

**Implementation of House Bill 133
Natural Resources - Chesapeake Bay –
Oyster Restoration**

*Maryland Oyster Advisory Commission's
2007 Interim Report*

*Concerning Maryland's Chesapeake Bay
Oyster Management Program*

**Submitted to the
Governor and General Assembly**

January 4, 2008

**Maryland Oyster Advisory Commission's 2007 Interim Report and Preliminary Thoughts
Concerning Maryland's Chesapeake Bay Oyster Management Program**

EXECUTIVE SUMMARY

The Maryland Oyster Advisory Commission (OAC) completed its first four months of work in 2007. During that period, the Commission had extensive discussions aimed to obtain a comprehensive understanding about the science, economics, social and cultural aspects of oyster management and restoration issues in Maryland's Chesapeake Bay. A number of complex issues have been identified and the Commission will continue working in 2008 to further examine these issues together with the findings of the multi-state and federal government Environmental Impact Statement (EIS) being prepared to evaluate oyster restoration alternatives for the Chesapeake Bay, including native and/or nonnative oysters.

Based upon the scientific information already reviewed and discussed, the Commission reached consensus on a possible vision for what a healthy oyster population in the Chesapeake Bay might look like and what functions it would serve in the 21st Century. The purpose for agreeing upon a vision at this point is not to determine what the final recommendation of the OAC will be, but rather to establish a challenging goal for restoring oysters to the Chesapeake Bay, and then test that vision against the scientific findings of the EIS and the realities that must be confronted if it is to be achieved. By establishing a vision and testing it against a wide range of realities, we will learn what difficult policy decisions must be made. And, as we explore the implications of those difficult decisions, we will undoubtedly fine-tune our vision. That is our primary job for the coming year. At the end we will recommend a bold action plan to (1) restore an abundant and self-sustaining oyster population that provides important ecological functions and (2) develop a sustainable, ecologically sound, and self-sufficient oyster industry, and in doing so, maximize the socio-economic benefits of oysters in Maryland's Chesapeake Bay.

In reviewing the list of questions that the Commission was asked to address in their 2007 report to the Governor and General Assembly, we reached consensus on three fundamental principles for managing oysters in Maryland's Chesapeake Bay. First, the dual goals of restoring the ecological and economic production benefits of Maryland's Chesapeake Bay oyster resource are currently mutually incompatible with the Chesapeake Bay's oyster population at 1% of historic levels and the factors limiting recovery. Secondly, the Commission agreed that the State has a clear role in restoring an abundant and self-sustaining oyster population because both oysters and the Bay are a public good resource, and thirdly, the State's ultimate role in the oyster industry is to manage the resource sustainably and prevent overfishing.

Based upon the scientific findings included in this report, the Commission agreed upon several preliminary thoughts about important issues for future action. Of most significance, we determined that a large oyster sanctuary program will be essential to restoring the ecological function of oysters in Maryland's Chesapeake Bay. We also agreed that the ecological benefits from more restrictive harvest measures, including a moratorium, will only be recognized if done in combination with a significant and sustained commitment of resources focused on

rehabilitating natural oyster bars, significantly minimizing disease impacts, and addressing water quality issues throughout the Chesapeake Bay watershed.

In regards to Maryland's oyster industry, the Commission learned that every major oyster producing area in the world is based on some degree of privatization. Based upon this finding, it is our view that the greatest opportunity for expanding the economic production of oysters in Maryland is through privatization and aquaculture. It is our thought at this time that a program to facilitate the transitioning of Maryland's traditional oyster fishery to privatization will be needed, and that this program should make a certain percentage of natural oyster bars available for private leasing and consider providing the first opportunity of available bottom to traditional oystermen. We also believe that an opportunity for a well managed public fishery that is sustainable, ecologically sound, and self-sufficient would still be available. Lastly, but of equal if not of utmost importance, the effectiveness of Maryland's oyster harvest management strategies and restoration program will be critically dependent on strong enforcement.

While Maryland's future oyster management and restoration program will be defined following the completion of the EIS and upon further considerations of this Commission, we believe that a significant increase and sustained commitment of government funding will be needed to support this new program for at least two decades. The success of this program will be critically dependent upon finding a strategy to mitigate oyster disease impacts, achieve significant improvements to oyster bar habitat, and improve Bay water quality. Therefore, we recommend that a decision to make an increased investment in this program should be based upon a scientific analysis of the probability that the implementation components of the new program will facilitate reestablishing an abundant and self-sustaining population of oysters in Maryland's Chesapeake Bay that would provide significant ecological benefits. The Commission has not had time to thoroughly identify and evaluate the components of this program and their associated costs, however, we have included our preliminary thoughts in this report because we believe it is important to begin discussing the level of funding that may be required to support this program and to identify potential funding sources.

The Commission recommends that DNR move expeditiously towards understanding the scientific findings and preliminary thoughts about important issues for future action contained in this report as they pertain to the specific tasks outlined in House Bill 133.

VISION STATEMENT

The Commission's agreed upon vision to be tested in 2008 is:

“Within two decades there will be a well established and expanding population of native oysters in significant portions of the potential oyster habitat of Maryland's Chesapeake Bay. These oysters will successfully reproduce and establish complex habitats and reef structures in spite of ongoing disease pressures. This large, viable population of oysters will provide a wide range of ecosystem services to the Chesapeake Bay, including important water cleaning services and the provision of habitat vital to other key Bay species. Appropriate levels of protection will exist to safeguard the condition of this population to ensure continued delivery of these

Maryland Oyster Advisory Commission 2007 Interim Report

ecosystem services. The protected, oyster population will have been re-established through a major sustained investment by the government over this time period, but that investment will have then ended except for low levels of funds for oyster bar maintenance and enforcement.

During the same timeframe, a highly successful Maryland oyster industry in Chesapeake Bay will have re-emerged, producing a “high quality” and “in-demand” seafood product for the consumer and resulting in the oyster industry re-emerging as a major economic contributor in the Bay region. This industry will be highly efficient and utilize innovative technologies for oyster cultivation. The backbone of this industry will be the marketing of “one of finest oysters in North America”. The industry will utilize a relatively modest portion of the available oyster habitat, leaving a majority of the oyster beds protected for ecological services. This industry will have evolved through privatization, thereby shifting much of the financial burden from the public to private sector. Arriving at this point will require targeted investment by the state in research and technology, as well as changes in legal and management regimes. The traditional state-private “put and take” oyster harvesting practices of the past, which have become economically unsustainable, will no longer exist. However, an opportunity for a well managed public fishery consistent with restoring the ecological function of oysters will still be available.

The vision necessary to get us where we need to proceed will require decisions based upon the best scientific information available but recognizing that even with that knowledge there is always uncertainty and that difficult public policy choices will arise. It will require a period of careful transition from current practices in oyster management and harvesting to the development of a new form of industry. Yet, based on what we know today, creating a sound vision will assure both the long term ecological and economic sustainability of the Bay’s oyster resource without permanent large-scale government financial subsidies.”

INTRODUCTION

On April 24, 2007, Governor Martin O’Malley, joined with Senate President Thomas V. Mike Miller Jr., House Speaker Michael E. Busch, and Lieutenant Governor Anthony G. Brown, signed into law House Bill 133 establishing an Oyster Advisory Commission (OAC) in the Maryland Department of Natural Resources (DNR). This legislation directs the OAC to:

- Review the best possible science and recommend changes to the framework and strategies for rebuilding and managing the oyster population in the Chesapeake Bay under the Chesapeake Bay Oyster Management Plan;
- Review the latest findings of the multi-state and federal government’s Environmental Impact Statement evaluating native and nonnative oyster restoration alternatives for the Chesapeake Bay; and
- Review any other scientific, economic, or cultural information relevant to oysters in the Chesapeake Bay.

In addition, the legislation directs the OAC to report their findings and recommendations on the following to the Governor and General Assembly by December 31, 2007:

- Strategies to minimize the impact of oyster disease, including the state repletion program and bar cleaning.

Maryland Oyster Advisory Commission 2007 Interim Report

- The framework and effectiveness of the oyster sanctuary, harvest reserve, and repletion programs, and the overall management of natural oyster bars, after performing a cost–benefit analysis that considers biological, ecological, economic, and cultural issues.
- Strategies to maximize the ecological benefits of natural oyster bars, and
- Strategies to improve enforcement of closed oyster areas.

In September 2007, under the direction of House Bill 133, DNR Secretary John R. Griffin appointed a 21-member commission consisting of scientists, watermen, anglers, businessmen, economists, environmental advocates, and elected officials. The concept behind the Commission’s membership was to include individuals with a range of experiences and perspectives, who were not overly invested in historical oyster management and restoration, and could present and openly discuss new ideas. The Oyster Advisory Commission chairperson and members are included in Appendix I.

The challenge to this Commission and the DNR is to find new strategies and not simply repeat the ideas and policy decisions of the past. The format selected by the OAC to facilitate this needed shift in paradigms was to look at the biology and ecology, oyster industry, and socio-economics individually first, and then in combination to determine what management strategies, if any, could be implemented to achieve multiple objectives without significantly compromising the primary goal of restoring an abundant and self-sustaining oyster population throughout Maryland’s Chesapeake Bay. This process enabled the OAC to obtain an improved understanding of these topics, broadly evaluate the specific tasks in House Bill 133, and reach an initial consensus on a vision for what a healthy oyster population in the Chesapeake Bay might look like and what functions it would serve in the 21st century.

The purpose for agreeing upon a vision at this point is not to determine what the final recommendation of the OAC will be, but rather to establish a challenging goal for restoring oysters to the Chesapeake Bay, and then test that vision against the scientific findings of the EIS and the realities that must be confronted if it is to be achieved. By establishing a vision and testing it against a wide range of realities, we will learn what difficult policy decisions must be made. And, as we explore the implications of those difficult decisions, we will undoubtedly fine-tune our vision. That is our primary job for the coming year. At the end we will recommend a bold action plan that will allow Maryland to restore an abundant and self-sustaining oyster population that provides important ecological functions and a new model for a sustainable oyster industry, and in doing so, maximize the socio-economic benefits of oysters in Maryland’s Chesapeake Bay.

BACKGROUND

Oyster restoration is a key element of Maryland’s multi-faceted Chesapeake Bay restoration strategy. Oysters were once considered the keystone species of the Chesapeake Bay, serving as a primary contributor to the Bay’s filtration system and providing rich habitat for many other species. Unfortunately, native oyster restoration has not been fully successful despite the massive effort and state and federal government expenditure of \$39.7 million on in-

the-water oyster recovery activities since 1994. The National Resource Council 2003 report “Nonnative Oysters in the Chesapeake Bay” identified the following risks with continuing native oyster restoration as status quo:

- Further declines in Bay water quality;
- Continued or accelerated losses of submerged aquatic vegetation (SAV) and oyster reef habitats, with cascading effects on the structure and stability of the Bay’s estuarine communities; and
- Continued decline of the oyster fishery and erosion of traditional economies and cultures of Bay watermen.

In recognition of the importance of oysters to Bay restoration and the need to evaluate alternatives, an Environmental Impact Statement (EIS) was initiated in January 2004 by the State of Maryland, Commonwealth of Virginia and the U.S. Army Corps of Engineers, Norfolk District to evaluate alternative approaches to increasing oysters in the Chesapeake Bay. The alternatives being evaluated include: continuing and expanding native oyster restoration efforts, including a significant increase in the scope of restoration and use of disease-resistant strains; implementation of a temporary harvest moratorium; introduction of a non-native oyster; and an expanded aquaculture program. This impact assessment effort began in 2004 and may be the most comprehensive evaluation of native oyster restoration strategies ever performed in the Chesapeake Bay region, and of a potential introduction of a nonnative species in the world. More information on the EIS can be found at:

<http://www.dnr.state.md.us/dnrnews/infocus/oysters.asp>

The results of this EIS will be important for the future direction of Maryland’s oyster management and restoration program. House Bill 133 recognized the importance of the EIS, and directed the Oyster Advisory Commission to review the scientific findings of this effort. At the time House Bill 133 was signed into law, a draft EIS was scheduled to be available for public review in May 2007. Shortly thereafter, however, it was announced that the draft EIS would be delayed until May 2008. While the Oyster Advisory Commission was provided the opportunity to review the available preliminary scientific information being used to support the EIS, a review of the draft EIS will be necessary in 2008.

Upon completion of the EIS, and taking into consideration the advice from the Oyster Advisory Commission, DNR plans to review and modify, as necessary, the 2004 Chesapeake Bay Oyster Management Plan. As is the case with the EIS and Oyster Advisory Commission, revisions to this Plan will be made in an open public forum.

2007 ACCOMPLISHMENTS OF THE OYSTER ADVISORY COMMISSION

- The Secretary of DNR established the Oyster Advisory Commission and appointed a chairperson and its members. The members were chosen based on range of experience and perspective, and for their proven ability to explore new strategies.
- The Oyster Advisory Commission established standard operating guidelines that include, but are not limited to, defined roles of the chairperson, members and DNR support staff,

Maryland Oyster Advisory Commission 2007 Interim Report

communication ground rules to facilitate group discussion, an agreed upon decision-making model, and procedures for disseminating meeting support information, preparing meeting summaries, and corresponding with the public.

- All four Commission meetings (Appendix II) have been open to the public and stakeholder input has been encouraged at each meeting. A public interest list has been established and individuals who sign up for the interest list receive regular e-mail communications. At each meeting, members of the public are invited to speak and present information to the Commission. Meeting summaries and meeting support information (e.g. presentations and handouts) for each meeting are available to the public through the DNR website <http://www.dnr.state.md.us/fisheries/oysters/>.
- The Commission agreed upon a conceptual model for managing and restoring oysters to the Chesapeake Bay in the 21st century that can be tested and refined in 2008 based upon the scientific findings of the EIS and the realities that must be confronted if it is to be achieved.
- The Commission reported on the tasks outlined in House Bill 133, and submitted a report of their findings and preliminary thoughts about important issues for future action to the Governor and General Assembly.

2007 FINDINGS

The Oyster Advisory Commission's findings are largely based upon recent findings of the oyster management and scientific communities that have resulted from efforts supporting the EIS and OMP. The Commission is very appreciative of the time and effort required to provide this information.

Fundamental Oyster Management Principles - In reviewing the list of questions that the Commission was asked to address in their 2007 report to the Governor and General Assembly, the Commission reached consensus on three fundamental principles.

- With the Chesapeake Bay's oyster population at 1% of historic levels and the many factors limiting recovery, there does not appear to be enough production of either oysters or shell habitat to maximize the economic benefits of the oyster fishery along with maximizing the ecological function of a re-established, abundant and self-sustaining oyster population.
- The State has a clear role in restoring an abundant and self-sustaining oyster population in Maryland's Chesapeake Bay because both oysters and the Bay are a public good resource. One estimate puts the economic value of the Bay at over five billion dollars, and it is widely acknowledged that oyster restoration is a critical component to restoring and preventing further degradation to the Bay. This role includes, but is not limited to, the rehabilitation of oyster bar habitat and addressing current and future land-based management activities that serve to degrade Bay water quality.

Maryland Oyster Advisory Commission 2007 Interim Report

- Ultimately, one of the State's roles in the oyster industry is to manage the resource sustainably taking into consideration biological and sociological perspectives, and prevent overfishing. In addition to traditional enforcement practices, it is probable that the State can accomplish this by assigning and protecting property rights to individual oystermen or oystermen cooperatives. It is possible for the State to provide incentives and resources to facilitate the transition of Maryland's traditional state-private and largely "put-and-take" oyster fishery to a privatized industry recognizing that a restored and sustainable oyster industry provides important socio-economic benefits to the region. In the long-run, however, the industry should be fully privatized.

Status of Oyster Population

- Best available estimates indicate that Maryland's Chesapeake Bay oyster population has varied without statistically significant trend since 1994. These estimates do not currently account for the additional 200 million hatchery seed oysters that have been added and estimated to be still living in the Bay's ecosystem. Even with these additional oysters, however, abundance remains at approximately 1% of historic levels.
- While regional population increases as result of oyster recovery efforts have not been observed, there have been clear benefits at individual sites. Improvements have included up to a hundred-fold increase in oyster abundance with additional improvements noted for organisms associated with and dependent on oysters and their associated reef habitat. These benefits, unfortunately, have not proven to be self-sustaining at this time.

Oyster Biology – Vital Population Rates

- Natural mortality rates have significantly increased from an estimated 10% annually prior to disease impacts (<1985) to current estimates that routinely range between 30-90% depending upon annual Bay salinity levels and locality. Modeling efforts indicate that changes in oyster population levels are most sensitive to changes in natural mortality rates.
- Annual recruitment (reproduction) has remained below the 22-year average since 1998, and has not produced a significant baywide spat set since 1991.
- Oyster growth rates remain unchanged over time, suggesting food is not a limiting factor, although low dissolved oxygen resulting from an abundance of phytoplankton, as well as transient Harmful Algal Blooms (HAB) that affect growth, have been documented in the Bay with increasing frequency.
- The subject of oyster biology is exceedingly complex and important. It will be treated in more detail in future deliberations of the OAC.

Oyster Disease (Dermo and MSX) Impacts and Mitigation Strategies

- The Commission's review of disease issues directly benefited from a June 2007 report prepared by oyster disease scientists from Virginia Institute of Marine Sciences (VIMS), Rutgers University, DNR Cooperative Oxford Laboratory and University of Maryland. This

report includes scientific consensus responses on the current state of knowledge of a series of questions relating to diseases issues from the 2004 Chesapeake Bay Oyster Management Plan. The Commission has not had time fully discuss these findings, however, we have included key findings pertinent to current issues before the Commission in Appendix III.

Oyster Bar Habitat

- The Chesapeake Bay's native oyster is a reef-building bivalve. The reef habitat it creates provides essential habitat for the maintenance of oyster populations through provision of substrate for larvae settlement, refuge from predators and near-bottom hypoxia, and vertical relief above the seafloor, which acts to reduce sediment deposition. Oyster reefs also function as "ecosystem engineers" through the creation and maintenance of unique habitats that are used by other species as predator refuges and feeding and nesting sites. As a consequence, the reefs enhance the Bay's ecosystem productivity and biodiversity.
- Impacts on oyster bar habitat from historical harvesting activities, and more recent increases in natural mortality and decreases in recruitment have increased the susceptibility of oyster bars to sedimentation. Over the last 25 years, it is estimated that Maryland's Chesapeake Bay oyster bar habitat has declined by approximately 70% from about 200,000 acres to around 36,000 acres with the majority of this habitat now being of low quality (heavy layers of mud and sand mixed with shell).
- Clean (sediment-free) oyster shell habitat or a comparable substrate is essential for successful settlement of oyster larvae and to provide a foundation for hatchery seed plantings. Implementation of a mega-scale oyster bar habitat rehabilitation program will be critically necessary to restore an abundant and self-sustaining oyster population throughout Maryland's Chesapeake Bay. This program will depend upon the availability of large quantities of oyster shell and alternate substrate materials.
- The dominant source of shells for oyster restoration since 1960 has been those dredged from buried shell deposits in the upper Bay. Access to these areas is currently restricted because of stakeholder conflict issues surrounding this dredging activity. Unless these controversies can be resolved and a new permit made available, this program will have to depend upon alternative approaches. Two permits, one to initiate a new program involving the reclamation of *in situ* shell and another to expand the use of alternative materials (e.g. concrete, stone, slag) were prepared by DNR in coordination with Maryland's oyster partners and are under review by the permitting agencies.

Sanctuary Program

- Maryland oyster sanctuaries are permanently closed to shellfish harvesting. There are currently 36 sanctuaries throughout Maryland's Chesapeake Bay that comprise an estimated 1,475 acres of viable oyster bottom or 4% of the remaining oyster habitat in Maryland.
- Analysis of the sanctuary program revealed that several of the sanctuaries were selected and managed with different criteria and approaches. As a consequence, it is difficult to evaluate the performance of this potentially promising program.

Maryland Oyster Advisory Commission 2007 Interim Report

- The success of restoration efforts in sanctuaries has been strongly influenced by both environmental factors (disease) and illegal harvesting, and compromised by the placement of sanctuaries in less than optimal locations. As a result, sanctuaries, in many areas, over a relatively short time, and in spite of restoration efforts, have come to look like adjacent remnant oyster bars not in sanctuary status.
- Sanctuaries are valuable because oysters that survive there constitute a presumptively disease-resistant broodstock that are given more opportunity to spawn in the absence of harvest pressure. Sanctuary populations over time are expected to become enriched for larger, disease-resistant oysters which will function as key spawners. Sanctuary reefs are also viewed as important repositories for natural genetic diversity and provide broader ecological functions as habitat. Oyster reef communities that develop in protected sanctuaries will have the capacity to enhance ecosystem services such as filtering capacity and will augment fish production by increasing fish prey densities and fish foraging efficiency.

Public Oyster Fishery

- During the past 5 years (2002-2006), Maryland's annual reported oyster harvest averaged 104,000 bushels. This is a significant decrease from the reported average harvest of 2.5 million and 1.3 million bushels reported during the 1920-69 and 1970-2002 periods, respectively.
- The average number of reported oyster harvesters between 2002 and 2006 was 529. This is a significant decrease from the more than 2,000 harvesters that the oyster fishery supported prior to the disease epizootics of the mid-1980s.
- The processing sector of the industry has also experienced a major decline. The number of oyster processing companies in Maryland declined from 58 operations in 1974, to 20 in 1990, and to 8 currently remaining.
- Repletion Program: DNR's repletion program was started in 1960 to improve habitat for the enhancement of Maryland's oyster industry. The two main components of the repletion program were the planting of shell and the production and movement of natural oyster seed. Shell was dredged from the upper bay and planted around the state to provide substrate for natural spat sets. The seed program consisted of planting shells in areas of high spat set, then transporting the spat to areas of lower salinity to help avoid disease mortality. The shell program officially ended in 2006 because of unresolved stakeholder controversies related to the potential environmental and socio-economic impacts of the program as well as the program's current use of this limited shell resource and lack of a long-term strategy focused towards restoring and sustaining the ecological benefits of the Bay's oyster population.

The oyster industry became increasingly dependent upon the repletion program during the 1980s. It is estimated that 70-80% of Maryland's annual oyster harvest has come from the repletion program during the past two decades. The repletion program is largely (60-80%) subsidized by State funding. Remaining funding (20-40%) is provided by the oyster industry through license sales and bushel taxes.

No where else in the world does an oyster fishery still operate like in Maryland, they have all transitioned to some degree of privatization and aquaculture.

- Managed Reserve Program:

The managed reserve program is unique to Maryland and is a combination of highly intensive (hatchery seed) and extensive aquaculture (bottom grow-out). Initiated in 2001, the managed reserve program seeks to balance the economic goals of creating a market product together with the ecologic goals of enhanced water filtration and other associated ecosystem services by leaving the oysters in the water an extra year (beyond the 3" legal minimum size). During this time, the reef is protected from harvest gear, thereby maintaining the integrity of the reef structure and providing additional habitat services.

A partnership of state, federal, non-profit organizations and county watermen groups work together to identify, designate, prepare and plant these oyster bars which are in turn harvested several years later by Maryland watermen. To date, the program has planted over 600 million oysters on 402 acres within 15 managed reserves. Through the 2006/2007 harvest season, 9,300 bushels (approximately 2,790,000 animals, assuming 300 oysters per bushel) have been harvested. The primary criteria for harvest is a median length of 4 inches. If the median length is not 4 inches but disease mortality threatens the population, then the intensity of the infection is used as the opening criteria. The disease criteria include a prevalence $\geq 50\%$ and/or a weighted prevalence (average infection intensity) of 1.0 (on a 0-5 scale) or 1.5 (on a 0-7 scale).

To date, the "production" costs (calculated based on bushels harvested) for a given managed reserve oyster bar generally varies between \$32 to \$225 per bushel. These costs exceed the current dockside harvest value of \$30 per bushel. A more comprehensive evaluation including the total economic impact of the harvest and/or the ecologic impacts of the oyster bar to the nearby water column is underway to determine whether or not the program has been successful from a financial, adaptive management or a strategic perspective (i.e. developing a balance between economic and ecologic goals).

The oyster industry is currently minimally dependent upon the reserve program. Less than 5% of the annual oyster harvest comes from reserve program activities. However, reserves have contributed more locally (i.e. Chester, Patuxent, and Choptank rivers) than statewide.

- Fisheries Management

The impact of more restrictive fishing mortality rates, including a temporary moratorium, is being evaluated in the EIS. A demographic model employed in this analysis indicates that reductions in fishing mortality rates, including a harvest moratorium have a relatively small impact on increasing the Bay's oyster population under current conditions. Ecological benefits from more restrictive harvest measures will only be recognized if done in combination with a significant and sustained commitment of resources focused on rehabilitating natural oyster bars, significantly minimizing disease impacts, and addressing water quality issues throughout the Chesapeake Bay. It should be noted that the

demographic model does not account for adverse impacts of harvest on the evolution of disease-resistance or on the availability of shell substrate.

The effects of the fishery on removing the larger, potentially resistant broodstocks should be re-evaluated in light of the emerging science that shows evidence of disease-resistance evolving in wild oyster populations.

Oyster shell is critical for rebuilding reefs and oysters themselves are the best source for this as they grow and reproduce. Some recent scientific opinion suggests that very low levels of harvest, estimated at 3-5 percent, should not be exceeded for this to occur. This data should be further investigated and, if validated, could affect future harvest restrictions.

Private Oyster Fishery

- Maryland's reported private oyster harvest has comprised less than 4% of the total annual harvest in Maryland since the 1974-75 season. Over this time period, the peak harvest was 79,989 bushels in 1975-76. The average private harvest during the past 5 years is negligible.
- According to State law established in 1906, only barren (uncharted) oyster bottom can currently be leased. Those areas set aside by a survey during 1906-1912 as Natural Oyster Bars have continued to be considered "off limits" to potential growers, even though most of these have long since ceased to be even marginal producing areas. This has been further restricted by certain counties banning leasing in their waters. Most of these are in areas that would be good for production.
- The number of acres leased to private oyster growers has decreased from 9,903 acres in 1974 to 7,276 acres in 2003. The number of lease holders is approximately 1/3 this number due to the ability to hold more than one lease. Many of these holding leases continue to do so because they consider that there may one day be a viable oyster and the fact that they also believe that the State will no longer allow further leasing, making their grounds of value.
- Every major oyster producing area in the world is based on some degree of privatization. The greatest opportunity for expanding the economic production of oysters in Maryland is through intensive and extensive aquaculture (i.e. seed from private hatcheries grown on private leases).
- The use of selectively bred disease resistant strains and triploid (sterile) native oysters by the privatized aquaculture industry in Virginia has recently been reported to be economically feasible and expanding.
- Compared to the majority of Maryland's oyster bars being open to the traditional oyster fishery, it is estimated that only a fraction would be required to satisfy the current market demands from the Chesapeake Bay (Maryland and Virginia, combined). In addition, some of the bottom culture methods (e.g. oysters suspended in floats) may not require siting at oyster bars.

- The Maryland Aquaculture Coordinating Council has the responsibility for advising the State on aquaculture issues. Therefore, coordinating activities between the Commission and the Council is needed. The Commission's membership benefits from having several Council members on it, with a history of recent Council activities that have direct application to goals and objectives of the Commission. Among these are the recent adoption of Best Management Practices and the ongoing development of Aquaculture Enterprise Zones.

Socio-Economics of Oyster Restoration

- The cultural analysis supporting the EIS found that while all stakeholders (watermen, environmentalists, scientists, sports fishermen, seafood consumers, oyster processors, restaurant owners) had particular preferences in the revitalization of the Bay's oyster population, the top three most important benefits of oysters expressed by stakeholders were economy, culture, and ecology (not in rank order). Without all three of these benefits people did not consider the effort to be oyster restoration. Engaging the public in "owning" the restoration of oysters provides a significant strength and opportunity to the program.
- A key objective of Maryland's oyster restoration program should be to continually build capacity within local communities in order to increase and sustain support for this program and raise citizen awareness about their impacts to local watershed health, oysters and the health of the Chesapeake Bay.
- Oyster harvest on public ground is only compatible with maximizing social benefits when oyster biomass is near or above the level that provides maximum ecological benefits. This harvest must be sustainable and remove only a small percentage of the population due to the fact that the fishery is also removing habitat (shell).

Oyster Management Program

- DNR is responsible for the management and oversight of the Maryland's oyster program. Through its partnership network, the Oyster Recovery Partnership, a non-profit formed in 1994 as a result of the previous Maryland Oyster Roundtable, has worked closely with DNR in bringing the various federal, state, environmental and industry groups together to reach consensus on restoration strategies and in turn complete many of the restoration activities.

Enforcement of Closed Oyster Areas

- The current wide-range of small and intermittent oyster harvest closure areas (sanctuaries, reserves, private leases) throughout Maryland's Chesapeake Bay are difficult to enforce, and as a result have been inadequately protected because of limited enforcement personnel and support by the judicial system.

Funding Expenditures

- The State of Maryland, alone has invested \$24.4 million on in-the-water oyster recovery activities (exclusive of hatchery investments) since 1994 of which 18% has supported

ecological restoration (sanctuaries) and 72% on industry recovery efforts (public oyster fishery).

- A portion of these State funds (<20%) was generated through oyster industry license fees, surcharges and bushel taxes.
- The Federal government (principally through the National Oceanic and Atmospheric Administration and U.S. Army Corps of Engineers) has invested \$15.3 million on in-the-water oyster recovery efforts activities in Maryland since 1994, of which 31% has supported ecological restoration (sanctuaries) and 69% on industry recovery efforts (public oyster fishery on natural and managed reserve bars).
- The State and Federal government combined have invested \$39.7 million on in the-water oyster recovery activities in Maryland since 1994 of which 23% has supported ecological restoration (sanctuaries) and 77% on industry recovery efforts (public oyster fishery).

PRELIMINARY THOUGHTS ABOUT IMPORTANT ISSUES FOR FUTURE ACTION

While the findings of the EIS are still pending, and the work of the Oyster Advisory Commission will continue in 2008, it is the view of the Commission that the following actions and estimated costs are indicative of the actions necessary to implement a coordinated, effective and efficient program to restore the ecological function and economic production of oysters in the Chesapeake Bay. The DNR should move expeditiously towards understanding the programmatic implications of these conclusions as they pertain to the specific tasks outlined in House Bill 133. Furthermore, conclusions and recommendations about implementing, at a large-scale, a new oyster management and restoration program will follow the completion of the EIS and further considerations of this Commission.

- A Program Plan designed to restore the ecological function of oysters needs to be developed based upon the best available scientific information available and sound economic principles. In order for the Program to be successful, it will necessarily be large and ambitious, adopting a “putting a man on the moon” philosophy. The Plan should be based upon the following principles: 1) wise use of science and monitoring; 2) appropriate scaling up; 3) explicit cost-benefit analysis; 4) adaptive management; and 5) principles of public accountability.
- A large oyster sanctuary program in Maryland will be essential to restoring the ecological function of oysters in the Chesapeake Bay. A strong effort should be directed toward identifying, protecting and enhancing the most productive oyster bars in recognition that conservation requires less effort than restoration. The selection and siting of sanctuaries should reflect an understanding of oyster dispersal patterns, and metapopulation structure.
- Ecological benefits from more restrictive harvest measures will only be recognized if done in combination with a significant and sustained commitment of resources focused on rehabilitating natural oyster bars, significantly minimizing disease impacts, and addressing water quality issues in the Chesapeake Bay watershed.

Maryland Oyster Advisory Commission 2007 Interim Report

- Implementation of an extensive oyster bar habitat rehabilitation program is an essential component to restoring an abundant and self-sustaining oyster population and associated habitat throughout Maryland's Chesapeake Bay. This program will depend upon the availability of large quantities of oyster shell (from *in situ* or remote sources) and comparable materials. An evaluation of oyster bar rehabilitation methods, including the availability and cost-benefit analysis of past and newly innovative sources of oyster shell and comparable materials should be conducted. This review should include, but not be limited to, efforts to return shell exported from Maryland and shell which may be used for road construction in other states.
- Oyster fisheries management and restoration strategies to mitigate and manage the effects from disease (dermo and MSX) need to be refined based upon emerging information from the scientific community. A review of the available data and scientific literature should be conducted to determine if oyster malnutrition currently exists, and if so, whether or not these oysters are more susceptible to dermo and MSX disease. This information may be valuable in siting oyster restoration projects.
- The continued degradation of Bay water quality from land-based management decisions will further impede Maryland's ability to restore oysters to the Bay. All agencies of the State need to become more influential in informing and educating local decision-makers about the "down-stream" implications of their decisions. Local land-use officials also need to obtain better technical and financial assistance to improve the outcomes of their land-use decision making processes.
- A program to facilitate the transitioning of Maryland's traditional oyster fishery to privatization will be needed. This program should make a certain percentage of natural oyster bars available for private leasing. Consideration of providing the first opportunity of available bottom to traditional oystermen should be given because of social factors, however, it should be recognized that economically, aquaculture development might be best simulated by a free-market approach.
- The managed reserve program needs to evolve from a 100% government supported program to one that is primarily supported by the industry, is driven by market demands and includes the ongoing innovation and implementation of operating efficiencies.
- The effectiveness of oyster harvest management strategies, including but not limited to the establishment of harvest closure areas, is critically dependent on strong enforcement. Reported problems with the enforcement of oyster harvesting restrictions and compliance with oyster harvest reporting requirements must be defined and solutions implemented. Adequate enforcement is needed to facilitate evaluation of oyster recovery efforts. The establishment of large sanctuaries as suggested throughout this report for biological and ecological reasons will likely be a cost-effective strategy for improving enforcement.
- Maryland's future oyster management and restoration program have not yet been defined, however, based upon the available scientific information presented to the Commission it is likely that a significant increase and sustained commitment of government funding will be needed to support this program for at least the first ten years. The Commission recommends

that a decision to make an increased investment in this program should be based upon a scientific analysis of the probability that the implementation components of the new program will facilitate reestablishing an abundant and self-sustaining population of oysters in Maryland's Chesapeake Bay that would provide significant ecological benefits. The following oyster restoration program components and associated cost estimates were provided to the Commission by DNR. Although the Commission has not had time to thoroughly evaluate the components of this program, these estimates are being reported because the Commission believes it is important to begin discussing the level of funding that may be required to support this program and to identify potential funding sources.

- During the past 5 years (2002-2006), the State of Maryland and Federal government have invested an average of \$5.0 million annually on in-the-water oyster recovery (sanctuary and public fishery) activities.
- It is estimated that between \$41-87 million annually will be needed to support the following components of Maryland's oyster restoration program during the first 10 years.

Increased Hatchery Production: \$20-40 million for annual operational expenses for 10 years. The production of 2 billion hatchery seed will likely be needed for a minimum of 10 years to support efforts to restore the ecological function of oysters in Maryland's Chesapeake Bay. Production at this level will require enhancements to the existing oyster hatchery at the University of Maryland Center for Environmental Science's Horn Point Laboratory. Maryland's 2007 General Assembly authorized the expenditure of \$9.2 million to expand setting capacity of the UMCES oyster culture facility. This initiative will allow the significant expansion of capacity for production of hatchery oysters from 350 million achieved in 2006 to as many as 2 billion per year. Additional operational funds to produce, transport and plant this increased level of hatchery seed is still needed. Based upon current cost estimates of \$0.02/seed oyster, \$40 million is needed annually. This hatchery expansion is expected to improve the cost-efficiency of this program, however, the degree to which is unknown at this time. If the costs reduced to \$0.01/oyster seed, \$20 million will be needed annually. The goal after a minimum of 10 years will be for ecological restoration efforts to be no longer dependent upon a government funded oyster hatchery, and for private hatcheries to be developed and satisfy the hatchery seed demands of private aquaculture operations.

Increased Oyster Bar Habitat Rehabilitation: \$14-40 million annually for 10 years

Clean (sediment-free) oyster shell or a comparable substrate is essential for successful settlement of oyster larvae. A recent study reported that more than 70% of Maryland's oyster bar habitat has been significantly impacted by sediment over the past 25 years, and the majority of this habitat that remains is of low quality (heavy layers of mud and sand mixed with shell). More than 10,000 acres of oyster bottom will likely need to be rehabilitated to facilitate large-scale recovery efforts over the next ten years. Efforts to rehabilitate oyster bar habitat through planting a 6-inch layer of dredged and reclaimed oyster shell or alternative non-shell materials (slag, concrete, stone) currently cost \$14K and \$40K per acre, respectively. Based upon these cost projections, between \$14M and \$40M will be needed annually to rehabilitate 1,000 acres, and this level of funding would be needed for a minimum of 10 years. The Commission will

evaluate past and newly innovative oyster bar habitat rehabilitation strategies in 2008 to determine if more cost-effective substrate materials and rehabilitation methods exist.

Oyster Population Monitoring and Stock Assessment: \$2 million annually

A comprehensive oyster stock assessment is needed to establish biological reference points to more effectively monitor and adaptively manage the Bay's oyster resource. Modifications to DNR's annual oyster survey will be needed to provide critical data to support this stock assessment. The design of such a survey was initiated in 2007 and is ongoing. The costs associated with this survey and annual stock assessment is not yet known but anticipated to be higher than the costs associated with monitoring blue crabs and striped bass. This stock assessment should be coordinated with Virginia in order to provide a comprehensive analysis of the Chesapeake Bay oyster population.

Oyster Bar Habitat Mapping and Characterization Survey: \$3 million annually for 5 years

The mapping and characterization of Maryland's oyster bars is critically needed to facilitate effective and cost-efficient oyster bar habitat rehabilitation efforts, identify sanctuary locations, and design an improved oyster population monitoring and stock assessment survey. Maryland's oyster bars were last surveyed between 1978-83, and due to the significant loss of this habitat, results of this survey are currently of little value. DNR Resource Assessment Service, who conducts such surveys in coordination with DNR Fisheries Service and with support from NOAA Chesapeake Bay Office, estimates this survey costing \$3 million annually for 5 years.

Oyster Research Program: \$2 million annually for 10 years

Regardless of the approach forward, research will be a critical component to the overall oyster management and restoration program. Research direction will initially be established based upon an analysis of the scientific finding of the EIS to separate the critical need-to-know issues about oysters in Chesapeake Bay from those issues that are simply interesting research questions. It is estimated that a minimum of \$2 million annually for 10 years will be needed.

APPENDIX I

Oyster Advisory Commission Membership

- Chair, William Eichbaum, Vice-President, World Wildlife Fund
- Sherman Baynard, Maryland Coastal Conservation Association
- Torrey Brown, M.D., President, Intralytix; Board of Trustees, Chesapeake Bay Trust,; Chairman, Oyster Recovery Partnership
- Mark Bryer, The Nature Conservancy
- Donald Boesch, Ph.D., President, University of Maryland Center for Environmental Science
- Kim Coble, Chesapeake Bay Foundation
- Honorable Richard Colburn, Maryland Senator, Dorchester County
- Honorable Stephen Lafferty, Maryland Delegate; Environmental Matters Committee
- Douglas Legum, General Partner, Real Estate Development
- Doug Lipton, Ph.D., University of Maryland, College Park, Department of Agricultural and Resource Economics, Sea Grant Extension Program
- Mark Luckenbach, Ph.D., Virginia Institute of Marine Sciences, Eastern Shore Laboratory
- Pat Montanio, National Oceanic and Atmospheric Administration, Director, Office of Habitat Conservation
- Honorable Tony O'Donnell, Maryland Delegate; Environmental Matters Committee; Maryland Aquaculture Coordinating Council; Legislative Sportsmen's Caucus 2001
- Midgett Parker, Former Chairman, Chesapeake Bay Trust; Partner, Linowes & Blocher, LLP
- Ben Parks, Maryland Watermen's Association, Dorchester County; Maryland Aquaculture Coordinating Council
- William Richkus, Ph.D., Vice President and Operations Manager, Versar, Inc.
- Brian Rothschild, Ph.D., Dean, Graduate School for Marine Science and Technology, University of Massachusetts – Dartmouth; Chair, Oyster EIS Advisory Panel
- Jason Ruth, Harris Seafood Company, LLC
- Eric Schott, Ph.D., University of Maryland, Biotechnology Institute, Center for Marine Biotechnology
- Don Webster, University of Maryland, Cooperative Extension, Wye Research Center; Maryland Aquaculture Coordinating Council
- Bill Windley, Maryland Saltwater Sportfishermen's Association

APPENDIX II

2007 Meetings of the Oyster Advisory Commission

- The first meeting was held on September 17, 2007, at the Smithsonian Environmental Research Center, Edgewater, Maryland. At this introductory meeting the Commissioners discussed the duties of the Commission, reviewed the status of Maryland's current oyster restoration efforts and results, and participated in a strategic planning exercise to evaluate Maryland's efforts towards achieving ecological and socio-economic benefits from the Bay's oyster resource.
- The second meeting was held on October 18, 2007 at the University of Maryland Center for Environmental Science Horn Point Laboratory in Cambridge, Maryland. The focus of this meeting was on the biology and ecology of oysters. The meeting included a series of scientific presentations, a tour of the Horn Point oyster hatchery, keynote talk by author Tom Horton, and break-out group discussions to identify potential strategies for increasing the ecological benefits of oysters in Chesapeake Bay, identify the potential regions of the Bay, site selection criteria and management/restoration strategies that would be implemented if an investment were to be made to maximize ecological benefits, and identify the appropriate scales, in terms of time and place, that oyster management and restoration strategies should be designed for and evaluated.
- The third meeting was held on November 19, 2007 in Annapolis, Maryland. The purpose of this meeting was to obtain information on the socio-economic importance of oysters for the ecology of the Bay, and private and public oyster industries so that the OAC could discuss and begin to identify potential strategies for rebuilding a sustainable oyster industry. The meeting included a series of scientific presentations, Larry Simns, President of Maryland Watermen's Association, as the keynote speaker, and break-out group discussions to identify potential strategies for achieving optimum sustainable socio-economic benefits pertaining to oyster restoration in terms of ecological restoration and industry restoration. The Commission also discussed what is the appropriate role for state government in ensuring maximum net ecological benefits from an oyster resource and in ensuring a profitable oyster fishery, and to what extent these government roles are complimentary and to what extent they are conflicting.
- The fourth meeting was held on December 20, 2007 in Annapolis, Maryland. The purpose of this meeting was to prepare this Legislative Report.

APPENDIX III

Scientific State of Knowledge on Chesapeake Bay Oyster Disease Issues

- Disease Impacts

“Is the biggest challenge to oyster restoration in Chesapeake Bay to overcome the effects of disease?” Disease is not the only or necessarily always the biggest challenge, but without disease other problems (broodstock abundance, recruit supply, substrate/habitat quantity and quality, water quality, etc.) could be mitigated more effectively. As continued harvests present a major challenge, steps should be considered to protect potentially resistant broodstocks. Sanctuaries have not been supported with adequate enforcement.” (Burreson et al. 2007).

“Is disease still the dominant factor in all restoration and repletion activities?” Disease is significant, especially dermo disease, but continued harvesting of depleted natural populations, with associated deterioration of substrate/habitat and loss of essential natural broodstocks, is also important. Disease is a limiting factor because in some areas epizootics can quickly erase the effectiveness of newly created habitat or restored broodstocks.” (Burreson et al. 2007)

- Disease Bar Cleaning:

Within the scientific community, there has been much recent discussion over disease bar cleaning and whether remnant oysters on once productive oyster bars should be moved prior to rehabilitating the oyster bar with disease-free spat on shell. In Maryland, the remnant oysters have been moved downriver to a harvest bar for future harvest to remove the potentially diseased animals from the water column entirely. Another scenario currently being used in Virginia is to move the large and potentially disease resistant animals to a protected oyster reef, like a sanctuary, for future spawning potential.

“Is Bar Cleaning an Effective Disease Mitigation Strategy?” Bar cleaning was originally conceived in the 1950s as a strategy for managing dermo disease on lower Chesapeake Bay planting grounds, the idea being that fallowing beds for a season or two would keep *Perkinsus marinus* levels low. Despite early reports (1950-1967) of inconsistent protective effects of isolating uninfected oysters from *P. marinus*-infected oysters in Virginia waters, there is no modern evidence that removal of infected oysters from oyster planting grounds inhibits infection of juvenile oysters planted there, especially when high infection pressures predominate during high-salinity (drought) periods. Several recent evidences confirm that *P. marinus* is broadly distributed in dermo disease-endemic waters, and that *P. marinus*-free oysters planted >5km from infected oysters rapidly acquire dermo disease by contact with infectious cells disseminated from distant sources.

The efficacy of bar cleaning is particularly questionable because of the 20% of oysters that are typically left behind by cleaning efforts. An indirect negative impact of bar cleaning is the indiscriminate removal of healthy, potentially resistant animals that are ideal broodstocks for restoration.” (Burreson et al. 2007)

Past disease bar cleaning efforts in Maryland are currently being analyzed by DNR to scientifically determine if oyster dermo disease transmission to disease-free spat planted in medium to low salinity waters are influenced by remnant oysters in close proximity.

- Evolution of Natural Disease Resistance

“What Signs Exist, If any, For the Presence or Evolution of Disease Resistance in Chesapeake Bay Oysters?” There is strong evidence for MSX disease-resistance in wild oyster populations from Delaware Bay, where droughts have allowed penetration of *Haplosporidium nelsoni* to reefs furthest up-Bay. With the most susceptible individuals lost to *H. nelsoni*, surviving natural broodstocks are substantially MSX-resistant. In Virginia, *H. nelsoni* is normally present at low prevalence and intensities unless susceptible oysters are deployed, in which case the MSX disease impact is devastating. Natural Virginia oysters clearly appear to harbor some MSX resistance. No equivalent data are available for Maryland.

Evidence for dermo disease resistance has been more elusive, including in Delaware Bay. Even among hatchery lines, evolution of dermo resistance has been slow. In nature, even susceptible oysters may spawn once or twice before dying from dermo disease, making a reproductive contribution that would retard the development of natural resistance within the larger population. Even in selective breeding programs, however, resistance to dermo disease has been much slower to develop than was the case for MSX disease. Nonetheless, data from Virginia suggest that populations from dermo-enzootic waters are relatively resistant, characterized by prevalences and intensities of *Perkinsus marinus* (and *H. nelsoni*) infection, and overall mortality, more similar to domesticated disease-resistant lines than to naïve controls. Size-specific *P. marinus* prevalence data indicate that large oysters exist in Virginia and Delaware Bay populations that remain healthy despite intense disease pressure. A disproportionate reproductive contribution from such “resistant” oysters—assuming such is heritable—may underlie development of *P. marinus* resistance in wild populations. These findings may not apply to Maryland waters, where dermo disease is normally less prevalent, and thus where selective pressure is lighter.” (Burreson et al. 2007).

When considering the potential evolution of disease resistance it is important to examine the temporal scale which may be required. No where in the world has a native oyster population impacted by dermo and MSX recovered to a significant level. Modest improvements in Delaware Bay’s oyster population have taken more than 30 years. A significant investment in maintaining oyster bar habitat will be required if this amount of time is needed.

- Use of Selectively Bred Disease Resistance Oysters

“Should Oysters Selectively Bred for Disease Resistance Be Used for Oyster Restoration?” Genetic issues aside, there is no compelling argument for use of domesticated oysters in ecological oyster restoration, given 1) the absence of evidence that planting of domesticated oysters yields improved survival, or higher subsequent recruitment; and 2) the comparable disease resistance and survival of natural strains in the field; and 3) the cost of hatchery seed. It is unknown whether domesticated MSX- and dermo-resistant lines would be as resilient as diverse natural populations in the face of future environmental or disease (viral, parasitic,

etc.) challenges. Nor do we know the costs or trade-offs of fast growth and disease resistance in domesticated lines.

A more cost-effective and defensible restoration strategy would begin with leaving natural oyster populations alone, creating sanctuaries and enforcing harvest moratoria to allow populations a chance to expand, and disease resistance to evolve.

Domesticated disease-resistant lines are acceptable for use in purely commercial restoration (i.e., repletion, harvest reserves) and recommended for use in aquaculture.” (Burreson et al. 2007)

- Movement of Infected Oyster Seed

“ Should infected seed be moved under any circumstances, and if so, what are suitable criteria? Anthropogenic parasite dispersal associated with the movement of relatively small numbers of lightly infected oysters may be relatively insignificant against a larger backdrop of natural parasite dispersal and transmission. Nonetheless, transplantation of infected natural seed is not advisable, in general. If infected oysters must be transplanted for repletion purposes, an assessment of infection levels and oyster numbers should be made prior to transplantation. Oysters should be transplanted at small size and only to areas characterized by similar or higher disease levels. Small, and presumably young, oysters are likely to have lower parasite burdens than larger, older oysters. Their smaller tissue mass further diminishes the total parasites per oyster. Under no circumstances should large numbers of even lightly infected oysters be planted in areas that have historically low *P. marinus* prevalences.”¹

¹ Burreson, Eugene M., Corinne Audemard, Ryan B. Carnegie, Christopher F. Dungan, Susan E. Ford, and Kennedy T. Paynter. 2007. Report from a June 5, 2007 meeting relating to oyster disease issues contained in the 2004 Chesapeake Bay Oyster Management Plan.