2022 Oyster Spat Recruitment Study

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ABSTRACT

This observational study on oyster recruitment in the St. Mary's River has been implemented over multiple years, beginning with a pilot study in 2018. The goal is to use cost effective methods to determine where substantial spatfall occurs. Decision-makers can use the spatfall data to identify future reserve areas for the deployment of substrate. In this way, industry can maximize investment and future harvest. An additional goal is to inform an expanding body of science regarding restoration efforts.

Spatfall in the St. Mary's River was measured throughout the lower seven miles of the tidal river at twelve sites inside and outside the sanctuary. We also measured spatfall at an additional site in Breton Bay (see Appendix A). Four "traps" (oyster cages with 120 oyster shells) were placed at each of these study sites in June and retrieved in October. As we have done in past years (2019 - 2021), we collected monthly water quality readings at each of the twelve sites in the St. Mary's River and tallied spat recruitment to the traps in November. Comparable data from prior years allowed for analysis of how the spatfall and water quality has changed over time.

Seven study sites had total spatfalls of over 1,000 spat; four had over 2,000 spat. The 2022 Recruitment Study results revealed that the total spatfall was much higher than previous years at all sites except for Priest Point and Mouth of Creek, which decreased from 2021 to 2022. All seven of the study sites with total spatfall above 1,000 were within or very close to the St. Mary's River sanctuary. Horseshoe had the highest total spatfall while Sage Point had the lowest. The spatfall and water quality results from 2022 and prior years were examined in detail for five sites (Bryan, Green Pond, Coppage, Priest Point, and Mouth of Creek).

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INTRODUCTION

The Eastern Oyster (*Crassostrea virginica*), a once prevalent organism in the Chesapeake Bay, is now at less than 1 % of its historic population (Newell, 1988). The population decline can be linked to destructive fishing practices (dredging) and continuous over harvesting (Rothschild et al, 1994). Diseases such as Dermo (*Perkinsus marinus*) and MSX (*Minchina nelsoni)* have furthered the decline (Ford and Tripp, 1996). The Eastern Oyster's depletion has had far reaching impacts and has led many to work to re-establish the organism's prominence. In the St. Mary's River, the oyster population was overharvested (above the maximum threshold for sustainability) from 2012-2018. However, in 2019, the St. Mary's River had harvest above the recommended maximum harvest for sustainability over time, but below the absolute maximum for sustainable harvest. Oyster harvest trended down from 2017-2019 while the market-size (> 3 in) abundance increased (Maryland Department of Natural Resources [MD DNR] Fishing and Boating Services, 2020).

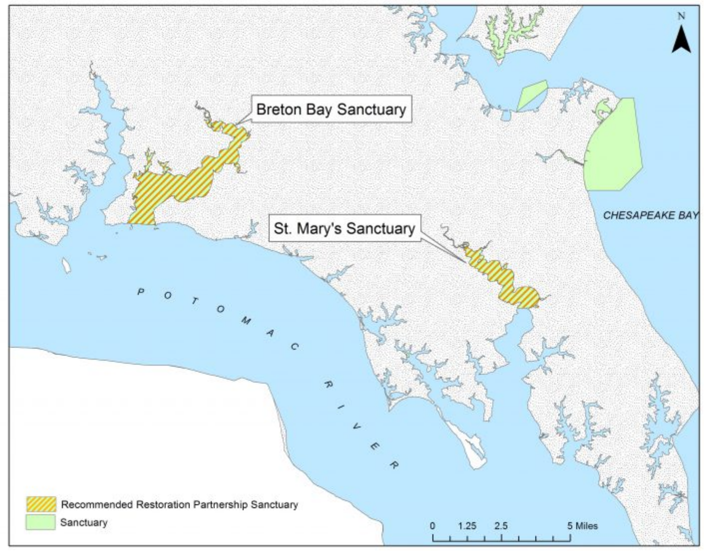

Figure 1. Map of planned Breton Bay and St. Mary's River oyster sanctuaries as of 2017 (Source: MD DNR, 2017).

The St. Mary's River is a Tier 1 tributary with the necessary requirements to support oyster restoration, including adequate overall salinity, temperature, and dissolved oxygen levels (USACE, 2012). There are fifty-one designated oyster sanctuaries in Maryland's portion of the Chesapeake Bay. The sanctuaries are of varying size and condition but represent the State's commitment to restore the Eastern Oyster population. The St. Mary's River shellfish sanctuary was first established on October 1, 2010 (Figure 1; Code of Maryland Regulations 08.02.04.15). The prohibition on harvest within the sanctuary has led to 1) the re-establishment of thriving oyster bars with multiple age classes, and 2) substantial oyster population growth—both in the overall area reefs and animal density (MD DNR, 2021). In 2022, Maryland celebrated the completion of the first phase of large scale oyster restoration in the St. Mary's River Shellfish Sanctuary. The state's oyster restoration effort installed 9.7 acres of stone reefs and seeded 25.5 acres with spat-on-shell. Within the sanctuary, a 5-acre three-dimensional reef area currently undergoing restoration is immensely successful with water clarity and quality noticeably enhanced compared to twelve years earlier. Ongoing scientific monitoring by St. Mary's College of Maryland (SMCM) and St. Mary's River Watershed Association (SMRWA) confirms this success.

The fertilized larvae of breeding oysters swim and drift in the water column for about two weeks prior to seeking permanent residence. Several factors play a role in where larvae may settle. Localized currents (or lack thereof), tidal flows, and wind effects are believed to be significant factors in larval settlements (Rothschild et al., 1994). Scientific studies in areas with recurring moderate to high velocity current suggest larval drift distance is significant and recruitment can happen miles away, and typically downriver for the Chesapeake Bay's tidal tributaries. The St. Mary's River has a weak current throughout most of the tidal estuary; some areas have recurring tidal flows and other areas have little current as a result of tidal rise and fall. In these areas, wind likely plays a greater role. A second known factor is that reproduction is highly successful in areas with high density of adult oysters, which are areas with more than 150 animals per square meter (MD DNR Fishing and Boating Services, 2018). Conversely, areas with few oysters have very poor reproductive success. The lower St. Mary's is recruiting few oysters likely due to the depleted stock and resulting low density (less than 5 per square meter). The upper tidal stretch, containing the shellfish sanctuary, does recruit successfully and has increased its biomass over the past ten years (MD DNR, 2021).

Data collected annually can inform the development and placement of shell-planted reserve areas or sanctuary areas that will have the best outcomes for the fishery. Some basic questions we seek answers to are:

1. To what extent does larval drift out of the sanctuary and recruit into the public fishery areas?
2. What areas of the public fishery receive the highest recruitment?
3. To what extent is successful recruitment a factor of larval drift and local adult oyster densities?
4. What other factors are important to know that might impact successful recruitment (i.e., weather factors, climate change, nutrient loading, algae blooms, chemical pollutants)?

SMCM and the SMRWA implement outreach programs such as the Marylanders Grow Oyster (MGO) program and the Living Reef Action Campaign, as well as other direct restoration related efforts within the St. Mary's River Shellfish Sanctuary. Additionally, they engage in or support research by a variety of different entities including local high school and college students, graduate students from regional institutions, and marine scientists. The five-acre Oyster Reef Project located adjacent to SMCM in many ways serves as a living classroom.

MATERIALS AND METHODS

The 2022 Recruitment Study used eleven of the twelve sites as the 2021 Recruitment Study: Bryan, Horseshoe, Seminary, Portobello, Green Pond (also known as Gravelly Run), Cooper Creek, Priest Point, Thompson, Coppage, Goad (also known as Graveyard), Sage Point (also known as Gum Edge), and Mouth of Creek (Figure 2). The Priest Point location was shifted slightly for 2022 (Table 1). A thirteenth site at Breton Bay was added in 2022 (Appendix A).

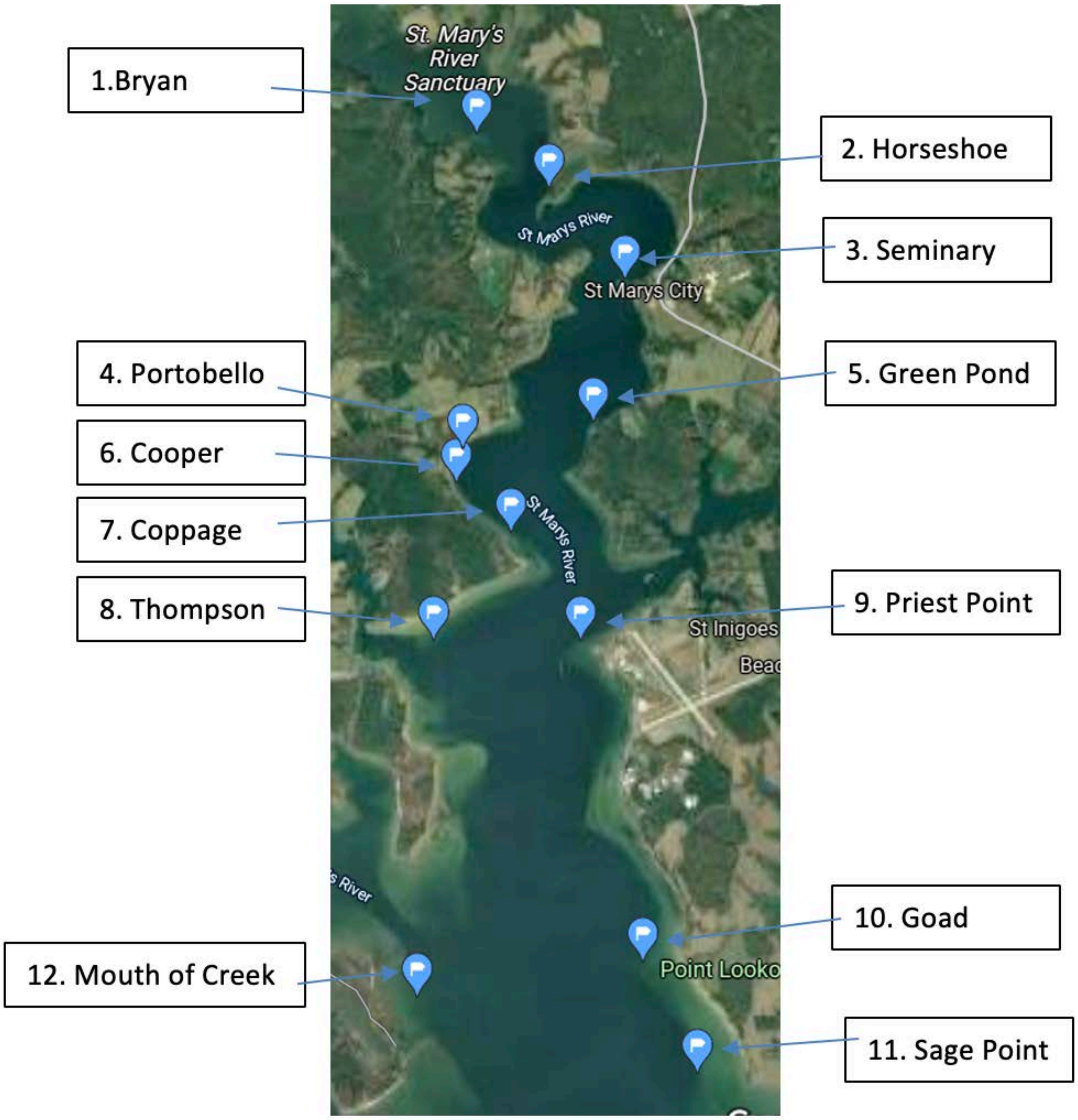

Figure 2. Map of study sites and their numbers.

Table 1. Coordinates (Latitude and Longitude) and depth (m) of study sites. Note: coordinates for Priest Point changed from 38.15151°, -76.44261° in 2022.

Site	Latitude	Longitude	Depth (meters)
01. Bryan	38.20361°	-76.45626°	2.5
02. Horseshoe	38.19792°	-76.44672°	1.5
03. Seminary	38.18859°	-76.43687°	2.0
04. Portobello	38.17131°	-76.45811	2.5
05. Green Pond	38.17402°	-76.44096-7°	2.2
06. Cooper Creek	38.16773°	-76.45881°	2.2
07. Coppage	38.16256°	-76.45119°	2.1
08. Thompson	38.15158°	-76.46190°	2.0
09. Priest Point	38.15192°	-76.44185°	2.8
10. Goad	38.11855°	-76.43439°	2.4
11. Sage Point	38.10708°	-76.42731°	2.5
12. Mouth of Creek	38.11483°	-76.46398°	2.2

Forty-eight “traps” (wire cages measuring 12” x 18” x 8”) were each filled with 120 wild grown, aged oyster shells selected for equivalent size, surface area, and no indication of spat scars. Shells were purchased from Shore Thing Shellfish, LLC, who had purchased them several years ago from Maryland Seafood. They are believed to be mostly from wild caught oysters from the St. Mary’s River system and the nearby Potomac River. The shells were power washed while the traps were rolled over several times. Four survey traps were placed on the river bottom in a square pattern and spaced three meters apart at each of the twelve study sites (Photo 1). Chain of custody forms tracked the traps throughout the project.

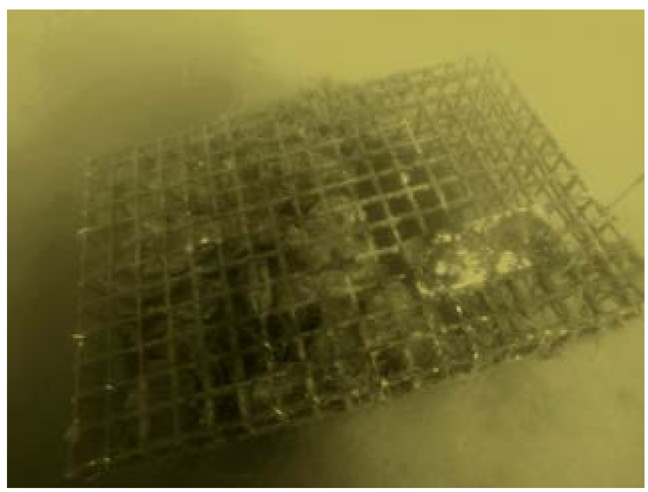

Photo 1. Underwater photo of trap deployed on river bottom.

Attached to one of the traps at each site was a buoy suspended in the water column to approximately one meter below mean low water (MLW). In addition to the underwater buoy, a second surface-floating buoy was attached to an anchor and was placed next to one of the nearshore traps at each of the twelve sites. Should a passerby disturb the floating buoy, it would not disturb the experiment. Each of the twelve floating buoys were labeled as follows:

DO NOT DISTURB

SCP202215

301-904-2387

The labeling indicated desire that the area not be disturbed, our scientific collections permit number, and a cell phone number where we could be reached to address any concerns or questions.

Traps were deployed on June 1st, and GPS coordinates were recorded for the central location of each deployment at the twelve sites. Traps were checked monthly and water quality readings taken on June 1st and 30th; August 1st; September 1st; October 4th, 14th and 31st. A Secchi disk and YSI PRO2030 were used to collect water quality readings. The YSI was fitted with a new DO sensor and calibrated for dissolved oxygen prior to each monthly sampling of the twelve sites. Standardized field log sheets were used to record the data, and, in every case, a second set of eyes verified the datum entered for each parameter. Readings were taken twice in October because strong winds (25 to 40 knots) from the remnants of Hurricane Ian (September 29-October 3) delayed the regularly scheduled monthly reading to October 4. Readings were taken again ten days later in order to provide a comparison to the October 4 readings, which we anticipated might have been impacted from five days of strong winds and 2 days of heavy rainfall. For site specific graphs, the measurements from the 4th were used, as they were not substantially different from the readings taken ten days later.

Traps were retrieved on October 21st, 24th, and 25th (Photo 2) and taken to a holding area at the SMCM waterfront where they were temporarily placed in shallow water on hardwood pallets.

Photo 2. Oyster cages immediately after retrieval.

Each shell within the traps was inspected for spat and a standardized field log sheet was used to record the presence of live and dead spat (referred to as “box”) in three size groupings: equal to and under 10 mm, 11 mm to 25 mm, and over 25 mm. Our analysis and graphs depict the size groupings, not the actual measurements. Counters included Bob Lewis, Emma Green, Rachel Becker, Jordan Manns, Colleen Smith, Jodi Baxter, Kira Wisner, David Sykes, Dave Lewis, Norm O’Foran, Laurinda Serafin, Katherine Cleveland, Morgan Watkins, Shelly O’Foran, Jordan Johnson, Charlotte Horn, Patricia Campion, and Yotam Delagahn. All volunteer counters were trained and, in all cases, the inexperienced worked with an experienced person. Spat counting occurred on October 24th, 26th, 30th, and 31st and November 2nd, 4th, 5th, and 7th.

Note that total spatfall includes both live and box, along with loose spat not attached to any shell, but still in or attached to the trap. In the description of the results, each site's total spatfall is reported by size grouping and by live and box/dead count. Mortality was also calculated for each site by dividing the number of box spat by the total spatfall (live and dead).

Our permit required us to remove the traps prior to November 1st, which is opening day for public harvest with dredges. The study area is not usually harvested during the hand tong season in October. Note that in some years the breeding season does linger well into October.

The dataset will be shared with decision makers—DNR Shellfish Division, St. Mary's County oyster committee, scientists at St. Mary's College of Maryland—and made publicly available through our website http://www.SMRWA.org.

RESULTS

<u>Total Spatfall</u>

The 2022 study had the highest spatfall count of all years studied, with almost double the 2021 spatfall (2021: 9,001 spat; 2022: 17,111 spat). In comparing years 2018 through 2021, 2021 was significantly higher than any of the prior three years. Therefore, 2022 again set a new high for spatfall (Figure 3; Figure 4). The total spatfall increase from previous years could possibly be attributed to more consistent water quality overall (discounting the effects of Hurricane Ian). The general trend of more spatfall closer to or within the sanctuary is consistent over the five years of observations.

Compared to 2021, ten of the twelve study sites showed an increase in total spatfall; two sites, Priest Point and Mouth of Creek, had lower spatfall (Figure 4). We will discuss these two sites and others in more detail later on.

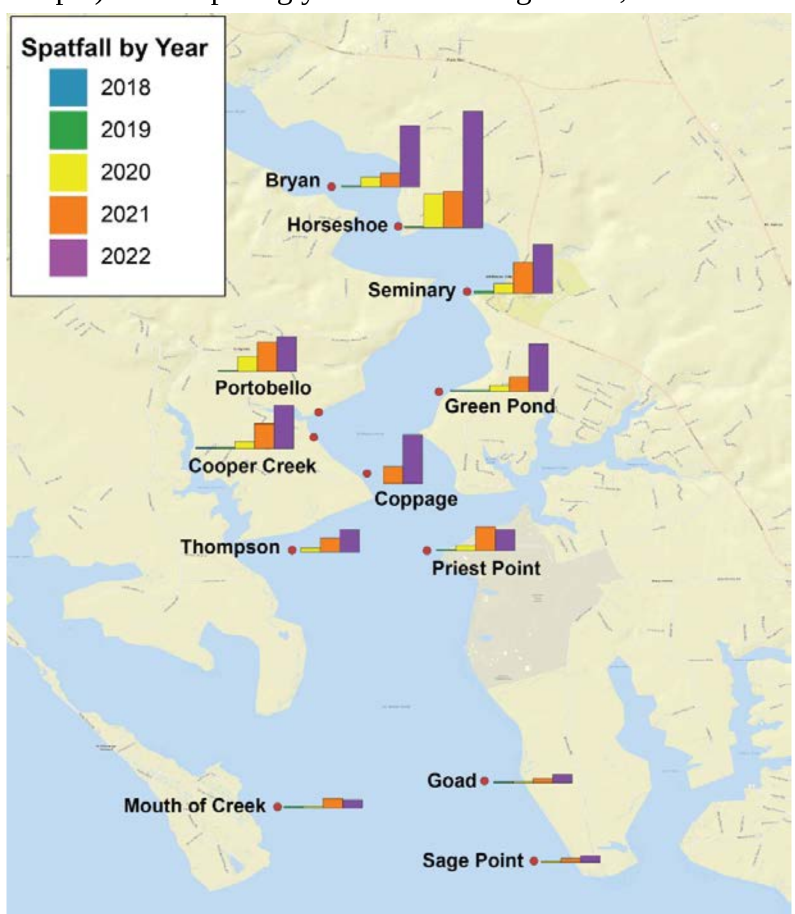

Figure 3. Locations of the 12 study sites with total spatfall for each year that the study was conducted at a given site.

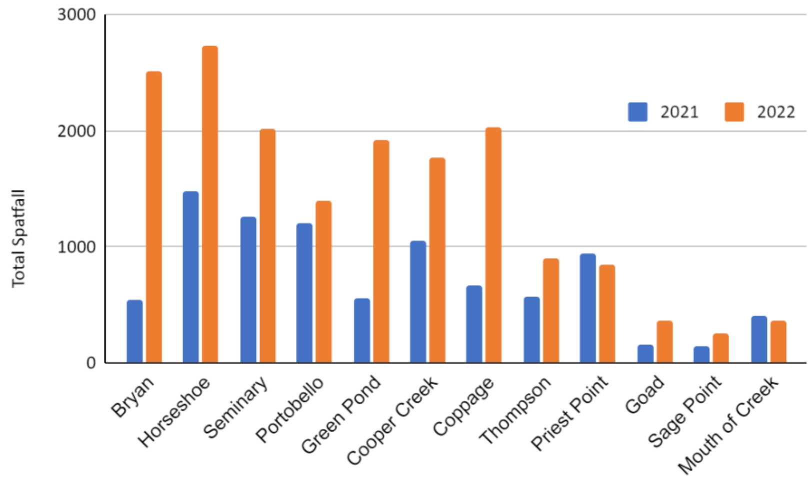

Figure 4. Comparison of 2021 and 2022 total spatfall counts. All but two sites (Priest Point and Mouth of Creek) had higher counts in 2022 than the previous year 2023.

<u>Mortality</u>

When data was aggregated for all sites in 2022, 82.4 % of spat were live and 17.6 % were box (Figure 4; Figure 5). Bryan and Sage Point had the higher mortality than the other ten sites (Brian: 31.3 %; Sage Point: 31.4 %). All study sites except for Bryan and Sage Point varied from 9.3 % to 19.3%. Stylochus were noted many times during the counting process although their observed abundance was only slightly higher than prior years. Low oxygen may have contributed to the higher mortality at Bryan and Sage Point. Watermen told us they had to move crab traps to deeper water around the Sage Point site during early to mid-July. The Bryan site appears to have recurring hypoxic events in the heat of summer. A large algal bloom was spotted in August running from Horseshoe Point upriver past Martins Point along the eastern shoreline. This bloom persisted for at least ten days and may have impacted the Bryan study site although Bryan is located along the western shoreline. Downriver an algal bloom was spotted on September 1 along the western

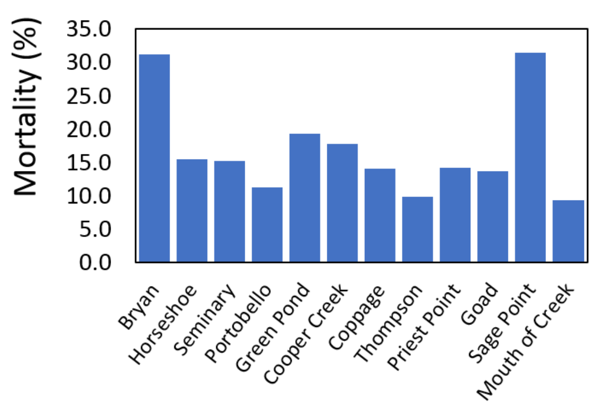

Figure 5. Percent mortality for each site in 2022. Mortality (%) was calculated by dividing the number of boxed spat by the total spatfall at the site.

shoreline from 350 meters west of Porto Bello Point to Windmill Point. Hypoxic conditions were recorded on September 1 at the river bottom in correlation to this bloom.

Spatfall by Size

Of the total spatfall by size, 83.1 % were above 11 mm, and 16.9 % were below 10 mm. Of the total live spatfall, the majority (57.7 %) were greater than 25 mm. The intermediate size class (11- 25 mm) accounted for 32.1 % of the total live spat while 10.2 % were less than 10 mm (Figure 6). The size distribution for total box spatfall differed from total live spatfall (Figure 7). Of the box spatfall, 47.1 % were less than 10 mm, 43.5 % were 11 – 25 mm, and only 9.4 % were over 25 mm. The vast majority of the box spat (90.6 %) died before they reached 25 mm (Figure 7).

The size distribution of live spatfall suggests that spawning occurred more than once over the summer and fall. Due to atypical cold water conditions in the first half of June, we believe the spawn did not begin until the last third of June and that spawning continued through July in localized areas or oyster bars. A few tiny spat were observed (under 5mm) suggesting a minimal late September-October spawn did occur.

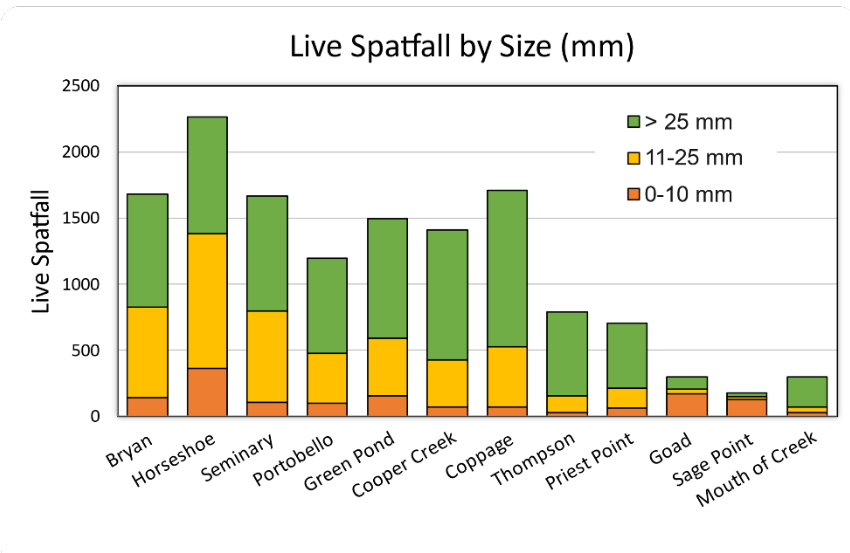

Figure 6. Comparison of live spatfall by size groupings in 2022.

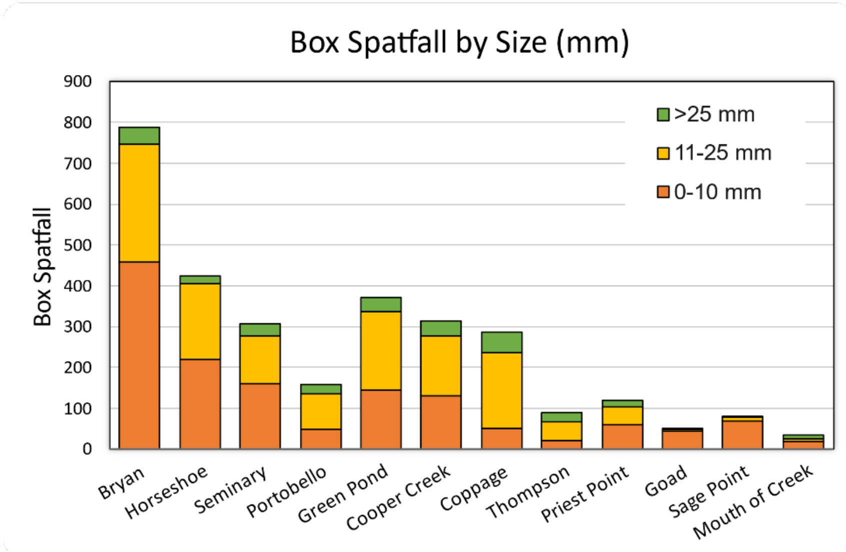

Figure 7. Comparison of box spatfall by size (mm) classifications in the 12 study sites.

Water Quality

In 2022, the remnants of Hurricane Ian arrived on September 28 with sustained high winds at 25 to 40 knots. This storm event caused us to delay readings until after the storm subsided on October 4th. We were concerned that the water quality readings on October 4th were altered by the storm as weather conditions can alter water quality readings temporarily. We decided to take water quality readings again on October 14th. However, these subsequent readings did not vary substantially from the October 4 readings. Therefore, our analysis here utilizes the October 4 readings to maintain calendar period consistency.

On the whole, dissolved oxygen levels at the river bottom were much higher in 2022 than in any other study year. Six sites had the lowest bottom dissolved oxygen in August, and three sites (Thompson, Coppage, and Cooper Creek) had the lowest in September. Bryan and Horseshoe, the two most upriver sites, had their lowest bottom dissolved oxygen on October 4, likely a result of the high rainfall and winds from the remnants of Hurricane Ian. Bryan measured 5.15 mg/l and Horseshoe was 6.00 mg/l in October. Both sites recovered by October 14 with 7.32 mg/l and 8.32 mg/l, respectively. Another two sites, Cooper Creek and Coppage had extremely low dissolved oxygen readings on September 1 at 0.89 mg/l and 2.15 mg/l, respectively. As noted above, an algal bloom was observed at the time we took these readings; the bloom was small and extended from 200 meters east of Cooper Creek study site to Windmill Point along the western shoreline.

In the report by the United States Army Corps of Engineers, "Chesapeake Bay Oyster Recovery: Native Oyster Restoration Master Plan," the authors suggest a minimum mean dissolved oxygen of 5.00 mg/L from June to August for successful oyster restoration. (USACE 2012). Dissolved oxygen remained above 5.00 mg/L on the days readings were taken at all sites except Cooper Creek and Coppage in September and Green Pond in August. Dissolved oxygen during the time in between water quality readings is unknown. Likely the hypoxic conditions were short-lived.

Salinity levels at the bottom increased at all sites from June through November, and the bottom salinity at all sites exceeded 16 ppt by the end of October. In 2021, the highest salinity recorded was 13.5 ppt at Sage Point. Bottom water alinity was lowest at Bryan and Horseshoe in June (6.5 ppt at Bryan and 6.7 ppt at Horseshoe). All other sites had salinities above 8 ppt in June.

Water temperatures at the bottom were similar in 2021 and 2022. The highest temperature was 29.4 °C at Horseshoe on September 1st and the lowest temperature was 16.1 °C at Seminary on October 31st.

SELECTED STUDY SITE OBSERVATIONS

In 2022, all sites except two (Priest Point and Mouth of Creek) continued the pattern of increased spatfall year-after-year. Throughout the five years that this study has been conducted, total spatfall has consistently been quite high at Bryan–one of the sites in the sanctuary. This is likely due to the higher oyster densities on the bars in that area. When oyster density was surveyed in 2019, the five sites in the lowest part of the tidal river had less than 5 oysters per square meter. The three sites in the sanctuary (upper river) had oyster densities that were much higher, exceeding 150 oysters per square meter at Bryan and Seminary.

<u>Bryan</u>

Bryan had the second highest total spatfall at 2,518, a 362.0 % increase in total spatfall from 2021 (Figure 8). However, Bryan had the second highest mortality rate, at 31.3 % (Figure 5).

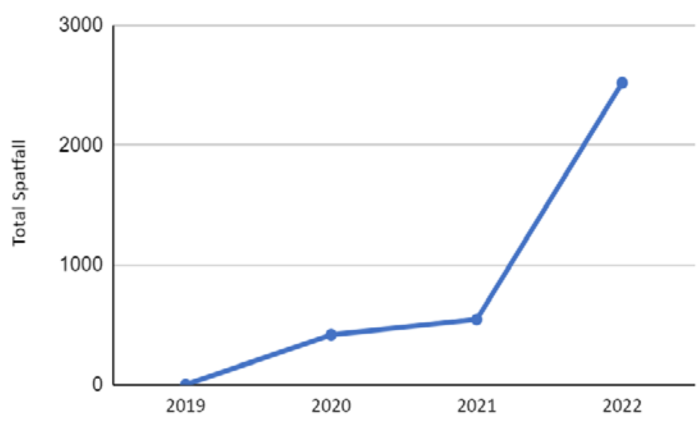

Figure 8. Total spatfall from 2019 - 2022 at Bryan.

Salinity and Temperature at Bryan were more consistent in 2022 compared to 2021 (Figure 9 and Figure 10). However, there was a noteworthy decrease in dissolved oxygen in October (Figure 11).

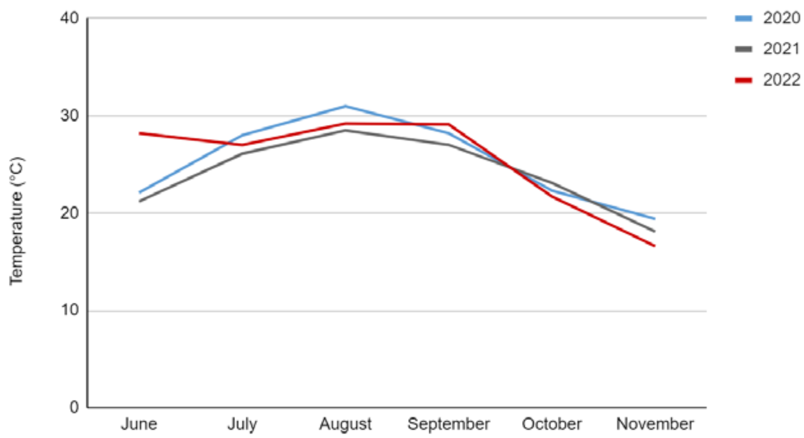

Figure 9. Bottom temperature (°C) measurements from June-November 2020-2022 at Bryan.

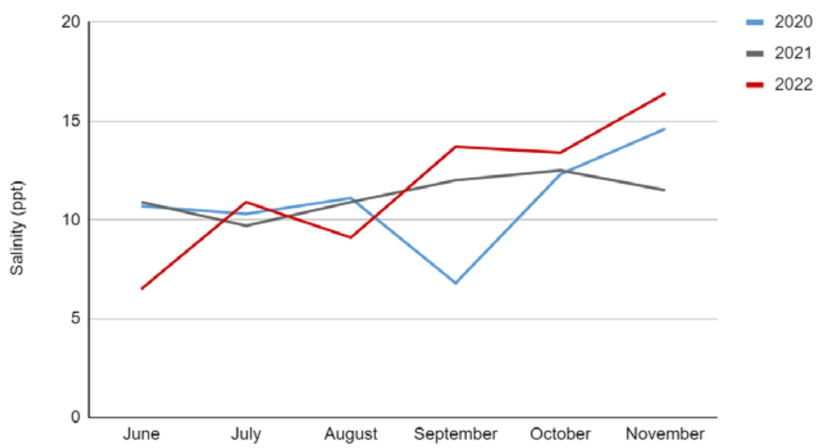

Figure 10. Bottom salinity (parts per thousand) measurements from June-November 2020-2022 at Bryan.

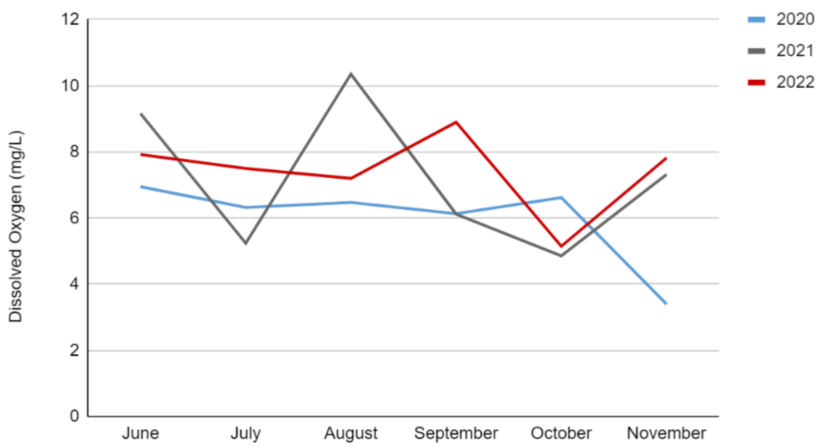

Figure 11. Bottom dissolved oxygen levels (mg/L) from June-November 2020-2022 at Bryan.

Photo 3. Spat on shell at Bryan.

Green Pond

Green Pond had a 240.6 % increase in spatfall from 2021, with a total of 1,924 spat (Figure 12). Green Pond had the third highest mortality of the twelve sites at 19.3 % (Figure 5).

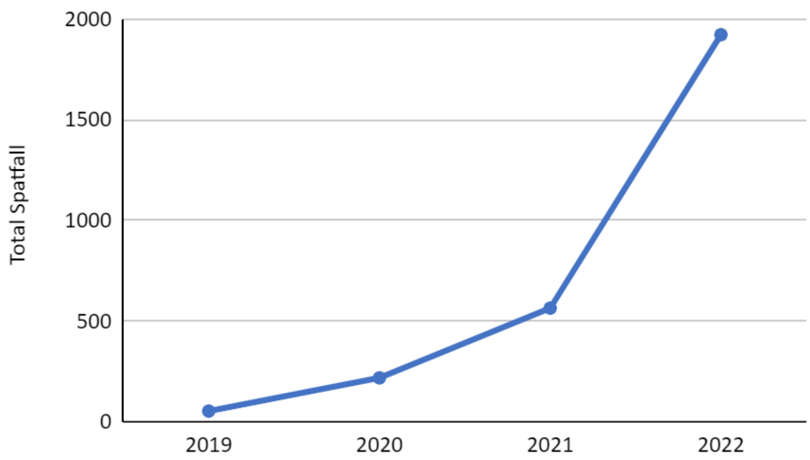

Figure 12. Total spatfall for 2019-2022 at Green Pond.

Water quality at Green Pond remained fairly consistent with previous years from June through November (Figure 14; Figure 15), although dissolved oxygen dipped below 5 mg/L in August (Figure 13).

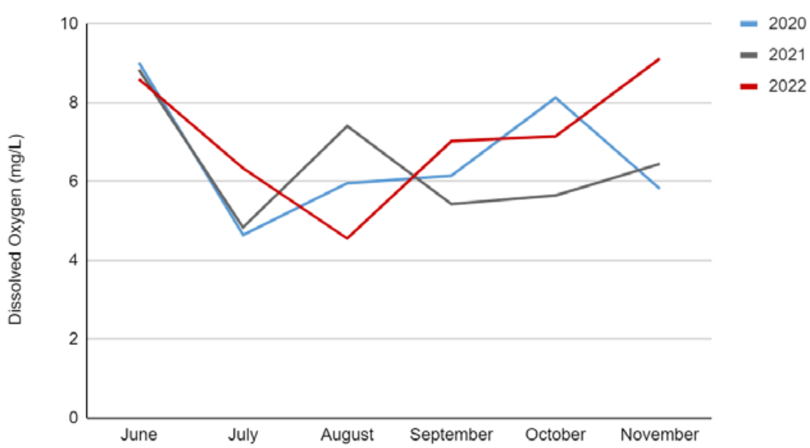

Figure 13. Bottom dissolved oxygen levels (mg/L) from June to November of 2020-2022 at Green Pond.

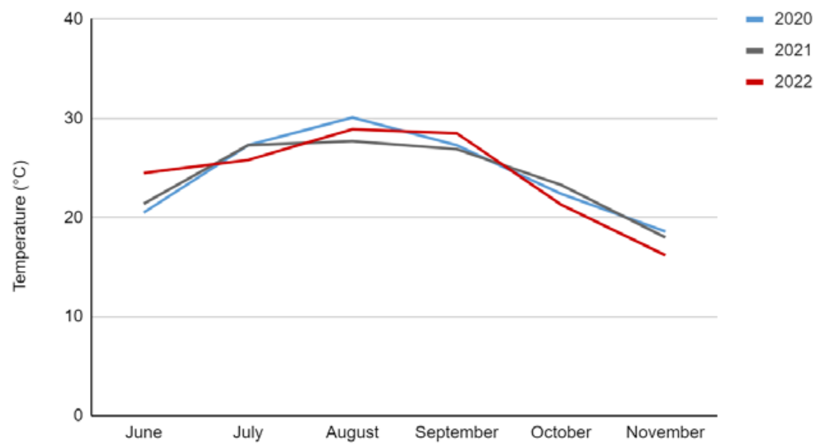

Figure 14. Bottom temperature (°C) measurements from June-November 2020-2022 at Green Pond.

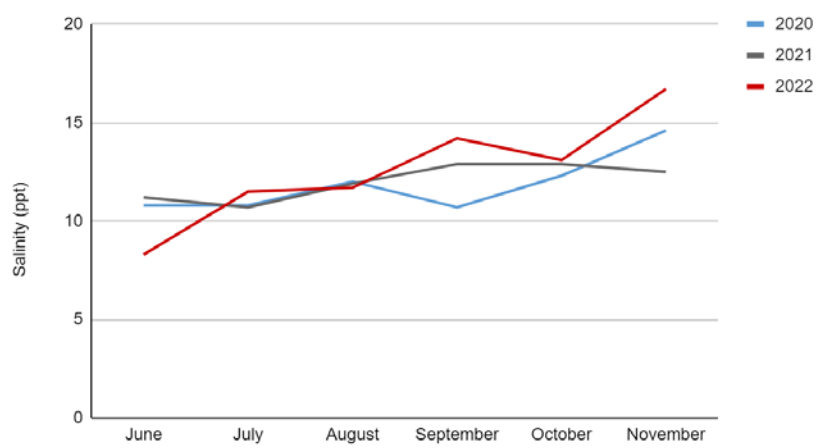

Figure 15. Bottom salinity (parts per thousand) measurements from June-November 2020-2022 at Green Pond.

Photo 4. Spat on shell at Green Pond.

Coppage

Coppage had a 202.2 % increase in spat counts from 2021 (2021: 671 spat; Figure 16) and the third highest spatfall for 2022 at 2,028 spat (Figure 4). The mortality at Coppage was 14.1 % (Figure 5). The data for total spatfall in 2020 was unavailable because the traps were lost that year.

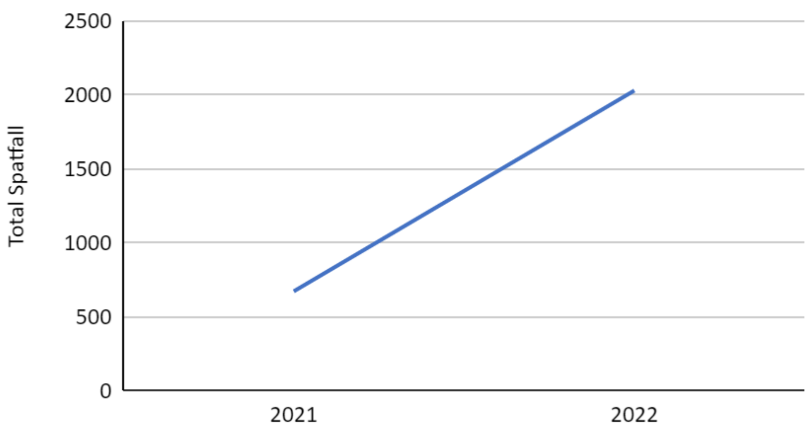

Figure 16. Total spatfall for 2021-2022 at Coppage (spatfall for 2020 is unavailable).

Water quality conditions for June-November remained consistent with previous years (Figure 18; Figure 19), and dissolved oxygen was at healthy levels (> 5.00 mg/L) until September when the bottom dissolved oxygen level was substantially lower than the surface measurement; 8.67 mg/l compared to 2.15 mg/l (Figure 17).

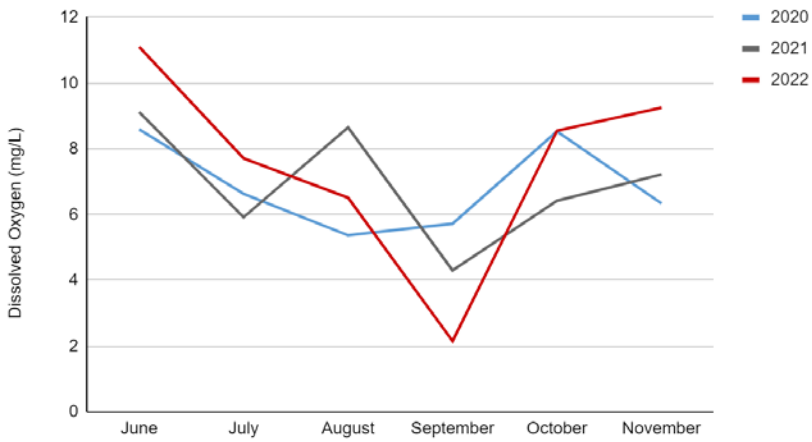

Figure 17. Bottom dissolved oxygen levels (mg/L) from June-November 2020-2022 at Coppage.

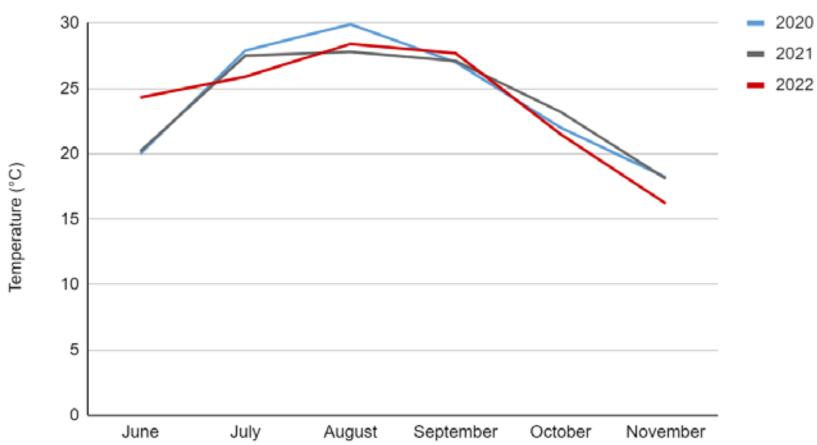

Figure 18. Bottom temperature (°C) measurements from June-November 2020-2022 at Coppage.

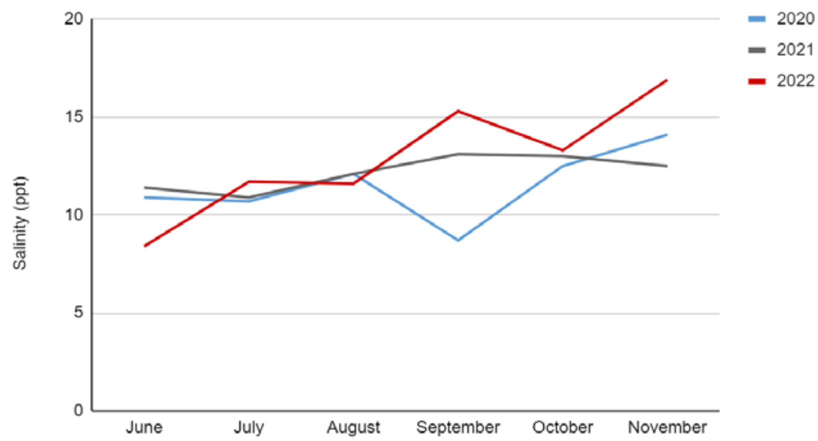

Figure 19. Bottom salinity (parts per thousand) measurements from June-November 2020-2022 at Coppage.

Photo 5. Spat on shell from Coppage.

Priest Point

Priest Point was one of two sites where the spat count decreased from 2021 to 2022. The site was relocated 80 meters ENE from the 2020 and 2021 location in order to have a better bottom habitat (Table 1). In 2022, there was an 11.1 % decrease in spat counts from 2021, with 841 total spatfall (Figure 16). The mortality was the same as at Coppage, at 14.1% (Figure 5).

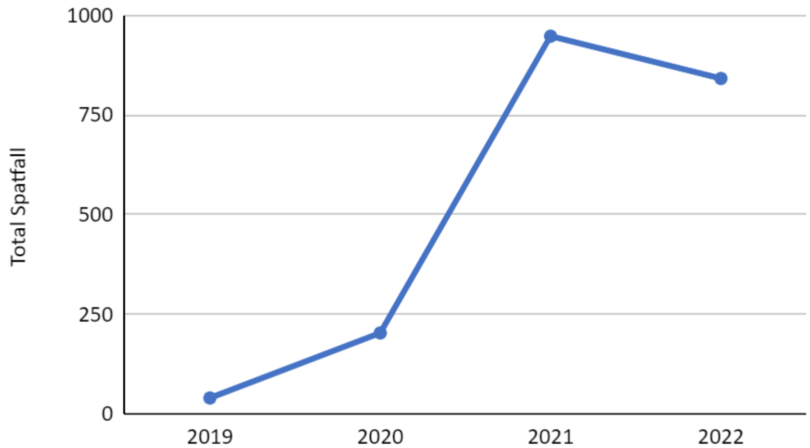

Figure 20. Total spatfall for 2019-2022 at Priest Point.

Dissolved oxygen remained above 5.00 mg/L at each monthly reading (Figure 21), and 2022 temperature and salinity measurements were similar to 2020 and 2021 (Figure 22 and Figure 23).

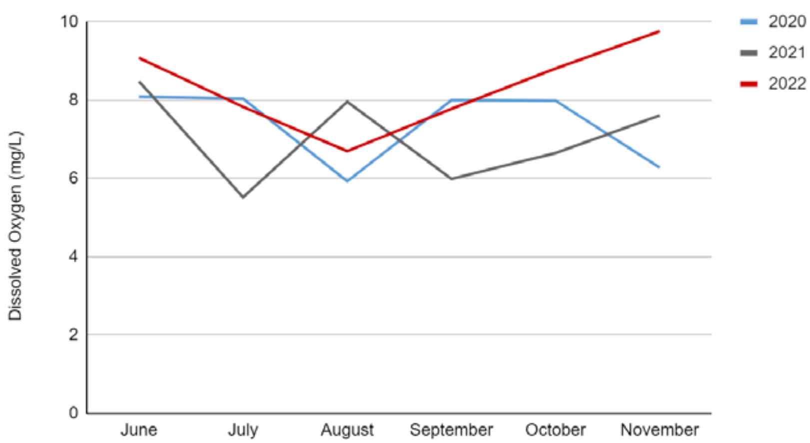

Figure 21. Bottom dissolved oxygen levels (mg/L) from June-November 2020-2022 at Priest Point.

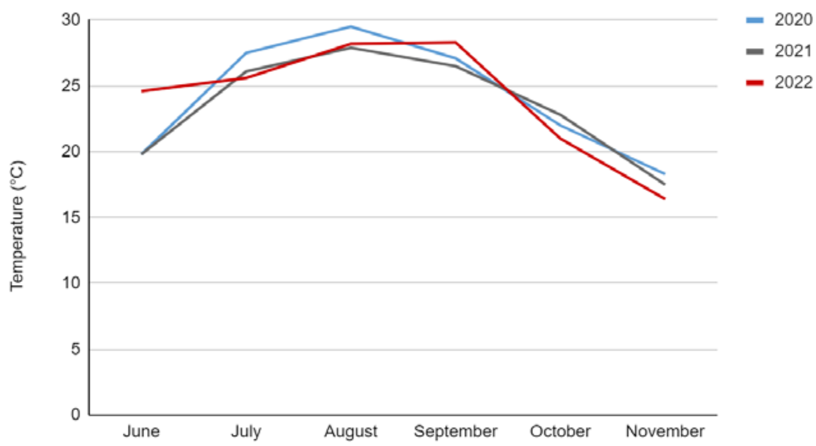

Figure 22. Bottom temperature (°C) measurements from June-November 2020-2022 at Priest Point.

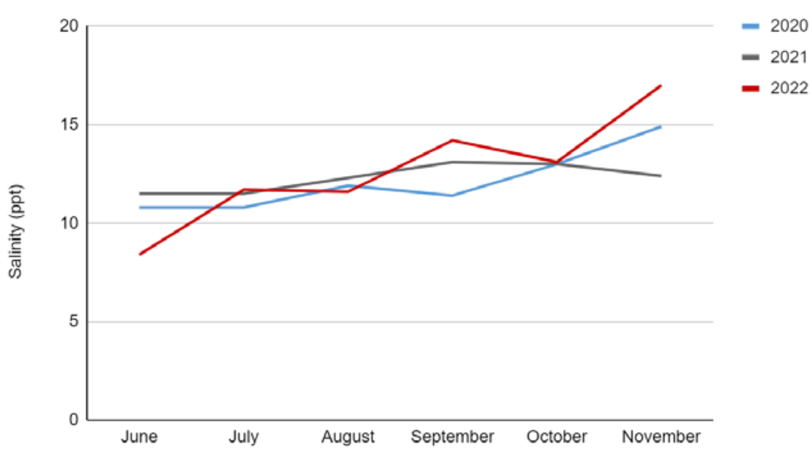

Figure 23. Bottom salinity (parts per thousand) measurements from June-November 2020-2022 at Priest Point.

Photo 6. Spat on shell at Priest Point.

Mouth of Creek

Mouth of Creek was the other site where the total spatfall decreased from 2021 to 2022, by 10.7 %. The total spatfall was 366 (Figure 24), which is the third lowest total spatfall at any site in 2022 (Figure 4). Mortality was 9.3 % and was the lowest mortality of all twelve study sites (Figure 4).

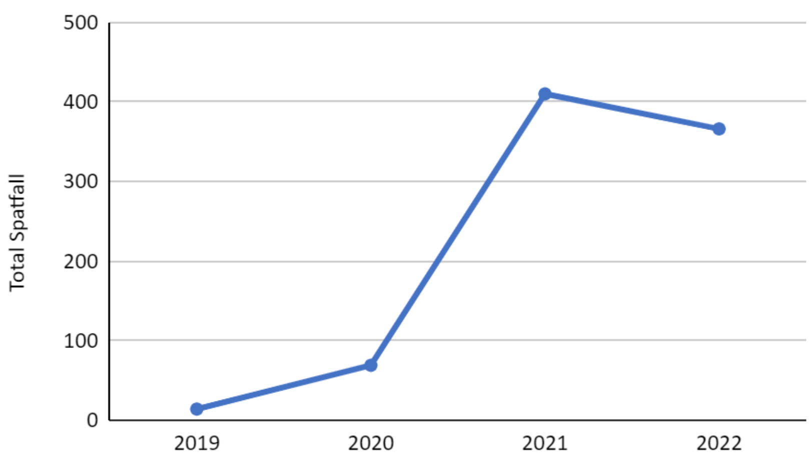

Figure 24. Total spatfall for 2019-2022 at Mouth of Creek.

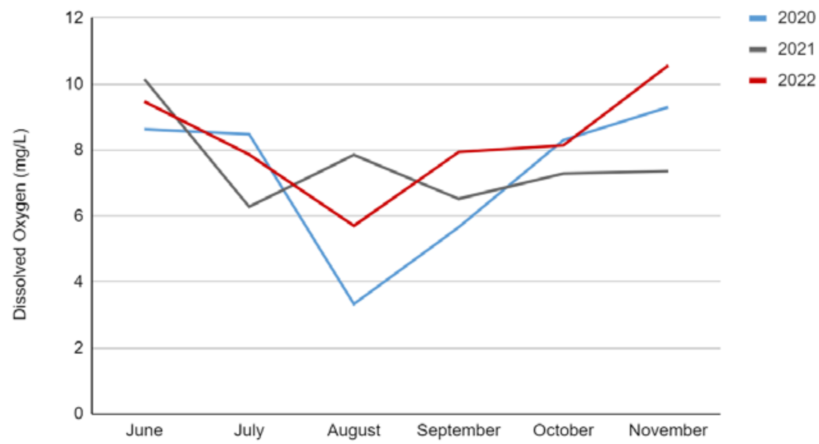

Figure 25. Bottom dissolved oxygen levels (mg/L) for June-November 2020-2022 at Mouth of Creek.

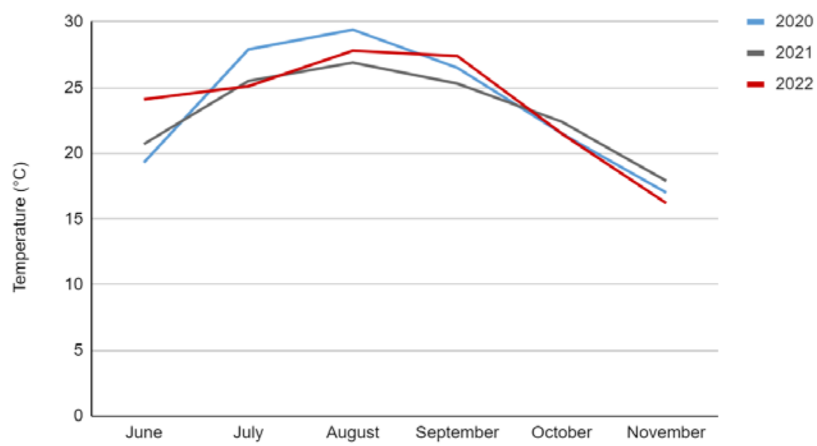

Figure 26. Bottom temperature (°C) measurements for June-November 2020-2022 at Mouth of Creek.

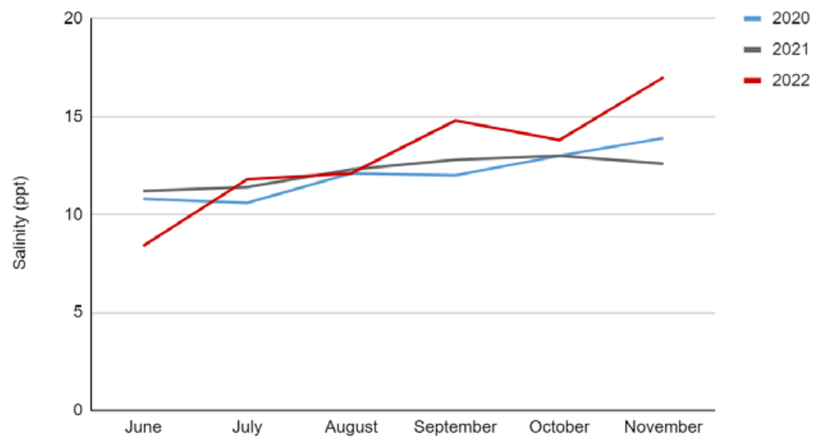

Figure 27. Bottom salinity (parts per thousand) measurements for June-November 2020-2022 at Mouth of Creek.

Photo 7. Spat on shell at Mouth of Creek.

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APPENDIX A

Monitoring Oyster Recruitment in Breton Bay

INTRODUCTION

The State of Maryland designated Breton Bay as an oyster sanctuary in 2010 because of its potential for oyster restoration. In 2017, it was initially chosen as one of five shellfish sanctuaries to receive large scale restoration. However, the next year the decision was revoked after a comprehensive survey returned poor results. There were no live oysters found in a patent tong oyster survey conducted by DNR in April of 2018 (MD DNR, 2018). Despite this, the community of Breton Bay continues to have strong support for restoration efforts there.

Although the DNR found no living oysters in April of 2018, the St. Mary's River Watershed Association (SMRWA) and Friends of St. Clements Bay has been planting oysters off of Lover's Point (Figure A1). From 2017 - 2021, Friends of St. Clements Bay and St. Mary's River Watershed Association planted 700,000 spat-on-shell, and Friends of St. Clements Bay planted 600,000 oysters from the Marylanders Grow Oysters program. In 2022, these organizations along with Shore Thing Shellfish LLC, Southern Maryland Recreational Fishing Organization, and St. Mary's River Watershed Association planted 820,000 additional spat-on-shell At Lover's Point. Friends of St. Clements Bay have monitored the oysters since 2018. The oysters are surviving, but reproduction could not be documented.

Figure A1. Map of Breton Bay study site. Coordinates for Lovers Point are 38.26384°N, -76.64951°W.

METHODS

In 2022, SMRWA added an additional recruitment study site to Breton Bay off of Lovers Point (Figure A1). Following the same methods as the St. Mary's River, we deployed four traps with 120 shells in each off of Lovers Point. The cages were deployed on June 2nd and retrieved on October 17th.

RESULTS

No live or dead spat were detected on any of the shells or traps at the Breton Bay site.

CONCLUSIONS

We did not detect any recruitment at Breton Bay even though oysters have been planted in this area since 2017. Multi-year age classes are present in substantial numbers and yearly mortality has remained between 25% and 35%. We will continue planting off Lovers Point and hope to include this site in our study again next year.

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APPENDIX B

Comparing Oyster Shells and Bluestone as Substrate

ABSTRACT

This study compares two different substrates for oyster spat recruitment: aged oyster shells and bluestone. Three cages with bluestone and four cages with oyster shells were placed at the Green Pond site following the same timeline and methods as the main study in this report. Results revealed that there were higher spat per trap and mortality in the cages with shells (313.5 spat per trap) rather than those with stones (222.3 spat per trap). Further study is needed to determine if bluestone is a viable (economic) alternative to oyster shells as a substrate for oysters.

INTRODUCTION

During the 2021 Recruitment Study, a comparison of shells, quartzite stone, and bluestone was conducted at Green Pond alongside the usual study at other sites to determine if either stone could serve as a viable substrate for oyster reefs. Oyster shells are in high demand which can make large quantities difficult to obtain. The 2021 results indicated that bluestone would be a good substitute for shells as the primary substrate for oyster reefs (quartzite: 86.7 spat per cage; bluestone: 135.3 spat per cage; shells: 141 spat per cage). In 2022, a similar comparison was conducted using only bluestone and shells to validate last year's results.

METHODS

Three cages were filled with 66.7 lbs of bluestone each and deployed at Green Pond on June 1st, 2022. Another four cages were each filled with 120 oyster shells and deployed at Green Pond at the same time. Cages with stones and shells were treated in the same manner. Surface area of the stones was most likely higher than the shells, however the exact surface areas of each were not measured.

All 7 traps were retrieved on October 21st, 2022 and spat were counted within a week by Bob Lewis, Emma Green, Rachel Becker, Jordan Manns, Norm O'Foran, Laurinda Serafin, and Katherine Cleveland. Spat counts were recorded by size (equal to and under 10 mm, 11 mm to 25 mm, and over 25 mm) and by whether they were live or dead (referred to as "box").

RESULTS

There was a total of 1,954 total spat counted in the cages at Green Pond, with 313.5 spat per trap in the traps with shells and 222.3 spat per trap in those with stones (Figure B1; Figure B2). The shells had higher mortality (24.4 %) than the stones (9.9 %). Compared to the 2021 results, the mortality in 2022 for shells was higher than in the 2021 study (17 %) and mortality for stones was lower in 2022 than in the 2021 study (13 %). Both the shells and stones also showed similar counts of spat in the different size categories (Figure B3).

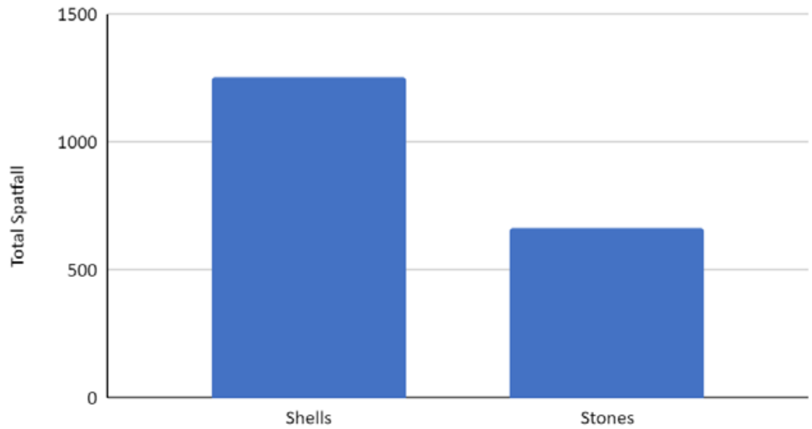

Figure B1. Total spatfall for shell and stone substrates at Green Pond.

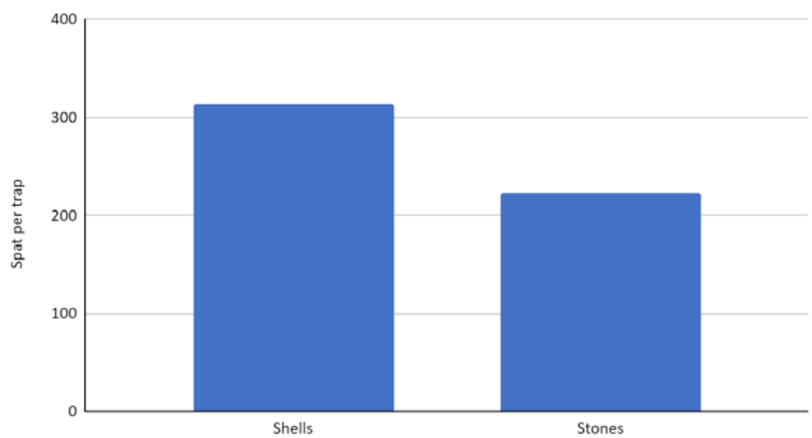

Figure B2. Spatfall per trap for shell and stone substrates at Green Pond.

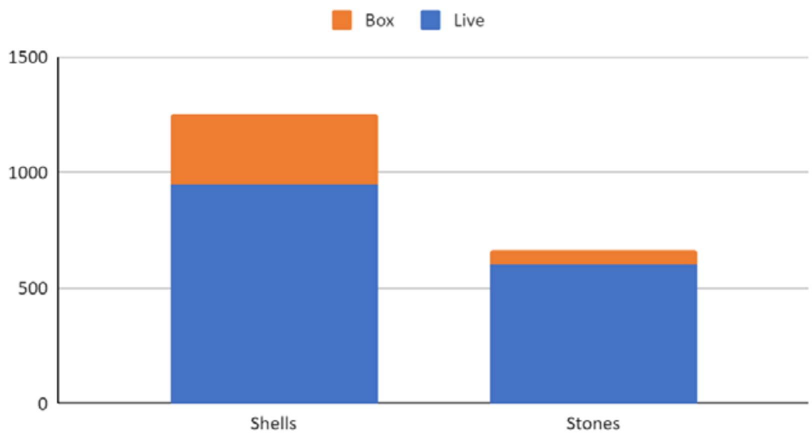

Figure B3. Amount of live and box (dead) spatfall on the shell and stone substrates at Green Pond.

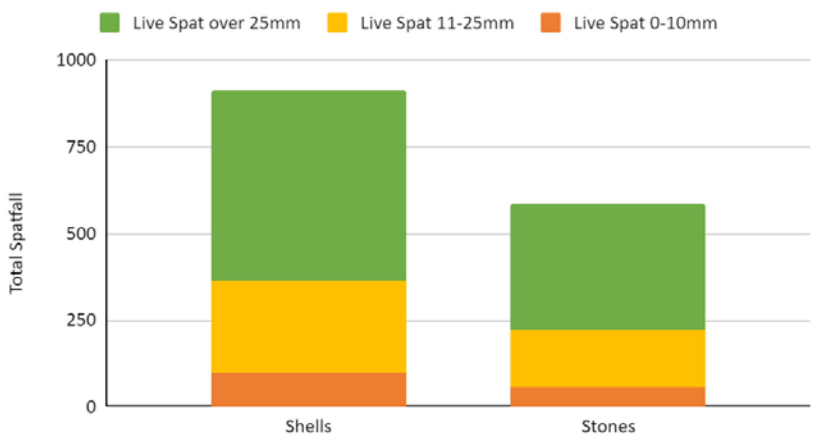

Figure B3. Live spatfall by size for shell and stone substrates.

RECOMMENDATIONS FOR FUTURE STUDIES

In 2021, there was little difference between the spat per trap on bluestone and oyster shells (six more spat per trap on the shell compared to the bluestone). However, in 2022, there were more spat per trap on the shell than the bluestone (91.2 more spat per trap on the shell compared to the bluestone). Future study should include a determination of the mortality of under-market size oysters on both substrates, shells and bluestones, as this may provide a better understanding of the economic aspects of hardening bottom with bluestone. Depending on spatfall each year, it may be advantageous or detrimental to have an increase or decrease in mortality of throwback oysters.

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