Indicator Title: Oyster Restoration

Relevant Outcome(s): Oyster Restoration

Relevant Goal(s): Sustainable Fisheries

Location within Framework (i.e., Influencing Factor, Output or Performance): Output

A. Data Set and Source

(1) **Describe the data set. What parameters are measured? What parameters are obtained by calculation? For what purpose(s) are the data used?**

Oyster restoration partners track the implementation progress of oyster restoration in selected tributaries. This indicator tracks the number of acres of oyster reefs in selected tributaries that have: 1) undergone restoration treatment (reef construction and/or seeding) to meet the outcomes established under the Executive Order 13508 and the Chesapeake Bay Watershed Agreement; 2) undergone restoration previous to the aforementioned agreements; 3) otherwise naturally occurring reefs that already meet the oyster density criteria. These numbers are added and reported as the "completed acreage" for each tributary.

This indicator also tracks the progress of each tributary effort in the overall oyster restoration process. The indicator defines the overall process for oyster restoration as three steps: developing a tributary restoration plan, implementing reef construction & seeding, and monitoring and evaluation. This indicator shows which steps are in progress for each tributary.

All ten tributaries have been selected and are tracked with this indicator: Harris Creek, Little Choptank, Tred Avon, upper St. Mary's and Manokin rivers in Maryland; Piankatank, Lafayette, Lynnhaven, Great Wicomico and lower York rivers in Virginia.

(2) **List the source(s) of the data set, the custodian of the source data, and the relevant contact at the Chesapeake Bay Program.**

- **Source:** Maryland and Virginia Oyster Restoration Interagency Teams (member organizations listed in the oyster restoration management strategy)
- **Custodian:** Stephanie Westby (NOAA)
- **Chesapeake Bay Program Contact (name, email address, phone number):** Bruce Vogt, bruce.vogt@noaa.gov, 410-267-5655

(3) Please provide a link to the location of the data set. Are metadata, data-dictionaries and embedded definitions included?

The full dataset (MD and VA tributaries) of completed acreage of oyster reefs is not compiled in one place on the web, except for this indicator. NOAA and USACE typically provide an update on oyster restoration progress each year at the December Sustainable Fisheries Goal Team meetings. All meeting materials can be found on the Sustainable Fisheries Goal Team's webpage. Maryland and Virginia partners publish an annual update on oyster restoration progress for oyster restoration, which can be found on the NOAA Chesapeake Bay Office website. The update reports for 2018 are available for Maryland and Virginia. Tributary plans for Harris Creek, Tred Avon and Little Choptank in Maryland are available. Tributary plans for the Lafayette River, Lynnhaven River and Piankatank River in Virginia have been completed. Tributary plans for the remaining tributaries are in progress.

B. Temporal Considerations

(4) Data collection date(s): Annual – total completed acreage is initially tallied in late Fall each year and documented in annual reports from the Maryland and Virginia Oyster Interagency team (spring of the following year).[EF1]

(5) Planned update frequency (e.g., annual, biannual, etc.):
- **Source Data:** annual
- **Indicator:** annual

(6) Date (month and year) next data set is expected to be available for reporting: June 2020

C. Spatial Considerations

(7) What is the ideal level of spatial aggregation (e.g., watershed-wide, river basin, state, county, hydrologic unit code)? Tributary-wide

(8) Is there geographic (GIS) data associated with this data set? If so, indicate its format (e.g., point, line polygon).

Yes, oyster reef locations and bottom habitat maps for each tributary are available as GIS data (polygon). These data are collected and maintained by the NOAA Chesapeake Bay Office.

(9) Are there geographic areas that are missing data? If so, list the areas.

Geospatial data exist for all selected tributaries for restoration.

(10) Please submit any appropriate examples of how this information has been mapped or otherwise portrayed geographically in the past.

Maps of existing and proposed oyster reef locations are an important part of the tributary planning process. The Harris Creek, Tred Avon, Little Choptank, Lafayette, Lynnhaven, and

Piankatank tributary plans include these maps. The restoration workgroups utilize geodatabases with spatial data for each tributary. Mapping is underway in additional tributaries.

D. Communicating the Data

(11) What is the goal, target, threshold or expected outcome for this indicator? How was it established?

The 2014 Watershed Agreement established the outcome to restore native oyster habitat and populations in 10 tributaries by 2025. More specifically, by 2025 the goal is to have selected 10 tributaries, developed a tributary plan for each, completed reef construction and seeding according to each tributary's acreage target, and begun the monitoring process. The monitoring and evaluation process will not be complete by 2025, as it requires 6 years of monitoring before a tributary can be deemed as "restored".

As defined in the Oyster Metrics, each tributary's acreage target is developed using the criteria of "a minimum of 50% of currently restorable area that constitutes at least 8% of historic oyster habitat within a given tributary." For example, the excerpt below from the Harris Creek Oyster Restoration Tributary Plan explains how the acreage target for Harris Creek was calculated. The final target acreage was 350 acres.
"2. Define restoration goal (target acreage):
As noted earlier, the oyster metrics report defined a successfully restored tributary as one where 50 to 100 percent of currently restorable bottom, constituting at least 8 percent of historic oyster habitat, consists of restored reefs.

(12)   What is the current status in relation to the goal, target, threshold or expected outcome?
Ten tributaries have been selected for oyster restoration. Tributary restoration plans are finalized for Harris Creek, Little Choptank River, Tred Avon River, Lafayette River, Lynnhaven River, and Piankatank River, and in progress for the remaining rivers. In-water restoration treatment (reef construction/seeding) is complete in Harris Creek and Lafayette River, and is in progress in other tributaries. Monitoring and evaluation is under way in Harris Creek, Little Choptank, Tred Avon, and Lafayette.
The Maryland and Virginia restoration partners publish annual updates on restoration. The 2018 updates are available for Maryland and Virginia.

(13)   Has a new goal, target, threshold or expected outcome been established since the last reporting period? Why?

No, the goal remains to restore oyster populations in 10 tributaries by 2025, per the 2014 Chesapeake Bay Agreement.

Background: In 2010, the Executive Order 13508 Strategy for Protecting and Restoring the Chesapeake Bay Watershed established a goal of restoring oyster populations in 20 tributaries of the Chesapeake Bay by 2025. Based on experience with current restoration implementation and resource availability, restoration partners determined that an outcome of restoring native oyster habitat and populations in 10 tributaries by 2025 is an appropriate target for the next 10 years and for the 2014 Chesapeake Bay Watershed Agreement.

(14)   Has the methodology of data collection or analysis changed since the last reporting period? How? Why? No.

(15)   What is the long-term data trend (since the start of data collection)? N/A. If resources allow, the completed acreage should increase each year if resources are available to construct and/or seed reefs.

(16)   What change(s) does the most recent data show compared to the last reporting period? To what do you attribute the change? Is this actual cause or educated speculation? Restoration work occurred in Tred Avon, Little Choptank, Lafayette, Lynnhaven and Piankatank Rivers.

(17)   What is the key story told by this indicator?
Chesapeake Bay partners are making progress on large-scale tributary oyster restoration. Ten tributaries have been selected (five in Maryland and five in Virginia) and each state or tributary has a specific workgroup dedicated to planning, implementing and monitoring restoration. In-water restoration (reef construction/seeding) was completed in Harris Creek in September 2015, and in Lafayette River in November 2018, and monitoring is underway of the restored reefs. In-water restoration is in progress in the other tributaries. Partners are currently working to continue planning and implementation (reef construction/seeding). More information to come. The Maryland and Virginia restoration partners publish annual updates on restoration. The 2018 updates are available for **Maryland** and **Virginia**.

E. Adaptive Management

(18)   What factors influence progress toward the goal, target, threshold or expected outcome? Implementation of oyster reef construction and seeding is dependent on resource availability of spat (oyster seed), shell/substrate and financial and human resources, as well as permitting processes and stakeholder input.

(19)   What are the current gaps in existing management efforts?
While all ten tributaries have been selected, the Maryland and Virginia Interagency Workgroups need to plan and implement restoration treatments in ongoing eight tributaries to meet the outcome of 10

restored tributaries. The workgroups will carefully consider a variety of factors, including current bottom uses, regulations, and biological/physical conditions, in order to choose tributaries that have the most potential for restoration success and for maintaining healthy oyster reefs into the future. The Manokin River was selected as the last tributary for restoration in Maryland.

The restoration process and monitoring efforts are heavily reliant upon available federal, state, and other partner funds over the long term. Restoration funds are not guaranteed, so partners should continue to work collaboratively to plan for future restoration activities and document the results of current efforts.

(20)   What are the current overlaps in existing management efforts? N/A

(21)   According to the management strategy written for the outcome associated with this indicator, how will we (a) assess our performance in making progress toward the goal, target, threshold or expected outcome, and (b) ensure the adaptive management of our work?

Success in oyster restoration efforts will need to be evaluated on several levels over varying spatial and temporal scales. Targets and metrics of operational success are required to guide restoration activity, such as what percentage of a historical bar or other area should be planted with shell or spat-on-shell. Monitoring of individual reefs following initial restoration activity will be required to determine success at various stages by evaluating recruitment success, early post-settlement or post-planting survival, natural mortality, disease status, growth, reproduction and shell accumulation. Ecosystem services benefits will also be evaluated using controlled experiments and modelling studies to quantify the benefits of oyster restoration in specific tributaries (Oyster Reef Ecosystem Services project update). The Oyster Metrics Report (pp. 21-23) summarizes the goals, assessment protocols, assessment frequency, and success measures established by the Oyster Metrics workgroups.

The participating partners and key stakeholders will use the following approaches to ensure adaptive management.

- Specific to tributary-scale oyster restoration, the Oyster Metrics Report (pg. 24) describes adaptive management as "makes use of knowledge gained through data collection to refine both targets and metrics in route to meeting its ultimate goal." Continuing research and data will be used to reevaluate specific tributary acreage targets and the success metrics to reflect the best available knowledge and experience from oyster restoration in the Bay.
- In addition to refining tributary targets and metrics as stated above, restoration partners will consider new knowledge that arises from future experience and research. These factors include new construction techniques, reef design, use of alternative substrate, etc.
- The status of the restored oyster reefs will need to be monitored and assessed in the long term to determine if restoration has achieved the desired ecosystem changes. This ecosystem change will take time, and previous restoration sites may need additional restoration treatment (shell replenishment, additional substrate and/or seeding) in the future to maintain the health of the oyster reefs.

F. Analysis and Interpretation

Please provide appropriate references and location(s) of documentation if hard to find.

(22)   What method is used to transform raw data into the information presented in this indicator? Please cite methods and/or modeling programs.
Number of constructed and/or seeded oyster reef acres completed is tracked by restoration partners and reported to the Chesapeake Bay Program's Sustainable Fisheries Goal Team each year to add to each tributary's total.

(23) Is the method used to transform raw data into the information presented in this indicator accepted as scientifically sound? If not, what are its limitations? Yes.

(24) How well does the indicator represent the environmental condition being assessed? The indicator shows the qualitative (steps in restoration process) and quantitative (completed acreage) progress for oyster restoration implementation in each tributary.

(25) Are there established reference points, thresholds, ranges or values for this indicator that unambiguously reflect the desired state of the environment?
 Each tributary has a target acreage for oyster reef restoration implementation. See the links to tributary plans in question #10 of this document.

(26) How far can the data be extrapolated? Have appropriate statistical methods been used to generalize or portray data beyond the time or spatial locations where measurements were made (e.g., statistical survey inference, no generalization is possible)? N/A

G. Quality

Please provide appropriate references and location(s) of documentation if hard to find.

(27) Were the data collected and processed according to a U.S. Environmental Protection Agency-approved Quality Assurance Project Plan? If so, please provide a link to the QAPP and indicate when the plan was last reviewed and approved. If not, please complete questions 28-30.
No.

(28) *If applicable:* Are the sampling, analytical and data processing procedures accepted as scientifically and technically valid? Yes.

(29) *If applicable:* What documentation describes the sampling and analytical procedures used?
The restoration plan for each tributary describes the process and details of implementation for each tributary (see question #3). The Oyster Restoration Success Metrics report summarizes the Baywide criteria for restored oyster reefs and outlines the process for monitoring and assessing reefs after construction/seeding.

(30) *If applicable:* To what extent are procedures for quality assurance and quality control of the data documented and accessible?

The Oyster Metrics described above can be found on the Chesapeake Bay Program website here.

(31) Are descriptions of the study design clear, complete and sufficient to enable the study to be reproduced? Yes.

(32) Were the sampling, analytical and data processing procedures performed consistently throughout the data record? Yes.

(33) If data sets from two or more sources have been merged, are the sampling designs, methods and results comparable? If not, what are the limitations? N/A

(34) Are levels of uncertainty available for the indicator and/or the underlying data set? If so, do the uncertainty and variability impact the conclusions drawn from the data or the utility of the indicator? No.

(35) For chemical data reporting: How are data below the MDL reported (i.e., reported as 0, censored, or as < MDL)? If parameter substitutions are made (e.g., using orthophosphate instead of total phosphorus), how are data normalized? How does this impact the indicator? N/A

(36) Are there noteworthy limitations or gaps in the data record? No.

H. Additional Information (*Optional)*

(37)   Please provide any further information you believe is necessary to aid in communication and prevent any potential misrepresentation of this indicator.

The Oyster Restoration Management strategy and workplan provide more details about the overall oyster restoration process and specific efforts in each tributary. These documents can be accessed here.
The Maryland and Virginia restoration partners publish annual updates on restoration. The 2018 updates are available for Maryland and Virginia.

Map: Oyster Restoration in Chesapeake Bay Tributaries (2018)

Data Point	Text
Harris Creek	o Project Name: Lower Choptank River o Tributary: Harris Creek o Completed/Target Acreage: 350/350 o Restoration Status: Between 2011 and 2015, 350 acres of reefs in Harris Creek were built and seeded with spat, marking the completion of the initial restoration phase for this tributary. Reef monitoring and evaluation occurred in 2015, 2016, and 2017 revealed that 98 percent of the reefs seeded in 2012, 2013, and 2014 met our criteria for success in oyster biomass and density. In 2017 and 2018, several Harris Creek reefs received a planned "second-year-class" seeding of spat. o Partners: National Oceanic and Atmospheric Administration (lead), U.S. Army Corps of Engineers, Maryland Department of Natural Resources, Oyster Recovery Partnership o [Learn More](#)

| Little Choptank River | o   Project Name: Little Choptank River
o   Tributary: Little Choptank River
o   Completed/Target Acreage: 338.8/440
o   Restoration Status: The Little Choptank River restoration plan calls for 440 acres of reefs to be restored. Of this total, 45 acres already meet our definition of a restored reef. Between 2014 and 2018, 338.8 acres of reefs were restored.
o   Partners: National Oceanic and Atmospheric Administration (lead), U.S. Army Corps of Engineers, Maryland Department of Natural Resources, Oyster Recovery Partnership
o   [Learn More](#) |
| Tred Avon River | o   Project Name: Lower Choptank River
o   Tributary: Tred Avon River
o   Completed/Target Acreage: 83.8/147
o   Restoration Status: The Tred Avon River restoration plan calls for 147 acres of reefs to be present in the sanctuary. Between 2015 and 2018, 83.8 acres of reefs were restored.
o   Partners: National Oceanic and Atmospheric Administration (lead), U.S. Army Corps of Engineers, Maryland Department of Natural Resources, Oyster Recovery Partnership
o   [Learn More](#) |

Great Wicomico	o Project Name: Great Wicomico o Tributary: Great Wicomico o Completed/Target Acreage: 61/TBD o Restoration Status: Partners are working to develop a restoration target and restoration plan. Due to past restoration work, 61 acres of reefs in this tributary already meet our definition of restored. o Partners: National Oceanic and Atmospheric Administration (lead), U.S. Army Corps of Engineers, Virginia Marine Resources Commission o *No Learn More link*
Lafayette River	o Project Name: Lafayette River o Tributary: Lafayette River o Completed/Target Acreage: 80/80 o Restoration Status: In the Lafayette River, partners have set a goal to restore 80 acres of reefs. Of this total, 70.5 acres already meet our definition of a restored reef, due to past restoration work and a decades-long harvest closure that has allowed some reefs to self-restore. In 2017, the Chesapeake Bay Foundation and Elizabeth River Project built four and a half acres of reefs, bringing the total acreage of restored reefs in the tributary to 75. The two nonprofit organizations built the remaining five acres of reefs in 2018, making it the first tributary in Virginia considered restored under the outcome. o Partners: National Oceanic and Atmospheric Administration (lead), U.S. Army Corps of Engineers, City of Norfolk, Christopher Newport University, Virginia Institute of Marine Science, Virginia Marine Resources Commission, Chesapeake Bay Foundation, Elizabeth River Partnership o [Learn More](#)

Lower York River	o Project Name: Lower York River o Tributary: Lower York River o Completed/Target Acreage: TBD o Restoration Status: Partners are working to develop a restoration target and restoration plan . o Partners: National Oceanic and Atmospheric Administration (lead), U.S. Army Corps of Engineers, Virginia Marine Resources Commission o *No Learn More link*
Lynnhaven River	o Project Name: Lynnhaven River o Tributary: Lynnhaven River o Completed/Target Acreage: 90.6/152 o Restoration Status: Due to past restoration work, 56 acres of reefs in this tributary already meet our definition of restored. The U.S. Army Corps of Engineers and the City of Virginia Beach plan to restore 31 acres of reefs in the Lynnhaven, but the first phase of this restoration project has not been scheduled. o Partners: U.S. Army Corps of Engineers (lead), National Oceanic and Atmospheric Administration, City of Virginia Beach, Virginia Institute of Marine Science, Virginia Marine Resources Commission, Chesapeake Bay Foundation, Lynnhaven River NOW, Oyster Reefkeepers o [Learn More]

Piankatank River	o Project Name: Piankatank River o Tributary: Piankatank River o Completed/Target Acreage: 278/437.67 o Restoration Status: In the Piankatank River, partners have set a goal to restore 437.67 acres of reefs. Of this , 278 acres are already restored due to past restoration work and the presence of existing reefs in the River. o Partners: National Oceanic and Atmospheric Administration (lead), U.S. Army Corps of Engineers, Virginia Institute of Marine Science, Virginia Marine Resources Commission, Chesapeake Bay Foundation, Nature Conservancy o Learn More

St Marys River:

o   Project Name: St Marys River

o   Tributary: St Marys River

o   Completed/Target Acreage: TBD

o   Restoration Status: The St Marys River was selected for large-scale oyster restoration in December 2017. Partners are developing a restoration target and a restoration plan for the River.

o   Partners: National Oceanic and Atmospheric Administration (lead), U.S. Army Corps of Engineers, Maryland Department of Natural Resources, Oyster Recovery Partnership

Manokin River

o   Project Name: Manokin River

o   Tributary: Manokin River

o   Completed/Target Acreage: TBD

o   Restoration Status: The Manokin River restoration was selected for large-scale oyster restoration in June 2019. Partners are working to develop a restoration target and a restoration plan for the River.

o   Partners: National Oceanic and Atmospheric Administration (lead), U.S. Army Corps of Engineers, Maryland Department of Natural Resources, Oyster Recovery Partnership