2016 Oyster Reef Monitoring Report

Analysis of Data from Large-Scale Sanctuary Oyster Restoration Projects in Maryland

July 2017

Produced in partnership with the Maryland Oyster Restoration Interagency Workgroup under the Chesapeake Bay Program's Sustainable Fisheries Goal Implementation Team

MARYLAND DEPARTMENT OF NATURAL RESOURCES

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Definitions

Seed only: Reefs treated only with hatchery-produced oyster seed (spat-on-shell). No base reef-building substrate was added prior to seeding. This treatment was generally used on reefs where the prerestoration population was five oysters per square meter or greater, but less than 50 oysters per square meter (see Harris Creek Tributary Plan for detailed description of how the Workgroup determined treatment type for each reef).

Substrate and seed: Reefs treated with reef-building substrate, generally six inches to one foot high (substrate used for the 2013 cohort was either mixed shell or stone). Substrate placement was followed by planting with hatchery-produced spat-on-shell. This treatment type was generally used where prerestoration oyster populations were below five oysters per square meter, or where sonar surveys found no evidence of shell.

Mixed-shell substrate: A mixture of scallop, conch, and clam shell from processing plants.

Stone substrate: Material geologically classified as amphibolite, graded to fit through a six-inch mesh screen.

Reference reef: Reefs in the Harris Creek oyster sanctuary (closed to harvest), left unrestored (untreated). These are to serve as comparisons to restored (treated) reefs. Typically, these would be called 'control' reefs, but they are not true controls, as it is not possible to ensure that restoring nearby reefs would not result in de facto treatment of these reference reefs. That is, reference reefs might receive larvae from nearby restored reefs. Hence the term 'reference reefs' is used.

Sentinel reefs: A subset of the restored reefs, which are monitored annually (rather than only three years and six years after restoration, as is standard for other restored reefs).

Executive Summary

Background and Context

The 2014 Chesapeake Bay Watershed Agreement includes a goal to restore oyster populations in ten Chesapeake Bay tributaries by 2025. This has generally been interpreted as five tributaries in Maryland and five in Virginia. In Maryland, partners including the National Oceanic and Atmospheric Administration (NOAA), U.S. Army Corps of Engineers' Baltimore District (USACE), and the Maryland Department of Natural Resources (DNR) are working to achieve this goal through the Maryland Interagency Oyster Restoration Workgroup.

Harris Creek was the first tributary selected for large-scale oyster restoration, followed by the Little Choptank and Tred Avon rivers (Fig. 1). The Maryland Oyster Advisory Commission is working on a recommendation for the next two Maryland tributaries. Partners developed tributary plans[1,2,3] to guide restoration in each tributary.

A set of oyster restoration success criteria, commonly known as the Chesapeake Bay Oyster Metrics[4], was developed by scientists and resource managers prior to implementing restoration work.

Consistent with the Harris Creek Tributary Plan and the Oyster Metrics success criteria, partners collaboratively monitor each restored oyster reef three years, and again six years, after restoration treatment. The first cohort of reefs, restored in 2012, were monitored in 2015, three years post restoration (see report at https://chesapeakebay.noaa.gov/images/stories/habitats/hc3ydcheckinjuly2016.pdf).

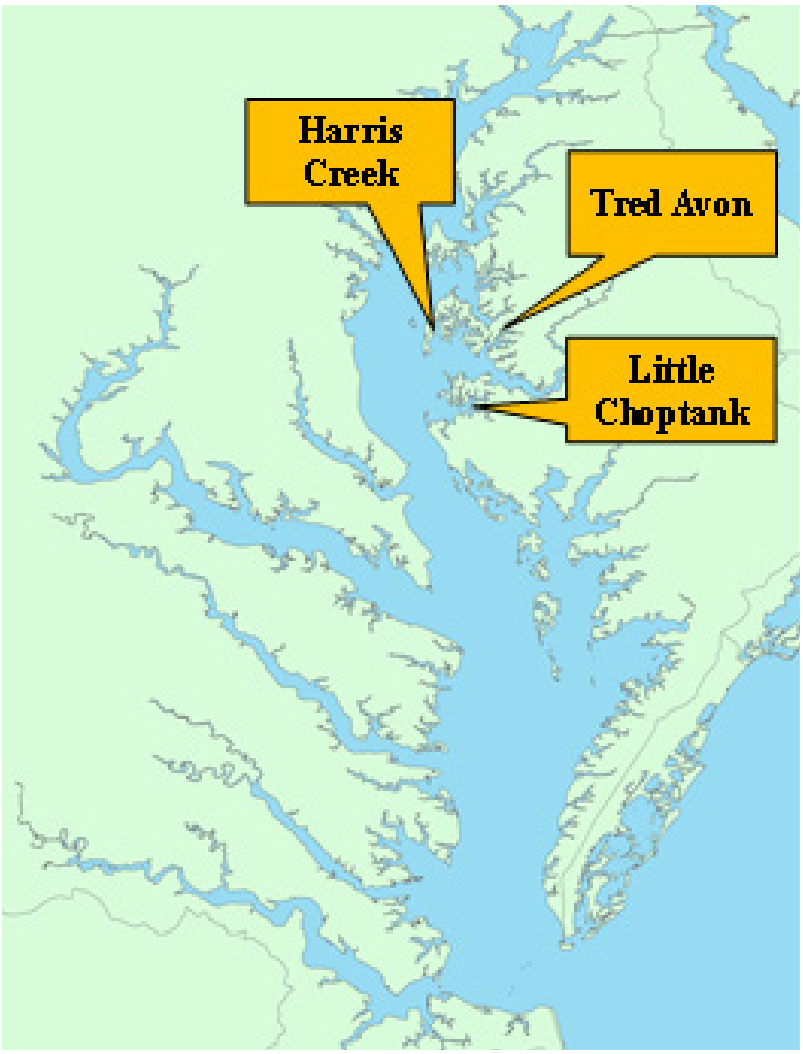


Figure 1: Location of Harris Creek, Little Choptank River, and Tred Avon River on the Chespeake Bay in Maryland.

The second cohort of Harris Creek reefs (restored in 2013, and hereafter called the '2013 cohort'), was monitored in fall 2016, three years post restoration. Data and analysis from those 30 reefs (90 acres) are provided in this report. Additional reefs were also monitored, including Harris Creek reference reefs, and sentinel reefs including five in Harris Creek and two each in the Little Choptank and Tred Avon rivers. This report describes how each reef in the 2013 cohort performed relative to the preestablished Oyster Metrics success criteria, as of fall 2016. See Discussion section for additional information.

Results Summary

Complete results are in the Results and Discussion sections. Of the 30 reefs in the 2013 cohort:

- 97% exceeded the minimum threshold success criteria for both oyster density and oyster biomass (Fig. 2).
- 80% exceeded the higher, target oyster density and biomass success criteria (Fig. 2).
- 100% had multiple year classes present, meeting the relevant Oyster Metrics success criterion for multiple year classes.
- Of the 23 reefs in the 2013 cohort for which both baseline and 2016 structural data were collected, 100% meet the Oyster Metrics criteria for a stable or increasing reef footprint and reef height.
- Because additional data are needed, shell budgets for these reefs will not be assessed until 2019.

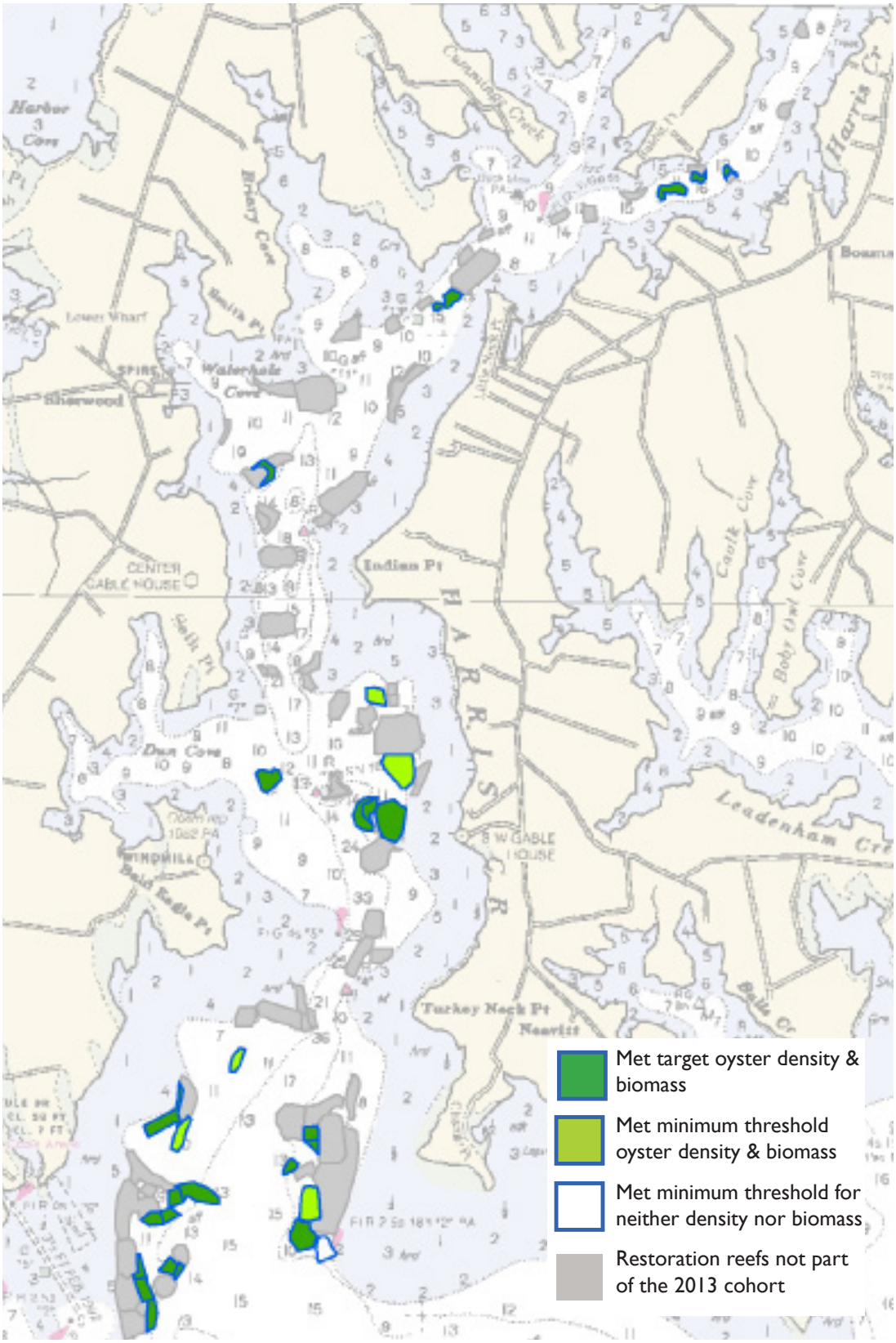


Figure 2: Performance of each Harris Creek 2013 cohort reef relative to Oyster Metrics density and biomass success criteria in 2016.

Oyster density success criterion:

- *minimum threshold = 15 oysters per m^2 over 30% of the reef area*
- *target = 50 oysters per m^2 over 30% of the reef area*

Oyster biomass success criterion:

- *minimum threshold = 15 grams dry weight per m^2 over 30% of the reef area*
- *target = 50 grams dry weight per m^2 over 30% of the reef area*

Table 1: Summary of how each monitored reef performed relative to each Oyster Metrics success criteria in 2016
Bold text shows success criteria; other columns show relevant reef information beyond the success criteria. TBD in 2019 = fall 2016 data will serve as baseline, and will be compared to fall 2019 data to determine success for these criteria. See Section 2.2 for explanation.

Criteria

Reefs

	Reef #	Geodatabase Site_ID	Bar Name	Substrate type added	Ave. live density across reef (#/ m2)	**Did reef meet minimum threshold* density?**	Did reef meet target* density?	**Did reef meet minimum threshold* biomass?**	Did reef meet target* biomass?	**Are multiple year classes present ?**	**Is shell volume stable/ increasing?**	**Is the reef footprint stable/ increasing?**	**Is the reef height stable/ increasing?**
2013 Harris Creek Monitoring Cohort	H18	AltSub_20A	LODGES	Stone	152.29	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H19	AltSub_20B	LODGES	Stone	139.43	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H20	AltSub_49A	TILGHMAN W	Stone	189.00	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H21	AltSub_57B	MILL POINT	Mixed shell	100.62	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H22	AltSub_71A	CHANGE	Stone	225.00	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H23	AltSub_71B	CHANGE	Stone	226.00	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H24	AltSub_49B	TILGHMAN W	Stone	173.75	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H25	AltSub_57A	MILL POINT	Mixed shell	68.89	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H26	AltSub_01	TILGHMAN W	Stone	130.00	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H27	AltSub_03	N/A	Stone	169.75	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H28	AltSub_25	LITTLE NECK	Mixed shell	30.05	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H29	AltSub_29	UPPER HARRIS	Stone	330.67	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H30	AltSub_30	UPPER HARRIS	Mixed shell	53.42	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H31	AltSub_31A	UPPER HARRIS	Mixed shell	129.57	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H32	AltSub_54	CHANGE	Stone	373.20	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H33	AltSub_62	TILGHMAN W	Stone	183.33	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H34	AltSub_79	TILGHMAN W	Stone	268.80	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H35	AltSub_108	TILGHMAN W	Mixed shell	63.35	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H36	AltSub_105	TILGHMAN W	Mixed shell	51.86	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H37	AltSub_101	N/A	Mixed shell	56.94	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H38	AltSub_102	N/A	Mixed shell	32.85	Yes	No	Yes	Yes	YES	TBD 2019	YES	YES
	H39	AltSub_103	N/A	Mixed shell	12.11	Yes	No	Yes	No	YES	TBD 2019	YES	YES
	H40	AltSub_107	CHANGE	Stone	388.00	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	YES
	H41	Seed_04	N/A	None (spat on shell only)	47.75	Yes	Yes	Yes	Yes	YES	TBD 2019	TBD 2019	TBD 2019
	H42	Seed_07	CHANGE	None (spat on shell only)	41.84	Yes	No	Yes	Yes	YES	TBD 2019	TBD 2019	TBD 2019
	H43	Seed_11	HUNTS	None (spat on shell only)	43.34	Yes	Yes	Yes	Yes	YES	TBD 2019	TBD 2019	TBD 2019
	H44	Seed_59	MILL POINT	None (spat on shell only)	43.09	Yes	Yes	Yes	No	YES	TBD 2019	YES	YES
	H45	Seed_75	CHANGE	None (spat on shell only)	3.04	No	No	No	No	YES	TBD 2019	TBD 2019	TBD 2019
	H46	Seed_13A	MILL POINT	None (spat on shell only)	25.06	Yes	No	Yes	No	YES	TBD 2019	TBD 2019	TBD 2019
	H47	Seed_13B	MILL POINT	None (spat on shell only)	50.88	Yes	Yes	Yes	Yes	YES	TBD 2019	TBD 2019	TBD 2019
Harris Sentinel Reefs	H1	AltSub_104	CHANGE	Mixed shell	43.31	Yes	Yes	Yes	Yes	YES	TBD 2019	YES	NO
	H10	TREATMENT_3	LITTLE NECK	None (spat on shell only)	70.30	Yes	Yes	Yes	Yes	YES	TBD 2019	TBD 2018	TBD 2018
	H11	TREATMENT_4	LODGES	None (spat on shell only)	27.76	Yes	No	Yes	Yes	YES	TBD 2019	TBD 2018	TBD 2018
	H13	EXCEDES_GOA	MILL POINT	None (spat on shell only)	31.49	Yes	Yes	Yes	Yes	YES	TBD 2019	TBD 2018	TBD 2018
Harris Reference Reefs	H14	CONTROL_1	EAGLE POINT	None (reference reef)	18.29	Yes	No	Yes	No	YES	TBD 2019	TBD 2018	TBD 2018
	H15	CONTROL_3	RABBIT ISLAN	None (reference reef)	5.80	Yes	No	Yes	No	YES	TBD 2019	TBD 2018	TBD 2018
	H16	CONTROL_4	RABBIT ISLAN	None (reference reef)	6.71	No	No	No	No	YES	TBD 2019	TBD 2018	TBD 2018
	H17	CONTROL_2	MILL POINT	None (reference reef)	8.24	No	No	No	No	YES	TBD 2019	TBD 2018	TBD 2018
Lt. Chptk Sentinel Reefs	L1	SO_17	LITTLE POLLA	None	28.16	Yes	No	Yes	No	YES	TBD 2019	TBD in 2019	TBD in 2019
	L2	SS_02	SUSQUEHANN	Fossil Shell	251.33	Yes	Yes	Yes	Yes	YES	TBD 2019	TBD in 2019	TBD in 2019
Tred Avon Sentinel Reefs	T1	SS_44	N/A	Mixed Shell	73.71	Yes	Yes	Yes	No	YES	TBD 2019	TBD in 2019	TBD in 2019
	T2	SS_56	BAMINGS CO	Mixed Shell	29.28	Yes	No	Yes	No	YES	TBD 2019	TBD in 2019	TBD in 2019

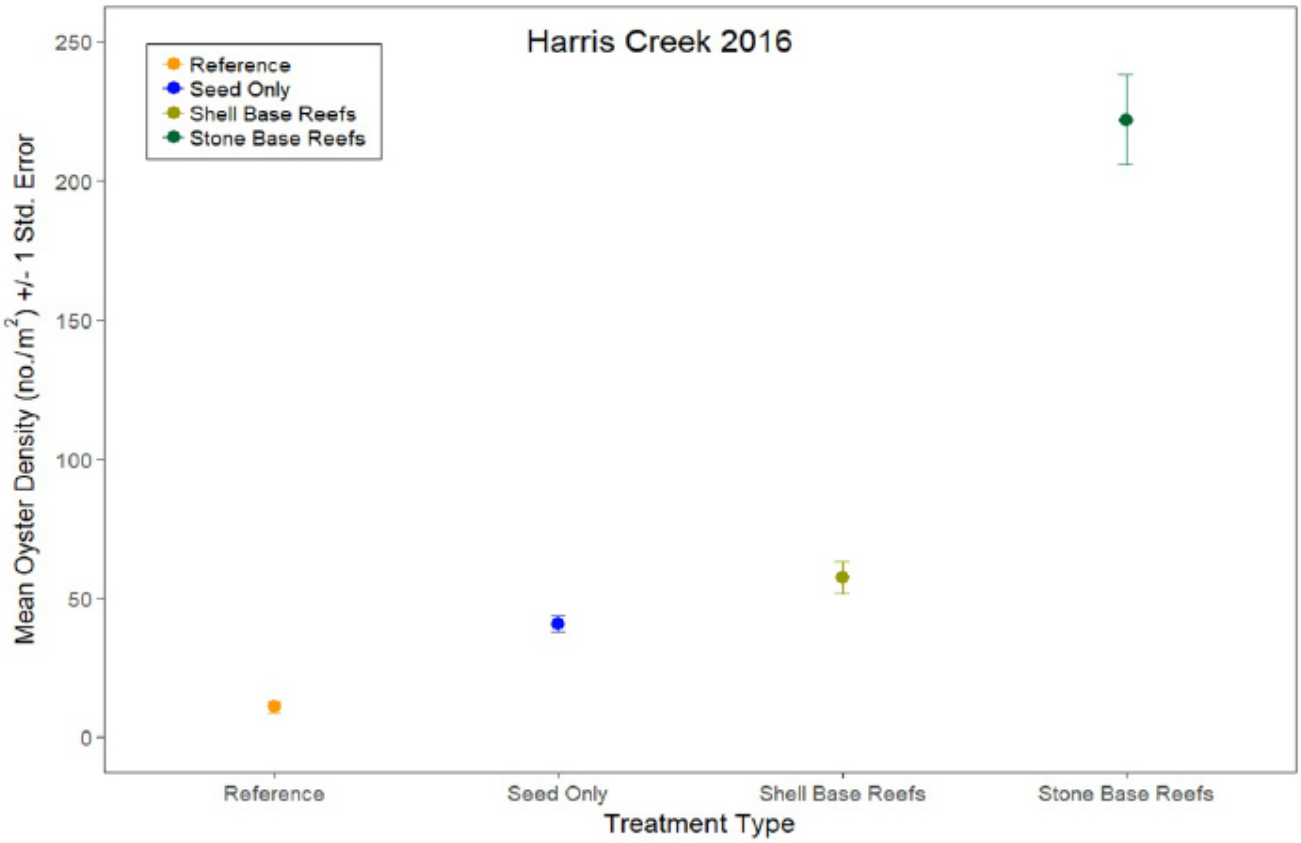
Additional patterns observed in monitoring include:

- The highest average oyster densities were found on stone base reefs, followed by shell-base reefs, then seed-only reefs, then reference reefs. (Figs. 3 and 7). Stone-base and shell-base reefs have similar reef heights (Table 4).
- The average oyster density on stone-base reefs was approximately four times higher than on shell-base reefs, and 22 times higher than control reefs (Fig. 3). Oyster density estimates differed significantly among treatments.
- A substantial quantity of the oysters found on stone-base reefs were attached to the pieces of stone base material rather than on shell. Because all hatchery-produced oysters planted on these reefs were set on shell, any oysters found on stone base material are the result of natural recruitment. Oysters found on shell could be either natural recruitment or hatchery-produced oysters. This suggests that stone is a suitable settlement substrate for juvenile oysters, and that oysters are setting on these reefs in sizable quantities (Fig. 8).

Although the information in the report looks promising for the eventual success of the Harris Creek project, several factors could affect continued success. These include future water-quality issues, oyster disease, funding, and poaching (illegal oyster harvesting).

Data and analysis in this report may be used by Maryland Interagency Oyster Restoration Workgroup partners to help inform what adaptive management measures, if any, should be taken on each of the '2013 cohort' reefs. It will also be used to guide restoration in other tributaries, notably the nearby Little Choptank and Tred Avon rivers.

Figure 3: Mean oyster density, by treatment type, for Harris Creek reefs monitored in 2016. *Orange point represents mean density on 4 reference reefs; blue point represents mean density on 7 seed-only reefs; light brown point represents mean density on 10 shell-base reefs; dark green point represents mean density on 13 stone-base reefs.*



Treatment type	Number of reefs with this treatment type	Number of samples collected	Mean oyster density (per m^2)	Standard deviation	Standard error
Reference	4	33	10.92	11.86	2.07
Seed Only	7	184	40.82	37.8	2.78
Shell-Base Reefs	10	67	57.38	46.45	5.67
Stone-Base Reefs	13	85	221.79	149.14	16.18

Section I: Introduction and Background

1.1 Policy Drivers, Oyster Metrics Success Criteria, and Oyster Restoration Planning

The 2014 Chesapeake Bay Watershed Agreement's oyster outcome calls for restoring oyster populations in 10 Chesapeake Bay tributaries by 2025. The Chesapeake Bay Program's Sustainable Fisheries Goal Implementation Team (Fisheries GIT) is charged with working to achieve this goal. Driven by Executive Order 13508 (Chesapeake Bay Protection and Restoration), some work toward tributary-scale oyster restoration was under way even before the Chesapeake Bay Watershed Agreement was signed in 2014. The Fisheries GIT previously convened the Chesapeake Bay Oyster Metrics Workgroup, which, in its 2011 report, Restoration Goals, Quantitative Metrics and Assessment Protocols for Evaluating Success on Restored Oyster Reef Sanctuaries[4] (hereafter, 'Oyster Metrics'), established Bay-wide, science-based, consensus success criteria for oyster restoration (Table 2).

Once those success criteria were adopted, the Fisheries GIT convened interagency workgroups in Maryland and Virginia to plan restoration work in each state, in consultation with appropriate partners. In Maryland, the Maryland Oyster Restoration Interagency Workgroup (hereafter, 'the Workgroup') is chaired by NOAA and includes members from the Maryland Department of Natural Resources (DNR), Oyster Recovery Partnership (ORP), and the U.S. Army Corps of Engineers' Baltimore District (USACE).

***Table 2: Oyster Metrics Success Criteria Adapted from* Restoration Goals, Quantitative Metrics and Assessment Protocols for Evaluating Success on Restored Oyster Reef Sanctuaries[4]**

Oyster density	Minimum threshold: 15 oysters per m^2 over 30% of the reef area Target: 50 oysters per m^2 over 30% of the reef area
Oyster biomass	Minimum threshold: 15 grams dry tissue weight per m^2 over 30% of the reef area Target: 50 grams dry tissue weight per m^2 over 30% of the reef area
Multiple year classes	Presence of multiple year classes on the reef
Shell budget	Stable or increasing shell budget on the reef
Reef footprint	Stable or increasing reef footprint compared to baseline
Reef height	Stable or increasing reef height compared to baseline

The first three Maryland tributaries selected for large-scale oyster restoration were Harris Creek, Little Choptank River, and Tred Avon River. These were selected primarily based upon their status as oyster sanctuaries (areas where harvest of oysters is not allowed) as established by DNR in 2010, historic and ongoing presence of oysters, and current-day water-quality and benthic habitat conditions suitable for oysters. The Workgroup has developed oyster restoration tributary plans for each river[1,2,3], in conference with a group of consulting scientists and the public. The first plan developed was the Harris Creek Oyster Restoration Tributary Plan[1] (hereafter, the Harris Creek Tributary Plan), and Harris Creek was the first to receive large-scale oyster restoration treatment. In September 2015, the last of 350 acres of planned reefs were seeded with oysters, completing initial in-water restoration work on the project. The Harris Creek Tributary Plan calls for a light second seeding on each reef four to five years postrestoration, depending on out-year oyster density, and to ensure the presence of multiple year classes. Table 4 shows the restoration treatment each reef in the 2013 cohort received.

1.2 Overview of Report Content

Consistent with the Harris Creek Tributary Plan and the Oyster Metrics success criteria, partners collaboratively monitor each restored oyster reef at three years and again at six years after restoration treatment. Over the course of four years (four cohorts), 350 acres of reefs were restored in Harris Creek. The '2012 cohort' (reefs treated in 2012) was monitored in 2015 (see report at https://chesapeakebay.noaa.gov/images/stories/habitats/hc3ydcheckinjuly2016.pdf)

The '2013 cohort' (reefs treated in 2013) was monitored in fall 2016. Data and analysis from the 30 reefs (90 acres) in the '2013 cohort' are provided in this report. The 2014 and 2015 cohorts will be monitored as they age to three years. Additional reefs were also monitored in fall 2016, including Harris Creek reference reefs and sentinel reefs in Harris Creek, Tred Avon River, and Little Choptank River (Table 1). Sentinel reefs are monitored annually. (See Definitions section at the beginning of this report.)

The 2013 cohort will be monitored again in fall 2019, per recommendations in the Oyster Metrics report and the Harris Creek Tributary Plan. Similarly, the remaining acres will be monitored as they mature to three years old, and again when they are six years old. At six years, a determination will be made whether each reef can be considered successfully restored, per the Oyster Metrics criteria.

1.3 Availability of Restoration Planning Data Related to This Report

Geographic Information System (GIS) data relevant to this report are available in the oyster restoration geodatabases for each tributary, http://www.habitat.noaa.gov/chesapeakebay/gis/Oyster_Restoration_Geodatabases/. In some cases, metadata or analyses are provided in the GIS geodatabases. These databases can be accessed using a GIS program, or by downloading the free and open-source QGIS program, http://www.qgis.org/en/site/.

Site_ID numbers were replaced with simpler reef numbers in this report for reader clarity. Site_ID numbers are consistent throughout the oyster restoration GIS geodatabases. Reef numbers in this report can be cross-referenced with Site_ID numbers in the geodatabase per Table 3.

1.4 Funding and Acknowledgements

Monitoring data for the biological success metrics (oyster density, oyster biomass, multiple year classes, and shell budget) were collected by the Paynter Labs at the University of Maryland, and by Versar, Inc., with funding from:

1. a $130,000 award from NOAA to ORP, via the National Fish and Wildlife Foundation (NFWF), and
2. a $127,096 programmatic agreement from USACE to ORP.

Monitoring data were managed by ORP, and data summaries and analysis were conducted by ORP, Paynter Labs at the University of Maryland, and Versar, Inc. Data for the reef structural metrics were collected and analyzed by the NOAA Chesapeake Bay Office. This report was drafted by NOAA, with guidance from the Maryland Interagency Oyster Restoration Workgroup. Results of this analysis will be used for adaptive management of these reefs, and to inform future oyster restoration efforts. Technical review of this report was provided by the Workgroup members, and by two additional technical reviewers, per NOAA research communications guidelines.

Section 2: Methods Summary

This section summarizes the data collection and analysis methods used in this report. For a full description of methods, see Appendix A: Methods for Data Collection and Analysis.

	Reef #	GIS Geodatabase Site_ID	Bar Name
2013 Harris Creek Monitoring Cohort	H18	AltSub_20A	LODGES
	H19	AltSub_20B	LODGES
	H20	AltSub_49A	TILGHMAN WRF
	H21	AltSub_57B	MILL POINT
	H22	AltSub_71A	CHANGE
	H23	AltSub_71B	CHANGE
	H24	AltSub_49B	TILGHMAN WRF
	H25	AltSub_57A	MILL POINT
	H26	AltSub_01	TILGHMAN WRF
	H27	AltSub_03	N/A
	H28	AltSub_25	LITTLE NECK
	H29	AltSub_29	UPPER HARRIS
	H30	AltSub_30	UPPER HARRIS
	H31	AltSub_31A	UPPER HARRIS
	H32	AltSub_54	CHANGE
	H33	AltSub_62	TILGHMAN WRF
	H34	AltSub_79	TILGHMAN WRF
	H35	AltSub_108	TILGHMAN WRF
	H36	AltSub_105	TILGHMAN WRF
	H37	AltSub_101	N/A
	H38	AltSub_102	N/A
	H39	AltSub_103	N/A
	H40	AltSub_107	CHANGE
	H41	Seed_04	N/A
	H42	Seed_07	CHANGE
	H43	Seed_11	HUNTS
	H44	Seed_59	MILL POINT
	H45	Seed_75	CHANGE
	H46	Seed_13A	MILL POINT
	H47	Seed_13B	MILL POINT
Harris Sentinel Reefs	H1	AltSub_104	CHANGE
	H10	TREATMENT_3	LITTLE NECK
	H11	TREATMENT_4	LODGES
	H13	EXCEDES_GOAL	MILL POINT
Harris Reference Reefs	H14	CONTROL_1	EAGLE POINT
	H15	CONTROL_3	RABBIT ISLAND
	H16	CONTROL_4	RABBIT ISLAND
	H17	CONTROL_2	MILL POINT
Lt. Chptk Sentinel Reefs	L1	SO_17	LITTLE POLLARD
	L2	SS_02	SUSQUEHANNA
Tred Avon Sentinel Reefs	T1	SS_44	N/A
	T2	SS_56	BAMINGS COVE

Table 3: Reef numbers to GIS geodatabase Site_ ID cross reference list

2.1 Biological Metrics Methods (oyster density, oyster biomass, multiple year classes, and shell budget)

Data to determine success relative to the four biological metrics were collected at the same time, using a systematic survey design (a systematic cluster design). A sampling grid was developed in GIS, and superimposed over a GIS layer of constructed oyster reefs. All reefs were sampled using a 25 X 25m, 50 x 50m, or 100 X 100m grid. Hydraulic patent-tongs were used to sample on seed-only reefs, and on mixed-shell-base reefs. Divers were used to sample on stone-base reefs. It is possible that there are some differences in sampling efficiency between samples collected using divers and those collected using patent tongs. However, previous field comparisons (Chai et al. 1992) on natural oyster reefs revealed no difference in sampling efficiency between oyster densities estimated using divers and those estimated using patent tongs. Therefore, for this report, the differences were assumed to be minimal. See Appendix A for full description of methods.

2.2 Structural Metrics Methods (reef height, reef footprint)

Staff from the NOAA Chesapeake Bay Office conducted multibeam bathymetric (depth) surveys following the construction of substrate and seed reefs, and again three years post restoration (fall 2016). Results were compared to determine persistence of reef height and footprint. See Appendix A for full description of methods.

2.3 Diagnostic Monitoring

In addition to monitoring to determine if reefs met the Oyster Metrics success criteria, information was also collected to aid in diagnosing why reefs may have succeeded or failed. These are primarily water-quality data and oyster disease data. With funding from The Nature Conservancy, DNR monitored three water-quality stations on Harris Creek (mddnr.chesapeakebay.net/eyesonthebay). Salinity and dissolved oxygen were suitable for oysters throughout 2016. Disease data will be available when DNR publishes its 2016 Fall Survey Report.

2.4 Location of Monitored Reefs

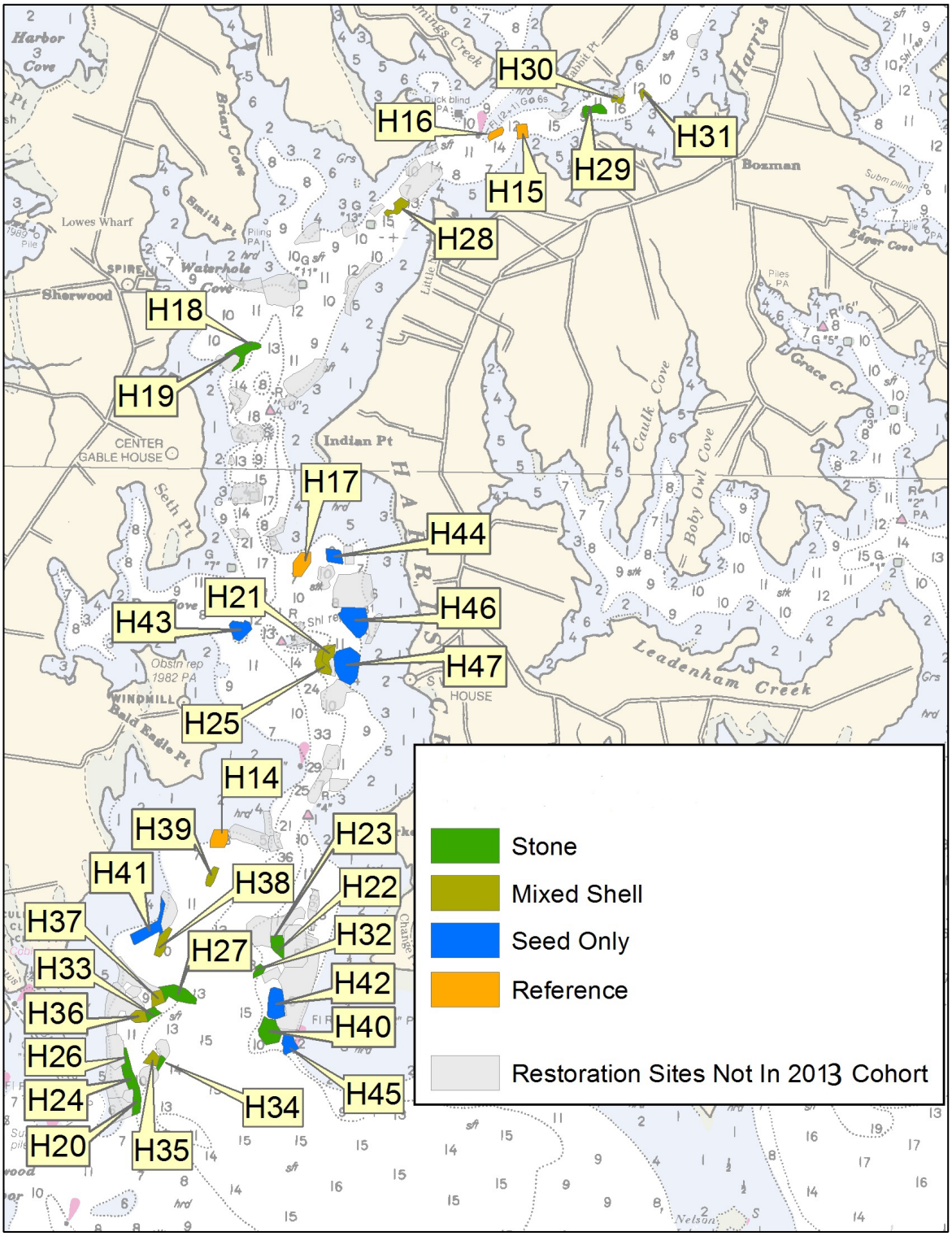


Figure 4: Location and reef number for each reef monitored in Harris Creek in 2016.

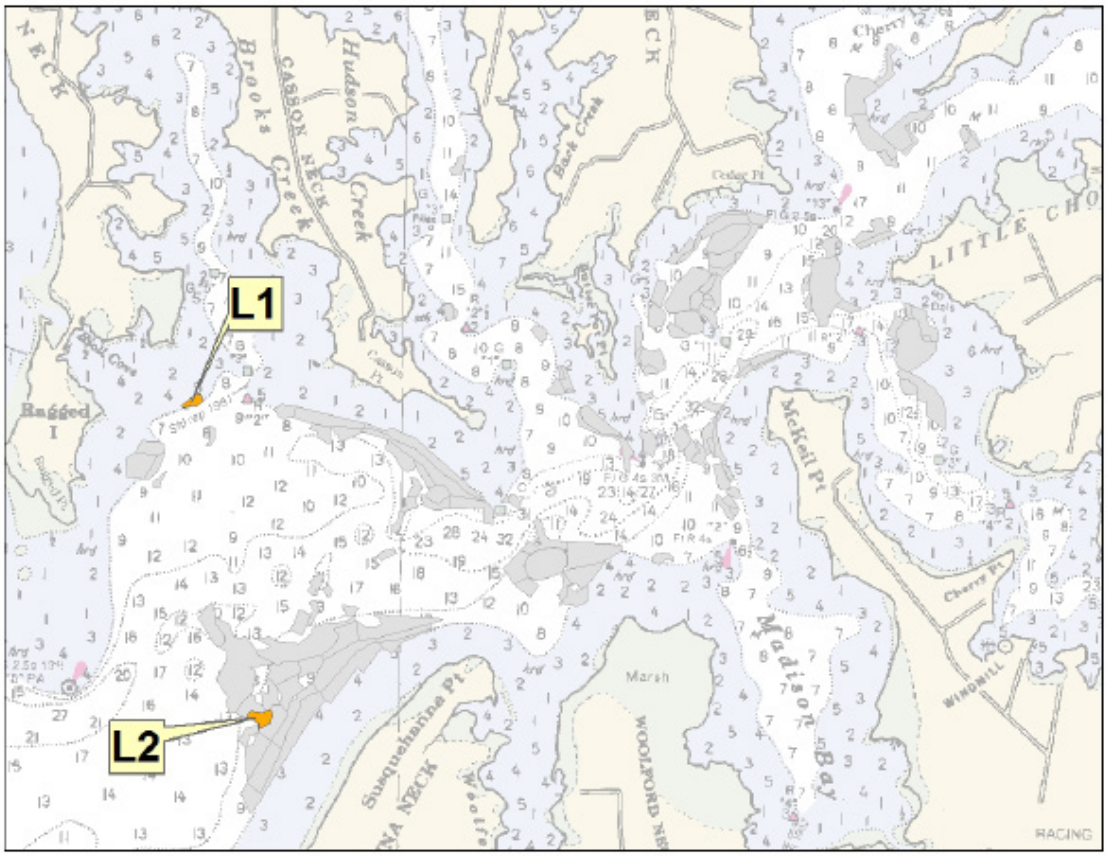


Figure 5: Location and reef number for each reef monitored in Little Choptank River in 2016.

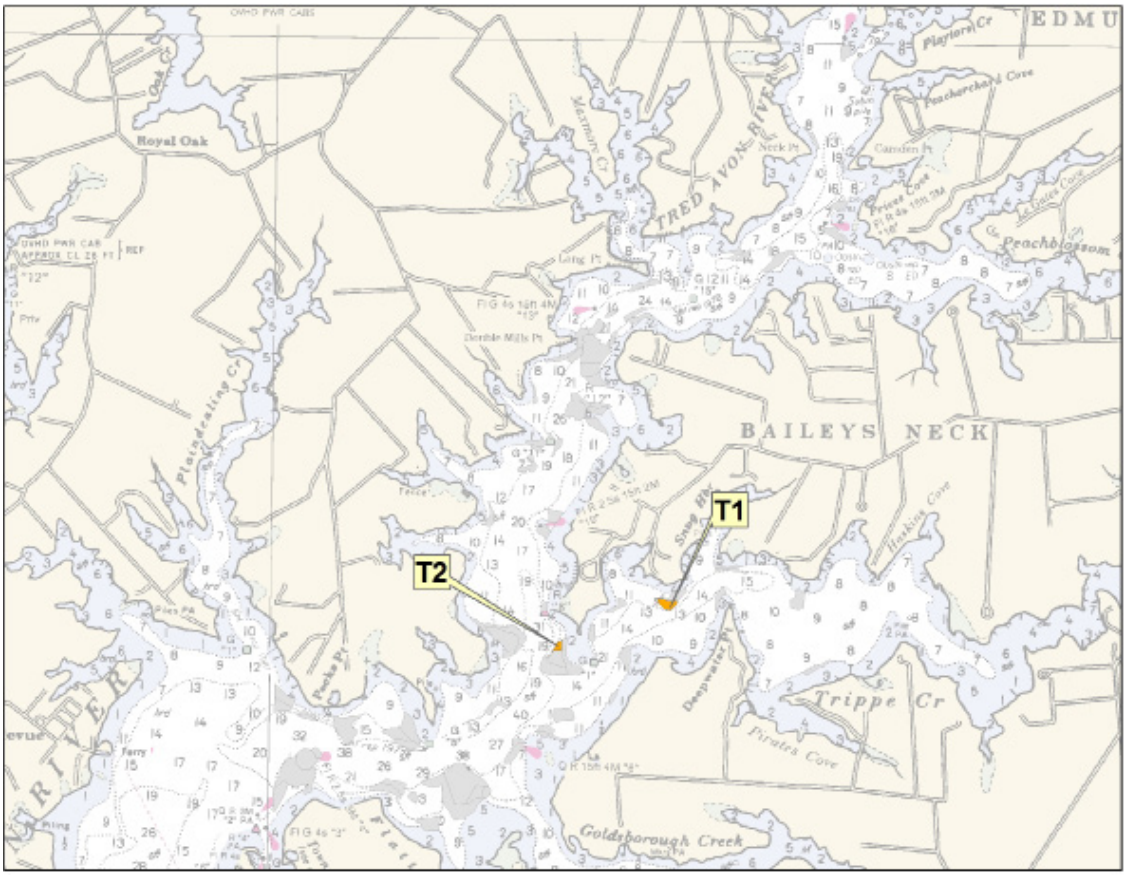


Figure 6: Location and reef number for each reef monitored in Tred Avon River in 2016.

Section 3: Results

Monitoring results for 2016 are shown below. To see all information for each specific reef, including sonar images and graphs of summarized data, see Appendix B: Reef Pages.

3.1 Harris Creek Results

Table 1 in the Executive Summary shows how each Harris Creek reef monitored in 2016 fared against the Oyster Metrics criteria (oyster density, oyster biomass, presence of multiple year classes, shell budget, reef footprint, reef height). Tables 4 through 9 in Section 3.1.4 show results in tabular form.

3.1.1 Summary of Harris Creek 2013 Cohort Results

Oyster Density Metric (Table 6)

Of the 30 reefs in the 2013 cohort:

- 29 reefs (97%) met the minimum threshold oyster density criteria for a successfully restored reef.
- 25 reefs (83%) met the higher, target oyster density criteria.
- One reef (3%) failed to meet even the minimum threshold oyster density. This was reef H45.
- Prior to restoration, none of the reefs in the 2013 cohort met the minimum threshold oyster density.

Oyster Biomass Metric (Table 7)

Oyster biomass generally tracked closely with oyster density.

Of the 30 reefs in the 2013 cohort:

- 29 reefs (97%) met the minimum threshold oyster biomass criteria for a successfully restored reef.
- 26 of the 30 reefs (87%) met the higher target criteria.
- One reef (3%) failed to meet even the minimum threshold for oyster biomass (Reef H45).

Multiple Year Class Metric (see Table 8)

- All 30 reefs in the 2013 cohort (100%) had multiple year classes present, as defined by the presence of oysters in at least two of the following size classes: market (>76 mm); small (40-75 mm); spat (<40 mm). These reefs thereby met the Oyster Metrics success criterion.

Shell Budget Metric (see Table 8)

- It is not yet possible to determine whether the 2013 cohort reefs meet the success criterion for shell budget (see Appendix A, Section A.2, for full explanation). The shell budget data collected in fall 2016 will be compared to data collected in fall 2019 to determine success against this metric at that time.

Reef Footprint Metric (see Table 8)

- Six reefs in the 2013 cohort had no baseline structural data collected. It is not possible, at this time, to determine success of these reefs against the reef footprint criteria. For these six reefs, fall 2016 data will be compared to fall 2019 data to determine success against these criteria at that time (see Appendix A, Section A.2, for full explanation). In addition, one reef (H18), had no structural data collected in 2016.
- Of the 23 reefs in the 2013 cohort for which baseline data and 2016 data were collected, all 23 (100%) met the Oyster Metric criterion for a stable/increasing reef footprint.

Reef Height Metric (see Table 8)

- Six reefs in the 2013 cohort had no baseline structural data collected. It is not possible, at this time, to determine success of these reefs against the reef height criteria. Fall 2016 data will be compared to fall 2019 data to determine success against these criteria at that time (see Appendix A, Section A.2, for full explanation). In addition, one reef (H18), had no structural data collected in 2016.
- Of the 23 reefs in the 2013 cohort for which baseline and 2016 data was collected in 2016, all 23 (100%) met the Oyster Metrics criterion for stable or increasing reef height.

3.1.2 Summary of Harris Creek Reference Reefs Results (see Tables 4 through 9)

Of the four reference reefs (H14, H15, H16, H17) monitored in fall 2016:

- Two reefs (50%) met the minimum threshold oyster density and biomass success criterion.
- None met the higher, target oyster biomass success criterion.

3.1.3 Summary of Harris Creek Sentinel Reefs Results (see Tables 4 through 9)

Oyster density trends are inconsistent across sentinel reefs. See Appendix B: Reef Pages, specifically pages for sentinel reefs H1, H10, H11, and H13, for graphs of oyster density trends across years.

3.1.4 Tables of Harris Creek Results

Table 4: Restoration treatment information for Harris Creek reefs monitored in 2016

**Ave planned reef height: The amount of reef-building material placed onto a reef was calculated by multiplying the desired average reef height (ex: 6"; 12 ") by the reef area. The actual height of the reef varied across the reef.*

Criteria

Reefs

	Reef #	Geo-database Site_ID	Bar Name	Reef area (acres)	Restoration treatment	Substrate type added	Ave planned reef height* (inches)	Year planted with spat	Spat produced by	Spat planted by	Spat planted (millions)	Spat planted per acre (millions)
2013 Harris Creek Monitoring Cohort	H18	AltSub_20A	LODGES	2.35	Substrate & Seed	Stone	12	2013	UMD	ORP	16.47	7.01
	H19	AltSub_20B	LODGES	2.02	Substrate & Seed	Stone	12	2013	UMD	ORP	14.18	7.01
	H20	AltSub_49A	TILGHMAN WRF	2.52	Substrate & Seed	Stone	12	2013	UMD	ORP	16.17	6.40
	H21	AltSub_57B	MILL POINT	2.01	Substrate & Seed	Mixed shell	12	2013	UMD	ORP	14.23	7.07
	H22	AltSub_71A	CHANGE	1.11	Substrate & Seed	Stone	12	2013	UMD	ORP	10.66	9.58
	H23	AltSub_71B	CHANGE	1.82	Substrate & Seed	Stone	12	2013	UMD	ORP	17.40	9.58
	H24	AltSub_49B	TILGHMAN WRF	2.52	Substrate & Seed	Stone	12	2013	UMD	ORP	16.47	6.40
	H25	AltSub_57A	MILL POINT	3.13	Substrate & Seed	Mixed shell	12	2013	UMD	ORP	13.61	4.34
	H26	AltSub_01	TILGHMAN WRF	1.43	Substrate & Seed	Stone	12	2013	UMD	ORP	9.15	6.40
	H27	AltSub_03	N/A	5.33	Substrate & Seed	Stone	6	2013	UMD	ORP	44.01	8.26
	H28	AltSub_25	LITTLE NECK	2.46	Substrate & Seed	Mixed shell	12	2013	UMD	ORP	23.41	9.51
	H29	AltSub_29	UPPER HARRIS	2.71	Substrate & Seed	Stone	12	2013	UMD	ORP	27.92	10.30
	H30	AltSub_30	UPPER HARRIS	0.97	Substrate & Seed	Mixed shell	12	2013	UMD	ORP	15.06	15.57
	H31	AltSub_31A	UPPER HARRIS	0.73	Substrate & Seed	Mixed shell	12	2013	UMD	ORP	32.81	44.70
	H32	AltSub_54	CHANGE	1.28	Substrate & Seed	Stone	12	2013	UMD	ORP	17.02	13.26
	H33	AltSub_62	TILGHMAN WRF	1.58	Substrate & Seed	Stone	12	2013	UMD	ORP	8.38	5.28
	H34	AltSub_79	TILGHMAN WRF	0.81	Substrate & Seed	Stone	12	2013	UMD	ORP	8.81	10.86
	H35	AltSub_108	TILGHMAN WRF	1.82	Substrate & Seed	Mixed shell	12	2013	UMD	ORP	19.72	10.86
	H36	AltSub_105	TILGHMAN WRF	2.06	Substrate & Seed	Mixed shell	12	2013	UMD	ORP	10.89	5.28
	H37	AltSub_101	N/A	2.10	Substrate & Seed	Mixed shell	12	2013	UMD	ORP	17.35	8.26
	H38	AltSub_102	N/A	2.91	Substrate & Seed	Mixed shell	6	2013	UMD	ORP	27.16	9.34
	H39	AltSub_103	N/A	1.79	Substrate & Seed	Mixed shell	12	2013	UMD	ORP	25.47	14.21
	H40	AltSub_107	CHANGE	5.72	Substrate & Seed	Stone	6	2013	UMD	ORP	42.09	7.35
	H41	Seed_04	N/A	5.49	Seed Only	None (spat on shell only)	N/A	2013, 2014	CBF	CBF	20.7	3.77
	H42	Seed_07	CHANGE	5.63	Seed Only	None (spat on shell only)	N/A	2013	UMD	ORP	49.58	8.80
	H43	Seed_11	HUNTS	4.52	Seed Only	None (spat on shell only)	N/A	2013	UMD	ORP	19.1	4.22
	H44	Seed_59	MILL POINT	2.58	Seed Only	None (spat on shell only)	N/A	2013	UMD	ORP	16.42	6.35
	H45	Seed_75	CHANGE	3.08	Seed Only	None (spat on shell only)	N/A	2013	UMD	ORP	52.51	17.03
	H46	Seed_13A	MILL POINT	7.95	Seed Only	None (spat on shell only)	N/A	2013	UMD	ORP	46	5.79
	H47	Seed_13B	MILL POINT	9.21	Seed Only	None (spat on shell only)	N/A	2013	UMD	ORP	40.85	4.44
Harris Sentinel Reefs	H1	AltSub_104	CHANGE	3.37	Substrate & Seed	Mixed shell	12	2012	UMD	ORP	31.27	9.28
	H10	TREATMENT_3	LITTLE NECK	10.88	Seed Only	None (spat on shell only)	N/A	2012	UMD	ORP	52.09	4.78
	H11	TREATMENT_4	LODGES	6.53	Seed Only	None (spat on shell only)	N/A	2012	UMD	ORP	28.19	4.32
	H13	EXCEDES_GOAL_2012	MILL POINT	3.40	Seed Only	None (spat on shell only)	N/A	2011	UMD	ORP	51.76	15.22
Harris Reference Reefs	H14	CONTROL_1	EAGLE POINT	3.47	None (reference reef)	None (reference reef)	N/A	N/A	N/A	N/A	0	0
	H15	CONTROL_3	RABBIT ISLAND	1.85	None (reference reef)	None (reference reef)	N/A	N/A	N/A	N/A	0	0
	H16	CONTROL_4	RABBIT ISLAND	1.39	None (reference reef)	None (reference reef)	N/A	N/A	N/A	N/A	0	0
	H17	CONTROL_2	MILL POINT	4.01	None (reference reef)	None (reference reef)	N/A	N/A	N/A	N/A	0	0

Table 5: Data collection information for Harris Creek reefs monitored in 2016

Criteria

	Reef #	Geo-database Site_ID	Monitoring type	Sample Method	Most recent sample date	# samples taken	# live oysters measured	# live oysters counted	# dead oysters counted	% dead oysters observed on reef
Reefs: 2013 Harris Creek Monitoring Cohort	H18	AltSub_20A	Three year/ sentinel	Diver	02-Nov-16	7	347	533	40	6.98%
	H19	AltSub_20B	Three year	Diver	02-Nov-16	7	219	488	31	5.97%
	H20	AltSub_49A	Three year	Diver	02-Nov-16	8	310	756	58	7.13%
	H21	AltSub_57B	Three year	Patent Tong	01-Nov-16	6	204	972	104	9.67%
	H22	AltSub_71A	Three year	Diver	18-Nov-16	4	144	450	29	6.05%
	H23	AltSub_71B	Three year	Diver	03-Nov-16	7	302	791	70	8.13%
	H24	AltSub_49B	Three year	Diver	02-Nov-16	8	224	695	40	5.44%
	H25	AltSub_57A	Three year	Patent Tong	16-Nov-16	11	337	1220	188	13.35%
	H26	AltSub_01	Three year	Diver	13-Oct-16	6	193	390	43	9.93%
	H27	AltSub_03	Three year	Diver	17-Oct-16	8	287	679	134	16.48%
	H28	AltSub_25	Three year	Patent Tong	17-Nov-16	8	191	387	44	10.21%
	H29	AltSub_29	Three year	Diver	03-Nov-16	9	491	1488	120	7.46%
	H30	AltSub_30	Three year	Patent Tong	17-Nov-16	6	164	516	24	4.44%
	H31	AltSub_31A	Three year	Patent Tong	17-Nov-16	5	171	1043	27	2.52%
	H32	AltSub_54	Three year	Diver	18-Nov-16	5	274	933	94	9.15%
	H33	AltSub_62	Three year	Diver	18-Nov-16	6	242	550	44	7.41%
	H34	AltSub_79	Three year	Diver	03-Nov-16	5	215	672	90	11.81%
	H35	AltSub_108	Three year	Patent Tong	01-Nov-16	4	128	408	54	11.69%
	H36	AltSub_105	Three year	Patent Tong	02-Nov-16	6	190	501	66	11.64%
	H37	AltSub_101	Three year	Patent Tong	16-Nov-16	6	202	550	30	5.17%
	H38	AltSub_102	Three year	Patent Tong	18-Nov-16	9	238	476	71	12.98%
	H39	AltSub_103	Three year	Patent Tong	18-Nov-16	6	117	117	10	7.87%
	H40	AltSub_107	Three year	Diver	02-Nov-16	5	324	970	99	9.26%
	H41	Seed_04	Three year	Patent Tong	02-Nov-16	16	488	1230	142	10.35%
	H42	Seed_07	Three year	Patent Tong	01-Nov-16	14	409	943	97	9.33%
	H43	Seed_11	Three year	Patent Tong	17-Nov-16	9	197	628	78	11.05%
	H44	Seed_59	Three year	Patent Tong	16-Nov-16	8	232	555	54	8.87%
	H45	Seed_75	Three year	Patent Tong	01-Nov-16	10	49	49	11	18.33%
	H46	Seed_13A	Three year	Patent Tong	17-Nov-16	20	504	807	90	10.03%
	H47	Seed_13B	Three year	Patent Tong	17-Nov-16	22	550	1802	338	15.79%
Harris Sentinel Reefs	H1	AltSub_104	Three Year/ sentinel	Patent Tong	16-Nov-16	11	331	767	127	14.21%
	H10	TREATMENT_3	Sentinel	Patent Tong	18-Nov-16	11	337	1245	155	11.07%
	H11	TREATMENT_4	Sentinel	Patent Tong	17-Nov-16	16	370	715	173	19.48%
	H13	EXCEDES_GOAL_2012	Sentinel	Patent Tong	17-Nov-16	10	295	507	82	13.92%
Harris Reference Reefs	H14	CONTROL_1	Reference	Patent Tong	28-Nov-16	11	254	324	86	20.98%
	H15	CONTROL_3	Reference	Patent Tong	28-Nov-16	6	55	56	5	8.20%
	H16	CONTROL_4	Reference	Patent Tong	18-Nov-16	5	54	54	7	11.48%
	H17	CONTROL_2	Reference	Patent Tong	28-Nov-16	11	106	146	17	10.43%

Table 6: Oyster density information for Harris Creek reefs monitored in 2016

**The Oyster Metrics success criteria for oyster density are:*

- *minimum threshold = 15 oysters per m^2 over 30% of the reef area*
- *target = 50 oysters per m^2 over 30% of the reef area*

Criteria

Reefs

	Reef #	Geo-database Site_ID	Ave. live density across reef (#/ m2)	Standard error of live density (#/ m2)	**Fall 2016: Did reef meet minimum threshold* density?**	Reef area meeting minimum threshold* density (%)	Fall 2016: Did reef meet target* density?	Reef area meeting target* density (%)	Pre restoration (2012): Did reef meet minimum threshold* density?	Pre restoration (2012): Did reef meet target* density?
2013 Harris Creek Monitoring Cohort	H18	AltSub_20A	152.29	26.51	**Yes**	100%	Yes	100%	No	No
	H19	AltSub_20B	139.43	25.66	**Yes**	100%	Yes	100%	No	No
	H20	AltSub_49A	189.00	47.41	**Yes**	100%	Yes	85%	No	No
	H21	AltSub_57B	100.62	24.77	**Yes**	82%	Yes	82%	No	No
	H22	AltSub_71A	225.00	56.45	**Yes**	100%	Yes	100%	No	No
	H23	AltSub_71B	226.00	18.99	**Yes**	100%	Yes	100%	No	No
	H24	AltSub_49B	173.75	78.66	**Yes**	94%	Yes	75%	No	No
	H25	AltSub_57A	68.89	9.35	**Yes**	97%	Yes	81%	No	No
	H26	AltSub_01	130.00	42.73	**Yes**	100%	Yes	100%	No	No
	H27	AltSub_03	169.75	25.14	**Yes**	100%	Yes	98%	No	No
	H28	AltSub_25	30.05	9.08	**Yes**	86%	Yes	40%	No	No
	H29	AltSub_29	330.67	42.80	**Yes**	100%	Yes	100%	No	No
	H30	AltSub_30	53.42	16.87	**Yes**	84%	Yes	51%	No	No
	H31	AltSub_31A	129.57	33.56	**Yes**	100%	Yes	89%	No	No
	H32	AltSub_54	373.20	69.31	**Yes**	100%	Yes	100%	No	No
	H33	AltSub_62	183.33	54.93	**Yes**	100%	Yes	92%	No	No
	H34	AltSub_79	268.80	80.85	**Yes**	100%	Yes	100%	No	No
	H35	AltSub_108	63.35	8.44	**Yes**	100%	Yes	76%	No	No
	H36	AltSub_105	51.86	7.13	**Yes**	100%	Yes	55%	No	No
	H37	AltSub_101	56.94	16.54	**Yes**	94%	Yes	53%	No	No
	H38	AltSub_102	32.85	8.18	**Yes**	81%	No	---	No	No
	H39	AltSub_103	12.11	3.89	**Yes**	62%	No	---	No	No
	H40	AltSub_107	388.00	96.69	**Yes**	100%	Yes	100%	No	No
	H41	Seed_04	47.75	7.42	**Yes**	89%	Yes	49%	No	No
	H42	Seed_07	41.84	10.88	**Yes**	88%	No	---	No	No
	H43	Seed_11	43.34	17.78	**Yes**	54%	Yes	36%	No	No
	H44	Seed_59	43.09	8.38	**Yes**	94%	Yes	39%	No	No
	H45	Seed_75	3.04	0.98	**No**	-	No	---	No	No
	H46	Seed_13A	25.06	4.37	**Yes**	76%	No	---	No	No
	H47	Seed_13B	50.88	11.79	**Yes**	85%	Yes	44%	No	No
Harris Sentinel Reefs	H1	AltSub_104	43.31	6.86	**Yes**	95%	Yes	48%	No	No
	H10	TREATMENT_3	70.30	12.35	**Yes**	78%	Yes	65%	No	No
	H11	TREATMENT_4	27.76	5.94	**Yes**	68%	No	---	No	No
	H13	EXCEDES_GOAL_2012	31.49	5.81	**Yes**	88%	Yes	52%	No	No
Harris Reference Reefs	H14	CONTROL_1	18.29	3.99	**Yes**	85%	No	---	No	No
	H15	CONTROL_3	5.80	3.76	**Yes**	35%	No	---	No	No
	H16	CONTROL_4	6.71	3.63	**No**	-	No	---	No	No
	H17	CONTROL_2	8.24	3.22	**No**	-	No	---	No	No

Table 7: Oyster biomass information for Harris Creek reefs monitored in 2016

**The Oyster Metrics success criteria for oyster biomass are:*

- *minimum threshold = 15 grams dry weight per m^2 over 30% of the reef area*
- *target = 50 grams dry weight per m^2 over 30% of the reef area*

Criteria

	Reef #	Geo-database Site_ID	Ave. live biomass across reef (g dry weight per m2)	Standard error of live biomass	**Did reef meet minimum threshold* oyster biomass?**	Reef area meeting minimum threshold* biomass (%)	Did reef meet target oyster biomass?	Reef area meeting target biomass (%)
Reefs 2013 Harris Creek Monitoring Cohort	H18	AltSub_20A	120.32	28.73	**Yes**	100%	Yes	100%
	H19	AltSub_20B	95.48	16.71	**Yes**	100%	Yes	81%
	H20	AltSub_49A	162.64	41.21	**Yes**	100%	Yes	86%
	H21	AltSub_57B	137.44	35.49	**Yes**	82%	Yes	82%
	H22	AltSub_71A	179.71	47.86	**Yes**	100%	Yes	100%
	H23	AltSub_71B	188.69	25.27	**Yes**	100%	Yes	100%
	H24	AltSub_49B	115.28	35.62	**Yes**	94%	Yes	70%
	H25	AltSub_57A	109.40	17.26	**Yes**	97%	Yes	97%
	H26	AltSub_01	129.21	43.64	**Yes**	100%	Yes	100%
	H27	AltSub_03	177.58	30.16	**Yes**	100%	Yes	98%
	H28	AltSub_25	32.95	11.15	**Yes**	65%	Yes	40%
	H29	AltSub_29	220.22	32.83	**Yes**	100%	Yes	100%
	H30	AltSub_30	51.11	16.61	**Yes**	84%	Yes	51%
	H31	AltSub_31A	88.39	19.06	**Yes**	100%	Yes	89%
	H32	AltSub_54	415.29	94.94	**Yes**	100%	Yes	100%
	H33	AltSub_62	168.98	50.74	**Yes**	100%	Yes	86%
	H34	AltSub_79	267.29	100.57	**Yes**	100%	Yes	100%
	H35	AltSub_108	92.01	15.30	**Yes**	100%	Yes	100%
	H36	AltSub_105	77.74	13.58	**Yes**	100%	Yes	86%
	H37	AltSub_101	64.32	22.40	**Yes**	94%	Yes	81%
	H38	AltSub_102	44.00	12.98	**Yes**	81%	Yes	32%
	H39	AltSub_103	13.57	4.65	**Yes**	42%	No	---
	H40	AltSub_107	348.71	77.49	**Yes**	100%	Yes	100%
	H41	Seed_04	57.48	9.78	**Yes**	89%	Yes	52%
	H42	Seed_07	57.66	15.88	**Yes**	83%	Yes	47%
	H43	Seed_11	52.52	20.39	**Yes**	59%	Yes	45%
	H44	Seed_59	38.50	8.86	**Yes**	87%	No	---
	H45	Seed_75	4.33	1.76	**No**	---	No	---
	H46	Seed_13A	26.89	5.53	**Yes**	54%	No	---
	H47	Seed_13B	59.35	14.23	**Yes**	85%	Yes	43%
Harris Sentinel Reefs	H1	AltSub_104	67.91	13.50	**Yes**	95%	Yes	54%
	H10	TREATMENT_3	62.04	10.52	**Yes**	99%	Yes	65%
	H11	TREATMENT_4	36.30	8.98	**Yes**	74%	Yes	31%
	H13	EXCEDES_GOAL_2012	30.48	6.48	**Yes**	82%	Yes	37%
Harris Reference Reefs	H14	CONTROL_1	29.66	6.22	**Yes**	89%	No	---
	H15	CONTROL_3	5.71	4.13	**Yes**	35%	No	---
	H16	CONTROL_4	9.50	4.93	**No**	---	No	---
	H17	CONTROL_2	7.76	3.11	**No**	---	No	---

Table 8: Information on multiple year classes, shell volume, reef height, and reef footprint for Harris Creek reefs monitored in 2016

Criteria

Reefs

	Reef #	Geo-database Site_ID	Are multiple year classes present ?	Is shell volume stable/ increasing?	shell volume across entire reef (liters per m2)	Standard error of shell volume	Total shell volume (liters)	Total surface shell volume (liters)	Ave brown shell across all samples (%)	Is the reef height stable/ increasing?	Is the reef footprint stable/ increasing?
2013 Harris Creek Monitoring Cohort	H18	AltSub_20A	YES	TBD 2019	11.86	5.25	111622.2	23121.74	79.29	YES in 2015; no data in 2016	YES in 2015; no data in 2016
	H19	AltSub_20B	YES	TBD 2019	6.71	2.54	51257.82	2929.02	94.29	YES	YES
	H20	AltSub_49A	YES	TBD 2019	15.38	5.67	157028.4	8832.85	94.38	YES	YES
	H21	AltSub_57B	YES	TBD 2019	21.07	5.17	166385.5	101217.8	39.17	YES	YES
	H22	AltSub_71A	YES	TBD 2019	17.5	12.11	78466.37	3923.32	95	YES	YES
	H23	AltSub_71B	YES	TBD 2019	20.29	6.05	145585.8	14558.57	90	YES	YES
	H24	AltSub_49B	YES	TBD 2019	16.25	6.33	165617.1	33537.46	79.75	YES	YES
	H25	AltSub_57A	YES	TBD 2019	17	2.12	212307.9	79132.92	62.73	YES	YES
	H26	AltSub_01	YES	TBD 2019	14	6.99	78256.96	5869.27	92.5	YES	YES
	H27	AltSub_03	YES	TBD 2019	36.75	8.84	789672.1	148063.5	81.25	YES	YES
	H28	AltSub_25	YES	TBD 2019	8.27	2.23	80305.88	49187.35	38.75	YES	YES
	H29	AltSub_29	YES	TBD 2019	20.44	5.32	208310.2	19673.74	90.56	YES	YES
	H30	AltSub_30	YES	TBD 2019	13.3	2.25	40317.49	17470.91	56.67	YES	YES
	H31	AltSub_31A	YES	TBD 2019	20.5	3.88	47223	11333.52	76	YES	YES
	H32	AltSub_54	YES	TBD 2019	59.6	13.81	300830.3	66182.67	78	YES	YES
	H33	AltSub_62	YES	TBD 2019	10.33	4.22	66081.66	4956.12	92.5	YES	YES
	H34	AltSub_79	YES	TBD 2019	38.6	16.55	94549.59	17018.93	82	YES	YES
	H35	AltSub_108	YES	TBD 2019	13.82	1.61	93662.51	24586.41	73.75	YES	YES
	H36	AltSub_105	YES	TBD 2019	14.6	1.36	120533.3	34151.1	71.67	YES	YES
	H37	AltSub_101	YES	TBD 2019	13.46	2.28	114296.3	59053.06	48.33	YES	YES
	H38	AltSub_102	YES	TBD 2019	10.46	2.07	120961.9	63169	47.78	YES	YES
	H39	AltSub_103	YES	TBD 2019	8.18	2.09	57188.78	41461.86	27.5	YES	YES
	H40	AltSub_107	YES	TBD 2019	36.8	15.86	832775.8	141571.9	83	YES	YES
	H41	Seed_04	YES	TBD 2019	13.43	1.84	296182.4	137909.9	53.44	TBD 2019	TBD 2019
	H42	Seed_07	YES	TBD 2019	10.09	1.8	227487	74745.71	67.14	TBD 2019	TBD 2019
	H43	Seed_11	YES	TBD 2019	11.73	3.72	176041	99023.05	43.75	TBD 2019	TBD 2019
	H44	Seed_59	YES	TBD 2019	11.1	1.88	114701	74555.65	35	YES	YES
	H45	Seed_75	YES	TBD 2019	1.21	0.39	15067.89	6629.87	56	TBD 2019	TBD 2019
	H46	Seed_13A	YES	TBD 2019	9.3	1.11	296096.2	194107.5	34.44	TBD 2019	TBD 2019
	H47	Seed_13B	YES	TBD 2019	13.5	2.54	498958.4	202078.1	59.5	TBD 2019	TBD 2019
Harris Sentinel Reefs	H1	AltSub_104	YES	TBD 2019	11.91	2.02	160847.8	48546.8	69.82	NO	YES
	H10	TREATMENT_3	YES	TBD 2019	14.34	1.77	631710.6	241198.6	61.82	TBD 2018	TBD 2018
	H11	TREATMENT_4	YES	TBD 2019	9.67	1.72	249036.9	106730.1	57.14	TBD 2018	TBD 2018
	H13	EXCEDES_GOAL_2012	YES	TBD 2019	10.34	1.59	139579.8	86958.22	37.7	TBD 2018	TBD 2018
Harris Reference Reefs	H14	CONTROL_1	YES	TBD 2019	8.95	1.28	124839.7	66392.01	46.82	TBD 2018	TBD 2018
	H15	CONTROL_3	YES	TBD 2019	3.16	1.91	22793.61	12536.49	45	TBD 2018	TBD 2018
	H16	CONTROL_4	YES	TBD 2019	3.88	1.25	21074.73	18703.82	11.25	TBD 2018	TBD 2018
	H17	CONTROL_2	YES	TBD 2019	4.36	1.29	70381.94	47667.77	32.27	TBD 2018	TBD 2018

Table 9: Average oyster densities found on stone substrate (natural recruited oysters) and on shell substrate (hatchery spat-on-shell or naturally recruited oysters) for Harris Creek reefs with a stone base monitored in 2016 (Fig. 8)
**Average planned reef height: The amount of reef-building material placed onto a reef was calculated by multiplying the desired reef height (ex: 6"; 12") by the reef area. The actual height of the reef varied across the reef.*

Criteria

Reefs

Reef #	Geodatabase Site_ID	Restoration treatment	Substrate type added	Ave planned reef height* (inches)	Ave live density on stone (#/m²)	Standard error of live density on stone	Ave live density on shell(#/m²)	Standard error of live density on shell
H18	AltSub_20A	Substrate & Seed	Stone	12	74.29	22.28	78.00	28.81
H19	AltSub_20B	Substrate & Seed	Stone	12	84.86	13.32	50.57	22.08
H20	AltSub_49A	Substrate & Seed	Stone	12	98.75	30.14	90.25	34.64
H22	AltSub_71A	Substrate & Seed	Stone	12	114.00	33.49	111.00	86.64
H23	AltSub_71B	Substrate & Seed	Stone	12	121.71	31.21	104.29	31.23
H24	AltSub_49B	Substrate & Seed	Stone	12	43.75	14.19	130.00	81.25
H26	AltSub_01	Substrate & Seed	Stone	12	66.00	12.34	64.00	36.38
H27	AltSub_03	Substrate & Seed	Stone	6	40.25	15.12	129.50	29.31
H29	AltSub_29	Substrate & Seed	Stone	12	174.67	39.89	156.00	42.20
H32	AltSub_54	Substrate & Seed	Stone	12	28.00	14.44	345.20	82.39
H33	AltSub_62	Substrate & Seed	Stone	12	129.67	38.22	53.67	24.55
H34	AltSub_79	Substrate & Seed	Stone	12	98.80	30.88	170.00	67.64
H40	AltSub_107	Substrate & Seed	Stone	6	143.60	27.37	244.40	95.69

3.2 Little Choptank River Sentinel Reefs Results

Table 1 in the Executive Summary shows how each Little Choptank reef monitored in 2016 performed relative to each Oyster Metric criteria (oyster density, oyster biomass, presence of multiple year classes, shell budget, reef footprint, reef height).

Restoration work began in the Little Choptank River in 2014. Per the Little Choptank Oyster Restoration Tributary Plan, reefs in this river will be monitored starting in 2017, when they age to three years. A subset of reefs in this river, however, have been designated as sentinel reefs, to be monitored annually starting in 2016. Two Little Choptank sentinel reefs were monitored in fall 2016 (L1 and L2). Specific information on how Little Choptank sentinel reefs L1 and L2 were performing as of fall 2016 can be found in Appendix B: Reef Pages.

3.3 Tred Avon River Sentinel Reefs Results

Table 1 in the Executive Summary shows how each Tred Avon reef monitored in 2016 performed relative to each Oyster Metric criteria (oyster density, oyster biomass, presence of multiple year classes, shell budget, reef footprint, reef height).

Restoration work began in the Tred Avon River in 2015. Per the Tred Avon Oyster Restoration Tributary Plan, reefs in this river will be monitored starting in 2018, when they age to three years. A subset of reefs in this river, however, have been designated as sentinel reefs, to be monitored annually starting in 2016. Two Tred Avon sentinel reefs were monitored in 2016 (T1 and T2). Specific information on how Tred Avon sentinel reefs L1 and L2 were performing as of fall 2016 can be found in Appendix B: Reef Pages.

Section 4: Discussion

Overall, the 2013 Harris Creek monitoring cohort shows substantial success relative to the preestablished Oyster Metrics success criteria. As of fall 2016, 97% of the 2013 cohort reefs (29 of 30 reefs) met the Oyster Metrics minimum threshold success criteria for oyster density, oyster biomass, and presence of multiple year classes. 24 of the 30 reefs (80%) met the higher, target level for both oyster density and biomass. Of the 2012 cohort reefs, monitored in fall 2015, 100% met the minimum threshold oyster density, and 50% met the target oyster density[6].

Notably, the 2016 monitoring data indicate that stone-base reefs show higher average oyster densities than shell-base, seed-only, and reference reefs (Fig. 7). Oyster density estimates differed significantly among treatments ($p<.001$, $F=120.5$, $r^{2=}.49$). Oyster densities on stone-base reefs averaged approximately four times higher than shell-base reefs, and 22 times higher than reference reefs.

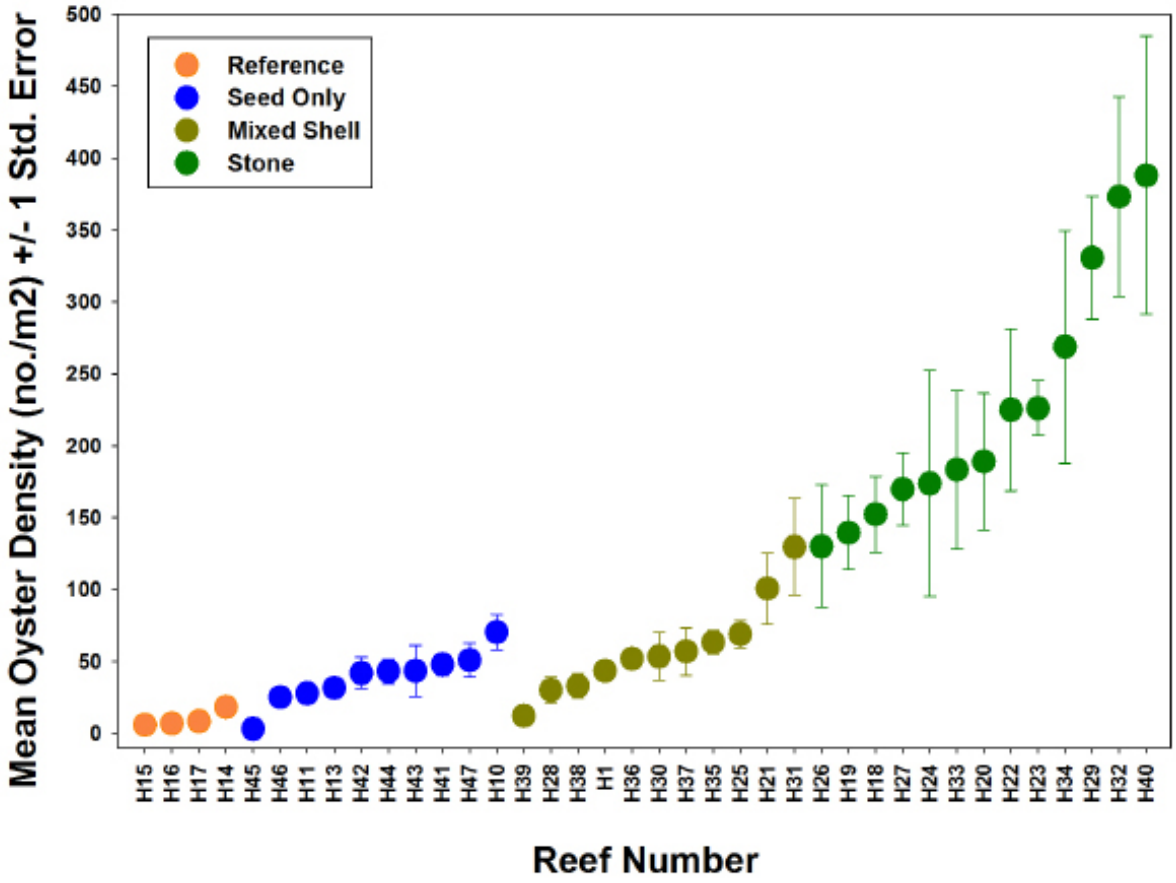


Figure 7: Average live oyster density on each reef, by restoration treatment type

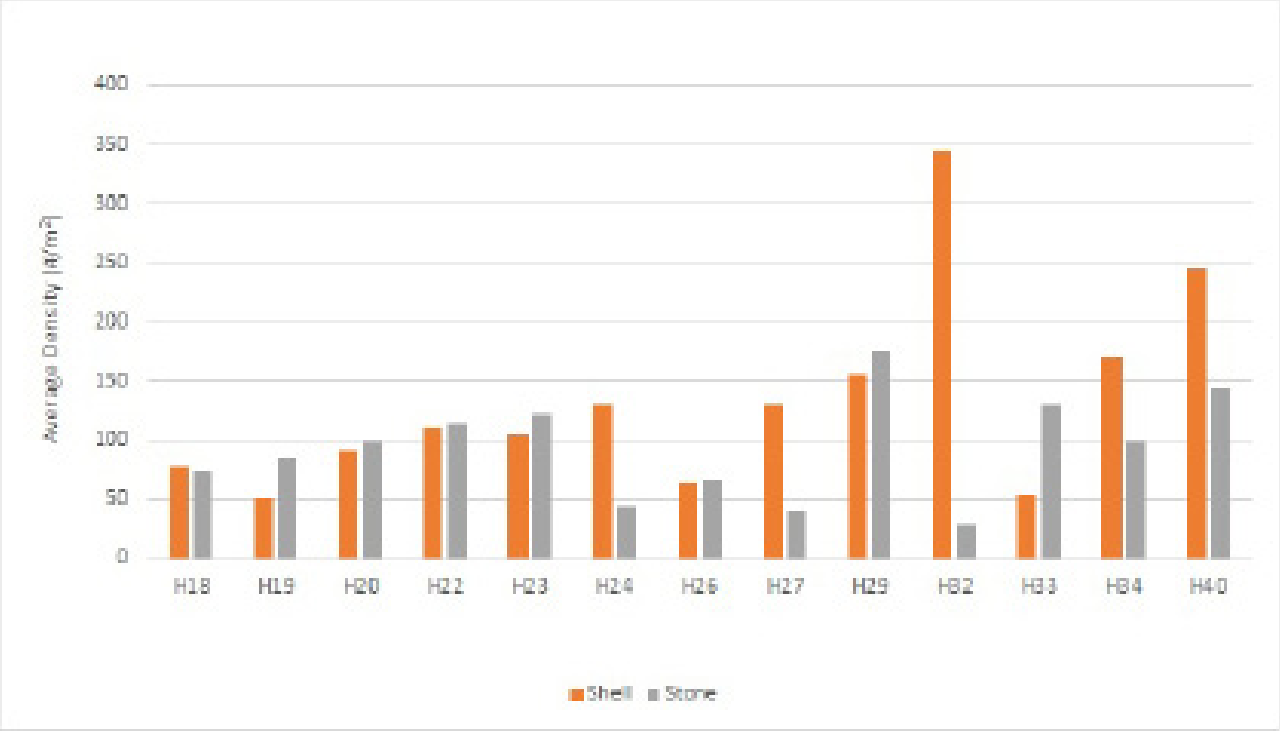


Figure 8: Average live oyster densities on stone-base reefs found attached to stone substrate vs. shell. (Oysters set on shell include single oysters and clumps not attached to any substrate.) Oysters found on tone substrate were the result of natural recruitment; oysters found on shell could be either natural recruitment or hatchery-produced oysters.

Also, a substantial quantity of the oysters found on stone-base reefs were found attached to pieces of stone-base material, rather than on shell (Fig. 8). Because all hatchery-produced oysters planted on these reefs were set on shell, any oysters found on stone base material are the result of natural recruitment. Oysters found on shell could be either natural recruitment or hatchery-produced oysters. This suggests that stone is a suitable settlement substrate for oysters, and that oysters are setting on these reefs in sizable quantities. The relative amount of surface area provided by shell vs. stone substrate was not evaluated.

It is unknown, at this time, why the stone-base reefs show higher average oyster densities than other treatments. Sonar images suggest greater structural complexity on stone-base reefs, and therefore likely more exposed surface area. This could affect oyster survival and/or recruitment. Another supposition is that traditional oyster harvest gear (hand tongs, oyster dredges) is ineffective on stone reefs, and therefore these reefs have protection from poaching that shell-base reefs and seed-only reefs lack. Yet another concept for consideration is that stone substrate may shed sediment better than shell and thus stay clean longer, allowing a greater window of opportunity for recruitment.

Taken together, the 2016 monitoring information is promising. However, there are factors that may influence the continued success of the Harris Creek project. These include:

- Future water quality issues: Although water quality in Harris Creek, the Little Choptank River, and Tred Avon River was favorable for oysters throughout 2016 (mddnr.chesapeakebay.net/eyesonthebay), it is possible that extreme low dissolved oxygen events or other water-quality issues in the future could result in significant oyster mortality. Upstream and upland activity, or watershed-wide water quality degradation, could also affect Harris Creek oysters.
- Oyster disease: Dermo disease generally has been highly prevalent in Harris Creek oysters, but at a very low (subletheal) intensity. A dry weather spell, resulting in high salinity, could cause an increase in Dermo intensity, and could lead to significant oyster mortality. Some scientists believe such outbreaks may actually benefit oyster populations in the long run, as the surviving oysters may pass along disease-resistant genes. This idea has both supporters and detractors in the scientific community.
- Funding: Funding for the Harris Creek project has come primarily from DNR, NOAA, and USACE. Other funding partners include the Chesapeake Bay Foundation, National Fish and Wildlife Federation, The Nature Conservancy, and CSX. Although initial in-water restoration work is complete in Harris Creek, funds are still needed for monitoring and

for smaller second plantings where needed. (The Harris Creek Tributary Plan calls for small second plantings on each reef between four and five years after the initial reefs are seeded.)

- Poaching: Arrests have been made for poaching in the Harris Creek Oyster Sanctuary, http://news.maryland.gov/dnr/2014/01/17/nrp-blotter-21/. It is not possible at this time to quantify the extent of the damage to restoration sites. Unchecked poaching has the potential to do substantial damage by lowering oyster densities and flattening reef structure.

Data and analysis in this report will be used by the Maryland Interagency Oyster Restoration Workgroup, consulting scientists, and oyster resource managers to help determine what adaptive management measures should be taken on each of the 2013 cohort reefs. It will also be used to guide restoration in other tributaries, notably the nearby Little Choptank and Tred Avon rivers.

Section 5: References

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Appendix A: Methods for Data Collection and Analysis

A.1: Methods for determining success against biological Oyster Metrics criteria (oyster density, oyster biomass, multiple year classes, shell budget)

The Oyster Metrics success criteria for each of the four biological metrics are described below, along with the methodology used to evaluate each criterion.

Oyster Density

Oyster Metrics success criteria:

- Minimum threshold = 15 oysters per m^2 over 30% of the reef area
- Target = 50 oysters per m^2 over 30% of the reef area

Method: The proportion of reef area with oyster density that met the minimum threshold or target reef-level restoration goal criteria was determined by standardizing each patent-tong grab or diver quadrat to the area of the sample unit (patent-tong or quadrat). The percent of reef area having greater than 15 and 50 oysters per m2 was calculated by summing the area of grid cells with equal to or greater oyster densities for each criteria and dividing by the total area of the reef.

Oyster Biomass

Oyster Metrics success criteria:

- Minimum threshold = 15 grams dry weight per m^2 over 30% of the reef area
- Target = 50 grams dry weight per m^2 over 30% of the reef area

Method: Oyster biomass per m^2 was calculated from the size of individual oysters within each sampling grid and then evaluated following the same approach as the density estimates (above).

Multiple Year Classes

Oyster Metrics success criterion: Presence of two or more year classes of live oysters

Methods: Year-class presence was approximated by examining length frequency data of all oyster heights measured at each reef. For simplicity, a reef was determined to have multiple year classes when oysters from at least two standard size class categories (market: 76 mm; small: 40 – 75 mm; spat <40 mm) were present.

Shell Budget

Oyster Metrics success criterion: Neutral or positive shell budget on the reef

Method: Changes to the shell budget at individual reefs could not be assessed because baseline information on shell volume did not exist. In the future, the shell budget calculated from 2016 monitoring data will be compared to fall 2019 shell budget data, and a determination of success against the established criteria will be made in fall 2019 (six years post restoration treatment).

Survey Design for Biological Metrics

A systematic survey framework was designed and implemented to quantify interreef scale distributions and densities of oysters and shell to evaluate reef performance in relation to the four biological metrics. The survey followed the same approach as the 2015 three-year check-in, but was optimized in 2016 to include unaligned samples that introduced a random component to the choice of all sampling points within a grid cell (see Analysis of Monitoring Data from Harris Creek Sanctuary Reefs, NOAA, July 2016 for details of previous survey design).

After application of systematic grid layers to oyster reef restoration sites, sampling points were generated randomly within each cell using ArcMap (ESRI, Version 10.5). Three different grid cell sizes, 25 x 25m, 50 x 50m, and 100 x 100m, were used both to ensure sufficient sample density were collected from reefs of differing sizes, and to account for logistical constraints of various sampling methods (see sampling methods below). The sampling framework was completed by creating grids for each cell size and extracting the portions of those grids (Fig. 9). The nature of the application of grids to irregularly shaped oyster restoration polygons created partial grid cells that overlapped the extent of all 2016 three-year check-in reefs (Fig. A1). Partial grids were too small to be sampled practically; therefore, cells smaller than 250 m^2 were

removed from the final sampling grid. A total of 332 sampling locations were generated to sample 2013 cohort reefs.

Sampling Methods for Biological Metrics

The density and distribution of oysters and shell were assessed using hydraulic patent-tong and diver sampling. Patent-tongs were used to sample oyster reef restoration sites that either had a natural base of oyster shell or were constructed using other natural shell (mixed shell, scallop, conch, clam). Divers were used to collect samples on stone-base reefs and fossilized shell. It is possible that there are some differences in sampling efficiency between samples collected using divers, and those collected using patent tongs. However, previous field comparisons conducted by Chai et al. 1992 on natural oyster reefs revealed no difference in sampling efficiency between oyster densities estimated using divers and those estimated using patent tongs. Therefore, for this report, the differences were assumed to be minimal. Diver sampling was scheduled and implemented by the University of Maryland Paynter Laboratory from the R/V *Callinectes*. Patent-tong sampling was conducted by Versar Inc. from the commercial fishing vessel *Captain's Lady*. Sampling was conducted during daylight hours and generally required 4 to 8 hours to complete. Navigation to sampling locations and sample coordinate documentation was done using a differential global positioning system (DGPS) attached to a laptop with ArcView 10.2 used as the navigational program.

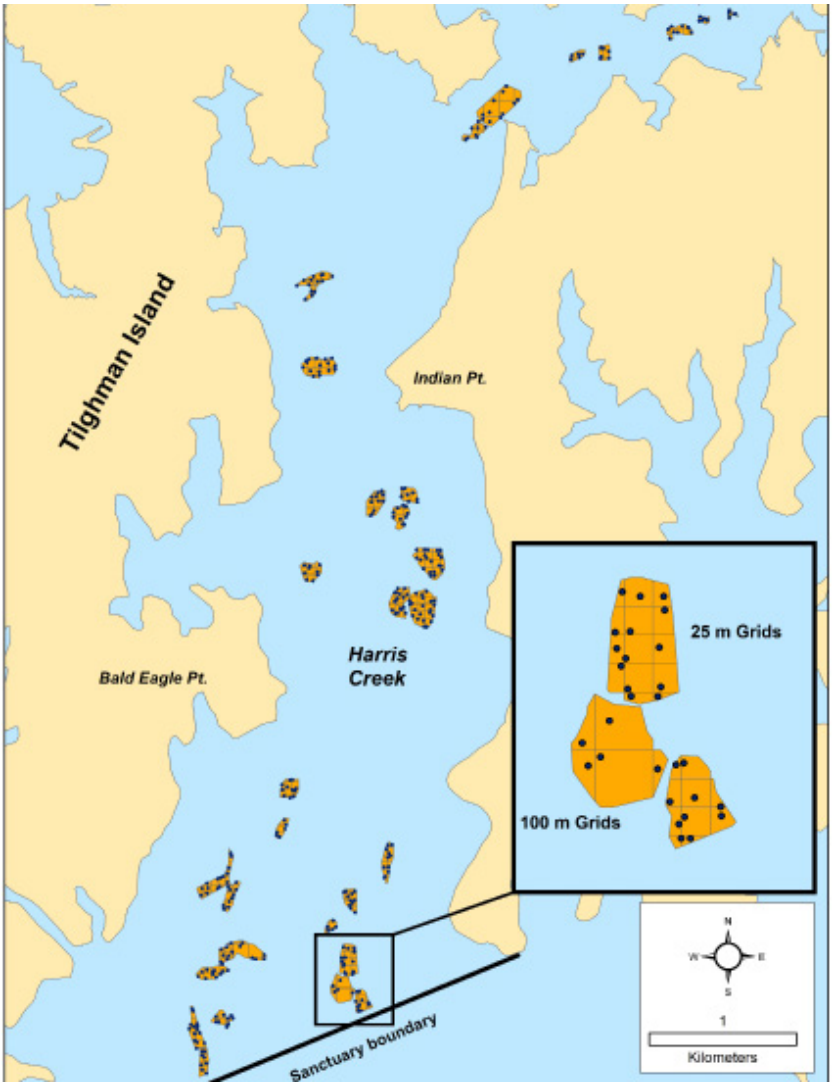

Figure A1: Map of three-year check-in reefs and systematic sampling grid used to sample oysters in Harris Creek. Insets show examples of 25m and 50m grid cells and the location of samples within them. Reef delineations and the sampling extent was derived from the Harris Creek Oyster Restoration Tributary Plan.

Hydraulic patent-tongs are a specialized commercial fishing gear used to harvest oysters in the Chesapeake Bay. The patent-tong design functions much like a benthic grab collecting oysters and underlying substrate from a known fixed area of the bottom. The patent-tongs were suspended from a boom over one side of the vessel and deployed to the bottom at each sampling location. One sample was collected within each sampling grid. A DGPS antenna was positioned adjacent to location where the patent-tongs were deployed and the geographic coordinates of each sample location was documented when the patent-tong sample was brought to the surface.

Diver surveys were used to collect samples on reefs constructed with a stone-base and fossil shell, and were conducted by navigating the vessel to each sampling location and deploying diver flag-labeled buoys with anchors to mark each sample location. Divers descended to the bottom of each buoy and sampling occurred in the general proximity of the buoy anchor. Samples were collected within a quadrat measuring 0.71m x 0.71m (0.5041m^2). Loose oysters and shell, including hatchery oysters and clumps, were removed and transported in bags to the vessel for processing. Oysters attached to the surface of substrate within each quadrat were counted in situ and the presence of multiple size classes of attached oysters was noted. Representative pieces of alternate substrate (stone) were collected at each reef to count and measure attached oysters.

The contents of patent-tong and diver samples were documented in the field on datasheets. Samples were processed on a sorting table at the stern or midpoint of the vessel, with a portion of the diver samples were taken back to the laboratory at University of Maryland for processing. The following habitat specific variables were documented from each

sample: total volume of shell, amount of shell hash, percent buried shell, and primary, secondary, and tertiary substrate type when present. Total volume of shell was measured for patent-tong and diver samples by placing the shell portion of the sample in 5-gallon buckets with liter volume increments marked on the outside. The percent exposed stone was also documented when it occurred in diver samples.

Total counts and shell height measurements of at least 30 live oysters were documented for each sample. Live oysters were categorized as market (76 mm), small (40–75 mm), and spat (<40 mm) size classes. Oyster clumps, the number of oysters associated with a clump, and the substrate type that oysters were attached to was also documented. The shell height and total count of dead (old box) and recently dead (gapers) oysters was also documented from each sample. The percent of the sample covered by tunicates or mussels was also documented for each sample. Surface and bottom water temperature, dissolved oxygen, pH, and salinity were collected during each sampling at representative locations over each oyster reef using a 6600 multiparameter water quality sonde (YSI Corporation, Yellow Springs, Ohio). Other environmental and station specific variables collected at each site included sample number, date and time, weather information, depth of water, Yates Bar name, vessel name, and staff present.

Statistical Analysis for Biological Metrics and Substrate Treatment Comparisons

Oyster density estimates were standardized to number per m^2 from the area sampled by patent-tong or by diver quadrat. Total counts of live oysters or other variables (e.g., oyster size class, shell volume) were averaged over all samples collected at the individual reef. This analysis was independent of the metrics evaluation and was performed to evaluate reef scale biological attributes.

Oyster biomass estimates were calculated for individual oysters using the equation $W = 0.000423 * L^{1.7475}$ where W = dry tissue weight in g and L = shell height in mm (Evans and Mann 1998). Biomass was then summed for the entire sample and standardized using the same method as density estimates. Biomass values were averaged over all samples collected at an individual reef. The standard error of the mean is estimated for all density and biomass estimates.

Total sampled shell and surface shell volume was estimated for each individual oyster reef. Field measurements of shell resources included total shell volume and the percent of black (buried) shell estimated in a sample. Average shell volumes were standardized by the area sampled by patent-tong or by diver quadrat. Total sampled shell volume was estimated using average sampled shell volume multiplied by the sampled area. Surface shell estimates were calculated as the percent of the total sampled shell volume that was not considered black shell. Total surface shell was estimated using the average percent surface shell multiplied by the total sampled reef shell volume.

Comparisons were also performed to evaluate whether 2016 live oyster density differed among oyster reefs constructed with a stone base, reefs constructed with a mixed-shell base, seed-only reefs, and reference reefs. For the analysis, each type was considered a treatment, and one-way ANOVA was used to determine the effects of treatment type on density estimates for each oyster reef. In addition, Tukey HSD test was used as a post-hoc review to determine the differences in density estimates between each treatment type. These comparisons helped identify the treatment types, which led to the differences observed in the one-way ANOVA.

A2: Methods for determining success against Oyster Metrics reef structural criteria (reef footprint; reef height)

Staff from the NOAA Chesapeake Bay Office conducted multibeam bathymetric (depth) surveys following the construction of substrate and seed reefs and again three years post restoration (fall 2016). For the planting years 2012-2015, seed-only reefs were not targeted for survey because bathymetric updates to nautical charts were not required. In a few instances, survey of constructed reefs overlapped with seed only sites to provide for post seeding survey data. Future seed-only plantings, 2016 and on, will be surveyed with multibeam to evaluate the structural metrics for all restoration sites. These survey data are acquired and processed to the standards set forth in "NOS Hydrographic Surveys Specifications and Deliverables, 2016"[5]. Surfaces derived from the processed data are exported from CARIS HIPS software at a 0.25m grid resolution using the BASE Cube Mean Depth, a repeatable method.

Reef Footprint (Spatial Extent)

Oyster Metrics success criterion: Neutral or positive change in reef spatial extent (footprint) as compared to baseline measurements

Methods:

- Substrate and Seed Reefs: Perimeter change was evaluated between the postconstruction bathymetric surface and the three-years-postconstruction bathymetric surface. A visual comparison was conducted to identify significant differences between the two perimeters in the event that a portion of the reef was lost due to subsidence or removal. If an observable loss was not detected, the reef spatial extent was reported as meeting the metric.
- Seed-Only Reefs: Bathymetric surface data was not collected on seed-only reef sites immediately following seed planting. Therefore, it is not possible at this time to determine whether or not the seed-only reefs meet the reef footprint success criteria. The bathymetric surface data collected at the three-year post restoration mark (fall 2016) will be compared against bathymetric surface data collected at the six-year post-restoration mark (fall 2019). At that time, evaluation of the two data sets will follow the methods above for the substrate and seed restoration sites. The success or failure of this metric on seed-only reefs is therefore noted as 'TBD in 2019.'

Reef Height

Oyster Metrics success criterion: Neutral or positive change in reef height as compared to baseline measurements

Methods:

- Substrate and Seed Reefs: To evaluate reef height, the difference between the post-construction surface and the three-years-post-construction surface is calculated by subtracting the former from the latter. To establish a common baseline elevation between multiple surfaces, the depth values for the two sources were compared at eight points around the outside of the restored site. The mean difference from the eight points was calculated and used to adjust one of the surfaces to the common elevation. ArcGIS Spatial Analyst extension raster math tool calculated differences between all of the cells within the restoration site polygon. The differences are assumed to have occurred from the construction of reef. Changes in the bottom occur from moving construction equipment, deposition of seed, scouring from currents, deposition of sediments, growth of oyster clumps, loss from poaching, loss from subsidence of the site base, or artifacts within the sonar data. If the mean calculated difference for the surface within the site boundary was neutral or positive, then the reef height was reported as meeting the metric.
- Seed-Only reefs: Surface data was not collected on seed-only reef sites immediately following seed planting. Therefore, it is not possible at this time to determine whether or not the seed-only reefs meet

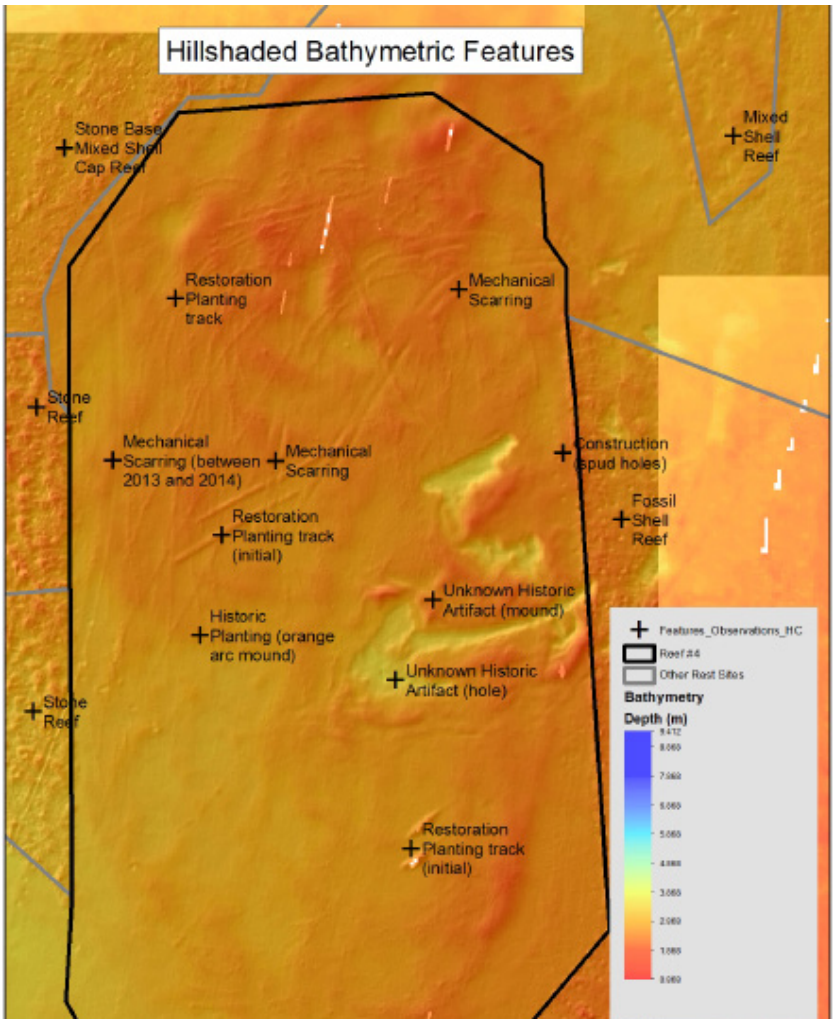

Figure A2: Interpretation of bathymetric features visible in sonar images of treated oyster reefs.

the reef height success criteria. Surface data collected at the three-year post-restoration mark (fall 2016) will be compared against surface data collected at the six-year postrestoration mark (fall 2019). At that time, evaluation of the two data sets will follow the methods above for the substrate and seed restoration sites to determine whether or not the reef height success criteria was met. The success or failure of this metric on seed-only reefs is therefore noted as 'TBD in 2019.'

Bathymetric Features and Observations

Postrestoration images created from multibeam bathymetric (depth) surveys on each reef are available in section 3C. Figure A2 shows interpretation of the various bathymetric features visible in these images.

Having two surveys repeated within a short period of time (2-3 years) provides an opportunity to identify and evaluate specific forms of seabed change at restoration sites. Features present in the three-year assessment sonar imagery (Section 3C) that are not present in the postconstruction imagery are attributed to the reef construction process or caused by other events that occurred between monitoring surveys. These features include the acoustic signature of different restoration materials, artifacts from tug and barge equipment that include drag marks and spud holes, scouring or deposition of sediments, growth of oyster clumps, and mechanical scarring from keel drag or commercial harvest (poaching). Each feature form has a somewhat unique signature on the seabed and can usually be attributed to a specific action. Based on observations of the various methods of harvesting oysters, one such unique signature is the oyster dredge drag scar, a furrowed feature that has been observed with video within harvest areas.

Diagnostic Monitoring Methods

In addition to monitoring to determine if reefs met the Oyster Metrics success criteria, information was also collected to aid in diagnosing why reefs may have succeeded or failed. These are primarily water-quality data and oyster disease data.

With funding from The Nature Conservancy, Maryland 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.

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.

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Appendix B: Reef Pages: Detailed Information and Sonar Images for Each Reef

Detailed information on the status of each reef, including restoration treatment, sampling information, and success relative to each Oyster Metrics criteria follows as 'reef pages'.

Each reef in the 2013 Harris Creek monitoring cohort has a reef page, as do each of the Harris Creek control reefs and the Harris Creek sentinel reefs.

The sentinel reefs in Little Choptank and Tred Avon rivers (two reefs each) that were monitored in fall 2016 do not have reef pages, as they are not yet three years old.

Reef H1 (AltSub_104) Data and Analysis

Reef Information	Reef #	H1
	Geodatabase Site_ID	AltSub_104
	Bar Name	CHANGE
	Tributary	Harris
	Reef area (acres)	3.37
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Mixed shell
	Ave planned reef height** (inches)	12
	Year planted with spat	2012
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	31.27
	Spat planted per acre (millions)	9.28
Monitoring Information	Monitoring type	Sentinel
	Sample Method	Patent Tong
	Most recent monitoring sample date	16-Nov-16
	# samples taken	11
	# live oysters measured	331
	# live oysters counted	767
	# dead oysters counted	127
	% dead oysters observed on the reef	14.21%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	43.31
	Standard error of live density (#/ m2)	6.86
	Reef area meeting min threshold* density (%)	95%
	Reef area meeting target density (%)	48%
Density on Stone vs. Shell	Ave live density on stone (#/m²)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m²)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	67.91
	Standard error of live biomass	13.50
	Reef area meeting min threshold* biomass (%)	95%
	Reef area meeting target* biomass (%)	54%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	11.91
	Standard error of shell volume	2.02
	Total shell volume (litres)	160847.84
	Total surface shell volume (litres)	48546.8
	Ave brown shell across all samples (%)	69.82
Reef Height & Footprint	**Is the reef height stable or increasing?**	NO
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

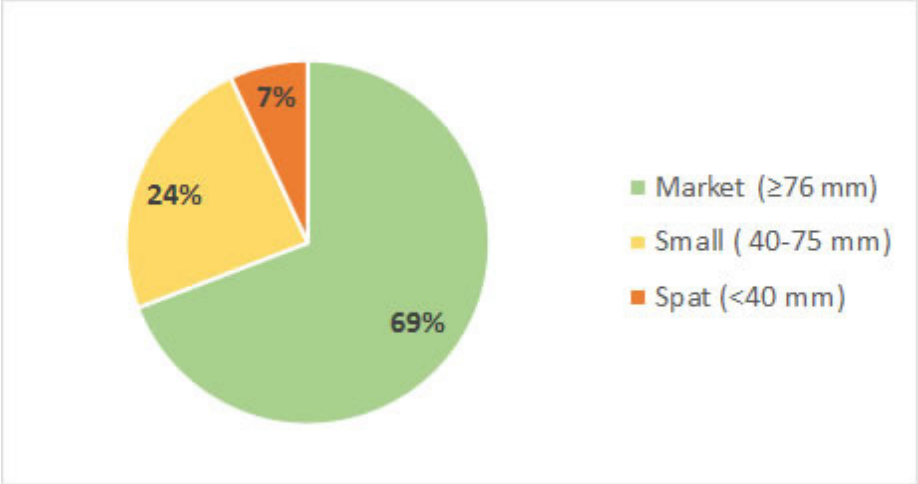
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

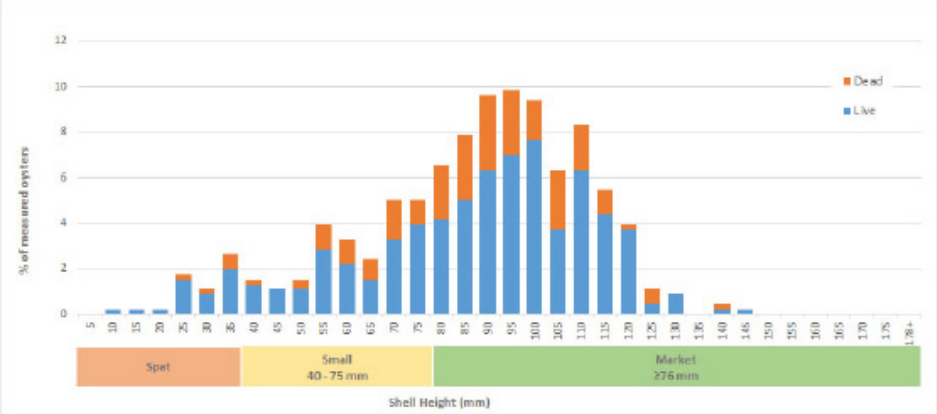
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H1 (AltSub_104) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories

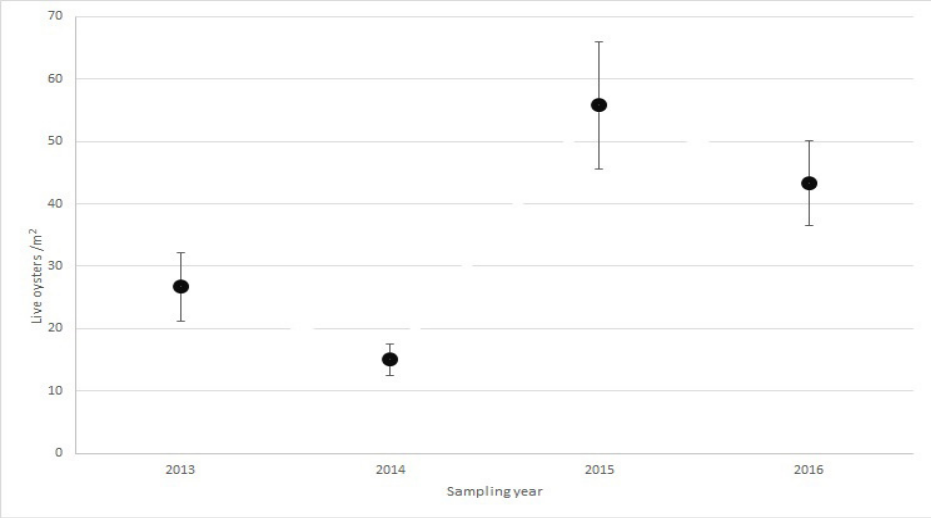


Shell Height of Oysters Measured on Reef



Average Live Oyster Densities Found on Reef H1 from 2013 through 2016

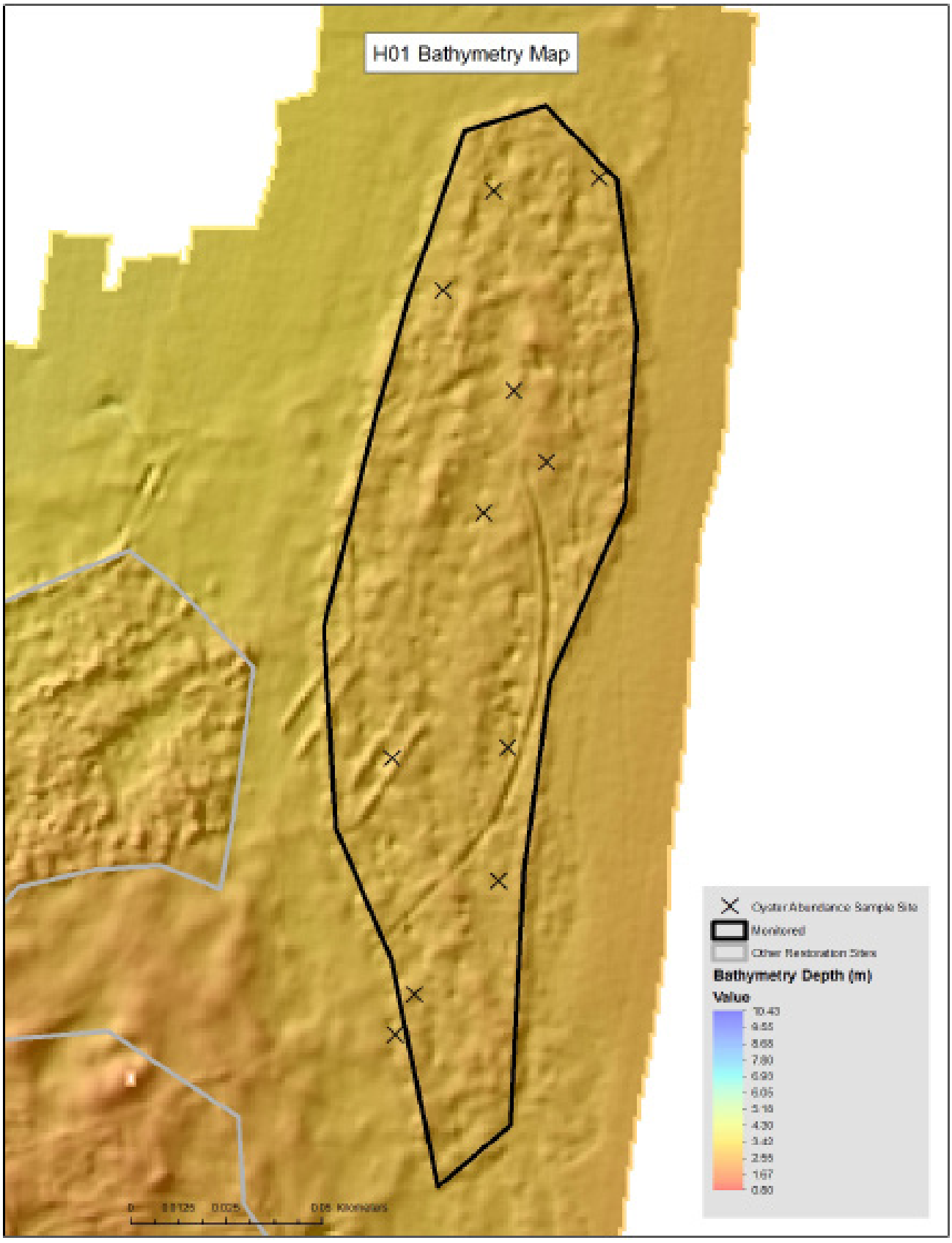
Error bars represent +/- standard error.



Reef H1 (AltSub_104) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H10 (TREATMENT_3) Data and Analysis

Reef Information	Reef #	H10
	Geodatabase Site_ID	TREATMENT_3
	Bar Name	LITTLE NECK
	Tributary	Harris
	Reef area (acres)	10.88
Restoration Treatment	Restoration treatment	Seed Only
	Substrate type added	None (spat on shell only)
	Ave planned reef height** (inches)	N/A
	Year planted with spat	2012
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	52.09
	Spat planted per acre (millions)	4.78
Monitoring Information	Monitoring type	Sentinel
	Sample Method	Patent Tong
	Most recent monitoring sample date	18-Nov-16
	# samples taken	11
	# live oysters measured	337
	# live oysters counted	1245
	# dead oysters counted	155
	% dead oysters observed on the reef	11.07%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	70.30
	Standard error of live density (#/ m2)	12.35
	Reef area meeting min threshold* density (%)	78%
	Reef area meeting target density (%)	65%
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m^2)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	62.04
	Standard error of live biomass	10.52
	Reef area meeting min threshold* biomass (%)	99%
	Reef area meeting target* biomass (%)	65%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	14.34
	Standard error of shell volume	1.77
	Total shell volume (litres)	631710.64
	Total surface shell volume (litres)	241198.61
	Ave brown shell across all samples (%)	61.82
Reef Height & Footprint	**Is the reef height stable or increasing?**	TBD 2018
	Is the reef footprint stable or increasing?	TBD 2018

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

***Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6”; 12”) by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

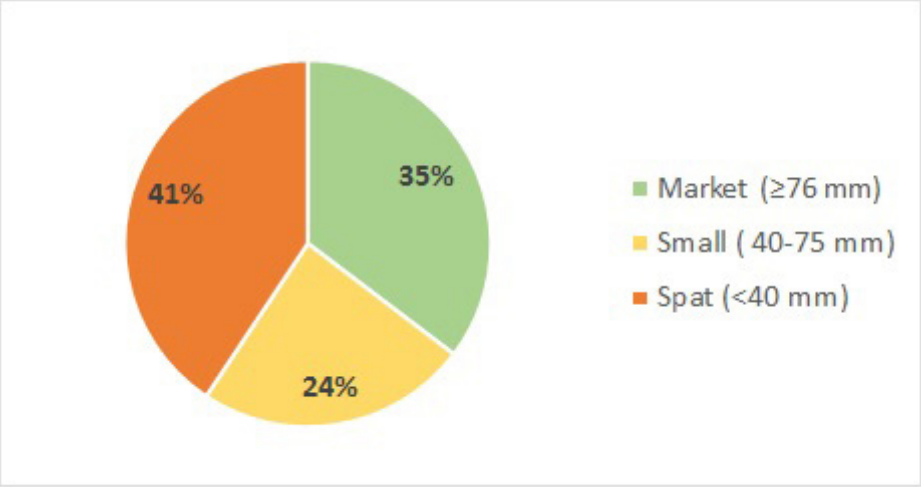
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

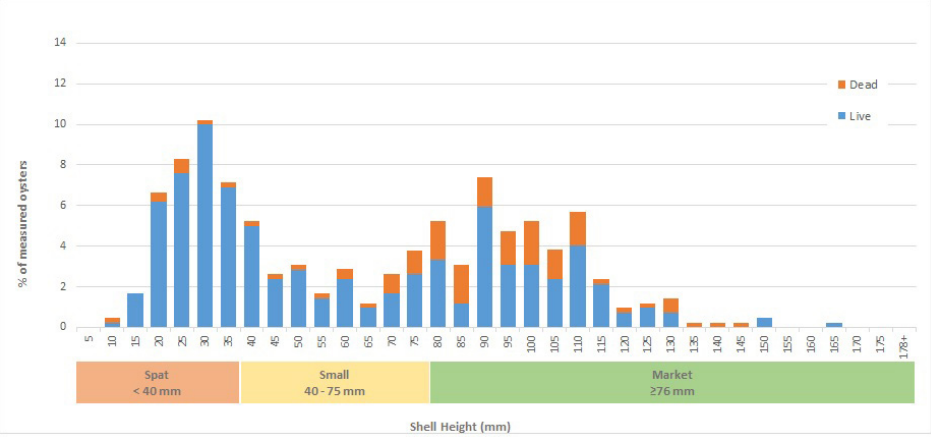
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H10 (TREATMENT_3) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories

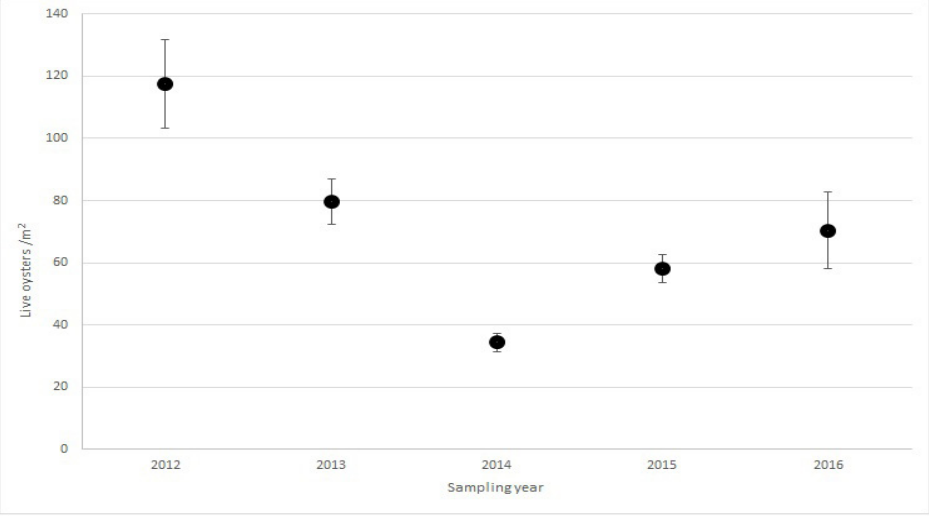


Shell Height of Oysters Measured on Reef



Average Live Oyster Densities Found on Reef H1 from 2013 through 2016

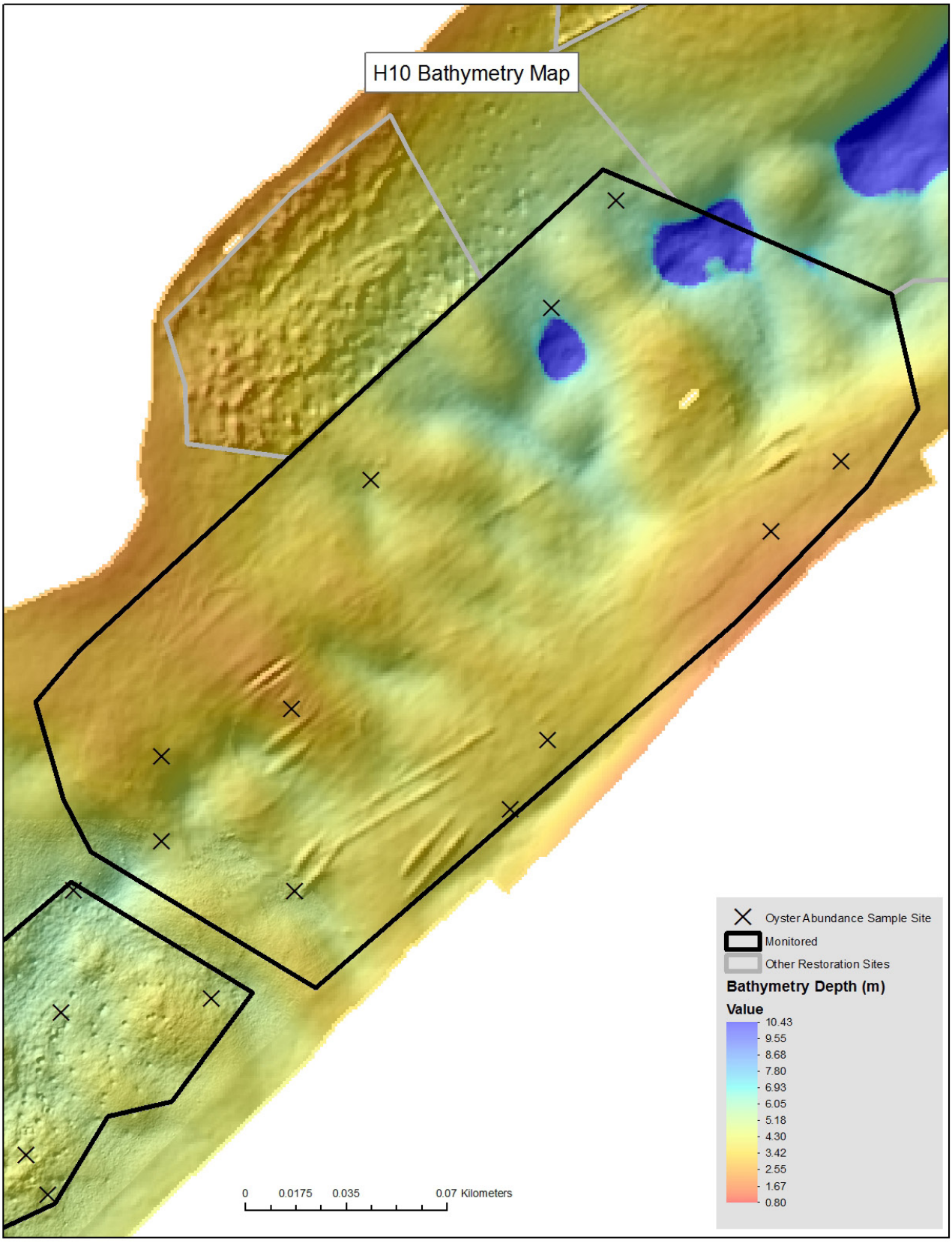
Error bars represent +/- standard error.



Reef H10 (TREATMENT_3) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H11 (TREATMENT_4) Data and Analysis

Reef Information	Reef #	H11
	Geodatabase Site_ID	TREATMENT_4
	Bar Name	LODGES
	Tributary	Harris
	Reef area (acres)	6.53
Restoration Treatment	Restoration treatment	Seed Only
	Substrate type added	None (spat on shell only)
	Ave planned reef height** (inches)	N/A
	Year planted with spat	2012
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	28.19
	Spat planted per acre (millions)	4.32
Monitoring Information	Monitoring type	Sentinel
	Sample Method	Patent Tong
	Most recent monitoring sample date	17-Nov-16
	# samples taken	16
	# live oysters measured	370
	# live oysters counted	715
	# dead oysters counted	173
	% dead oysters observed on the reef	19.48%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	No
	Ave live density across reef (#/ m2)	27.76
	Standard error of live density (#/ m2)	5.94
	Reef area meeting min threshold* density (%)	68%
	Reef area meeting target density (%)	---
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m^2)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	36.30
	Standard error of live biomass	8.98
	Reef area meeting min threshold* biomass (%)	74%
	Reef area meeting target* biomass (%)	31%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	9.67
	Standard error of shell volume	1.72
	Total shell volume (litres)	249036.87
	Total surface shell volume (litres)	106730.09
	Ave brown shell across all samples (%)	57.14
Reef Height & Footprint	**Is the reef height stable or increasing?**	TBD 2018
	Is the reef footprint stable or increasing?	TBD 2018

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

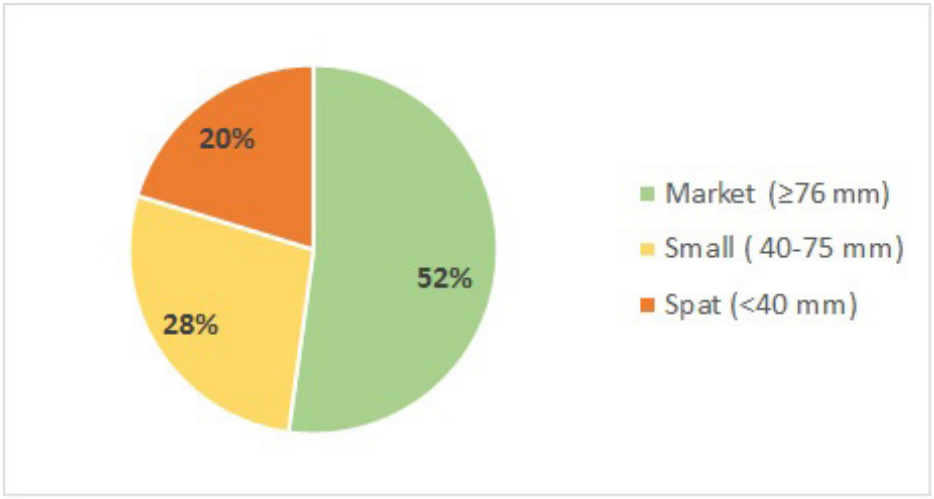
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

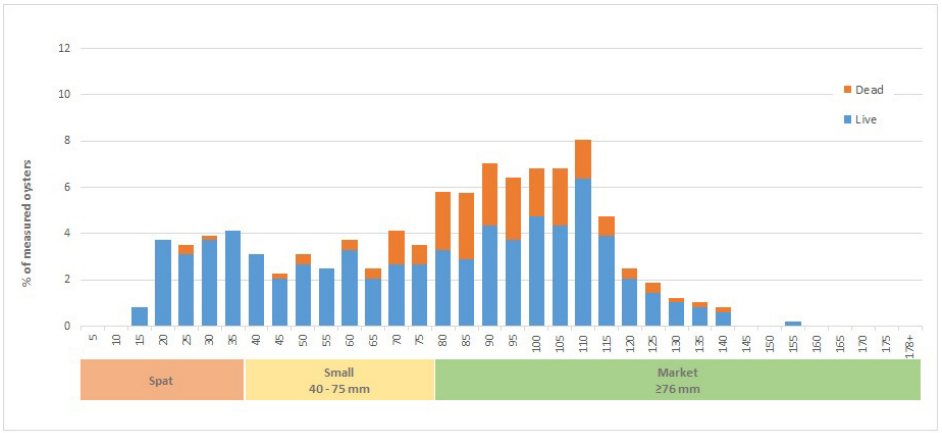
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H11 (TREATMENT_4) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories

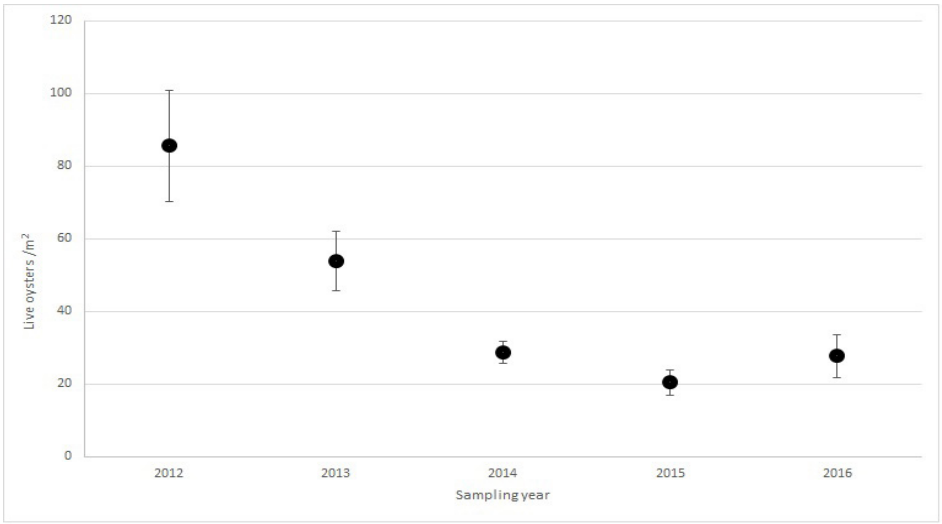


Shell Height of Oysters Measured on Reef



Average Live Oyster Densities Found on Reef H1 from 2013 through 2016

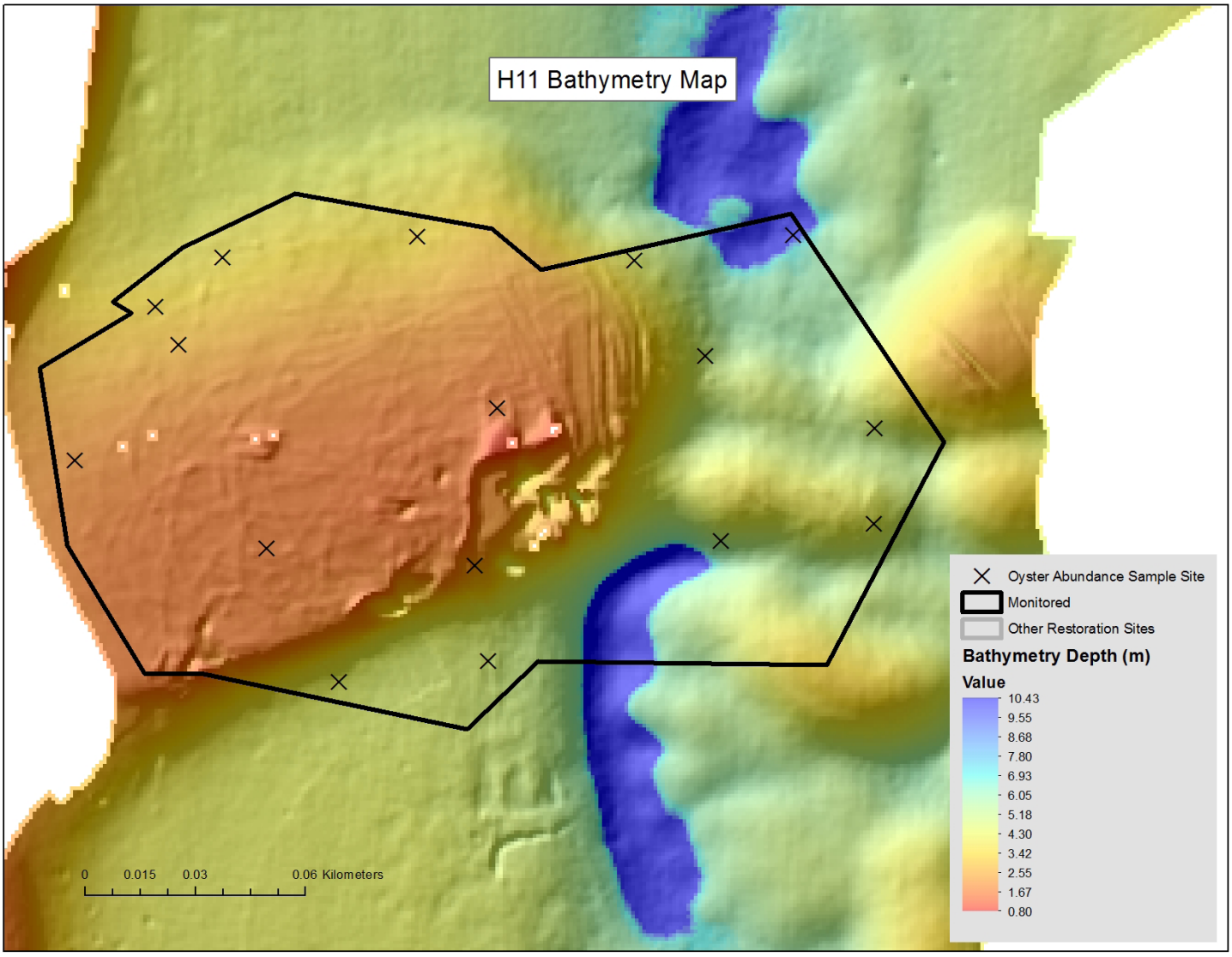
Error bars represent +/- standard error.



Reef H11 (TREATMENT_4) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H13 (EXCEDES_GOAL) Data and Analysis

Reef Information	Reef #	H13
	Geodatabase Site_ID	EXCEDES_GOAL_2012
	Bar Name	MILL POINT
	Tributary	Harris
	Reef area (acres)	3.40
Restoration Treatment	Restoration treatment	Seed Only
	Substrate type added	None (spat on shell only)
	Ave planned reef height** (inches)	N/A
	Year planted with spat	2011
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	51.76
	Spat planted per acre (millions)	15.22
Monitoring Information	Monitoring type	Sentinel
	Sample Method	Patent Tong
	Most recent monitoring sample date	17-Nov-16
	# samples taken	10
	# live oysters measured	295
	# live oysters counted	507
	# dead oysters counted	82
	% dead oysters observed on the reef	13.92%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	31.49
	Standard error of live density (#/ m2)	5.81
	Reef area meeting min threshold* density (%)	88%
	Reef area meeting target density (%)	52%
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m^2)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	30.48
	Standard error of live biomass	6.48
	Reef area meeting min threshold* biomass (%)	82%
	Reef area meeting target* biomass (%)	37%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	10.34
	Standard error of shell volume	1.59
	Total shell volume (litres)	139579.8
	Total surface shell volume (litres)	86958.22
	Ave brown shell across all samples (%)	37.7
Reef Height & Footprint	**Is the reef height stable or increasing?**	TBD 2018
	Is the reef footprint stable or increasing?	TBD 2018

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

***Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6”; 12”) by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

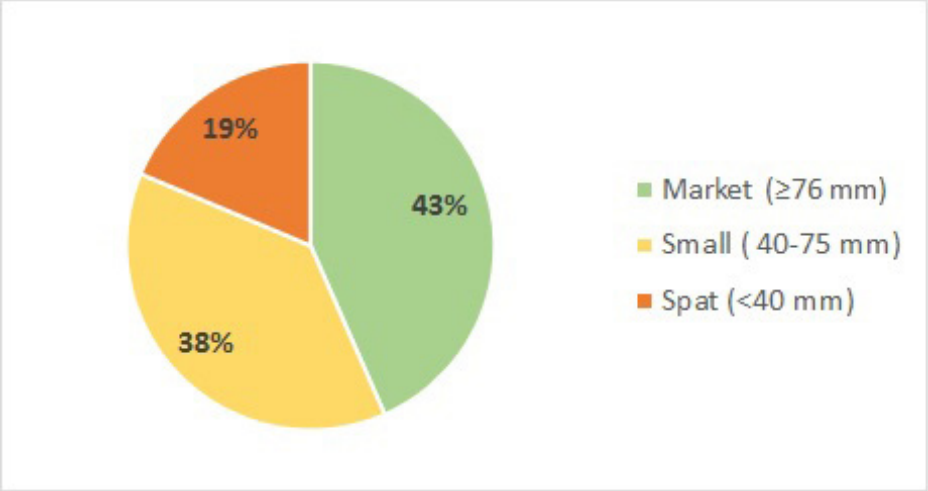
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

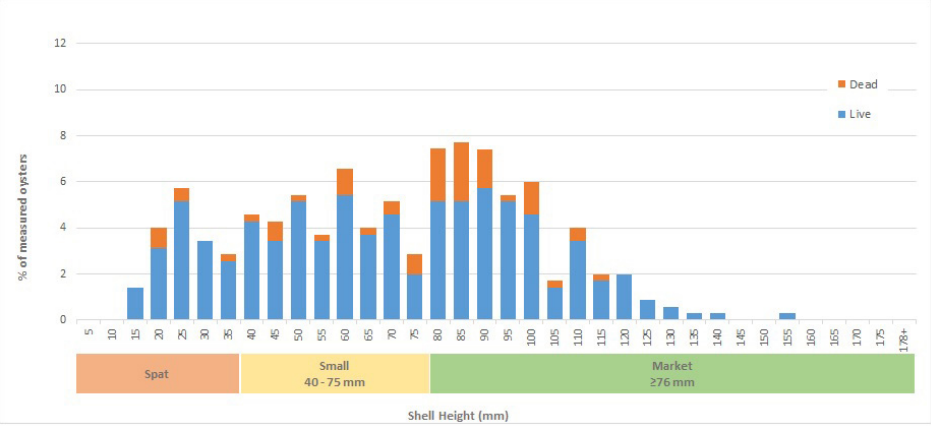
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H13 (EXCEDES_GOAL) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories

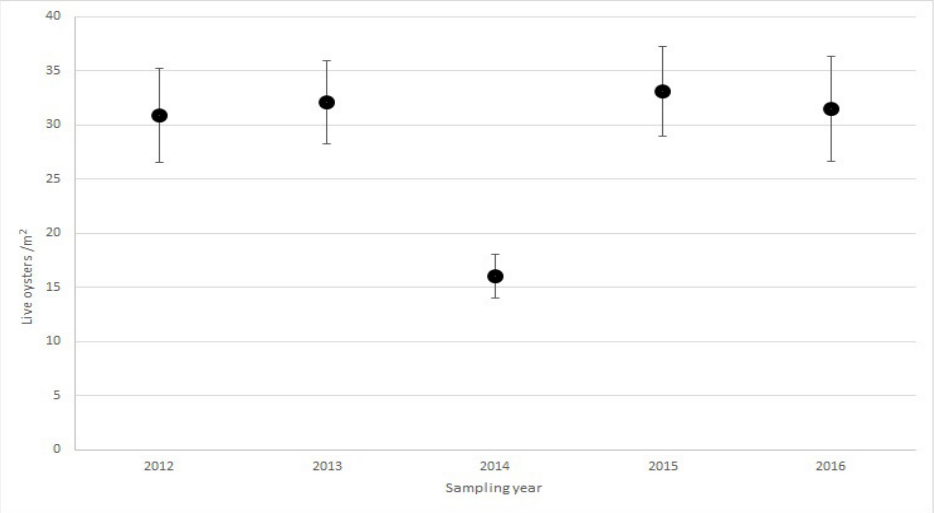


Shell Height of Oysters Measured on Reef



Average Live Oyster Densities Found on Reef H1 from 2013 through 2016

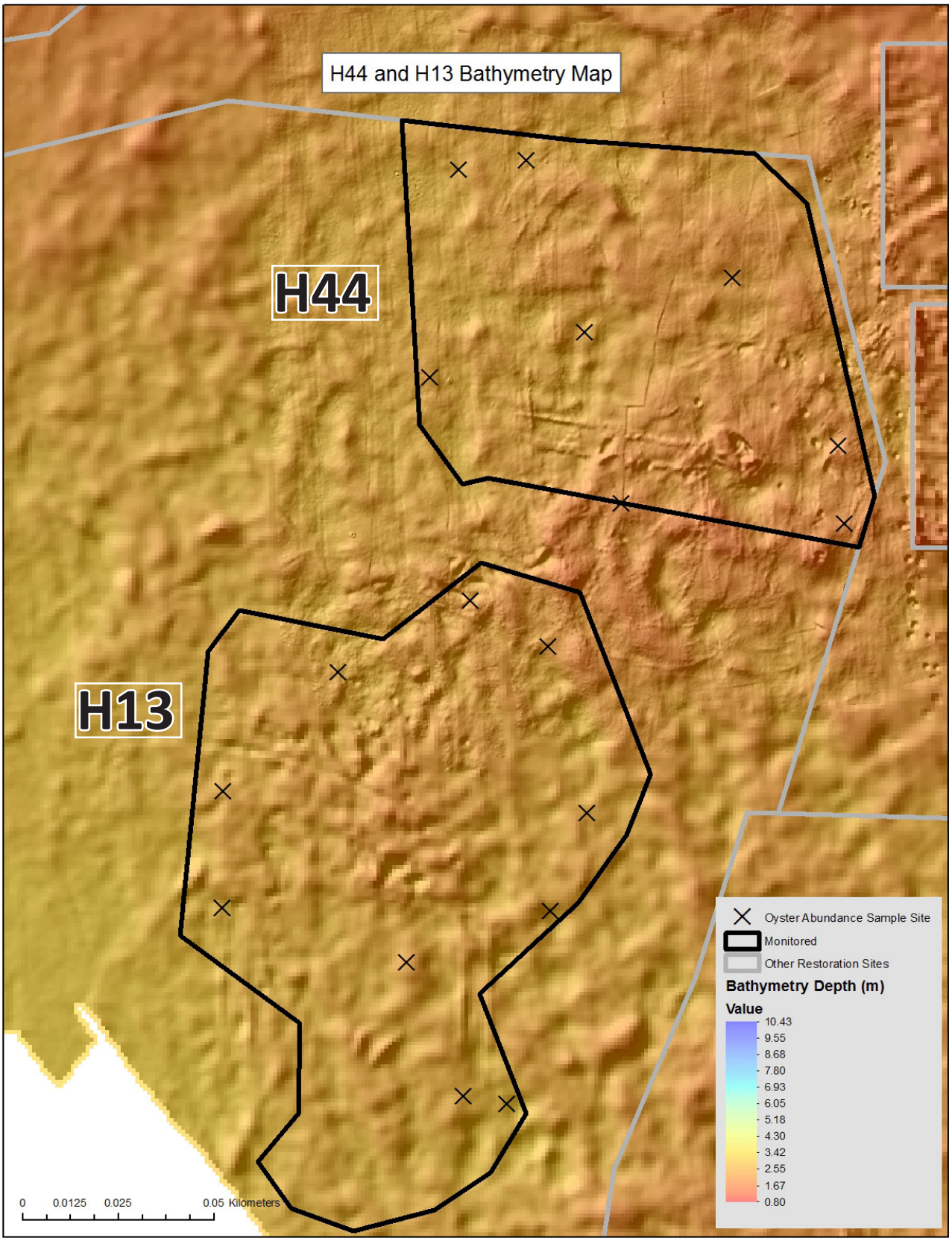
Error bars represent +/- standard error.



Reef H13 (EXCEDES_GOAL) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H14 (CONTROL_1) Data and Analysis

Reef Information	Reef #	H14
	Geodatabase Site_ID	CONTROL_1
	Bar Name	EAGLE POINT
	Tributary	Harris
	Reef area (acres)	3.47
Restoration Treatment	Restoration treatment	None (reference reef)
	Substrate type added	None (reference reef)
	Ave planned reef height** (inches)	N/A
	Year planted with spat	N/A
	Spat produced by	N/A
	Spat planted by	N/A
	Spat planted (millions)	0
	Spat planted per acre (millions)	0
Monitoring Information	Monitoring type	Reference
	Sample Method	Patent Tong
	Most recent monitoring sample date	28-Nov-16
	# samples taken	11
	# live oysters measured	254
	# live oysters counted	324
	# dead oysters counted	86
	% dead oysters observed on the reef	20.98%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	No
	Ave live density across reef (#/ m2)	18.29
	Standard error of live density (#/ m2)	3.99
	Reef area meeting min threshold* density (%)	85%
	Reef area meeting target density (%)	---
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m^2)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	No
	Ave live biomass across reef (g dry weight per m2)	29.66
	Standard error of live biomass	6.22
	Reef area meeting min threshold* biomass (%)	89%
	Reef area meeting target* biomass (%)	---
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	8.95
	Standard error of shell volume	1.28
	Total shell volume (litres)	124839.67
	Total surface shell volume (litres)	66392.01
	Ave brown shell across all samples (%)	46.82
Reef Height & Footprint	**Is the reef height stable or increasing?**	TBD 2018
	Is the reef footprint stable or increasing?	TBD 2018

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height***: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

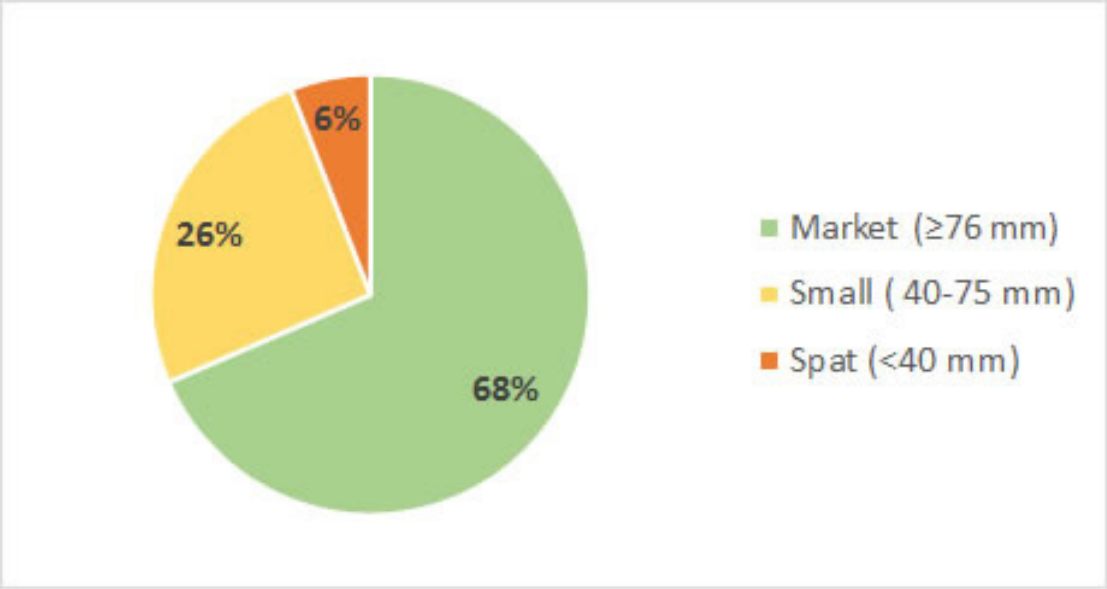
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

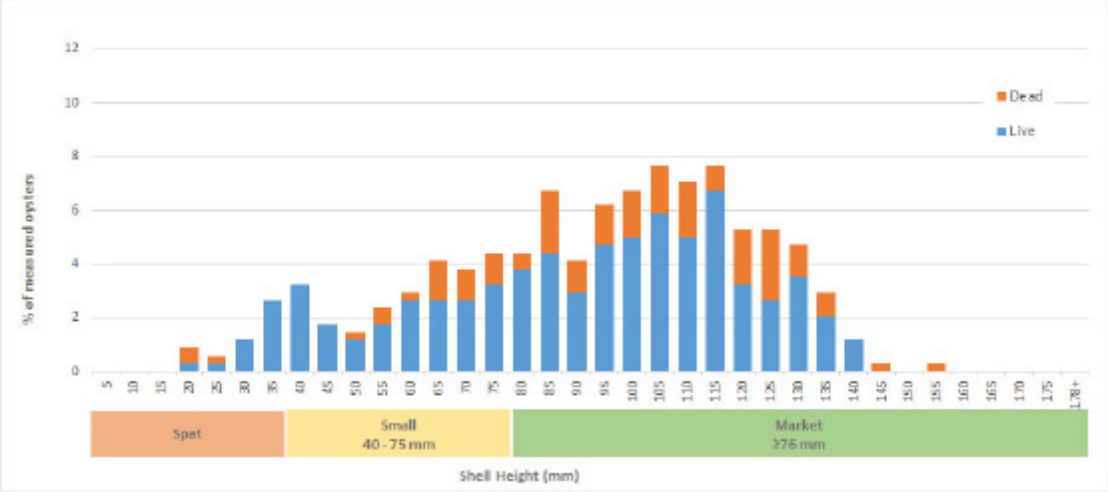
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H14 (CONTROL_1) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



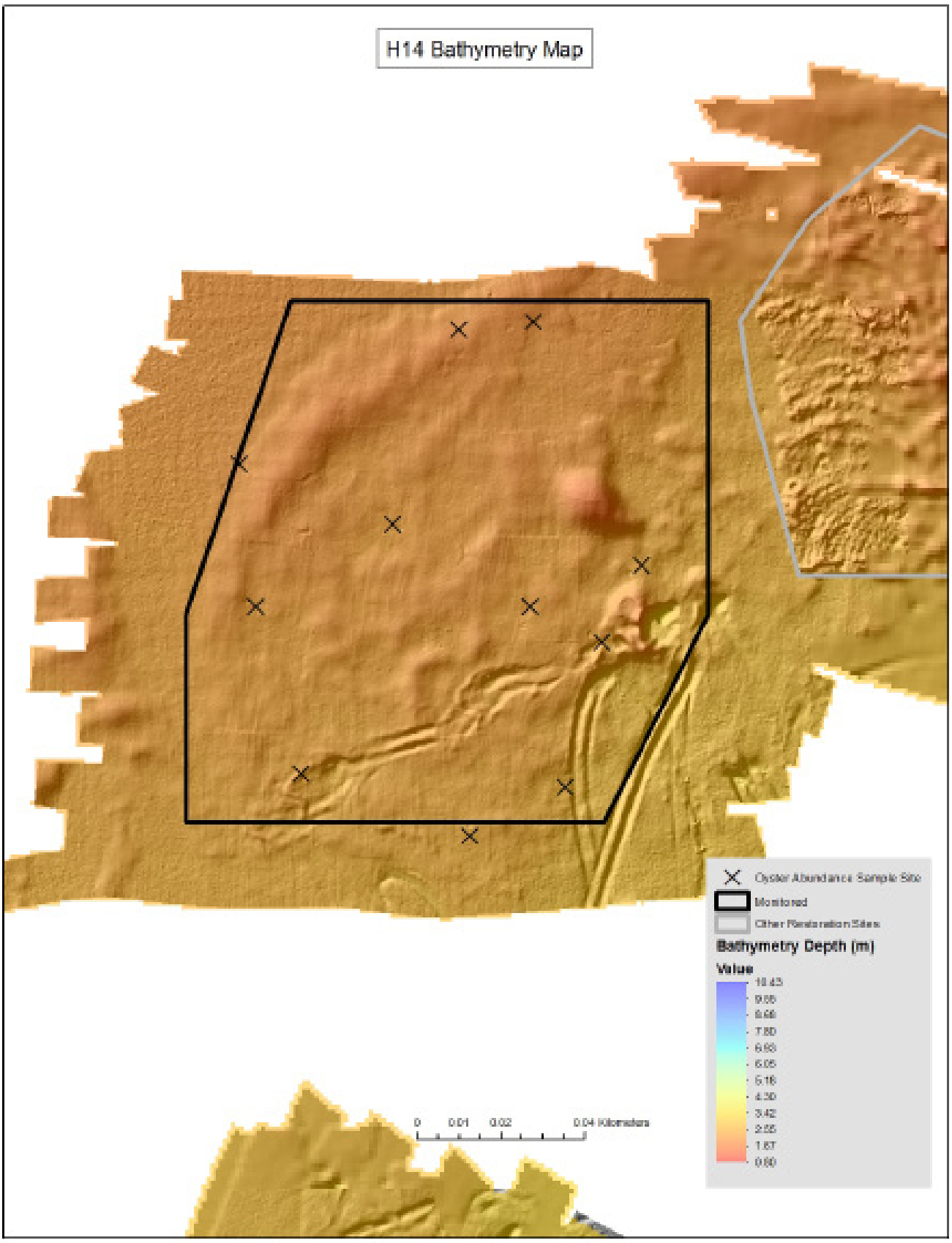
Shell Height of Oysters Measured on Reef



Reef H14 (CONTROL_1) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H15 (CONTROL_3) Data and Analysis

Reef Information	Reef #	H15
	Geodatabase Site_ID	CONTROL_3
	Bar Name	RABBIT ISLAND
	Tributary	Harris
	Reef area (acres)	1.85
Restoration Treatment	Restoration treatment	None (reference reef)
	Substrate type added	None (reference reef)
	Ave planned reef height** (inches)	N/A
	Year planted with spat	N/A
	Spat produced by	N/A
	Spat planted by	N/A
	Spat planted (millions)	0
	Spat planted per acre (millions)	0
Monitoring Information	Monitoring type	Reference
	Sample Method	Patent Tong
	Most recent monitoring sample date	28-Nov-16
	# samples taken	6
	# live oysters measured	55
	# live oysters counted	56
	# dead oysters counted	5
	% dead oysters observed on the reef	8.20%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	No
	Ave live density across reef (#/ m2)	5.80
	Standard error of live density (#/ m2)	3.76
	Reef area meeting min threshold* density (%)	35%
	Reef area meeting target density (%)	---
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m^2)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	No
	Ave live biomass across reef (g dry weight per m2)	5.71
	Standard error of live biomass	4.13
	Reef area meeting min threshold* biomass (%)	35%
	Reef area meeting target* biomass (%)	---
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	3.16
	Standard error of shell volume	1.91
	Total shell volume (litres)	22793.61
	Total surface shell volume (litres)	12536.49
	Ave brown shell across all samples (%)	45
Reef Height & Footprint	**Is the reef height stable or increasing?**	TBD 2018
	Is the reef footprint stable or increasing?	TBD 2018

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

***Oyster density** (per Oyster Metrics):

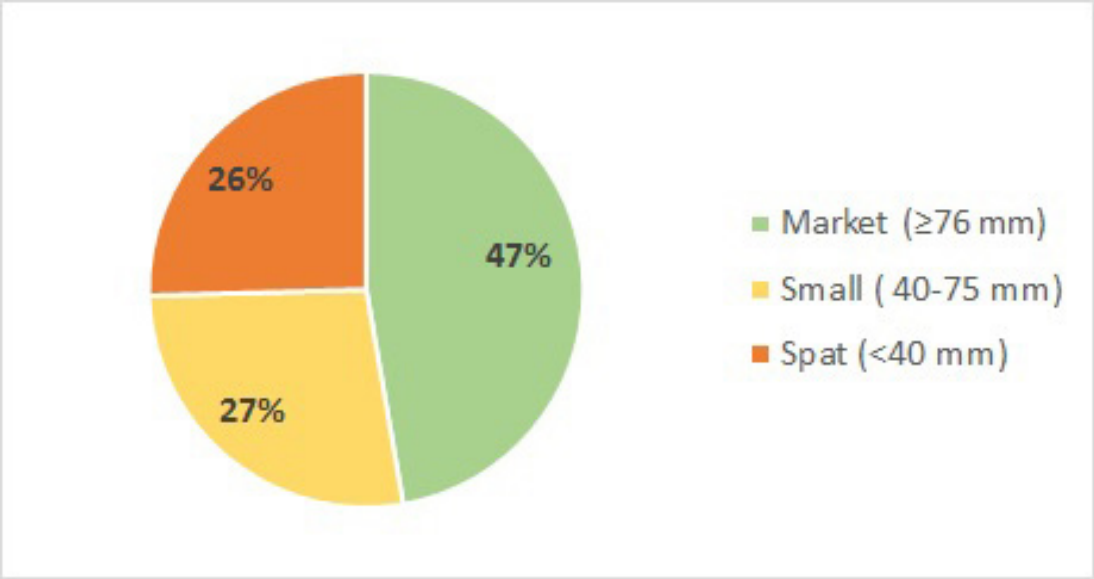
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

*O**yster biomass** (per Oyster Metrics):

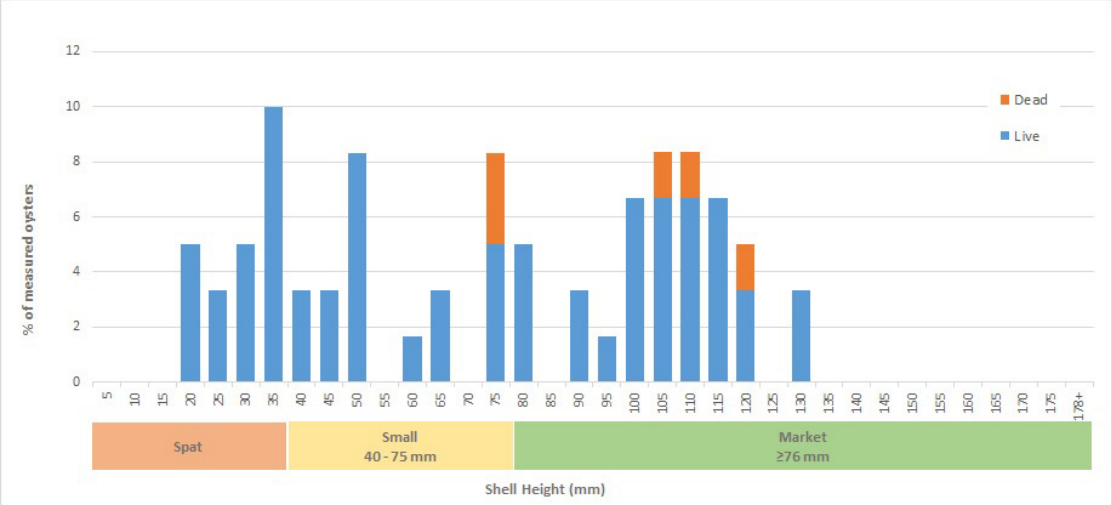
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H15 (CONTROL_3) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



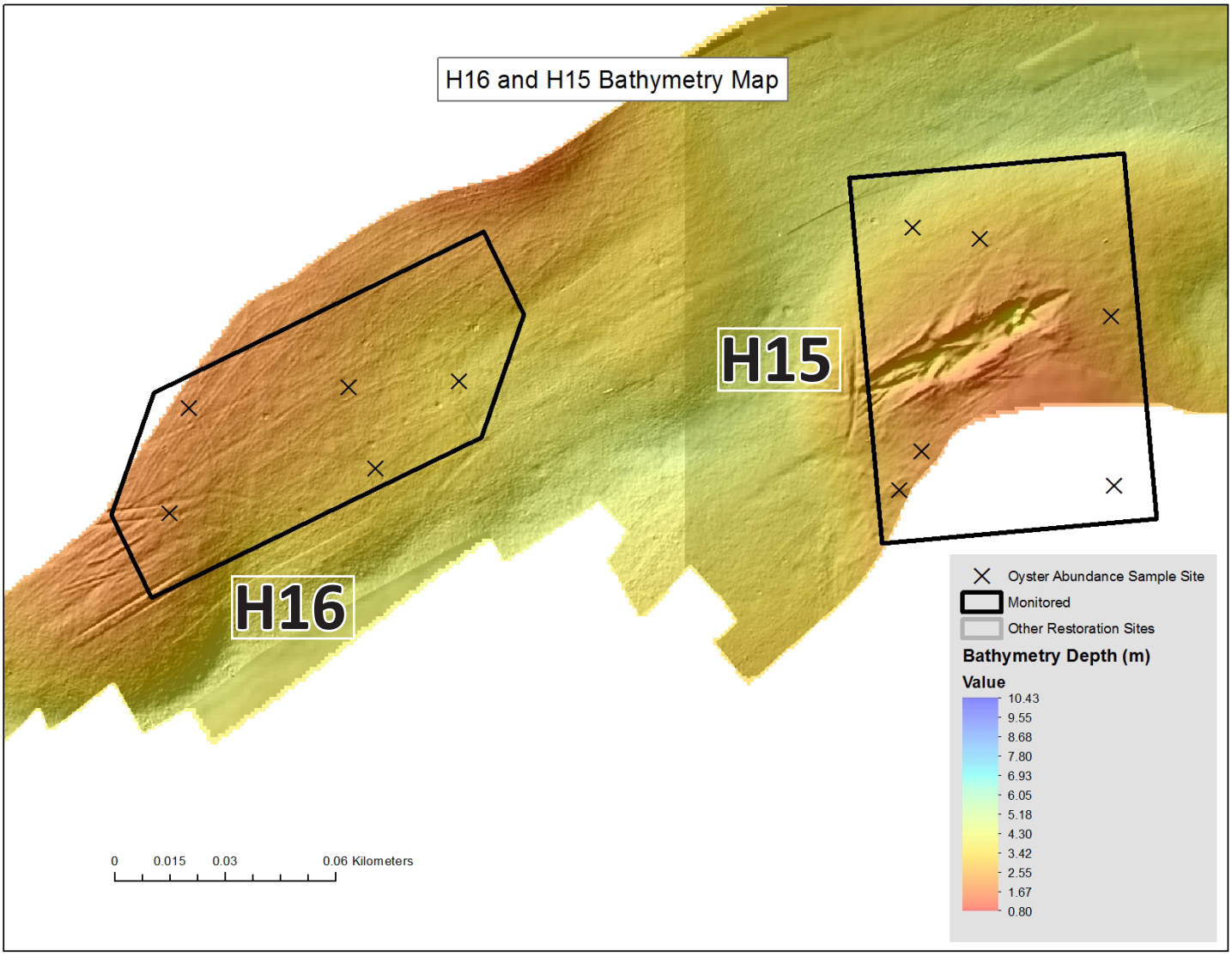
Shell Height of Oysters Measured on Reef



Reef H15 (CONTROL_3) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H16 (CONTROL_4) Data and Analysis

Reef Information	Reef #	H16
	Geodatabase Site_ID	CONTROL_4
	Bar Name	RABBIT ISLAND
	Tributary	Harris
	Reef area (acres)	1.39
Restoration Treatment	Restoration treatment	None (reference reef)
	Substrate type added	None (reference reef)
	Ave planned reef height** (inches)	N/A
	Year planted with spat	N/A
	Spat produced by	N/A
	Spat planted by	N/A
	Spat planted (millions)	0
	Spat planted per acre (millions)	0
Monitoring Information	Monitoring type	Reference
	Sample Method	Patent Tong
	Most recent monitoring sample date	18-Nov-16
	# samples taken	5
	# live oysters measured	54
	# live oysters counted	54
	# dead oysters counted	7
	% dead oysters observed on the reef	11.48%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	No
	Fall 2016: Did reef meet target* density?	No
	Ave live density across reef (#/ m2)	6.71
	Standard error of live density (#/ m2)	3.63
	Reef area meeting min threshold* density (%)	---
	Reef area meeting target density (%)	---
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m^2)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	No
	Fall 2016: Did reef meet target* oyster biomass?	No
	Ave live biomass across reef (g dry weight per m2)	9.50
	Standard error of live biomass	4.93
	Reef area meeting min threshold* biomass (%)	---
	Reef area meeting target* biomass (%)	---
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	3.88
	Standard error of shell volume	1.25
	Total shell volume (litres)	21074.73
	Total surface shell volume (litres)	18703.82
	Ave brown shell across all samples (%)	11.25
Reef Height & Footprint	**Is the reef height stable or increasing?**	TBD 2018
	Is the reef footprint stable or increasing?	TBD 2018

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

***Ave planned reef height*: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6”; 12”) by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

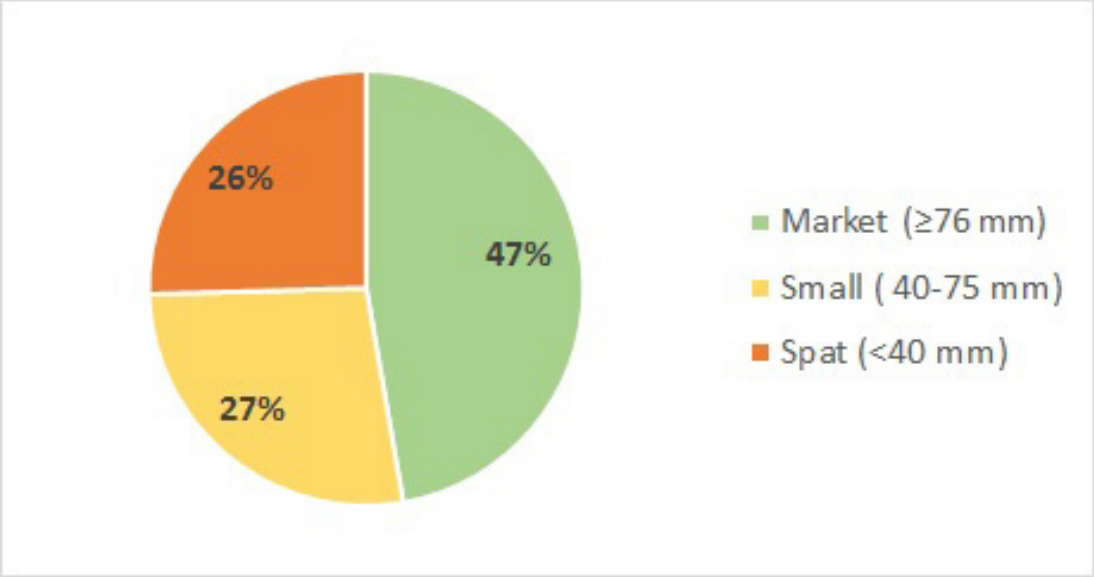
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

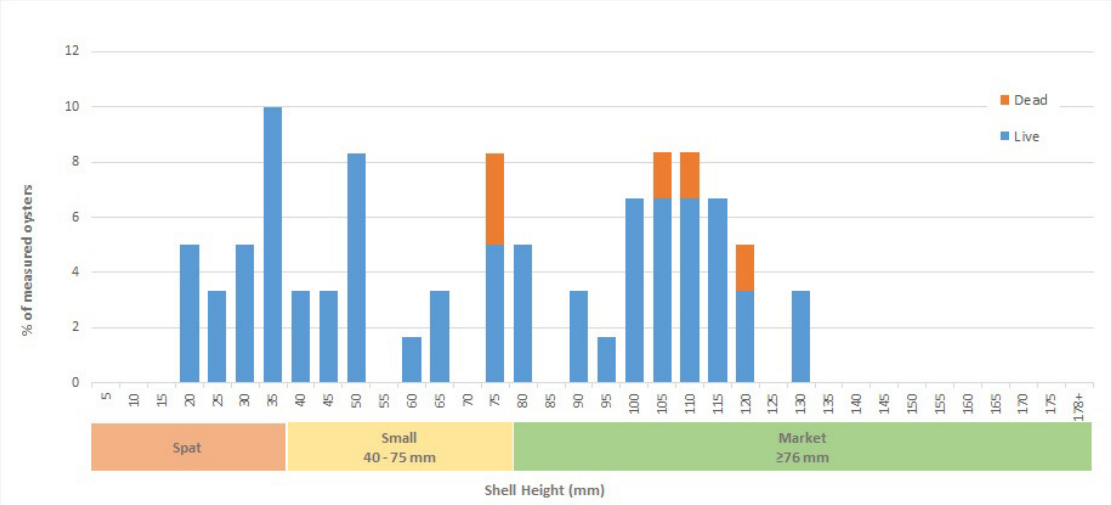
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H16 (CONTROL_4) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



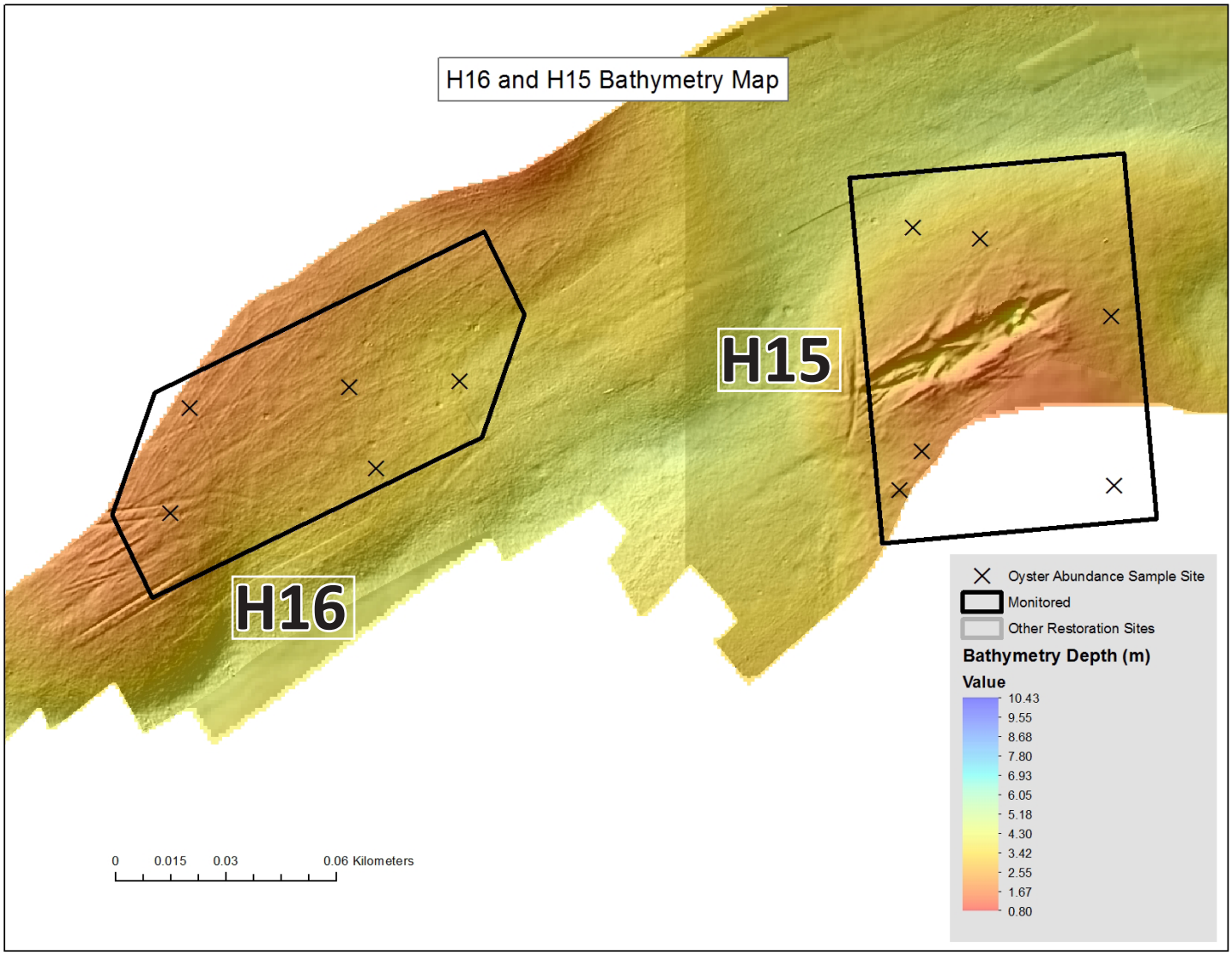
Shell Height of Oysters Measured on Reef



Reef H16 (CONTROL_4) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H17 (CONTROL_2) Data and Analysis

Reef Information	Reef #	H17
	Geodatabase Site_ID	CONTROL_2
	Bar Name	MILL POINT
	Tributary	Harris
	Reef area (acres)	4.01
Restoration Treatment	Restoration treatment	None (reference reef)
	Substrate type added	None (reference reef)
	Ave planned reef height** (inches)	N/A
	Year planted with spat	N/A
	Spat produced by	N/A
	Spat planted by	N/A
	Spat planted (millions)	0
	Spat planted per acre (millions)	0
Monitoring Information	Monitoring type	Reference
	Sample Method	Patent Tong
	Most recent monitoring sample date	28-Nov-16
	# samples taken	11
	# live oysters measured	106
	# live oysters counted	146
	# dead oysters counted	17
	% dead oysters observed on the reef	10.43%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	No
	Fall 2016: Did reef meet target* density?	No
	Ave live density across reef (#/ m2)	8.24
	Standard error of live density (#/ m2)	3.22
	Reef area meeting min threshold* density (%)	---
	Reef area meeting target density (%)	---
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m^2)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	No
	Fall 2016: Did reef meet target* oyster biomass?	No
	Ave live biomass across reef (g dry weight per m2)	7.76
	Standard error of live biomass	3.11
	Reef area meeting min threshold* biomass (%)	---
	Reef area meeting target* biomass (%)	---
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	4.36
	Standard error of shell volume	1.29
	Total shell volume (litres)	70381.94
	Total surface shell volume (litres)	47667.77
	Ave brown shell across all samples (%)	32.27
Reef Height & Footprint	**Is the reef height stable or increasing?**	TBD 2018
	Is the reef footprint stable or increasing?	TBD 2018

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

***Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

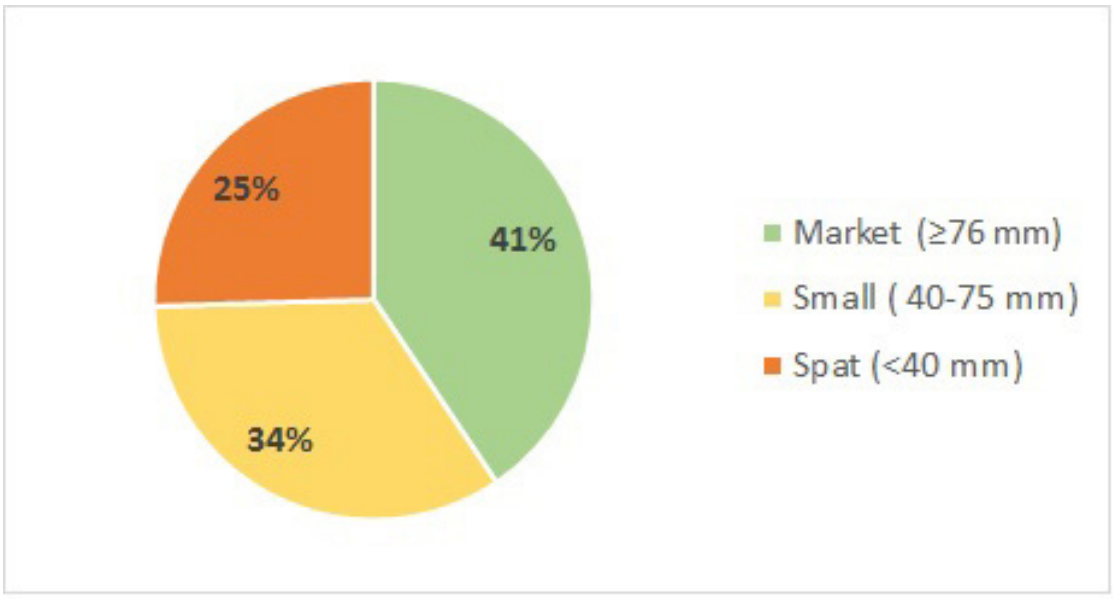
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

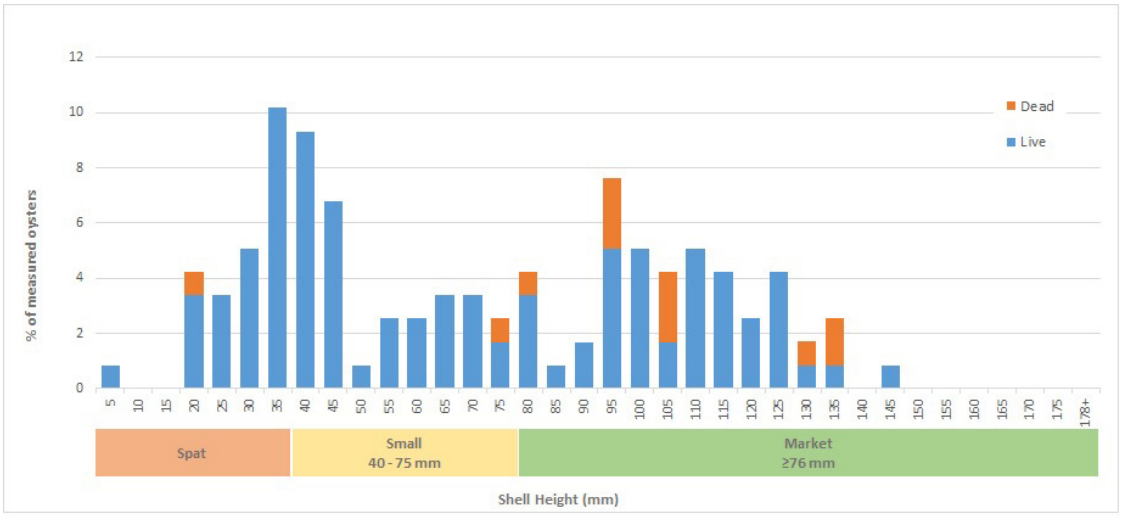
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H17 (CONTROL_2) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



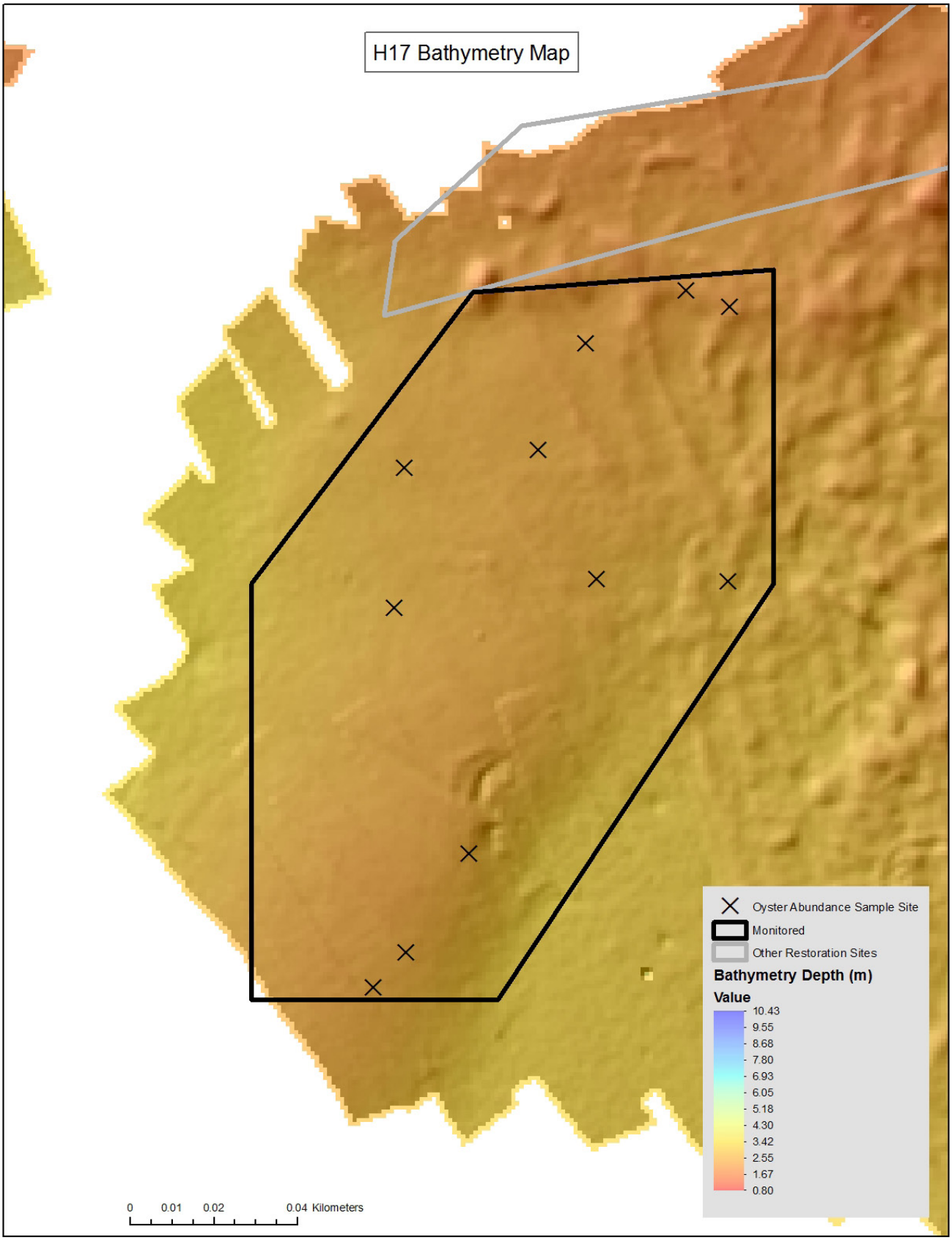
Shell Height of Oysters Measured on Reef



Reef H17 (CONTROL_2) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H18 (AltSub_20A) Data and Analysis

Reef #	H18
Geodatabase Site_ID	AltSub_20A
Bar Name	LODGES
Tributary	Harris
Reef area (acres)	2.35
Restoration treatment	Substrate & Seed
Substrate type added	Stone
Ave planned reef height** (inches)	12
Year planted with spat	2013
Spat produced by	UMD
Spat planted by	ORP
Spat planted (millions)	16.47
Spat planted per acre (millions)	7.01
Monitoring type	Three year/ sentinel
Sample Method	Diver
Most recent monitoring sample date	02-Nov-16
# samples taken	7
# live oysters measured	347
# live oysters counted	533
# dead oysters counted	40
% dead oysters observed on the reef	6.98%
Fall 2016: Did reef meet min threshold* density?	Yes
Fall 2016: Did reef meet target* density?	Yes
Ave live density across reef (#/ m2)	152.29
Standard error of live density (#/ m2)	26.51
Reef area meeting min threshold* density (%)	100%
Reef area meeting target density (%)	100%
Ave live density on stone (#/m^2)	74.29
Standard error of live density on stone	22.28
Ave live density on shell (#/m^2)	78.00
Standard error of live density on shell	28.81
Fall 2016: Did reef meet min threshold* oyster biomass?	Yes
Fall 2016: Did reef meet target* oyster biomass?	Yes
Ave live biomass across reef (g dry weight per m2)	120.32
Standard error of live biomass	28.73
Reef area meeting min threshold* biomass (%)	100%
Reef area meeting target* biomass (%)	100%
Pre restoration (2012): Did reef meet min threshold* density?	No
Pre restoration (2012): Did reef meet target* density?	No
Fall 2016: Are multiple year classes present ?	YES
Fall 2016: Is shell volume stable or increasing?	TBD 2019
Ave shell volume across entire reef (litres per m2)	11.86
Standard error of shell volume	5.25
Total shell volume (litres)	111622.2
Total surface shell volume (litres)	23121.74
Ave brown shell across all samples (%)	79.29
Is the reef height stable or increasing?	YES in 2015; no data in 2016
Is the reef footprint stable or increasing?	YES in 2015; no data in 2016

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

***Oyster density** (per Oyster Metrics):

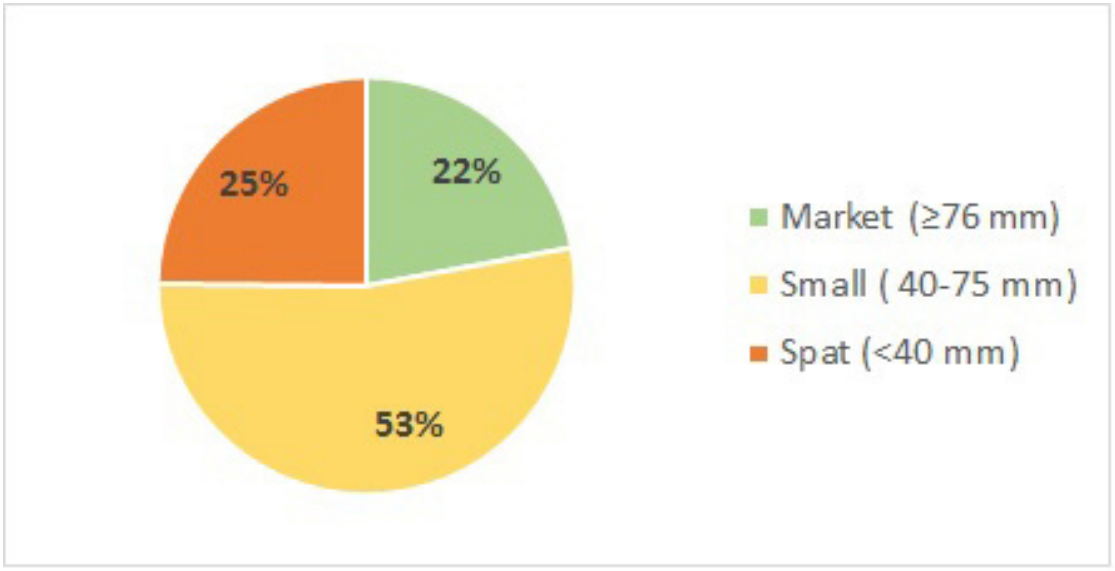
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

***Oyster biomass** (per Oyster Metrics):

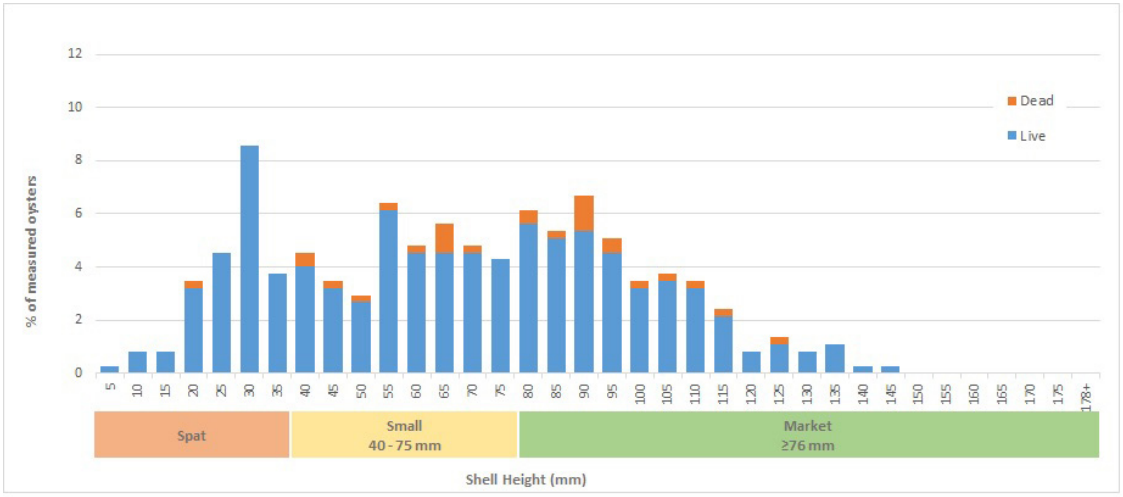
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H18 (AltSub_20A) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



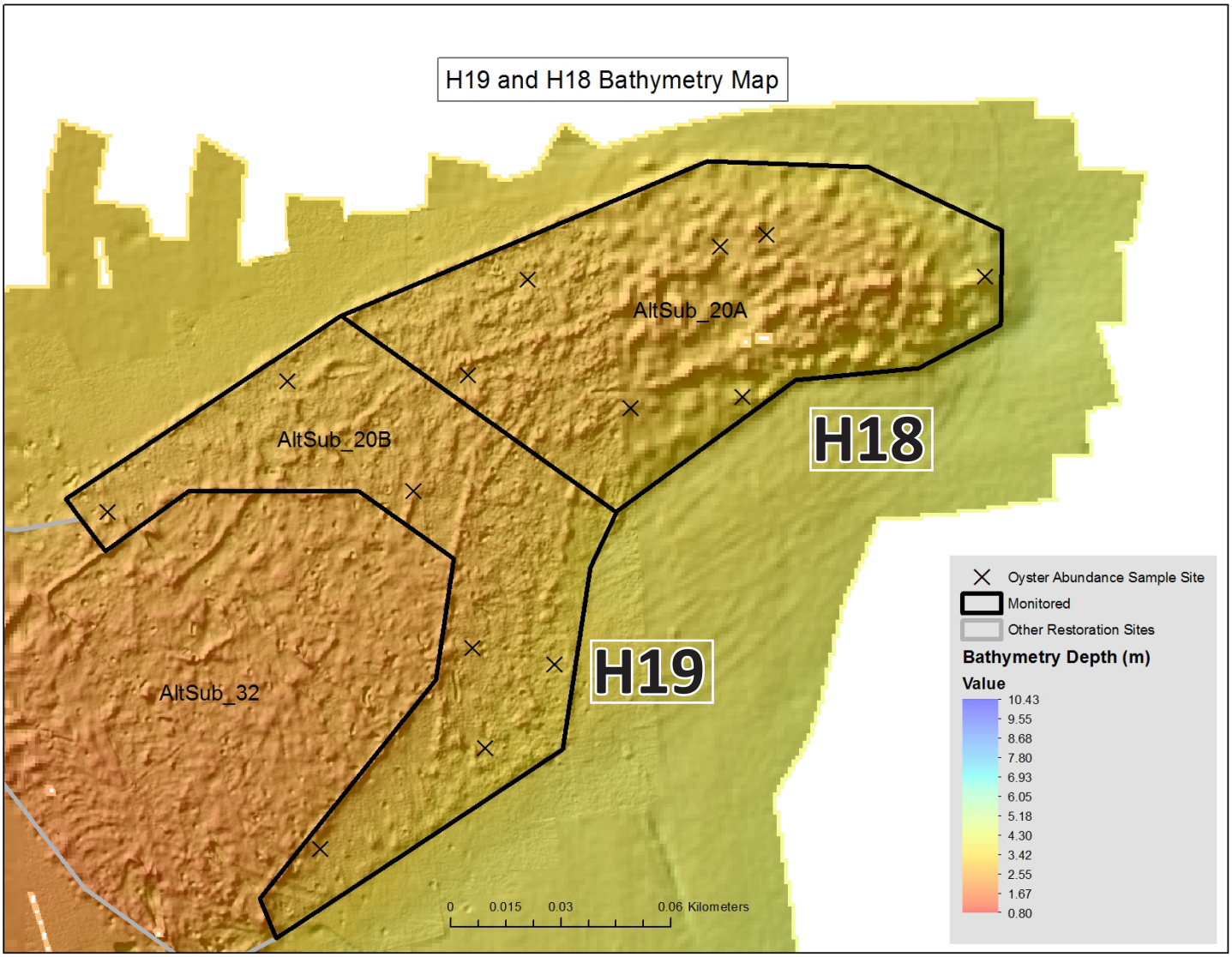
Shell Height of Oysters Measured on Reef



Reef H18 (AltSub_20A) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H19 (AltSub_20B) Data and Analysis

Reef Information	Reef #	H19
	Geodatabase Site_ID	AltSub_20B
	Bar Name	LODGES
	Tributary	Harris
	Reef area (acres)	2.02
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Stone
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	14.18
	Spat planted per acre (millions)	7.01
Monitoring Information	Monitoring type	Three year
	Sample Method	Diver
	Most recent monitoring sample date	02-Nov-16
	# samples taken	7
	# live oysters measured	219
	# live oysters counted	488
	# dead oysters counted	31
	% dead oysters observed on the reef	5.97%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	139.43
	Standard error of live density (#/ m2)	25.66
	Reef area meeting min threshold* density (%)	100%
	Reef area meeting target density (%)	100%
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	84.86
	Standard error of live density on stone	13.32
	Ave live density on shell (#/m^2)	50.57
	Standard error of live density on shell	22.08
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	95.48
	Standard error of live biomass	16.71
	Reef area meeting min threshold* biomass (%)	100%
	Reef area meeting target* biomass (%)	81%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	6.71
	Standard error of shell volume	2.54
	Total shell volume (litres)	51257.82
	Total surface shell volume (litres)	2929.02
	Ave brown shell across all samples (%)	94.29
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

***Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

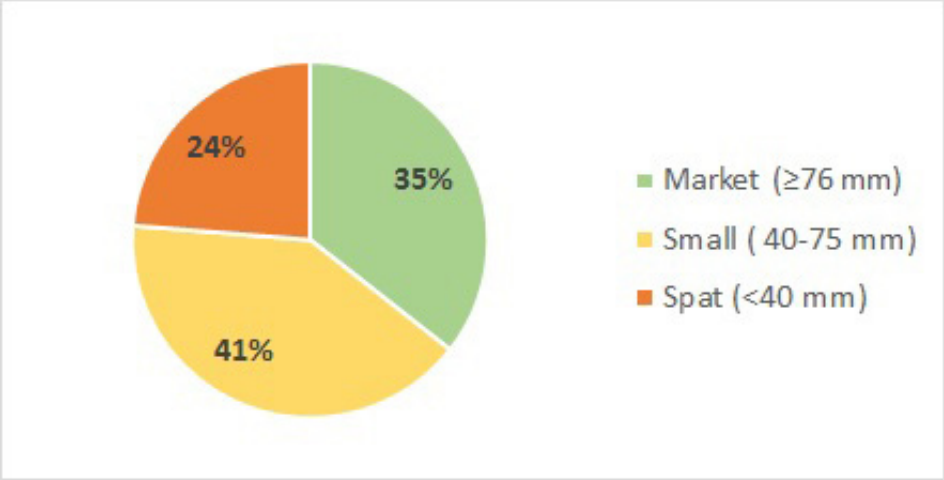
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

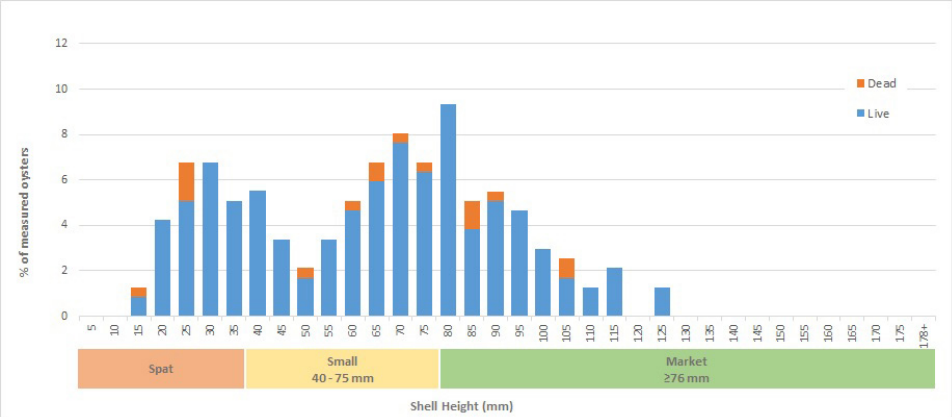
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H19 (AltSub_20B) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories

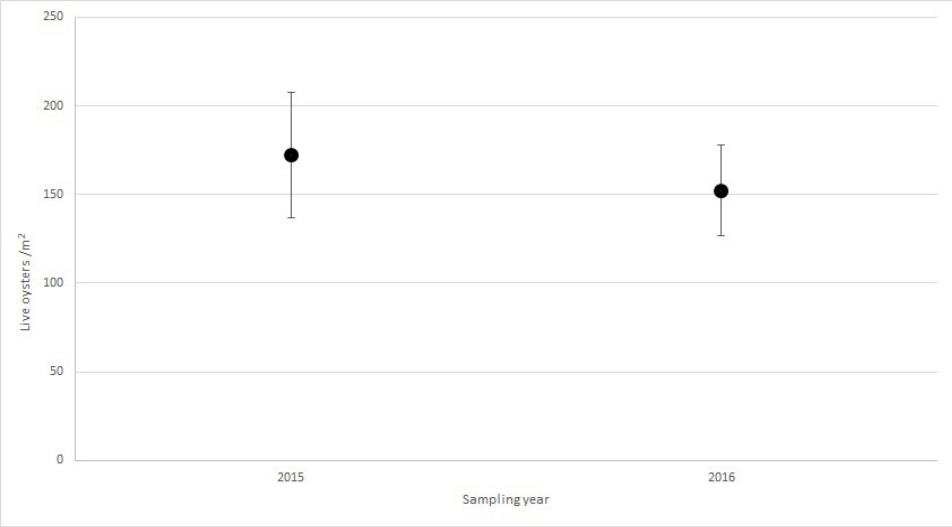


Shell Height of Oysters Measured on Reef



Average Live Oyster Densities Found on Reef H1 from 2013 through 2016

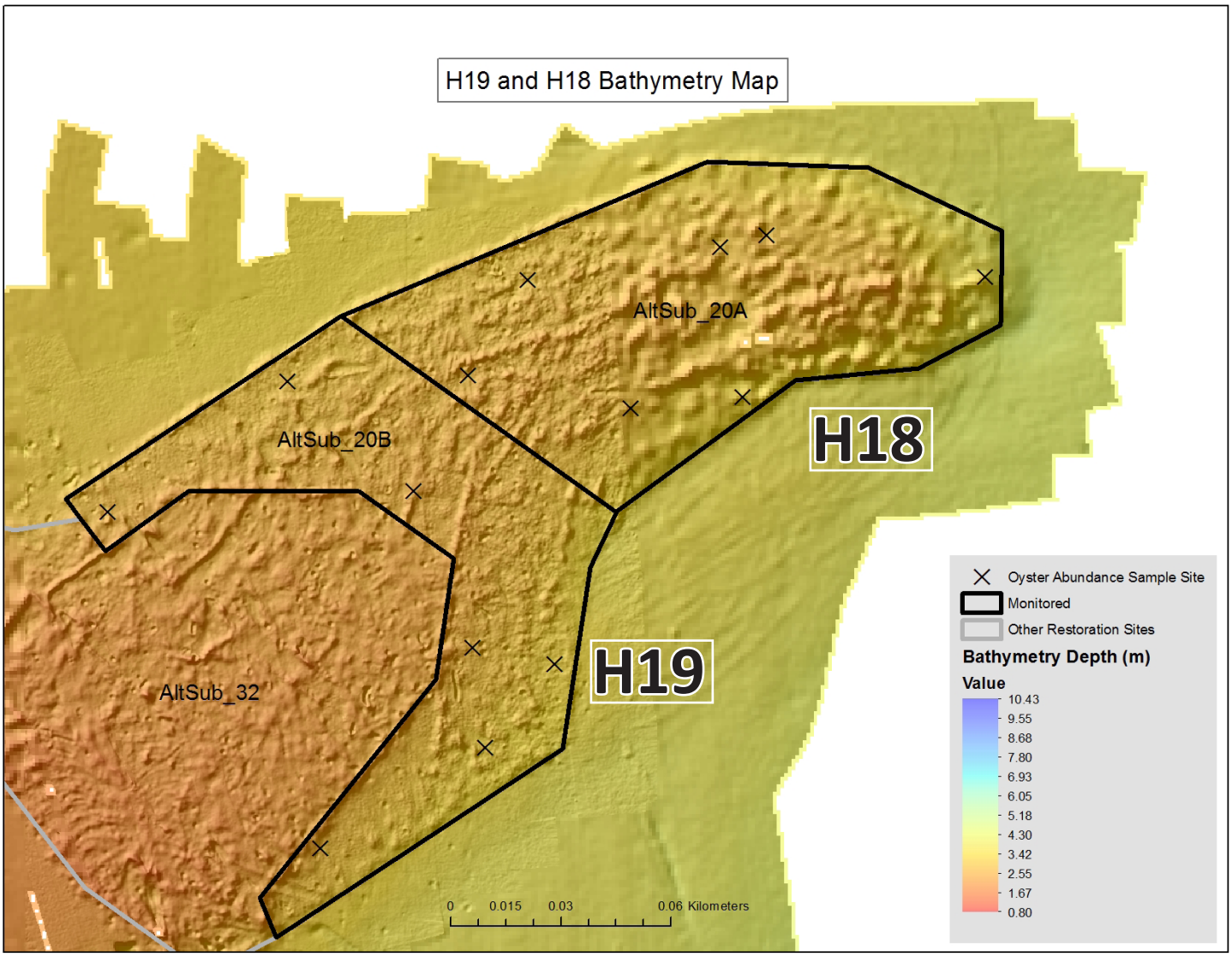
Error bars represent +/- standard error.



Reef H19 (AltSub_20B) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H20 (AltSub_49A) Data and Analysis

Reef Information	Reef #	H20
	Geodatabase Site_ID	AltSub_49A
	Bar Name	TILGHMAN WHARF
	Tributary	Harris
	Reef area (acres)	2.52
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Stone
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	16.17
	Spat planted per acre (millions)	6.40
Monitoring Information	Monitoring type	Three year
	Sample Method	Diver
	Most recent monitoring sample date	02-Nov-16
	# samples taken	8
	# live oysters measured	310
	# live oysters counted	756
	# dead oysters counted	58
	% dead oysters observed on the reef	7.13%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	189.00
	Standard error of live density (#/ m2)	47.41
	Reef area meeting min threshold* density (%)	100%
	Reef area meeting target density (%)	85%
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	98.75
	Standard error of live density on stone	30.14
	Ave live density on shell (#/m^2)	90.25
	Standard error of live density on shell	34.64
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	162.64
	Standard error of live biomass	41.21
	Reef area meeting min threshold* biomass (%)	100%
	Reef area meeting target* biomass (%)	86%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	15.38
	Standard error of shell volume	5.67
	Total shell volume (litres)	157028.42
	Total surface shell volume (litres)	8832.85
	Ave brown shell across all samples (%)	94.38
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

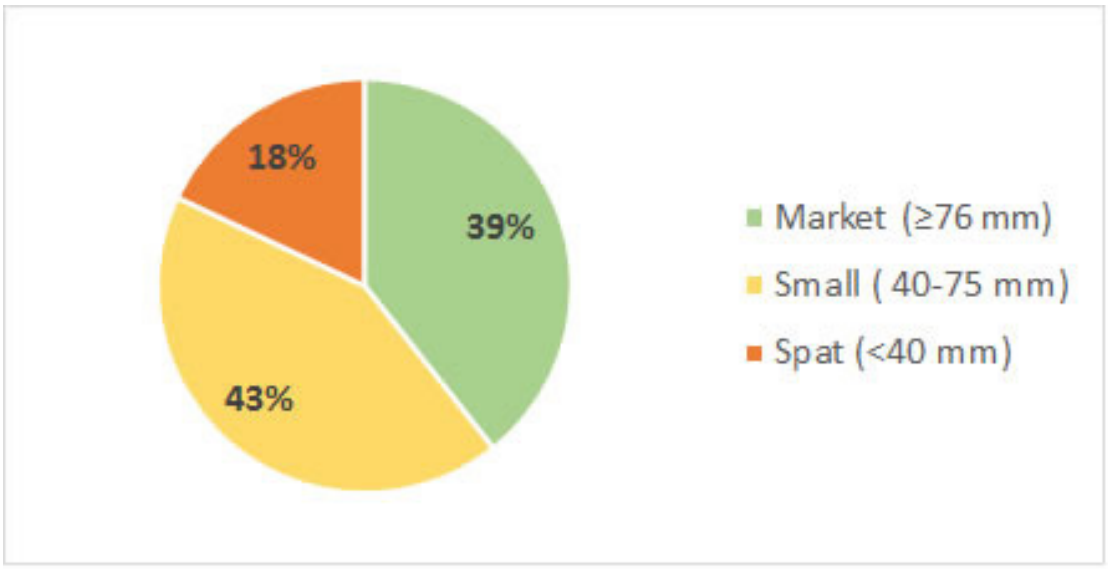
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

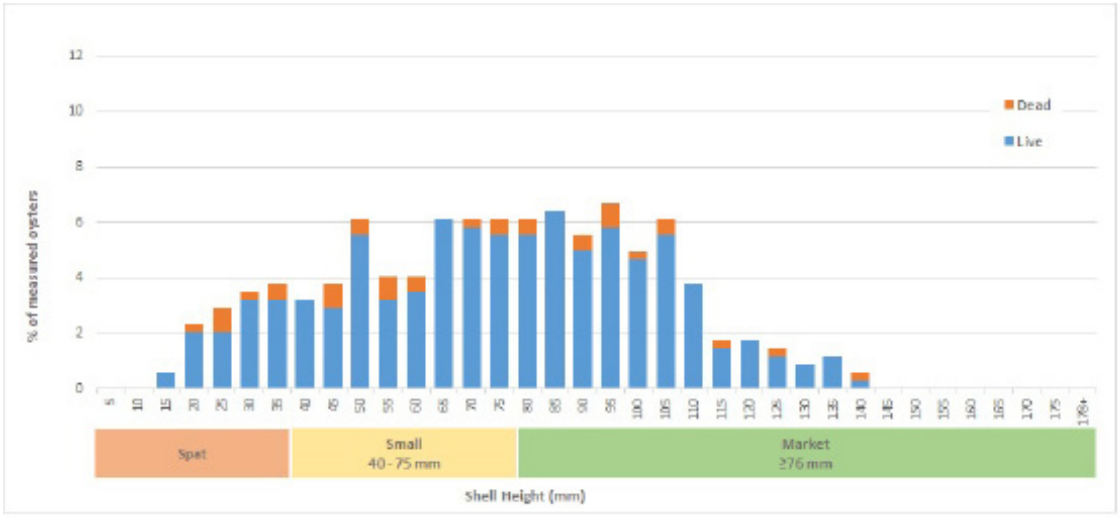
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H20 (AltSub_49A) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



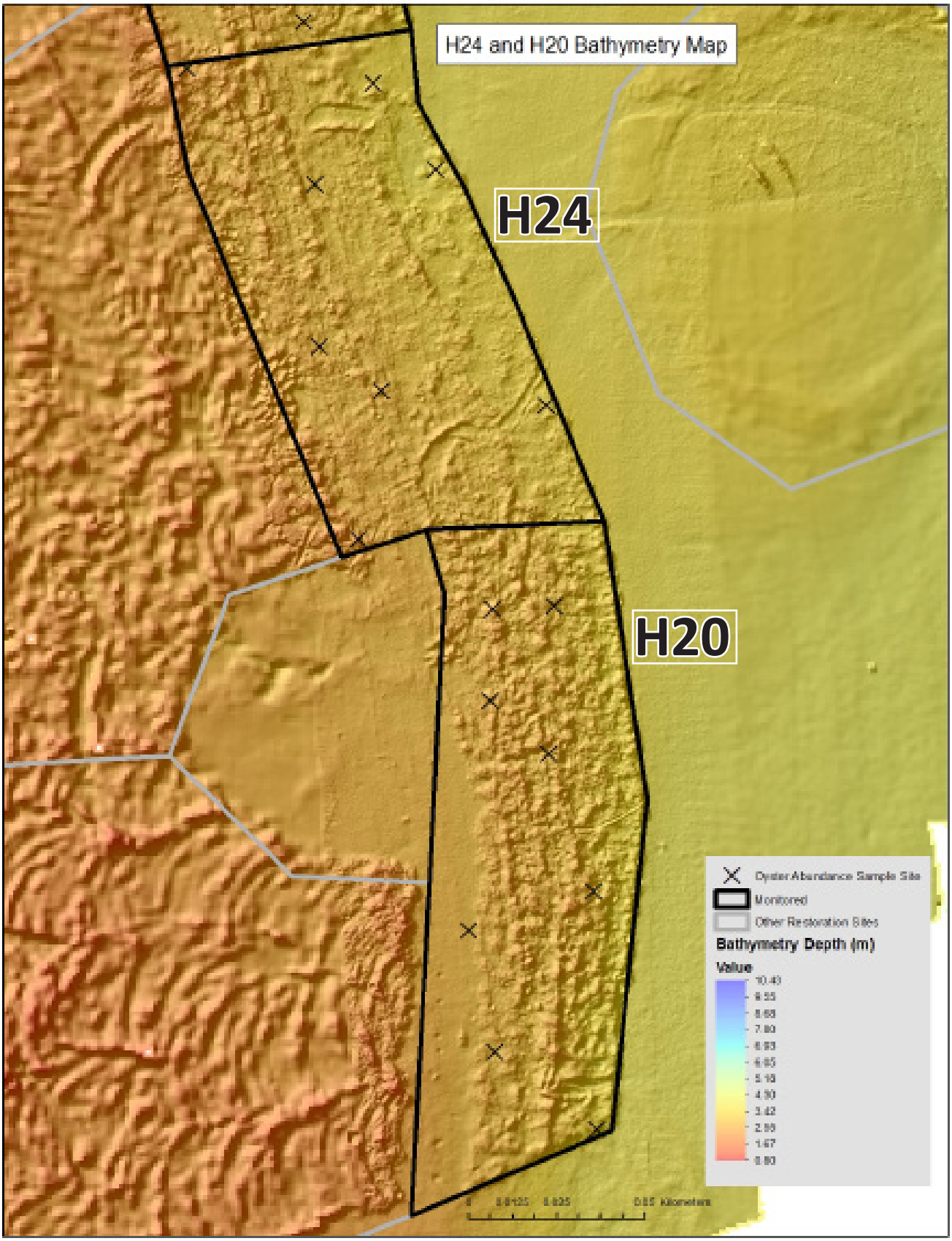
Shell Height of Oysters Measured on Reef



Reef H20 (AltSub_49A) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H21 (AltSub_57B) Data and Analysis

Reef Information	Reef #	H21
	Geodatabase Site_ID	AltSub_57B
	Bar Name	MILL POINT
	Tributary	Harris
	Reef area (acres)	2.01
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Mixed shell
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	14.23
	Spat planted per acre (millions)	7.07
Monitoring Information	Monitoring type	Three year
	Sample Method	Patent Tong
	Most recent monitoring sample date	01-Nov-16
	# samples taken	6
	# live oysters measured	204
	# live oysters counted	972
	# dead oysters counted	104
	% dead oysters observed on the reef	9.67%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	100.62
	Standard error of live density (#/ m2)	24.77
	Reef area meeting min threshold* density (%)	82%
	Reef area meeting target density (%)	82%
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m^2)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	137.44
	Standard error of live biomass	35.49
	Reef area meeting min threshold* biomass (%)	82%
	Reef area meeting target* biomass (%)	82%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	21.07
	Standard error of shell volume	5.17
	Total shell volume (litres)	166385.47
	Total surface shell volume (litres)	101217.83
	Ave brown shell across all samples (%)	39.17
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

***Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

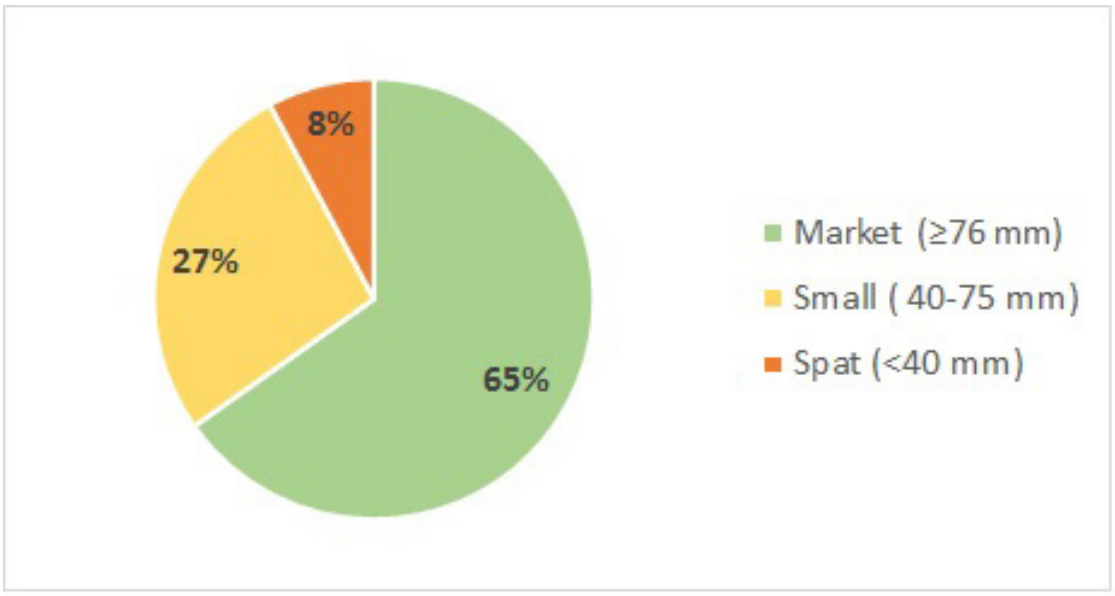
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

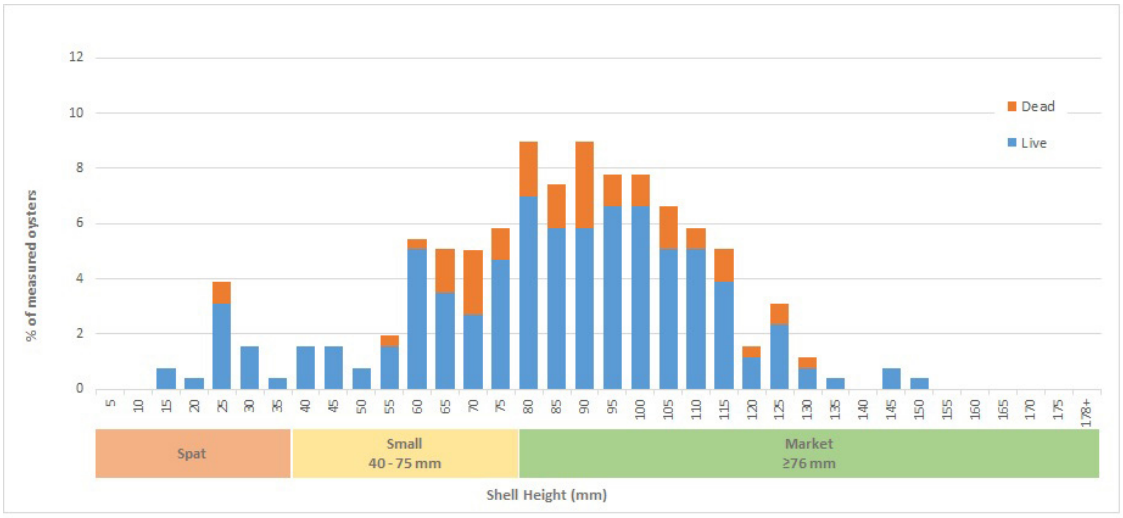
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H21 (AltSub_57B) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



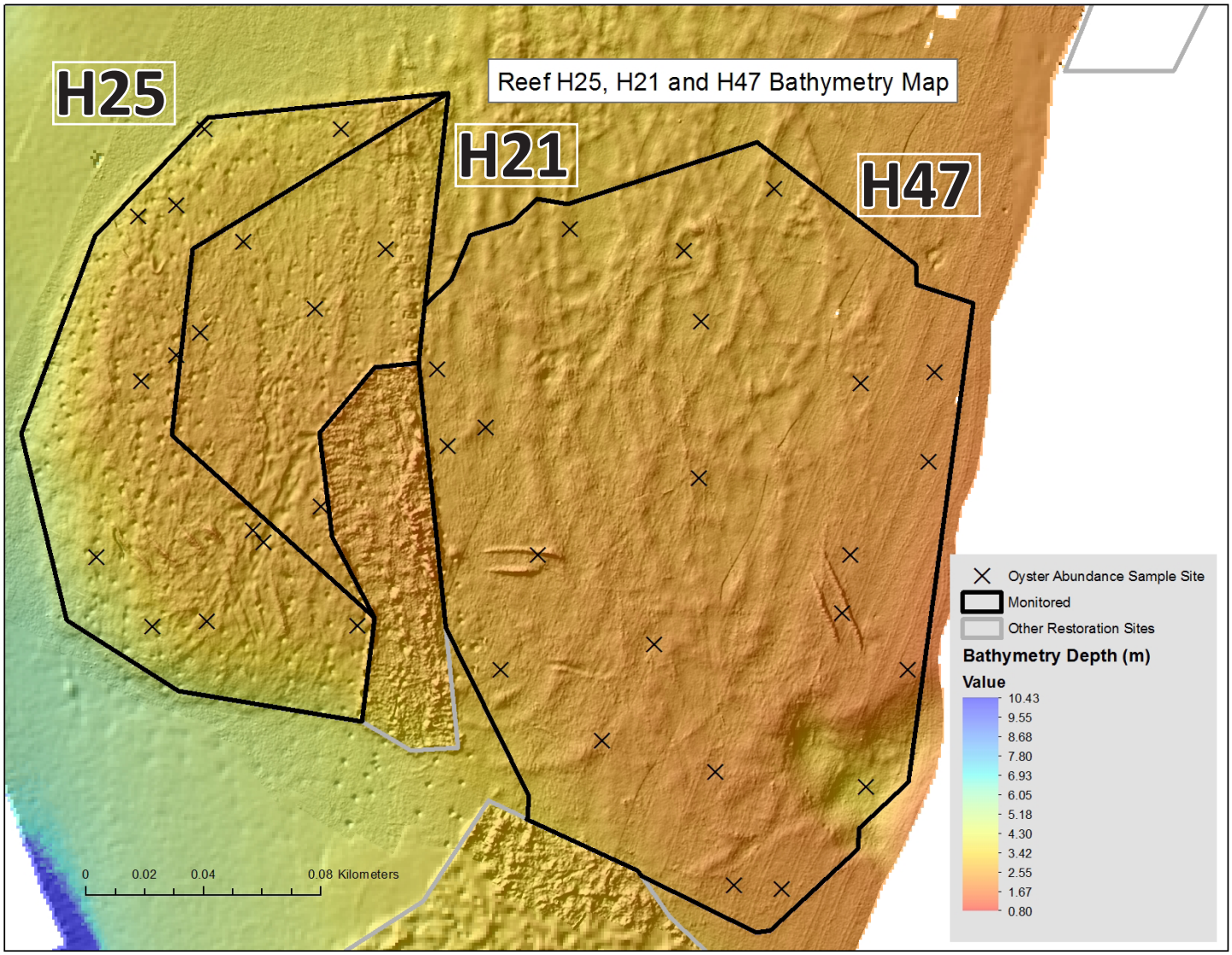
Shell Height of Oysters Measured on Reef



Reef H21 (AltSub_57B) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H22 (AltSub_71A) Data and Analysis

Reef Information	Reef #	H22
	Geodatabase Site_ID	AltSub_71A
	Bar Name	CHANGE
	Tributary	Harris
	Reef area (acres)	1.11
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Stone
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	10.66
	Spat planted per acre (millions)	9.58
Monitoring Information	Monitoring type	Three year
	Sample Method	Diver
	Most recent monitoring sample date	18-Nov-16
	# samples taken	4
	# live oysters measured	144
	# live oysters counted	450
	# dead oysters counted	29
	% dead oysters observed on the reef	6.05%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	225.00
	Standard error of live density (#/ m2)	56.45
	Reef area meeting min threshold* density (%)	100%
	Reef area meeting target density (%)	100%
Density on Stone vs. Shell	Ave live density on stone (#/m²)	114.00
	Standard error of live density on stone	33.49
	Ave live density on shell (#/m²)	111.00
	Standard error of live density on shell	86.64
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	179.71
	Standard error of live biomass	47.86
	Reef area meeting min threshold* biomass (%)	100%
	Reef area meeting target* biomass (%)	100%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	17.5
	Standard error of shell volume	12.11
	Total shell volume (litres)	78466.37
	Total surface shell volume (litres)	3923.32
	Ave brown shell across all samples (%)	95
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

***Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

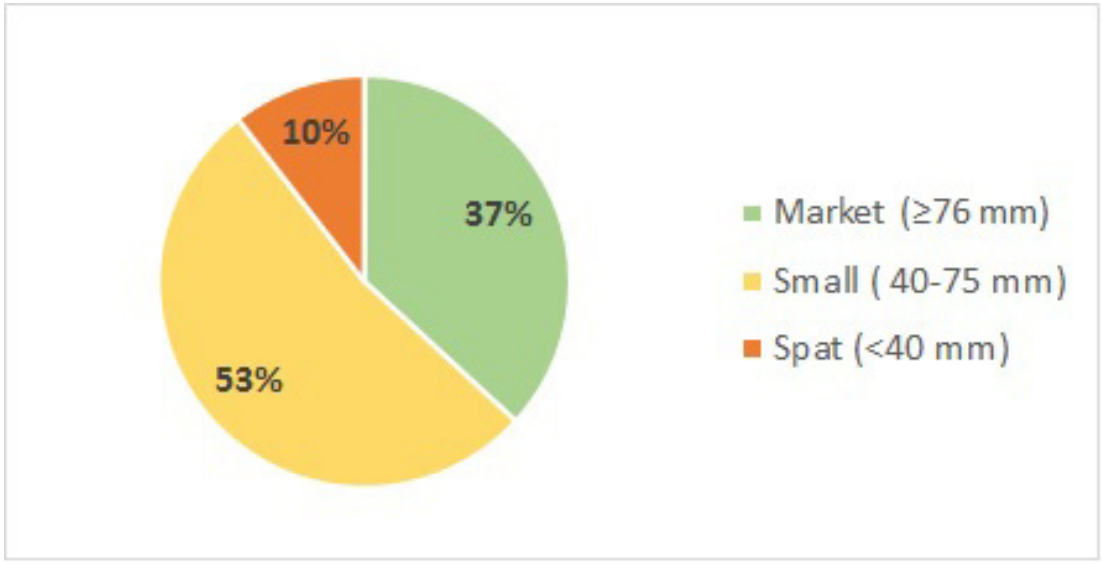
- Min. threshold: 50% of reef is covered with at least 15 oysters per m²
- Target: 30% of reef is covered with at least 50 oysters per m²

**Oyster biomass* (per Oyster Metrics):

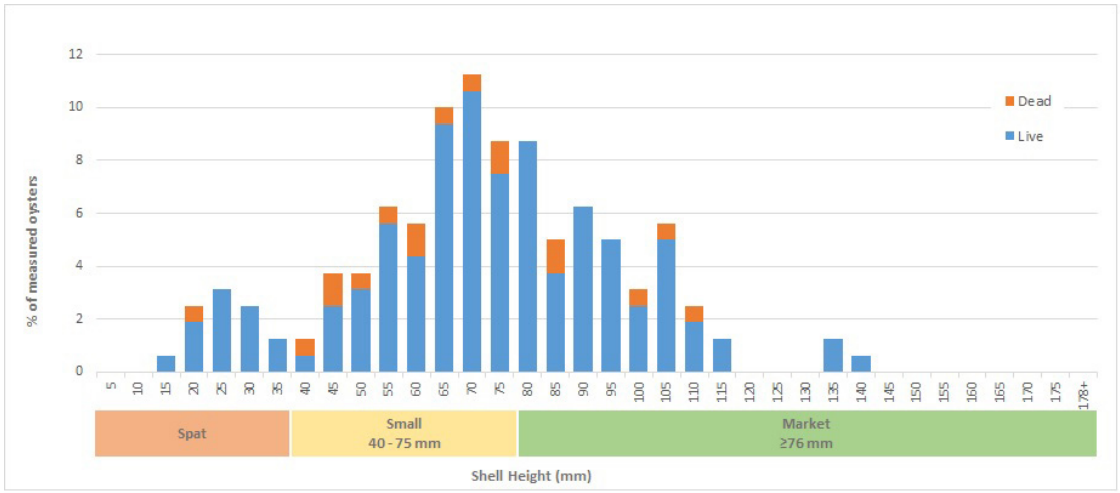
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m²
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m²

Reef H22 (AltSub_71A) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



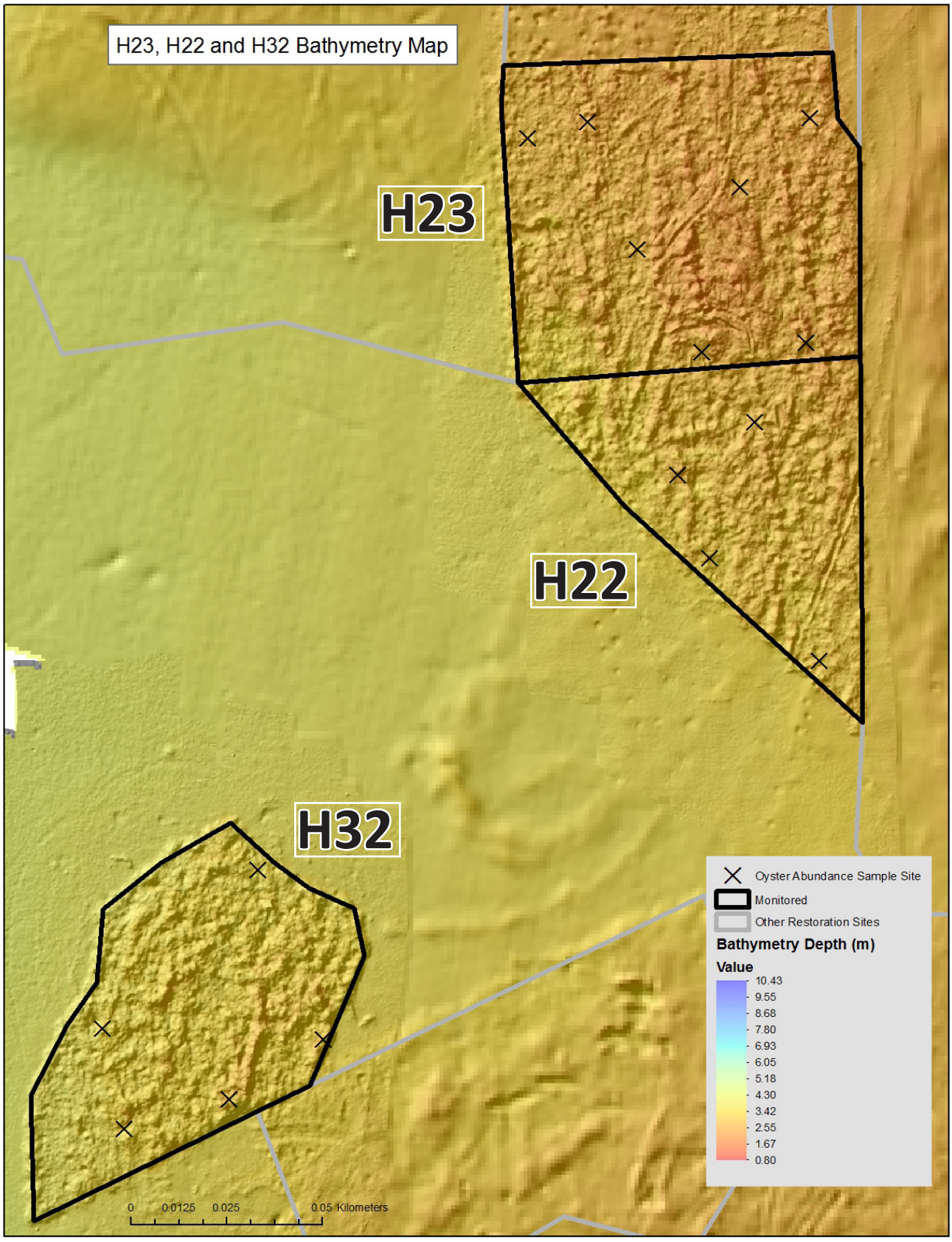
Shell Height of Oysters Measured on Reef



Reef H22 (AltSub_71A) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H23 (AltSub_71B) Data and Analysis

Reef Information	Reef #	H23
	Geodatabase Site_ID	AltSub_71B
	Bar Name	CHANGE
	Tributary	Harris
	Reef area (acres)	1.82
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Stone
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	17.40
	Spat planted per acre (millions)	9.58
Monitoring Information	Monitoring type	Three year
	Sample Method	Diver
	Most recent monitoring sample date	03-Nov-16
	# samples taken	7
	# live oysters measured	302
	# live oysters counted	791
	# dead oysters counted	70
	% dead oysters observed on the reef	8.13%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	226.00
	Standard error of live density (#/ m2)	18.99
	Reef area meeting min threshold* density (%)	100%
	Reef area meeting target density (%)	100%
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	121.71
	Standard error of live density on stone	31.21
	Ave live density on shell (#/m^2)	104.29
	Standard error of live density on shell	31.23
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	188.69
	Standard error of live biomass	25.27
	Reef area meeting min threshold* biomass (%)	100%
	Reef area meeting target* biomass (%)	100%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	20.29
	Standard error of shell volume	6.05
	Total shell volume (litres)	145585.75
	Total surface shell volume (litres)	14558.57
	Ave brown shell across all samples (%)	90
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):*

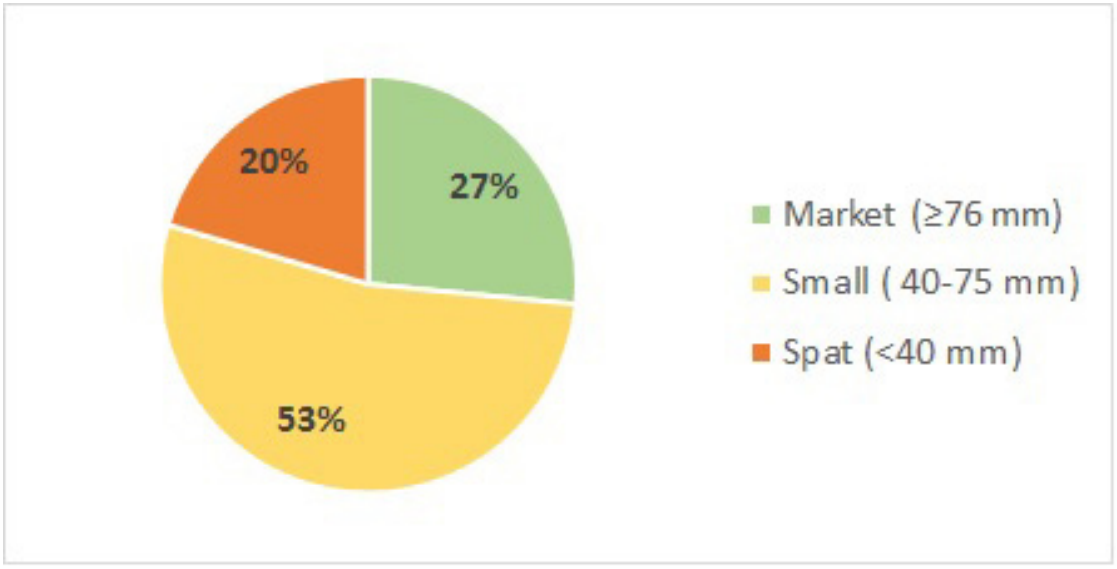
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

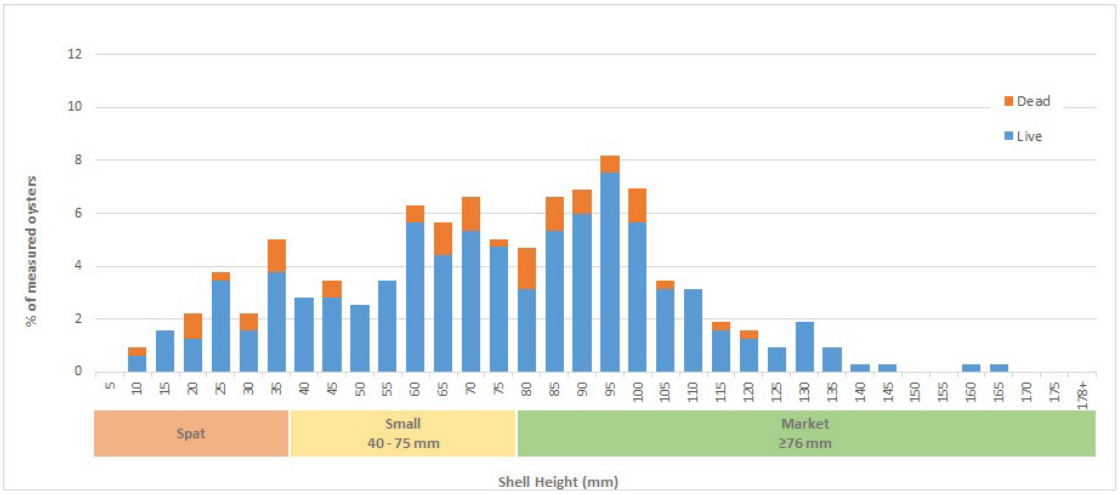
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H23 (AltSub_71B) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



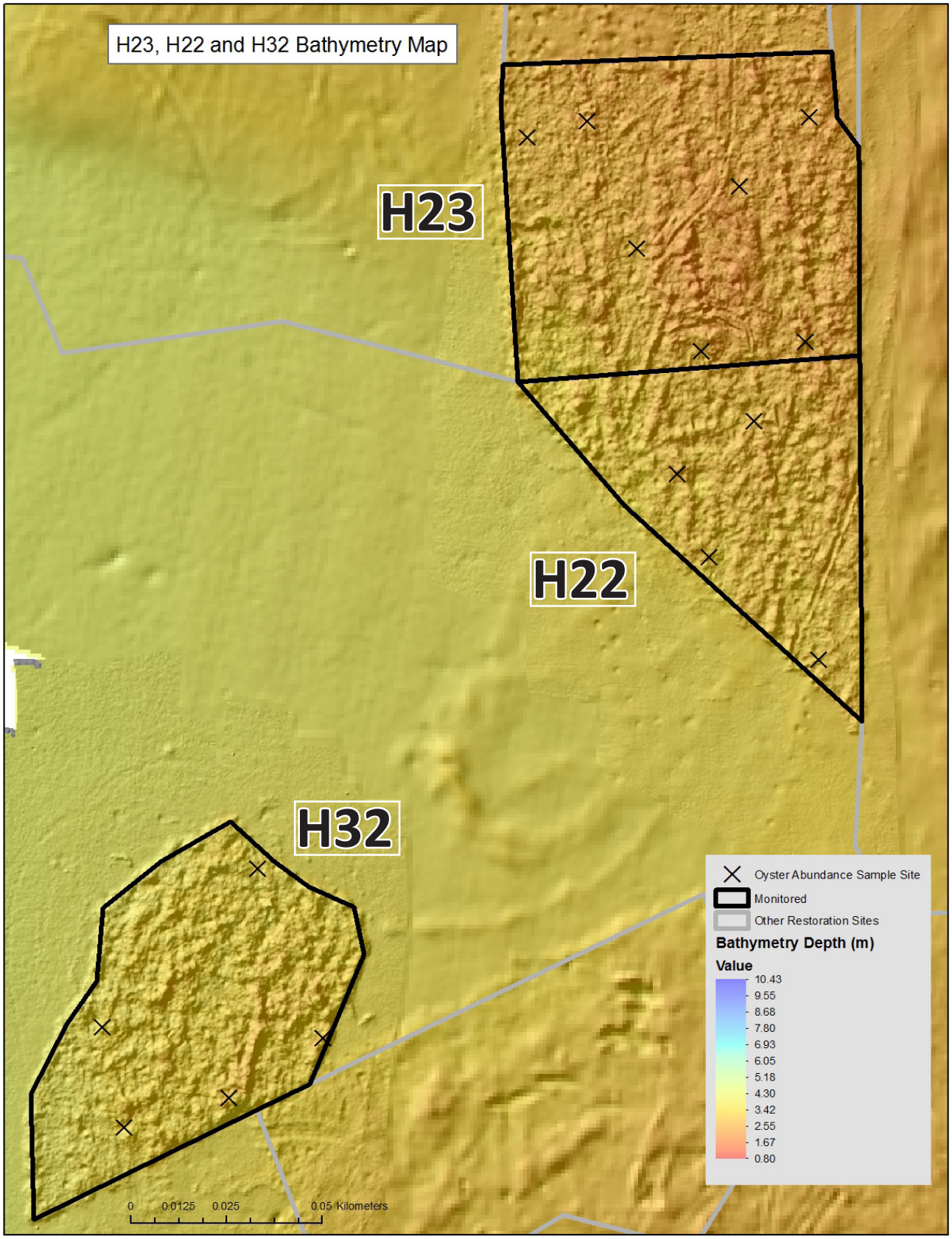
Shell Height of Oysters Measured on Reef



Reef H23 (AltSub_71B) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H24 (AltSub_49B) Data and Analysis

Reef Information	Reef #	H24
	Geodatabase Site_ID	AltSub_49B
	Bar Name	TILGHMAN WHARF
	Tributary	Harris
	Reef area (acres)	2.52
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Stone
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	16.47
	Spat planted per acre (millions)	6.40
Monitoring Information	Monitoring type	Three year
	Sample Method	Diver
	Most recent monitoring sample date	02-Nov-16
	# samples taken	8
	# live oysters measured	224
	# live oysters counted	695
	# dead oysters counted	40
	% dead oysters observed on the reef	5.44%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	173.75
	Standard error of live density (#/ m2)	78.66
	Reef area meeting min threshold* density (%)	94%
	Reef area meeting target density (%)	75%
Density on Stone vs. Shell	Ave live density on stone (#/m²)	43.75
	Standard error of live density on stone	14.19
	Ave live density on shell (#/m²)	130.00
	Standard error of live density on shell	81.25
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	115.28
	Standard error of live biomass	35.62
	Reef area meeting min threshold* biomass (%)	94%
	Reef area meeting target* biomass (%)	70%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	16.25
	Standard error of shell volume	6.33
	Total shell volume (litres)	165617.08
	Total surface shell volume (litres)	33537.46
	Ave brown shell across all samples (%)	79.75
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

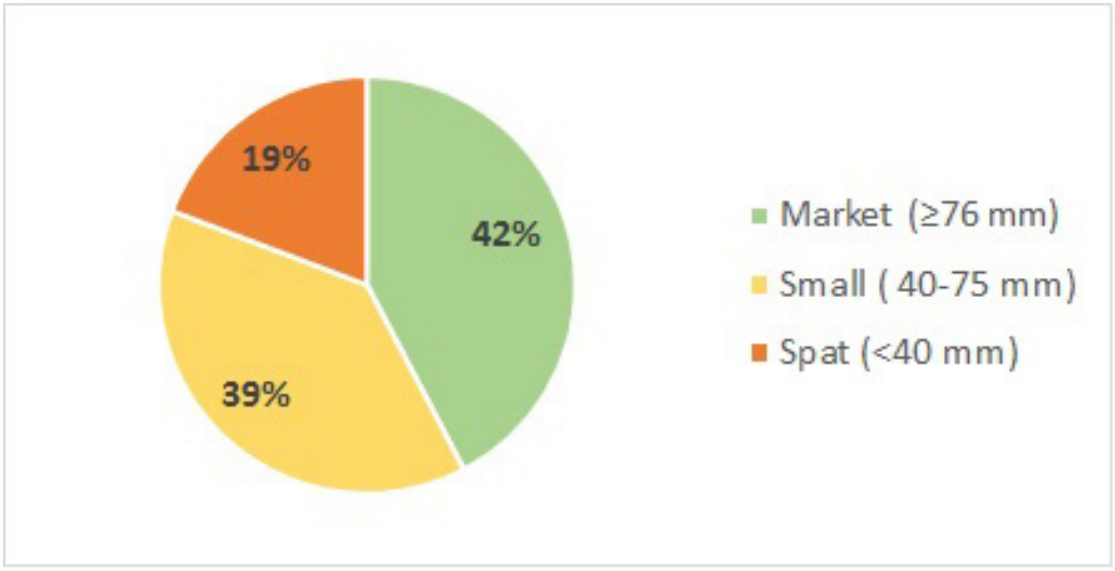
- Min. threshold: 50% of reef is covered with at least 15 oysters per m²
- Target: 30% of reef is covered with at least 50 oysters per m²

**Oyster biomass* (per Oyster Metrics):

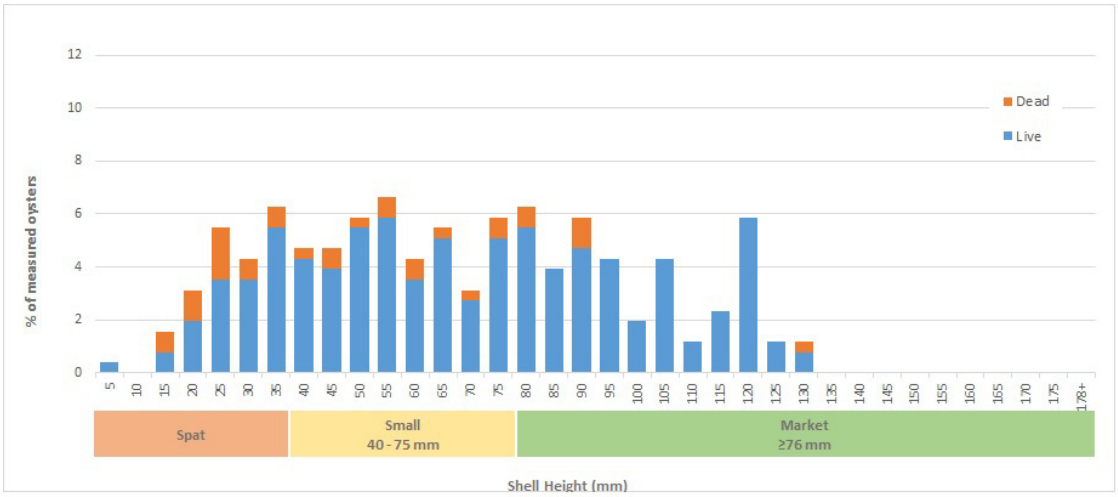
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m²
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m²

Reef H24 (AltSub_49B) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



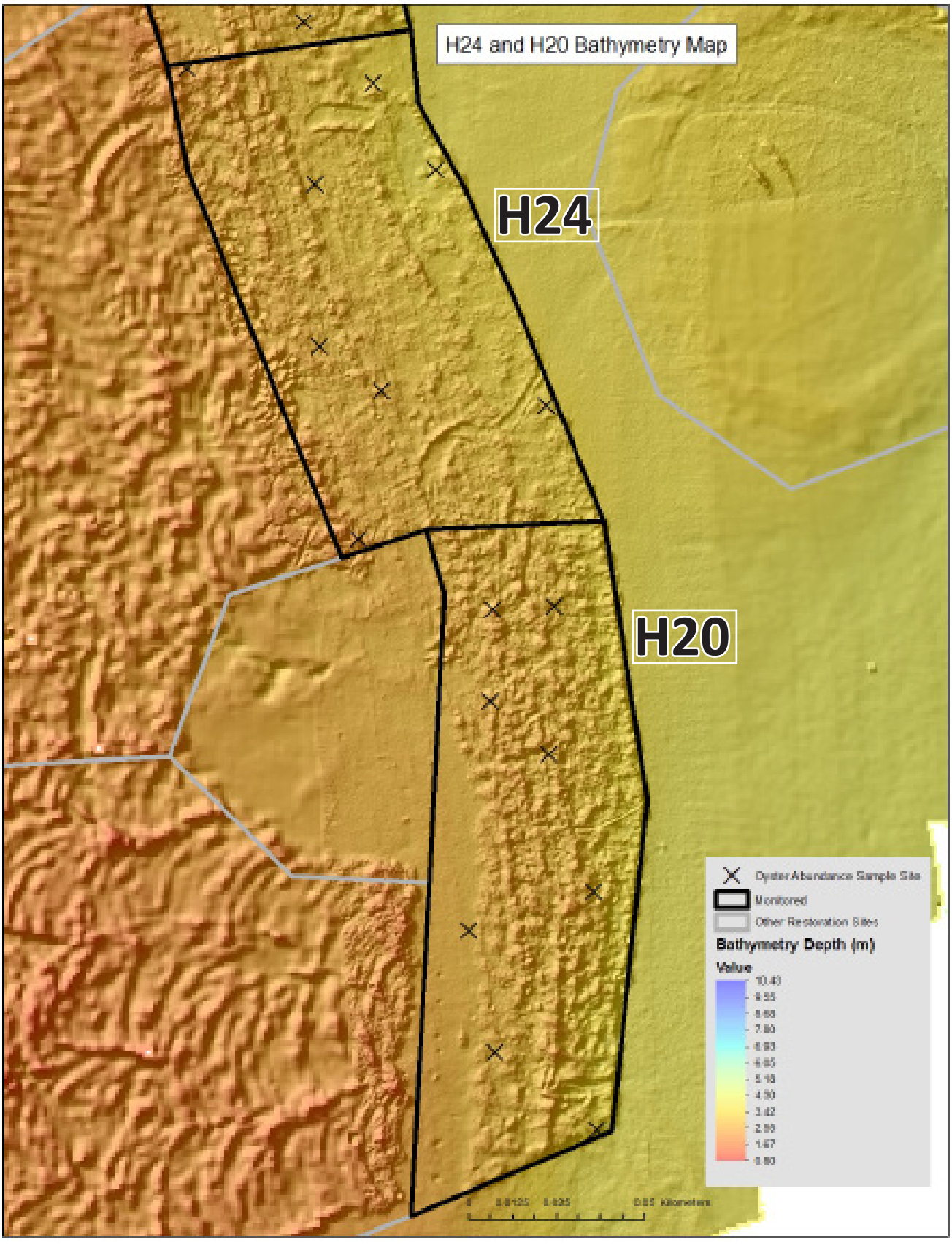
Shell Height of Oysters Measured on Reef



Reef H24 (AltSub_49B) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H25 (AltSub_57A) Data and Analysis

Reef Information	Reef #	H25
	Geodatabase Site_ID	AltSub_57A
	Bar Name	MILL POINT
	Tributary	Harris
	Reef area (acres)	3.13
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Mixed shell
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	13.61
	Spat planted per acre (millions)	4.34
Monitoring Information	Monitoring type	Three year
	Sample Method	Patent Tong
	Most recent monitoring sample date	16-Nov-16
	# samples taken	11
	# live oysters measured	337
	# live oysters counted	1220
	# dead oysters counted	188
	% dead oysters observed on the reef	13.35%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	68.89
	Standard error of live density (#/ m2)	9.35
	Reef area meeting min threshold* density (%)	97%
	Reef area meeting target density (%)	81%
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m^2)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	109.40
	Standard error of live biomass	17.26
	Reef area meeting min threshold* biomass (%)	97%
	Reef area meeting target* biomass (%)	97%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	17
	Standard error of shell volume	2.12
	Total shell volume (litres)	212307.85
	Total surface shell volume (litres)	79132.92
	Ave brown shell across all samples (%)	62.73
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

***Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

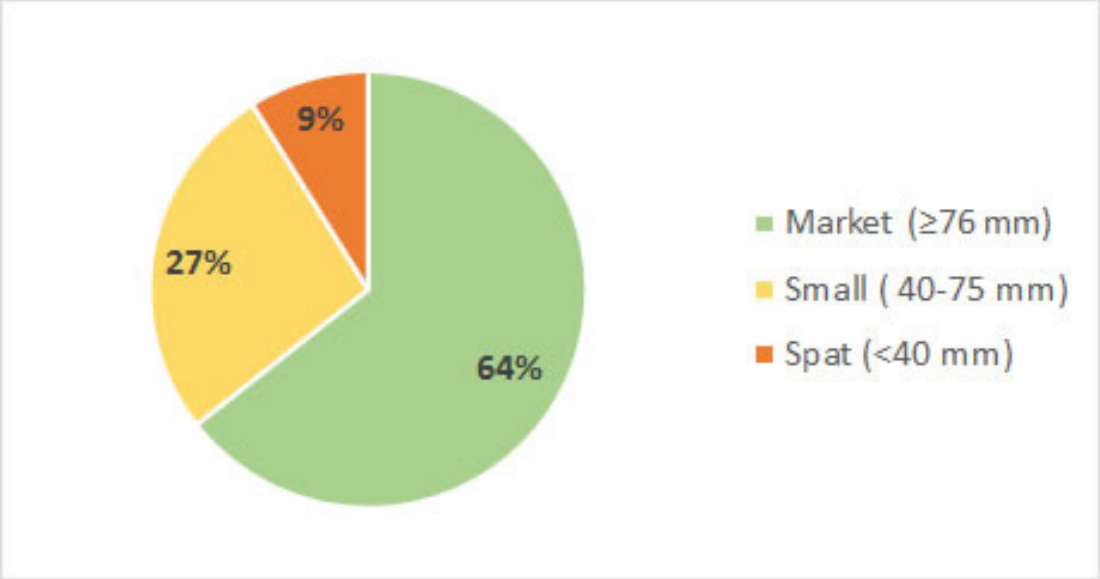
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

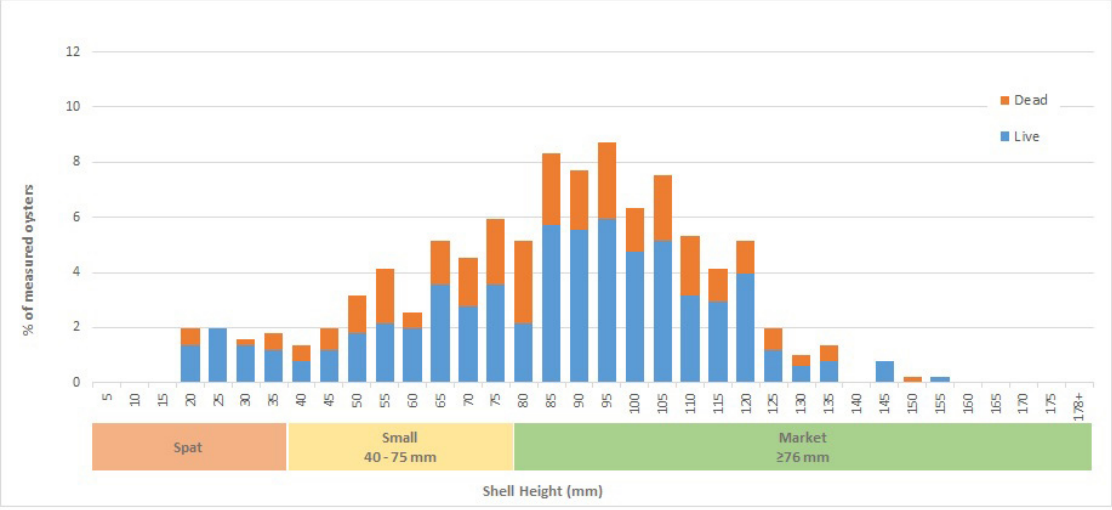
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H25 (AltSub_57A) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



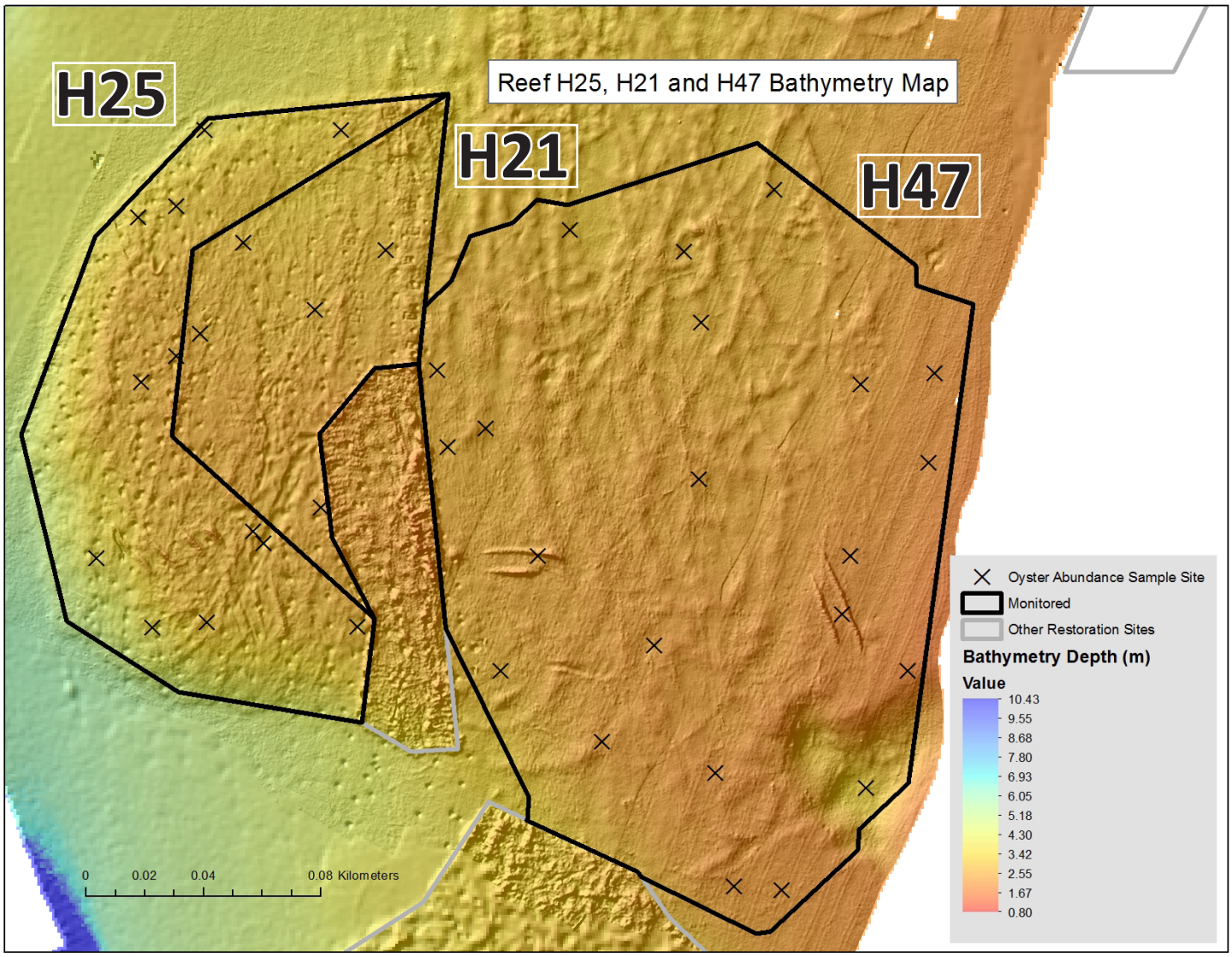
Shell Height of Oysters Measured on Reef



Reef H25 (AltSub_57A) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H26 (AltSub_01) Data and Analysis

Reef Information	Reef #	H26
	Geodatabase Site_ID	AltSub_01
	Bar Name	TILGHMAN WHARF
	Tributary	Harris
	Reef area (acres)	1.43
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Stone
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	9.15
	Spat planted per acre (millions)	6.40
Monitoring Information	Monitoring type	Three year
	Sample Method	Diver
	Most recent monitoring sample date	13-Oct-16
	# samples taken	6
	# live oysters measured	193
	# live oysters counted	390
	# dead oysters counted	43
	% dead oysters observed on the reef	9.93%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	130.00
	Standard error of live density (#/ m2)	42.73
	Reef area meeting min threshold* density (%)	100%
	Reef area meeting target density (%)	100%
Density on Stone vs. Shell	Ave live density on stone (#/m²)	66.00
	Standard error of live density on stone	12.34
	Ave live density on shell (#/m²)	64.00
	Standard error of live density on shell	36.38
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	129.21
	Standard error of live biomass	43.64
	Reef area meeting min threshold* biomass (%)	100%
	Reef area meeting target* biomass (%)	100%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	14
	Standard error of shell volume	6.99
	Total shell volume (litres)	78256.96
	Total surface shell volume (litres)	5869.27
	Ave brown shell across all samples (%)	92.5
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

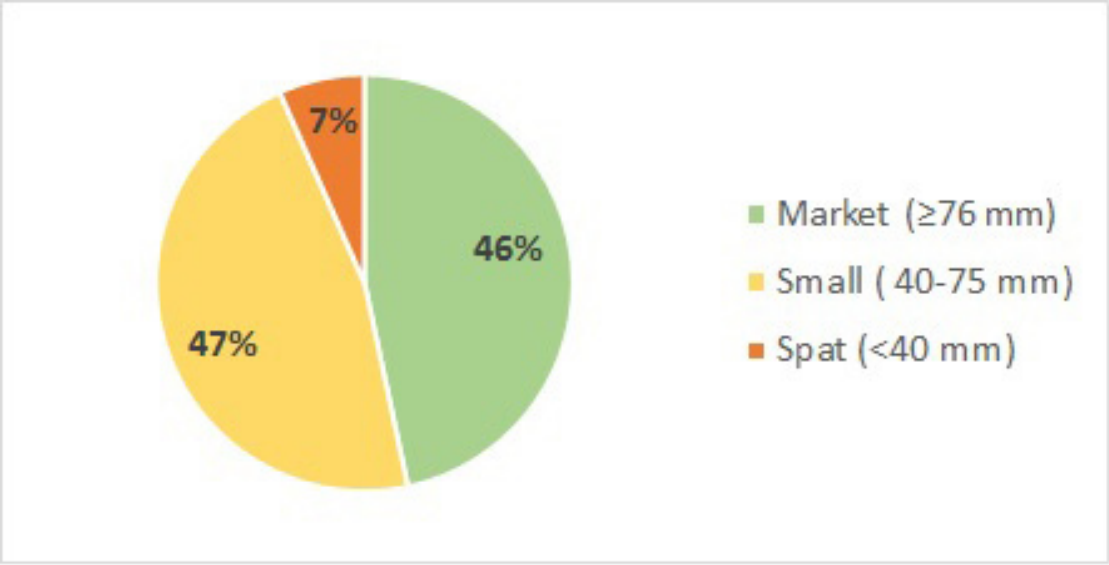
- Min. threshold: 50% of reef is covered with at least 15 oysters per m²
- Target: 30% of reef is covered with at least 50 oysters per m²

**Oyster biomass* (per Oyster Metrics):

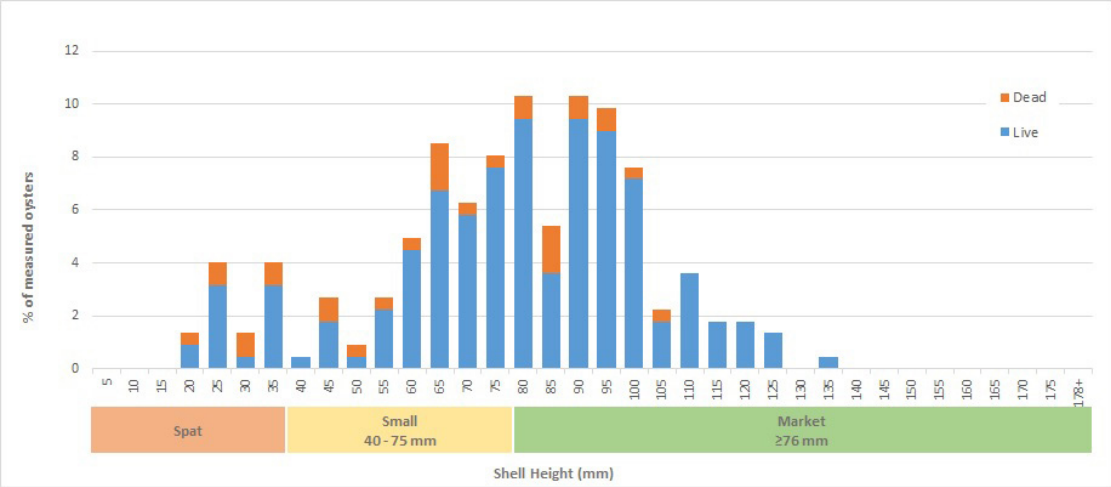
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m²
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m²

Reef H26 (AltSub_01) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



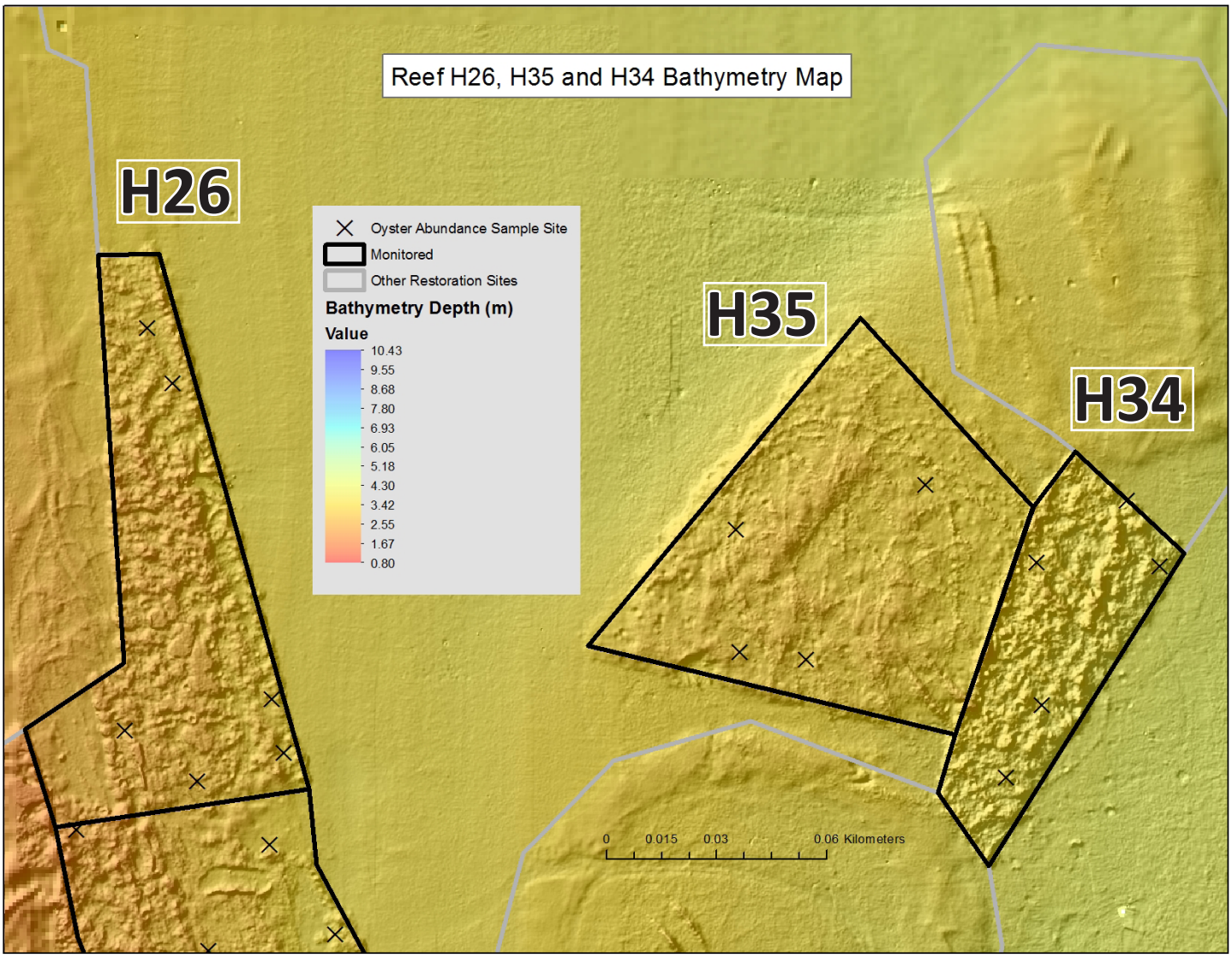
Shell Height of Oysters Measured on Reef



Reef H26 (AltSub_01) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H27 (AltSub_03) Data and Analysis

Reef Information	Reef #	H27
	Geodatabase Site_ID	AltSub_03
	Bar Name	N/A
	Tributary	Harris
	Reef area (acres)	5.33
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Stone
	Ave planned reef height** (inches)	6
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	44.01
	Spat planted per acre (millions)	8.26
Monitoring Information	Monitoring type	Three year
	Sample Method	Diver
	Most recent monitoring sample date	17-Oct-16
	# samples taken	8
	# live oysters measured	287
	# live oysters counted	679
	# dead oysters counted	134
	% dead oysters observed on the reef	16.48%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	169.75
	Standard error of live density (#/ m2)	25.14
	Reef area meeting min threshold* density (%)	100%
	Reef area meeting target density (%)	98%
Density on Stone vs. Shell	Ave live density on stone (#/m²)	40.25
	Standard error of live density on stone	15.12
	Ave live density on shell (#/m²)	129.50
	Standard error of live density on shell	29.31
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	177.58
	Standard error of live biomass	30.16
	Reef area meeting min threshold* biomass (%)	100%
	Reef area meeting target* biomass (%)	98%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	36.75
	Standard error of shell volume	8.84
	Total shell volume (litres)	789672.12
	Total surface shell volume (litres)	148063.52
	Ave brown shell across all samples (%)	81.25
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

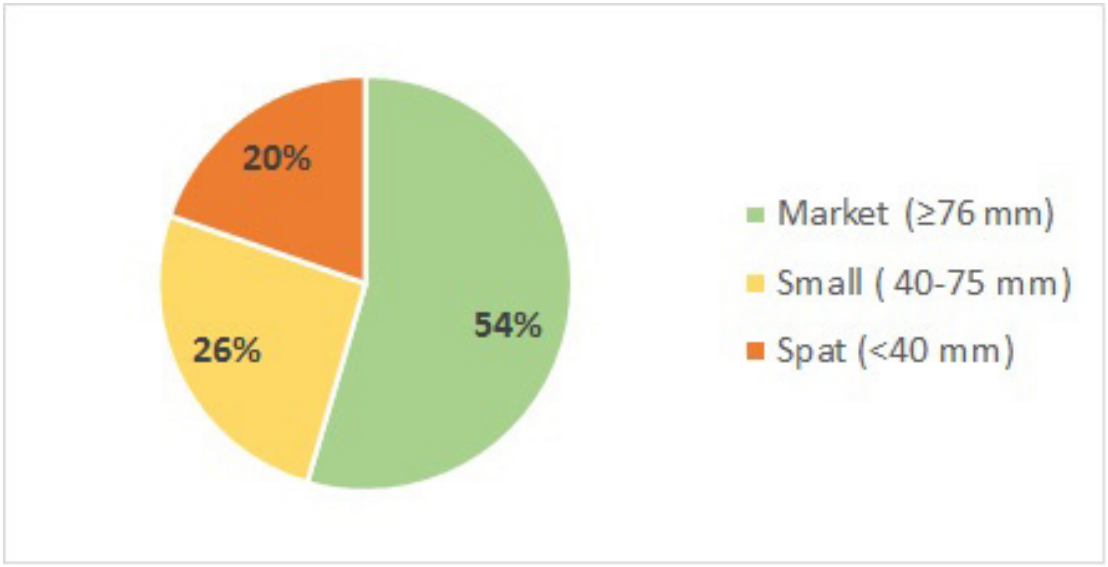
- Min. threshold: 50% of reef is covered with at least 15 oysters per m²
- Target: 30% of reef is covered with at least 50 oysters per m²

**Oyster biomass* (per Oyster Metrics):

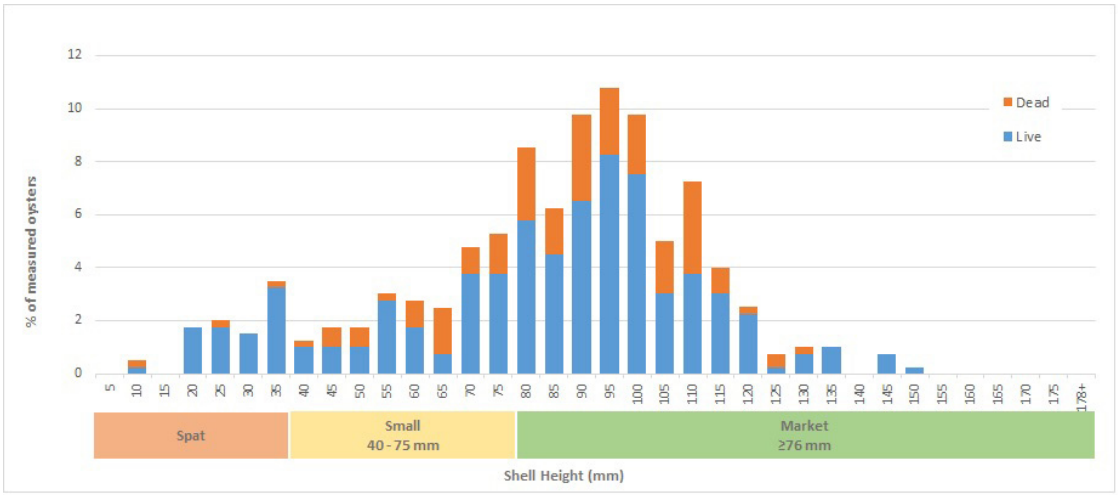
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m²
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m²

Reef H27 (AltSub_03) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



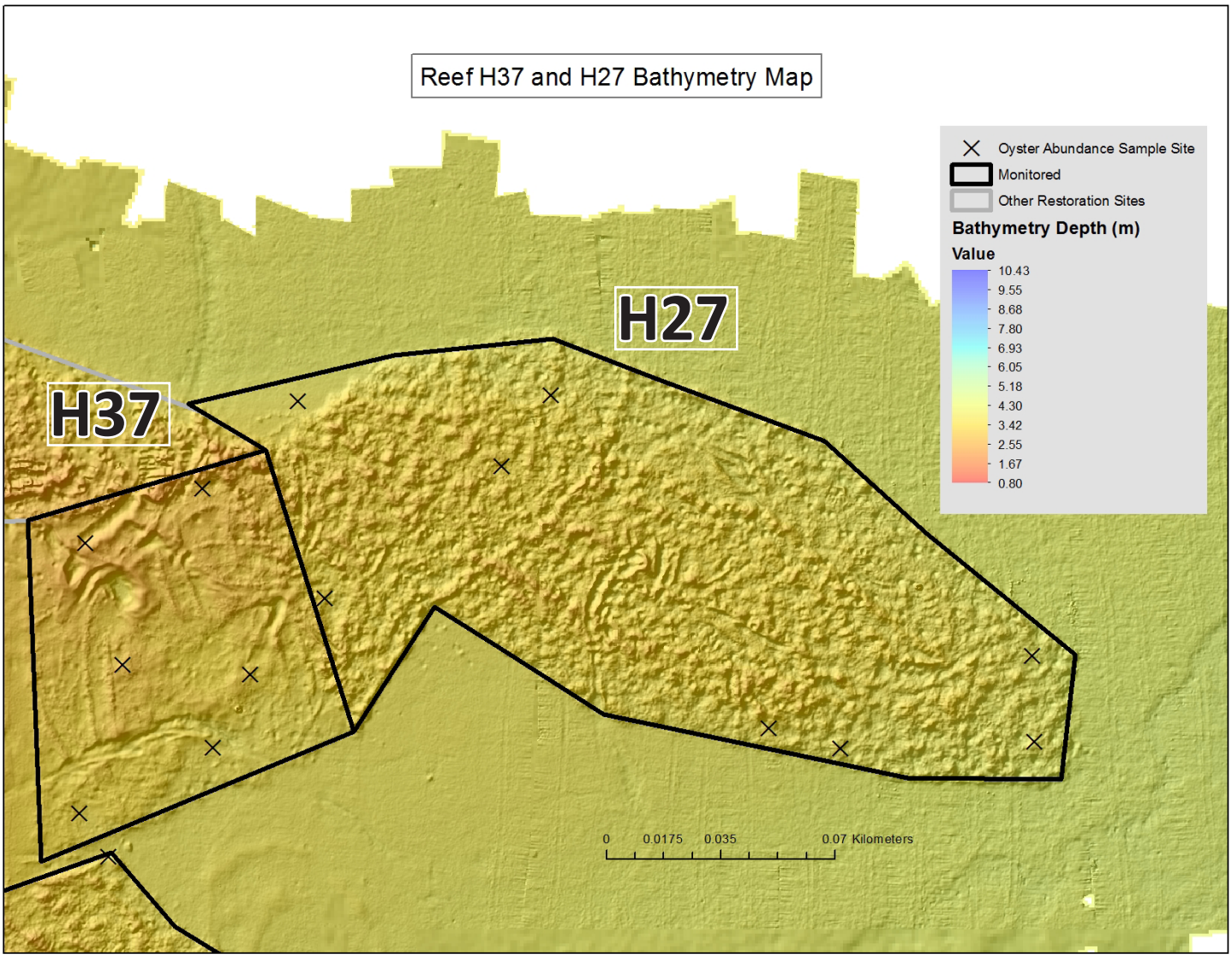
Shell Height of Oysters Measured on Reef



Reef H27 (AltSub_03) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H28 (AltSub_25) Data and Analysis

Reef Information	Reef #	H28
	Geodatabase Site_ID	AltSub_25
	Bar Name	LITTLE NECK
	Tributary	Harris
	Reef area (acres)	2.46
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Mixed shell
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	23.41
	Spat planted per acre (millions)	9.51
Monitoring Information	Monitoring type	Three year
	Sample Method	Patent Tong
	Most recent monitoring sample date	17-Nov-16
	# samples taken	8
	# live oysters measured	191
	# live oysters counted	387
	# dead oysters counted	44
	% dead oysters observed on the reef	10.21%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	30.05
	Standard error of live density (#/ m2)	9.08
	Reef area meeting min threshold* density (%)	86%
	Reef area meeting target density (%)	40%
Density on Stone vs. Shell	Ave live density on stone (#/m²)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m²)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	32.95
	Standard error of live biomass	11.15
	Reef area meeting min threshold* biomass (%)	65%
	Reef area meeting target* biomass (%)	40%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	8.27
	Standard error of shell volume	2.23
	Total shell volume (litres)	80305.88
	Total surface shell volume (litres)	49187.35
	Ave brown shell across all samples (%)	38.75
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

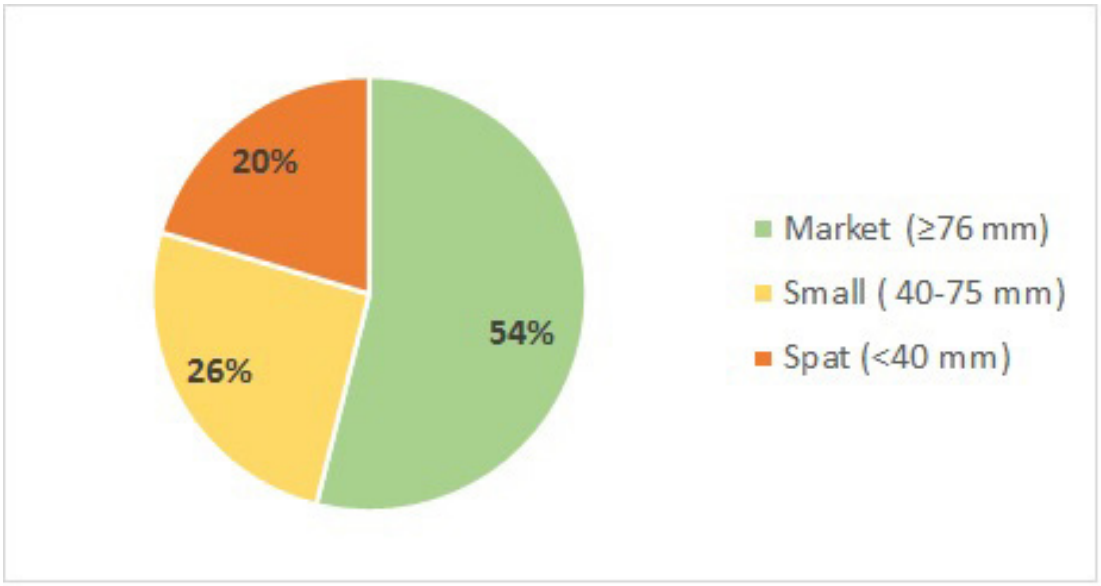
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

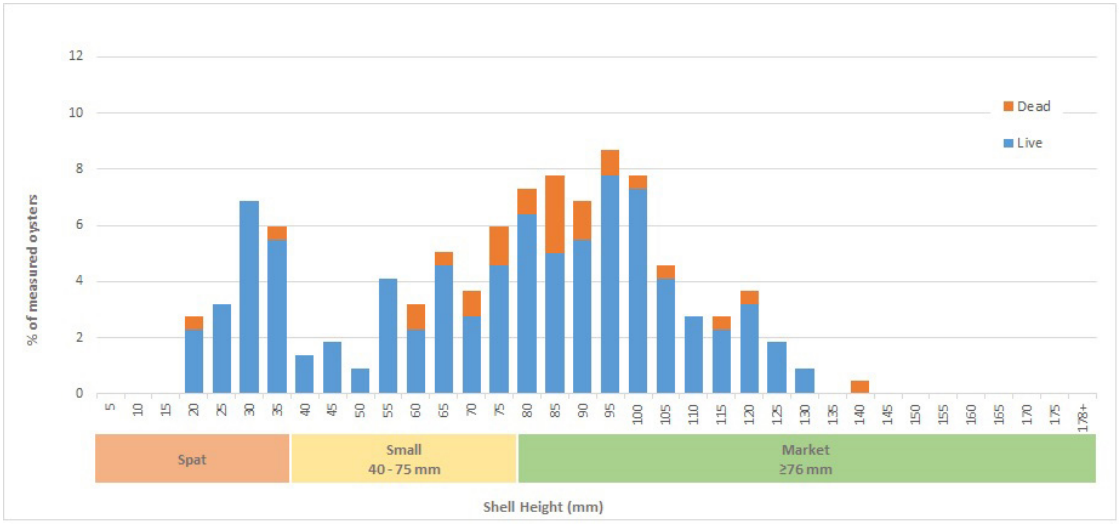
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H28 (AltSub_25) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



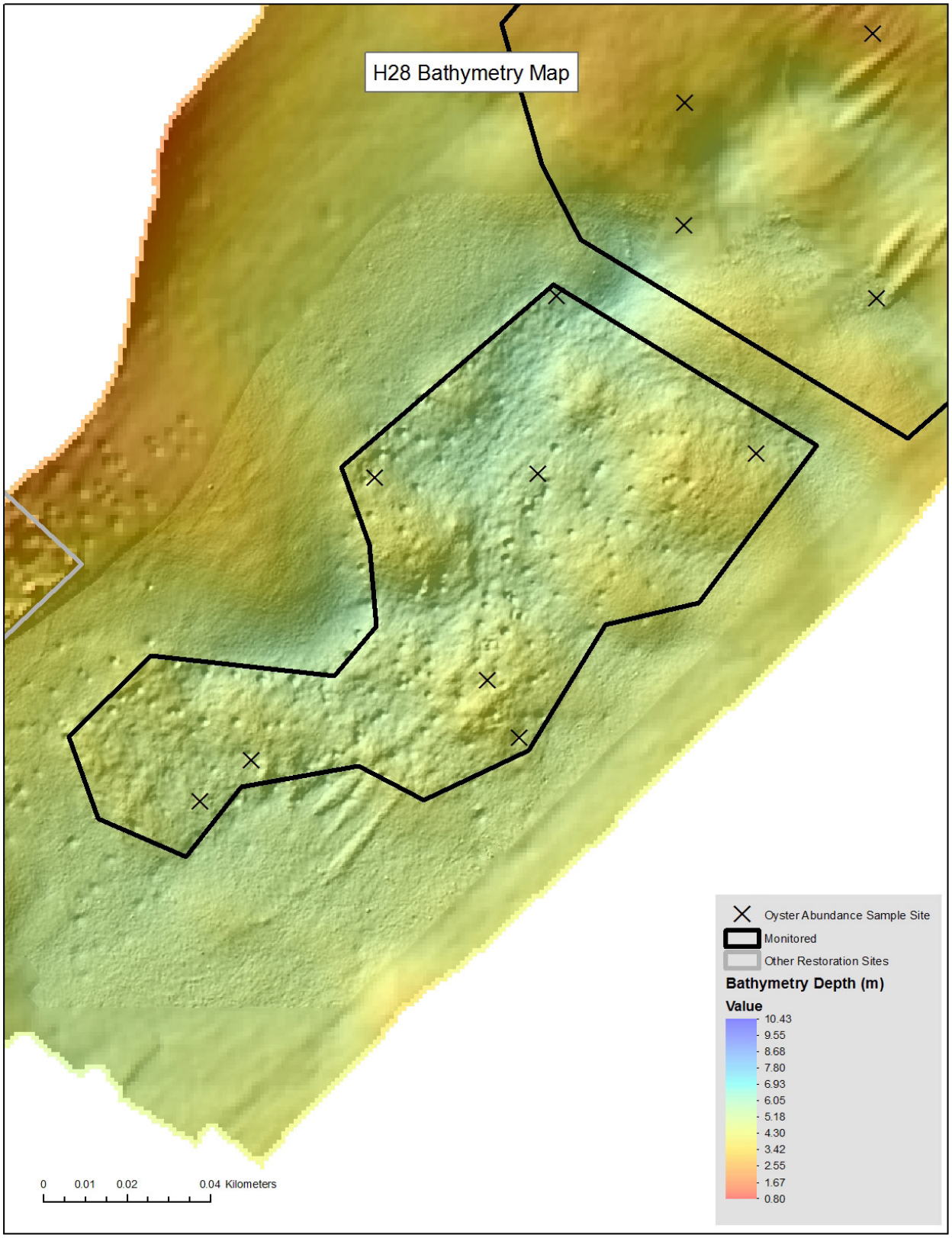
Shell Height of Oysters Measured on Reef



Reef H28 (AltSub_25) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H29 (AltSub_29) Data and Analysis

Reef Information	Reef #	H29
	Geodatabase Site_ID	AltSub_29
	Bar Name	UPPER HARRIS
	Tributary	Harris
	Reef area (acres)	2.71
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Stone
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	27.92
	Spat planted per acre (millions)	10.30
Monitoring Information	Monitoring type	Three year
	Sample Method	Diver
	Most recent monitoring sample date	03-Nov-16
	# samples taken	9
	# live oysters measured	491
	# live oysters counted	1488
	# dead oysters counted	120
	% dead oysters observed on the reef	7.46%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	330.67
	Standard error of live density (#/ m2)	42.80
	Reef area meeting min threshold* density (%)	100%
	Reef area meeting target density (%)	100%
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	174.67
	Standard error of live density on stone	39.89
	Ave live density on shell (#/m^2)	156.00
	Standard error of live density on shell	42.20
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	220.22
	Standard error of live biomass	32.83
	Reef area meeting min threshold* biomass (%)	100%
	Reef area meeting target* biomass (%)	100%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	20.44
	Standard error of shell volume	5.32
	Total shell volume (litres)	208310.21
	Total surface shell volume (litres)	19673.74
	Ave brown shell across all samples (%)	90.56
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

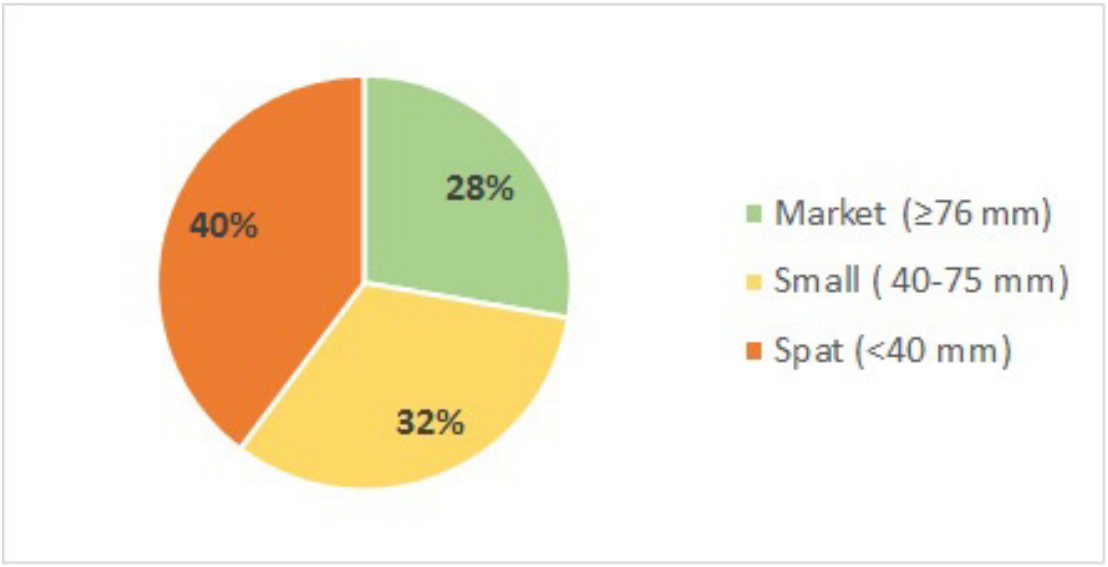
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

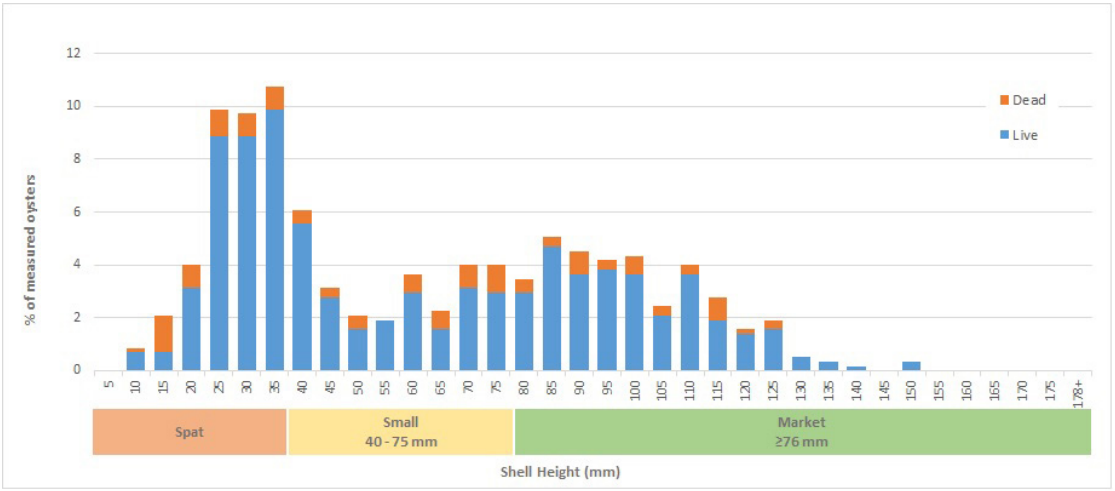
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H29 (AltSub_29) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



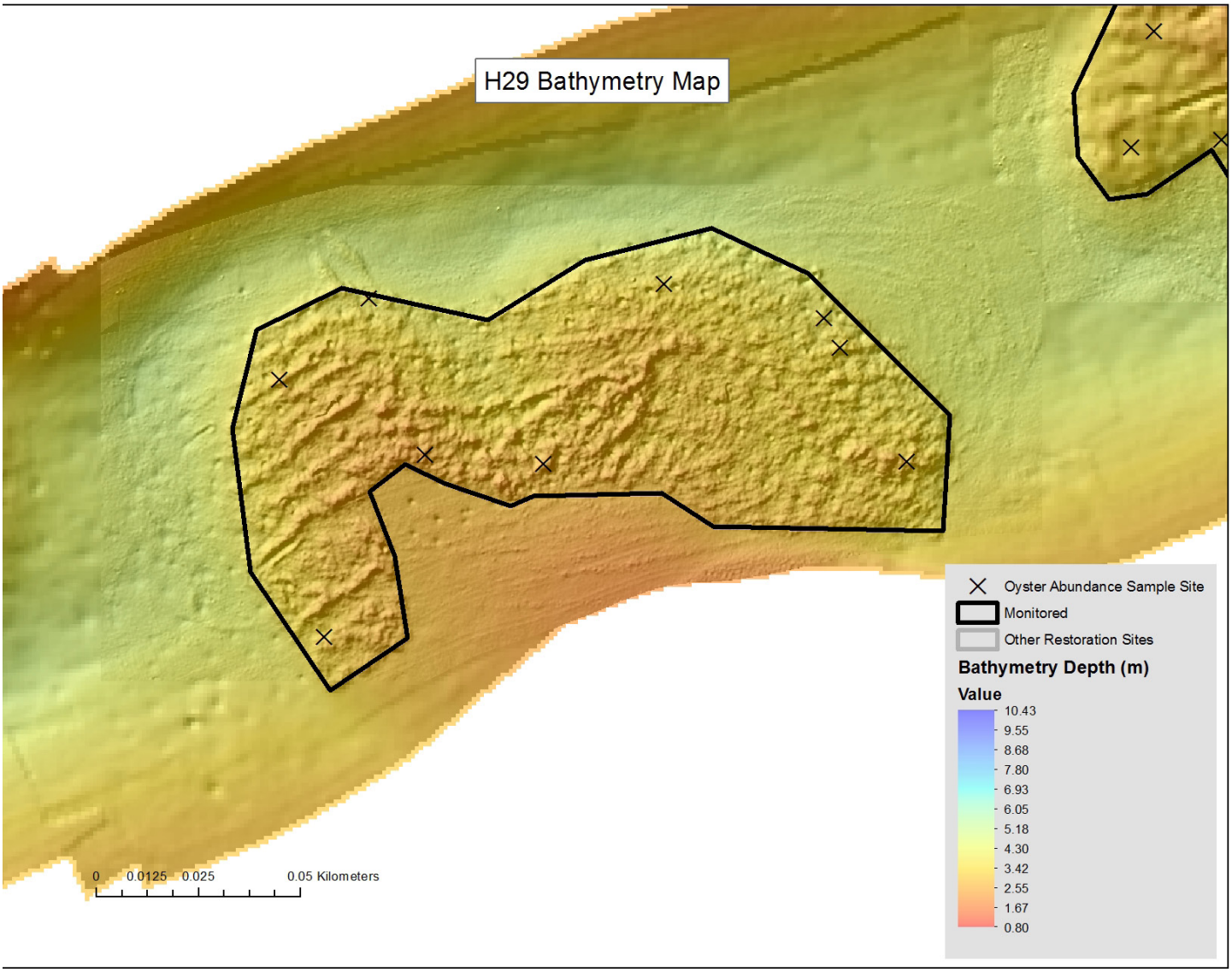
Shell Height of Oysters Measured on Reef



Reef H29 (AltSub_29) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H30 (AltSub_30) Data and Analysis

Reef Information	Reef #	H30
	Geodatabase Site_ID	AltSub_30
	Bar Name	UPPER HARRIS
	Tributary	Harris
	Reef area (acres)	0.97
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Mixed shell
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	15.06
	Spat planted per acre (millions)	15.57
Monitoring Information	Monitoring type	Three year
	Sample Method	Patent Tong
	Most recent monitoring sample date	17-Nov-16
	# samples taken	6
	# live oysters measured	164
	# live oysters counted	516
	# dead oysters counted	24
	% dead oysters observed on the reef	4.44%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	53.42
	Standard error of live density (#/ m2)	16.87
	Reef area meeting min threshold* density (%)	84%
	Reef area meeting target density (%)	51%
Density on Stone vs. Shell	Ave live density on stone (#/m²)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m²)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	51.11
	Standard error of live biomass	16.61
	Reef area meeting min threshold* biomass (%)	84%
	Reef area meeting target* biomass (%)	51%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	13.3
	Standard error of shell volume	2.25
	Total shell volume (litres)	40317.49
	Total surface shell volume (litres)	17470.91
	Ave brown shell across all samples (%)	56.67
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

***Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

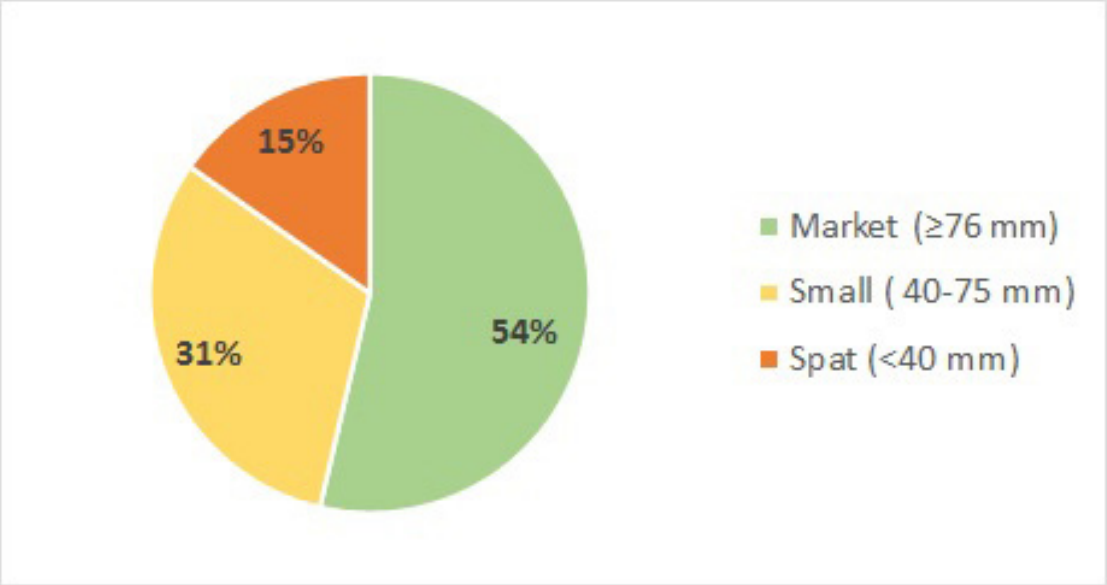
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

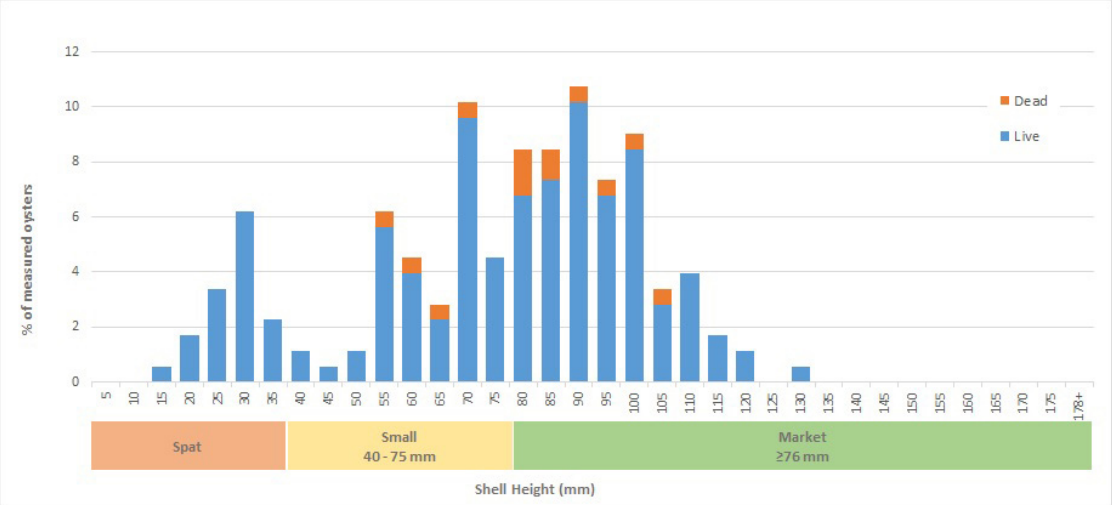
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H30 (AltSub_30) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



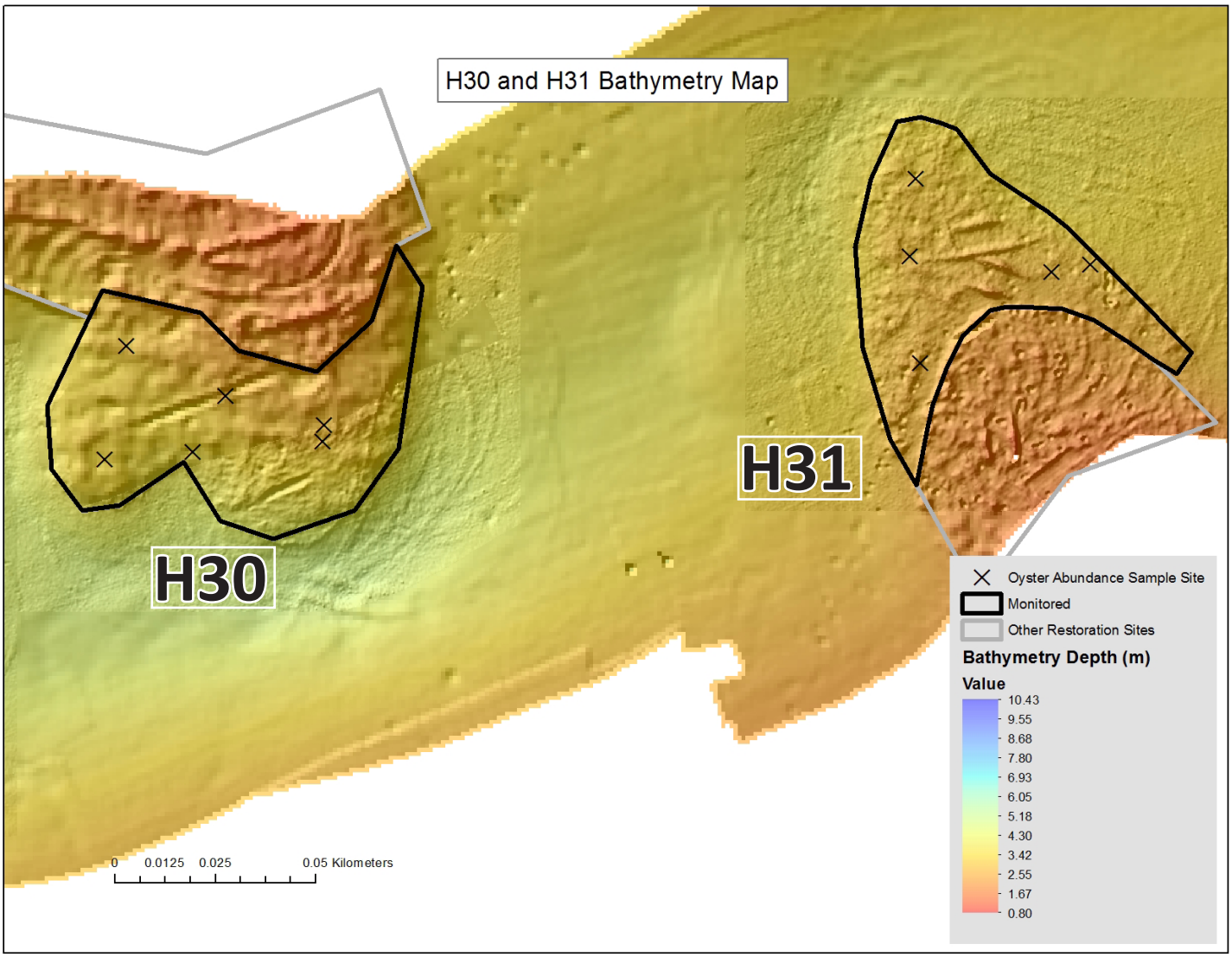
Shell Height of Oysters Measured on Reef



Reef H30 (AltSub_30) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H31 (AltSub_31A) Data and Analysis

Reef Information	Reef #	H31
	Geodatabase Site_ID	AltSub_31A
	Bar Name	UPPER HARRIS
	Tributary	Harris
	Reef area (acres)	0.73
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Mixed shell
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	32.81
	Spat planted per acre (millions)	44.70
Monitoring Information	Monitoring type	Three year
	Sample Method	Patent Tong
	Most recent monitoring sample date	17-Nov-16
	# samples taken	5
	# live oysters measured	171
	# live oysters counted	1043
	# dead oysters counted	27
	% dead oysters observed on the reef	2.52%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	129.57
	Standard error of live density (#/ m2)	33.56
	Reef area meeting min threshold* density (%)	100%
	Reef area meeting target density (%)	89%
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m^2)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	88.39
	Standard error of live biomass	19.06
	Reef area meeting min threshold* biomass (%)	100%
	Reef area meeting target* biomass (%)	89%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	20.5
	Standard error of shell volume	3.88
	Total shell volume (litres)	47223
	Total surface shell volume (litres)	11333.52
	Ave brown shell across all samples (%)	76
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

***Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

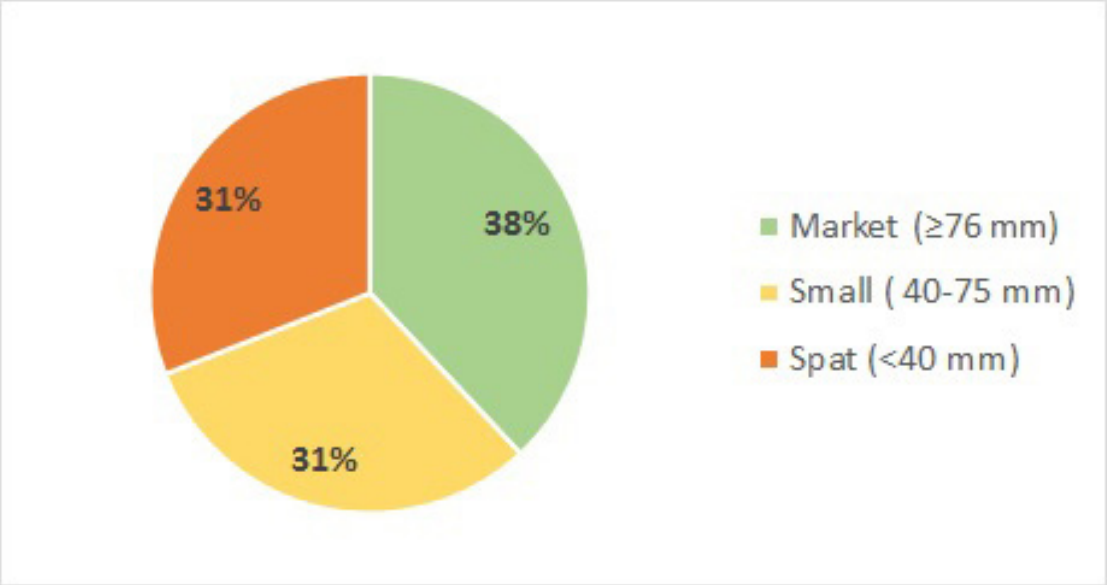
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

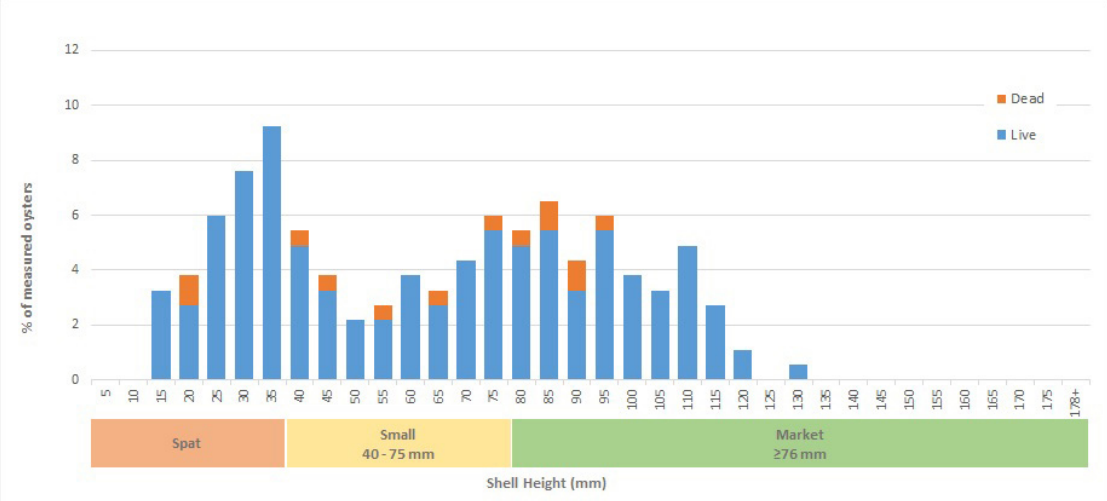
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H31 (AltSub_31A) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



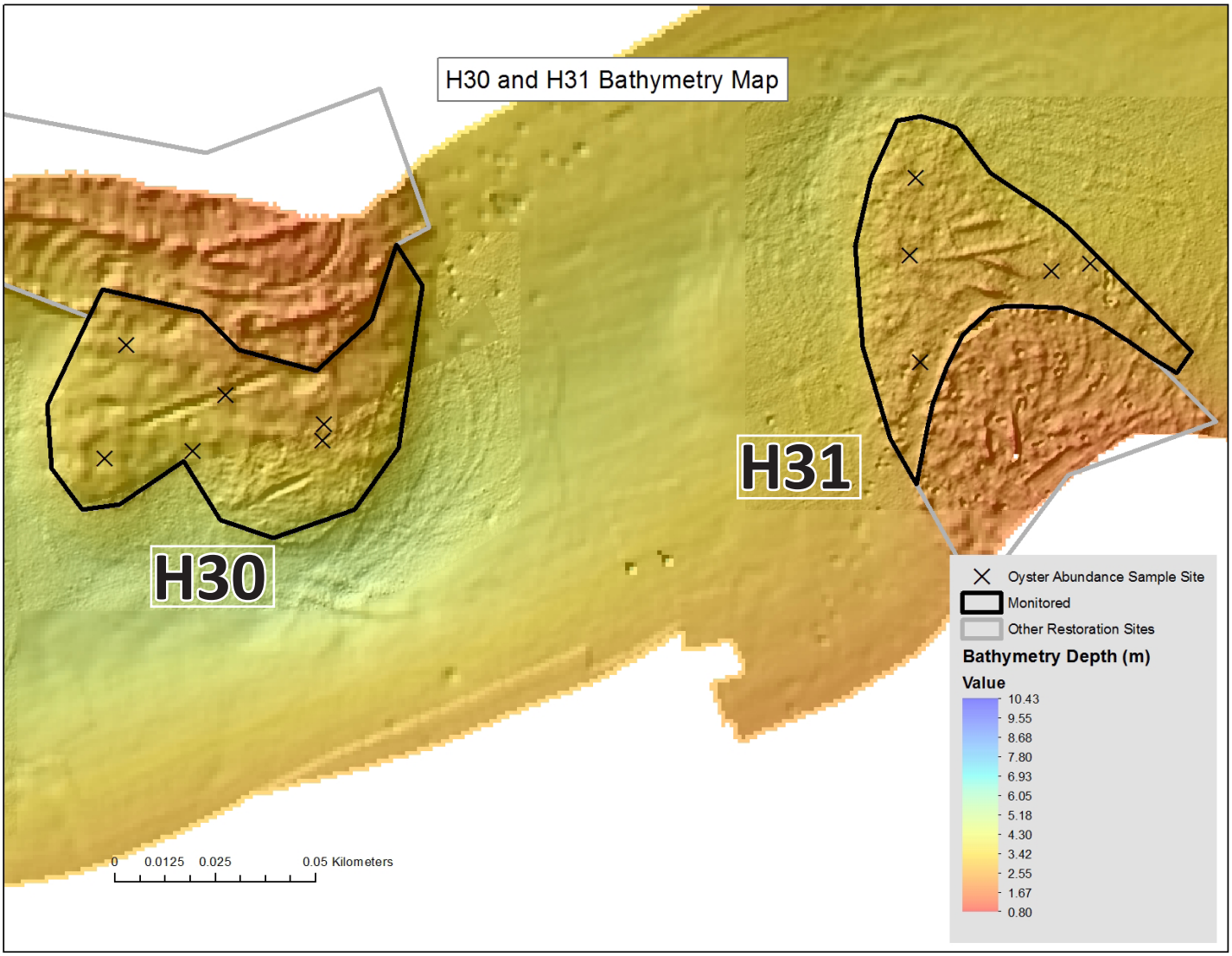
Shell Height of Oysters Measured on Reef



Reef H31 (AltSub_31A) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H32 (AltSub_54) Data and Analysis

Reef Information	Reef #	H32
	Geodatabase Site_ID	AltSub_54
	Bar Name	CHANGE
	Tributary	Harris
	Reef area (acres)	1.28
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Stone
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	17.02
	Spat planted per acre (millions)	13.26
Monitoring Information	Monitoring type	Three year
	Sample Method	Diver
	Most recent monitoring sample date	18-Nov-16
	# samples taken	5
	# live oysters measured	274
	# live oysters counted	933
	# dead oysters counted	94
	% dead oysters observed on the reef	9.15%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	373.20
	Standard error of live density (#/ m2)	69.31
	Reef area meeting min threshold* density (%)	100%
	Reef area meeting target density (%)	100%
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	28.00
	Standard error of live density on stone	14.44
	Ave live density on shell (#/m^2)	345.20
	Standard error of live density on shell	82.39
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	415.29
	Standard error of live biomass	94.94
	Reef area meeting min threshold* biomass (%)	100%
	Reef area meeting target* biomass (%)	100%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	59.6
	Standard error of shell volume	13.81
	Total shell volume (litres)	300830.32
	Total surface shell volume (litres)	66182.67
	Ave brown shell across all samples (%)	78
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

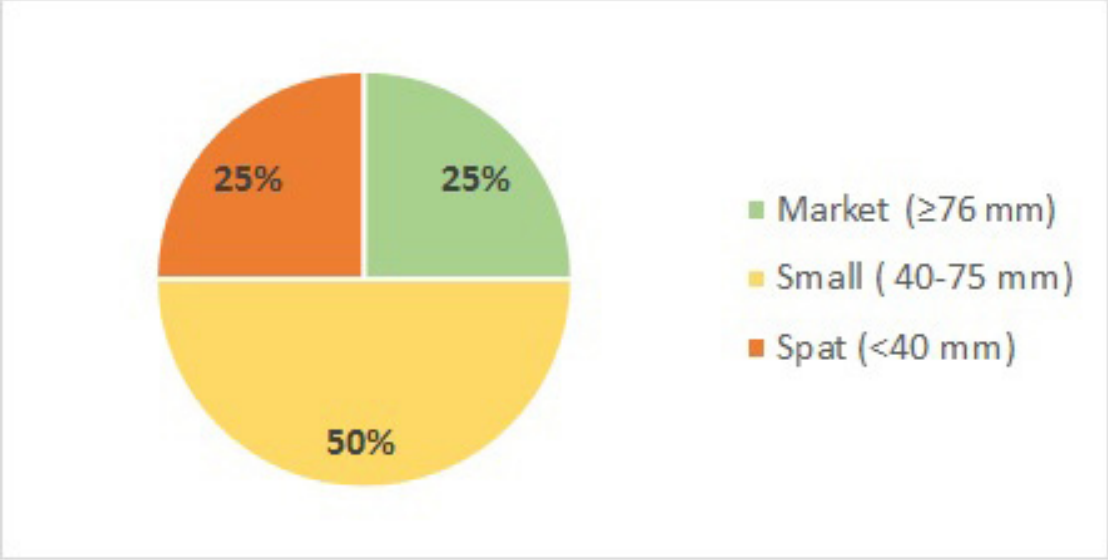
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

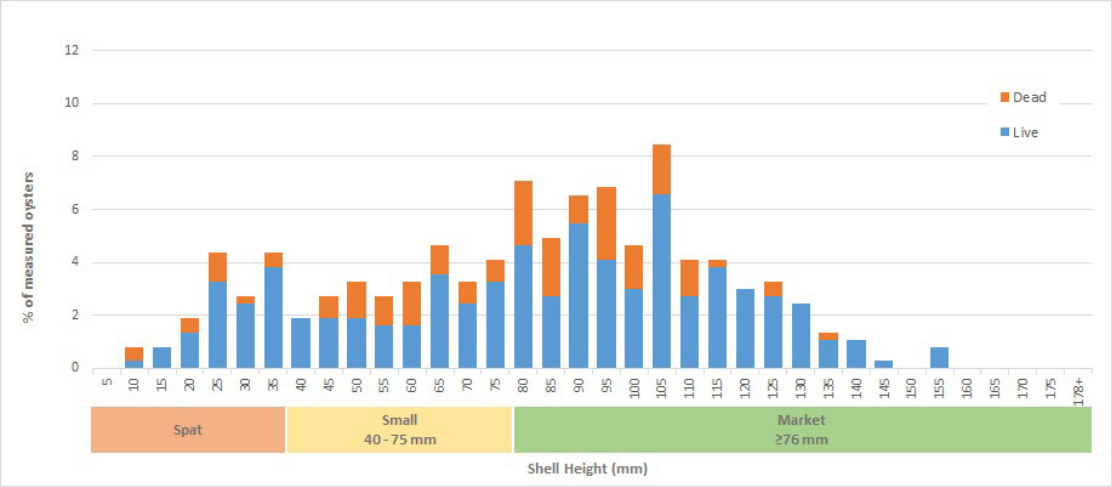
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H32 (AltSub_54) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



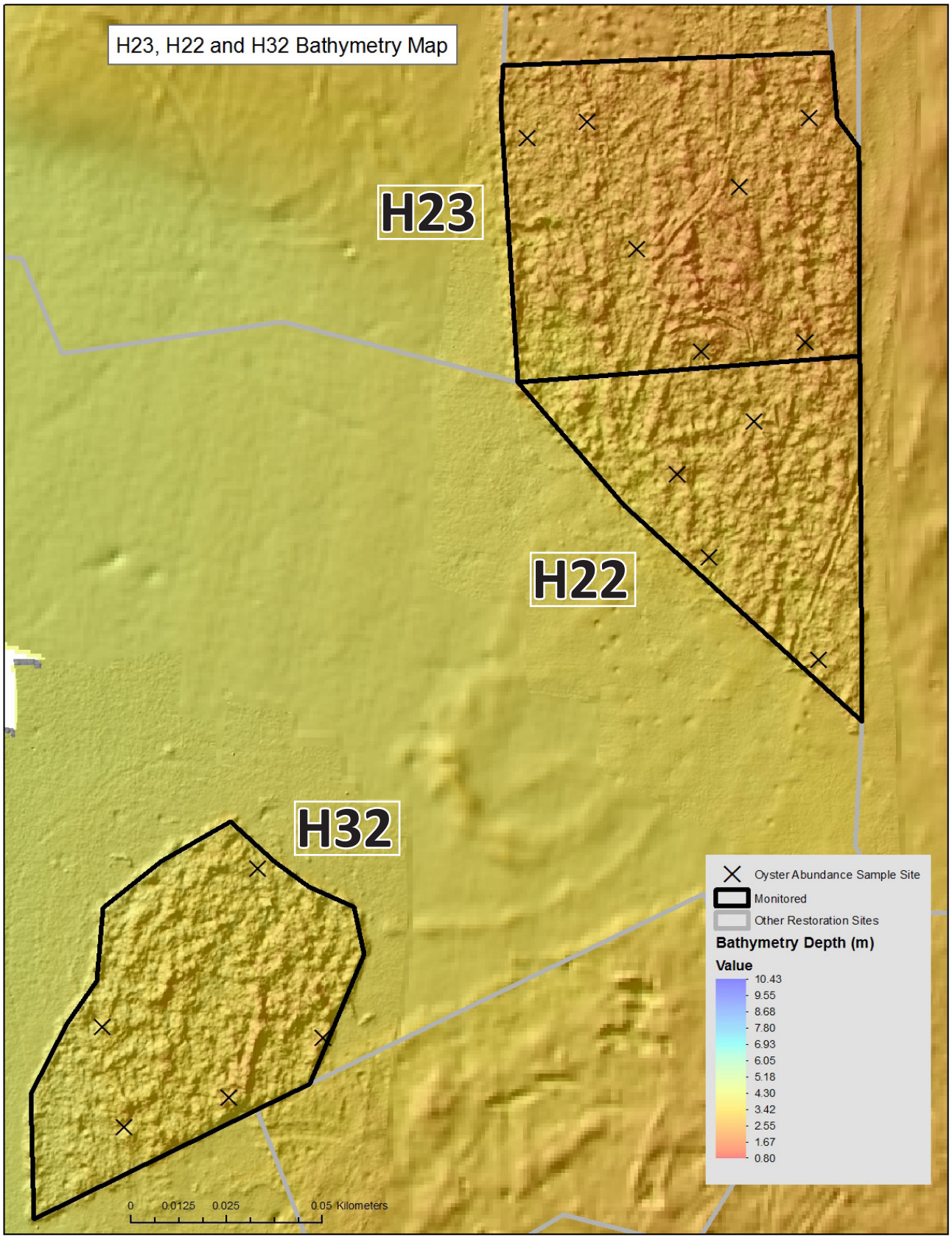
Shell Height of Oysters Measured on Reef



Reef H32 (AltSub_54) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H33 (AltSub_62) Data and Analysis

Reef Information	Reef #	H33
	Geodatabase Site_ID	AltSub_62
	Bar Name	TILGHMAN WHARF
	Tributary	Harris
	Reef area (acres)	1.58
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Stone
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	8.38
	Spat planted per acre (millions)	5.28
Monitoring Information	Monitoring type	Three year
	Sample Method	Diver
	Most recent monitoring sample date	18-Nov-16
	# samples taken	6
	# live oysters measured	242
	# live oysters counted	550
	# dead oysters counted	44
	% dead oysters observed on the reef	7.41%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	183.33
	Standard error of live density (#/ m2)	54.93
	Reef area meeting min threshold* density (%)	100%
	Reef area meeting target density (%)	92%
Density on Stone vs. Shell	Ave live density on stone (#/m²)	129.67
	Standard error of live density on stone	38.22
	Ave live density on shell (#/m²)	53.67
	Standard error of live density on shell	24.55
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	168.98
	Standard error of live biomass	50.74
	Reef area meeting min threshold* biomass (%)	100%
	Reef area meeting target* biomass (%)	86%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	10.33
	Standard error of shell volume	4.22
	Total shell volume (litres)	66081.66
	Total surface shell volume (litres)	4956.12
	Ave brown shell across all samples (%)	92.5
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

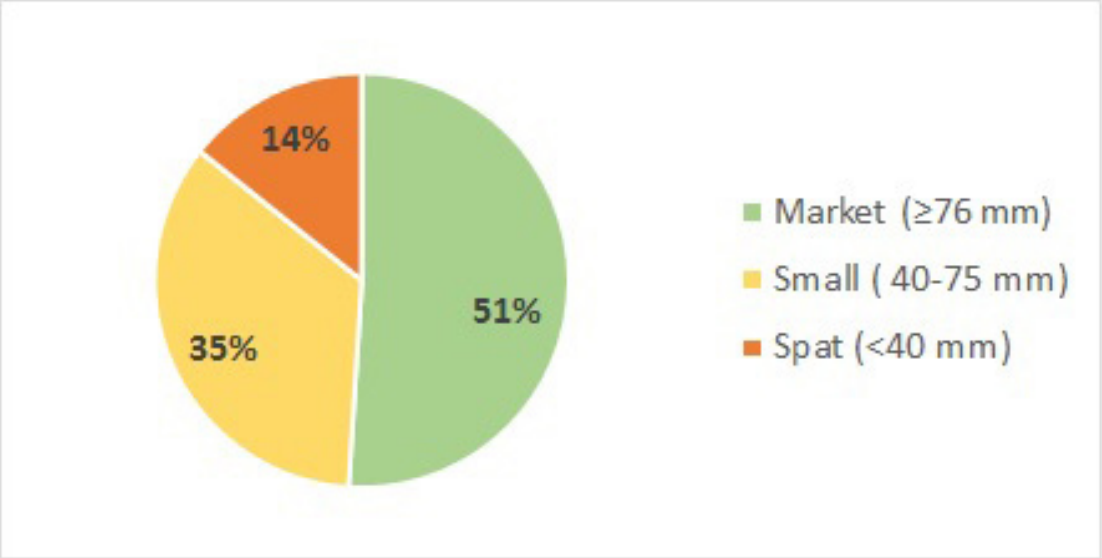
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

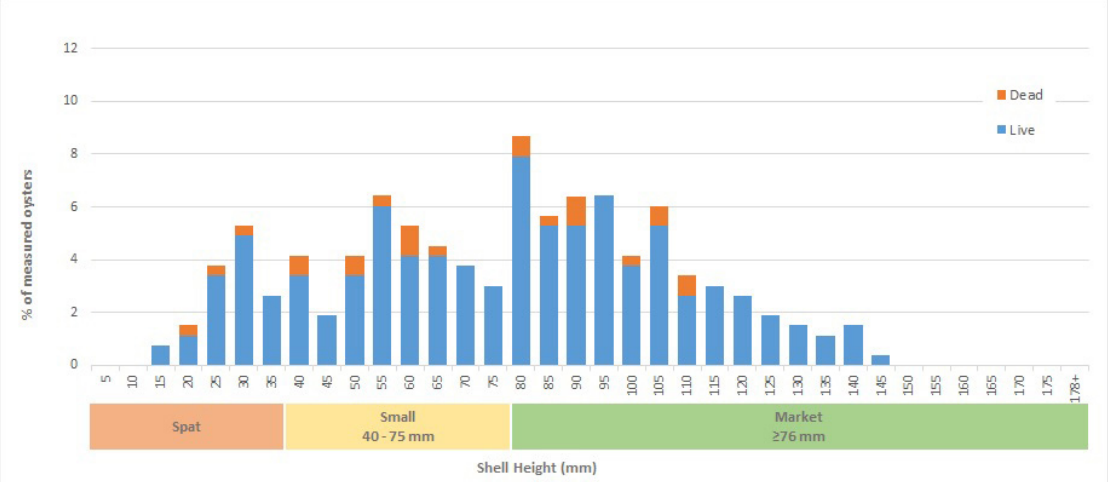
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H33 (AltSub_62) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



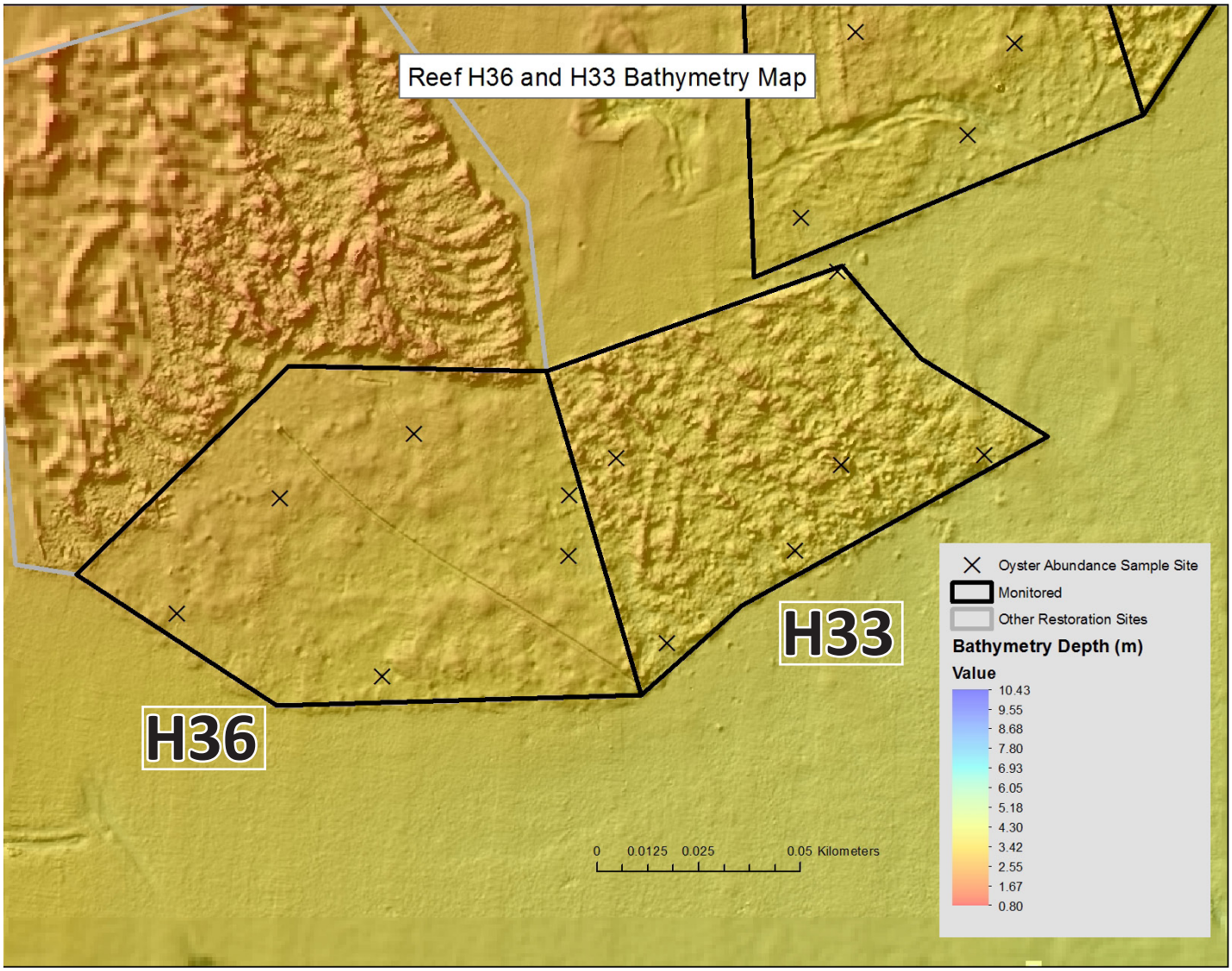
Shell Height of Oysters Measured on Reef



Reef H33 (AltSub_62) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H34 (AltSub_79) Data and Analysis

Reef Information	Reef #	H34
	Geodatabase Site_ID	AltSub_79
	Bar Name	TILGHMAN WHARF
	Tributary	Harris
	Reef area (acres)	0.81
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Stone
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	8.81
	Spat planted per acre (millions)	10.86
Monitoring Information	Monitoring type	Three year
	Sample Method	Diver
	Most recent monitoring sample date	03-Nov-16
	# samples taken	5
	# live oysters measured	215
	# live oysters counted	672
	# dead oysters counted	90
	% dead oysters observed on the reef	11.81%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	268.80
	Standard error of live density (#/ m2)	80.85
	Reef area meeting min threshold* density (%)	100%
	Reef area meeting target density (%)	100%
Density on Stone vs. Shell	Ave live density on stone (#/m²)	98.80
	Standard error of live density on stone	30.88
	Ave live density on shell (#/m²)	170.00
	Standard error of live density on shell	67.64
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	267.29
	Standard error of live biomass	100.57
	Reef area meeting min threshold* biomass (%)	100%
	Reef area meeting target* biomass (%)	100%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	38.6
	Standard error of shell volume	16.55
	Total shell volume (litres)	94549.59
	Total surface shell volume (litres)	17018.93
	Ave brown shell across all samples (%)	82
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

***Oyster density** (per Oyster Metrics):

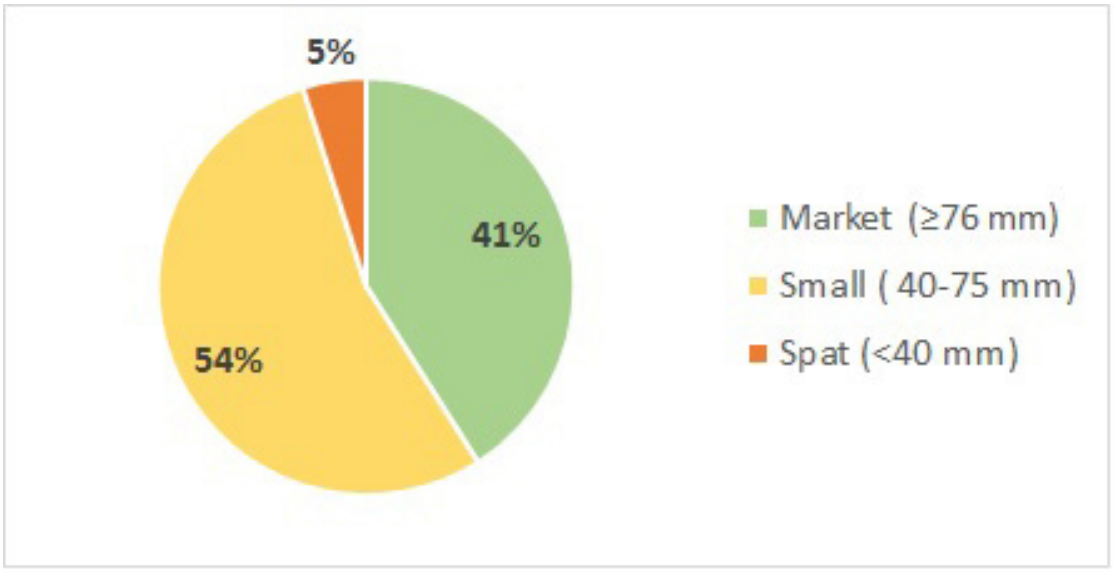
- Min. threshold: 50% of reef is covered with at least 15 oysters per m²
- Target: 30% of reef is covered with at least 50 oysters per m²

***Oyster biomass** (per Oyster Metrics):

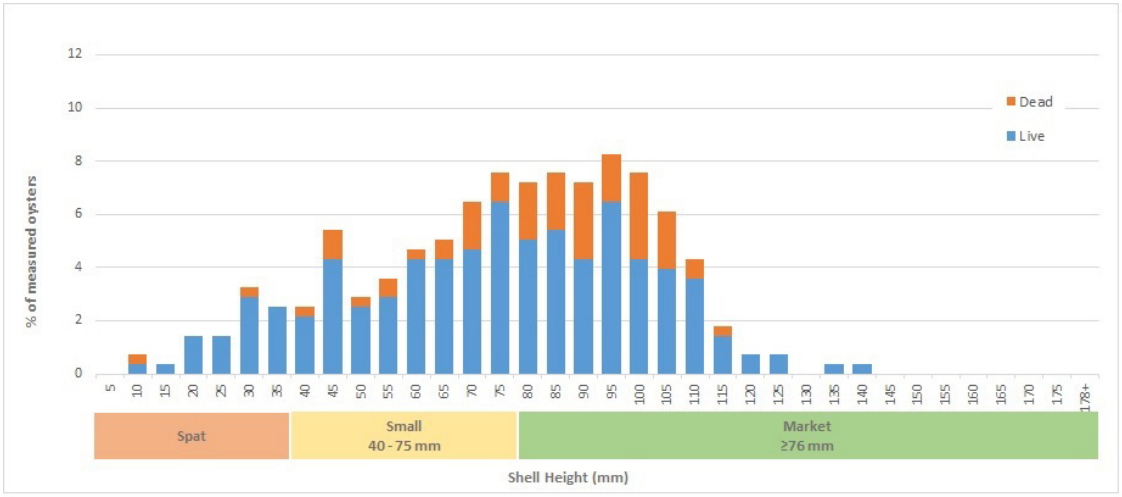
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m²
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m²

Reef H34 (AltSub_79) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



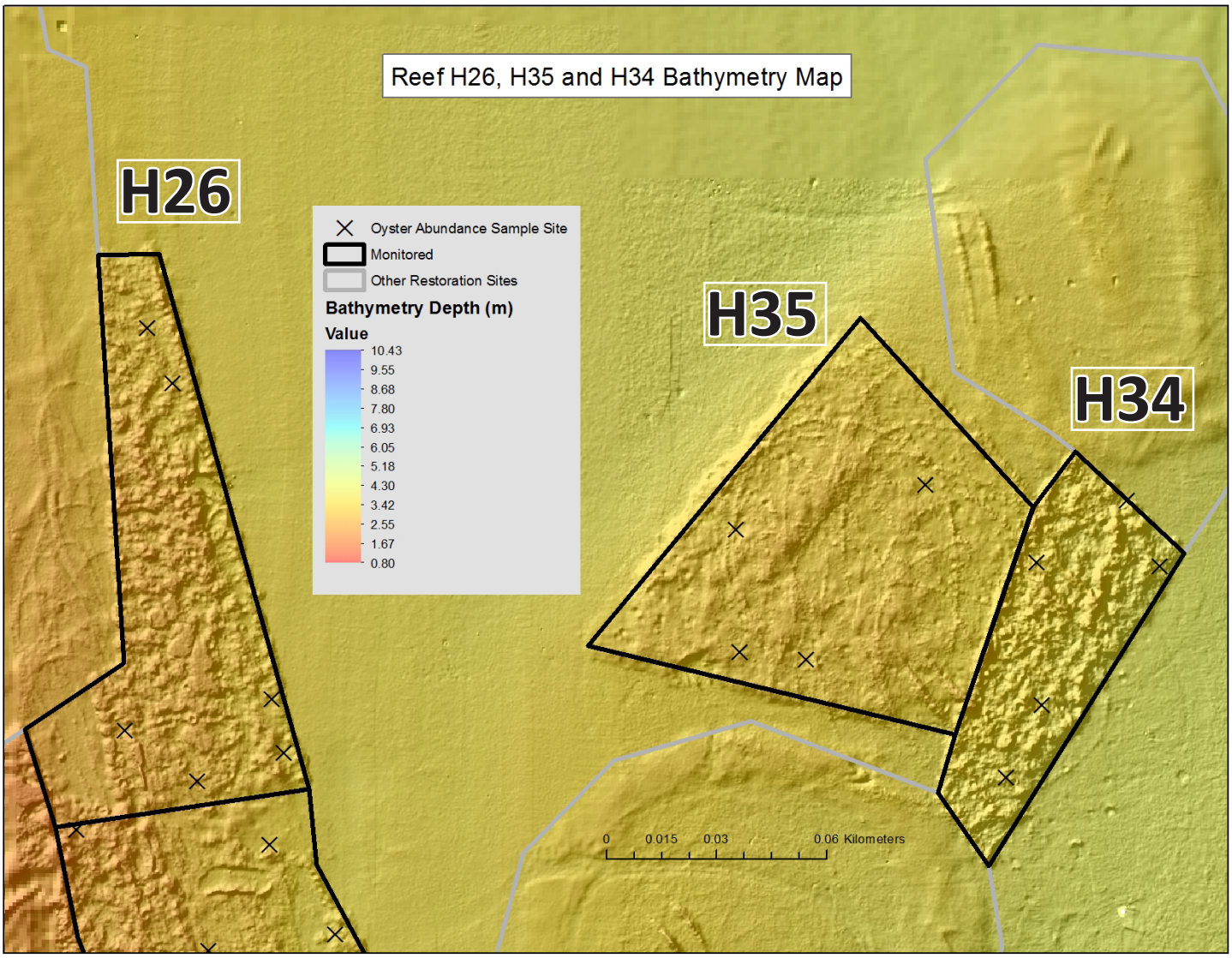
Shell Height of Oysters Measured on Reef



Reef H34 (AltSub_79) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H35 (AltSub_108) Data and Analysis

Reef Information	Reef #	H35
	Geodatabase Site_ID	AltSub_108
	Bar Name	TILGHMAN WHARF
	Tributary	Harris
	Reef area (acres)	1.82
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Mixed shell
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	19.72
	Spat planted per acre (millions)	10.86
Monitoring Information	Monitoring type	Three year
	Sample Method	Patent Tong
	Most recent monitoring sample date	01-Nov-16
	# samples taken	4
	# live oysters measured	128
	# live oysters counted	408
	# dead oysters counted	54
	% dead oysters observed on the reef	11.69%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	63.35
	Standard error of live density (#/ m2)	8.44
	Reef area meeting min threshold* density (%)	100%
	Reef area meeting target density (%)	76%
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m^2)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	92.01
	Standard error of live biomass	15.30
	Reef area meeting min threshold* biomass (%)	100%
	Reef area meeting target* biomass (%)	100%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	13.82
	Standard error of shell volume	1.61
	Total shell volume (litres)	93662.51
	Total surface shell volume (litres)	24586.41
	Ave brown shell across all samples (%)	73.75
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

***Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6”; 12”) by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

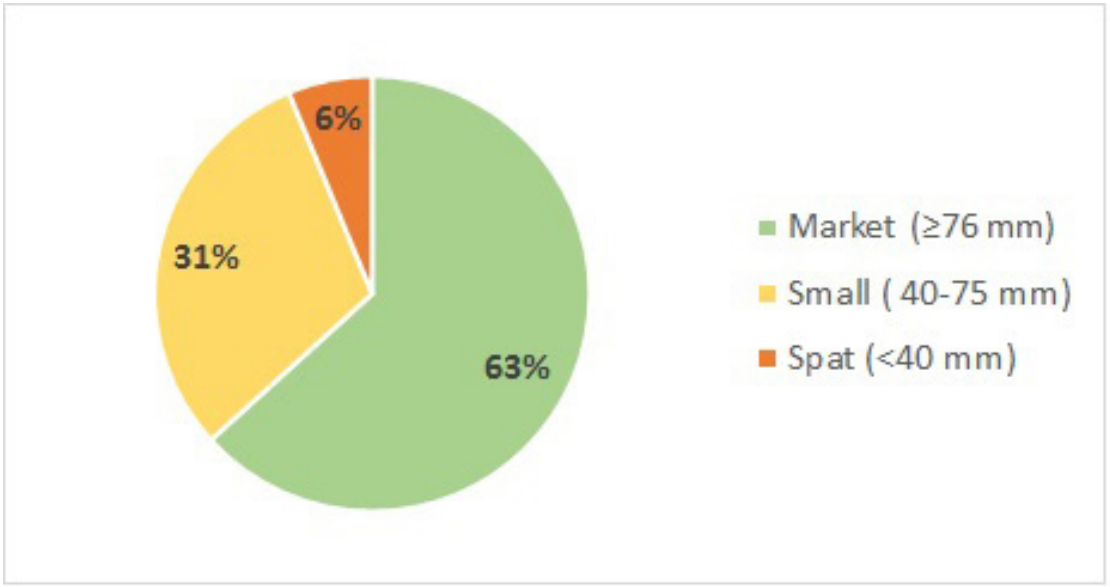
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

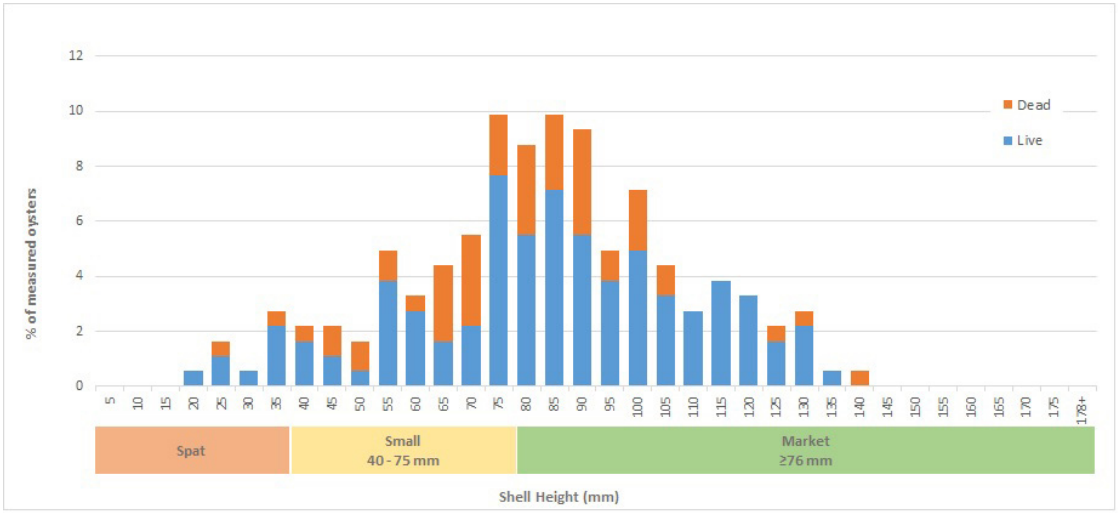
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H35 (AltSub_108) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



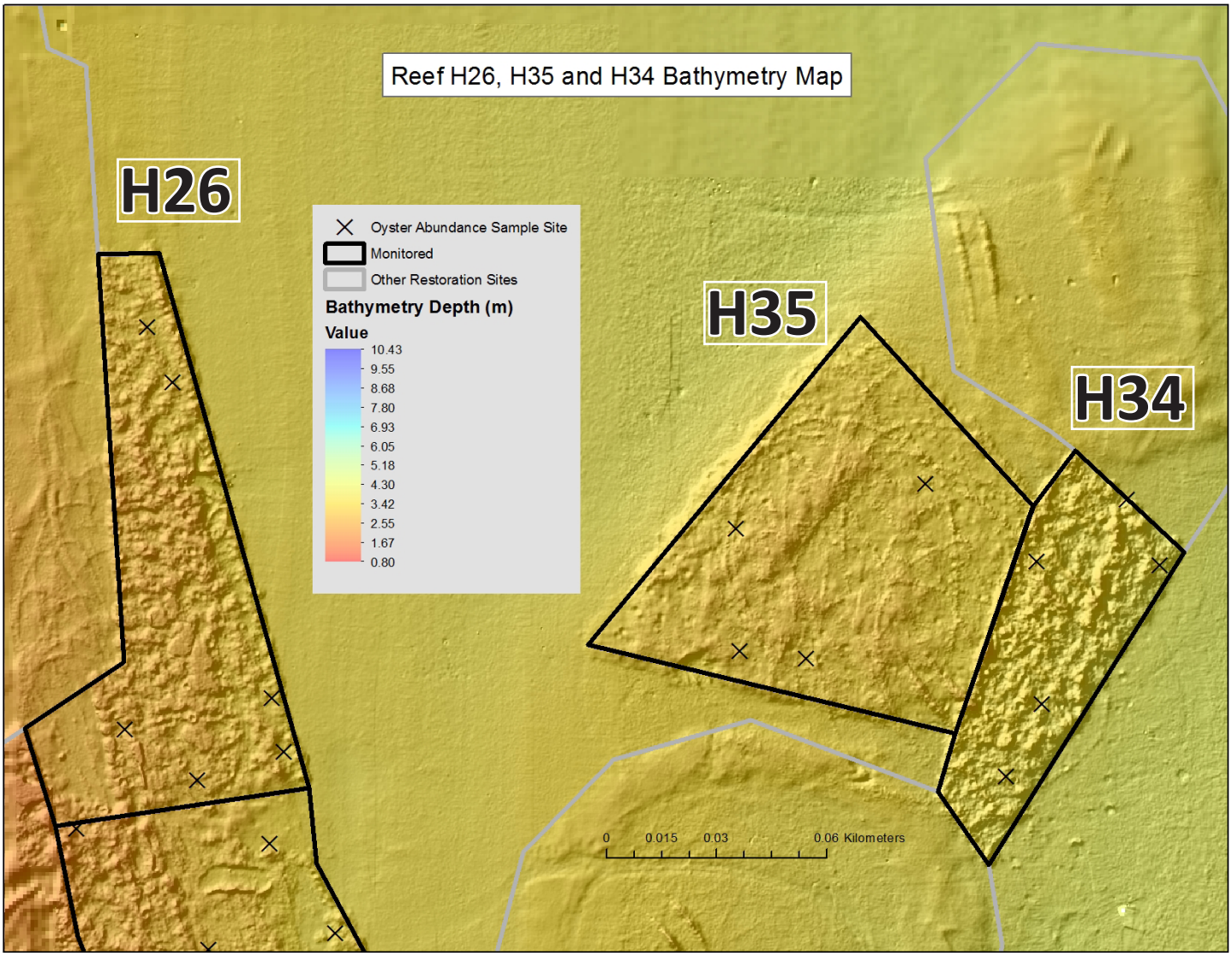
Shell Height of Oysters Measured on Reef



Reef H35 (AltSub_108) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H36 (AltSub_105) Data and Analysis

Reef Information	Reef #	H36
	Geodatabase Site_ID	AltSub_105
	Bar Name	TILGHMAN WHARF
	Tributary	Harris
	Reef area (acres)	2.06
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Mixed shell
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	10.89
	Spat planted per acre (millions)	5.28
Monitoring Information	Monitoring type	Three year
	Sample Method	Patent Tong
	Most recent monitoring sample date	02-Nov-16
	# samples taken	6
	# live oysters measured	190
	# live oysters counted	501
	# dead oysters counted	66
	% dead oysters observed on the reef	11.64%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	51.86
	Standard error of live density (#/ m2)	7.13
	Reef area meeting min threshold* density (%)	100%
	Reef area meeting target density (%)	55%
Density on Stone vs. Shell	Ave live density on stone (#/m²)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m²)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	77.74
	Standard error of live biomass	13.58
	Reef area meeting min threshold* biomass (%)	100%
	Reef area meeting target* biomass (%)	86%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	14.6
	Standard error of shell volume	1.36
	Total shell volume (litres)	120533.29
	Total surface shell volume (litres)	34151.1
	Ave brown shell across all samples (%)	71.67
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

***Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

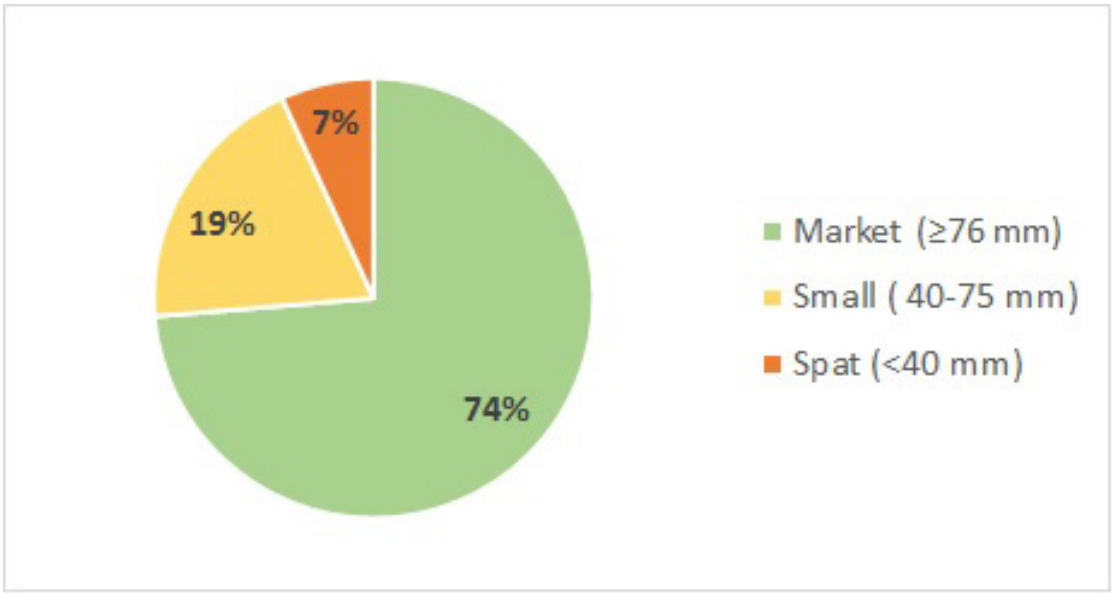
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

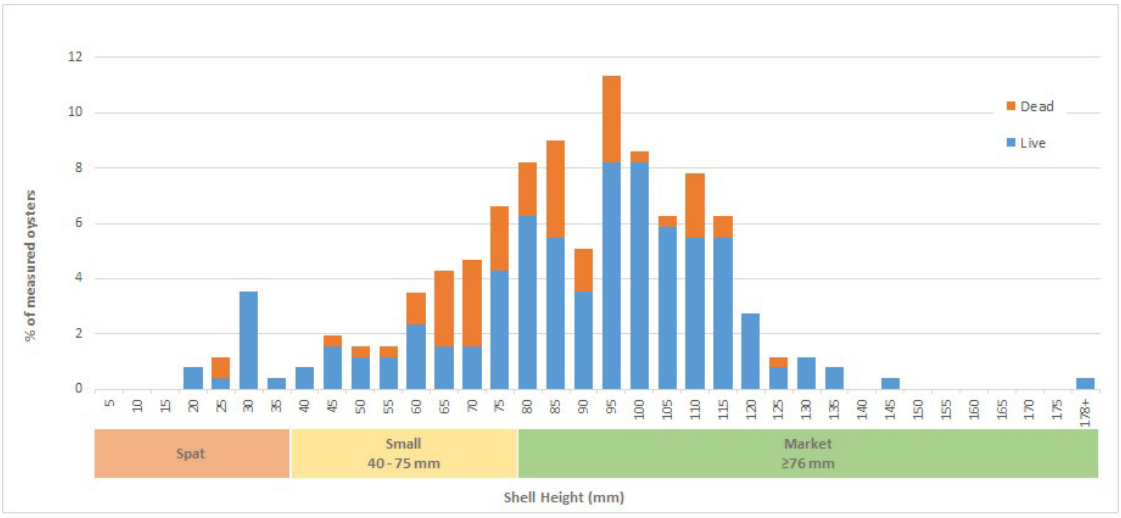
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H36 (AltSub_105) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



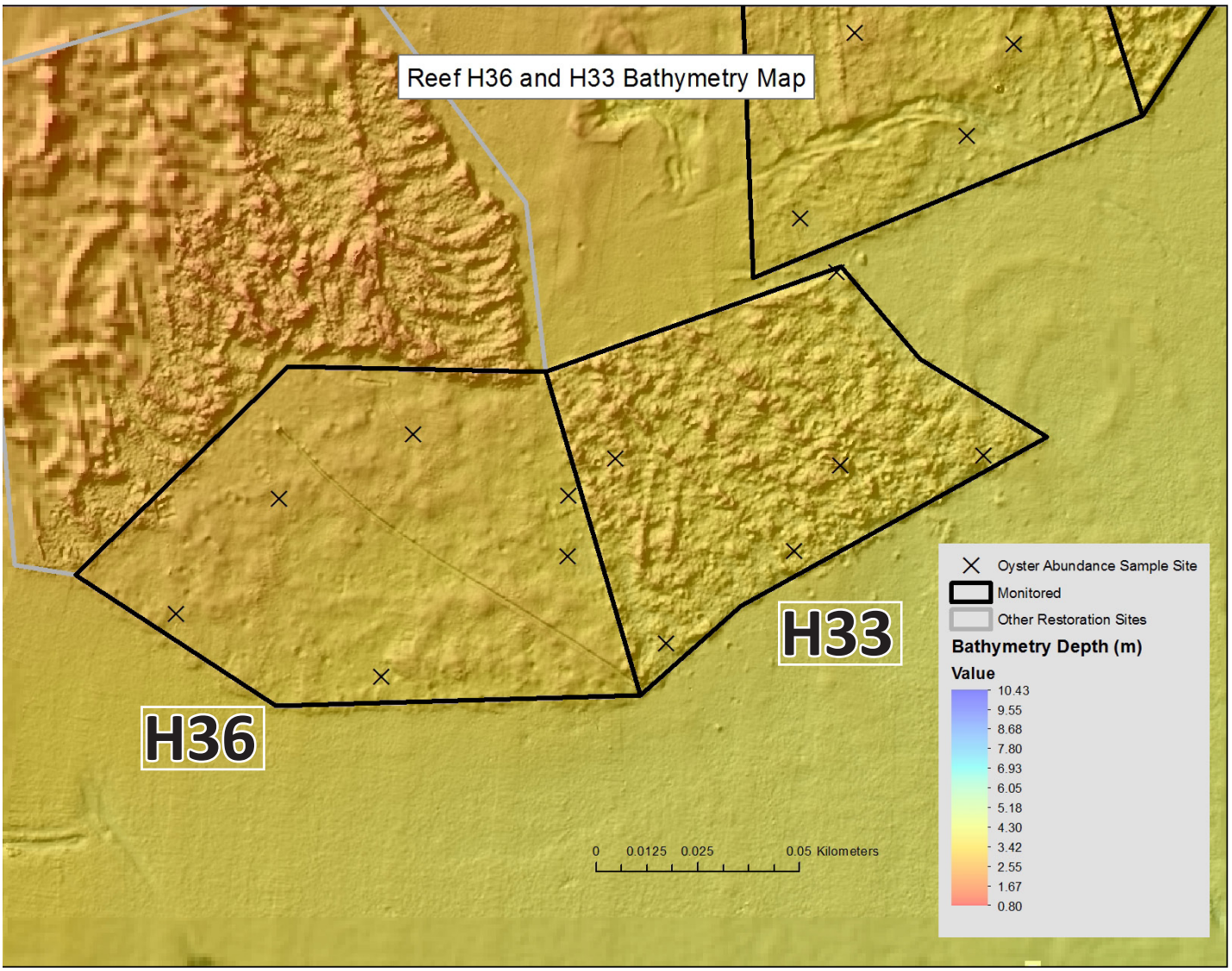
Shell Height of Oysters Measured on Reef



Reef H36 (AltSub_105) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H37 (AltSub_101) Data and Analysis

Reef Information	Reef #	H37
	Geodatabase Site_ID	AltSub_101
	Bar Name	N/A
	Tributary	Harris
	Reef area (acres)	2.10
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Mixed shell
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	17.35
	Spat planted per acre (millions)	8.26
Monitoring Information	Monitoring type	Three year
	Sample Method	Patent Tong
	Most recent monitoring sample date	16-Nov-16
	# samples taken	6
	# live oysters measured	202
	# live oysters counted	550
	# dead oysters counted	30
	% dead oysters observed on the reef	5.17%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	56.94
	Standard error of live density (#/ m2)	16.54
	Reef area meeting min threshold* density (%)	94%
	Reef area meeting target density (%)	53%
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m^2)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	64.32
	Standard error of live biomass	22.40
	Reef area meeting min threshold* biomass (%)	94%
	Reef area meeting target* biomass (%)	81%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	13.46
	Standard error of shell volume	2.28
	Total shell volume (litres)	114296.25
	Total surface shell volume (litres)	59053.06
	Ave brown shell across all samples (%)	48.33
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

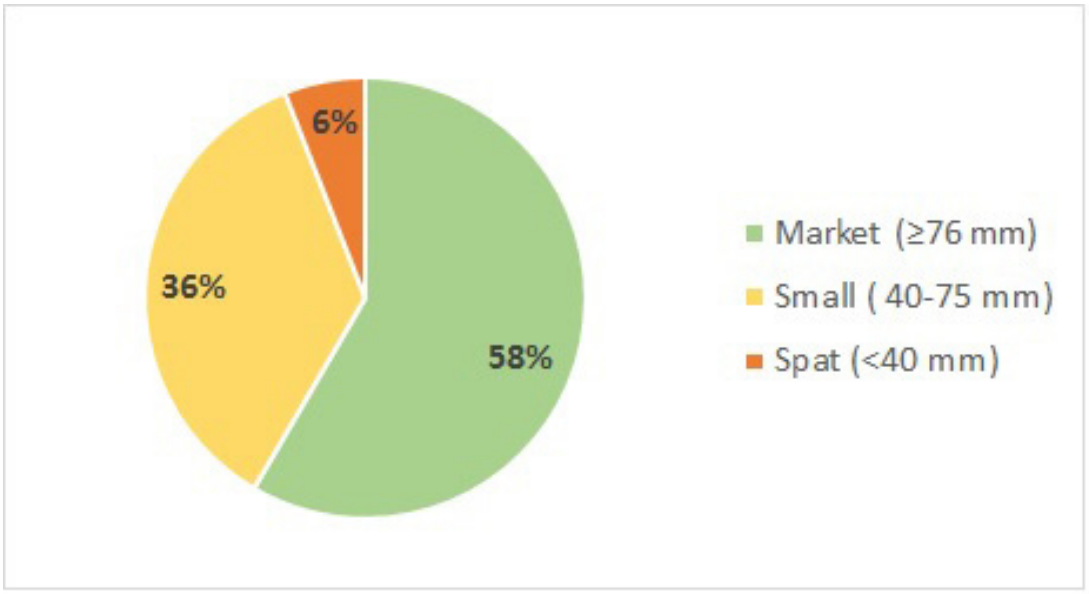
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

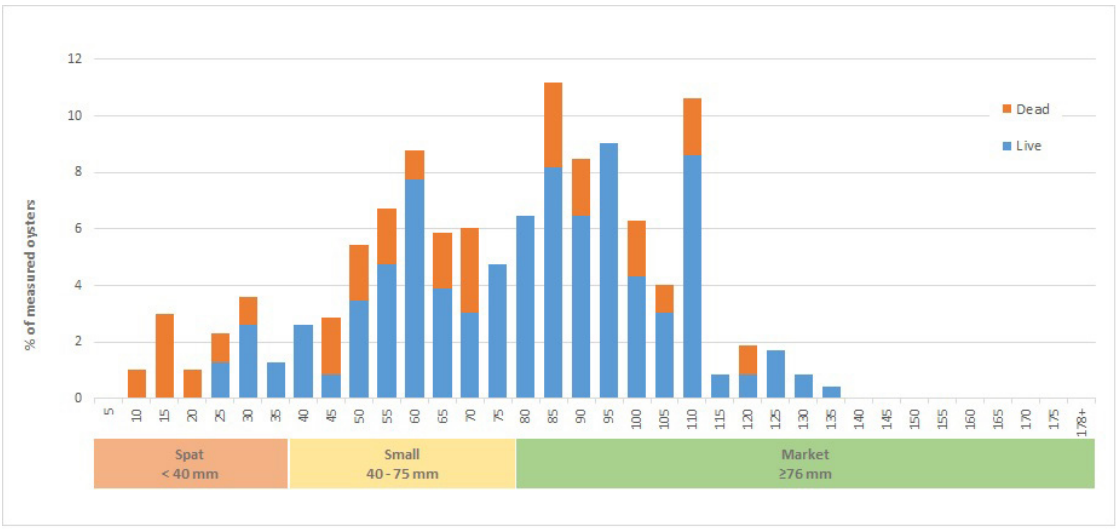
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H37 (AltSub_101) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



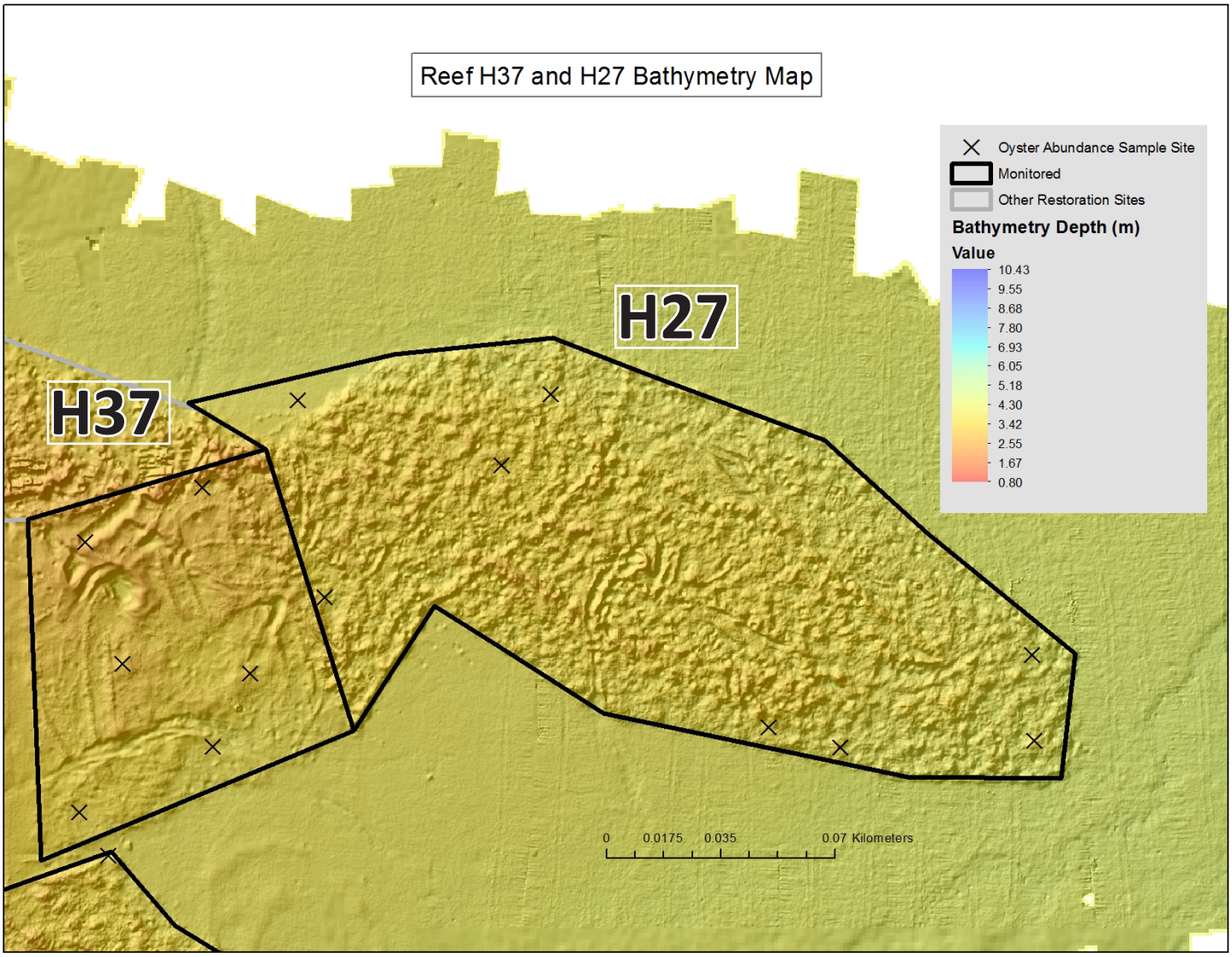
Shell Height of Oysters Measured on Reef



Reef H37 (AltSub_101) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H38 (AltSub_102) Data and Analysis

Reef #	H38
Geodatabase Site_ID	AltSub_102
Bar Name	N/A
Tributary	Harris
Reef area (acres)	2.91
Restoration treatment	Substrate & Seed
Substrate type added	Mixed shell
Ave planned reef height** (inches)	6
Year planted with spat	2013
Spat produced by	UMD
Spat planted by	ORP
Spat planted (millions)	27.16
Spat planted per acre (millions)	9.34
Monitoring type	Three year
Sample Method	Patent Tong
Most recent monitoring sample date	18-Nov-16
# samples taken	9
# live oysters measured	238
# live oysters counted	476
# dead oysters counted	71
% dead oysters observed on the reef	12.98%
Fall 2016: Did reef meet min threshold* density?	Yes
Fall 2016: Did reef meet target* density?	No
Ave live density across reef (#/ m2)	32.85
Standard error of live density (#/ m2)	8.18
Reef area meeting min threshold* density (%)	81%
Reef area meeting target density (%)	---
Ave live density on stone (#/m²)	N/A
Standard error of live density on stone	N/A
Ave live density on shell (#/m²)	N/A
Standard error of live density on shell	N/A
Fall 2016: Did reef meet min threshold* oyster biomass?	Yes
Fall 2016: Did reef meet target* oyster biomass?	Yes
Ave live biomass across reef (g dry weight per m2)	44.00
Standard error of live biomass	12.98
Reef area meeting min threshold* biomass (%)	81%
Reef area meeting target* biomass (%)	32%
Pre restoration (2012): Did reef meet min threshold* density?	No
Pre restoration (2012): Did reef meet target* density?	No
Fall 2016: Are multiple year classes present ?	YES
Fall 2016: Is shell volume stable or increasing?	TBD 2019
Ave shell volume across entire reef (litres per m2)	10.46
Standard error of shell volume	2.07
Total shell volume (litres)	120961.91
Total surface shell volume (litres)	63169
Ave brown shell across all samples (%)	47.78
Is the reef height stable or increasing?	YES
Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6”; 12”) by the reef area. The actual height of the reef varied across the reef.

***Oyster density** (per Oyster Metrics):

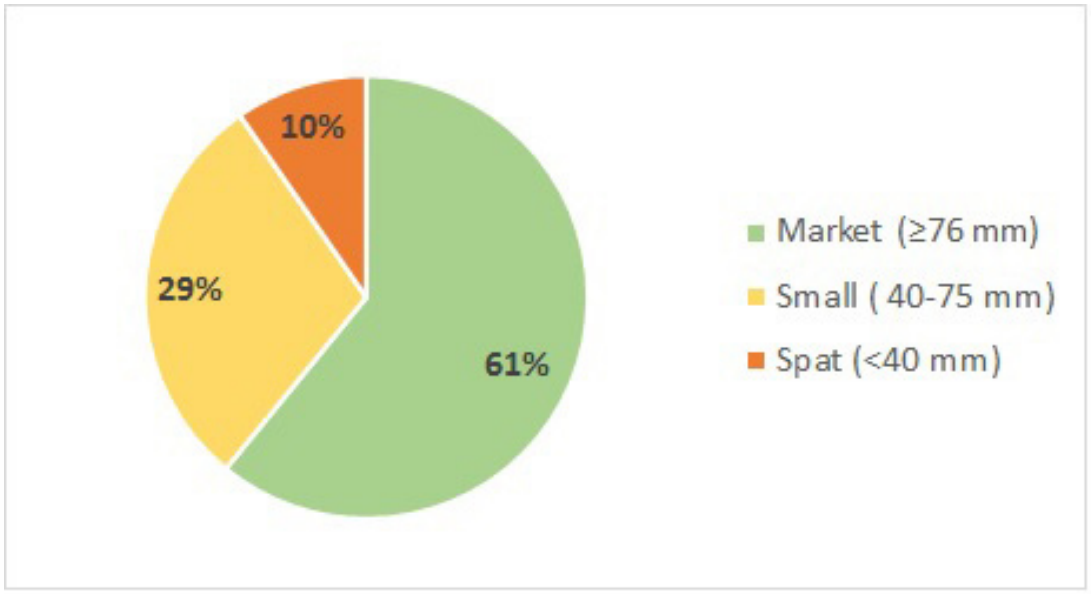
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

***Oyster biomass** (per Oyster Metrics):

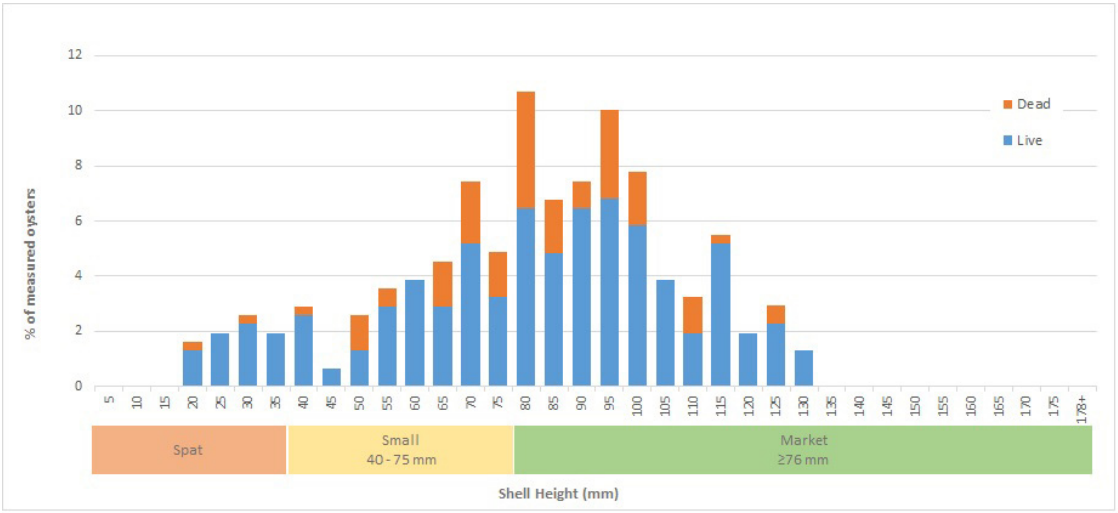
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H38 (AltSub_102) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



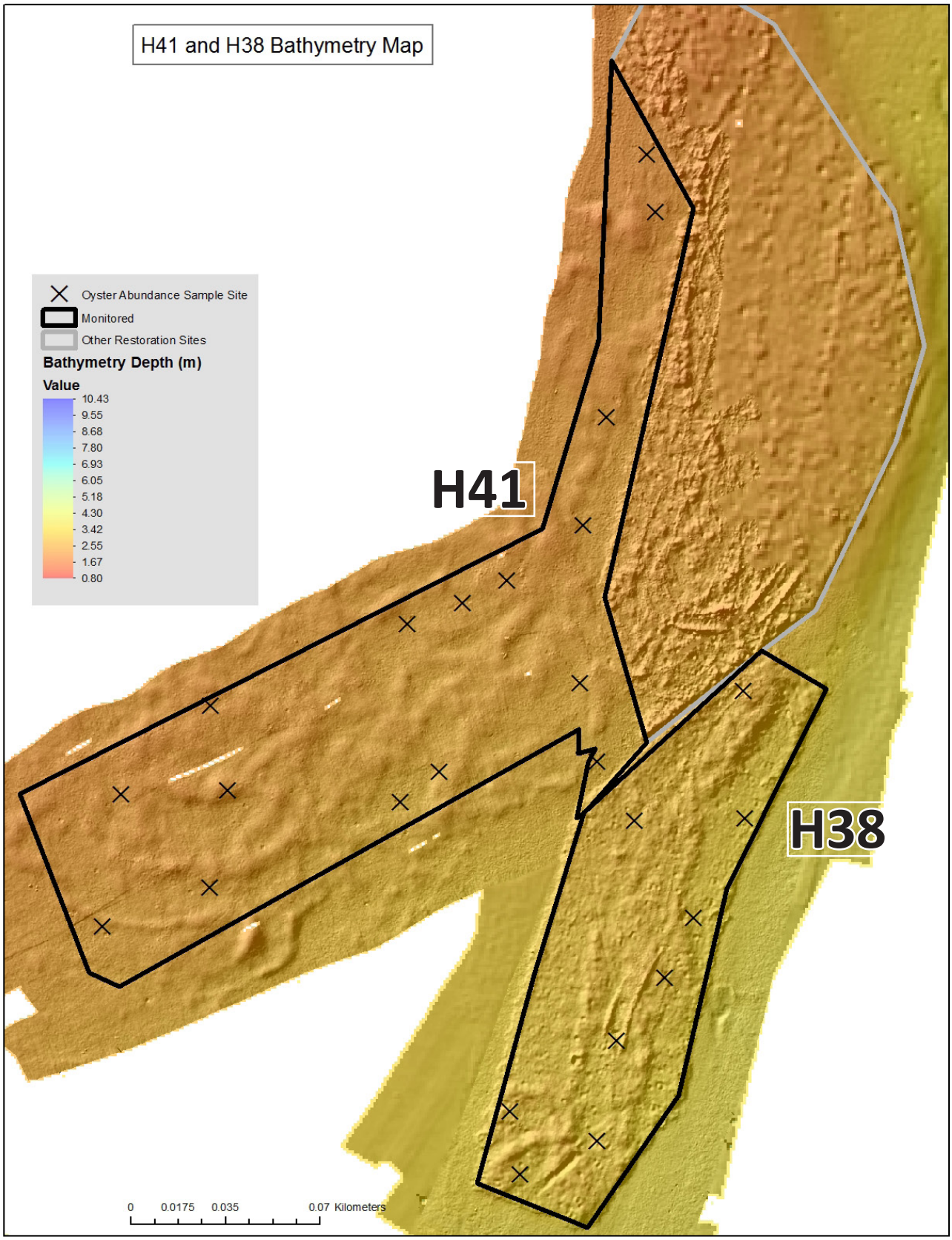
Shell Height of Oysters Measured on Reef



Reef H38 (AltSub_102) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H39 (AltSub_103) Data and Analysis

Reef Information	Reef #	H39
	Geodatabase Site_ID	AltSub_103
	Bar Name	N/A
	Tributary	Harris
	Reef area (acres)	1.79
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Mixed shell
	Ave planned reef height** (inches)	12
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	25.47
	Spat planted per acre (millions)	14.21
Monitoring Information	Monitoring type	Three year
	Sample Method	Patent Tong
	Most recent monitoring sample date	18-Nov-16
	# samples taken	6
	# live oysters measured	117
	# live oysters counted	117
	# dead oysters counted	10
	% dead oysters observed on the reef	7.87%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	No
	Ave live density across reef (#/ m2)	12.11
	Standard error of live density (#/ m2)	3.89
	Reef area meeting min threshold* density (%)	62%
	Reef area meeting target density (%)	---
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m^2)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	No
	Ave live biomass across reef (g dry weight per m2)	13.57
	Standard error of live biomass	4.65
	Reef area meeting min threshold* biomass (%)	42%
	Reef area meeting target* biomass (%)	---
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	8.18
	Standard error of shell volume	2.09
	Total shell volume (litres)	57188.78
	Total surface shell volume (litres)	41461.86
	Ave brown shell across all samples (%)	27.5
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

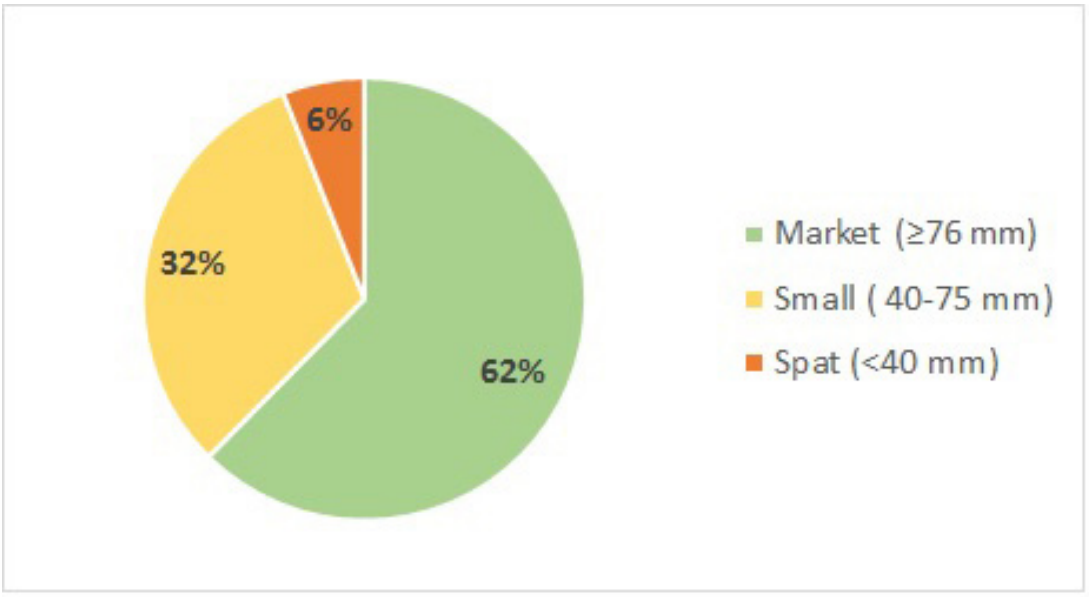
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

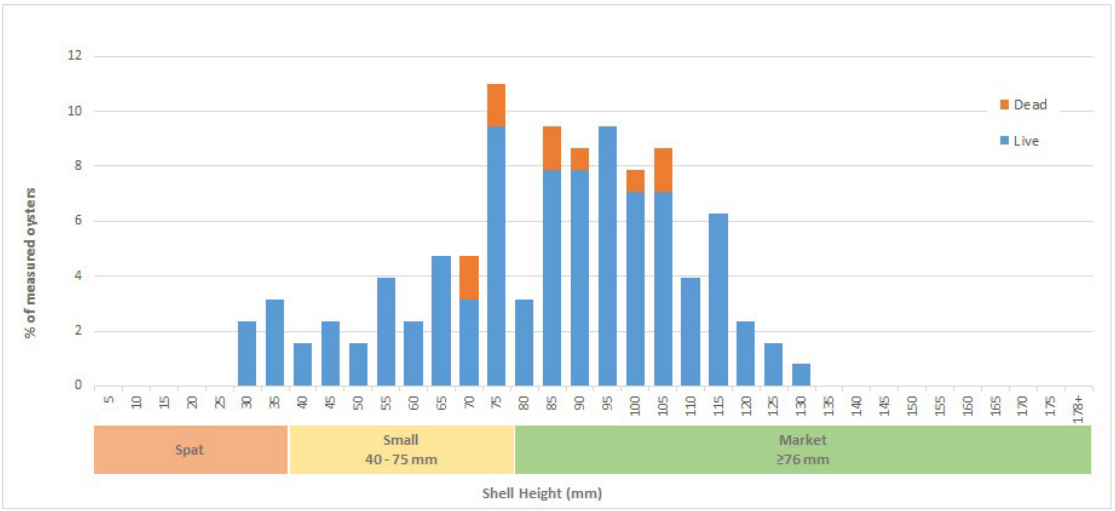
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H39 (AltSub_103) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



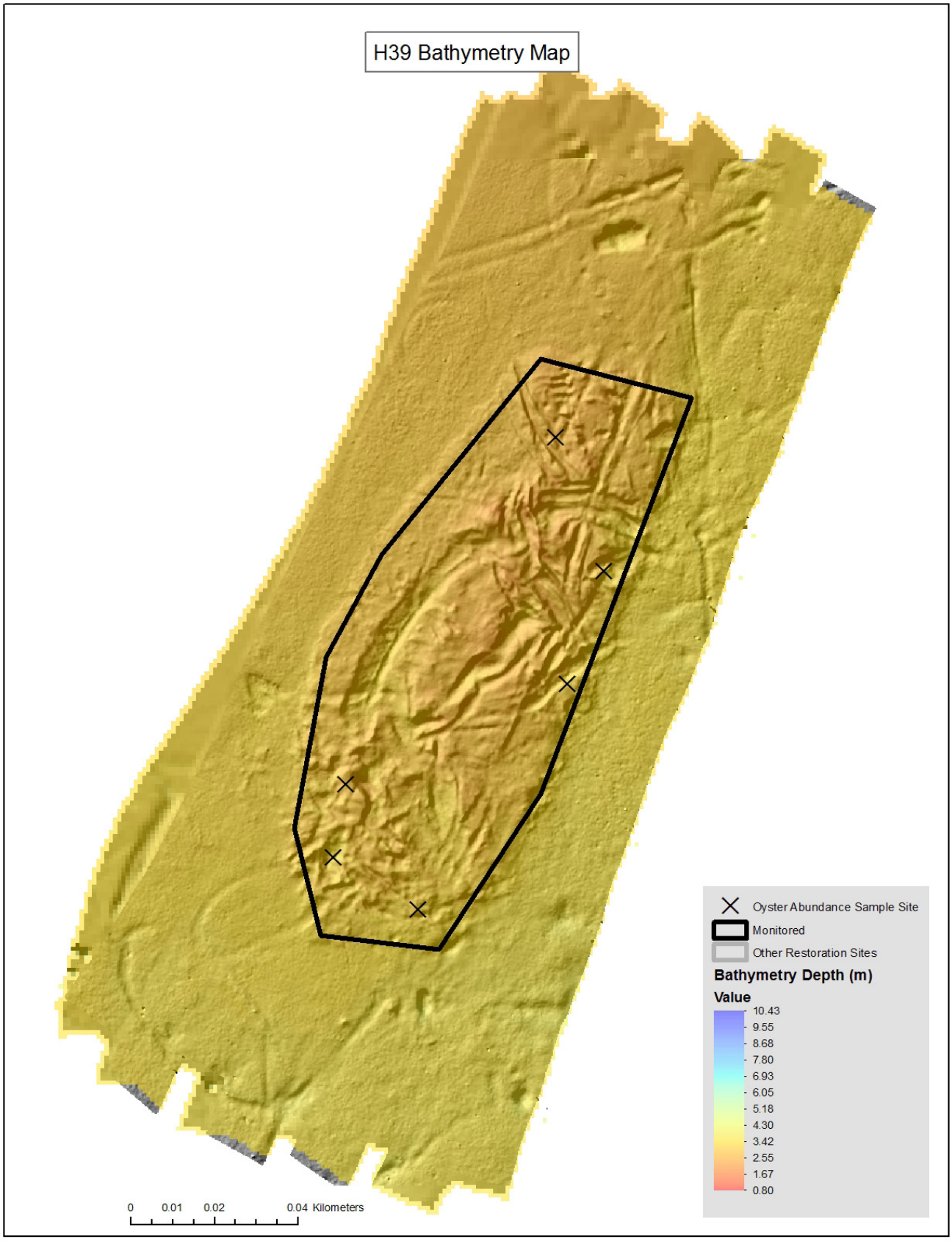
Shell Height of Oysters Measured on Reef



Reef H39 (AltSub_103) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H40 (AltSub_107) Data and Analysis

Reef Information	Reef #	H40
	Geodatabase Site_ID	AltSub_107
	Bar Name	CHANGE
	Tributary	Harris
	Reef area (acres)	5.72
Restoration Treatment	Restoration treatment	Substrate & Seed
	Substrate type added	Stone
	Ave planned reef height** (inches)	6
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	42.09
	Spat planted per acre (millions)	7.35
Monitoring Information	Monitoring type	Three year
	Sample Method	Diver
	Most recent monitoring sample date	02-Nov-16
	# samples taken	5
	# live oysters measured	324
	# live oysters counted	970
	# dead oysters counted	99
	% dead oysters observed on the reef	9.26%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	388.00
	Standard error of live density (#/ m2)	96.69
	Reef area meeting min threshold* density (%)	100%
	Reef area meeting target density (%)	100%
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	143.60
	Standard error of live density on stone	27.37
	Ave live density on shell (#/m^2)	244.40
	Standard error of live density on shell	95.69
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	348.71
	Standard error of live biomass	77.49
	Reef area meeting min threshold* biomass (%)	100%
	Reef area meeting target* biomass (%)	100%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	36.8
	Standard error of shell volume	15.86
	Total shell volume (litres)	832775.79
	Total surface shell volume (litres)	141571.88
	Ave brown shell across all samples (%)	83
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

***Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

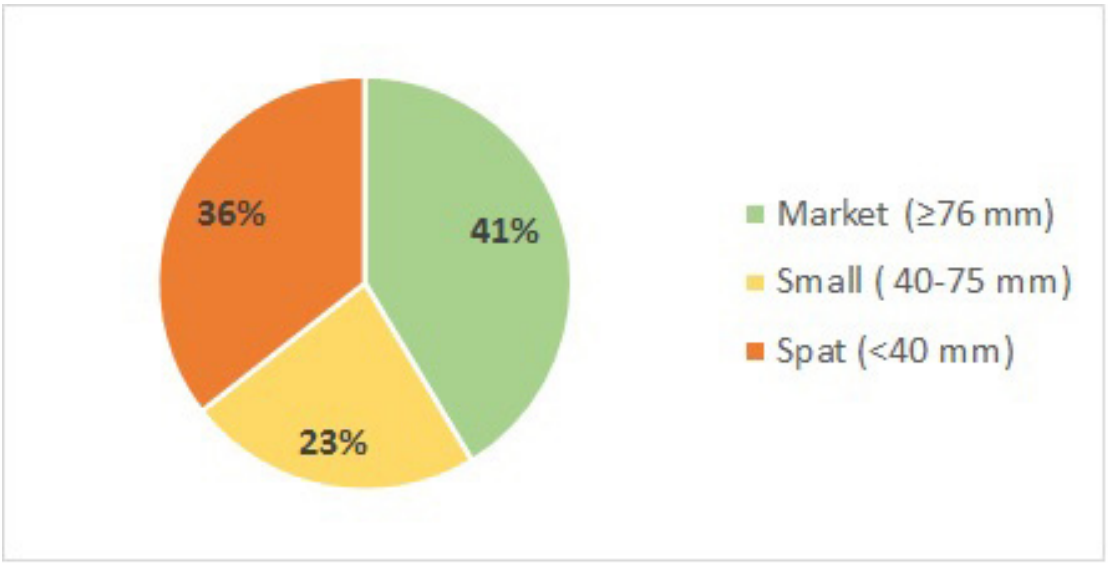
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

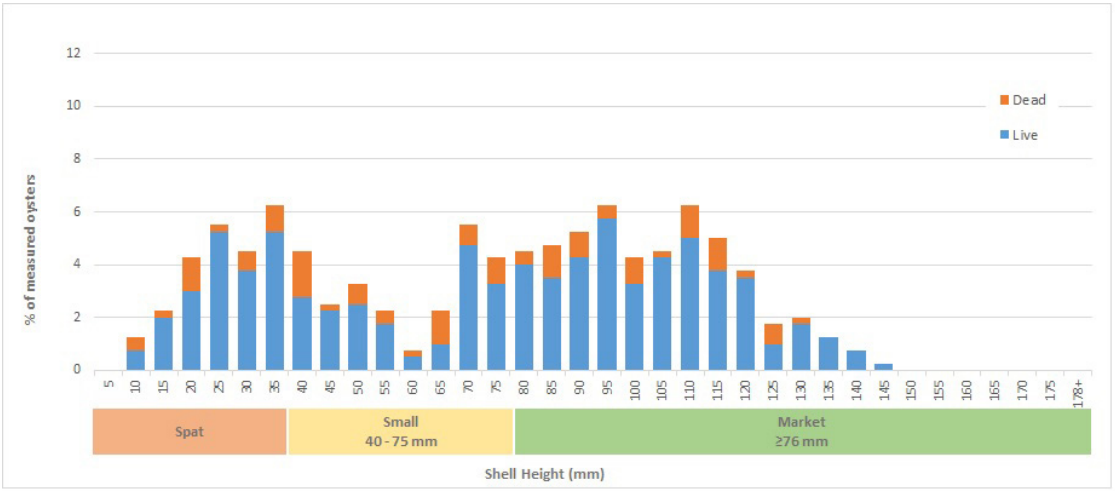
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H40 (AltSub_107) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



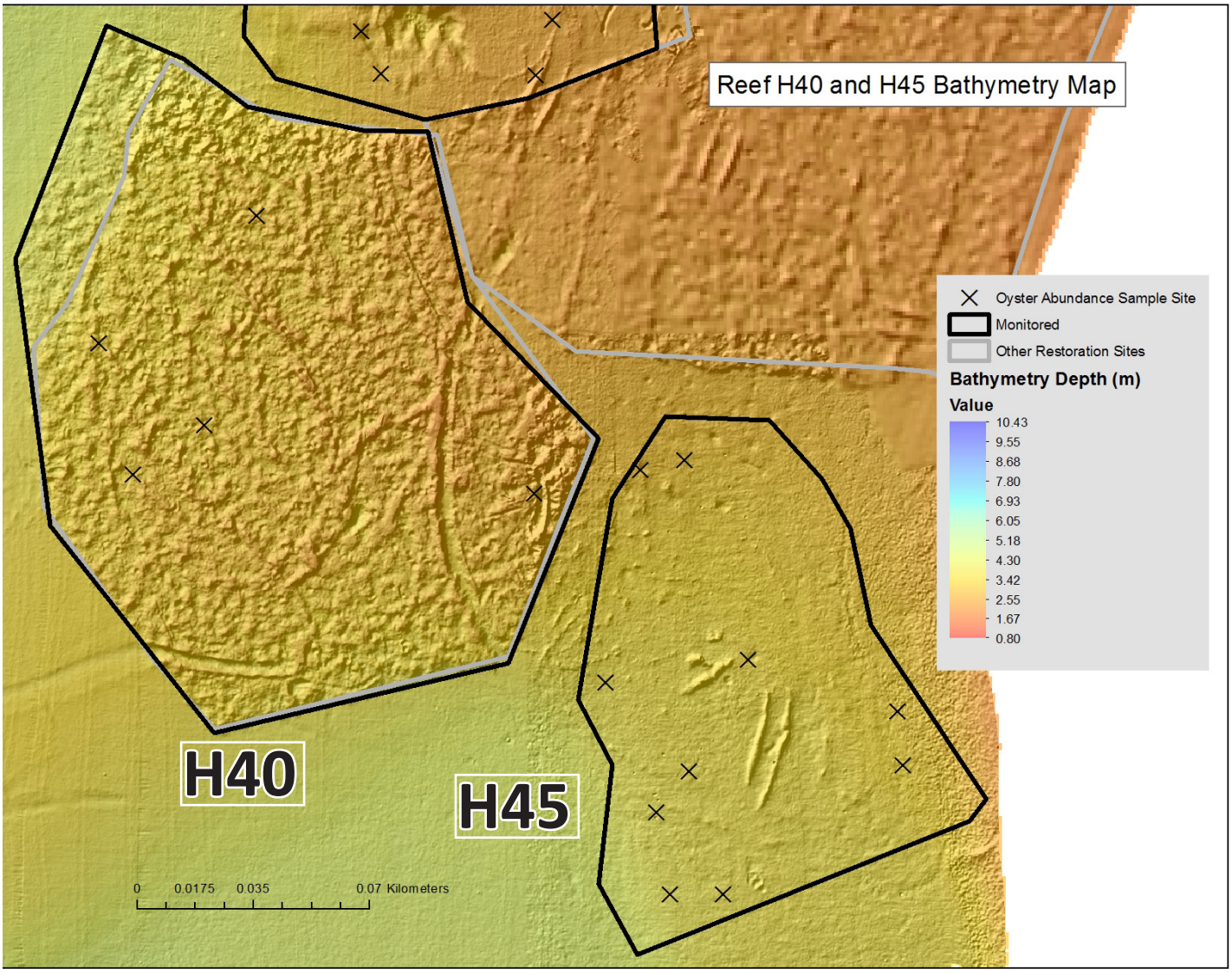
Shell Height of Oysters Measured on Reef



Reef H40 (AltSub_107) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H41 (Seed_04) Data and Analysis

Reef Information	Reef #	H41
	Geodatabase Site_ID	Seed_04
	Bar Name	N/A
	Tributary	Harris
	Reef area (acres)	5.49
Restoration Treatment	Restoration treatment	Seed Only
	Substrate type added	None (spat on shell only)
	Ave planned reef height** (inches)	N/A
	Year planted with spat	2013, 2014
	Spat produced by	CBF
	Spat planted by	CBF
	Spat planted (millions)	20.7
	Spat planted per acre (millions)	3.77
Monitoring Information	Monitoring type	Three year
	Sample Method	Patent Tong
	Most recent monitoring sample date	02-Nov-16
	# samples taken	16
	# live oysters measured	488
	# live oysters counted	1230
	# dead oysters counted	142
	% dead oysters observed on the reef	10.35%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	47.75
	Standard error of live density (#/ m2)	7.42
	Reef area meeting min threshold* density (%)	89%
	Reef area meeting target density (%)	49%
Density on Stone vs. Shell	Ave live density on stone (#/m²)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m²)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	57.48
	Standard error of live biomass	9.78
	Reef area meeting min threshold* biomass (%)	89%
	Reef area meeting target* biomass (%)	52%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	13.43
	Standard error of shell volume	1.84
	Total shell volume (litres)	296182.39
	Total surface shell volume (litres)	137909.92
	Ave brown shell across all samples (%)	53.44
Reef Height & Footprint	**Is the reef height stable or increasing?**	TBD 2019
	Is the reef footprint stable or increasing?	TBD 2019

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

***Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):*

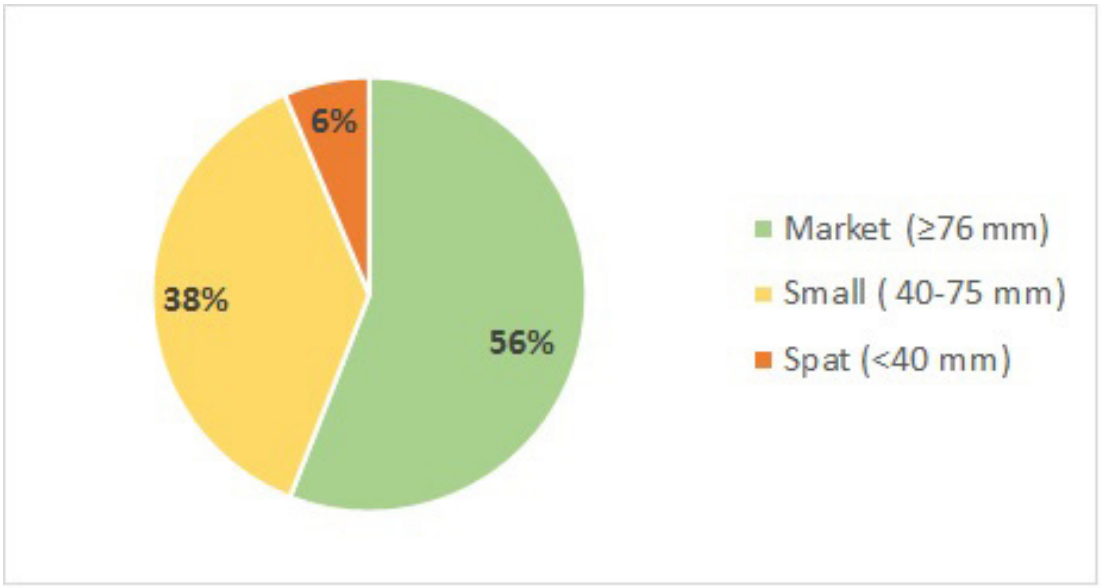
- Min. threshold: 50% of reef is covered with at least 15 oysters per m²
- Target: 30% of reef is covered with at least 50 oysters per m²

**Oyster biomass* (per Oyster Metrics):

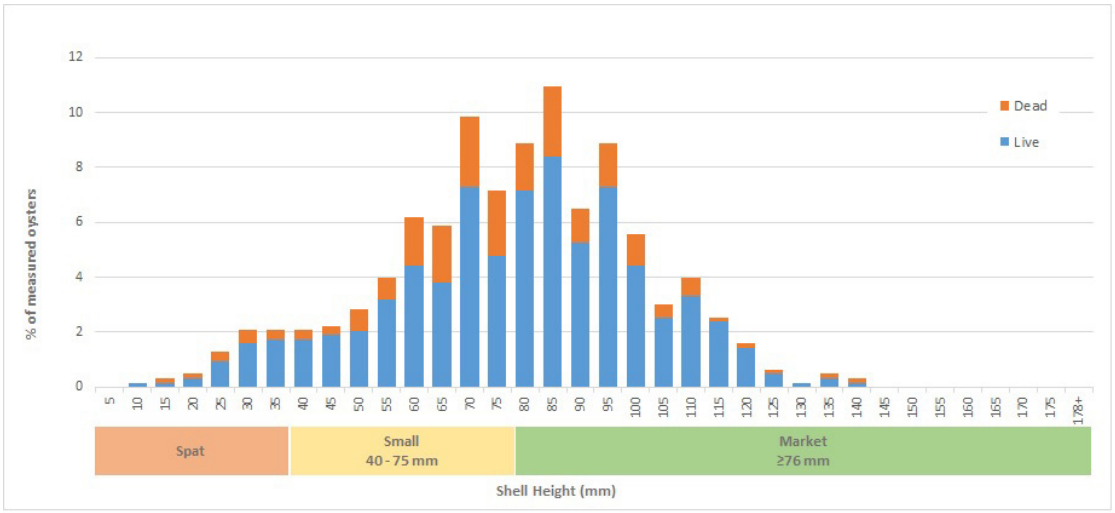
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m²
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m²

Reef H41 (Seed_04) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



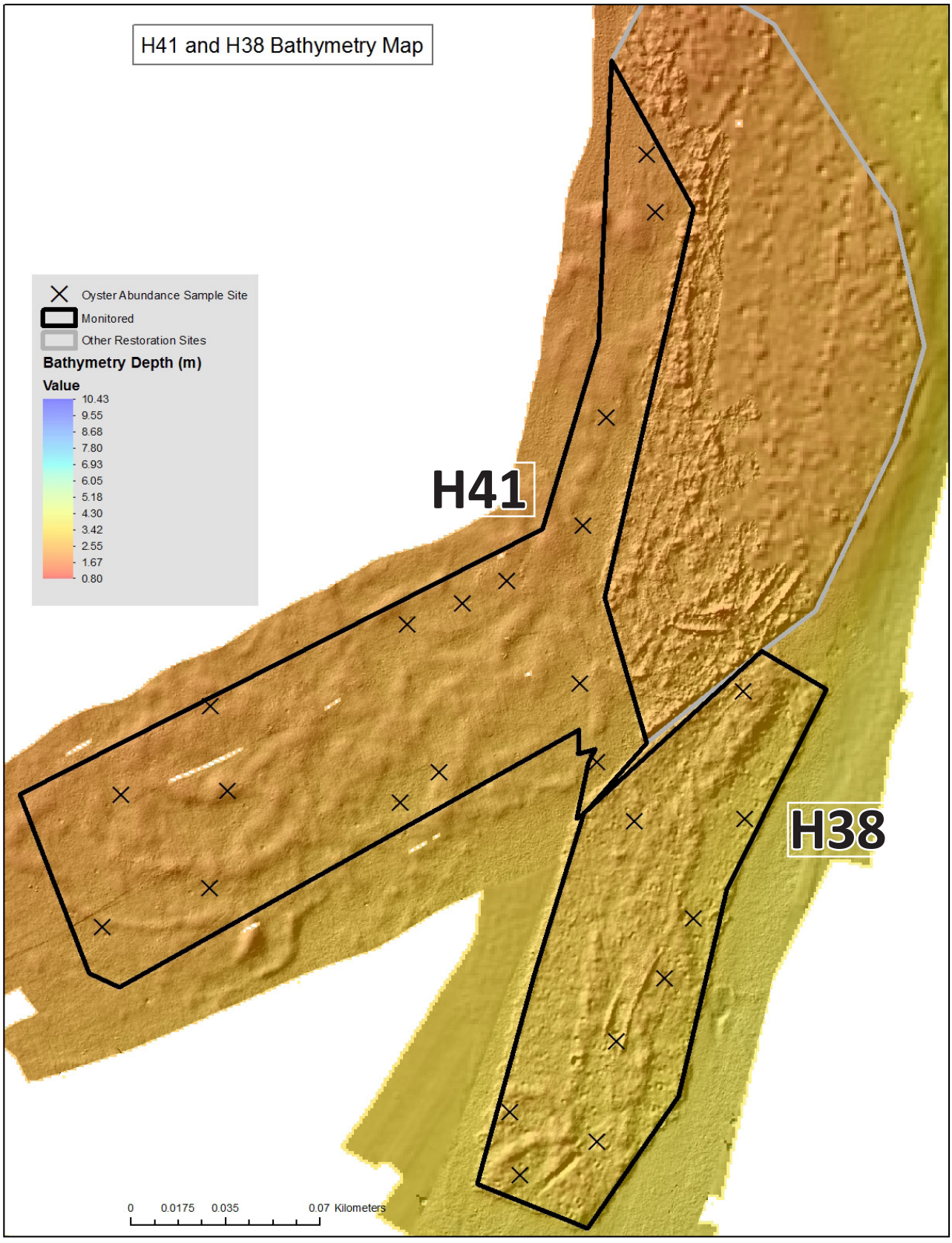
Shell Height of Oysters Measured on Reef



Reef H41 (Seed_04) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H42 (Seed_07) Data and Analysis

Reef Information	Reef #	H42
	Geodatabase Site_ID	Seed_07
	Bar Name	CHANGE
	Tributary	Harris
	Reef area (acres)	5.63
Restoration Treatment	Restoration treatment	Seed Only
	Substrate type added	None (spat on shell only
	Ave planned reef height** (inches)	N/A
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	49.58
	Spat planted per acre (millions)	8.80
Monitoring Information	Monitoring type	Three year
	Sample Method	Patent Tong
	Most recent monitoring sample date	01-Nov-16
	# samples taken	14
	# live oysters measured	409
	# live oysters counted	943
	# dead oysters counted	97
	% dead oysters observed on the reef	9.33%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	No
	Ave live density across reef (#/ m2)	41.84
	Standard error of live density (#/ m2)	10.88
	Reef area meeting min threshold* density (%)	88%
	Reef area meeting target density (%)	---
Density on Stone vs. Shell	Ave live density on stone (#/m²)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m²)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	57.66
	Standard error of live biomass	15.88
	Reef area meeting min threshold* biomass (%)	83%
	Reef area meeting target* biomass (%)	47%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	10.09
	Standard error of shell volume	1.8
	Total shell volume (litres)	227486.95
	Total surface shell volume (litres)	74745.71
	Ave brown shell across all samples (%)	67.14
Reef Height & Footprint	**Is the reef height stable or increasing?**	TBD 2019
	Is the reef footprint stable or increasing?	TBD 2019

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

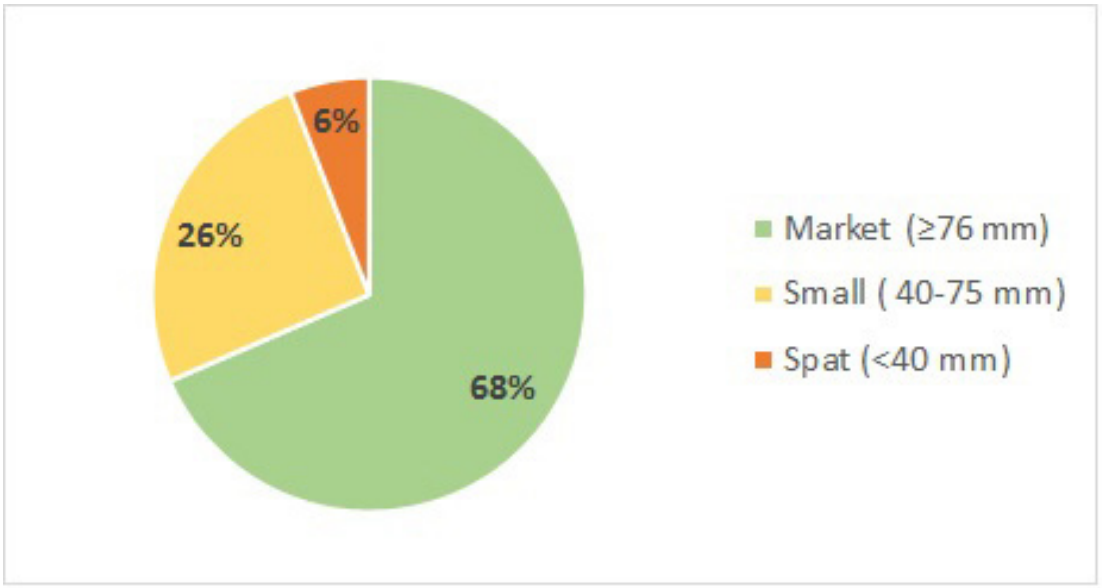
- Min. threshold: 50% of reef is covered with at least 15 oysters per m²
- Target: 30% of reef is covered with at least 50 oysters per m²

**Oyster biomass* (per Oyster Metrics):

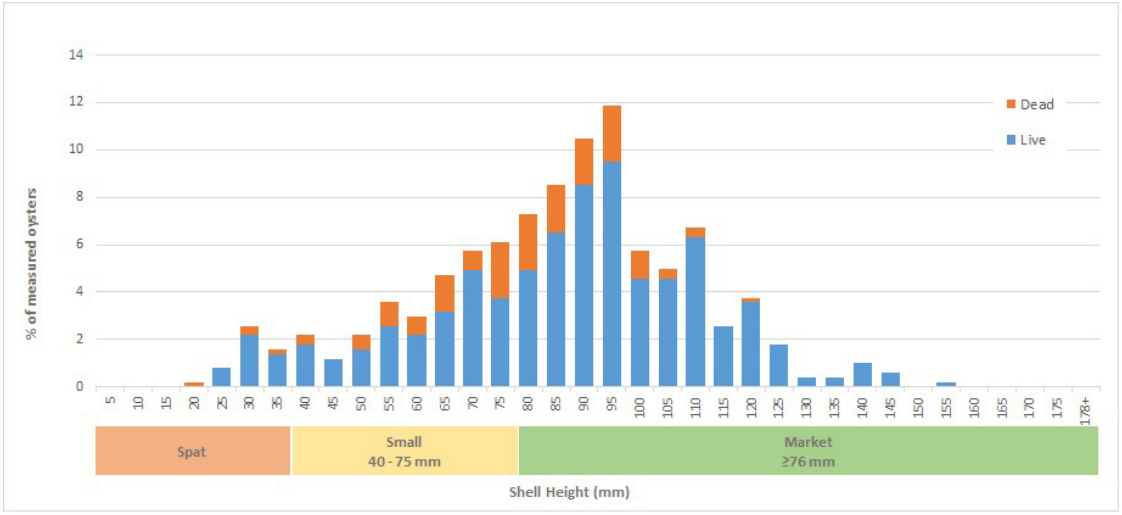
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m²
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m²

Reef H42 (Seed_07) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



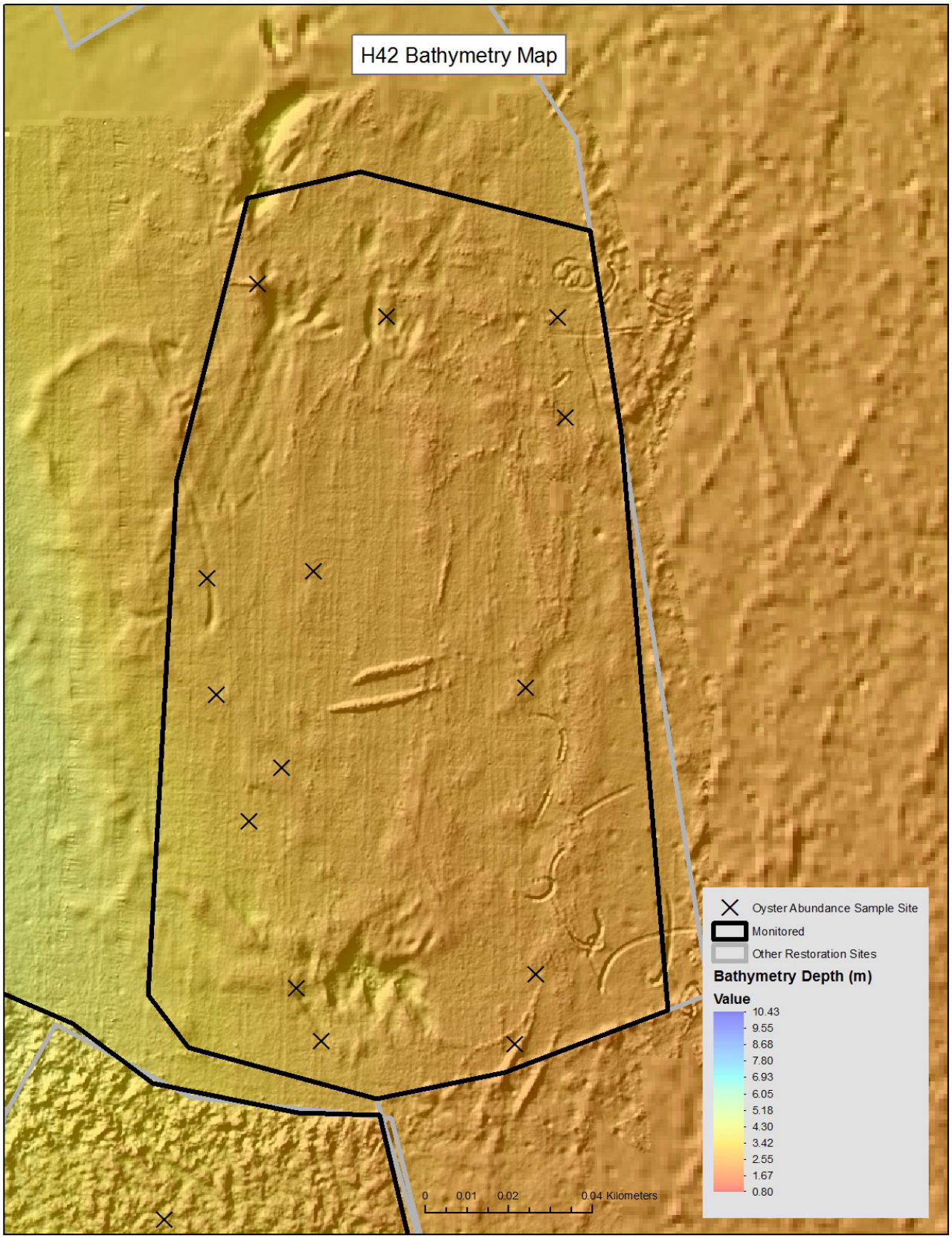
Shell Height of Oysters Measured on Reef



Reef H42 (Seed_07) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H43 (Seed_I I) Data and Analysis

Reef Information	Reef #	H43
	Geodatabase Site_ID	Seed_11
	Bar Name	HUNTS
	Tributary	Harris
	Reef area (acres)	4.52
Restoration Treatment	Restoration treatment	Seed Only
	Substrate type added	None (spat on shell only
	Ave planned reef height** (inches)	N/A
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	19.1
	Spat planted per acre (millions)	4.22
Monitoring Information	Monitoring type	Three year
	Sample Method	Patent Tong
	Most recent monitoring sample date	17-Nov-16
	# samples taken	9
	# live oysters measured	197
	# live oysters counted	628
	# dead oysters counted	78
	% dead oysters observed on the reef	11.05%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	43.34
	Standard error of live density (#/ m2)	17.78
	Reef area meeting min threshold* density (%)	54%
	Reef area meeting target density (%)	36%
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m^2)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	52.52
	Standard error of live biomass	20.39
	Reef area meeting min threshold* biomass (%)	59%
	Reef area meeting target* biomass (%)	45%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	11.73
	Standard error of shell volume	3.72
	Total shell volume (litres)	176040.98
	Total surface shell volume (litres)	99023.05
	Ave brown shell across all samples (%)	43.75
Reef Height & Footprint	**Is the reef height stable or increasing?**	TBD 2019
	Is the reef footprint stable or increasing?	TBD 2019

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

***Oyster density** (per Oyster Metrics):

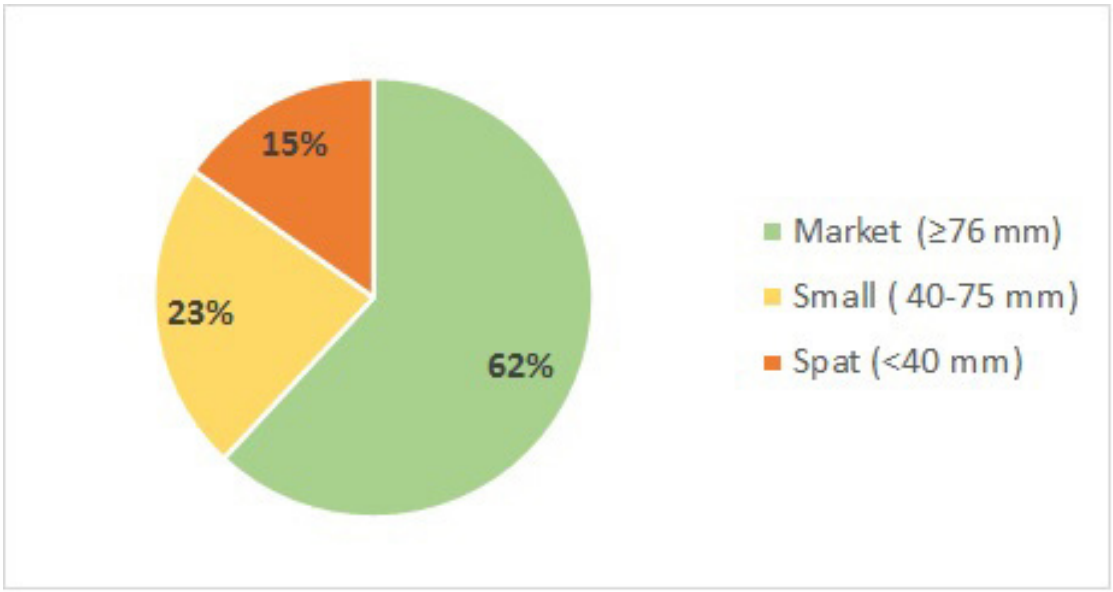
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

***Oyster biomass** (per Oyster Metrics):

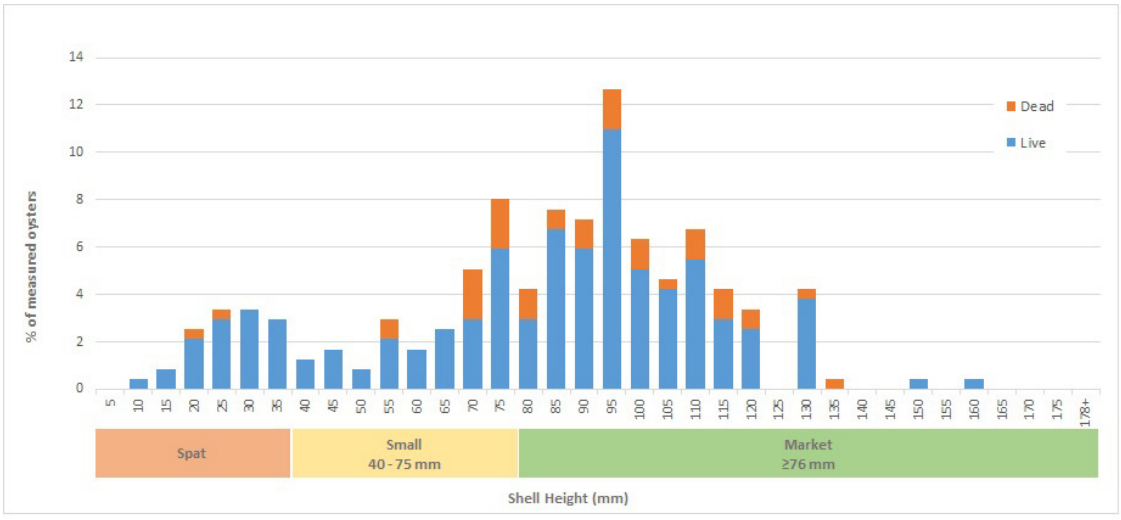
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H43 (Seed_I I) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



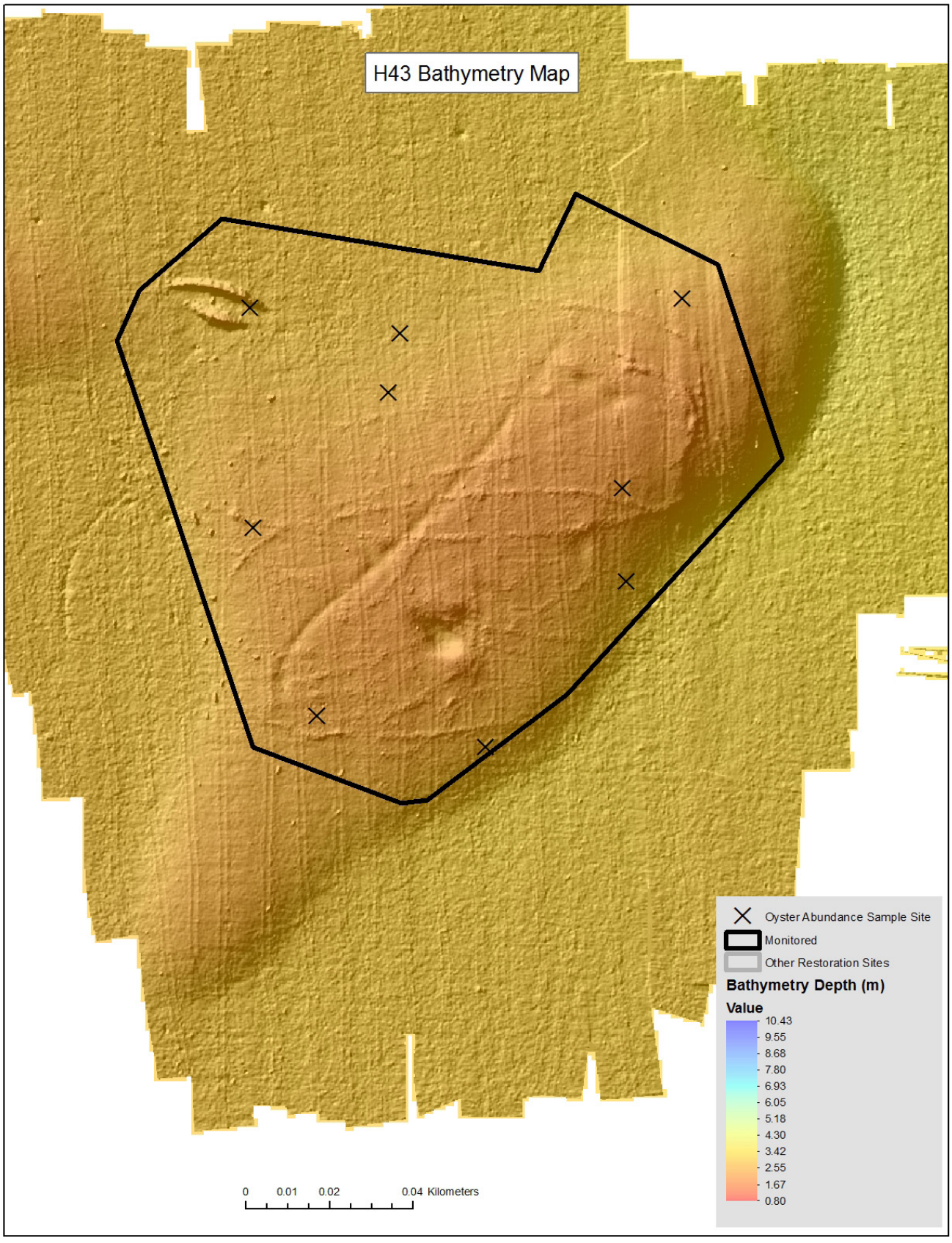
Shell Height of Oysters Measured on Reef



Reef H43 (Seed_I I) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H44 (Seed_59) Data and Analysis

Reef Information	Reef #	H44
	Geodatabase Site_ID	Seed_59
	Bar Name	MILL POINT
	Tributary	Harris
	Reef area (acres)	2.58
Restoration Treatment	Restoration treatment	Seed Only
	Substrate type added	None (spat on shell only
	Ave planned reef height** (inches)	N/A
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	16.42
	Spat planted per acre (millions)	6.35
Monitoring Information	Monitoring type	Three year
	Sample Method	Patent Tong
	Most recent monitoring sample date	16-Nov-16
	# samples taken	8
	# live oysters measured	232
	# live oysters counted	555
	# dead oysters counted	54
	% dead oysters observed on the reef	8.87%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	43.09
	Standard error of live density (#/ m2)	8.38
	Reef area meeting min threshold* density (%)	94%
	Reef area meeting target density (%)	39%
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m^2)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	No
	Ave live biomass across reef (g dry weight per m2)	38.50
	Standard error of live biomass	8.86
	Reef area meeting min threshold* biomass (%)	87%
	Reef area meeting target* biomass (%)	---
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	11.1
	Standard error of shell volume	1.88
	Total shell volume (litres)	114701.01
	Total surface shell volume (litres)	74555.65
	Ave brown shell across all samples (%)	35
Reef Height & Footprint	**Is the reef height stable or increasing?**	YES
	Is the reef footprint stable or increasing?	YES

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

***Ave planned reef height*: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6”; 12”) by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

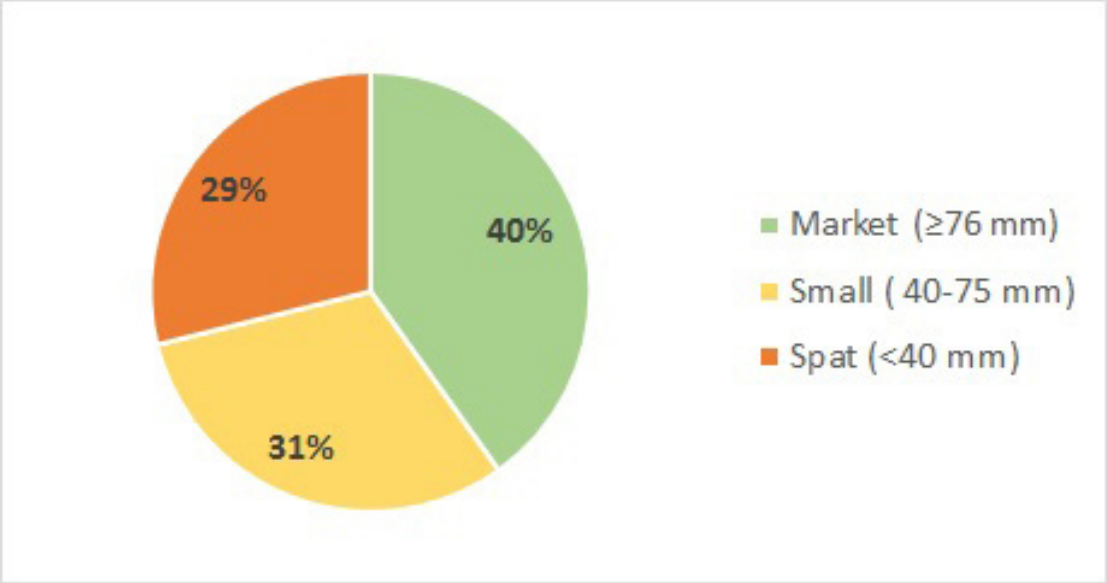
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

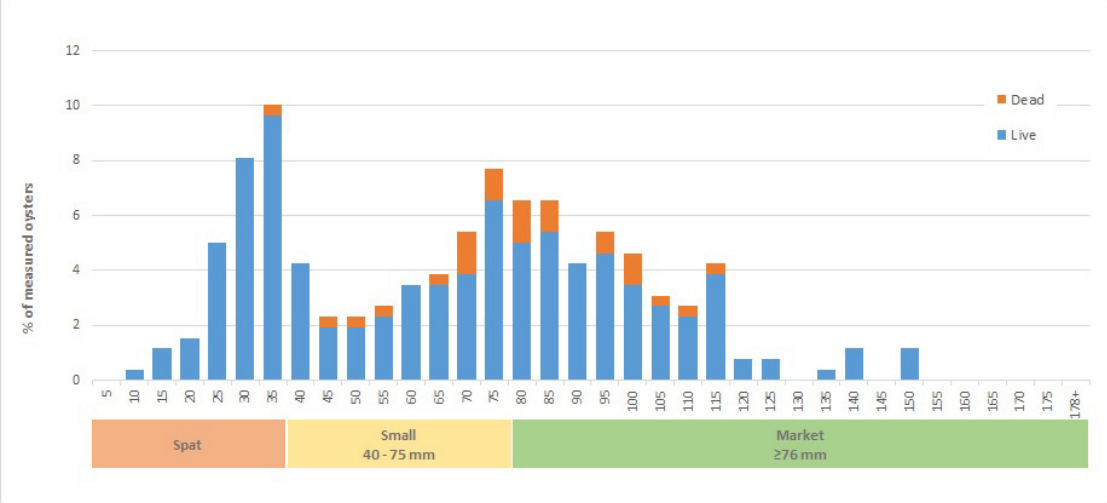
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H44 (Seed_59) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



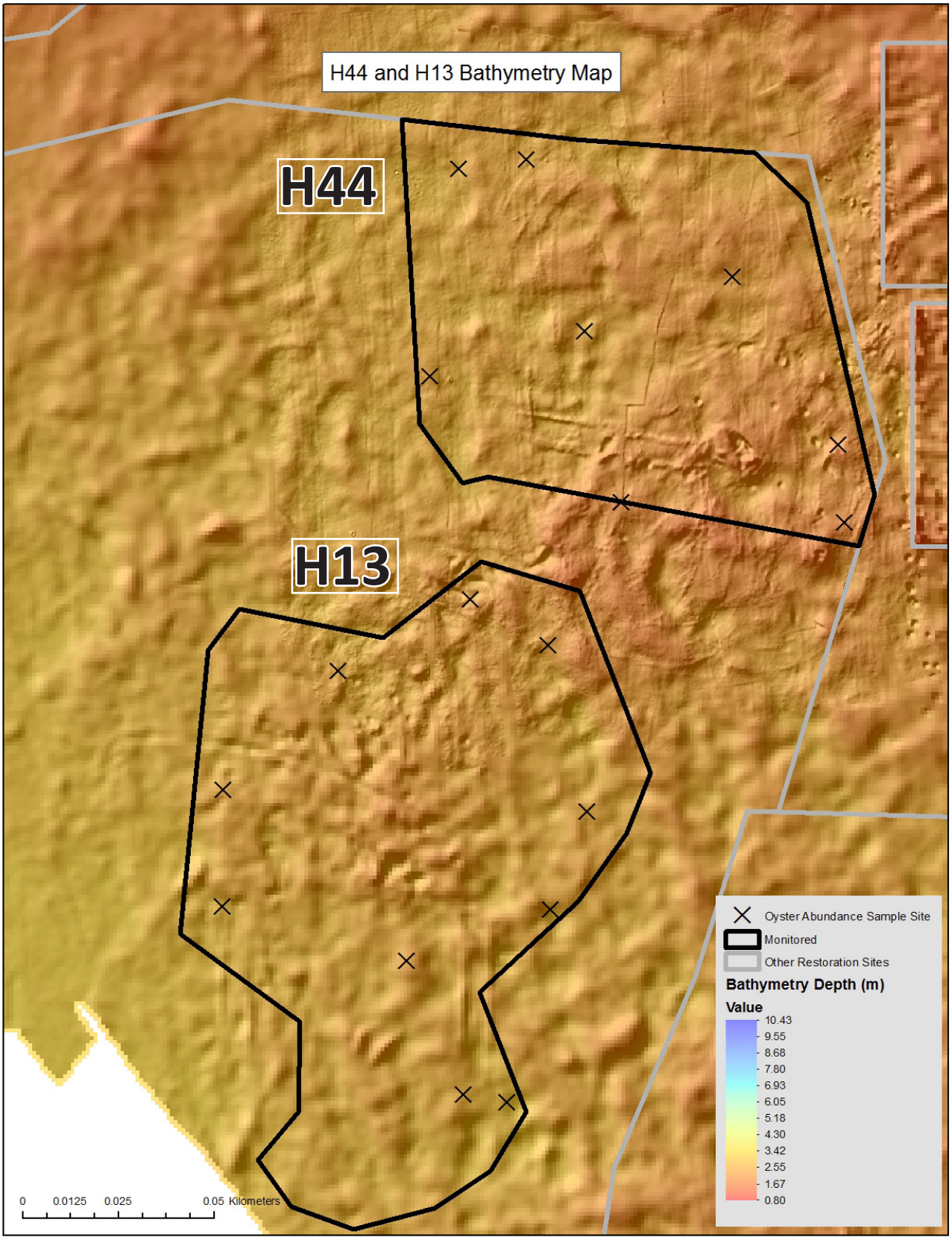
Shell Height of Oysters Measured on Reef



Reef H44 (Seed_59) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H45 (Seed_75) Data and Analysis

Reef Information	Reef #	H45
	Geodatabase Site_ID	Seed_75
	Bar Name	CHANGE
	Tributary	Harris
	Reef area (acres)	3.08
Restoration Treatment	Restoration treatment	Seed Only
	Substrate type added	None (spat on shell only
	Ave planned reef height** (inches)	N/A
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	52.51
	Spat planted per acre (millions)	17.03
Monitoring Information	Monitoring type	Three year
	Sample Method	Patent Tong
	Most recent monitoring sample date	01-Nov-16
	# samples taken	10
	# live oysters measured	49
	# live oysters counted	49
	# dead oysters counted	11
	% dead oysters observed on the reef	18.33%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	No
	Fall 2016: Did reef meet target* density?	No
	Ave live density across reef (#/ m2)	3.04
	Standard error of live density (#/ m2)	0.98
	Reef area meeting min threshold* density (%)	---
	Reef area meeting target density (%)	---
Density on Stone vs. Shell	Ave live density on stone (#/m²)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m²)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	No
	Fall 2016: Did reef meet target* oyster biomass?	No
	Ave live biomass across reef (g dry weight per m2)	4.33
	Standard error of live biomass	1.76
	Reef area meeting min threshold* biomass (%)	---
	Reef area meeting target* biomass (%)	---
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	1.21
	Standard error of shell volume	0.39
	Total shell volume (litres)	15067.89
	Total surface shell volume (litres)	6629.87
	Ave brown shell across all samples (%)	56
Reef Height & Footprint	**Is the reef height stable or increasing?**	TBD 2019
	Is the reef footprint stable or increasing?	TBD 2019

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

***Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6”; 12”) by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):*

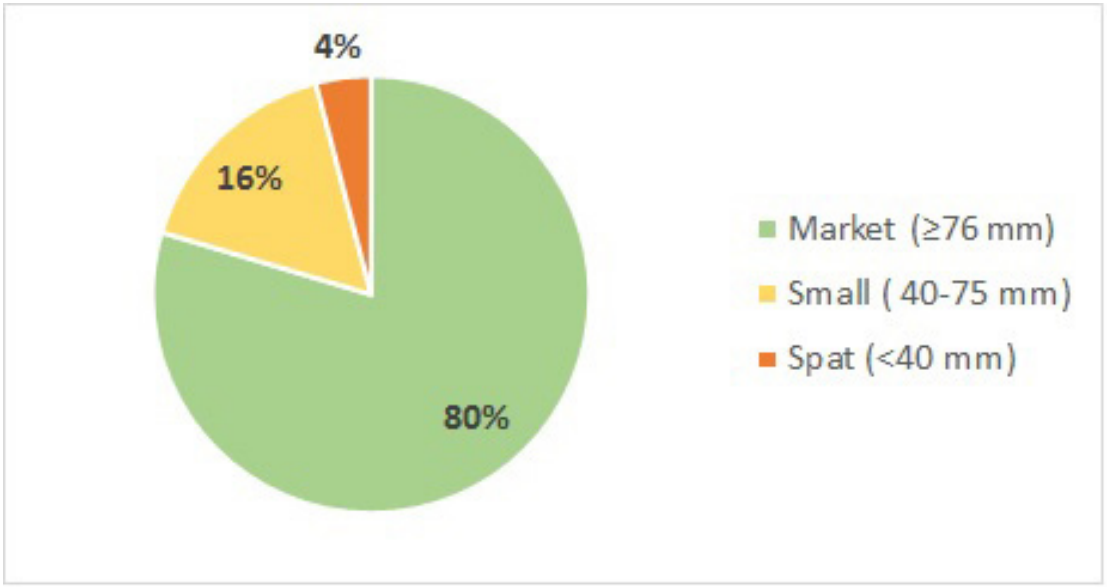
- Min. threshold: 50% of reef is covered with at least 15 oysters per m²
- Target: 30% of reef is covered with at least 50 oysters per m²

**Oyster biomass* (per Oyster Metrics):

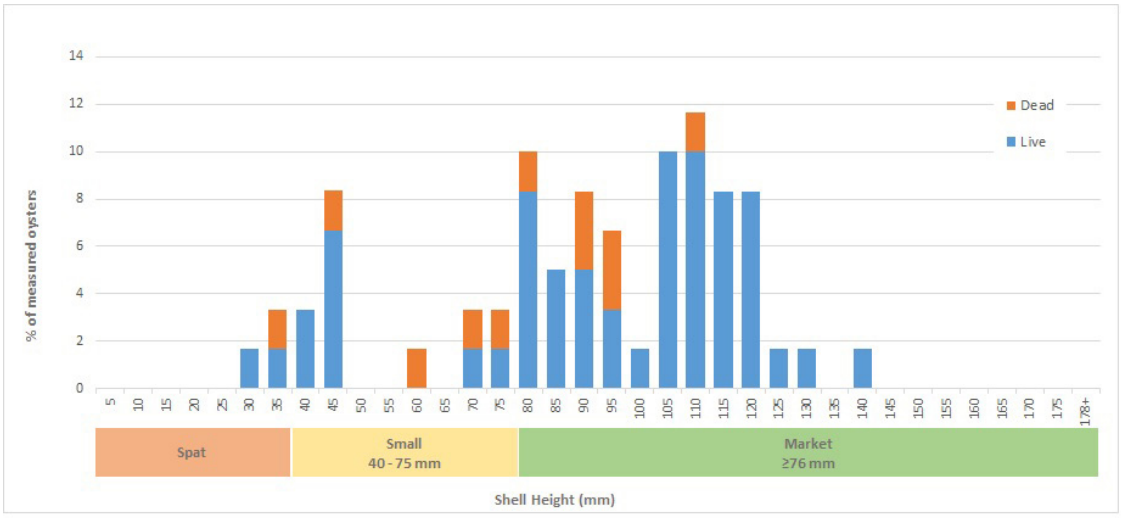
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m²
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m²

Reef H45 (Seed_75) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



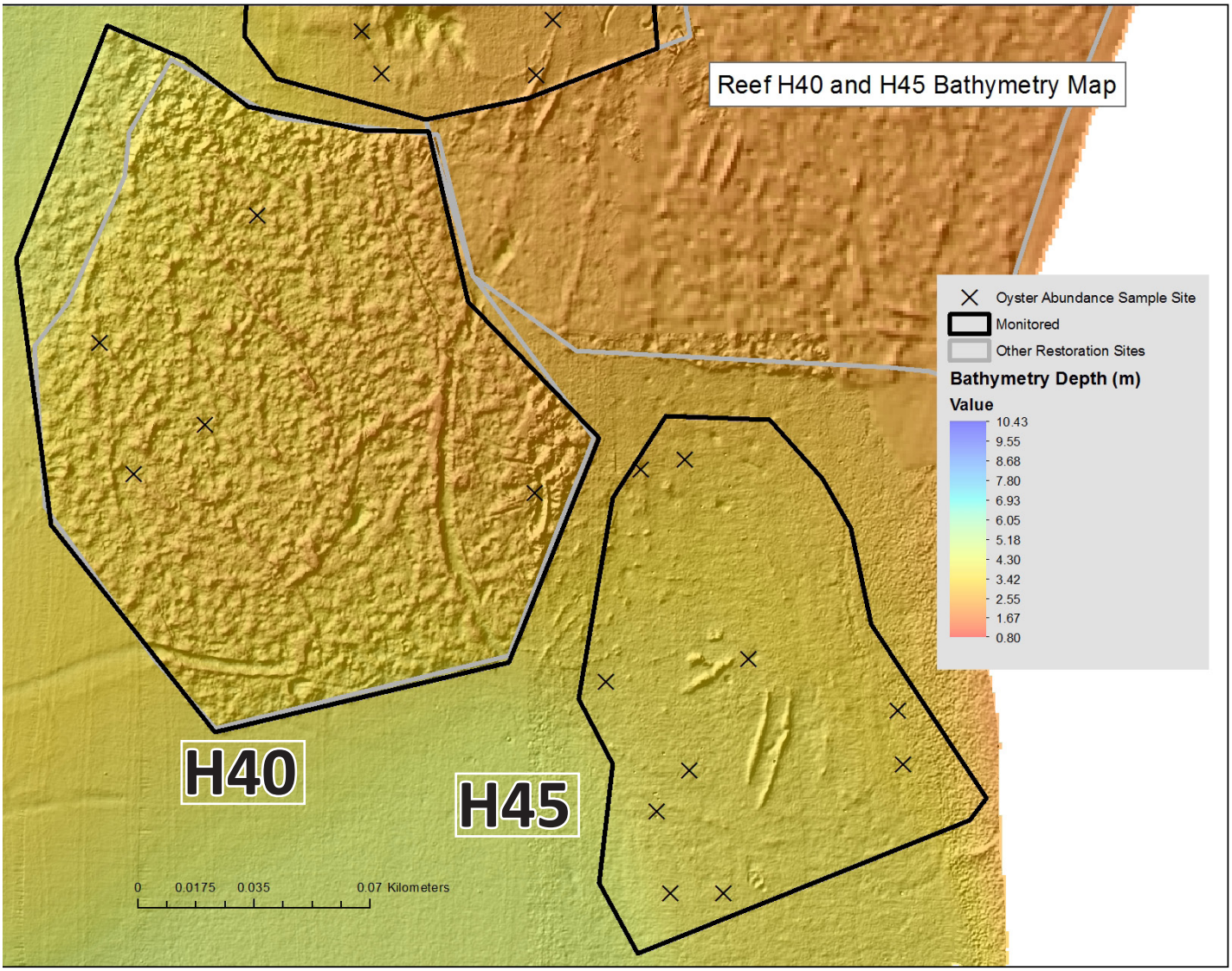
Shell Height of Oysters Measured on Reef



Reef H45 (Seed_75) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H46 (Seed_13A) Data and Analysis

Reef Information	Reef #	H46
	Geodatabase Site_ID	Seed_13A
	Bar Name	MILL POINT
	Tributary	Harris
	Reef area (acres)	7.95
Restoration Treatment	Restoration treatment	Seed Only
	Substrate type added	None (spat on shell only
	Ave planned reef height** (inches)	N/A
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	46
	Spat planted per acre (millions)	5.79
Monitoring Information	Monitoring type	Three year
	Sample Method	Patent Tong
	Most recent monitoring sample date	17-Nov-16
	# samples taken	20
	# live oysters measured	504
	# live oysters counted	807
	# dead oysters counted	90
	% dead oysters observed on the reef	10.03%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	No
	Ave live density across reef (#/ m2)	25.06
	Standard error of live density (#/ m2)	4.37
	Reef area meeting min threshold* density (%)	76%
	Reef area meeting target density (%)	---
Density on Stone vs. Shell	Ave live density on stone (#/m²)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m²)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	No
	Ave live biomass across reef (g dry weight per m2)	26.89
	Standard error of live biomass	5.53
	Reef area meeting min threshold* biomass (%)	54%
	Reef area meeting target* biomass (%)	---
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	9.3
	Standard error of shell volume	1.11
	Total shell volume (litres)	296096.15
	Total surface shell volume (litres)	194107.48
	Ave brown shell across all samples (%)	34.44
Reef Height & Footprint	**Is the reef height stable or increasing?**	TBD 2019
	Is the reef footprint stable or increasing?	TBD 2019

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height***: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6”; 12”) by the reef area. The actual height of the reef varied across the reef.

**Oyster density* (per Oyster Metrics):

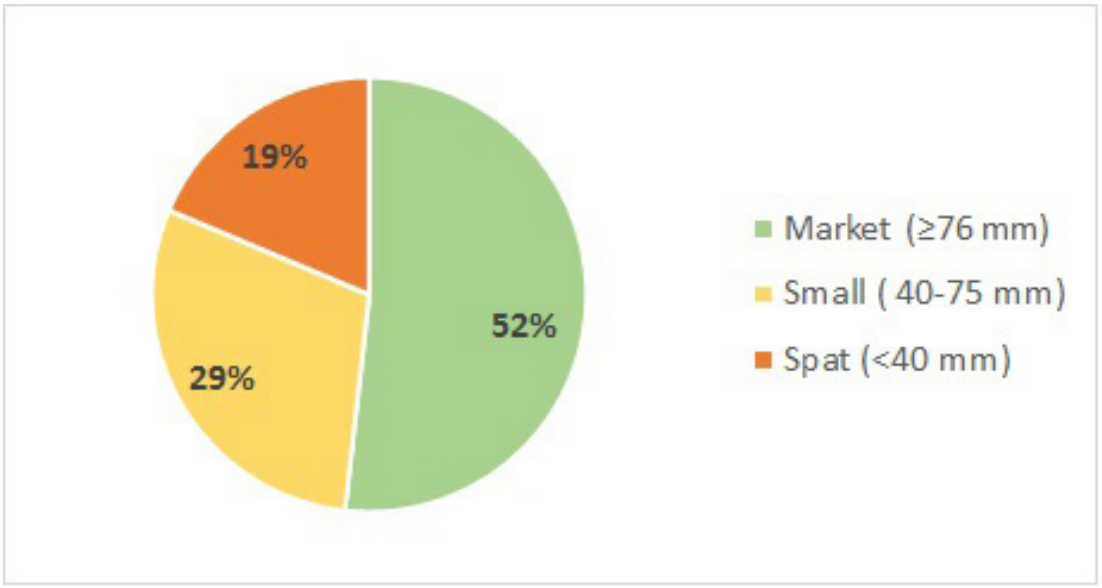
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

**Oyster biomass* (per Oyster Metrics):

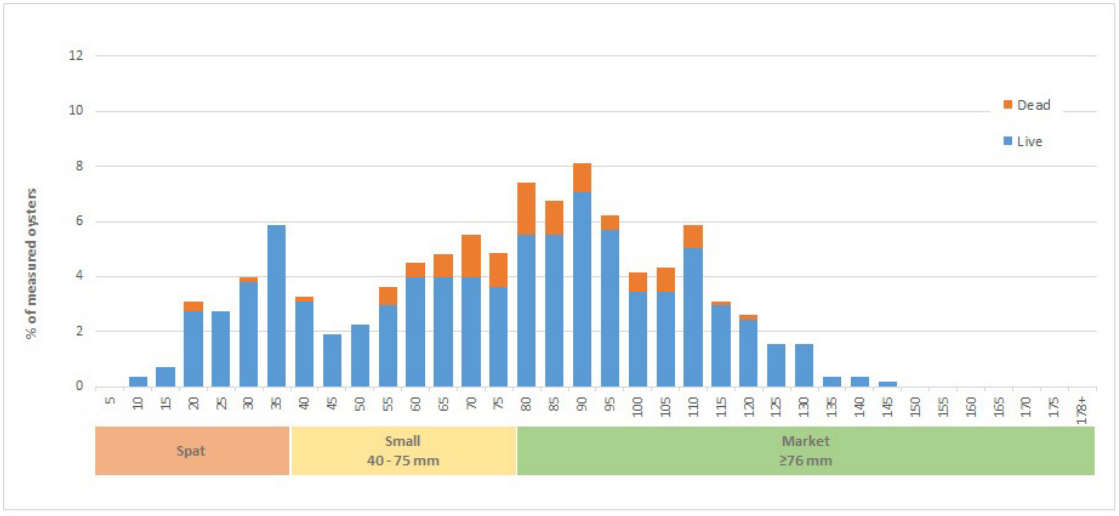
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H46 (Seed_13A) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



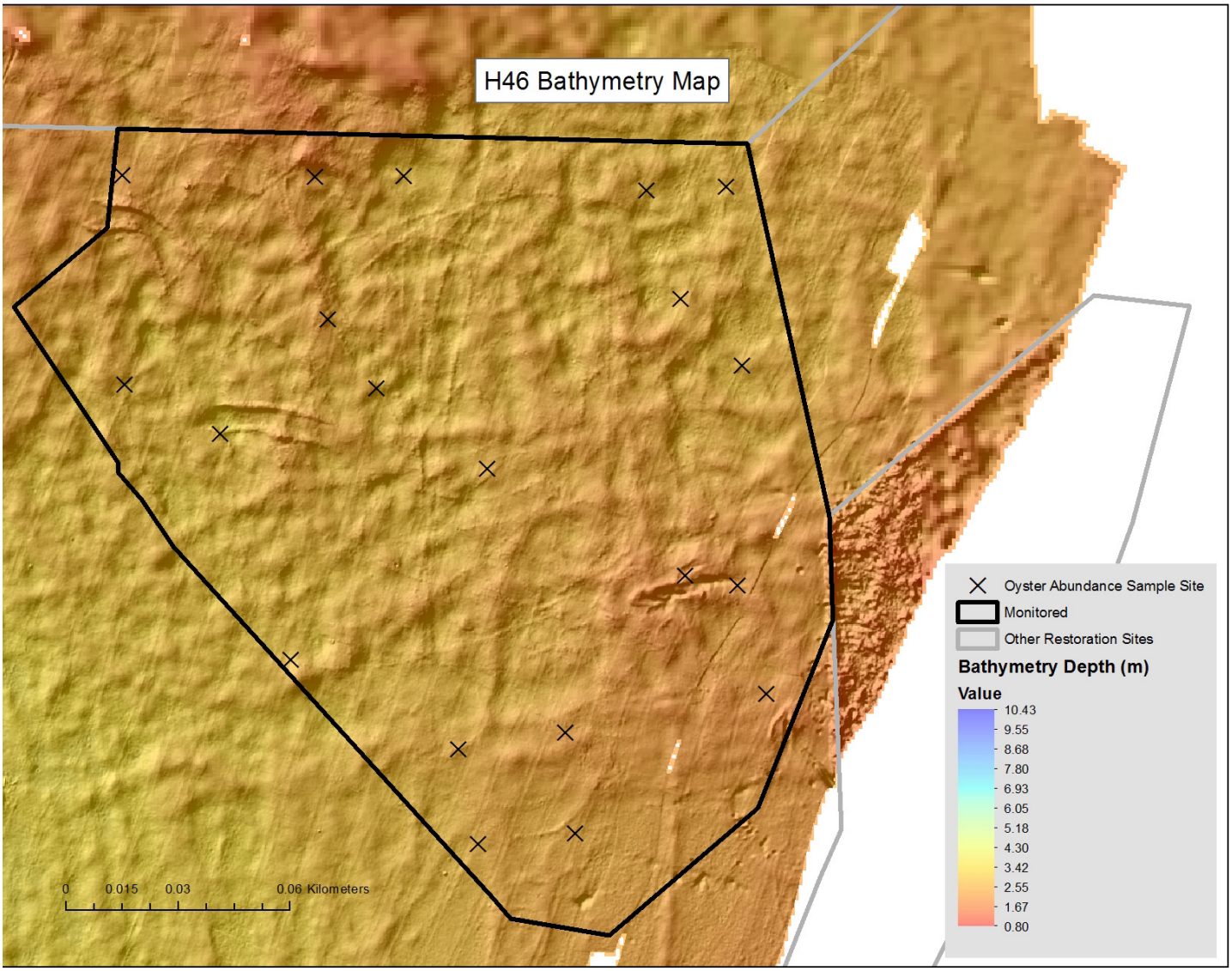
Shell Height of Oysters Measured on Reef



Reef H46 (Seed_13A) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



Reef H47 (Seed_13B) Data and Analysis

Reef Information	Reef #	H47
	Geodatabase Site_ID	Seed_13B
	Bar Name	MILL POINT
	Tributary	Harris
	Reef area (acres)	9.21
Restoration Treatment	Restoration treatment	Seed Only
	Substrate type added	None (spat on shell only
	Ave planned reef height** (inches)	N/A
	Year planted with spat	2013
	Spat produced by	UMD
	Spat planted by	ORP
	Spat planted (millions)	40.85
	Spat planted per acre (millions)	4.44
Monitoring Information	Monitoring type	Three year
	Sample Method	Patent Tong
	Most recent monitoring sample date	17-Nov-16
	# samples taken	22
	# live oysters measured	550
	# live oysters counted	1802
	# dead oysters counted	338
	% dead oysters observed on the reef	15.79%
Oyster Density	**Fall 2016: Did reef meet min threshold* density?**	Yes
	Fall 2016: Did reef meet target* density?	Yes
	Ave live density across reef (#/ m2)	50.88
	Standard error of live density (#/ m2)	11.79
	Reef area meeting min threshold* density (%)	85%
	Reef area meeting target density (%)	44%
Density on Stone vs. Shell	Ave live density on stone (#/m^2)	N/A
	Standard error of live density on stone	N/A
	Ave live density on shell (#/m^2)	N/A
	Standard error of live density on shell	N/A
Oyster Biomass	**Fall 2016: Did reef meet min threshold* oyster biomass?**	Yes
	Fall 2016: Did reef meet target* oyster biomass?	Yes
	Ave live biomass across reef (g dry weight per m2)	59.35
	Standard error of live biomass	14.23
	Reef area meeting min threshold* biomass (%)	85%
	Reef area meeting target* biomass (%)	43%
Pre-Restoration Density	Pre restoration (2012): Did reef meet min threshold* density?	No
	Pre restoration (2012): Did reef meet target* density?	No
Multiple Year Classes	**Fall 2016: Are multiple year classes present ?**	YES
Shell Volume	**Fall 2016: Is shell volume stable or increasing?**	TBD 2019
	Ave shell volume across entire reef (litres per m2)	13.5
	Standard error of shell volume	2.54
	Total shell volume (litres)	498958.38
	Total surface shell volume (litres)	202078.14
	Ave brown shell across all samples (%)	59.5
Reef Height & Footprint	**Is the reef height stable or increasing?**	TBD 2019
	Is the reef footprint stable or increasing?	TBD 2019

Parameters in **bold** are Chesapeake Bay Oyster Metrics success criteria.

See Figures 4, 5, and 6 for reef locations (pages 10-11).

****Ave planned reef height**: The amount of reef-building material placed into a reef was calculated by multiplying the desired average reef height (ex.: 6"; 12") by the reef area. The actual height of the reef varied across the reef.

***Oyster density** (per Oyster Metrics):

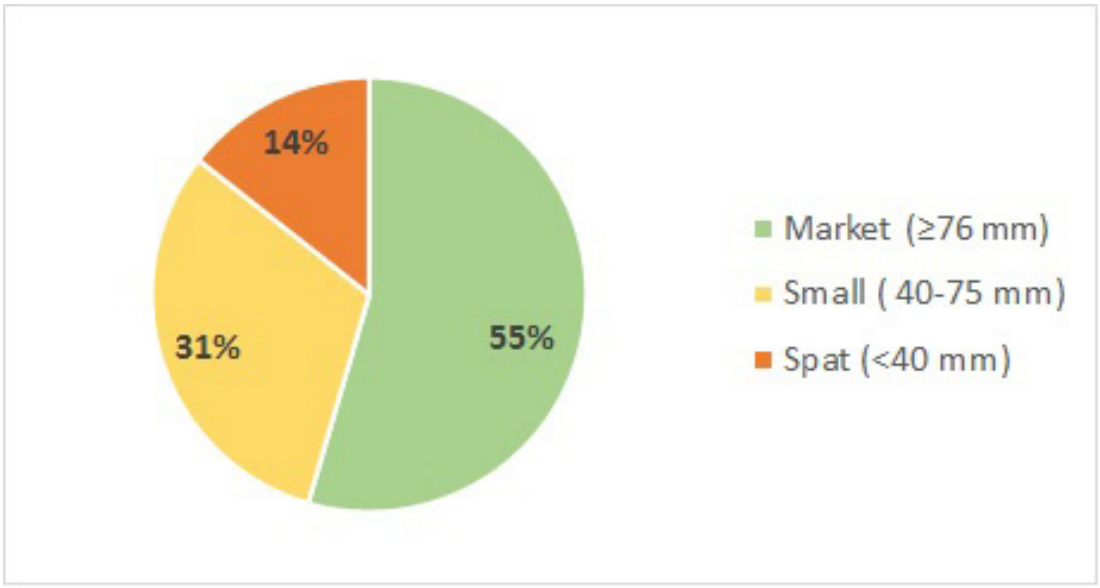
- Min. threshold: 50% of reef is covered with at least 15 oysters per m^2
- Target: 30% of reef is covered with at least 50 oysters per m^2

*O**yster biomass** (per Oyster Metrics):

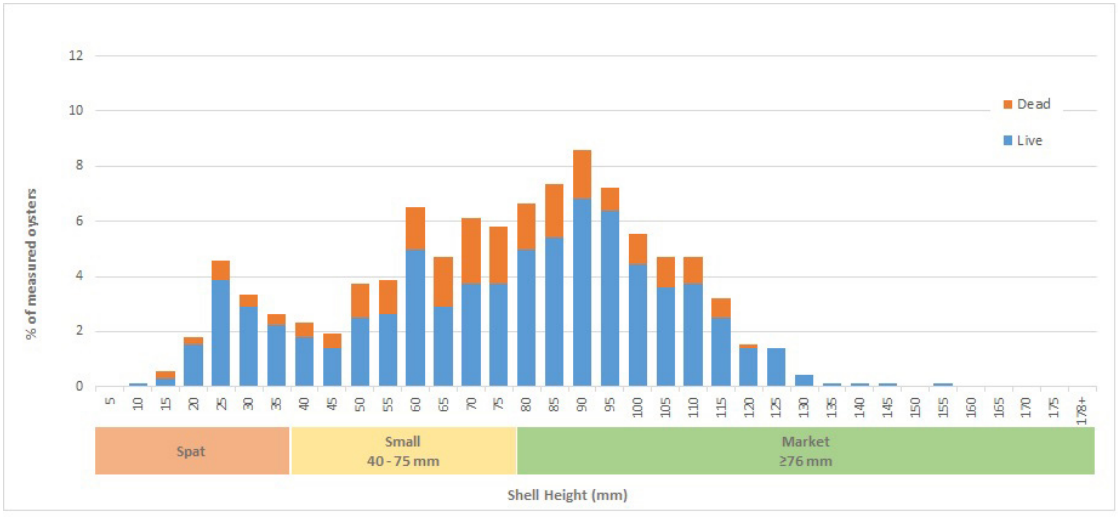
- Min. threshold: 30% of reef is covered with at least 15 grams dry weight per m^2
- Target: 30% of the reef area is covered with 50 or more grams dry weight per m^2

Reef H47 (Seed_13B) Data and Analysis

Percent of Measured Oysters in the Market, Small, and Spat Categories



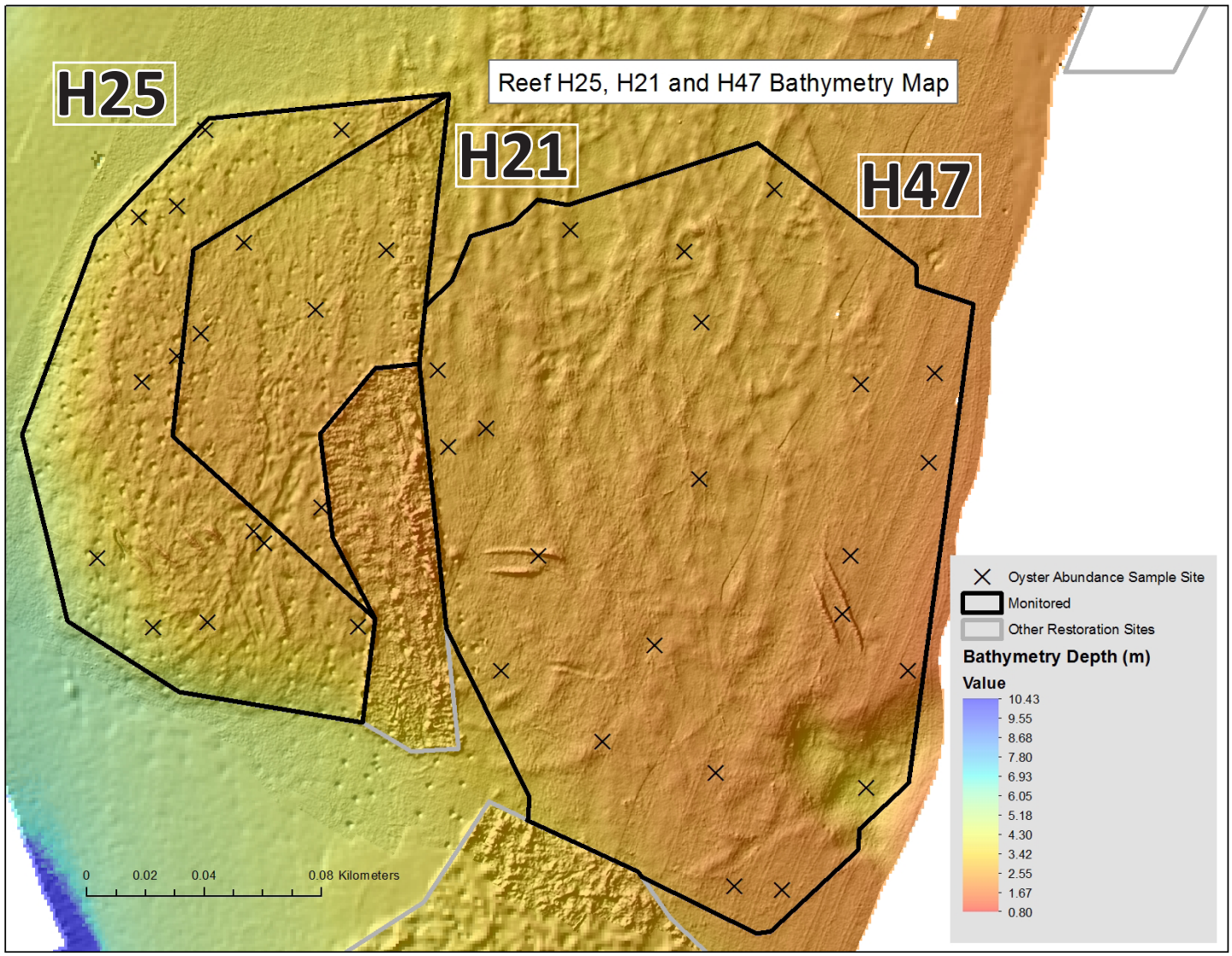
Shell Height of Oysters Measured on Reef



Reef H47 (Seed_13B) Data and Analysis

Fall 2016 Hillshaded Bathymetry Surface Derived from Multibeam Sonar

For interpretations of features in sonar imagery, see Appendix A: Methods.



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This report is available online at www.chesapeakebay.noaa.gov

Cover photo: U.S. Army Corps of Engineers Baltimore District

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