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

Fall 2022

Prepared by Oyster Recovery Partnership

December 2022

Table of Contents

List of Tables and Figures

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. Progress to complete the 5 tributary restoration strategy is monitored by the Maryland Oyster Restoration Interagency Workgroup (hereafter Workgroup). The Manokin River is the fifth tributary selected for restoration under the 5 tributary strategy. 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 Workgroup used data from the 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 Manokin River sanctuary. National Oceanic and Atmospheric Administration (NOAA) provided additional spatial information to describe bottom type. These data were used to identify potential sites for restoration and assign restoration treatment types to these areas: premet (already meet density and biomass targets), seed-only, and substrate and seed (Table 1). This process identified 20 acres of premet reefs, 305 acres of seed-only reefs, and 438 acres of areas needing substrate and seed in the Manokin River sanctuary. Oyster Recovery Partnership (ORP) conducted a systematic patent tong survey to verify the predominant bottom type and assess whether the restoration treatments assigned to these areas were appropriate. This report summarizes the final round of groundtruthing in the Manokin River.

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) also on hard subsurface sediments identified by sub-bottom profiling sonar	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 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

Oyster Recovery Partnership (ORP) conducted the final round of Manokin River groundtruthing between October and December of 2022 in collaboration with local waterman, Bobby Walters. The methods implemented during the Manokin sanctuary surveys were similar to previous groundtruthing surveys conducted by ORP. A 25 x 25m grid was created in ArcGIS (ESRI ArcMap version 10.7.1) and overlain on the target sites provided by DNR. A 35 x 35m grid was used for the two control sites (Drum Pt A and Drum Pt B) to reduce sampling effort but still ensure comprehensive spatial coverage. When creating sample grids on irregularly shaped polygons, some resulting cells are too small or too narrow to be sampled effectively. In this case, cells under 250m^2 were removed. Target sample points were generated in the centroid of each grid cell. A total of 15 sites and 155 acres were sampled with patent tongs (Table 2).

Table 2. Sites sampled for the Fall 2022 groundtruthing survey in Manokin River Sanctuary.

Round	Restoration Type	Site ID	Area (acres)	Number of PT samples	Report Reef ID
Fall 2022	Control	Control-Drum Pt A	23.27	89	N/A
Fall 2022	Control	Control-Drum Pt B	11.24	45	N/A
Fall 2022	Substrate and Seed	SS_05	1.13	6	MN_49
Fall 2022	Substrate and Seed	SS_06	1.63	9	MN_50
Fall 2022	Substrate and Seed	SS_17	5.03	34	MN_61
Fall 2022	Substrate and Seed	SS_18	6.97	47	MN_62
Fall 2022	Substrate and Seed	SS_31	27.40	184	MN_75

Fall 2022	Substrate and Seed	SS_33	8.62	60	MN_77
Fall 2022	Substrate and Seed	SS_34	2.89	19	MN_78
Fall 2022	Substrate and Seed	SS_35	28.06	187	MN_79
Fall 2022	Substrate and Seed	SS_38	10.77	75	MN_82
Fall 2022	Substrate and Seed	SS_39	3.34	25	MN_83
Fall 2022	Substrate and Seed	SS_40	5.54	30	MN_84
Fall 2022	Substrate and Seed	SS_41	3.46	25	MN_85
Fall 2022	Substrate and Seed	SS_47	16.84	111	MN_89
Totals			**155.18**	**946**	

Two analytical approaches were used to assess the accuracy of the pre-assigned restoration types and determine the appropriate restoration treatment type for the sites listed in Table 2. The first approach determined whether a site needs restoration based on the abundance and biomass of oysters currently on the site. The second approach used an index of habitat quality to determine whether a site is suitable for restoration and identify the restoration treatment required (seed-only, substrate and seed, not suitable). A habitat score was assigned to each grid cell overlain on the restoration site. Six benthic habitat components 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

The first five benthic components were assigned a binary score expressed as a 1 or 0; 1 indicates a grid cell is suitable for restoration, 0 indicates a grid cell is not suitable for restoration (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 (score = 1)**
Exposed Shell	> 50% Shell 50% is exposed
Bottom Type	Oyster, loose shell, or shell hash

Surface Sediment	< 5 cm
Number of Live Oysters	> 5 oysters m^{-2}
Surface Shell Volume	> 10 liters m^{-2}

A final habitat suitability score for each grid cell is calculated by adding the scores of each individual benthic component:

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

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 resulting habitat suitability score can range from 0 to 5; scores of 4 or 5 are suitable for seed-only restoration: scores of 3 may require additional review: scores of 1 or 2 are suitable for substrate and seed restoration (Table 4). If oyster density and biomass are greater than 50 oysters per m^2 and 50 grams per m^2, the reef is considered premet and does not require restoration.

For other tributaries, a score of 0 was considered not suitable or unable to support any restoration treatment because the dominant bottom type was soft mud and no hard bottom was present (e.g., St. Mary's River; ORP 2019b). In the Manokin River, the groundtruthing survey indicated that a large Yates oyster bar was classified as sand with little to no co-occurring shell.

Historically sand has been avoided because oysters can be buried or reefs can subside. However, there are instances where restoration has been successful on sand in both Harris Creek and Little Choptank River sanctuaries (ORP 2019a). In the Manokin River, historic Winslow and Yates surveys suggested that oysters were present on this reef. In addition, DNR has records of planting shell in this area under their historic dredged shell program. Due to the loss of oyster habitat at this reef over time and the transition to sand, it is important to carefully consider the suitability of sand substrate for oyster restoration.

Given that sand particles vary in size and compaction, sand substrate can range from soft, to moderate, to firm. This will affect the degree to which planted substrate might be buried by sand that is transported or resuspended from currents and waves. Areas that have a layer of sand on top of clay or other hard bottom may be appropriate areas for restoration, as they can withstand the weight of the restoration material. Additional surveys and data analysis on sand bottom should be conducted to determine whether sand in the Manokin River can support restoration.

The Workgroup agreed to implement an amended groundtruthing methodology (similar to ORP 2019a) that splits samples with scores of 0 into two subcategories:

- 0Mud – a score of 0 with a predominant mud bottom type. If the majority of the site receives ranks of 0Mud, the sites are not suitable for restoration.
- 0Non-Mud – a score of 0 with a predominant bottom type that is not mud. If the majority of the site receives ranks of 0Non-Mud, more information is needed to determine if a site is suitable for restoration.

Sites that have a majority of 0Non-Mud scores 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 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 ability to support restoration.

Table 4. Restoration treatment designation based on habitat suitability composite score for the Manokin River Sanctuary.

Habitat Suitability Score		**Restoration Treatment Suitability**
5		Seed-Only restoration or Premet
4		Seed-Only restoration
3		Requires further review of all variables at the site level to determine suitability for seed-only restoration or substrate and seed restoration
2		Substrate and Seed restoration
1		Substrate and Seed restoration
0	Non-Mud	Requires further review to determine suitability at the site level for Substrate and Seed restoration (bottom type is sand or clay)
	Mud	Not suitable for restoration (bottom type is mud)

Results

A total of 946 patent tong grabs were collected over 9 days during this phase of groundtruthing. Of those, 134 were on DNR’s control sites and 812 were on restoration sites slated for substrate and seed (Table 2). The composite score for each cell was displayed in ArcGIS to allow visual review of the results for each site. The restoration sites were almost entirely made up of sand and contained very few oysters, suggesting that these sites should be further evaluated for suitability of restoration.

Across the restoration sites, 757 cells (93%) possessed a dominant substrate of sand, while 40 cells (5%) were predominantly mud or sandy mud, and the remaining 15 cells (2%) were loose shell (Table 5). In total, only 66 live oysters were collected across all restoration sites, resulting in an average density of 0.04 individuals/m^2. 792 samples (97.5%) had no live oysters.

The primary bottom type and other scored benthic components at the restoration sites resulted in 719 cells (88.5%) receiving a composite score of 0Non-Mud and 31 cells (3.8%) receiving a score of 0-mud. Two cells (0.2%) received a 4, 43 cells (5.3%) received a 3, and 17 cells (2.1%) received a 1 or 2 (Table 6).

The control sites had 93 cells (69%) with a dominant substrate of oysters or loose shell, mostly in Drum Point A, and 30 cells (22%) with a dominant substrate of sand, mostly in Drum Point B (Table 5; Figure 1). A total of 4,373 live oysters were collected across the control sites, resulting in an average density of 17 individuals/m^2. 35 samples (26%) had no live oysters. There was also an abundance of tunicates (noted in "Comments" section of RepData) at both control sites, comprising about half of many individual patent tong grabs.

The primary bottom type and other scored benthic components at the control sites resulted in the control sites receiving much higher scores than the restoration sites (Table 7). Twenty-seven cells (20%) in the control sites received a score of 0, with 4 (3%) 0-Mud and 23 (17%) 0Non-Mud. Four cells (3%) received a 2, 31 (23%) received a 3, and 72 (54%) received a 4 or 5. Control Drum Point A scored much better than Control Drum Point B, as almost half of the cells in Control Drum Point B were sand grabs and received a score of 0Non-Mud, while almost all of Control Drum Point A received a 4 or 5 (Figure 1).

Table 5. Substrate, oyster, and total volume results from the Fall 2022 groundtruthing survey.

Site ID	Dominant Substrate Type	Total Live Oysters Observed	Average Total Volume (L/m^2)	SD Volume
Control-Drum Pt A	Oysters	4,282	11.7	7.1
Control-Drum Pt B	Sand	91	1.5	2.2
SS_05	Sand	0	0	0
SS_06	Sand	22	3	4.9
SS_17	Sand	10	0.7	2.0
SS_18	Sand	0	0.1	0.3
SS_31	Sand	7	0.2	0.5
SS_33	Sand	0	0	0
SS_34	Sand	0	0	0
SS_35	Sand	2	0	0.2
SS_38	Sand	0	0	0
SS_39	Sand	0	0	0
SS_40	Sand	1	0.3	1.5

SS_41	Sand	0	0.1	0.2
SS_47	Sand	24	0.3	1.3

Table 6. Results from composite scores across restoration sites slated for treatment with substrate and seed (Table 2). Total cells = 812.

Habitat Suitability Score		Number of cells	Percentage of cells
5		0	0%
4		2	0.2%
3		43	5.3%
2		5	0.6%
1		12	1.5%
0	Sand	719	88.5%
	Mud/Sandy Mud	31	3.8%

Table 7. Results from composite scores across DNR's control sites not slated for restoration. Total cells = 134.

Habitat Suitability Score		Number of cells	Percentage of cells
5		6	4.5%
4		66	49.3%
3		31	23.1%
2		4	3.0%
1		0	0%
0	Non-Mud	23	17.2%
	Mud	4	3.0%

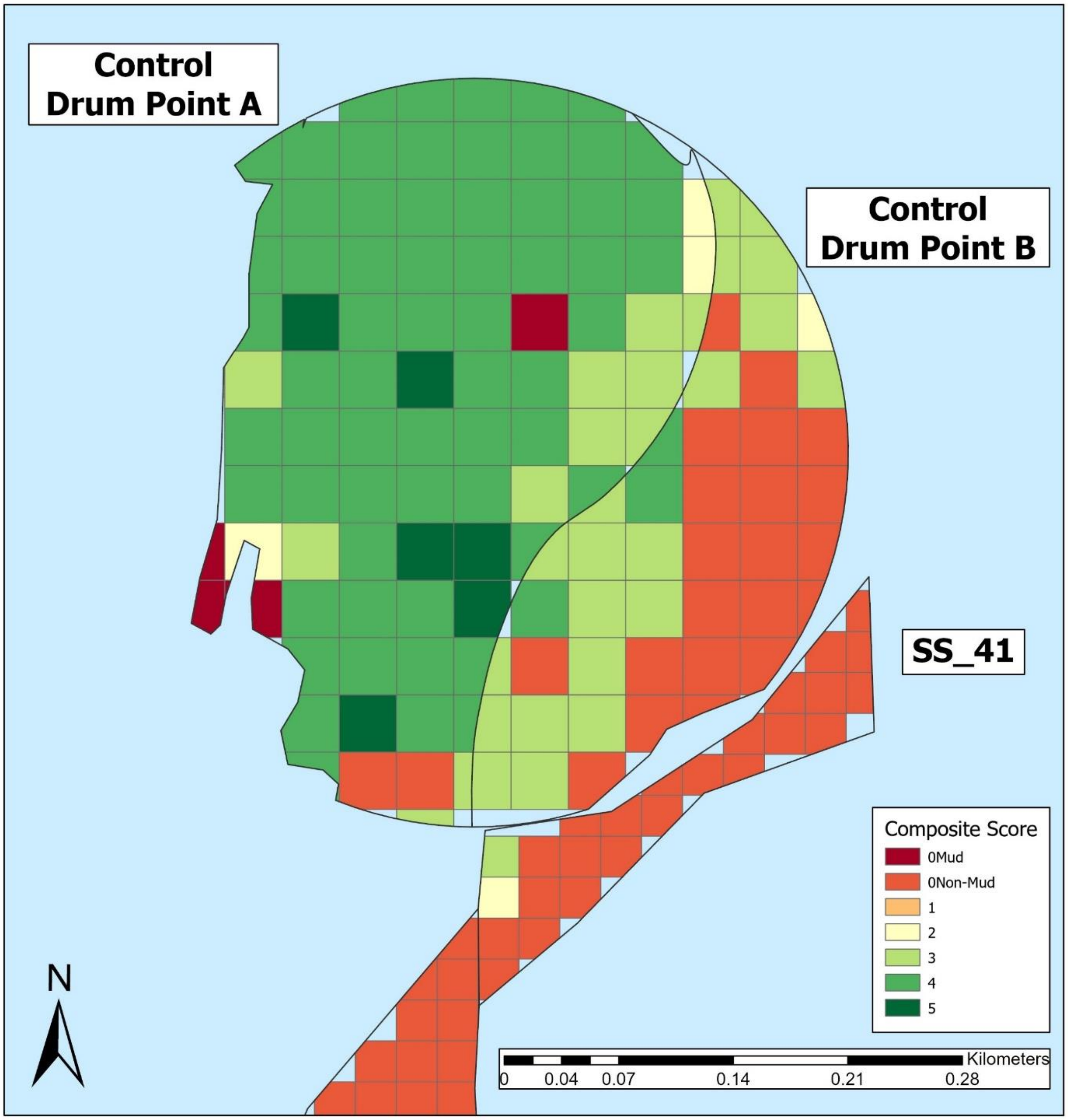

Figure 1. Composite score results for the two control sites (Drum Point A and Drum Point B), and restoration site SS_41. Note that a larger grid size (35x35 m^2) was used for control sites.

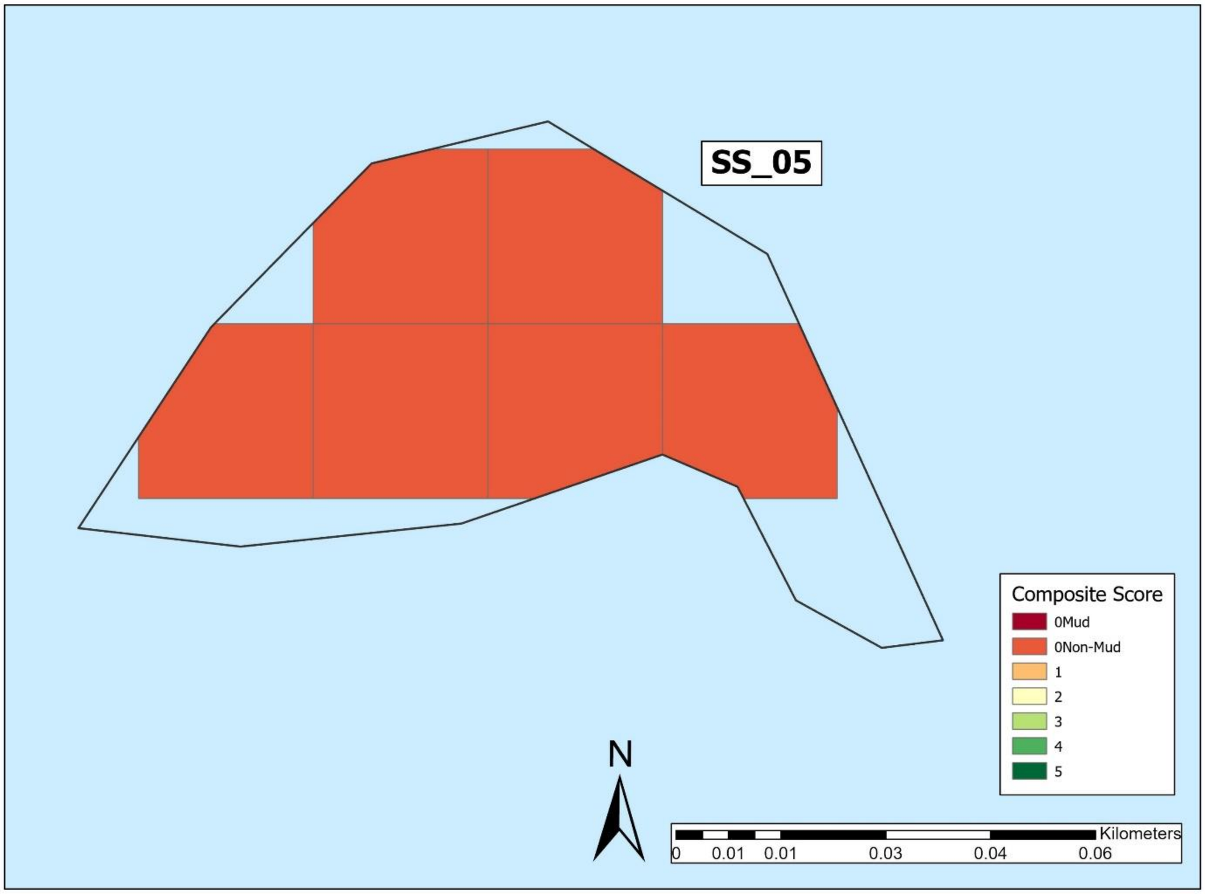

Figure 2. Composite score results for restoration site SS_05.

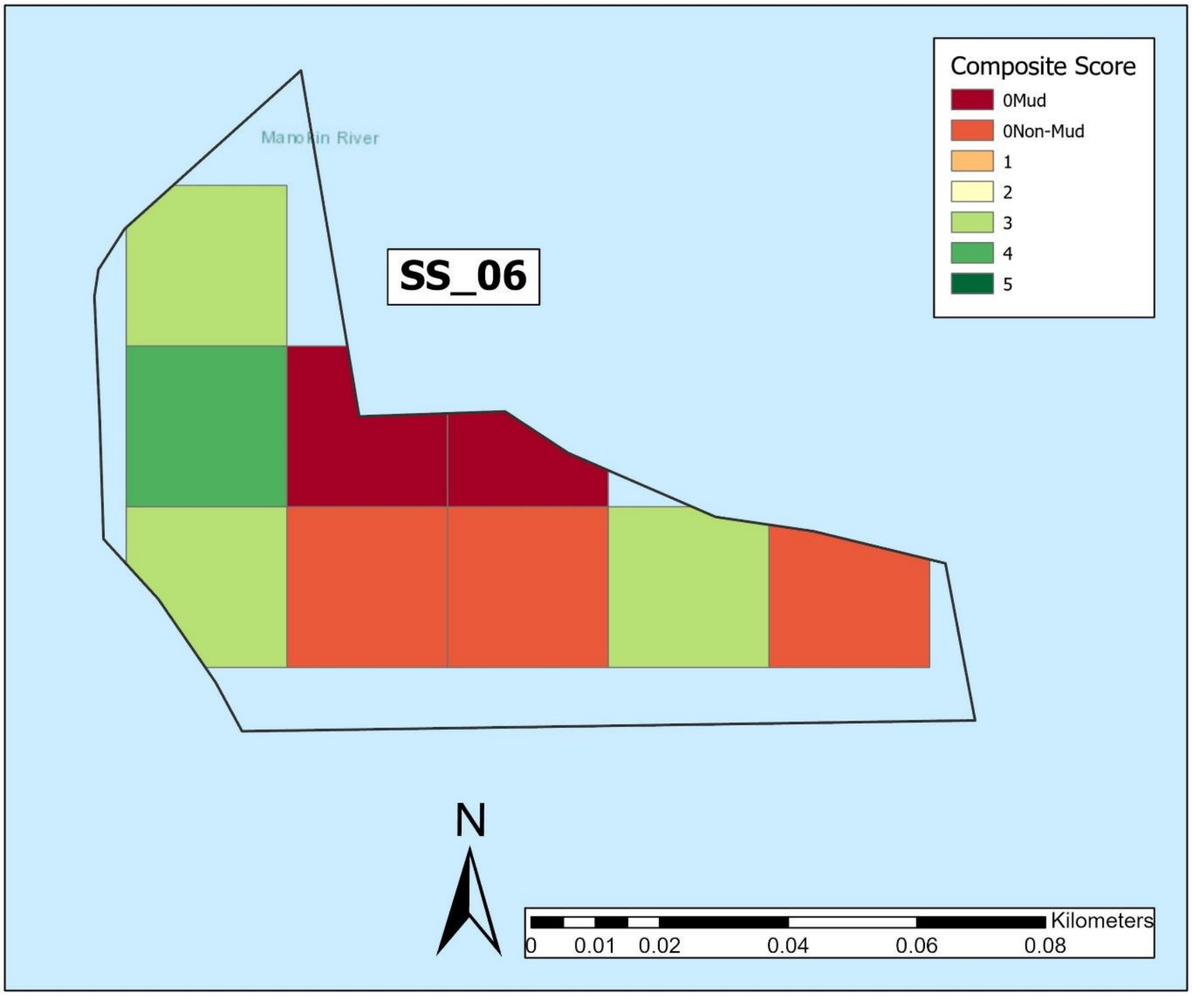

Figure 3. Composite score results for restoration site SS_06.

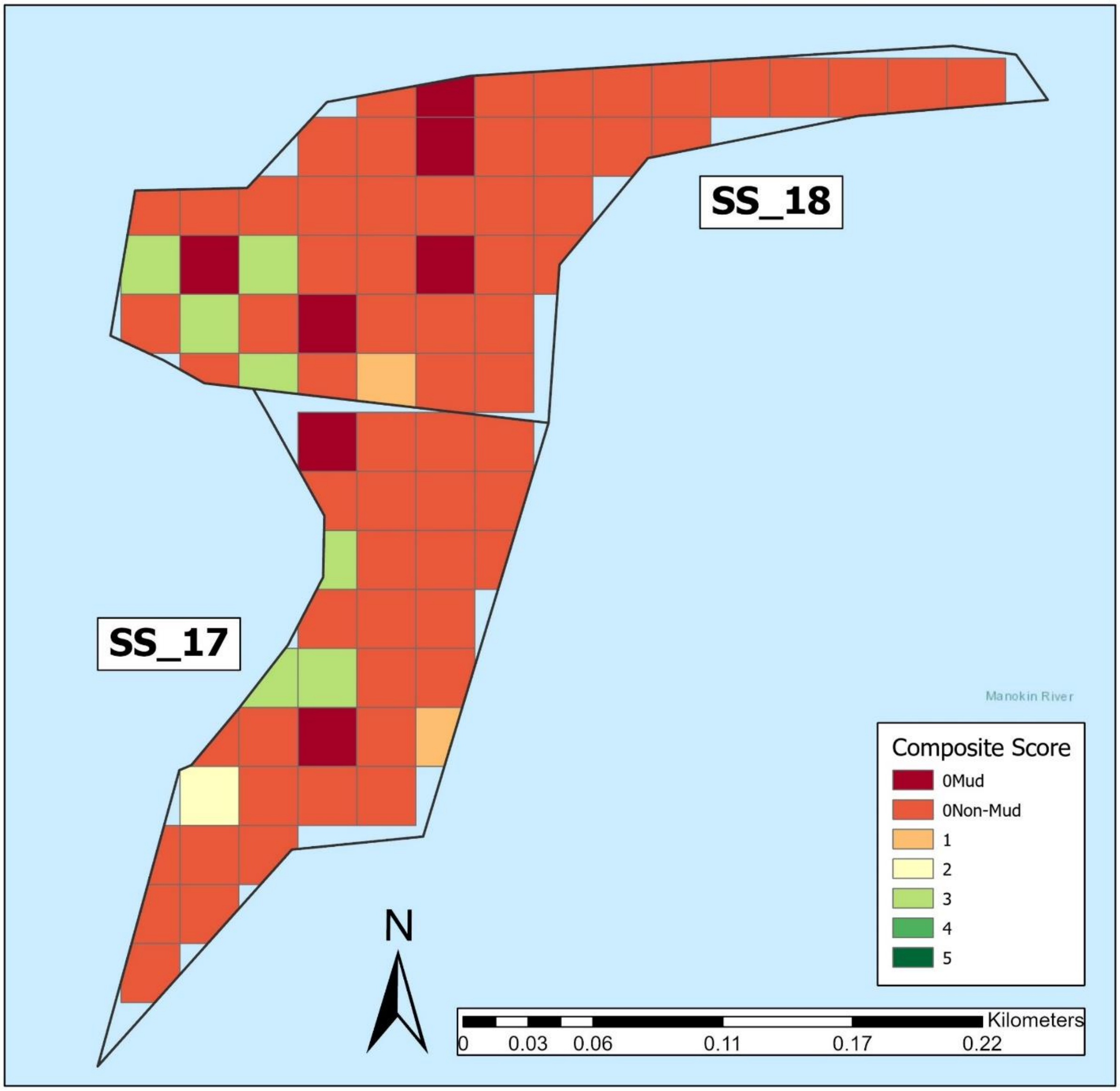

Figure 4. Composite scores for restoration sites SS_18 and SS_17.

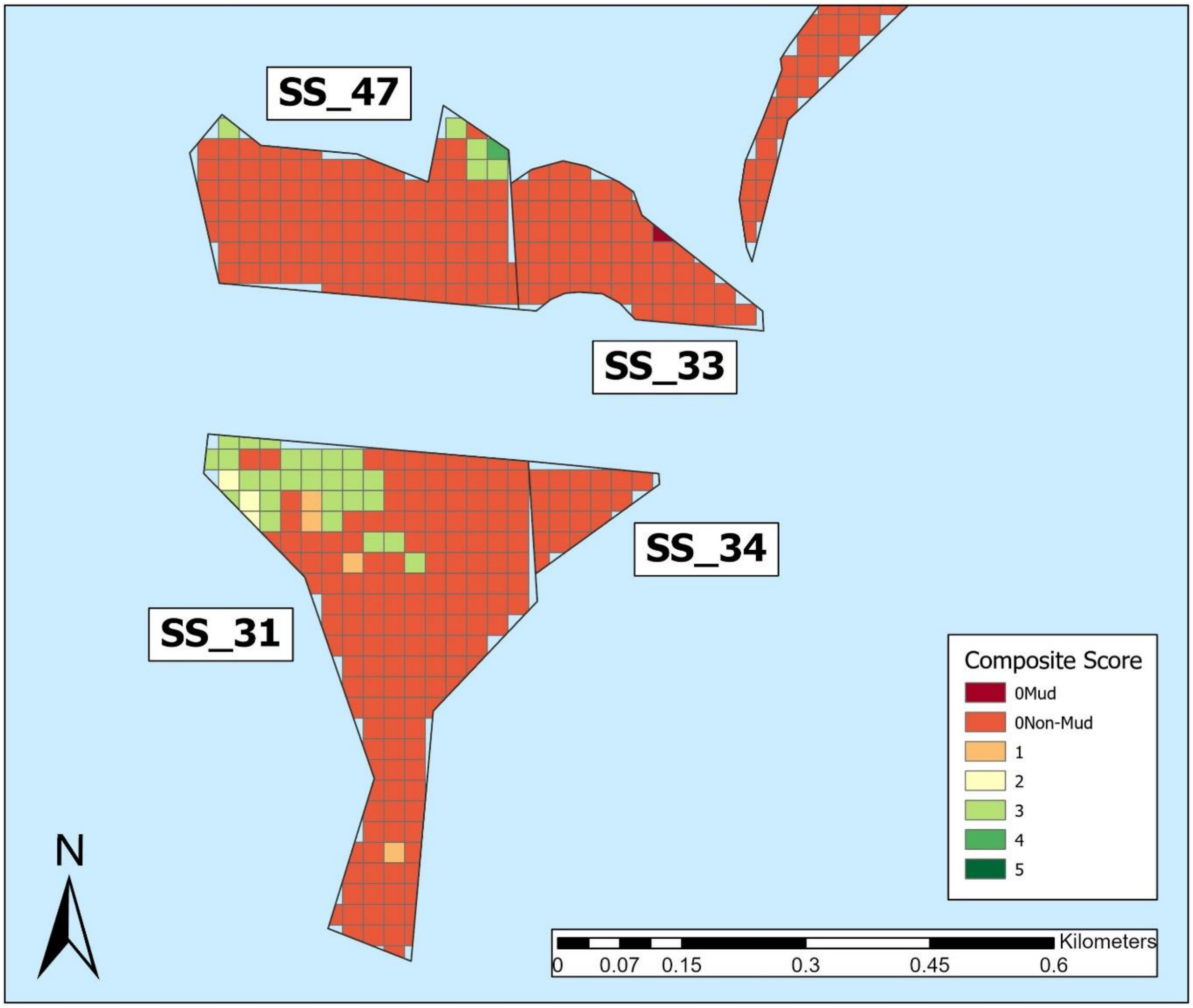

Figure 5. Composite score results for restoration sites SS_47, SS_33, SS_31, and SS_34.

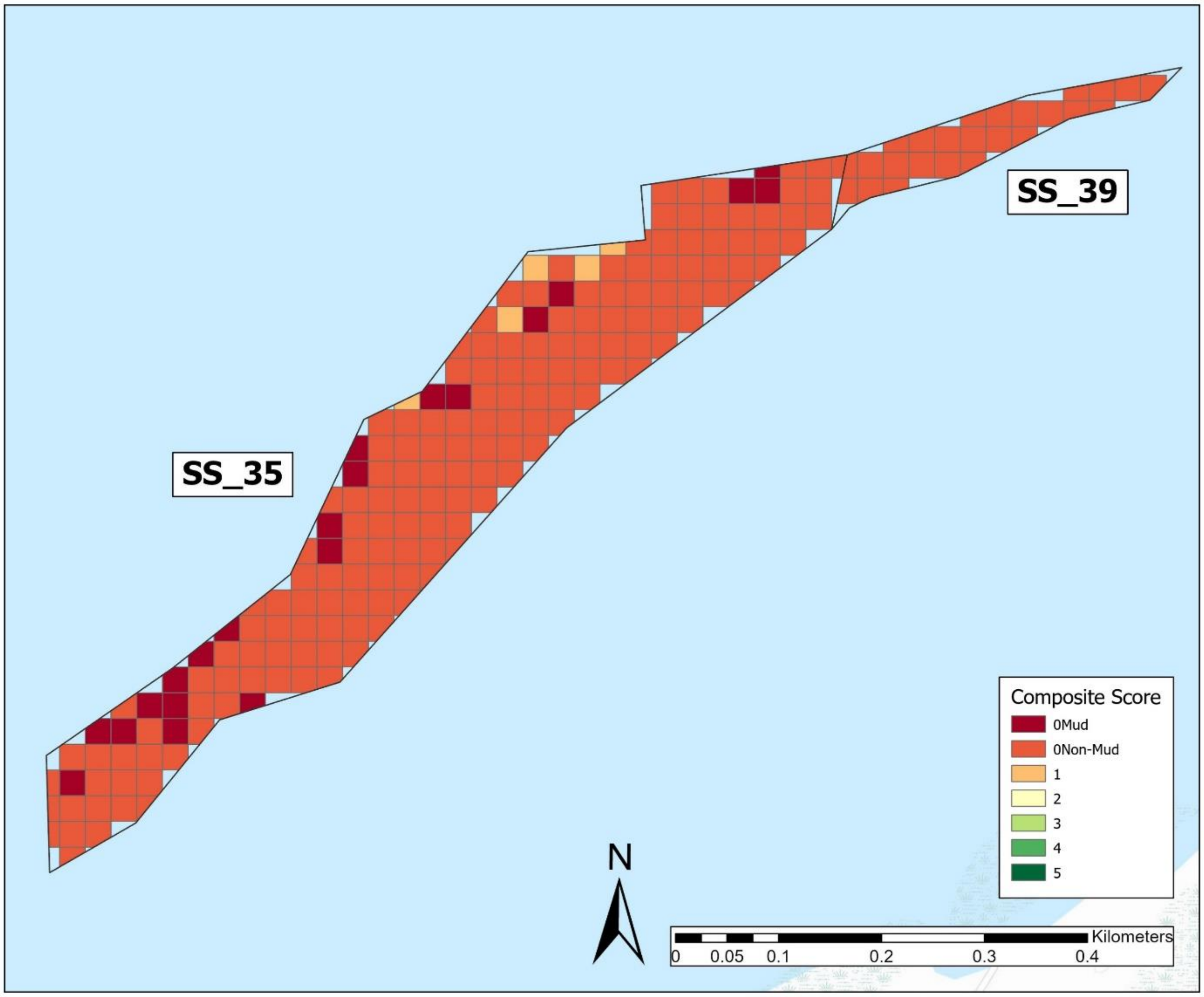

Figure 6. Composite score results for restoration sites SS_35 and SS_39.

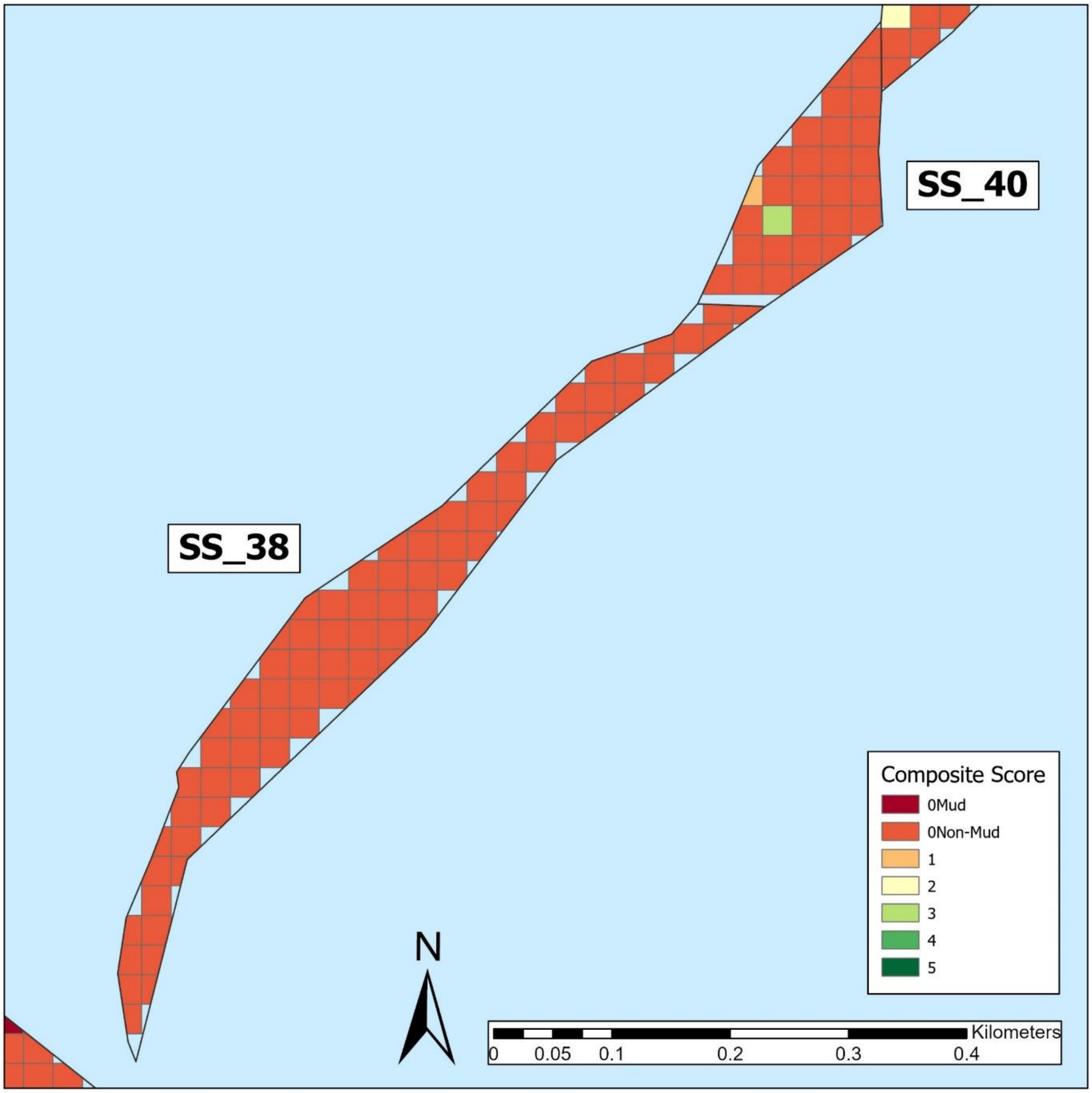

Figure 7. Composite score results for restoration sites SS_38 and SS_40.

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 #605P740019.