

2015 Oyster Restoration Implementation Update

Progress in the Choptank Complex (Harris Creek, Little Choptank River, and Tred Avon River Oyster Sanctuaries)

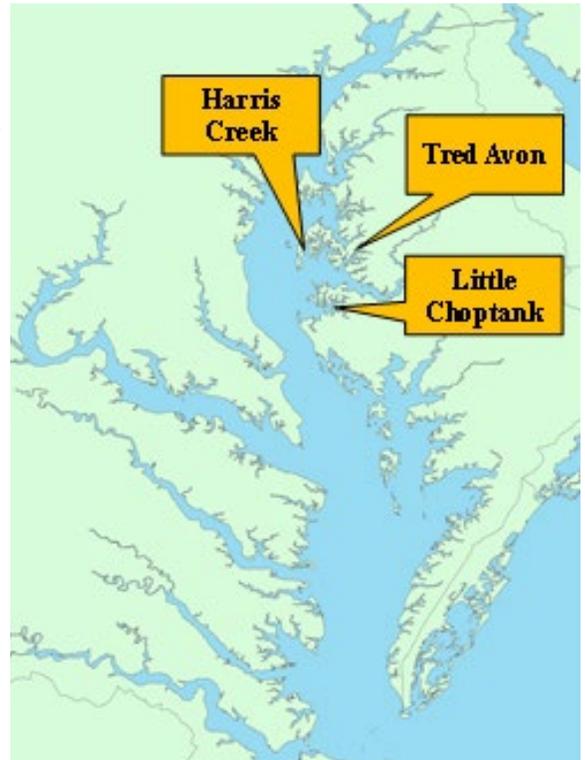
May 2016

The Chesapeake Bay Watershed Agreement calls for state and federal partners to “restore native oyster habitat and populations in 10 Bay tributaries by 2025 and ensure their protection.” This overlaps with existing policy drivers, including Chesapeake Bay Executive Order 13508, the U.S. Army Corps of Engineers’ Oyster Restoration Master Plan, and Maryland’s Oyster Restoration and Aquaculture Development Plan.

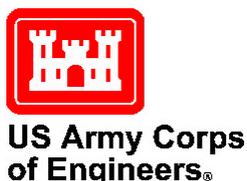
To achieve this outcome, the U.S. Army Corps of Engineers’ Baltimore District (USACE), National Oceanic and Atmospheric Administration (NOAA), Maryland Department of Natural Resources (DNR), and Oyster Recovery Partnership (ORP) formed the Maryland Oyster Restoration Interagency Workgroup under the auspices of the Sustainable Fisheries Goal Implementation Team of the Chesapeake Bay Program.

This group, with guidance from consulting scientists and the public, works to advance and coordinate oyster restoration in selected Maryland tributaries. This document describes progress made in implementing oyster restoration tributary plans for:

- Harris Creek (www.chesapeakebay.noaa.gov/images/stories/habitats/harriscreekblueprint1.13.pdf)
- Little Choptank River (www.chesapeakebay.noaa.gov/images/stories/pdf/oystertribplanlittlechoptank.pdf)
- Tred Avon River (draft) (www.chesapeakebay.noaa.gov/images/stories/habitats/drafttredavontribplan.pdf)



These plans detail how each tributary will be restored and monitored, consistent with the restoration success metrics developed in the Chesapeake Bay Oyster Metrics report (see www.chesapeakebay.noaa.gov/images/stories/fisheries/key-FishSpecies/oystermetricsreportfinal.pdf). Combined, these three plans call for the restoration of more than 950 acres in the Choptank River Complex, focusing on Harris Creek, the Little Choptank River, and the Tred Avon River.



Additional partners include the National Fish and Wildlife Foundation, The Nature Conservancy, University of Maryland, Virginia Institute of Marine Science, and the Chesapeake Bay Foundation.

Restoration Progress in Harris Creek, Little Choptank River, and Tred Avon River Combined

Since 2011, initial restoration work has been completed on 399.3 acres of sanctuary oyster reefs in the Choptank Complex (350.9 acres in Harris; 45.8 acres in Little Choptank; 2.6 acres in the Tred Avon River). Initial restoration work means that the reefs have been constructed with substrate (if needed) and seeded with juvenile oysters. Some reefs may require maintenance seeding in the future. In addition, 118.6 acres have been partly restored (either constructed, but not yet seeded; or have received some seed, but not the full, planned amount). The constructed—but not yet seeded—reefs are noteworthy, as reef construction is generally several times more expensive than seeding. These partly complete reefs will be seeded in 2016, as hatchery production allows. Seed oysters were produced by either the University of Maryland’s (UMD) Horn Point hatchery (with funding from NOAA and DNR), or by the Chesapeake Bay Foundation (CBF) (with NOAA funding). This is the largest oyster restoration project in the United States.

Video of typical prerestoration and typical postrestoration oyster reefs is posted at www.chesapeakebay.noaa.gov/images/stories/habitats/underwater-oyster-video-12816.mp4.



Typical prerestoration bottom conditions, taken from video from the Tred Avon River, July 2014, by divers.



Live oysters in Harris Creek (stone substrate reef base, planted in 2013 with hatchery-produced oyster seed). NOAA staff captured this image in October 2015, using an underwater camera fastened to a metal frame. Marks on frame are 1 cm apart.

Summary of Restoration Progress in the Choptank Complex

Year	Initial Restoration Complete <i>(reefs constructed and seeded)</i>	Initial Restoration Partly Complete <i>(reefs constructed and awaiting seed, or reefs partly seeded)</i>	Oyster Seed Planted	Funds Spent [†]
2015	127.7 acres	44.6 acres	550.49 million	\$13.12 million
Cumulative (2011-2015)	399.3 acres	118.6 acres	2.3 billion	\$43.91 million

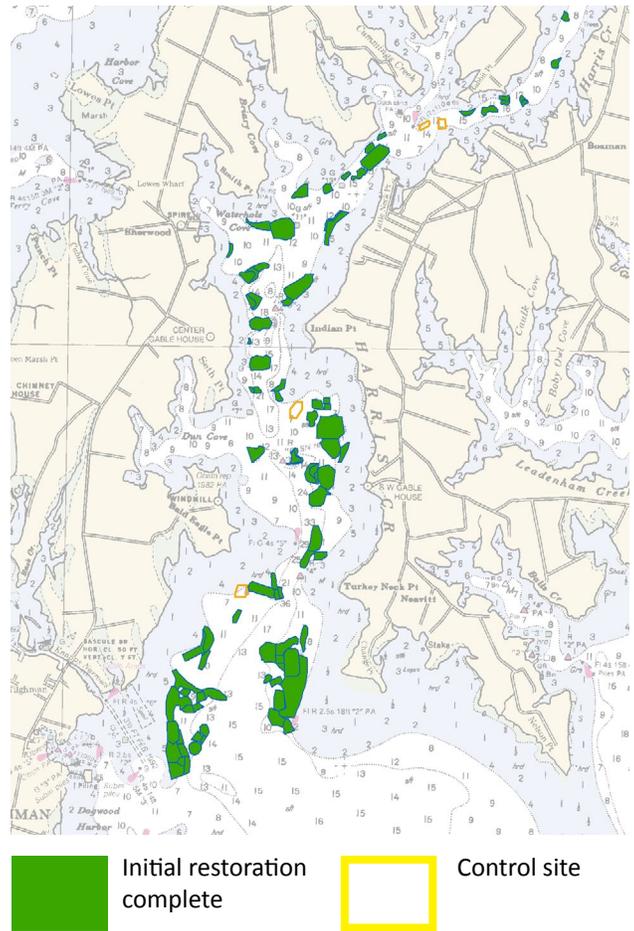
[†]These costs represent only funds expended on reef construction and seeding. Costs associated with focusing existing resources into Harris Creek (such as benthic surveys, oyster population and disease surveys, and water-quality monitoring) are not reflected; nor are staff salaries. Similarly, the \$31.6 million project cost described in the Harris Creek Tributary Plan was for reef construction and seeding only, plus a small amount for monitoring required in excess of ongoing monitoring programs.

Harris Creek

2015 Progress

- In September 2015, leadership from NOAA, DNR, USACE, ORP, and partner organizations planted the last spat-on-shell in the initial in-water construction phase of the Harris Creek restoration project. This completed the initial planting of 350.9 acres of oyster reefs with just over 2 billion spat. This is a major milestone toward completing oyster restoration in 10 tributaries, as called for in the Chesapeake Bay Agreement. Video at www.chesapeakebay.net/videos/clip/two_billion_oysters_harris_creek_reaches_a_recovery_milestone.
- In 2015, USACE placed reef-building substrate onto 55.4 acres in Harris Creek, using 77,444 cubic yards of rock and 10,703 cubic yards of mixed shell (mixed clam species). This work started in January 2015 and continued through June 2015. The \$5.18 million contract was performed by Argo Systems, LLC (a disabled-veteran owned small business in Hanover, Maryland).
- DNR completed its reef substrate placement work in Harris Creek in 2014; no new substrate was placed by DNR in 2015. DNR helped fund production and planting of oyster seed for Harris Creek in 2015. (See table.)
- ORP planted 366.89 million seed oysters into Harris Creek in 2015, with funding from NOAA and DNR. These oysters were produced by UMD's Horn Point hatchery.
- CBF, with volunteer help and NOAA funding, produced and planted 22.65 million seed into Harris Creek in 2015.

Restoration Sites in Harris Creek



Natural spat set in Harris Creek, on Florida shell substrate in 2014 (top) and on stone substrate in 2015 (bottom).



Leaders from Workgroup agencies planted the last spat-on-shell onto a reef in Harris Creek in September 2015 (photo by Dave Harp/Bay Journal).

Monitoring and Adaptive Management

Reef sites planted in Harris Creek in 2012 were monitored in late 2015 to determine whether they meet the preestablished Chesapeake Bay Oyster Metrics criteria (www.chesapeakebay.noaa.gov/images/stories/fisheries/keyFishSpecies/oystermetricsreportfinal.pdf). NOAA funded this monitoring work through a grant to ORP; field work was performed by Paynter Labs at the UMD.

- A full report on this monitoring is expected in mid-2016. Meanwhile, a preliminary analysis was done on one key criterion: oyster density. A fact sheet on this criterion is at www.chesapeakebay.noaa.gov/habitats-hot-topics/preliminary-data-show-harris-creek-oyster-restoration-project-doing-well. Key results are:
 - Initial results show that 100% of the reefs seeded in 2012 currently meet the threshold success criterion (15 oysters per m² over 30% of the bottom), and 50% meet the higher target criterion (50 oysters per m² over 30% of the bottom).
 - In addition, one stone substrate reef (planted in 2013, one year later than the other Harris reefs monitored) was also monitored in 2015. Data show that oyster density on this reef is more than three times that of any reef site monitored in Harris Creek to date.
- Oyster disease is a factor that may influence the success of this project. Partners continue to evaluate available disease data and adapt project management as needed.
- With funding from The Nature Conservancy, DNR monitored three water-quality stations on Harris Creek, (mddnr.chesapeakebay.net/eyesonthebay). Water conditions were favorable for oysters throughout 2015 except for brief periods of hypoxia in late summer.
- Following full analysis of 2015 monitoring data on 2012 sites, some reefs may require light maintenance plantings of seed oysters.
- Some reefs constructed in 2015 did not meet specifications to maintain the required 5 feet of navigational clearance. A portion of the areas have been corrected. The work on a few sites is pending. In the future, actions will be taken during construction to gauge the accuracy of reef heights, and postconstruction surveys will be targeted for the weeks immediately after construction, to confirm heights prior to planting with spat-on-shell and the busy waterways use of the spring and summer. Efforts will be made to notify boaters of changes in bathymetry resulting from the project through the Coast Pilot or other appropriate medium.

Outlook

- Initial in-water restoration work is complete in Harris Creek. No additional reef construction is planned, although some reefs may receive light seed plantings to keep densities at target levels.
- Monitoring work, including water-quality monitoring, is planned through 2021. This will determine whether these reefs meet the preestablished success criteria over the six-year time horizon recommended in the Chesapeake Bay Oyster Metrics Report. Monitoring will also inform adaptive management. NOAA, through an award to National Fish and Wildlife Foundation and ORP, plans to support continued monitoring in Harris Creek.

Summary of Harris Creek Restoration Progress

Year	Initial Restoration Complete (reefs constructed and seeded)	Oyster Seed Planted	Funds Spent [†]
2015	91 acres	389.55 million	\$7.52 million*
Cumulative (2011-2015)	350.9 acres	2.07 billion	\$27.48 million**

*Funding breakdown: NOAA: \$832,000 (seed; to ORP and CBF); USACE: \$5.184 million (reef construction); DNR: \$1.5 million (seed).

**This includes a revised accounting of the 2014 funds spent.

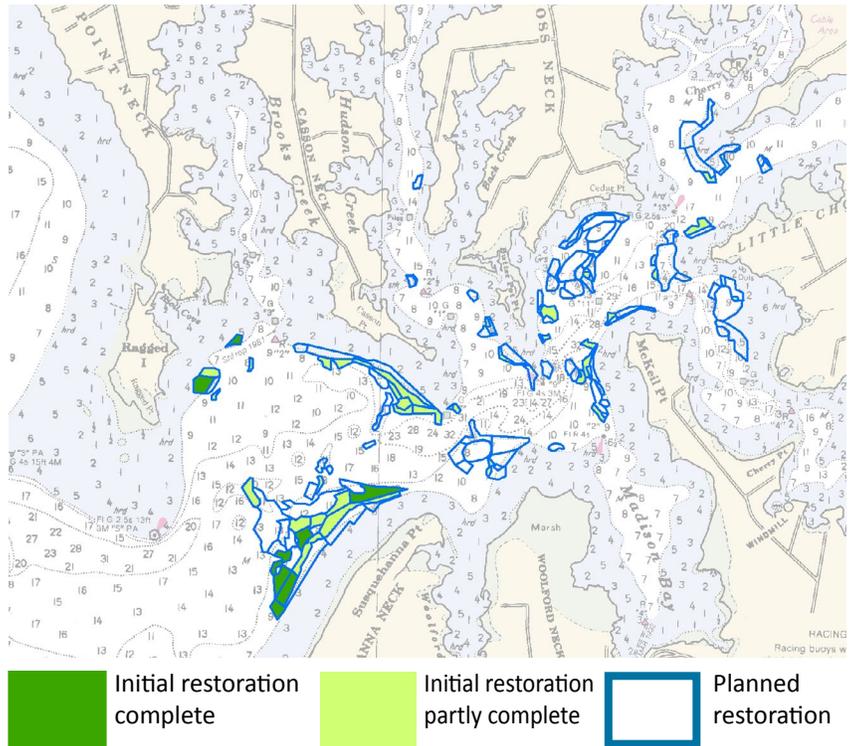
[†]These costs represent only funds expended on reef construction and seeding. Costs associated with focusing existing resources into Harris Creek (such as benthic surveys, oyster population and disease surveys, and water-quality monitoring) are not reflected; nor are staff salaries. Similarly, the \$31.6 million project cost described in the Harris Creek Tributary Plan was for reef construction and seeding only, plus a small amount for monitoring required in excess of ongoing monitoring programs.

Little Choptank River

2015 Progress

- The Little Choptank River oyster restoration plan (www.chesapeakebay.noaa.gov/images/stories/pdf/oystertribplanlittlechoptank.pdf) calls for restoring 440 acres of reefs, requiring 1.9 billion seed oysters and 314,600 cubic yards of reef-building substrate, at an anticipated cost of \$29 million. Of the 440 acres, 40 acres already meet the Oyster Metrics definition of a restored reef due to natural reproduction. These reefs will be monitored as part of the plan, but may not require any restoration treatment.
- In-water restoration work began on the Little Choptank in 2014 and continued in 2015.
- In 2015, DNR constructed 32.2 acres of reefs from rock, fossil oyster shell, or a combination thereof. Some of these reefs were seeded in 2015; the remainder will be seeded in 2016, as hatchery production allows.
- ORP planted 148.3 million seed oysters in the Little Choptank in 2015. These oysters were produced by UMD (with funding from NOAA, DNR, and NFWF). CBF (with NOAA funding) produced and planted 2.42 million seed oysters in the Little Choptank in 2015. Both the ORP seed oysters and the CBF seed oysters (totaling 150.76 million) were planted onto reefs DNR had constructed.
- A total of 34.1 acres of reefs were fully seeded in the Little Choptank in 2015. Additional reefs have been partly seeded, and are slated to receive the remainder of their required seed in 2016.
- Little Choptank water quality was favorable for oysters throughout 2015, except for a brief period of hypoxia on August 4.
- Oyster disease is a factor that may influence the success of this project. Partners continue to evaluate disease data and adapt project management as needed.

Restoration Sites in the Little Choptank River



Summary of Little Choptank River Restoration Progress

Year	Initial Restoration Complete (reefs constructed and seeded)	Initial Restoration Partly Complete (reefs constructed and awaiting seed, or reefs partly seeded)	Oyster Seed Planted	Funds Spent [†]
2015	34.1 acres	28.6 acres	150.76 million	\$4.17 million*
Cumulative (2014-2015)	45.8 acres	102.6 acres	222.1 million	\$15 million**

*2015 Funding breakdown: NOAA: \$322,000 (to CBF, and to ORP/DNR, for seed); DNR: \$3.48 million (\$2.9 million for substrate; \$581,000 for seed); NFWF: \$370,000 (to ORP, for seed)

**This includes a revised accounting of the 2014 funds spent.

[†]These costs represent only funds expended on reef construction and seeding. Costs associated with focusing existing resources into Little Choptank (such as benthic surveys, oyster population and disease surveys, and water-quality monitoring) are not reflected; nor are staff salaries. Similarly, the \$29 million project cost described in the Little Choptank Tributary Plan was for reef construction and seeding only, plus a small amount for monitoring required in excess of ongoing monitoring programs.

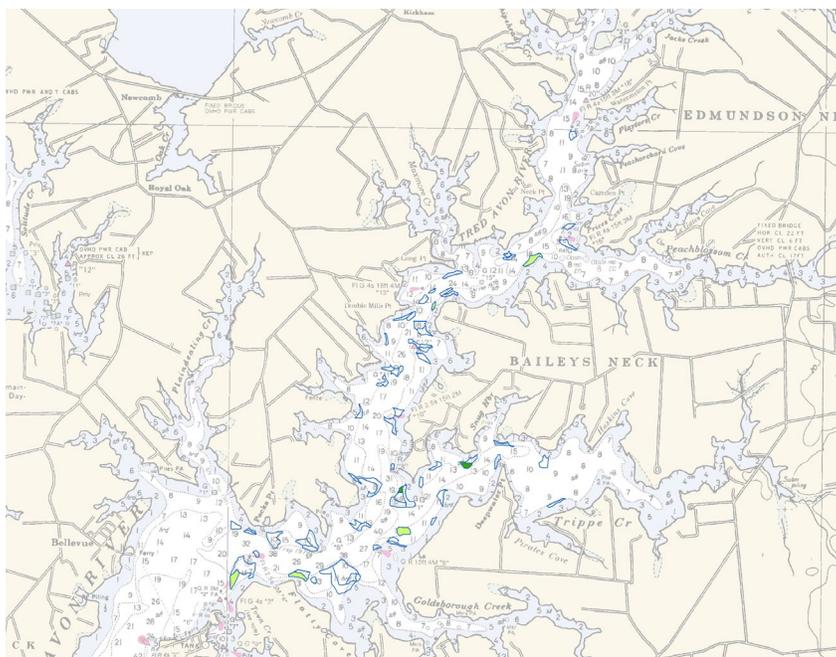
Outlook

- The as-yet unseeded sites where DNR placed reef substrate in 2014 and 2015 are slated to be seeded with juvenile oysters in 2016. Some select 'seed only' areas in the river are also slated to receive seed in 2016. Seed are produced by UMD, planted by ORP, and funded by NOAA, DNR, UMD, and NFWF, or produced and planted by CBF with NOAA funding.
- In late 2013, DNR applied to the Maryland Department of the Environment and USACE regulatory branch for a permit to place reef substrate (fossil shell from Florida, mixed shell, and rock) on another 187 acres of reefs in the Little Choptank River. These reefs would allow for 5 feet of navigational clearance (the reefs already constructed in the Little Choptank allow for 8 feet of navigational clearance). This permit application has been temporarily suspended at DNR's request, to allow time to evaluate industry concerns. However, there are sites in the Little Choptank River that require only oyster seed (they do not require reef-building substrate). These sites may be seeded under existing permits. Without a permit to construct the additional 196 acres in the river, however, the acreage goals in the Little Choptank River oyster restoration plan cannot be met.

Tred Avon River

- The draft Tred Avon Tributary Plan, (www.chesapeakebay.noaa.gov/images/stories/habitats/april2015tredavontrib-plan.pdf) calls for restoring 147 acres of reefs in the Tred Avon oyster sanctuary. The Workgroup is consulting with scientists and the public to finalize this plan.
- In-water restoration work on the Tred Avon began in 2015.
- USACE built 16 acres of a planned 24-acre project in the river.
- Prior to construction, revisions were made to the restoration plans at the request of the watermen community. These revisions involved shifting shell that was planned for placement in Harris Creek to the Tred Avon River, to minimize the amount of rock used in the Tred Avon River. Shell shortages prevented the full 24 acres from being completed.

Restoration Sites in the Tred Avon River



- Of the 16 acres constructed, 6 acres were constructed from shell substrate, and 10 acres from rock substrate. To complete the 16 acres, 15,732 cubic yards of rock and 8,793 cubic yards of mixed shell (mixed clam species) were placed at seven sites. Contract cost for this work was \$1.37 million, awarded to Argo Systems, LLC (a disabled-veteran owned small business Hanover, Maryland). The substrate work started January 2015 and continued through June 2015.
- 2.57 acres of the shell-substrate reefs built by USACE were planted in 2015 by ORP. These oysters were produced by the UMD Horn Point hatchery, with funding from NOAA and DNR.
- USACE had planned to construct the remaining 8 acres of the 24-acre project in January/February 2016. These reefs were the unfinished work from the spring 2015 construction. However, DNR requested that USACE delay construction until after DNR releases its five-year analysis of oyster management areas in July 2016.
- Tred Avon water quality was favorable for oysters throughout 2015 except for a period of low salinity from June 21-25.
- Oyster disease is a factor that may influence the success of this project. Partners continue to evaluate disease data and adapt project management as needed.

Outlook

- USACE plans to construct the originally planned 8 acres of shell substrate reefs in winter 2016-17, assuming that DNR's five-year analysis of oyster management areas (expected in July 2016; dnr2.maryland.gov/fisheries/Documents/Oyster%20Packages%20September%202010.pdf) supports continued restoration.
- USACE is developing a supplemental environmental assessment to enable Tred Avon reef construction that would leave 6 feet of navigational clearance (the current environmental assessment requires 8 feet of clearance). These reefs would be constructed on a portion of the blue-outlined areas on the above map.
- The supplemental environmental assessment is planned for completion in 2016, and would be required for any future reef construction activities beyond the initial 24 acres.
- In addition to the constructed and proposed substrate reefs, there are 70 acres in the Tred Avon that can be restored using just oyster seed (no reef-building substrate is required). Some of these reefs will likely be planted in 2016 with seed produced by the UMD and ORP, with funding from NOAA and DNR. Assuming sufficient funding, the remainder is slated to be seeded in 2017, as hatchery production allows.

Summary of Tred Avon River Restoration Progress

Year	Initial Restoration Complete (reefs constructed and seeded)	Initial Restoration Partly Complete (reefs constructed and awaiting seed, or reefs partly seeded)	Oyster Seed Planted	Funds Spent [†]
2015	2.6 acres	16 acres	10.18 million	\$1.43 million*

*Funding breakdown: NOAA: \$218,000 (seed; to ORP through DNR); USACE: \$1.37 million (reef construction); DNR: \$39,000 (seed).

[†]These costs represent only funds expended on reef construction and seeding. Costs associated with focusing existing resources into Little Choptank (such as benthic surveys, oyster population and disease surveys, and water-quality monitoring) are not reflected; nor are staff salaries. Similarly, the \$29 million project cost described in the Little Choptank Tributary Plan was for reef construction and seeding only, plus a small amount for monitoring required in excess of ongoing monitoring programs.

Choptank Complex Restoration Project: A Research Platform

The large-scale oyster restoration projects on Harris Creek, Little Choptank River, and Tred Avon River serve as important platforms for scientific research and monitoring. Because the tributary plans describe where reefs will be built and what restoration treatment each will receive, scientists can design experiments without needing to construct reefs exclusively for research. In collaboration with the Maryland Oyster Restoration Interagency Workgroup, scientists plan research to take place on or near restored reefs, as well as to obtain preresoration baseline data and track control reefs (areas that do not receive restoration treatment). This means that these three tributaries can serve as *in situ* laboratories.

NOAA's Oyster Reef Ecosystem Services project (ORES) seeks to quantify the benefits restored oyster reefs provide to other species and the environment. This includes field work to determine what species are present on oyster reefs before, during, and after oyster restoration work; economic analysis to place dollar values on these services; and NOAA-funded research at leading academic institutions to further improve understanding of the suite of services oyster reefs deliver to the Chesapeake Bay ecosystem. (See www.chesapeakebay.noaa.gov/images/stories/fisheries/oysterecosystem-servicespresentation.pdf for more information.) A summary of ORES research to date is expected in late spring 2016.

Related work by Lisa Kellogg and Mark Brush (both Virginia Institute of Marine Science), funded by NFWF and ORP, resulted in an online calculator to help estimate the ecosystem service value of various Harris Creek oyster restoration scenarios. Services estimated include denitrification, nitrogen, and phosphorous sequestration and burial, water filtration, and chlorophyll and total suspended solids filtered. The preliminary model framework is complete and available at netsim.vims.edu/netsims/brush/harris_creek_model/index.html. Additional funding has been secured to update the model with data from the ORES projects in Harris Creek as they become available.

Researchers Keryn Gedan (UMD), Kellogg, and Denise Breitburg (Smithsonian Environmental Research Center) used oyster reef restoration planned for Harris Creek, together with laboratory data and computer modeling, as the basis to quantify water-quality benefits from oysters and associated organisms. USACE is working with researchers at UMD to investigate larval transport in the Choptank Complex—specifically, computer models will be used to determine which areas may see increased larval recruitment following Harris Creek restoration efforts.

USACE contracted Paynter Labs at UMD in fall 2014 to monitor restored reefs at Cook Point (www.life.umd.edu/biology/paynterlab/labpub/2014%20USACE%20Report%20Final%2020150902.pdf), an oyster sanctuary in the Choptank River. Oyster reef habitat at this restoration site was constructed using rock at a variety of elevations off the bottom. Some sites received a veneer of clam shell, while others were composed entirely of rock. The sites were studied to provide information on how various substrates perform for restoration purposes. This study reaffirmed the importance of hard substrate for oyster planting. Sand sites (soft substrate) had the fewest oysters, and less biological diversity, than sites with any other substrate type. Further, reefs with a shell veneer on top of granite had more oysters and greater oyster biomass than reefs constructed solely of granite. At the heights investigated, reef height did not play a significant role in the density of oyster populations. With respect to the reef community, non-oyster sessile organisms (mussels, barnacles, anemones, hydroids, tunicates, and bryozoans) were more diverse and dense on restored reef areas than on unrestored sand. Highest densities were seen on granite-only reefs. Although these organisms can compete with oysters for resources, they also provide water filtering benefits.

The 2015 Implementation Update was compiled by the Maryland Oyster Restoration Interagency Workgroup of the Chesapeake Bay Program's Sustainable Fisheries Goal Implementation Team:

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