**TESTIMONY OF**
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**GRAND VALLEY STATE UNIVERSITY**
**BEFORE THE COMMITTEE ON OVERSIGHT AND GOVERNMENT REFORM, SUBCOMMITTEE ON THE INTERIOR**
**MICHIGAN HOUSE OF REPRESENTATIVES**

**December 1, 2015**

ORAL TESTIMONY

Good morning. Chairman Lummis, members of the subcommittee, I thank you for the invitation to appear before you and testify with regard to the threats posed by invasive species, and in particular, the ecological and economic impacts of aquatic invasive species (hereafter, AIS) in the Great Lakes region and in Michigan, specifically. My name is Alan Steinman and I have spent the past 14 years as Director of the Annis Water Resources Institute at Grand Valley State University, located in Muskegon, MI. Prior to that, I was Director of the Lake Okeechobee Restoration Program for the South Florida Water Management District, which is responsible for overseeing the Comprehensive Everglades Restoration Program.

I have four main areas that I would like to cover in my comments:

*1. Invasive Species and the Great Lakes*

Let's be clear—*most* introduced species do not become established, and even fewer result in either direct or indirect significant societal costs. This is true whether we are referring to terrestrial or aquatic invasive species. However, it takes only one species to cause disproportionate harm. In aquatic ecosystems, the Great Lakes have served as the poster child for AIS[1]; it is now estimated that since the 1800s, over 180 non-native species have invaded the Great Lakes ecosystem[2]. Numerous studies have identified AIS as one of, if not the, most important stressor impacting the health of the Great Lakes[3,4].

Concerns regarding AIS in the Great Lakes, as well as inland waters, are not merely academic. The Great Lakes hold nearly 20% of the world's surface fresh water and

~90% of the surface fresh water in the United States. The importance of this resource, both in terms of water quality and water quantity cannot be overstated, especially with increasing concerns over the status of fresh water resources in this nation and around the world. AIS issues are acutely felt in Michigan, a state which touches 4 of the 5 Great Lakes, contains over 11,000 inland lakes, and where 1 in 5 jobs are linked to water[5].

*2. Ecological Impacts of Invasive Species*

Ecological impacts involving AIS include habitat loss, food chain disruption, and alterations to native fisheries[1,4]. Two AIS that have been particularly disruptive in the Great Lakes are the sea lamprey (*Petromyzon marinus*) and dreissenid mussels (*Dreissena polymorpha* [zebra mussel] and *D. bugensis* [quagga mussel]).

The sea lamprey is an eel-like parasite, whose native habitat is the ocean. Historically, Niagara Falls served as a natural barrier, confining them to Lake Ontario after swimming up the St. Lawrence Seaway, and preventing them from entering the remaining four Great Lakes. However, the lamprey were able to bypass Niagara Falls after improvements were made to the Welland Canal in the late 1800s. The improvements enhanced the shipping connection between Lakes Ontario and Erie, but also allowed sea lampreys access to the rest of the Great Lakes.

Sea lampreys had reached all of the other Great Lakes by 1938. And they thrived in the Great Lakes because they had no natural predator and there was an abundance of host fish to prey upon. Sea lamprey parasitism is not a pretty sight (Figure 1). They attach to fish with a suction cup mouth, and then dig their teeth into fish flesh. Sea lampreys feed on the fish body fluids by secreting an enzyme that prevents blood from clotting.

Sea lampreys have had a devastating effect on the Great Lakes fishery; prior to their invasion, approximately 15 million pounds of lake trout were harvested from the upper Great Lakes each year. By the early 1960s, the catch had declined to approximately 300,000 pounds, about 2% of the previous average[6]. The good news is that there is a sea lamprey control program, administered by the Great Lakes Fishery Commission. The control program involves not only the application of lampricides, which are

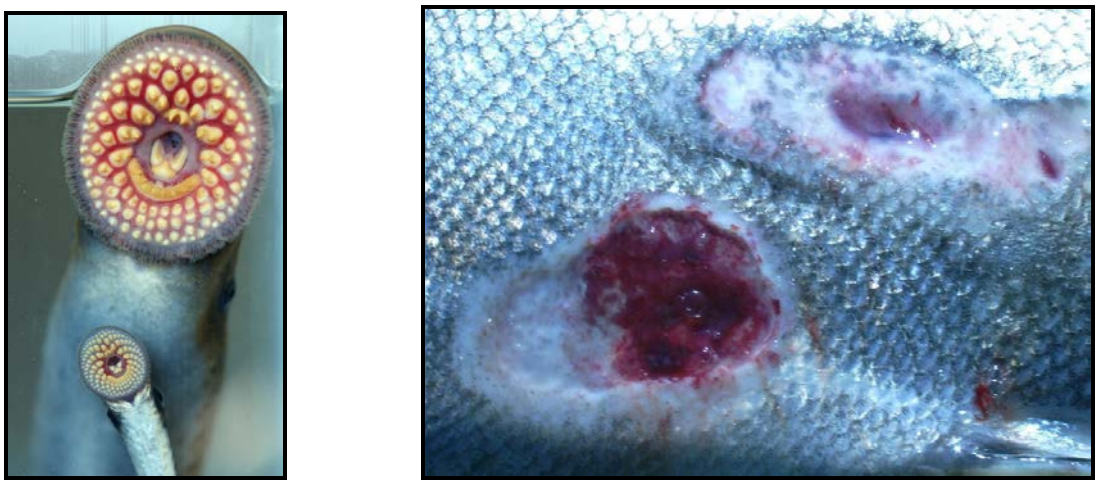

**Figure 1. Sea lamprey suction cup mouth (right) and wounds to fish host (left). Photo credit: MI Sea Grant (left) and Smith-Root (right).**

pesticides that are selective to lampreys and are deployed to kill larval (young) sea lampreys when they still live in tributaries before migrating to a Great Lake, but also a combination of barriers and traps to prevent the upstream migration and reproduction of adult sea lampreys. The bad news is that control doesn't come without a cost—the sea lamprey control program budgets of the Great Lakes Fishery Commission, Fisheries and Oceans Canada, and control agents of the U.S. Fish and Wildlife collectively exceed $20 million per year[7].

Zebra and quagga mussels have caused extensive damage to the Great Lakes. The zebra mussel was first found in the Great Lakes in 1988[8] and was quickly followed by its larger and more aggressive cousin, the quagga mussel. These filter-feeding organisms, introduced through ballast water discharge, have had profound effects on the ecology and chemistry of the Great Lakes, inland lakes, and beyond[9]. Given their extremely high numbers—quagga mussel densities can reach 35,000 per $m^2$ in Lake Michigan—these organisms on the bottom of lakes can filter enormous amounts of water. Ironically, the clearing of the water is considered a good thing by some people, as it improves the clarity of the water. However, the over-removal of algae, which is happening in lakes with extensive zebra and quagga mussel populations, can also disrupt the food web, as these algae form the base of the web, providing the nutritional support for all the organisms that are directly or indirectly dependent on them. Indeed, this "bottom-up" regulation of

the food web is likely responsible for the serious decline in fish stocks in the Great Lakes over the past 25 years[4].

And to make matters even worse, while the dreissenid mussels filter all types of algae, they actually "spit out" or egest (as pseudo-feces), the blue-green algae (cyanobacteria) that form the harmful algal blooms that are becoming more prevalent in the Great Lakes region[10] and throughout the world[11]. Hence, these mussels may actually contribute to the proliferation of harmful algal blooms, such as the one last summer in Lake Erie that resulted in the loss of drinking water to approximately 400,000 citizens in Ohio. In some cases, these potentially toxic cyanobacteria in the Great Lakes are also invasive, originating in subtropical areas but now adapted to northern climates presumably in response to warming temperatures[12].

*3. Economic Impacts of Invasive Species*

Perhaps surprisingly, there have been very few rigorous economic analyses quantifying the collective economic impact of AIS in the Great Lakes. The Anderson Economic Group (AEG)[13] has performed perhaps the most rigorous analysis to date; in their research, they found that many prior studies have aggregated cost estimates of AIS, but the original sources of data were lacking. The AEG study conservatively estimated, using imperfect data, that the overall aggregate annual cost of AIS to the Great Lakes region is significantly greater than $100 million. In Michigan, industries especially affected by AIS include power generation, industrial facilities, tourism, and sport and commercial fishing, which account for 30,000 jobs and almost $12 billion in total sales volume based on 2010 data[13].

While there is no doubt that the recreational and commercial fisheries industry is seriously imperiled by AIS, the actual economic cost will depend on the specific invasive species and the magnitude, intensity, and duration of its impact. The current value of the Great Lakes fishery is estimated to be in the $4-7 billion range. A recent study found that in the U.S. waters of the Great Lakes, commercial fishing is harvesting an average of 19.3 million pounds of fish product for resale, with an ex-vessel value (i.e., the quantity of fish landed by commercial fishermen multiplied by the average price [ex-vessel price] received by them at the first point of sale) of $22.5 million (in 2010 dollars)[14].

*4. Management Implications*

AIS are one of the greatest, if not the greatest, threats facing the Great Lakes. They have disrupted the Great Lakes ecosystem and have resulted in profound economic distress to our region. Although the majority of invasive species do not end up disrupting the native ecosystem, I believe in the precautionary principle—why take the chance? However, this type of vigilance can be expensive, so it is critical that we use peer-reviewed science and best professional judgment in deciding where, when, and how to establish surveillance.

We must be coordinated in our approaches to 1) monitor our waterways to keep new AIS from getting into the Great Lakes; 2) quarantine AIS species when necessary and where possible; and 3) eradicate AIS when feasible. With respect to monitoring and treatment, it is critical to recognize that in a hydrologically connected system such as the Great Lakes, the ability to control AIS is only as strong as the weakest link in that hydrologic chain. Regardless of how vigilant or aggressive Michigan may be in dealing with AIS, its waters remain vulnerable if any of the other 7 Great Lakes states or 2 Canadian provinces are not equally vigilant or aggressive. And this concept of vulnerability applies to any connected ecosystem that crosses jurisdictional boundaries, whether it is aquatic or terrestrial.

My comments regarding vigilance and connectivity are particularly appropriate given the growing concerns in the Great Lakes region over Asian carp, which are hovering at the gateways to the Great Lakes. They have received a lot of attention and funding. As I noted in my remarks, I believe in the precautionary principle. However, at the same time we know that there are an estimated 950 trillion invasive quagga mussels at the bottom of Lake Michigan, actively filtering the water column, reducing nutrient levels, and literally sucking the bioenergetic life out of Lake Michigan. Without adequate supplies of nutrients and algae, the fish that depend on these items will eventually starve. And this problem currently receives far less attention than Asian carp, despite the fact that quagga mussels are already here and are having impacts, albeit less visible to the naked eye because they are located beneath the lake surface, and of course, they do not jump out of the water.

By no means am I trying to minimize the threat of Asian carp—I am merely trying to emphasize that we need 1) a coordinated effort to tackle invasive species instead of jumping from one crisis to another; and 2) good science to make informed management decisions. I know science is not the ultimate answer—science helps inform policy but does not dictate it; there are many other factors that come into play. But, let me leave you with this thought, taken from Peter Gleick, one of the foremost water resource scientists on the planet: *It's very difficult to make good public policy without good science, and it's even harder to make good public policy with bad science.*

Thank you again for the invitation to appear today.

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# *Alan D. Steinman, Ph.D.*

***Director, Annis Water Resources Institute***
***Professor of Water Resources***
***Grand Valley State University***
***Muskegon, MI***

Alan (Al) Steinman has been Director of Grand Valley State University's Annis Water Resources Institute since 2001. Previously, he was Director of the Lake Okeechobee Restoration Program at the South Florida Water Management District. Steinman has published over 135 scientific articles and book chapters, has been awarded over $50 million in grants for scientific and engineering projects, has raised over $5 million in private donations, has testified before Congress and the Michigan and Florida state legislatures, and has been invited to speak throughout the world. Among his awards are Phi Beta Kappa, the U.S. Army Corps of Engineers Outstanding Planning Achievement Award, the Joan Hodges Queneau Palladium Medal from the National Audubon Society, induction into the Massapequa High School Hall of Fame, and Journal of Environmental Quality (JEQ) Outstanding Reviewer.

Currently he is a member of science advisory boards for the U.S. EPA, the International Joint Commission, Michigan DEQ, Sea Grant, Healing our Waters, University of Michigan's Water Center, the Cooperative Institute for Limnology and Ecosystems Research, the National Estuarine Research Reserve System, and CMU's BioStation on Beaver Island. He currently serves as Associate Editor for the scientific journal Freshwater Biology and previously was Associate Editor of Freshwater Science, Journal of Phycology, and Scientific World Journal. He also has served on the State of Michigan's Groundwater Conservation Advisory Council and Phosphorus Advisory Committees. Steinman's research interests include aquatic ecosystem restoration, harmful algal blooms, phosphorus cycling, and water policy. He recently co-authored a report on Michigan's Blue Economy (http://michiganblueeconomy.org/) with John Austin.

Steinman's current community service includes serving on the Board of Directors of the Michigan Chapter of The Nature Conservancy, Goodwill Industries of West Michigan, and the Community Foundation for Muskegon County. Previously, he served on the boards of the West Michigan Symphony, Congregation B'Nai Israel, and the West Michigan Land Conservancy.

Dr. Steinman holds a Postdoctoral Research Fellowship from Oak Ridge National Laboratory, a Ph.D. in Botany/Aquatic Ecology from Oregon State University, an M.S. in Botany from the University of Rhode Island and a B.S. in Botany from the University of Vermont.

**Committee on Oversight and Government Reform**
**Witness Disclosure Requirement – "Truth in Testimony"**
**Required by House Rule XI, Clause 2(g)(5)**

Name: Alan Steinman

1. Please list any federal grants or contracts (including subgrants or subcontracts) you have received since October 1, 2011. Include the source and amount of each grant or contract.

| | |
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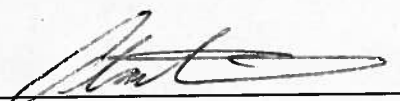
| US Army Corps of Engineers (Great Lakes water level study) | $30,000 |
| US Army Corps of Engineers (Molecular Analysis of Eurasian watermilfoil) | $4500 |
| US Department of Transportation (Little Black Creek-stormwater study) | $294,555 |
| NOAA (Bear Creek Hydrological study) | $44,998 |
| USEPA (GLRI): Ruddiman Creek stormwater study | $247,212 |
| NOAA (ARRA): Muskegon Lake shoreline restoration monitoring | $226,828 |
| US HUD: AWRI Field Station Renovation | $500,000 |

2. Please list any entity you are testifying on behalf of and briefly describe your relationship with these entities.

N/A

3. Please list any federal grants or contracts (including subgrants or subcontracts) received since October 1, 2010, by the entity(ies) you listed above. Include the source and amount of each grant or contract.

N/A



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*I certify that the above information is true and correct.*
Signature: Date: