

**RESPONSE OF**

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**To Follow-Up Questions from the**

**U.S. COMMISSION ON OCEAN POLICY**

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- **Question: The problem of invasive species and why research and education are needed to address this problem. Also, the Commission would like more information on current, effective education initiatives.**

**Response:** The invasive species problem is a huge problem facing all of this country's aquatic systems. The zebra mussel has become the poster child for the problem, but the problem is much more significant than this one species. In the Great Lakes alone, we have experienced an influx of over 160 aquatic nuisance species, and two thirds of these have come in since the St. Lawrence Seaway opened in 1959.

When an invasive species enters a system, because it is not native, the managers and users of the system are not likely to have any experience with it or even be able to identify it. **Research is needed immediately to review the literature to learn from the experience of others in the native land of the species. We must then determine if the species is behaving the same in its new habitat.** In the case of zebra mussels in Lake Erie, we learned that this was not the case. The European literature indicated that they would spawn when they were 3-4 years old, lay 50,000 eggs, and the eggs could remain suspended for up to 11 days. In Lake Erie, they can spawn when they are 11 months old, lay 1 million eggs, and the eggs can remain suspended for up to 33 days.

**After we have learned a little about the basic biology of the species, we must conduct additional research to determine its impact on its new ecosystem.** In this regard, the invading species is now interacting with a host of new species, and neither the native species nor the invader has likely interacted in the past. We know nothing of their competitive interactions or their compatibility. In Lake Erie we observed the zebra mussel completely eliminate large populations of native clams while populations of amphipods showed a mixed response, i.e. one species increased several hundred fold while another was almost eliminated. These ecosystem impacts could go unnoticed by casual observers, but reduction in the economic value of the Ohio walleye fishery from

over \$600 million to about \$250 million was hard to miss. It is also important to note that ecosystem impacts will not all appear immediately and that continued research is needed to document the changes that occur as the system moves toward a new and more stable end point. As an example, in Lake Erie the first zebra mussel was observed in 1988. One year later the density reached 30,000/square meter. A great deal of research was done to learn about the biology of the zebra mussel and its impact. Then we noted that a new mussel, the quagga, had invaded but was much less prevalent—in 1993 we found 1 quagga for every 100 zebras. Today we find 90 quaggas for every 10 zebras, but we know almost nothing about the impact of the quagga because there has not been sufficient investment in research to allow us to study it.

**While research is progressing on the basic biology of the species and its ecosystem impacts, we must also initiate research to determine methods to control it and to determine its impact on humans.** The rationale for this work should be obvious.

**Education is required to prevent people from inadvertently spreading the invader, being personally or financially harmed by it, and to help them understand what is happening to the resource that they use and love and what they can do to help.** In the 1970s Lake Erie became the poster child for pollution problems in the country, and most of the problems were caused by human activity. At that time we said that humans had changed Lake Erie more in the past 30 years than nature had changed the Lake in the previous 300 years. I would now argue that zebra mussels have changed the Lake more in the past 10 years than humans ever did. However, it is very difficult for the public to comprehend the biocomplexity of the interactions of invasive species with humans and the biophysical ecosystem. Education will also save us a great deal of money by reducing the spread of invasive species and by helping resource users behave in a fashion that minimizes the negative impacts of invasives, e.g. if industrial and municipal water users (intakes) monitor for zebra mussel veligers (larvae) and chlorinate when they are present, they will not have to shut down their systems and go through the major expense of removing adults. With regard to education and personal injury, I am often asked, “can’t we just eat them or feed them to something else.” I respond by explaining the results of our research that have shown the zebra mussels accumulate PCBs at about 10 times the level of native clams. Furthermore, beach goers and coastal divers that don’t wear gloves and boots are sure to return with cuts requiring up to 7 stitches from zebra mussel shells.

**I believe the most effective education programs go directly to the people/users and provide some real-world examples and images/photos of the problem.** It is said that a picture is worth a thousand words. I agree but would add that first-hand, in-the-water experience is worth even more. This is what we do at Ohio Sea Grant and Stone Laboratory and through local Sea Grant programs all over the country. It is also important to note that effective education programs must address all age groups and must be done in both the formal and informal settings. Finally, we are very fortunate with the work we do and where we do it. There is a mystique about aquatic research and aquatic issues. Many people simply love to study this information. However, we must never forget to make our educational programs fun and exciting. Fortunately, we can do that

easier than many other fields of study. **Focus on “edutainment” and your audience will like the learning process and retain the information longer.**

- **Question: Data and trends that illustrate the rapidity at which the introduction of nonnative species is taking place.**

**Response: As stated above, in the Great Lakes alone, we have experienced an influx of over 160 aquatic nuisance species, and two thirds of these have come in since the St. Lawrence Seaway opened in 1959.** Furthermore, the first aquatic nuisance species legislation was passed in 1990. It was reauthorized in 1996, and is up again this year. A great deal of effort has gone into preventing invasions, but we are still experiencing, on average, one new aquatic nuisance species entering the Great Lakes each year.

- **Question: Efforts being made to address the need for monitoring the influx of invasive species and for developing an effective rapid response strategy.**

**Response: In the Great Lakes Region this work is the responsibility of the Aquatic Nuisance Species Panel that reports to the Aquatic Nuisance Species Task Force.** This summer we hosted the group at Stone Laboratory as they addressed this very issue. While we have the expertise to monitor the influx of invasive species, funding for the National Sea Grant College Program and the Coast Guard would have to be greatly increased to allow it to happen. We would also have to provide a source of funds to assist water users/intakes with monitoring. **With regard to rapid response, our efforts are clearly not adequate. However, it is not clear to me that our efforts can ever be adequate, for in many cases, by the time we observe an invasive species, it is already too late. It would be wiser to work harder on prevention.**

- **Question: The introduction of Atlantic salmon in the Pacific Northwest and whether this event was intentional or inadvertent.**

**Response: This is outside of my area of personal expertise, so I went directly to the National Aquatic Nuisance Species Report prepared by Ohio Sea Grant for the entire Sea Grant network. The following statement is a quote from Oregon Sea Grant from that report: “Nonindigenous species have long been established in the Pacific Northwest, including a number that have been intentionally introduced and that form an integral part of the regional aquaculture industry like the Pacific oyster (*Crassostrea gigas*) and the Atlantic salmon (*Salmo salar*).**

- **Question: Your views on the current invasive species legislation pending in Congress (specifically, the proposed revisions to the National Invasive Species Act).**

**Response: This is the third piece of invasive species legislation since 1990. I have supported each, and each has been an improvement over its predecessor. However, our goal should clearly be to prevent all introductions and we are not there yet, even with the new legislation. More research is needed in this area, for science has not provided us with enough tools yet.**

- **Question: Additional data and trends that support the statement that Sea Grant's current funding is insufficient to provide nation-wide education on issues related to invasive species—in addition to other important issues. What specific funding level is needed?**

**Response: The National Sea Grant College Program supports 30 individual state Sea Grant programs and currently receives about \$62 million including about \$3 million for aquatic nuisance species research, education and outreach. The National Program normally allocates about \$2 million of the \$3 million to research and \$1 million to education/outreach efforts. Due to the importance of this issue, I would argue that at a minimum, each program should support at least one full-time education/outreach specialist in the area of aquatic nuisance species. **This would only require \$3 million, or 3 times the current appropriation for education on aquatic nuisance species.** However, the \$2 million provided for aquatic nuisance species research is akin to using a garden hose to put out a forest fire. The ANS report Ohio did for the National Sea Grant College Program summarized the work of 24 Sea Grant programs on 22 nuisance species. **The aquatic nuisance species issue is so important to the well being of this country and our people and businesses that we should be allocating at least 10 times that amount (\$20 million) each year to Sea Grant for research to address these problems nationally, regionally, and locally.****

With regard to Sea Grant's funding for education on other important issues, we must recognize how much is currently available and what some of the other education issues are. Currently base funding for the 30 Sea Grant programs is \$43 million—decimal dust in the federal funding arena. From this each program attempts to support research, education, extension, communication, management, and program development. Approximately half the funding is used for research and 25% for extension/outreach. With access to literally every college and university in the country and with over 200 colleges and universities currently involved, the program is arguably the most capable marine and aquatic program in the world and potentially capable of addressing almost any issue. Currently we are addressing issues and working with audiences related to: commercial fishing, sport fishing, charter fishing, erosion, coastal processes, nutrient loading, aquatic nuisance species, aquaculture, shipping, pollution abatement, tourism development, coastal business development, k-12 education, undergraduate education, graduate education, teacher training, adult education, urban sprawl, brownfield redevelopment, remote sensing, underwater welding, coastal forecasts, marine biotechnology, wetland protection/restoration, seafood processing and safety, boating safety, artificial reefs, water treatment, sewage treatment, nonpoint source pollution and watershed management, to name a few along with the development of new technologies

for each. I would argue that in order to conduct programs of research, education, extension, and more, on all of the above issues, Sea Grant's national budget of \$62 million should be at least doubled. Furthermore, based on the tremendous impact and huge successes the program has had and continues to produce, I believe we should be thinking in \$100 million dollar increments when discussing increases to the budget for the National Sea Grant College Program.

- **Question:** A statement of what a strengthened Sea Grant program would do for the nation.

**Response:** This country needs a program that would create partnerships between government, academia, and the private sector and focus on issues related to our oceans, Great Lakes, and their coasts. We should take advantage of what we have learned from the Land-Grant system and pattern the program after it using research, education, and extension/outreach to focus on the 3 E's: the environment, the economy, and education. Every coastal state should be involved and we should base leadership within coastal states at academic institutions to avoid regulatory biases. We should develop national priorities but allow the local state programs to determine how best to address those national issues locally where the impact can be maximized. The program should be a true partnership between government, academia and the private sector, and to assure that this occurs, each federal dollar should be matched by at least \$0.50 from the states, universities, and private sector partners. Thankfully, we already have such a program. We call it Sea Grant. Unfortunately, we have never allowed it to reach its full potential by adequately funding it at the federal level.

A fully funded National Sea Grant College Program would receive at least twice as much as it currently receives, but as stated earlier, the capabilities of this program and the tremendous needs and opportunities that exist in our coastal, ocean, and Great Lakes areas demand that we think in \$100 million increments. The program and the issues deserve nothing less.

The Sea Grant strategy is to: 1) utilize and engage the capabilities of this country's academic scientists and universities to address Great Lakes, ocean and coastal issues; and, 2) be proactive and invest in research, education and outreach projects that improve the environment, public policy, education, and the economic competitiveness of this great country. A fully funded program would do all of these things for the nation.

- **Question:** More information on the Lake Erie project and how aspects of this project could be used as education and outreach models.

**Response:** There are many aspects of our programs that have made them successful, but I will try to highlight a few. We have focused on Benjamin Franklin’s model for education: Tell me, I forget; show me, I remember; involve me, I understand.

Our program is a unique partnership between a Sea Grant program and a National Marine Laboratory—Stone Laboratory. Within Sea Grant we have made extensive use of private sector advisory committees, but we have made them more than observers and advisors—we have really put them to work. In Stone Laboratory, we have created a Friends of Stone Laboratory group that has worked as hard as our Sea Grant Advisory Committees and that has just completed development of its 10<sup>th</sup> endowment within the Ohio State University, some of which support education and scholarships, and some of which support research.

Much of the focus of our Sea Grant education programs has been on k-12 education and teacher training to maximize the impact, but as a result of surveys of the general public, we have also been encouraged to develop educational programs for our elected officials and decision makers. This has been extremely successful and has allowed us to have much more significant impacts on the environment, education, and the economy. When the program started there were 34 charter captains on Lake Erie, and, as Johnny Carson once said, “Lake Erie is the place fish go to die.” Today we have over 900 charter captains, and Lake Erie is the Walleye Capital of the World.

With the help of Sea Grant, at Stone Laboratory we formally expanded our focus on education from upper level undergrads and graduate students to adults, teachers, and students in grades 5-12. Enrollment has increased 350% and our workshop program for grades 5-12 attracts 175 groups and over 5000 participants annually. I am sure Benjamin Franklin would be pleased because these students learn by doing. They go out on our research vessels, collect samples and analyze them in the laboratory, and spend the night in a dormitory on an island. They get wet and dirty, they smell like fish, and they love it!! Better yet, their retention of the information jumps to 80%.

I hope some aspects of these education and outreach programs can serve as national models and be helpful to others.

- **Question: The recent NSF proposal that addresses aquatic nuisance species education for a mass audience. The Commission requested a copy of this proposal.**

**Response:** As requested I have attached a copy of our preproposal dealing with aquatic nuisance species education for mass audiences. We are currently working on a full proposal. Please note that this preproposal was submitted to the National Sea Grant College Program, not NSF.