

2025 Oyster Recruitment Study

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Submitted: January 30, 2026

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 oyster spat recruitment (hereafter spatfall) occurs. Understanding where spatfall occurs can aid decision-makers in deciding where to establish reserve areas or to deploy 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 7.5 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" (wire cages with 120 oyster shells each) were placed at each of these study sites in June and retrieved in October. Due to very high spatfall this year, spat were counted from only two of the four traps. As we have done in past years (2019 - 2024), we collected monthly water quality readings at each of the twelve sites in the St. Mary's River and counted the number of spat in and on the traps in late October and November. Then, we compared the 2025 spatfall and water quality to prior years.

Spatfall was exceptionally high in 2025. The average number of spat per cage in 2025 in the St. Mary's River traps was 4,427 — a 33-fold increase from the 2024 average of 131 spat per cage, and an eleven-fold increase from the previous record of 398 spat per cage in 2022. Total spatfall increased at all sites from 2024 to 2025. Six study sites had an average of over 5,000 spat per cage, and two had an average of under 100 spat per cage. For the first time, the highest spatfall was not found within the St. Mary's River shellfish sanctuary. Portobello, located downriver of the sanctuary, had the highest mean spatfall of all the sites, while Chicken Cock had the lowest. The spatfall and water quality results from 2025 and prior years are examined in detail for five sites (Bryan, Horseshoe, Portobello, Coppage, 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 one percent of its historic population (Wilberg et al., 2011). The population decline can be linked to destructive fishing practices (dredging) and over harvesting (Rothschild et al., 1994). Diseases such as Dermo (*Perkinsus marinus*) and MSX (*Haplosporidium nelsoni*) have furthered the decline (Ford and Tripp, 1996). The eastern oyster's depletion has had far reaching impacts and has led to Chesapeake Bay-wide efforts to re-establish the organism's prominence (Maryland Department of Natural Resources [MD DNR], 2021).

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 (United States Army Corps of Engineers [USACE], 2012). The Upper St. Mary's River is one of 51 designated oyster sanctuaries in Maryland's portion of the Chesapeake Bay and was 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 of reefs and animal density (MD DNR, 2021).

In 2022, Maryland celebrated the completion of the initial oyster restoration phase in the St. Mary's River shellfish sanctuary, where 25 acres were restored. Of the 25 acres restored, 9 acres were constructed with stone, followed by seeding with spat-on-shell while the remainder were planted with only spat-on-shell (Maryland and Virginia Oyster Restoration Interagency Workgroups of the Chesapeake Bay Program's Sustainable Fisheries Goal Implementation Team, 2023). Additionally, the St. Mary's River Watershed Association (SMRWA)'s five-acre three-dimensional Oyster Reef Project is self-sustaining with an average oyster density of 241 oysters per m² (Green & Nishiura, 2023).

Juvenile oyster recruitment is critical to the long-term success of an oyster population, and many factors affect recruitment patterns. The fertilized larvae of breeding oysters swim and drift in the water column for about two weeks prior to seeking permanent residence. Several features 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 settlement (Rothschild et al., 1994). Scientific studies in areas with recurring moderate to high-velocity currents suggest larval drift distance is significant, and recruitment can happen miles away (North et al., 2008). These

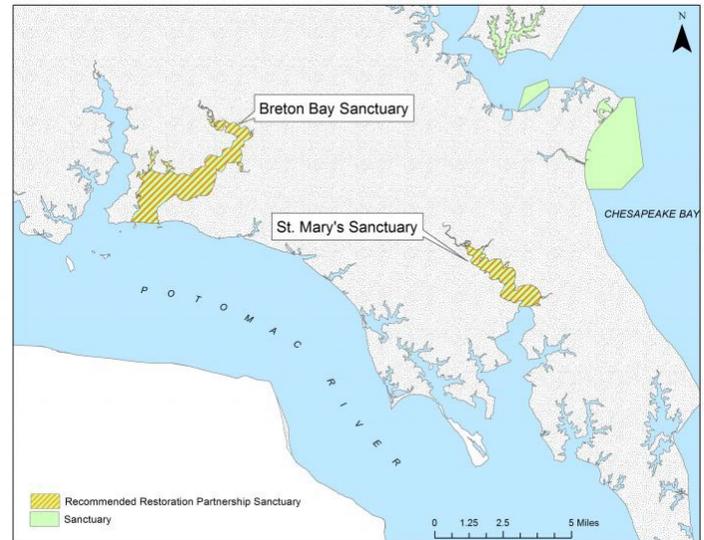


Figure 1. Map of Breton Bay and St. Mary's River shellfish sanctuaries (Source: MD DNR, 2017).

currents are typically downriver for the Chesapeake Bay's tidal tributaries. Oyster reproduction is also dependent on oyster density. In areas with a high density of adult oysters, with more than 150 oysters per square meter, oyster reproduction tends to be high (MD DNR Fishing and Boating Services, 2018). Conversely, areas with few oysters have poor reproductive success (Marshall et al., 2020).

Oyster reproduction data collected annually can inform the development and placement of shell-planted reserve areas or sanctuary areas that will have the best outcomes for restoration. Some questions we seek to answer with this study are:

1. To what extent do larvae drift out of the sanctuary and recruit into the public fishery areas?
2. What areas of the St. Mary's River 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, water quality monitoring)?

SMRWA began this study with a pilot in 2018 that measured spatfall at two sites. Since then, the study has been conducted annually and expanded to 12 sites in the St. Mary's River. In addition to this study, SMRWA implements outreach programs such as the Marylanders Grow Oysters (MGO) program, the Living Reef Action Campaign, and other direct restoration-related efforts within the St. Mary's River shellfish sanctuary. Additionally, they engage in or support research with groups, including local high school and college students, graduate students from regional institutions, and marine scientists. Their five-acre Oyster Reef Project adjacent to St. Mary's College of Maryland (SMCM) serves as a living classroom and enhances SMCM's marine science and biology curriculum.

MATERIALS AND METHODS

The 2025 Recruitment Study measured spatfall at the same twelve sites as the 2021-2024 Recruitment Studies: Bryan, Horseshoe, Seminary, Portobello, Green Pond (also known as Gravelly Run), Cooper Creek, Coppage, Thompson (also known as Carthage Creek), Priest Point, Chicken Cock (previously known as Goad and Graveyard), Sedge Point (also known as Gum Edge), and Mouth of Creek (Figure 2; Table 1). However, this year the location of the Priest Point site was moved from 38.15192° , -76.44185° to 38.15204° , -76.44103° . When we arrived to conduct water quality monitoring on July 1, the cages were moved from the original site (38.15192° , -76.44185°) to a shallower area near 38.15204° , -76.44103° (38.1512708° , -76.4416121°). With guidance from our contact at MD DNR, we decided to move the cages deeper but keep them in the general area that they had been moved to (Table 1). A 13th study site in Breton Bay was added in 2022 (Appendix A).



Figure 2. Map of study sites in the St. Mary's River and their corresponding numbers. The purple area denotes the upper St. Mary's River shellfish sanctuary.

Table 1. Coordinates (Latitude and Longitude) and mean low water depth (m) of study sites. Note: coordinates for Priest Point changed from 38.15151°, -76.44261° to 38.15192°, -76.44185° in 2022 and from its location in 2022 to its current coordinates in 2025.

| Site | Latitude | Longitude | Depth (meters) |
|--------------------|-----------|--------------|----------------|
| 01. Bryan | 38.20361° | -76.45626° | 2.2 |
| 02. Horseshoe | 38.19792° | -76.44672° | 1.5 |
| 03. Seminary | 38.18859° | -76.43687° | 2.4 |
| 04. Portobello | 38.17131° | -76.45811° | 3.1 |
| 05. Green Pond | 38.17402° | -76.44096-7° | 3.0 |
| 06. Cooper Creek | 38.16773° | -76.45881° | 3.0 |
| 07. Coppage | 38.16256° | -76.45119° | 3.0 |
| 08. Thompson | 38.15158° | -76.46190° | 2.3 |
| 09. Priest Point | 38.15204° | -76.44103° | 2.9 |
| 10. Chicken Cock | 38.11855° | -76.43439° | 2.8 |
| 11. Sedge Point | 38.10708° | -76.42731° | 2.8 |
| 12. Mouth of Creek | 38.11483° | -76.46398° | 2.9 |

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 (places where oysters had previously settled and died). Shells were obtained from wild caught oysters originating from Harris Creek recycled at the US Oyster Festival in 2024. Prior to deployment, the shells were power washed in the traps to remove any dirt or debris. At each of the twelve sites, four survey traps were placed vertically on the river bottom and spaced approximately one meter apart (Photo 1). Chain of custody forms tracked the traps throughout the project.

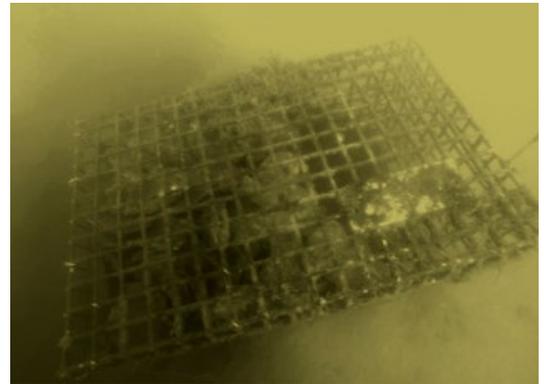


Photo 1. Underwater photo of trap deployed on river bottom.

Attached to or near one of the traps at each site was an anchor with a floating buoy labeled as follows:

DNR Spat Study
MDE Permit
#25-GL-0390

Traps were deployed on June 11. Water quality readings were taken on June 2 and 11, July 1 and 31, August 13, September 2 and 18, October 2, and November 3. A Secchi disk and YSI PRO2030 were used to collect water quality readings. The YSI receives annual maintenance and was calibrated for dissolved oxygen before each sampling. Standardized field log sheets were used to record data.

Traps were retrieved on October 17, 20, 23, 27, and 28. Upon collection, we labeled each trap both internally and externally with a tag that indicated the study site and trap identifier (A,

B, C, or D). The traps were taken to a holding area at the SMCM waterfront, where they were temporarily placed in shallow water on hardwood pallets. Only two traps were retrieved from the Mouth of Creek site. The two other cages and the buoy were missing when we visited the site in October; we dove on the site and searched the area by boat but only located two cages.

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”). Spat were measured in three size groupings: equal to and under 10 mm, 11 mm to 25 mm, and over 25 mm using rulers. Therefore, our analysis and graphs depict the size groupings, not the actual measurements. Spat counting occurred on thirteen occasions from October 25 to November 25, and in total, 32 people assisted with spat counting¹. All volunteer counters were trained, and an inexperienced counter was paired with an experienced counter.

Due to exceptionally high spatfall, spat from only two of the four replicate cages per site were counted this year. As such, average number of spat per cage will be analyzed in this report, rather than total spatfall as in years past. Please note that average 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 average spatfall is reported by size grouping and by live and box count. Mortality was also calculated for each site by dividing the number of boxed spat by the total spatfall (live and box).

Our permit required us to remove the traps prior to November 1, which is the opening day for public harvest with dredges. The study area is not usually harvested during the hand tong season in October.

The dataset will be shared with decision-makers—DNR Shellfish Division and the St. Mary’s County oyster committee—and made publicly available through our website <http://www.SMRWA.org>.

RESULTS

Total Spatfall

2025 was a monumental year for oyster recruitment in the St. Mary’s River. The previous spatfall record occurred in 2022 when a total of 19,111 spat were counted from 48 cages. In 2025, a total of 106,250 spat were counted from only 24 cages. Average spatfall per cage was 33.7 times higher in 2025 (4,427 spat/cage) than 2024 (131 spat/cage) and 11.1 times higher than 2022 (398 spat/cage), the previous record.

In 2025, all study sites experienced an increase in spatfall from the previous year, ranging from Chicken Cock, which was 3.7 times higher than 2024, to Bryan, which was 121.3 times higher than 2024. Additionally, all sites experienced new record amounts of spatfall except

¹ Spat counters included Meredith Nishiura, Megan Sheperd, Emma Green Ewing, Norm O’Foran, Glenn Howansky, Bob Paul, Tina Riley, Tony Pait, Diane Bell, Nancy Bosket, Carolyn Goul, Mia Dyer, Ella Voos, Dorothy Birch, Joe Anderson, Anne Barnes, Lance Hudson, Leila Hudson, Katherine Cory, Ruby Schneider, Abby Aina, Brady McOmber, Katie Cory, Jessie Fulcher, Ryder Pobst, Audrey Kindgren, Armirah Gonzales, Johnny Schwaner, Laila Siler, Payton Jameson, Lexi Thelen, and Vivian Thompson.

Chicken Cock, Sedge Point, and Mouth of Creek, where average spatfall was less than in 2022. In previous years, the site with the highest recruitment was located in the sanctuary; however; for the first time in this study, the highest spatfall was not recorded at a site in the sanctuary, and spatfall in the middle of the river surpassed that in the sanctuary (Figure 3).

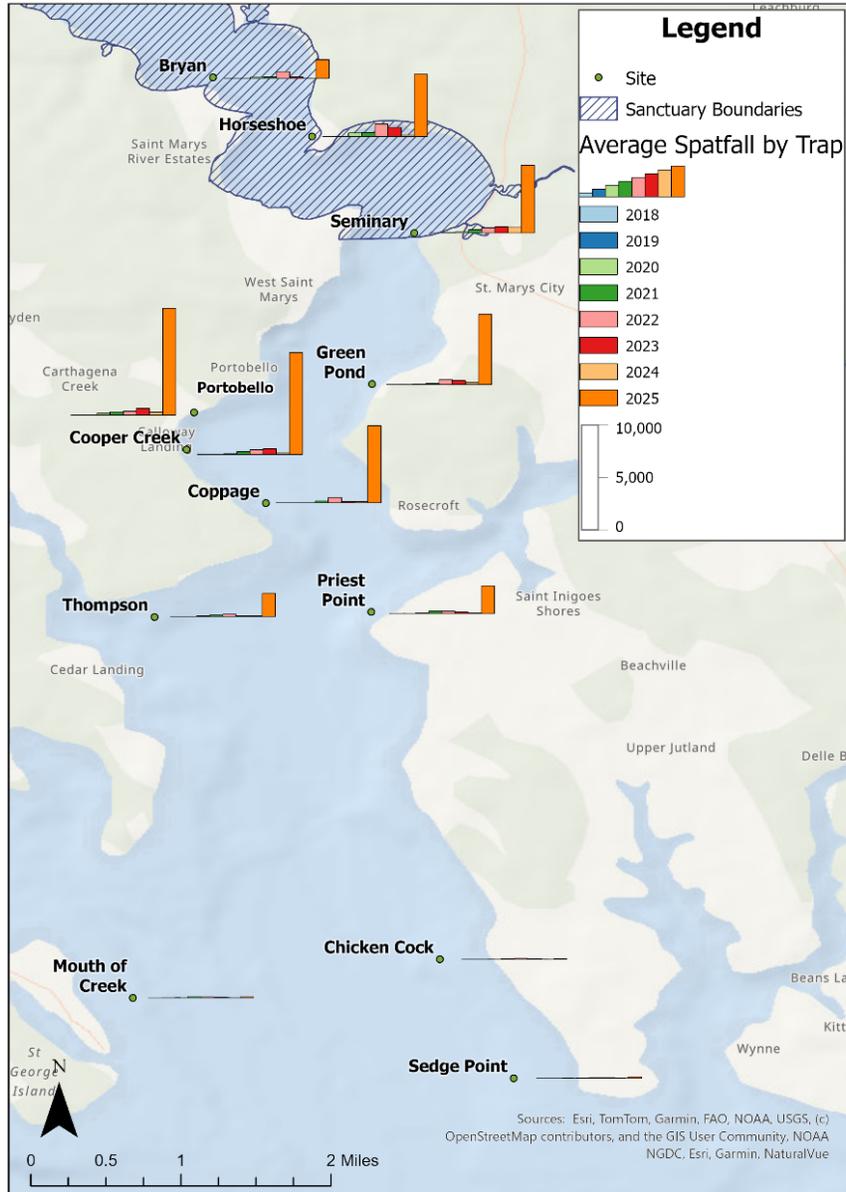


Figure 3. Locations of the 12 study sites with average spatfall per trap for each year that the study was conducted at a given site. The map also includes the boundary of the St. Mary’s River Shellfish Sanctuary.

Identifying the causes of a change in oyster recruitment can be difficult because there are many elements that interact to influence oyster reproduction, and oyster reproduction is naturally variable (Kimmel & Newell, 2007). The dramatic increase from 2024 to 2025 is likely due to a combination of both favorable conditions and natural variability. According to the Maryland Department of Natural Resources (MD DNR) 2024 Oyster Stock Assessment, spatfall indices in the St. Mary's River have exceeded the 40-year average for the past four years. It is possible that these large year classes of oysters, particularly from spawns in 2022 and 2023, are beginning to increase the overall breeding population in the St. Mary's River. Larger oysters have greater fecundities, so as these year classes age, they could increase overall reproductive output exponentially (Kennedy et al., 1996). In addition, the 2024 stock assessment reported decreasing prevalence of diseases such as Dermo, which negatively impact gametogenesis. Improved health of oysters along with the increased number of oysters in the St. Mary's River could have contributed to increased reproduction.

Additionally, the St. Mary's River experienced unusually high temperatures in July and August. In general, higher temperatures result in increased gametogenesis and greater reproduction in oysters (Kennedy et al., 1996). The majority of spat counted this year were 10 mm or less, indicating that a very high number were spawned later in the season. For this later spawning event, gametogenesis, which requires around two to three months, would likely have begun in July or August; therefore, the unusually high temperatures during these months could have contributed to the exceptionally strong spawning event in the fall. Oysters may have also been responding to an environmental parameter not measured in this study. The exact effects of water quality on spatfall are unclear, and water quality has not been a reliable predictor of recruitment in this study. Oyster reproduction experiences considerable natural variability and generally does not neatly correspond with known environmental or population characteristics (Kennedy et al., 1996; Mann et al., 2014). Although favorable conditions likely facilitated high recruitment in 2025, it remains possible that oyster populations were responding to an unknown variable or were simply experiencing a natural reproductive high.

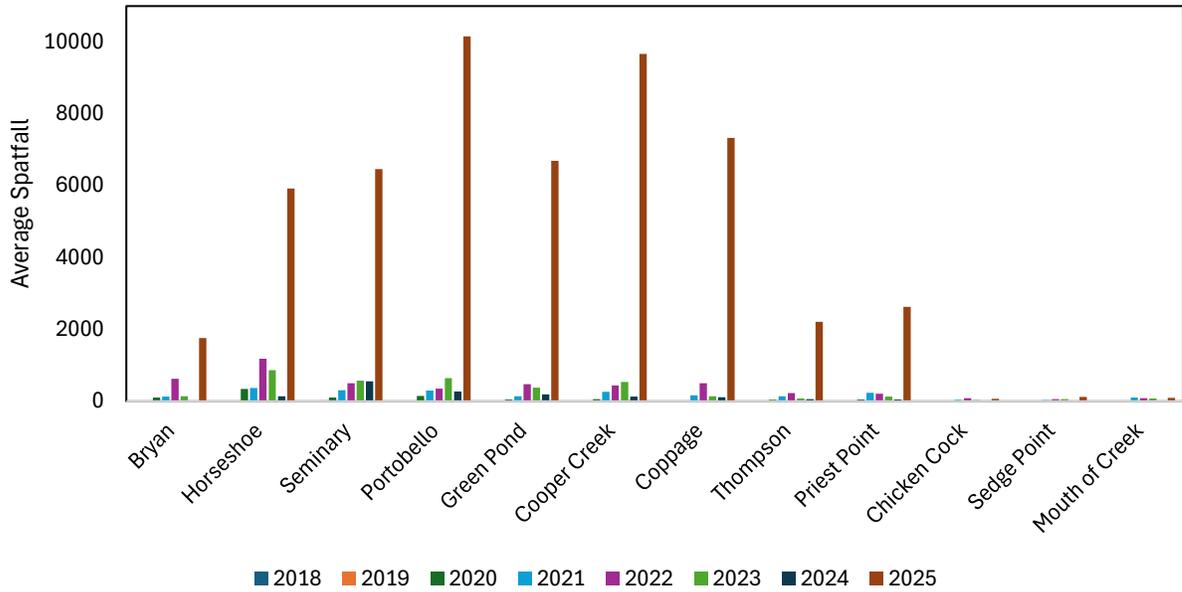


Figure 4. Comparison of average spatfall counts from 2018 to 2025. All sites had higher counts in 2025 than the previous year 2024. Note: Not all sites were included in the study from 2018 to 2020.

Mortality

Mortality rates in 2025 were substantially higher than in previous years. Mortality in previous years typically fell between 10 and 20 %, but in 2025, 60.5 % of spat were dead and 39.5 % were alive (Figure 5). All study sites experienced over 40 % mortality except for Chicken Cock and Mouth of Creek, which experienced 28.6 % and 13.0 % mortality respectively (Figure 6). High mortality rates are due in large part to an exceptionally high number of small dead spat. The vast majority (88.9 %) of dead spat were 10 mm or below, and out of all the spat counted in 2025, an average of 54.4 % were small dead spat (Figure 8).

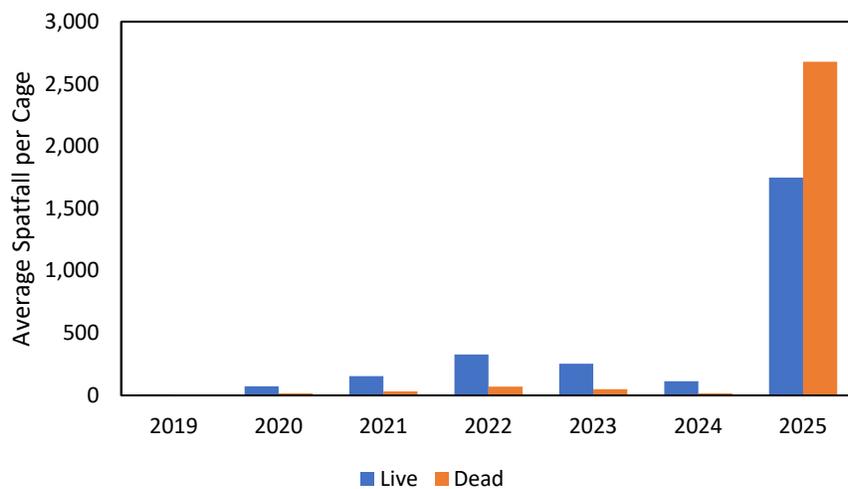


Figure 5. Comparison of average live and dead spatfall counts from 2019-2025.

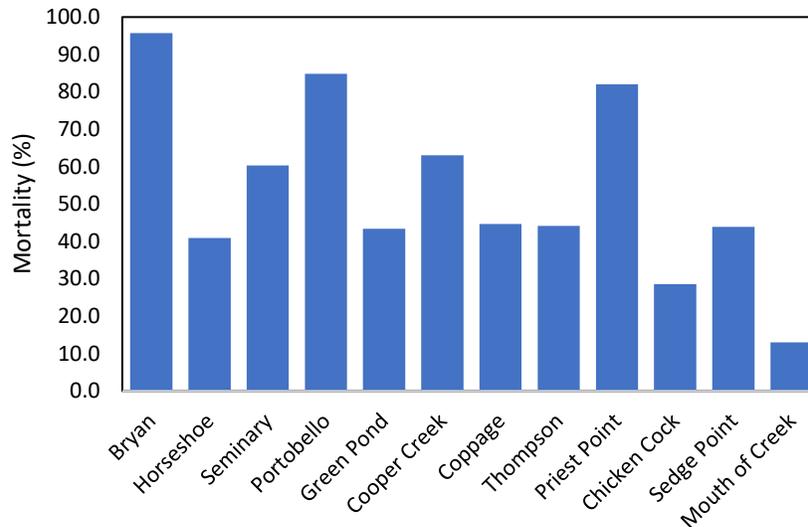


Figure 6. Percent mortality for each site in 2025. Mortality (%) was calculated by dividing the number of boxed spat by the total spatfall at the site.

The reason for such unusually high mortality is unclear. Water quality parameters, particularly dissolved oxygen, were generally good throughout the study period. Water quality also did not differ greatly between the majority of sites and the two, Chicken Cock and Mouth of Creek, that experienced much lower mortality. *Stylochus* were noted during counting at higher abundances than previous years, but not at high enough numbers to reasonably explain such elevated mortality. During counting, we observed differences in mortality depending on the spat's location in the cage. Spat that had settled on the cage or on shells near the outside of the cage were generally larger and had lower mortality. Shells in the inner portion of the cage were densely packed, and these shells often had smaller and more boxed spat. It is possible that excessive spat growth near the outside of the cage reduced water flow to spat within the cage and caused mortality. Additionally, dissolved oxygen levels may have been insufficient to support the large number of oysters in the trap.

Spatfall by Size

The spatfall size distribution in 2025 was unique and marked by a very high number of small spat, particularly small dead spat. Of the total spatfall by size, 74.7 % were 10 mm or less, 18.0 % were 11-25 mm, and 7.3 % were above 25 mm. This is the inverse of the size distribution patterns observed in all previous years, where the majority of spat were greater than 25 mm and the fewest were 10 mm or less. Of the total live spatfall in 2025, the majority (52.3 %) were 10 mm or less. The intermediate size class (11-25 mm) accounted for 30.5 % of the total live spat while 17.2 % were greater than 25 mm (Figure 7). Of the box spatfall, 88.9 % were less than 10 mm, 10.0 % were 11-25 mm, and only 1.1 % were over 25 mm. Most boxed spat (98.9 %) died before they reached 25 mm (Figure 8).

The size distribution of live spatfall strongly suggests that spawning occurred more than once over the summer and fall. Similar to other areas of the Chesapeake Bay, the spawn likely began in June and continued through July or August in localized areas. Many very small spat (under 5mm) were observed, suggesting that a late September-October spawn did occur.

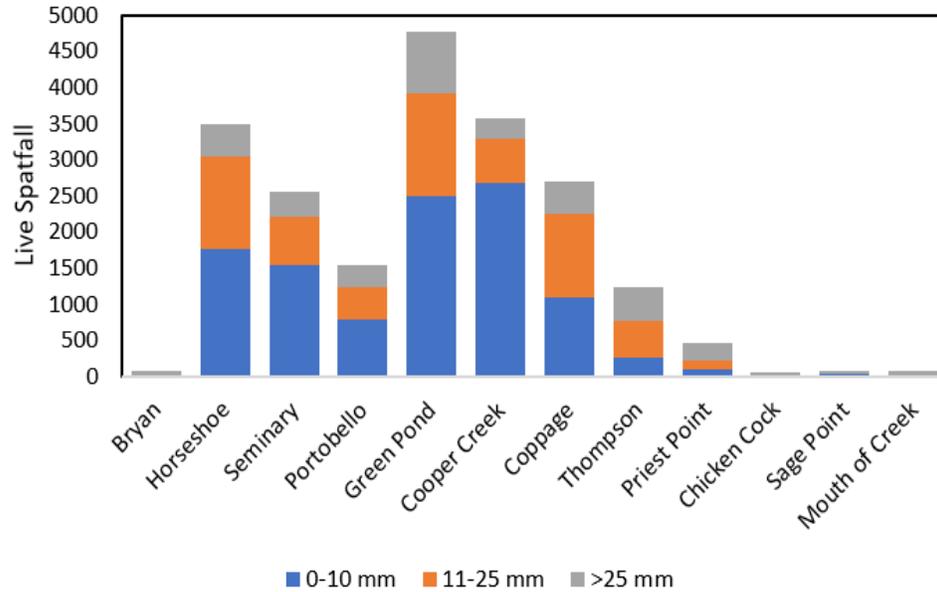


Figure 7. Comparison of average live spatfall by size groupings in 2025.

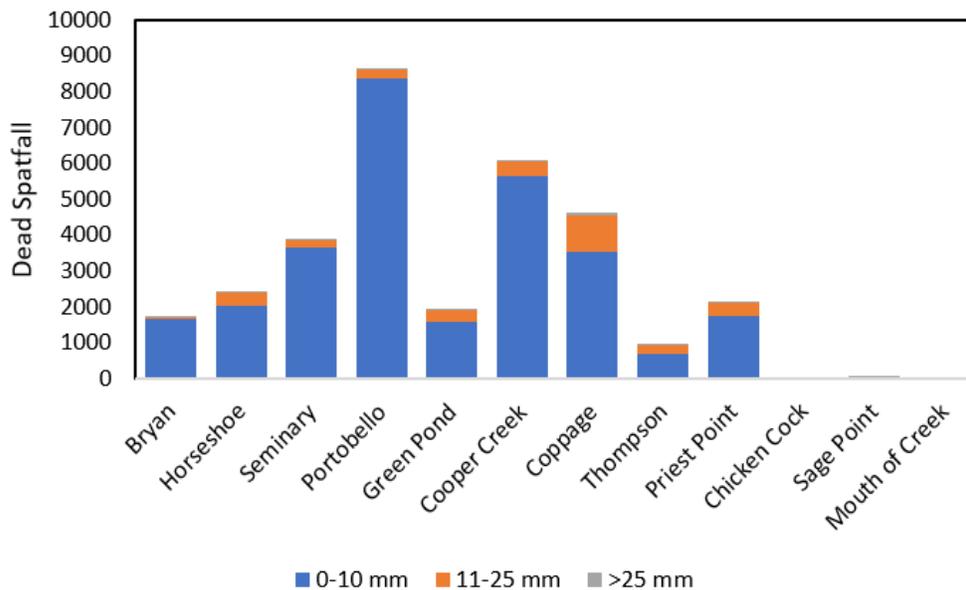


Figure 8. Comparison of average dead spatfall by size groupings in 2025.

Water Quality

Water quality in the St. Mary's River in 2025 was distinguished by higher than average temperatures in the late summer, followed by lower than average temperatures in early fall. In 2025, July mean bottom water temperature was 2.3 °C warmer than in 2024, August mean bottom water temperature was 1.8 °C warmer, and September mean bottom water temperature was 3.7 °C cooler. Water temperature reflected air temperature by a one-month delay (Figure 9; National Centers for Environmental Information, 2025). Air temperature was above the 100-year average for St. Mary's County in June and July (National Centers for Environmental Information, 2025), but water temperature did not increase above normal until July. Low air temperatures in August were reflected in low water temperatures in September. The highest recorded temperature was 31.7 °C at Seminary on July 31, and the lowest temperature was 15.2 °C at Mouth of Creek on November 3. Temperature did not vary greatly between sites (Figure 10).

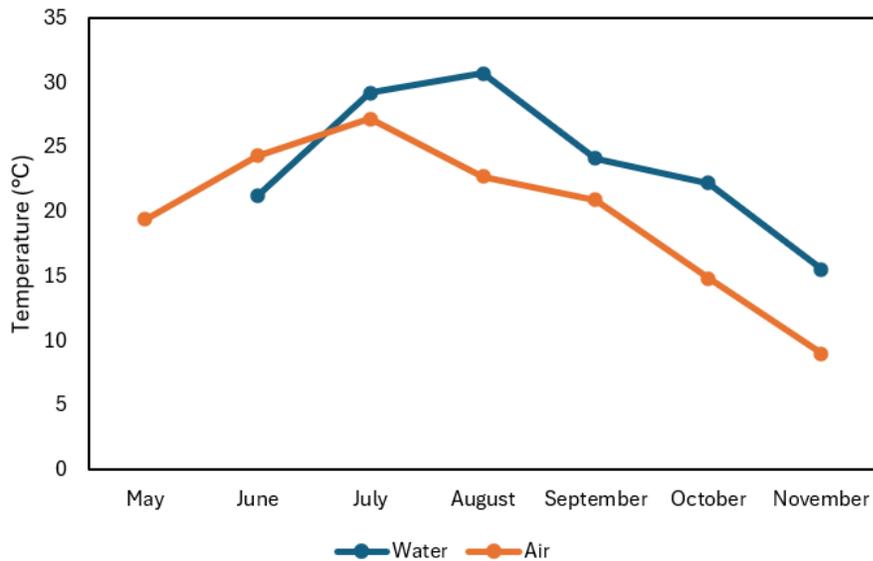


Figure 9. Average air and bottom water temperature (°C) measurements from May-November in 2025. Air temperature data were retrieved from the National Centers for Environmental Information (2025).

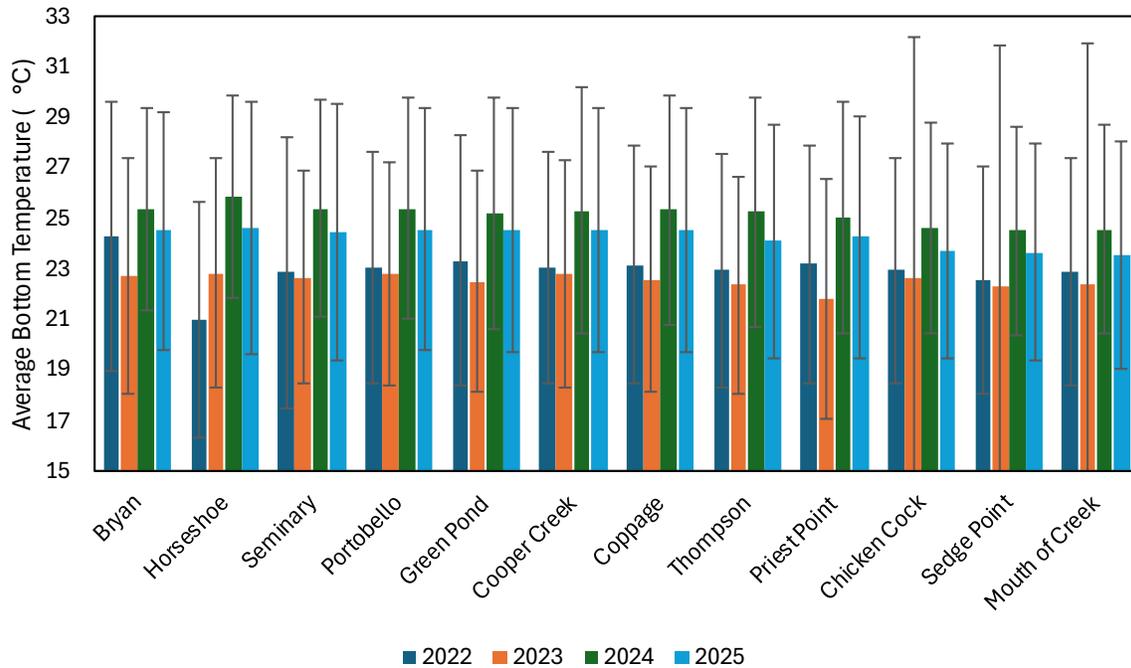


Figure 10. Average bottom temperature (°C) during the study period (\pm SD) at all sites from 2022-2025.

Salinity in the St. Mary’s River in 2025 was slightly higher than normal. This high salinity was especially apparent in June and October, where average values exceeded those in 2024 by 2.7 and 2.8 ppt respectively. Overall, mean bottom salinity across the entire study period was 13.5 ppt, 1.3 ppt higher than in 2024. However, this increased salinity does not reflect precipitation patterns—precipitation was greater in 2025 than 2024 in all months except August and November (National Centers for Environmental Information, 2025). St. Mary’s County also experienced no drought and only 13 weeks of abnormally dry conditions during the 23-week study period in 2025; in 2024, it experienced drought for four weeks and abnormally dry conditions for 21 weeks (U.S. Drought Monitor, 2025). The reason for elevated salinity this year is therefore unclear. Both the lowest and highest bottom salinities were recorded at Priest Point: 10.6 ppt on July 1 and 17.7 ppt at on November 3. Salinity did not greatly vary between sites (Figure 11).

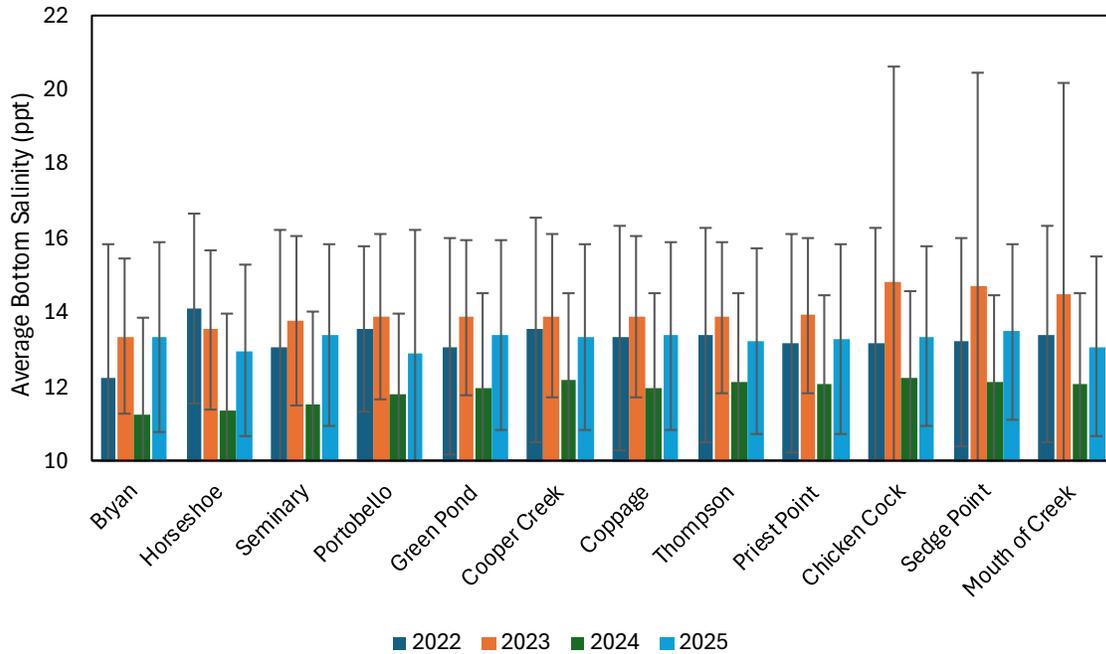


Figure 11. Average bottom salinity (ppt) during the study period (\pm SD) at all sites from 2022-2025.

Dissolved oxygen (mg/L) at the river bottom in 2025 was generally similar to previous years. Average bottom dissolved oxygen in June was unusually high at 7.5 mg/L, which exceeded 2024's average by 1.5 mg/L. Most other average monthly values in 2025 were slightly less than those in 2024, but, due to the high in June, overall mean dissolved oxygen in 2025 was identical to 2024 at 6.5 mg/L. July and August experienced the lowest average dissolved oxygen at 4.7 and 5.2 mg/L respectively, and November experienced the highest at 8.4 mg/L. All sites experienced their lowest bottom dissolved oxygen in either July or August, a pattern typical of previous years. Hypoxic conditions were recorded at two sites: Bryan on July 1 and 31 at 1.53 and 1.95 mg/L and Mouth of Creek on July 3 at 1.81 mg/L. Average dissolved oxygen at Bryan was lower than at all other sites (Figure 12).

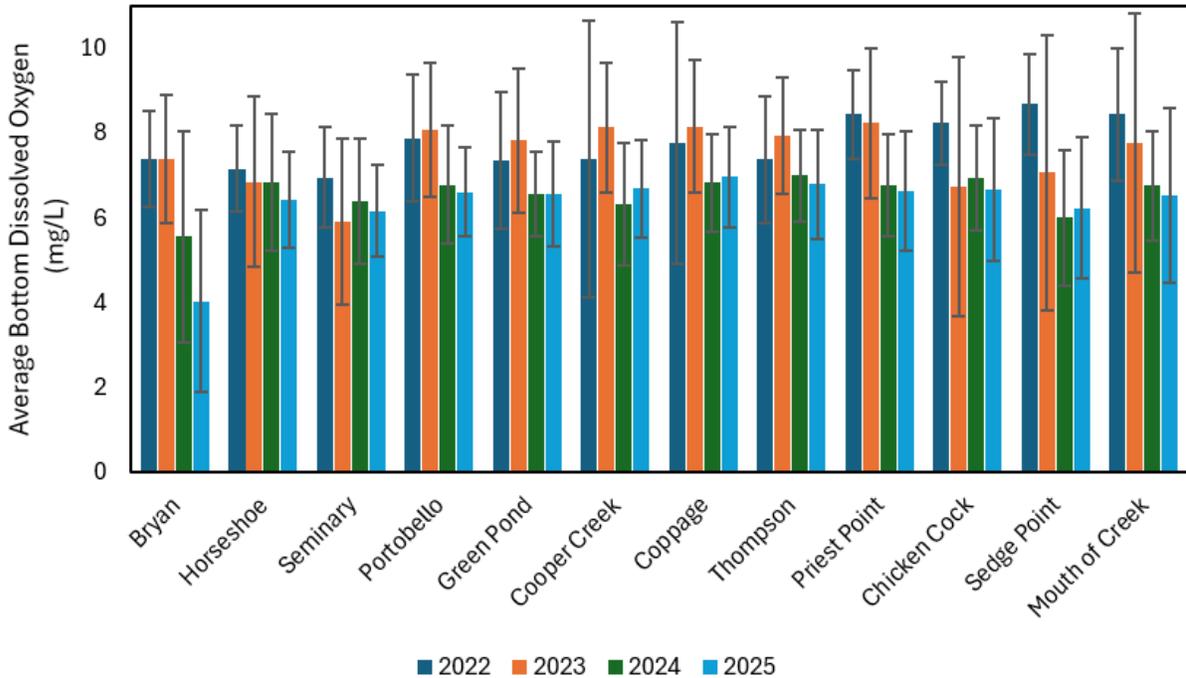


Figure 12. Average bottom dissolved oxygen (mg/L) during the study period (\pm SD) at all sites from 2022-2025.

In the report by the USACE, “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 on which readings were taken except for twelve occasions: Bryan on June 11 (2.05 mg/L), July 1 (1.53 mg/L), July 31 (1.95 mg/L), August 13 (3.45 mg/L), and October 2 (2.7 mg/L); Seminary on June 11 (4.88 mg/L); Cooper Creek on July 31 (4.79 mg/L); Thompson on July 3 (4.44 mg/L); Chicken Cock on July 3 (3.17 mg/L); Sedge Point on July 3 (3.27 mg/L) and September 2 (4.21 mg/L); and Mouth of Creek on July 3 (1.81 mg/L). Bryan frequently experiences low dissolved oxygen and was the only site where these conditions were measured at multiple samplings. At other sites, dissolved oxygen had returned to pre-event levels by the following sampling. Dissolved oxygen during the time between water quality readings is unknown.

SELECTED STUDY SITE OBSERVATIONS

In 2025, spatfall increased from the previous year at all twelve sites, and nine sites experienced new records (Figure 4). When oyster density was surveyed in 2019, the five sites in the lowest part of the tidal river (Thompson, Priest Point, Chicken Cock, Sedge Point, and Mouth of Creek) had less than 5 oysters per square meter. The three sites in the sanctuary (upriver) had oyster densities that were much higher, exceeding 150 oysters per square meter at Bryan and Seminary. Oyster density in 2019 did not necessarily correlate with spatfall.

Bryan

Bryan experienced the greatest increase in spatfall from the previous year—in 2025, average spatfall per cage at Bryan was 121.3 times higher than in 2024 (2024: 14.5 spat/cage, 2025: 1758.5 spat/cage; Photo 2; Figure 13). Mortality at Bryan (95.7 %) was the highest recorded at any point in this study and was well above this year’s average mortality of 60.5 % (Figure 6). This high mortality was almost entirely due to small dead spat, and very few dead spat of any other size class were observed (n=25). Dissolved oxygen at Bryan was very low across multiple consecutive sampling dates in July and August, suggesting that prolonged hypoxic conditions may have limited spat survival at this location (Figure 16).

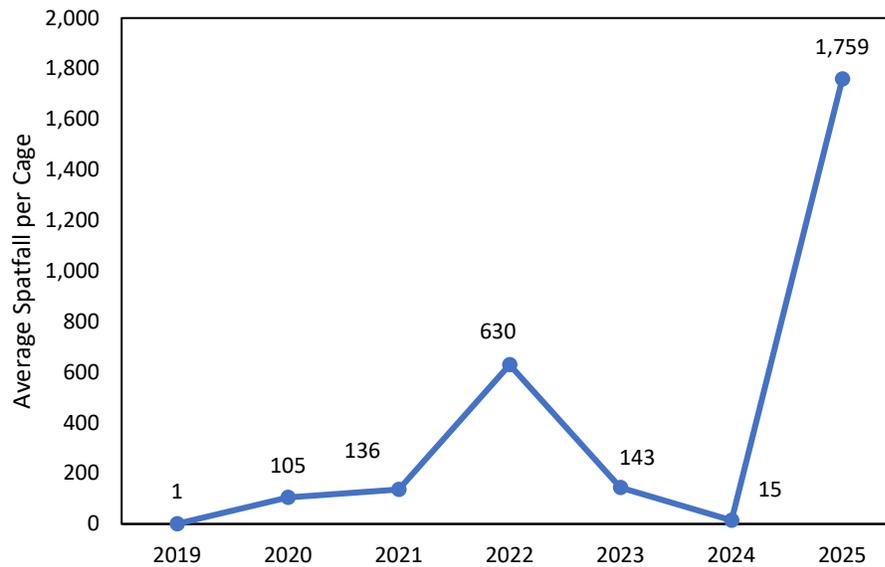


Figure 13. Average spatfall per cage from 2019 to 2025 at Bryan.

Salinity (parts per thousand [ppt]) at Bryan in 2025 was particularly high in June, October, and November (Figure 14). Temperature (°C) was high in July and August and particularly low in September, a pattern seen at many sites (Figure 15). Dissolved oxygen (mg/L) was very low in July, August, and October (Figure 16).

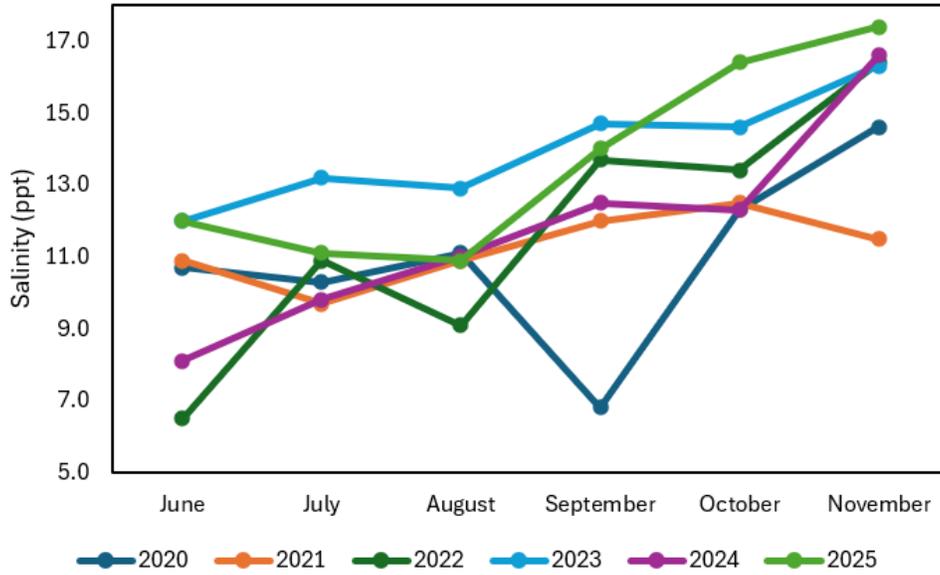


Figure 14. Bottom salinity (ppt) measurements from June-November 2020-2025 at Bryan.

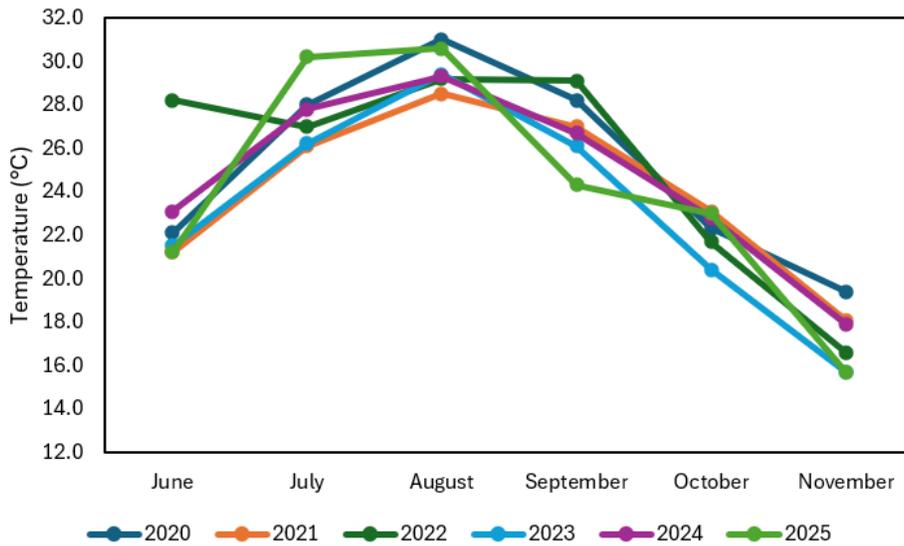


Figure 15. Bottom temperature (°C) measurements from June-November 2020-2025 at Bryan.

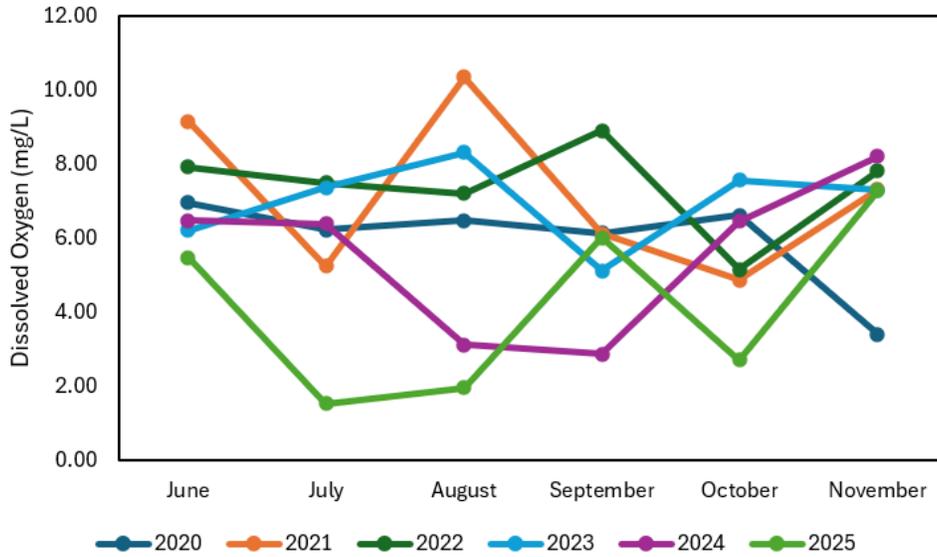


Figure 16. Bottom dissolved oxygen (mg/L) from June to November of 2020-2025 at Bryan.



Photo 2. Spat-on-shell at Bryan.

Horseshoe

Average spatfall at Horseshoe was 41.6 times higher in 2025 than 2024 (2024: 142, 2025: 5920; Photo 4; Figure 17). Horseshoe typically has the highest or second highest spatfall of all the study sites; in 2025, it had the sixth highest spatfall after Portobello, Cooper Creek, Green

Pond, and Seminary. However, it had the fourth highest number of live spat, at 6,992 per cage. It had the third lowest mortality at 40.9 % (Figure 6).

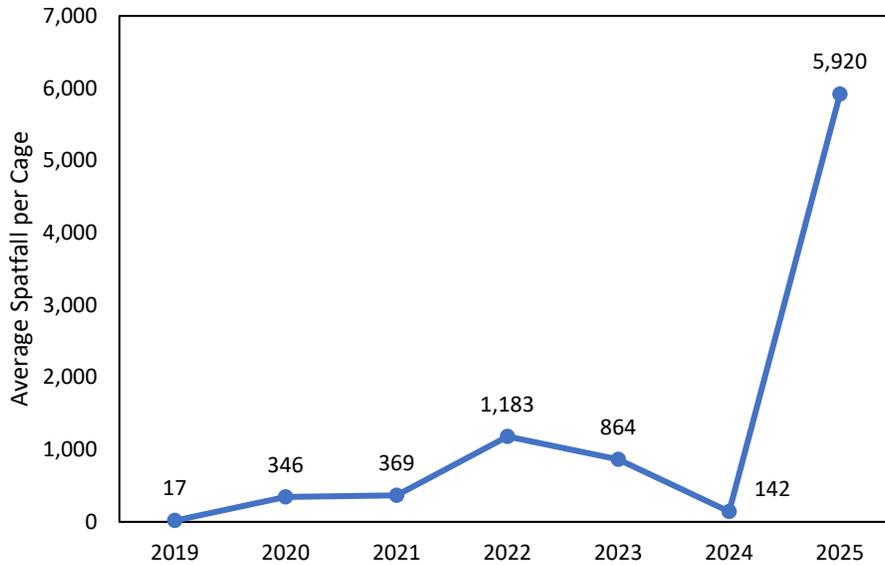


Figure 17. Average spatfall per cage for 2019-2025 at Horseshoe.

Dissolved oxygen (mg/L) at Horseshoe remained fairly consistent throughout the study period before increasing in November (Figure 18). Temperature (°C) was higher than usual in July and August and lower than usual in September (Figure 19). Salinity (ppt) was slightly higher than most previous years (Figure 20).

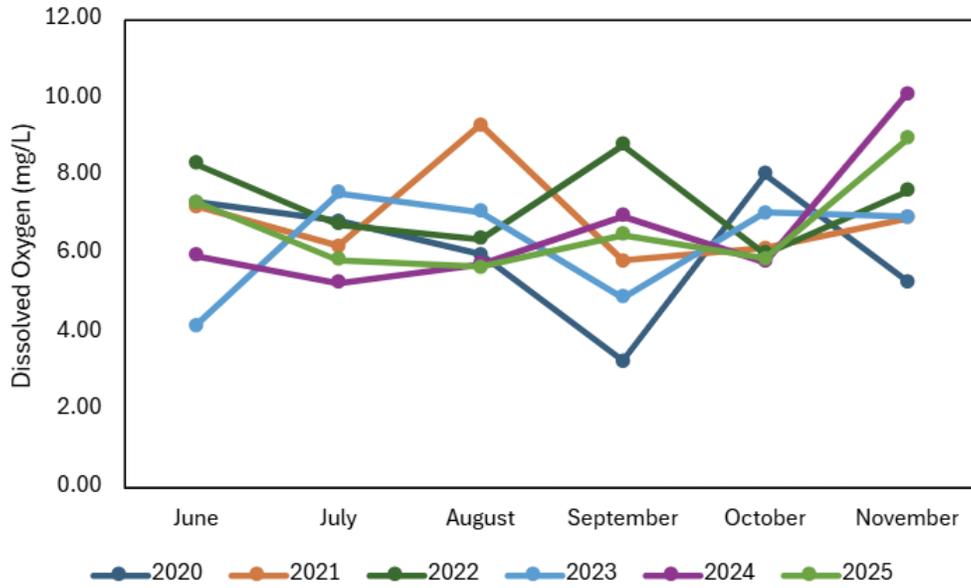


Figure 18. Bottom dissolved oxygen (mg/L) from June to November of 2020-2025 at Horseshoe.

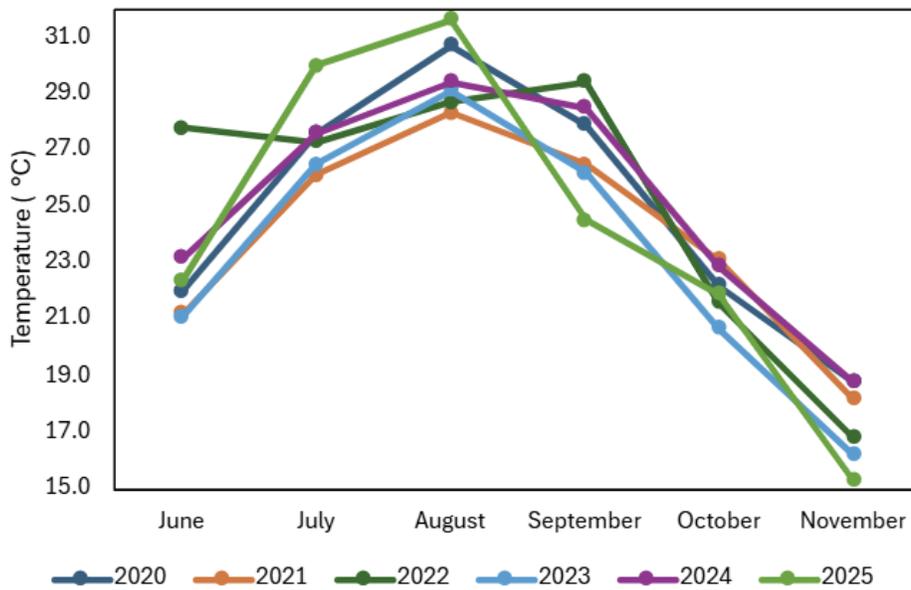


Figure 19. Bottom temperature (°C) measurements from June-November 2020-2025 at Horseshoe.

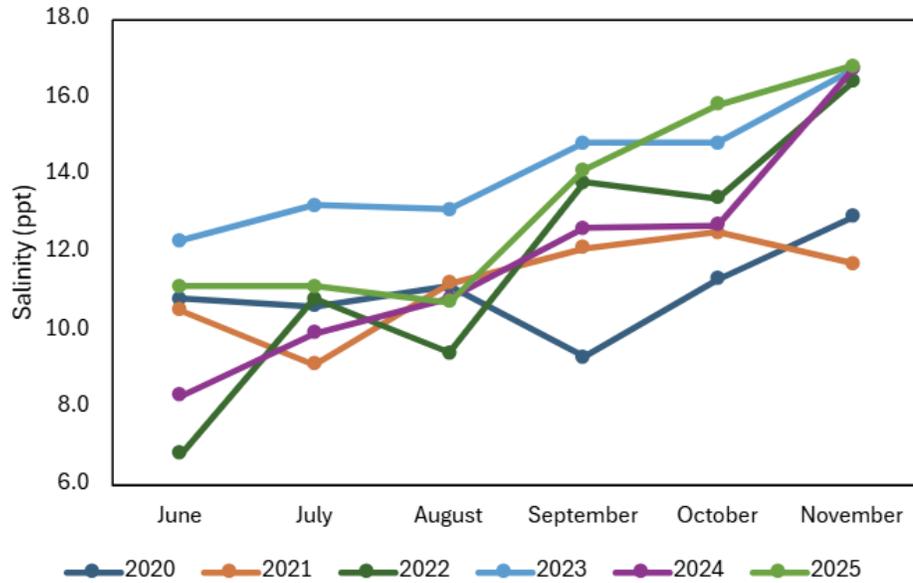


Figure 20. Bottom salinity (ppt) measurements from June-November 2020-2025 at Horseshoe.



Photo 3. Subset of representative spat-on-shell at Horseshoe.



Photo 4. Spat-on-shell at Horseshoe.

Portobello

In 2025, average spatfall at Portobello was 37.2 times higher than in 2024, setting a new record for both this year and the entire study at an average of 10,158 spat per cage (Photo 5; Figure 21). However, because Portobello also had the second highest mortality rate at 84.9 %, it had the sixth highest number of live spat at 3,074 per cage (Figure 6).

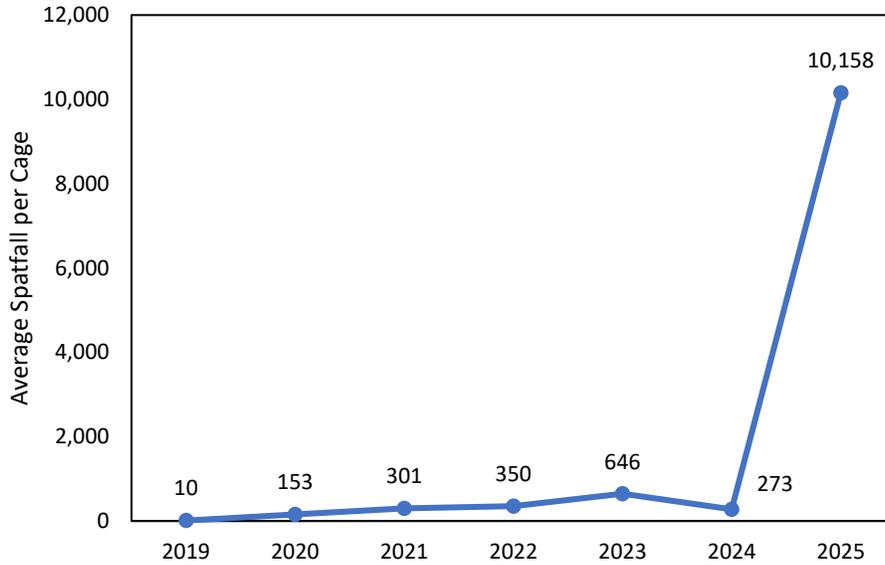


Figure 21. Average spatfall per cage for 2019-2025 at Portobello.

As with other sites, temperature ($^{\circ}\text{C}$) at Portobello was unusually high in July and August and unusually low in September (Figure 22). Dissolved oxygen (mg/L) remained fairly consistent with previous years (Figure 23). Salinity (ppt) was extremely low on the July 1 sampling date at 6.6 ppt and remained low on July 16 at 7.1 ppt, before rising to 11.4 ppt on July 31 (Figure 24). No extreme weather events occurred near these sampling dates, and salinity at all other sites remained within three ppt of each other on all July dates.

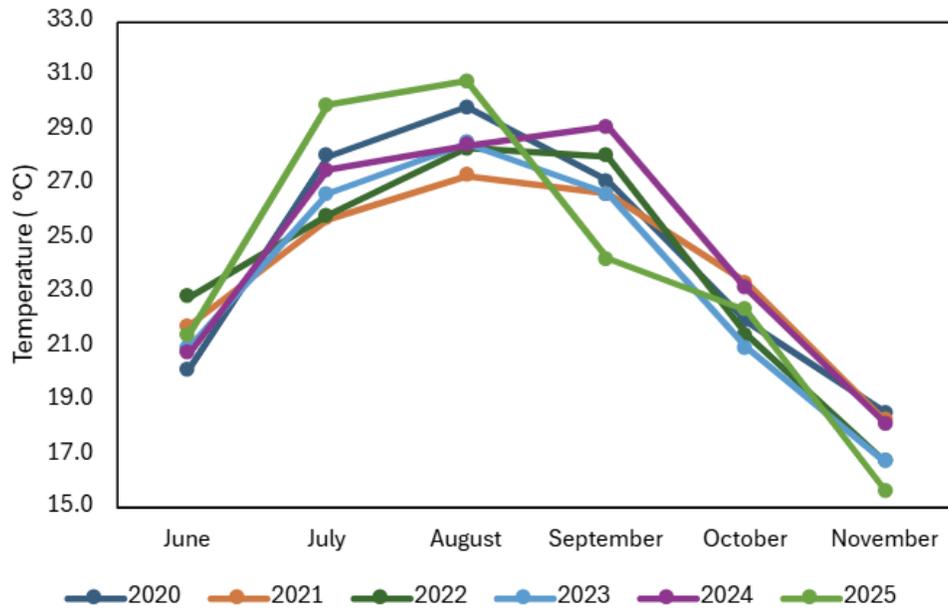


Figure 22. Bottom temperature (°C) measurements from June-November 2020-2025 at Portobello.

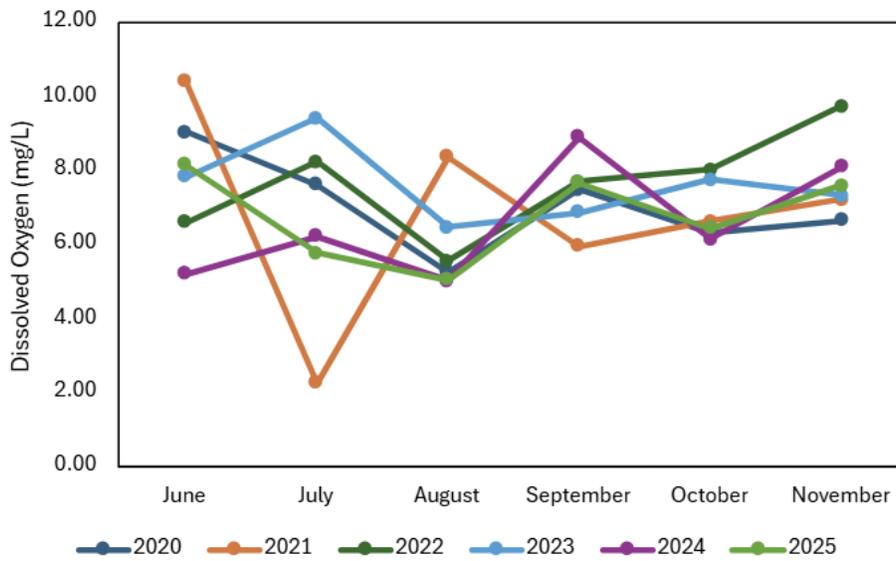


Figure 23. Bottom dissolved oxygen levels (mg/L) from June-November 2020-2025 at Portobello.

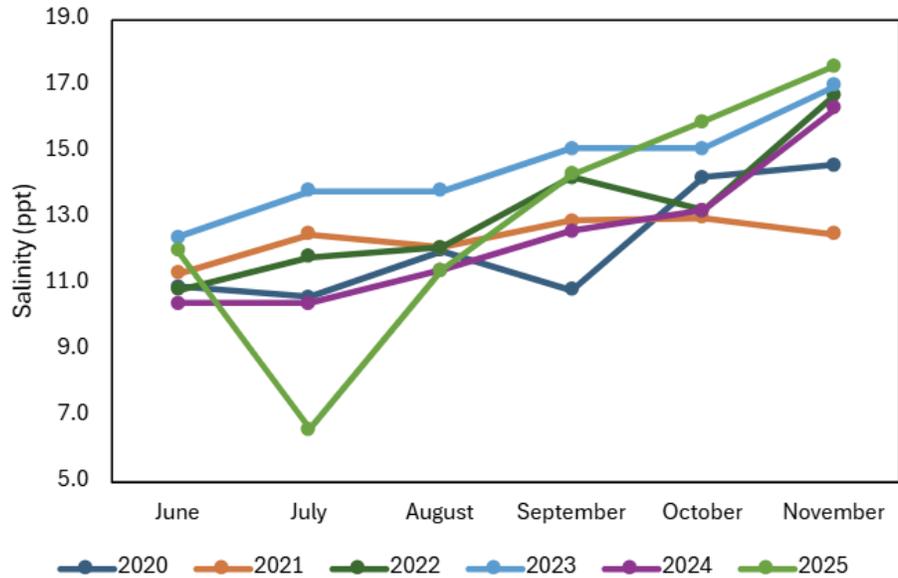


Figure 24. Bottom salinity (parts per thousand [ppt]) measurements from June-November 2020-2025 at Portobello.



Photo 5. Subset of representative spat-on-shell at Portobello.

Coppage

Coppage had the third highest average spatfall in 2025 at 7,336 spat per cage—64.6 times higher than in 2024 (Photo 6; Figure 25). It had the greatest number of live spat. The mortality rate at Coppage was 44.7 % (Figure 6). Spatfall data for 2020 are unavailable because traps were lost that year.

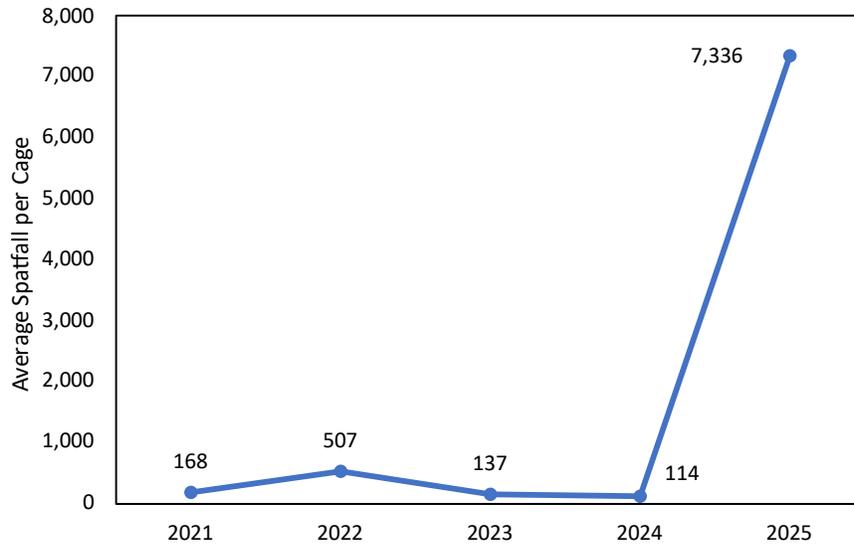


Figure 25. Average spatfall per cage for 2021-2025 at Coppage (data from 2020 are unavailable).

Dissolved oxygen (mg/L) remained above 5.00 mg/L at each monthly reading (Figure 26), and temperature (°C) and salinity (ppt) patterns were consistent with other sites in 2025 (Figure 27; Figure 28).

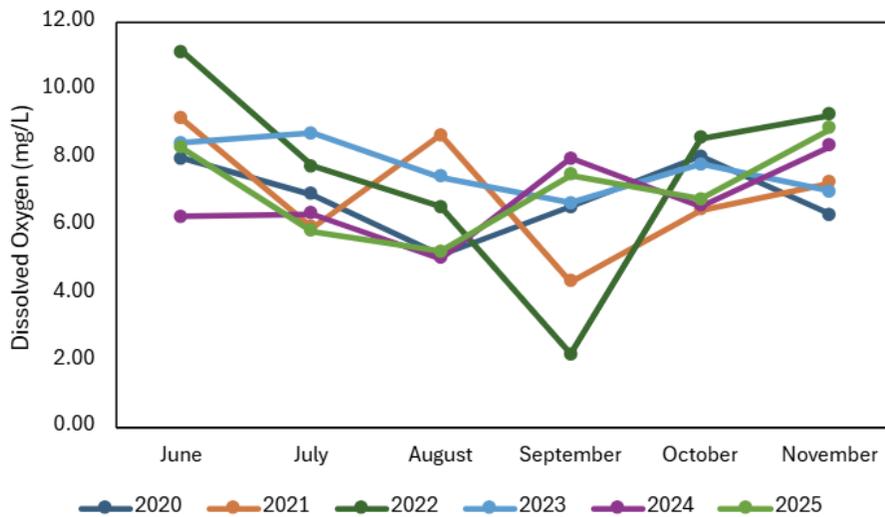


Figure 26. Bottom dissolved oxygen levels (mg/L) from June-November 2020-2025 at Coppage.

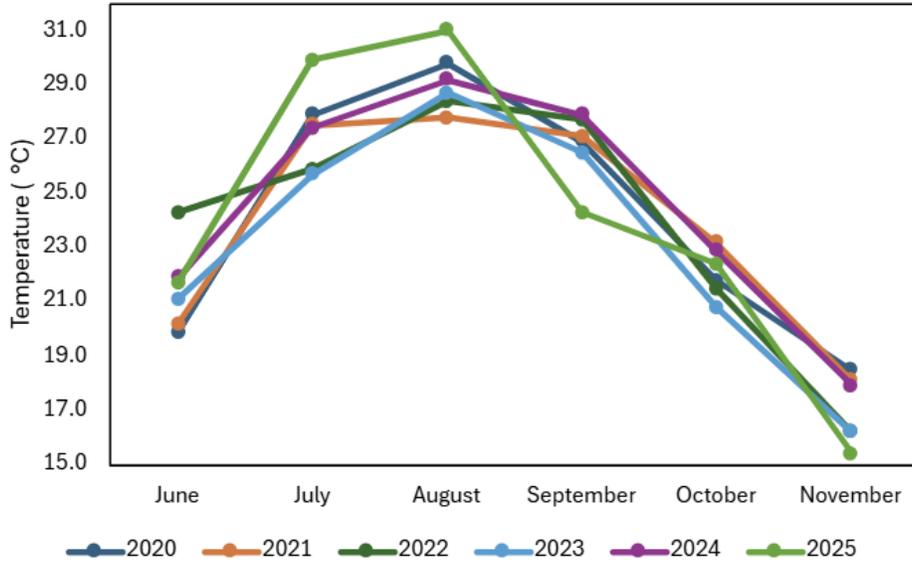


Figure 27. Bottom temperature (°C) measurements from June-November 2020-2025 at Coppage.

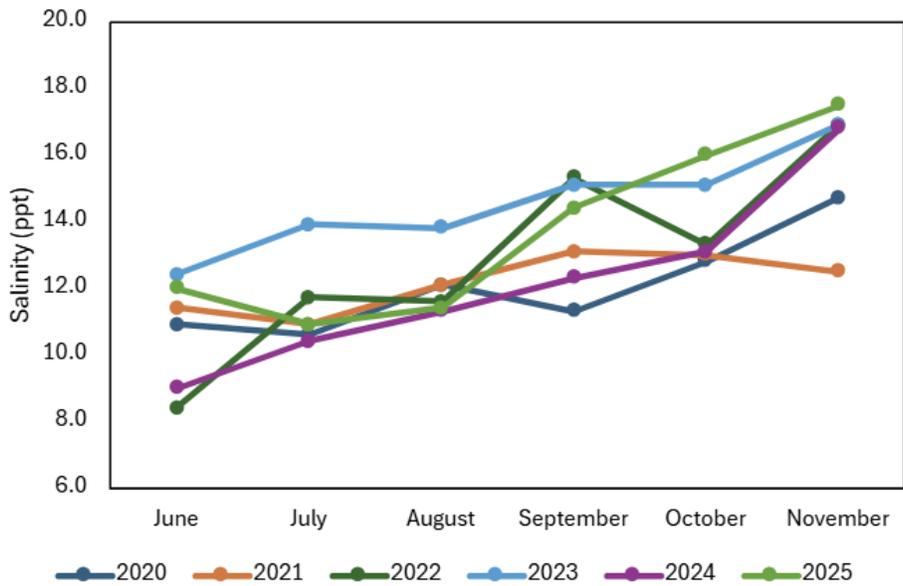


Figure 28. Bottom salinity (ppt) measurements from June-November 2020-2025 at Coppage.



Photo 6. Subset of representative spat-on-shell at Coppage.

Mouth of Creek

Average spatfall at Mouth of Creek was 8.0 times higher in 2025 than 2024 at 93 spat per cage (Figure 29), which is the second lowest at any site in 2025, above only Chicken Cock (Figure 4). Mortality was the lowest among the study sites at 13.0 % (Figure 6). Mouth of Creek had the fourth lowest live spatfall, above Chicken Cock, Sedge Point, and Bryan.

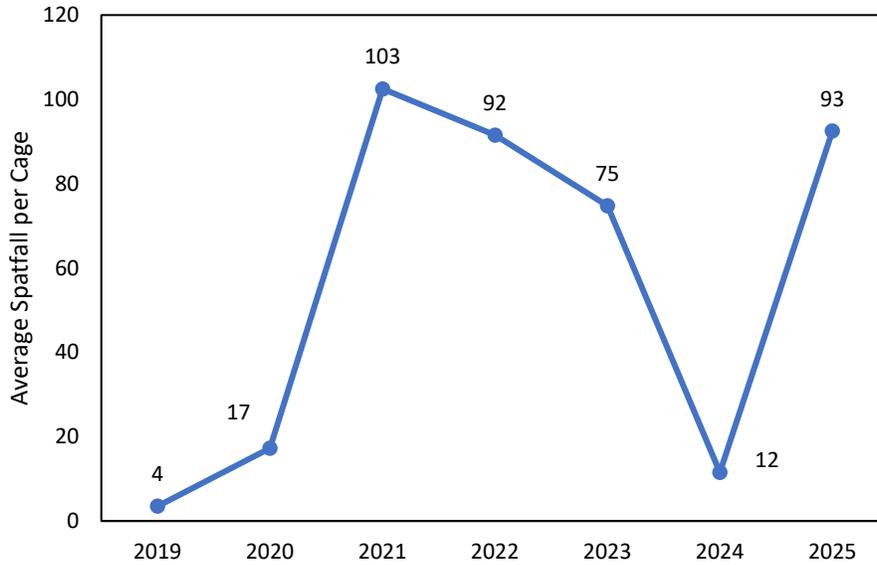


Figure 29. Average spatfall per cage for 2019-2025 at Mouth of Creek.

Hypoxia was recorded at Mouth of Creek in July; at all other sampling dates, dissolved oxygen (mg/L) remained above 5.00 mg/L (Figure 30). Temperature (°C) at Mouth of Creek followed patterns similar to the other sites, with high temperatures in July and August and low temperatures in September (Figure 31). Salinity (ppt) was lowest in August and ascended sharply in the fall months (Figure 32).

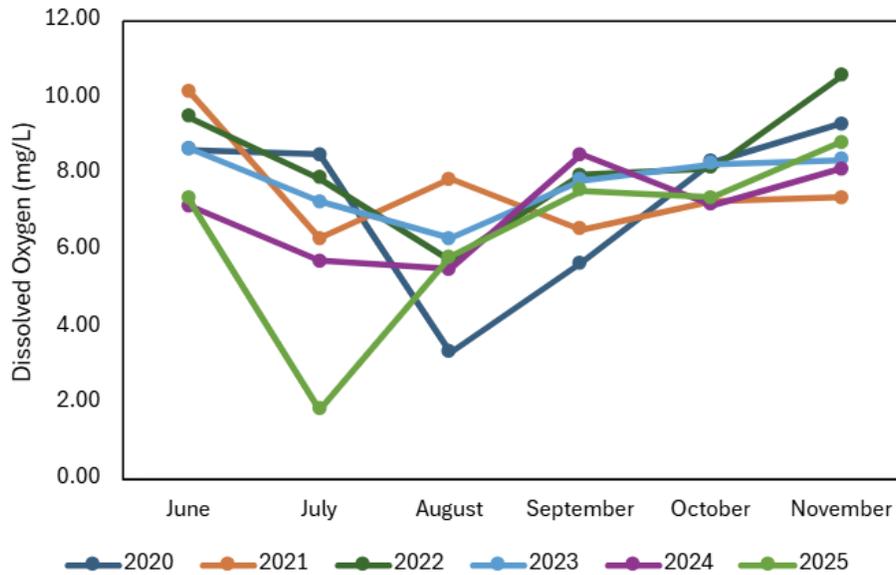


Figure 30. Bottom dissolved oxygen levels (mg/L) from June-November 2020-2025 at Mouth of Creek.

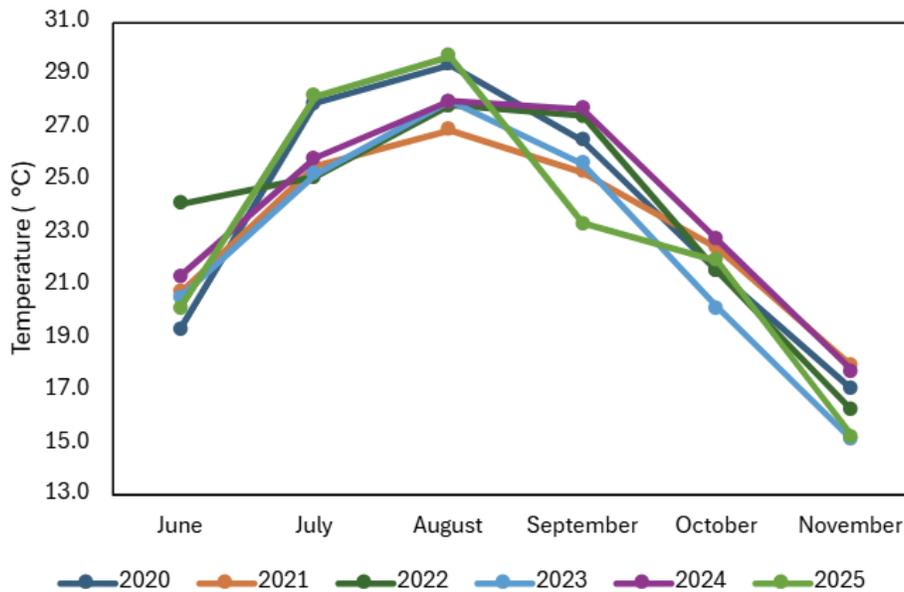


Figure 31. Bottom temperature (°C) measurements from June-November 2020-2025 at Mouth of Creek.

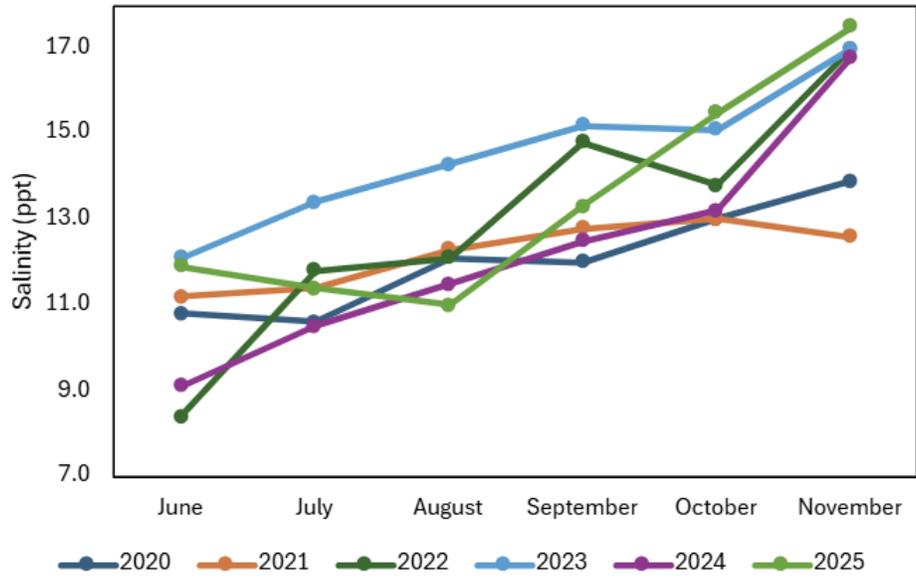


Figure 32. Bottom salinity (ppt) measurements from June-November 2020-2025 at Mouth of Creek.



Photo 7. Subset of representative spat-on-shell at Mouth of Creek.

CONCLUSION

2025 was an exceptional year for spatfall in the St. Mary’s River. This year set a new record that exceeds the previous record by over ten times. Average mortality rate and size distribution of spat were also unusual this year. Mortality rate, which is typically between 10 and 20 %, was 60.5 % in 2025. In previous years, the highest number of spat have been over 25 mm and lowest number have been 10 mm or less; this year, we observed the inverse of that pattern. The cause of such large changes is unclear. Water temperature was unusually high in July and August and unusually low in September, and salinity was fairly high; it is possible that this combination allowed for increased reproduction. It is also possible that natural variation contributed to this increase—spatfall in the St. Mary’s River has long experienced yearly fluctuations (Figure 33; Meritt & Webster, 2022). Such a successful year may also be the result of substantial efforts to protect and restore oyster populations, particularly in the Upper St. Mary’s River Sanctuary, where large-scale restoration was completed in 2022. Hopefully this landmark year for oysters can contribute to greater success in the years to come.

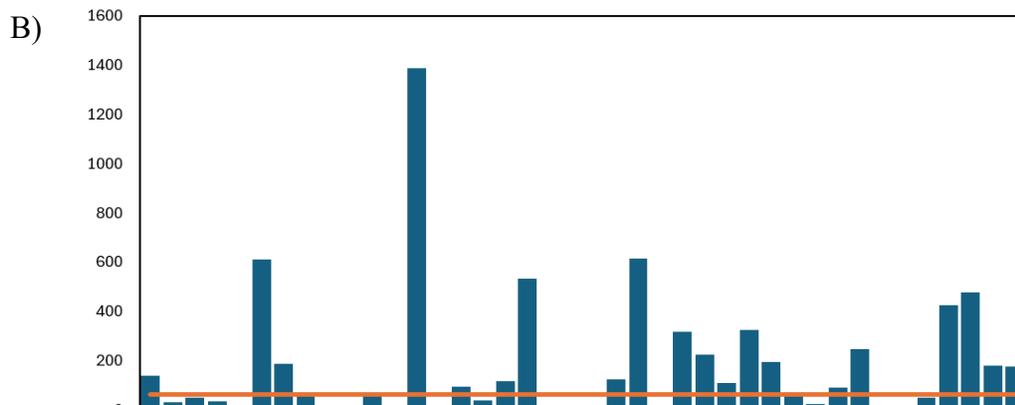
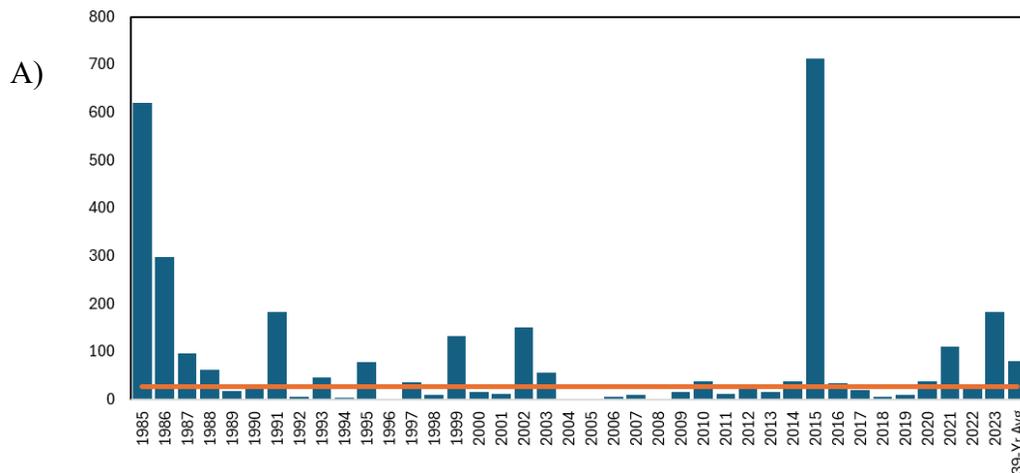


Figure 33. Number of spat per bushel from 1985-2023 at two oyster bars in the St. Mary’s River: A) Chicken Cock and B) Pagan. Orange lines represent the median number of spat per bushel (data from Tarnowski, 2024)

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APPENDIX A

Monitoring Oyster Recruitment in Breton Bay

INTRODUCTION

The State of Maryland designated Breton Bay an oyster sanctuary in 2010. 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. Despite this, the local community continues to strongly support restoration efforts in Breton Bay.

The Friends of St. Clements Bay and the St. Mary's River Watershed Association (SMRWA) have planted over 4.5 million oysters at Lover's Point (Figure A1). These 4.5 million oysters include oysters from the Friends of St. Clements Bay (FSCB)'s Marylanders Grow Oysters program, which has been ongoing since 2017, and 200 bushels of spat-on-shell planted by SMRWA, FSCB, partners, and volunteers each year for the past four years.



Figure A1. Map of Breton Bay depicting Lovers Point study site coordinates: 38.26384°N, -76.64951°W.

METHODS

In 2022, SMRWA added an additional oyster recruitment study site in Breton Bay at the Lover's Point oyster restoration site (Figure A1). The cages were deployed on May 22, 2025, and retrieved on September 10, 2025, following the same methods as in the St. Mary's River; however, monthly water quality was not measured in Breton Bay. Spat were counted in accordance with the procedures in the St. Mary's River.

RESULTS

Natural spatfall was observed for the first time in 2023, and no spatfall was observed in 2024. In 2025, natural spatfall was observed for the second time at the Lover's Point site (Photo A1; Photo A2). One live spat and fifteen spat scars were found on shell across four study traps, representing 93.8 % mortality. The majority (68.8 %) of spat were over 25 mm. The remaining 16.1 % of spat fell into the intermediate size class (11-25 mm), and none fell into the smallest size class (0-10 mm). A variety of other organisms also settled on shell in Breton Bay, such as barnacles and mussels.



Photo A1. Live spat from Breton Bay.



Photo A2. Spat scars from Breton Bay.

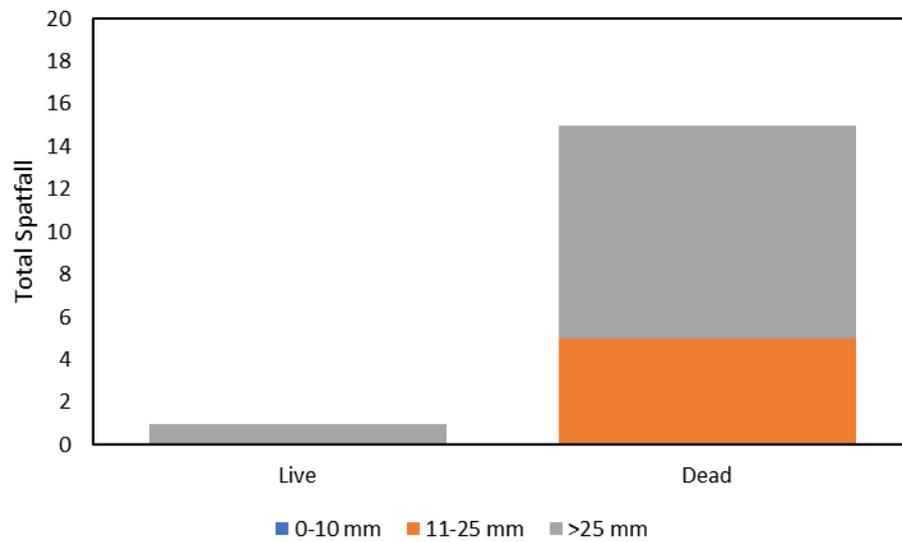


Figure A2. Comparison of Breton Bay spatfall by size groupings in 2025.

CONCLUSIONS

Observing spatfall for the second time in Breton Bay provides important evidence for the success of its oyster population and recent restoration efforts. Although mortality was high at 93.8 %, it was comparable to rates in the St. Mary’s River. The absence of small spat indicates that oysters likely spawned earlier in the season. A highly intermittent spawning pattern has been typical of Breton Bay in recent years—between 2003 and 2015, spatfall was detected in only 2010 and 2015 (MD DNR, 2016)—so it is encouraging to document oyster reproduction twice in three years. The recruitment of spat again in 2025 represents progress towards restoration goals and indicates that oysters in Breton Bay are capable of both survival and reproduction. We hope to further this progress and continue to plant and monitor the population at this site in 2026.

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