations of power plants, zebra mussels can jeopardize the reliable supply of electricity. The worst-case impact from Dreissena on Power Authority operations would be the total interruptions of electric

[1] Northeast-Midwest Institute: "Power Plants in the Great Lakes Basin", January, 2005

generation in order to perform mechanical maintenance. It is difficult to accurately quantify the financial impact of a worst case scenario. However, the real economic impact would be felt by customers who would have to be served by alternative power sources. Replacing NYPA hydropower, supplied at wholesale commodity prices in the 1-2 cents per kilowatt-hour range, alternatives are dramatically more expensive, ranging from 5-10 cents per kilowatt-hour.

In 1995, Charles O'Neill, of New York Sea Grant, reported[2] on the economic impact of zebra mussels. That analysis surveyed infrastructure owners/operators in thirty-five states and three Canadian provinces, including all the Great Lakes States. That analysis showed the mean expenditure for zebra mussel control at nuclear power plants was $786,670 per facility. The mean expenditure for fossil fuel generating facilities was $146,620 per facility. These expenditures included plant retrofits, chemical control activities, and prevention projects.

To date, the New York Power Authority, to a large degree, has overcome the initial effects of invasive species on the operations of our facilities, but it has not been without impact to both our operations and costs.

Zebra mussel infestation has presented one of the most daunting environmental challenges for the users of the waters of the Great Lakes and others. Changes to the Great Lakes basin from introductions of invasive species are still yet to be entirely known. Will the introduction of the Round Goby have a detrimental affect on other fish species? Will the fishhook water flea adversely affect the multi-billion dollar sport fishing industry? What new invasive may be on the horizon? Without taking decisive action on the invasive species entering the Great Lakes Basin, detrimental effects will continue. Perhaps even to a greater extent that we have seen in the past.

The New York Power Authority supports efforts on the state and federal levels to regulate and control the exchange of ballast water, as this is clearly the vector of choice in the worldwide movement of aquatic invaders. Continued funding of invasive

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[2] Charles R. O'Neill, Jr. New York Sea Grant: "Economic Impact of Zebra Mussels - Results of the 1995 National Zebra Mussel Information Clearinghouse Study". Great Lakes Research Review, Vol. 3, No. 1, April 1997

monitoring and control programs and the research that augments these programs is essential. With out these efforts it is a certainty that additional invasive species will infect the Great Lakes and their tributaries. Those new species will present new social and economic challenges to power production, industry, recreation, safety and health in Great Lakes communities.

On behalf of the New York Power Authority, I want to express my appreciation to the Chairman and the members of this Subcommittee for their attention to my testimony and the time and energy they are devoting to this significant issue.

Thank you again for the opportunity to contribute to your deliberations. I will be pleased to try to answer any questions.

Testimony by David M. Lodge

before the
U.S. House of Representatives Committee on Transportation and Infrastructure
Subcommittee on Water Resources and Environment

Hearing on
The Impact of Aquatic Invasive Species on the Great Lakes
Wednesday, 7 March 2007, 2:00 pm

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Madame Chairwoman and Subcommittee members, I am honored to have the opportunity to participate in this hearing. I thank the subcommittee, especially Chairwoman Johnson, for the invitation to testify.

As you may know from my resume, I come to the issue of invasive species from the perspective of an active researcher in this field and from my experiences at the science-policy interface. I have been working on invasive species for 24 years. I am the Director of the Center for Aquatic Conservation and a Professor of biology at the University of Notre Dame. My colleagues, collaborators, and I have on-going research that includes the following topics: (a) quantifying the probability of ship-related releases of invasive species by analyzing global shipping patterns, sampling organisms in and on ships, developing genetic probes for detecting harmful organisms in ballast water, and modeling the growth of small, newly introduced populations; (b) forecasting the spread and impact—both environmental and financial--of zebra mussel, Eurasian river ruffe, and other organisms introduced originally by ships into the Great Lakes; (c) measuring and controlling the impact of invasive rusty crayfish; (d) developing species screening protocols, focused on fishes, mollusks, plants and other organisms in the Great Lakes and other U.S. waters; and (e) combining economic and ecological risk analyses to guide allocation of resources among management options. I am a past Chairman of the national Invasive Species Advisory Committee.

The round goby—a fish story with big impacts

Let me begin by summarizing the many detrimental impacts of the round goby, a small to medium-sized fish from Eurasia that lives on the bottom of lakes and rivers. In North America, the first round goby was caught in Lake St. Clair in 1990. The species had been introduced via the discharged ballast water of a ship. Over the ensuing decade, round gobies spread throughout the Great Lakes, escaped down the Chicago Sanitary and Ship Canal, and under their own steam are now on their way toward colonizing the Mississippi River basin. The addition of just one species to North America matters for several related reasons.

In southern Lake Michigan, where recreational and commercial anglers used to harvest vast numbers of prized native yellow perch, now only invasive round gobies are caught. In the lakeside economically depressed areas in northern Indiana and southwestern Michigan, where poor boys and girls used to be able to catch their dinner off the breakwaters, fishing is now futile, unless they want round gobies on the menu. I've had this experience myself: pulling in small and useless goby after goby, with not a single native or valuable fish species in hours of fishing. Why? Because round gobies eat the eggs and fry of smallmouth bass and other highly valued fishes, out-compete valuable fishes for food, and out-compete native bottom-dwelling fishes for shelter. Finally, increasing evidence suggests that the microorganism that causes botulism occurs in round goby because they consume lots of zebra mussel and quagga mussel, in which the botulinum toxin accumulates. I'll have more to say later about these mussels, which are other bottom-dwelling invasive species. Botulism in turn has caused massive die-offs in lakes Erie and Ontario of sport fish and especially of water birds that consume

round gobies and other affected fish species. A potential threat exists to humans that consume these fish, but so far there are no known cases of human poisoning. For similar reasons, PCBs and heavy metals bioaccumulate in zebra mussel, and also accumulate further in the fishes that eat them. Humans must now limit their consumption of fishes to avoid PCB and heavy metal poisoning (Kwon et al. 2006). Accumulating toxins in Great Lakes invasive species are potentially an ecological time bomb.

Hence the impacts of just one species added to the Great Lakes have resulted in large environmental and financial costs, as well as threats to human health. These costs are still increasing as round gobies become more abundant within the Great Lakes, and the damages are spreading as the fish moves south in the Mississippi River basin and elsewhere. As we talk today, the ranges and abundances of round gobies and many other species are increasing. Given the long-term damages that will continue from these species, investments in prevention efforts are likely to bring large net returns to society.

Shipping as one of several major pathways of aquatic invasions

I could continue with stories about the impact of many, many more invasive species in terrestrial, marine, and freshwater ecosystems. Everywhere biologists look, we find more and more alien species, with the total number of alien species increasing over time (Ricciardi 2006, Cohen and Carlton 1995, Baltic Marine Biologists 2005). Perhaps more important than the number of species is the fact that in many situations the abundance of these aliens reaches extremely high levels--like that of round gobies and zebra mussels—so that there is literally very little room left for native species, and the total environmental and financial impact is very high. Each of these species is fascinating biologically, with its own idiosyncrasies. Thus I could go on and on telling you about the 184 alien species known to exist in the Great Lakes, but I won't for two reasons. We don't have time and we would lose the forest for the trees—or 'lose the lake for the species,' if you will. What is more important for today, and for using science to inform a policy discussion, is to get the big picture. And the first brushstroke in that big picture is to put shipping in the context of the other pathways by which alien species are introduced.

Shipping is only one of several major pathways by which alien species are introduced into the nation's ecosystems (Lodge et al. 2006). If we narrow our focus to the Great Lakes and neighboring waterways, shipping has historically accounted for about one-third to two-thirds of freshwater alien species (Mills et al. 1993). The most recent tally suggests that shipping currently accounts for about 70% of alien species discovered in the Great Lakes since ocean-going ships gained access to the upper Great Lakes in 1959 (Ricciardi 2006). It is important, therefore, to focus considerable attention on shipping. It is also important to recognize that, without more effective policies for multiple pathways, species have been and will continue to be introduced via other pathways, including dispersal through canals; stocking by private and public agencies; aquaculture escapes; the aquarium trade; the watergarden trade; the live bait trade; the biological supply trade; and the live food trade.

For the purposes of today's hearing, though, I'll focus the rest of my comments on shipping as a pathway for the introduction of aquatic alien species in the Great Lakes, and the impacts of those species.

Ships as pathways—ballast water and hull fouling

Ships are huge, floating aquaria, with entire ecosystems of mud and water and organisms inside. For example, bulk carriers can carry 100,000 m^3 of ballast water, equivalent to 40 Olympic size swimming pools. Dr. James Carlton has estimated that 5000-8000 species of organisms are in transit daily in the ballast tanks of ships.

Of the 184 alien aquatic species known in the Great Lakes, about 55 are attributable to release in the ballast water of ships since the opening of the St. Lawrence Seaway in late 1950s, with another four species attributable to dispersal through shipping canals (Ricciardi 2006). Of the 55 species attributed to ballast water release, 26 are free-living animals; most of the rest are algae, protozoans, and parasites of fish. The rate at which these animal species have been discovered has increased in recent years (Holeck et al. 2004, Drake et al 2005). I believe that reflects an increasing invasion rate. But we cannot be sure to what extent this increased discovery rate results from changes in sampling effort by biologists, increases in populations of species that were introduced and established years ago (and therefore only now detected), or a recent increase in the actual number of species introduced and established (Costello et al. 2007). What we know for certain is that these numbers are generally underestimates: monitoring efforts are few and poorly funded, and we are far more likely to discover large species rather than microorganisms, including pathogens and parasites. No doubt there are many more alien species in the Great Lakes than we know about (Costello et al. 2007). In any case, a novel alien animal species is now discovered about every 8 months in the Great Lakes, and we know that many additional novel species are being introduced every year even if they don't all establish self-sustaining populations (Drake & Lodge 2007).

Until recently, it has been assumed that all species introduced recently by ships into the Great Lakes were released in ballast water. However, in saltwater ecosystems, about one-half of ship-related invasions result from species transported on the hulls of ships. Very recent evidence suggests that hull fouling may be important in the Great Lakes also. From samples scraped from the hull of one ship that entered the St. Lawrence Seaway, my collaborators and I estimated that at least 100-200 different kinds of organisms were living on the hull. We identified two species of freshwater copepods never before observed in the Great Lakes. To my knowledge, this is the only ship in the Great Lakes whose hull has been sampled by biologists. Because ships that enter the Great Lakes have been in salt water for days or weeks, hull fouling is likely to be less important than for saltwater ecosystems, but these recent results suggest that we cannot continue to ignore the threat of hull-fouling organisms in the Great Lakes. At least for badly fouled ships, like the one we sampled, the number of species on the hull is of the same order of magnitude as the number of species typically sampled in ballast water.

Without additional policies, ships--these big floating aquaria--will cause increasing invasions around the world. For the Great Lakes, we have not begun to exhaust the supply of species native elsewhere in the world that would thrive in the Great

Lakes. For most of the history of Great Lakes shipping, ships have come from northern European ports, especially from the Baltic Sea. In addition to commercial goods they have intentionally delivered, these ships have also delivered species occurring in the Baltic Sea, which ranges from salty to fresh. And not all of the species occurring in the Baltic Sea originated in the Baltic Sea. Many invaded the Baltic decades or centuries ago from more southerly parts of Eurasia via canals and commercial vessels moving north through Europe. Thus the Great Lakes have received many species from the Baltic that came originally from the Black and Caspian seas region. As the number, size, and speed of ships in the growing network of global shipping increases, we can expect that many species will colonize many of the world's ports, even those not directly linked. It is useful to think of the ports of the globe as stepping stones; if a species invades one port, it is more likely to invade another. If shipping continues in the Great Lakes, then, we can expect to discover more and more species in future from places other than the Baltic and Eurasia.

Impact of ship-borne alien species in the Great Lakes

No comprehensive analysis of the impact on the Great Lakes region of ship-borne alien species exists. A group of us, including economists and biologists, are in the process of conducting such a study, with support from NOAA Sea Grant and EPA. What I can offer today is a summary of the state of our analysis, including some examples from the 26 alien animal species. At least 40% of the 26 known alien animal species cause undesirable impacts, either in the Great Lakes (although many have not been in abundance very long) or in similar freshwater environments. Because these species cause net negative impacts, we refer to them as invasive species. These damages include environmental change; loss of native biodiversity, including reductions in the health of highly valued fish and wildlife; threats to human health; and direct financial impact on industry and consumers. The health of our ecosystems—and therefore our well-being—is at stake.

In my opening comments, I offered the example of round goby, which has harmful impacts on native biodiversity, including commercially and recreationally valuable fishes, and which likely caused botulinum poisoning of 100s-1000s of water birds in some years. In the table below, I summarize the available data on the net negative impacts of round goby and seven other invasive species. These include the best documented species. We know very little about the impact of most species, especially many of the algae, protists, and parasites. It is not safe to assume, however, that they have no impact; rather we know so little because so little effort is devoted to learning about them. Therefore the impacts summarized in the table are a bare minimum of the aggregate impacts of ship-borne alien aquatic species in the Great Lakes.

It is instructive to examine two of the listed species in more detail, zebra mussel and quagga mussel. Their impacts are the best documented of any species listed, for two reasons. First, they have large, direct, financial impacts on industry. Second, zebra mussels were the first discovered among those listed, in the mid 1980s. So they've had more time to express their impacts. Like round gobies, both these mussel species originated in Eurasia. These two bivalve species look very similar; even biologists have

difficulty distinguishing them. But they differ somewhat ecologically: quagga mussel thrive in deeper portions of the Great Lakes and on softer sediments than do zebra mussel.

Preliminary analysis of net negative impacts of selected ship-borne invasive species: 1=low impacts; 3=high impacts; blank=no documented impacts.

	Native biodiversity	Infra-structure	Commercial fishing	Navigation	Recreation	Human health
Round goby[1]	2		1		2	1
Eurasian ruffe[2]	1		1		1	
NZ mud snail[3]	1?	1?				
Amphipod[4]	1					
Spiny water flea[5]	2				1	
Fish hook water flea[6]	1				1	
Quagga mussel[7]	2	2	2	1?	2	
Zebra mussel[8]	3	3	2	1	2	1

[1]*Neogobius melanostomus*; [2]*Gymnocephalus cernuus*; [3]*Potamopyrgus antipodarum*; [4]*Echinogammarus ischnus*; [5]*Bythotrephes longimanus*; [6]*Cercopagis pengoi*; [7]*Dreissena bugensis*; [8]*D. polymorpha*

The direct financial impacts of zebra and quagga mussels result from the mussels' habit of gluing themselves to any hard surface, including the inside of water intakes. Thus any municipality or industry that has intakes in a lake or river infested with zebra mussel has had to respond with some combination of control efforts, preventive maintenance, infrastructure redesign, and lost production. The best available data, now more than 10 years old, add up to annual expenditures in the Great Lakes region of at least $150 million in current dollars (O'Neill 1996). The nuclear power plant closest to my home spends between $1-2 million per year in response to zebra mussel. These costs are probably dramatic underestimates of financial damage and certainly do not include either the environmental damages or damages to commercial and recreational fishing.

Damages to fisheries are now well documented in the Hudson River (Strayer et al. in press), and strongly implicated in the Great Lakes through a series of interactions in the food web. Where the mussels become abundant in deeper waters the native amphipod (*Diporeia*) disappears. The amphipod, in turn, was the major food source for highly valued native whitefishes, the catches for which have declined by about 70% since the mid 1990s (Hoyle et al. 1995). In shallower waters, large changes in the abundance of many native organisms also occur, with, for example, the large native clams driven to local extinction.

The feces and other egesta of the invasive mussels accumulate into thick layers of organic matter that become anoxic, making them a great environment for the bacterium *Clostridium botulinum*, which manufactures a toxin that bioaccumulates in zebra and quagga mussels, and is then passed to round gobies that eat the mussels, and thence to fish like yellow perch and smallmouth bass that eat the round gobies and that are highly valued and consumed by people (Yule et al. 2006). The fish are also consumed by loons, ducks and other water birds, which then succumb to botulinum poisoning. Especially in lake Ontario and Erie, where vast numbers of zebra mussels exist in shallow waters, die-offs of 100s-1000s of water birds have increased in recent years.

Finally, the mussels are also strongly associated with increasingly frequent and severe blooms of harmful bluegreen algae, especially in the shallower, more productive parts of the lower Great Lakes. These blooms of *Microcystis* create taste and odor problems in drinking water, which reduce human satisfaction and/or require increased water treatment costs. I do not know of another region of the country where so many people withdraw drinking water from sources into which ballast water is dumped.

Thus, only two invasive mussels, especially in concert with other invasive species like round gobies, have produced a number of strong and harmful changes to the Great Lakes. Shipping brings with it a tax in the form of the damages done by invasive species—a tax that was formerly hidden but is increasingly obvious and large.

Damages from invasions in the Great Lakes—a threat to nation's freshwaters

These damages are irreversible to a large degree. In the context of endangered species, you've probably heard it said that "extinction is forever." Unfortunately, it is also usually true that invasion is forever. Biological invasions are the least reversible form of pollution. In contrast, most other forms of pollution--like the nitrogen and sulfur compounds of air pollution, the CFCs that destroy ozone, and PCBs—degrade or get buried (unless they are resurrected by invasive mussels), and the problems they cause decline eventually, if only we stop adding molecules of them to the environment. Chemical pollutants, in other words, do not reproduce; species do. Even if we stop adding individual round gobies and zebra mussels to Lake Michigan, their populations and those of many other invasive species will continue to grow, they will continue to spread throughout the Mississippi River basin and across the continent, and their environmental and economic damage will grow exponentially.

For example, in a soon-to-be-published report (Bossenbroek et al. 2007), we predicted that Lake Mead would be the most likely waterway west of the 100th Meridian to be colonized by invasive mussels. We made that prediction based on modeling efforts based on two perspectives: Lake Mead offers habitat suitable for zebra mussels, and many boaters from infested waterways in the Midwest visit Lake Mead. Some accidentally carry mussels on or in their boat or trailer. Before our paper was in print, quagga mussels were discovered in early January 2007 in Lake Mead and other locations on the Colorado River. As the mussels increase in abundance, large environmental and financial damages will ensue in the West as they have in the Midwest. In addition, other western waterways are now at a much higher risk of invasion because there are source populations of mussels nearby. All these impacts, including those yet to come

throughout the west, are ultimately caused by ocean-going ships bringing species into the Great Lakes.

If releases of organisms from the shipping pathway are not managed more effectively in future, many more invasive species will unfortunately be following those that I've talked about today—into the Great Lakes and eventually throughout the waterways of North America. In the long run, greater investments in management of the ship pathway will be far cheaper than continually reacting forever to new invasions.

Thank you again for the opportunity to offer my thoughts on the impact of invasions in the Great Lakes.

Please enter my entire written and oral testimony into the published record. I look forward to responding to your questions.

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Impact of Aquatic Invasive Species in the Great Lakes

David M. Lodge
University of Notre Dame

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Round Goby: Small Fish, Big Impacts

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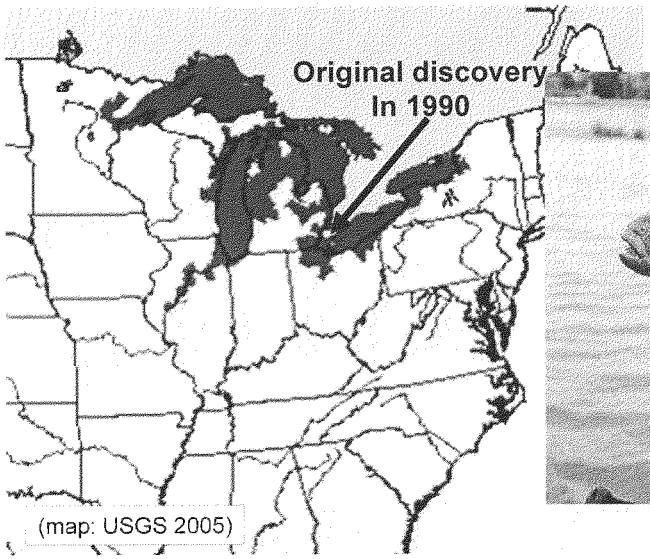

(map: USGS 2005)

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Big Impacts from Three Small Species

Loon

Harmful algae

Whitefish

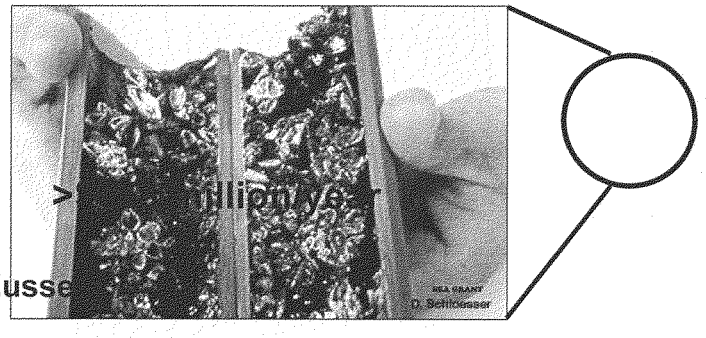
Zebra Mussels

Diporeia

Round Goby

Quagga Mussels

Big Impacts from Three Small Species

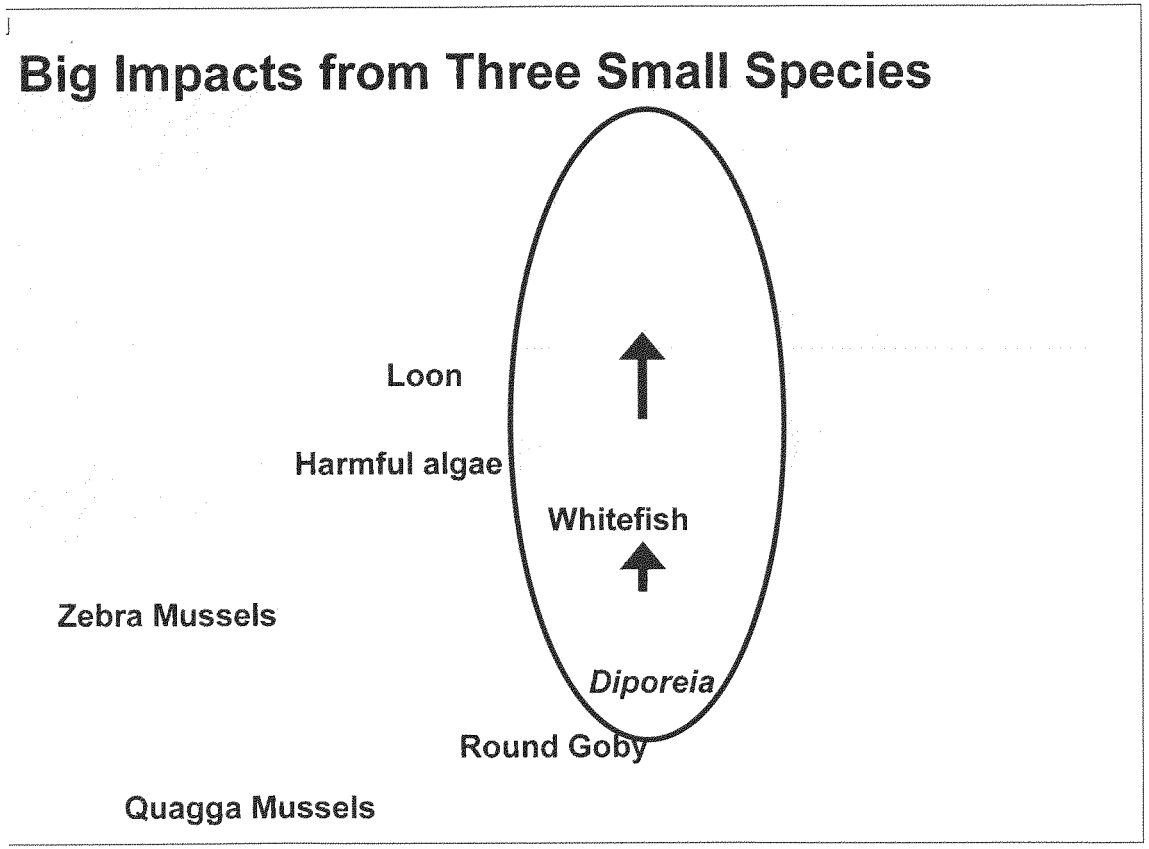


Zebra Musse

Diporeia

Round Goby

Quagga Mussels


Big Impacts from Three Small Species
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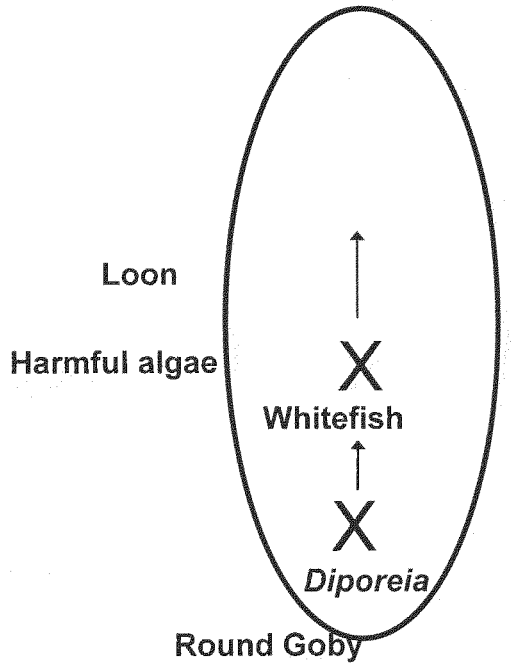
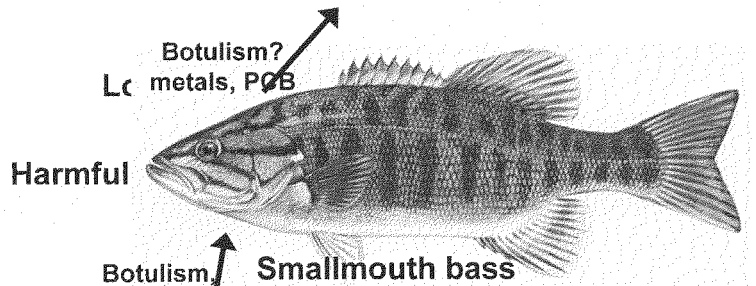
Harmful algae
Whitefish
Zebra Mussels
Diporeia
Round Goby
Quagga Mussels

Big Impacts from Three Small Species



Big Impacts from Three Small Species



Botulism?
Lc metals, PCB

Harmful

Botulism,
metals, PCB

Smallmouth bass

Zebra Mussels

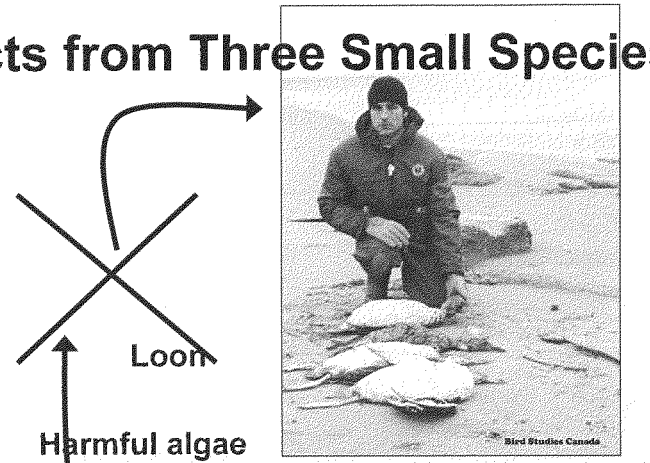
Diporeia

Round Goby

Quagga Mussels

Botulism, heavy metals, PCB

Big Impacts from Three Small Species



Loon

Harmful algae

Whitefish

Botulism

Zebra Mussels

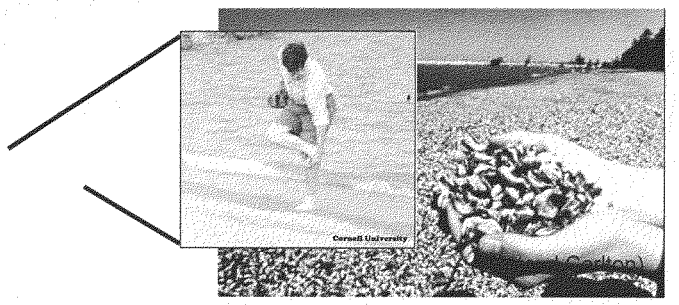
Diporeia

Round Goby

Quagga Mussels

Botulism

Big Impacts from Three Small Species



Harmful algae

Whitefish

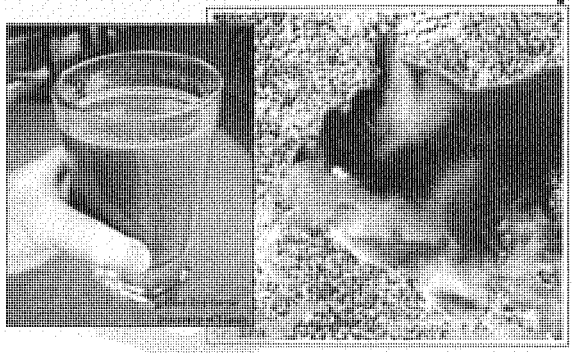
Zebra Mussels

Diporeia

Round Goby

Quagga Mussels

Big Impacts from Three Small Species



Harmful algae

Whitefish

Zebra Mussels

Diporeia

Round Goby

Quagga Mussels

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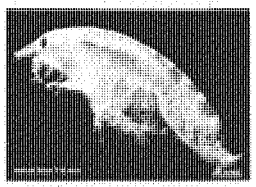
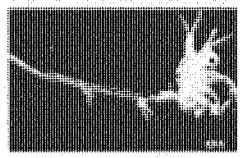
	Biod	Infra	Fish	Nav	Recr	Health
Round goby						
Eurasian ruffe						
NZ mud snail	?	?				
Amphipod						
Spiny water flea						
Fish hook water flea						
Quagga mussel						
Zebra mussel						





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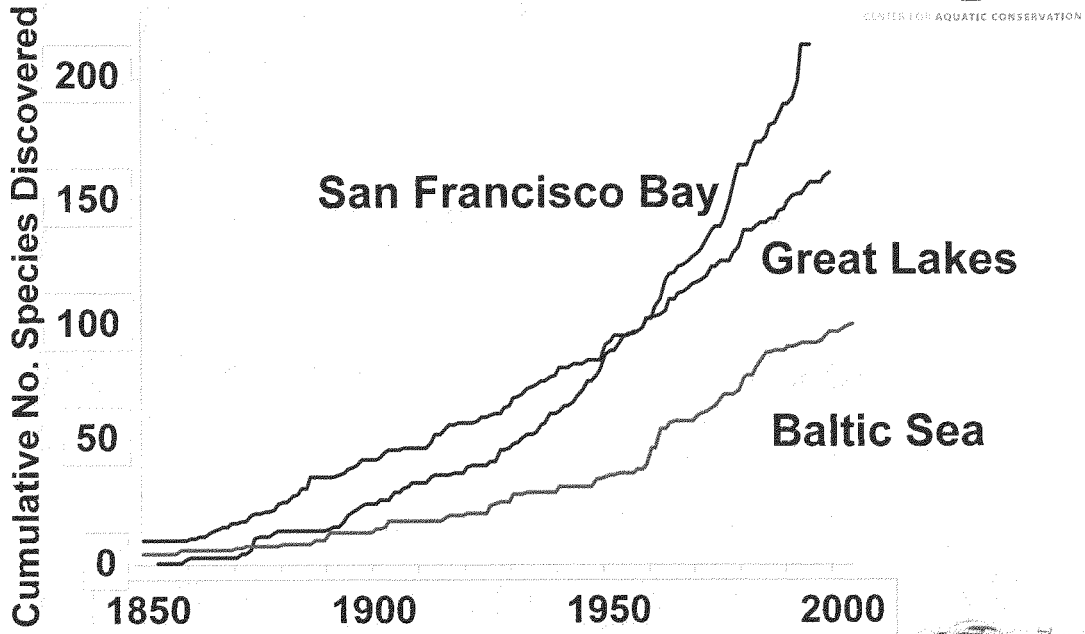
Alien Species in Aquatic Ecosystems



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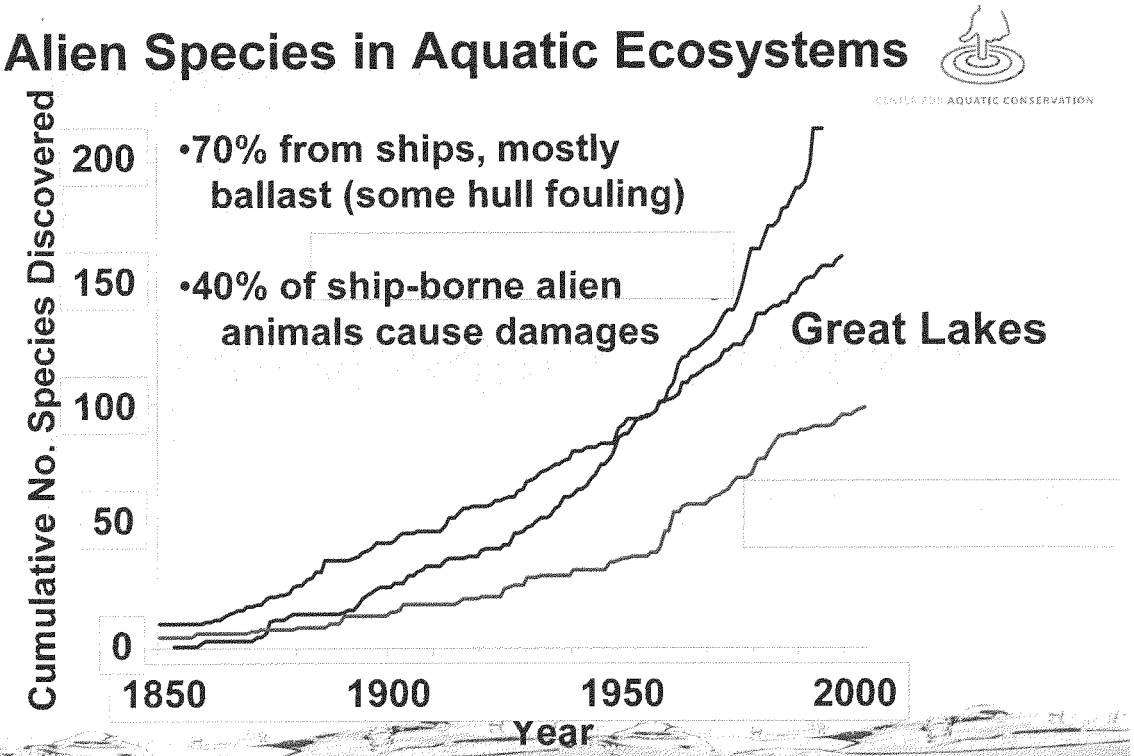
Alien Species in Aquatic Ecosystems



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Spread of Zebra and Quagga Mussels

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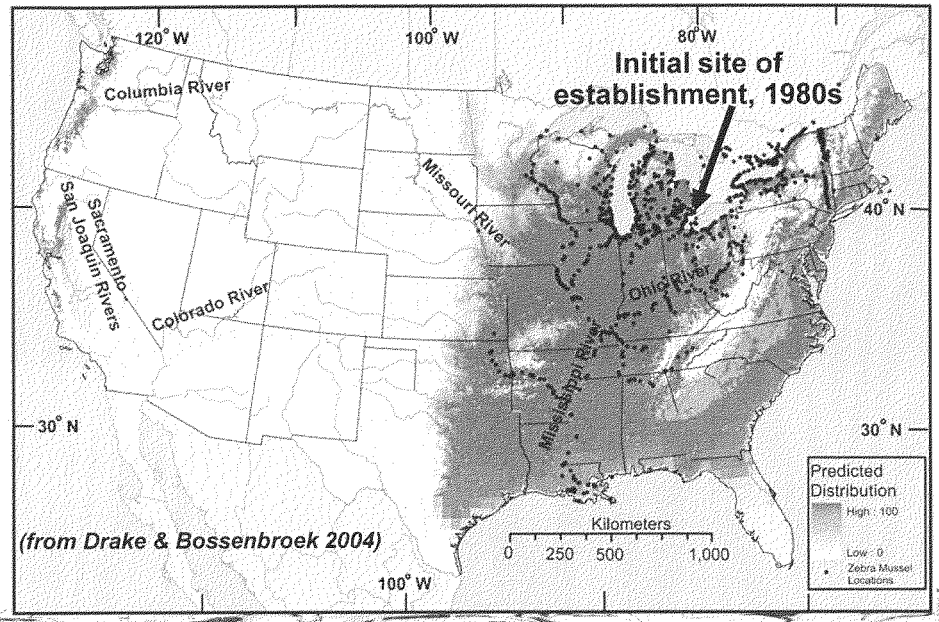

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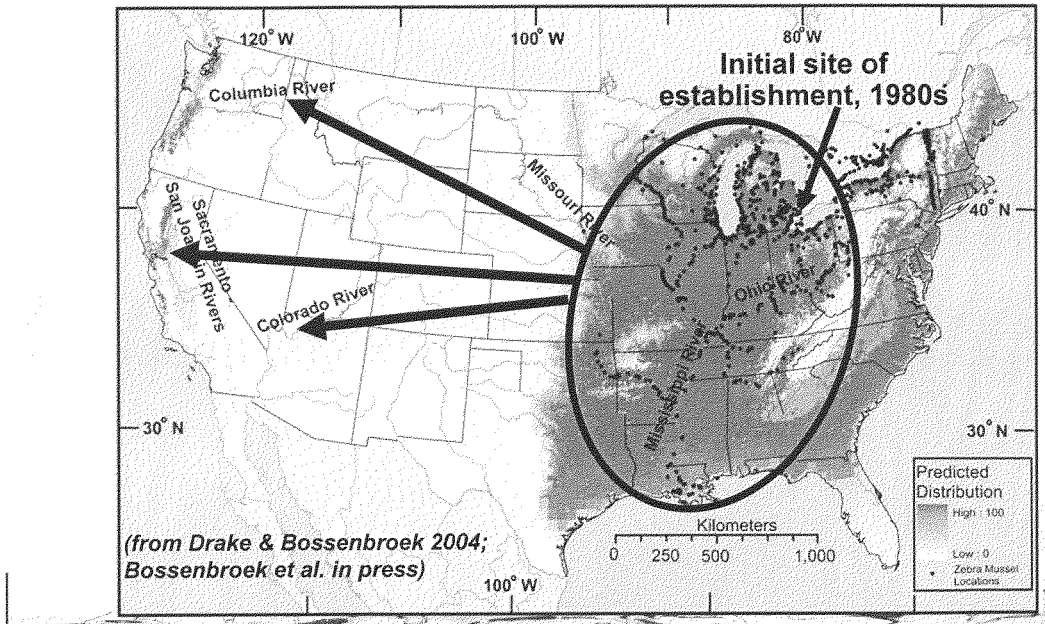
Spread of Zebra and Quagga Mussels



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Summary

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1. Damages from GL invasions are high
2. Shipping is the major pathway for GL invasions
3. What is in the GL now will soon be coming to a waterway near you
4. More species are arriving every year
5. Improved policy and management are needed

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TESTIMONY OF
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BEFORE THE
HOUSE TRANSPORTATION AND INFRASTRUCTURE COMMITTEE
SUBCOMMITTEE ON WATER RESOURCES AND ENVIRONMENT
March 7, 2007

"The Impact of Aquatic Invasive Species on the Great Lakes"

Mr. Chairman, members of the subcommittee, I am Adolph Ojard, Executive Director of the Duluth Seaway Port Authority in Duluth, Minnesota. I am here today as the President of the American Great Lakes Ports Association. Our organization represents the 12 public port authorities on the U.S. side of the Great Lakes. While I am here specifically on behalf of the Great Lakes port community, I can assure you that the views I express today are shared by the majority of private maritime interests in the Great Lakes-St. Lawrence Seaway system.

I want to thank you and the subcommittee for your leadership and your willingness to hold this hearing in such a timely manner at the beginning of the 110th Congress. Although today's hearing focuses on the Great Lakes, where aquatic invasive species have had a considerable impact, it is important to keep in mind that this issue is of broad national and international concern. San Francisco Bay, Puget Sound, the Gulf of Mexico, Chesapeake Bay and many other regions are not far behind the Great Lakes in the damage being done to their aquatic ecosystems by invasive species.

While the various witnesses testifying today will offer differing perspectives, we all agree on one thing: *Congress must act quickly to enact a national program requiring the treatment of ships' ballast water.*

The Great Lakes/Seaway Transportation Corridor continues to develop as an essential component of our national transportation policy. In a sense, it is the Danube of North America, feeding the industrial heartland and---at 2,342 miles in length from the Atlantic Ocean to Duluth---this is the longest deep-draft waterway in the world. The binational region it serves is home to more than 90 million people (nearly one-quarter of North America's population); creates more than a third of North America's gross national product; produces two-thirds of Canada's industrial output; grows almost half the soybean and corn in the U.S.; and accounts for some 40 percent of U.S. manufacturing.

The shipping industry - like any industry - operates under the terms of an unwritten social contract with the public. That is, our industry should add value to society, and do no harm. Indeed, maritime commerce offers numerous benefits. Studies have shown that waterborne transportation is widely regarded as the safest, cleanest, and least costly mode of commercial transport. For example, shipping by water requires only 10% to 20% of the energy required by road. Seaway-sized ships can carry cargoes equivalent to the loads of 870 trucks or 225 rail cars. Ships emit one-tenth the greenhouse gas of trucks and half that of trains. Only one marine accident is recorded for every 13.7 rail accidents and 74.7 truck accidents. Unfortunately, the emergence of aquatic invasive species has become our industry's "Achilles' heel." We stand ready to solve this problem - and let me assure you that we will solve it.

Ballast water is essential to present day commercial ship operations. When ships are empty or partially empty of cargo, they take on ballast water to maintain draft and stability, submerge the propeller and rudder, and uphold acceptable stress loads on the hull. Weather conditions and water depth influence a ship's ballast operations, but the amount, weight, and distribution of cargo on board ultimately determine ballast loads

and distribution within the ship. The greater the load of cargo, the less ballast water and vice versa.

While some have been critical of both Congress and the Coast Guard in responding to this issue, I would like to acknowledge the measures that have been taken. After discovery of the zebra mussel in Lake St. Clair in 1988, Congress enacted the "Non-Indigenous Aquatic Nuisance Prevention and Control Act of 1990." This law implemented the first U.S. ballast management regime by requiring all vessels carrying ballast water to flush their tanks with seawater prior to entering the Great Lakes. This practice was expected to reduce the number of organisms transferred into the Great Lakes. In 1996, the National Invasive Species Act expanded this requirement to not only include the Great Lakes, but all coastal ports. While ballast water exchange is an important tool to reduce the introduction of aquatic invasive species, it is not a full-proof solution. Aquatic invasive species continue to be introduced into the Great Lakes and it is apparent that more must be done.

Trade patterns are an important consideration to the invasive species issue. The Great Lakes St Lawrence Seaway was designed and built to provide global connectivity. The principal inbound cargoes have been steel from Europe and iron ore from Canada, delivered to our industrial centers. Ships discharging in the lower Great Lakes will then sail to Duluth -Superior and Thunder Bay, Ontario, to load prairie grains for export back to North Europe, the Mediterranean and North Africa markets. As you can see, a typical cargo ship will call at multiple ports in the U.S. and/or Canada before exiting the Seaway.

A comprehensive federal ballast water treatment program is needed to accomplish two important goals: 1) harness market forces to protect the environment, and 2) create an orderly regulatory environment within which commerce can flow unimpeded.

Thousands of ships move commerce into and out of the U.S. ports each year. The owners of these vessels represent a potential multi-billion dollar market for the manufacturers of ballast water treatment systems. Many of these systems have undergone initial

development; however, they are not being brought to market due the lack of a federal ballast water treatment standard and deadlines for system installations. The single quickest means of developing the technology needed to protect the aquatic environment is to harness the profit motive of these manufacturers.

To bring about a win-win solution, Congress should not only take steps to accelerate protection of the Great Lakes ecosystem, but do so in a manner that maintains an orderly and consistent regulatory environment in which maritime commerce can flourish. For this reason, it is of critical importance that the federal government establish sole jurisdiction over this issue.

The focus of this hearing is the "Impact of Aquatic Invasive Species on the Great Lakes." For the Great Lakes shipping industry, that impact is the fear of a growing patchwork of differing and conflicting state laws - each attempting to regulate ships engaged in interstate or international commerce. Since most Great Lakes vessels load or discharge cargo in numerous jurisdictions, the potential for chaos is considerable.

Chairman Oberstar has for many years advocated legislation to bi-nationalize the management and operation of the St. Lawrence Seaway. He believes strongly that a streamlined regulatory environment will result in a more efficient and successful shipping system. It is for that very reason that I urge the Committee to develop ballast water legislation that establishes exclusive federal jurisdiction.

Since the year 2000, the states of New York, Michigan, Indiana, Illinois, Wisconsin and Minnesota have all considered legislation to regulate ships' ballast water. Additionally, the Province of Ontario has also considered legislation. Many of these efforts have been misguided and reflect the lack of maritime expertise at the state level. To date, only the State of Michigan has actually enacted a ballast water statute. That law requires all ships conducting port operations in Michigan to obtain a permit from the state. Further, it requires that a ship owner either certify that it will not discharge ballast in Michigan waters, or that it will do so only after treating the ballast with one of four ballast water

treatment systems. These systems were arbitrarily selected by the Michigan Department of Environmental Quality. Not one of them has been scientifically tested and shown to prevent the introduction and spread of aquatic invasive species.

It is important to note that states **do not** want to get involved in the regulation of ballast water. Based on our experiences, all branches of state government seem to recognize the negative consequences of their actions. They seem to understand the harm they would inflict on their own citizens and their own economies by imposing added costs and isolating valuable Great Lakes maritime commerce. Yet the continuing lack of action on a federal level has driven the states into attempting independent remedies. With minimal understanding of the intricacies of the maritime industry, the state legislation that is being developed is ineffective at best, absurdly impractical at worst. Further complicating the issue is that state regulatory bodies have little or no knowledge of shipboard issues.

When federal standards are finally enacted, the U.S. Coast Guard must be the regulatory agency. Vessel operations are highly complex. The Coast Guard is the only agency with the knowledge, experience and skill to effectively regulate vessel operations. That, in fact, is what the Coast Guard does---facilitate commerce through safe navigation in safe harbors. They know what to do and when to do it. Just as important, they know what not to do and when not to do it. Any other agency would not only be an impediment to operations, it would be a safety and environmental hazard.

The negative impacts of aquatic invasive species are not in dispute. The need of both the environment and industry is for Congress to create a regulatory framework within which the private sector can begin making the necessary investments to solve this problem. I believe we can protect the aquatic environment and maintain a healthy shipping industry. There is a win-win scenario, and its not far out of reach. Today, technology vendors have developed a host of products to treat ships' ballast water, but absent a federal ballast treatment program, they are reluctant to make the investment necessary to bring these products to market.

So what is needed?

- Defined and enforceable federal standards for ballast water treatment.
- Federal preemption over state and local jurisdiction.
- Uniform national standards and regulation.
- Authorization for the USCG to exclusively regulate shipboard ballast operations.
- Public and private investment in both shipboard ballast water technology and eradication of harmful invaders from our waters.
- Incentives to encourage vessel operators to pursue early installation of approved ballast water treatment systems.

Again, I want to thank the Subcommittee for hosting this hearing and for being sensitive to the need to move quickly on federal legislation. I look forward to continuing this dialogue with the Committee as solutions are crafted and debated. Finally, I would be happy to take answer any questions.

WRITTEN STATEMENT FOR THE RECORD
COLLISTER JOHNSON, JR., ADMINISTRATOR
SAINT LAWRENCE SEAWAY DEVELOPMENT CORPORATION

BEFORE THE
SUBCOMMITTEE ON WATER RESOURCES AND ENVIRONMENT
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE
U.S. HOUSE OF REPRESENTATIVES

MARCH 7, 2007

I want to thank Chairwoman Johnson, Ranking Member Baker, and Members of the Subcommittee for this opportunity to present a written statement to be included in the hearing record on this important topic of aquatic invasive species in the Great Lakes.

The U.S. Saint Lawrence Seaway Development Corporation (SLSDC) is responsible for the operations and maintenance of the U.S. portion of the St. Lawrence Seaway between Montreal and Lake Erie. This responsibility includes maintaining and operating the two U.S. Seaway locks located in Massena, N.Y., and vessel traffic control in areas of the St. Lawrence River and Lake Ontario. For nearly 50 years, the binational St. Lawrence Seaway has served as a vital transportation corridor for the international movement of bulk and general cargoes such as steel, iron ore, grain, and coal.

Maritime commerce on the Great Lakes Seaway System is a critical transportation link for the continent's agricultural and industrial heartland, annually sustaining more than 150,000 U.S. jobs, $4.3 billion in personal income, $3.4 billion in transportation-related business revenue, and $1.3 billion in federal, state, and local taxes.

Maritime commerce, however, has also served as one pathway of introduction of aquatic invasive species as they are transported into the System in the ballast water of ships. Ships take on ballast water in other countries for stability during the ocean crossing. This water is pumped out when the ships unload and/or pick up cargo in Great Lakes ports. Many of the species, such as zebra mussels, are thought to have arrived in the Great Lakes this way. Now they are being spread throughout the continent's interior through natural processes and by the activities of humans through a variety of commercial and recreational activities. Aquatic invasive species clearly pose a major environmental challenge to the waterway, and action is needed now to stop the further introduction and spread of aquatic invasive species.

There is a compelling need for federal legislation to address this serious environmental challenge. International rules, national laws, state laws, and a myriad of regulations govern the use and discharge of ballast water, and are constantly changing. Recent court rulings on ballast water laws have also been adding new, sometimes stricter interpretations of existing statutes. Clearly, consistency is lacking in this 'patchwork' approach. To be effective, a strong, uniform federal statute addressing ballast water is required.

A number of considerations must be taken into account in the formulation of this federal legislation. The water quality standard for ballast water discharged in U.S. waters is an area subject to debate. Without a uniform standard, there is uncertainty in the industry and shipowners are reluctant to proceed with installing ballast water technology if it does not perform to the most rigid standard. Formulation of a reasonable but environmentally sound standard is a critical first step in solving the problem. I believe there are several technologies – ranging from biocides to de-oxygenation to Ultraviolet radiation – that can be employed to meet a uniform federal standard.

Secondly, the timetable for implementation of the technology must be given careful consideration. I understand that shipowners can incorporate ballast water technology into the new build process efficiently and relatively inexpensively. The problem lies with existing ships, especially older ships. The timetable must not be so strict that it discourages owners from retrofitting their ships with new technology. A reasonable phase-in of appropriate and available technology is recommended.

Finally, there does not exist today any widely accepted and validated testing protocols or criteria for enforcing a ballast water standard once one is promulgated. This needs to be addressed concurrently with the development of ballast water technology.

A number of legislative proposals were introduced in the 109th Congress to combat invasive species. One proposal, S. 363, the Ballast Water Management Act of 2005, was approved by the Senate Committee on Commerce, Science and Transportation on July 21, 2005, but saw no further action in the 109th Congress. The Department of Transportation presented its position on S. 363 in a May 16, 2006 views letter to then Committee Chairman Senator Ted Stevens:

> *"...The Department of Transportation believes that a strong, consistent, national Federal standard is necessary to address the environmental and commercial issues posed by this problem. Inconsistent standards throughout the country fail to recognize that the national nature of this problem calls for a national solution. Only national ballast water standards can control what is essentially a matter involving interstate maritime commerce and international environmental issues."*

In that letter, the Department provided additional comments and expressed its support for federal legislation to prevent the further introduction of invasive species through ballast water, and for S. 363 specifically. The Department is prepared to again be engaged in the discussion as the 110th Congress proceeds to address this important issue.

Turning to ballast water management requirements, I want to point out to the Committee that those standards employed in the Great Lakes St. Lawrence Seaway System are the most stringent in the world. U.S. Coast Guard (USCG) regulations and Transport Canada's ballast water control and

management regulations require all ships destined for Great Lakes ports from beyond the Exclusive Economic Zone to exchange their ballast at sea. If the ships have not complied, they may be required to retain the ballast water on board, pump the ballast water ashore, treat the ballast water in an environmentally sound manner or return to sea to conduct a ballast water exchange. In addition, Transport Canada regulations now require all ships destined for the Great Lakes in NOBOB – no ballast on board – condition, to conduct salt water flushing.

The SLSDC continues to perform its Enhanced Seaway Inspection (ESI) program, inspecting all ocean vessels for safety and environmental protection issues in Montreal, Quebec, before they enter U.S. waters. The SLSDC and the USCG, in conjunction with Transport Canada and the Canadian St. Lawrence Seaway Management Corporation (SLSMC), signed a Memorandum of Understanding in March 1997 to develop the program of coordinated vessel inspection and enforcement activities to expedite the safe transit of shipping through the Great Lakes Seaway System. The ballast water exchange program continues to be an important function of the ship inspection program. These inspections are carried out concurrently with the ESIs, by SLSDC personnel in Montreal and by USCG and Corporation staff at Snell Lock in Massena. These programs support the Oil Pollution Act of 1990 and the Non-Indigenous Aquatic Nuisance Prevention and Control Act of 1990. The inspectors verify a vessel's successful ballast water exchange through a boarding program, which includes measuring the salinity of on-board ballast. Ballast with a salinity of 30 parts per thousand or more is considered evidence that the tanks have been adequately exchanged and provide a reasonably harsh environment for any remaining organisms. During the 2006 season, Seaway marine inspectors conducted 82 ballast water inspections in conjunction with the ESI program, and performed an additional 57 ballast water exams for subsequent voyages at the U.S. Seaway locks in Massena, N.Y.

However, we recognize that the Great Lakes have still experienced new introductions of aquatic invasive species, even after the inception of a well-enforced mandatory ballast water exchange program. There is a growing consensus that ballast water exchange – the best practice method now employed to deal with the problem – is not adequate to protect the Great Lakes and the St. Lawrence River.

While the SLSDC does not have statutory jurisdiction over ballast water regulation, which is the domain of the USCG, aquatic invasive species is an issue of prime importance to our mission of moving vessels safely into the Great Lakes. As a result, the SLSDC is involved, where appropriate, in projects that are seeking a workable, sustainable solution to the problem of aquatic invasive species through better technology and commercial marine practices that promise a more effective resolution than ballast water exchange alone is able to supply.

I have been working with Great Lakes Seaway System stakeholders to catalyze industry-government partnerships to address the ballast water issue through research and development of new technologies. The SLSDC is involved in the "Green Marine" program, a marine industry environmental partnership of seven marine trade associations and more than 500 Canadian and U.S. companies including shipowners, which has identified exotic species vectoring via ballast water as one of the highest priorities within the System requiring prompt action. One of the System's largest international carriers is in the final phase of implementing a ballast water treatment program, conducting full-scale tests for months onboard two operating vessels. The

system employs a combination of treatments but, unlike others, does not use any chemical additives. The treatment technology is promising, and testing to determine its effectiveness in complying with standards set by the International Maritime Organization is ongoing.

The desire to operate vessels and implement shipping procedures responsive to the publics' needs prompted creation of the Great Ships Initiative (GSI), which is focusing resources and expertise on producing solutions to the problem of ship-mediated invasive species in the Great Lakes. The GSI is an industry-led cooperative effort initiated by the Northeast-Midwest Institute, in collaboration with the American Great Lakes Ports Association, designed to develop safe, effective, affordable and quick answers. It incubates treatment alternatives for promising technologies such as ultraviolet irradiation, deoxygenation, filtering, nonoxydizing biocides and shoreside treatment. The initiative has three objectives: (1) identify promising treatment systems; (2) provide expert technical support to accelerate the research and testing of promising systems; and (3) facilitate the evaluation and approval by regulators of promising treatment alternatives. There will be research capabilities at three different levels: "bench scale" in the laboratory; "pilot scale" (barge-based); and at full size ship-board scale. The two primary activities will be to (1) identify and verify treatment technologies that stop the introduction of exotic organisms by ocean-going ships; and (2) monitor Great Lakes ports and harbors for new introductions of invasive species by ships. The two Seaway Corporations are actively involved in the GSI.

I want to mention another major player in helping address broad environmental problems, the Great Lakes Maritime Research Institute, a U.S. Maritime Administration National Maritime Enhancement Institute established in 2004. A joint project between the University of Minnesota-Duluth and the University of Superior-Wisconsin, the Institute pursues research efforts in marine transportation and environmental planning including aquatic invasive species, as outlined in the Coast Guard and Maritime Transportation Act of 2004. The Seaway Corporations are working closely with the Institute, as well as the U.S. Maritime Administration, the U.S. Army Corps of Engineers, the USCG and U.S. Navy, along with the marine industry to move forward on implementation of safe, reliable and affordable ballast water solutions from the many potential technologies that scientists have reviewed over the past decade.

In addition, the SLSDC plays a key role on the Great Lakes Regional Waterways Management Forum, a group of U.S. and Canadian federal representatives who work cooperatively to identify and resolve waterways management issues in the Great Lakes region. The Forum specifically reviews issues that cross multiple jurisdictional zones and/or involve international issues and is tasked with developing operational solutions that improve the use and effectiveness of the Great Lakes for the public. Over the past few years, the SLSDC has played an active role on the Forum's ballast water working group. The ballast water working group was developed to harmonize efforts between the USCG, Transport Canada, and the two Seaway Corporations to coordinate and exchange compliance and research efforts for reducing aquatic nuisance species invasions via ballast water in the Great Lakes.

The two Seaway Corporations are also committed to sharing with the public the progress that has been made to date on marine environmental challenges impacting the waterway. The binational website, www.greatlakes-seaway.com, now includes a section providing timely updates on ballast water initiatives as well as other environmental activities.

Substantial coordination and research is ongoing in an aggressive effort to find solutions to the problem of aquatic invasive species in the Great Lakes. The SLSDC will continue to pursue and promote the responsible, coordinated efforts underway to address the serious problems that result from invasive species. We are committed to working with Congress to construct the federal legislative response necessary to address the problem quickly and uniformly.

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Before the House Transportation and Infrastructure's Subcommittee on Water Resources and Environment
Hearing on "The Impact of Aquatic Invasive Species on the Great Lakes"

Testimony of Jennifer McKay
Policy Specialist, Tip of the Mitt Watershed Council

March 7, 2007

Madame Chairwoman and members of the Subcommittee, thank you for the opportunity to submit testimony on the impact of aquatic invasive species on the Great Lakes. As a means of introduction, Tip of the Mitt Watershed Council, founded in 1979, is a nonprofit organization whose purpose is to protect, restore, and enhance water resources, including inland lakes, rivers, wetlands, groundwater, and the Great Lakes. We base all our programs on sound science and policy analysis, and have garnered respect for our work from local, state, and federal agencies, businesses, fellow environmental organizations, and citizens. As the lead organization for water resources protection in Antrim, Charlevoix, Cheboygan, and Emmet Counties, the Watershed Council is working to preserve the heritage of Northern Michigan - a tradition built around our magnificent waters.

My testimony focuses on the need to act now to prevent future aquatic invasive species from entering the Great Lakes ecosystem, the local impacts associated with aquatic invasive species, and local efforts to combat their spread.

We need to act now.

The invasion of exotic species is one of the gravest dangers facing the Great Lakes today. Invasive species such as round-gobies, zebra and quagga mussels, sea lamprey, and ruffe have taken over Great Lakes ecosystems not only at the expense of native species, but also to the expense of Great Lakes residents and businesses as well.

Since the 1800s, more than 180 alien species have invaded the Great Lakes ecosystem from around the world, costing us millions, and in some cases, irreparably damaging the Great Lakes ecosystem. Most invasive species introductions can be linked to economic activities, such as production, trade, shipping, and recreation. More than one-third of these organisms have been introduced in the past 30 years - since the St. Lawrence Seaway opened up. Exotic species are brought to the Great Lakes region and spread in ballast water dumped by ships that have been overseas, and are further spread on board personal watercraft and by people traveling between bodies of water.

There are both economic and ecological impacts, both of which are quite serious. Ecologically, aquatic invasive species impacts include food-web disruptions, native species reduction or loss (and dependent species), water quality degradation, and the introduction of pathogens. Furthermore, ecosystem disruptions and imbalances can result in increased danger to human health. Once introduced into the Great Lakes, many aquatic invasive species can find their way into inland lakes, rivers, wetlands, and other waterways, thus greatly compounding the problems associated with invasive species.

Moreover, 42 percent of threatened and endangered species in the U.S. are at risk, mainly because of invasive species.

The negative economic impact of invasive species is in the billions of dollars and once they are introduced into the Great Lakes ecosystem, controlling them is a losing battle. Invasive species adversely affect many commercial, agricultural, aquacultural, and recreational activities that rely heavily on a strong and stable ecosystem. Economic losses in the Great Lakes Basin from aquatic invasive species were estimated in 2005 at $5 billion per year. Additionally, the costs incurred by the state, local municipalities, and businesses to respond to the introduction of an aquatic invasive species is quite significant. Damage estimate from zebra mussels alone exceed $3 billion over the past ten years. Furthermore, studies have estimated lost property values on infested water bodies of up to $12,000 per property.

Of great importance, the economies of the Great Lakes states and especially Northern Michigan is inextricably linked to our water resources, capitalizing on the astounding beauty that stems from the diverse array of wildlife and natural places in the region. As a result, tourism has grown to become one of the top industries in each of the eight Great Lakes states. Economically, aquatic invasive species result in losses in tourism, sports-fisheries, and more. In Michigan, fishing expenditures alone exceed $800,000,000 per year, a figure that could drop substantially as aquatic invasive species disrupt ecosystems and impact fisheries. In Michigan, tourism boasts a $16 billion business that supports approximately 173,000 jobs. The boating industry in Michigan exceeds $2.4 billion a year and supports a total of 51,329 jobs statewide.

Clean water, vibrant wildlife habitat, and beautiful landscapes are fundamental to the success of tourism in Northern Michigan. The continual onslaught of aquatic invasive species threatens the very attributes that allow our tourism industry to thrive. For an area whose population triples in the summer months due to the tourists, introductions of invasive species could mean devastation. If we don't act now to combat invasive species, more boaters will be denied access to their favorite spot due to excessive aquatic plant growth, our children and grandchildren will be unable to swim or walk the beach without slicing their foot or hand on the shells of the zebra or quagga mussels, and fisherman will be unable to catch the perch and whitefish that were once staples in the Great Lakes. The Great Lakes as a tourist destination is at stake. The Great Lakes experience, way of life, and heritage declines with each new invasion.

Invasive species are entering the Great Lakes at an average of every 6 to 8 months. What will be the next organism to further degrade the Great Lakes? What will be the next organism to destroy the Great Lakes fishery or disrupt the food chain? None of us care to sit around and find out. We must act now.

Local Impacts

As with every community throughout the Great Lakes Basin, Northern Michigan has felt the effects of aquatic invasive species. Among the many effects, we have experienced an infestation of Eurasian watermilfoil causing adverse impacts to the ecosystem and to recreation. Eurasian watermilfoil tolerates lower temperatures and starts earlier than other aquatic plants, quickly forming thick underwater stands of tangled stems and vast mats of vegetation at water's surface. In addition to impeding navigation, no one likes to swim in areas where these dense weed beds

are at the surface. The lake ecosystem suffers because Eurasian watermilfoil displaces and reduces native aquatic plant diversity, which is needed for a healthy fishery. Infestations can also impair water quality due to dissolved oxygen depletion as thick stands die and decay.

Extensive stretches of shoreline are also experiencing a resurgence of algae with where large amounts of green algae have accumulated in nearshore areas. One of the Great Lakes most notorious aquatic invasive species, zebra mussels, is a primary culprit in the proliferation of increased algae growth. Filtering up to one liter of water per day, zebra mussels remove nutrients such as free floating algae or phytoplankton from the water. As a result of their feeding, the clearer water allows sunlight to penetrate to deeper depths, thus improving growth conditions for bottom-dwelling, or periphyton algae. Zebra mussel waste also adds nutrients to the bottom, providing more nutrients for the growth of periphyton or attached algae. Because the water is clearer and the light can penetrate further, rocky areas commonly found in our region are now suitable for bottom-dwelling algae. Over the past few years there has been an increase in Lake Michigan shoreline property owners distressing over algae on their shorelines.

Recently, analyses of fish sampled from northern Lake Huron have confirmed the existence of viral hemorrhagic septicemia (VHS) in lake whitefish, walleyes and Chinook salmon. While posing no threat to public health, the fish kills on Great Lakes have involved thousands of fish infected by the VHS. Currently, there is no vaccine against VHS, and any measures to control its spread will require monitoring outbreaks and isolating fish so they don't spread the disease. We now must wait and see how VHS will impact our local community.

Paramount to our mission to protect our water resources, Tip of the Mitt Watershed Council works on many fronts when it comes to invasive species. We have programs to monitor the spread of invasive species, such as the Aquatic Invasive Species Patrol which trains volunteers to identify and inventory aquatic invasive species. We also actively work to manage invasive species in our lakes and streams where it is feasible. We have worked with several lake associations throughout Northern Michigan to control Eurasian watermilfoil. However, our monitoring and management efforts will not prevent more aquatic invasive species from entering our waterways.

Additionally, while waiting for federal action, the State of Michigan has taken leadership to address aquatic invasive species by being the first Great Lakes state to enact legislation regulating ballast water. Michigan's Ballast Water Control General Permit, the first of its kind in the nation, requires ongoing vessels to treat their ballast water prior to entering Michigan ports to prevent aquatic invasive species from being introduced into the Great Lakes. Michigan has taken action using scientifically sound methods under the Clean Water Act's existing authority to set standards to control the largest known source of new invasions. While the State of Michigan hopes their leadership will set an example that our other Great Lakes neighbors will follow, federal action is the most effective and comprehensive way to prevent the Great Lakes from the threat of invasive species. It is essential for the federal government to act swiftly to prevent new introductions. There is far too much at stake to wait any longer to respond to the tide of invasive species that is taxing our natural heritage and disrupting our region's way of life.

Conclusion

We commend the Chairwoman and the members of this Subcommittee for your leadership in scheduling this hearing. The Great Lakes are some of the most magnificent natural resources on Earth, holding nearly 20% of the planet's fresh surface water. In addition to the Lakes themselves, the region is richly endowed with high quality inland lakes, expansive forests, blue-ribbon trout streams, prairies, bogs, and the largest freshwater coastal wetlands on Earth. We are witnessing an increasing rate of discovery of non-native species with severe environmental and economic impacts. While scientists throughout the region agree that invasive species are one of the greatest threats to the Great Lakes, you do not have to be a scientist to recognize the damage these invaders inflict on our fisheries, economy, and human health. Comprehensive legislation is needed to combat the future wave of invasions from occurring. If we are going to maintain the proud heritage of the Great Lakes, now is the time to shut the door on aquatic invasive species. The longer the wait, the more expensive the investment will be and the more we will lose because of the delay.

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