PEI MSX Monitoring

2024 Report

Technical Report # 285

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ACKNOWLEDGEMENTS

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INTRODUCTION

Multinucleate Sphere Unknown (MSX) is an oyster disease caused by the parasite *Haplosporidium nelsoni*. MSX mainly affects Eastern oysters (*Crassostrea virginica*), while Pacific oysters (*C. gigas*) may be infected at low levels (<5%) with little to no associated mortality (Friedman et al., 1991; Burreson et al., 2000). MSX can infect oysters of all ages, from spat to adults, but mass mortalities (up to 95%) are typically observed in those more than two years old (Haskin & Ford, 1979; Stephenson et al., 2003). Mass oyster mortality events were first reported on the North American east coast in Delaware Bay and Chesapeake Bay in 1957 and 1959, respectively (Andrews, 1962; Haskin et al., 1966). Warming winter temperatures induced by climate change are thought to have facilitated the northward proliferation of MSX along the American eastern seaboard. MSX was first documented in Canada in 2002 in Cape Breton, Nova Scotia (Hofmann et al., 2001; Burreson & Ford, 2004; Burge et al., 2014). Annual provincial (See Figure 1 for 2023 surveillance locations in PEI) and federal monitoring programs were subsequently conducted with no further spread of the disease until 2024, when it was detected in Prince Edward Island (PEI) and New Brunswick.

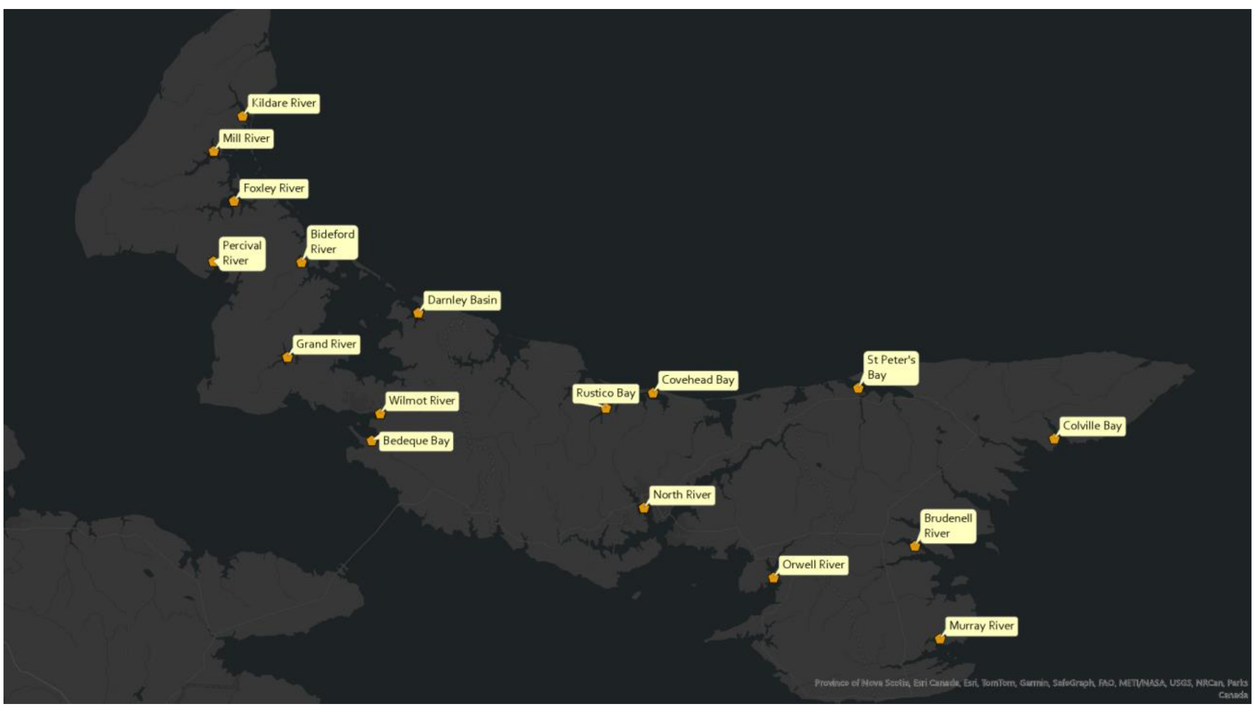

Figure 1. Map of locations sampled in 2023 for oyster disease surveillance in Prince Edward Island.

Despite many laboratory attempts, the controlled transmission of *H. nelsoni* from an infected oyster to a non-infected oyster has never been successful, and it is therefore thought that an unknown intermediate host transmits the parasite (Ford et al., 2018). The complete lifecycle of *H. nelsoni* is currently unknown, but two life stages are well documented (Figure 2): multinucleate plasmodia (4-50 µm depending on number and size of the nuclei) and 7 µm spores (Carnegie & Burreson, 2012). Infections are acquired through gill and mantle tissue, then spread rapidly throughout the oyster ([oyster-diseases-CB]). Spores may be released through feces; however, their fate in the environment is unknown (Carnegie & Burreson, 2012). The infective stage is believed to be a uninucleate form released by a spore ([oyster-diseases-CB]).

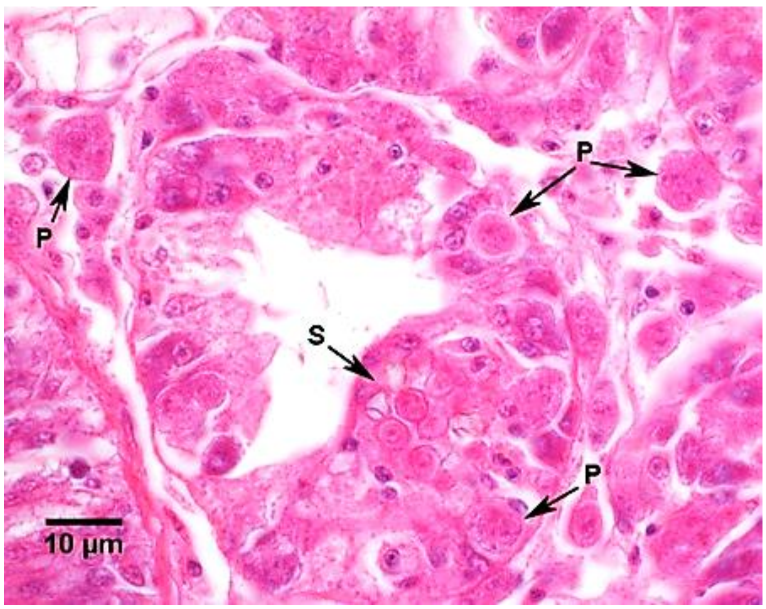

Figure 2. Histological section through the digestive gland of *C. virginica* infected with *H. nelsoni*, showing multinucleate plasmodia (P) and mature spores (S). Source: [Haplosporidium nelsoni (MSX) of Oysters].

Salinity and water temperature are environmental triggers for MSX severity (i.e., infection rates and associated mortality). *Haplosporidium nelsoni* cannot survive in salinities below 10 ppt and is only pathogenic above 15 ppt (Andrews, 1966; Haskin & Ford, 1982; Ford, 1985; Ford & Haskin, 1988; Hofmann et al., 2001). At water temperatures between 5 and 20°C, infections are acquired, and the parasite proliferates (Ford, 1985). The infection period begins in the spring and continues through the summer (Carnegie & Burreson, 2012). Peak mortalities of susceptible oysters occur in the fall, when water temperatures return below 20°C, although mortality can vary from five weeks to ten months after infection depending on prevalence, temperature, and salinity (Andrews, 1966; Haskin & Andrews, 1988). Surviving oysters, and newly set spat first exposed to MSX in the fall, may maintain infection throughout the winter, causing a mortality event the following spring and summer (Haskin & Ford, 1979). Winter temperatures may affect disease status of the following months, with mass mortality events typically occurring following warmer winter conditions (Ford & Haskin, 1982; Haskin & Andrews, 1988; Paraso et al., 1999).

Oyster industries in the USA have used selectively bred oysters for "MSX-resistance" as their primary means of protection (Carnegie & Burreson, 2012). This is done by breeding survivors of earlier outbreaks which inherently show a higher tolerance and rapid growth, allowing them to spawn and reach market size despite infection (Haskin & Ford, 1979). In the USA, "resistant" oysters have been produced after two to three generations (Haskin & Ford, 1979), which may take four to six years in hatcheries, and up to ten years in wild oyster populations. However, the use of "resistant" oysters does not fully eliminate oyster mortality events, which have historically been observed every few years in the USA (Carnegie & Burreson, 2011). Additionally, MSX has been present in Cape Breton for more than 20 years with no evidence of natural resistance, highlighting that much remains unknown about MSX infection in Atlantic Canadian populations of *C. virginica.*

In June 2024, PEI FTSC staff were notified that oyster fishers had observed higher mortality than typical in Bedeque Bay (see Figure 1). An initial investigation was conducted on 13 June 2024 and oysters were sent to the Atlantic Veterinary College (AVC) for histological analysis. Results were reported on 2 July 2024, suggesting the presence of plasmodial stages of a haplosporidian; however, the species (*H. nelsoni* or *H. costale*) was unable to be determined by histology at the time. This finding triggered the provincial veterinarian to notify the Canadian Food Inspection Agency (CFIA), as MSX is a "federally reportable disease", and all suspect cases must be reported. Additional oysters were collected from Bedeque Bay by provincial staff on 3 July 2024 to confirm the haplosporidian species by polymerase chain reaction (PCR) analysis, and the oysters were transferred to the CFIA for confirmatory testing. On 11 July 2024, the CFIA confirmed that the case definition for MSX had been met, and MSX was officially confirmed present in the Bedeque Bay area. Rigorous province-wide sampling was subsequently conducted throughout the remaining months of 2024, by both the PEI FTSC and the CFIA, with results indicating the presence of *H. nelsoni* in many oyster fishing and culture sites (Figure 3 and Appendix VI).

The primary objective of this report is to document MSX infection rates, *H. nelsoni* infection severity, and oyster mortality rates in Bedeque Bay, while using Foxley River as a reference site. This study follows oysters of different sources and ages to develop a comprehensive understanding of local MSX effects. Additionally, all surveillance results collected in 2024 are included in Appendix VI.

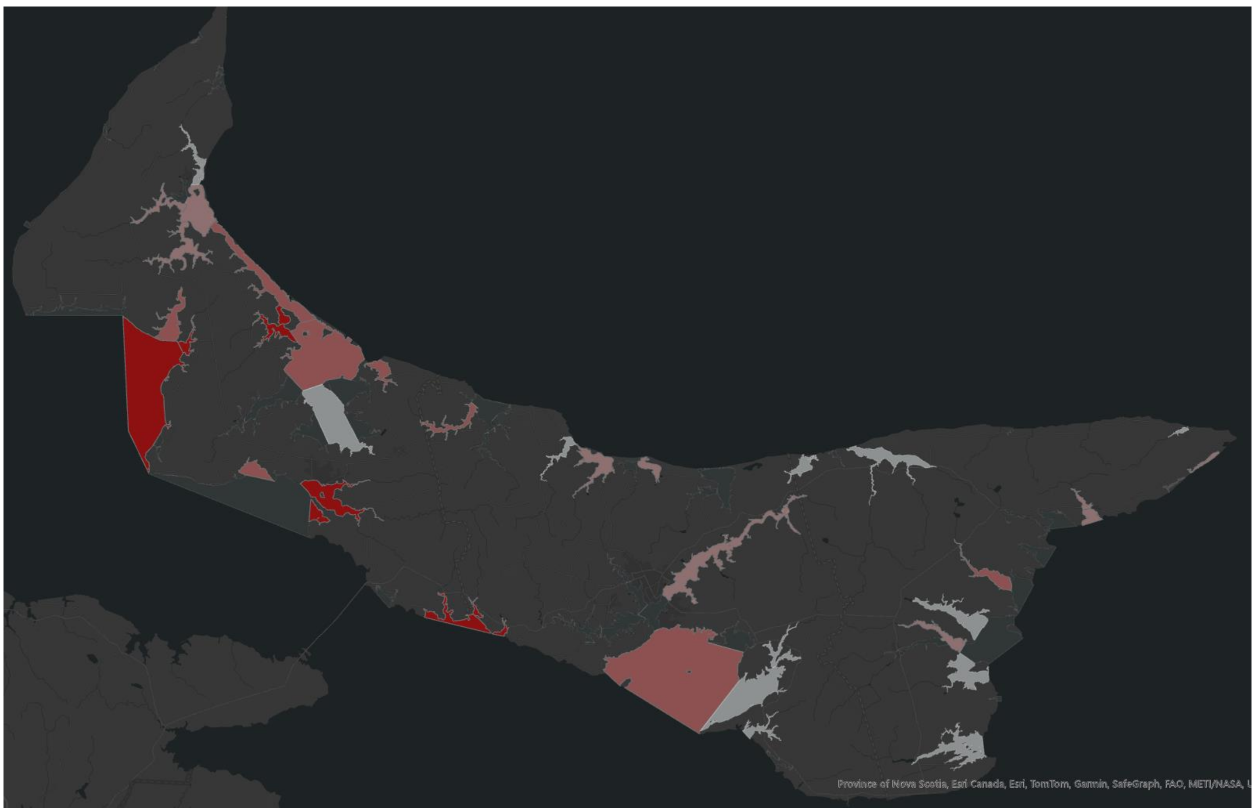

Figure 3. PEI MSX prevalence map based on wild and cultured oysters collected by both the PEI FTSC and the CFIA from July to December 2024. White = not detected, light red = <10 %, medium red = 10 - 50%, dark red = >50%.

METHODS

STUDY AREA

This report follows five sites in Bedeque Bay (site 4 was excluded due to low numbers of wild oysters) and two sites in Foxley River (Figure 4).

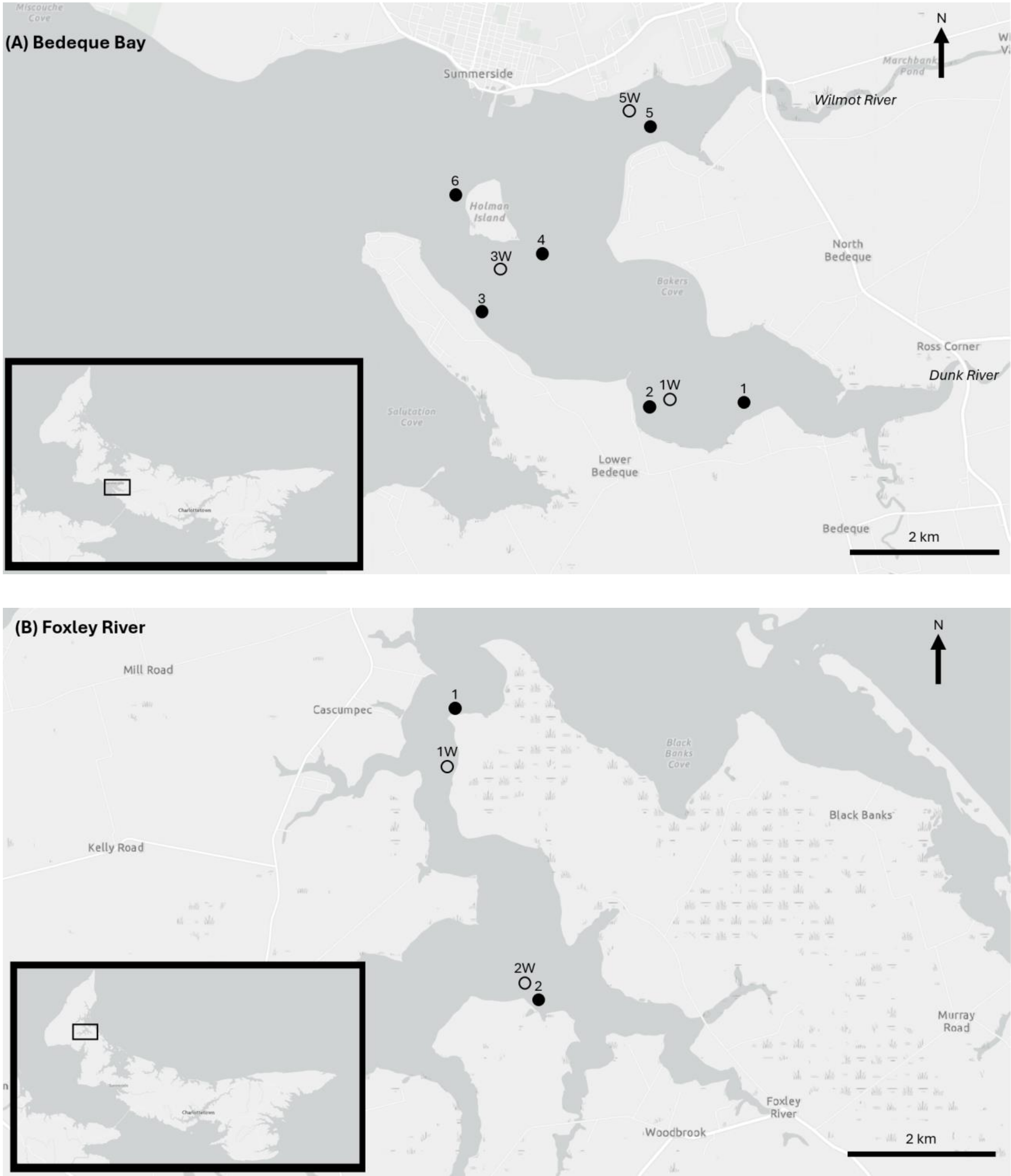

Figure 4. Sampling sites at (A) Bedeque Bay and (B) Foxley River. Hollow circles (W) indicate overwintering locations for bagged trials.

MORTALITY ASSESSMENT & DISEASE STATUS: BY "TONGING"

Mature wild oysters were collected at five sites in Bedeque Bay (Figure 4A, Appendix I) on 26 August, 18 September, 18 October, 21 November (Site 6), and 26 November 2024 (Sites 1 - 3, 5). Live and dead wild oysters (>50 mm) were collected using long-handled (6 to 12 feet) oyster tongs that end in rake-like teeth (Figure 5). Samples were also collected on 11 December 2024 at sites 1 to 3 using a drag. Sites 5 and 6 were not assessed in December due to poor weather conditions.

Figure 5. Fishers in Bedeque Bay using tongs to harvest oysters.

At each site, sample collection continued until a minimum of 20 live oysters were obtained (totals from 50 to 280 oysters including both live and dead). To assess mortality rates, live and dead oysters were separated and counted (Figure 6). Dead oysters were defined as oysters with shells still attached at the hinge, either gaping with meat or no meat contents. Singular oyster shells were not quantified.

Figure 6. Oysters collected from Site 1 in Bedeque Bay on 26 November 2024. Live oysters on the left and dead oysters on the right.

For each site, 20 live oysters were fixed with 10% formalin in seawater and submitted to the University of Prince Edward Island Atlantic Veterinary College Aquatic Diagnostics Services (AVC-ADS) laboratory for histological examination using light microscopy of paraffin embedded tissue sections. Prevalences of infection and sporulation, as well as infection severity, were quantified. Prevalence of infection is the percentage of samples that contain plasmodia stages of *Haplosporidium*. During histological analysis, the plasmodia stages of *H. nelsoni* cannot be distinguished from a related parasite *H. costale*, also known as seaside organism (SSO); therefore, this number may represent both species. However, confirmations from PCR tests and sporulation indicate that the plasmodia stages are highly likely to represent *H. nelsoni*. Prevalence of sporulation is the percentage of samples that contain spores of *H. nelsoni*. Infection severity provides a score as described by Carnegie and Burreson (2011) where 0 = none, 1 = mild, 2 = moderate, and 3 = marked (severe).

MORTALITY ASSESSMENT USING BAGGED OYSTERS

At each of three sites in Bedeque Bay (Sites 1, 3 & 5; See Figure 4A), 100 mature wild oysters were locally collected in September and stored in a vexar bag tied to a cement block to be held on bottom. These oysters were counted every two weeks to assess mortality rates.

IMPACT ON NAIVE OYSTERS: "ENHANCEMENT OYSTERS"

At each site in Bedeque Bay and Foxley River (Figure 4), 400 one-year old wild seed (22 to 62 mm, average 38 mm) from Bideford River were bagged (200 per bag, 2 bags per site; see Figure 7). Prior to bagging in Bedeque Bay, the seed was spread by the PEI Shellfish Association (PEISA) as part of their oyster enhancement program to repopulate wild beds for the commercial fishery. PEI FTSC staff used tongs to collect the seed in Bedeque Bay, whereas the seed used in Foxley River was received and bagged prior to spreading. The seed was tested on 19 July and 12 September 2024 to confirm that it was non-detect for MSX prior to introduction to Bedeque Bay and Foxley River, respectively. Every two weeks, the 2023 wild seed was counted to assess mortality rates, and 10 oysters were tested using PCR until MSX infection was confirmed at 100% prevalence for two subsequent sampling dates. Histological analysis was conducted following positive detections by PCR.

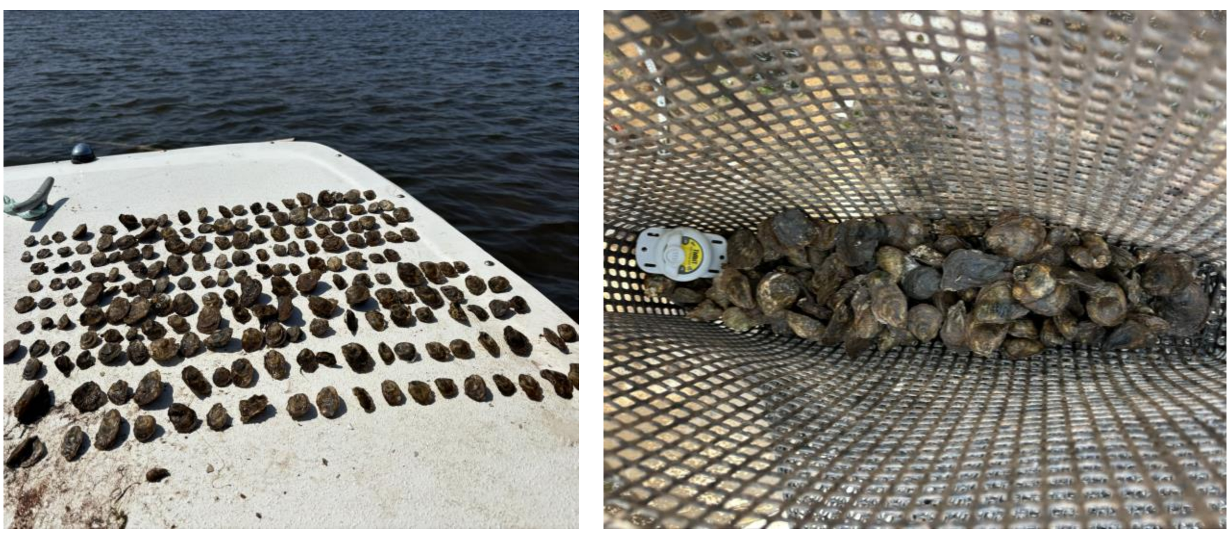

Figure 7. Enhancement oysters are counted (left) and placed in a vexar bag with a temperature recorder (right).

“WILD” CAUGHT VERSUS HATCHERY PRODUCED OYSTERS

2024 Wild Seed: At each site in Bedeque Bay, 600 wild seed (2024 year class) collected in Mill River (average 25 mm; Figure 8) were bagged (300 per bag, 2 bags per site). Time 0 PCR analysis indicated that 12% (6/49) of the seed tested positive for MSX; therefore, it was decided to only use the seed in Bedeque Bay where MSX prevalence was already considered high, and not in Foxley River where the trial sites remained non-detect. Results for the 2024 wild seed are not currently included in this report and will become available starting in spring 2025.

***2024 Hatchery Seed*:** At each site in Bedeque Bay and Foxley River, 600 selectively bred (for optimal production, not MSX resistance) hatchery seed (2024 year class) from Mallet Hatchery in New Brunswick (average 25 mm; Figure 8) were bagged (300 per bag, 2 bags per site). Time 0 PCR analysis indicated that all seed tested negative for MSX prior to introduction. Results for the 2024 hatchery seed are not currently included in this report and will become available starting in spring 2025.

Figure 8. Oyster seed sourced from Mill River (left) and from Mallet Hatchery in New Brunswick (right).

ENVIRONMENTAL CONDITIONS

Water temperature loggers (Onset HOBO TidbiT MX2203 Wireless Temperature Data Logger 400) recorded hourly water temperature (on-bottom) at each site in Bedeque Bay and Foxley River, except for Bedeque Bay Site 1 which had a Star-Oddi DST CTD (Conductivity, Temperature and Depth) logger to provide hourly water temperature and salinity measurements (Appendix II).

Measurements of water temperature and salinity were additionally obtained at 0.5 to 1 m below surface using a Hoskin Scientific Pro30 Conductivity Meter every two weeks (Appendix III). Hourly bottom water temperature and salinity measurements for the winter months will become available when the trial equipment is retrieved in Spring 2025.

All bags used for the monitoring activities were moved to deeper water and sunk in cages for the winter to ensure no ice contact during freeze-up (Figure 9). Sinking of the winter cages took place on 29 October 2024 in Bedeque Bay and on 4 November 2024 in Foxley River. All bags will be returned to their original sites in early Spring 2025 for continued monitoring.

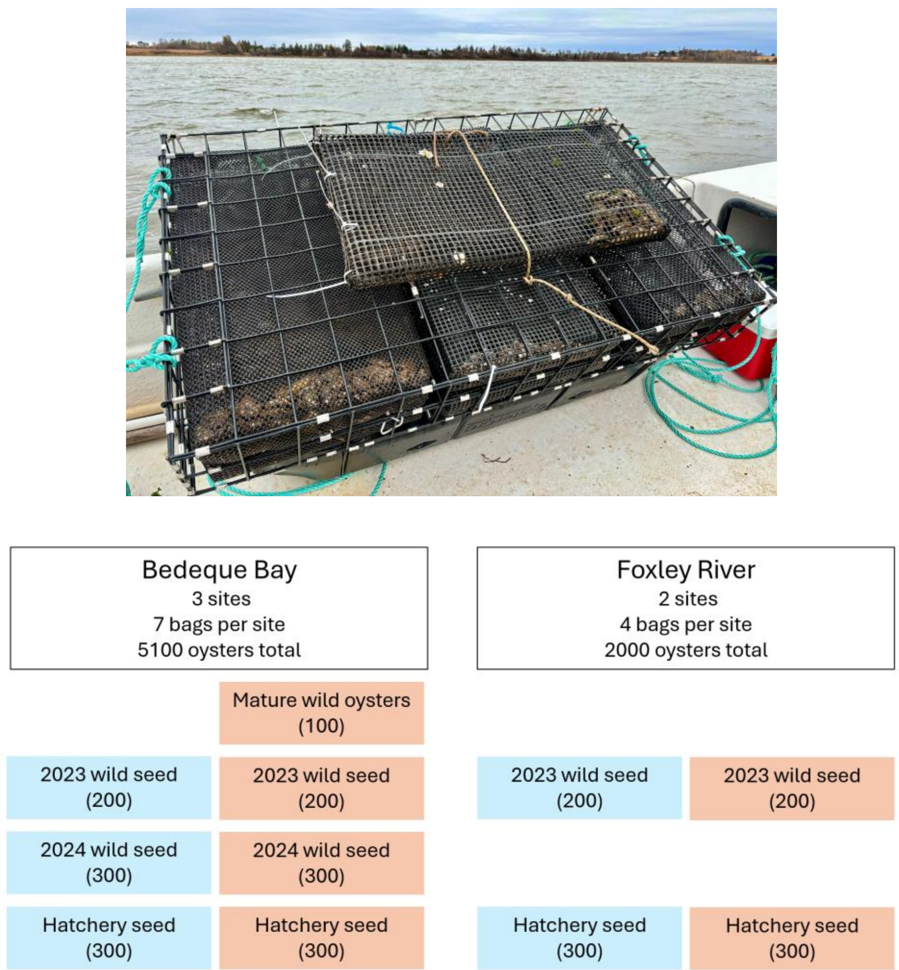

Figure 9. Oyster bags used for the 2024 monitoring activities are placed in an oyster cage and moved to deeper water for the winter. Numbers presented here are indicative of starting numbers, not the exact number remaining in each bag for overwintering.

RESULTS

MORTALITY ASSESSMENT & DISEASE STATUS: BY "TONGING"

Estimated mortality of mature wild oysters in Bedeque Bay ranged from 27 to 62% in August, 29 to 70% in September, 54 to 76% in October, 69 to 83% in November, and 56 to 88% in December (Figure 10). Average mortality increased each month, from an average of 34% in late August to an average of 77% in mid December. Note that results from December do not include sites 5 or 6 and may therefore be skewed. Site 2 showed generally greater mortality rates than the rest of the sites.

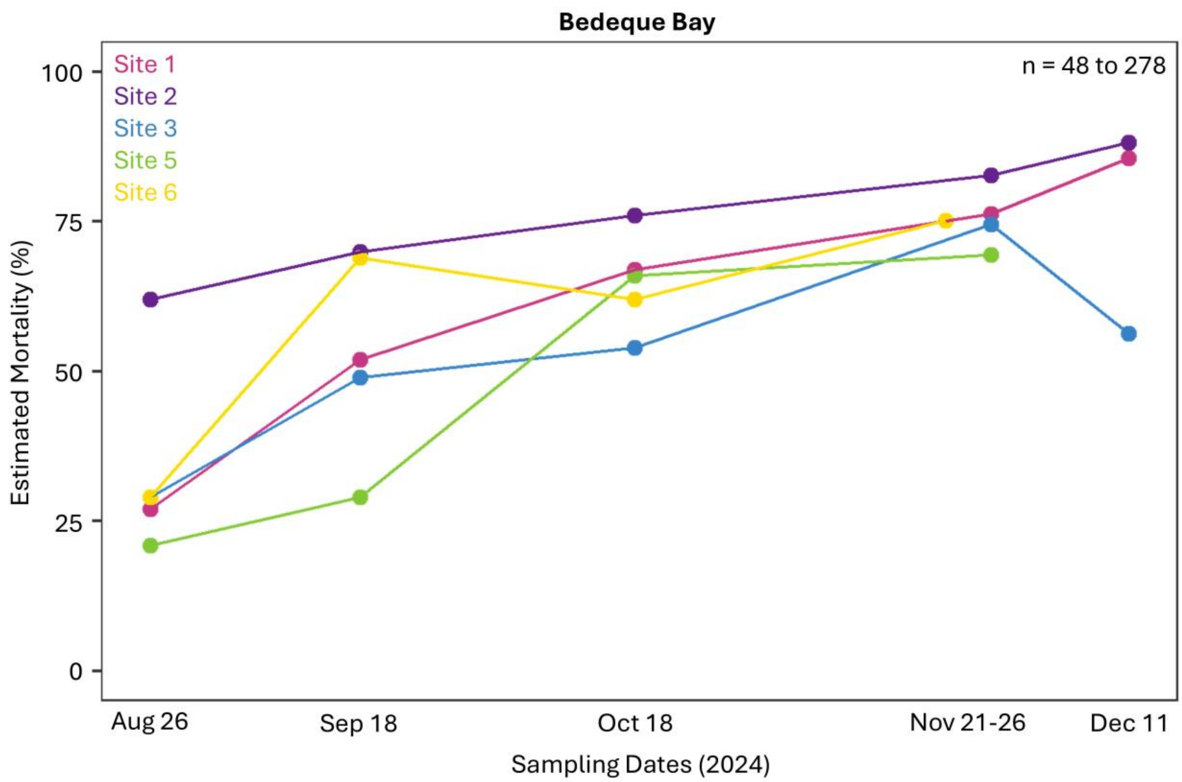

Figure 10. Estimated mortality of mature wild oysters collected by tonging at five sites in Bedeque Bay. Note that samples were collected using a drag in December.

Some of the dead oysters observed had very clean ("shiny") shells on the inside (Figure 11). The cleanliness of the inside of oyster shells may provide a relative indication of the timing of mortality.

Figure 11. Oysters with one shell removed to show the "shininess" of the shell, as an indication of the relative timing of mortality.

MSX prevalence, determined by histology (as example, Figure 12), in mature wild oysters in Bedeque Bay ranged from 0 to 60% in July, 78 to 100% in August, 80 to 100% in September, 85 to 100% in October, 84 to 100% in November, and 90 to 95% in December (Appendix IV). The average MSX prevalence by histology was significantly lower in early July (average 26%) than in all other sampling months (August to December), which averaged 92-94%. Average MSX prevalence was similar at all sites, except site 6, which showed lower prevalence (Figure 13D).

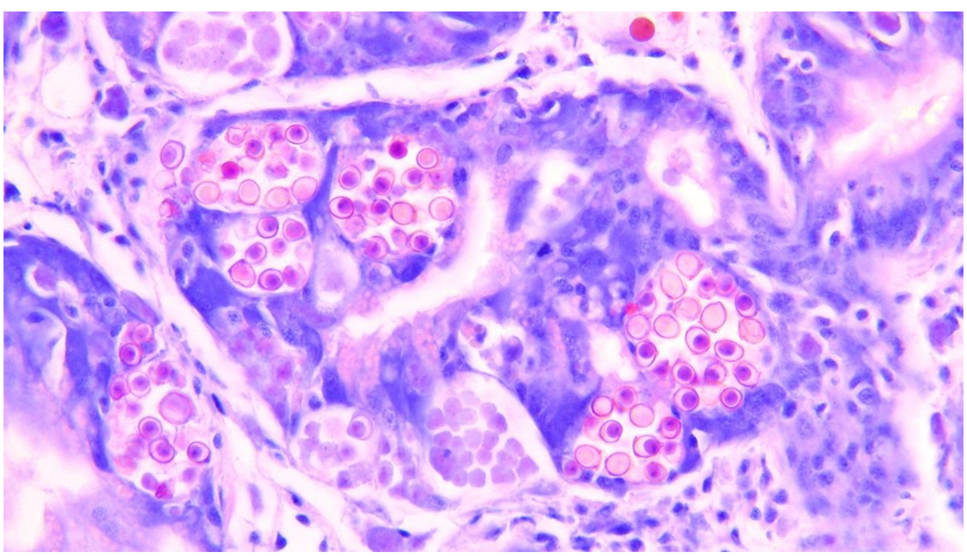

Figure 12. Histological examination of an oyster collected at Site 1 in Bedeque Bay showing mature MSX spore production. Photo credit D. Groman.

Prevalence of sporulation ranged from 14 to 35% in August, 10 to 60% in September, 15 to 25% in October, 5 to 30% in November, and 5 to 20% in December (Appendix IV). Sporulation was generally greatest in September, as well as lowest at site 3 (Figures 13E-F). Average MSX infection severity ranged from 1.3 to 2.4 on a scale from 0 to 3 (Appendix IV; see Figures 13 & 14 for distribution of scores). Overall, average infection severity was lowest in August (1.6) and highest in September (2.1) and October (2.0; Figures 13G & 14). Site 6 showed generally lower infection severity scores than the other sites (Figure 13H & 14).

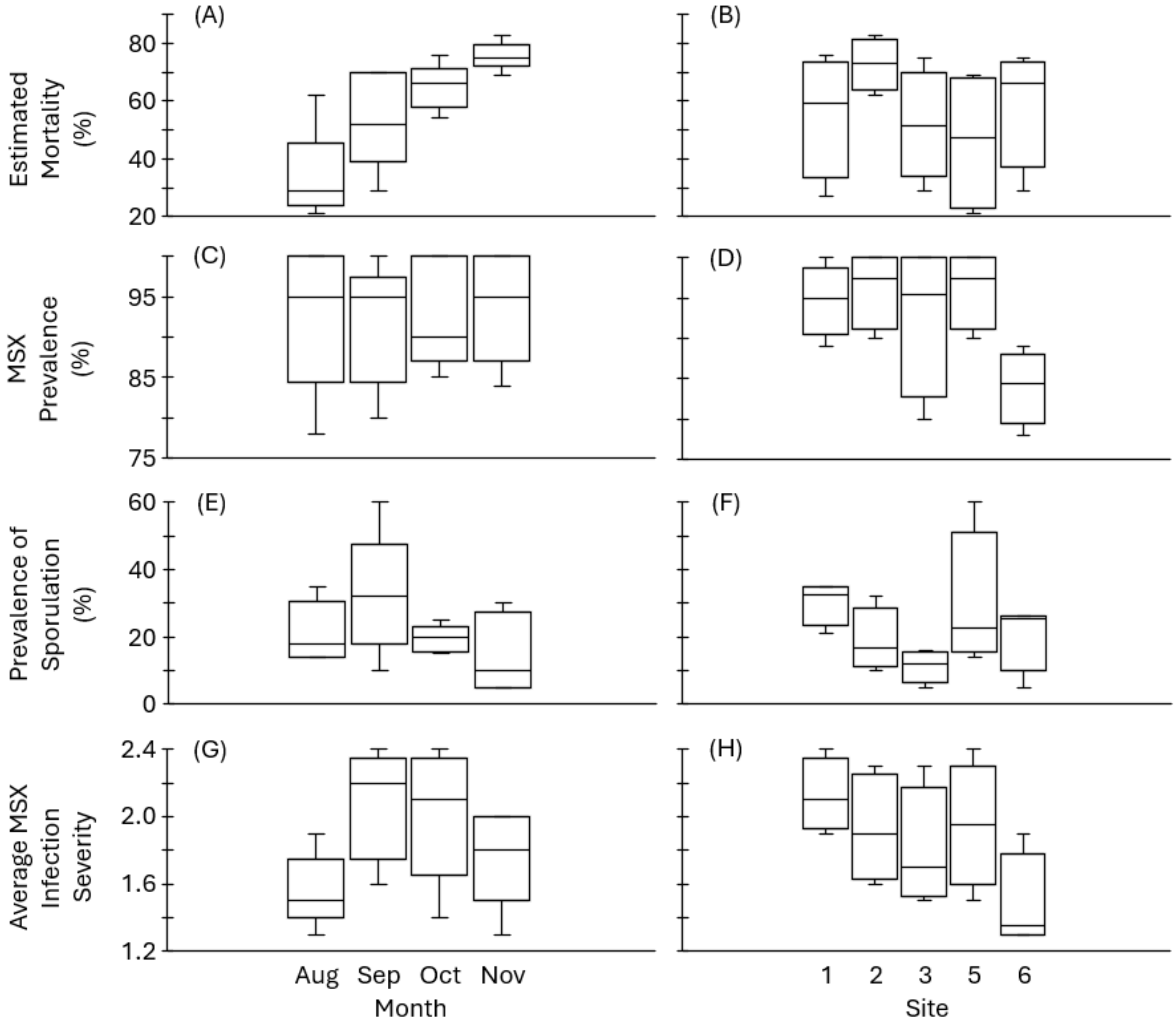

Figure 13. Boxplots of mortality estimates, and histological results of mature wild oysters collected by tonging in Bedeque Bay. Results from July and December are not included to allow for consistency between sites.

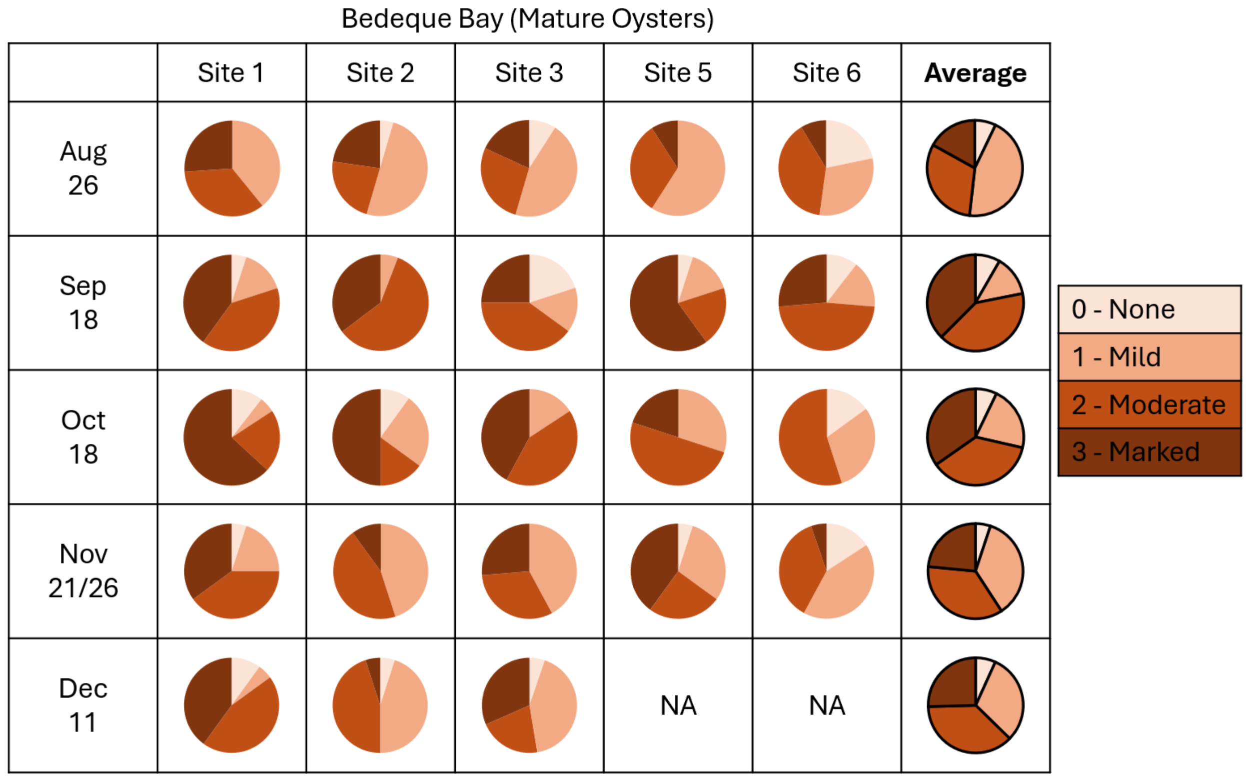

Figure 14. MSX infection severity scores by histology of wild oysters collected by tonging in Bedeque Bay. Note that samples were collected using a drag in December.

MORTALITY ASSESSMENT USING BAGGED OYSTERS

Mature wild oysters were bagged and held on bottom at three sites in Bedeque Bay and assessed every two weeks for cumulative mortality (Figure 15). Oyster mortality rates were generally consistent for the duration of the trial, although large differences between sites were observed. After 41 days, site 1 had the greatest cumulative mortality at 64%. Sites 5 and 3 showed cumulative mortalities of 49% and 25%, respectively.

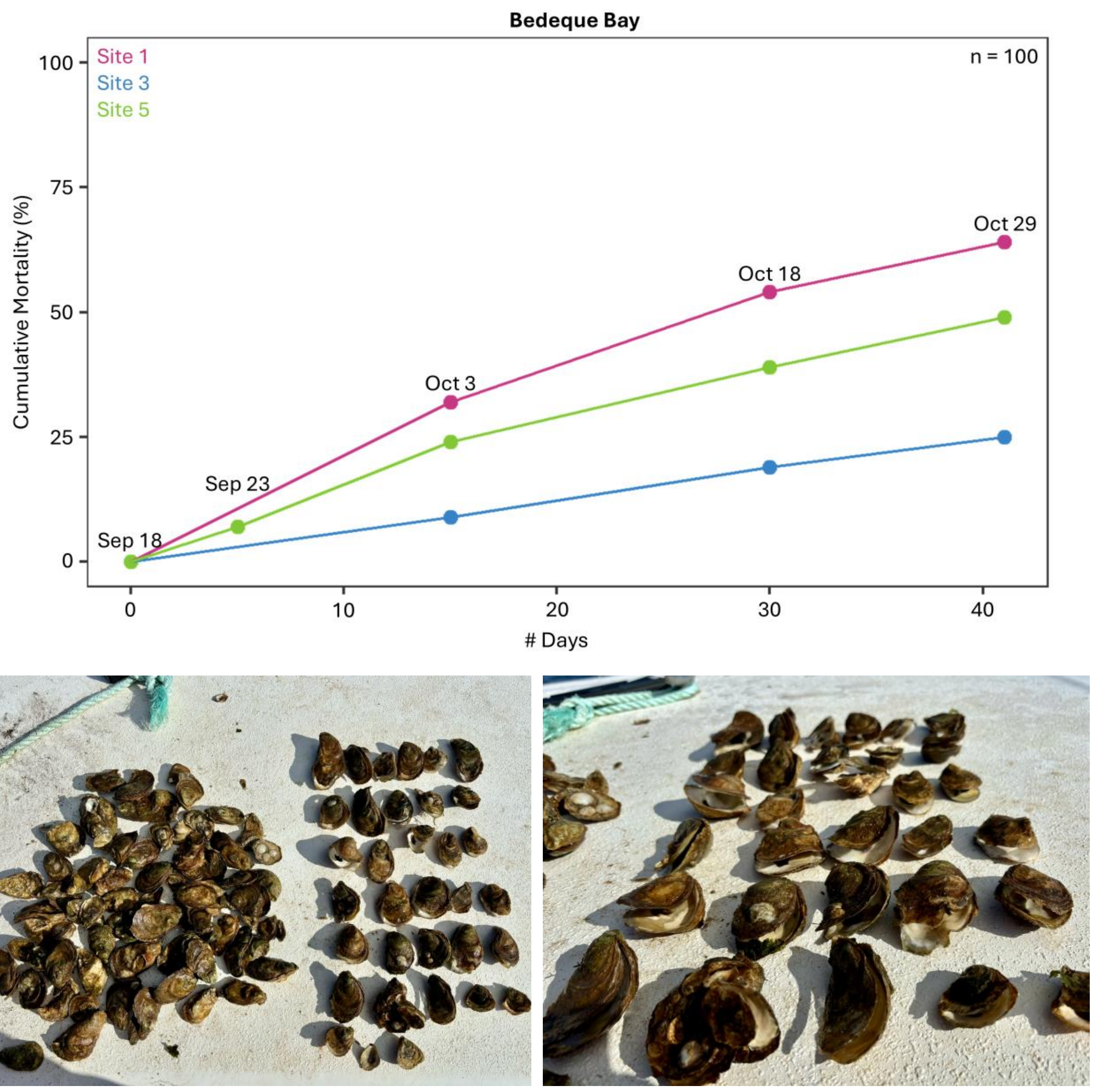

Figure 15. Cumulative mortality of mature wild mature oysters, held in vexar bags on bottom, in Bedeque Bay (top). Oysters from Site 1 in Bedeque after 15 days (bottom left) and close-up of dead oysters (bottom right).

IMPACT ON NAIVE OYSTERS: "ENHANCEMENT OYSTERS"

In Bedeque Bay, all 2023 wild seed reported 100% MSX prevalence by PCR (10/10 oysters tested) within 40 to 50 days (Figure 16). The quickest MSX prevalence progression was observed at site 5, which reported 38% by day 13, 60% by day 32, and 100% by day 42. Cumulative mortality was the greatest at site 5, reaching 11% in bag 1 and 41% in bag 2. It is unclear why bag 2 experienced much greater mortality than bag 1, as no other differences in bag condition were observed. Site 1 tested non-detect for MSX for the first 22 days, then reported 70% by day 35 and 100% by day 50. At site 1, cumulative mortality reached 12% in bag 1 and 5% in bag 2. Site 3 showed the slowest MSX prevalence progression, reporting non-detect by day 14, 10% by day 28, and 100% by day 43. Cumulative mortality was lowest at site 3, reaching 6% in both bags. In Foxley River, the 2023 wild seed reported non-detect for MSX for the duration of the trial (53 days), with the exception of one positive detection at site 1 on day 40 (Figure 17). All samples collected on day 40 were subsequently sent for histological analysis, where MSX infection was confirmed (severity score of 1 on a scale from 0-3) in the gonads for the positive detection. Cumulative mortality remained low (<3%) at both sites.

Histological analysis of 2023 wild seed in Bedeque Bay showed MSX prevalences ranging from 30 to 90% in early October and 80 to 100% in mid- and late-October (Appendix V). Average MSX prevalence by histology increased from 63% in early October to 93% in late October. Site 3 consistently showed the lowest MSX prevalence by histology as well as the lowest MSX infection severity. Although individual sites showed fluctuating infection severity scores (Figure 18), the average of all three sites increased throughout the month of October. Prevalence of sporulation ranged from 0 to 40% throughout October with greatest sporulation observed at site 5 (Appendix V).

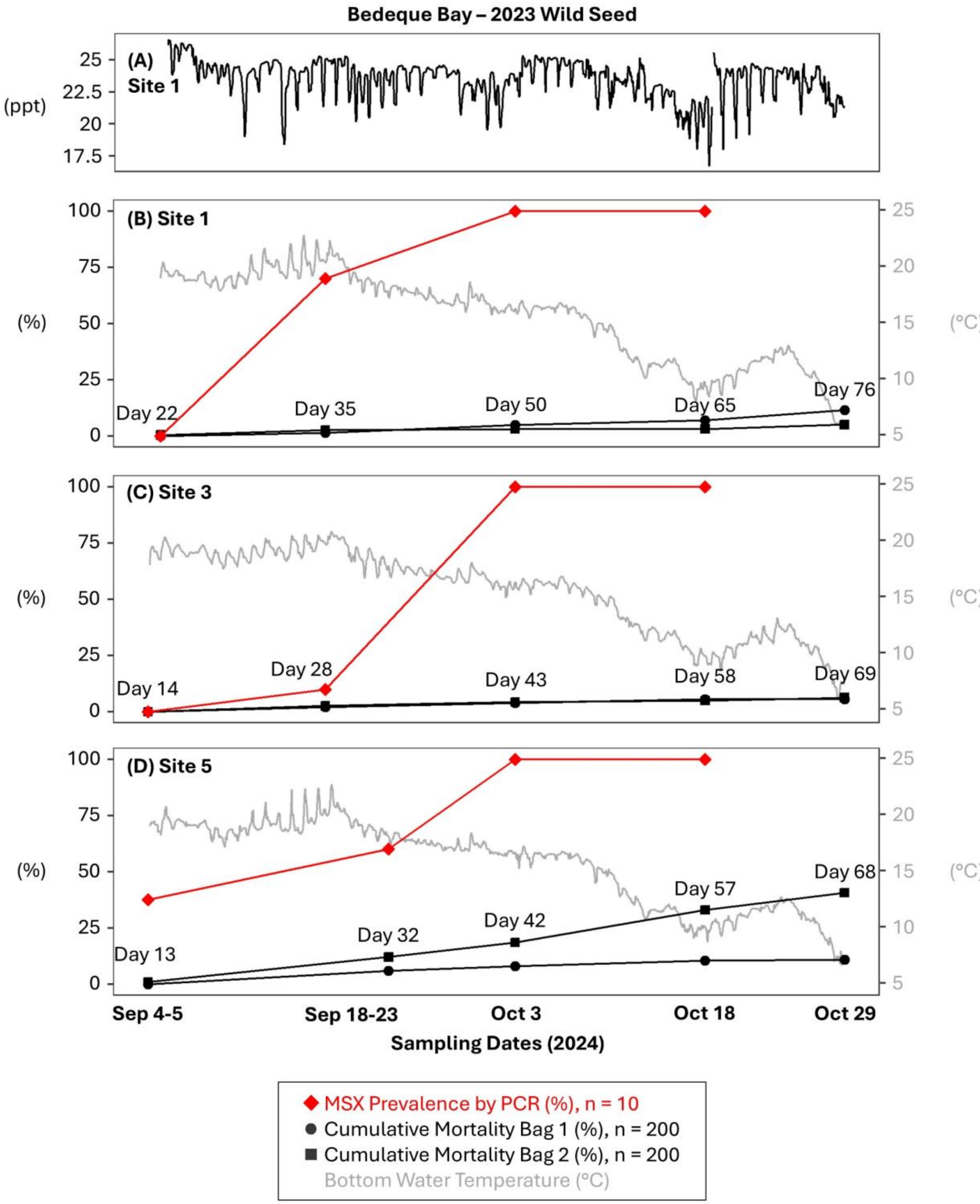

Figure 16. Results from wild seed (2023) kept in bags on the bottom in Bedeque Bay. Bottom salinity (plot A) and water temperature (grey) were recorded hourly. MSX prevalence determined by PCR and cumulative mortality assessments were determined every two weeks.

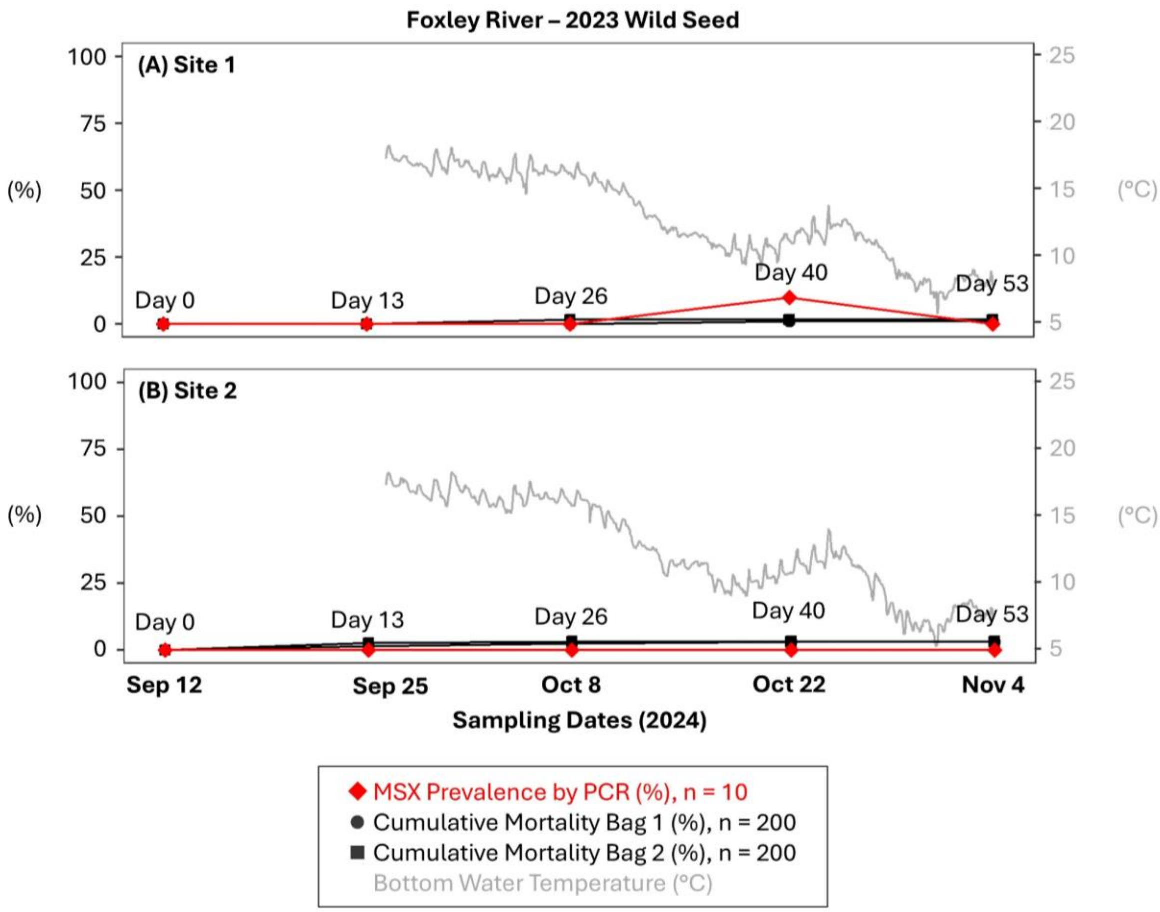

Figure 17. Results from wild seed (2023) kept in bags on the bottom in Foxley River. Bottom water temperature (grey) was recorded hourly. MSX prevalence determined by PCR and cumulative mortality assessments were determined every two weeks.

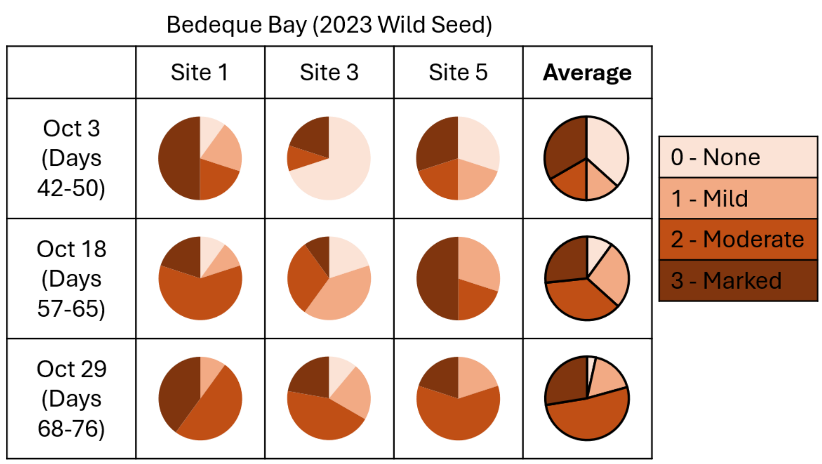

Figure 18. MSX infection severity scores by histology of 2023 wild seed kept in bags on the bottom in Bedeque Bay.

“WILD” CAUGHT VERSUS HATCHERY PRODUCED OYSTERS

This portion of the monitoring activity was initiated in October 2024. Time 0 PCR analysis indicated that all hatchery seed tested negative for MSX prior to introduction. Results for the 2024 hatchery seed are not currently included in this report and will become available starting in spring 2025.

ENVIRONMENTAL CONDITIONS

Bottom water temperatures in Bedeque Bay ranged from 16 to 23°C (averaging 18 to 19°C) in September and from 5 to 17°C (averaging 12 to 13°C) in October (Figure 16; Appendix II). Bottom water temperatures in Foxley River ranged from 5 to 18°C (averaging 12°C) in October (Figure 17; Appendix II). Bottom salinity measured at Bedeque Bay site 1 ranged from 18 to 27 ppt (average 24 ppt) in September and from 17 to 26 ppt (average 23 ppt) in October (Figure 16). The optimal temperatures and salinities for MSX severity (infection rates and associated mortality) are between 5 and 20°C, and >15 ppt; therefore, September and October 2024 represented a timeframe for optimal MSX severity.

DISCUSSION

MSX INFECTION RATES AND ASSOCIATED OYSTER MORTALITIES

In June 2024, PEI FTSC staff responded to an oyster mortality report in Bedeque Bay, which suggested the presence of MSX. By early July, mature oyster populations in Bedeque Bay showed MSX prevalences ranging from 0 to 60%. From August to December 2024, monthly testing for MSX prevalence by histology and oyster mortality estimates were conducted on mature oyster population in Bedeque Bay to track MSX infection and associated mortality. MSX prevalence was significantly higher, ranging from 78 to 100%. Our results seem to align with seasonal prevalence trends observed in the USA, where the infection period begins in the spring and continues through the summer and fall (Carnegie & Burreson, 2012). Previous studies in the USA have shown that mortalities of susceptible oysters are observed five weeks to ten months after infection, depending on MSX prevalence as well as temperature and salinity, with peak mortalities observed in the fall when water temperatures return below 20°C (Andrews, 1966; Haskin & Andrews, 1988). Estimated mortality rates of mature oysters in Bedeque Bay increased each month from August (21 to 62%, average 34%) to December (56 to 88%, average 77%).

Historical mortality events in the USA have shown up to 95% mortality within two years of infection, therefore it is possible that we may see a continued increase in oyster mortalities in 2025.

To gain a higher-resolution understanding of infection rates and subsequent mortalities, we conducted bi-weekly testing for MSX prevalence by PCR and quantified cumulative mortality in 2023 wild seed introduced to Bedeque Bay and Foxley River and kept in bags on the bottom from August to the beginning of November 2024. In Bedeque Bay, all 2023 wild seed reached 100% MSX prevalence by PCR after 1.5 months and reached cumulative mortalities between 5 and 12% within 2.5 months (except for site 5 bag 2, which reached 41%, although it is unclear why this bag experienced much greater mortality). In Foxley River, all but one of the 2023 wild seed tested non-detect for MSX by PCR and cumulative mortality remained negligible (<3%) after 1.5 months. All seed is being kept on the bottom throughout the winter months, and trials will continue in the spring 2025 to gain an understanding of overwintering effects on MSX prevalence and oyster mortality. Bottom water temperature and salinity are being recorded throughout the winter and spring months to link environmental conditions to MSX effects. Bags of 2024 wild seed and 2024 hatchery seed were additionally introduced to the trial sites in October 2024 and overwintered on the bottom, to be monitored starting in spring 2025.

SPATIAL VARIATION

Histological results showed much variation between the five study sites in Bedeque Bay, highlighting the complexity of MSX infection patterns and suggesting that one study site per system (i.e., bay, harbour, river) is likely not representative of MSX dynamics within the entire system. Freshwater input may drive some of this variation (Paraso et al., 1999). The Dunk and Wilmot Rivers may create different hydrodynamics at sites 1, 2, and 5, compared to sites 3 and 6 which are located closer to the outlet of the bay. Additionally, habitat differences between sites, such as substrate (rocky vs muddy bottom), amount of seaweed, the presence of predators (crabs, sea stars), or co-infection with other parasites or pests (such as *Cliona* boring sponges which are prevalent in Bedeque Bay) may affect oyster vulnerability to illness and environmental stress between sites (e.g., Tracy et al., 2024). This may explain why higher/lower MSX prevalence or infection severity did not necessarily translate to higher/lower oyster mortality in the present study. For example, site 6 generally showed the lowest MSX prevalence and severity, yet mortality rates were similar to the rest of the sites. Site 2 serves as another example of this disconnect, as MSX prevalence and severity were comparable to the other sites, yet mortality rates were consistently higher.

SPORULATION

In Bedeque Bay, sporulation reached up to 60% prevalence in mature oysters and up to 40% prevalence in 2023 wild seed. This contradicts past studies from the United States, which suggested that sporulation is rare (less than 1%) in mature infected oysters but is more common (up to 83%) in infected oysters that are less than 1-year old (Barber et al., 1991; Burreson, 1994). Andrews (1984) suggested that spores of *H. nelsoni* are too rare to be a probable source of infection in *C. virginica* populations. Since i) direct oyster to oyster MSX transmission experiments failed and ii) sporulation has been extremely rare in mature oysters, researchers have concluded that an intermediate host is likely required to complete the *H. nelsoni* lifecycle (Ford et al., 2018). However, Haskin & Andrews (1988) suggested that perhaps *H. nelsoni* could complete its lifecycle by producing spores in juvenile oysters, but that they have been underrepresented in sampling programs and therefore not properly considered. A sampling effort was therefore established between 1988 and 1994 to test this theory (see Ford et al., 2018 for details). Barber et al. (1991) suggested that spat may have a metabolic element required for spore development that is not present in mature oysters. However, several studies have since shown that even in the absence of spore production in spat, naïve oysters deployed as sentinels continued to experience heavy MSX infection (Ford et al., 2009; Carnegie & Burreson, 2011; Ford et al., 2012; Ford & Bushek, 2012). There is therefore no current evidence that spores produced within oysters are the principal source of MSX infection and transmission. Our results present new findings, not previously seen in oyster populations in the USA, highlighting the need to understand how Atlantic Canadian oysters may interact differently with *H. nelsoni* and react differently to MSX infection.

CONCLUSION

This study assessed MSX infection and associated oyster mortality by conducting monthly monitoring of mature oysters in Bedeque Bay, and bi-weekly monitoring of 2023 wild seed in Bedeque Bay and Foxley River. Using histological methods, mature oyster populations in Bedeque Bay showed MSX prevalences ranging 0 to 60% in early July, and 78 to 100% from August to December. Estimated oyster mortality increased from August (21 to 62%) to December (56 to 88%). Bottom water temperature and salinity were recorded hourly to provide linkages to environmental conditions, confirming that September and October 2024 fell within the window of greatest MSX severity (5 to 20°C). In Bedeque Bay, all 2023 wild seed reached 100% MSX prevalence by PCR after 1.5 months and reached cumulative mortalities between 6 and 12% within 2.5 months. In Foxley River, almost all 2023 wild seed tested non-detect for MSX by PCR and cumulative mortality remained negligible (<3%) over 1.5 months. Seed of various sources (2023 wild seed, 2024 wild seed, 2024 hatchery seed) is being kept on the bottom throughout the winter for continued monitoring in spring 2025. Sporulation reached up to 60% prevalence in mature oysters and up to 40% prevalence in 2023 wild seed, contradicting past studies from the United States, which suggested that sporulation is rare (less than 1%) in mature infected oysters but is more common (up to 83%) in juveniles. Much remains unknown about MSX, particularly regarding Atlantic Canadian populations of oysters. High-resolution monitoring will continue in 2025 to better understand MSX impacts on the PEI oyster industry.

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APPENDIX I MSX MONITORING IN BEDEQUE BAY AND FOXLEY RIVER (LOCATION AND SAMPLING DATES)

<table>
<tr><th colspan="6">Tonged Oysters</th></tr>
<tr><th>Area</th><th colspan="5">Bedeque Bay</th></tr>
<tr><th>Site</th><th>1</th><th>2</th><th>3</th><th>5</th><th>6</th></tr>
<tr><td>Latitude (°N)</td><td>46.352481</td><td>46.351995</td><td>46.363186</td><td>46.385781</td><td>46.376649</td></tr>
<tr><td>Longitude (°W)</td><td>63.742033</td><td>63.760695</td><td>63.790906</td><td>63.760774</td><td>63.794326</td></tr>
<tr><td>Dates (2024)</td><td colspan="5">3-Jul, 26-Aug, 18-Sep, 18-Oct, 21/26-Nov, 11-Dec</td></tr>
</table>

<table>
<tr><th colspan="7">Bagged Oysters</th></tr>
<tr><th colspan="2">Area</th><th colspan="3">Bedeque Bay</th><th colspan="2">Foxley River</th></tr>
<tr><th colspan="2">Site</th><th>1</th><th>3</th><th>5</th><th>1</th><th>2</th></tr>
<tr><td rowspan="2">Trial</td><td>Latitude (°N)</td><td>46.3516</td><td>46.3629</td><td>46.3859</td><td>46.7407</td><td>46.7059</td></tr>
<tr><td>Longitude (°W)</td><td>63.7433</td><td>63.7906</td><td>63.7605</td><td>64.0714</td><td>64.0549</td></tr>
<tr><td rowspan="2">Winter</td><td>Latitude (°N)</td><td>46.352939</td><td>46.367222</td><td>46.3877</td><td>46.733596</td><td>46.707822</td></tr>
<tr><td>Longitude (°W)</td><td>63.757378</td><td>63.787163</td><td>63.76241</td><td>64.071738</td><td>64.057596</td></tr>
<tr><td rowspan="4">Start date (2024)</td><td>Mature wild oysters</td><td colspan="3">18-Sep</td><td colspan="2">-</td></tr>
<tr><td>2023 wild seed</td><td>14-Aug</td><td>21-Aug</td><td>22-Aug</td><td colspan="2">12-Sep</td></tr>
<tr><td>2024 wild seed</td><td colspan="3">23-Oct</td><td colspan="2">-</td></tr>
<tr><td>Hatchery seed</td><td colspan="3">17-Oct</td><td colspan="2">17-Oct</td></tr>
<tr><td rowspan="4">End date (2024)</td><td>Mature wild oysters</td><td colspan="3" rowspan="4">29-Oct</td><td colspan="2">-</td></tr>
<tr><td>2023 wild seed</td><td colspan="2">4-Nov</td></tr>
<tr><td>2024 wild seed</td><td colspan="2">-</td></tr>
<tr><td>Hatchery seed</td><td colspan="2">4-Nov</td></tr>
</table>

APPENDIX II WATER TEMPERATURE & SALINITY (BOTTOM)

Water temperature (°C)				
Month	**Site**	**Min**	**Max**	**Avg**
September 2024	Bedeque Bay – Site 1	15.9	22.7	18.8
	Bedeque Bay – Site 3	16.2	20.8	18.2
	Bedeque Bay – Site 5	16.7	22.6	18.6
October 2024	Bedeque Bay – Site 1	4.8	17.0	12.3
	Bedeque Bay – Site 3	5.9	16.8	12.8
	Bedeque Bay – Site 5	6.3	17.2	13.0
	Foxley River – Site 1	5.7	17.6	12.4
	Foxley River – Site 2	5.2	17.5	12.0

Salinity (ppt)				
Month	**Site**	**Min**	**Max**	**Avg**
September 2024	Bedeque Bay – Site 1	18.4	26.6	23.8
October 2024	Bedeque Bay – Site 1	16.7	25.5	23.1

APPENDIX III WATER TEMPERATURE & SALINITY (0.5 – 1 M BELOW SURFACE)

Bedeque Bay							
Site		**1**	**2**	**3**	**5**	**6**
3-Jul-24	Time	10:12am	10:29am	10:54am	12:10pm	-
	Temperature (°C)	21.1	20.4	20.4	20.8	
	Salinity (ppt)	23.5	24.6	24.7	25	
26-Aug-24	Time	10:24am	10:00am	12:27pm	11:01am	12:00pm
	Temperature (°C)	23.7	22.2	23	23.3	23.8
	Salinity (ppt)	23.8	26.3	27.8	19.8	28
4-Sep-24	Time	-	-	12:41pm	10:38am	-
	Temperature (°C)			18.6	18.7	
	Salinity (ppt)			27.7	27.7	
5-Sep-24	Time	9:50am	-	-	-	-
	Temperature (°C)	18.5				
	Salinity (ppt)	25.8				
18-Sep-24	Time	1:04pm	2:00pm	11:51am	10:30am	11:38am
	Temperature (°C)	21.1	20.3	21.2	19.8	19.8
	Salinity (ppt)	26.4	27.5	26.4	27.6	27.8
3-Oct-24	Time	11:15am	-	10:40am	10:00am	-
	Temperature (°C)	15.9		15.8	15.7	
	Salinity (ppt)	26.4		27.1	27.3	
18-Oct-24	Time	12:50pm	12:20pm	11:40am	10:23am	11:10am
	Temperature (°C)	9.6	9.4	9.3	9.6	10.4
	Salinity (ppt)	26.5	26.2	26.6	27.4	28.2
29-Oct-24	Time	9:20am	-	10:45am	12:00pm	-
	Temperature (°C)	4.9		6.3	6.4	
	Salinity (ppt)	25		28.3	27.7	
21-Nov-24	Time	-	-	-	-	9:36am
	Temperature (°C)					5.8
	Salinity (ppt)					27.1
26-Nov-24	Time	10:00am	9:18am	10:43am	11:18am	-
	Temperature (°C)	5.8	5.8	5.6	6.0	
	Salinity (ppt)	23.1	23.3	20.3	22.8	
11-Dec-24	Time	12:15pm	10:00am	11:17am	-	-
	Temperature (°C)	-0.9	-1.0	-1.0		
	Salinity (ppt)	18.4	26.3	26.7		

Foxley River			
Site		1	2
12-Sep-24	Time	11:05am	11:23am
	Temperature (°C)	18.8	19
	Salinity (ppt)	27.5	26.8
25-Sep-24	Time	11:42am	11:25am
	Temperature (°C)	16.6	17
	Salinity (ppt)	28	26.6
8-Oct-24	Time	11:15am	10:40am
	Temperature (°C)	15.1	15.3
	Salinity (ppt)	28	26.8
22-Oct-24	Time	12:32pm	11:46am
	Temperature (°C)	12.1	11.1
	Salinity (ppt)	26.7	25.6
4-Nov-24	Time	12:00pm	11:05am
	Temperature (°C)	6.6	6.6
	Salinity (ppt)	27.1	26.1

APPENDIX IV MORTALITY, MSX PREVALENCE & HISTOLOGY RESULTS: TONGED OYSTERS FROM BEDEQUE BAY

Site	1	2	3	4	5	6	Average
Estimated Mortality (%)							
Aug 26	27	62	29	NA	21	29	**34 ± 14**
Sep 18	52	70	49	NA	29	70	**54 ± 15**
Oct 18	67	76	54	NA	66	62	**65 ± 7**
Nov 21/26	76	83	75	NA	69	75	**76 ± 4**
Dec 11	86	88	56	NA	NA	NA	**77 ± 15**
MSX Prevalence by Histology (%)							
Jul 3	0	20	20	30	60	NA	**26 ± 20**
Aug 26	100	95	91	NA	100	78	**93 ± 8**
Sep 18	95	100	80	NA	95	89	**92 ± 7**
Oct 18	89	90	100	NA	100	85	**93 ± 6**
Nov 21/26	95	100	100	NA	90	84	**94 ± 6**
Dec 11	90	95	95	NA	NA	NA	**93 ± 2**
Prevalence of Sporulation by Histology (%)							
Aug 26	35	18	14	NA	14	26	**21 ± 8**
Sep 18	35	32	10	NA	60	26	**33 ± 16**
Oct 18	21	15	16	NA	20	25	**19 ± 4**
Nov 21/26	30	10	5	NA	25	5	**15 ± 10**
Dec 11	20	5	5	NA	NA	NA	**10 ± 7**
Average MSX Infection Severity by Histology (scale 0-3)							
Aug 26	1.9	1.6	1.5	NA	1.5	1.3	**1.6 ± 0.9**
Sep 18	2.2	2.3	1.6	NA	2.4	1.9	**2.1 ± 0.9**
Oct 18	2.4	2.1	2.3	NA	1.9	1.4	**2.0 ± 0.9**
Nov 21/26	2.0	1.7	1.8	NA	2.0	1.3	**1.8 ± 0.9**
Dec 11	2.2	1.5	1.8	NA	NA	NA	**1.8 ± 0.9**

APPENDIX V HISTOLOGY RESULTS: ENHANCEMENT OYSTERS IN BEDEQUE BAY

Site	1	3	5	Average
MSX Prevalence by Histology (%)				
Oct 3	90	30	70	**63**
Oct 18	90	80	100	**90**
Oct 29	100	80	100	**93**
Prevalence of Sporulation by Histology (%)				
Oct 3	0	0	40	**13**
Oct 18	0	20	40	**20**
Oct 29	10	0	20	**10**
Average MSX Infection Severity by Histology (scale 0-3)				
Oct 3	2.1	0.8	1.5	**1.5**
Oct 18	1.9	1.3	2.2	**1.8**
Oct 29	2.3	1.6	2.0	**2.0**

APPENDIX VI 2024 MSX SURVEILLANCE RESULTS (CFIA & FTSC)

The following table provides an overview of all MSX surveillance results, including samples collected by the Canadian Food Inspection Agency (CFIA) and the Government of PEI Department of Fisheries, Tourism, Sport and Culture (FTSC), from June to December 2024. This table provides results for both wild and cultured oysters. Collection areas are identified to the bay-scale to avoid providing lease identification. The exception to this is Bedeque Bay, where the specific sites (all wild beds) are identified as these results were also included in the main report.

In an effort to include all MSX testing conducted in PEI in 2024 by both federal and provincial governments, there may be some gaps in information as a result of various collection teams, sampling objectives and protocols, and testing methods.

For oysters tested by histology (Bedeque Bay only), the following information is provided: prevalence of infection, prevalence of sporulation, and infection severity on a scale of 0-3. For oysters tested by qPCR, the following information is provided when available: average cycle threshold (Ct) value, Ct range, and prevalence of infection. For oysters tested by traditional PCR, only prevalence of infection is provided.

Dermo is another oyster disease of concern and is caused by the parasite *Perkinsus marinus*. The first Canadian detections of dermo disease were in New Brunswick and Nova Scotia in November 2024. As of 2024, dermo has not been detected in PEI. The last two columns of the table indicate which samples collected in 2024 were also tested for dermo disease.

Area	Collection Date	Water Temp (°C)	Salinity (ppt)	Testing Method	MSX Status	MSX Avg Ct Value	MSX Ct Range	MSX Sample Size	Number MSX Positive	MSX Prevalence	MSX Prevalence & Sample Size	MSX Prevalence of Sporulation	MSX Avg Infection Severity (0-3)	Dermo Status	Dermo Prevalence & Sample Size
Baltic River	NA	NA	NA	qPCR	Not Detected	NA	NA	NA	NA	0%	NA	NA	NA	Not Tested	NA
Bedeque Bay	4-Jun-24	13.0	NA	NA	Positive	NA	NA	NA	NA	NA	NA	NA	NA	Not Tested	NA
Bedeque Bay	3-Jul-24	NA	NA	qPCR	Positive	9.80	9.09-10.14	NA	NA	NA	NA	NA	NA	Not Tested	NA
Bedeque Bay Site 1	3-Jul-24	21.1	23.5	Histology	Not Detected	NA	NA	10	0	0%	0% (0/10)	0%	NA	Not Tested	NA
Bedeque Bay Site 2	3-Jul-24	20.4	24.6	Histology	Positive	NA	NA	10	2	20%	20% (2/10)	0%	NA	Not Tested	NA
Bedeque Bay Site 3	3-Jul-24	20.4	24.7	Histology	Positive	NA	NA	10	2	20%	20% (2/10)	0%	NA	Not Tested	NA
Bedeque Bay Site 4	3-Jul-24	20.9	24.2	Histology	Positive	NA	NA	10	3	30%	30% (3/10)	0%	NA	Not Tested	NA
Bedeque Bay Site 5	3-Jul-24	20.8	25.0	Histology	Positive	NA	NA	10	6	60%	60% (6/10)	0%	NA	Not Tested	NA
Bedeque Bay Site 1	3-Jul-24	21.1	23.5	PCR	Positive	NA	NA	9	8	89%	89% (8/9)	NA	NA	Not Tested	NA
Bedeque Bay Site 2	3-Jul-24	20.4	24.6	PCR	Positive	NA	NA	10	9	90%	90% (9/10)	NA	NA	Not Tested	NA
Bedeque Bay Site 3	3-Jul-24	20.4	24.7	PCR	Positive	NA	NA	10	10	100%	100% (10/10)	NA	NA	Not Tested	NA
Bedeque Bay Site 4	3-Jul-24	20.9	24.2	PCR	Positive	NA	NA	10	10	100%	100% (10/10)	NA	NA	Not Tested	NA
Bedeque Bay Site 5	3-Jul-24	20.8	25.0	PCR	Positive	NA	NA	10	10	100%	100% (10/10)	NA	NA	Not Tested	NA

Bedeque Bay Site 1	26-Aug-24	23.7	23.8	Histology	Positive	NA	NA	23	23	100%	100% (23/23)	35%	1.9	Not Tested	NA
Bedeque Bay Site 2	26-Aug-24	22.2	26.3	Histology	Positive	NA	NA	22	21	95%	95% (21/22)	35%	1.6	Not Tested	NA
Bedeque Bay Site 3	26-Aug-24	23.0	27.8	Histology	Positive	NA	NA	22	20	91%	91% (20/22)	14%	1.5	Not Tested	NA
Bedeque Bay Site 5	26-Aug-24	23.2	19.8	Histology	Positive	NA	NA	22	22	100%	100% (22/22)	14%	1.5	Not Tested	NA
Bedeque Bay Site 6	26-Aug-24	23.8	28.0	Histology	Positive	NA	NA	23	18	78%	78% (18/23)	26%	1.3	Not Tested	NA
Bedeque Bay Site 1	18-Sep-24	21.1	26.4	Histology	Positive	NA	NA	20	19	95%	95% (19/20)	35%	2.2	Not Tested	NA
Bedeque Bay Site 2	18-Sep-24	20.3	27.5	Histology	Positive	NA	NA	17	17	100%	100% (17/17)	32%	2.3	Not Tested	NA
Bedeque Bay Site 3	18-Sep-24	20.0	27.2	Histology	Positive	NA	NA	20	16	80%	80% (16/20)	10%	1.6	Not Tested	NA
Bedeque Bay Site 5	18-Sep-24	19.8	27.6	Histology	Positive	NA	NA	20	19	95%	95% (19/20)	60%	2.4	Not Tested	NA
Bedeque Bay Site 6	18-Sep-24	19.8	27.8	Histology	Positive	NA	NA	19	17	89%	89% (17/19)	26%	1.9	Not Tested	NA
Bedeque Bay Site 1	18-Oct-24	9.6	26.5	Histology	Positive	NA	NA	19	17	89%	89% (17/19)	21%	2.4	Not Tested	NA
Bedeque Bay Site 2	18-Oct-24	9.4	26.2	Histology	Positive	NA	NA	20	18	90%	90% (18/20)	15%	2.1	Not Tested	NA

Bedeque Bay Site 3	18-Oct-24	9.3	26.6	Histology	Positive	NA	NA	19	19	100%	100% (19/19)	16%	2.3	Not Tested	NA
Bedeque Bay Site 5	18-Oct-24	9.6	27.4	Histology	Positive	NA	NA	20	20	100%	100% (20/20)	20%	1.9	Not Tested	NA
Bedeque Bay Site 6	18-Oct-24	10.4	28.2	Histology	Positive	NA	NA	20	17	85%	85% (17/20)	25%	1.4	Not Tested	NA
Bedeque Bay Site 6	21-Nov-24	5.8	27.1	Histology	Positive	NA	NA	19	16	84%	84% (16/20)	5%	1.31	Not Tested	NA
Bedeque Bay Combo of Sites	26-Nov-24	5.6 to 6	20.3 to 27.1	qPCR	Positive	18.43	13.19 - 35.37	23	23	100%	100% (23/23)	NA	NA	Not Tested	NA
Bedeque Bay Site 1	26-Nov-24	5.8	23.1	Histology	Positive	NA	NA	20	19	95%	95% (19/20)	30%	2.05	Not Tested	NA
Bedeque Bay Site 2	26-Nov-24	5.8	23.3	Histology	Positive	NA	NA	20	20	100%	100% (20/20)	10%	1.65	Not Tested	NA
Bedeque Bay Site 3	26-Nov-24	5.6	20.3	Histology	Positive	NA	NA	19	19	100%	100% (19/19)	5%	1.84	Not Tested	NA
Bedeque Bay Site 5	26-Nov-24	6.0	22.8	Histology	Positive	NA	NA	20	19	95%	95% (19/20)	25%	2	Not Tested	NA
Bedeque Bay Site 1 adults	11-Dec-24	-0.9	18.4	qPCR	Positive	14.93	11.19 - 25.57	18	18	100%	100% (18/18)	NA	NA	Not Detected	0% (0/18)
Bedeque Bay Site 1 spat	11-Dec-24	-0.9	18.4	qPCR	Positive	17.20	11.28 - 28.28	9	9	100%	100% (9/9)	NA	NA	Not Detected	0% (0/9)
Bedeque Bay Site 2 adults	11-Dec-24	-1.0	26.3	qPCR	Positive	23.60	14.51 - 30.92	7	7	100%	100% (7/7)	NA	NA	Not Detected	0% (0/7)

Bedeque Bay Site 2 spat	11-Dec-24	-1.0	26.3	qPCR	Positive	16.59	11.23 - 31.00	17	17	100%	100% (17/17)	NA	NA	Not Detected	0% (0/17)
Bedeque Bay Site 3 adults	11-Dec-24	-1.0	26.7	qPCR	Positive	19.98	9.71-35.59	44	44	100%	100% (44/44)	NA	NA	Not Detected	0% (0/44)
Bedeque Bay Site 3 spat	11-Dec-24	-1.0	26.7	qPCR	Positive	15.85	11.21 - 27.58	22	22	100%	100% (22/22)	NA	NA	Not Detected	0% (0/22)
Bedeque Bay Site 1	11-Dec-24	-1.0	26.7	Histology	Positive	NA	NA	20	18	90%	90% (18/20)	20%	2.15	Not Tested	NA
Bedeque Bay Site 2	11-Dec-24	-1.0	26.7	Histology	Positive	NA	NA	20	19	95%	95% (19/20)	5%	1.5	Not Tested	NA
Bedeque Bay Site 3	11-Dec-24	-1.0	26.7	Histology	Positive	NA	NA	19	18	95%	95% (18/19)	5%	1.8	Not Tested	NA
Bideford River	16-Jul-24	25.2	21.8	qPCR	Not Detected	NA	NA	70	0	0%	0% (0/70)	NA	NA	Not Tested	NA
Bideford River	16-Jul-24	23.1	26.2	qPCR	Not Detected	NA	NA	70	0	0%	0% (0/70)	NA	NA	Not Tested	NA
Bideford River	19-Jul-24	23.5	27.0	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Bideford River	19-Jul-24	24.2	26.4	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Bideford River	28-Oct-24	6.9	27.2	qPCR	Positive	31.47	30.46 - 33.97	20	20	100%	100% (20/20)	NA	NA	Not Detected	0% (0/20)
Bideford River	28-Oct-24	7.7	27.7	qPCR	Not Detected	36.52	NA	20	0	0%	0% (0/20)	NA	NA	Not Detected	0% (0/20)
Bideford River	28-Oct-24	7.9	27.8	qPCR	Positive	31.47	24.81 - 37.01	20	1	5%	5% (1/20)	NA	NA	Not Detected	0% (0/20)
Bideford River	28-Oct-24	7.0	27.8	qPCR	Positive	26.04	12.96 - 30.22	20	15	75%	75% (15/20)	NA	NA	Not Detected	0% (0/20)

Bideford River	28-Oct-24	7.5	28.0	qPCR	Positive	29.04	13.25 - 36.17	20	13	65%	65% (13/20)	NA	NA	Not Detected	0% (0/20)
Bideford River	28-Oct-24	8.0	28.3	qPCR	Positive	19.48	9.5-30.44	20	11	55%	55% (11/20)	NA	NA	Not Detected	0% (0/20)
Boughton River	18-Jun-24	14.0	NA	qPCR	Positive	15.95	10.56 - 21.31	14	2	14%	14% (2/14)	NA	NA	Not Tested	NA
Boughton River	16-Jul-24	24.5	27.8	qPCR	Positive	18.95	18.8-19.06	62	7	11%	11% (7/62)	NA	NA	Not Tested	NA
Brackley Bay	17-Jun-24	17.0	NA	NA	Not Detected	NA	NA	NA	NA	0%	NA	NA	NA	Not Tested	NA
Brudenell River	1-Aug-24	24.4	27.7	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Brudenell River	1-Aug-24	24.8	26.5	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Brudenell River	1-Aug-24	NA	NA	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Brudenell River	20-Nov-24	7.0	27.8	qPCR	Inconclusive	1/150 = 36.50	NA	30	0	0%	0% (0/30)	NA	NA	Not Detected	0% (0/30)
Brudenell River	20-Nov-24	7.0	26.4	qPCR	Not Detected	NA	NA	30	0	0%	0% (0/30)	NA	NA	Not Detected	0% (0/30)
Brudenell River	20-Nov-24	7.0	28.4	qPCR	Not Detected	NA	NA	30	0	0%	0% (0/30)	NA	NA	Not Detected	0% (0/30)
Brudenell River	20-Nov-24	7.0	28.4	qPCR	Not Detected	NA	NA	30	0	0%	0% (0/30)	NA	NA	Not Detected	0% (0/30)
Brudenell River	20-Nov-24	7.0	28.3	qPCR	Not Detected	NA	NA	30	0	0%	0% (0/30)	NA	NA	Not Detected	0% (0/30)
Brudenell River	2-Dec-24	4.5	25.6	qPCR	Positive	36.34	29.69 - 37.67	62	2	3%	3% (2/62)	NA	NA	Not Detected	0% (0/62)
Cascumpec Bay	24-Jul-24	22.0	27.1	qPCR	Positive	26.12	26.12	62	1	2%	2% (1/62)	NA	NA	Not Tested	NA
Conway Narrows	15-Jul-24	25.0	NA	qPCR	Positive	20.30	11.42 - 27.78	62	5	8%	8% (5/62)	NA	NA	Not Tested	NA

Conway Narrows	15-Jul-24	23.9	27.2	qPCR	Positive	20.30	11.42 - 27.78	59	1	2%	2% (1/59)	NA	NA	Not Tested	NA
Conway Narrows	16-Jul-24	25.0	NA	qPCR	Positive	10.40	9.19-12.76	62	17	27%	27% (17/62)	NA	NA	Not Tested	NA
Covehead Bay	26-Sep-24	16.4	24.4	qPCR	Positive	NA	NA	80	1	1%	1% (1/80)	NA	NA	Not Tested	NA
Covehead Bay	26-Sep-24	16.4	24.4	NA	Not Tested	NA	NA	180	NA	NA	NA	NA	NA	Not Tested	NA
Covehead Bay	16-Oct-24	11.0	24.4	PCR	Positive	NA	NA	30	1	3%	3% (1/30)	NA	NA	Not Tested	NA
Covehead Bay	16-Oct-24	10.9	25.5	PCR	Not Detected	NA	NA	30	0	0%	0% (0/30)	NA	NA	Not Tested	NA
Covehead Bay	16-Oct-24	11.0	26.0	PCR	Not Detected	NA	NA	30	0	0%	0% (0/30)	NA	NA	Not Tested	NA
Covehead Bay	16-Oct-24	11.0	26.0	PCR	Not Tested	NA	NA	30	NA	NA	NA	NA	NA	Not Tested	NA
Covehead Bay	16-Oct-24	11.0	26.0	PCR	Not Tested	NA	NA	30	NA	NA	NA	NA	NA	Not Tested	NA
Covehead Bay	16-Oct-24	10.9	25.9	PCR	Not Tested	NA	NA	30	NA	NA	NA	NA	NA	Not Tested	NA
Darnley Basin	11-Jul-24	NA	NA	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Darnley Basin	11-Jul-24	NA	NA	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Darnley Basin	11-Jul-24	NA	NA	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Darnley Basin	13-Jul-24	22.0	27.0	NA	Not Detected	NA	NA	NA	0	0%	NA	NA	NA	Not Tested	NA
Darnley Basin	22-Jul-24	NA	NA	NA	Not Detected	NA	NA	NA	0	0%	NA	NA	NA	Not Tested	NA
Darnley Basin	23-Jul-24	NA	NA	NA	Not Detected	NA	NA	NA	0	0%	NA	NA	NA	Not Tested	NA
Darnley Basin	29-Jul-24	22.9	NA	qPCR	Positive	9.60	8.88-10.55	62	23	37%	37% (23/62)	NA	NA	Not Tested	NA
Darnley Basin	4-Dec-24	1.7	27.1	qPCR	Positive	36.20	35.19 - 37.15	30	1	3%	3% (1/30)	NA	NA	Not Detected	0% (0/30)

Darnley Basin	4-Dec-24	1.0	26.0	qPCR	Inconclusive	36.30	35.3-37.46	30	NA	NA	NA	NA	NA	Not Detected	0% (0/30)
Darnley Basin	4-Dec-24	1.1	26.9	qPCR	Positive	35.60	34.04 - 36.95	30	6	20%	NA	NA	NA	Not Detected	0% (0/30)
Darnley Basin	4-Dec-24	2.2	26.9	qPCR	Inconclusive	36.70	36.0-37.31	30	NA	NA	NA	NA	NA	Not Detected	0% (0/28)
Darnley Basin	early Dec 2024	NA	NA	qPCR	Positive	35.65	34.07 - 36.48	20	1	5%	5% (1/20)	NA	NA	Not Tested	NA
East River	4-Jun-24	16.0	NA	NA	Not Detected	NA	NA	NA	NA	0%	NA	NA	NA	Not Tested	NA
East River	4-Sep-24	19.1	24.0	PCR	Not Detected	NA	NA	62	0	0%	0% (0/62)	NA	NA	Not Tested	NA
East River	4-Sep-24	19.2	21.9	PCR	Positive	NA	NA	62	1	2%	2% (1/62)	NA	NA	Not Tested	NA
East River	5-Sep-24	18.8	26.5	PCR	Positive	NA	NA	62	1	2%	2% (1/62)	NA	NA	Not Tested	NA
East River	5-Sep-24	18.5	27.6	PCR	Not Detected	NA	NA	62	0	0%	0% (0/620	NA	NA	Not Tested	NA
Egmont Bay	31-Jul-24	NA	NA	NA	Not Detected	NA	NA	NA	0	0%	NA	NA	NA	Not Tested	NA
Egmont Bay	18-Oct-24	NA	NA	qPCR	Positive	29.17	14.20 -37.2	62	55	89%	89% (55/62)	NA	NA	Not Tested	NA
Enmore River	NA	NA	NA	qPCR	Not Detected	NA	NA	NA	0	0%	NA	NA	NA	Not Tested	NA
Enmore River	7-Oct-24	15.6	28.8	NA	Not Tested	NA	NA	180	NA	NA	NA	NA	NA	Not Tested	NA
Enmore River	7-Oct-24	15.6	28.8	qPCR	Positive	26.15	8.37-35.59	80	80	100%	100% (80/80)	NA	NA	Not Detected	0% (0/NA)
Foxley River	11-Jul-24	21.5	25.6	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Foxley River	11-Jul-24	23.4	22.7	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Foxley River	11-Jul-24	22.3	25.3	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA

Foxley River	11-Jul-24	NA	NA	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Foxley River	24-Jul-24	22.4	26.6	NA	Not Detected	NA	NA	NA	0	0%	NA	NA	NA	Not Tested	NA
Foxley River	25-Jul-24	23.5	23.1	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Foxley River	1-Aug-24	NA	NA	PCR	Positive	NA	NA	50	5	10%	10% (5/50)	NA	NA	Not Tested	NA
Foxley River	1-Aug-24	NA	NA	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Foxley River	1-Aug-24	NA	NA	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Foxley River	1-Aug-24	NA	NA	PCR	Positive	NA	NA	50	25	50%	50% (25/50)	NA	NA	Not Tested	NA
Foxley River	1-Aug-24	NA	NA	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Foxley River	15-Aug-24	22.6	26.3	qPCR	Positive	32.00	31.02 - 34.11	62	2	3%	3% (2/62)	NA	NA	Not Tested	NA
Foxley River	15-Aug24	22.3	26.6	qPCR	Positive	32.20	32.05 - 32.36	62	1	2%	2% (1/62)	NA	NA	Not Tested	NA
Foxley River	16-Aug-24	24.1	26.7	qPCR	Positive	24.27	24.41 - 24.14	62	1	2%	2% (1/62)	NA	NA	Not Tested	NA
Foxley River	16-Aug-24	22.4	26.7	NA	Not Detected	NA	NA	NA	O	0%	NA	NA	NA	Not Tested	NA
Foxley River	31-Oct-24	NA	NA	PCR	Positive	NA	NA	62	2	3%	3% (2/62)	NA	NA	Not Tested	NA
Foxley River	4-Nov-24	5.4	23.5	PCR	Not Detected	NA	NA	62	0	0%	0% (0/62)	NA	NA	Not Tested	NA
Hunter River	17-Jun-24	17.8	NA	NA	Not Detected	NA	NA	NA	0	0%	NA	NA	NA	Not Tested	NA
Hunter River	16-Sep-24	NA	NA	NA	Not Tested	NA	NA	180	NA	NA	NA	NA	NA	Not Tested	NA
Hunter River	16-Sep-24	19.2	27.1	qPCR	Not Detected	NA	NA	180	0	0%	0% (0/180)	NA	NA	Not Tested	NA

Kildare River	5-Aug-24	23.3	25.3	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Kildare River	5-Aug-24	22.4	26.6	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Lennox Channel	13-Jul-24	22.8	26.7	qPCR	Positive	9.80	9.07-10.49	62	15	24%	24% (15/62)	NA	NA	Not Tested	NA
Lennox Channel	13-Jul-24	22.9	26.1	qPCR	Positive	9.40	8.96-10.06	62	25	40%	40% (25/62)	NA	NA	Not Tested	NA
Lennox Channel	13-Jul-24	22.8	26.8	qPCR	Positive	10.80	9.76-11.54	62	22	35%	35% (22/62)	NA	NA	Not Tested	NA
Lennox Channel	4-Oct-24	NA	NA	PCR	Positive	NA	NA	20	20	100%	100% (20/20)	NA	NA	Not Tested	NA
Lennox Channel	4-Oct-24	NA	NA	PCR	Positive	NA	NA	20	20	100%	100% (20/20)	NA	NA	Not Detected	0% (0/16)
Lennox Channel	4-Oct-24	NA	NA	PCR	Positive	NA	NA	15	13	87%	87% (13/15)	NA	NA	Not Tested	NA
Lennox Channel	4-Oct-24	NA	NA	PCR	Positive	NA	NA	20	19	95%	95% (19/20)	NA	NA	Not Tested	NA
Lennox Channel	4-Oct-24	NA	NA	PCR	Positive	NA	NA	15	12	80%	80% (12/15)	NA	NA	Not Tested	NA
Lennox Channel	4-Oct-24	NA	NA	PCR	Positive	NA	NA	15	14	93%	93% (14/15)	NA	NA	Not Tested	NA
Lennox Channel	4-Oct-24	NA	NA	PCR	Positive	NA	NA	15	9	60%	60% (9/15)	NA	NA	Not Tested	NA
Lennox Channel	7-Oct-24	NA	NA	PCR	Positive	NA	NA	11	10	91%	91% (10/11)	NA	NA	Not Tested	NA
Lennox Channel	7-Oct-24	NA	NA	PCR	Positive	NA	NA	15	14	93%	93% (14/15)	NA	NA	Not Tested	NA
Lennox Channel	7-Oct-24	NA	NA	PCR	Positive	NA	NA	11	10	91%	91% (10/11)	NA	NA	Not Tested	NA
Lennox Channel	7-Oct-24	NA	NA	PCR	Positive	NA	NA	15	14	93%	93% (14/15)	NA	NA	Not Tested	NA
Lennox Channel	7-Oct-24	NA	NA	PCR	Positive	NA	NA	15	14	93%	93% (14/15)	NA	NA	Not Tested	NA
Malpeque Bay	17-Jun-24	16.0	NA	NA	Not Detected	NA	NA	NA	0	0%	NA	NA	NA	Not Tested	NA

Malpeque Bay	11-Sep-24	17.9	27.6	qPCR	Not Detected	NA	NA	180	0	0%	0% (0/180)	NA	NA	Not Tested	NA
Malpeque Bay	11-Sep-24	NA	NA	NA	Not Tested	NA	NA	NA	NA	NA	NA	NA	NA	Not Tested	NA
Malpeque Bay	12-Sep-24	NA	NA	NA	Not Tested	NA	NA	180	NA	NA	NA	NA	NA	Not Tested	NA
Malpeque Bay	12-Sep-24	18.7	28.9	qPCR	Positive	33.20	19.98 - 36.77	80	28	35%	35% (28/80)	NA	NA	Not Tested	NA
Mill River	NA	NA	NA	NA	Not Detected	NA	NA	NA	0	0%	NA	NA	NA	Not Tested	NA
Mill River	19-Jul-24	24.1	23.3	NA	Not Detected	NA	NA	NA	0	0%	NA	NA	NA	Not Tested	NA
Mill River	31-Jul-24	23.8	24.2	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Mill River	31-Jul-24	23.7	23.3	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Mill River	31-Jul-24	23.5	24.2	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Mill River	19-Aug-24	21.6	26.1	qPCR	Not Detected	NA	NA	NA	0	0%	NA	NA	NA	Not Tested	NA
Mill River	1-Oct-24	NA	NA	PCR	Not Detected	NA	NA	62	0	0%	0% (0/62)	NA	NA	Not Tested	NA
Mill River	22-Oct-24	NA	NA	qPCR	Positive	34.20	29.7-37.45	24	5	21%	21% (5/24)	NA	NA	Not Tested	NA
Mill River	22-Oct-24	NA	NA	PCR	Positive	NA	NA	25	1	4%	4% (1/25)	NA	NA	Not Tested	NA
Murray River	26-Jul-24	21.5	25.4	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Murray River	1-Oct-24	16.1	28.1	qPCR	Not Detected	NA	NA	180	0	0%	0% (0/180)	NA	NA	Not Detected	0% (0/180)
New London Bay	16-Jul-24	22.0	26.8	qPCR	Positive	10.70	9.74-11.33	62	21	34%	34% (21/62)	NA	NA	Not Tested	NA
Nine Mile Creek	23-Oct-24	NA	NA	qPCR	Positive	34.56	29.63 -36.5	30	4	13%	13% (4/30)	NA	NA	Not Detected	0% (0/30)

Nine Mile Creek	23-Oct-24	NA	NA	qPCR	Positive	30.64	12.91 - 36.74	30	7	23%	23% (7/30)	NA	NA	Not Detected	0% (0/30)
North Lake	17-Oct-24	NA	NA	qPCR	Not Detected	NA	NA	180	0	0%	0% (0/180)	NA	NA	Not Tested	NA
North River	15-Nov-24	5.6	28.5	qPCR	Not Detected	NA	NA	30	0	0%	0% (0/30)	NA	NA	Not Detected	0% (0/30)
North River	15-Nov-24	5.3	28.2	qPCR	Not Detected	NA	NA	30	0	0%	0% (0/30)	NA	NA	Not Detected	0% (0/30)
North River	15-Nov-24	5.3	28.1	qPCR	Not Detected	NA	NA	30	0	0%	0% (0/30)	NA	NA	Not Detected	0% (0/30)
North River	15-Nov-24	5.8	28.6	qPCR	Not Detected	NA	NA	30	0	0%	0% (0/30)	NA	NA	Not Detected	0% (0/30)
Orwell River	15-Jul-24	26.0	25.0	PCR	Not Detected	NA	NA	25	0	0%	0% (0/25)	NA	NA	Not Tested	NA
Orwell River	3-Sep-24	20.0	29.1	qPCR	Not Detected	NA	NA	180	0	0%	0% (0/180)	NA	NA	Not Tested	NA
Orwell River	3-Sep-24	20.0	29.1	qPCR	Not Detected	NA	NA	70	0	0%	0% (0/70)	NA	NA	Not Tested	NA
Orwell River	3-Sep-24	20.0	29.1	qPCR	Not Detected	NA	NA	70	0	0%	0% (0/70)	NA	NA	Not Tested	NA
Percival River	2-Aug-24	24.3	27.3	qPCR	Positive	19.40	13.26 - 27.24	62	8	13%	13% (8/62)	NA	NA	Not Tested	NA
Percival River	2-Aug-24	NA	NA	qPCR	Positive	12.95	11.96 - 14.13	62	17	27%	27% (17/62)	NA	NA	Not Tested	NA
Pinette River	31-Jul-24	24.3	25.0	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Pinette River	31-Jul-24	23.4	26.7	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Rustico Bay	25-Jul-24	22.8	27.1	PCR	Suspect	NA	NA	50	NA	NA	NA	NA	NA	Not Tested	NA
Rustico Bay	5-Aug-24	NA	NA	PCR	Not Detected	NA	NA	50	0	0%	0% (0/50)	NA	NA	Not Tested	NA
Rustico Bay	16-Sep-24	18.2	28.1	qPCR	Positive	35.50	35.23 - 35.78	81	1	1%	1% (1/81)	NA	NA	Not Tested	NA

Rustico Bay	16-Sep-24	NA	NA	NA	Not Tested	NA	NA	180	NA	NA	NA	NA	NA	Not Tested	NA
Salutation Cove	13-Jul-24	25.1	27.3	qPCR	Positive	9.60	8.95-10.16	62	46	74%	74% (46/62)	NA	NA	Not Tested	NA
Salutation Cove	9-Dec-24	-0.8	28.0	qPCR	Not Tested	NA	NA	NA	NA	NA	NA	NA	NA	Not Detected	0% (0/NA)
Savage Harbour	8-Aug-24	NA	NA	NA	Not Detected	NA	NA	NA	0	0%	NA	NA	NA	Not Tested	NA
Savage Harbour	23-Sep-24	16.6	29.1	qPCR	Not Detected	NA	NA	180	0	0%	0% (0/180)	NA	NA	Not Tested	NA
Savage Harbour	23-Sep-24	16.8	28.4	qPCR	Not Detected	NA	NA	180	0	0%	0% (0/180)	NA	NA	Not Tested	NA
Savage Harbour	2-Dec-24	3.6	28.7	qPCR	Inconclu sive	36.65	NA	180	0	0%	0% (0/180)	NA	NA	Not Detected	0% (0/53)
Savage Harbour	18-Dec-24	NA	NA	qPCR	Not Detected	NA	NA	109	0	0%	0% (0/109)	NA	NA	Not Detected	0% (0/NA)
Seal River	7-Aug-24	21.6	27.7	PCR	Not Detected	NA	NA	25	0	0%	0% (0/25)	NA	NA	Not Tested	NA
Seal River	7-Aug-24	21.6	27.7	PCR	Not Detected	NA	NA	25	0	0%	0% (0/25)	NA	NA	Not Tested	NA
Souris River	30-Aug-24	20.9	26.8	qPCR	Positive	NA	NA	156	1	1%	1% (1/156)	NA	NA	Not Tested	NA
Souris River	30-Aug-24	20.9	26.8	qPCR	Inconclu sive	NA	NA	78	0	0%	0% (0/78)	NA	NA	Not Tested	NA
Souris River	30-Aug-24	20.9	26.8	qPCR	Positive	NA	NA	156	2	1%	1% (2/156)	NA	NA	Not Tested	NA
Souris River	6-Nov-24	10.0	28.9	qPCR	Positive	31.76	26.41 - 35.93	30	2	7%	7% (2/30)	NA	NA	Not Detected	0% (0/30)
Souris River	6-Nov-24	9.7	27.7	qPCR	Positive	32.78	32.78	30	1	3%	3% (1/30)	NA	NA	Not Detected	0% (0/30)
Souris River	6-Nov-24	10.4	27.9	qPCR	Not Detected	NA	NA	30	0	0%	0% (0/30)	NA	NA	Not Detected	0% (0/30)
Souris River	6-Nov-24	8.6	27.7	qPCR	Not Detected	NA	NA	30	0	0%	0% (0/30)	NA	NA	Not Detected	0% (0/30)

South Lake	17-Oct-24	9.9	27.7	qPCR	Positive	NA	NA	80	5	6%	6% (5/80)	NA	NA	Not Tested	NA
St. Mary's Bay	3-Oct-24	NA	NA	PCR	Not Detected	NA	NA	62	0	0%	0% (0/62)	NA	NA	Not Detected	0% (0/19)
St. Peter's Bay	17-Jun-24	16.0	NA	NA	Not Detected	NA	NA	NA	0	0%	NA	NA	NA	Not Tested	NA
St. Peter's Bay	21-Oct-24	11.0	26.7	qPCR	Not Detected	NA	NA	180	0	0%	0% (0/180)	NA	NA	Not Tested	NA
St. Peter's Bay	18-Nov-24	6.3	28.6	PCR	Not Detected	NA	NA	62	0	0%	0% (0/62)	NA	NA	Not Tested	NA
Sunbury Cove	19-Jul-24	24.0	NA	qPCR	Positive	NA	NA	35	14	40%	40% (14/35)	NA	NA	Not Tested	NA
Sunbury Cove	19-Jul-24	24.0	NA	qPCR	Positive	NA	NA	35	15	43%	43% (15/35)	NA	NA	Not Tested	NA
Tryon River	25-Sep-24	16.2	18.9	qPCR	Positive	22.70	9.99-32.62	81	79	98%	98% (79/81)	NA	NA	Not Detected	0% (0/81)
Tryon River	15-Oct-24	NA	NA	PCR	Positive	NA	NA	60	53	88%	88% (53/60)	NA	NA	Not Tested	NA
Vernon River	15-Jul-24	26.0	25.0	PCR	Not Detected	NA	NA	25	0	0%	0% (0/25)	NA	NA	Not Tested	NA
Vernon River	3-Sep-24	19.9	29.0	NA	Not Detected	NA	NA	NA	0	0%	NA	NA	NA	Not Tested	NA
Vernon River	3-Sep-24	19.9	29.0	NA	Not Detected	NA	NA	NA	0	0%	NA	NA	NA	Not Tested	NA
Victoria	21-Oct-24	NA	NA	PCR	Positive	NA	NA	62	28	45%	45% (28/62)	NA	NA	Not Tested	NA