TESTIMONY
OF
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OYSTER RESTORATION IN CHESAPEAKE BAY
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Introduction

Thank you Chairwoman Bordallo and distinguished members of the Subcommittee for the opportunity to provide testimony today. My name is Denise Breitburg. I am a Senior Scientist at the Smithsonian Environmental Research Center located in Edgewater, Maryland. I hold an advanced degree in Marine Ecology. I have led the Chesapeake Bay Program's Scientific and Technical Advisory Committee's activities related to oyster restoration and the proposed introduction of the non-native Asian oyster to Chesapeake Bay, and have recently served on National Research Council Committees that reviewed River Basin and Coastal Systems Planning by the U.S. Army Corps of Engineers (2004) and the Ocean Research Priority Plan and Implementation Strategy (2007) that is intended to guide marine research in the Nation over the next decade.

The greatest challenges to our environment today are in the coastal zone where 70 percent of the world's population lives, works, and plays. These ecosystems at the land-sea interface are also among the most biologically productive, and their health is critical for the survival of both our oceans and our terrestrial environments.

The Smithsonian Environmental Research Center (SERC) is one of the world's leading research centers for environmental studies of the coastal zone. Our accomplishments range from running some of the longest continuous ecological studies in the world, to creating new technology that expands the horizons of science. Scientists at the Smithsonian Environmental Research Center conduct research relevant to critical environmental issues facing this nation and the world, and work with government agencies and the public to incorporate sound science into management and stewardship decisions.

Factors Contributing to the Continued Decline of the Native Eastern Oyster (Crassostrea virginica)

There is no question that oyster populations have declined to historically low levels in Chesapeake Bay. Current abundances are probably between 1% and 0.1% of those in the mid-1800s. The decline in this important resource has been caused by over a century of overfishing, and a combination of disease and fishing mortality in more recent years. (Figure 1.) The general outline of this decline is well known, and I would like to make two important points.

The first is that fishing is still a major cause of mortality of oysters in Chesapeake Bay. The precipitous decline in oyster abundances over the past 20 years is not solely a consequence of disease. It reflects heavy fishing mortality imposed on a population suffering high disease mortality. The precipitous decline in fisheries landings during the past 20 years clearly demonstrates that this combination of stressors – that is, both fishing and disease - does not allow for sustainable oyster populations in Chesapeake Bay at population sizes considered desirable by management agencies, conservation organizations or the fisheries industry. There is growing

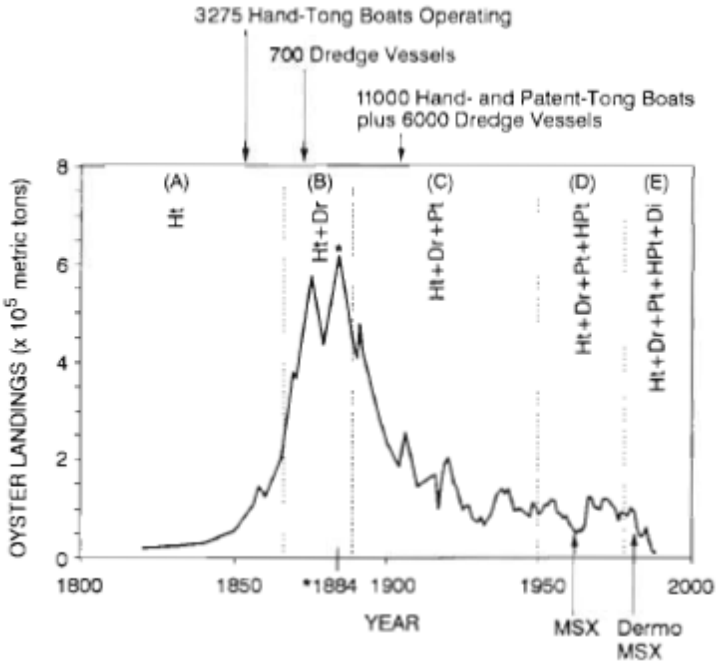

Figure 1. From a paper by Brian Rothschild and colleagues published in 1994. The data plotted show oyster landings in the Maryland fishery from the late 1800s until the publication of the paper from which this figure is extracted. As oyster landings declined, an increasing number of techniques – and often, increasingly more destructive techniques - were used to remove oysters from the Bay. The figure illustrates the relationship between oyster landings, fisheries and disease over time. '(A) use of hand tongs only (Ht); (B) introduction of dredges (Dr) (*note production peak in 1884); (C) introduction of patent tongs (Pt) which corresponds with the beginning of the catch decline; (D) introduction of the hydraulic patent tong (HPt) in 1950 and date when disease was first recorded; (E) the addition of diver harvesting (Di) in 1980. ' Note that earlier evidence of dermo has been found since the publication of Rothschild's paper.

consensus among researchers in the Chesapeake Bay region that a wild fishery, even at its current low levels of landings and supplemented by programs that move and supplement stocks with native and hatchery-produced seed, is not sustainable in Chesapeake Bay.

The second point is that the extent to which water quality problems in Chesapeake Bay have contributed to this decline is not known. It is clear that water quality, especially sediment in the water, as well as low oxygen and algal blooms that result from nutrient over enrichment, have contributed to the difficulty of restoring oysters. But it is not clear whether these factors

would have had a substantial negative impact on the abundance of oysters in Chesapeake Bay in the absence of fishing and disease mortality. The ability to correctly identify the causes of declining oyster populations and the impediments to restoration are critical to management and restoration of living resources such as oysters.

Factors Limiting Successful Restoration of the Native Eastern Oyster

I believe the impediments that have been most critical in limiting the success of oyster restoration efforts to date are: (1) the scale of the efforts relative to the scale of the problem, (2) limited emphasis on research and restoration designed specifically to learn how to restore oysters, (3) use of suboptimal sites for restoration, and (4) the variety of environmental and technical hurdles that need to be overcome. I want to be clear that what I am referring to here is ecological restoration conducted specifically to increase the abundance of oysters that remain in Chesapeake Bay, not shell and oyster additions designated for eventual removal from the Bay by the fishery.

Table 1. Percentage of $58 million in State and Federal funding allocated to ecological restoration (i.e., restoring oysters and oyster habitat not destined for harvest) versus supporting the oyster fishery. Data were provided by Maryland Department of Natural Resources for this testimony. Allocation of funds expended in VA waters was not available.

Source of Funds	Funding Level (million dollars)	Use of Funds	
		Ecological Restoration (not available to fishery)	Fishery
Total	58	29%	71%
Federal expenditures in MD	15.3	31%	69%
Maryland	24.4	18%	72%
Virginia plus Federal and Potomac Fisheries Commission expenditures in VA	18.3	?	?

Of the $58 million in State and Federal funds referred to in a recent Washington Post article that has been spent on oyster restoration in Chesapeake Bay since 1994, over $41 million was spent on efforts to support the Chesapeake Bay oyster fishery (Table 1). Over the 14 year period, about $17 million was spent on restoration of oysters not destined to be removed from the Bay by the fishery. This is not intended to imply that restoration projects whose primary goal is to support the fishery provide no ecological services, or that sites that remain closed to harvest may not have positive effects on the fishery. However, the primary goals, as well as criteria for measuring the success of restoration efforts, is largely determined by whether or not sites remain closed or are eventually opened to the fishery.

At the turn of the 20th century, after substantial fishing had already occurred, Maryland had about 275,000 acres of oyster habitat. However, Maryland lost over 164,000 acres of oyster bed habitat just in the past 25 years. To date, restoration efforts have added shell and oysters to only a small fraction of this once productive bottom. Considering the time scale is probably as important as considering the magnitude of the spatial scale. It has taken over a century of overfishing, more recently compounded by problems of disease and habitat degradation to get to the current depleted state of oyster populations and habitat in Chesapeake Bay. It is not

surprising that our actions over the past 14 years have been unable to reverse a problem that has been caused by over a century of human activities.

Of the $17 million spent since 1994 on ecological restoration, only a small fraction has been spent on in-water research and project evaluation required to learn how to do ecological restoration. In fact, $14 million has been spent on the ongoing Environmental Impact Statement (EIS) to evaluate the proposed introduction of the Asian oyster and other alternatives and courses of action-- more than has been spent in Chesapeake Bay since 1994 on in-the-water research on how to improve the success of native oyster restoration. The research community in the Chesapeake Bay region has repeatedly and consistently called for restoration efforts to be designed in ways that allow for learning and adaptive management, and for increased monitoring to evaluate the effectiveness and provide the basis to improve restoration strategies and practices. It is the only way to learn what works, what doesn't work, and to improve the chance for future success.

There are two barriers to this adaptive learning strategy that will be important to overcome. The first is the limited emphasis on evaluating the success of ecological restoration efforts relative to the enormity of the problem and the fact that we do not have an effective blueprint for successful restoration of oysters in Chesapeake Bay. The second problem is the suboptimal design and siting of restoration efforts. To learn what works best, what provides only limited benefit, and which restoration practices are unsuccessful and should be abandoned, requires that restoration projects be designed in a replicated and systematic way that allows their results to be compared and analyzed. This requires both a decision by agencies designing the restoration program to follow this principle, and sufficient funding to construct and monitor projects at the scale needed to meet this approach.

Instead, the design and siting of restoration projects have often been dictated by numerous considerations other than ones that would provide the best opportunity to evaluate the effectiveness of restoration practices or provide the highest chance of success. The process of accommodating fishery interests' use of highly productive oystering areas, as well as the desire to accommodate citizens groups that are enthusiastic about supporting oyster restoration, has often resulted in sub-optimal choices for the location of restoration efforts. If ecological restoration truly is the highest priority of oyster restoration efforts in Chesapeake Bay, then selecting sites based on the highest probability of contributing to increasing sustainable oyster populations would need to be the highest priority in selecting locations for those restoration efforts.

There is no question that there are a variety of factors that make restoring oysters in Chesapeake Bay a difficult process. As oyster abundances decline, the habitat they create for their own species declines in quantity and quality. Disease imposes mortality even at locations where fishing mortality is eliminated. But poaching has also contributed to the mortality of oysters and failures of restoration efforts in areas where regulations prohibit fishing. Although we have learned a lot about oyster restoration since 1994, we do not currently know how to best ensure that oyster restoration projects, and ultimately restoration of oyster populations baywide, will succeed. A greater reliance on sound scientific principles is important to improve our chances for success in this important venture.

The proposed introduction of the Asian oyster (Crassostrea ariakensis) to Chesapeake Bay

I chaired the workshop[1] for the Chesapeake Bay Program's Scientific and Technical Advisory Committee (STAC) that provided recommendations on the research needed to better predict the potential risks and benefits of introducing the Asian oyster to Chesapeake Bay, and recently coordinated STAC comments on the Ecological Risk Assessment that is a critical piece of the evaluation that will form the core of the Programmatic Environmental Impact Study for the proposed introduction of the Asian oyster. My comments here reflect conclusions of those activities, the NRC report on the same topic[2], and recent research on the Asian oyster and non-native oysters introduced elsewhere. I would like to make a few brief points.

First, as highlighted in the STAC and NRC reports, an introduction of the Asian oyster to Chesapeake Bay is an introduction of this species to the Atlantic Ocean. If it is successfully introduced to Chesapeake Bay, there is a very high level of certainty that it will not be possible to eliminate it if it is found to cause problems, and it will spread beyond the boundaries of Chesapeake Bay. The level of certainty around these statements was so high that of the 80 or so researchers convened for the STAC workshop, no one suggested that there was any need to conduct research to test or verify the validity of these statements. To the best of my knowledge, there is no scientific disagreement on these points.

Second, there is a very high probability that large scale aquaculture of triploid oysters will ultimately lead to an introduction of diploid Asian oysters in Chesapeake Bay. Because they have three copies of each chromosome, triploids are sterile. Diploid individuals have two copies of each chromosome and are capable of reproduction. The introduction of reproductively capable Asian oysters could result from hatchery accidents, reproduction by the small percentage of animals that are not effectively sterilized, or reversion of triploids to a reproductively capable state. At a briefing for STAC and the Atlantic States Marine Fisheries Commission this spring, VERSAR presented an estimate that there was a 20% chance that large scale triploid aquaculture would result in a diploid introduction within 5 years. Although this risk estimate was based on very rough calculations and its precision is uncertain, the important point is that the risk is non-trivial. As a result, the only real difference between an intentional introduction of diploid animals and large scale triploid aquaculture is how long it will likely take for a reproductive population of reproductive Asian oysters to become established in Chesapeake Bay.

Third, in spite of an incredible marshalling of scientific effort, the net risks and benefits of introducing the Asian oyster to Chesapeake Bay are still highly uncertain. There are clear differences between the species in growth rates, mortality due to diseases that are currently problematic in Chesapeake Bay, the potential to harbor diseases not currently a problem in the Chesapeake, susceptibility to predators, and other factors. Risks to native oysters that could be caused by introduced Asian oysters have been identified. At its most recent meeting, the Oyster Advisory Panel for the Programmatic EIS concluded that the net result of an introduction was unclear. Thus, the introduction of the Asian oyster to Chesapeake Bay would be an irreversible decision with highly uncertain consequences.

Given the numerous problems that have been caused by invasive species worldwide, the uncertainty of consequences both within and outside the Bay, the irreversibility of the decision, and the reality that we have not exhausted possibilities for native oyster restoration, I would strongly recommend that it is not time to introduce a non-native oyster species to Chesapeake

[1] Identifying and Prioritizing Research Required to Evaluate Ecological Risks, Benefits, and Alternatives Related to the Potential Introduction of *Crassostrea ariakensis* to Chesapeake Bay. December 2-3, 2003, Annapolis, MD.
[2] Nonnative Oysters in Chesapeake Bay. The National Academies Press. 2004.

Bay. There is no question that the Chesapeake is simultaneously challenged by problems of degraded water quality and declines in important living resources such as oysters. A major challenge that must be addressed in order to restore the Chesapeake to the national treasure it should be is to clearly identify which problems are caused by which human activities, and how the effects of the multitude of human activities in the Bay and its watershed interact. That knowledge is necessary to move forward effectively.

Looking Forward: Changes and New Approaches Under Active Consideration

There are several encouraging signs. Maryland has convened an Oyster Advisory Commission to consider a comprehensive approach to native oyster management and restoration in Chesapeake Bay. Although they have not yet made formal, final recommendations, they are seriously considering a combined strategy of enhanced and increased restoration, promotion of native oyster aquaculture and much more restrictive fishing regulations than are currently in place. Last month, the agencies and committees for the Programmatic EIS that is currently underway agreed to evaluate a formal alternative to the proposed action of introducing reproductive Asian oysters to Chesapeake Bay that consisted of these same three strategies – native oyster restoration, native oyster aquaculture, and far more restrictive fishing regulations. In both the Maryland and Programmatic EIS cases, a moratorium on non-aquaculture fisheries is being considered. My professional judgment is that the severely overfished state of the Chesapeake oyster resource, combined with the problems of enforcing small-scale closures, warrants closing the fishery at least at the scale of several major tributaries, and perhaps Baywide.

On the research front, I want to highlight some recent progress. First, more detailed surveys of some of the sanctuary and harvest reserve sites in Maryland waters were conducted this past summer. The second project is a major, collaborative effort to analyze data on oyster restoration efforts Baywide since 1990 to attempt to learn first of all what has been done, and secondly, which efforts, habitats and approaches have provided benefits and which have not. This effort is funded by the National Oceanic and Atmospheric Administration and the Keith Campbell Foundation, facilitated by Maryland Sea Grant, and includes researchers from both Maryland and Virginia. I am on that committee. To date, it has been a monumental effort just to compile data taken by the various state and federal agencies and research laboratories that have been involved. This difficulty highlights the need to make changes as oyster management and restoration move forward that will allow data collection and analysis to be coordinated across agencies, states and research labs, and for data compilation and analysis to be included and funded as an ongoing part of all oyster programs in Chesapeake Bay.

In sum, based on my best scientific judgment, I would make the following recommendations:

1) Do not give up on native oyster restoration.
2) Do not introduce the Asian oyster, *Crassostrea ariakensis.*
3) Separate ecological restoration from support for the fishery.
4) Develop a strategy for the combination of restoration and management practices most likely to succeed.
5) Emphasize research on techniques for improving oyster restoration and evaluations of historical efforts. Consider these needs broadly.
6) Implement all future restoration efforts in ways that allow for scientifically valid comparisons and analyses that will allow us to learn and continually improve restoration.
7) Focus future efforts on evaluating the success of restoration projects.
8) Better integrate water quality and fisheries management and restoration. Take the much-talked about step of moving towards true ecosystem-based fisheries management in Chesapeake Bay

Concluding remarks:

The Smithsonian hopes to continue to play a major role in collaboration with State and Federal partners, and utilize its substantial scientific capabilities towards increasing the chances for success in restoring and managing native oysters in Chesapeake Bay. It is true that substantial hurdles need to be surmounted, and that increasing native oyster populations in Chesapeake Bay will be neither rapid nor inexpensive. However, the potential for strong, scientifically based programs to substantially increase populations of this ecologically important species has not yet been exhausted.

Thank you for the opportunity to testify today and I look forward to answering any questions you may have.