2024 Oyster 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 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 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" (wire cages with 120 oyster shells each) were placed at each of these study sites in May and retrieved in October. As we have done in past years (2019 - 2023), 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 November. Then, we compared the 2024 spatfall and water quality to prior years.

The total number of spat collected in 2024 in the St. Mary's River traps was 6,310 - a decrease from the 2023 count of 14,696 spat. Total spatfall decreased at all sites; two study sites had over 1,000 spat, and four had under 100 spat. Seminary, a site within the St. Mary's River shellfish sanctuary, had the highest total spatfall of all the sites, while Sedge Point had the lowest. The spatfall and water quality results from 2024 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 1% 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).

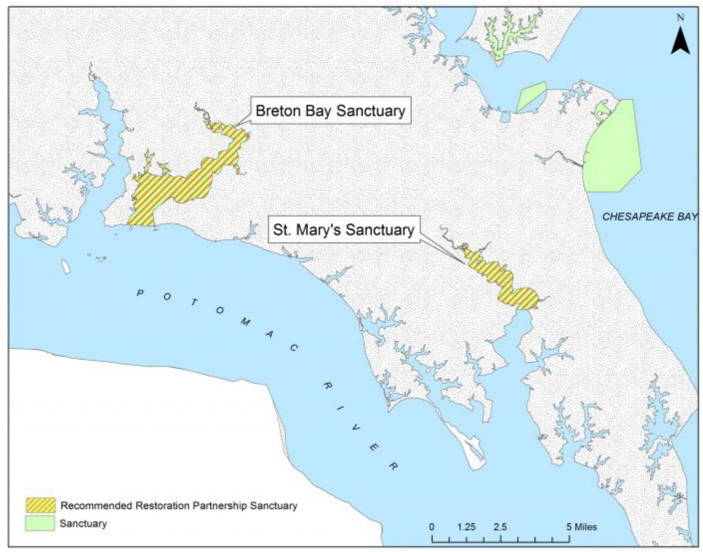

Figure 1. Map of Breton Bay and St. Mary's River shellfish sanctuaries as of 2017 (Source: MD DNR, 2017).

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 (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. 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 of 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. This first phase restored 25 acres of oyster reef. Of the 25 acres restored, 9 acres were constructed with stone, followed by seeding with 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 immensely successful, with water clarity and quality noticeably enhanced compared to ten years earlier. Scientific monitoring by St. Mary's College of Maryland (SMCM) and SMRWA confirms this reef's success (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 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 animals 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.

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 2024 Recruitment Study measured spatfall at the same twelve sites as the 2021-2023 Recruitment Studies: Bryan, Horseshoe, Seminary, Portobello, Green Pond (also known as Gravelly Run), Cooper Creek, Priest Point, Thompson, Coppage, Goad (also known as Graveyard), Sedge Point (also known as Gum Edge), and Mouth of Creek (Figure 2; Table 1). A 13^{th} study site in Breton Bay was added in 2022 and examined again this year (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° in 2022.

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	38.15192°	-76.44185°	2.9
10. Goad	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 baby oysters had previously settled and died). Shells were purchased from Shore Thing Shellfish, LLC, who had purchased them several years ago from Maryland Seafood. The shells are believed to be mostly from wild caught oysters from the St. Mary's River system and the nearby Potomac River. Prior to deployment, the shells were power washed in the traps to remove any dirt or debris. The traps were rolled over several times while power washing. At each of the twelve sites, four survey traps were placed on the river bottom and spaced approximately three meters apart (**Error! Reference source not found.**). Chain of custody forms tracked the traps throughout the project.

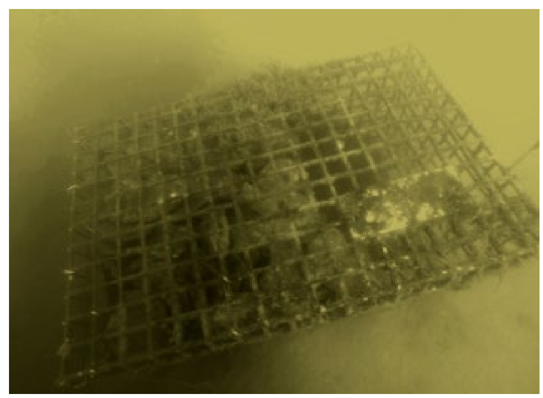

Photo 1. Underwater photo of trap deployed on river bottom.

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

DO NOT DISTURB
SCP202442
301-395-5757

The labeling indicated that the area should 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 May 30, and GPS coordinates were recorded for the central location of each deployment at the twelve sites. Traps were checked monthly, and water quality readings were taken at nine sites on May 1, at all sites on May 31, July 2, July 16, August 1, August 29, October 2, and October 31, and at three sites on June 16. 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 monthly sampling of the twelve sites. Standardized field log sheets were used to record data, and a second set of eyes verified the datum entered for each parameter.

Traps were retrieved on October 24, 25, 28, and 29. Upon collection, each trap was labeled 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.

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 counters included Meredith Nishiura, Emma Green Ewing, Norm O'Foran, Shelly O'Foran, Lani O'Foran, Sarah Luersen, Mike Angel, Fred Millhiser, Dave Lewis, Bob Paul, Jake Stergio, Megan Sheppard, Joel Galarzalsa, Isa Harris, and Evelyn Rolle. All volunteer counters were trained, and, in all cases, an inexperienced counter was paired with an experienced counter. Spat counting occurred on October 26 and November 7, 9, 11, 14, 17, and 18.

Please 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 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. In some years, the breeding season lingers 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

Total Spatfall

In 2024, there was a 57.1 % decrease in oyster recruitment compared to 2023 (2023: 14,696 spat; 2024: 6,310 spat) and a 63.1 % decrease compared to 2022 (17,111 spat). 2022 had the highest spatfall recorded in this study. Spatfall in 2024 was also lower than the spatfall in 2021 (9,001 spat).

In 2024, all study sites experienced a decrease in spatfall from 2023, ranging from Seminary with a 4.2 % decrease to Bryan with an 89.9 % decrease. The trend of higher recruitment in or near the sanctuary observed in previous years remains generally consistent in 2024 (Figure 3).

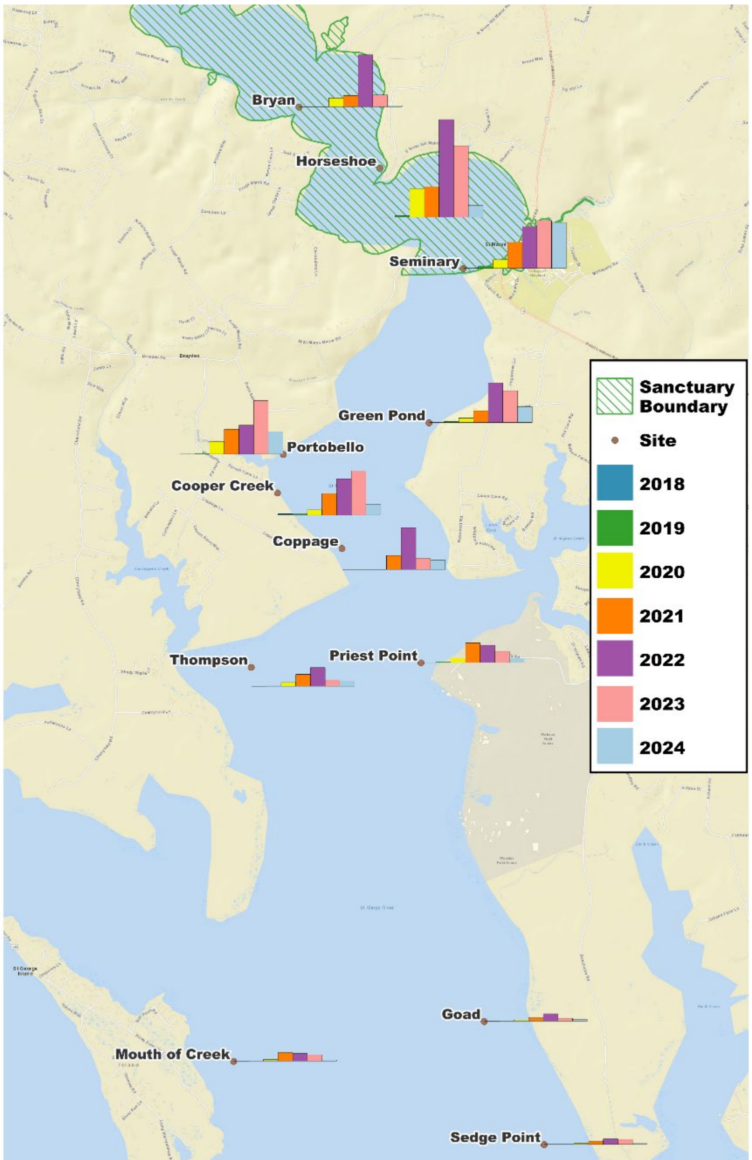

Figure 3. Locations of the 12 study sites with total spatfall for each year that the study was conducted at a given site. The map also includes the boundary of the St. Mary's River Shellfish Sanctuary.

When excluding sites that were not measured during 2018–2020, the total spatfall in 2024 exceeded the totals recorded during those earlier years. In 2020, Coppage was not included in the study, and the adjusted total spatfall in 2024 (excluding spatfall at Coppage) was 5,835, significantly higher than the 3,859 recorded in 2020. In 2019, Coppage and Sedge Point were not included, and adjusting for their absence, the total spatfall in 2024 was 5,796, compared to just 416 in 2019. In 2018, Green Pond and Cooper Creek had spatfalls of only 18 and 63, respectively, but by 2024, these sites showed increases, with Green Pond reaching 756 spat and Coppage 522 spat. Therefore, the decrease in spatfall from 2023 to 2024 does not represent a return to levels before State of Maryland's large-scale oyster restoration efforts in 2021 and 2022.

Photo 2. Blue crab found in cage in fall 2024.

Identifying the causes of a change in oyster recruitment can be difficult because there are many elements that interact to influence oyster reproduction (Kimmel & Newell, 2007). The total spatfall decrease from 2023 to 2024 is likely due to a combination of such factors. According to the Maryland Department of Natural Resources (MD DNR) 2023 Oyster Stock Assessment, as of 2023, the St. Mary's River is one of only two NOAA codes in the Chesapeake Bay where harvesting has exceeded the upper sustainability limit for four or more consecutive seasons. These unsustainable practices could have depleted the reproductive population and decreased spatfall. Although the data for 2024 have not yet been published, oyster populations can take years to respond to changing stressors, so overharvesting could continue to harm the population even if harvest pressures were reduced in 2024 (Austin et al., 1996).

Additionally, the St. Mary's River experienced some of the lowest dissolved oxygen levels recorded over the course of this study at the beginning of the summer, particularly in the months of June and July, which could have interfered with oyster spawning. Similarly, salinity was lower at the beginning of summer 2024 than in 2023, and oysters do not set on shell reliably unless the salinity is 9 ppt or above, with higher salinities producing better results (Webster et al., 2019). However, the exact effects of water quality on spatfall are unclear, and water quality has not been a reliable predictor of recruitment in this study. For example, although the 2024 salinity was lower than in 2023, it was similar to the salinity in 2022, the year with the highest recorded spatfall.

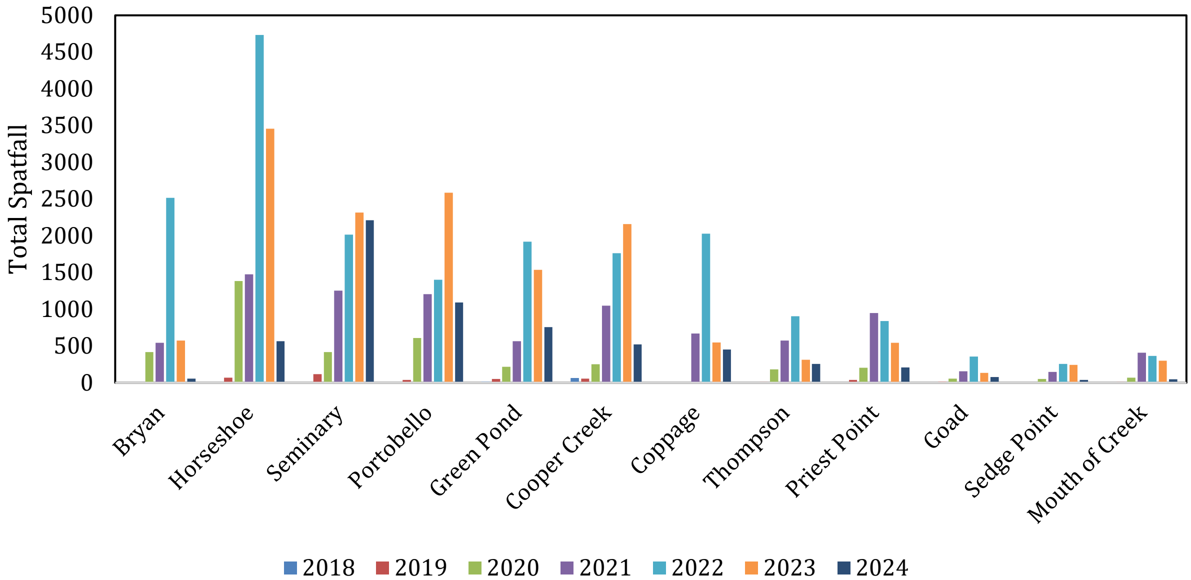

Figure 4. Comparison of total spatfall counts from 2018 to 2024. All sites had lower counts in 2024 than the previous year 2023. Note: Not all sites were included in the study from 2018 to 2020.

<u>Mortality</u>

When data were aggregated for all sites in 2024, 87.6 % of spat were live and 12.4 % were boxed. All study sites except for Sedge Point and Priest Point ranged from 7.8 % to 26.3 % mortality (Figure 5). *Stylochus* were noted several times during the counting process although their observed abundance was not different from previous years. The highest mortality rates were observed at Priest Point (46.4 %) and Sedge Point (48.7 %). High mortality at these sites could be attributable to the presence of large blue crabs in the cages, which had presumably entered at a smaller size and subsequently inhabited the cages after growing too large to escape (Photo 2). It is possible that the blue crabs used the spat as a food source. Upon retrieval, three cages from Priest Point and two cages from Sedge Point contained large blue crabs.

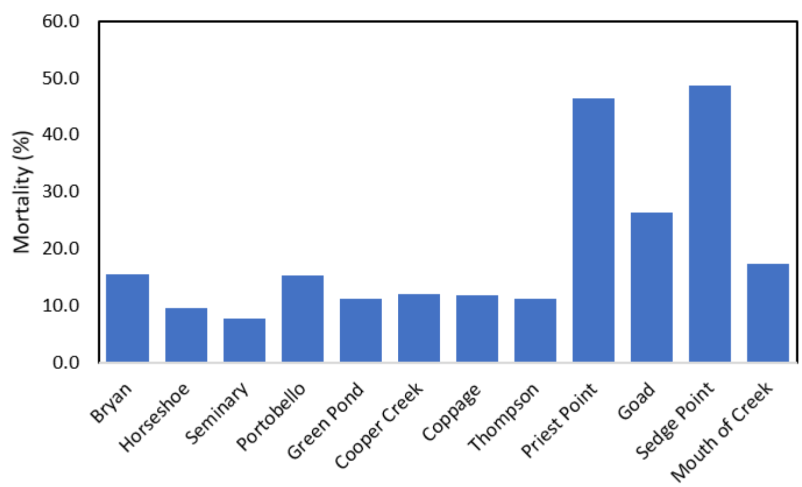

Figure 5. Percent mortality for each site in 2024. Mortality (%) was calculated by dividing the number of boxed spat by the total spatfall at the site.

The rest of the study sites had similar mortality rates. Bryan, the site that experienced the lowest dissolved oxygen, did not experience high levels of mortality. Sedge Point also had low dissolved oxygen at the July sampling, which could have contributed to its high mortality rate.

Spatfall by Size

Of the total spatfall by size, 7.7 % were 10 mm or less, 28.6 % were 11-25 mm, and 63.8 % were above 25 mm. Of the total live spatfall, the majority (69.4 %) were greater than 25 mm. The intermediate size class (11-25 mm) accounted for 26.3 % of the total live spat while 4.3 % 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, 31.4 % were less than 10 mm, 44.7 % were 11-25 mm, and only 23.8 % were over 25 mm. Most boxed spat (76.1 %) 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. Similar to other areas of the Chesapeake Bay, the spawn likely began in June and continued through July or August in localized areas. Several very small spat (under 5mm) were observed, suggesting a minimal late September-October spawn did occur.

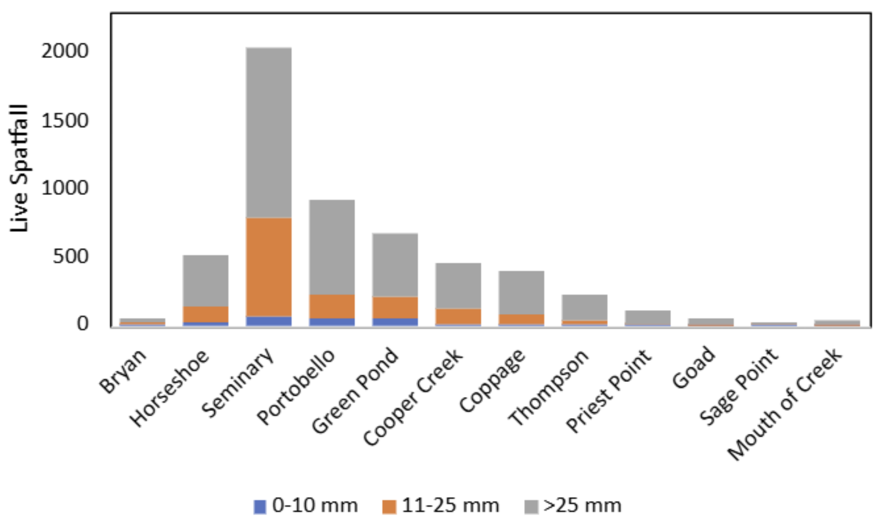

Figure 6. Comparison of live spatfall by size groupings in 2024.

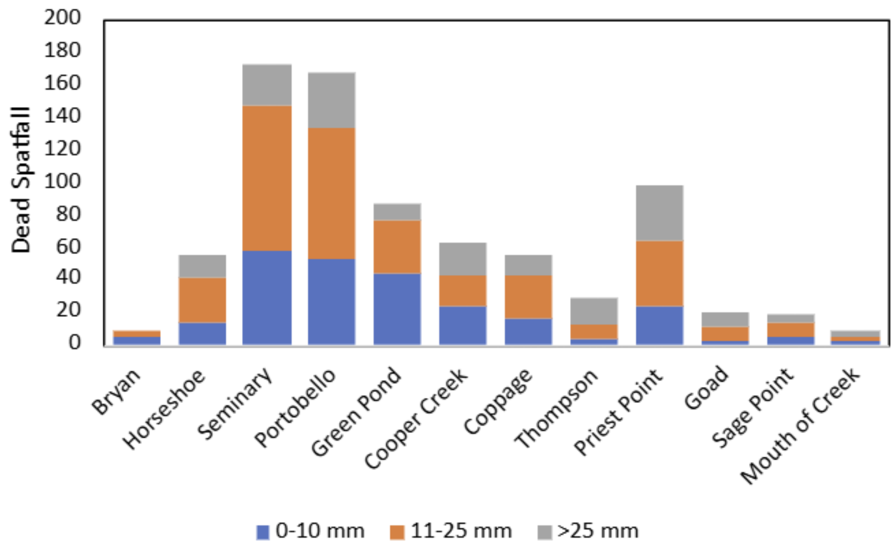

Figure 7. Comparison of box spatfall by size groupings in 2024.

Water Quality

Salinity in the St. Mary's River in 2024 represented a return to more typical levels from the unusual high in 2023. For example, the mean salinity across all study sites in June 2024 was an average of 2.95 ppt lower than in June 2023 (2023: 12.25 ppt; 2024: 9.30 ppt). However, this decrease in salinity does not reflect precipitation; rainfall was lower in 2024 than in 2023 in June, July, September, and October and nearly identical in August (Des Moines Register, n.d.). Additionally, although St. Mary's County did not experience a drought as sustained or intense as that of 2023 in summer 2024, it did experience drought for four weeks and abnormally dry conditions for 21 weeks of the approximately 23-week period during which cages were in the water (U.S. Drought Monitor, 2024). Nonetheless, salinity readings this year more closely resemble those measured in 2022 despite having generally lower precipitation (Des Moines Register, n.d.). For all sites, salinity was lowest in June (average salinity: 9.3 ppt) and increased an average of approximately one ppt each month between June and October (average October salinity: 13.1 ppt). Average salinity increased 3.6 ppt between October and November as drought conditions in the county spread at the end of October (U.S. Drought Monitor, 2024). In 2024, the highest bottom water salinities recorded were at Cooper's Creek and Thompson in November; both salinity readings were 16.9 ppt. The lowest salinity recorded was 8.1 ppt at Bryan in June.

Dissolved oxygen (mg/L) at the river bottom was generally lower in 2024 than in previous years, particularly at the beginning of the summer. High average bottom dissolved oxygen in May (10.55 mg/L across nine study sites) decreased sharply in June (6.06 mg/L across 12 study sites), and average dissolved oxygen remained lower than the May readings for the duration of the summer. In 2024, mean dissolved oxygen across all study sites was typically lower than in 2023: 1.37 mg/L lower in June (2023: 7.43 mg/L; 2024: 6.06 mg/L) and 2.61 mg/L lower in July (2023: 8.10 mg/L; 2024: 5.49 mg/L). September and November were the only months where dissolved oxygen was higher in 2024 than in 2023. Two sites experienced their lowest bottom dissolved oxygen in June, and five sites experienced their lowest bottom dissolved oxygen in July. The other five sites experienced their lowest dissolved oxygen in August or September, a pattern more typical of previous years. Near hypoxic conditions were observed at two sites: Sedge Point on July 2 with 3.27 mg/L and Bryan on July 16, August 1, and August 29, with readings of 2.30 mg/L, 3.11 mg/L, and 2.86 mg/L, respectively. At both Sedge Point and Bryan, dissolved oxygen returned to pre-event levels the following month; Bryan was the only site where unusually low dissolved oxygen was measured for two consecutive months.

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 Seminary and Cooper's Creek in June, Green Pond, Sedge Point, and Goad in July, and Bryan in mid-July, August, and September. Dissolved oxygen during the time between water quality readings is unknown.

Bottom water temperatures (°C) were slightly higher in 2024 than in 2023. From June to November, the temperature was an average of 1.35 °C higher in 2024 than in 2023 and ranged from 0.43 °C higher in August to 2.18 °C higher in October. The highest temperature was 29.5 °C at Seminary on August 1, and the lowest temperature was 17.7 °C at Priest Point and Mouth of Creek on October 31.

SELECTED STUDY SITE OBSERVATIONS

In 2024, spatfall decreased at all twelve sites, continuing the general decrease in spatfall following 2022 (Figure 4). When oyster density was surveyed in 2019, the five sites in the lowest part of the tidal river (Thompson, Priest Point, Goad, 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 had the largest percent decrease in spatfall from 2023 at 89.9 %, with 58 total spat (Photo 3; Figure 8). Mortality at Bryan (15.5 %) was close to the mean mortality of 12.4 % (Figure 5). We observed several polychaete tube casings on shells at Bryan (Photo 4). Although the exact species of polychaete is unknown, other species, such as *Polydora cornuta*, can develop large colonies with the ability to reduce water flow within cages (Hood et al., 2020). It is possible that these polychaetes lowered spatfall at Bryan by reducing water flow or competing with spat for substrate. Bryan also experienced at least two low dissolved oxygen events in August and September, which could have lowered spatfall.

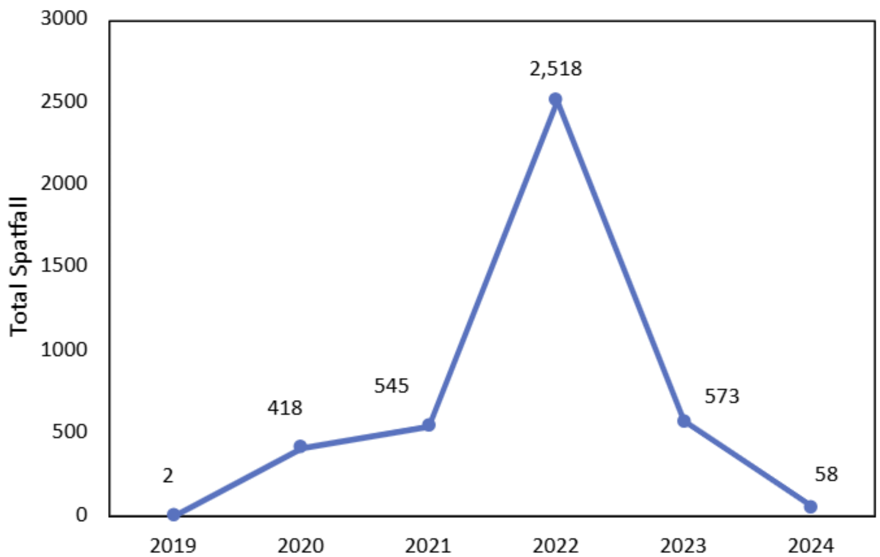

Figure 8. Total spatfall from 2019 to 2024 at Bryan.

Salinity (parts per thousand [ppt]) and temperature (°C) at Bryan were similar in 2024 to previous years (Figure 9; Figure 10). Dissolved oxygen (mg/L) was lowest in August and September and increased in November (Figure 11).

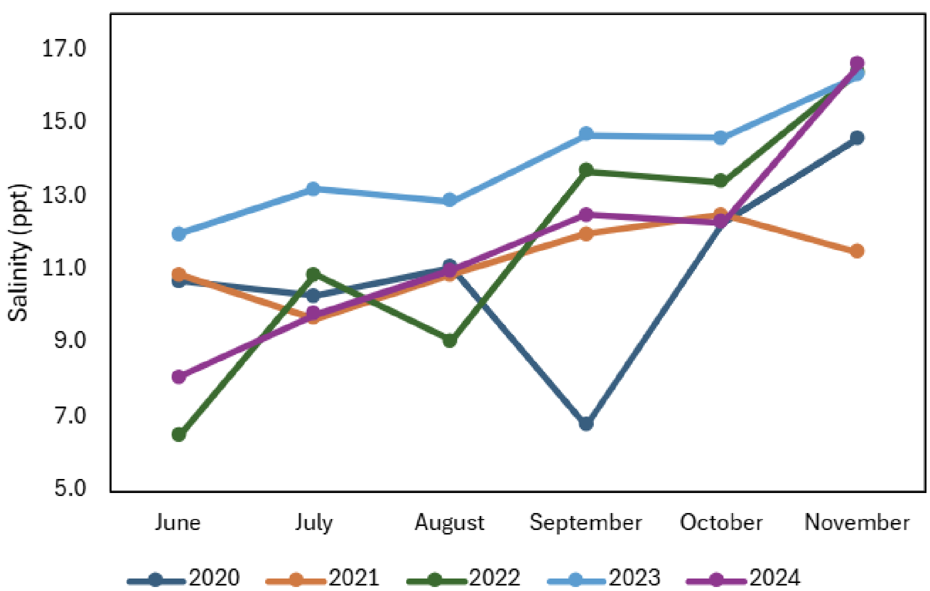

Figure 9. Bottom salinity (parts per thousand [ppt]) measurements from June-November 2020-2024 at Bryan.

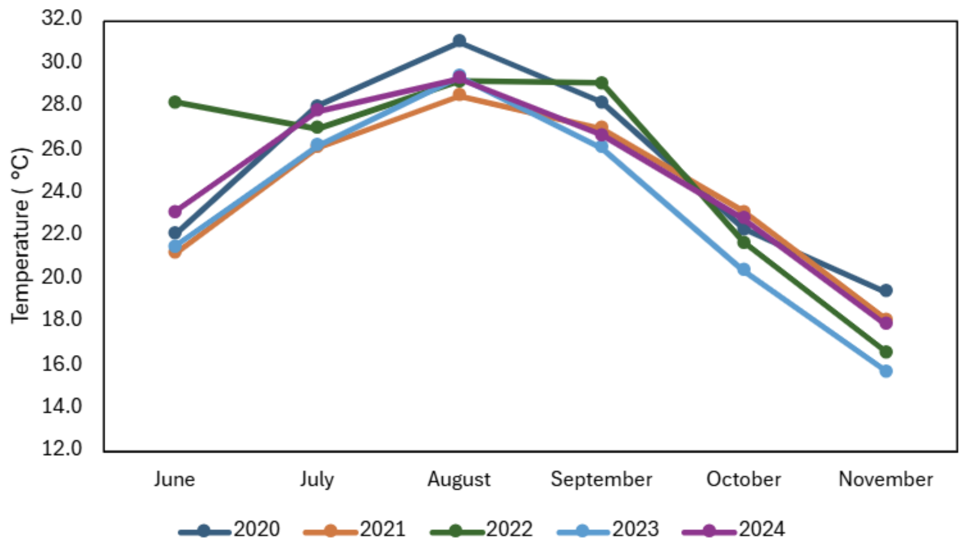

Figure 10. Bottom temperature (°C) measurements from June-November 2020-2024 at Bryan.

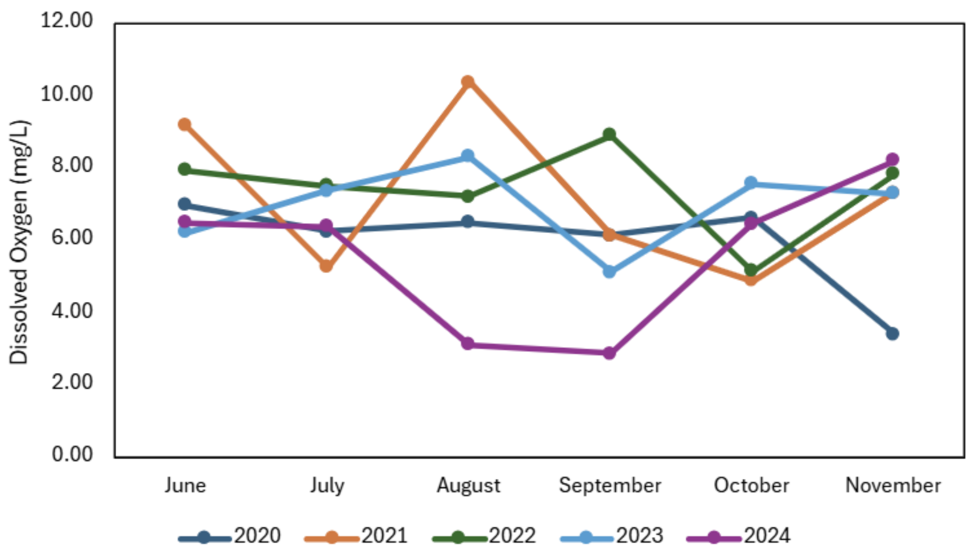

Figure 11. Bottom dissolved oxygen levels (mg/L) from June-November 2020-2024 at Bryan.

Photo 3. Spat on shell at Bryan.

Photo 4. Shell with worm casings at Bryan.

Horseshoe

Horseshoe had the second largest decrease in spatfall from 2023 at 83.5 %, with 569 total spat in 2024 (Photo 5; Figure 12). It declined from the highest spatfall in 2023 to the fourth highest spatfall in 2024. It had the second lowest mortality at 9.7 % (Figure 5).

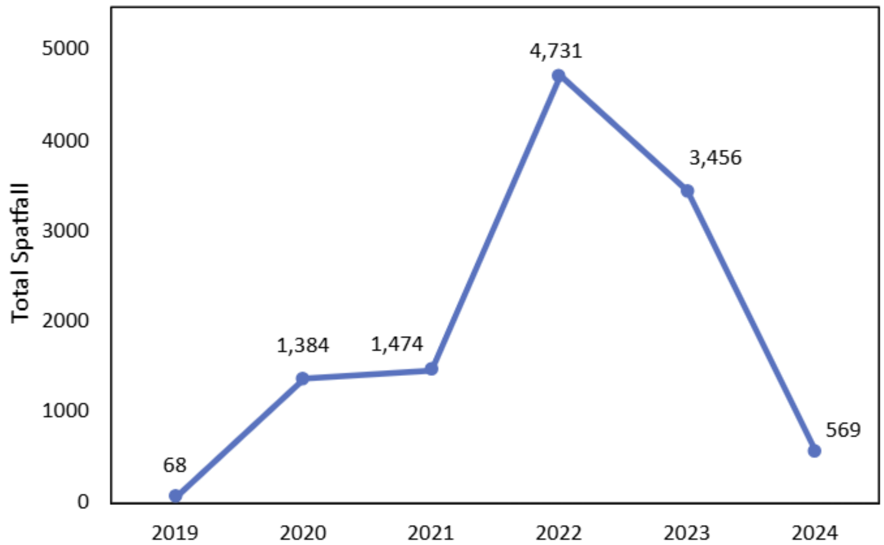

Figure 12. Total spatfall for 2019-2024 at Horseshoe.

Dissolved oxygen (mg/L) at Horseshoe was lowest in July and August (Figure 13). Temperature (°C) remained fairly consistent with previous years from June through November (Figure 14). Salinity (ppt) was similar to previous years (Figure 15).

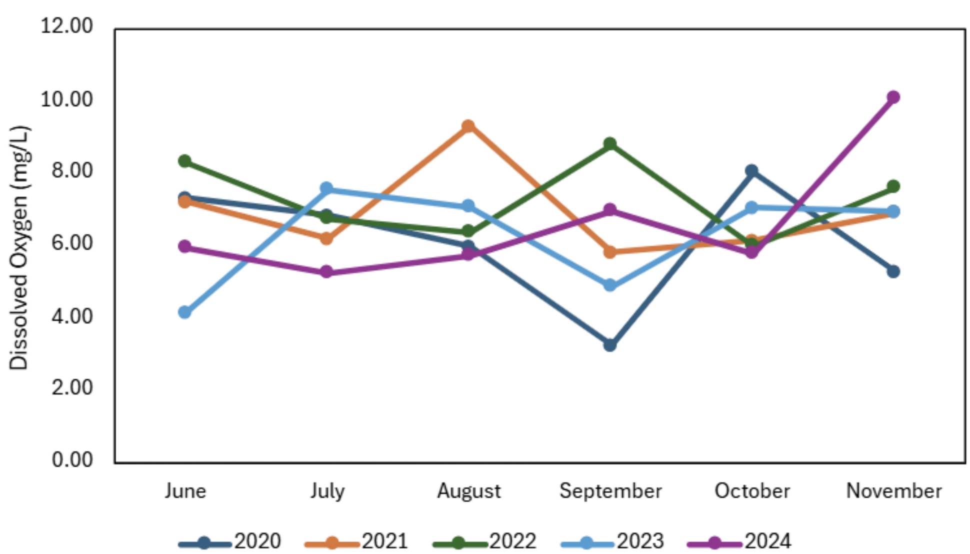

Figure 13. Bottom dissolved oxygen (mg/L) from June to November of 2020-2023 at Horseshoe.

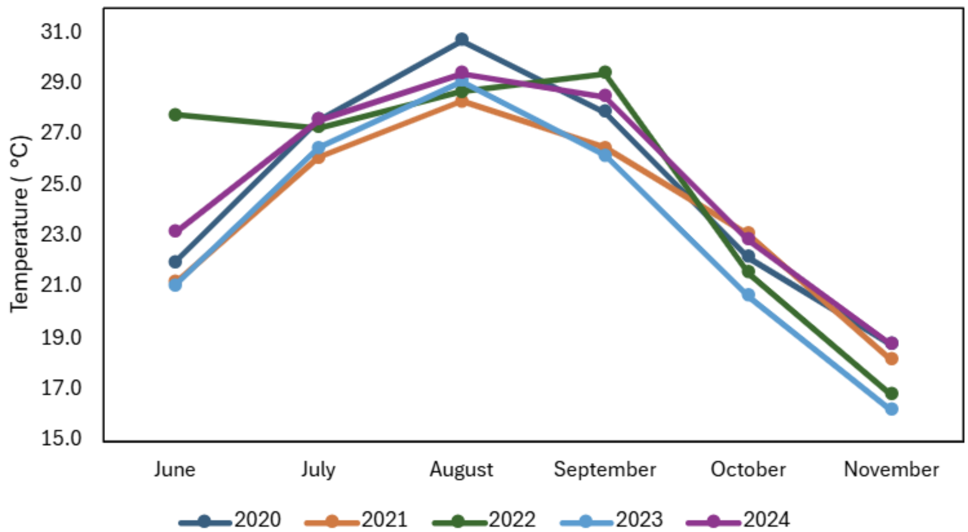

Figure 14. Bottom temperature (°C) measurements from June-November 2020-2024 at Horseshoe.

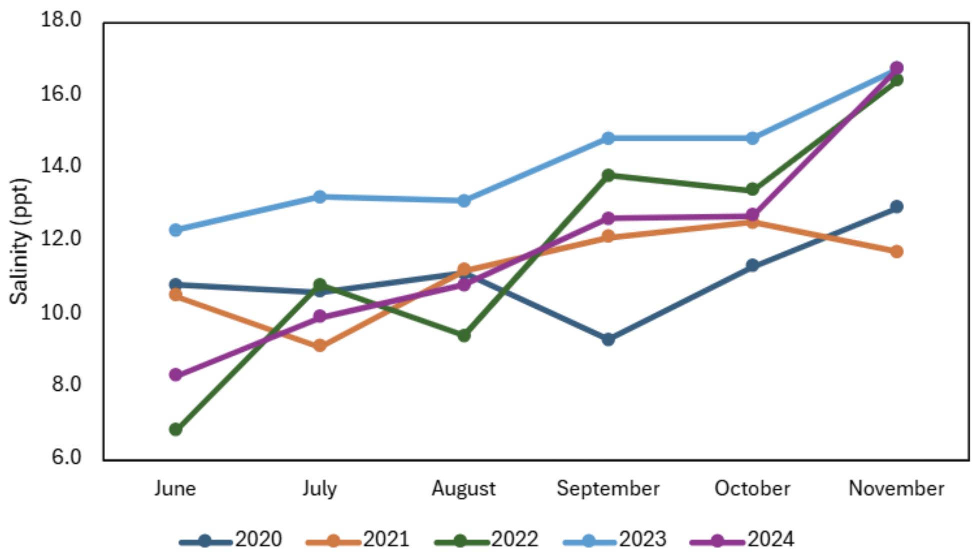

Figure 15. Bottom salinity (ppt) measurements from June-November 2020-2024 at Horseshoe.

Photo 5. Subset of representative spat on shell at Horseshoe.

Portobello

Portobello had a total spatfall decrease of 57.7 %, with a total of 1,093 spat in 2024 (Photo 6; Figure 16). However, it had the second highest spatfall among all the study sites. Portobello had a mortality rate of 15.3 %, close to the mean of 12.4 % (Figure 5).

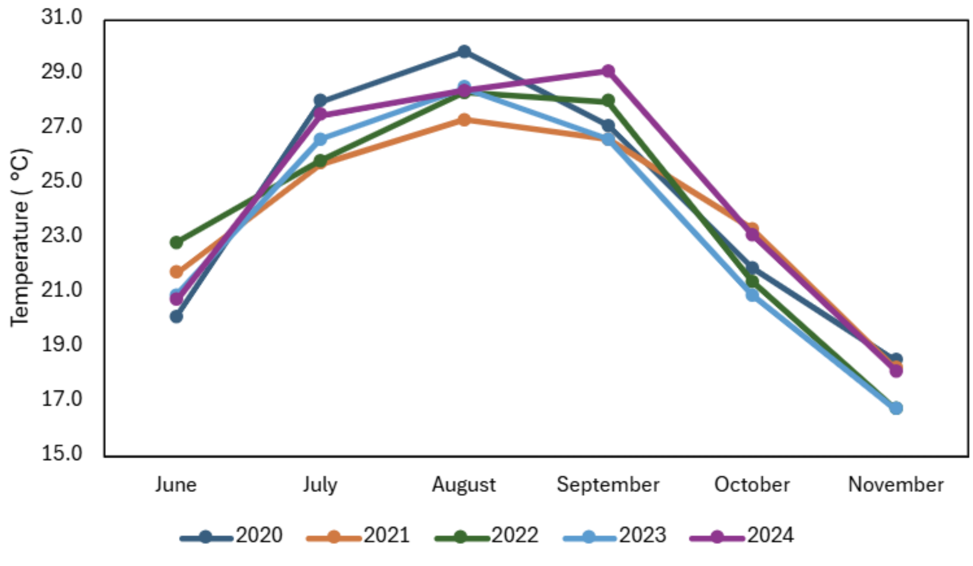

Figure 17. Bottom temperature (°C) measurements from June-November 2020-2024 at Portobello.

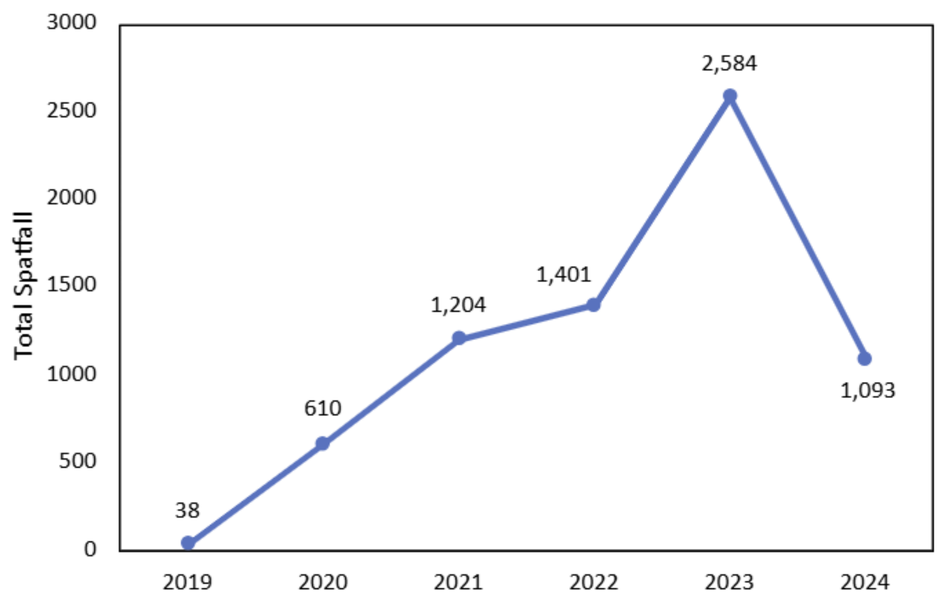

Figure 16. Total spatfall for 2019-2024 at Portobello.

Temperature (°C) at Portobello was consistent with previous years (Figure 17). Dissolved oxygen (mg/L) remained above 5.00 mg/L for all measurements in June through November but was lower at the beginning of the summer (Figure 18). Salinity (ppt) was similar to previous years (Figure 19).

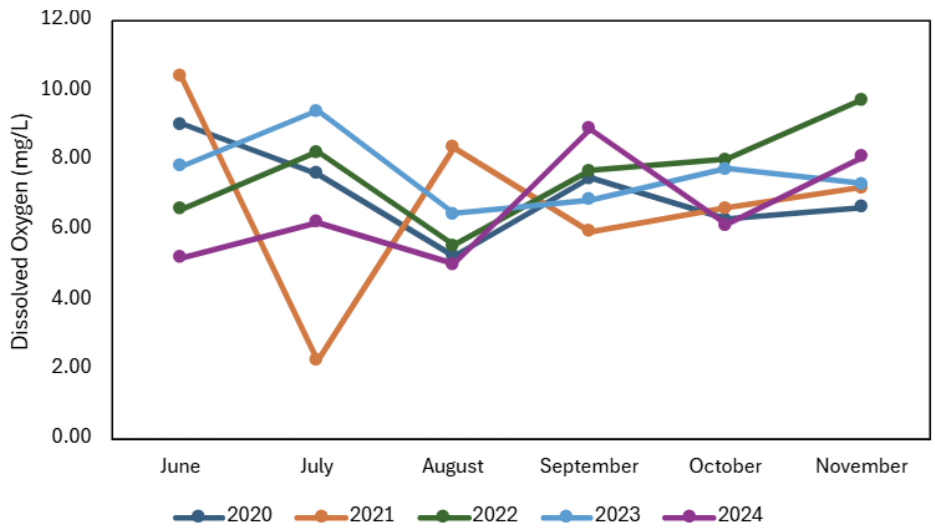

Figure 18. Bottom dissolved oxygen levels (mg/L) from June-November 2020-2024 at Portobello

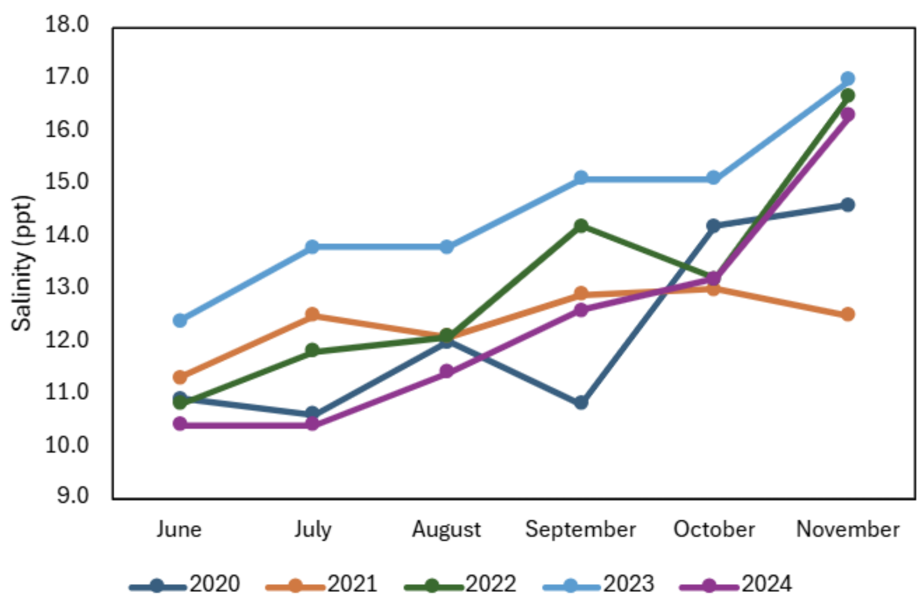

Figure 19. Bottom salinity (parts per thousand [ppt]) measurements from June-November 2020-2023 at Portobello.

Photo 6. Subset of representative spat on shell at Portobello.

<u>Coppage</u>

Coppage had a 17.3 % decrease in spatfall from 2023, with a total of 454 spat (Photo 7; Figure 20). The mortality at Coppage was 11.9 % (Figure 5). The data for total spatfall in 2020 are unavailable because traps were lost that year.

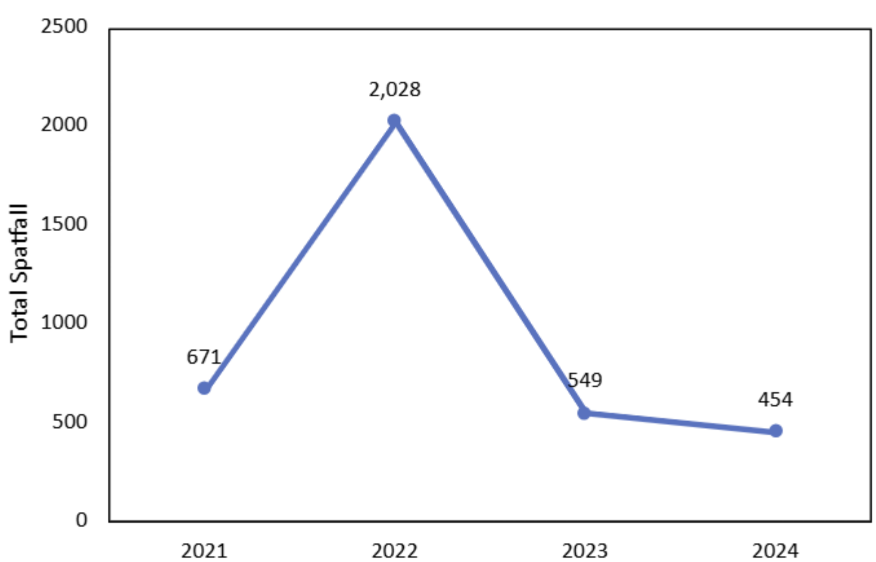

Figure 20. Total spatfall for 2021-2024 at Coppage (data from 2020 are unavailable).

Dissolved oxygen (mg/L) remained above 5.00 mg/L at each monthly reading (Figure 21), and temperature (°C) was consistent with previous years (Figure 22). Salinity (ppt) at Coppage in 2024 was slightly lower than in most past study years (Figure 23).

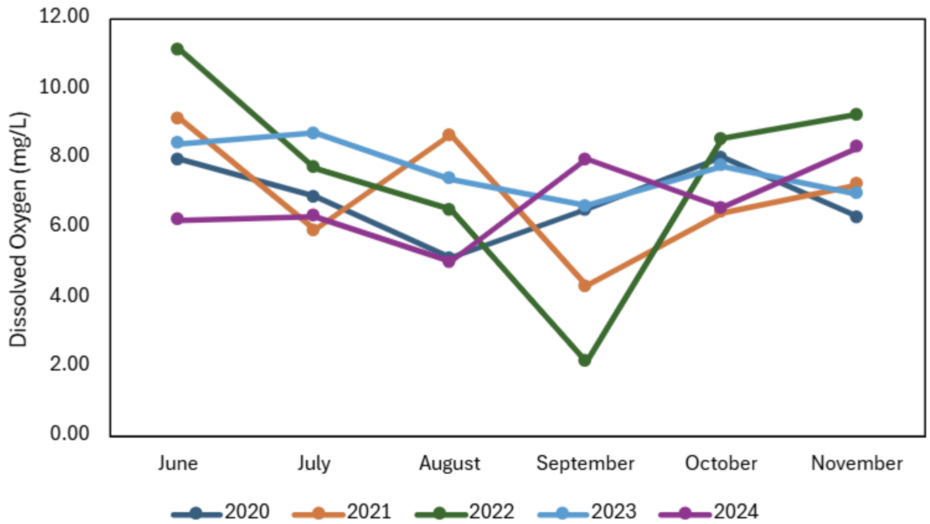

Figure 21. Bottom dissolved oxygen levels (mg/L) from June-November 2020-2024 at Coppage.

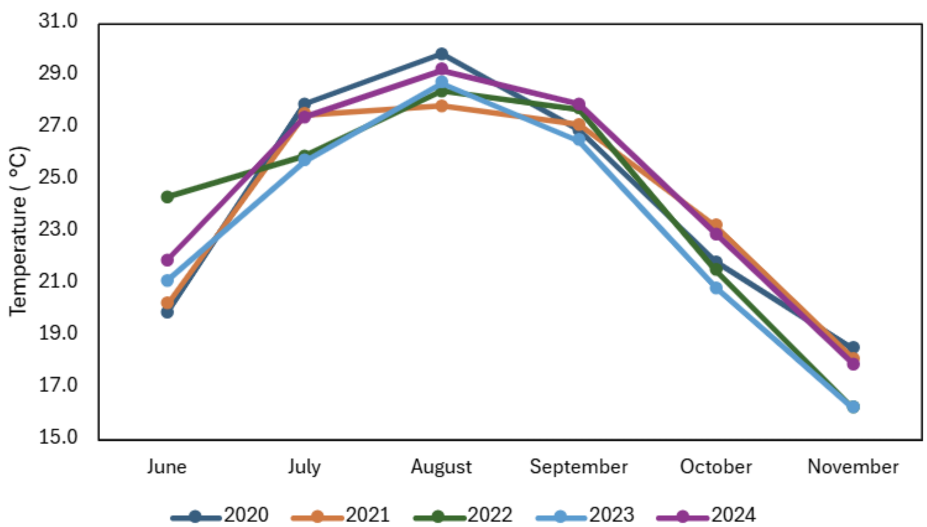

Figure 22. Bottom temperature (°C) measurements from June-November 2020-2024 at Coppage.

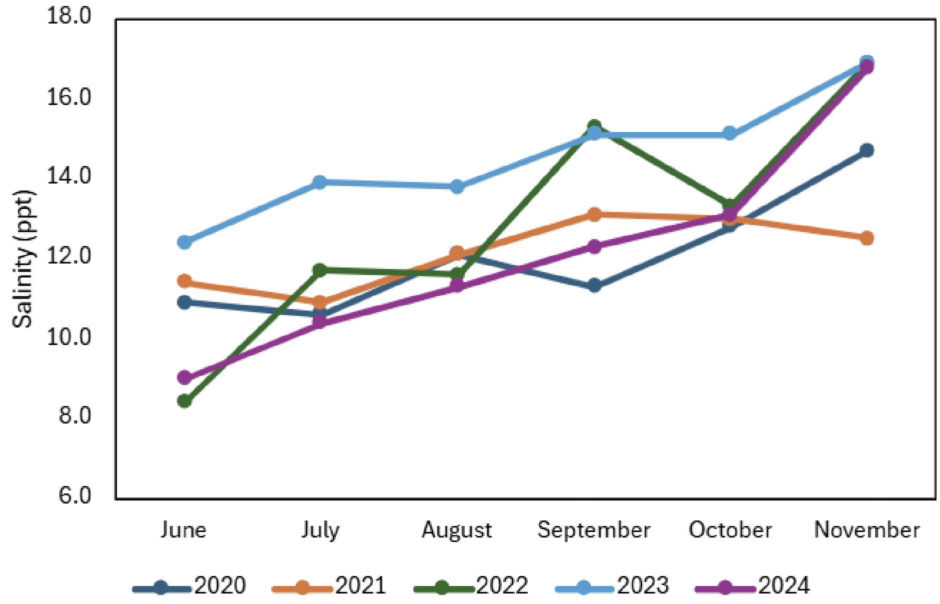

Figure 23. Bottom salinity (ppt) measurements from June-November 2020-2024 at Coppage.

Photo 7. Subset of representative spat on shell at Coppage.

Mouth of Creek

Spatfall at Mouth of Creek decreased by 84.6 %, the second largest decrease. The total spatfall was 46 (**Error! Reference source not found.**; Figure 24), which is the second-lowest total spatfall at any site in 2024 (Figure 4). Mortality was the fourth highest among the study sites at 17.4 % (Figure 5).

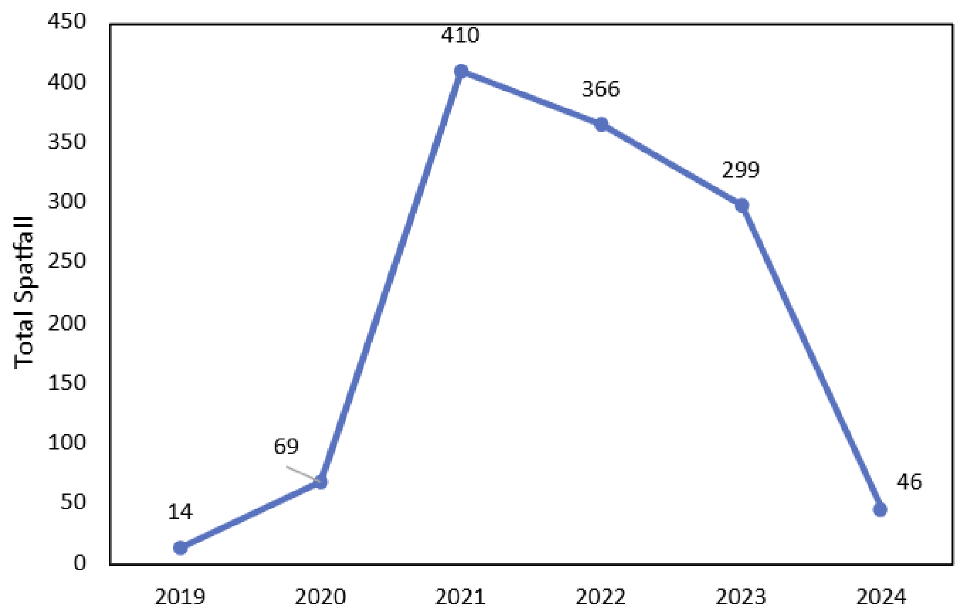

Figure 24. Total spatfall for 2019-2024 at Mouth of Creek.

As with other sites, dissolved oxygen (mg/L) at Mouth of Creek was lower in the beginning months of the summer but remained above 5.00 mg/L at all sampling dates (Figure 25). Temperature (°C) and salinity (ppt) at Mouth of Creek were similar to previous years (Figure 27; Figure 26).

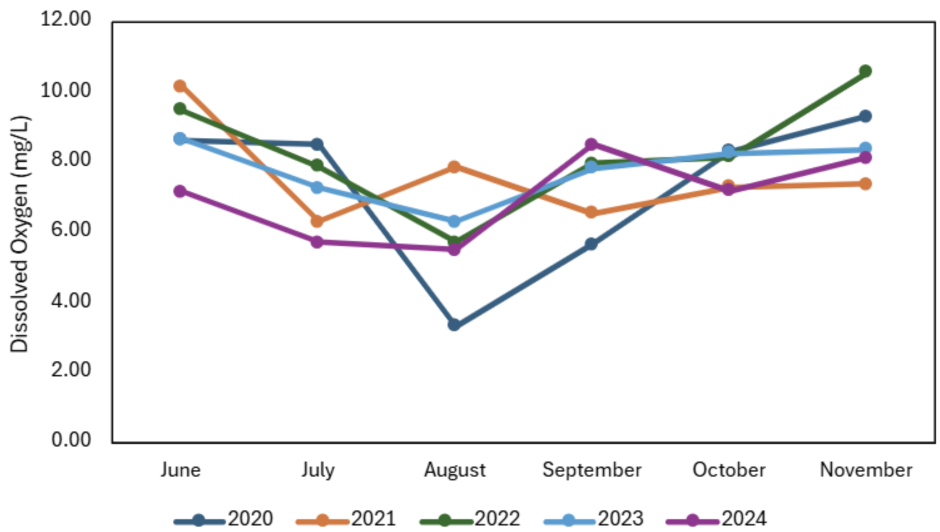

Figure 25. Bottom dissolved oxygen levels (mg/L) from June-November 2020-2024 at Mouth of Creek.

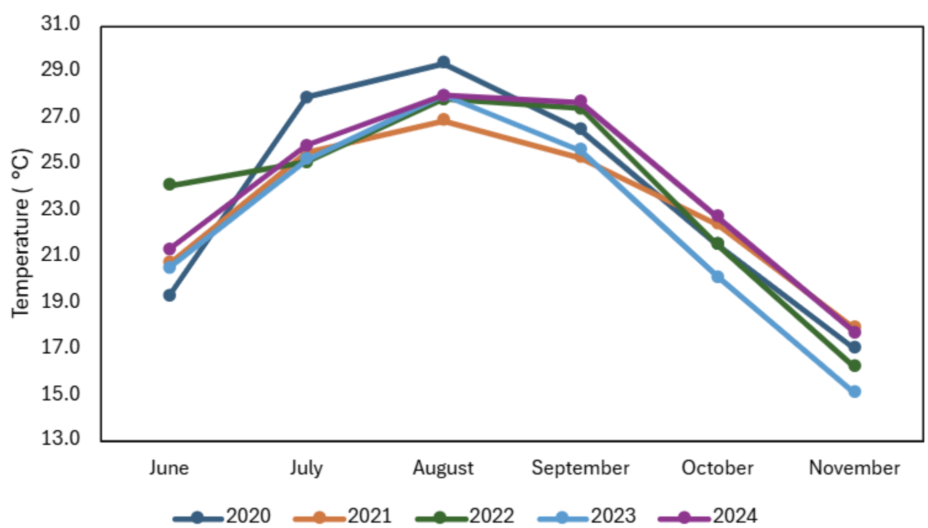

Figure 26. Bottom temperature (°C) measurements from June-November 2020-2024 at Mouth of Creek.

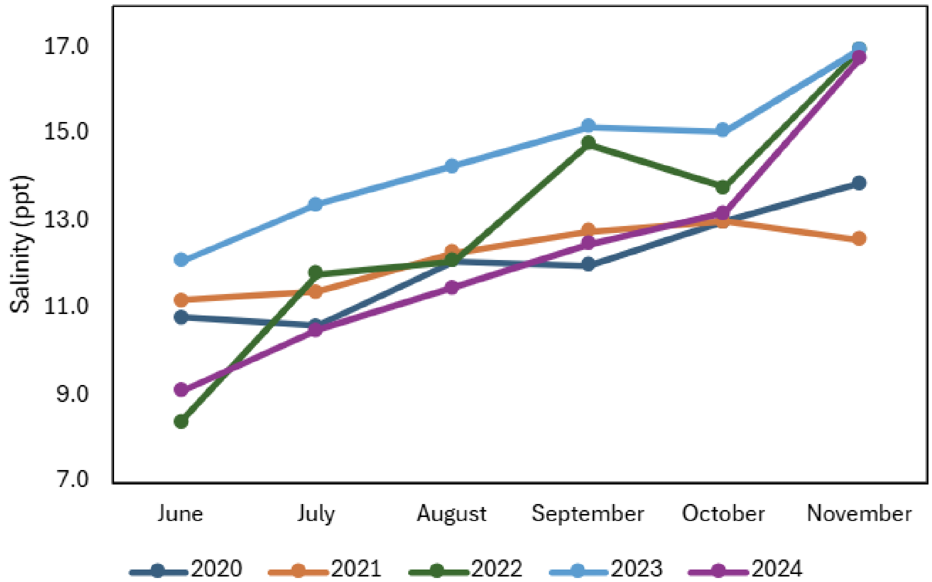

Figure 27. Bottom salinity (ppt) measurements from June-November 2020-2024 at Mouth of Creek.

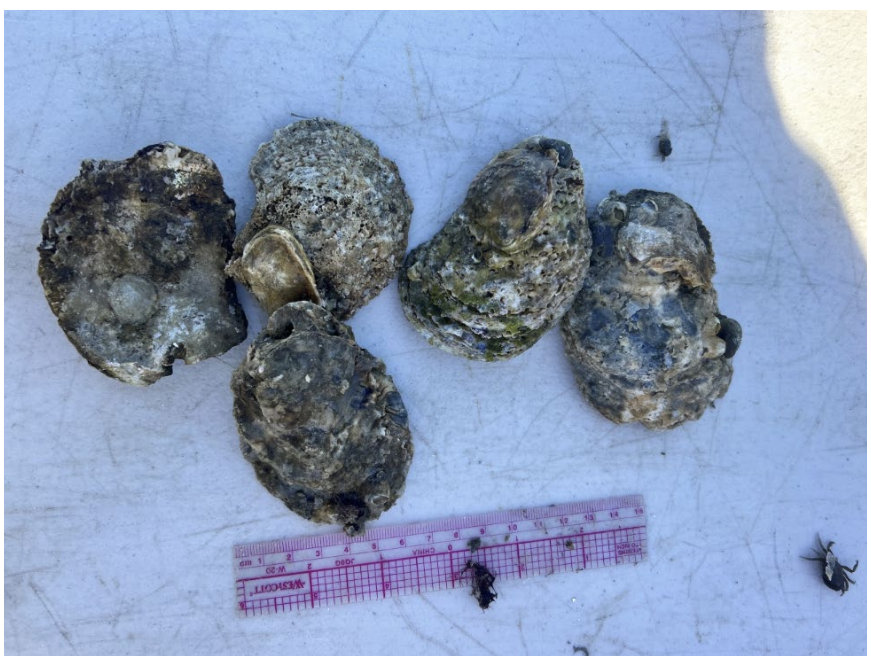

Photo 8. Subset of representative spat on shell at Mouth of Creek.

CONCLUSION

Total spatfall in the St. Mary's River in 2024 was lower than in 2021-2023 but higher than in 2018-2020 when correcting for sites excluded in the early years of the study. This decrease is potentially due to a variety of factors, such as changes in water quality and a history of overharvesting. Part of this decrease could also be caused by natural variation; spatfall in the St. Mary's River has experienced yearly fluctuations (Figure 28; Meritt & Webster, 2022). It is promising that spatfall remained higher in 2024 than in 2018-2020, despite the decrease from the previous three years. Large-scale oyster restoration began in 2021 in the Upper St. Mary's River, and those efforts may have led to the subsequent increase in spatfall.

A)

B)

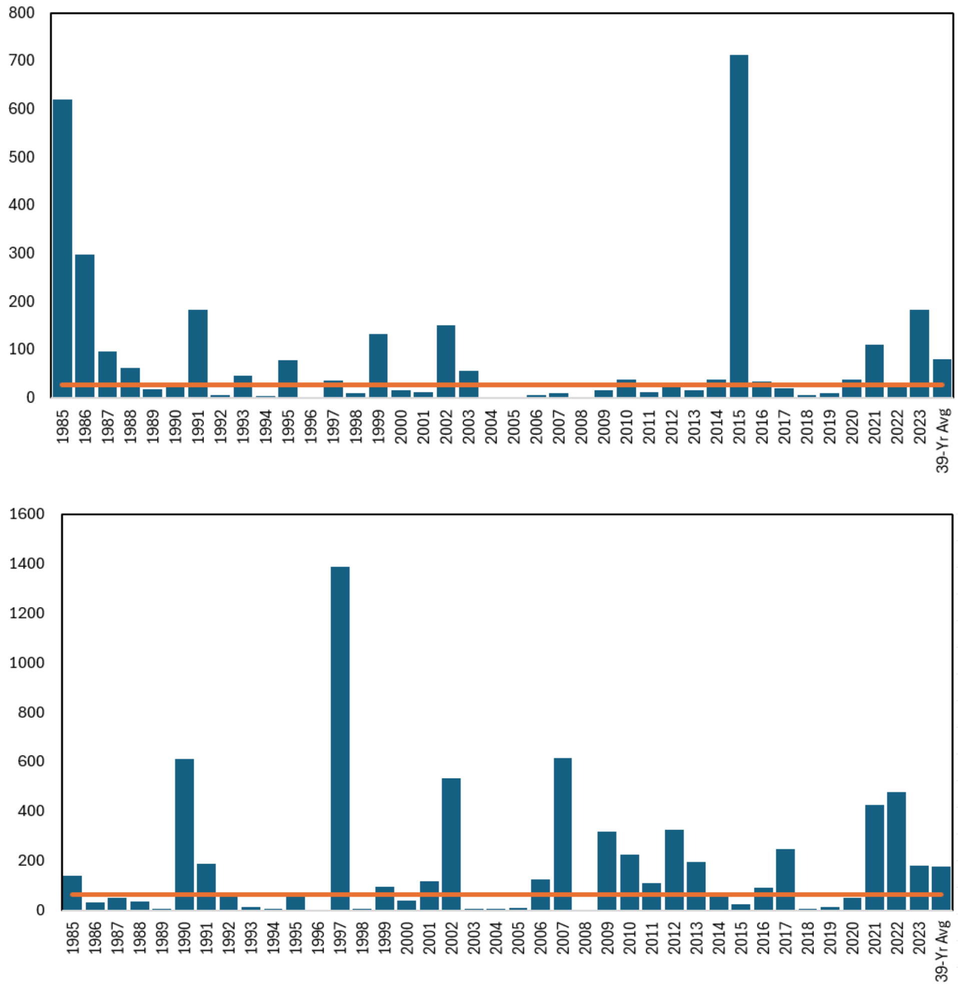

Figure 28. Number of spat per bushel from 1985-2023 at two commercially harvested oyster bars in the St. Mary's River: A) Chicken Cock and B) Pagan. Orange lines represent the median number of spat per bushel (data from the Tarnowski, 2024)

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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 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. 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 three million oysters at Lover's Point (Figure A1). The Friends of

St. Clements Bay has been planting oysters from their Marylanders Grow Oysters program each year since 2017. In 2022, these organizations, along with Shore Thing Shellfish LLC and Southern Maryland Recreational Fishing Organization, added 820,000 spat-on-shell to the Lover's Point restoration site. In September and October (2023), 250 bushels of spat-on-shell, approximately 981,157 spat, were scattered throughout areas planted in prior years. In September 2024, approximately 1.3 million additional spat were planted throughout the restoration area.

Friends of St. Clements Bay have monitored the oysters since 2018 and have observed that the oysters are surviving. Spatfall surveying at Lover's Point was launched in 2022 with four traps.

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 16, 2024, and retrieved on October 4, 2024, following the same methods as in the St. Mary's River; however, monthly water quality was not measured in Breton Bay. Only three cages were retrieved from Breton Bay; it appeared that the buoy and first cage were dragged away by a boat. Spat were counted in accordance with the procedures in the St. Mary's River.

RESULTS

In 2023, natural spatfall was observed for the first time at the Lover's Point site. In 2024, several living organisms were observed in Breton Bay (Photo 9). No live or dead spatfall was observed.

Photo 9. Barnacles on shell in Breton Bay.

CONCLUSIONS

Although no recruitment was observed in 2024, an intermittent spawning pattern is typical in Breton Bay. Between 1990 and 2002, the Maryland Department of Natural Resources recorded eight years with detectable spatfall and five years without detectable spatfall, where generally, a year without spatfall occurred between two years with spatfall (MD DNR, 2016). The frequency of successful spawning decreased from 2003 to 2015, with spatfall detected in only 2010 and 2015. Therefore, the lack of recruitment in 2024 does not necessarily represent a sudden decrease in the health of the Breton Bay oyster population and instead reflects trends common in the estuary. The recruitment of spat in 2023 remains a significant step in restoring the Breton Bay oyster population. We hope to further this progress and continue to plant and monitor the population at this site in 2025.

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