PEI Oyster Monitoring Report

2021 Report

Technical Report # 269

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BACKGROUND

The Oyster Monitoring Program (OMP) is a technical service provided to PEI oyster growers by the Department of Fisheries and Communities (DFC). The OMP has been in place since 2001 and is designed to provide Island oyster growers with information to assist them in oyster seed collection and the management of their oyster farm. The Program also allows DFC and industry members to monitor the timing and magnitude of oyster spawning in Island river systems.

The OMP's primary purpose is to collect and provide information on larvae abundance and size to oyster growers to assist them in deciding when to deploy their spat collectors. Sampling is carried out at several sites across the province however sampling effort is highest in the Bideford, Foxley River, East River and Vernon-Orwell systems which are the major oyster seed collection areas on PEI. Monitoring is typically carried out between June and August and results are communicated to growers as it is collected throughout the oyster spawning season.

Figure 1. Oyster seed collectors.

At the time of this report, the landings for 2021 have yet to be released. The oyster landings in PEI in 2020 were 3,453 tonnes - a decrease of ~1,400 tonnes from landings in 2019 (Figure 2). The value of landed oysters decreased from $17.23 million in 2019 to $12.18 million in 2020. Overall, oyster landings and the economic value of the oyster industry, which includes both aquaculture and the shellfishery, to the province have been increasing since 2010 with the exception of 2020 where oyster landings and economic value decreased due to the impacts of the COVID- 19 pandemic (Figure 2). With the COVID- 19 vaccines and the return to normal, the oyster industry looks to rebound for 2021. Hence, sufficient oyster seed supply is critical to the aquaculture industry as oyster production continues to increase.

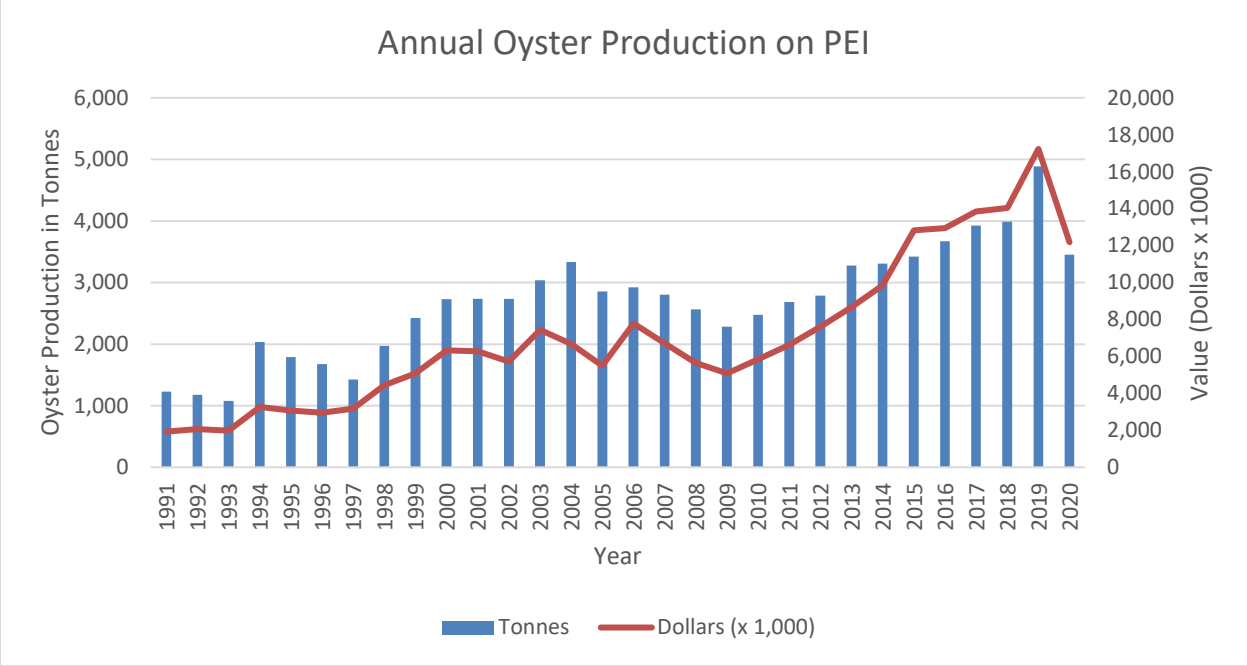


Figure 2. PEI oyster landings and values, 1991-2020.

METHODS

Monitoring Sites

Data was collected from 17 monitoring sites in 2021 (Figure 3). Sampling locations in Eastern PEI were East River (Cranberry Wharf and MacWilliam's Seafood), Pownal Bay, Orwell River, Vernon River, and New London. The New London site was added to the OMP due to increased interest by industry in developing new oyster seed collection areas. Western sampling locations included three sites in Bideford River (Station, Paugh's Creek, and Green Park), three sites in Foxley River (Lot 10, Lot 6 and Gibb's Creek), Enmore River, Percival River, Dock River, Bentick Cove, and Grand River. In 2021, Dunk River, Wilmont River and Rustico were removed because there was no collection in these areas and there had been increased interest in other areas (New London). Maps displaying the exact locations of each sampling site are found in Appendix III.

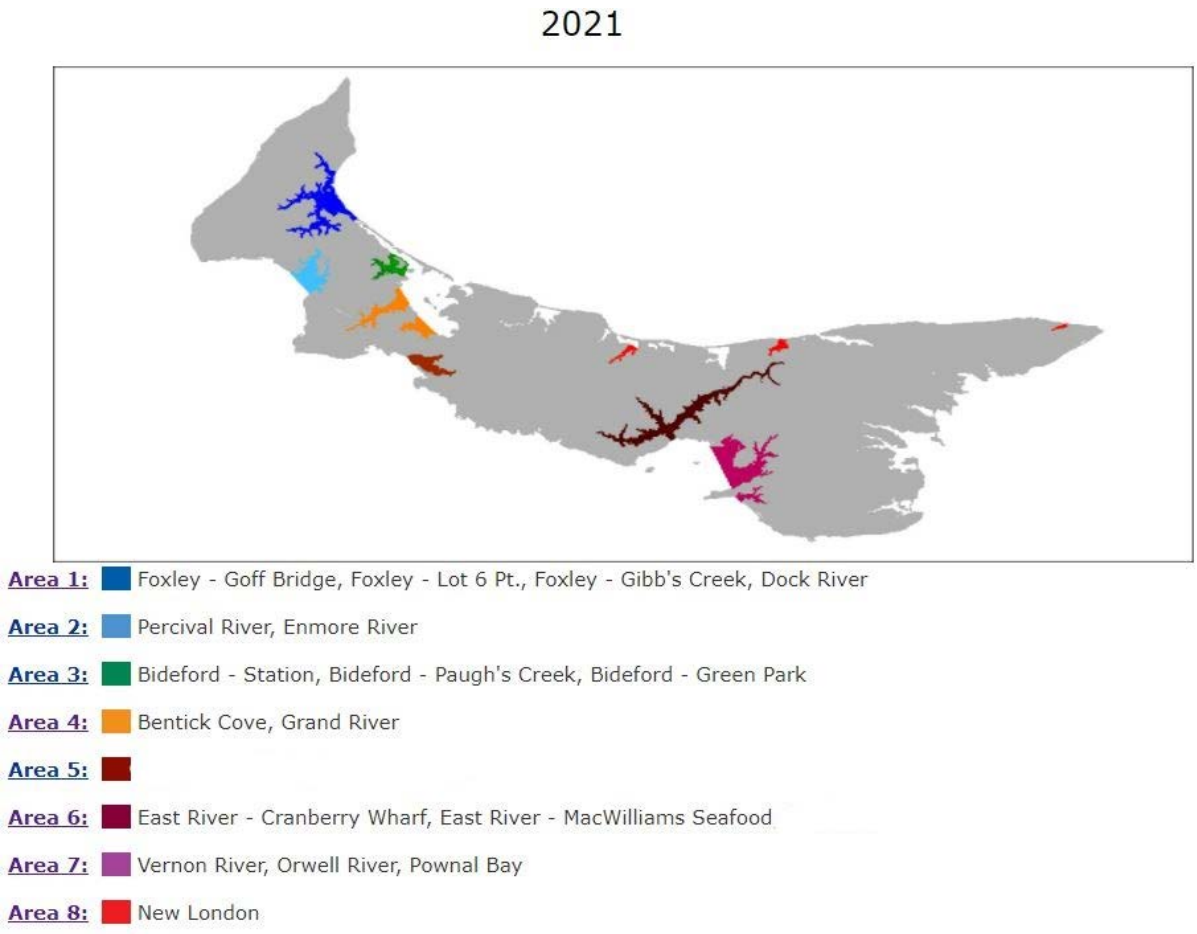


Figure 3. Map of PEI showing general location of 2021 OMP sampling sites.

Larvae Monitoring

Larvae samples were collected from June 22 to August 18. Sampling frequency at each site ranged from 1-3 times per week with more frequent sampling occurring during the peak setting period (mid July to early August). Samples were obtained by towing a 2.5 m (5 ft) long plankton net (30 cm diameter mouth, 63 µm mesh net and bucket), from the surface to mid water column, at idle speed for approximately 5 minutes (Figure 4). Samples were transferred to a 1 L bottle and taken to the lab for analysis. Water temperature and salinity were recorded at each site at the time of sampling. To help isolate oyster larvae in the lab, samples were sorted by size using two sieves (44 µm and 308 µm). The screened sample was then transferred to a 1 L beaker, where it was stirred to concentrate the contents at the bottom of the beaker. A 1 mL subsample was collected using a pipette and placed on a gridded slide for microscopic examination (Figure 4). The concentration (low = 1-5, medium = 6-19, high = 20-99, and very high >100), total number of larvae, size range of oyster larvae in sample and larvae >250 µm (250 µm larvae take 1-3 days to reach a setting size of 365 µm) in the subsample were measured and recorded.

Figure 4. Plankton net used for sampling (left) and DFC personnel examining oyster larvae sample in the lab (right).

If the subsample contained a very high number of larvae, half the slide was examined, and an estimate provided for the total number of larvae for the 1 mL subsample. The concentration, total number, and size range for all oyster larvae and for larvae >250 µm, as well as water conditions (temperature and salinity) were uploaded to the Oyster Monitoring website https://www.princeedwardisland.ca/en/feature/view-oyster-monitoring-results#/service/OysterMonitoring/OysterMonitoringSearch and recorded on the OMP's voice mail system (1-888-831-5801).

Spat-fall

The level and timing of setting oyster larvae (i.e., spat) were monitored at the Station site (Bideford River) and the Lot 10/Goff's Bridge site (Foxley River) using shell collectors consisting of ~6 ft lengths of galvanized wire with three scallop shells placed at different locations on the wire: 30 cm (1 ft), 60 cm (3 ft), and 90 cm (5 ft) (Figure 5). Shell collectors were hung from collector lines for 7 days, retrieved and taken to the lab for reading. Recently set oyster spat were identified and the total number for each shell counted using a dissecting microscope.

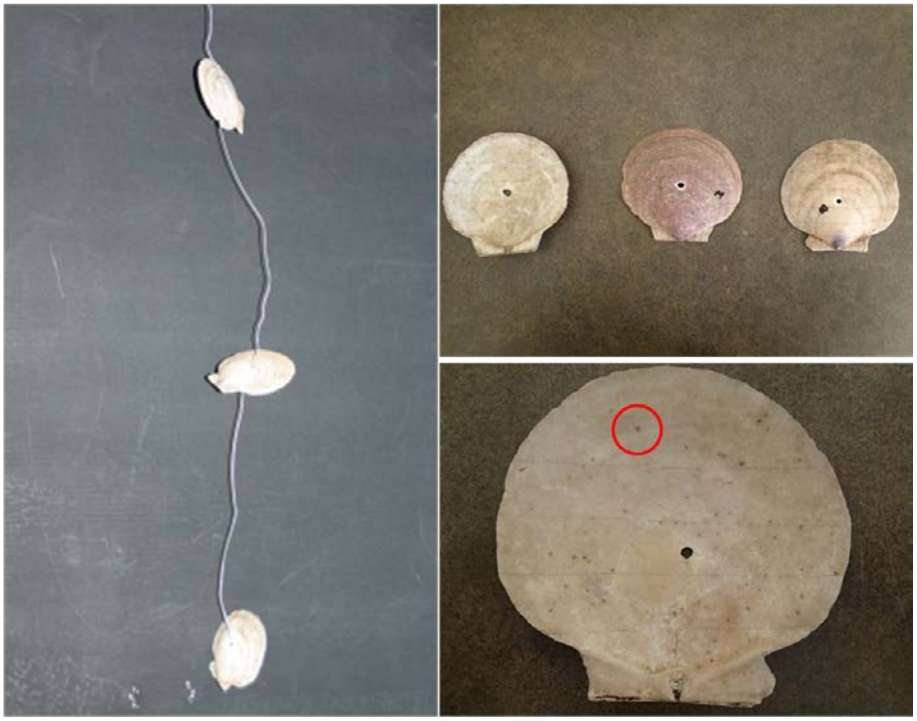


Figure 5. Short-term oyster spat collectors (STC) ready to be deployed (*left*), prepared for reading in lab (*upper right*) and individual scallop shell showing oyster spat set (*lower right*).

Tunicate Monitoring

Oyster collector lines as well as oyster and mussel farming operations in several Island rivers were examined by Aquaculture Division personnel to collect information on tunicate densities as well as the introduction of new aquatic invasive species. Monitoring efforts focused on important seed collection areas and high risk non-infested areas.

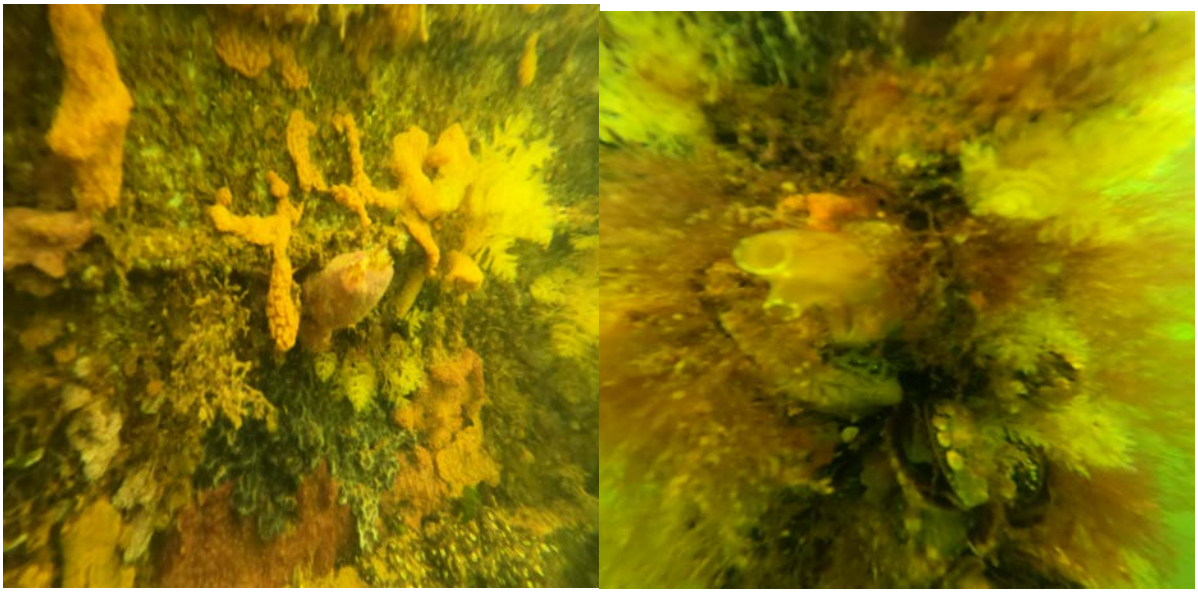


Figure 6. Examining oyster pods and mussel lines in South West River for tunicates (left) and close-up of fouled oyster seed pod showing sea squirts (*Molgula sp.*, underside of collector) and violet tunicate (*Botrylloides violaceus*, pink colour). Close up view of *Ciona* on back line of mussel crop in St. Peter's Bay (right).

RESULTS

Larvae Monitoring

A total of 312 larvae samples were collected between June 22 and August 18 in 2021. The concentration, size ranges and total numbers of larvae collected as well as water temperature at each site are shown in Appendix I. The pattern of seasonal abundance of oyster larvae >250 µm for all primary and secondary sites are shown in Appendix II. Oyster larvae were first observed between June 24^{h} and June 29th at most sites across PEI. Larvae >250 µm were first observed between July 5th and 13th at western sites except for Foxley which was between July 19th and 21st,

and eastern sites which was between July 14th and 22nd (Appendix I). In general, larvae >250 µm appeared later at some of the secondary sites (lower concentration of collection, sampled 1-2 times per week) compared to the primary sites (higher concentration of collection, sampled 3 times a week). Peak numbers of larvae >250 µm were observed between July 20th and July 30th in all areas except for Enmore River (July 13th), Percival River (July 15th) and Grand River (August 5th) (Appendices I and II).

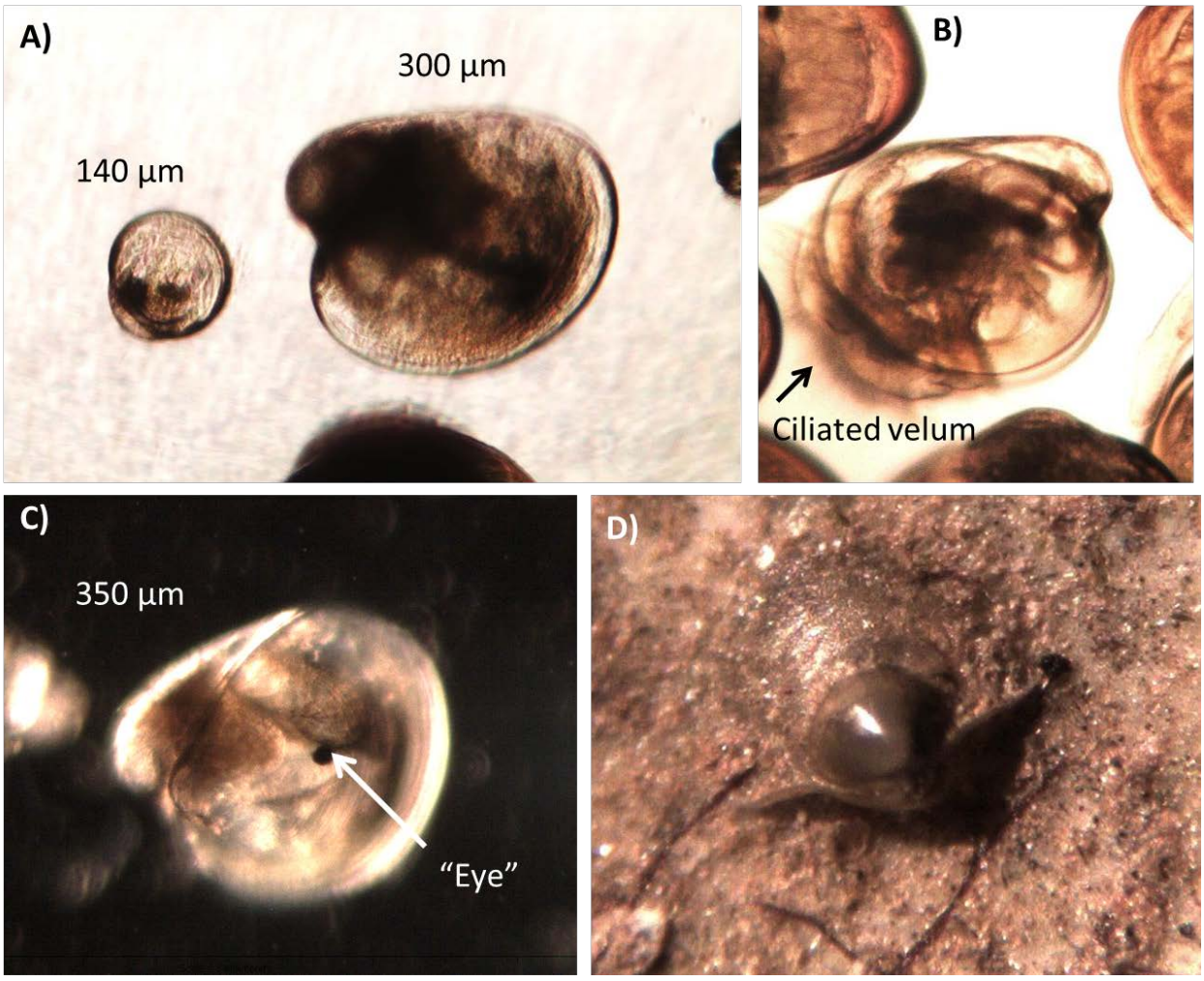


Figure 7. Oyster larvae at different stages of development. A) 140 and 300 µm larvae, B) Free swimming larvae showing ciliated velum, C) Eyed larvae ready to set, and D) Settled larvae (spat) on collector shell.

Tunicate Monitoring

Current distribution maps of invasive tunicates (clubbed, vase, golden star and violet) and other aquatic invasive species on PEI are shown in Appendix IV. The presence of the clubbed tunicate is now in some of our oyster growing areas. Additionally, with the growth and interest in oyster culture, there are now oyster growing operations in all areas of the province including areas with vase tunicates. The process of regular air drying (every 2-3 weeks) as a normal husbandry practice appears to be sufficient for management of these invasive species on oyster grow-out gear, however, some fouling on oyster spat collection gear has created some issues for growers. Observation have shown that vase tunicate has been found in Borden (2019), St. Peter's Bay (2020), New London (2020 Unconfirmed), and Alberton (2021). Clubbed tunicate has been found in Percival (2021), Dock (2021) and Alberton (2021). Invasive tunicate species as well as native fouling organisms continue to be a concern for the Island's aquaculture industry. However, the ability to control gear fouling by air-drying oyster growing equipment has proven to be very effective and is widely used by PEI oyster growers.

DISCUSSION

Larvae (spat-fall prediction)

In 2021, oyster larvae numbers were variable across the Island. The first observation of oyster larvae and peak numbers of larvae >250 µm appeared to meet the normal expectations of historical trends. Overall, the onset of the presence and peaks in abundance of oyster larvae in Island waters (mid July – early Aug) remain consistent with historical OMP data trends. Fall inspection of oyster spat collector lines by DFC personnel as well as anecdotal reports from oyster growers indicated that 2021 was an average year for many growers. Collection in the east namely Vernon River, Pownal Bay, and Orwell River showed the best spat collection for 2021. As with most years, some areas performed better than others. There are several environmental factors, as well as grower and husbandry factors, that play a role in spatfall. However, identifying a specific cause for poor or more abundant spatfall is challenging because oyster spawning is initiated by a sudden increase in water temperature.[1] It is possible that interruptions in water temperature can affect spawning

[1] Medcof, J.C. (1939), Larval Life of the Oyster (Ostrea virginica) in Bideford River. Journal of Fisheries Board of Canada

conditions and larval survival. Results from 2021 show that there remains considerable variation in larvae numbers and timing of peak larvae abundance between Island river systems, particularly eastern areas versus western areas. The low concentrations of oyster larvae reported at some sites may have contributed to less than optimal oyster seed collection in those areas. Anti-fouling treatments (lime dipping) continue to be an important measure against unwanted gear fouling for the successful collection of oyster spat for most growers. While there were no major problems reported by fouling organisms or predators in 2021, the high concentrations of newly settled barnacles (*Balanus crenatus*) on collectors continues to be a concern for many growers.

Limitations of the OMP

Several factors make oyster larvae sampling difficult to standardize. Larvae concentrations are not typically evenly distributed vertically in the water column or within river systems and are influenced heavily by tidal flow. Hence, tows that are conducted at specific times irrespective of tidal stage may lead to over or underestimation of oyster larvae concentrations. Furthermore, fresh water influences the vertical distribution of larvae by causing larvae to move lower in the water column to find suitable salinity levels. Therefore, precipitation events can affect the number of oyster larvae in tow samples. Although efforts are made to maintain a consistent flow through the plankton net, current and boat speeds can potentially affect the volume of water filtered and thus numbers of larvae captured. Lastly, the sampling interval (sampling may occur as often as every 2 days in some areas but only once or twice a week in others) may make it difficult to compare larvae concentrations between river systems.

APPENDIX I

2021 Oyster Monitoring Data by Site

Foxley River- Goff's Bridge			
Date	**Size Range**	**Larvae Sample**	**Water Temp**
6/22/2021	0	0	22.5
6/28/2021	90	0	21.1
6/30/2021	95-110	0	23.1
7/5/2021	85-130	0	14.7
7/7/2021	100-230	0	19.7
7/9/2021	100-170	0	19.9
7/12/2021	85-180	0	23.9
7/14/2021	90-210	0	22.3
7/16/2021	100-220	0	22.2
7/19/2021	85-150	0	24.1
7/21/2021	110-310	52	22.2
7/23/2021	110-330	40	19.2
7/26/2021	120-320	1050	21.7
7/28/2021	130-310	136	21.5
7/30/2021	180-320	62	21.2
8/2/2021	130-320	14	21.4
8/4/2021	110-330	34	20.4
8/6/2021	210-330	14	21.3
8/9/2021	230-340	18	21.7
8/11/2021	300-340	16	23.1
8/16/2021	210	0	24.9

Foxley River- Lot 6 PT.			
Date	**Size Range**	**Larvae Sample**	**Water Temp**
6/22/2021	0	0	21.9
6/28/2021	85	0	19.9
6/30/2021	85	0	22.1
7/5/2021	85-100	0	15.1
7/7/2021	100-160	0	18.7
7/9/2021	110-120	0	19
7/12/2021	90-150	0	20.6

7/14/2021	**100-150**	**0**	**21.5**
7/16/2021	**90-230**	**0**	**21.7**
7/19/2021	**90-320**	**24**	**22.6**
7/21/2021	**110-300**	**108**	**21.8**
7/23/2021	**110-330**	**512**	**19.6**
7/26/2021	**110-350**	**238**	**21.2**
7/28/2021	**110-310**	**124**	**21.1**
7/30/2021	**110-330**	**148**	**21.1**
8/2/2021	**150-340**	**156**	**20**
8/4/2021	**130-340**	**166**	**19.3**
8/6/2021	**130-330**	**98**	**20.4**
8/9/2021	**190-330**	**48**	**21.4**
8/11/2021	**200-330**	**42**	**22.4**
8/16/2021	**100-330**	**10**	**24.4**

Foxley River- Gibb's Creek			
Date	**Size Range**	**Larvae Sample**	**Water Temp**
6/28/2021	**90-110**	**0**	**20.1**
6/30/2021	**0**	**0**	**21.8**
7/5/2021	**85-150**	**0**	**15.9**
7/7/2021	**90-110**	**0**	**18.2**
7/9/2021	**110-160**	**0**	**20.7**
7/12/2021	**95-170**	**0**	**20.6**
7/14/2021	**100-260**	**4**	**21.9**
7/16/2021	**100-270**	**0**	**21.4**
7/19/2021	**120-300**	**10**	**22.3**
7/21/2021	**110-280**	**88**	**22.2**
7/23/2021	**120-300**	**320**	**19.9**
7/26/2021	**120-320**	**46**	**21.6**
7/28/2021	**90-320**	**190**	**21.3**
7/30/2021	**110-310**	**44**	**21.5**
8/2/2021	**170-330**	**6**	**20.9**
8/4/2021	**130-320**	**24**	**21.6**
8/6/2021	**140-300**	**2**	**21.1**
8/9/2021	**200-320**	**4**	**21.9**
8/11/2021	**190-330**	**14**	**22.4**
8/16/2021	**0**	**0**	**25.3**

Dock River			
Date	**Size Range**	**Larvae Sample**	**Water Temp**
6/30/2021	**0**	**0**	**19.3**
7/8/2021	**90**	**0**	**18.8**
7/15/2021	**90-160**	**0**	**21**
7/21/2021	**110-300**	**40**	**19.3**
7/28/2021	**110-300**	**190**	**20.5**
8/2/2021	**110-340**	**80**	**20**
8/9/2021	**190-340**	**36**	**20.2**

Bideford River- Station			
Date	**Size Range**	**Larvae Sample**	**Water Temp**
6/24/2021	**90**	**0**	**20.9**
6/28/2021	**100-110**	**0**	**22.1**
6/30/2021	**90-160**	**0**	**22.4**
7/5/2021	**100-200**	**0**	**16.9**
7/7/2021	**0**	**0**	**19.3**
7/9/2021	**90-240**	**0**	**18.6**
7/12/2021	**110-320**	**10**	**19.4**
7/14/2021	**110-320**	**34**	**21.7**
7/16/2021	**100-330**	**0**	**23.3**
7/19/2021	**90-310**	**14**	**23.0**
7/21/2021	**100-300**	**4**	**21.6**
7/23/2021	**110-290**	**22**	**20.8**
7/26/2021	**110-330**	**14**	**22**
7/28/2021	**90-310**	**116**	**21**
7/30/2021	**110-340**	**158**	**22**
8/2/2021	**110-250**	**0**	**21.6**
8/4/2021	**110-330**	**40**	**20.8**
8/6/2021	**150-330**	**22**	**21.7**
8/9/2021	**210-310**	**14**	**22.3**
8/11/2021	**210-250**	**0**	**23.2**
8/16/2021	**210-270**	**2**	**23.3**

Bideford River- Paugh's Creek			
Date	**Size Range**	**Larvae Sample**	**Water Temp**
6/24/2021	**90**	**0**	**21.1**
6/28/2021	**90-130**	**0**	**21.8**
6/30/2021	**115-160**	**0**	**22.1**
7/5/2021	**90-240**	**0**	**17**
7/7/2021	**100-270**	**2**	**17.7**
7/9/2021	**130-300**	**4**	**18.2**
7/12/2021	**85-320**	**6**	**19.2**
7/14/2021	**90-340**	**10**	**23.4**
7/16/2021	**100-310**	**24**	**22.9**
7/19/2021	**90-350**	**30**	**24.2**
7/21/2021	**100-300**	**20**	**20.8**
7/23/2021	**90-320**	**24**	**20.9**
7/26/2021	**110-350**	**18**	**22.7**
7/28/2021	**90-310**	**42**	**20.9**
7/30/2021	**110-310**	**156**	**20.9**
8/2/2021	**110-310**	**4**	**21.6**
8/4/2021	**130-310**	**14**	**20.7**
8/6/2021	**170-330**	**16**	**22.5**
8/9/2021	**210-330**	**8**	**22.5**
8/11/2021	**250-310**	**6**	**23.5**
8/16/2021	**310-340**	**8**	**23**

Bideford River- Green Park			
Date	**Size Range**	**Larvae Sample**	**Water Temp**
6/24/2021	**0**	**0**	**20.5**
6/28/2021	**90-110**	**0**	**21.5**
6/30/2021	**90-150**	**0**	**23.2**
7/5/2021	**90-270**	**2**	**15.7**
7/7/2021	**100-270**	**12**	**18.6**
7/9/2021	**90-250**	**0**	**18.2**
7/12/2021	**90-350**	**8**	**19.4**
7/14/2021	**90-350**	**8**	**20.7**
7/16/2021	**130-340**	**40**	**20.8**
7/19/2021	**100-130**	**2**	**22.4**
7/21/2021	**110-320**	**8**	**21.7**
7/23/2021	**100-320**	**10**	**20**
7/26/2021	**100-320**	**48**	**20.8**
7/28/2021	**90-310**	**62**	**21.4**
7/30/2021	**110-340**	**1368**	**20.3**
8/2/2021	**110-310**	**24**	**20**
8/4/2021	**110-340**	**318**	**19.9**
8/6/2021	**150-330**	**138**	**20.5**
8/9/2021	**260-330**	**14**	**21.7**
8/11/2021	**150-340**	**12**	**21.9**
8/16/2021	**340**	**2**	**24.3**

Enmore River			
Date	**Size Range**	**Larvae Sample**	**Water Temp**
6/29/2021	**95-150**	**0**	**22.6**
7/2/2021	**90-200**	**0**	**18.8**
7/6/2021	**85-240**	**0**	**18.7**
7/8/2021	**90-230**	**0**	**21.3**
7/13/2021	**100-330**	**244**	**22**
7/15/2021	**100-320**	**26**	**21.1**
7/20/2021	**100-300**	**27**	**23.8**
7/22/2021	**120-270**	**2**	**20.7**
7/27/2021	**150-320**	**4**	**21.1**
7/29/2021	**110-270**	**10**	**21.4**
8/3/2021	**150**	**0**	**19.8**
8/5/2021	**110-330**	**20**	**23.5**
8/10/2021	**270**	**2**	**22.3**
8/12/2021	**190-330**	**16**	**23.8**
8/18/2021	**0**	**0**	**24.9**

Percival River			
Date	**Size Range**	**Larvae Sample**	**Water Temp**
6/29/2021	**95-150**	**0**	**22.5**
7/2/2021	**90-200**	**0**	**20.1**
7/6/2021	**100-270**	**18**	**17.7**
7/8/2021	**100-290**	**12**	**20.1**
7/13/2021	**90-340**	**16**	**22.3**
7/15/2021	**90-350**	**198**	**21.7**
7/20/2021	**90-310**	**14**	**23.7**
7/22/2021	**110-320**	**135**	**21.2**
7/27/2021	**110-290**	**48**	**21.2**
7/29/2021	**64**	**100**	**21.3**
8/3/2021	**110-310**	**42**	**19.7**
8/5/2021	**130-340**	**34**	**21.3**
8/10/2021	**190-340**	**40**	**22**
8/12/2021	**310**	**2**	**23.6**
8/18/2021	**0**	**0**	**24**

Grand River			
Date	**Size Range**	**Larvae Sample**	**Water Temp**
6/24/2021	**90**	**0**	**22.7**
6/29/2021	**95-130**	**0**	**24.1**
7/2/2021	**85-165**	**0**	**17.4**
7/6/2021	**90-250**	**0**	**19.8**
7/8/2021	**100-270**	**58**	**21**
7/13/2021	**130-350**	**50**	**23.3**
7/15/2021	**100-290**	**16**	**20.9**
7/20/2021	**100-350**	**246**	**22.6**
7/22/2021	**110-370**	**184**	**19**
7/27/2021	**130-330**	**162**	**21.1**
7/29/2021	**100-290**	**116**	**19.9**
8/3/2021	**150-340**	**98**	**18.6**
8/5/2021	**150-330**	**398**	**21**
8/10/2021	**310-330**	**10**	**21.5**
8/12/2021	**270-340**	**18**	**23**
8/18/2021	**100-340**	**14**	**22.9**

Bentic Cove			
Date	**Size Range**	**Larvae Sample**	**Water Temp**
7/8/2021	**90-110**	**0**	**19.3**
7/15/2021	**95-170**	**0**	**20.6**
7/20/2021	**90-340**	**14**	**22.8**
7/29/2021	**130-350**	**2000**	**20.9**
8/3/2021	**290-330**	**26**	**19.5**
8/10/2021	**210-340**	**44**	**21.6**
8/18/2021	**0**	**0**	**22.6**

East River- MacWilliams Seafood			
Date	**Size Range**	**Larvae Sample**	**Water Temp**
6/23/2021	**0**	**0**	**21.4**
6/28/2021	**90-110**	**0**	**21.5**
6/30/2021	**85-115**	**0**	**22.6**
7/2/2021	**90-140**	**0**	**20.4**
7/5/2021	**85-170**	**0**	**16.8**
7/7/2021	**130**	**0**	**19**
7/12/2021	**110-200**	**0**	**20.9**
7/14/2021	**110-240**	**0**	**21.4**
7/19/2021	**90-320**	**6**	**22.9**
7/21/2021	**110-320**	**20**	**23.4**
7/23/2021	**100-300**	**2**	**20.4**
7/26/2021	**190-300**	**18**	**21.8**
7/28/2021	**90-300**	**4**	**22**
7/30/2021	**230-250**	**0**	**21.4**
8/2/2021	**280**	**2**	**20.6**
8/4/2021	**220-250**	**0**	**20**
8/6/2021	**290**	**2**	**21.1**
8/9/2021	**340**	**2**	**21.9**
8/11/2021	**330**	**2**	**22.9**
8/13/2021	**210-300**	**2**	**24.1**
8/17/2021	**110**	**0**	**24.1**

East River- Cranberry Wharf			
Date	**Size Range**	**Larvae Sample**	**Water Temp**
6/28/2021	**95**	**0**	**21.7**
6/30/2021	**85-95**	**0**	**22.5**
7/2/2021	**90-110**	**0**	**20.3**
7/5/2021	**0**	**0**	**16.8**
7/7/2021	**100-160**	**0**	**19.5**
7/9/2021	**90-190**	**0**	**19.3**
7/12/2021	**100**	**0**	**21**
7/14/2021	**110**	**0**	**21.5**
7/16/2021	**100-330**	**2**	**21.7**
7/19/2021	**90-110**	**0**	**23.3**
7/21/2021	**100-310**	**2**	**22.6**
7/23/2021	**110-200**	**0**	**20.3**
7/26/2021	**290-330**	**10**	**21.4**
7/28/2021	**280-290**	**4**	**21.9**
7/30/2021	**0**	**0**	**21.2**
8/2/2021	**270-310**	**4**	**20.5**
8/4/2021	**130-290**	**4**	**20.5**
8/6/2021	**150-310**	**4**	**21.4**
8/9/2021	**330**	**2**	**21.8**
8/11/2021	**210-330**	**4**	**22.6**
8/13/2021	**210-280**	**2**	**24.3**
8/17/2021	**310**	**2**	**24.3**

Vernon River			
Date	**Size Range**	**Larvae Sample**	**Water Temp**
6/23/2021	**0**	**0**	**21.7**
6/25/2021	**90-95**	**0**	**19.8**
6/28/2021	**85-100**	**0**	**22**
6/30/2021	**90-100**	**0**	**22.7**
7/2/2021	**110-150**	**0**	**19.8**
7/5/2021	**90-110**	**0**	**14.6**
7/7/2021	**130-200**	**0**	**18.4**
7/9/2021	**150-190**	**0**	**18.5**
7/12/2021	**130-260**	**2**	**20.9**
7/14/2021	**90**	**0**	**21.3**
7/16/2021	**90-270**	**4**	**21.4**
7/19/2021	**100-310**	**4**	**23**
7/21/2021	**100-330**	**66**	**23**
7/23/2021	**110-330**	**162**	**19.4**
7/26/2021	**140-320**	**36**	**20.8**
7/28/2021	**150-290**	**2**	**21.7**
7/30/2021	**220-300**	**4**	**21**
8/2/2021	**210-340**	**14**	**20.5**
8/4/2021	**230-280**	**2**	**20.1**
8/6/2021	**270-320**	**8**	**0**
8/9/2021	**230-340**	**46**	**21.7**
8/11/2021	**210-320**	**2**	**23.1**
8/13/2021	**250-340**	**14**	**24.7**
8/17/2021	**110-330**	**12**	**23.7**

Orwell River			
Date	**Size Range**	**Larvae Sample**	**Water Temp**
6/23/2021	**0**	**0**	**20.7**
6/25/2021	**0**	**0**	**20.3**
6/28/2021	**90-100**	**0**	**21.3**
6/30/2021	**85-90**	**0**	**22.3**
7/2/2021	**100-120**	**0**	**19.6**
7/5/2021	**100-160**	**0**	**14.3**
7/7/2021	**100-170**	**0**	**17.3**
7/9/2021	**150-210**	**0**	**18**
7/12/2021	**130-250**	**0**	**20**
7/14/2021	**210-310**	**2**	**20.9**
7/16/2021	**90-300**	**8**	**21.2**
7/19/2021	**90-300**	**6**	**22.6**
7/21/2021	**110-340**	**80**	**22.3**
7/23/2021	**110-320**	**196**	**18.3**
7/26/2021	**100-330**	**86**	**19.9**
7/28/2021	**130-320**	**38**	**21.3**
7/30/2021	**150-320**	**6**	**20.9**
8/2/2021	**280-310**	**6**	**19.6**
8/4/2021	**170-320**	**24**	**19.6**
8/6/2021	**190-330**	**4**	**0**
8/9/2021	**230-330**	**30**	**21.1**
8/11/2021	**310-340**	**12**	**22.5**
8/13/2021	**300**	**2**	**24.4**
8/17/2021	**150-310**	**4**	**23.4**

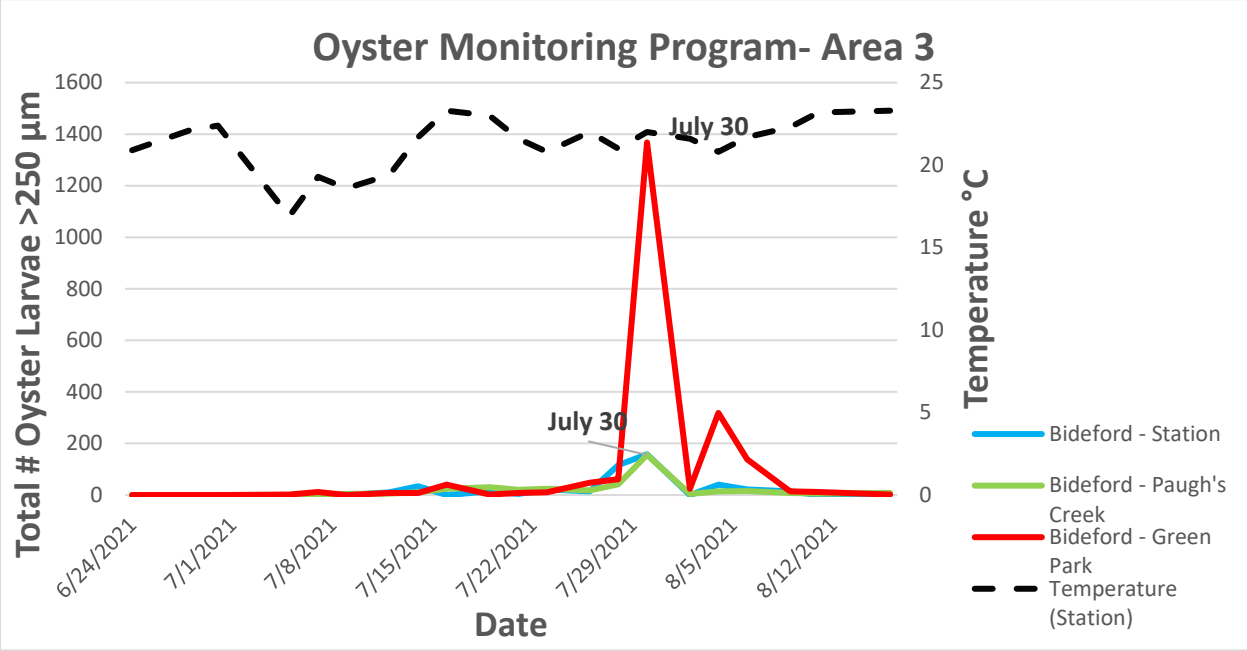
Pownal Bay			
Date	**Size Range**	**Larvae Sample**	**Water Temp**
6/28/2021	**90**	**0**	**21.6**
6/30/2021	**85-120**	**0**	**22.7**
7/2/2021	**150**	**0**	**20**
7/5/2021	**100-170**	**0**	**14.5**
7/7/2021	**110-150**	**0**	**19.2**
7/9/2021	**110-210**	**0**	**18.3**
7/12/2021	**150-230**	**0**	**20.6**
7/14/2021	**140-240**	**0**	**20.7**
7/16/2021	**90-300**	**4**	**20.7**
7/19/2021	**90-340**	**190**	**23.5**
7/21/2021	**100-340**	**342**	**23.3**
7/23/2021	**110-330**	**530**	**18.9**
7/26/2021	**130-330**	**228**	**20.1**
7/28/2021	**170-370**	**40**	**21.7**
7/30/2021	**150-340**	**24**	**20.7**
8/2/2021	**170-340**	**8**	**20**
8/4/2021	**110-340**	**166**	**20.1**
8/6/2021	**190-340**	**32**	**0**
8/9/2021	**280-340**	**243**	**21.6**
8/11/2021	**170-340**	**122**	**23**
8/13/2021	**80**	**310**	**25.2**
8/17/2021	**230-340**	**30**	**22.4**

New London			
Date	**Size Range**	**Larvae Sample**	**Water Temp**
6/29/2021	**85**	**0**	**20**
7/6/2021	**100-110**	**0**	**17**
7/8/2021	**85-200**	**0**	**19.2**
7/13/2021	**100**	**0**	**20.9**
7/15/2021	**90-110**	**0**	**20.5**
7/20/2021	**90-200**	**0**	**22.5**
7/22/2021	**100-270**	**2**	**20.3**
7/27/2021	**130-330**	**38**	**20.5**
7/29/2021	**110-350**	**26**	**20.9**
8/3/2021	**290- 340**	**10**	**19.6**
8/5/2021	**120-320**	**6**	**20.4**
8/10/2021	**220-340**	**24**	**21.3**
8/12/2021	**170-310**	**4**	**22.7**
8/17/2021	**200-220**	**0**	**23.9**

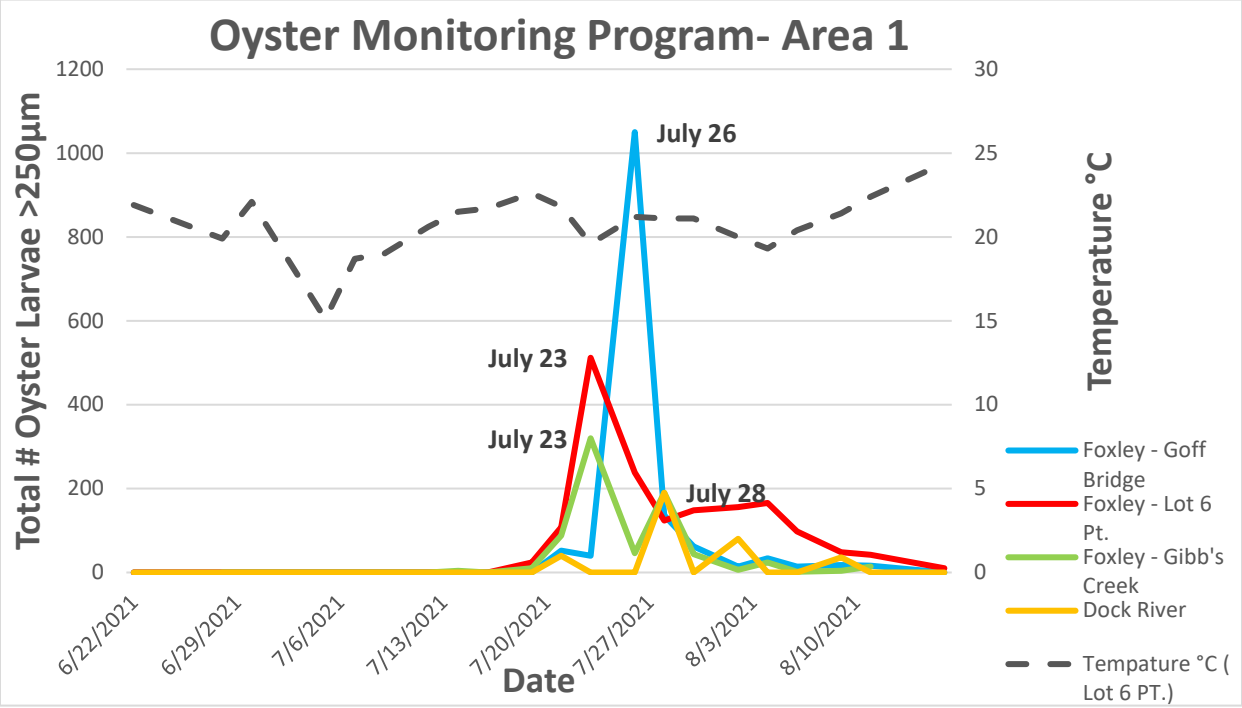
APPENDIX II

Seasonal Larvae Abundance and Water Temperature by Site

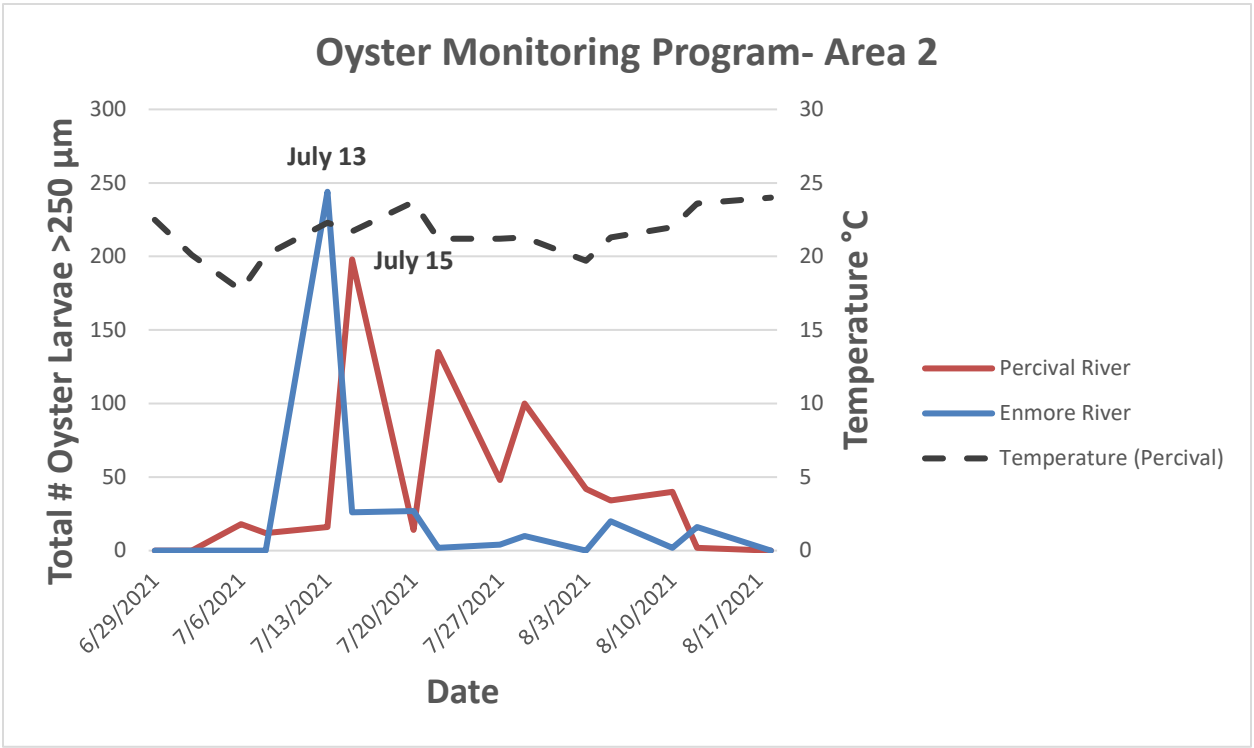
BIDEFORD RIVER



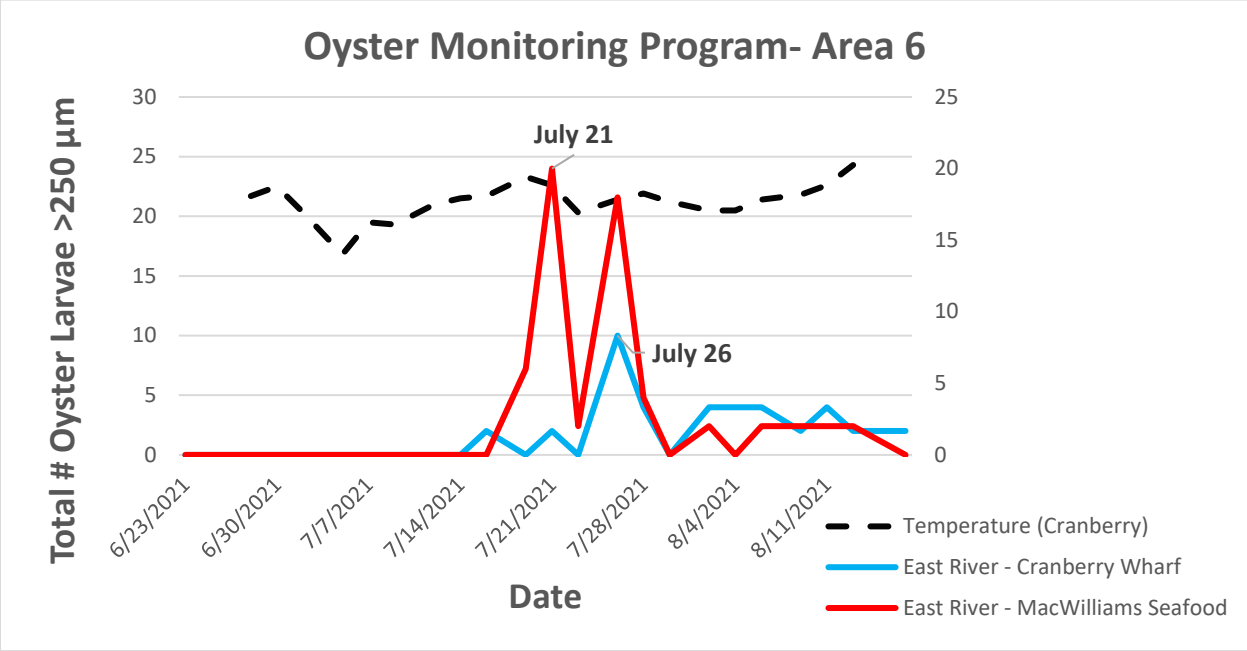
FOXLEY RIVER



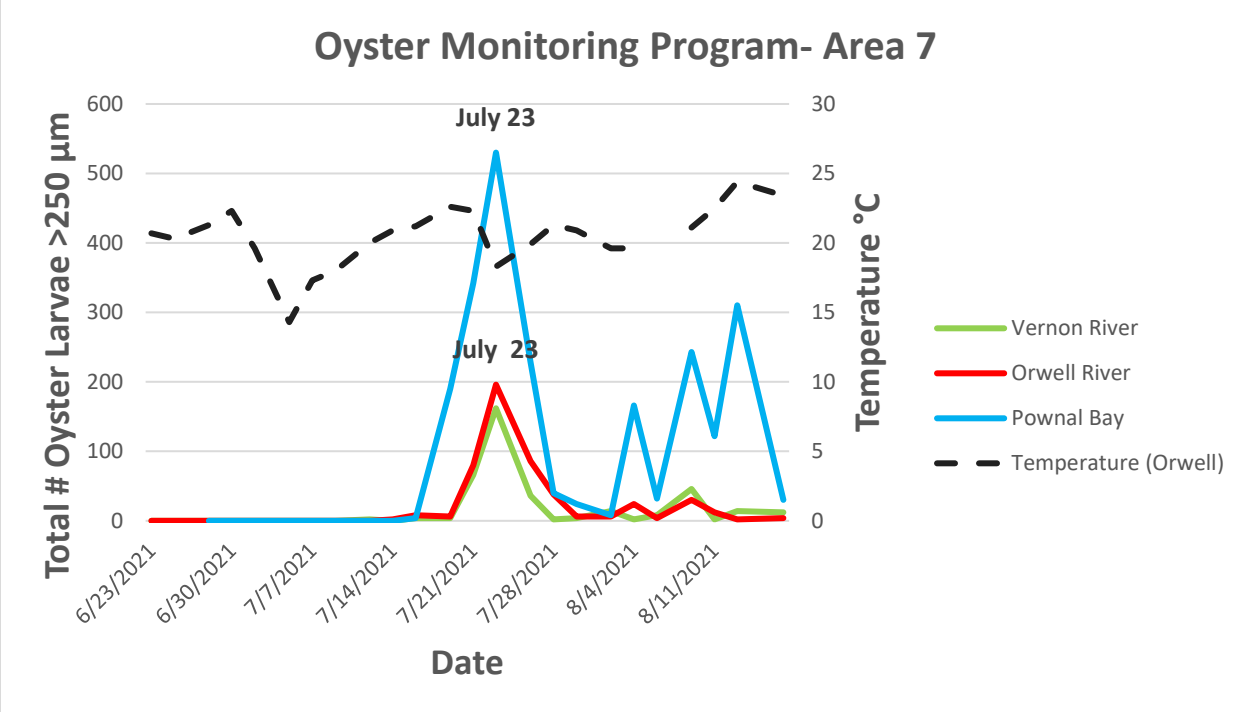
PERCIVAL and ENMORE RIVERS



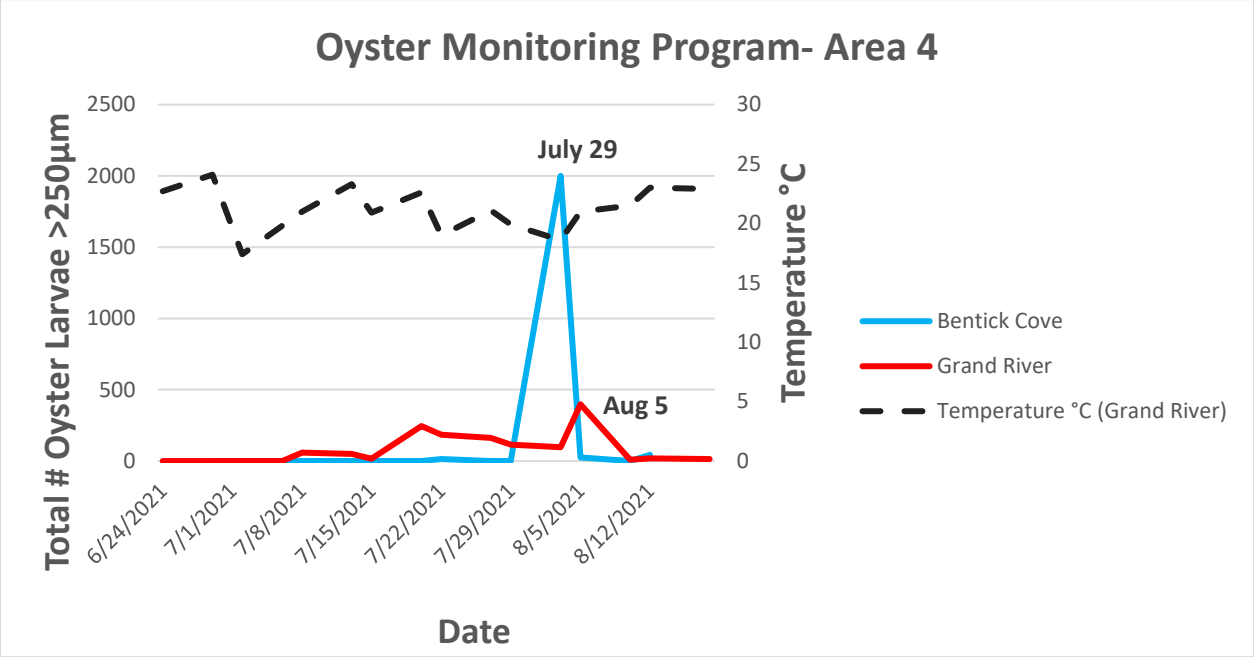
EAST RIVER



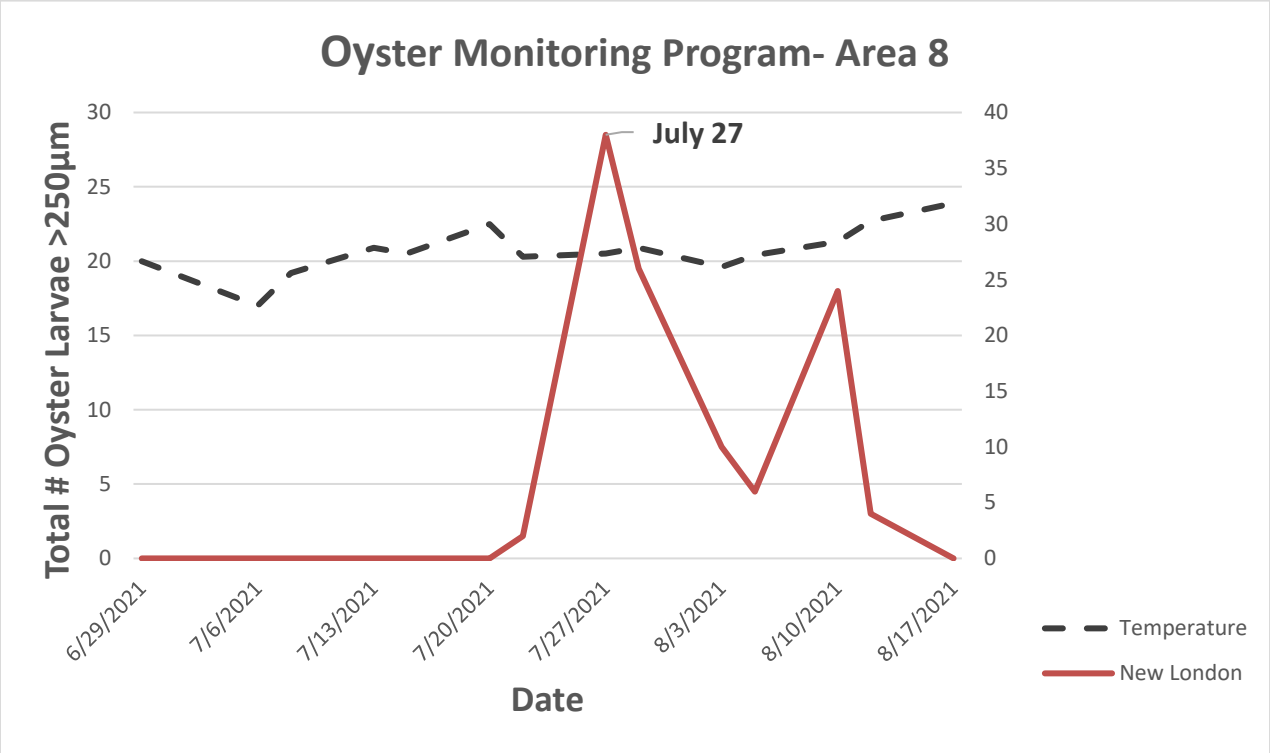
POWNAL BAY, VERNON RIVER and ORWELL RIVER



BENTICK COVE and GRAND RIVER

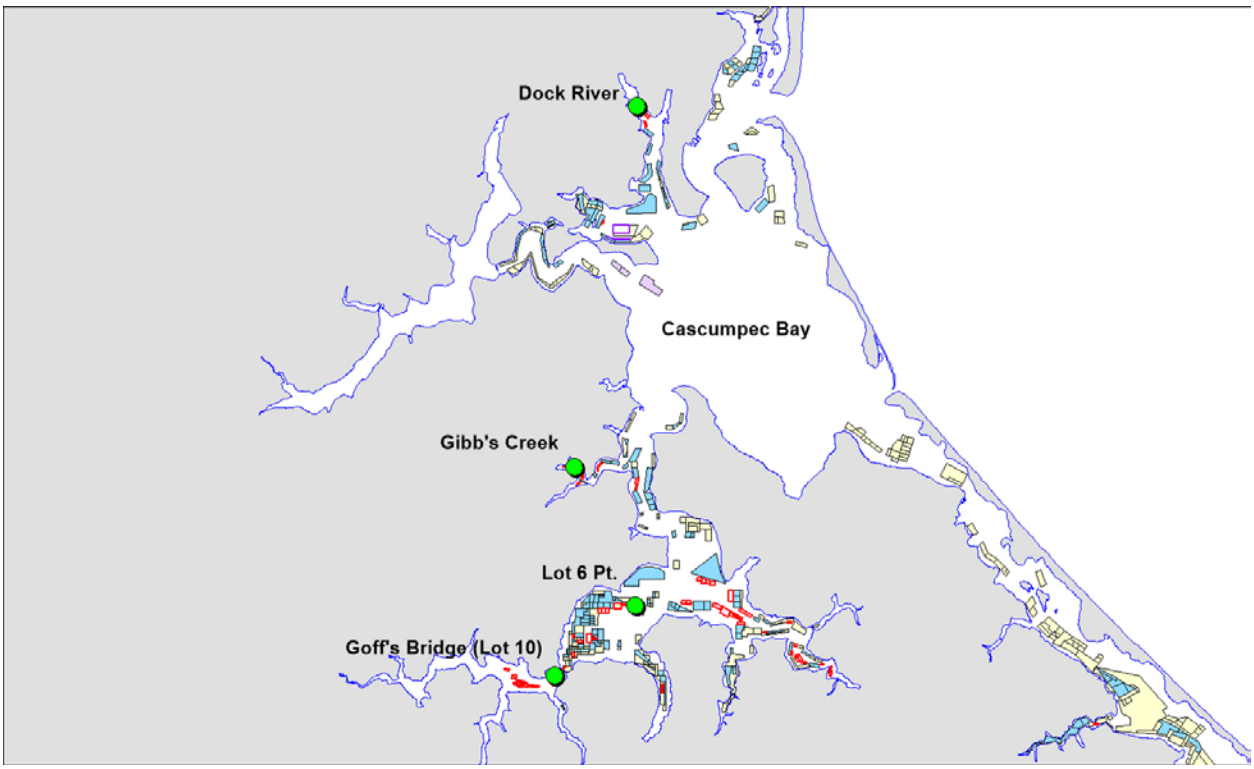


NEW LONDON

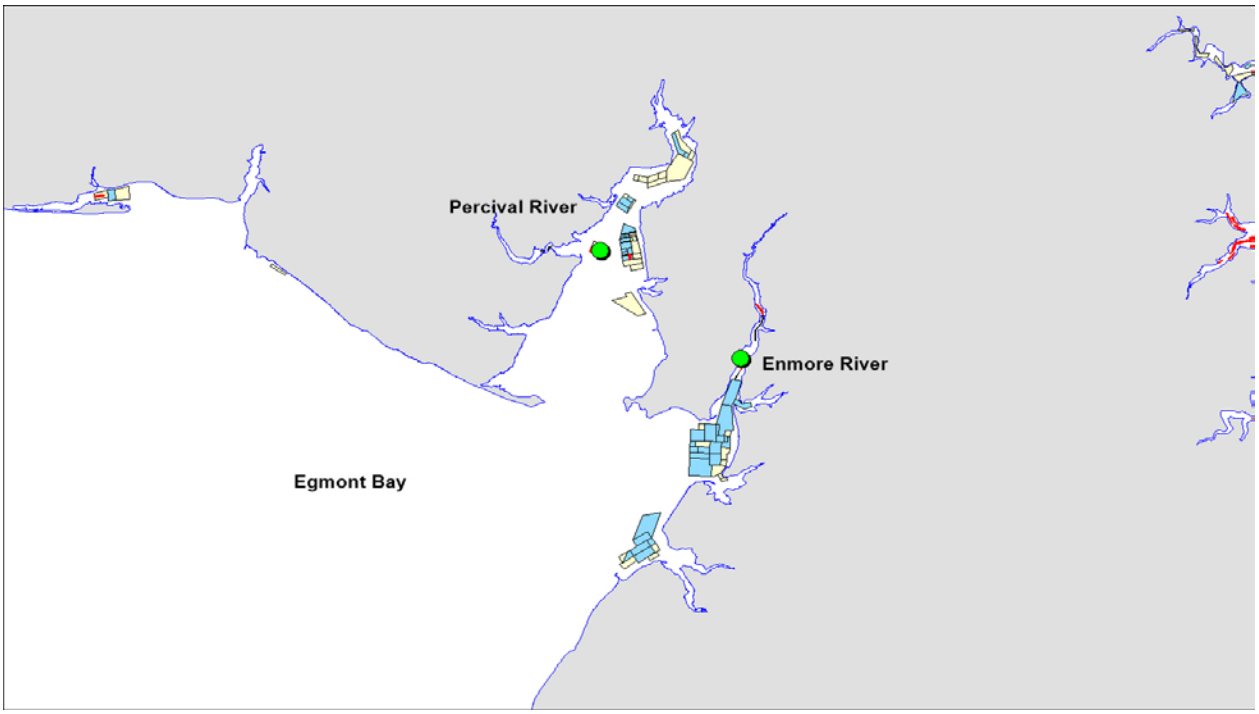


APPENDIX III

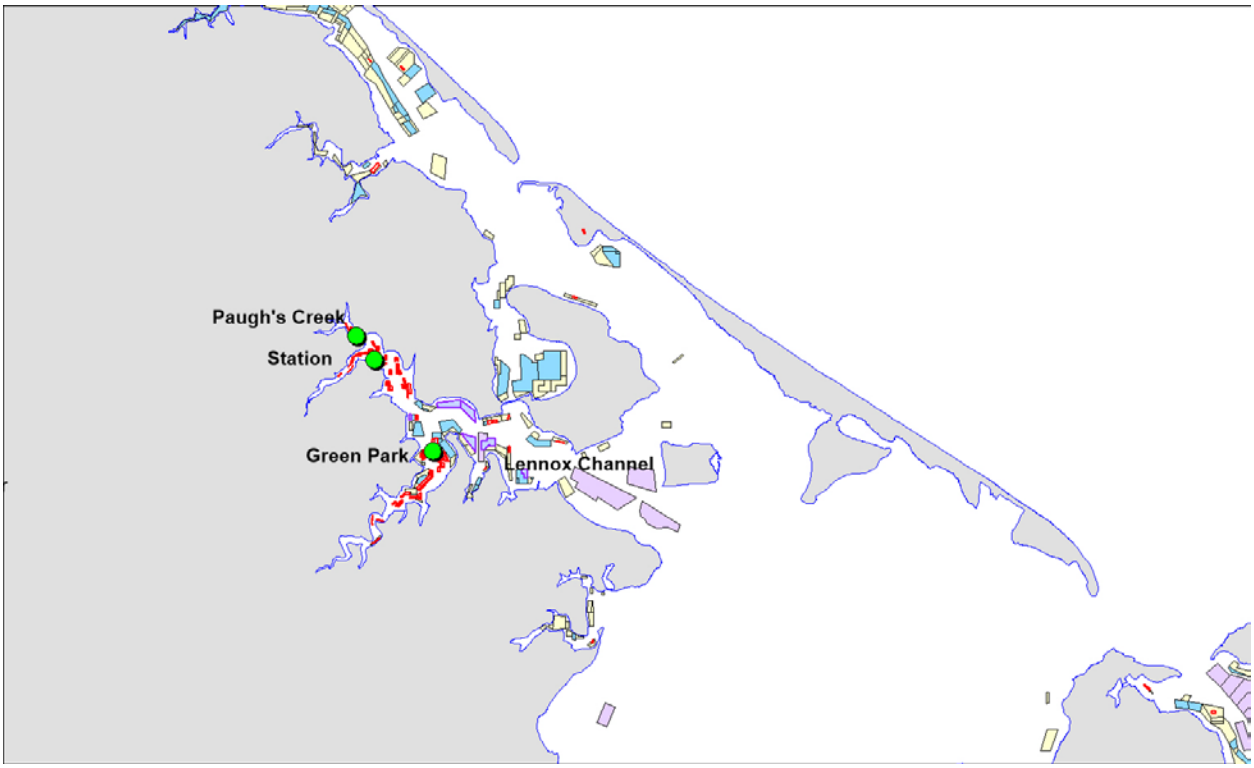
Locations of 2021 Sampling Sites



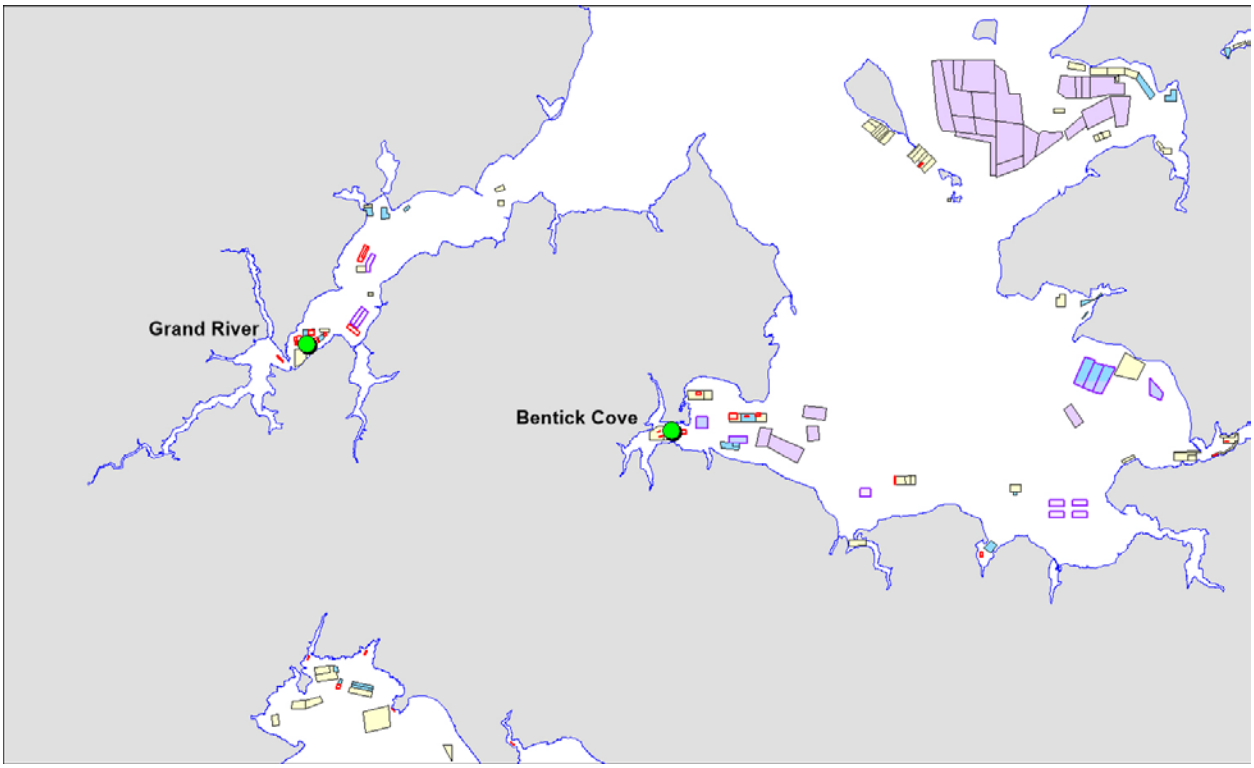
Foxley River (3 sites) and Dock River



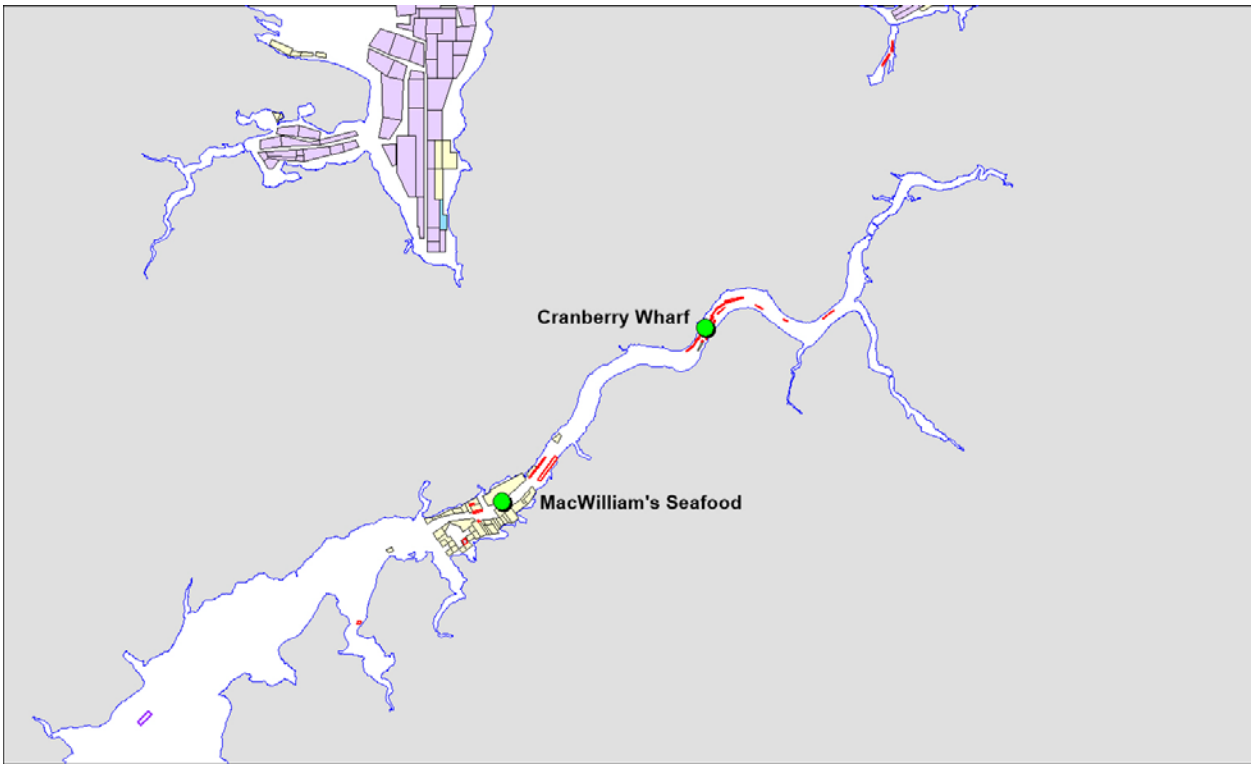
Percival River and Enmore River



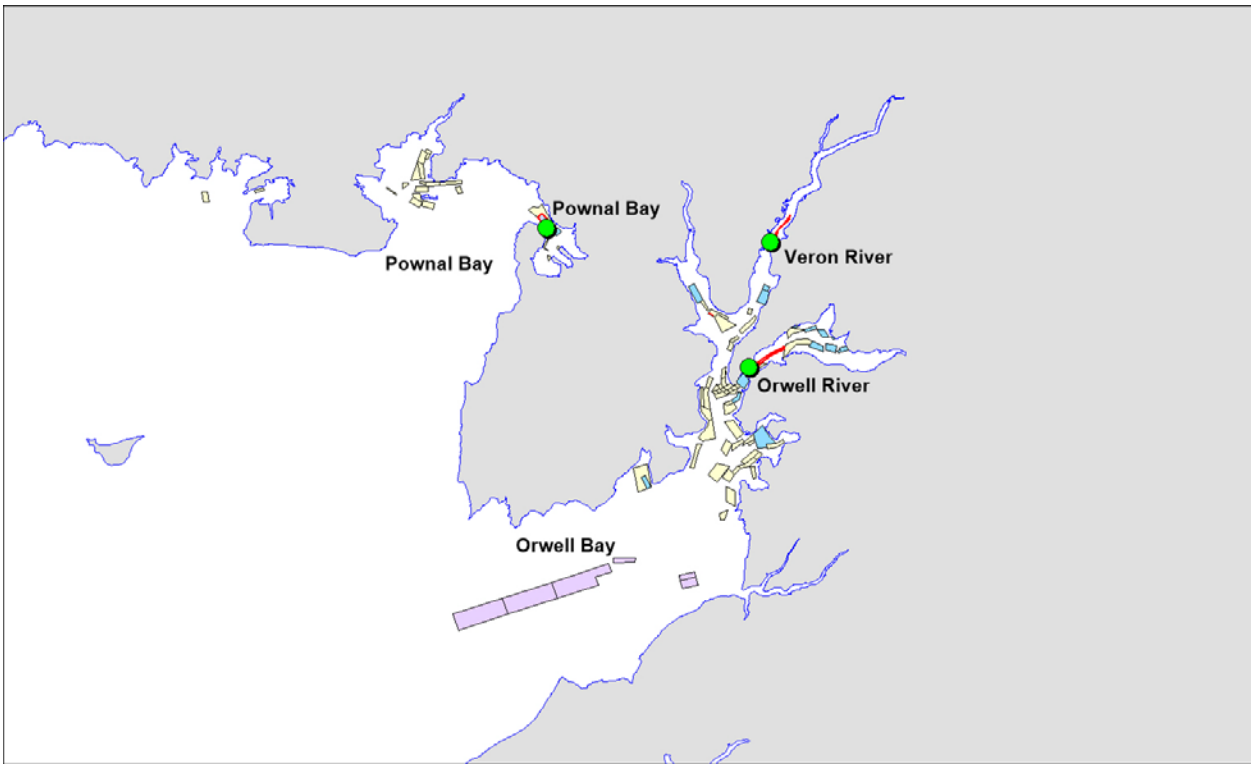
Bideford River



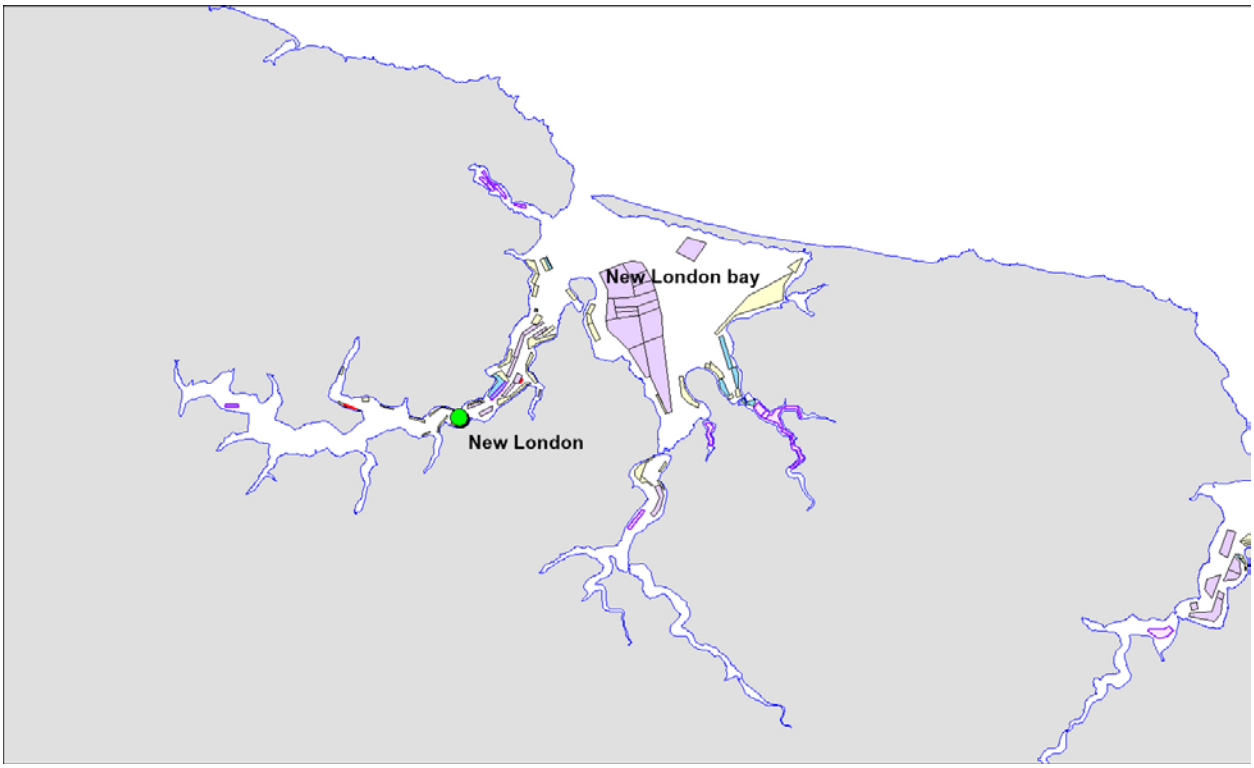
Bentick Cove, Grand River



East River (2 sites)



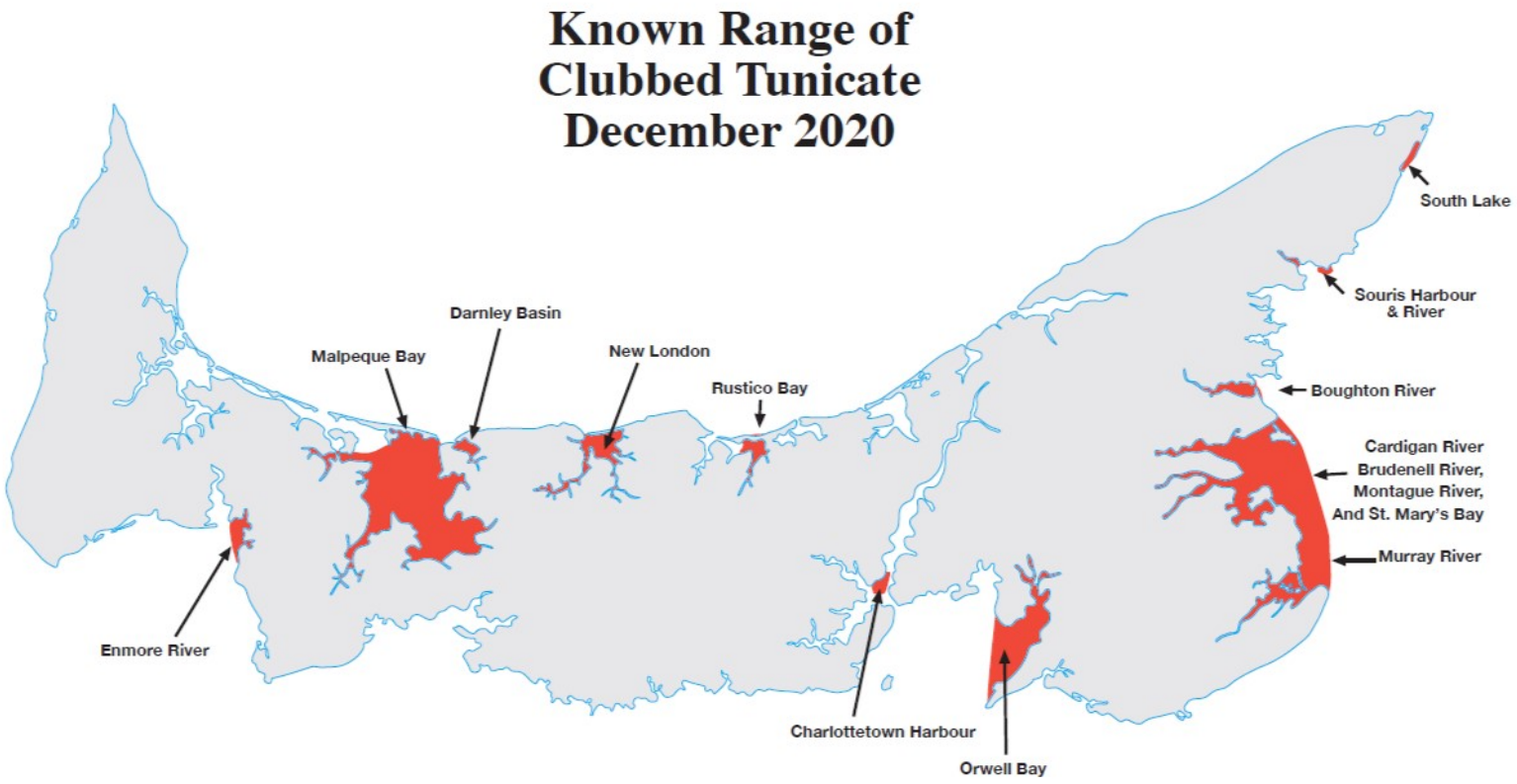
Pownal Bay, Vernon River, Orwell River



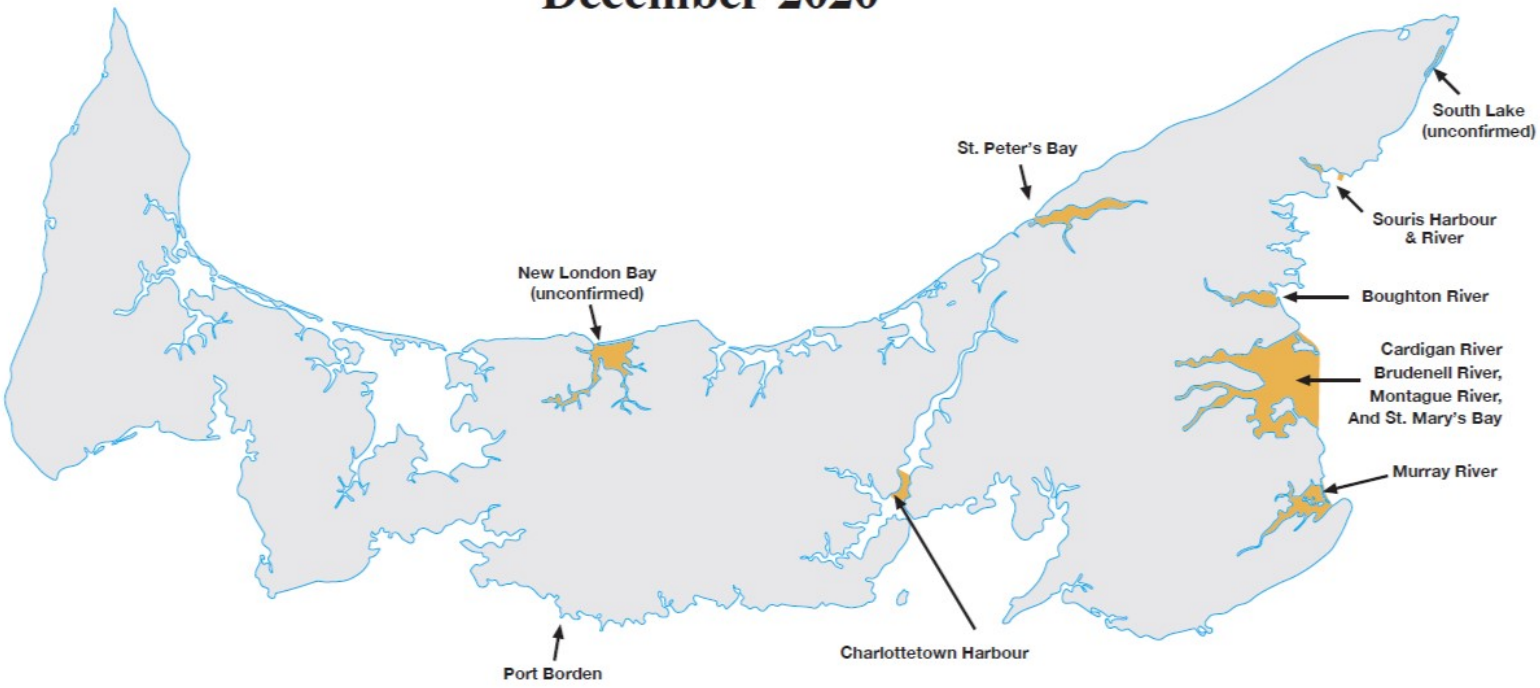
New London

APPENDIX IV

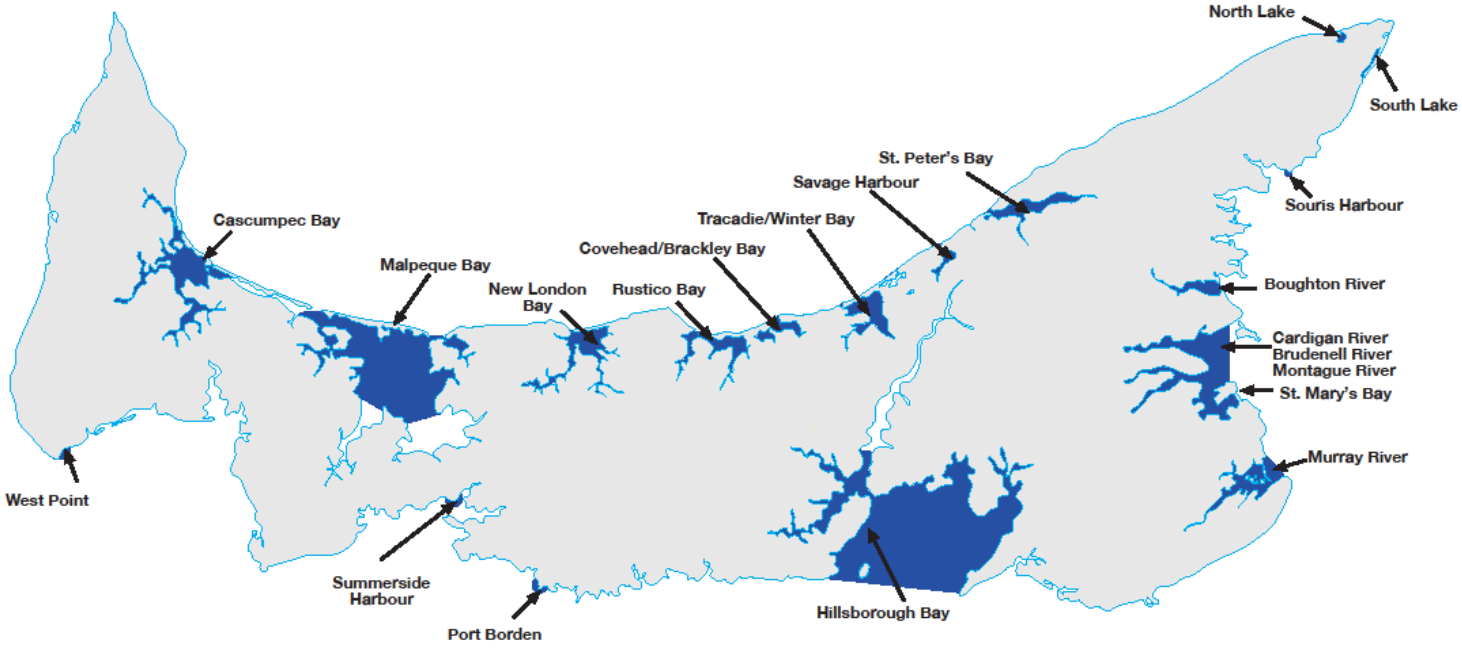
Current Distribution Maps of Known Aquatic Invasive Species in PEI



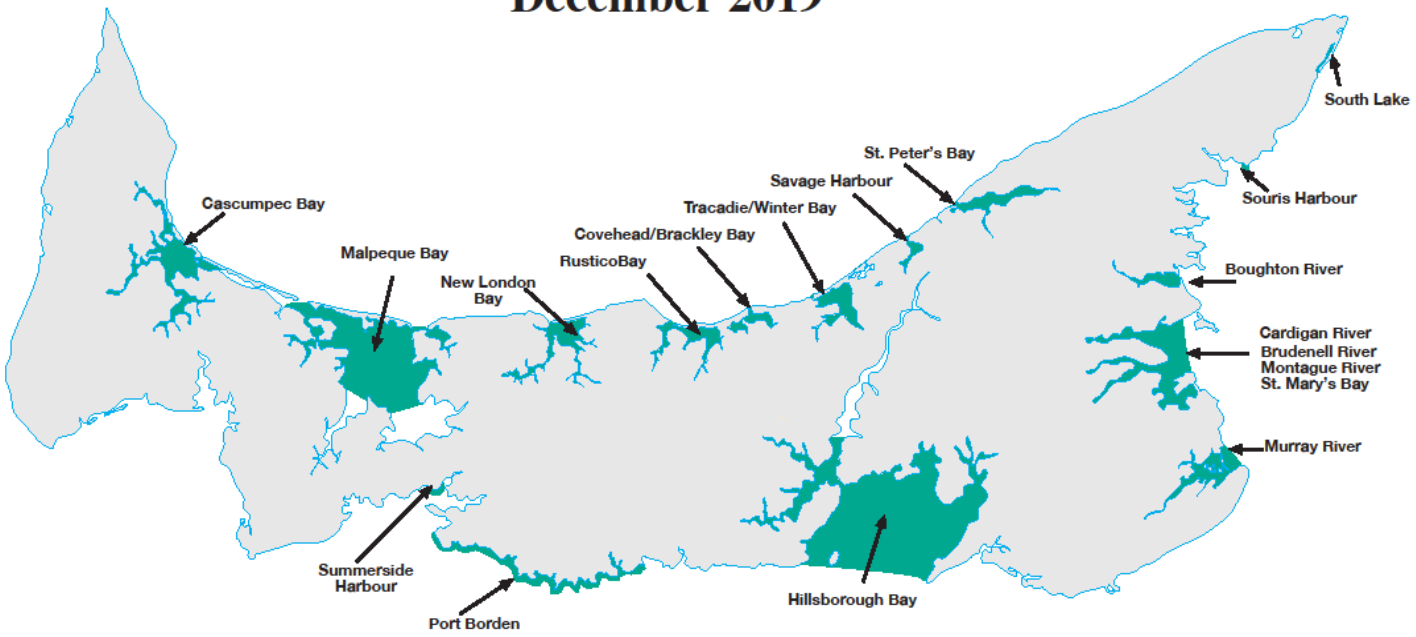
Known Range of Vase Tunicate December 2020



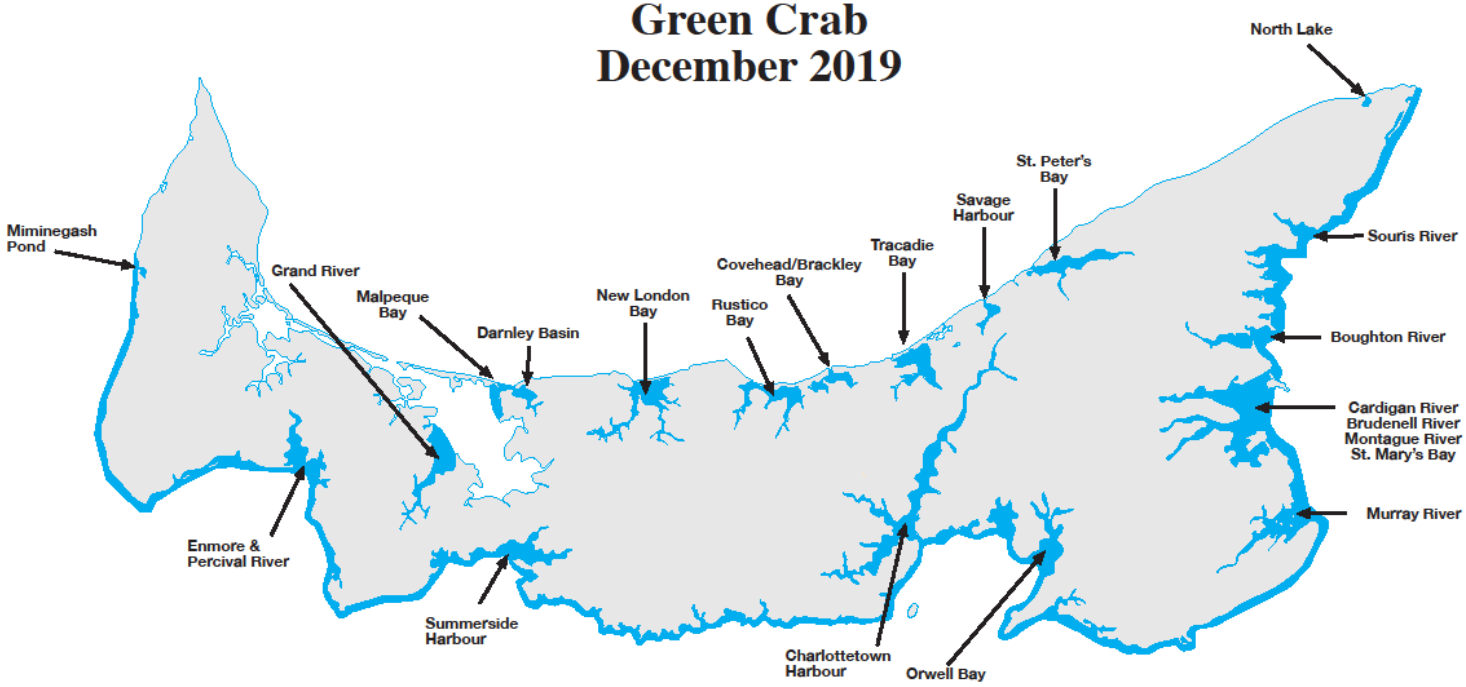
Known Range of Golden Star Tunicate December 2019



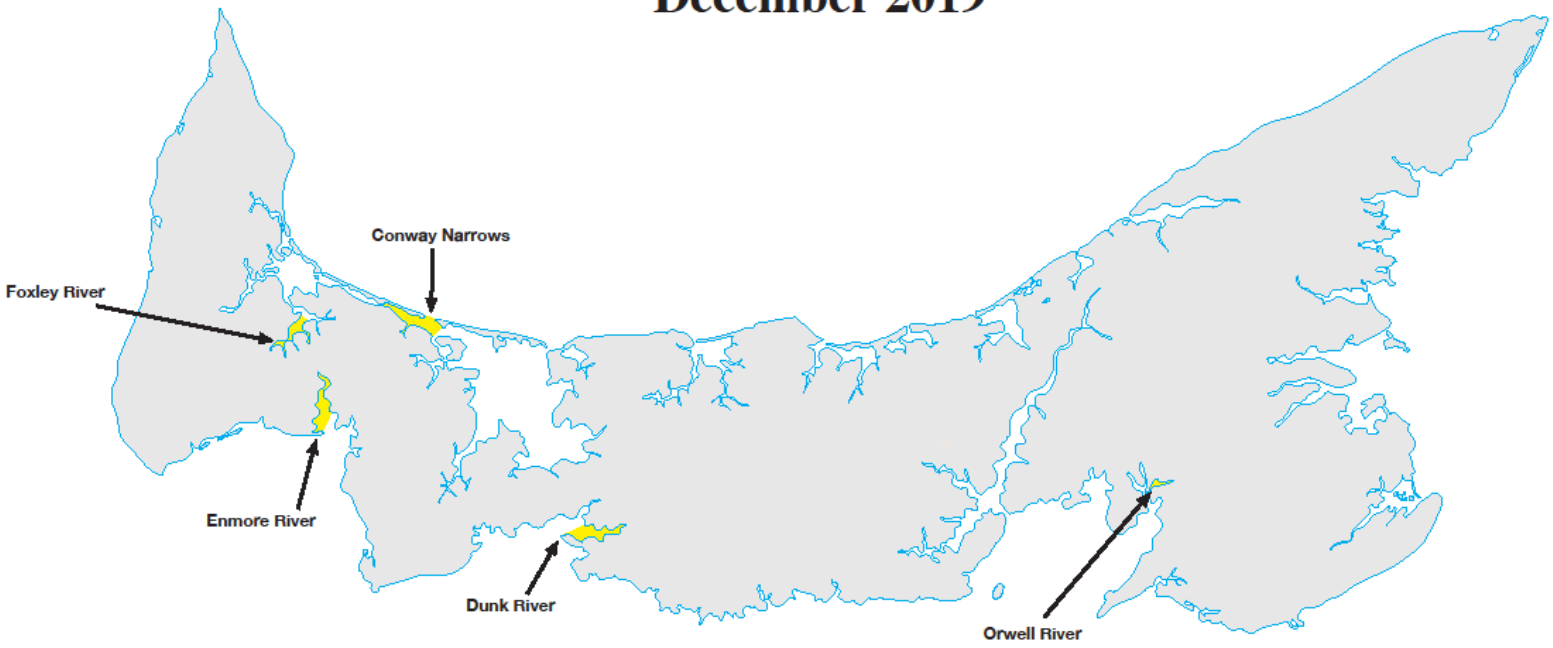
Known Range of Violet Tunicate December 2019



Known Range of Green Crab December 2019



Known Range of Oyster Drill December 2019



Known Range of Oyster Thief December 2019