Monitoring TDS and Conductivity in Murrels Inlet, SC

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Introduction

Total Dissolved Solids or TDS is a measure of inorganic salts, and other dissolved materials in water. TDS can be nutrients that provide benefits to the ecosystem but they can also contain contaminants such as pollutants or toxic metals. The concentration and composition of TDS in natural waters is determined by the geology of the drainage, atmospheric precipitation and the water balance (evaporation-precipitation). TDS can cause toxicity to organisms by increasing the salinity in the water. Increases in salinity have been shown to cause shifts in biotic communities, limit biodiversity, exclude less tolerant species and cause acute or chronic effects in certain life stages. Because of all this monitoring TDS levels in our local waterways is very important to keep track on the health our environment and if human activity is affecting it in any dangerous way. Electrical Conductivity or EC is a measure of water's ability to conduct electric current. Conductivity is frequently used as a water parameter to describe the salinity in the water which makes it very useful for studying seawater intrusion. The conductivity abilities of water depend on dissolved ion concentrations, ionic strength, and temperature of measurements. Like TDS, monitoring EC can be very important to know the current state of the environment. In this study we monitored the TDS and EC levels at the Murrels Inlet Oyster Landing in South Carolina and found the K constant ratio between TDS and EC.

K Ratio Between TDS & EC

Since EC and TDS are both dependent on dissolved ionic salts or ions, they share a relationship. EC and TDS can be related to each other through a mathematical function. Researchers have done numerous investigations in find this mathematical equation correlating TDS and EC, so we can find the TDS concentration levels by using the EC value of the water. The relationship between these two water quality parameters can be found using the following equation:

$$TDS\ \left(\frac{mg}{L}\right) = K\ \times EC\ \left(\frac{\mu S}{cm}\right)$$

Where K is the ratio constant between EC and TDS. We will use this equation with information given in Table 1 and Table 2 in our results to find our K constant of the water in Murrels Inlet, South Carolina. This K ratio between EC and TDS is not easily defined and as varying ranges. In general, the range for the K ratio between EC and TDS is 0.55 to 0.75. Freshwater will usually have a lower K value of closer to 0.55 and seawater will have a higher K value closer to 0.7. For the water in Murrels Inlet we can expect to have a higher K value sense it is connected to the Atlantic Ocean.

Methods

This project was to study and monitor the EC and TDS concentration levels at the Murrells Inlet Oyster Landing in South Carolina. , the Murrels Inlet oyster landing is a small sandy beach surrounded by shallow waters. It is connected to Oaks Creek which flows out into the Atlantic Ocean. For this project TDS and Conductivity levels were measured using a portable Hanna HI 9828 with multiparameter probes using the Standard Operating Procedures developed by the Waccamaw Watershed Academy's Volunteer Water Quality Monitoring Program. 293 samples were taken between May 20th 2008 and February 23rd 2021.

Results and Discussion

The Volunteer Water Quality Monitoring Program using their 293 samples taken at the Murrels Inlet Oyster Landing were able to develop graphs and statistics that we can use. Looking at Table 1 and Figure 2 gives us lots of insight and information about the EC levels in the water at the Murrels Inlet Oyster Landing. From Table 1, our maximum EC level is 57,050µS/cm and minimum EC level of 38,780µS/cm with a mean EC level of 51,899µS/cm and a median EC level of 52,120µS/cm. From Figure 2, the box plot of conductivity, we can tell we have a couple low outliers in EC level such as our minimum level of 38,780µS/cm.

Table 1: *Conductivity (µS/cm) levels at the Murrels Inlet Oyster Landing*

# Samples	Mean	S.D.	Median	Max	Min	10th	25th	75th	90th
293	51,899	2,004	52,120	57,050	38,780	49,410	50,950	53,200	54,000

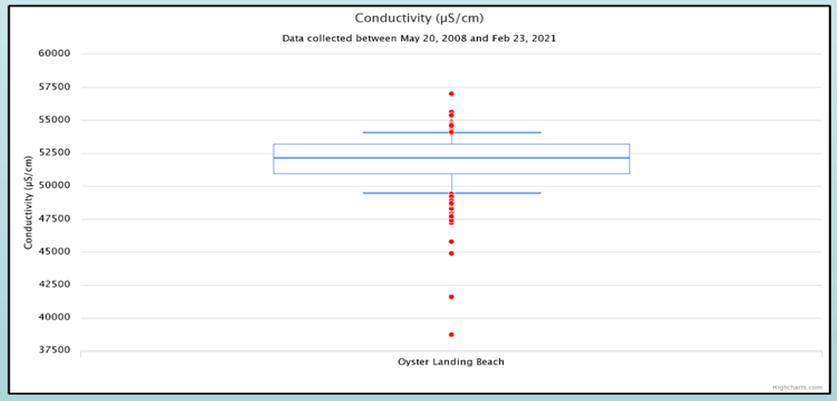

Figure 2: *Geographic Trend Box Plot of Conductivity at the Murrels Inlet Oyster Landing.*

Table 2 and Figure 3 gives us our information of the TDS concentration of the water at the Murrels Inlet Oyster Landing. Looking at Table 2, our mean TDS concentration is 29,581mg/L, median TDS concentration is 31,800mg/L. With a maximum TDS concentration of 35,000mg/L and minimum TDS concentration level of only 32.4. Looking at Figure 3 we can tell that our minimum TDS level of only 32.4 is an extreme outlier with most our TDS concentration levels ranging from 26,000mg/L to 33,000mg/L.

Table 2: *TDS (mg/L) concentration levels at the Murrels Inlet Oyster Landing*

# Samples	Mean	S.D.	Median	Max	Min	10th	25th	75th	90th
293	29,581	4,331	31,800	35,000	32.4	24,690	25,690	33,200	34,100

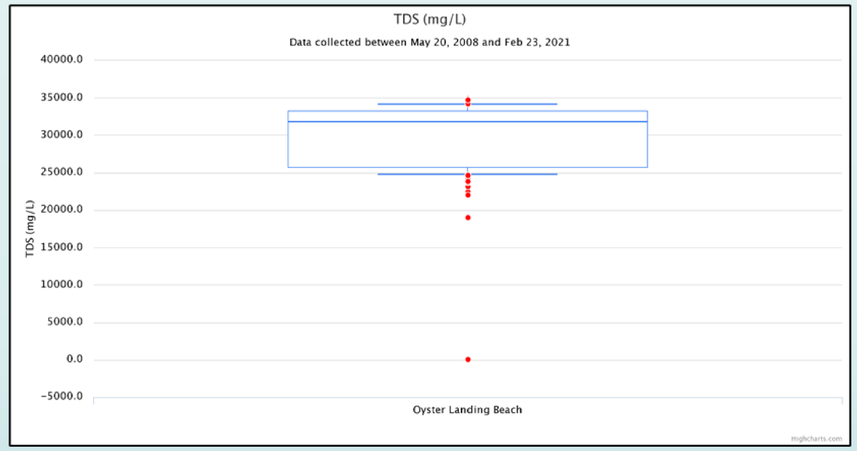

Figure 3: *Geographic Trend Box Plot of TDS at the Murrels Inlet Oyster Landing*

Calculating K Ratio

Using these results and our equation found during the introduction describing the correlation between TDS and EC we can find the K constant of the water at the Murrels Inlet Oyster Landing. Using the equation: $TDS\ \left(\frac{mg}{L}\right) = K\ \times EC\ \left(\frac{\mu S}{cm}\right)$ and solving for K and we can find that $K = \frac{TDS}{EC}$. Using this new equation and our EC and TDS values given in Table 1 and Table 2 we can solve for the K constant ratio between TDS and EC. Because we had some outliers in our data it is most accurate to use our median values sense the mean is affected more by the outliers. With our median EC and median TDS values we find that $K = \left(\frac{31800}{5210}\right) = 0.61$. This K value makes sense based on the varying ranges the K value can have. It also makes sense because the water at the Oyster Landing will have a higher salinity because of its connection to the Atlantic Ocean.

Conclusion

From this study we concluded that there is a relationship between TDS and EC levels in water. EC and TDS are both important water quality parameters that can describe the salinity level of water. Many researchers have studied and found an equation/ratio that connects TDS levels with the EC levels in water. We found that the K value ratio between EC and TDS for the water at the Murrels Inlet Oyster Landing in South Carolina is 0.61 using the median EC and TDS values. The value of this ratio does fall within our expected K ranges. The ratio of 0.61 correlates with a higher more brackish salinity content. The K value does vary depending on what day you look at the sample, this is expected because TDS and EC are dependent on recent weather patterns and storm drainage. Looking at the concentration levels of TDS and EC you know that this water is not safe for human consumption.

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