St. Mary's River Recruitment Study 2020

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Summary

Multiple year studies provide data on oyster recruitment (spatfall) throughout the tidal St. Mary's River as it varies from year to year. The 2020 Recruitment Study results differ from prior years in that, in general, spatfall was higher especially in the upper river. The goal of this study is to use both cost effective and accurate methods to determine where the best spatfall occurs - in order to inform decision-makers (government, industry, public, etc.) in determining where substrate plantings should be located. In this way, industry can maximize investment and future harvest. An additional goal should be to inform an expanding body of science regarding restoration efforts that seek to answer questions such as: Are sanctuaries playing a significant role in restoration of non-sanctuary waters? How important is it to have areas of high density of oysters (>150/m2) within the overall goal of restoration? Are sanctuaries playing a role in the genetic development of disease resistance? How does the placement and size of sanctuaries play into the overall goals of the sanctuaries as stated in the 2010 executive order expanding Maryland's sanctuaries?

Spatfall (oyster recruitment) in the St. Mary's River was studied at twelve sites both inside and outside the sanctuary and spread throughout the lower seven miles of the tidal river. Data collected at each of the twelve sites included number of spat recruited during the study timeline, June through October 2020, and monthly water quality readings (turbidity, salinity, temperature, and dissolved oxygen). Multiple year studies provide data on oyster recruitment (spatfall) throughout the tidal St. Mary's River as it varies from year to year.

Study assistant, Julia Wright, pilots the skiff to collect water quality readings on July 1, 2020.

Study sites located within the sanctuary (3 sites) had the highest spatfall. 2019 bottom surveys at each site suggests that existing oyster density was related to recruitment success; those sites in the sanctuary that had high densities of existing oysters also had the highest spatfall. The three study sites located farthest downstream near the river's confluence with the Potomac exhibited poor spatfall. 2019 bottom surveys at three nearby sites indicated that no living oysters were within several meters.

Overall, 2020 spatfall was significantly higher than either of the prior two years.

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Background

The decline of the Eastern Oyster (*Crassostrea virginica*) can be directly linked to over harvesting. In addition, diseases such as Dermo and MSX have furthered the decline and have pushed the Eastern Oyster, a once prevalent organism in the Chesapeake Bay, to the brink of extinction [O'Beirn et al. 2000]. The depletion of the Eastern Oyster has had far reaching impacts and has led many to work to re-establish the organism's prominence.

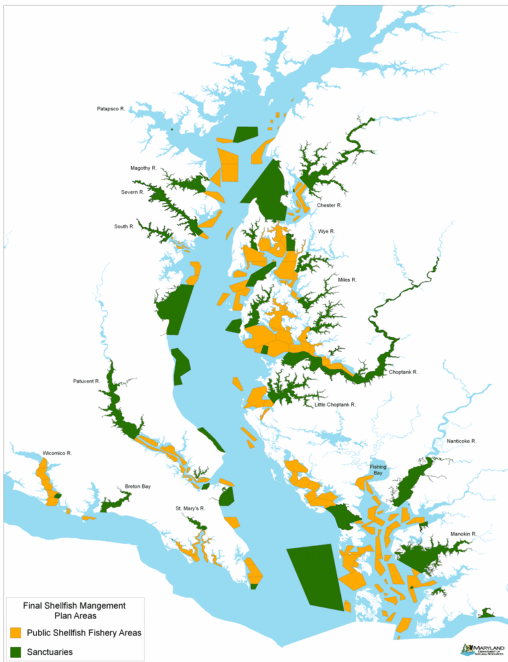


Figure 1. Maryland's fifty-one shellfish sanctuaries and designated public shellfish fishery areas. Image courtesy Maryland DNR.

The St. Mary's River qualifies as a Tier 1 tributary and has most of the characteristics supporting oyster restoration (Maryland Department of Natural Resources, 2018). There are fifty-one documented oyster sanctuaries in Maryland's portion of the Chesapeake Bay. [Figure 1.] 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. [Code of Maryland Regulations 08.02.04. 2016] The prohibition on harvest within the sanctuary has led to: 1) the re-establishment of thriving oyster bars with multi-age-classes, which today exhibit better survival rates than the 20-year average, and 2) substantial oyster population growth—both in overall area and animal density. Within the sanctuary, a five-acre three dimensional reef is currently undergoing restoration and is immensely successful with water clarity and quality noticeably enhanced compared to ten years earlier. Ongoing scientific monitoring by St. Mary's College of Maryland confirms this success.

Harvesting brood stock for the Horn Point Hatchery aboard the *Elizabeth B* working just southeast of Pagan Point—February 6, 2020, SMRWA File Photo

The wild oyster in the St. Mary's River has been overharvested for several years according to the University of Maryland's recent report "Stock Assessment of the Eastern Oyster, Crassostrea virginica, in the Maryland waters of Chesapeake Bay." [Wilberg 2018] The fertilized larvae of breeding oysters swim and drift in the water column for about two weeks prior to seeking permanent residence. Several factors play a role in where larvae may settle. Localized currents (or lack of), tidal flows, and wind effects are significant factors. Scientific studies in areas with recurring moderate to high velocity current suggest larval drift distance is significant and recruitment can happen miles away, and typically downriver for the Chesapeake Bay's tidal tributaries. The St. Mary's River has a weak current throughout most of the tidal estuary; some areas have steady tidal flows while others areas have little current. In these areas, wind likely plays a greater role. A second known factor is that reproduction is highly successful in areas with high density of adult oysters (more than 150 per square meter). Conversely, areas with few oysters have very poor reproduction success. The lower St. Mary's River is recruiting few oysters likely due to the depleted stock and resulting low density (less than 5 per square meter). The upper tidal stretch, the shellfish sanctuary, does recruit successfully and has increased its biomass over the past ten years.

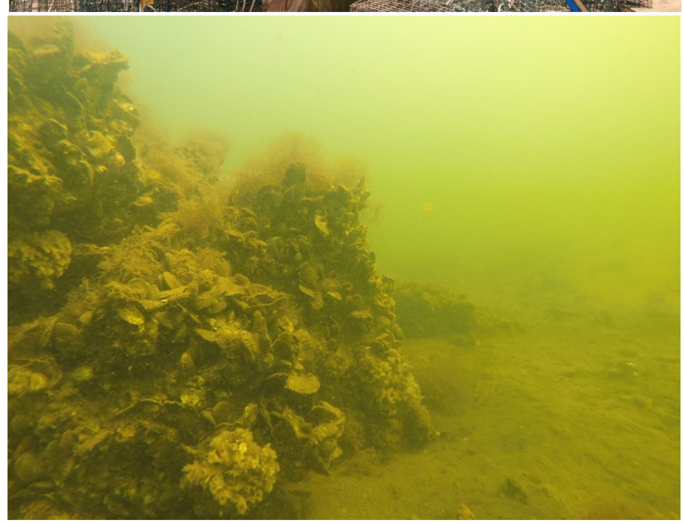
This study establishes baseline data on oyster larvae recruitment throughout the St. Mary's tidal estuary. Data collected over years can inform the development and placement of shell-planted reserve areas or sanctuary areas that will have the best outcomes for the fishery. Some basic questions we seek answers to are:

To what extent does larval drift out of the sanctuary into the public fishery areas?

What areas of the public fishery receives the highest larvae recruitment?

To what extent is successful recruitment a factor of larval drift and local adult oyster densities?

What other factors are important to know that might impact successful recruitment? i.e. (weather factors, climate change, nutrient loading, algae blooms, chemical pollutants).

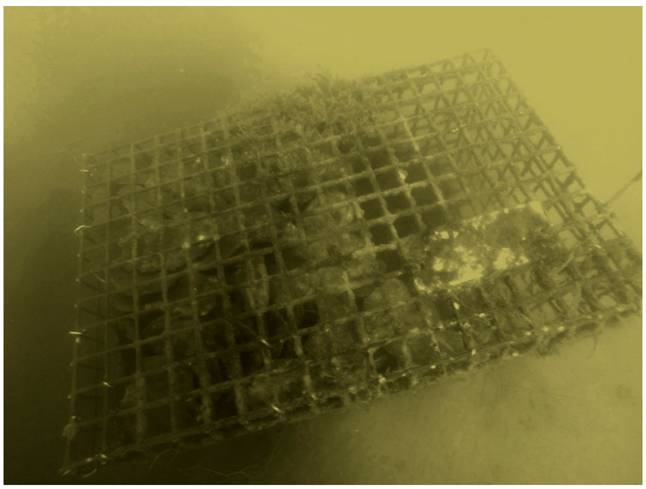


Top: Volunteers fill cages for the Marylanders Grow Oysters program September 2017. Bottom: Underwater photograph of the St. Mary's River Oyster Reef Project October 2015. SMRWA file photos.

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

Methodology

The 2020 Recruitment Study differs from prior years in that 1) two sites studied in 2019 were eliminated (Pagan, Edmund); 2) two sites were combined (Gravely Run, Green Pond); 3) three sites were adjusted several hundred meters to be located on bottom preferred by watermen (West St. Mary's to Portobello, Kennedy to Priest Point, Fort to Goad/Graveyard); and 4) one site was added (Sedge Point). These adjustment were made after consultation with the chair of the county oyster committee and Maryland Department of Natural Resources staff (February 24, 2020).



Photograph of trap deployed on the River Bottom. SMRWA file photo.

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 and surface area. Shells were received "green" from a shucking house and aged for several years. Shells were then power washed while the traps were rolled over several times in order to insure complete washing of all side of the shells. Four of these survey traps were placed on the river bottom in a square pattern and spaced three meters apart at each of the twelve study sites.

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

DO NOT DISTURB
SCP202070
301-904-2387

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

Traps were deployed on June 2nd, 2020, and exact GPS coordinates [Figure 2. below] were recorded for the central location of each deployment at the twelve sites. These study sites are depicted in Figure 3. (below)

Traps were checked monthly and water quality readings taken on June 2nd, July 1st, August 3rd, September 2nd, October 2nd, and October 31st. A Secchi disk and a YSI PRO2030 were used to collect water quality readings each time. The YSI was calibrated for dissolved oxygen immediately prior to sampling. Standardized field sheets were used to record the data and in every case a second set of eyes verified the datum entered for each parameter.

A visual check was made on at least two of four of the traps situated at each site on August 1st to ensure that the cages were not getting fouled by aquatic growth or flotsam. While numerous barnacles were observed on the shells inside the cages, all cages remained without fouling.

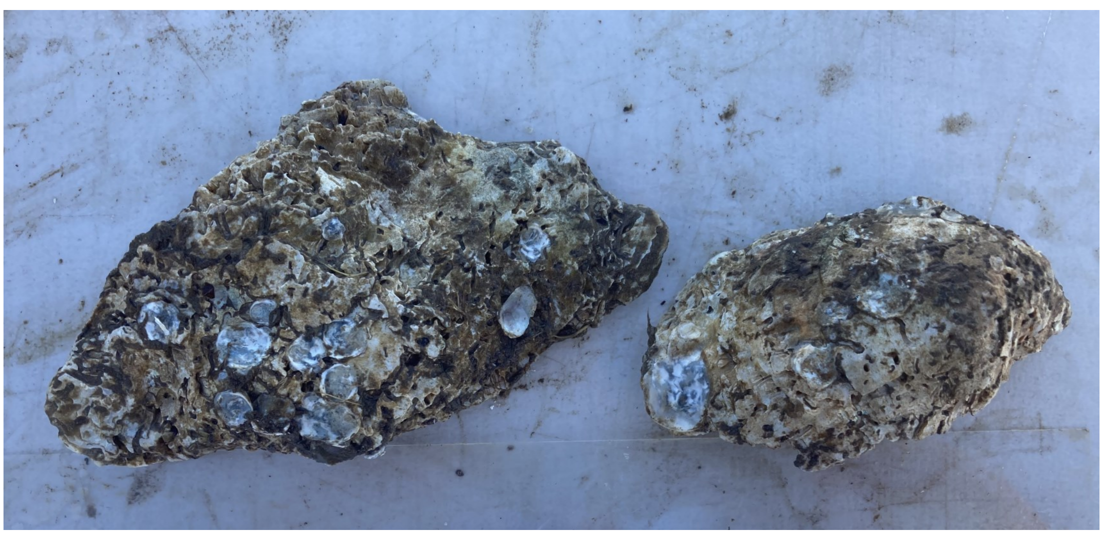
Traps were retrieved on October 26th and 28th and taken to a holding area at the St. Mary's College of Maryland waterfront where they were placed in shallow water on hardwood pallets. The fours traps at Coppage were not found. Teams searched the area for two days and solicited the help of Captain Craig Kelley who determined that the traps had "disappeared."

Each shell within the traps was inspected for spatfall and a standardized field data sheet was used to record the number of live and dead spat (referred to as "boxes") in three size groupings: equal to and under 10mm, 11mm to 25mm, and over 25mm.

TOP & MIDDLE: STEM intern Julia Wright collects and records water quality readings July 1, 2020; BOTTOM: Volunteer Christy Pototsky counts spatfall November 7, 2020—SMRWA File Photos

Figure 2.

SPATFALL STUDY SITES 2020	
SITE	Coordinates
01. Bryan	38.20361° -76.45626°
02. Horseshoe	38.19792° -76.44672°
03. Seminary	38.18859° -76.43687°
04. Portobello	38.17131° -76.45811°
05. Green Pond	38.17402° -76.44096-7°
06. Cooper Creek	38.16773° -76.45881°
07. Coppage	38.16267° -76.45178°
08. Thompson	38.15158° -76.46190°
09. Priest Point	38.15151° -76.44261°
10. Goad/Graveyard	38.11855° -76.43439°
11. Sedge Point	38.10708° -76.42731°
12. Mouth of Creek	38.11483° -76.46398°



Spatfall at Bryan was all box (dead) except for one spat. Bryan had the heaviest spatfall of the twelve study sites and the highest mortality in 2020. SMRWA file photo.

Figure 3.


Spatfall Study 2020 Sites
St. Mary's River
#1 Bryan
#2 Horseshoe
#3 Seminary
#4 Portobello
#5 Green Pond
#6 Cooper Creek
#7 Coppage
#8 Thompson
#9 Priest Point
#10 Goad - Graveyard
#12 Mouth of Creek
#11 Sedge Point - Gum Edge
N
Google Earth
3 mi

Counters included Bob Lewis, Colleen Smith, Julia Wright, Piper Pratt, and Christy Pototsky. Counting of spat occurred on October 30th, 31th and November 2nd, 4th, 6th, and 7th. Note that total spatfall counts include both live and boxes (dead) and are used to compare study sites. [Figure 4.]

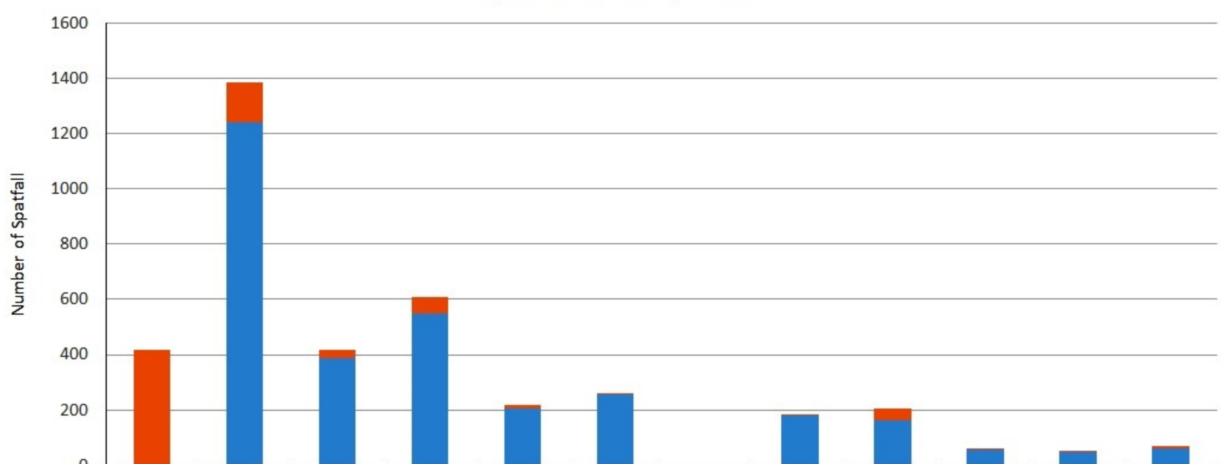
The dataset will be shared with decision makers—DNR Shellfish Division, county oyster committee, scientists at St. Mary’s College of Maryland—and made publicly available through our website http://www.SMRWA.org .

Our permit required us to remove the cages prior to November 1st, which is opening day for public harvest with dredges. The study areas are not usually harvested with hand tongs in October. Note that in some years the breeding season does linger well into October and we suspect this may have been the case in 2019 (James from Piney Point Hatchery reported heavy spawn in September). Observed spatfall in 2020 suggests that an October spawn was minimal, although a few live spat under 10mm were found and noted.

Results

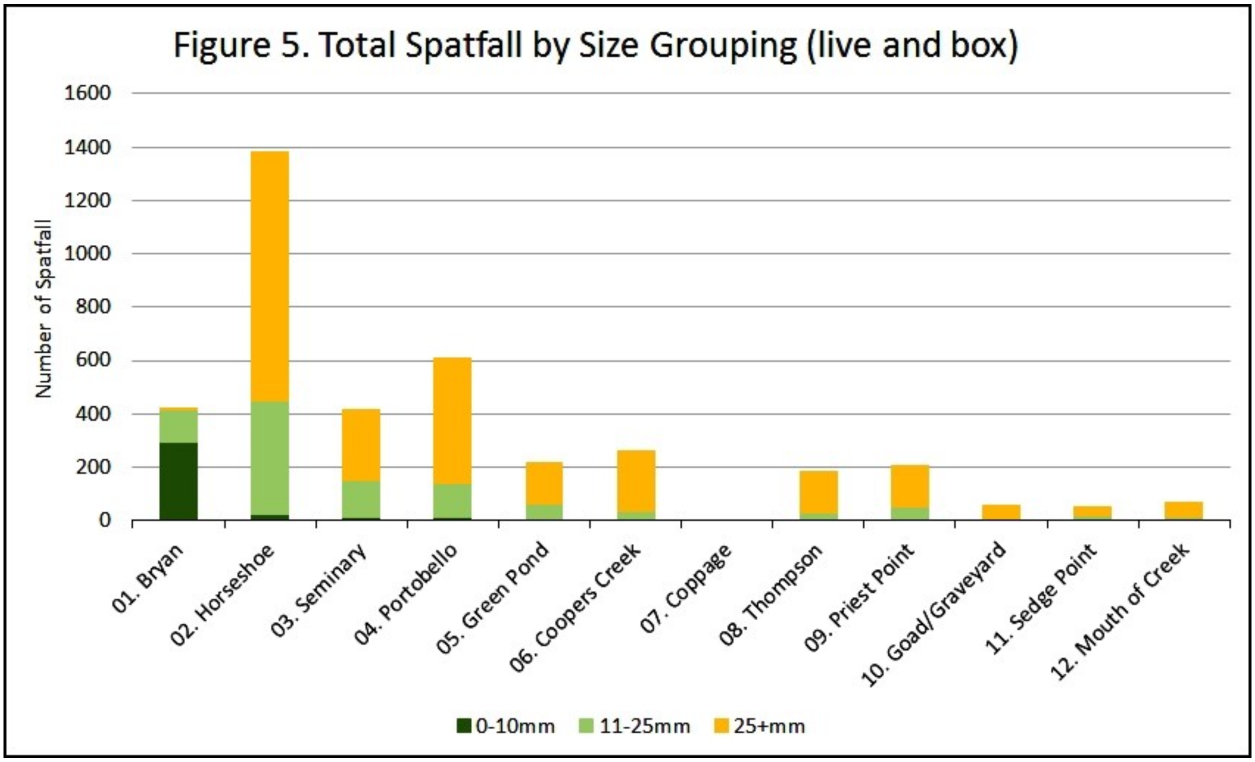
Results demonstrate spatfall at eleven of the twelve study sites in the St. Mary’s River. (We could not find and retrieve Coppage.) [Figure 4.] Bryan, Horseshoe, Seminary, and Portobello had the highest spatfall. Except for Bryan, all sites had the greatest spatfall early in the study season (the season ran June 2nd to October 26th) as indicated by the number of quite large spat (up to 73mm). Late-season spatfall, as indicated by spat size 10mm and under, did occur to some extent at some of the study sites. [Figure 5.] Bryan is an outlier with its spatfall having died without significant growth. Therefore, it cannot be determined when the strike occurred.

Figure 4. Total Spatfall



	01. Bryan	02. Horseshoe	03. Seminary	04. Portobello	05. Green Pond	06. Coopers Creek	07. Coppage	08. Thompson	09. Priest Point	10. Goad/Graveyard	11. Sedge Point	12. Mouth of Creek
Box Spat	417	145	28	60	12	7	0	2	41	1	1	7
Live Spat	1	1239	388	550	206	255	0	181	162	55	49	62

Live Spat Box Spat



At all sites, mortality of spat was minimal with the exception of Bryan and Priest Point—99.7% mortality (one spat of 418 was alive) and 20% mortality (162 spat of the 203 were alive) respectively. Both sites may have endured elevated mortality as a result of low dissolved oxygen levels from a dinoflagellate bloom beginning on or around August 4th and ending in early September. At Bryan, most of the spat was measured at 10mm and under, suggesting the spat had from a few weeks up to two months, at most, to grow prior to death. River bottom oxygen readings at the Bryan study site taken on August 3rd and 24th were fairly typical and non-lethal at 6.47 mg/l and 4.62 mg/l respectively.

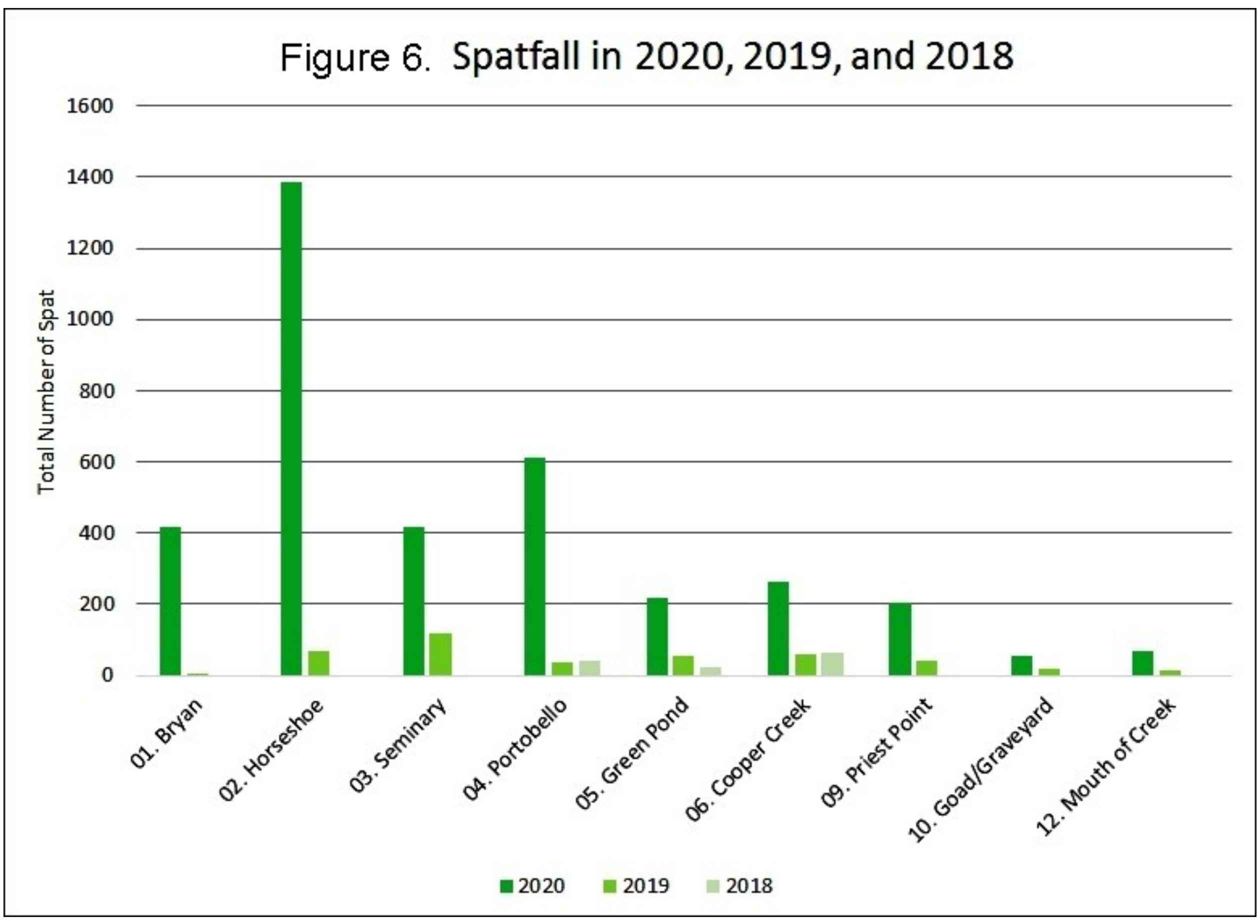
Some of the heaviest algae bloom observations (color of the water) were in the upper reaches of St. Inigoes Creek and on August 10 and again on August 17 waters near the mouth of St. Inigoes Creek, where the Priest Point study site is located, remained discolored. River bottom oxygen readings at the Priest Point study site taken on August 3rd and 24th were fairly typical and non-lethal at 5.93 mg/l and 4.69 mg/l respectively.

Mahogany color of the water in upper St. Inigoes Creek (1.75 miles from the Priest Point study site) on August 17. SMRWA file photo.

Total spatfall count was highest at Horseshoe with 1,384. Portobello was second highest with 610 total spatfall followed by Bryan and Seminary, which had 418 and 416 total spatfall respectively. (Seminary had the highest spatfall in 2019.) Both Horseshoe and Seminary are known for having good recruitment as they are both located on fairly large and thriving oyster bars. Cooper Creek, Green Pond, Priest Point, and Thompson were all very similar with 262, 218, 203, and 183 total spatfall respectively. The three sites at or near the mouth of the river had the poorest spatfall. This finding is consistent with our 2019 study for sites near the river's mouth. [Figure 6.]

Site seven, Coppage, could not be found when the cages were retrieved. The reason for the disappearance of the cages is unknown, and it was hoped they would be retrieved during the oyster dredging season. At this time, Coppage has yet to be found resulting in no spatfall data being shown from this site.

Since the study began two years ago in 2018, three sites have been surveyed three times—Coopers Creek, Coppage, and Green Pond. Four more sites were repeated a second time since the 2019 study; Bryan, Horseshoe, Seminary, and Mouth of Creek. Former site Fort was adjusted south about 1/4 mile to Goad/Graveyard; former site Edmund was adjusted north 1 mile to Thompson; former site Kennedy was moved southwest 6/10 mile. A comparison of the three years is shown below in Figure 6.



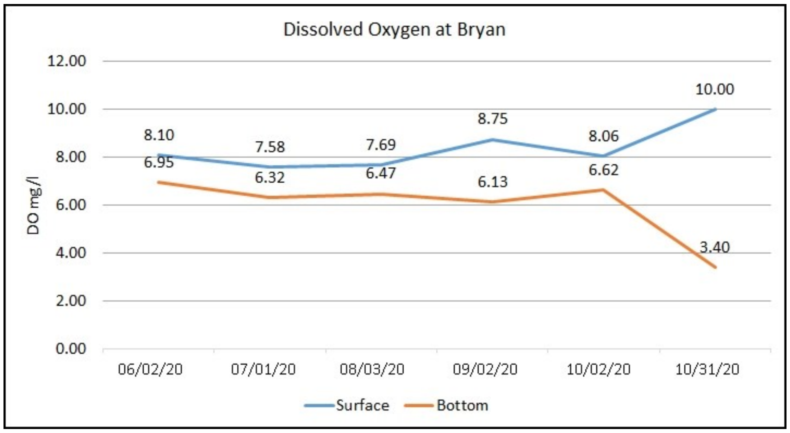
Overall, spatfall was significantly higher throughout the study sites. Cages were retrieved one month earlier in 2018 and 2019; although, due to the small percentage of small spat under 11mm found in this year's study, October spatfall is likely to be minimal. Therefore the yearly data merits comparison. Bryan, with a very poor total spatfall of just 2 animals in 2019, had the biggest increase in 2020 at nearly 21,000%. Horseshoe, Portobello, and Thompson all had large increases ranging from 1605% to 2035%. The increase for each of the comparable sites is in Figure 7 below.

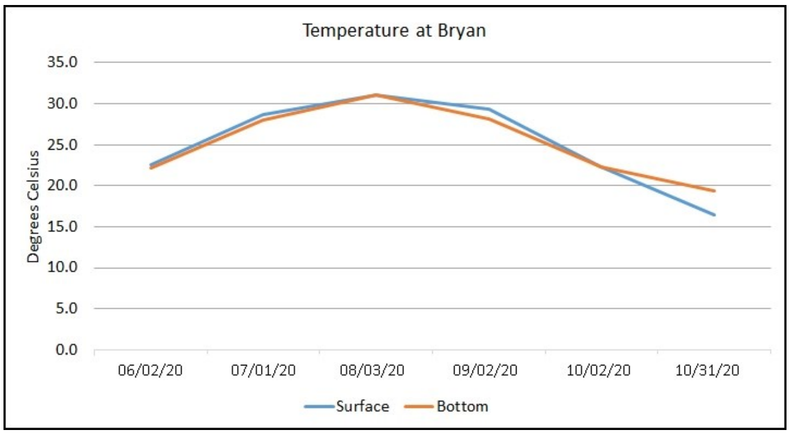
Figure 7. Percentage Increase Spatfall

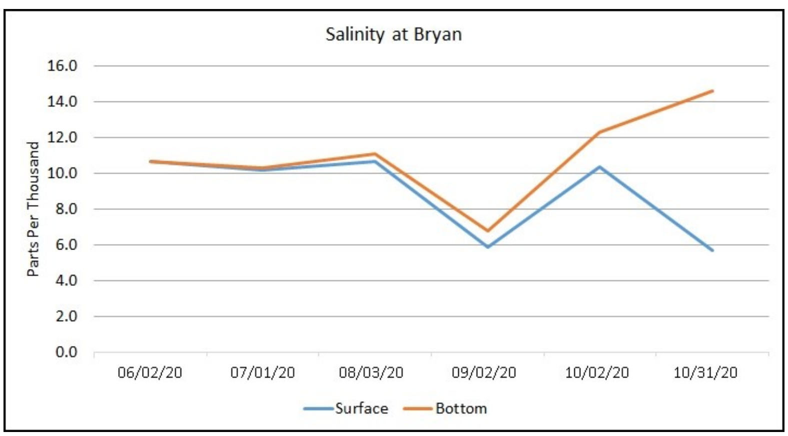
Sites	2019	2020	% INCREASE
01. Bryan	2	418	20,900
02. Horseshoe	68	1384	2,035
03. Seminary	117	416	356
04. Portobello	38	610	1,605
05. Green Pond	53	218	411
06. Coopers Creek	57	262	460
08. Thompson	11	183	1,664
09. Priest Point	40	203	508
10. Goad/Graveyard	16	56	350
12. Mouth of Creek	14	69	493

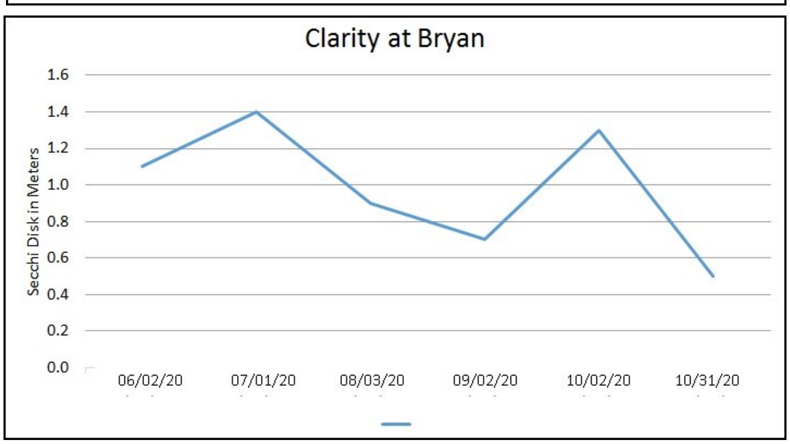
Figure 8. Spatfall Counts

	Live Spat			Box Spat		
Sites	0-10mm	11-25mm	25+mm	0-10mm	11-25mm	25+mm
01. Bryan	0	1	0	294	119	4
02. Horseshoe	6	336	897	16	89	40
03. Seminary	4	121	263	6	17	5
04. Portobello	3	86	461	11	39	10
05. Green Pond	3	45	158	1	10	1
06. Coopers Creek	1	29	225	1	5	1
07. Coppage						
08. Thompson	0	29	152	0	2	0
09. Priest Point	1	24	137	3	20	18
10. Goad/Graveyard	0	4	51	0	1	0
11. Sedge Point	4	11	34	0	1	0
12. Mouth of Creek	1	6	55	0	3	4



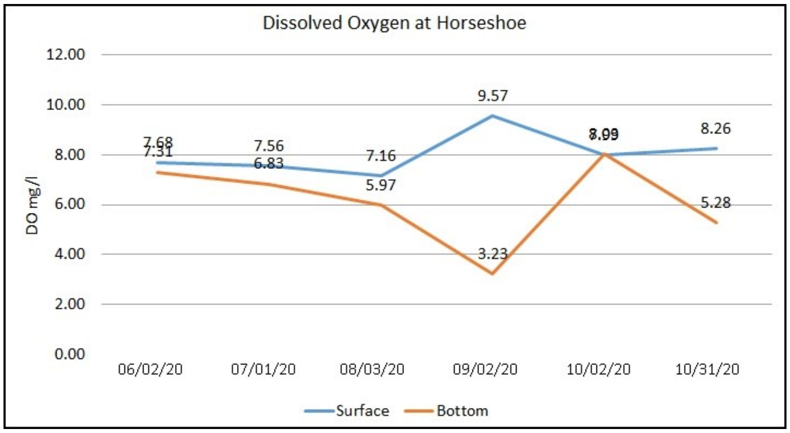






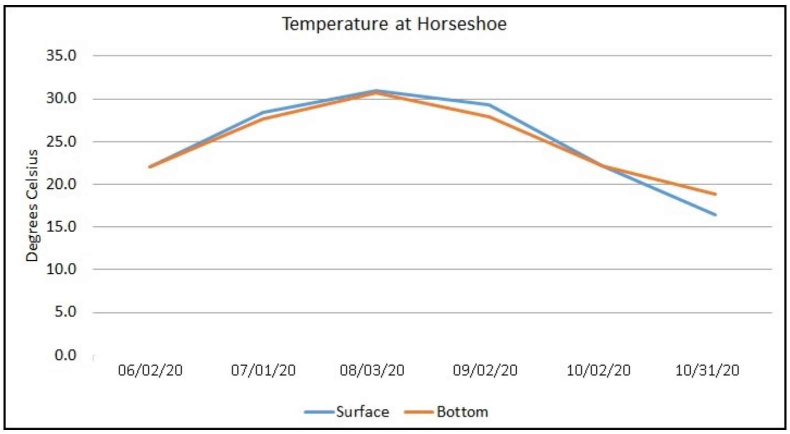
Water Quality

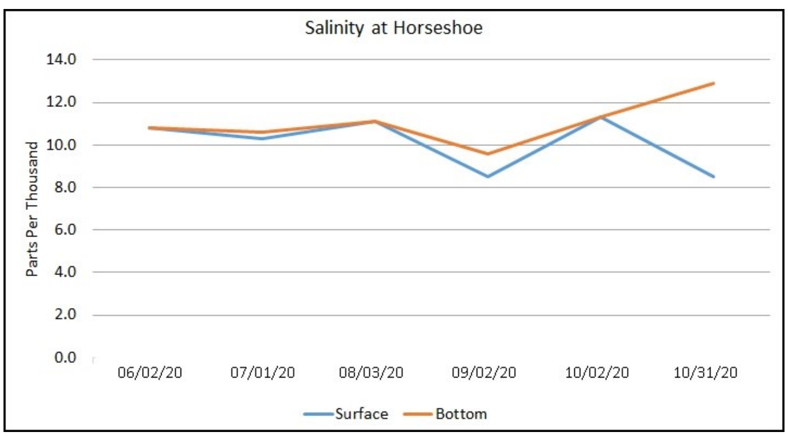
Site 01. Bryan

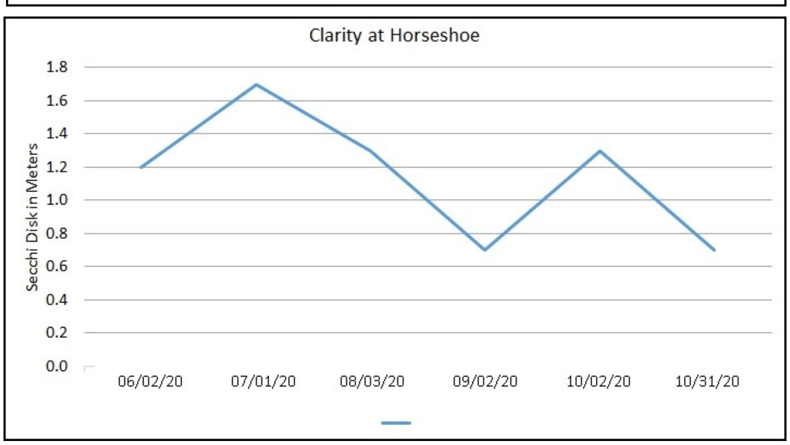


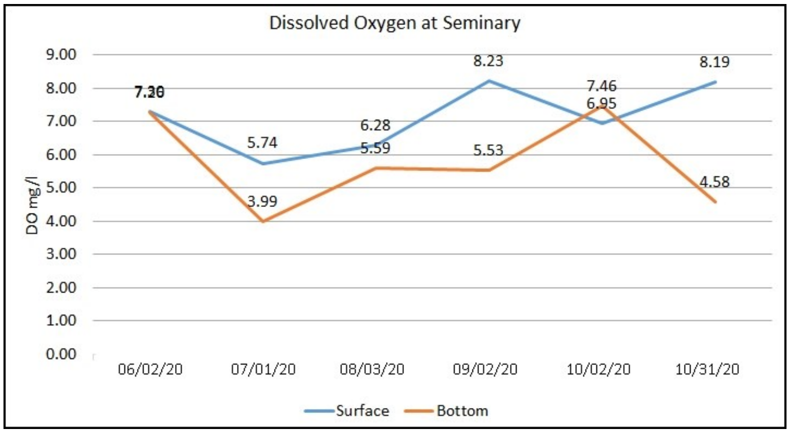
Water Quality

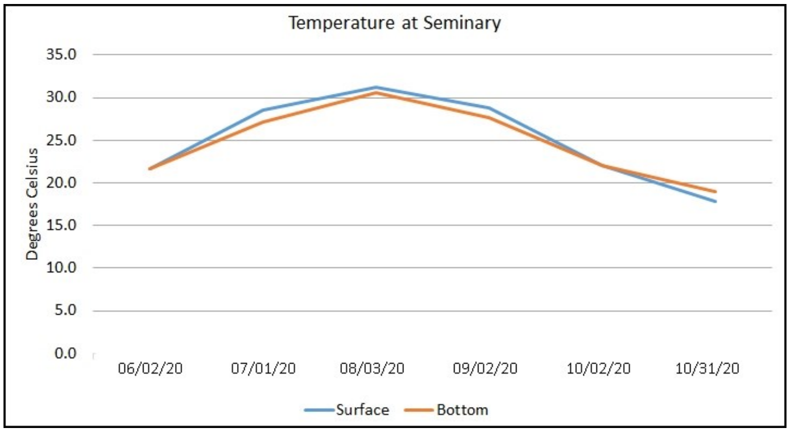
Site 02. Horseshoe

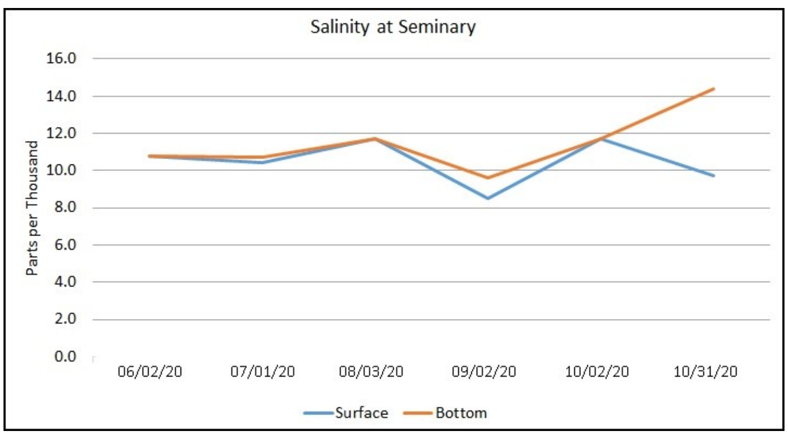


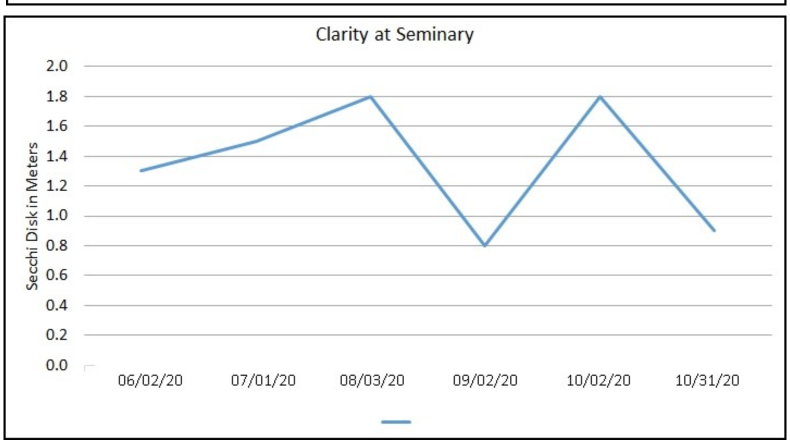






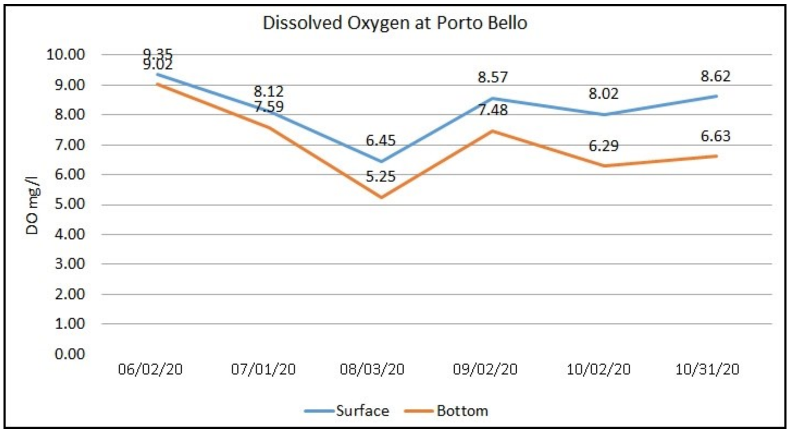






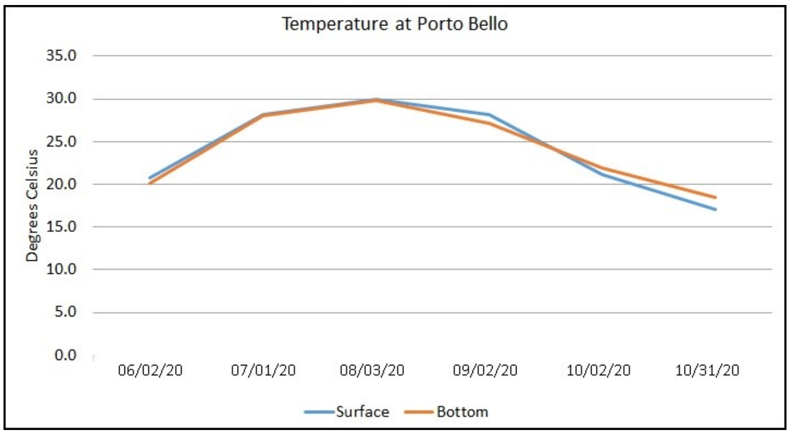
Water Quality

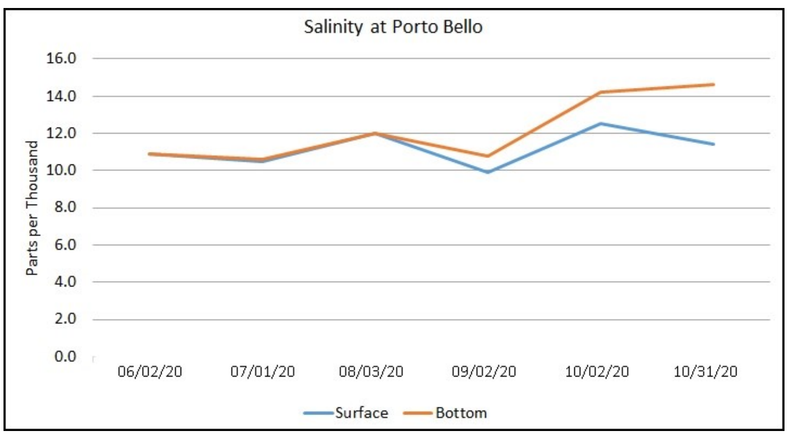
Site 03. Seminary

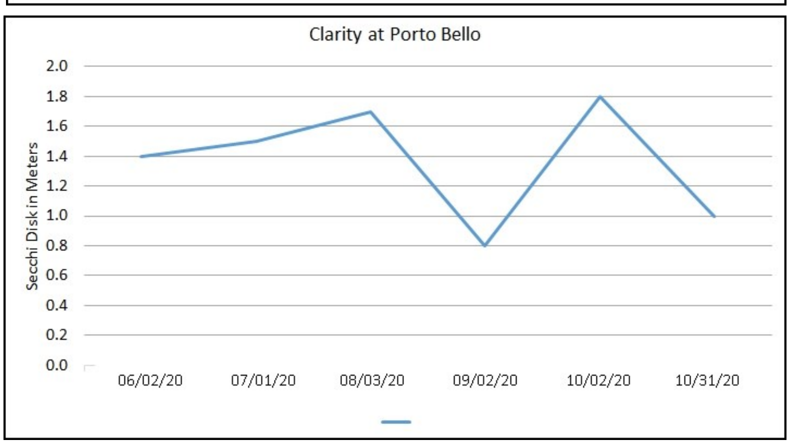


Water Quality

Site 04. Portobello

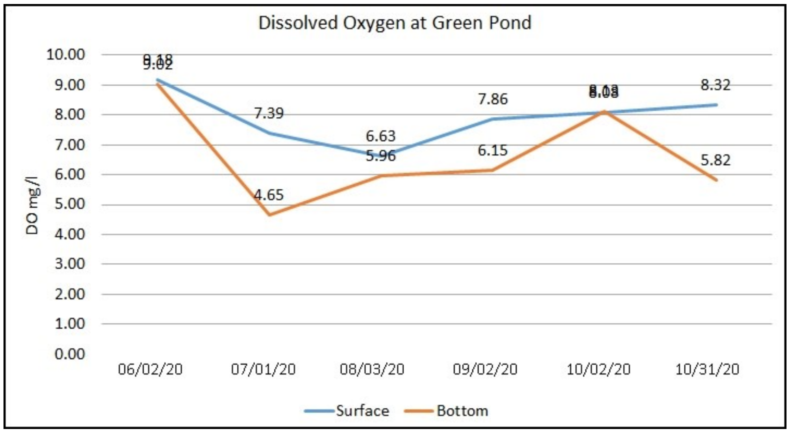


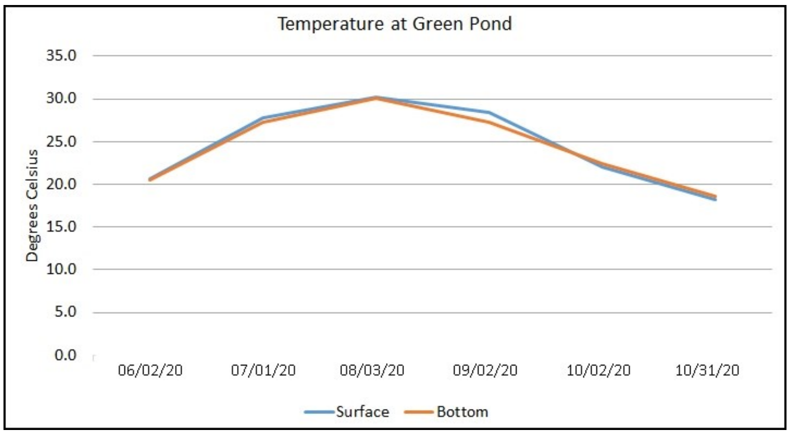


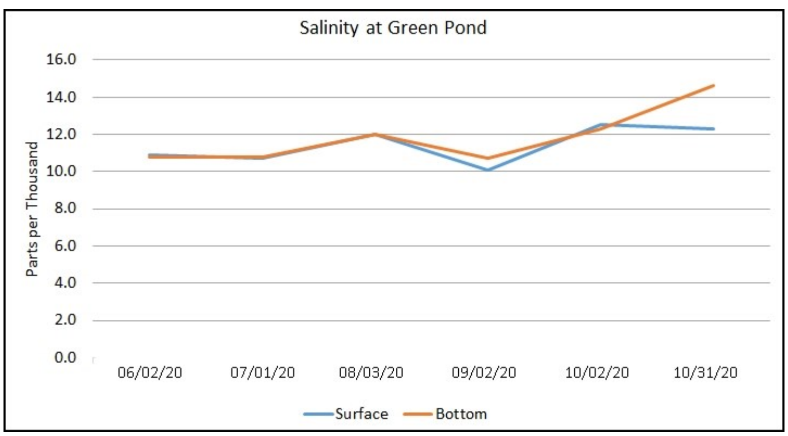


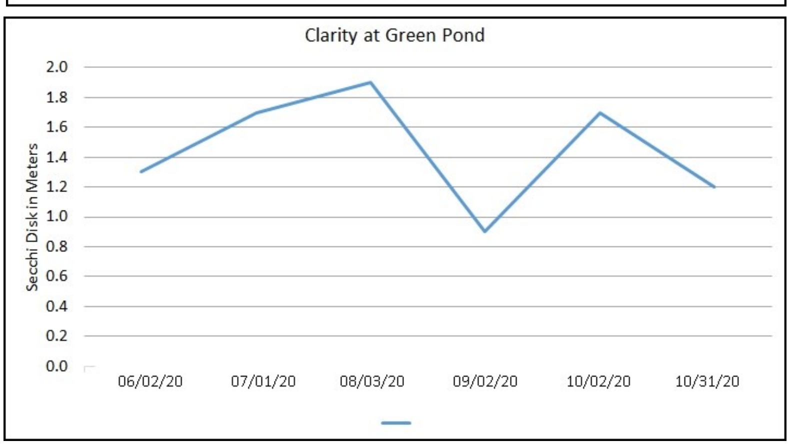
Water Quality

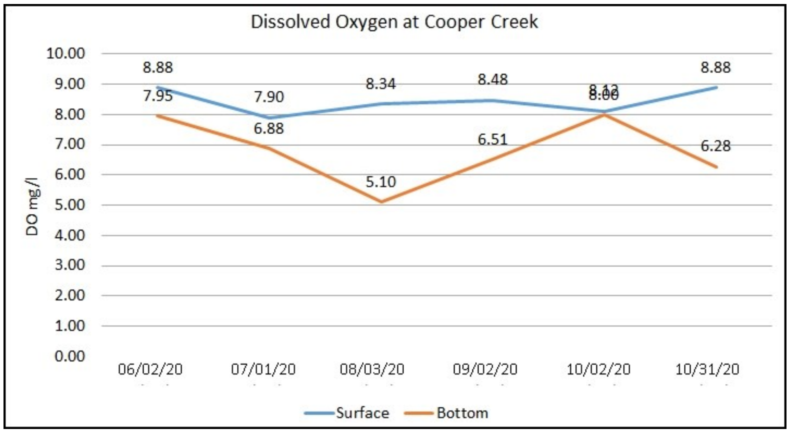
Site 05. Green Pond

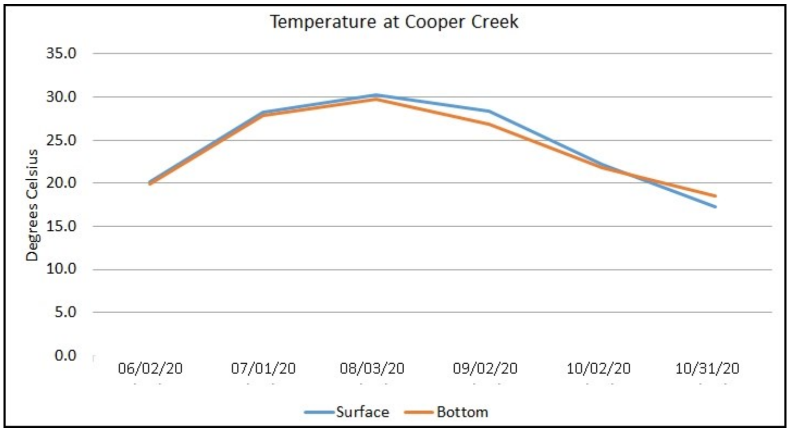


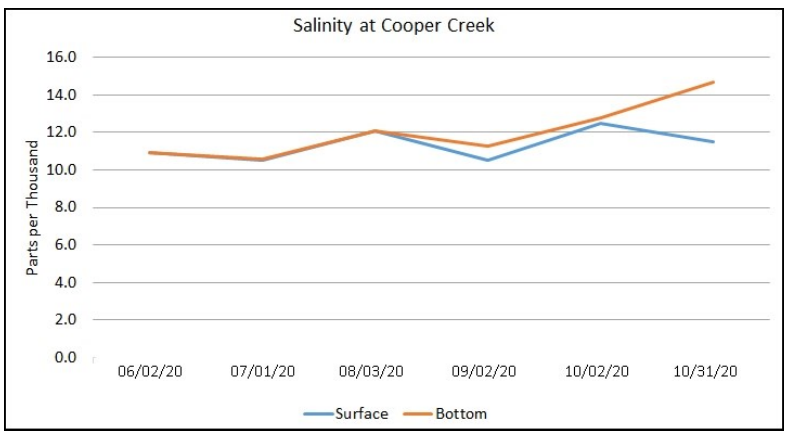


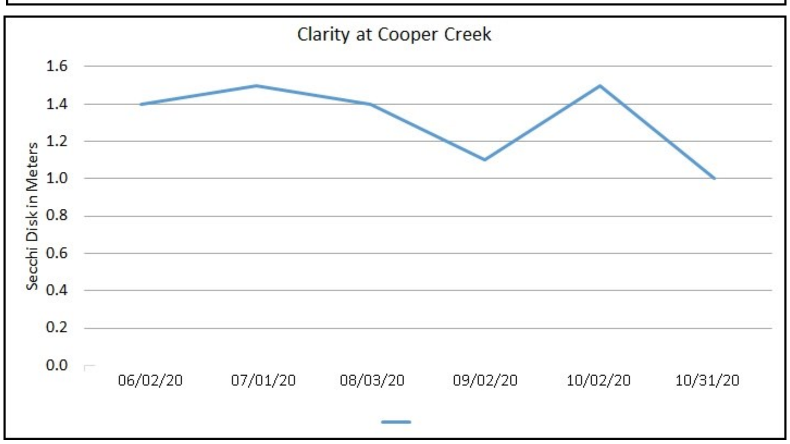






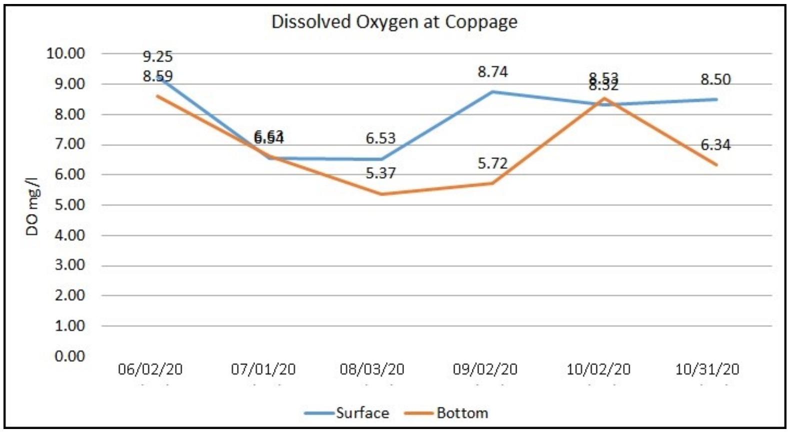


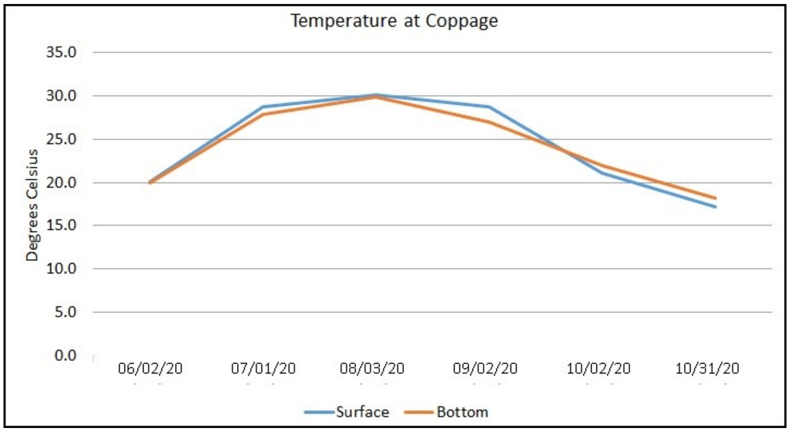


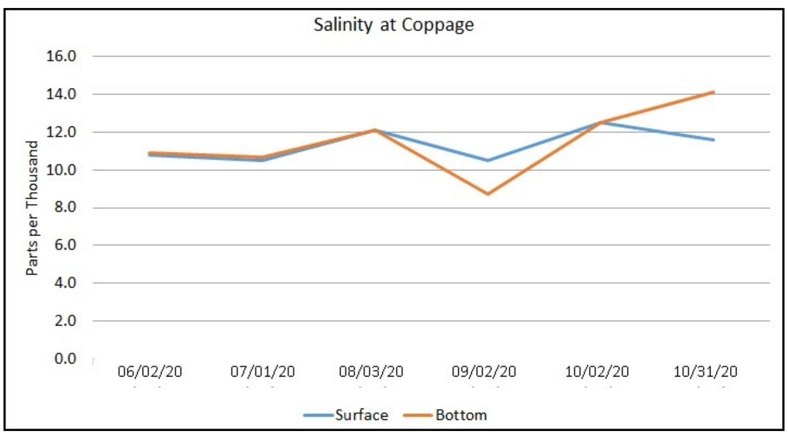


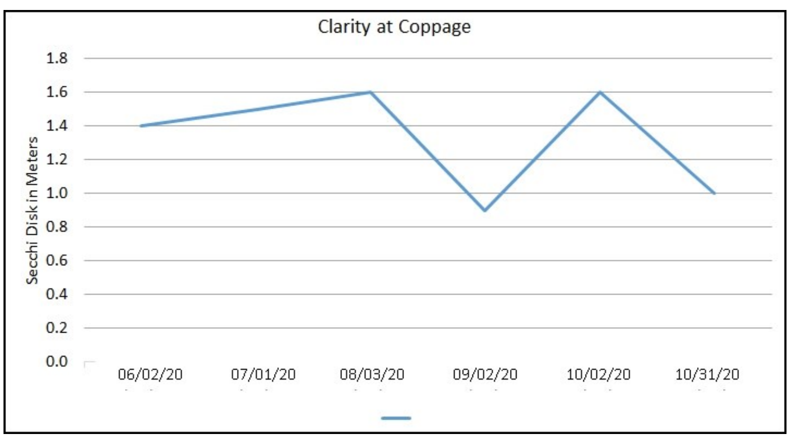
Water Quality

Site 06. Cooper Creek



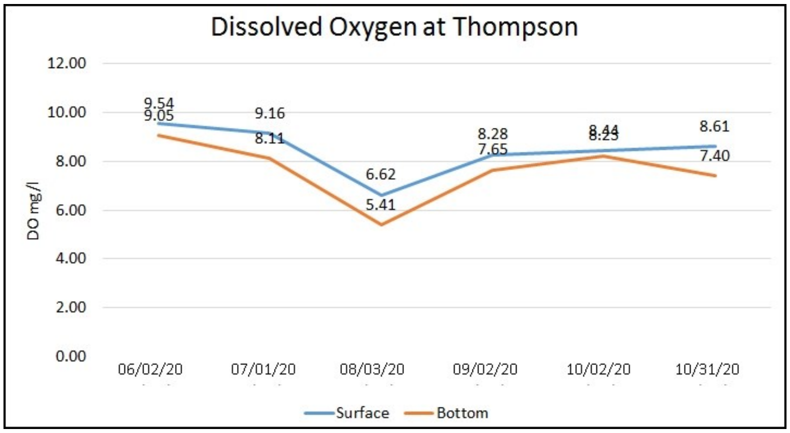


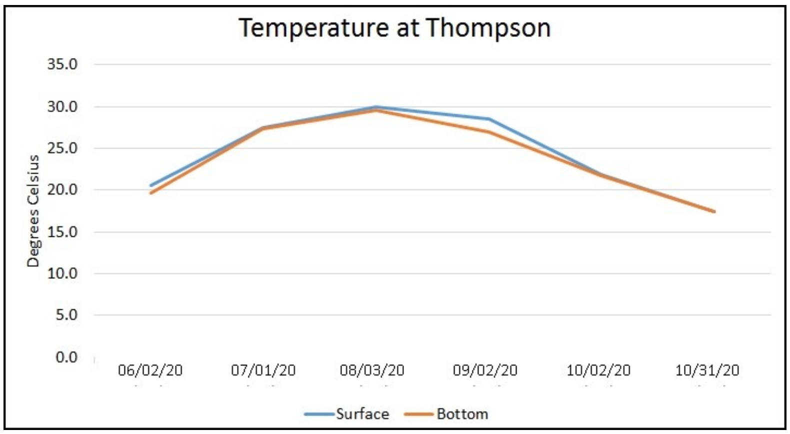


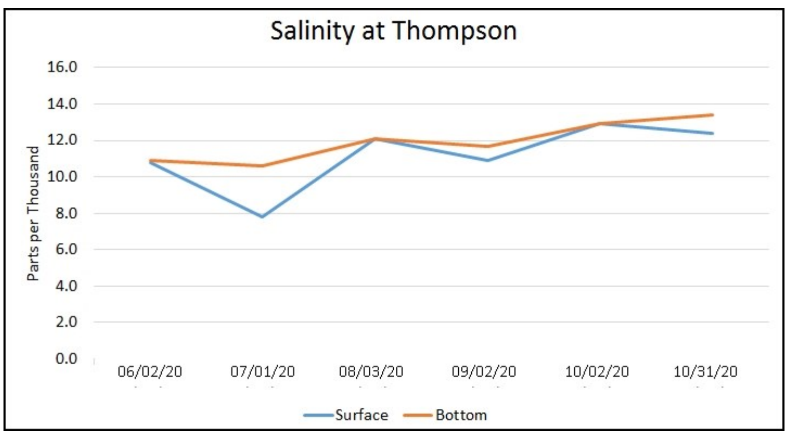


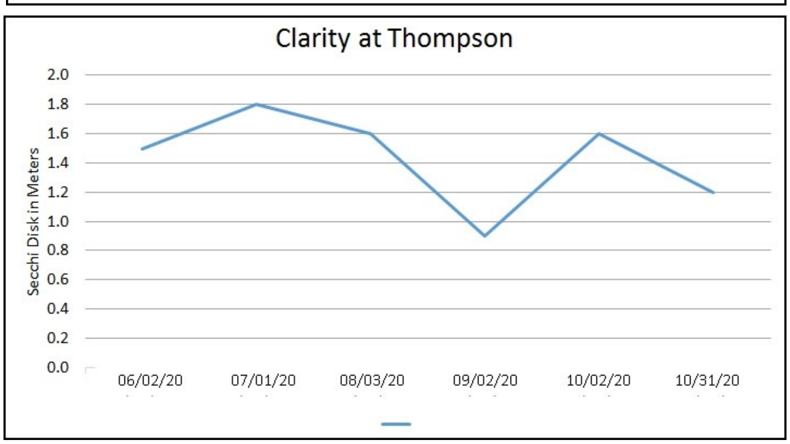
Water Quality

Site 07. Coppage







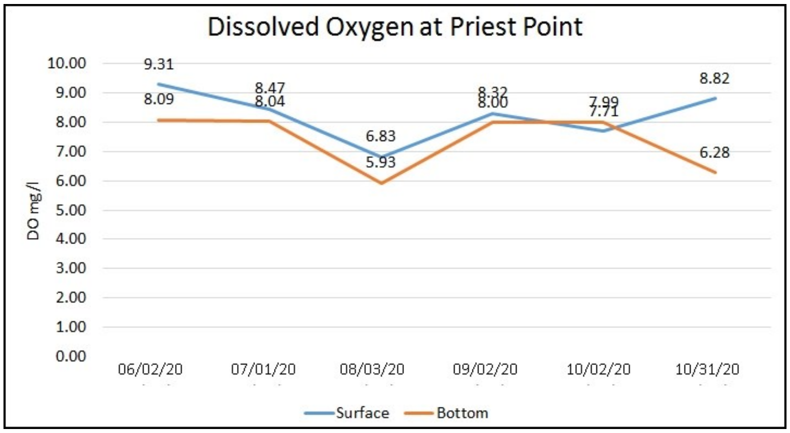


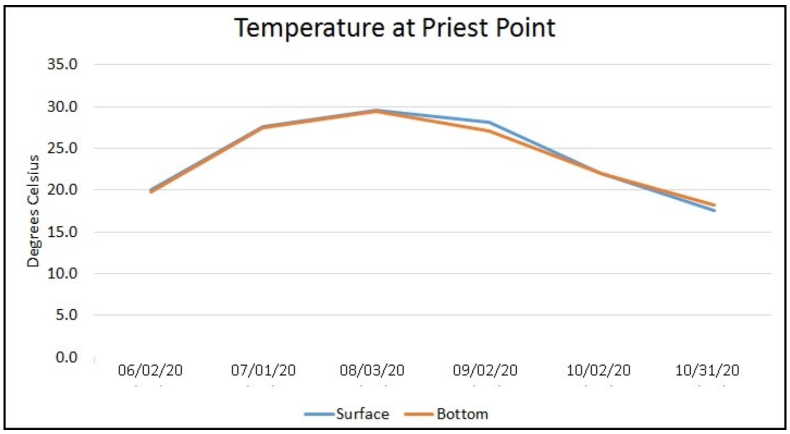
Water Quality

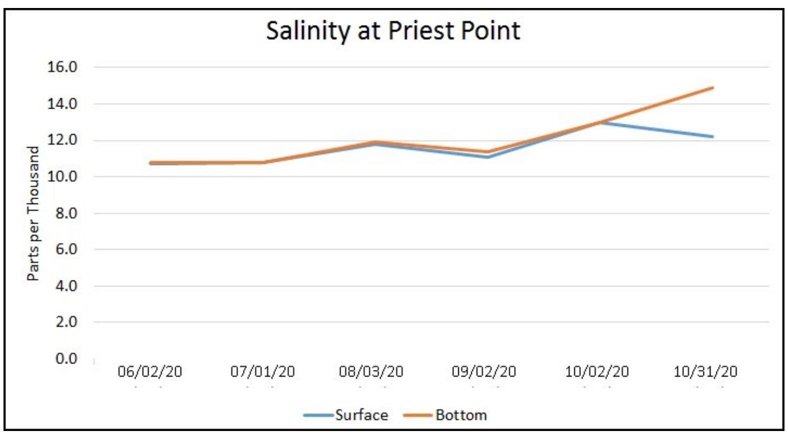
Site 08. Thompson

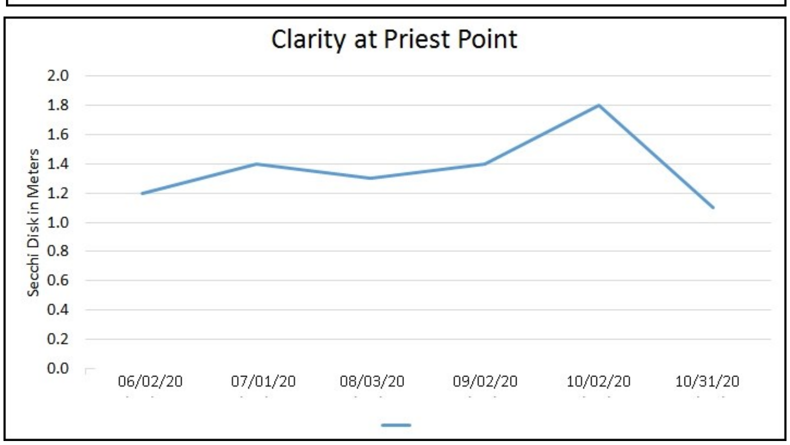
Water Quality

Site 09. Priest Point



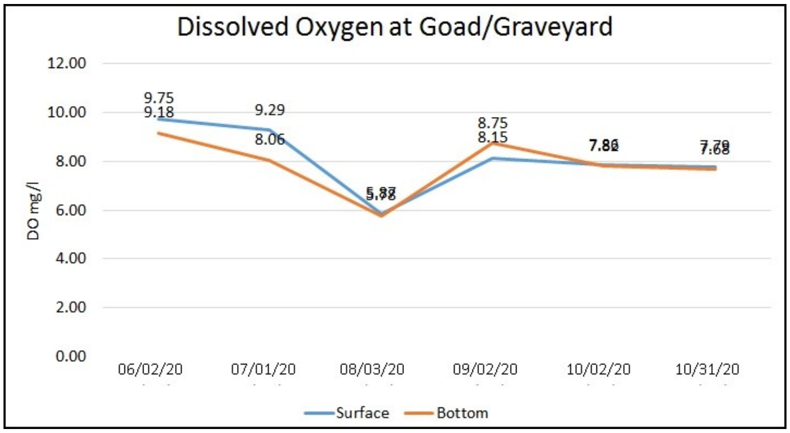


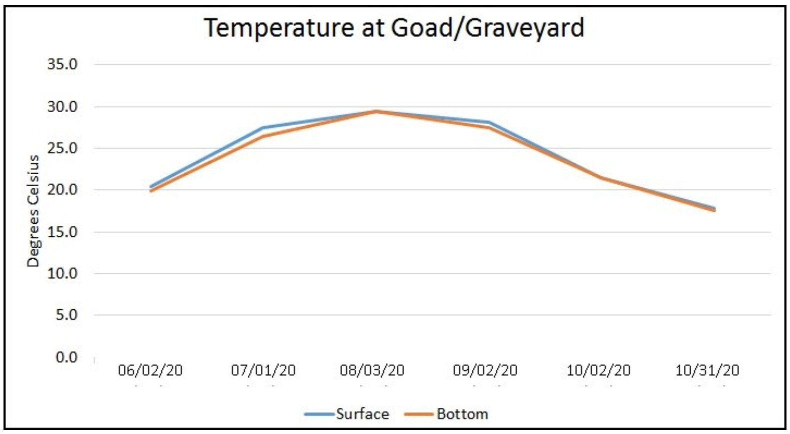


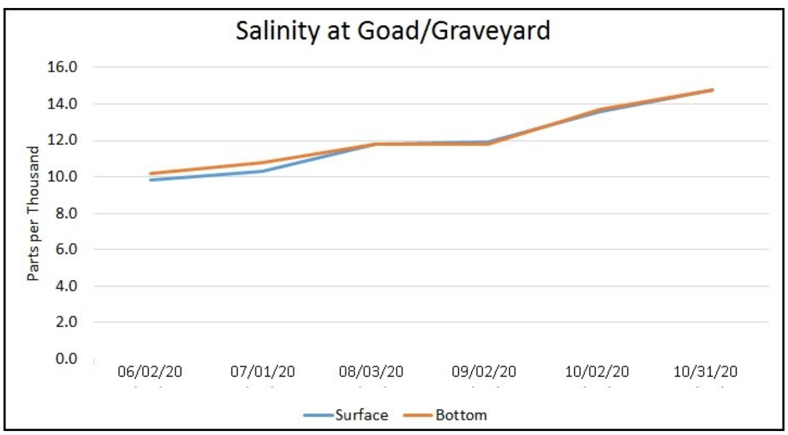


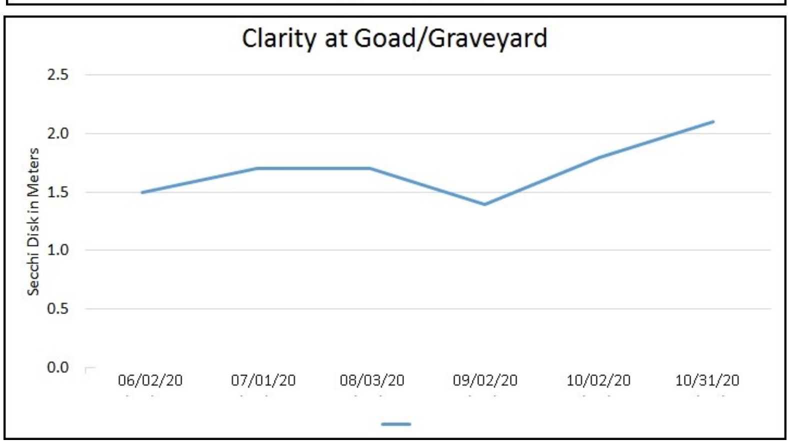
Water Quality

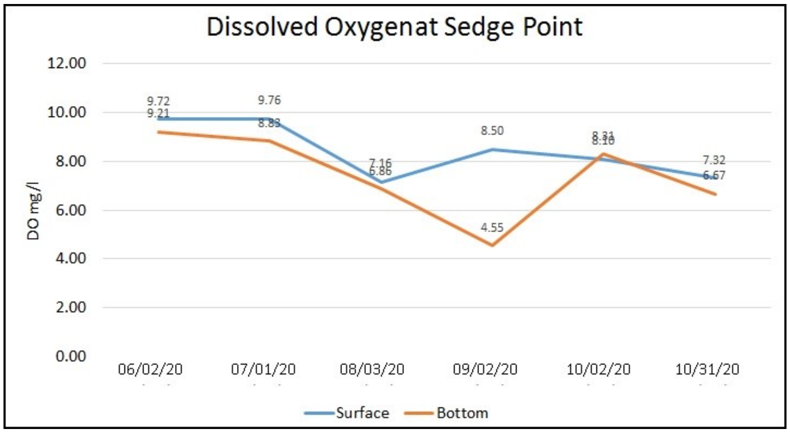
Site 10. Goad/ Graveyard





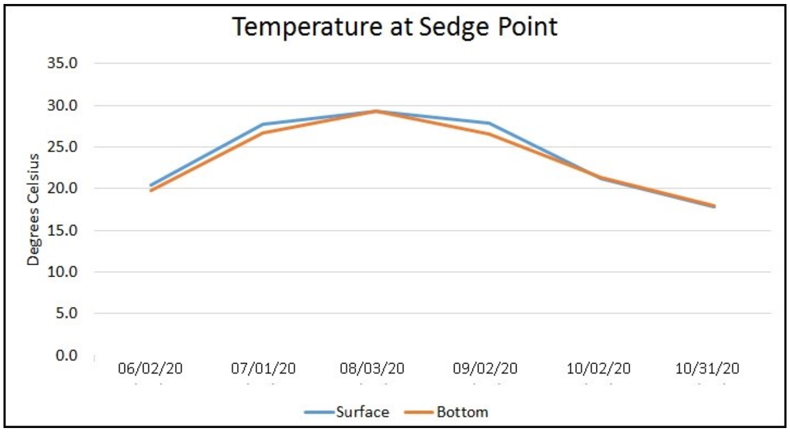


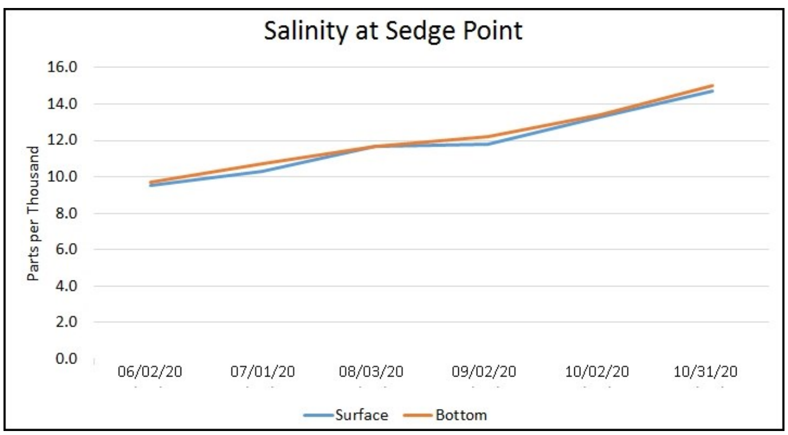


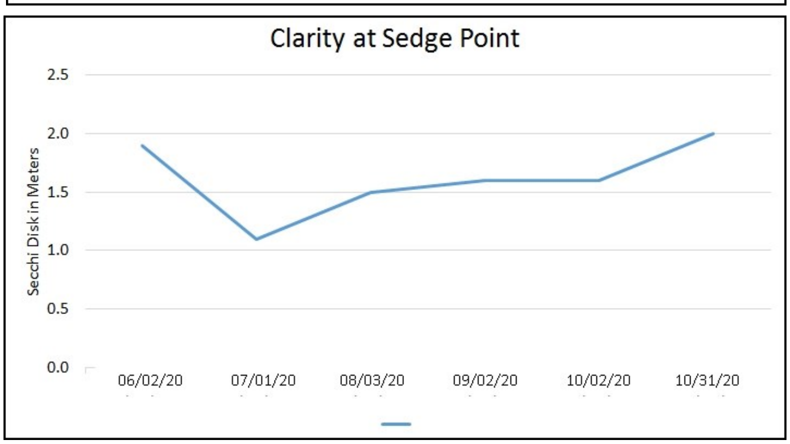


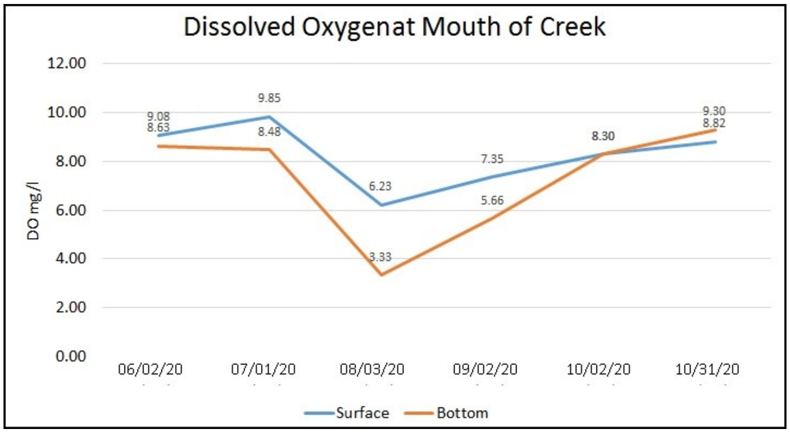
Water Quality

Site 11. Sedge Point



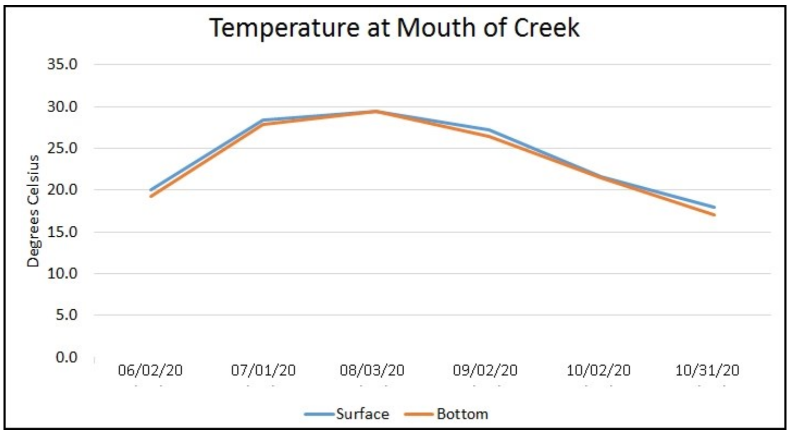


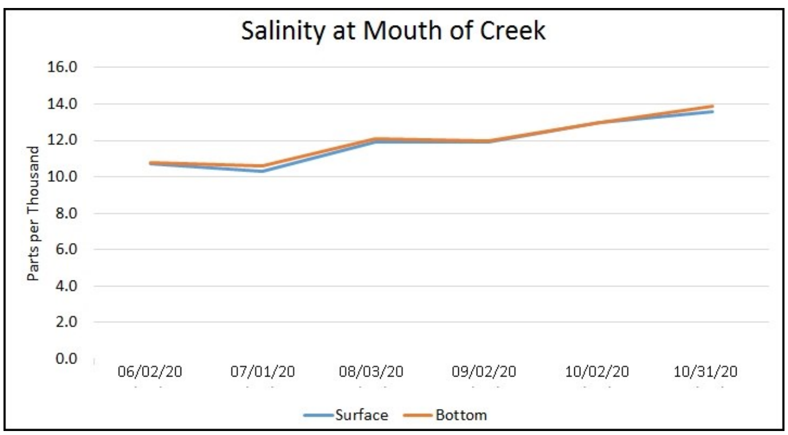


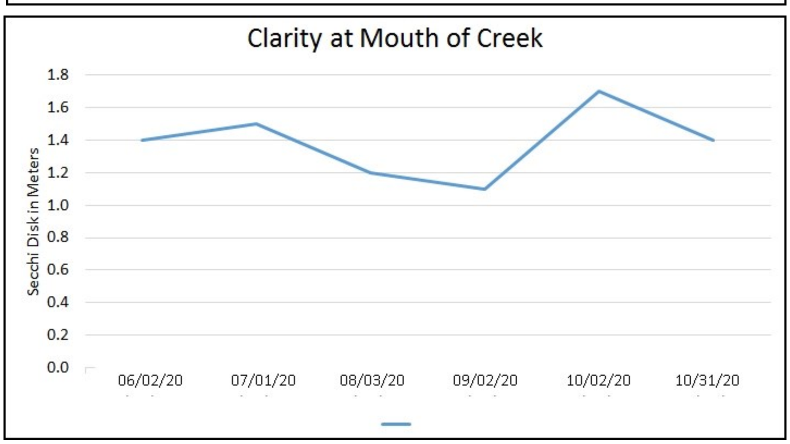


Water Quality

Site 12. Mouth of Creek







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