Nacote Creek and NERRS Analysis

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Abstract

In the first part of this report, different sets of data are analyzed from two NERRS sites (Old Woman Creek and Jacques Cousteau) looking at which parameters are more relevant in the specific area based off of the threats the NERRS area faces. Each sets of these data were representative of each season for the past five years (2014-2018) I choose to look at dissolved oxygen levels and water temperature to see variation, and what causes dissolved oxygen levels to change at Old Woman Creek area. Here I found that as water temperature increases, dissolved oxygen increased and vice versa. These two parameters share a negative relationship. As for the Jacques Cousteau area, I choose to look at salinity from two different devices to look at the effect rising sea levels has on the area. I found that the more upriver you moved, the less saline the water became. However, although the probe that was more near the ocean was much more saline, less variation occurred than in the more upriver probe. Also, the upriver probe showed trends of decreasing salinity levels at springtime for each five years, while the probe closer to the ocean did not show any trends.

Part two of this report shows a map of the five areas we tested, as a class, at the Jacques Cousteau reserve for multiple water quality parameters. This map also shows the five other locations maintained by the reserve that gather data every 15 minutes. Part two also discusses variation between the two probes used by the class, and the difference between the data we recorded at the surface and the data that is recorded by the continuously monitoring probes. The measurements we obtained both showed drops in pH, salinity, Dissolved Oxygen and Conductivity as we moved upriver. Temperature did not show much of a change and turbidity levels were too erratic. Even thought our data collected lined up nicely with the data collected by one of the continuously monitoring probes we passed, our data are much less meaningful than the continuously monitoring probes data. Our data only show a little blip in time and cannot help us discover trends, but the other probes can because they have recorded data for a great amount of time. Data needs to be recorded often in order for it to be useful in telling a story, and our data just helps us see the now, not the future or past.

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Introduction

This report deals with in-situ monitoring from two National Estuarian Research Reserve System (NERRS) sites. NERRS has 29 sites all throughout the country that multiple water quality, nutrient and weather parameters for their area 24/7/365. This report is split into two parts During part I, I will look at two different sites, Old Woman Creek and Jacques Cousteau and dissect parameters of my choosing based on threats that the area faces. The data will be based off the past five years and I will try to see particular trends within the data that relate back to the threats in the area. Part II deals with both, data gathered as a class and data gathered from continuously monitoring probes from the Jacques Cousteau reserve. Here I will dissect the class data we obtained and compare its accuracy, as well as importance to the continuously monitoring probes within the Reserve.

Old Woman Creek, Ohio (573 acres)

The Old Woman Creek Reserve has a total of five water quality buoys, however only four are active as one shut down in 2007 and another took its place. Out of the four active buoys, three deliver data in near real-time. The parameters covered by each buoy consist of the following; water temperature, specific conductivity, salinity, dissolved oxygen (in % and mg/l), depth and pH. Each of these parameters is measured every 15 minutes.

The Old Woman Creek reserve is a creek that feeds into Lake Erie, so it is 100% fresh water, non-tidal, and not influenced by oceans, but the area still faces major threats. The most predominant threat that is faced is a decrease in dissolved oxygen. This parameter is heavily discussed in the NOAA site profile and is monitored very extensively within the region. Factors such as algal blooms can affect dissolved oxygen. Algae suspended in water is good for dissolved oxygen, as algae photosynthesizes, and release oxygen. However, the problem occurs when the algae die and begin to decompose. Decomposition is an oxygen absorbing process, which leaves the water drastically lacking in oxygen, but the main factor affecting dissolved oxygen is water temperature. This parameter is also extensively monitored within the area.

Primary Parameters- I choose to look at how Dissolved Oxygen changed seasonally within the Old Woman Creek area. I choose One month to represent the correlating season and did so for a five-year span and I obtained data from all four active probes. It is important to note that was only able to collect data for three out of the four months due to the water around the reserve freezing throughout the winter months. That being said, throughout the five-year span, each year experiences a similar pattern. DO levels are high once measurements can be taken again when the ice thaws in the spring, then a decline in DO levels is seen during the summer months and finally, DO levels began to rise again towards the end of fall. The NOAA site profile links the increase of DO in the fall to a change of wind patterns. The summer months decline in DO could be a combination of algal blooms along with higher temperatures.

Some years saw a much more drastic change in OD levels than other years. When looking at 2016 and 2018, these two years began as the highest two averages of DO for spring, however, once summer arrived, these two years became the two lowest averages for summer DO levels. Dissolved Oxygen measurements greatly vary from year to year and even though a five-year span includes a lot of valuable data, it may take data from over 30 years or so to try to read any trends that are occurring. However, one trend that seems to be quite apparent is the decrease of DO levels during the summer months.

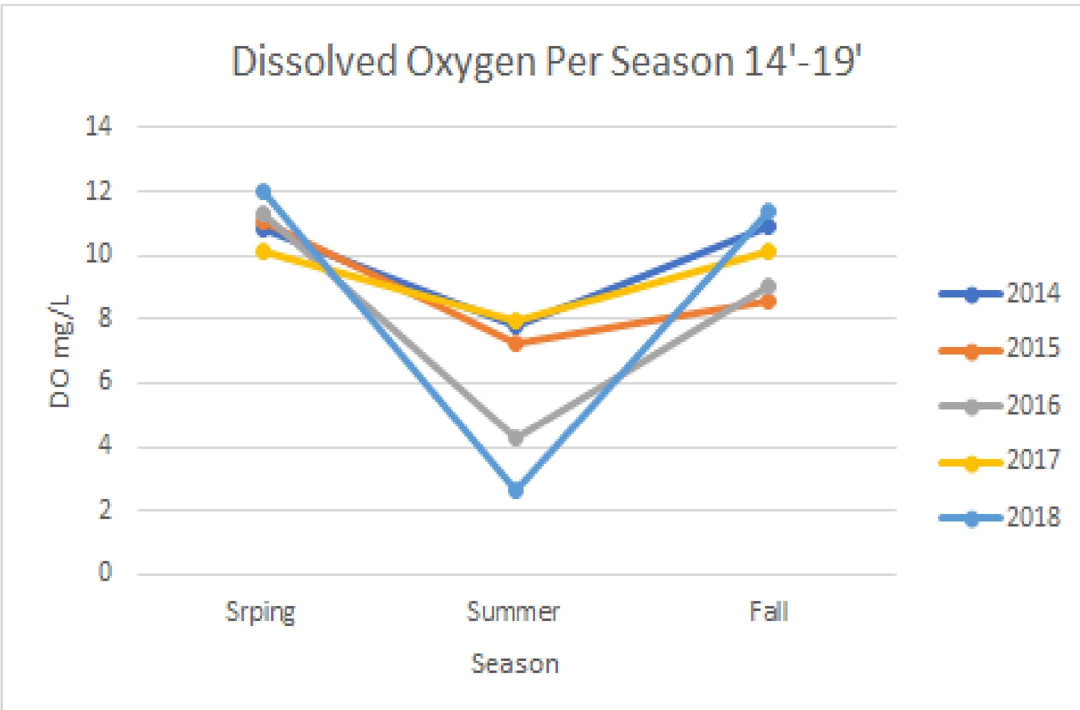


Figure 1 - Seasonal measurements of Dissolved Oxygen for Old Woman Creek from 2014-2019

I also choose to measure water temperature as this parameter shares a negative relationship with dissolved oxygen. As was the case for DO chart, I was only able to obtain data for three of the four seasons due to ice. When looking at the two charts, the most obvious conclusion that can be drawn is as temperature changes, DO levels also change, but in the opposite direction. This is due to colder water being able to hold more overall DO than warmer water. Water temperature measurements vary noticeably less than DO measurements do. There is an obvious connection between water temperature and the season it is measured in, with the summer months being the warmest and fall temperature measurements being slightly colder than in spring. All in all, water temperature is not an extremely important parameter to look at when it comes to water quality when it is by itself. Water Temperature becomes important when it is linked to another parameter or factor in the ecosystem. For the sake of this report, I linked the effect that water temperature has on Dissolved Oxygen and the relationship they share.

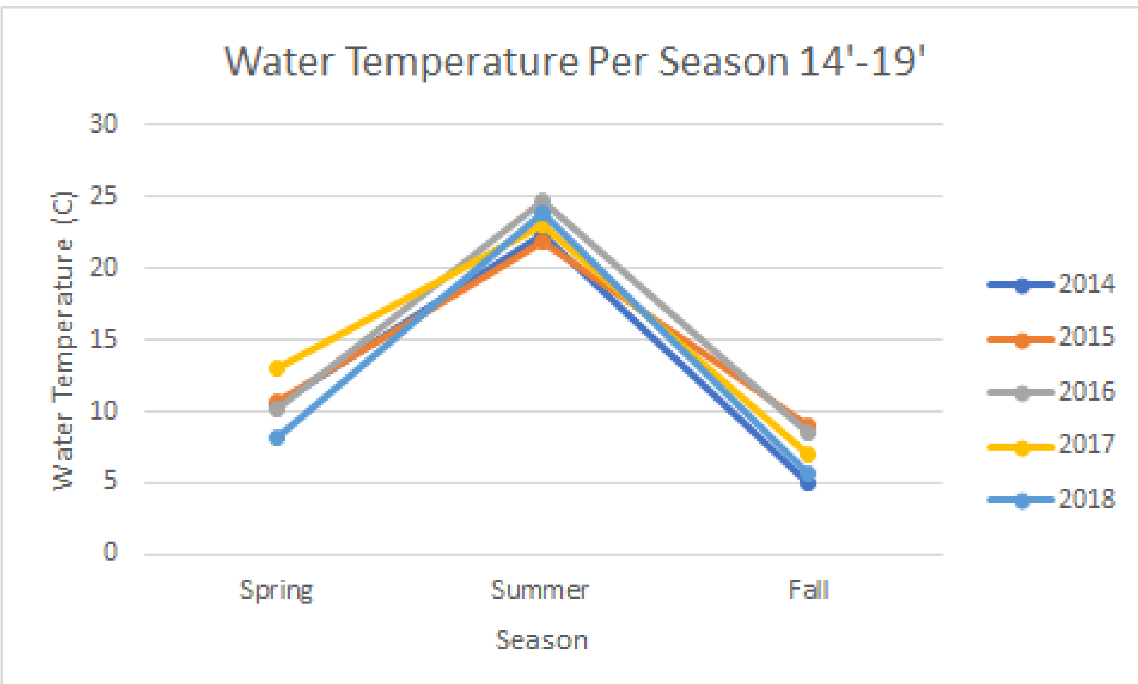


Figure 2 - Seasonal measurement of Water Temperature for Old Woman Creek from 2014-2019

Jacques Cousteau, NJ (114,873 acres)

The Jacques Cousteau Reserve has four buoys constantly measuring water quality. As of now, two of the four buoys are delivering near real-time data. The parameters covered by each buoy consist of the following; water temperature, specific conductivity, salinity, dissolved oxygen (in % and mg/l), depth and pH. Each of these parameters is measured every 15 minutes.

Being that the area is a tidal area, and is heavily influenced by the ocean, one major threat facing the area is sea level rise caused by climate change. Sea level rise in the area can lead to more and worse floods, especially when strong storms, such as hurricanes, impact the area. Specifically, Superstorm Sandy affected the area with flood levels at never before seen heights. However, the effect of sea level rise does not stop at historically high flood levels. Rising sea levels also poses a threat to the surrounding ecosystem by increased salinity, or longer periods of saline water presence in areas farther inland than normally experienced. As talked about in the NOAA site profile, salinity is believed to the major factor in restricting species from living in certain areas and is monitored extensively because of this reason.

<u>Primary Parameter</u> - The salinity levels within the waters of the Jacques Cousteau Reserve are depends on how far, or close you are to the ocean. While traveling upriver you will notice a drop in salinity, and as you travel downriver, you will notice an increase in salinity levels. For this reason, I choose two probes to collect data from, one probe being further upriver (Lower Bank) and another further downriver (buoy 126). When looking at the data collected by the Lower bank probe, there seems to be a persistent seasonal decrease of salinity from winter to spring, then the salinity levels rise back up again once summer arrives. As for the Buoy 126 probe, data does not vary greatly with only a range of about 4 psu and does not show any trends . This makes sense being that this probe is the closest to the ocean that Jacques Cousteau has for water quality monitoring. Between the two probes, overall salinity drastically differed. Buoy 126 ranged from about 26.0-30.3 psu while the Lower Bank ranged from about 0.8-6.5 psu.

Unfortunately, for winter in both 2015 and 2018, ice stopped the probes from making readings. Also, in 2018, during spring, the reserve did maintenance on the probes, which also kept them from gathering data. Again, in 2018, the Lower bank Probe experienced a power failure and could not gather data.

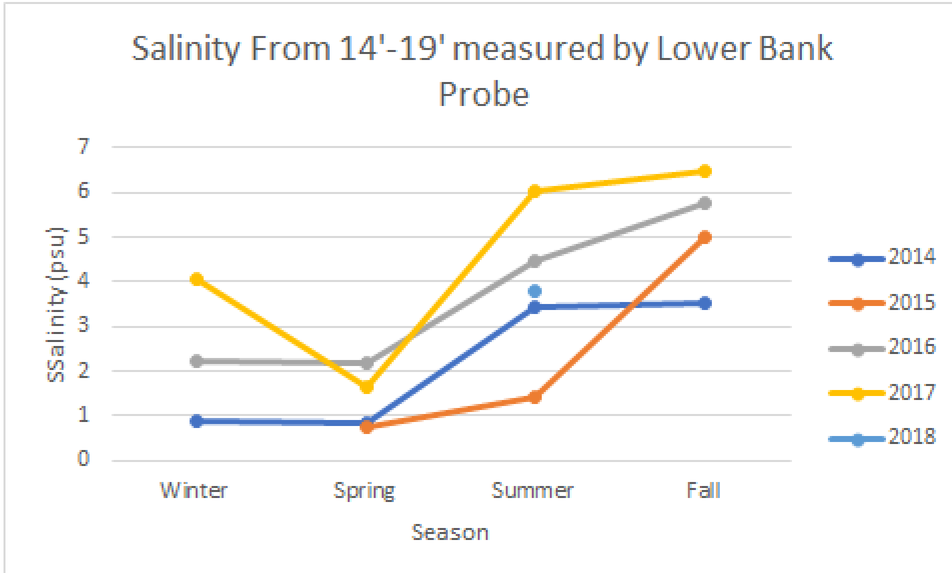


Figure 3 - Seasonal measurement of salinity for Jacques Cousteau from the Lower Bank probe

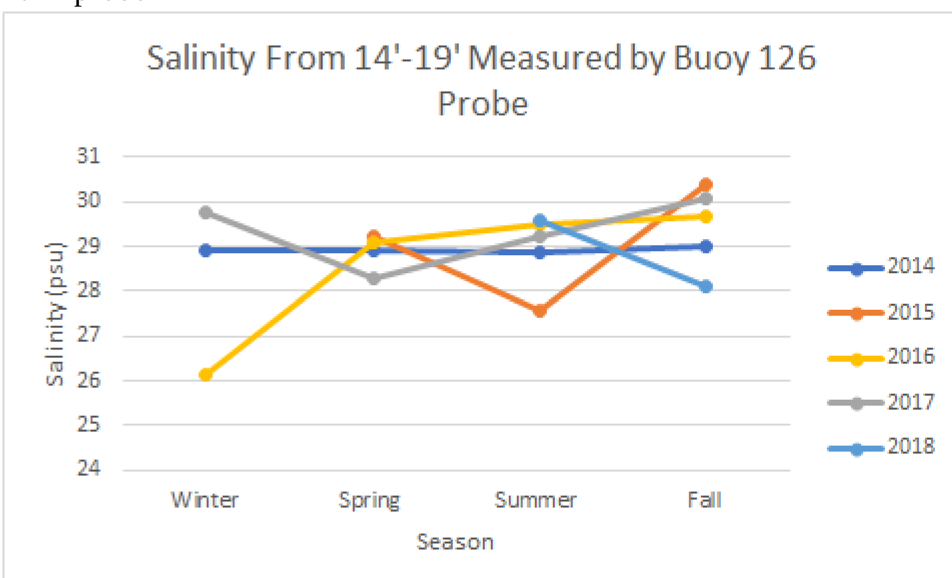
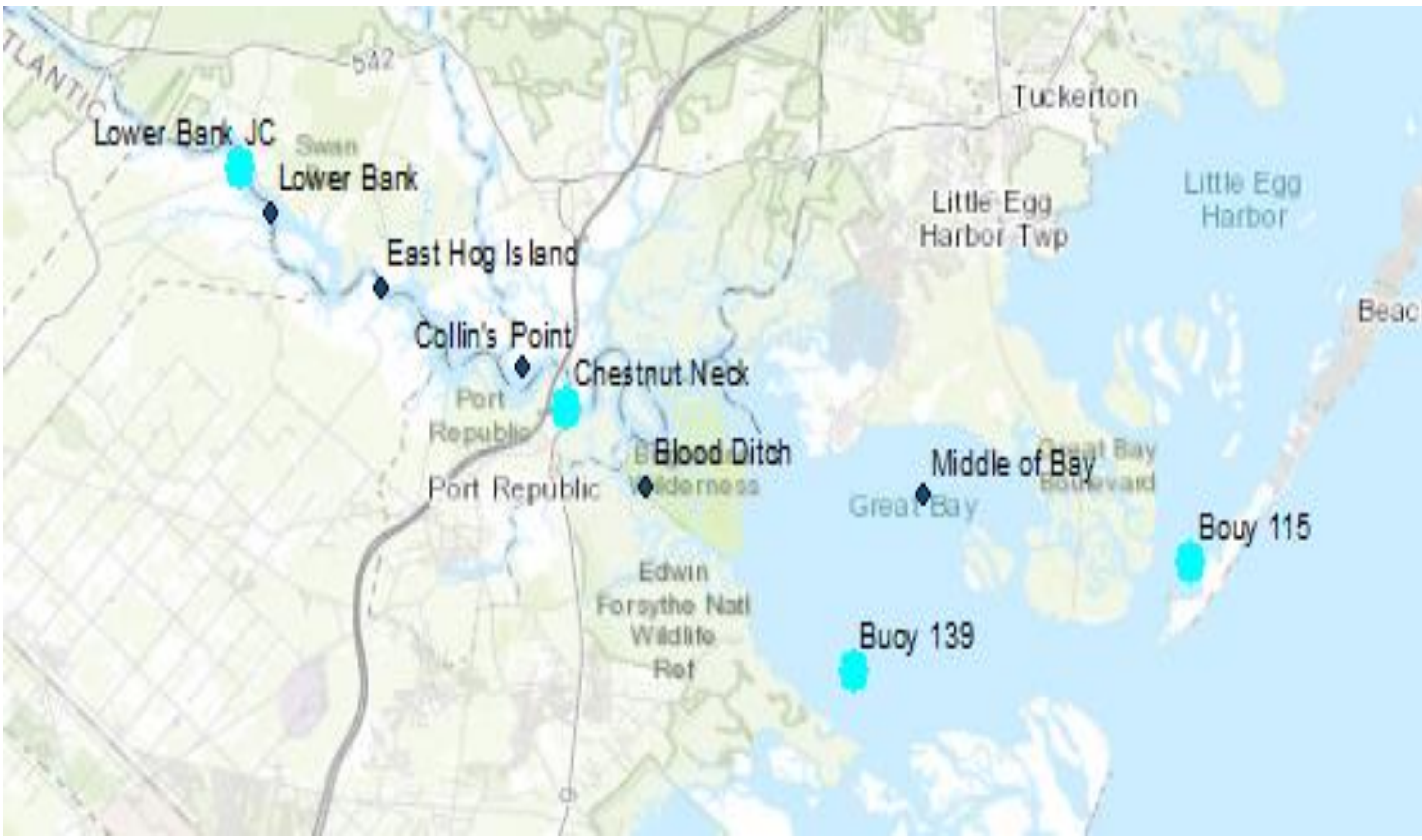


Figure 4 - Seasonal measurement of salinity for Jacques Cousteau from the Buoy 126 probe

Methods

This exercise tested water quality parameters in five different sites within the Jacques Cousteau Reserve. The first site was closest to the ocean and each of the four remaining stops we made were increasingly farther away from the ocean and more upriver. At each site, we used two different probes to measure both sub-surface water quality parameters, as well as parameters at the surface. The parameters we tested for consisted of the following; Temperature, Conductivity, Salinity, Dissolved Oxygen (% and mg/L), pH and turbidity. We ran into an issue with measuring turbidity at the sub-surface level though, which was most likely due to settling of sediments at the floor of the water body. We dealt with this problem accordingly and continued to collect the rest of the measurements we were testing for.



<u>Probe Comparison</u>

When comparing data between the two probes we used at both the surface and subsurface level, certain parameters lead me to suggest that there are sites of clear impairment and sites that would be considered cleaner that other sites studied. Sites of impairment were sites located closer to the ocean, such as the Middle of the Bay, Blood Ditch and even Collin's port. These sites had high levels of salinity and conductivity. These sites had such measurements due to the proximity to the ocean. Mixing between the Nacote creek and the highly saline waters of the ocean and in conjunction, the highest salinity levels we measured was at the Middle of the Bay, which was the closest we got to the ocean. Conductivity also decreased, as salinity did, as we moved upriver towards East Hog Island and the Lower Bank. This is not much of a surprise because as water becomes less saline, it also becomes less conductive. Dissolved oxygen decreased as we moved upriver too. This is due to less wind forcing air into the water and causing less waves. Just like the other parameters, pH dropped as we moved upriver as well. Turbidity measurements were too erratic to get a constant reading, especially in the sub-surface measurements. I would consider The Middle of the Bay site to be the most impaired, and the Lower Bank site to be the cleanest.

Although the data we collect between the two probes are relatively consistent with each other, at both the surface and sub-surface, it is only a measure of parameters at a certain point in time. These measurements we found will not lead us to any conclusions nor will they help us understand trends that are occurring within the Nacote Creek. The better, more accurate data are found when analyzing the parameter measurements collected by the continuously monitoring probes. This is because you are able to tell an actual story and read trends with the data collected by these probes, rather than see what is just happening right here and right now. As we obtained measurements for each site we passed by two of the continuously monitoring probes, and the data we had compared pretty accurately with the probe we passed, besides for pH being slightly off (only found available data for one of the two probes we passed). This is a good sign that our data are accurate for current conditions, but only continuous data over a long period of time holds any accuracy in predicting future conditions.

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