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Chesapeake Bay oyster restoration : consensus of a meeting of scientific experts, Virginia Institute of Marine Science, Wachapreague, Virginia

Virginia Institute of Marine Science

Chesapeake Research Consortium

Chesapeake Bay Oyster Restoration

Consensus of a Meeting of Scientific Experts
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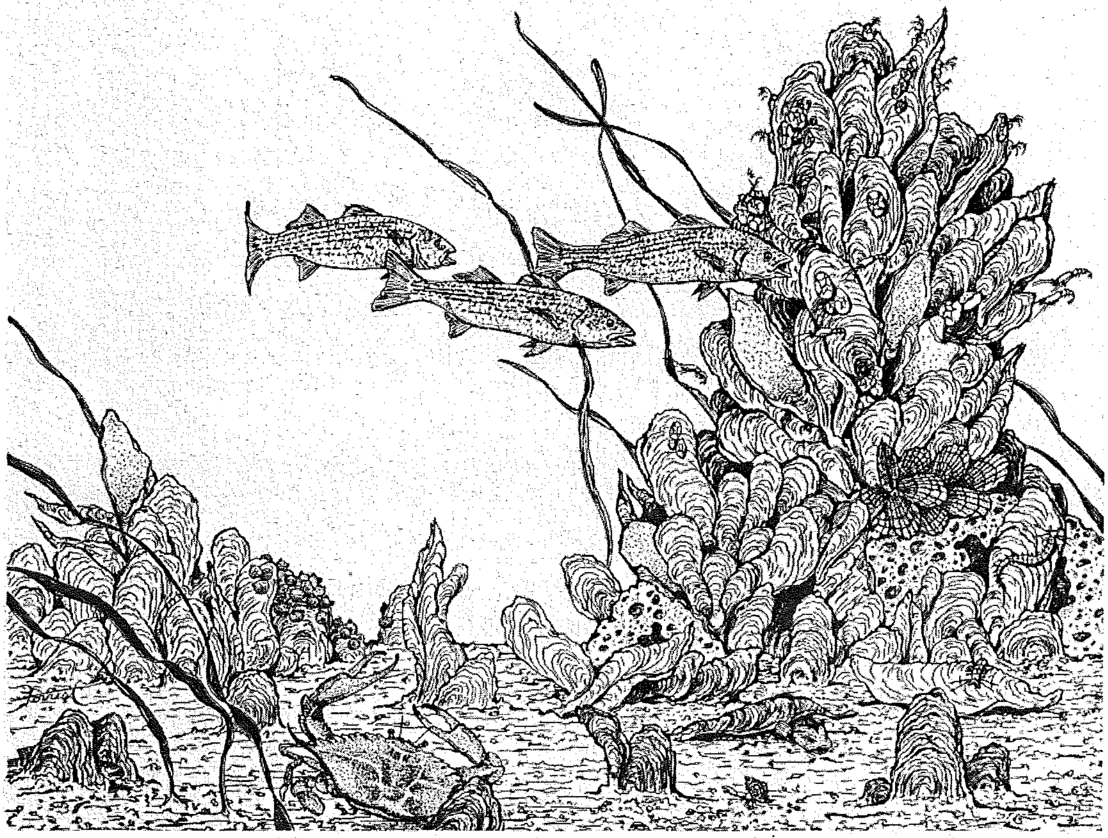

"The abundance of oysters is incredible. There are whole banks of them so that the ships must avoid them. They surpass those in England by far in size, indeed they are four times as large."

Francis Louis Michel

after a visit to Virginia in 1701

Chesapeake Research Consortium
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Executive Summary

A small group of oyster experts from Maryland, Virginia and North Carolina met at the Virginia Institute of Marine Science Eastern Shore Laboratory, Wachapreague, VA on January 18, 1999 to recommend measures to restore and protect the oyster resource of the Chesapeake Bay.

Restoration Philosophy

- The goal for Chesapeake Bay oyster restoration should be to restore and manage oyster populations for their ecological value in such a way that a sustainable fishery can exist while maintaining the essential ecosystem functions of oyster reefs.

Protection Philosophy

- The oyster fishery should be managed regionally based on stock assessments.
- Proper disease management means minimizing, or even prohibiting, movement of infected oysters.

Essential Components of Oyster Restoration Efforts

- Three-dimensional reefs, standing substantially above the bottom, are essential for oyster reproductive success, for predator protection and to create habitat for other organisms.
- Permanent reef sanctuaries permit the long-term growth and protection of large oysters that provide increased fecundity and may lead to development of disease resistant oysters.
- For success, both components, three dimensional reefs as permanent sanctuaries, are necessary; neither component alone will be sufficient.

Reef Siting and Design

- Sanctuary reefs must be placed on hard bottom in areas of natural spatset. Three-dimensional structure equal to at least one-half the water depth is recommended.
- Adult oysters may need to be added to reefs to "jumpstart" recruitment.
- Oyster shell is a limiting resource in all areas and availability may affect recruitment around reefs.

Goals

- Long-term goals are to set aside and restore 10% of historic productive oyster reef acreage for its habitat and ecological value and to restore a sustainable public fishery that would not require additional public monies.
- Short-term goals are to increase spatset, increase the number of adult oysters and to increase habitat and fish utilization of that habitat in tributaries where reef sanctuaries have been established.
- Intermediate goals (4-8 years) are to demonstrate the effectiveness of reef sanctuaries in selected tributaries in Maryland and Virginia.

The Consensus

Restoration Philosophy

Overfishing in the late 1800s and early 1900s reduced Chesapeake Bay market oyster landings from a peak of about 24 million bushels in 1887 to a more-or-less steady state of about 5 million bushels by 1930. This high harvest pressure also mined the oyster reefs themselves, greatly reducing the reef habitat in the Bay. In the last four decades two protozoan diseases (MSX disease caused by *Haplosporidium nelsoni* and Dermo disease caused by *Perkinsus marinus*) have combined to further reduce oyster populations throughout Chesapeake Bay to about 1% of historical levels.

Restoration and proper management of oyster populations in the Chesapeake Bay are critical, but we must move away from the concept of restoring and managing oysters strictly to support an industry. The primary impetus for oyster restoration should be because their filter-feeding lifestyle is an important ecological component in the Bay ecosystem and because their reef-building nature provides valuable habitat for oysters themselves and for other organisms. Oysters can improve water quality because they consume phytoplankton that contribute to anoxia in bottom waters and they also reduce suspended particulate matter, thereby improving water clarity and light penetration critical for aquatic plants. Oyster reefs support a diverse macrofaunal community that provides shelter and food for crabs and fish. An increase in oyster reefs will increase habitat and food for other important species in the Bay.

The restoration philosophy must be to restore and manage oyster populations for their ecological value, but in such a way that a sustainable fishery can exist. The restoration philosophy must not be to manage oysters just to support a fishery. Oysters should be managed on a regional basis with regional quotas established for a fishing season based on stock assessments.

Essential Components of Any Restoration Effort

1. Permanent Reef Sanctuaries

There are really two parts to this component—reefs and permanent sanctuaries. It is clear from historical documents that three-dimensional oyster reefs were a dominant feature of the Chesapeake Bay when colonists arrived in the New World. Oyster reefs provide aggregations of oysters that maximize reproductive success and the resulting structure enhances recruitment and growth of young oysters and provides protection from predators. In Chesapeake Bay, oyster densities are currently so low at most historical reef sites that reproductive success is likely low. Further, the lack of reef structures results in sub-optimal habitat for oyster growth and survival. Three-dimensional reefs are critical for reproductive success, predator protection and, of course, for the habitat they provide for other estuarine fauna.

Permanent sanctuaries are critical for a number of reasons. Permanent sanctuaries will allow for the development and protection of large oysters. It is well documented that fecundity in oysters increases exponentially with length. Thus, a small number of very large oysters can produce many more eggs than a large number of small oysters. In addition, large oysters in disease-endemic areas have a demonstrated ability to survive diseases, a characteristic that is, at least in part, inherited by their offspring. Natural disease resistance has not developed in Chesapeake Bay for two reasons. First, there has been historically a large unselected gene pool in low salinity that diluted any selected gene pool. Second, the fishery harvested all the large oysters that were surviving in disease-endemic areas and that may have been disease resistant. We cannot guarantee that disease resistant oysters will become widespread in the Bay with the protection of large oysters, but certainly disease resistance will never become widespread without the protection of large oysters.

Reef sanctuaries are also critical for habitat and ecological value. The reef structure provides important habitat for myriad organisms that contribute to the overall health of the Bay and provide food for recreationally and commercially important fish and shellfish species. In short, reef sanctuaries contribute to ecosystem restoration. Large oysters may be important for the structural integrity of a reef and it has been documented that a range of oyster sizes, including large individuals, is important for the ecological role of reefs (e.g. nesting sites for small fishes). Reefs must be considered "ecological sanctuaries." Harvesting must not be allowed on reef sanctuaries or the community of organisms important for reef structure and function will never fully develop.

Thus, the combination of restored three-dimensional reefs and permanent sanctuaries is critical to the success of oyster restoration. Restored reefs where harvesting is allowed will be unsuccessful as will sanctuaries alone. It is the combination of the two concepts that is important.

Areas around reef sanctuaries can be managed for harvest. Shells planted around reefs to catch spat can be harvested eventually in place or the small oysters can be moved to other areas for growout and harvest. However, a long-term goal should be to create a sustainable regional fishery and thereby reduce the necessity to move oysters. Properly placed reef sanctuaries will likely reduce or eliminate the need to move oysters for harvest because the reefs will be a source of larvae that will settle on local harvestable beds.

2. Proper Disease Management

One of the basic tenets of disease management is that infected organisms should not be moved into areas where the disease is not present or is present at lower levels. Much of the spread of Dermo throughout the Bay resulted from moving infected oysters. Managers argue that because Dermo is now present throughout the Bay it doesn't hurt to move infected seed oysters into low salinity because the disease is already there. However, the historical distribution of Dermo was restricted to the lower Bay and the mouths of major tributaries. Prior to the severe droughts of the late 1980s Dermo was not present in most Maryland tributaries and there is reason to expect that if rainfall patterns return to normal Dermo will eventually return to its historical range. It is well documented that Dermo is not pathogenic below about 12 ppt, so managers argue that it doesn't make any difference if infected seed oysters are moved to salinities below that level. However, if a drought occurs Dermo will multiply rapidly, kill oysters and spread to other oysters, thereby perpetuating the disease in the area.

At the very least, a policy must be established against moving any infected oysters into salinities lower than where they set or into areas where disease levels are low. However, there was strong sentiment among most committee members that infected oysters should not be moved at all.

Issues

There are many other issues involved with the successful implementation of a reconstructed oyster reef sanctuary program. Issues that the committee felt were important are discussed briefly below.

1. Reef Siting

Reef sanctuaries should be placed in areas that historically supported productive oyster bars if there has been no subsequent change in hydrography or sedimentation patterns. To be self-sustaining they must be placed on stable, hard bottom and in areas where natural spatset occurs. If reefs are to be a source of spat for shell plantings, and for sustainability of the reef itself then salinity, flow regime and basin morphology will be important considerations. Hydrodynamic models or drifter studies will be useful in determining fate of larvae from any proposed reef site.

2. Reef Design Criteria

A reef is defined here as a three-dimensionally-complex biogenic structure that rises substantially from the seafloor. Verticality is critical and reefs should have sufficient vertical relief that recruitment and growth of the reef will outpace sedimentation. Substantial three-dimensional structure equal to at least one-half the water depth is recommended. Historically, some reefs may have broken the surface at low water and the goal should be to reproduce historical reefs to the best of our ability.

The core of the reef may be composed of any substrate that will provide stability to the vertical structure. There should be a veneer of oyster shell or other suitable substrate for spat settlement. The veneer must have a three-dimensional matrix sufficient to allow spat settlement and provide protection for the spat from predators.

Optimal size of reef sanctuaries has not been determined and will likely be dictated by funding constraints. In Virginia, reefs as small as one acre have substantially increased spat set in the surrounding area. An archipelago of small reefs may be more effective than a single large reef.

3. Reef Protection

It is critical that reef sanctuaries be protected from poaching. They should be sited such that enforcement of the sanctuary will be feasible. Community awareness can be important for enforcement so reefs should be sited, if possible, in areas where community oversight can develop.

4. Broodstock Supplementation on Reefs

It will probably be important to add adult oysters to some restored reefs to enhance recruitment to the reef and to the surrounding area. Large natural oysters can be harvested and aggregated on reefs to enhance fertilization success. This strategy worked successfully in Virginia where large, but scattered, oysters from Tangier Sound were aggregated on a reef in the Great Wicomico River. Spatset on and around the reef increased dramatically the following year. If natural recruitment is low then it may be necessary to add adults to a reef in high density to "jumpstart" recruitment.

Where possible and when available, progeny from genetically selected oysters could be stocked on reefs. There are a number of programs underway to select oysters for a variety of traits including growth in low salinity, fast growth, or disease resistance. These strains will require evaluation for their effectiveness for use on reef sanctuaries.

5. Shellplants Around Reefs

An important component of the restoration strategy will be to plant shell around reef sanctuaries to enhance spatset, although the need for shell planting will likely be site specific. Good quality oyster shell is a limiting resource for spatset around reefs in all areas. Shallow buried and fossil shell are currently available, but more emphasis needs to be placed on returning harvested shell to the Bay. After spatfall, the shell could be left in place for future harvest or it could be moved to other areas to develop sanctuaries or for future harvest. The oysters moved to other areas would contribute ecological value until they were harvested. However, as stated above, a long-term goal is to use reef sanctuaries to provide a sustainable regional source of spat to reduce or eliminate the need to move seed oysters.

Siting of shellplants will be important to maximize spatset. Circulation models may help determine current patterns and where best to plant shell.

Restoration Goal

The long-term restoration goal should be to construct and protect a sufficient number of reef sanctuaries bay-wide such that 1) habitat and ecological function will be restored, 2) water quality will improve and anoxia will decrease, and 3) a sustainable fishery can exist with no addition of public funds. In lieu of specific data on the required sanctuary area necessary to meet this goal, we recommend that 10% of traditional oyster bar acreage in formerly high-yielding harvest locations be set aside and restored as permanent sanctuaries. As additional data become available it may be possible to refine this estimate.

The short-term goal will be to increase spatset, increase the number of adult oysters, and increase habitat and fish utilization of that habitat in specific tributaries where reef sanctuaries have been constructed.

Over the next four to eight years the intermediate goal should be to demonstrate effectiveness of reef sanctuaries for ecological improvement in one or two selected tributaries in each state. The tributaries will have to be monitored to evaluate success, using criteria listed above under short-term goals.

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