2015 Oyster Reef Ecosystem Services (ORES) Research Update

July 2015

In order to quantify the ecosystem benefits provided by restored oyster reefs, the NOAA Chesapeake Bay Office (NCBO) initiated the Oyster Reef Ecosystem Services (ORES) project. This effort consists of three primary efforts: an NCBO-implemented field study of fish utilization of a variety of sites in the Choptank River area; NOAA-funded work being carried out by other research institutions on fish utilization, denitrification rates, and other topics; and computer modeling to explore ecosystem and economic benefits of restored reefs.

NOAA Chesapeake Bay Office Fish Utilization Field Study

To identify the fish and other species currently using oyster reefs as habitat in the Choptank River area, the NCBO field science team has conducted field work since 2013. (The Choptank River watershed was designated to be a NOAA Habitat Focus Area in 2014.) Working from on board NCBO's research vessel Bay Commitment, NCBO scientists deploy and then retrieve—after soaking for 24 hours—numerous of lines of fish traps. Each line includes traps of different sizes, each designed to catch different types of fish. While retrieving traps, NCBO staff record the species, numbers, and size of each animal before returning them to the water.

In summer 2014, sampling work was done in the Little Choptank and Tred Avon Rivers, prior to oyster reef restoration work in those subtributaries. Restoration at the Little Choptank sampling sites began in fall 2014, and gets under way in the Tred Avon in early 2015. Fish sampling will continue in summer 2015 in both tributaries.

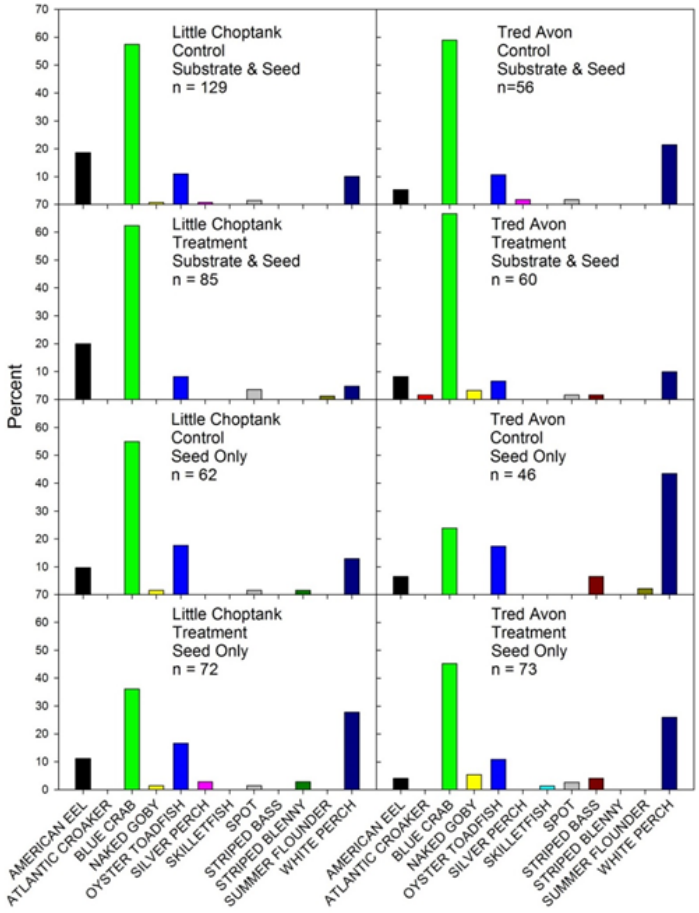
In each location, fish traps were set on eight sites (two lines at each site, each line consisting of six different trap types) that were defined in four categories:

- Existing oyster shell bottom to be restored by augmentation with hatchery oyster seed,
- Sandy bottom to be restored by substrate reef construction and hatchery seed,
- Sandy bottom, suitable for substrate reef construction, but not to be restored, and
- Oyster shell bottom, suitable for hatchery oyster augmentation, but not to be restored.

This is a before-after, control-impact (BACI) study design, which allows comparison of fish abundance before and after restoration in addition to comparisons between restored and unrestored sites.

Nine fish taxa were observed in the Little Choptank samples and 11 from the Tred Avon; American eel, blue crab, oyster toadfish, and white perch were the most frequently encountered. Similar sampling was accomplished in the Tred Avon River in 2013, but only four trap types were used then.

ORES research is under way in seven tributaries around the Chesapeake Bay.



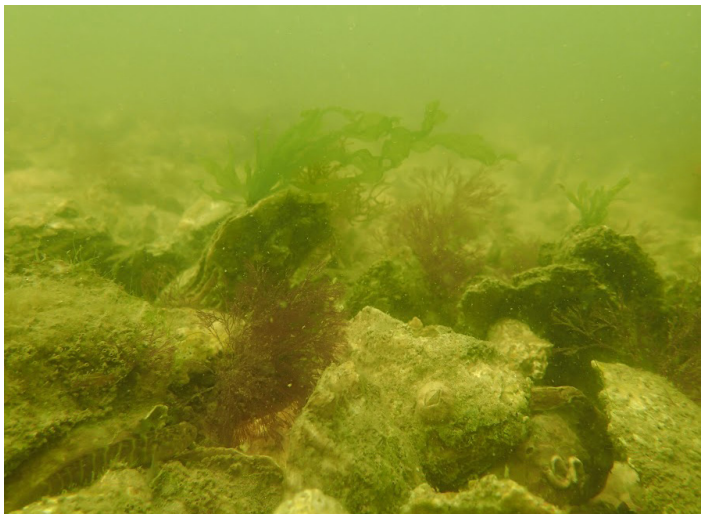
NOAA Chesapeake Bay Office field team members deploy and retrieve fish traps; they document each animal before returning it to the water.

The chart at left shows the species observed durign NCBO ORES field work in in the Little Choptank and Tred Avon Rivers in 2014. "N" is the total number of fish collected, and treatment type indicates whether any restoration--and if so, what kind--had taken place at those sampling sites.

NCBO-Funded Research by Academic Partners

NCBO initiated funding projects to be conducted at academic research institutions that are complementary; these projects cover different geographic areas and different types of ecological and economic benefits of oyster reef habitats. NCBO and researchers from these academic institutions work closely throughout their research to share information and discuss implications of their findings and develop a holistic picture of the ecosystem services provided by Chesapeake Bay oysters. To date, the following projects have gotten under way:

- ***Virginia Institute of Marine Science (VIMS), "Ecosystem Services of Restored Oyster reefs in the Lower Chesapeake Bay,"*** which uses fish traps and video in the Great Wicomoco, Lafayette, and Lynnhaven Rivers, Virginia. In 2014, researchers used habitat maps derived from NOAA side-scan sonar surveys to select sampling sites in the Lynnhaven, Lafayette, and Great Wicomoco River. They worked with watermen to aid in patent-tong sampling of oysters in the Lynnhaven and Lafayette Rivers, and to complete sampling in the Great Wicomico River. They found successful sanctuary reefs in the Lynnhaven River and identified for the first time successful subtidal oyster reefs in the Lafayette River. This finding was significant because it indicates that native oyster populations can persist for a long time in the lower Chesapeake Bay, contrary to the concept that oyster shell accretion cannot compensate for shell degradation. Also, in late



A diver took a photo of this restored reef in the Piankatank River, Virginia. Initial findings from VIMS researchers demonstrate a direct link between oyster biomass and macrofaunal biomass in suitably constructed restoration reefs such as this one.

2014, researcher selected sampling locations (Lynnhaven, Lafayette, and Piankatank Rivers) for 2015; four benthic settling trays will be deployed on four reefs in each river. Natural reefs will be sampled except in the Lafayette, where two will be natural relic reefs and two will be restored. In late 2014-early 2015, researchers also processed and analysed oyster reef samples that were taken in 2014, this included identifying reef organisms and estimating biomass of live oysters.

Researchers discuss the process of deploying macrofauna baskets in Harris Creek.

- ***University of Maryland/VIMS, "Integrated Assessment of Oyster Reef Ecosystem Services: Macrofaunal and Productivity Utilization, Secondary Production, and Nutrient Sequestration,"*** is sampling benthic organisms at restoration sites and nearby unrestored sites in Harris Creek, Maryland (a tributary of the lower Choptank River). While delayed a bit due to extensive ice coverage in the Bay in late winter/early spring 2015, divers on this project deployed four macrofauna baskets at each of eight sites in April 2015. They were retrieved in May, and samples from these baskets were transported to VIMS Eastern Shore Laboratory for initial sample processing. A new set of 32 baskets was deployed in May for retrieval in June.

- ***VIMS, "Integrated Assessment of Oyster Reef Ecosystem Services: Fish and Crustacean Utilization, Secondary Production, and Trophic Linkages,"*** uses a combination of fish traps, crab pots, gill nets, and gut content analyses to compare finfish and crustacean communities at restoration sites and nearby nonrestored sites in Harris Creek, Maryland. Five restoration and three control sites were selected. Permits and approvals were acquired, and in November 2014, an initial site visit allowed the sampling crew to assess conditions at each of the sampling sites and to adjust gear and plans based on local conditions. In April 2015, the first full set of transient finfish and crustacean sampling was completed; striped bass were the most abundant species collected.

- ***University of Maryland Center for Environmental Science (UMCES)/VIMS, "Integrated Assessment of Oyster Reef Ecosystem Services: Quantifying Denitrification Rates and Nutrient Fluxes,"*** collects intact sections of substratum from restoration sites and nearby nonrestored sites in Harris Creek, brings them into the laboratory, and measures nutrient fluxes over five seasons at eight sites per season. This project adds to prior studies of denitrification rates associated with oyster reefs funded by the NOAA Chesapeake Bay Office in FY11 and FY12, which measured nutrient fluxes on experimental oyster reefs at two sites in Virginia. While locating acceptable sites took a considerable effort, the fluxes of oxygen and nutrients were measured at 12 sediment sites and one restored oyster reef site in fall 2014. Rates of sediment respiration—measured using oxygen fluxes—were more than 20 times the rate of sediment respiration at unrestored sites. In addition, early in 2014, researchers determined that shell is a location where denitrification can occur.

SERC researchers deploy a DIDSON sonar to obtain video of fish utilization of oyster reefs.

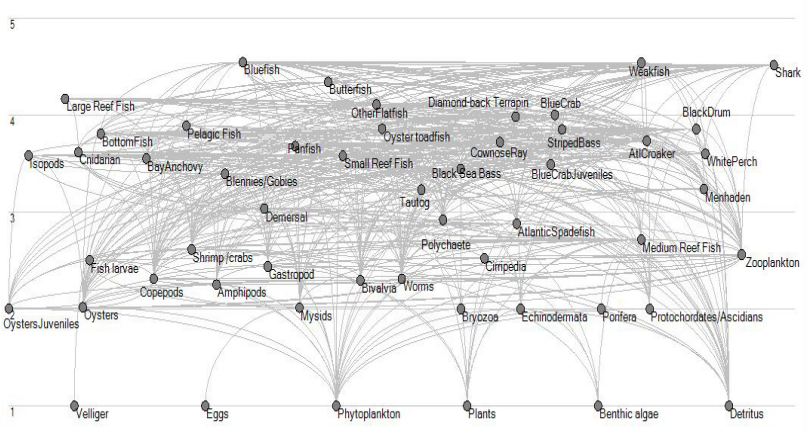
- ***UMCES, "Natural Engineers in Ecosystem Restoration: Modeling Oyster Reef Impacts on Particle Removal and Nutrient Cycling"*** features increasingly complex use of computer models to describe how oyster reefs benefit the ecosystem. In this project, ecosystem modelers are making improvements to an existing advection-diffusion model of particle capture on an oyster reef to incorporate processes related to nutrient cycling and oyster biogenetics. In year 1 of their project, researchers were able to integrate nitrogen cycling into the oyster reef model and to consider formulations that will describe additional mechanistic processes related to particle capture and nutrient cycling.

- ***Virginia Commonwealth University (VCU), "Pathways to Production: An assessment of fishery responses to oyster reef restoration and the trophic pathways that link the resource to the reef"*** is focusing on fish utilization of reefs in the Piankatank River. VCU researchers set their project design and have mapped and visited chosen experimental and control sites for their BACI-design study. In late summer/early fall 2014, they used traps and gill nets to obtain preliminary, pre-reef-construction data from the sites proposed to be constructed next.

- ***Smithsonian Environmental Research Center (SERC), "Application of Dual-frequency Imaging Sonar to the Study of Oyster Reef Ecosystem Services,"*** is getting under way in spring 2015 to identify the fish and other organisms found on a reef in areas where turbidity prevents visual identification of fish on reefs and without the biases of traditional fish sampling gear.

NCBO and Partner Ecosystem and Economic Modeling

Experts at NCBO and partner organizations are using results from ORES field studies and literature to develop a food web model of a typical Chesapeake oyster reef. Scientists at NCBO and partner organizations are working to quantify ecological production functions of oyster reefs before and after large-scale restoration in selected Bay tributaries. As these production functions are defined, economists from the NOAA Fisheries Office of Habitat Conservation and academic partners will be able to develop socioeconomic models that will be able to put dollar values on the reefs' ecosystem services.



Data from current ORES projects is incorporated into a food web model of an Chesapeake oyster reef being developed as part of ORES.

Next Steps

Work in all three aspects of ORES will continue in 2015, as many of the NCBO-funded projects will be in their first full year of sampling and study after using 2014 to set protocols for their work. The NCBO field work is already under way, and computer modelers seek to add additional data and processes into their complex computations. NCBO will feature news from ORES projects throughout the year via its website, www.chesapeakebay.noaa.gov.