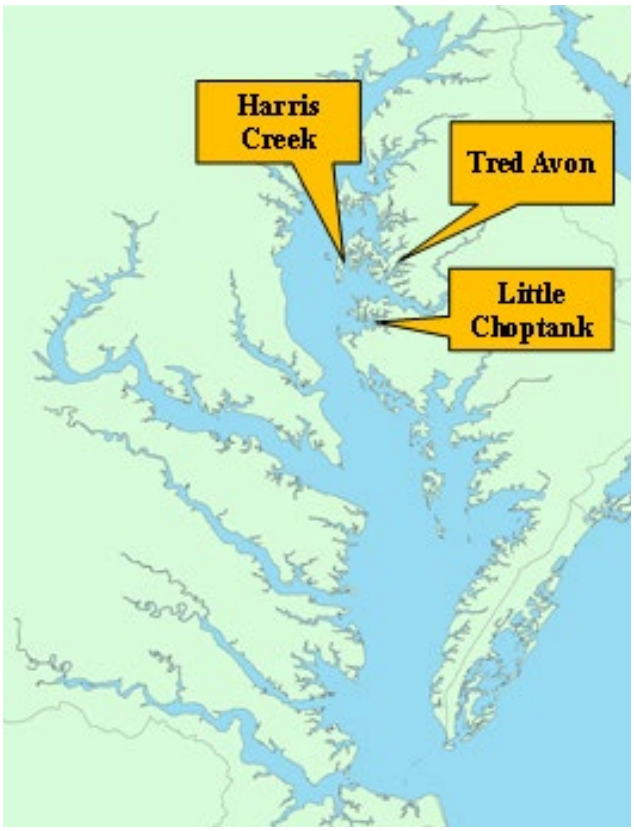
2016 Maryland Oyster Restoration Update

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

April 2017

The Chesapeake Bay Watershed Agreement, which guides the work of the Chesapeake Bay Program, calls for state and federal partners to "restore native oyster habitat and populations in 10 Bay tributaries by 2025, and ensure their protection." This reinforces 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), the National Oceanic and Atmospheric Administration (NOAA), the Maryland Department of Natural Resources (DNR), and the 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.

The Workgroup, with guidance from consulting scientists and the public, coordinates large-scale oyster restoration in selected Maryland tributaries. To date, the Workgroup has developed "tributary plans" that describe how three Maryland tributaries will be restored and monitored, consistent with standards described in the Chesapeake Bay Oyster Metrics report, www.chesapeakebay.noaa.gov/images/stories/fisheries/keyFishSpecies/oystermetricsreportfinal.pdf.

This update 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 (www.chesapeakebay.noaa.gov/images/stories/habitats/april2015tredavontribplan.pdf; draft)

Combined, these three plans call for the restoration of more than 900 acres in the Choptank River complex.

An overview of Bay-wide progress toward the Chesapeake Bay Watershed Agreement oyster outcome is available at www.chesapeakeprogress.com/abundant-life/sustainable-fisheries/oysters.

An overview of Virginia progress toward the Chesapeake Bay Watershed Agreement oyster outcome is available via chesapeakebay.noaa.gov/oysters/oyster-restoration.

NOAA National Oceanic and Atmospheric Administration · U.S. Department of Commerce

US Army Corps of Engineers®

Maryland Department of Natural Resources

Oyster Recovery® Partnership | ORP

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 more than 563 acres of sanctuary (non-harvest) oyster reefs in the Choptank Complex (351 acres in Harris Creek, 178 acres in the Little Choptank River, 35 acres in the Tred Avon River). These reefs were constructed with substrate (where needed) and seeded with juvenile oysters. The tributary plans call for a second seeding on each reef—but the additional seed may not be necessary, depending on oyster survival and natural spat set. Seed oysters (spat-on-shell) were produced by the University of Maryland's (UMD) Horn Point hatchery (with funding from NOAA, DNR, and National Fish and Wildlife Foundation [NFWF]) and the Chesapeake Bay Foundation (CBF) (with NOAA funding). Harris Creek alone is the largest sanctuary oyster restoration project in the United States. Video of typical pre- and post-restoration oyster reefs is available at www.chesapeakebay.noaa.gov/images/stories/habitats/underwater-oyster-video-12816.mp4.

Restored oyster reef in the Little Choptank River near Susquehanna Point, constructed in 2014 from stone and Florida fossil shell, and planted with hatchery-produced spat on shell. Photo by ORP.

Summary of Restoration Progress in the Choptank Complex

Year	Initial Restoration Complete*	Oyster Seed Planted	Funds Spent on Implementation†
2016	164.6 acres	796.23 million	$3.81 million
Cumulative (2011-2016)	563.92 acres	3.1 billion	$47.61 million

**Reef-building substrate has been added, if needed, and reef has been seeded with juvenile oysters. Additional seeding may be required in order to attain the desired target density.*

†These costs represent only funds expended on reef construction and seeding. Associated costs, such as benthic surveys, oyster population and disease surveys, and water-quality monitoring, are not reflected; nor are staff salaries. Similarly, the cost estimate described in each river's tributary plan is for reef construction and seeding only, plus a small amount for monitoring required in excess of ongoing monitoring programs.

Harris Creek

2016 Update

- In September 2015, seed oysters were planted onto the last of the 351 acres of restoration reefs in Harris Creek. This was the initial round of plantings, and a major milestone toward completing oyster restoration in 10 tributaries, as called for in the Chesapeake Bay Watershed Agreement.
- In 2016, four Harris Creek reefs were seeded with a total of 61.3 million seed oysters to ensure each reef received its full complement of seed oysters. No additional acreage is considered restored in 2016, as these acres were counted in 2015.

Summary of Harris Creek Restoration Progress

Year	Initial Restoration Completed*	Oyster Seed Planted	Funds Spent†
2016	0 acres	61.3 million	$293,000**
Cumulative (2011-2016)	350.92 acres (153. 82 seed only; 197.1 substrate & seed)	2.13 billion	$27.68 million

**In 2016, four Harris Creek reefs were seeded with a total of 61.3 million seed oysters to ensure each reef received its full complement of seed oysters. No additional acreage is considered restored in 2016, as these acres were counted in 2015.*
***2016 funding breakdown: NOAA: $80,000 (for seed; funds awarded to DNR/ORP/UMCES); DNR: $213,000 (for seed).*
†These costs represent only funds expended on reef construction and seeding. Associated costs, 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.

Monitoring and Adaptive Management

The tributary plan for Harris Creek calls for monitoring reefs three and six years after initial restoration to determine whether they meet the preestablished Chesapeake Bay Oyster Metrics criteria for restored reefs. Reefs planted with seed in 2012 were monitored in fall 2015 (results below). NOAA funding to NFWF and ORP enabled field work that was performed by Paynter Labs at the University of Maryland and Versar. Reefs constructed in 2013 were monitored in fall 2016; a full report on this most recent monitoring will be released in spring 2017.

Oysters on a restored Harris Creek reef between Turkey Point and Indian Point. Reef was constructed from mixed shell and planted with spat in 2013. Photo taken November 2016 by Matthew B. Ogburn, Smithsonian Environmental Research Center Fish and Invertebrate Ecology Lab.

Key findings from fall 2015 monitoring:

- 100% of the reefs seeded in 2012 met the threshold for success (15 oysters per m^2 over 30% of the bottom), and 50% meet the higher target (50 oysters per m^2 over 30% of the bottom).
- In addition, one stone substrate reef (planted in 2013, one year later than the other Harris Creek reefs monitored) was also monitored in 2015. Data show that oyster density on this reef was more than three times that of any reef site monitored in Harris Creek to date.

A summary of 2015 oyster density data is available at www.chesapeakebay.noaa.gov/habitats-hot-topics/preliminary-data-show-harris-creek-oyster-restoration-project-doing-well; the full monitoring report is at www.chesapeakebay.noaa.gov/images/stories/fisheries/keyFishSpecies/oystermetricsreportfinal.pdf.

The Harris Creek tributary plan calls for a second seeding on each reef four years after restoration. The additional seed may not be necessary, depending on spat survival and natural spat set as observed during monitoring.

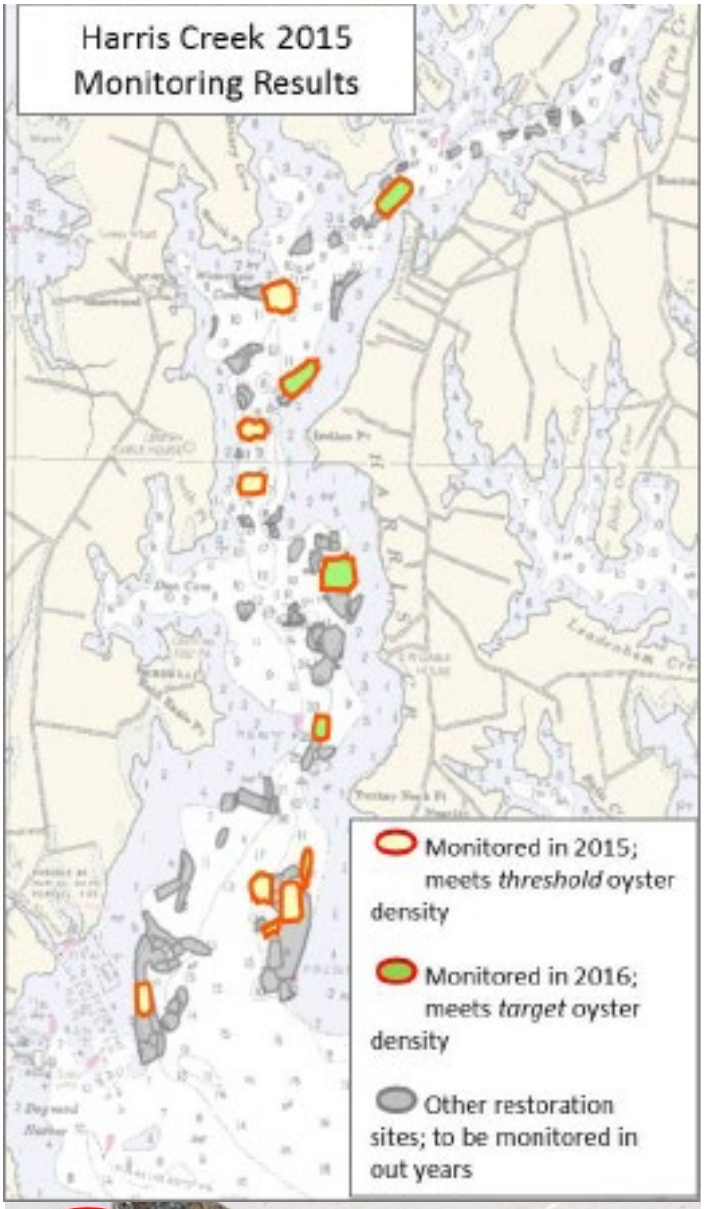
DNR collected oyster disease data in fall 2016 on nearby nonrestored Harris Creek reefs as part of its annual Fall Survey; that information will be available when DNR publishes its 2016 Fall Survey Report. DNR's 2015 Fall Survey Report, posted at dnr.maryland.gov/fisheries/Pages/shellfish-monitoring/reports.aspx, shows Harris Creek Dermo prevalence ranged from 73% to 93% (average = 80%) over hatchery plantings and natural populations and that MSX was not found in Harris Creek sanctuary samples.

With funding from The Nature Conservancy, DNR monitored three water-quality stations in Harris Creek. Data from these stations is available via eyesonthebay.dnr.maryland.gov. Salinity and dissolved oxygen were suitable for oysters throughout 2016, except for brief periods of hypoxia in late summer.

Some of the reefs constructed in Harris Creek in 2015 were constructed too high, and as a result did not maintain the required five feet of water depth needed for boats to safely navigate over them. The majority of these areas have been corrected; work is continuing to correct the remaining sites. In the future, additional actions will be taken to gauge the accuracy of reef heights, including completing postconstruction surveys sooner; ensuring contractors use a consistent bucket size for material deployment; and marking the depth on the bucket cable as an addition visual cue. Efforts will continue to notify boaters of changes in bathymetry resulting from the project through the Coast Pilot, Notice to Mariners, or other appropriate media.

Outlook for 2017

- Initial in-water restoration work is complete in Harris Creek. No additional reef construction is planned, although some reefs may receive light (low-density) seed plantings to reach target densities.
- Monitoring work, including water-quality monitoring, is planned through 2021. Results from this work will determine whether these reefs meet the Chesapeake Bay Oyster Metrics success criteria. Monitoring will also inform adaptive management.



These oysters have "set," or attached to, the stone substrate used to construct this reef in Harris Creek. These are naturally occurring oysters. Hatchery-produced oysters are set onto old oyster shell, not stone; thus they are distinguishable from these natural oysters. Photo by ORP, fall 2016.

Little Choptank River

2016 Update

- The Little Choptank River tributary plan calls for restoring 440 acres of reefs. Of the 440 acres, 40 acres already meet the definition of a restored reef, by virtue of the existing natural oyster population there. These reefs will be monitored, but may not require any restoration treatment.
- In-water restoration work began on the Little Choptank in 2014, and continued in 2015 and 2016.
- A total of 132.2 acres of reefs were seeded in 2016.
- 592 million seed oysters were planted in the Little Choptank in 2016. ORP and UMCES produced and planted 562 million seed oysters with funding from NOAA, NFWF, and DNR. CBF, with NOAA funding, produced and planted 29.5 million seed oysters. All seed oysters were planted onto reefs that either required no reef-building substrate prior to planting or where reef-building substrate had been placed in 2014 and 2015, but which had not yet been seeded.
- No new reef-building substrate was placed into the Little Choptank in 2016.
- Water quality was monitored at the mouth of the Little Choptank River, outside the sanctuary boundary; data are available at eyesonthebay.dnr.maryland.gov. Salinity and dissolved oxygen were suitable for oysters throughout 2016.
- DNR collected oyster disease data in fall 2016 on nearby nonrestored Little Choptank reefs as part of its annual Fall Survey; that information will be available when DNR publishes its 2016 Fall Survey Report. DNR's 2015 Fall Survey Report, posted at dnr.maryland.gov/fisheries/Pages/shellfish-monitoring/reports.aspx, shows Little Choptank River Dermo prevalence ranged from 93% to 100%, and MSX prevalence ranged from 20% to 23%.

Summary of Little Choptank River Restoration Progress

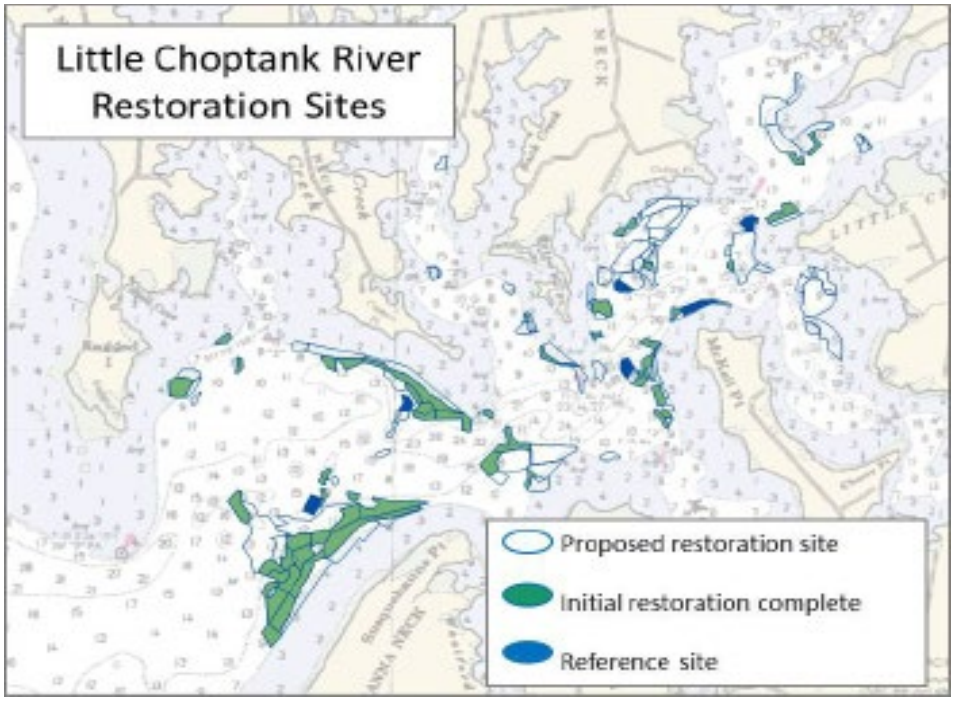
Year	Initial Restoration Completed	Oyster Seed Planted	Funds Spent†
2016	132.2 acres	592.04 million	$2.83 million*
Cumulative (2011-2016)	178 acres (54.4 seed only; 123.4 substrate & seed)	814.14 million	$17.82 million

**2016 funding breakdown: NOAA: $778,000 (for seed; funds awarded to CBF and to DNR/ORP/UMCES); DNR: $1,886,000 (for seed); NFWF: $168,000 (for seed)*

†These costs represent only funds expended on reef construction and seeding. Associated costs, 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.

Little Choptank reefs are not yet due for their scheduled three-year post-seeding monitoring, but preliminary observations show natural spat set on stone (top) and Florida shell (bottom). Photos by ORP.

Outlook for 2017



- More than 120 remaining acres on the Little Choptank require only the addition of seed oysters (not reef-building substrate) to complete initial restoration. These areas are slated to receive seed oysters in 2017, as hatchery production allows, after final preplanting examination of the sites by divers to determine their suitability.
- Another 118 acres are slated for restoration under the Little Choptank River oyster restoration plan. This requires USACE and the Maryland Department of the Environment (MDE) to issue an additional permit because these reefs are in shallower water. In late 2013, DNR applied to MDE and USACE regulatory branch for a permit to place reef-building substrate (fossil shell from Florida, mixed shell, and stone) on these reefs. These reefs, if approved, would allow for five feet of navigational clearance (the reefs already constructed in the Little Choptank allow for eight feet). This permit application was temporarily suspended at DNR's request, to allow time to evaluate industry concerns. The permit application was reactivated in November 2016, and is currently being evaluated by USACE and MDE. Without a permit to construct the additional 118 acres, the acreage goals in the Little Choptank River oyster restoration plan cannot be achieved.

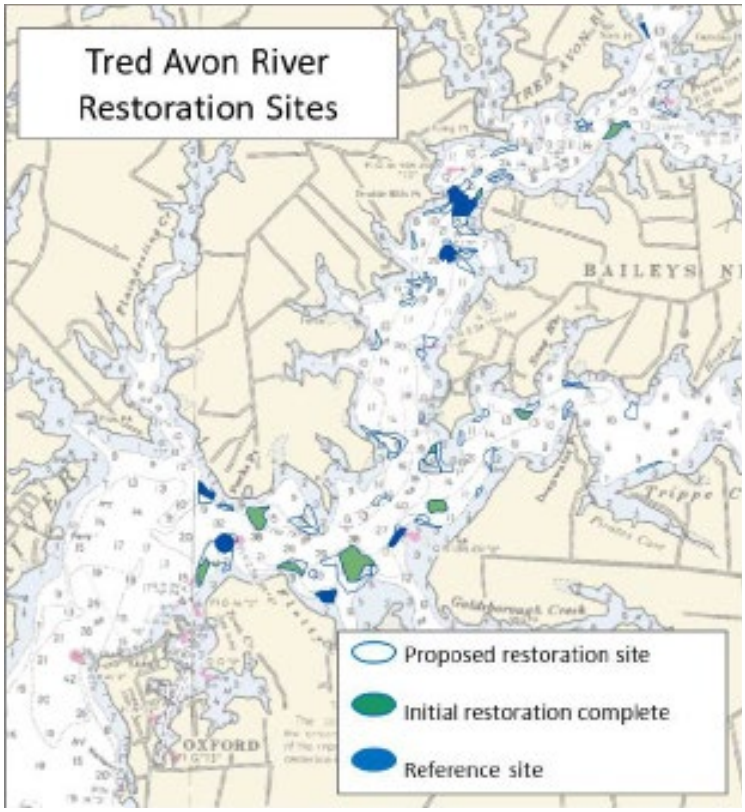
Tred Avon River

2016 Update

- The draft Tred Avon Tributary Plan calls for restoring 147 acres of oyster 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 and continued in 2016.
- In 2016, ORP planted 32.4 acres of reefs in the Tred Avon River with more than 142 million seed oysters. These oysters were produced by UMCES' Horn Point hatchery and setting facility, with funding from NOAA and DNR.
- No new reef-building substrate was added into the Tred Avon River in 2016. In 2015, USACE built 16 acres of a planned 24-acre project. USACE's construction plans incorporated revisions requested by the commercial fishing community to minimize the amount of stone substrate used in the Tred Avon River. A shortage of shell (the reef-building material preferred over stone by the commercial fishing community) prevented the full 24 acres from being completed in 2015.
- Planned work by USACE to construct the remaining eight acres of reefs in January/February 2016 was delayed to the following year pending the completion and results of DNR's five-year analysis of oyster management areas in July 2016. In late 2016, the project was brought before the Maryland Oyster Advisory Commission, dnr.maryland.gov/fisheries/Pages/mgmt-committees/oac-index.aspx, which recommended continuing the project. See 'Outlook for 2017' section for 2017 planned construction.
- Water quality was monitored in the Tred Avon oyster sanctuary. Salinity and dissolved oxygen were suitable for oysters throughout 2016.
- DNR collected oyster disease data in fall 2016 on nearby nonrestored Tred Avon reefs as part of its annual Fall Survey; that information will be available when DNR publishes its 2016 Fall Survey Report. DNR's 2015 Fall Survey Report, posted at dnr.maryland.gov/fisheries/Pages/shellfish-monitoring/reports.aspx, shows Tred Avon River Dermo disease prevalence was 70%. MSX was not found in Tred Avon River samples.

Outlook for 2017

- In 2017, USACE will construct the eight acres of shell substrate reefs originally planned for winter/spring 2015, using shell.
- In November 2016, USACE completed a supplemental environmental assessment to enable placement of reef-building substrate in areas that would leave six feet of navigational clearance (the current environmental assessment allows eight feet). These reefs will be constructed on a portion of the blue-outlined areas on the map. Construction of reefs within the shallower depths (between 6.5 and 9 feet) is planned to begin in 2017.
- In addition to the areas that require reef-building substrate, there are approximately 50 acres remaining in the Tred Avon slated to receive only seed oysters (no reef building materialis required). These reefs are scheduled to receive seed oysters in 2017, as hatchery production allows, after final preplanting examination of the sites by divers to determine their suitability for seed.



Summary of Tred Avon River Restoration Progress

Year	Initial Restoration Completed	Oyster Seed Planted	Funds Spent†
2016	32.4 acres	142.89 million	$684,000*
Cumulative (2011-2016)	35 acres (18.92 seed only; 16.04 substrate & seed)	153.07 million	$2.11 million

**2016 funding breakdown: NOAA: $188,000 (for seed; funds awarded to DNR/ORP/UMCES); DNR, $496,000 (for seed).*
†These costs represent only funds expended on reef construction and seeding. Associated costs, such as benthic surveys, oyster population and disease surveys, and water-quality monitoring, are not reflected; nor are staff salaries. Similarly, the $11.4 million project cost described in the Tred Avon Tributary Plan was for reef construction and seeding only, plus a small amount for monitoring required in excess of ongoing monitoring programs.

Factors Influencing Successful Completion of the Chesapeake Bay Watershed Agreement Oyster Outcome

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." The following factors may influence partners' ability to successfully reach this goal.

Oyster disease

2015 DNR Fall Survey data, posted at dnr.maryland.gov/fisheries/Documents/FallSurvey-2015, indicate that oyster diseases (MSX and Dermo) are present in the Choptank complex, although generally at sublethal levels (see specific tributary information above). A disease outbreak could affect oyster populations throughout the Choptank complex. DNR's 2016 oyster disease data will be available when DNR publishes its 2016 Fall Survey Report.

Water quality

Water-quality data are collected in or near each of these three tributaries (see eyesonthebay.dnr.maryland.gov). To date, water quality in all three tributaries has been conducive to oyster survival and growth. A decline in water quality could negatively affect oyster growth, survival, and reproduction.

Funding

Funding for Maryland's large-scale oyster restoration effort has come primarily from the state and federal governments, with some additional funds provided by nongovernmental organizations (see specific tributary information above). It is unknown whether this funding will continue in the future, or at what level.

Possible poaching on restored reefs

It is not possible at this time to quantify the scale or impact of poaching (illegal oyster harvest) on the restored reefs. DNR's Maryland Natural Resources Police has stepped up law enforcement efforts in and around Harris Creek, the Little Choptank River, and the Tred Avon River, including aerial surveillance by helicopter. DNR has made arrests for poaching in oyster sanctuaries, news.maryland.gov/dnr/2014/01/17/nrp-blotter-21. Unchecked poaching would potentially damage restored reefs by lowering oyster densities and flattening reef structure.

Availability of reef-building substrate

Some reefs in the Tred Avon and Little Choptank rivers will require the addition of substrate to rebuild the reef base, prior to planting with seed oysters. Typically, substrate has been either shell (from shucking houses, dredged from historic deposits, or mined in Florida), or stone. Shell is in short supply, and is used extensively for the production of seed oysters, in aquaculture, and in the wild fishery. Early monitoring results indicate that oysters are surviving better when planted on stone substrate, and stone is readily available and comparable in cost to shell. The commercial fishing community has expressed concerns about the use of stone substrate.

Selecting the next tributaries for large-scale oyster restoration

The Chesapeake Bay Watershed Agreement calls for restoring oysters in 10 tributaries by 2025. This has generally been interpreted as five tributaries in Maryland and five in Virginia. Maryland has focused on Harris Creek, the Little Choptank River, and the Tred Avon River; the final two Maryland tributaries have yet to be named. DNR is collecting stakeholder input on this decision through the Maryland Oyster Advisory Commission (see dnr.maryland.gov/fisheries/Pages/mgmt-committees/oac-index.aspx). The final two tributaries will likely be named in 2017. Once named, planning and data collection can begin.

Restoration Reefs as a Research Platform

The large-scale oyster restoration projects in the Choptank Complex serve as important platforms for scientific research, including:

- NOAA's Oyster Reef Ecosystem Services project (ORES) seeks to quantify the benefits restored oyster reefs provide to other species and the environment. See chesapeakebay.noaa.gov/images/stories/habitats/2016oresresearchupdate.pdf.

- Work by scientists from 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. See 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.

- In fall 2014, USACE contracted Paynter Labs at the University of Maryland to monitor restored reefs at Cook Point, an oyster sanctuary in the Choptank River. This study reaffirmed the importance of hard substrate for oyster planting. See life.umd.edu/biology/paynterlab/labpub/2014%20USACE%20Report%20Final%2020150902.pdf.

Crew from NOAA's Oyster Reef Ecosystem Services project collect finfish data on oyster reefs.

The 2016 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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