



Habitat CONNECTIONS

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Oyster Restoration on the East and Gulf Coasts

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Introduction

Oyster reefs are a valuable component of estuarine ecosystems (areas where freshwater and saltwater mix). Oysters provide many services in these systems, such as filtering sediments and algae from the water column, providing a unique reef habitat type for many species, and supporting commercial and recreational fishing.

The Eastern oyster fishery helped define a way of life in the mid-Atlantic and along the Gulf Coast. Unfortunately, from Maine to the Gulf of Mexico, the native Eastern oyster (*Crassostrea virginica*) has drastically declined since the late 1800's as a result of overfishing, physical habitat degradation, reduced water quality, and increases in disease mortality.

NOAA is committed to restoring oyster populations, habitat, and fisheries, with the understanding that reversing more than 100 years of decline will not be easy. Through partnerships involving federal and state agencies, the scientific community, and the oyster industry, NOAA is applying new and innovative approaches to restoring this vital resource.

Restoration

What problems does restoration solve? Restoration typically relates to one or both of the following limitations:

- A lack of hard substrate (habitat) on which young oysters can attach and grow.

- Reduced or nonexistent propagation of young oysters by the resident population.

To counteract these problems, restoration practitioners have employed the following tools and management strategies.

Rehabilitating habitat

Oyster restoration typically involves rehabilitating the physical habitat by planting shell collected either from harvested oysters in processing houses or dredged from ancient buried shell deposits. Although oyster shell is the preferred building block for new habitat, natural shell is limited and

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Oysters are a keystone species in coastal embayments. They grow naturally in reefs that create and provide habitat, not just for current and future generations of oysters, but for many species of commercially and recreationally important finfish and shellfish. Oyster reefs were once a dominant hard-bottom habitat in estuaries from New England to the deep South. Ecologists think our ability to restore overall water quality, habitat, and fisheries in these areas is linked to our ability to restore oyster populations.

Oysters are filter feeders, which makes them natural water purifiers, removing algae and sediments from coastal waters. For example, scientists believe that at one time the oyster population in Chesapeake Bay was able to filter the entire volume of water in the Bay in three days; at the current population level, estimates show this process would take 300 times longer. Filtration increases water clarity, improving the amount of sunlight available to submerged aquatic vegetation (SAV) which, in turn, facilitates SAV growth, providing habitat and feeding grounds for numerous species above and below the water. Restoring this natural filtration capability is critical to the overall health of estuaries.

alternative materials are being investigated. Field and laboratory studies have shown that free-swimming oyster larvae will settle on virtually any available hard substrate. However, results of monitoring suggest that the refuge provided by irregular surfaces and pore spaces of certain materials (stone, crushed concrete, limestone-marl, and crushed porcelain) provides small oysters the best protection from predation.

Increasing propagation via hatcheries or oyster gardening

In some areas, appropriate habitat exists but with too few oysters to seed it. In other instances, restoration projects need to jump-start the local oyster population on newly created habitat. In these cases, habitat is seeded with juvenile (spat) or adult (broodstock) oysters. Spat typically is produced by a hatchery, whereas broodstock oysters may be raised by volunteers as part of oyster gardening programs. These human-directed methods are necessary in areas where natural recruitment is low or sporadic. The process buys time for oysters to establish healthy populations before the substrate is fouled by other bottom-dwelling organisms.

Improving disease resistance and growth rates

Through the NOAA Sea Grant Oyster Disease Research Program, scientists from academic institutions collaborate to select and breed individual oysters that are above average in combating disease-causing pathogens. These hardy strains are often developed from native oysters that have demonstrated an ability to survive and grow, even in the presence of disease. (See the section *Spotlight on Chesapeake Bay*.)

Another genetic solution involves reproductively sterile triploid native oysters created in a laboratory or shellfish hatchery. Triploids grow much faster than diploid oysters, making them well-suited for aquaculture. Although their sterility makes triploids unsuitable for restoring self-sustaining oyster populations, aquaculture production of triploids

could contribute to restoration by easing harvest pressure on wild populations.

Spotlight on Chesapeake Bay

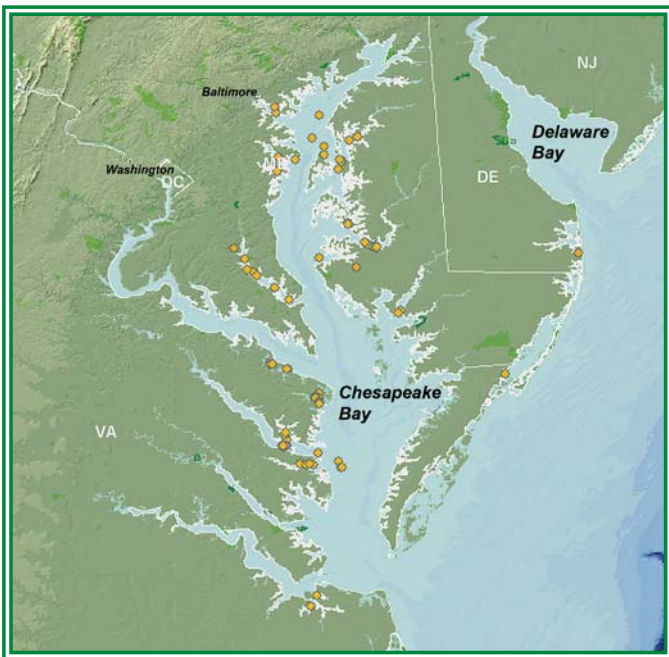
Three approaches to oyster restoration are being implemented in Chesapeake Bay: sanctuaries, managed reserves, and genetic rehabilitation. These strategies use various combinations of the basic oyster restoration methods.

Sanctuaries are restored oyster bars protected from harvest. Restoration usually involves planting shell or other hard substrate. Areas that do not receive natural oyster spat sets are planted with hatchery spat or broodstock oysters. The rationale behind sanctuaries is twofold: (1) oysters within sanctuaries will reproduce and provide oyster larvae that will seed harvest areas outside the sanctuary, and (2) freedom from harvest will promote disease resistance through natural selection, as surviving oysters produce offspring with similar genetic properties.

Managed reserves are cooperative ventures between resource managers and the oyster industry. Specific reef areas are restored and opened for harvest on a schedule that promotes both ecological and economic benefits. This relatively new strategy is being tested in Maryland. Watermen are hired to remove all oysters from the site prior to planting so none remain to harbor disease. The bottom is reconditioned by removing sediment, dredging up and replanting shell, or adding substrate. Hatchery spat are then planted and allowed to grow for several years. During this harvest-free time, the oysters provide ecological benefits by filtering water and reproducing. When the reserve is opened to harvest, the economic benefit is a healthy supply of oysters for market.

In recent years, disease-tolerant strains of the native oyster have been field tested as part of restoration efforts. A project under way in Virginia uses these strains as part of a **genetic rehabilitation** strategy. By repeatedly seeding relatively small sub-estuary systems with large numbers of disease-tolerant spat, researchers hope to effectively change the genetics of the local population. Even slight increases in survival will result in larger, more reproductively fertile oysters. The goal of this technique is to establish self-sustaining oyster populations, genetically programmed for improved disease tolerance.

Another approach being considered in Maryland, Virginia, and North Carolina involves the possible introduction of a non-native, Asian oyster species with greater resistance to oyster diseases. Considerable controversy surrounds this proposal and many questions remain about the consequences of such an introduction. Federal and state agencies are preparing an Environmental Impact Statement on this proposed action, and numerous studies are under way to provide a scientific basis for a decision. This issue will be examined in greater detail in the next edition of *Habitat Connections*.



The NOAA Restoration Center and its partners are conducting oyster restoration activities throughout Chesapeake Bay.

“A New York frame of mind”— the Hudson-Raritan

New York/New Jersey Baykeeper is partnering with the NOAA Community-based Restoration Program to restore the oyster reefs that once dotted New York Harbor. This is one of the most severely altered and degraded coastal areas on the eastern seaboard with respect to oyster habitat; in areas that historically supported oyster beds, so many have been destroyed or removed that neither the shell base nor the historic oyster population remain. Therefore, restoration activities in the Hudson-Raritan area involve both habitat construction and seeding.

At three sites, including one at the foot of the Statue of Liberty, project partners used clam and oyster shell

as substrate to help keep oysters out of the mud. After the reef substrate is created, it is seeded with oysters from a volunteer oyster gardening program and a lab-based collaborative program between NOAA, the State of New Jersey, and a local high school. The lab-based program allows high school students to grow oysters in tanks at the NOAA Northeast Fisheries Science Center in Sandy Hook, NJ. Once the oysters have matured, they are planted on reefs in the bay.

An oil spill and “the silver lining”— Narragansett Bay

Historic overfishing and environmental degradation depleted oyster resources in Rhode Island. In winter, 1996, shellfish in the area were injured by a large oil spill that devastated estuarine and shoreline habitats. NOAA recovered funds in compensation for injuries to wildlife and habitat resulting from the spill. The NOAA Restoration Center, in partnership with other federal, state, and local agencies, is using these funds to restore local shellfish populations. These activities include oyster restoration in coastal ponds and areas within Narragansett Bay. Suitable substrate exists in these areas but, because natural spat production is extremely low, restoration efforts focus on establishing breeding populations to increase the supply of recruits. Funding from the 1996 spill is being used to purchase oyster larvae, set it onto shell, and grow it out in a nursery area. Once the oysters mature, monies fund projects to place spat at restoration sites.

“Way down south in Dixie”—Mobile Bay

In highly productive areas of Mobile Bay in Alabama, natural production of oyster spat is already occurring; however, some areas have been so drastically altered or depleted that restored substrate is required for restoration to succeed. NOAA’s Restoration Center, in partnership with the University of South Alabama, is directing and supervising the placement of oyster shell in various configurations and locations in Mobile Bay. NOAA monitors these reefs for survivability, productivity, and benefits to fisheries. Through monitoring and other activities, the program is developing the scientific understanding necessary to direct current and future oyster restoration and enhancement in Alabama. NOAA is also contributing to a long-term strategy for sustaining

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both oyster productivity and the species supported by oyster reefs.

“Recycling, naturally”—South Carolina

South Carolina Oyster Restoration and Enhancement (SCORE) partners restore and enhance oyster habitat by planting “recycled” oyster shells in the intertidal environment to form new, self-sustaining oyster reefs. These activities counteract restoration limitations imposed by a shortage of suitable hard substrate. Shell recycling is a simple concept that encourages local restaurants and residents to deposit salvaged shell at one of 13 statewide recycling locations, making it available for restoration projects. To date, more than 2,000 volunteers have given more than 10,000 hours to construct 98 intertidal oyster reefs from recycled shell.

Conclusion

Oyster restoration is occurring on many scales at sites along the Atlantic and Gulf coasts. Participants range from school groups to government agencies, and

techniques run the gamut from basic conservation practices and placement of shell substrate to the latest genetic manipulations. Participants get involved in restoration efforts for various reasons—a desire to revive failing fisheries, retain a rapidly disappearing way of life, or provide coastal habitats with a natural mechanism to improve water quality. Successful restoration of oyster habitats is critical to maintaining coastal biodiversity and ensuring the stability and production of estuarine ecosystems.

Additional Information

Hudson-Raritan Oyster Restoration:
<http://www.nynjbaykeeper.org/programs/42>

NOAA Restoration Center:
http://seahorse.nmfs.noaa.gov/rcdb/class/projects_main.html

NOAA Sea Grant’s Oyster Disease Research Program:
<http://www.nsgo.seagrant.org/themesnpa/oystershellfishdisease.html>

South Carolina Oyster Restoration and Enhancement (SCORE): <http://www3.csc.noaa.gov/scoysters/>