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

Maryland Oyster Advisory Commission's 2008 Report

Concerning Maryland's Chesapeake Bay Oyster Management Program

Submitted to the Governor and General Assembly

January 30, 2009

EXECUTIVE SUMMARY

There is an unprecedented opportunity for the State of Maryland to exert bold leadership in setting out a comprehensive approach to achieve the vision of both the ecological restoration of oysters in the Chesapeake Bay as well as the revitalization of the oyster industry. The following recommendations offered in this document by the Oyster Advisory Commission, when taken together, can stimulate and catalyze the needed actions to transform the commercial wild industry and the ecology of the Bay. Actions will be required not only by the State, but also by the communities, the industry, and the public. The State's leadership is needed to ensure that these recommendations, if adopted, receive the funding necessary to ensure the successful fulfillment of these goals.

Major recommendations include:

- Focusing ecological restoration efforts in a large-scale, interconnected fashion (river system wide) as the strategy most likely to allow large populations of oysters to persist in the face of disease and other stressors.
- Implementing a new oyster fisheries management plan, based on maximum fishing mortality rates, improved annual population and habitat surveys and more accurate harvest reporting.
- Addressing and resolving illegal oyster harvesting from all areas of the Chesapeake Bay especially protected, prohibited and leased areas.
- Revising restrictive laws and regulations that currently inhibit private cultivation of shellfish. These will include a streamlined and timely permitting process, production standards for use and oversight for sustainable industry growth.
- Developing a transparent and balanced transition strategy for growing Maryland's oyster industry based primarily on aquaculture that includes education, training and start-up funding resources for watermen.
- Reversing habitat degradation and loss must be a primary focus for both ecologic and economic conditions. 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.
- Increasing and diversifying sources of disease-free oyster seed and identifying new sources of substrate to meet future ecologic and economic needs.

The Commission recognizes that a significant increase and sustained financial investment will be required to transition the industry and support the ecologic goals outlined below. The recent 2009 state capital funds, federal crab disaster funding and the annual state and federal support for in-the-water oyster recovery (sanctuary and public fishery) activities has been and will continue to be vital to reversing the oyster's ecologic and economic decline. In the 2007 Interim Report, the OAC estimated that $40 million annually will be required to support Maryland's oyster recovery and the transition of the wild fishery to a sustainable aquaculture program for at least the first 10 years. The Commission will be working with the State in refining the budget requirements and goals in 2009.

INTRODUCTION

On April 24, 2007, House Bill 133 was signed into law establishing an Oyster Advisory Commission (OAC or Commission) in the Maryland Department of Natural Resources (DNR). The legislation directed 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;
- The latest findings of the multi-state and federal government's Environmental Impact Statement (EIS) evaluating native and non-native oyster restoration alternatives for the Chesapeake Bay; and
- Any other scientific, economic, or cultural information relevant to oysters in the Chesapeake Bay.

In addition, the legislation directed the OAC to report their findings and recommendations on the following to the Governor and General Assembly:

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

During 2008, the OAC has considered a number of issues critical to the achievement of that vision. This 2008 report sets forth the basic elements of a course which, if followed, provides the best, if not the only, opportunity for achieving both the ecological restoration and economic recovery of the Bay's oyster resources. The initial recommendations offered below are organized along four themes: Ecology, Industry, Economics, and Law. These themes reflect areas where the OAC, through its own working groups and also in collaboration with others such as the Maryland Aquaculture Coordinating Council (MACC), Fisheries Management Task Force, and the Department of Natural Resources (DNR), has carried out particular analyses and deliberations. It is the Commission's intent to continue in 2009 to refine the strategies outlined below while concurrently advising DNR on an implementation plan and pilot restoration and aquaculture projects.

In addition, the Commission, as directed by its legislation, has taken into account the latest findings of the bi-state and federal government's Environmental Impact Statement (EIS) evaluating native and non-native oyster restoration alternatives for the Chesapeake Bay, a draft of which was released in the fall of 2008. While the parties have not yet selected a preferred alternative, the OAC takes note of the fact that major scientific bodies and resource agencies have offered comments on the draft in strong support of Alternative 8a to enhance efforts to restore and cultivate the native Eastern oyster, *Crassostrea virginic*a. This has been the vision under which the OAC has done its research and the strategies under development are well poised to address.

VISION STATEMENT

On January 4, 2008, a 2007 Interim Report was submitted to the Governor and General Assembly wherein the Maryland Oyster Advisory Commission agreed upon a vision for the future of oysters in Maryland's Chesapeake Bay. That vision is set forth below.

"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 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."

ECOLOGY

1. Ecology

A. Introduction

The OAC believes that the state should take bold and creative steps to achieve the vision of expanding native oyster populations and the ecological services that a rebounding oyster

population provides. This can be achieved by focusing ecological restoration efforts in a large-scale, interconnected fashion that address two realities found within different populations of the Bay's oysters: (1) generally in lower salinity waters there is limited oyster spat recruitment and habitat with low animal mortality, and (2) generally in higher salinity waters there is recurring recruitment, limited by habitat and declining brood stock, with high mortality. The recommended approach requires large-scale harvest closure of areas to conserve remaining brood stock and remnant viable reefs, to foster development of natural disease resistance, sanctuary designation of those areas[1], and targeted investment focused on these targeted recovery areas (as available resources allow). Reversing habitat degradation and loss must be a primary focus under both conditions. Even where resources cannot be immediately invested, the state should act to protect additional areas that conserve and protect remnant viable reefs and brood stock to provide source populations for future expansion potential and ecological services.

These actions have the best probability of assuring a viable self-sustaining population of native oysters through:

- The re-establishment of three dimensional reef structures which significantly elevates oysters above the bottom.
- The protection of 'survivor' oysters and their progeny, resulting in long-term development (multi-decadal) of genetically-based disease tolerance.
- Creation of a linked system (through larval dispersal) of oyster habitats at a scale that is resilient in the face of climatic variability and change.
- The prevention of the spread of disease.
- The simplified and manageable control of illegal harvest activities in very large closed areas.

It is clear that there is a growing and substantial scientific view that such a bold and creative strategy offers the only significant possibility of restoring viable large populations of native oysters to Maryland's Chesapeake Bay. A February 2008 consensus statement by the scientists at the University of Maryland Center for Environmental Science concluded that "because of the extremely depleted spawning stock of oysters in the Chesapeake Bay, the number and size of sanctuaries should be greatly enlarged and closure and other measures to reduce fishing mortality of the mature oysters should be implemented..." More recently, important scientific comment on the Draft Environmental Impact Statement (DEIS) for Oyster Restoration in Chesapeake Bay from the Atlantic States Marine Fisheries Commission, the Chesapeake Bay Program Scientific and Technical Advisory Committee and the Virginia Institute of Marine Science all recommended Alternative 8a in the DEIS as the preferred alternative. That alternative provides for enhanced efforts to restore Eastern oysters, and the imposition of a temporary harvest moratorium. What the Commission proposes below is a detailed strategy for implementing, with some modifications, Alternative 8a of the DEIS in Maryland.

Finally, it should be noted that a significant proximate cause of oyster decline in the Chesapeake Bay is disease. The DEIS itself notes that "harvesting an oyster population that is

[1] Current protected sanctuaries account for only four percent of the native oyster bars (NOBs) in Maryland's portion of the Chesapeake Bay.

severely affected by diseases may slow or prevent the development of disease resistance in the exploited population. Oysters that survive to reach and exceed the legal market size (three inches) may be individuals that are naturally genetically resistant to disease…removing a large percentage of oysters that may be exhibiting some level of disease resistance would clearly impede the rate at which such resistance could be propagated throughout the stock." (DEIS 4-30).

B. Detailed Discussion and Findings

The two overriding immediate impediments to achieving the re-establishment of expanding populations of native oysters are poor oyster survival and poor oyster recruitment. Together these two factors contribute not only to continued decline in the population, but also to a reduction in shell substrate on which successful recruitment and population growth depend. Key factors contributing to poor oyster recruitment include low brood stock abundances, low reproductive output in low salinity environments, poor larval survival in some areas and, perhaps most importantly, a lack of adequate substrate for oyster settlement. The key factors contributing to poor oyster survival include disease-related mortality, predation and harvest pressures. Mortality has likely been enhanced by poor water quality conditions, weather, poor food sources, low physical relief in degraded oyster habitats, disease transfer from infected areas, in part as a result of the movement of infected seed.

During the course of the ecological review, the following findings were determined:

- An evaluation of bar-specific data suggests that mortality is not solely controlled by salinity (i.e., there are bars with mature reproducing oysters within all salinity zones).

- In the absence of harvest (legal and illegal), high survival of hatchery-produced oysters has been observed on rehabilitated reefs in low and moderate salinities and the available data suggest that these rehabilitated reefs provide valuable ecological services, including water filtration and habitat for valued species.

- There is insufficient data to evaluate the contribution of oysters in low salinity sanctuaries to regional oyster recruitment. To evaluate the potential of these hatchery-produced oysters to contribute to region-wide recruitment, better data on gametogenesis, spawning, larval dispersal and recruitment are needed.

- A greater regional (i.e., seascape-level) perspective in the designation of sanctuaries and addition of substrate for larval settlement is needed. To date, the placement of oysters on managed reefs (including sanctuaries and managed reserves) and shell plantings designed to provide settlement habitat have not been located with the goal of expanding oyster populations more broadly, but rather for maximum survival. Other criteria, including limits on the willingness to establish sanctuaries on productive grounds, local interests in restoration, and harvests interests, have been dominant. Recently developed larval dispersal models already offer a potentially powerful tool for siting reefs and restoration sites that could be important sources of recruits or important recipients for settling larvae. These will become even more powerful tools as they are refined.

- Though oysters in higher salinity regions within Maryland are generally susceptible to higher disease pressures and mortality rates, oyster recruitment rates in these regions remain higher than elsewhere. This indicates the presence of reproductively-viable populations in these areas. Thus, in these regions significant numbers of oysters are reproducing prior to succumbing to disease, predation or harvest. These populations may be self-sustaining and while they may not be increasing, they are providing ecological services despite the fact that many oysters do not reach market size. A better understanding of the distribution of these source populations would aid in the protection of this natural brood stock, the potential increase in recruitment, and in the placement of substrate for new recruits.

- A shortage of high quality habitat for oyster larvae settlement and growth in higher salinity environments represents a significant limitation on the population's expansion potential. DNR's fall survey data and shell planting program illustrates that this region regularly experiences significant recruitment. Recent limitations on the availability of dredged shell have curtailed the shell planting program. Alternatives to the use of fossil dredged shell—including rehabilitating oyster bars, reclaiming previously planted shell, purchasing shell from out-of-state suppliers and the use of alternative materials—all will need to be considered for enhanced restoration. Equally important may be the more judicious use (e.g. targeted placement) of shell in these areas to enhance sites which serve as brood stock sanctuaries.

- The Programmatic Environmental Impact Statement on oyster restoration alternatives for the Chesapeake Bay, including native and/or non-native oysters, suggests that there is evidence of the emergence of natural disease tolerance with the native oyster against MSX and dermo Specifically "eliminating harvest clearly would increase the possibility of development of disease resistance in the native oyster population; however, the resulting magnitude of increase in the rate of population growth over time cannot be estimated." (DEIS 4)

- There is a high level of citizen interest in oyster restoration. The role of citizen-engagement programs is largely for education, outreach, and to create a groundswell of public support for oyster restoration. These programs also have the potential to contribute to a broader framework for restoration.

Achieving the goals of an expanding oyster population for the purpose of enhancing ecological services (e.g., habitat and filtration) is not synonymous with restoring an economically-viable fishery. That is, a viable, reproductively-capable and expanding oyster population need not necessarily (especially in its initial phases) contain harvestable quantities of market-sized oysters. Conversely, oysters grown for harvest through some form of cultivation may provide only modest ecological services based on current quantified data. Although the ultimate goal of the Commission's vision is for *self-sustaining* and expanding oyster populations, the Commission accepts that for an indeterminate period of time *sustainable* populations through limited socially-acceptable additions of substrate and/or seed oysters may be required to achieve the goal of expanding populations.

C. Ecological Restoration Strategies

The Commission's vision speaks to the need to employ large-scale (tributary wide) protected areas to achieve the ecological restoration goal. Our recommendation is that *sanctuaries* should not be viewed as a plot of bottom or even single, large oyster bars, but as regions sufficiently large to contain a diversity of oyster habitats and brood stock populations to seed them. Through this approach, oyster recovery efforts will have a measurable impact on the oyster population on a regional scale. This approach considers that oyster populations on individual bars are connected via larval transport, with some bars serving as source locations and others as receiving locations for larvae. It is also likely that only such an interconnected system will have sufficient resilience to remain viable in the face of the variability in weather and climate with its resultant impacts on salinity and hydrology.

There are also several practical consequences of this approach including staging rehabilitation efforts in a sequential fashion that optimizes available resources (hatchery seed, substrate and/or funding), includes citizen-based programs, and enables the best opportunity for efficient and effective restoration. Concentrating efforts within a region under different scenarios allows sound adaptive management decisions and ongoing evaluation review to occur.

<u>Limited recruitment with low mortality condition</u>

Low and mid salinity regions within the Bay and its tributaries naturally experience only intermittent low recruitment events, often separated by many years. This scenario is likely exacerbated by brood stock depletion, and could improve under intense restoration efforts (although still remain comparatively lower than high salinity areas). Restoration attempts in recent years in these regions have been exemplified by sanctuary and managed reserve bars on which hatchery seed oysters have been placed. Typically, these sites experience low disease mortality, but infrequent spawning and very low recruitment, such that the oyster populations are dominated by the hatchery-planted oysters. The ecological goals of restoration in this area have been ecosystem services directly from the planted oyster and some (hoped for) enhancement of larval production and recruitment within the region. Some data exist for the former, but few do for the latter goal.

Specific recommendations include:

- The state should initiate a process to select and designate several large scale sanctuaries, in this region within which to focus large scale ecologic restoration efforts. The OAC discussed the Magothy, Severn and South Rivers as potential candidates.
- In rivers other than those designated initially as large scale sanctuaries, the seascape-level issues discussed above should be addressed by designation of larger regions, such as a tributary or a significant part of one, as sanctuaries. The state should act to protect additional areas that are not part of active, large-scale restoration programs but provide potential for oysters to re-establish themselves. Restoration activities at all sites may include substrate rehabilitation (e.g., shell rehabilitation, reclamation and shell planting) to reconstruct bars prior to the deployment of hatchery-produced seed as well as

placement of shell (and alternative substrate) to serve as recruitment reefs, in the mid-salinity regimes.

- Mapping and evaluation of evaluating existing bottom conditions (exposed shell), historic trends in water quality, larval transport model predictions, staged restoration actions and specific evaluation approaches should be conducted as part of restoration within these sanctuaries.
- More thorough evaluation of sanctuary reef design (e.g., size, amount of topographic relief) and oyster plantings onto the sanctuary reefs (e.g., densities, size, timing and frequency) will help to optimize the available resources.
- The foregoing recommendations, coupled with rigorous assessment of intermediate success criteria, should be implemented in the best possible location. Factors to be considered in assessing the best location should include existing substrate quality, oyster survival and growth rates, and potential for enhanced recruitment.

Recurrent recruitment with high mortality condition

Achieving the OAC vision in the higher salinity zones in the southern portion of the Maryland Chesapeake Bay is predicated on: (1) the observation that, despite high disease mortality, sufficient oyster stocks remain in this region to provide for recurrent recruitment, though modest by historical standards, (2) the knowledge that, even under conditions in which disease is devastating to a fishery (by killing many of the oyster just prior to their reaching market size), an oyster population comprised of relatively few age classes can persist and reproduce, (3) the fact that these disease-impacted populations provide valuable ecological services and (4) recognizing that the prevailing practice of the industry is to sequentially harvest productive bars until they are no longer economically viable. We presume that the principal restoration activity within this region will be the rehabilitation of substrate to provide habitat for larval recruitment, and that seeding with cultivated spat is generally not necessary and only required under limited circumstances to augment local populations and to accelerate natural reproduction.

Specific recommendations include:

- At a minimum the state should initiate a process to create large sanctuaries in this region within which to focus large scale ecological restoration efforts. The OAC discussed the Honga and St. Mary's Rivers as potential candidates. These rivers naturally re-populate themselves and these actions would have modest restoration costs. The actions would focus on: (1) the preservation of reef structure, (2) the protection of 'survivor' oysters and development of disease tolerant progeny, (3) the prevention of the spread of disease, and (4) the control of illegal harvest in closed areas.
- Staged implementation of these approaches should be undertaken in a "proof-of-concept" that allows for evaluation and refinements to the strategy. Considerable attention should be paid to providing the best quality habitat (presumably through elevated substrate and good site selection) to promote rapid growth and thence enhanced tolerance to Dermo infections.
- Assessment protocols should be built into the design of the restoration project to support adaptive management and evaluate the ecosystem services provided by oyster

populations whose age structure is affected by disease and evaluate the potential emergence of disease tolerance in wild populations.

Variable salinity, recruitment and mortality conditions

Conducting restoration efforts in tributaries with diverse salinity regimes addresses limited recruitment with low mortality in the upper portion of the river and recurrent recruitment with high mortality in the lower portion of the river. Complete closure of such a system and targeted restoration offers a unique opportunity to test over time the interplay between climatic variability, larval transport and other factors critical to establishment of an ecologically viable and significant oyster population. This approach maximizes the scale of investment to produce results and learn in a complex ecological and operational context. As previously stated, this is the only approach likely to have a measurable impact on the regional oyster population.

Specific recommendations include:

- The state should undertake a large-scale ecological restoration effort in at least one large tributary with the necessary characteristics and close that system to wild harvest. The OAC discussed the Choptank River as a potential candidate. This would not preclude carefully managed oyster cultivation for economic purposes within the tributary. This approach would maximize the scale of investment to make progress and learn in these different ecological contexts. The recovery model that is utilized would be expanded over time to other tributary systems.

D. Conclusion

The proposed strategies outlined above do not ensure complete success, but are based on the best science currently available. The bay maps in Appendix III provide a visual representation of several alternative ways where these proposed oyster management strategies might be implemented. They are not offered as options but as mutually supportive strategies. They are not a short-term fix, but a long-term investment that will yield results over the coming decades.

Climatic conditions (severe drought or excessive run-off) can alter salinity regimes and compromise these strategies, but the establishment of sanctuaries on a very large scale offers a margin of protection in light of these variables. Further degradation of water quality (e.g. un-mediated agricultural and/or impervious runoff) and changes in predator abundances (e.g. continued increase in predation by cow-nosed rays) could threaten their success. Shell degradation rates may exceed regeneration rates, especially in higher salinity habitats, necessitating at least interim use of alternative substrate. Normal inter-annual variability in recruitment, growth and survival will play a significant role in how an oyster population develops. Even within the context of an expanding population over the long-term there will be good years and bad years—there have always been.

INDUSTRY

With the Maryland wild oyster fishery at historic lows, where once there were thousands of boats and harvesters, today there are barely a few hundred watermen who harvest in the six month oyster season. There is a growing realization within the watermen community that relying solely on a wild and put and take fishery is not a sustainable long term strategy. While the OAC recognizes the importance of retaining the remaining industry, it also believes that there are several requirements that need to be satisfied to assist the oyster industry to re-emerge as a national producer and distributor of oysters. They broadly include:

1. Developing new management concepts for the reemergence of a large oyster fishery based on private sector principles of investment and ownership.
2. Revising the structure of county oyster committees to reflect modern communications, joint decision making, and reduced industry size.
3. Increasing enforcement for protection of public and private oyster resources with penalties significant enough to deter theft.

In support of the Maryland Aquaculture Coordinating Council's (MACC)[2] recommendations, the OAC recommends strategies that it believes offer a good chance of rebuilding Maryland's oyster industry through the development of a vibrant aquaculture industry. This industry would integrate traditional and cultural oyster practices including retaining the harvesters, packers and processors still working in the industry, while looking ahead to build additional capacity through modern methods of sustainably-managed aquaculture. To meet our stated goal of producing *'the best oyster in North America',* it is important to keep Maryland product in the marketplace year round, support the remaining seasonal harvesters while concurrently expanding the marketing outreach efforts of this high quality, locally grown, sustainable seafood product.

Specific recommendations include:

- Revising restrictive laws and regulations that currently inhibit private cultivation of shellfish including a streamlined and timely permitting process (e.g. months not years) with production standards for use and oversight for sustainable industry growth.
- Consolidating the authority for aquaculture and permitting into a single state agency for increased accountability.

[2] The Maryland Aquaculture Coordinating Council (MACC) advises the state on matters of aquaculture policy and was created by the legislature in 2005 for the purpose of "advancing aquaculture." The Council is comprised of seventeen members in designated categories that represent agencies, institutions and industry involved in aspects of the aquaculture industry. The MACC held meetings to develop recommendations to advise the OAC for revising bottom and water column leasing programs. This was given further priority when Governor Martin O'Malley called for an aquaculture plan to be provided to him in September 2009. The MACC provided recommendations to serve as a framework for creating a new shellfish aquaculture leasing program, leading to economic and environmental benefits for Maryland.

- Attracting private capital for aquaculture development, including construction and operation of hatcheries, vessels, and processing facilities.
- Increasing legal protection of private property for growers.
- Developing and implementing a transparent and balanced transition strategy for existing commercial watermen from the wild fishery to aquaculture.

1. Fisheries Management Transition

Management strategies will need to strike a wise balance among ecological recovery, aquaculture and the existing wild fishery. Adaptive management and interim success criteria will be crucial to the implementation of these strategies. Moreover, since expanding the ecological services provided by oysters is explicitly part of our goals, quantifying those services provided by the proof-of-concept projects will be required to assess their effectiveness. Thus, appropriate monitoring programs should be developed as integral parts of any project designed to implement these strategies. Critical to these programs, and dependent upon the locations selected for large-scale sanctuaries, will be the estimation of the numbers of oysters and substrate needed to achieve targeted restoration efforts. This needs assessment will also guide long-term planning for acquisition of these resources, such as providing incentives to increase hatchery capacity and identification of novel sources of substrate. Lastly, illegal harvesting from all closed areas (protected, prohibited and leased) will compromise all of the state's recovery efforts if not satisfactorily addressed and resolved.

It is clear, given the current status of both oyster populations and oyster habitat, the continued existence of multiple stressors on oyster populations, resource limitations, and natural variability, that success must ultimately be measured on decadal time scales. Thus, it is important that intermediate criteria be established and measured (e.g., within five-year assessment window) to evaluate progress and modify restoration approaches as appropriate. Examples of relevant six year short-term goals include:

- Implementing a spatial management plan that clarifies the role of ecological restoration with aquaculture, the public fishery and other Bay uses.
- Implementing a new fisheries management plan, based on maximum fishing mortality rates, improved annual population and habitat surveys and enhanced harvest reporting, that establishes biological and ecological reference points, promotes the retention of reef habitat and the development of disease tolerance, and acknowledges the importance of connectivity between reef habitats. Previously protected oyster sanctuaries should be reviewed for viability and a determination made as to their future potential as a source reef.
- Developing regional private hatchery capacity to meet the growing needs of aquaculture development and perhaps restoration efforts.
- Expanding the oyster production at the University of Maryland Center for Environmental Science (UMCES) Horn Point Laboratory from 500,000 to two billion spat on shell per year, with optimal allocation of these resources to strategic restoration and stimulus for the development of private-sector aquaculture.
- Identifying new sources of substrate that meet future economic and ecological restoration needs.

- Measurably increasing oyster reef habitat and populations in targeted rivers.

DNR needs to carefully assess the impact of implementing the ecologic strategies recommended above on the public fishery and existing harvesters, as well as the potential development of new aquaculture practices. The Commission recognizes that eliminating the public fishery alone will not rebuild and restore the oyster population, therefore full implementation of the plan recommended by the OAC may leave areas of the Bay open to a well managed fishery. A public consultation process should be undertaken for new closures and, where possible, economic alternatives considered for affected watermen.

In those areas available for wild harvest (see Appendix III), the OAC recommends the state enhance its management of the fishery, as outlined in the Oyster Management Plan, to include setting limits on fishing mortality rates based on biological reference points, harvest quotas and/or the feasibility of implementing elements of a catch share type program. The oyster harvest would be managed based on attaining naturally sustainable population thresholds through oyster bar harvest quotas, and not daily catch limits. The ideal situation is to estimate the amount of oysters that can be taken safely from the population while maintaining a sustainable population and fishery.

An important factor in measuring fishing mortality is accurate reporting of catch. Current evidence suggests that this is not being carried out and that both the statistical benefits necessary for an effective management program, along with payment of taxes designed to support the public fishery, are suffering. The OAC recommends that DNR immediately review its reporting system to accurately determine catch rates and consider restructuring the current bushel tax. This program would serve as a basis for future measurement activities in all areas that are open to public harvest.

2. Aquaculture Management Options and Findings

A. Lease Program and Aquaculture Enterprise Zones

One of the most viable aquaculture management options is for the State of Maryland to modernize and rewrite its existing shellfish aquaculture statutes for its bottom leasing program and work towards a more efficient structure for managing off-bottom aquaculture. The current laws have contributed to the systemic problem that has plagued Maryland's shellfish aquaculture efforts for over a hundred years by preventing many aspects of aquaculture that are considered necessary for attracting capital and entrepreneurs. One of the principal reforms needed is a transition from a program managed by legislative directives to one of broad regulatory authority. Regulations will offer the aquaculture program greater flexibility to adapt as the program evolves.

The Commission endorses repealing DNR 4-11A and restructuring the current submerged land leasing laws to enable increased access to Bay bottom including natural oyster bars (NOBs), statewide, and to develop a robust leasing program to encourage shellfish aquaculture. This program would: (1) establish Aquaculture Enterprise Zones (AEZs) that are intended to streamline the process for obtaining the necessary permits to conduct shellfish aquaculture in Maryland, and (2) grant state agencies the authority to promulgate regulations related to compliance with the National Shellfish Sanitation Program (NSSP) and permit conditions established through the Departments of Natural Resources, Environment and Agriculture.

The Aquaculture Enterprise Zone (AEZ) concept was developed to designate locations that would have pre-approved permits for all types of oyster aquaculture. Developing these zones would aid in accelerating the permitting process, providing protection from poachers through "safety in numbers" and targeting enforcement by NRP and minimizing user conflicts by having designated areas for production. These AEZs would be placed in approved waters, negating the problems that many have with being situated in restricted waters and being forced to relay oysters to approved waters for depuration prior to sale.

The state would seek to acquire permits through a transparent public process from the US Army Corps of Engineers, Baltimore District, and relevant state agencies. The state would then sublease plots within each AEZ to growers, thereby minimizing the time to acquire a permit from years to months. Off-bottom growers would not be restricted to AEZs, but operating in an AEz would speed up the permit process, and being co-located with other growers would provide protection against illegal harvest. Other incentives could include the availability of dedicated financing, training programs, enhanced protection status, and priority by the Maryland Department of the Environment for monitoring water quality.

To ensure that these areas would be managed in an environmentally responsible manner, the lessee would agree to abide by current Best Management Practices and agree to production standards developed for them. This would include mandatory goals for planting and harvesting, with administration and oversight of the program by the designated aquaculture agency. To attract current harvesters to this new opportunity, the Commission believes there should be a provision granting active watermen priority in obtaining access to areas at the onset of the program. Future expansion of AEZs should also be taken into account when establishing them so that they could be enlarged for future development, if proven viable, to minimize adverse public reaction to their location.

Specific recommendations include:

- The Commission endorses repealing DNR 4-11A, restructuring the current submerged land leasing laws and establishing aquaculture enterprise zones (AEZ) via a regulatory process.

B. Industry Management Areas

Through a range of discussions and demonstrations, watermen have expressed interest in cooperative production of oysters. This has led to the new concept of the Industry Management Area (IMA), where groups of watermen could participate in the management of natural oyster bars. Allowing watermen and/or watermen groups (co-ops) to manage these areas, individually or regionally through a coordinating organization, would decrease the reliance upon public funds with the intent that over time they would be funded solely by private funds generated by the operation.

The Industry Management Area (IMA) concept grew out of a project begun in 2007 by the Calvert County Watermen's Association (CCWA). The group obtained leases and grew oysters as a group, selling them when the market price was highest. They would determine methods to reimburse members who had worked on this project and ensure that part of the profit went into future expansion activities. This project included the principles of group ownership of the resource with incentives for productivity. Similarly, in 2008, the Tangier Sound Watermen's

Association (TSWA) initiated its own program and has planted an area with hatchery raised spat on shell. As the pilot program begins its third year, a remote setting facility is being established in the lower Patuxent River to enable CCWA members to learn and produce oyster spat through educational outreach by the University of Maryland and logistical support provided by the Oyster Recovery Partnership. A similar program is being planned for the TSWA project where a remote setting system will be installed on Smith Island and training activities provided to watermen. Other watermen groups in St. Mary's, Charles, Dorchester, Kent and Somerset counties are also expressing interest in developing their areas.

The Commission recommends that the IMA concept be evaluated further and brought to action by legislation, if required. Watermen groups who participate will have access to resources necessary to establish and plant these areas. The structure of the program would allow groups of watermen to participate in the management of non-productive public oyster bars.

To assist the watermen during this transition phase, the areas currently designated within the Managed Reserve program would be integrated into the IMA (or AEZ) framework to begin within the next five years. This integration would thereby jump start the transition of the watermen community towards aquaculture, while simultaneously conducting pilot training programs with the watermen to maximize harvest and revenue opportunities. Opportunities would include remote setting, nursery operations, site monitoring, and other management and logistical issues.

3. Oyster Committees

The County Oyster Committees have been part of the state's oyster management structure for decades. These committees (comprised of 128 watermen), authorized by the Maryland legislature, were to provide advice to the Department of Natural Resources for its oyster repletion activities. Each oyster producing county had four committees elected from oyster harvesters (sail dredgers, hand tongers, patent tongers, and divers.) Committees were consulted by DNR personnel when determining where shell and seed would be moved and placed within the different parts of the river. A series of meetings were scheduled during the open oyster season to gain input from the various groups around the bay.

While the system appeared to work well in the past when the seed repletion program was active, it has fallen into functional disrepair. County oyster committees that share river systems neither meet together nor, in some instances, even speak with each other and few sailing dredge boats remain. Currently most counties do not have their full compliment of committees, and the ones that do are not comprised of watermen who "earn their livelihood by catching oysters" as prescribed in law.

Specific recommendations include:

- DNR should restructure the current oyster committees into six regional committees that are (Potomac, Patuxent, Upper Western Shore, Upper Eastern Shore, The Choptanks, and Tangier Sound regions). The committees, appointed by DNR, would be comprised of only five members each (total composition of 30 active oyster harvesters) and be advisory in nature.

4. Education and Training

In rebuilding the oyster industry, it will be necessary to support and expand industry training projects. While these have been offered over the years in Maryland, there is a need to expand them in a comprehensive manner. These should aid in developing new and innovative ways to build a comprehensive industry base through education. Also, there should be investigation of developing training for future generations through youth programs such as 4-H.

"Aquaculture is agriculture" is a familiar mantra of the industry, and extension programs have been a mainstay of education in farming for generations. The same types of programs are useful in building aquaculture skills and demonstrating equipment and techniques to increase productivity. Current aquaculture legislation assigns the task of extension programming to the University of Maryland where outreach and extension programs have been made available to the shellfish industry by the UM Extension and Sea Grant programs for many years. These have included seed production by remote setting, data and analysis for growers, managing oyster grounds, hatchery operations (short course), and predator control techniques.

While many of these programs have direct application to the current industry, expansion will require a needs assessment and further development. Courses that would likely be required as the aquaculture industry evolves include:

- Health and bio-security – Disease has been one of the most important factors in the loss of the oyster resource in the bays. This program would provide an overview of the major diseases affecting shellfish in the region, with information on visual signs of epizootic and where to obtain health diagnosis (using the best available technology). It would provide options for growers experiencing problems from disease and steps for bio-security from the hatchery through the grow-out process. It would be similar to the Integrated Pest Management programs that were used in crop agriculture for many years.
- Grounds Management – The program would work with growers to determine the most cost-effective methods of renovating existing shell deposits, stabilizing grounds through innovative techniques, and developing grow-out equipment for a variety of conditions for sustainable production of shellfish.

Specific recommendations include:

- University of Maryland Cooperative Extension will assess current educational programs and develop new topics to support the training of new and existing growers, watermen, and 4-H and youth audiences by developing comprehensive training activities in shellfish aquaculture, including cage construction, oyster husbandry and hatchery management.

ECONOMICS[3]

According to statistics provided by the Food and Agricultural Organization (FAO), 4.7 million tons of oysters valued at $3.2 billion were produced in aquaculture worldwide in 2006. U.S. oyster aquaculture production has grown steadily in recent decades. By region, U.S. oyster aquaculture production is dominated by the Pacific coast states where production in 2006 exceeded 94 million pounds at a value of over $84 million. The existence of an industry of this magnitude exhibiting substantial growth clearly indicates that aquaculture of oysters, under the appropriate circumstances, can be a profitable enterprise. Recent successes in Virginia and Maryland have established the technical and biological feasibility of culturing native oysters in the Chesapeake Bay, even in the face of the endemic oyster diseases.

1. Strategies for Culturing Oysters in Maryland

Three of the biggest challenges facing commercial production of wild oysters in Maryland are: (1) disease mortality in high and mid salinity regions, (2) low recruitment in all salinity areas and (3) the unpredictability and reliability of recruitment. While there may be multiple approaches towards overcoming these limitations, the use of hatchery technology to produce seed with desired characteristics (e.g., disease tolerance and rapid growth) or seed for areas with low recruitment is the common denominator among them. Though we do not know all of the details of the approaches that will be used by successful oyster aquaculture ventures in Maryland— those will depend upon entrepreneurial innovation by the culturists—the following three scenarios have been reviewed: (1) extensive aquaculture (bottom culture using spat on shell); (2) intensive aquaculture (bottom cage culture); and (3) intensive aquaculture (surface culture (oyster floats)).

A. Paths to Profitability – An Economic Analysis Tool for Oyster Aquaculture

For oyster aquaculture in Maryland to be economically viable, it will have to provide a competitive return on investment and compensate factors of production at their opportunity cost. If it is clear that oyster aquaculture in Maryland can be profitable, and a regulatory framework is in place to allow for that production, it is likely that a substantial oyster aquaculture industry will develop within the state.

Aquaculture production takes place in a world of uncertainty and variability. Often the difference between financial success and failure is the ability of the aquaculture manager to incorporate this knowledge of uncertainty and variability into management decisions. This is particularly important in the adoption of a relatively new technology where there is limited experience and performance parameters are often based on laboratory experiments or pilot systems that may vary considerably from commercial applications. Even with a substantial

[3] Most of the material is based on the "A Framework for Native Oyster Aquaculture Development in Maryland" (12/14/08) that was prepared in part for the Oyster Advisory Commission with funding being provided by the Keith Campbell Foundation for the Environment (KCF) and the NOAA Chesapeake Bay Office (NCBO).

aquaculture industry to draw information from, production cost and return data are not readily available, and even when they are, there is uncertainty in applying them to growth conditions in Maryland's portion of Chesapeake Bay.

The Aquasim simulation model (Table 1) is for a grow-out operation that plants 1.5 million seed oysters per year. From a financing perspective, this requires two years of investment at an average of $45,000 per year prior to any cash return. Cash flow requirements, including other related expenditures, require ideally about $120,000 be available to the operation prior to any positive revenue stream, making this an unlikely enterprise for an individual waterman without significant financial support in the form of low interest loans and/or loan guarantees. The more intensive the operation, the greater the likelihood additional financing (labor and equipment (cage) costs) is required, but this is accompanied by an earlier positive cash flow.

There are a variety of options available for an industry to follow to achieve financial success in oyster aquaculture. Evidence from other regions has demonstrated that any of the scenarios presented below can be profitable if performance is similar to the ranges specified in the operating and pricing assumptions. While the results are positive (see Table 1 for summary), it should be recognized that the net present value[4] estimates are returns to management; they do not explicitly account for compensation for the management time provided by an individual or group of individuals that is required to create the enterprise and run it on a day-to-day basis.

B. Paths to Profitability – Summary

All of the operations modeled require significant financing to carry the operations through to the period of positive cash flow. Under financing has been one of the major causes of failure for aquaculture operations in general. Thus, it will be essential to work carefully with perspective growers and the financing sector so that the level of financing required to achieve success in the industry is clearly understood. It should also be understood that not all operations will achieve the performance standards suggested here, and some business failures will occur as a necessary component of market operation. Finally, the scenarios presented in the review are just examples of profitable operations and outcomes. It is expected that actual operations will vary greatly in methods of operation and in finding the appropriate scale in which to operate.

Table 1. Major differences in assumptions for profitable scenarios of three oyster production methods and the expected revenue outcome. *Data estimates were produced using Aquasim, a modeling tool developed for the EIS. The data reference points (price and survival) were acquired by surveying oyster aquaculturists.*

	Bottom Culture	**Bottom Cage Culture**	**Surface Culture**
Time to Market	26 months	18 months	14 months
Survival (Minimum)	15%	40%	40%
Survival (Max)	65%	70%	70%
Survival (Most Likely)	40%	65%	65%

[4] Net present value is a calculation which takes revenues and costs that occur over a certain time period and equates them using a specified discount rate to a value as if all the revenues and costs occurred in the first year. For the analyses in this paper we look at revenues and costs over a ten year time period and discount them at 3% per year.

Market Price (Mean)	$.15	$.20	$.30
Market Price (std dev)	$.06	$.04	$.06
Outcome			
Net Present Value	$284,000	$830,000	$1,100,000
Coefficient of Variation (Risk) [1]	41%	9.4%	9.5%

[1]Coefficient of variation is for the net present value. It is calculated by taking the standard deviation of net present value and dividing it by the mean. The higher the coefficient of variation; the greater the variability of the result.

Start-up financing will be the biggest constraint in implementing an aquaculture program in Maryland. Rerunning the model suggests that minimum initial start-up costs range from $40,000 to $80,000 depending on the grow-out method for planting 1.5 million oysters on one acre which is a reasonable planting density per acre and minimum lease size. Based on the harvest statistics provided by DNR and discussed in the OAC Interim Report, the typical annual gross revenue of a waterman harvesting oysters is $6,000. Therefore, it is unlikely that a majority of individual watermen will have the start-up funds necessary to implement any form of aquaculture on their own. Groups of watermen might organize themselves in a business relationship to help overcome this financing constraint.

Specific recommendations include:

- Identifying start-up funding and insurance programs to reduce the barrier to entry and risk levels by watermen who pursue aquaculture. As a reference point, funding programs should consider the costs associated to achieve a five year growth plan based on 100,000 bushels of oysters harvested 2014.
- Develop watermen pilot programs in 2009 to validate the simulation model data and determine less costly scenarios to enter the marketplace.

2. Achieving a Million Bushel Aquaculture Industry

Recognizing that the transition from a wild fishery to aquaculture could take years, Table 2 provides a summary of metrics and sample milestones to illustrate the estimated requirements needed to achieve a million bushel industry. These figures do not include initial capital investments, equipment, insurance or labor. The restriction will initially be capital for private entities and watermen to enter the industry, regardless of the grow-out method that they select. The restriction long-term will be the availability of seed. Over the next five years, private hatcheries will have a window to build the necessary infrastructure and capacity to support the aquaculture industry's long-term seed requirements. Until then, the public hatchery at UMCES could augment seed demands while concurrently supporting restoration efforts. Within ten years, seed requirements could exceed Maryland's current public hatchery capacity. (See Hatchery Capacity and Seed Production under Other Considerations)

Table 2: Aquaculture Growth Program (*Bottom culture*)

	2010	2012	2014	2016	2018
Harvest (bushels) (300 oysters/bu)	10,000 bu / 3m oysters	50,000 bu / 15m oysters	100,000 bu / 30m oysters	500,000 bu / 150m oysters	1,000,000 bu / 300m oysters
Seed/Spat needed (40% survival)	7.5m	37.5m	75m	375m	750m
Acres needed 1.5M/acre	5 acres	25 acres	50 acres	250 acres	500 acres
Seed costs ($0.03)	$225,000	$1,125,000	$2,250,000	$11,250,000	$22,500,000
Seed costs ($0.015)	$112,500	$562,000	$1,125,000	$5,620,000	$11,250,000
Substrate (Oyster shell) $14,000 / acre	$70,000	$350,000	$700,000	$3,500,000	$7,000,000

LAW

Currently, there is no single factor more important to the future of ecologic restoration and aquaculture than to address and dramatically reduce the ongoing illegal oyster harvesting activities. All stakeholder groups, including commercial watermen, current leaseholders and environmental organizations and government agencies, agree that illegal harvesting is a problem that needs to be resolved. The problem has been part of the oyster industry since the 1800s, leading to creation of the Oyster Navy, forerunner of today's Natural Resources Police (NRP). Unfortunately over the last seventeen years, while the NRP has lost over 40% of its personnel, the conservation enforcement demands placed on its staff has only increased with its state park and homeland security obligations. As such, the unit has been spread very thinly which has resulted in rampant theft of oysters in all areas of the state's waters.

Many state-authorized committees and commissions have called for NRP resources to be increased. The Fisheries Management Task Force and the Aquaculture Coordinating Council have requested additional law enforcement resources for the last two legislative sessions to "advance aquaculture". All are in agreement that without a change in current enforcement policies, increased police presence in helping to guard the bays, oyster recovery and private aquaculture efforts will likely not succeed. In addition, prosecutors and judges must understand that the illegal removal of oysters, especially those "purposely cultivated" is theft of public and/or private property. In this regard, prosecutors frequently fail to understand the severity of the crime when viewed against other criminal acts in society. Judges similarly look upon natural resource violations as minor offenses with the fines, when paid, are often set so low that they looked upon merely as a "cost of doing business" by those who illegally harvest oysters.

Outlined below is a list of law enforcement and policy recommendations that the Commission recommends that the state legislature and management agencies review and adopt via legislation or regulation to minimize illegal harvesting activities in Maryland's portion of the Chesapeake and Coastal Bays.

Specific recommendations include:

- Prohibiting the use of power dredges in Maryland on non-leased areas unless specifically authorized by DNR.
- Applying buffer areas around sanctuary bars.
- Holding seafood buyers responsible for possessing and/or selling undersized oysters to include ongoing inspections by NRP for compliance.
- Clearly requiring dockside vouchers for sale of lease bottom oysters.
- Increasing current fine schedule for oyster related offenses, with a specific emphasis on undersized and un-culled oysters and harvesting in prohibited, protected and leased areas to include modifying the current policy of 'graduated violations' for harvesting within a sanctuary (distance from boundary) to one standard violation.
- Authorizing NRP to seize the vessel and/or equipment upon arrest and/or ticket issuance, if harvester(s) onboard are taking oysters/clams without a commercial license, operating with a suspended license or committing theft in prohibited, protected and leased area.
- Enabling TFL license suspension by a court conviction as well as through an administrative hearing upon receiving a citation.

The Aquaculture Coordinating Council drafted a list of potential recommendations that the Oyster Advisory Commission concurrently supports including:

- Assigning one/two prosecutors to handle all natural resource cases state-wide OR train one prosecutor in each county to handle these specialized cases. DNR/NRP would provide training to these prosecutors regarding Natural Resource law.
- Establishing a dedicated day each month in each county to hear natural resource cases.
- Coordinating with the state's Attorney General's office to develop a system for complex conservation cases.
- As stated in the Legal Review Report, giving judges the discretion to assess restitution on the defendant for egregious crimes.

Recognizing that additional NRP staff funding is limited, consideration should be given to deploying:

- Vessel Monitoring System (VMS) tracking devices on all commercial watermen vessels and require the system to be in operation anytime the vessel leaves the dock.
- Remote vessel monitoring systems that would integrate into NRPs video surveillance network.

OTHER CONSIDERATIONS

Substrate

Suitable substrate, ideally oyster shell or other suitable, low cost alternative is critical to any ecologic restoration program and some bottom-based spat on shell aquaculture cultivation programs. The Commission spent considerable time reviewing the state's current shell acquisition programs and recommended as outlined in Appendix II that the DNR proceed to prepare an application for a permit to dredge fossil shell at Man-O-War Shoal. The OAC was

also very supportive of DNR's other current activities in utilizing alternative substrate, purchasing shell on the commercial market, securing a permit to reclaim shell from previously planted sites, and utilizing watermen to reclaim shells on previously productive oyster bars. After issuance, DNR should consult with the OAC about the actual use of dredged shell at which time a decision will be made regarding reinstituting a limited seed repletion program.

Hatchery Capacity and Seed Production

A majority of all ecologic and aquaculture options are dependent upon hatchery-produced seed. As outlined in the Framework for Native Oyster Aquaculture Development in Maryland, publicly-funded hatcheries will play a role in research and development, development of superior oyster strains, demonstration projects and restoration projects, but they cannot meet the needs of a private aquaculture industry for several reasons. If private oyster aquaculture is successful in Maryland, demand for seed will quickly exceed the capacity of a state-run public hatchery. Moreover, as private hatcheries within the state begin to produce oyster seed, both for their own grow-out and for sale to other growers, state-run hatcheries pose undesired competition. Shellfish aquaculture industry experts at the workshop were unanimous in their advice that private hatcheries, driven by market demand, are the best approach towards meeting the needs of a thriving oyster culture industry.

A current lack of a reliable supply of high quality oyster seed, especially selectively-bred, triploid oysters, is frequently cited by oyster aquaculturists in Virginia as a limiting factor; new growers in Maryland would face similar limitations. Numerous commercial shellfish hatcheries are in operation in other states along the U.S. Atlantic coast of which sixteen of these hatcheries currently report that they produce oyster seed. A few of these hatcheries have worked with growers from the Chesapeake Bay region to safely (bio-security) produce seed from stocks selected for growing in disease endemic areas. As demand for oyster seed from Maryland increases, this capacity among out-of-state hatcheries could increase. Maryland has an Aquatic Animal Health Policy in effect, with procedures for out-of-state hatcheries to follow in transferring animals into this state.

The high capital costs, technical training, and relatively long development time required for successful hatchery production pose significant impediments to the creation of new hatcheries in the region. Facilitating the expansion of private oyster hatcheries in Maryland will require a clear, consistent, and manageable regulatory framework, including discharge permits, zoning requirements, and the like. Additionally, the state should consider financial incentive programs, including low interest or state-backed loans and tax incentives[5]. Perhaps the most cost effective approach is for the state and other restoration organizations to purchase guarantees for some amount of oyster seed for restoration from private hatcheries. This approach would help to ensure that an entrepreneur who invests in developing a hatchery will have an initial market for seed or larvae.

[5] The state of Maine has a Seed Grant Program, providing $12,500 in renewable start-up funds that has been successful in assisting start-up hatcheries. Federal programs are also in place to assist this capacity-building, through NOAA (e.g. Fishery Finance Program) and USDA.

Aquaculture Funding Findings and Recommendations

A key component for aquaculture to succeed in Maryland will be the ability for entrepreneurs to have access to financial assistance programs. In risky enterprises such as aquaculture it is usually necessary to have government assume part of the risk through grants, loans, and guarantees. Both state and federal programs currently exist that could be used to aid in this regard.

- The Maryland Agriculture and Resource Based Industries Development Corporation (MARBIDCO) loans capital to industries such as aquaculture and has expressed an interest in expanding its offering in aquaculture. It is recognized that initial loans will likely be risky but assume that their repayment will be made in many cases. MARBIDCO is a stand-alone agency that works with many other departments, and has many years of experience with aquaculture, forestry and similar resource based industries. Providing aquaculture funding will recognize that this industry has many of the same risks and benefits as other rural economic development areas but that it can become successful as many other areas have.
- Other programs that exist include the Farm Credit Service, which has been allowed to loan money to fisheries and aqua-businesses for decades. These local cooperatives are found in many counties throughout the Chesapeake Bay area and have a successful record of providing funds in rural areas. While their goal is to ensure repayment of all loans, they have provided funding for some aquaculture projects in the past and, as success builds in the future, could be a strong source of working capital for growers.
- The National Marine Fisheries Service has programs that can provide financial assistance for vessels. Their programs have been in effect for many decades and they have a strong track record in working with industry in order to provide financing for vessel construction and reconstruction. These will likely become necessary as the industry grows and larger vessels for renovating and moving shell may be required.
- The Maryland Department of Business and Economic Development (DBED) administer programs to assist industries that wish to locate in the state. The staff is available to work directly with entrepreneurs who wish to build businesses within the boundaries of the state. While a complete listing of DBED programs is outside the scope of this report, their information is readily available online.
- The Maryland Industrial Partnership (MIPS) program is unique to this state and has been used in several instances to aid in developing aquaculture businesses. MIPS teams researchers with industry to conduct applied research and implement it to solve identified problems or initiate new product or production methods. Funding rules depend upon the scope of the project and whether the company is in start-up mode or already in business. Generally, two rounds of proposals are reviewed and funded annually.

Specific recommendations include:

- A state agency or institution should compile, at the earliest possible time, a package of information listing federal, state and local funding agencies and sources available

to growers. This information should be widely disseminated and readily available for those who seek to establish businesses within Maryland.

- The Aquaculture Coordinating Council has recommended and OAC concurs that a cost-share program for Maryland watermen be initiated. This could help provide funds for the purchase of remote setting equipment, larvae, or seed for the planting of leases. These funds should not be available to support instruction or operation of vessels or for salary. Creating a fund of this type would aid watermen in transitioning to this industry.
- Developing a package of financial incentives (including tax breaks and small business loans) to include the construction of small-scale oyster hatcheries. As part of such incentives, provide additional "credits" for employment of working watermen in the construction/development of the facilities.

Appendix I -Working Waterfront Commission

The Working Waterfront Commission (WWC) was created under Senate Bill 414 by the 2007 legislature. Its task was to study and make recommendations "regarding protecting and preserving Maryland's commercial seafood industry's access to public trust waters." The seventeen member group had its authorization extended through 2008 and will finalize its work prior to the end of this year.

While final recommendations have yet to be submitted, the work of this group has important ramifications for the development of aquaculture. Without shoreline areas in which to dock boats, stage gear, and offload shellfish, the industry will not be able to thrive. Too many former seafood processing plants have already been converted to other uses and the loss of these businesses will be detrimental to future of the seafood industry. The WWC has brought a great deal of information into their deliberations. These have included surveys of other states' working waterfront groups, with solutions provided by programs that have been instituted in many of our coastal state worried about similar losses. The issue is one that pervades the nation, owing to the increasing demand for development in areas that were formerly used for commercial fisheries by those who desire to live in coastal areas and with an appreciation of the traditional uses of them.

The Oyster Advisory Commission supports the work of the WWC. When the final recommendations of the WWC are completed, they would be presented to the OAC for final review and consideration prior to submission to the legislature.

Appendix II - Dredged Shell Decision Document

Dredged Shell

DECISION DOCUMENT

OYSTER ADVISORY COMMISSION

August 20, 2008

Prepared By: William M. Eichbaum, Chairman

Introduction

During the 2007 Session of the Maryland General Assembly, legislation was enacted directing the Department of Natural Resources to apply for appropriate permits to dredge fossil buried oyster shells on or before December 1, 2008 if the Oyster Advisory Commission recommends the application. The legislation also noted that the Commission should take into account the findings of the draft Environmental Impact Statement concerning oysters currently under preparation. The Oyster Advisory Commission has considered information regarding the dredging of shell at several of its recent meetings. At the July meeting, the Chairman of the commission advised that the Commission would take up this issue at its August meeting and make a recommendation. Unfortunately the draft EIS will not be available until October 17, 2008. Waiting until a November meeting to make a recommendation would leave little time for DNR to prepare and submit an application by the date directed in the legislation. Although, all of the conditions of the legislation are not possible to comply with, it still seems useful to provide DNR with preliminary recommendations regarding a permit application.

Discussion

It is clear that the availability of oyster shell or other suitable substrate is a critical limiting condition to the restoration of oysters to Maryland's portion of the Chesapeake Bay and is also vital to the continued existence of the oyster harvesting industry. It is equally clear that there are very few significant sources of oyster shell available. DNR has applied for, and may receive; a permit to reclaim buried shell from oyster beds but that will produce only about 18 million bushels of shell. This is only a very tiny fraction of the volume needed for ecological restoration of oyster populations.

DNR has examined a range of options regarding the possible dredging of fossil shell. (A long standing process discontinued several years ago.). Those options have been discussed with the OAC. Of the various options Man-O-War Shoal has the largest volume of shell available --- approximately 86 to103 million bushels. This would allow for restoration of up to 5,000 acres of oyster bottom. Although substantially greater volumes of shell are ultimately needed for extensive ecological restoration of oysters, this shell would allow for a significant step forward. Some portion of this volume could also be allocated for supporting the industry while in transition, if needed. Dredging at Man-O-war has a low impact on fish spawning activities, the benthic community, and dissolved oxygen levels. It does have a high impact on an area important for fish habitat; although there are a range of ideas about the design of the dredging activities that could result in no reduction in this feature and might even enhance it. Finally it should be noted that if DNR were to apply for a permit this winter it would take at least a year

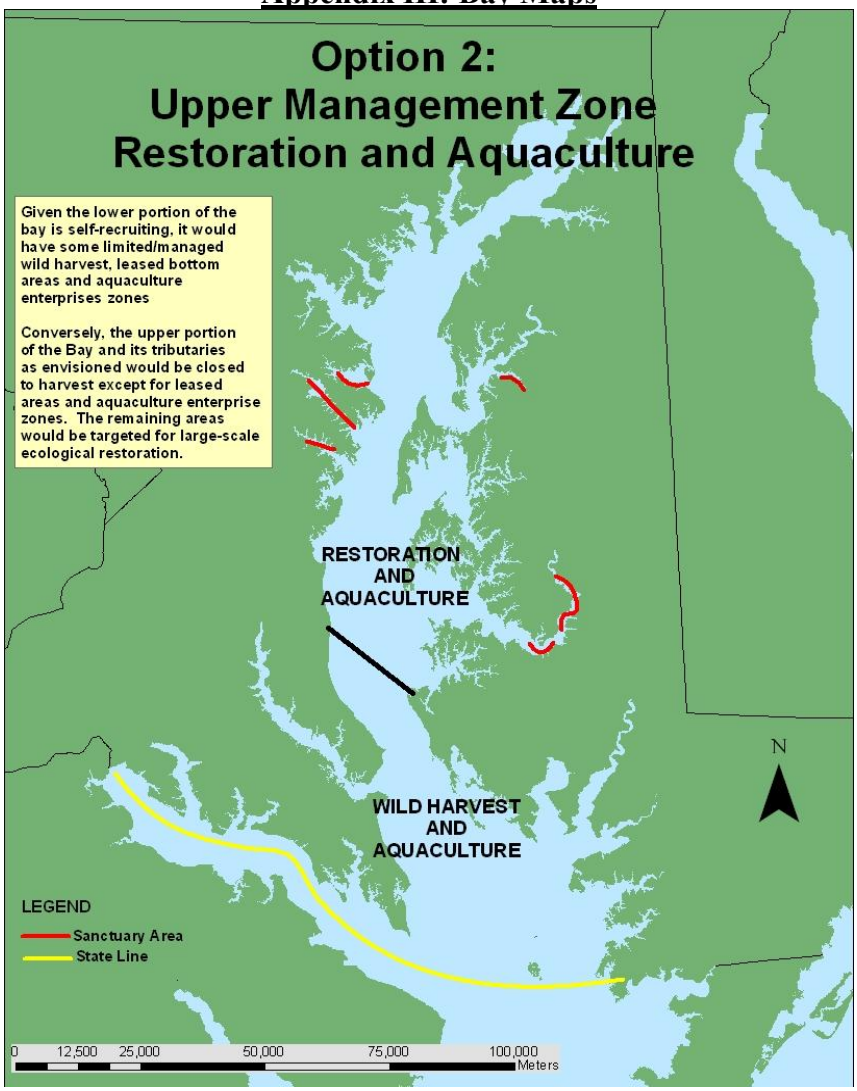
for that permit to be issued. It should also be noted that in the late fall of 2008; the OAC will have a full set of recommendations on how Maryland should proceed to restore ecological viable populations of oysters and rebuild the oyster harvesting industry. Any recommendations will depend upon the timely availability of shell.

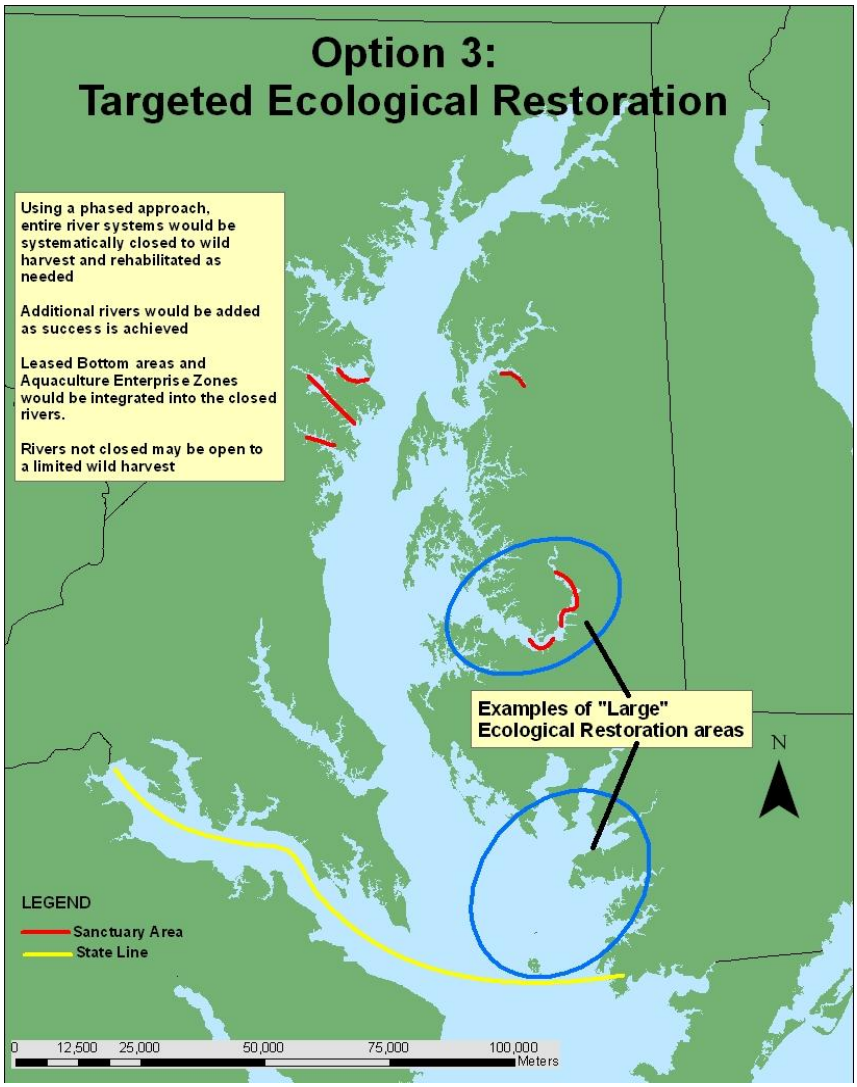
Recommendation

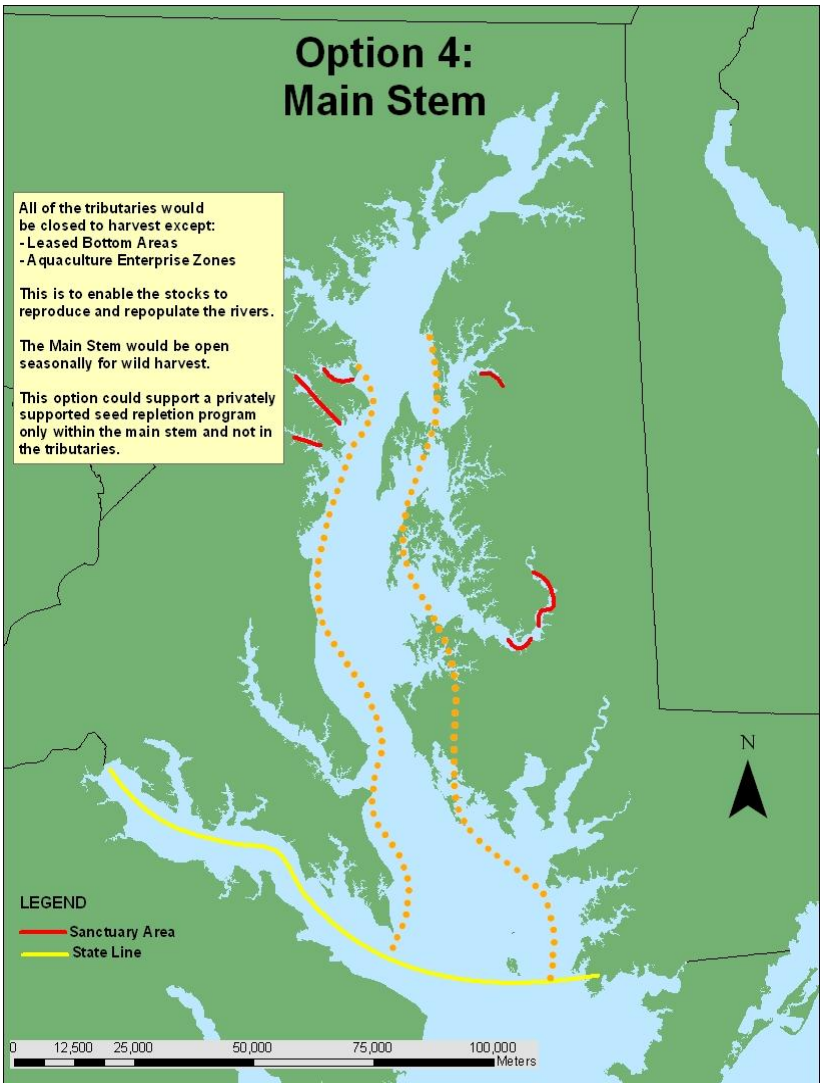
It is the recommendation of the OAC that DNR proceed to prepare an application for a permit to dredge fossil shell at Man-o-War Shoal. During the permit preparation process, DNR should carefully consider innovative design and operational characteristics that will minimize the short term and long term possible adverse impact of the dredging operation, the findings of the draft EIS, as appropriate, and the evolving recommendations of the OAC. Before submission the permit application should receive a final review by the OAC.

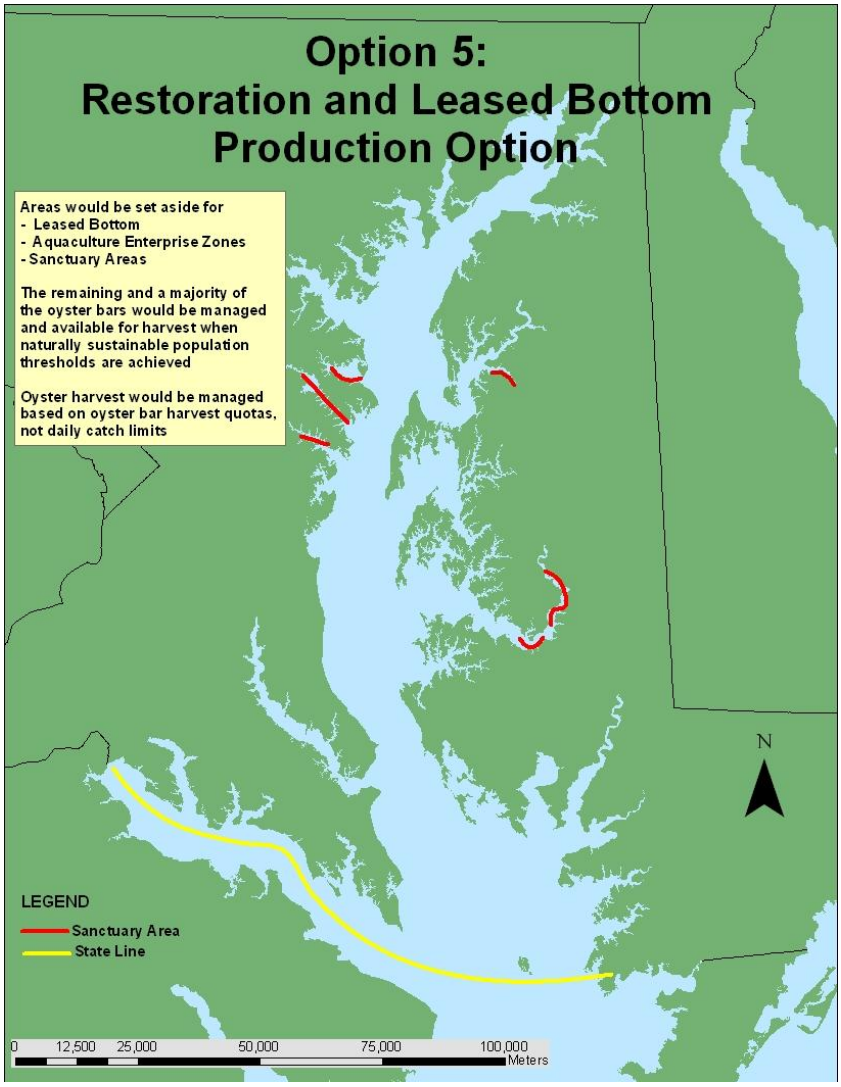
It is the view of the OAC that this permit should only be finally applied for if it is consistent with and will further the plan developed this fall by it for the ecological restoration of Oysters in Maryland's portion of the Chesapeake Bay. Therefore, the OAC would anticipate that the majority of the dredged shell will be used in restoration activities and only limited amounts as agreed by the OAC used for continued support of the industry. It is the expectation of the OAC that both during the permit application process and during its review sufficient interaction can take place between the OAC and DNR to assure that this is the case. After issuance, DNR will consult with the OAC about the actual use of dredged shell.

Appendix III: Bay Maps




Option 3:
Targeted Ecological Restoration
Using a phased approach, entire river systems would be systematically closed to wild harvest and rehabilitated as needed
Additional rivers would be added as success is achieved
Leased Bottom areas and Aquaculture Enterprise Zones would be integrated into the closed rivers.
Rivers not closed may be open to a limited wild harvest
Examples of "Large" Ecological Restoration areas
N
LEGEND
Sanctuary Area
State Line
0 12,500 25,000 50,000 75,000 100,000
Meters


Option 4:
Main Stem
All of the tributaries would be closed to harvest except:
- Leased Bottom Areas
- Aquaculture Enterprise Zones
This is to enable the stocks to reproduce and repopulate the rivers.
The Main Stem would be open seasonally for wild harvest.
This option could support a privately supported seed repletion program only within the main stem and not in the tributaries.
N
LEGEND
Sanctuary Area
State Line
0 12,500 25,000 50,000 75,000 100,000
Meters


Option 5:
Restoration and Leased Bottom Production Option
Areas would be set aside for
- Leased Bottom
- Aquaculture Enterprise Zones
- Sanctuary Areas
The remaining and a majority of the oyster bars would be managed and available for harvest when naturally sustainable population thresholds are achieved
Oyster harvest would be managed based on oyster bar harvest quotas, not daily catch limits
N
LEGEND
Sanctuary Area
State Line
0 12,500 25,000 50,000 75,000 100,000
Meters

Appendix IV – Oyster Advisory Commission Membership

2008 Oyster Advisory Commission Membership

- Chair, William Eichbaum, Vice-President, World Wildlife Fund
- Sherman Baynard, Maryland Coastal Conservation Association
- Torrey Brown, M.D., Chairman, Intralytix; 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 (UMD), 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, NOAA, Director, Office of Habitat Conservation
- Honorable Tony O'Donnell, Maryland Delegate; Environmental Matters Committee; Maryland Aquaculture Coordinating Council; Legislative Sportsmen's Caucus 2001
- 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., UMD, Biotechnology Institute, Center for Marine Biotechnology
- Don Webster, UMD Cooperative Extension, Wye Research Center; Chairman, Maryland Aquaculture Coordinating Council
- Bill Windley, Maryland Saltwater Sportfishermen's Association

Ecological workgroup members:

- OAC Members: Dr. Don Boesch, Mark Bryer, Dr. Mark Luckenbach and Dr. Brian Rothschild
- Assistance provided by:
    - Denise Breitburg, Smithsonian Environmental Research Center
    - Chris Dungan, Chris Judy and Mitch Tarnowski, MD DNR
    - Dr. Elizabeth North and Dr. Ken Paytner, University of Maryland

Economic workgroup members:

- OAC Members: Don Webster, Ben Parks and Jason Ruth
- Tommy Zinn, President, Calvert County Watermen's Association
- Jack Brooks, President, Chesapeake Bay Seafood Industries Association
- F. William Sieling, III, Executive Director, Chesapeake Bay Seafood Industries Association
- Greg Price, Somerset County Watermen's Association
- Roland Bradshaw, President, Tangier Sound Watermen's Association
- Larry Powley, Dorchester County Watermen's Association
- Robert "Moochie" Gilmore, Maryland Oystermen's Association
- Danny Webster, Somerset County Watermen's Association