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BEFORE THE
SUBCOMMITTEE ON FISHERIES, WILDLIFE, AND THE OCEANS
COMMITTEE ON NATURAL RESOURCES
U.S. HOUSE OF REPRESENTATIVES

September 27, 2007

Good afternoon, Chairwoman Bordallo and members of the Subcommittee. I am Timothy Keeney, Deputy Assistant Secretary of Commerce for Oceans and Atmosphere and the National Oceanic and Atmospheric Administration (NOAA) co-chair of the Aquatic Nuisance Species Task Force (ANSTF). I appreciate the opportunity to discuss the status of aquatic invasive species issues. As you are aware, the last reauthorization of the Nonindigenous Aquatic Nuisance Species Prevention and Control Act (NANPCA) was in 1996. Much has happened since then. I also appreciate the fact that the subcommittee has asked that our testimony be focused on issues other than ballast water. Ballast water has received a considerable amount of attention recently, but there are other elements of the issue that are important.

The Subcommittee requested that I discuss progress that has been made on aquatic invasive species issues. In the most general sense, we now have a better understanding of invasion processes, the characteristics of specific organisms that either have become invasive or hold the potential for becoming invasive, and the range of impacts caused by invasive organisms. This is reflected in a marked increase in the number of studies published in the scientific literature. In many respects, this is an outgrowth of the original NANPCA. I have previously commented that it would have been very easy for the Congress to pass a zebra mussel control act in 1990, but the Congress recognized that the problem encompassed more than zebra mussels.

Although a significant portion of this research has been funded through aquatic invasive species programs, I would rather focus on the mandates contained in section 1202 of NANPCA. That section gives the ANSTF responsibility for prevention, monitoring, and control activities. While the authorizations to implement those provisions go to the individual agencies, they are in the context of ANSTF responsibilities. Therefore, even though NOAA has an internal program, we view our activities as part of overall ANSTF actions. The three major areas in the law are prevention, monitoring, and control, with research, education and outreach included as supporting elements.

Prevention

Even though the focus of this hearing is not on ballast water, to date the most significant effort on prevention has been in this area. The importance of this issue is reflected in the fact that the first half of NANPCA deals with ballast water. Despite the frustration that is often expressed, I have seen genuine progress and am optimistic that we are approaching a resolution to the ballast water issue. It is safe to say that the risks associated with ballast water introductions have been reduced by the regulatory requirements imposed on vessels entering U.S. ports from beyond the EEZ. NOAA's Great Lakes Environmental Research Laboratory (GLERL), in conjunction with the Smithsonian Environmental Research Center, recently completed a scientific assessment of the effectiveness of ballast water exchange and concluded that, in the absence of effective alternative treatment technologies, the use of ballast water exchange has reduced the risk of ballast associated invasions to our coastal estuaries. In addition, new policies and regulations by both the United States and Canada have been established for vessels entering the Great Lakes that officially have no ballast on board (NOBOB vessels). These new requirements were based on findings of the NOBOB Research Program led by GLERL that NOBOB vessels still presented a level of invasion risk. Finally, considerable work has been done on development of new technologies to treat ballast water.

In its five-year Strategic Plan issued last March (http://www.anstaskforce.gov/Documents/ANSTF_Strategic_Plan_2007_Final.pdf), the ANSTF recognized that additional emphasis should be placed on non-ballast water pathways. First, the plan called for development of an objective means to identify priority pathways. This process is well underway. Under the leadership of the Animal and Plant Health Inspection Service of the Department of Agriculture, a joint committee of the ANSTF and the National Invasive Species Council has produced a document containing a protocol for ranking pathways of introduction.

The ANSTF Strategic Plan also emphasizes taking steps to interdict non-ballast water pathways. From a NOAA perspective, next to ballast water, hull fouling is probably the most important vector for ship-related non-ballast introductions into coastal waters. In some places such as Hawaii, hull fouling is a more significant pathway for introductions than ballast water.

Even though many of our activities have been directed at ballast water introductions, significant progress has been made in addressing other vectors. In many instances aquatic invasive pathways are not conducive to regulatory solutions, and the most effective method of reducing risks is through education and outreach. Dr. Parker's testimony contains information on efforts to reach recreational users. I would like to relate three examples involving NOAA's Sea Grant College Program.

At the request of bait dealers, the Sea Grant program developed a training program to prevent the transfer of unwanted organisms through bait shipments and hatchery stocking activities. The methodology was based on a concept used in food safety: Hazard

Analysis and Critical Control Point. The methodology was successful enough that it has been adopted by a number of state hatchery programs and even by the Ontario Wholesale Bait Dealers Association. The U.S. Fish and Wildlife Service recognized that this methodology had application beyond the initial use and has adapted it to deal with a number of other issues.

As another example of working with the private sector, NOAA's Sea Grant College Program, the U.S. Fish and Wildlife Service, and the pet industry have worked together on a message to aquarium hobbyists not to release plants and animals. It should be noted that the pet industry has contributed over \$1 million to spread this message and they estimate that over 30 million people have received materials with the message.

My final example demonstrates how opportunities can present themselves to address even relatively minor pathways. Dr. Samuel Chan of Oregon Sea Grant saw a news broadcast on a release day event for animals that had been in classrooms (as class pets, etc.). Knowing that some of these organisms were non-native species supplied by biological supply houses, Dr. Chan developed an educational program for the state urging schools not to release the animals that may have been in classrooms. Not only was this a means of protecting our environment, but it was also a learning opportunity for the students. NOAA is considering expanding the program and reaching out to biological supply houses to provide lesson materials.

Monitoring

The second mandate — monitoring — actually has several elements. First, monitoring ecosystems for nonindigenous species occurrences; second, monitoring the spread of individual invasive species; and third, monitoring the impacts of species introductions.

When NANPCA was first enacted, one of the real challenges in dealing with nonindigenous species was a lack of baseline data. This is particularly important in determining whether the documentation of a nonindigenous species is, in fact a new introduction, and warrants further action. There were really two needs in this area — (1) protocols for conducting surveys, and (2) the data itself. The ANSTF has compiled an extensive list of protocols for sampling different ecosystems and different types of organisms. As an example, different methods must be used to sample benthic and pelagic organisms.

I can only speak to the state of our knowledge on nonindigenous species occurrences in coastal and marine systems. Before doing so, however, I should mention the yeoman work done by the U.S. Geological Survey in documenting freshwater occurrences and in maintaining a comprehensive database. We have made real progress in establishing baselines for coastal areas in various parts of the country. Although some of the projects have been funded by NOAA, much of the effort has come from entities such as state governments, the Smithsonian Institution, and other federal agencies such as the Environmental Protection Agency (EPA). We currently have good information for much of the west coast. In large measure, this has been due to the efforts of the state governments, but NOAA, EPA, and the U.S. Coast Guard have sponsored baseline

studies in various areas. As part of a pilot early warning system, NOAA's National Centers for Coastal Ocean Science has worked with the Bishop Museum in Hawaii, and we are working with the State of Texas to do something similar on the Texas coast. On the east coast, the Smithsonian Environmental Research Center has extensively documented species occurrences in Chesapeake Bay, and surveys have been completed in much of the Northeast. Our records are much sparser for the South Atlantic coast and the Gulf of Mexico although even in these areas progress has been made, including NOAA-funded survey work in Mobile Bay. Some of the best documented areas are the Great Lakes, where both Canadian and U.S. entities, including NOAA's GLERL, have played a significant role in documenting nonindigenous species occurrences. GLERL is creating a specific Great Lakes database in partnership with the U.S. Geological Survey, which will be rolled-out by the end of this calendar year.

Even with baselines, though, monitoring of new introductions and invasion rates will continue to be problematic. Survey work is expensive in terms of both human and financial resources, and we cannot monitor all areas all of the time. We will continue to be dependent on observant individuals (including the general public), as illustrated by the most recent discovery in the Great Lakes. Even though GLERL does extensive survey work, the bloody red shrimp was not found by our scientists as part of a formal survey. Instead, it resulted from an independent observation by one of our scientists at our boat docking facility near Muskegon, Michigan. Recognizing that identification of new species (and ascertaining whether they are new introductions) and determining if such species are potentially invasive will continue to be an issue, the ANSTF has recently set up an experts database. This database would be designed for access by natural resource managers, such as those at state and local governments.

The second type of monitoring is to determine changes in the range and distribution of specific species. For the most part, this activity has been conducted on an as needed basis. As an example, NOAA has worked with west coast states from California to Alaska to monitor range expansion of the green crab. Additionally, NOAA's National Centers for Coastal Ocean Science has been monitoring the population and possible ecosystem impacts resulting from the introduction of lionfish off the southeast coast of the United States.

Finally, the most extensive scientific work has been done on monitoring the impacts of specific species. Since the passage of NANPCA, literally hundreds of scientific papers have been published on impacts of invasive aquatic species. We continue to discover new impacts even for species such as zebra mussels. When the law was initially enacted, we were aware that zebra mussels were clogging up water intake pipes and were having a major impact on native bivalve species. Since then, we have documented an apparent connection between zebra mussels and toxic blue-green algal blooms, major impacts in the trophic chain with the disappearance of the benthic amphipod *Diporeia*, decreased growth of Great Lakes whitefish, avian botulism in the Great Lakes causing thousands of water fowl deaths, and now research is being conducted to determine if there is a link between zebra mussels and expansion of the dead zone in Lake Erie.

Control

Section 1202(e) of NANPCA currently focuses on a rather lengthy process for developing and implementing management plans for specific species. As Dr. Parker's testimony shows, the ANSTF has developed several very good, detailed management plans. However, Section 1202(e) does not address the entire scope of control activities undertaken by the members of the ANSTF. More often, agencies respond to individual problems without going through the development of a comprehensive management plan. This is due to a number of reasons. First, the number of species does not lend itself to such an approach. Second, for at least some species that may have been introduced earlier and spread to new areas, control techniques are already known. In other instances, control activities may actually be researched as we try to find either an appropriate approach for a specific species or to develop a new technique. Finally, we recognize the fact that the majority of control work is really being done by our partners in state governments, and there are occasions when we can assist them in their efforts.

In many cases, control actions involve cooperation from a variety of entities. Perhaps the best example of this was the successful eradication of *Caulerpa taxifolia* from two sites in southern California. As a result of 40,000 hectares in the Mediterranean being blanketed by this algal species, it became popularly known as the "Killer Algae." The ANSTF was already in the process of developing a control plan for potential introductions when it was first discovered. Within a month, following a recommendation from the ANSTF, an interagency team had been set up to deal with the problem. That team was composed of four federal agencies, several state and local agencies, and even some private entities such as a local utility. Each of the members of the team contributed something to the response effort. The contributions were not solely monetary — some provided scientific expertise, others provided equipment and personnel, and assisted in working with local people. Very early on, it was recognized that this effort could be a learning experience in how to structure a rapid response, and the team was requested to provide the ANSTF with a report on structuring a response based on the lessons that they learned. The *Caulerpa* incidents show the importance of responding very quickly. The plants were covered with a tarp, and a chlorine solution was injected under the tarp. At the time, the total impacted area was less than an acre. Such an action would not have been feasible if the infestation had spread.

State-Federal Coordination

The most obvious coordination between the federal government and the states is through the Section 1204 provisions on development of State Management Plans. Upon approval of a State Management Plan by the ANSTF, a state becomes eligible to receive partial funding to implement that Plan. That is a rather dry way of describing a much more dynamic process. It begins with preparation of the Plan itself. In virtually every case, Sea Grant programs have played a significant role in developing a Plan, and states also ask federal agencies to provide expertise in identifying issues and actions. Staff from EPA-funded National Estuary Programs have led the development of State management Plans for California and Massachusetts.

Recognizing that some of the original State Plans are now over a decade old, NOAA provided the Great Lakes Commission with funding to review the State Plans in the Great Lakes region to see if they were meeting needs. The Commission held a series of workshops in each state involving leadership provided by the Commission, state resource agencies, and the state Sea Grant program. That review was a starting point for an all day session at the last ANSTF meeting to review the State Management Plan process and the criteria for content. We will be following up on this at the next ANSTF meeting. We have asked our Regional Panels to review the criteria and make recommendations for improving them.

The ANSTF has had particularly close contact with state and tribal resource agencies. From the very beginning, our ex officio membership has included representatives from both the Association of Fish and Wildlife Agencies and the Native American Fish and Wildlife Society. We also have reserved a seat for a representative from the National Association of State Aquaculture Coordinators. Although not limited to state representatives, regional panels often select someone from a state agency to serve on the ANSTF. The ANSTF has made a concerted effort to involve regional panels and state resource agencies in the education and outreach campaigns I mentioned above.

The regional panels of the ANSTF are a key component in this coordination and I cannot emphasize enough how valuable they have been to the Task Force. Although membership on these panels includes federal personnel, academics, and non-governmental stakeholders, the core of each panel consists of representatives from state governments. They help keep us focused on the practical realities involved with managing nonindigenous species. They often are a source of information on new problems and issues. They have provided significant input on virtually every one of the programs and documents of the ANSTF. They are so important that for every other meeting of the ANSTF, a regional panel acts as host and provides a full day presentation of regional issues.

There are times when we rely heavily on the expertise of the regional panels. To give a recent example, NOAA Sea Grant College Program currently has a request out for proposals for the national Sea Grant Aquatic Nuisance Species competition. In order to establish priorities, we asked each of the regional panels to provide us with priorities for research and education and outreach. The regional priorities are included in the Federal Register notice and in the ranking system that will be used to decide on awards. The ANSTF has also asked regional panels to address specific issues. I mentioned their role in review of the State Management Plan process, but there have been others. As an example, as the ANSTF began working on early detection and rapid response, the regional panels were asked to look at this issue and to start developing regional rapid response plans. NOAA provided a bit of funding to help in this effort.

I really cannot call it an unintended side effect, but one of the benefits of the regional panels does not directly relate to the federal government. By having representatives from each of the states, they often have found an opportunity to work together on shared problems.

In many ways, having Sea Grant colleges in the coastal states is a unique asset for NOAA. I have mentioned the program a number of times, but I should also point out that the majority of funding under the program is core funding that allows an individual institution to determine its priorities in issuing grants. Many of the colleges have used that funding to address invasive species issues within the states. Some of the best education and outreach material on invasive species has come from individual state institutions.

I think that I speak for all of the federal ANSTF members when I say that we are acutely aware that there needs to be a full partnership with the states if we are to address the issue of aquatic nuisance species. First, most of the waters that we are trying to protect are within state jurisdiction. Second, in a time of limited resources, the states have resources that the federal government does not. I am not speaking solely of financial resources. Most of the on-the-ground work, particularly in the area of control, is, of necessity, accomplished by state governments. They have personnel and equipment in areas where federal resources are not in place.

Gaps and Emerging Issues

The subcommittee asked us to identify gaps in the existing law and emerging issues. To some extent, the five year Strategic Plan developed earlier this year identifies items that the ANSTF considers to be priorities. We were limited, however, by the existing statutory structure. In certain instances, we were comfortable that existing legal authorities could be used. In other areas where additional regulatory authority was needed, items were not included.

Screening

One of the items not addressed in the Strategic Plan because of questions concerning legal authority also is one of the foci of this hearing, i.e. making sure that imported organisms do not contribute to the invasive species problem.

Attention to the issue has reduced the risk of one type of intentional introduction. Historically, one of the major sources of invasive introductions has been deliberate introductions by various levels of government to try to “improve” the existing species mixture. Now, all levels of government resource agencies are being much more careful about introducing new species and looking at possible impacts and relative benefits and costs. There is a good example in the Chesapeake Bay. Because of the decline of native oysters, it has been proposed that a non-native Asian oyster be introduced that is less vulnerable to disease and parasites. The justification has been that the non-native would restore the commercial fishery as well as replacing the important ecological functions of native oysters. In response to the original proposal, both federal and state agencies recognized that there were a number of questions that needed to be answered before a full-scale commitment was made. Federal agencies recently have spent millions of dollars on the research needed to prepare a full Environmental Impact Statement.

Even with progress on the part of governments, however, the ANSTF recognized that screening of imports remained a significant issue. Section 1207 of the original NANPCA, required the ANSTF to examine the issue of intentional introductions and submit a report to Congress containing recommendations. In March 1994, the report was submitted. Most of the recommendations made at that time still have validity. One of the recommendations dealt specifically with creating a screening process and setting up a permit system for new introductions. It read as follows:

Recommendation 4A: Establish a Federal permitting system for imports from outside the United States to provide a credible review of proposed new introductions of nonindigenous aquatic organisms.

Recommendation 4B: The USDA Animal and Plant Health Inspection Service, the Fish and Wildlife Service, and the National Marine Fisheries Service should establish a joint permit review process. Congress should take appropriate legislative action recommended by the Administration to authorize the agreed to process.

It should be noted that this recommendation was limited to new introductions, i.e., species that were not already being imported. In this instance, I can only speak from a NOAA perspective. Although NOAA believes the concept of evaluating species not previously imported is valid, we would favor a single screen rather than setting up a permitting system.

Early Detection and Rapid Response

As previously mentioned, the ANSTF has recognized that the ability to conduct a rapid assessment and respond to new introductions is extremely important. It has been identified as a priority in the ANSTF Strategic Plan. In evaluating possible approaches, the Task Force made a decision to adapt the existing Incident Command System that is already in place for incidents such as oil spills or forest fires. Currently, there is no mention of Early Detection and Rapid Response in NANPCA. It may help, although it is not necessary, to have Early Detection and Rapid Response identified in the NANPCA as an authorized approach to invasive aquatics.

The ANSTF has also promoted the provision of technical assistance to state and local entities involved in rapid response to an invasion. EPA has developed and disseminated a report about EPA authorities that natural resource managers need to consider with respect to rapid response actions.

Control Technologies

Even if the structural and financial resources exist for rapid response, it is possible that we may not be able to respond to a situation because the toolbox of control technologies in aquatic systems is very limited. There are entire taxonomic groups for which no control methods have been developed. As an example, during the summer of 2000, there was a massive bloom of Australian spotted jellyfish in the Gulf of Mexico. When commercial shrimpers complained about their nets being clogged and asked for help,

NOAA realized that there was no information available on controlling jellyfish. One paper in a scientific journal estimated the cost that summer to shrimpers in Alabama and Mississippi at \$10 million.

Even for species where there is knowledge of possible control techniques, limitations on our ability to implement them still exist. Perhaps the best illustration is the local infestation of the northern snakehead fish. It was initially discovered in a small pond in Crofton, Maryland. The solution was to poison the pond. When another snakehead was found in a small lake in Wheaton, Maryland, the solution was to drain the lake. Then snakeheads were found in the Potomac River. Obviously neither poisoning nor draining was a viable option, and we now have a reproducing population of snakeheads very close to where this hearing is taking place.

Perhaps the one exception is with aquatic weeds. The Army Corps of Engineers has done an outstanding job of developing control methodologies for specific weed species through their Engineer Research and Development Center. They have put together a CD-ROM on control methods and made it widely available to resource managers. It should be noted, however, that their success was the result of a decades-long commitment involving significant financial resources.

Unfortunately, the methods developed by the Corps of Engineers have limited application in marine systems. Although their methods are being used for saltmarsh species such as *Spartina* and *Phragmites*, invasive plant species in marine systems are more likely to be algal species than vascular species. Although they have received less attention than vascular plants, marine algae are causing problems in several places. In the Northeast, *Codium* has expanded. Perhaps one of its common names illustrates our concern — oyster thief. Although we were successful in stopping *Caulerpa* on the west coast, *Undaria* is spreading there. One of the issues with many algal species is that they can vegetatively reproduce (i.e. reproduce asexually), and even a small fragment can become the source of a new infestation. However, *Undaria* does not vegetatively reproduce. The Monterey Bay National Marine Sanctuary is working on a physical removal project utilizing volunteers.

Controlling invasive species is a serious problem in Hawaii. Five algal species are fouling coral reefs. In addition to the ecological damage to the reefs, there are very real economic costs. A university of Hawaii study estimated the annual cost involving beach cleanups, reduced tourist and tax revenue, and reductions in property value to be \$20 million for the island of Maui alone. NOAA has funded some pilot control studies in Hawaii. One of these is use of something called a “super-sucker.” It is a giant underwater vacuum cleaner. By using such a system it is hoped that we can capture fragments that could re-establish.

Even though some progress has been made with plant species, there is a need to develop new methods for controlling aquatic species. There are methods being used by our terrestrial counterparts that may have application.

Pheromones have the potential for both attracting individuals into areas where they can be trapped and repelling individuals from an area to prevent spread. Pheromones are being used on an experimental basis as one method to control sea lampreys in the Great Lakes, and NOAA is currently funding a project to see if they can assist in controlling green crabs on the west coast.

Other than work done by the Corps of Engineers on aquatic invasive plants, very little research has been done on possible use of biological control agents for controlling aquatic species. To show you the difficulties involved if one starts from a baseline of no information, I would like to mention a project funded by both NOAA and the Department of Energy to find a species specific pathogen for zebra mussels. Dr. Daniel Malloy and his colleagues investigated over 600 potential pathogens before he found a *Pseudomonas* bacterium that seemed to hold real promise. It acted on the mussel's digestive gland and caused extremely high mortality rates. Once a promising technology was found, it was necessary to make sure that it was species specific and would not affect native mussels—many of which are listed as either endangered or threatened. There was real excitement when tests showed that the pathogen was apparently species specific. However, it took over a decade to reach the point where a pilot test in open systems could be contemplated. As we all know zebra mussels have continued to expand their range, and it has become impossible to totally eradicate them. In this instance, a new technology may help to deal with localized infestations and to prevent utilities from having intake pipes fouled.

The ANSTF saw a presentation on another possible technology that probably is still over the horizon. It was on use of genetically modified organisms in control activities. The theory is that a genetic alteration can be introduced into a population that will ultimately result in elimination of that population. The most significant work in this area has been done in Australia where research is being done on daughterless carp. In this case, a genetic modification is introduced into a population so that all offspring and their subsequent offspring are males. Before such technology leaves the laboratory, however, there are very serious environmental and social questions that must be answered.

I previously commented that the majority of control measures are being conducted by state governments. This will probably be the case for the foreseeable future. An appropriate federal role may be the development of methods that can be used by our partners. Currently, there are individual projects but no systematic effort to conduct research into this area. Research will continue to help ensure new management tools are identified new control measures.

Pathogens and Parasites

The recent introduction of viral hemorrhagic septicemia (VHS) into the Great Lakes highlights an emerging issue and shows how serious pathogenic and parasitic invaders can be. It has the potential of devastating a \$3-4 billion recreational fishery. It is far from the only example, however. In the past the introduction of whirling disease has affected salmonids, and a genetic study shows that the MSX parasite which has contributed to the decline of native oysters in the Chesapeake Bay probably originated in

eastern Asia. More recently, \$12 million worth of aquacultured Atlantic salmon had to be destroyed in Maine when infectious salmon anemia was discovered, and shrimp aquaculture around the world has been plagued by a number of different viruses. In both of these cases, there is serious concern that eventually the pathogens could be introduced into wild populations.

The movement of fish and shellfish diseases is not a new problem. It has been approximately 40 years since the International Council on Exploration of the Sea (ICES) adopted a protocol on intentional introductions designed to prevent movement of diseases, and there are several scientific journals dealing exclusively with fish and shellfish diseases.

Even though the issue has been present for some time, it is likely to increase with the increasing movement of live aquatic organisms unless steps are taken to improve management practices and methods of detecting pathogens and parasites before they enter the United States. To date, we have responded — often after the fact — to individual problems rather than taking a systematic approach. Considerable progress has been made in our ability to detect pathogenic organisms, e.g., genetic testing with polymerase chain reaction, but there really is not a systematic approach to identifying potential problems and applying new technologies. It should be possible to work with industry on developing best practices and detection methods to reduce the likelihood that new introductions will occur.

To summarize my testimony, substantial progress has been made since NANPCA was originally enacted, but these have only been the first steps in a long journey before we resolve the issue of aquatic invasives. It is now over a decade since the Act was last reauthorized, and we continue to improve our ability to address aquatic invasive issues.

I appreciate the opportunity to give NOAA's perspective on this issue and would be happy to respond to any questions the members of the subcommittee may have.