Oyster Restoration
Pre-construction Site Assessment of the Manokin River Sanctuary

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Introduction

As part of the 2014 Chesapeake Bay Watershed Agreement, Maryland committed to restoring oyster populations in five tributaries in Maryland's portion of the Chesapeake Bay by 2025. The fifth tributary selected for restoration within Maryland's waters is the Manokin River. This tributary is located on the lower eastern portion of Maryland's Chesapeake Bay and has been closed to wild commercial harvest since 2010. The mouth of the river empties into Tangier Sound and this area has historically exhibited strong oyster recruitment.

The Maryland Interagency Workgroup (hereafter Workgroup), tasked with overseeing the restoration of the tributary, used data from Maryland Department of Natural Resources (DNR) patent tong surveys conducted in 2012, 2015, 2017 and 2018 to determine the status of the oyster populations on habitat within the sanctuary. National Oceanic and Atmospheric Administration (NOAA) completed additional GIS analysis, and this information was used to determine initial restoration construction areas: premet (defined as already meeting density and biomass targets), seed-only, and substrate and seed. Premet reefs were estimated to be 20 acres, seed-only restoration reefs were estimated to be 305 acres, and substrate and seed restoration reefs were estimated to be 438 acres (Table 1). A systematic patent tong survey will be conducted on these areas prior to restoration to groundtruth and verify the current status areas selected for restoration. This survey will take place over multiple years, encompassing between 401 to 763 acres.

This report details the methods and results for the second round of pre-construction habitat assessment, which took place in summer 2020.

Table 1. The general guidelines for determining the most appropriate type of restoration.

	Premet Criteria	**Seed-Only Criteria**	**Substrate and Seed Restoration Criteria**
Depth	4-20 ft	4-20 ft	7-20 ft
Bottom Type	on shell dominant bottom, sand, sand & shell, muddy sand, muddy sand & shell, and sandy mud & shell (not on shell dominant bottom)	on shell dominant bottom	sand, sand & shell, muddy sand, muddy sand & shell, and sandy mud & shell (not on shell dominant bottom). also on hard subsurface sediments

	also on hard subsurface sediments identified by sub-bottom profiling sonar		identified by sub-bottom profiling sonar
Oyster Density	> 50 per m^2 (also oyster biomass > 50 g per m^2)	<50 per m^2	< 5 per m^2
Lease Proximity	Not within 150 ft of leases	Not within 150 ft of leases	Not within 150 ft of leases
Navigation Aid Proximity	Not within 250 ft of navigation aids	Not within 250 ft of navigation aids	Not within 250 ft. of navigation aids
Dock Proximity	Not within 50 ft of private docks	Not within 50 ft of private docks	Not within 250 ft. of private docks
SAV Proximity	No intersection with SAV beds	No intersection with SAV beds	No intersection with SAV beds

Methods

Five days of sampling were conducted in August 2020 aboard a contracted vessel, the F/V *Billie Jean.* After conversations with DNR staff, four sites were selected for this round of surveys (Table 2). Project partners wanted to focus on sites in deeper water that would likely need substrate added prior to seeding, to prepare for winter 2020 construction.

Table 2. Substrate and seed sites designated for the second round of Manokin Sanctuary pre-construction surveys. Patent tong data comes from DNR surveys over the period of 2012-18.

Site ID	Area (acres)	Patent Tong primary bottom type	CMECS Classification
SS_19	3.77	Mud sand	Sand
SS_28	41.58	Sand	Sand
SS_29	29.22	Sand mud	Sand, muddy sand
SS_30	19.48	Sand	Sand

The methods implemented during the Manokin Sanctuary surveys are similar to the Upper St. Mary's River Oyster Restoration Tributary Plan (ORP 2019). Assessment protocols require fine-scale resolution information to determine whether benthic habitats are suitable for oyster

population growth. For the first round of pre-construction surveys, a 25 x 25m grid was created in ArcGIS (ESRI ArcMap version 10.7.1) and overlaid on the target sites (Figure 1). When creating sample grids on irregularly shaped polygons, some resulting cells are too small or too narrow to sampled effectively. In this case, cells under 250m^2 were removed. ORP staff then created target sample points in the centroid of each grid cell.

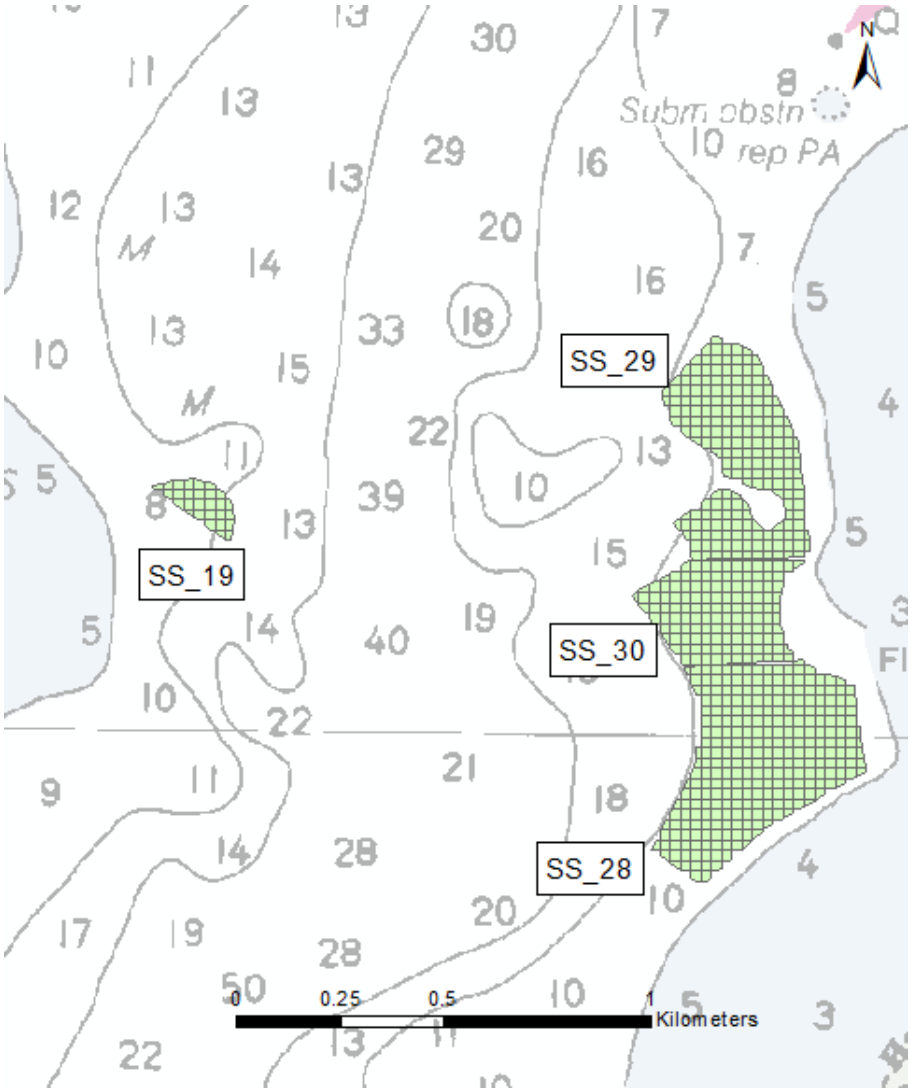

Figure 1. Sites chosen for the second round of patent tong groundtruthing surveys, with the sampling grid overlay.

During the August 2020 survey, habitats were sampled using patent tongs, a specialized commercial fishing gear used to harvest oysters. Patent tongs function much like a benthic grab and are well suited to quantify the condition of benthic habitat through the retrieval of the sediment surface layer which could include oysters, shell, or other sediment features. The coordinates of each patent-tong sample were collected when the patent tongs reached the sediment surface. A Differential Global Positioning System (DGPS) antenna was positioned adjacent to the location where the patent tongs were deployed so no position offset was

required. Aboard the *Billie Jean*, the patent tongs sampled an area on the bottom equal to 1.875m^2. Several qualitative measurements were made once each grab was brought to the surface, including the depth of sediment covering shell (Surface Sediment), the percent of shell not covered by sediment (Exposed Shell), and the amount of material in the sample (Patent Tong Fullness). The substrate composition was recorded based on observations of the sample during sorting and processing. At least 30 live oysters are measured and all remaining oysters and boxes were enumerated.

Two analytical approaches were used to assess the data. The first approach determines whether a site needs restoration based on the abundance and biomass of oysters currently on the site, while the second approach used an index of habitat quality to determine whether a site is suitable for restoration and the type of restoration required. An index of habitat quality was developed to determine whether oyster habitat was suitable for seed-only restoration, substrate and seed restoration, or not suitable for either (e.g. an area consisting of all mud that cannot support restoration). Six benthic habitat components observed from samples were used to develop the index:

1. Exposed Shell
2. Primary Substrate and Secondary Substrate
3. Surface Sediment
4. Number of Live Oysters
5. Surface Shell, calculated as (Total shell volume x percent gray shell) – total shell volume
6. Oyster density and biomass data

The first five benthic components are given a binary score expressed as a 1 or 0, with a result of 1 suitable for restoration construction and 0 being unsuitable (Table 3).

Table 3. Five benthic habitat components used to develop the index of habitat quality and the criteria used to establish a binary score for each component.

Benthic Component	**Suitable for Oysters**
Exposed Shell	Shell 50% exposed or greater
Bottom Type	Oyster, loose shell, or shell hash
Surface Sediment	Less than 5 cm
Number of Live Oysters	Greater than 5 oysters per square meter
Surface Shell Volume	Greater than 10 liters per square meter

This creates a final habitat suitability score for each grid cell is calculated as the sum of each benthic component score at the individual grid cell using the equation:

$$Habitat\ Suitability\ Score = S1 + S2 + S3 + S4 + S5$$

Where S1 = Exposed Shell Score, S2 = Bottom Type Score, S3 = Surface Sediment Score, S4 = Number of Live Oysters Score, and S5 = Surface Shell Volume Score. The result of habitat suitability scores will determine whether benthic habitat represented by each sampling grid cell is suitable for restoration construction. Ranks of one or two are suitable for substrate and seed restoration, ranks of three require additional review, and ranks of four and five are suitable for seed-only restoration.

In the St. Mary's Sanctuary methods, a rank of zero is considered unsuitable for restoration (ORP, 2019b). However, the Manokin sanctuary is very different than the St. Mary's Sanctuary, with a large Yates oyster bar area classified as sand with little to no co-occurring shell. The original Little Choptank Sanctuary groundtruthing methodology is more appropriate to use on the Manokin River Sanctuary given range of bottom types in both rivers.

During the Winslow and Yates surveys, the survey indicated an oyster population was present and, in the past, some of these areas did receive shell plantings under the DNR's historic dredged shell program. However, due to the loss of oyster habitat over time and the transition to sand bottom, it is important to carefully consider the use of sand for oyster restoration. Historically sand has been avoided because oysters can subside and be lost. However, there are instances of successful restoration on primarily sandy bottom, in both Harris Creek and Little Choptank (ORP, 2019a).

Given that sand particles vary in size and compaction, sand bottom can range from soft, to moderate, to firm. This will affect the degree to which planted substrate might bury or be covered by shifting sand due to currents and wave action. Areas that have a layer of sand on top of clay or other hard bottom type may be appropriate areas to construct, as they can withstand the weight of the substrate material. Additional surveys and data analysis on sand bottom should be conducted to determine these impacts when considering constructing on sand bottom.

The amended groundtruthing methodology, similar to the one used in the Little Choptank Sanctuary, splits samples with ranks equal to zero into two subcategories:

- 0Mud – a ranking of zero with a predominate mud bottom type. If the majority of the site receives ranks of 0Mud, the sites are not suitable for restoration.
- 0Non-Mud – a ranking of zero with a predominant bottom type that is not mud. If the majority of the site receives ranks of 0Non-Mud, the sites require more information prior to determining if they are suitable for restoration.

Sites that have majority ranking of 0Non-Mud require further assessment to determine the suitability for restoration. Additional surveys using sounding poles, ponar sediment grabs, sediment cores, and an oyster dredge can be conducted on the site to collect more data on site suitability. Additional information can be gained from DNR's old Seed and Shell Program planting geodatabase: a site that is sand now but was once planted may have shells under the sand that add to its firmness and suitability.

The oyster density and biomass data assessment for each grid are over the entire reef and if both density and biomass are greater than 50 oysters per m^2 and 50 grams per m^2, the reef is considered premet.

Results

Over 600 patent tong grabs were collected during this round of Manokin Sanctuary sampling (Table 4). Very few oysters were observed.

Table 4. Results of August 2020 patent tong survey at the site level. SD represents standard deviation.

Site ID	Dominant Substrate Type	Total Live Oysters Observed	Average Total Volume (L/m^2)	SD Volume	Samples taken (N)
SS_19	Sand	0	0	0	28
SS_28	Sand	185	0.104	0.508	274
SS_29	Sand	0	0.032	0.243	200
SS_30	Sand	2	0.034	0.304	127

Based on patent tong samples, no sites were classified as premet, meaning no areas displayed live oyster density greater than or equal to 50 oysters/m^2 and live oyster biomass greater than or equal to 50 g/m^2. Just over 2% of samples contained live oysters. Most grabs were composed of hard sand. Figures 2-4 show the results at grid cell level for each site surveyed.

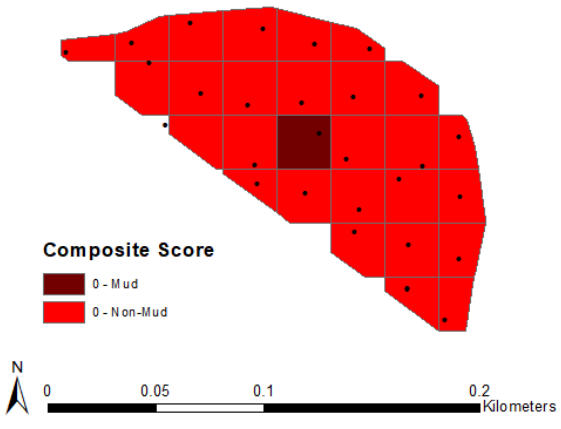

Figure 2. Composite scores for each grid cell of SS_19, showing that no oysters or shell substrate were found across the site. Black dots represent actual locations of patent tong grabs.

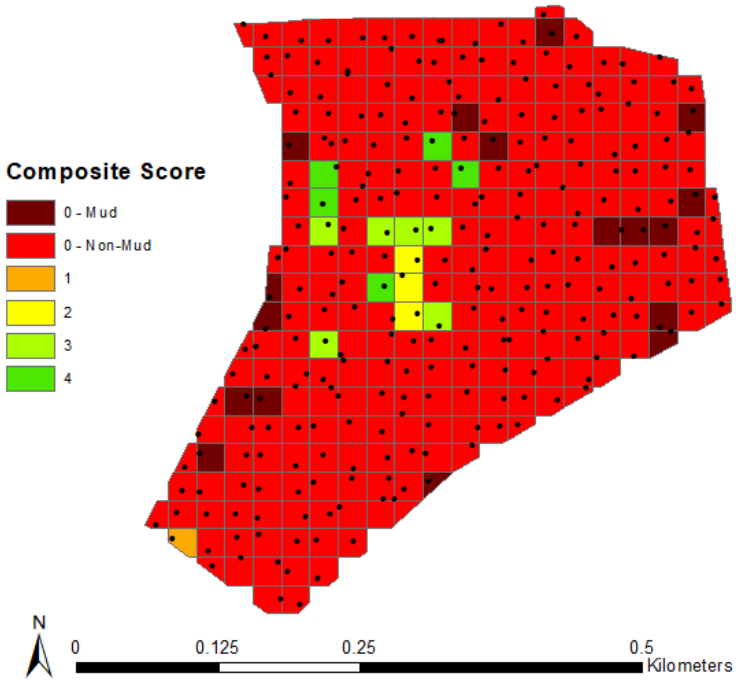

Figure 3. Composite scores for each grid cell of SS_28. Black dots represent actual locations of patent tong grabs. This site had the most live oysters observed.

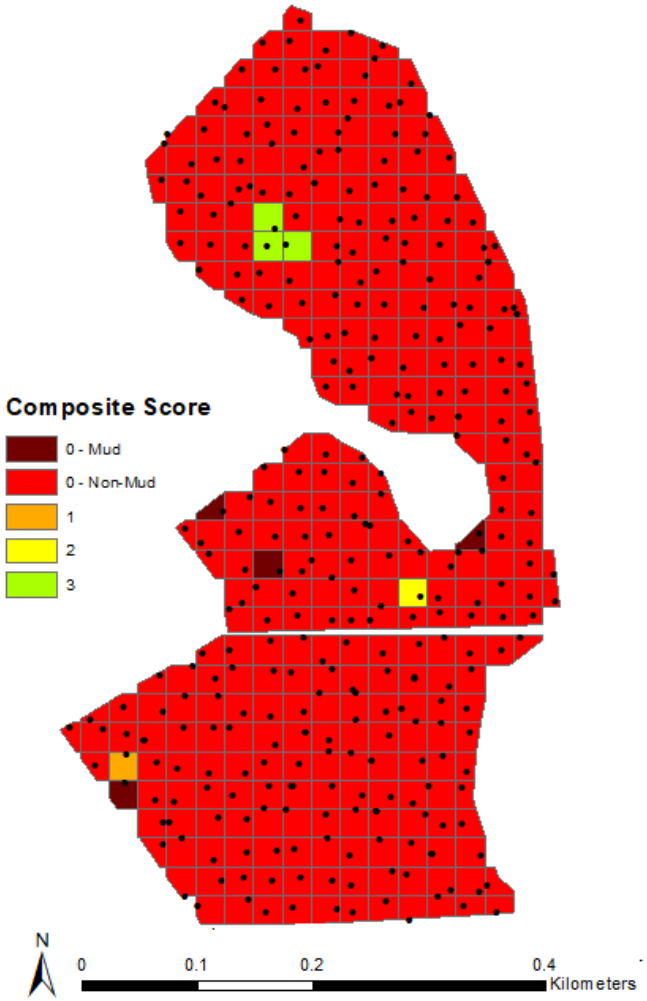

Figure 4. Composite scores of grid cells sampled on SS_29 (top) and SS_30. Black dots represent actual locations of patent tong grabs.

Conclusion

Over 90% of grid cells sampled in August 2020 received a composite score of 0Non-Mud, suggesting that additional surveys are needed. The primary bottom type of these 0Non-Mud ranked samples was sand. The use of sounding poles, ponar sediment grabs, sediment cores, or an oyster dredge may provide more information on these areas to determine suitability for restoration. If these sites are composed of coarse sand or were once planted under DNR's Seed and Shell Program, restoration using substrate and seed may be successful. A concern for these areas, however, is that sand is typically indicative of high energy. Twenty-two sampled cells received a score of 0Mud, indicating that they are not restorable.

Very few cells received a composite score that is suitable for seed only restoration; all were located on SS_28. After additional data are collected, the Maryland Interagency Workgroup will determine the proper treatment types for each site.

References

Oyster Recovery Partnership (ORP). 2019a. Oyster Restoration Pre-Construction Site Assessment of Oyster Shell Dominated Benthic Habitats in Little Choptank River, Chesapeake Bay. Submitted in partial fulfillment of MOU #605P7400192

Oyster Recovery Partnership (ORP). 2019b. Oyster Restoration Pre-Construction Site Assessment of Oyster Shell Dominated Benthic Habitats in St. Mary's River Sanctuary, Maryland. Submitted in partial fulfillment of MOU #605P7400192