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**DRAFT**  
**Chesapeake Bay  
Oyster  
Management Plan**

*Chesapeake Bay Program*

JUNE 1994

## Introduction

The oyster (Crassostrea virginica) resource in the Chesapeake Bay has been significantly impacted by the oyster parasites MSX and Dermo, habitat losses, water quality, and harvesting. In 1989, an Oyster Fishery Management Plan (FMP) was completed for oysters and included strategies to address the problems of harvest decline, recruitment, disease mortality, leased ground production, habitat issues, shellfish sanitation, market production and the repletion program. The oyster commercial harvest continued to decline and special committees were organized to review the situation. In Maryland, the role of the State in oyster management was analyzed and critiqued by a special committee appointed by the governor (Wolman Report 1990). As a result of the Wolman Report recommendations, the Maryland Department of Natural Resources (MDNR) increased oyster taxes and license fees, continued a seed supply for private aquaculture, continued the repletion program, developed stock assessment efforts and increased disease research and monitoring (Refer to Appendix I for a summary of the Wolman Report's major recommendations).

As the ecological value of the oyster resource in regards to water quality was recognized and disease became more limiting, an improved framework was needed for managing the oyster resource. In Virginia, a 33-member "Blue Ribbon" Panel met to discuss oyster issues and develop recommendations for restoring Virginia's oyster industry. Four potential oyster sources were considered: traditional state and private culture of C. virginica; off-bottom culture in approved waters; on-bottom culture of a non-native species, C. gigas; and on-shore depuration of moderately polluted oysters. The recommendations of the Virginia Blue Ribbon Panel were prepared and reported in the Virginia Holton Plan (Refer to Appendix II for a summary).

The Chesapeake Bay Program's Scientific and Technical Advisory Committee (STAC) initially played a dominant role in coordinating efforts to draft a baywide oyster restoration action agenda. After several workshops, eight problem areas were defined to maintain the oyster fishery and restore the oyster reef community. These problem areas were: restoration of habitat; recognition of ecological function; control of fishing mortality; improvement of the repletion program; management around disease; support of research; promotion of aquaculture and the establishment of oyster sanctuaries. The STAC work provided the framework for revising the 1989 Oyster FMP. Specific actions and details concerning these problem areas were developed by committee through the Maryland Oyster Roundtable (MOR) and the Virginia Holton Plan (VHP). The Virginia and Maryland committee reports served as the source documents for the 1994 Oyster FMP.

One of the major innovations resulting from the MOR was defining oyster recovery areas (ORA's). Restoration areas will be

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established in the Chester, Choptank, Magothy, Nanticoke, Patuxent, and Severn Rivers. These areas will be targeted for restoring oyster populations and then scientifically monitored to see how well new techniques are working. A non-profit corporation will be formed by aquaculturists, environmentalists and watermen to play a major role in developing and applying innovative oyster restoration techniques. The delineation of ORA's has resulted in two management sections in the revised 1994 Oyster FMP, the first section addresses baywide strategies and actions, and the second section addresses Maryland strategies and actions for the ORA's. The biological background section from the original 1989 Oyster FMP has been updated and included after the management sections. In addition to establishing ORA's, Maryland DNR will also establish a pilot permitting program for oyster aquaculture demonstration projects.

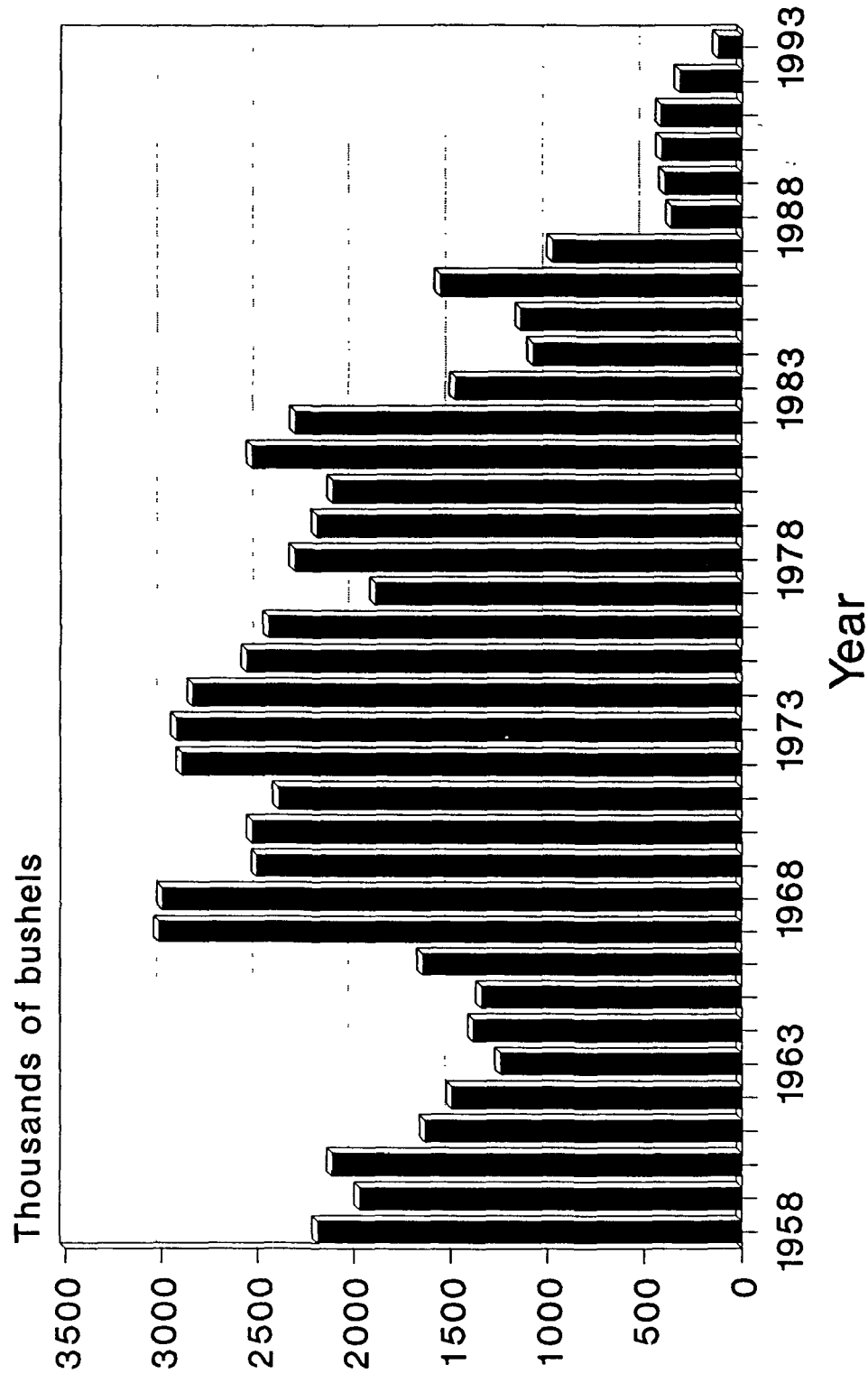
### **Ecological Role**

The ecological value of oyster reefs to the Chesapeake Bay ecosystem includes the effects of oyster filtration on water quality and the biological diversity associated with reef communities. Oysters filter phytoplankton and other organic particulate matter from the water column, thus clarifying the water and reducing organic loads contributing to anoxia (STAC 1992). Results from oyster modelling (Ulanowicz and Tuttle 1992) suggest that increasing oyster stocks either by aquaculture or enhancing natural oyster bars could augment the attainment of water quality goals. Although the ecological role of oysters in the Chesapeake Bay ecosystem is recognized, its benefit is indirect and hard to measure. Few data are available to quantify oyster reef community structure and function. Myatt and Myatt (1990) conducted an ecological study of hard-substrate communities within the Chesapeake Bay. They concluded that an artificial reef program would be an asset to the Bay environment. Since ecological functions overlap with other problem areas, specific actions addressing this issue have not been developed. Strategies and actions that restore oyster habitat and enhance/increase oyster production will benefit the ecosystem.

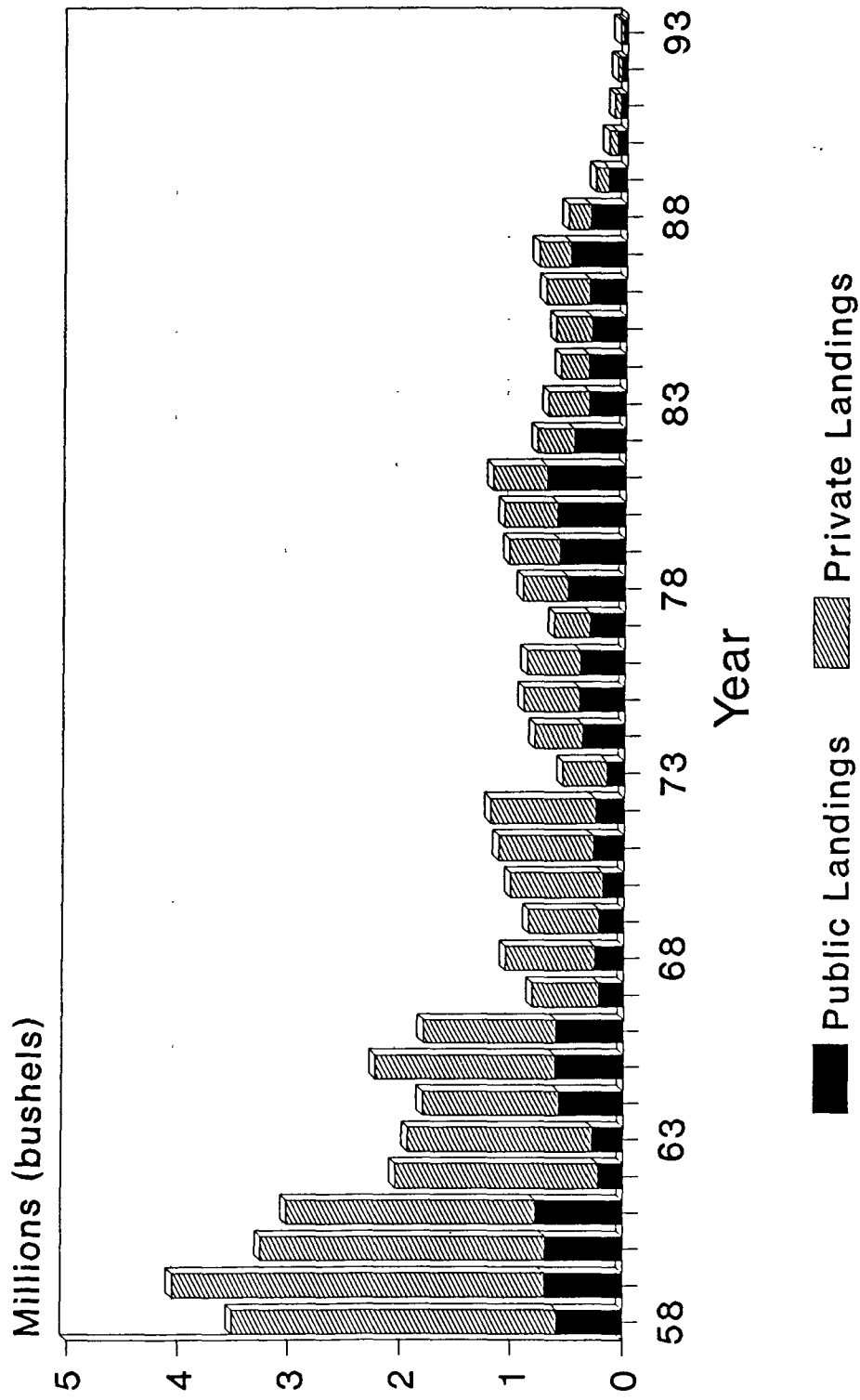
### **Current Status of the Oyster Fishery**

Currently, oyster harvest from the Chesapeake Bay is at an all time low. The fishery is restricted to a few areas where legal-sized oysters can be harvested. These are low salinity areas, where natural recruitment (spat set) is low and unpredictable, where the State's repletion programs expend the greatest effort, and where oysters are at greatest risk from freshets. During the 1992/1993 oyster season, 124,000 bushels were harvested from Maryland, 64,500 bushels from Virginia and 105,000 bushels from the Potomac River. Preliminary 1993/1994 commercial oyster landings from Maryland are 76,000 bushels. This is the seventh consecutive year of harvests below 500,000 bushels (Figure 1 and 2). Preliminary 1993/1994

Figure 1. Maryland Commercial Oyster Landings by Season



# Figure 2. Virginia Oyster Ground Production by season



oyster harvests from Virginia and the Potomac River were 30,000 and 223 bushels, respectively. Oyster surveys in Maryland indicate that oyster diseases have expanded their range. Oyster spat set has been variable (Figure 3). The 1991 spat fall index, the average number of young oysters found on a given amount of oyster shell, was the highest recorded in 27 years at over 200 spat per bushel. The 1993 oyster spat set was 16.2 spat per bushel. For greater detail on the biology and life history of oysters and an historic perspective on the oyster fishery, refer to the biological background section (p. 24).

The Virginia Marine Resources Commission (VMRC) biologists recommended a moratorium on the harvest of oysters from public grounds during 1993. After much deliberation and public hearings, the VMRC decided to shorten the oyster season and set a 6,000 bushel limit from October 15th through December 31st, restrict the length of tongs to 18 feet, and prohibit harvest after 12 noon. The VMRC's actions did not affect the harvest of oysters from private grounds. The restrictions were similar to those approved by the Potomac River Fisheries Commission (PRFC) in response to high oyster mortalities. Mortalities as high as 90% were reported in parts of the Potomac River due to a high freshwater influx from spring rainfall and snowmelt.

#### **FMP Status and Management Unit**

A Chesapeake Bay Oyster Management Plan was completed in 1989. The 1994 Oyster FMP supersedes the 1989 FMP. The management unit is the American or eastern oyster (Crassostrea virginica) throughout its range in the Chesapeake Bay. The Virginia oyster industry has two different environments, the Bay and Seaside. Management considerations for the Virginia resource are for the Bay oyster bars and do not include the intertidal Seaside bars.

#### **Goals and Objectives**

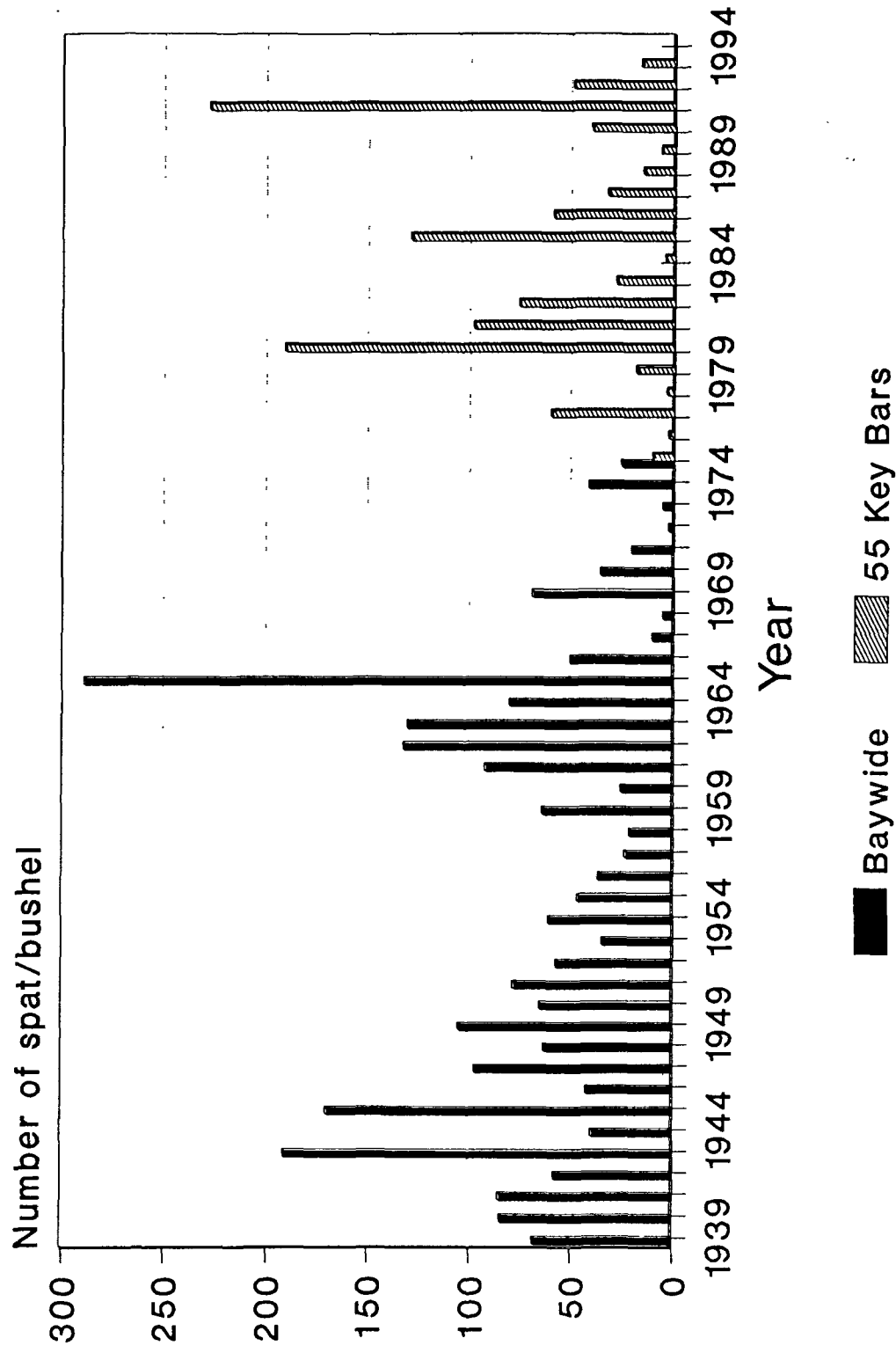
Overall, the jurisdictions will:

Enhance the ecological value of oysters in the Chesapeake Bay ecosystem by restoring habitat, controlling fishing mortality, promoting aquaculture and continuing the repletion programs.

The objectives defined by the Maryland Oyster Roundtable are:

- 1) Maximize and enhance the ecological benefits of oysters;
- 2) Maximize and enhance the economic benefits derived from harvesting in the public and private oyster fisheries; and
- 3) Maximize the ability of government to respond effectively to the magnitude of the problem.

Figure 3. Maryland spat set, 1939-1993



The objectives defined by the Virginia Holton Plan are:

- 1) Determine fair and justifiable harvest quotas through a data collection and analysis system.
- 2) Rejuvenate the public oyster fishery by redesigning the repletion program and evaluate the effectiveness of a redesigned oyster repletion program.
- 3) Implement a limited entry program for fisheries in order to protect both full-time fishermen and the resource.
- 4) Implement regulatory reforms and technical advisory service to strengthen off-bottom culture.
- 5) Explore the feasibility and ultimate construction of a depuration facility for oysters from both the private and public bottom.
- 6) Test in the laboratory and, conditionally, in the York River, the suitability of the non-native oyster, C. gigas, as a factor in the rejuvenation of Virginia oyster industry.

#### MANAGEMENT SECTION 1.

##### BAYWIDE PROBLEM AREAS AND MANAGEMENT STRATEGIES

##### Disease

Haplosporidium nelsoni (MSX) and Perkinsus marinus (Dermo) are the major impediments to restoring oyster stocks to the level of abundance of recent decades in the Chesapeake Bay. Approximately 100% of Maryland and Virginia oyster beds are infected with disease. MSX and Dermo are single-celled parasites that grow within oyster tissue. They cause significant mortalities within the first two years of life and have altered the size and age structure of the oyster population. Maryland stock survey data from limited areas, indicate adequate numbers of juvenile and premarket oysters but greatly reduced numbers of market-sized oysters. Although oysters exhibit highly variable growth rates, they can reach market size in about 3 years. This is enough time for diseases to eliminate all market-size oysters on a bar. Younger, less than 3" oysters, can still reproduce and maintain moderate recruitment success or spat set. Climate and subsequent changes in salinity affect disease distribution and infection. Salinities below 10-15 ppt and above 30-32 ppt are associated with decreased MSX activity. MSX can inhibit oyster growth and gametogenesis in spring. Dermo can tolerate lower salinities and is more persistent and damaging to oyster populations than MSX.

Currently, there are no known disease-resistant oysters available. Rutgers has developed an MSX resistant strain which can



become infected with MSX but will survive to market size. This strain, however, is more susceptible to Dermo than regular oysters. A major breakthrough in 1993 was the culture of Dermo in the laboratory. This breakthrough will make it easier to study the organism and, hopefully, facilitate some advances in disease research. In order to provide a successful research program, stable and carefully targeted funding must be provided over several years. After a pre-determined time frame, the research and management program should be critically evaluated to determine its effectiveness in reversing the decreasing trend in oyster stocks and progress towards controlling MSX and Dermo.

#### **Strategy 1.1**

The Bay jurisdictions will monitor the prevalence and intensity of MSX and Dermo in the Bay and attempt to minimize the spread of disease.

#### **Actions:**

- 1.1.1** The Bay jurisdictions will continue the annual disease survey, increase sample size and develop new disease detection techniques at the Oxford Laboratory and the Virginia Institute of Marine Science (VIMS).

##### **Implementation 1.1.1**

Continue existing sampling schedule during October/November and March.

- 1.1.2** The Bay jurisdictions will establish a protocol for certifying oysters, including seed oysters, for the prevalence and intensity of MSX, Dermo, or other pathogens.

##### **Implementation 1.1.2**

1995

- 1.1.3** Maryland and Virginia will continue their repletion programs using natural seed with low levels of MSX and Dermo contamination until enough hatchery produced, disease-free seed is produced. At that time in Maryland, movement of seed which cannot be certified will cease. Techniques for disease monitoring will include histocytology (thioglycolate assays and histological analysis), immunological detection tests and histopathology.

##### **Implementation 1.1.3**

Continue. Implement movement of disease-free seed from hatcheries as it becomes available.

- 1.1.4** The jurisdictions will continue to rotate seed areas to avoid transport of older year classes that have a higher probability of disease infestation.

#### **Implementation 1.1.4**

Continue

- 1.1.5** The jurisdictions will conduct a pilot study to test the difference in survival between seed moved in the fall compared to seed moved in the spring and investigate other approaches for seed planting to reduce the possibility of disease infestation before transport (part of improved repletion program).

#### **Implementation 1.1.5**

September 1994- April 1995

#### **Strategy 1.2**

The Bay jurisdictions will implement a coordinated, multi-year, goal-oriented research program to identify, understand, prevent and control MSX, Dermo, and other potential pathogens. Funding for this research should be stable, carefully targeted for specific research issues and followed by an evaluation after five years to assess progress and determine continuation.

#### **Actions:**

- 1.2.1** The Bay jurisdictions will delegate responsibility for coordinating the research program to a specific person/agency.

#### **Implementation 1.2.1**

1994

- 1.2.2** Maryland will initiate the first five-year phase of a multi-year research program aimed at early detection, prevention, and control of MSX and Dermo which will include the following:

- 1) Improve the methodology for early detection of disease during all life stages of oysters;
- 2) Obtain a better understanding of the life cycle of MSX and Dermo, including environmental requirements and identification of alternate hosts;
- 3) Identify existing information and intensify research on the physiological aspects of MSX and Dermo, including immune system function;
- 4) Determine why some oyster species are not susceptible to MSX or Dermo;
- 5) Utilize cell culture to learn Dermo's requirements for survival and the best methods of eradicating it;
- 6) Understand the effects of cold temperature and low salinity on parasites and relate them to various management scenarios;
- 7) Examine the response of C. virginica from other regions (outside the Chesapeake Bay) to MSX and/or Dermo when transplanted in the Bay.

**Implementation 1.2.2**  
1995-2000

**Strategy 1.3**

Research will continue on disease-resistant oysters, hybridization, and the possible effects of introducing a hybrid or exotic species into the Bay.

**Actions:**

- 1.3.1** Maryland will initiate a pilot field program to plant strains of the eastern oyster not native to Chesapeake Bay in higher salinity areas of the Bay and its tributaries. Adequate precautions will be taken to prevent the introduction of new disease strains and undesirable genetic stock (see Action 1.3.3).

**Implementation 1.3.1**  
1995

- 1.3.2** a) Virginia, through the Virginia Institute of Marine Science (VIMS), is currently conducting an environmental impact assessment of the introduction of a non-native oyster. Research at VIMS includes the following:

- 1) An on-shore test on the temperature-salinity tolerances of C. gigas (to include all geographical strains) to determine the best growing conditions and to establish whether C. gigas, introduced into the water column at the proper time, will outgrow its predators' ability to destroy it. This data will be used to estimate the probable range of C. gigas in the Chesapeake Bay, its overlapping range with C. virginica and its potential use as a commercial product.
- 2) A study of river currents in the York River to determine the best location for a reef and broodstock sanctuary for C. gigas.
- 3) Culture a sufficient number of C. gigas in the hatchery in quarantine status, condition them to spawn at the optimum time for planting after the conclusion of the on-shore test, and take conditional actions (1) (below) if it is warranted.
- 4) A literature search to determine to what degree C. gigas will replace C. virginica ecologically.

**Conditional action (1)**

- 5a) If the results of the temperature-salinity and ecological studies are positive (i.e., show that C. gigas placed in the York will outgrow its predators), establish a small, pilot, sanctuary reef in the York River of about one acre and put C. gigas overboard on the reef (must request the

Commissioner to allow the planting).

5b) If the results of the temperature-salinity study are negative, discontinue research on C. gigas.

Conditional action (2)

6) If the pilot reef is a success, if C. gigas grow to reproducing and/or market size in reasonable numbers after 3 years, establish a program to expand the sanctuary and build multiple reefs on the York River to allow seed larvae to naturally settle there from the sanctuary.

Conditional action (3)

7) If C. gigas proves resistant to MSX after a significant potential infection, distribute seed for use in MSX-dominated areas where flow patterns will tend to isolate C. gigas from productive C. virginica.

b) Maryland will conduct an environmental impact assessment of the potential introduction of a non-native oyster species as a contingency plan if the action items in this plan are not enough to increase oyster stocks in the Bay. Maryland will utilize the results of the Virginia assessment (Action 1.3.2.a) to avoid duplicating efforts.

**Implementation 1.3.2**

a) Continue b) Open

**1.3.3** The Bay jurisdictions will follow the guidelines set forth in the Exotic Species Policy developed by the Chesapeake Bay Program's Living Resources Subcommittee.

**Implementation 1.3.3**

1994

**Repletion Programs**

State repletion programs have focused on increasing the size of the oyster harvest by moving shell and transplanting seed oysters. Currently, state agencies move seed oysters to grow-out regions so watermen who pay a license fee can harvest them for market. Since there is little to no production from natural bars, the repletion program supports a put-and-take fishery. In Maryland, license fees pay about half the cost of the repletion program and the state and federal government funds the rest. In Virginia, state funds cover 90% of a smaller state repletion program.

The State repletion program is the major source for harvestable oysters in Maryland at this time. It is limited by

natural reproduction (spat set), disease infection, the amount of available shell or cultch, and funding. Because of high disease pressure in most lower-Bay locations, seed repletion programs move oyster seed from high salinity, high spat set areas, to low salinity, low spat set areas which have slow growth and low disease. Maryland and Virginia currently have no disease-free, seed-producing areas and transplanting seed may facilitate the spread of disease throughout the Bay. The repletion program in each state should be adapted, as appropriate, to the initiatives recommended in this plan. Monitoring efforts should continue and adjustments made to optimize the timing and location of shell and seed plantings which will result in enhanced oyster production (Refer to Appendix III and IV for a summary of each state's repletion program during 1993).

#### **Strategy 2.1**

The Maryland and Virginia repletion programs will minimize the possibility of spreading MSX and Dermo.

##### **Actions:**

- 2.1.1** The Bay jurisdictions will implement the disease strategies and actions defined in the Disease Section of this management plan to minimize the spread of disease.

##### **Implementation 2.1.1**

Variable, depending on actions defined in the previous management section.

#### **Strategy 2.2**

The Bay jurisdictions will maintain and adapt their current state repletion programs to promote natural oyster production and meet the changing needs of the oyster resource. This includes adjusting plantings based on salinity patterns and disease information. The programs will be modified as new initiatives from the MOR and VHP are implemented. Repletion efforts will be monitored then evaluated after a three year period (1997).

##### **Actions:**

- 2.2** Maryland will maintain the state repletion program as funds are available at a level of at least 2 million bushels of shell and 500,000 bushels of seed if spat set levels permit. As new initiatives by the MOR are implemented, the repletion program may be modified.

##### **Implementation 2.2**

Continue. Seed plantings begin in April 1994 and shell plantings in June and early July 1994.

- 2.3** Maryland will continue the fall dredge survey which provides data on oyster mortality, recruitment (spat set), and disease patterns, to direct the oyster repletion efforts.

**Implementation 2.3**  
Continue

- 2.4 Maryland will provide fresh shell to the state hatchery and to community groups for habitat enhancement and develop a policy on minimum desiccation period to prevent spread of MSX and Dermo with fresh shell.

**Implementation 2.4**  
1995

- 2.5 Maryland DNR will support the ORA efforts by providing the program with a percentage of available shell. The amount of shell will be negotiated annually. For 1994/1995, 200,000 bushels of shell will be available.

**Implementation 2.5**  
Beginning in 1994 and continuing annually.

- 2.6 Virginia will restore two major areas where setting is good, the James and the Rappahannock Rivers, forming sanctuaries for maintaining the biological stock. Restoration efforts will include: 1) locating the best substrate; 2) prohibiting harvest in these areas; 3) adding shell or other material to build reef structure; 4) adding seed; and, 5) monitoring the growth of oysters.

**Implementation 2.6**  
Begin in 1994

- 2.7 Virginia will turn and clean on a rolling basis oyster beds near sanctuary reefs in the James and Rappahannock Rivers to prepare them to receive spat set from the sanctuary areas. The cleaning procedure will include: 1) identifying the best areas; 2) delineating the best time to turn the beds; 3) monitoring the growth of new oysters; 4) opening the beds to harvest and setting a quota; and, 5) closing the beds once the quota is met and starting the process again.

**Implementation 2.7**  
1995

- 2.8 a) The Bay jurisdictions will continue to monitor their repletion efforts and adjust the timing and location of shell and seed planting based on the best available data.  
b) Virginia will establish a computer data-base system to monitor the progress of the repletion program on a bar by bar basis.

**Implementation 2.8**  
a) Continue b) 1995

- 2.9 When the hatchery production of seed is adequate to meet planting needs, the repletion programs will be modified.

**Implementation 2.9**

Open. Dependent on seed production.

**Habitat/Water Quality**

Overfishing has contributed to the reduction in available oyster habitat in the Chesapeake Bay by removing shell. Oyster bars have become small mounds with relatively thin layers of shell scattered over the bottom. Reef flattening has taken oysters out of the higher water column where currents bring fresh food supplies and made them particularly vulnerable to siltation. Heavy sediment loads from agricultural and urban run-off, construction activities, natural erosion, dredging, and forestry activities can impact oyster bars. The reduction in reef surface area has also reduced the amount of substrate for oyster larvae to settle. Oyster shell is the most suitable substrate for spat settlement and should be considered an important natural resource. Loss of shell due to the export of oysters out of the state is detrimental to restoring oyster beds. Shell conservation should be practiced. Oyster beds can be re-established by building up the base with additional firm substrate. Rebuilding efforts should be focused in shallow areas (below 10m) where low oxygen is not a problem.

Oysters are an important part of the Bay ecosystem especially in their role as filter-feeders. They consume large quantities of suspended organic particles, recycle nutrients, and transfer energy throughout the food web. Adequate water quality is essential for oysters to reproduce, grow and maintain health. Habitat requirements for temperature, salinity, sediment, pH, and dissolved oxygen have been summarized in Table 1 in the background section (p.25). Oyster eggs and larvae can be killed by suspended sediments. Adult oysters can withstand periods of increased turbidity and sedimentation but extended exposure can result in damage to their filtering apparatus. Of greatest concern baywide are the effects of excess nutrients and the impacts of toxic materials.

**Strategy 3.1**

The Bay jurisdictions will conduct a phased program to evaluate and implement projects to restore the physical habitat for oysters.

**Actions:**

- 3.1.1 The Bay jurisdictions will restore physical oyster habitat through the Maryland and Virginia Aquatic Reef Program (refer to the Aquatic Reef Habitat Plan 1994 for details).
- 1) Approximately 5000 acres each of new oyster reef habitat will be created in Maryland and Virginia and 1000 acres in the Potomac River, over the next 5 years.

- 2) Oyster harvest will be prohibited at designated sites.
- 3) A research plan will be prepared to obtain hydrodynamics, unit design, and deployment configuration recommendations.
- 4) The reefs will be monitored to determine compliance and evaluate ecological performance.
- 5) The Reef Program will expand into additional areas and sites as guided by the findings of research and monitoring.

#### **Implementation 3.1.1**

See specifics in the 1994 Aquatic Reef Habitat Plan

- 3.1.2** The Bay jurisdictions will redefine sanctuaries with adequate geographic extent and distinctiveness.
- 1) Virginia will expand the 25 acre broodstock sanctuary in the James River (Lower Jail Island/Wreck Shoal) currently used by the Oyster Repletion Program to an area not less than 2000 acres, north of the channel and chosen by the VMRC.
  - 2) Virginia will establish a broodstock sanctuary in a geographically distinct area of approximately 50 acres in the Rappahannock River.
  - 3) Virginia will establish a broodstock sanctuary of less than 50 acres in Mobjack Bay and manage it according to the repletion plan.
  - 4) Virginia will continue to use specific areas within the Piankatank and Great Wicomico Rivers as seed areas for the repletion program.

#### **Implementation 3.1.2**

Variable, but beginning in 1994.

- 3.1.3** The Bay jurisdictions will evaluate innovative techniques for restoring physical oyster habitat, conduct projects such as cleaning bottom areas, and evaluate optimal physical structures and alternative materials for rebuilding oyster bars.

#### **Implementation 3.1.3**

1995

### **Strategy 3.2**

The Bay jurisdictions will ensure that water quality is maintained at levels necessary to support healthy oyster populations.

#### **Actions:**

- 3.2.1** Current programs established under the Chesapeake Bay Program to reduce pollutant sources that adversely affect oyster stocks will be maintained. The Tributary Strategy will incorporate specific measures to protect oyster stocks from adverse water quality.



**Implementation 3.2.1**  
Continue

- 3.2.2** Local, state, and federal agencies will utilize their permitting and environmental review programs to ensure that oyster habitat is not adversely affected by the discharge of pollutants, dredging, and other human activities.

**Implementation 3.2.2**  
Continue

- 3.2.3** Virginia will continue to support the efforts of SENTAF, the Department of Health and the Department of Conservation and Recreation's Division of Soil and Water Conservation to identify and control non point-source pollution.

**Implementation 3.2.3**  
Continue

- 3.2.4** The ORA advisory committee will assess the potential impact of activities which may adversely affect oysters in ORA's and provide recommendations to the appropriate agencies for prevention and restoration of adequate water quality.

**Implementation 3.2.4**  
1995

**Management to Increase Oyster Production**

The disease problem, the lack of oyster habitat, variability in recruitment, and harvest pressures have placed considerable constraints on oyster production. Current production levels of certified oyster larvae and seed oysters will not meet the needs of stocking the ORA's or providing for private aquaculture and community association projects. Past and current oyster culture techniques should be analyzed and coordinated with management approaches to enhance production. New technology is needed for the restoration, culture, and production of oysters. In the past, institutional barriers made it difficult to obtain aquaculture permits. To allow progress toward opportunities for private aquaculture ventures, efforts should be made to assist and encourage the private industry. There will be difficulty enforcing property rights relevant to private oyster aquaculture in the Bay without significant social change. Presently, MDNR has oyster hatcheries at Deal Island and Piney Point, and the University of Maryland has a hatchery at Horn Point. Production at these hatchery facilities in Maryland should be increased to provide spat and larvae.

The advantages and disadvantages of a 'slot limit' should be evaluated as a means of increasing oyster production. Lowering the minimum size to 2.5" would allow oysters to be harvested before they succumb to disease. A 4" maximum size would protect larger oysters that have survived MSX and Dermo infestation and allow the possible development of disease-resistant individuals and eventually, the build-up of a disease resistant stock.

#### **Strategy 4.1**

The Bay jurisdictions will work to improve and increase oyster production in the private and public oyster fisheries.

#### **Actions:**

- 4.1.1** Maryland and Virginia will prepare a comprehensive analysis of past and current oyster culture techniques in the Chesapeake Bay and other relevant areas to help focus effort and finances into projects with the best chances of success. In preparing the document, existing expertise and experience in the National Marine Fisheries Service will be utilized.

##### **Implementation 4.1.1** 1995

- 4.1.2** Maryland will increase the hatchery production of oyster larvae and seed oysters by maximizing production at Horn Point and using fresh shells supplied by MDNR. In addition, field surveys are currently underway to evaluate plantings of hatchery reared seed which will guide utilization of larvae and seed from state facilities.

##### **Implementation 4.1.2** Field study of hatchery reared seed is in its second year. Shells were delivered to Horn Point in February 1994.

- 4.1.3** Maryland will establish remote setting sites for eyed-larvae purchased from public or private hatcheries, in appropriate locations with low levels of MSX and Dermo.

##### **Implementation 4.1.3** 1995

- 4.1.4** Maryland and Virginia will encourage private companies to develop oyster hatcheries. Encouragement will include competitive bidding for contracts to provide oyster larvae and seed for ORA's and other areas.

##### **Implementation 4.1.4** 1995

- 4.1.5 Maryland and Virginia will initiate a grant program with matching funds provided by private industry, to stimulate the development of innovative techniques for oyster restoration, culture and production.

**Implementation 4.1.5**

Dependent and limited by availability of funding.

- 4.1.6 Maryland DNR will establish a pilot permitting program for oyster aquaculture demonstration projects. The pilot program will include the following aspects:
- 1) an initial 5 year permit;
  - 2) a limit of 20 permits;
  - 3) permits will be limited to 5 acres per individual;
  - 4) total area under a single permit may include more than one location;
  - 5) permittees will be required to prepare and submit a report summarizing the activities on the permitted area to MDNR. The report should include information on what restoration activities were undertaken, the production techniques utilized, and amount of oysters planted and harvested;
  - 6) if a permittee fails to report or does not undertake any production activities, MDNR may revoke the permit;

**Implementation 4.1.6**

As of February 1994, a draft document entitled, Oyster Aquaculture Permit Guidelines 1994 has been developed (see Appendix V for details).

- 4.1.7 MDNR will establish an aquaculture permit clearinghouse service for applicants which will include:
- 1) designating a single point of contact for questions related to the regulatory requirements for aquaculture, tracking permit applications, and coordinating state agency permitting activities related to aquaculture permits;
  - 2) coordinating the preparation of a permitting handbook for potential applicants for aquaculture permits.

**Implementation 4.1.7**

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- 4.1.8 The Bay jurisdictions will define the acreage available for leasing oyster bottom.
- 1) MDNR will identify areas to be characterized as Aquaculture Zones through recommendations by the MOR.
  - 2) VMRC will implement the following for off bottom culture:
    - a) VIMS will establish criteria for identifying potentially productive areas, classifying waters as appropriate (I), marginal (II), and not appropriate

- (III) for aquaculture;
  - b) establish regulations for aquaculture in regulation title 28.1, Fish, Oysters, Shellfish and Other Marine Life (includes a permitting process for aquacultural off-bottom projects that accommodates structures of changeable configuration and permit time-spans of appropriate length);
  - c) establish Department of Health regulations specifically for aquaculture through discussions among the Department of Health, industry representatives, and advisors;
  - d) draft a model legislative package by VIMS that establishes tax incentives for the start-up of private hatcheries to provide a steady supply of seed to farmers;
  - e) designate a technical advisory agent with the VIMS Advisory Service who will specialize in hatchery advice, grow-out advice, permitting assistance and site selection assistance.
- 3) PRFC will not permit any leasing except by authorization from both Maryland and Virginia

**Implementation 4.1.8**  
Variable beginning in 1994

- 4.1.9** The enforcement of property rights relevant to private oyster aquaculture will be added to the public education program.

**Implementation 4.1.9**  
1995

- 4.1.10** The VMRC will develop and operate a depuration facility to utilize oysters in less than optimum water quality situations. The development of a depuration facility will not lessen the need to continue to improve water quality.

**Implementation 4.1.10**  
1995

**Strategy 4.2**

The Bay jurisdictions will reduce and control fishing mortality.

**Actions:**

- 4.2.1** Maryland will utilize the following guidelines for controlling fishing mortality:
- a) The population structure of oysters on a bar within a region will be established before the harvest season, the areas will be monitored during the season, and harvesting rates will be determined. If harvest rates from the previous year exceed the guidelines (see 4.2.1 b), regional adjustments will be made concerning the opening

and closing of specific areas for harvest.

b) Maryland will regulate harvest on open bars at fishing mortality rates dependent on region and gear type. The following annual fishing mortality rates will be established in repleted areas:

1) Tributaries -

- |                |     |
|----------------|-----|
| a. Hand Tong   | 50% |
| b. Patent Tong | 40% |
| c. Dredge      | 40% |
| d. Diver       | 40% |

2) Mainstem -

- |                                      |       |
|--------------------------------------|-------|
| a. Lower Bay (MD/VA line to Cove Pt) | - 50% |
| b. Mid Bay (Cove Pt. to Holland Pt.) | - 40% |
| c. Upper Bay (Holland Pt north)      | - 40% |

The following annual fishing mortality rates will be established in unrepleted areas and apply to all gears:

1) Tributaries - 30% once every 3 years

2) Mainstem -

- |              |   |
|--------------|---|
| a. Lower Bay | - 50% once every 2 years;<br>cull size = 2.5" |
| b. Mid Bay   | - 50% once every 2 years                      |
| c. Upper Bay | - 0%; area will be closed                     |

**Implementation 4.2.1**

1995

**4.2.2**

The Bay jurisdictions will evaluate the potential advantages and disadvantages of a 'slot limit' with a minimum size for harvesting of 2.5" and a maximum size of 4".

1) Slot limit already in effect for PRFC below the hand scrape line.

2) Maryland will collect oysters over 4" from diseased areas and test their resistance to disease and the resistance of their progeny. The patent tong survey data will be reviewed to provide estimates of the impact of harvesting small oysters from the population.

**Implementation 4.2.2**

1) Continue. 2) Begin collection in March 1994 and review patent tong data beginning April 1994.

**4.2.3**

VMRC will manage the public oyster grounds in specific areas by establishing the following:

James River

1) establish an 18' length limit on shaft tongs to protect oysters in deeper water;

2) establish a market oyster harvest quota that is updated yearly and based on estimates of standing stock;

- 3) increase the minimum size in the Jail Island clean cull area to 3";
- 4) as part of the culling practices, reduce the tolerance for blank shells in seed oysters from 10 quarts per bushel to 6 quarts per bushel;
- 5) open Deep Water Shoal to public fishery on a limited basis;
- 6) establish beds for intensive repletion near the sanctuary and manage them according to the repletion plan.

#### Rappahannock River

- 7) expand the prohibited area for patent tonging to include the area on the southside of the river to the channel above a line connecting Bailey Point (Urbanna/Southside) and the mouth of Beach Creek (Northside) in order to reduce harvest pressure on productive stocks;

- 8) establish beds for intensive repletion near the sanctuary and manage them according to the repletion plan.

#### Pocomoke/Tangier Sounds

- 9) Prohibit patent tonging and dredging for a 3 year period and re-evaluate the health of the rocks at the end of that period.

#### Seaside Eastern Shore

- 10) establish a 3" minimum size limit on market oysters.

### **Implementation 4.2.3**

#### **Variable**

### **Collection of Management Quality Data**

Oyster population data and harvest information is currently being collected but improvements in recording the data should be made. A summary of the Maryland and Virginia 1993 Oyster Programs can be found in Appendix II. The summaries include descriptions of various sampling surveys and management programs already conducted by the states. In addition to the research data on disease (Strategies 1.2 and 1.3), the following research topics and data needs should be encouraged:

- 1) Determine the density of spawning stock necessary to repopulate an area decimated by disease;
- 2) Determine natural and fishing mortality rates;
- 3) Define stock/recruitment relationship;
- 4) Determine factors affecting abundance, survival and growth of larvae and juveniles.

### **Strategy 5.1**

The Bay jurisdictions will improve the collection of management quality data.

**Actions:**

- 5.1** The Bay jurisdictions will continue to collect quantitative data on oyster stocks, habitat and diseases and make the information available in an annual report.

**Implementation 5.1**

Annually.

- 5.2** VMRC will establish a computer data-base system for the collection, storage and analysis on a bar-by-bar basis, updated weekly, of information to estimate standing stock and establish yearly catch quotas. Data will include daily entries for total landings, boat numbers, landings per boat, where harvested, and number of harvesters per boat.

**Implementation 5.2**

1995

## **Management Section 2.**

### **Management for Maryland Oyster Recovery Areas (ORAs)**

Due to the dominating impact of MSX and Dermo on Chesapeake oyster stocks, geographic areas termed Oyster Recovery Areas (ORAs), will be designated in low salinity reaches of the Bay and its tributaries where MSX and Dermo are apparently less viable. The objectives for managing these areas are 1) limit transplantation activities which would serve to perpetuate MSX and Dermo in a region and 2) evaluate different methods to rehabilitate, rebuild, plant and otherwise restore oyster populations in these areas. The following section describes the specific, intensive management effort that will be implemented in the ORAs.

#### **Strategy 1**

The implementation of activities within the ORAs by the MDNR will be guided by an advisory committee.

#### **Actions:**

- 1.1 Each ORA advisory committee will be constituted by MDNR and include representatives of the following organizations and interests: watermen; aquaculture; environmentalists; scientists; Departments of Natural Resources, Agriculture, and Environment.
- 1.2 A technical committee of scientists will be established to determine the experimental design and oversee the monitoring and evaluation of the ORAs.

#### **Strategy 2**

Each ORA will be comprised of from one to three zones and must include a Zone A and/or a Zone B. Specific activities will be defined for each area.

#### **Actions:**

- 2.1 A) Zone A will be in the lowest salinity area of the ORA. The following activities will apply:
  - 1) Clam and oyster harvesting will be suspended for five years, to reopen consistent with management objectives.
  - 2) Sections will be managed as ecological, brood stock sanctuaries.
  - 3) Natural bars will be rehabilitated to facilitate natural set.
  - 4) Intensive monitoring for MSX and Dermo will occur.
  - 5) Only certified seed will be planted on cultch placed on prepared bottom. Plots may be used for experimental off-bottom culture techniques and other pilot programs. Other plots will be left undisturbed for monitoring purposes.
  - 6) A portion of the plantings will become a



permanent sanctuary for broodstock.

7) Sections will be transferred to higher salinity growout areas after 1, 2, and 3 years. Aquaculture permits may be obtained for parallel grow-out experiments using water column and floating raft culture.

B) Zone B will be immediately downstream of Zone A, or in a river without zone A. The following activities will apply:

- 1) Shellfish harvesting will be allowed.
- 2) Only certified seed will be planted.
- 3) Natural bars will be rehabilitated.
- 4) There will be intensive monitoring for MSX and Dermo

C) Zone C will be a large zone downstream from Zone B. The following activities will apply:

- 1) Shellfish harvesting will be allowed.
- 2) Natural seed will be imported until it can be replaced with certified seed.
- 3) Experimental seeding will be allowed in selected areas.
- 4) Natural bars will be rehabilitated in selected areas.
- 5) Intensive monitoring for MSX and Dermo will occur.
- 6) One or more sanctuaries will be established to test techniques for rebuilding and rehabilitating oyster populations.

### **Strategy 3**

A subcommittee of the Oyster Roundtable will define the criteria determining where the boundaries of ORAs are and submit them to MDNR for their adoption by regulation.

#### **Actions:**

3.1 The Chester, Choptank, Magothy, Nanticoke, Patuxent, and Severn Rivers will be designated as initial sites for ORAs.

3.2 The Oyster Roundtable will review the progress of activities in the initial ORAs and recommend the designation of additional ORAs if warranted, with a long-range objective of restoring and rebuilding all natural bars.

### Section 3. Biological Background

American or eastern oysters occur along the east coast of North America from the Gulf of St. Lawrence, Canada, to Key Biscayne, Florida. In the Caribbean, the range of American oysters extends to the Yucatan Peninsula of Mexico and the West Indies of Venezuela. Chesapeake Bay, which provides optimal environmental conditions for the species, is close to the center of its geographical distribution. However, oyster production varies within the Bay system depending on habitat conditions.

Oysters generally spawn from May through September in Chesapeake Bay. Increases in water temperature to 18-20°C stimulates spawning activity. Eggs hatch into free-swimming larvae that settle to the bottom two to three weeks after hatching. They attach to oyster shells or other hard substrates and the attaching phase is termed "setting." The newly attached oysters are called "spat." Oysters grow at the rate of about one inch per year. Growth rates can be affected by temperature, food quantity, salinity and parasitic infection. Shell growth usually occurs in the spring and soft body tissue growth occurs after spawning. Oysters usually enter the market three to five years after spat settlement.

Oysters are filter feeders and depend on phytoplankton for their energy requirements. Oysters play an important role in filtering the water. It has been hypothesized (Newell 1988) that the decrease in oyster abundance in the Bay has contributed to an apparent shift from microbial food webs to an increase in zooplankton and their predators (ctenophores and jellyfish).

#### Biological Parameters

<u>Natural mortality rate:</u>	Currently, very high due to disease and freshwater inflow.
<u>Fecundity:</u>	5 - 15 million eggs at one spawning. Smaller oysters produce less eggs (See Figure 4).
<u>Longevity:</u>	Up to 15 years.
<u>Age at maturity:</u>	2 years

#### Habitat Requirements (refer to Table 1)

Spawning season:	May through September.
Spawning area:	Throughout Chesapeake Bay.

Oyster fecundity v. size

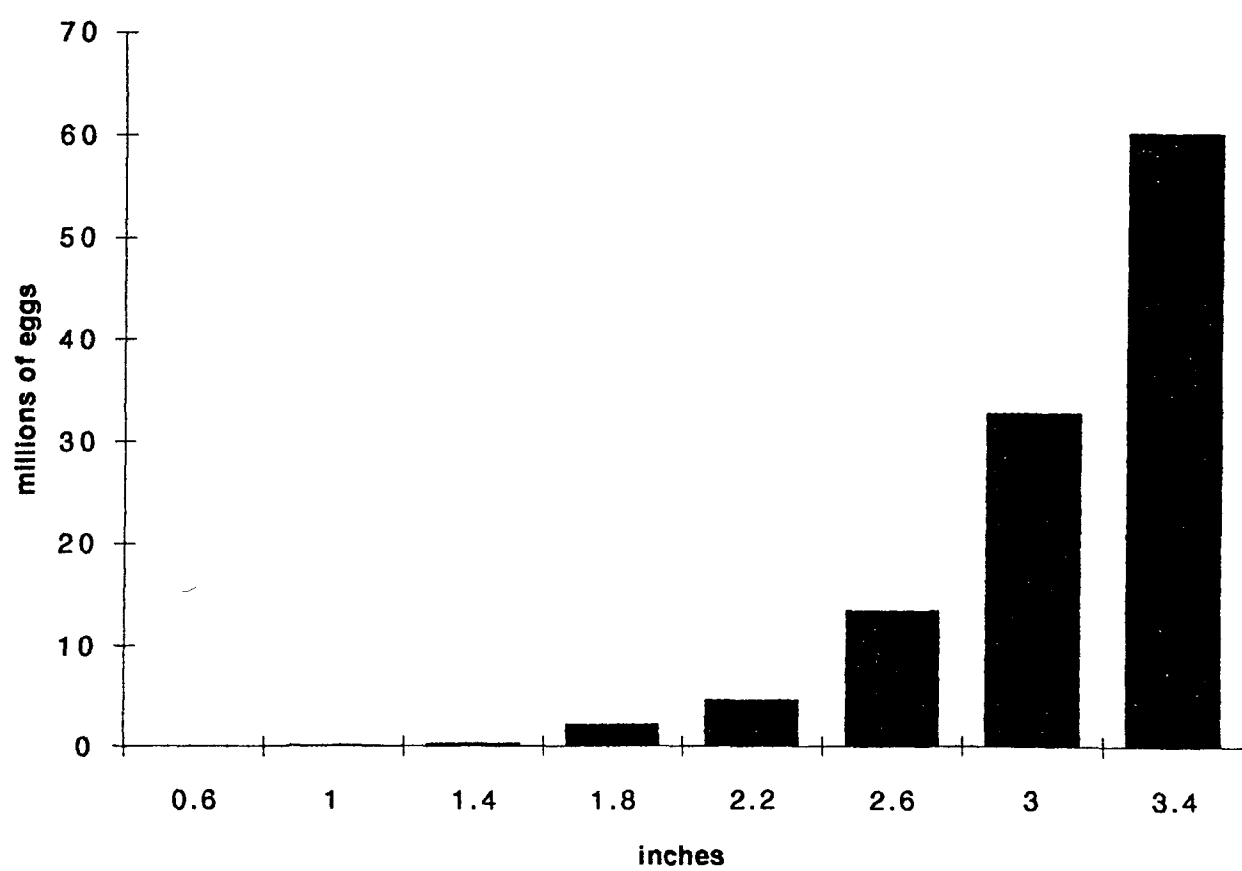


Table 1. Habitat requirements for oyster eggs, larvae, spat, and adults. Ranges are based on broad estimates and may vary with geographic location (from Habitat Requirements for Chesapeake Bay Living Resources, 1991).

LIFE STAGE	LIFE ZONE	TEMP. <sup>a</sup> ° C	SALINITY <sup>a</sup> ppt	SEDIMENT <sup>b</sup> g L <sup>-1</sup>	pH	DISSOLVED O <sub>2</sub> mg L <sup>-1</sup>
Eggs	water column	19-32	12.5-35 <sup>c</sup> 7.5-22.5 <sup>d</sup>	<0.25	6.75-8.75	?
Larvae	water column	19-32	12.5-27.0 <sup>e</sup>	<0.5	6.75-8.75	e
Spat	hard substrate	0-32+	15.0-22.5 <sup>f</sup>	?	?	g
Young (30-50mm)	benthos					<0 at 10°C <sup>h</sup> 0.8-1.49 at 20°C <sup>h</sup> 2.75-4.98 at 30°C <sup>h</sup>
Adults	benthos					
survival		0-32+	0-36+	?	?	~1(5 days)
feeding		6-32; (15-25 "optimum")	5+	<0.4	?	?
growth		6-32; (15-25 "optimum")	12+	?	?	?
gametogenesis		7.5-30+	10+	?	?	?
spawning		20±	10+	?	6-10	?

<sup>a</sup> Salinity can affect temperature tolerances, and vice versa. Tolerance to temperature is roughly adult>spat>veliger larvae>zygotes.

<sup>b</sup> Effects depend upon type and size of particle; experimental values have been higher than values normally encountered in nature except during intense storms.

<sup>c</sup> Adults acclimated to 26.0-27.9 ppt; optimal egg development at 22.5 ppt and optimal larval growth at 17.5 ppt.

<sup>d</sup> Adults acclimated to 9 ppt; optimal egg development at 10-15 ppt.

<sup>e</sup> Median mortality times in anoxia: 11 hours for 82µm larvae; larval swimming rates unaffected at 0.5mg L<sup>-1</sup> for up to 12 hours.

<sup>f</sup> Spat had been set at near marine salinities.

<sup>g</sup> Median mortality times in anoxia: 150 hours for 16mm spat.

<sup>h</sup> LC<sub>50</sub>-PO<sub>2</sub> (mg L<sup>-1</sup>) causing 50% mortality after 28 days of exposure at 10, 20, and 30°C, with oysters held at 10 ppt, 20 ppt, and 30 ppt at each temperature.

## Habitat Issues

Some of the more important environmental factors affecting oyster distribution include substrate type, depth, salinity, and disease prevalence. Oysters need a clean, stable substrate on which to set and grow. Soft mud, shifting sand or silted bottom are unsuitable. Oysters are generally limited to waters less than 25' deep due to hypoxic/anoxic conditions that develop in many deeper waters of the Bay. Salinities above about 6-8 ppt increase oyster mortality from predation and disease.

Man's activities have impacted the distribution and abundance of oysters. Sediment from channel dredging, upland construction and agricultural activities can smother oyster beds and foul cultch to prevent setting. Nitrogen and phosphorus enrichment from sewage treatment plants and agricultural runoff have increased the extent of hypoxic and anoxic conditions. Sewage input results in high coliform bacterial counts which force the closure of shellfish harvesting areas close to the treatment outfall. In 1986 only 45,500 out of 158,900 acres in the James River were classified by the National Shellfish Sanitation Program as approved shellfish growing waters. Maryland oyster samples collected and analyzed from 1980-1986 revealed that heavy metal or PCB concentrations were below action levels in all oyster growing areas sampled in the state. However, these oysters did have levels higher than would be found in a pristine environment.

## Disease

Oyster diseases have been monitored and studied in the Chesapeake Bay since the late 1950's. Increased natural mortality has been linked to the spread and intensification of two parasites, Perkinsus marinus (Dermo) and Haplosporidian nelsoni (MSX). These parasites are single-celled organisms (protozoans) that infect oysters but have no effects on humans, whether the oysters are eaten raw or cooked. The exact mechanisms by which the parasites kill the oysters are not understood. There are no known cures for the diseases. The only strategy currently available is to move seed oysters, less than 1 year old, to areas where diseases are less prevalent to protect them while they are growing. These areas are usually less saline and do not provide the best growth environment. Low salinity areas rarely produce a good natural spat set. Without seed plantings, these areas would not produce continuing harvests. Seed areas are currently checked for disease during the fall and spring disease surveys, prior to being transplanted to the upper Bay and tributary grow-out areas.

There is no evidence that low levels of pollution have any relationship either to susceptibility to the diseases or to their virulence. There is also very little information that any habitat factors except salinity and temperature, have any significant effects on disease.

## **Fishery Parameters**

Status of exploitation:	Fully exploited.
Long term potential catch:	Highly dependent on prevalence and intensity of diseases, harvesting and freshets.
Importance of recreational fishery:	Insignificant.
Importance of commercial fishery:	Historically, highly significant; harvests have declined in the Chesapeake region, oysters still rank nationwide as one of the top seafood species in dockside value.
Fishing mortality rates:	Highly variable.

## **The Historic Fisheries**

Before the turn of the century, over 10 million bushels of oysters (which yielded approximately 64 million pounds of meat) were harvested annually in Maryland by a large dredge fleet. Virginia harvests at this time were approximately 6-7 million bushels (38-45 million pounds of meat), and were harvested primarily by hand tongs. Landings have declined dramatically since that time and continue to show a downward trend. During the past 30 years, oyster harvests in Maryland ranged from 3.2 million bushels in 1973 to 124,000 bushels in 1993. In Virginia, the harvest of market oysters ranged from 1.9 million bushels in 1964 to 64,500 bushels in 1993.

## **The Oyster Resource**

The Baywide oyster stock can be characterized as severely depleted. Recent expansions of the range of oyster diseases, MSX and Dermo, low dissolved oxygen episodes and past harvesting practices are primarily responsible for the population's current decline. Average levels of spatfall have dropped in the past decade and the number of natural beds receiving spatfall adequate for replenishment has been reduced from historic levels. In Maryland, the 1983 and 1984 spat sets were virtually non-existent. Although the 1985 spatfall was exceptionally high and well distributed, the year class has been effectively wiped out in those areas infected by disease. Maryland's 1986 spatfall was considered average and of limited distribution. Many of the 1986 year class have been infected by MSX and Dermo and may be killed if high salinities continue in the Maryland portion of the Bay. Continued low levels and poor geographic distribution of spatfall levels occurred during

1987 and 1988. The 1991 spat set was a record high.

Since 1985, the James River has become the center of the market oyster landings in Virginia. The low number of surviving spat and decreasing bushel counts of spat, small, and market oysters, as determined from the VIMS oyster shoal surveys since the spring of 1986, indicates that the James River is failing to match the losses in number of oysters with an equal recruitment of spat. Since 1992, spat set in the Piankatank, Great Wicomico and Rappahannock Rivers have been at historically low levels.

## **Laws and Regulations**

### **Limited entry:**

Maryland adopted a limited entry to the commercial fishery, April 1994, which repeals the Delay of Application Process of September 1, 1988, and allows MDNR to limit the number of tidal fish licenses which may be issued.

Virginia's delayed entry went into effect December 1, 1992. It requires previously unlicensed applicants to wait two years after registering before a license to harvest oysters with commercial gear will be issued.

On the Potomac River, only Maryland and Virginia residents may commercially oyster.

### **Minimum size limit:**

Maryland - 3" with 5% tolerance, market oysters with small oysters or spat attached may be kept if separating the small oysters or spat would kill them.

Potomac River- 3" with 5% tolerance, however, market oysters with small oysters attached must be returned if separating them kills the small oyster (including spat). High salinity areas 2 1/2" minimum and a 4" maximum.

Virginia - Clean cull areas - 3". No cull size for seed areas and leased ground.

### **Daily catch limit:**

Recreational -- Maryland, Potomac River and Virginia: no license required for the taking of one bushel per day from public grounds.

Commercial -- Maryland: shaft and patent

tongs, diving - 15 bushels per licensee, but not to exceed 30 bushels per boat; dredge boat - 150 bushels per boat; power dredging (in designated waters of Somerset county) - 12 bushels per licensee but not to exceed 24 bushels per boat.

Commercial--Potomac River: None.

Commercial -- Virginia: None.

Harvest quotas:

Virginia: variable by season and area.

Season (actual  
restrictions determined  
prior to season)  
and time  
restrictions:

Maryland - Shaft tongs, patent tongs and diving: September 15 to March 31, Monday through Saturday, sunrise to sunset, except Worcester County where the season is January 1 to December 31, Monday through Saturday, sunrise to sunset. Dredging: Sail dredging in designated waters state-wide, November 1 to March 15, Monday through Saturday, sunrise to sunset. Power dredging: in designated waters of Somerset County, November 1 to March 15, Monday through Saturday, sunrise to 3 pm. Private grounds: no seasonal restrictions, but harvesting between sunset and sunrise or on Sunday is prohibited.

Potomac River - Hand shaft tongs: October 1 through March 31. Hand Scrape: Months of November, December and March. Hand tongs, lawful only Monday through Friday from sunrise to 12:00 noon EST. Hand scrapes, lawful only Monday through Thursday during March and Monday, Wednesdays and Fridays during November and December from 8:00 a.m. to 12 noon each day

Virginia - Shaft tongs or hand tongs: James River Seed Area, October 1 to July 1, sunrise to 12:00 noon. All other public areas, October 1 to June 1, sunrise to 12:00 noon. Private grounds, no seasonal restrictions; but harvesting



on Sunday or between sunset and sunrise is prohibited.

Patent tongs: October 1 to March 1, sunrise to sunset, for all public areas not prohibited by Section 28.1-82 of the Code of Virginia or VMRC Regulations and Orders. October 1 to the last day of February, sunrise to 2 p.m., in the Piankatank River, Pocomoke Sound/Tangier and Chesapeake Bay Management Areas. Private grounds, Sunday and sunset to sunrise harvesting is prohibited.

Dredge: Pocomoke/Tangier Management Area, 15 November-last day of February (sunrise-2 P.M.). Chesapeake Bay Management Area, 1 November-last day of February (sunrise-2 P.M.). Private grounds, generally no restrictions, except Sunday and sunset to sunrise harvesting is prohibited. Bay and tributaries sunrise to 12:00 noon; Seaside - sunrise to sunset.

#### Gear Restrictions:

Maryland - The legal gear types for harvesting oysters in Maryland include hand tongs, patent tongs, diving gear, handscrapes and dredges. The use of each gear type is restricted to certain designated areas as set forth in Maryland's laws and regulations. Dredges or handscrapes cannot exceed 200 lbs. in weight or have a tooth bar greater than 42 inches in length (as measured from the outside teeth) on dredges used on rock bottom, or 44 inches in length for dredges used on mud bottom. No "devil catch", "devil diver", or similar device is to be attached to the dredge to steer it to the bottom. No power boat may have on board or in tow any gear used for dredging unless it is permitted by the Department to harvest oysters from leased bottom, from State seed areas, or unless it is a sail dredge boat using its yawl boat on push days. On Monday and Tuesday during the oyster dredging season a dredge boat may be propelled by an auxiliary yawl boat in certain areas. Diving -each person engaged in the diving operation must be licensed. Not more than two divers can work from a boat at one time. Each diver shall have one attendant

on the boat. An International Code Flag "A" of the proper specifications must be displayed. Power assisted lifting devices may be used subject to specified conditions. Hand tong winders are allowed.

Potomac River - Patent tongs and power or sail scrapes or dredges, power or hand-operated winch, spool, winder, etc. are prohibited. Hand scrapes limited to 22" catching bar. Diving for oysters limited to recreational harvest of 1 bushel per person per day. Legal gear types include hand shaft tongs, power assisted hand shaft tongs and hand scrape.

Virginia - Only one type of gear, either hand tongs, patent tongs (limit of 2) or a single dredge, is allowed on a vessel at one time in the Pocomoke/Tangier and Chesapeake Bay Management areas. Only one type of gear, either hand tongs or patent tongs (limit of 2), is allowed on a vessel at one time in the Piankatank River Management Area. Patent tongs - the teeth of patent tongs shall not exceed four inches in length, and patent tongs exceeding 100 pounds in gross weight, including any attachments (excluding rope for the taking or catching of oysters), are prohibited. Dredge - a dredge and attachment cannot exceed 100 pounds total weight.

Area Restrictions:

Maryland - Hand tongs are allowed Statewide, with portions of most tributaries reserved for hand tongs only. Downstream of these areas, diving is allowed. Patent tongs are permitted in the mainstem Chesapeake Bay, the lower Patuxent River and all of Somerset County. Power dredging is restricted to designated waters of Somerset County. Sail dredging is restricted to the Mainstem Bay, Tangier Sound, and portions of the Choptank River.

Potomac River - No harvest allowed in 25 acre oyster sanctuary on Jones Shore. Hand tongs, none except sanctuary. Hand

scrapes, not allowed on Jones Shore or above a line from Herring Creek, MD to Bonum Creek, VA.

Virginia - Only hand tongs are permitted in most areas, with patent tongs restricted to those areas specified by the Code of Virginia or VMRC Regulations and Orders (Piankatank River, Chesapeake Bay and Pocomoke/Tangier Management Areas). Dredging is restricted to the Pocomoke/Tangier and Chesapeake Bay Management Areas.

### **Status of Traditional Fishery Management Approaches**

**Catch-Effort:**

Commercial fisheries data for Chesapeake Bay are a reasonable indicator of the current status of the marketable stock. In Maryland and Virginia, catch and effort statistics for the commercial fishery are, in general, of low quality and of limited value in developing fisheries management models. The PRFC catch and effort data are highly reliable.

**Estimates of mortality:**

Depends on disease prevalence, freshets, and harvesting.

**Yield-per-Recruit  
(spat survival to  
markets):**

Traditionally, very low.

**Stock-Recruitment:**

The stock-recruitment relationship for Chesapeake Bay oysters is unknown.

## References

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# **THE ROLE OF THE STATE OF MARYLAND IN OYSTER FISHERIES MANAGEMENT**



**RECOMMENDATIONS  
OF THE GOVERNOR'S COMMITTEE  
TO REVIEW STATE POLICY  
FOR FUNDING  
MARYLAND'S CHESAPEAKE FISHERIES  
SEPTEMBER 1990**

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## SUMMARY

### COMMITTEE TO REVIEW STATE POLICY FOR FUNDING MARYLAND'S CHESAPEAKE FISHERIES

Charge: To review the condition of the resource, how DNR manages the resource, and the costs and returns of management programs to the State economy.  
To recommend future management strategies and whether the State should subsidize the programs.

Members: Dr. M. Gordon Wolman, Chairman  
Russel Dize Senator Lewis Riley  
Eamonn McGeedy Sam Shriver  
Billy Martin Delegate John Slade  
Dr. Roger Newell Dr. Ivar Strand  
John Parran

Meetings: August 15, 1989 to August 15, 1990  
Monthly

Topics Discussed: Watermen's Compensation Program  
Freshwater Hatchery Program  
Oyster Repletion Program

Reports: Watermen's Compensation Program - submitted June 1990  
Freshwater Hatchery Program - submitted September 1990  
Oyster Repletion Program - submitted September 1990,  
released for distribution May 1991

#### Recommendations:

##### Watermen's Compensation Program

- \* Discontinue the Watermen's Compensation Program as structured.
- \* If data collection needs are justifiable, institute a new program open to all qualified watermen.

##### Freshwater Hatchery Program

- \* Continue the freshwater hatchery program.

##### Oyster Repletion Program and Oyster Fishery

- \* Encourage the public fishery and develop the private fishery.
- \* Continue the repletion program but increase the financial contribution made by the industry by raising license fees and oyster taxes. Conversely, decrease the General Fund subsidy.
- \* Promote scientific rather than political management.
- \* Develop aquaculture by removing various legal impediments, increasing the bottom available for leasing, and permitting the use of the water column.
- \* Intensify enforcement.
- \* Develop knowledge of oyster pathology, ecology, markets.
- \* Develop and enforce standard weights, measures, and minimum quality.
- \* Scientifically/quantitatively assess oyster stocks, monitor production and evaluate the quality of oyster beds.

June 1991

## MAJOR RECOMMENDATIONS

The situation in Maryland's oyster industry is dire and the State must make some crucial changes if the industry is to rebound. Recent outbreaks of oyster disease, past mismanagement and an ever-competitive marketplace have reduced the Maryland oyster industry and resource to near obscurity. To restore it to economic, social and ecological significance, major shifts in policy must be made. We recommend that the State of Maryland:

1. Encourage both the enhancement of the public oyster fishery and the development of a private fishery. Public access to natural oyster beds, a part of Maryland's heritage, should be sustained by continuing the oyster repletion program. The promise of the private fishery must be encouraged by the State through research, permitting processes and law enforcement.
2. Continue to enhance the public fishery through the repletion program but insist that an increasing share of its costs be borne by the public fishery. The repletion program is needed for production from public beds and the industry alone is currently unable to bear the entire cost of the program. Current policy should be directed towards generating more tax revenue from the public fishery to offset the existing subsidy in the repletion program. Thus, gradual increases in

taxes should be instituted with a long-run goal of program self-sufficiency. To implement this recommendation, we suggest that:

- a. The existing severance tax be revised to be a fixed percentage of dockside price and increased to reflect the resources scarcity. When established at its present level in 1982, the current tax of \$.45/bushel represented about 5% of the dockside price. The present tax rate is 1.8% of the dockside value. Existing circumstances warrant a tax increase to at least the 1982 percentage rate.
- b. The export tax be raised from its current level to an amount not less than the replacement costs of exported shell. When oysters are exported from Maryland, all legal remedies to guarantee the return of shell are lost. The replacement cost of the lost shell thus should be charged on exports.
- c. The license fees for public harvesters should be raised from the current \$50 per licensee to \$350 per licensee. Some of the costs of the repletion program are essentially overhead, with benefits accruing to all (for example, policing sanctuaries). Raising license fees will assure coverage of fixed costs.



3. Review the industry's legal and regulatory framework with the goal of promoting scientific management and enhancing the efficiency of public harvesters. The regulatory framework which has accumulated over the last century is unresponsive to current circumstances.
4. Remove certain legal impediments constraining the production of oysters through private aquaculture. Although there appears to be great promise for production from oyster aquaculture, it must be encouraged by:
  - a. expanding the bottom available for private leasing;
  - b. establishing a process to permit use of the water column;
  - c. increasing the leasehold fee (from \$3.50 annual per acre) to provide funds for enforcing leasehold rights and to discourage unproductive use of leases.
5. Intensify the enforcement of regulations related to Maryland oyster production. The protection of oyster sanctuaries, enforcement of leasehold rights and the collection of taxes must be guaranteed to assure equity among industry participants and public trust in the programs of the State.

6. **Increase its knowledge of oyster pathology, ecology and markets.** Oyster diseases have recently plagued the industry. A greater understanding of oysters, their diseases and alternatives to avoid them is critical in developing plans for the future of the industry. This should be done in cooperation with adjacent states, the Potomac River Fisheries Commission and the Federal Government. Likewise, reaching aquaculture's potential may only be possible through developing new seed technologies, new product forms and new markets.
7. **Develop and enforce standard weights, measures and minimum quality both to protect consumers and to enhance demand.** While efforts cannot be completely independent of Federal standards, the State, in conjunction with adjacent states, must develop and enforce internally consistent, replicable standards essential to a modern commercial enterprise. Quality control of the oyster product must be guaranteed so that consumer perceptions of Maryland's oyster quality are maintained or improved.
8. **Strengthen its role in assessing oyster stocks, monitoring production and evaluating the quality of oyster beds.** In order to determine policy, appraise programs and assure consumer safety, effort is required to collect, assimilate and analyze data. Both the public and private fisheries will

require careful scientific management on the part of the State. Use of less political influence and more scientific information in the allocation of resources within and between the public and private fishery is essential.

## REPORT OF THE "BLUE RIBBON" PANEL

Prepared in late 1991 by a 33-member advisory panel of scientists, environmentalists, watermen, planters, economists, and others, this report (also, "The Holton Plan") sets forth issues and recommendations for restoring Virginia's oyster industry. Four potential oyster sources are considered:

- Traditional state and private culture of *C. virginica*;
- Off-bottom culture in approved waters;
- On-bottom culture of a non-native species (*C. gigas*);
- On-shore depuration of moderately polluted oysters.

The eight recommendations in the Holton Plan are summarized below:

- 0 **Data Collection and Monitoring** -- The State should establish computerized data base systems for detailed collection, storage, and analysis of stock assessment data and landings data, as well as for detailed monitoring of the Virginia repletion program.
- 0 **Legislation** -- The Virginia Marine Resources Commission should be empowered to control or limit entry to the commercial fishery, enabling the VMRC to protect the full-time fishermen and the resource.
- 0 **Repletion** -- The State should establish a repletion program for the public fishery, based upon oyster biology and river dynamics, and assure systematic monitoring of the program. The strategy should include programs to:
  - Restore two sanctuary reefs in the James and Rappahannock rivers, and cover them with seed oysters to maintain biological stock close to harvest areas (adjacent beds);
  - Prepare nearby beds to receive spawn from the sanctuaries, and monitor growth, harvest to quotas, close beds, and repeat;
  - Plant seed in low-set areas but with good growth potential, in the Mobjack River and the Pocomoke-Tangier areas; monitor, harvest, close, and repeat.

Initially, this should be a three-year program, with thorough data collection and monitoring, followed by an evaluation of the repletion strategy.

- 0 **Market Evaluation and Development** -- Commission a joint effort with the Virginia Institute of Marine Science (VIMS) and Virginia Tech to examine the marketing

potential of current oyster products, and possible new product lines, including depurated oysters. In addition, there should be a joint industry-academic study to evaluate current State-funded marketing programs and recommend new or expanded marketing strategies for Virginia seafood products. Finally, a marketing and economics advisory agent should be appointed through VIMS to develop economic markets for off-bottom cultured oysters, and to work closely with aquaculturists and others in the industry.

- o **Off-Bottom Culture** -- The State should identify areas as appropriate, marginal, or non-appropriate for aquaculture (VIMS), and establish regulations and a permitting process for off-bottom oyster culture (VMRC). To encourage start-up of private hatcheries, VIMS should draft model tax incentive legislation. A technical advisory agent should be appointed through VIMS, who will specialize in hatchery matters.
- o **Depuration** -- The VMRC should estimate oyster stocks and potential daily supplies of clean and depurable oysters from public and private sources, both on- and off-bottom, supplies that will support year-round depuration plant operations. After a complete economic analysis of such a facility (VIMS), cooperating State agencies should design a pilot plant. If economic analyses warrant, the State should establish a public-private partnership to construct an experimental depuration facility, and design a fee system to make it self-supporting.
- o **Management of Public Grounds** -- This recommendation addresses specific management steps for the James and Rappahannock rivers, Pocomoke/Tangier sounds, Seaside Eastern Shore, Mobjack Bay, and the Piankatank and Great Wicomico rivers. Included in these specific steps are limits on shaft length of tongs, quotas, changes in cull length, increases in sanctuary size, new repletion strategies, and harvest prohibitions in some areas.
- o **Introduction of Non-Native Species** -- The State (VIMS) should conduct full laboratory tests of *Crassostrea gigas*, investigating temperature and salinity tolerances, as well as ecological relationships. If preliminary tests warrant, a pilot study in the York River should be established to evaluate *C. gigas*' ability to grow and reproduce in a natural Bay environment. These studies should include evaluations of disease resistance. Based on success of preliminary studies, *C. gigas* sanctuary reefs should be expanded.

**A SUMMARY OF THE MARYLAND DEPARTMENT OF NATURAL RESOURCES**  
**1993 OYSTER PROGRAM**

**An Index of Survey and Program Sites, Available Data and Reports, and Source Contacts**

Prepared by Maryland Department Of Natural Resources

Tidewater Administration

Fisheries Division, Shellfish Program

April, 1994

This report includes, by location, the 1993 effort associated with various surveys and management programs conducted by Maryland's Department of Natural Resources Shellfish Group. These are indexed by program and by the location of data files. A substantial amount of this information is stored on computer files and these are noted in this report. Data source contacts and a brief description of each program are included. Computer stored data are kept on the following software packages:

Spreadsheet: Quattro Pro 5.0 for Dos and for Window and Axum 3.0.

Database: dBase III+ and IV, mBase, and Paradox 1.5.

GIS: Mapinfo for Windows.

<u>REGION</u>	<u>OYSTER BAR</u>	<u>PROGRAM</u>	<u>DATA CONTACT</u>
UPPER BAY EAST	DEEP SHOAL	FS	MA
	TOLCHESTER	FS	MA
	HODGES	FS;SA	MA;PP
	SWAN POINT	MFSD;SA;FT;SSRP3	OXL;PP;PP;TA
CHESTER RIVER: UPPER CHESTER	SHEEP	FS;SA	MA;PP
	EMORY HOLLOW	FS;SA	MA;PP
	SPANIARD POINT	FS;FT;SSRP1	MA;PP;TA
	CLIFF	FS;SSRP1	MA;TA
	EBB POINT	FS;SSRP1	MA;TA
	DRUM POINT	FS	MA
	BOATHOUSE	FS;SSRP1	MA;TA
	OLDFIELD	MFSD;SA;SSRP1	OXL;PP;TA
	CHESTER RIVER MIDDLEGROUND	FS;SSRP1	MA;TA
	BLUFF POINT	FS;SSRP1	MA;TA
	HELL'S DELIGHT	FS;SSRP1	MA;TA
	BAY BUSH POINT	FS	MA
	PINEY POINT	FS;FT;SSRP1	MA;PP;TA
	DURDIN	FS;SSRP1	MA;TA
	HORSE RACE	FS;SA;SSRP1	MA;PP;TA
	CARPENTER ISLAND	FS;SA	MA;PP
LOWER CHESTER	BUOY ROCK	MFSD;SA;FT	OXL;PP;PP
	WICKES BEACH	FS;SSRP1	MA;TA
	LOVE POINT	FS;FT;SSRP1	MA;PP;TA
KENT SHORE	BROAD CREEK	FS	MA
	BRICK HOUSE	FS;SA	MA;PP
	GRAVEYARD (KENT POINT)	FS	MA
MILES RIVER	LONG POINT	MFSD	OXL
	SECOND POINT	FS	MA
	ASH CRAFT	MFS	OXL
	HERRING ISLAND	FS	MA
	COFFEE	FS	MA
	TURTLEBACK	MFSD	OXL
WYE RIVER	WHETSTONE	FS	MA
	MILLS	FS	MA
	BRUFF'S ISLAND	MFSD	OXL
EASTERN BAY: NORTH	BUGBY	MFSD	OXL
	MILL HILL	FS	MA
	BALD EAGLE ADDITION #3	FS;SSRP3	MA;TA
	SAW MILL CREEK	FS	MA
	HOOD	FS;SSRP3	MA;TA
	WELL COVE	FS	MA
	WALTER WHITE	FS	MA
	DOMINION	FS	MA
	PARSON'S ISLAND NARROWS ADDITION	FS;SA	MA;PP



<u>REGION</u>	<u>OYSTER BAR</u>	<u>PROGRAM</u>	<u>DATA CONTACT</u>
<b>EASTERN BAY NORTH (cont)</b>	PARSON'S ISLAND	MFSD;SA	OXL;PP
	CEDAR ISLAND	FS	MA
	TURKEY POINT	FS	MA
	JONES HOLE	FS	MA
	RINGOLD MIDDLEGROUND	FS	MA
	WILD GROUND	MFS	OXL
	HOLLICUTTS NOOSE	MFSD;SA	OXL;PP
<b>SOUTH</b>	TILGHMANS POINT	FS	MA
	COOPERS HOLLOW	FS;SA	MA;PP
<b>WYE RIVER</b>	WHETSTONE	FS	MA
	MILLS	FS	MA
	BRUFFS ISLAND	MFSD	OXL
<b>MILES RIVER</b>	LONG POINT	MFSD	OXL
	SECOND POINT	FS	MA
	ASH CRAFT	MFS	OXL
	HERRING ISLAND	FS	MA
	TURTLEBACK	MFSD	OXL
	COFFEE	FS	MA
<b>TALBOT SHORE</b>	POPLAR ISLAND	FS	MA
	STONEROCK	MFSD;SA*	OXL;PP
<b>POPLAR ISLAND NARROWS</b>	SHELL HILL	MFS	OXL
<b>CHOPTANK RIVER: UPPER CHOPTANK</b>	DRUM POINT	FS;SA*;SSRP4	MA;PP;TA
	CABIN CREEK ENTRANCE	SA*;SSRP4	PP;TA
	CABIN CREEK	FS;SA;FT;SSRP4	MA;PP;PP;TA
	SPAR BUOY	SA	PP
	TANNERS PATCH	FS;SA;SSRP4	MA;PP;TA
	JAMAICA POINT	SA*	PP
	DIXON	FS;SA;SSRP5	MA;PP;TA
	MILL DAM	FS;SA;FT;SSRP3;SSRP5	MA;PP;PP;TA;TA
	GOOSE POINT	SA*	PP
	BRITISH HARBOUR	SA	PP
	OYSTER SHELL POINT	MFSD;SA;FT	OXL;PP;PP
	CHANCELLORS POINT	SA*	PP
	BLACK BUOY	FS;FT	MA;PP
	STATES BANK	SA*	PP
	SUGAR LOAF	SA*	PP
	SHOAL CREEK	FS;SA*	MA;PP
	BOLINBROKE SANDS	FS;SA*	MA;PP
<b>MIDDLE CHOPTANK</b>	GREEN MARSH	FS;SA*	MA;PP
	KIRBY	FS;SA*	MA;PP
	HAMBROOKS	SA*	PP
	DICKINSON	FS	MA
	SANDY HILL	MFSD;SA;FT	OXL;PP;PP
	SANDY HILL ADDITION	SA	PP

<u>REGION</u>	<u>OYSTER BAR</u>	<u>PROGRAM</u>	<u>DATA CONTACT</u>
MIDDLE CHOPTANK (cont)	HOWELLS POINT	FS;SA*	MA;PP
	HORNS POINT ADDITION	FS	MA
	BEACONS	FS;SA*	MA;PP
	CHLORA POINT	FS;SA*	MA;PP
LOWER CHOPTANK	LIGHT HOUSE	MFSD;SA*	OXL;PP
	CHOPTANK LUMPS	SA*	PP
	TODD POINT	FS	MA
	DAWSON	FS;SA	MA;PP
	FRANCE	FS;SA*	MA;PP
	COOK'S POINT	MFSD;SA	OXL;PP
TRED AVON RIVER	DOUBLE MILLS	MFSD	OXL
	PECK'S POINT	FS	MA
	TOWN POINT	FS;SA*	MA;PP
	STONE CHURCH	FS	MA
	FOX HOLE	FS;SA	MA;PP
	BACHELOR POINT	FS;SA*	MA;PP
BROAD CREEK	MULBERRY PONT	SAS	MA/OXL
	DEEP NECK	MFSD	OXL
	BROWN	FS	MA
	GREAT BAR	FS	MA
	ROYSTON	MFSD	OXL
	IRISH CREEK	FS;SA*	MA;PP
HARRIS CREEK	LITTLE NECK	FS	MA
	MILL POINT	SA*;SAS	PP;MA/OXL
	EAGLE POINT (LOMAX)	MFS	OXL
	CHANGE	SA*	PP
	TILGHMAN WHARF	MFSD	OXL
	GREAT MARSH	FS;SSRP3	MA;TA
TRIPPES BAY	BRANNOCK	SA	PP
	BRANNOCK ADDITION	SA	PP
	DIAMOND	FS	MA
	HILLS POINT NORTH	FS	MA
LITTLE CHOPTANK RIVER	TOWN POINT	FS;SAS	MA;MA/OXL
	GRAPEVINE	FS	MA
	BUTTERPOT	FS	MA
	CASON	MFSD	OXL
	SUSQUEHANNA	FS	MA
	SLAUGHTER CREEK	FS	MA
	CATORS	FS	MA
	RAGGED POINT	MFSD;SAS	OXL;MA/OXL
	PEANUT HILL	SAS	MA
	CEDAR COVE	SAS	MA
	LITTLE CHOPTANK	SAS	MA
DORCHESTER SHORE	PUNCH ISLAND CREEK	FS	MA

<u>REGION</u>	<u>OYSTER BAR</u>	<u>PROGRAM</u>	<u>DATA CONTACT</u>
HONGA RIVER	TUBMAN'S DRAIN SMOKE POINT LAKES COVE WINDMILL LONG POINT NORMAN ADDITION#1	FS FS FS;SA* MFS;SA* FS MFSD;MS	MA MA MA;PP OXL;PP MA OXL;MA
HOOPER STRAITS	LIGHTHOUSE HOOPER STRAITS ADDITION#1	FS FS	MA MA
HOLLAND STRAITS	HOLLAND STRAITS WEST HOLLAND STRAITS	FS MFSD	MA OXL
KEDGES STRAITS	OYSTER CREEK WESTERN ISLANDS KEDGES STRAIT	FS SAS;SSRP2 SAS	MA MA;TA MA
TANGIER SOUND: UPPER	SHARKFIN SHOAL HAINES MUD ROCK HOLLAND STRAITS	MFSD;SA;MS FS FS FS	OXL;PP;MA MA MA MA
MIDDLE	TURTLE EGG ISLAND CHAIN SHOAL MUSSEL HOLE GRAVEYARD PINEY ISLAND WEST PINEY ISLAND EAST HARRIS ADDITION FLACK COVE (BACK COVE) TERRAPIN SANDS INNER ADDITION TERRAPIN SANDS INNER	MFS FS;SA* FS SA* FS MFSD;SA*;MS FS MFSD;SA*;SSRP2 FS FS;SA*	OXL MA;PP MA PP MA OXL;PP;MA MA OXL;PP;TA MA MA;PP
LOWER	OLD WOMANS LEG GREAT ROCK	MFSD;SSRP3 MFS	OXL;TA OXL
FISHING BAY	HALF-WAY MARK HILL OLD HOUSE GOOSE CREEK WARE SANDS TEDIOUS CREEK CLAY ISLAND EVANS	FS FS FS MFSD SA FS MFS FS	MA MA MA OXL PP MA OXL MA
NANTICOKE AND WICOMICO RIVERS	UPPER STAKE WETIPQUIN HICKORY NUT CEDAR SHOAL LONG SHOAL CHERRY TREE OUTER HOLE	MS MFS;MS FS;SSRP1 FS;SA FS FS SA	MA OXL;MA MA;TA MA;PP MA MA PP

<u>REGION</u>	<u>OYSTER BAR</u>	<u>PROGRAM</u>	<u>DATA CONTACT</u>
NANTICOKE AND WICOMICO RIVERS (cont)	BEAN SHOAL	FS	MA
	WILSON SHOALS	MFS;SA;MS	OXL;PP;MA
	ROARING POINT EAST	FS	MA
	MIDDLEGROUND	MFS	OXL
	MOUNT VERNON	MFS	OXL
	GREAT SHOALS	FS	MA
	EVANS	MFS;SA	OXL;PP
	HALLS POINT	FS;SA	MA;PP
	WHITE SHOALS	FS;SSRP3	MA;TA
MANOKIN RIVER	GEORGES	MFSD	OXL
	MARSHY ISLAND	FS	MA
	DRUM POINT	MFS	OXL
	PINEY ISLAND SWASH	FS	MA
	MINE CREEK	FS	MA
BIG ANNEMESSEX RIVER	BIG ANNEMESSEX	FS	MA
LITTLE ANNEMESSEX RIVER	OLD HOUSE COVE	FS	MA
POCOMOKE SOUND	MARUMSCO	MFSD	OXL
	GUNBY	MFS	OXL
	FLAT ROCK	FS	MA
	WARE ROCK	FS	MA
	TERRAPIN LEAD	FS	MA
	OLD ROCKS	FS	MA
LOWER BAY EAST	CHURCH CREEK	FS	MA
	FOG POINT	SAS;SSRP2	MA/OXL;TA
UPPER BAY WEST	COAL LUMP	FS	MA
	GALES LUMPS	FS;SA	MA;PP
	MAN-O-WAR SHOALS	FS;SA*;FT	MA;PP;PP
UPPER ANNE ARUNDEL SHORE	BODKIN POINT NORTH	HS	PP
	SEVEN FOOT KNOLL	FS;SA*	MA;PP
	SIX FOOT KNOLL	FS;FT	MA;PP
	CRAIGHILL LUMPS	FS;SSRP1	MA;TA
	MOUNTAIN POINT	MFS;FT	OXL;PP
	OUTER MAGOTHY	FS	MA;PP
LOWER ANNE ARUNDEL SHORE	SANDY POINT SOUTH	FS;FT	MA;PP
	HACKETT POINT	MFSD;SA;FT;SSRP1	OXL;PP;PP;TA
	TOLLY POINT	FS;SSRP1	MA;TA
	THOMAS POINT NORTH	FS;SSRP1	MA;TA
	THREE SISTERS	MFS;SSRP1	OXL;TA
	WILD GROUND	FS	MA
	HOLLAND POINT	MFSD	OXL
SEVERN RIVER	FERRY POINT	HS	TA

<u>REGION</u>	<u>OYSTER BAR</u>	<u>PROGRAM</u>	<u>DATA CONTACT</u>
SOUTH RIVER	THUNDER AND LIGHTNING	SAS	TA
	SWAN REEF	FS	MA
	MARSHY POINT	FS	MA
UPPER CALVERT SHORE	HOG POINT ADDITION	FS	MA
	FLAG POND	MFSD	OXL
LOWER CALVERT SHORE	LITTLE COVE POINT	FS;SA*	MA;PP
	SIMMONS	FS;SA*	MA;PP
	HOG ISLAND	MFSD;SA	OXL;PP
PATUXENT RIVER:			
UPPER	HOLLAND POINT	FS	MA
	BUZZARD ISLAND	FS	MA
	BROAD NECK	FS	MA
	THOMAS	FS	MA
	PRISON POINT	FS	MA
	JACKS MARSH	FS	MA
MIDDLE	BROOME ISLAND	MFSD	OXL
	GATTON	FS	MA
LOWER	HELLEN	FS	MA
	HAWKS NEST	FS	MA
	BARN GATES	SA*	PP
	HUNGERFORD HOLLOW	FS	MA
	BACK OF THE ISLAND	MFSD	OXL
	TOWN CREEK	FS	MA
	SANDY POINT LUMPS	SA*;HS	PP;PP
	SWASH	FS	MA
	SOUTHEAST MIDDLEGROUND	FS;SSRP3	MA;TA
ST. MARY'S SHORE	CEDAR POINT HOLLOW	FS	MA
	ROCKY BEACH	FS	MA
	SHAVING PILE ADDITION	FS	MA
	BUTLER	MFSD;SA	OXL
	POINT LOOK-OUT	SAS;SSRP2	PP;TA
POTOMAC RIVER:			
UPPER	BEACON	FS; FT	MA;PP
	POPE'S CREEK	FS;FT	MA;PP
	PASCAHANNA	FS;SA*;FT	MA;PP;PP
	LOWER CEDAR POINT	MFSD;SA*;FT;SAS	OXL;PP;PP;MA/OXL
	SWAN POINT	FS;SA*;FT	MA;PP;PP
	STONY POINT	FS	MA
	WATSONS	FS	MA
	COLONIAL BEACH	FS	MA
	GUM	FS	MA
	OLD FARMS	FS	MA
MIDDLE	COBB ISLAND	FS;SA*	MA;PP
	SHEEPSHEAD BAY	FS;SAS	MA;MA/OXL
	HERON ISLAND	FS	MA

<u>REGION</u>	<u>OYSTER BAR</u>	<u>PROGRAM</u>	<u>DATA CONTACT</u>
POTOMAC RIVER MIDDLE (cont)	KINGSCOPSICO	FS	MA
	HUGGINS POINT	FS	MA
	POSEYS BLUFF	FS	MA
	COLES POINT	FS	MA
	RAGGED POINT	MFSD;SA	OXL;PP
	BLAKE CREEK	FS	MA
LOWER	PINEY POINT HOLLOW (PINEY POINT)	FS	MA
	ST. GEORGES ISLAND	FS	MA
	KITTS	FS;SAS	MA;MA/OXL
	JONES SHORE	SA*;SAS	PP;MA/OXL
	CORNFIELD HARBOR	MFSD;SA;HS	OXL;PP;PP
	BONUMS	FS	MA
	LYNCH POINT	FS	MA
	THICKET POINT	FS	MA
	HOG ISLAND	FS	MA
	GREAT NECK	FS	MA
WICOMICO RIVER	KEY	FT;SA*	PP;PP
	STODDARD	FS;SA*;FT	MA;PP;PP
	COHOUCK	SA*;FT	PP;PP
	CHAPTICO LUMPS	FS	MA
	MILLS WEST	MFSD;SA*	OXL;PP
	WINDMILL	FS;SA*;SSRP3	MA;PP;TA
	BRAMLEIGH CREEK	FS;SA*	MA;PP
	WHITE POINT	FS;SA*	MA;PP
	LANCASTER	MFSD;SA*;FT	OXL;PP;PP
	ROCK POINT	FS;SSRP1	MA;TA
	MOUTH OF RIVER	FS;SA*	MA;PP
	ST. CATHERINE	FS;FT;SSRP1	MA;PP;TA
	SILVER SPRING	FS	MA
ST CLEMENTS AND BRETON BAYS	GUEST MARSHES	FS	MA
	ABELL	FS	MA
	BLACK WALNUT	MFS	OXL
	BLUE SOW	MFS	OXL
	DUKEHART CHANNEL	MFS	OXL
ST MARY'S RIVER: UPPER	HORSESHOE	FS	MA
	PAGAN	MFSD	OXL
	SEMINARY	SAS;HS	MA/OXL;MA
	GRAVELLY RUN	SAS	MA/OXL
LOWER	COPPAGE	FS	MA
	THOMPSON CREEK	FS	MA
	CHERRY	FS	MA
	CHICKEN COCK	MFSD;SA	OXL;PP
ST. GEORGES CREEK	HURDLE	FS	MA
	PINEY POINT AQUACULTURE LEASE	SAS	PP

<u>REGION</u>	<u>OYSTER BAR</u>	<u>PROGRAM</u>	<u>DATA CONTACT</u>
SMITH CREEK	GRAVES	FS	MA
	BARNES POINT	FS	MA
	CALVERT BAY	SAS	MA
CHINCOTEAGUE BAY:			
UPPER	SOUTH POND		
	SOUTH POND ADDITION	COS	PP
	HANDYS HAMMOCK	COS	PP
	LAMBERSTON LANDING	COS	PP
	ENNIS	COS	PP
	TURPIN	COS	PP
	ROBINS MARSH	COS	PP
	ROBINS MARSH ADDITION	COS	PP
	SCARBORO CREEK ADDITION	COS	PP
	NEWPORT	COS	PP
LOWER	DIAMOND	COS	PP
	MARTON POINT	COS	PP
	KENNEL	COS	PP
	TOBY	COS	PP
	WHITE ROCK	COS	PP
	STRIKING MARSH	COS	PP

**Key to Program Abbreviations.**

Abbreviation	Program Name	Site	Sampling Period	Sampling Gear
FS	Annual Fall Survey.	Baywide, 300 to 400 oyster bars.	Oct.- Nov.	Oyster dredge.
MFS (MFSD)	Modified Fall Survey (Disease Survey).	Baywide, 64 "key" bars, 43 disease bars.	Oct. - Nov.	Oyster dredge.
SA (SA*)	Oyster Stock Assessment Program.	Baywide, 20,000 to 30,000 acres annually.	March- Nov.; SA* lists surveys prior to 1993.	Patent tongs.
FT	Freshet Watch Survey	Baywide, 18 bars.	May- July	Oyster dredge.
MS	Oyster Mortality Survey	Lower Bay, 10-12 oyster bars.	June- Aug.	Oyster dredge.
HS	Oyster Habitat Survey	Baywide, site number highly variable.	March- Dec.	Dredge, patent tongs, acoustics.
SAS	Seed Area Survey	Baywide, variable number of sites.	Spring and Fall	Oyster dredge.
COS	Chincoteague Bay Shellfish Inventory	Coastal Bays, 2,300 acres of oyster bars.	April- Nov.	Hydraulic clam escalator, handscrape
SSRP:  1=Seed Planting; 2=Dredged Shell Planting; 3=Fresh Shell Planting; 4=Pollute Planting, Source  5=Pollute Plantin, Location.	Seed and Shell Repletion Program.	Baywide, highly variable number of sites.	April- Aug.	Plantings made by various vessels.



**Key to Data Contact Abbreviations.**

ABBREVIATION	DATA CONTACT	
	LOCATION	PERSON/PHONE NUMBER
MA	Matapeake Terminal, Fisheries Division.	Roy Scott/ 410-643-6785.
PP	Piney Point Aquaculture Center, Fisheries Division.	Mark Homer/ 301-994-0214.
TA	Tawes Building, Fisheries Division.	William Outten, Chris Judy/ 410-974-3733.
OXL	Cooperative Oxford Laboratory, Chesapeake Bay Research and Monitoring Division.	Steve Jordan, Gary Smith, George Krantz/ 410-226-0078.

## **SYNOPSIS OF OYSTER PROGRAMS**

### **Fall Survey**

Initiated in 1939, this survey was designed to provide geographically extensive information on the quality of oyster populations and habitat and to assess spatset. During most years, between 300 and 400 oyster bars are sampled as are numerous seed and shell planting sites. Since 1960, the Oyster Disease Survey has been concurrent with the Fall Survey and in 1990 the Modified fall Survey (see below) was implemented. Samples are collected from oyster dredge tows with data recorded from 0.5 bushel (26 liter) subsamples. Records include the number of live spat, smalls, and markets, the number and stage of dead oysters (boxes), conditional oyster data, and the extent and type of fouling on bottom material. In addition, live oyster size ranges and averages are noted, as are water quality data, the type of sample site, ie. natural, planted with seed, etc., and the geographical position of the sample. A summary of spatfall and oyster parasite data are included in an annual Fall Survey report. Data records are kept on file at the Matapeake Terminal.

### **Modified Fall Survey/Disease Survey**

The Modified Fall Survey focuses on a subset of 64 oyster bars that are annually surveyed. Sampling on these sites involves the collection of 5 independent 0.2 bushel replicate samples. From each of the 5 samples data are recorded on the number of spat, shell height measurements of each live and dead oyster (grouped into 5mm interval categories), and the stage of each oyster box. Additional information as described for the Fall Survey are taken from a pooled sample. At the Disease Survey locations, a subset of 43 of the "key" bars, 30+ oysters > 50mm are randomly selected and shipped to the Cooperative Oxford Laboratory for disease analysis. Data from the Modified Fall Survey and from the Disease Survey are stored in database files linked to a GIS at the Oxford facility. Data from these surveys are included in an annual report.

### **Oyster Stock Assessment Program**

Using a 1m<sup>2</sup> patent tong-based, randomly initiated systematic sampling scheme, this program obtains unbiased estimates of oyster abundance and shell quantity. Since its implementation in 1990, this monitoring program has surveyed over 50,000 acres of charted oyster bottom in Maryland's Chesapeake Bay. Field records include the stations (corrected) latitude and longitude estimates of the number and volume of live and spat, smalls, and markets per unit area, the size class distribution of live and dead oysters, volumetric estimates, per unit area, of surface and subsurface (gray) oyster shell, softclam shell, recurved mussel shell, and live tunicates, and bottom type and depth. Between 30 and 40 different oyster bars are surveyed each year, with a subset of 15 oyster bars monitored on an annual basis. Between 5,000 and 10,000 acres of oyster grounds previously surveyed in 1975 using similar sampling techniques are resurveyed. Data are stored at the Piney Point facility on spreadsheet and database files linked to a GIS. Annual reports are prepared for the Oyster Stock Assessment Program.

### **Winter 1993 Freshet Survey**

Following the unusually wet winter of 1993, a survey was initiated during May, 1993 to track freshet related oyster mortality. Sampling was conducted using a handscrape on oyster bars in the Potomac, Wicomico, Chester, and Choptank Rivers and in the Upper Bay. The Eastern Shore tributary and Upper Bay oyster populations were sampled once, as the freshet was relatively shortlived in these areas. The Potomac and Wicomico Rivers were surveyed intensively, every ten days, over a two month period as freshet effects in these systems persisted. Data recorded included the number of live spat, smalls, and markets and the number and stage of spat, smalls, and market boxes. Conditional oyster information was kept along with water quality data and size range information. Interval and cumulative oyster mortality was calculated. All data were entered and stored in spreadsheet and database files at the Piney Point facility and two reports were prepared.

### Oyster Mortality Survey

Previously referred to as the "bay Peak", this effort generally takes place during the summer months. It's purpose is to provide an early check on the status of oyster parasite infection and related oyster mortality rates. The biological data are kept on file at the Matapeake Terminal with oyster disease information entered and stored at the Oxford Laboratory.

### Habitat Surveys

These are special surveys made when issues arise over the use or proposed use of oyster bottom. Generally dredge-based, these surveys have also used patent tongs, hand tongs, and acoustic gear to assess oyster populations and habitat. Survey results are generally included in reports or memos with some data stored on computer files. Field data are kept at the Tawes Building, while computer file records are stored at the Piney Point facility.

### Seed Area Surveys

During the Annual Fall Survey, seed oyster, dredged shell, and fresh shell planting sites are surveyed to provide information on the biological status of seed oysters from shell and hatchery plantings. These data are on file at the Matapeake Terminal with disease data stored in the oyster database located at the Oxford facility. Seed tracking information is included in the annual Fall Survey report.

### Chincoteague Bay Shellfish Inventory

In 1993, a program was initiated to survey shellfish resources in Maryland's coastal bays. During the first year, surveys were conducted on hardclam beds using a commercial hydraulic escalator dredge. Numerous sampling locations were on previously charted oyster bottom allowing for the accumulation of data on the current structural status of these areas. In 1994, a more focused effort on the old oyster bars is scheduled with handscrape samples to be collected from most of these sites. In addition, surveys of the intertidal zones are planned. All data are stored at the Piney Point facility in spreadsheet and database files linked to a Gis. Quarterly and annual reports are prepared.

### **Seed and Shell Repletion Program**

Since 1961, Maryland has conducted a program to rehabilitate oyster bars through the planting of dredged and fresh oyster shell, the planting of seed oysters set on dredged shell, and the translocation of "pollute", oysters from areas of elevated fecal coliform counts. Records are kept of all Repletion Program activities including dredged and fresh shell planting quantities and sites, the source, destination, and quantity of seed and "pollute" oysters, and associated costs. These records are kept on file at the Tawes Building and are included in an annual Seed and Shell Program report.

## Appendix IV

### A Summary of the Virginia Marine Resources Commission 1993 Oyster Repletion Program.

#### Fall Dredge and Patent Tong Survey

A fall dredge survey has been used by the Repletion Program for many years to provide a qualitative assessment of oyster populations. Usually 150 to 200 oyster bars are sampled throughout Virginia's Bay and tributaries and the seaside of the Eastern Shore. Sampling efforts provide information on bottom condition and water quality, qualitative oyster population data, spatset, mortality rates, and meat condition.

In 1993, a patent tong-based oyster stock assessment program was initiated in Virginia. This assessment provides quantitative estimates of oyster abundance and shell quantity that will provide a statistically evaluated database for future oyster management decisions. Most of the actively harvested oyster rocks in the James and Rappahannock Rivers were sampled in 1993. Future sampling efforts will include all oyster production areas of the state.

#### Seed and Shell Repletion Program

Virginia has had a repletion fund for the replenishment of oyster beds since 1928. During the past 15 years expenditures have varied from \$660,000 to \$1,590,000 for oyster replenishment activities. In 1993 (Table 1) Virginia planted approximately 500,000 bushels of shell and 12,000 bushels of seed. Several new programs were also initiated in 1993, which included the construction of two oyster reef areas, experiments in methods to produce disease-free seed oysters in a natural situation and the evaluation of a hydraulic excavating machine to recover buried cultch material from old oyster bars. The total 1993 expenditures were over \$686,000 with \$426,000 contributed from the General Fund and \$250,000 from Special Funds derived from oyster taxes and permit and dredging fees.

Body of Water	Area	Shells		Seed		Hydraulic		Bagless		COST (\$)				Total Cost (\$)
		Bushels	Type	Acres	Bushels	Acres	Hours	Acres	Per Bu.	Per Hr.	Per Day	Per LP (1)	Per Acre	
Saddle, Eastern Shore Wills Wharf														
Hog Island Bay	Short Prong Cut	1,800	(he)	0.11					0.7				11435	1260
	Lower Draft	8,200	(he)	1.05					0.7		200		5467	5740
	Upper Draft							0.79					1013	800
	Crab Hook							0.73		100			443	850
Outlet Bay Oyster	Poles Channel					1.56	13.5			100	200		1096	800
	Narrows Channel	3,200	(he)	0.57					.65/7				981	1350
	Narrows Channel					2.49	18		.65/7	100			3789	2160
	Ranbora	7,200	(he)	0.9		3.59	13.75		.65/7	100			723	1800
Quincy	Ranbora	5,600	(he)	0.99					.65/7	100			363	4,860
	Point of Rock					1.73	7.75		.65/7	100			3818	1375
	E. Brokenberry	19,200	(he)	2.09					.65/7				448	3,760
													11306	775
Upshurs Bay	Middle Gap	31,200	(reed)	2.67					1.00				11685	23,630
	Middle Gap					1.46	13.75		1.00	100			942	31,200
	Major Hole Bay					1.01	12.25		1.00	100			1213	1375
	Barge Point	7,200	(reed)	0.4		0.56	11.75		1.00	100			18000	1225
Wachapreague	Barge Point												2098	7,200
														1175
	Hummock	16,800	(reed)	1.16					1.00				14463	16,800
	Hummock					4.35	24		1.00	100			552	2400
Bradford Bay	Gate Channel	7,200	(reed)	0.6					1.00				12000	7,200
	East/West					1.73	17.5		1.00	100			1012	1750
	South Bradford	4000	(reed)	1.41					1.00				2837	4,000
	Green Channel					3.55	9			100			254	900
Swash Bay Chincoteague						4.05	39			100			963	3,900
Watts Bay	PG 1820													
SUBTOTALS		111,600		12	0	0	28	191	2					\$128,505

[illegible]



Body of Water	Area	Shells			Seed		Hydraulic Dredging		Bagless Dredging		Cost (\$)				TOTAL COST (\$)
		Busbels	Type	Acres	Busbels	Acres	Acres	Hours	Acres	Per Bu.	Per Hr.	Per Day	Per LF (1)	Per Acre	
Northern Area															
Great Wisconsin River	Haytle Bar														
	Cleaning	29,960	(lue)	5						0.65					19,474
SUBTOTALS		29,960		5	0	0			0			400			4,800
PROGRAM TOTALS		506,343		80	12,398	31			2						\$24,274
															\$673,728

NOTES: 1) LF = Linear Foot

- 2) Mulberry Pt., James River project cancelled because of conditions of oysters and water temperature/salinity in James River
- 3) Bowlers Light, Rappahannock River project cancelled because of conditions of oysters and water temperature/salinity in James River
- 4) Oyster seed moved from Palaces Bar 1992 cleaned area

costs incurred for issuing the notice will be paid by applicant.

## Administration of Tidal Aquaculture Permits

The Maryland Fisheries Division will:

- Provide permits applications.
- Provide technical advice for growing and disease.
- Collect avoidance production information.
- Monitor environmental data collected by grower.
- Supervise permits for compliance with rules and regulations.

## Laws and Regulations which may Pertain to Shellfish Aquaculture

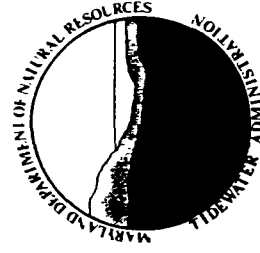
Section Laws	Page
4-102a State laws apply regardless of origin of shellstock	2
4-206 Department's authority over packers & dealers Audits, Forms and Reporting	2
4-514 Interference with another person's fishing equipment	3
4-741 Domestic animals prohibited	11
4-742 Restrictions on taking shellfish from polluted waters	11
4-743 Quarantine for shellfish	12
4-1004 License required to catch oysters and clams commercially	15
4-1006 Catching in polluted areas is prohibited	16
4-1007 Buying stations	17
4-1015 Oyster culling - small oysters from (c,d) leased bottom, in state and out of state, afloat or ashore	26

4-1017 Dealers license required	27
4-1019 Report of buyers or sellers of shells required	29
4-1020 Oyster taxes	30
4-1103(f) Sale of seed oysters to lease holders and aquaculture permit holders	44
4-11A-12 Species of shellfish	57
4-1203 Search warrants (suspicion of illegal species for example)	62
4-1204 Search warrants	63
4-1205 Seizure and disposition of illegal fish	63
4-1206 Seizure and disposition of equipment	60
4-11A-18 Taking oysters less than 3" for replanting	

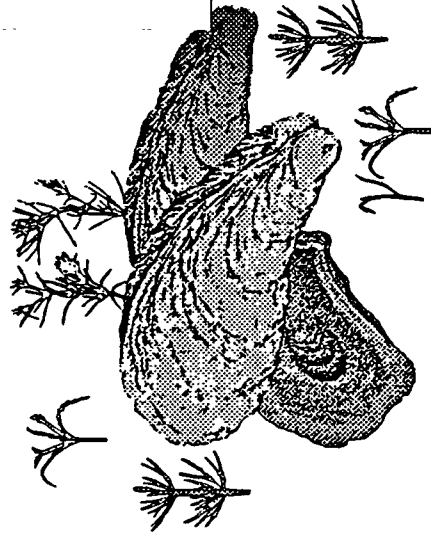
08.02 Regulations	75
.04.04 Oyster Containers	76
.04.06 Daily Catch Limit	84
.08.01 Importation of shellfish - permit required	85
.08.04 Recording the catch and disposal of oysters	103
.14.02 Aquaculture - entire chapter 14	

## National Shellfish Sanitation Program - 1993

Section C Growing Area Survey and Classification	
Section G Aquaculture	
Copies of Laws and Regulations concerning shellfish may be obtained from the Maryland Fisheries Division, Phone: (410) 974-3733 or by FAX (410) 974-2600.	



*This guide was prepared for the Oyster Action Plan which was developed by the Oyster Round Table and is one of many oyster restoration activities being implemented.*



Appendix V

# DRAFT Oyster Aquaculture Permit Guidelines 1994

## A Pilot Permitting Program for Oyster Aquaculture Demonstration Projects

The Maryland Fisheries Division has assembled this guide to assist in the development of private experimental oyster aquaculture in Maryland tidal waters.

The attached permit guidelines establish a pilot permitting program for oyster aquaculture demonstration projects.

- Five-year duration for permit - subject to review and renewal for additional five year terms
- Initial limit of number of permits issued not to exceed 20
- Area permitted not to exceed 5 acres per individual. Two or more persons may jointly obtain a permit for up to 10 acres
- A single permit may include more than one location
- An annual report is required for each permit summarizing activities on the permit area including information on restoration activities undertaken, production techniques utilized and amount of oysters planted and harvested
- Failure to submit an annual report or to conduct the planned activities may result in DNR revoking the permit
- The purpose of the permitted projects is to demonstrate the feasibility of various oyster production techniques

The Fisheries Division Aquaculture Project, located in the Tawes State Office Building, Annapolis, Maryland (410) 974-3733 will act as a permit clearing house service for applicants. Prior to applying for the necessary permits, the applicant should see that the project satisfies the following conditions:

- Cannot take place in currently designated Oyster Recovery Areas (Chester and Choptank)
- Cannot preclude oyster bottom lease activities
- Must be reviewed and approved by Oyster Round Table representatives

#### Permitting Process

Two permits are required for all aquaculture activities in Maryland tidal waters:

- (1) Tidal Wetland Permit and
- (2) Tidal Aquaculture Permit

A completed Tidal Wetland Permit (Joint Federal/State Application for the alteration of any floodplain, waterway, tidal or nontidal wetland in Maryland) with completed Aquaculture Permit Application attached is submitted to:

Maryland Department of Natural Resources  
Water Resources Administration  
Central Processing Service  
Tawes State Office Building D-2  
Annapolis, MD 21401  
ATTN: Andi Cunabaugh  
Phone (410) 974-3871  
FAX (410) 974-2807

This joint permit application receives a tracking number and is distributed by the Water Resources Permit Service Center to all appropriate agencies. These agencies may include:

Army Corps of Engineers  
Maryland Department of the Environment -  
State Shellfish Control Agency permit  
Chesapeake Bay Critical Areas Commission

Upon receipt of a Wetlands/aquaculture permit all agencies involved will initiate procedures for issuing any other necessary permits. These permits may include water use permit, waste discharge permit and 401 certification.

Progress through the permit process can be monitored by the applicant by contacting the Fisheries Division, Aquaculture Project, Phone (410) 974-3733 Fax (410) 974-2600.

It is the responsibility of the applicant to insure that oyster aquaculture will only take place in approved shellfish growing waters. To determine the status of the water at proposed site, contact:

Maryland Department of the Environment  
Standards and Certification Division  
Natural Resources Biologist Kathy Brohawn  
Phone (410) 631-3609

It is the responsibility of the applicant to obtain appropriate county permits. Zoning variance and building permits may be required.

Prior to issuing a Tidal Aquaculture Permit, the Maryland Fisheries Division will issue a public notice to inform interested parties of the proposed activity in order to resolve any conflicting interests which may exist. The

Required for all operations involving interstate commerce or sale.



\* 3 1 1 8 5 7 9 3 \*

Draft Chesapeake Bay  
oyster management plan  
EJDD CB 00615