

Nitrogen and Phosphorus Monitoring in Crabtree Swamp Water

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Introduction

- Nitrogen and phosphorus are two types of organic matter that can be found in freshwater ecosystems.
 - Essential nutrients for all living organisms that are required to support the growth of plants, feed animals, and ultimately provide adequate nutrition for an expanding global population (Borba et al. 2014).
 - Fundamental factor and has a direct influence on algal growth kinetics (Xin et al. 2010).
- The negative effects that come from excessive nutrients outweigh the positive effects
 - Can lead to a decline in water quality for freshwater ecosystems (Wurtsbaugh et al. 2019).
- Crabtree Swamp is experiencing rapid growth rates and boom in construction of urban environments (Schroer et al. 2018).
 - Sources of nutrients, such as lawns; urbanization increases; impervious surfaces; increase runoff; carrying nitrogen and phosphorus in them. Impervious surfaces, such as roads, parking lots, and buildings increase the volume of runoff water during storm events, which can increase the transport of these nutrients (Schroer et al. 2018).
- Water quality testing was done in this study to determine the levels of nitrogen and phosphorus in the Crabtree Swamp and analyze how their levels effect the ecosystem.

Motivation

- These increased inputs have been found to cause massive changes in biological diversity in aquatic ecosystems (Elser et al. 2007). This organic matter has caused algal blooms, resulting from nitrogen and phosphorus contamination, to become a major problem in many freshwater ecosystems (Liu et al. 2012).
- Occurrences of nitrogen and phosphorus species in water can have serious environmental and human health impacts. Infants younger than 3 months of age are particularly prone to adverse effects of high nitrogen exposure (Nieder et al. 2018). High nitrogen levels in drinking water has also been seen in cases of cancers of the digestive track (Nieder et al. 2018).

Methods

Nitrogen and phosphorus levels are often measured in mg/L (Xin et al. 2010). The samples in this study were analyzed by the Alkaline Persulfate Oxidation method.

- The current standards or recommendations for the amount of nitrogen and phosphorus are:
 - Total phosphorus should not exceed 0.09 mg/L
 - Total nitrogen should not exceed 1.50 mg/L
 - according to SCDHEC (Regulation 61-68 Water Classifications and Standards et al. 2014).
- A total of 227 nitrogen samples were collected, along with 224 samples of phosphorus. These samples were taken over a total time period of 12 years that from January 31, 2008 to December 17, 2020. Samples were taken through a syringe that was filtered through GFF glass fiber acidify (<2 pH with sulfuric acid).
- Once the samples were taken, they were then stored in a cooler at a range of 1-6 °C. The samples were then brought back to the lab and stored in refrigerator at 1-6 °C. These samples would sit and be analyzed within 21 days.

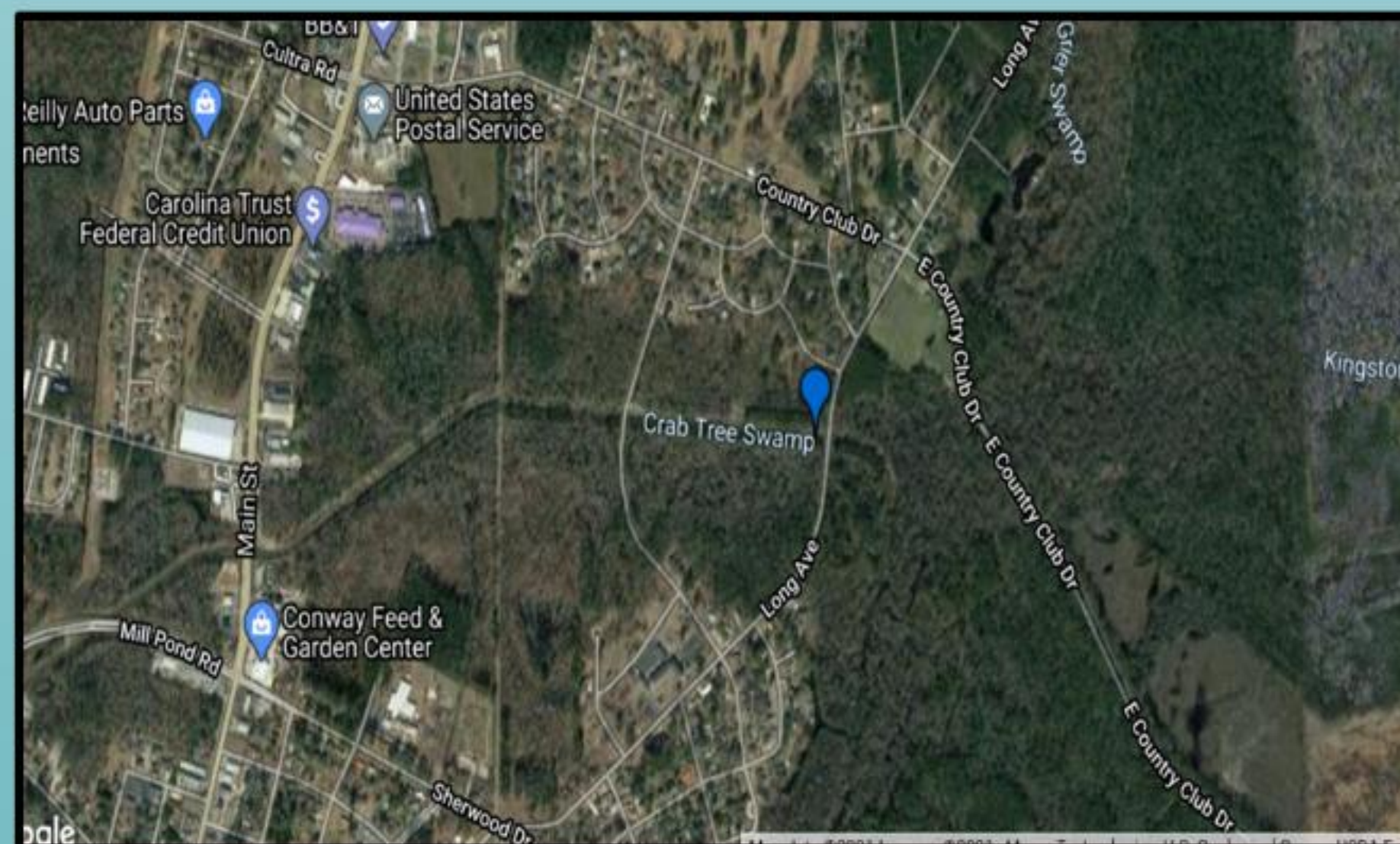


Figure 1: Crabtree Swamp Location (Solid Blue Marker)

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Results

Table 1: Measured Total Nitrogen values including mean, standard deviation, median, maximum, and minimum.

| Total Nitrogen (mg/L) | | | | | | | | | |
|-----------------------|-----------|-------|-------|--------|-------|-------|------------------|------------------|------------------|
| Site Name | # Samples | Mean | S.D. | Median | Max | Min | 10 th | 25 th | 75 th |
| Crabtree Swamp | 227 | 0.638 | 0.255 | 0.600 | 2.530 | 0.256 | 0.432 | 0.494 | 0.710 |

Table 2: Measured Total Phosphorus values including mean, standard deviation, median, maximum, and minimum.

| Total Phosphorus (mg/L) | | | | | | | | | |
|-------------------------|-----------|-------|-------|--------|-------|-------|------------------|------------------|------------------|
| Site Name | # Samples | Mean | S.D. | Median | Max | Min | 10 th | 25 th | 75 th |
| Crabtree Swamp | 224 | 0.062 | 0.029 | 0.055 | 0.266 | 0.000 | 0.037 | 0.045 | 0.072 |

- The average observed total nitrogen was 0.638 mg/L with a standard deviation of 0.255 mg/L and the average total phosphorus was 0.062 mg/L with a standard deviation of 0.029 mg/L
- From the average total nitrogen was measured to be 0.638 mg/L, which is lower than the regulation provided by SCDHEC of 1.50 mg/L. From Table 2, the average total phosphorus was measured at 0.062 mg/L which is also lower than the SCDHEC regulation of 0.09 mg/L.

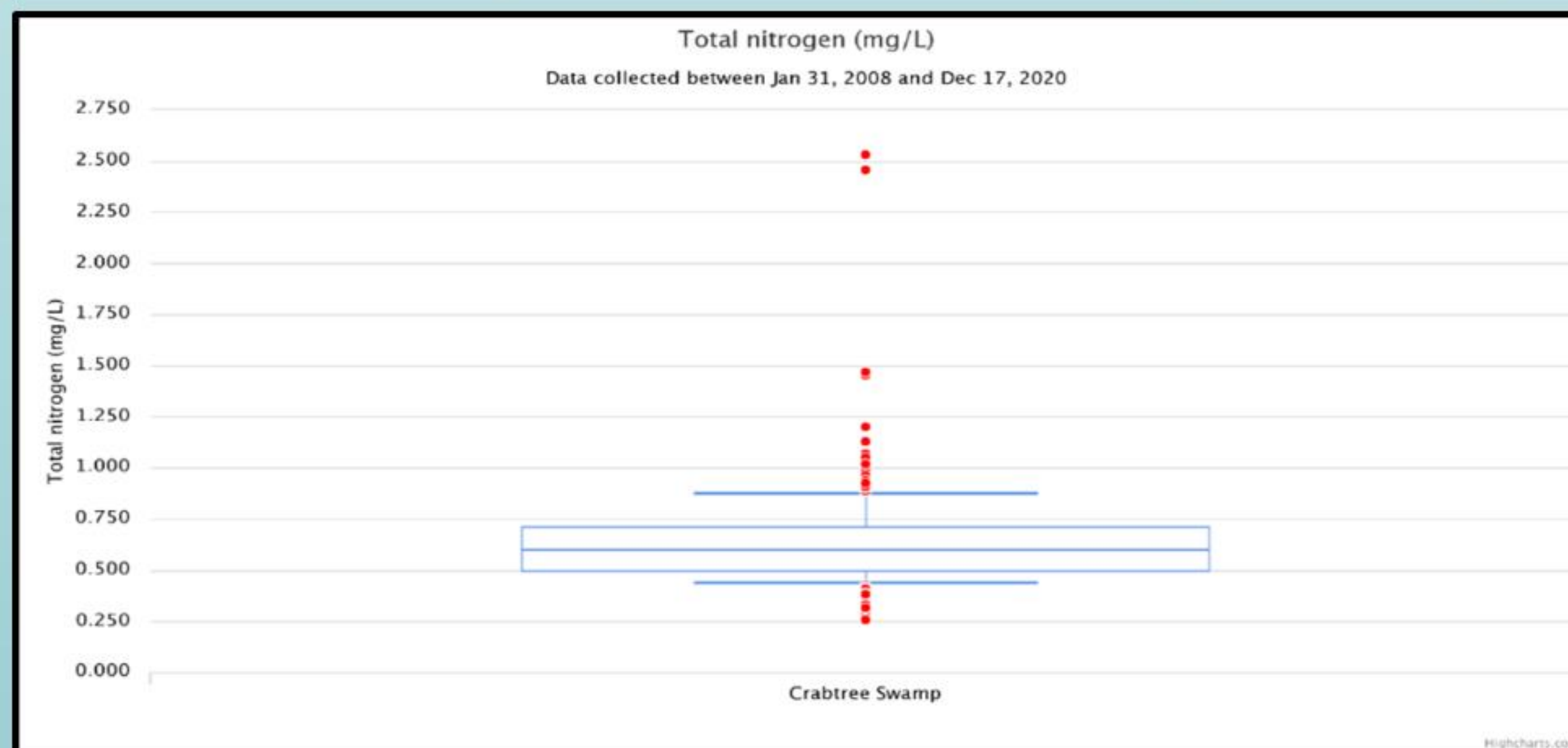


Figure 2: Box Plot of total nitrogen values.

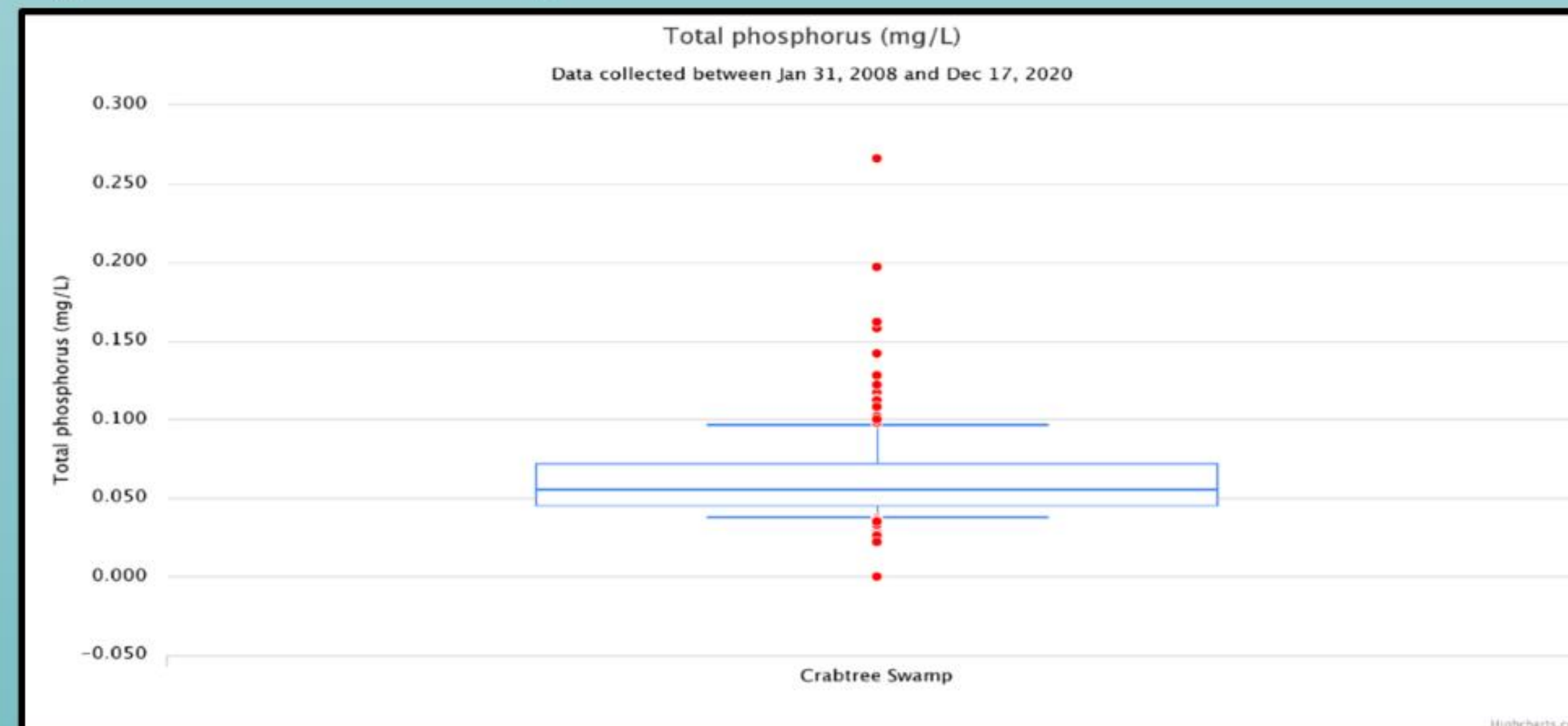


Figure 3: Box Plot of total Phosphorus values

- The outliers that were measured above the SCDHEC regulations of 0.09 mg/L for phosphorus and 1.50 mg/L for nitrogen could be considered harmful and unhealthy for the water ecosystem. However, the reason that these random high measurements are called outliers is because they do not conform to the pattern of the other measurements..

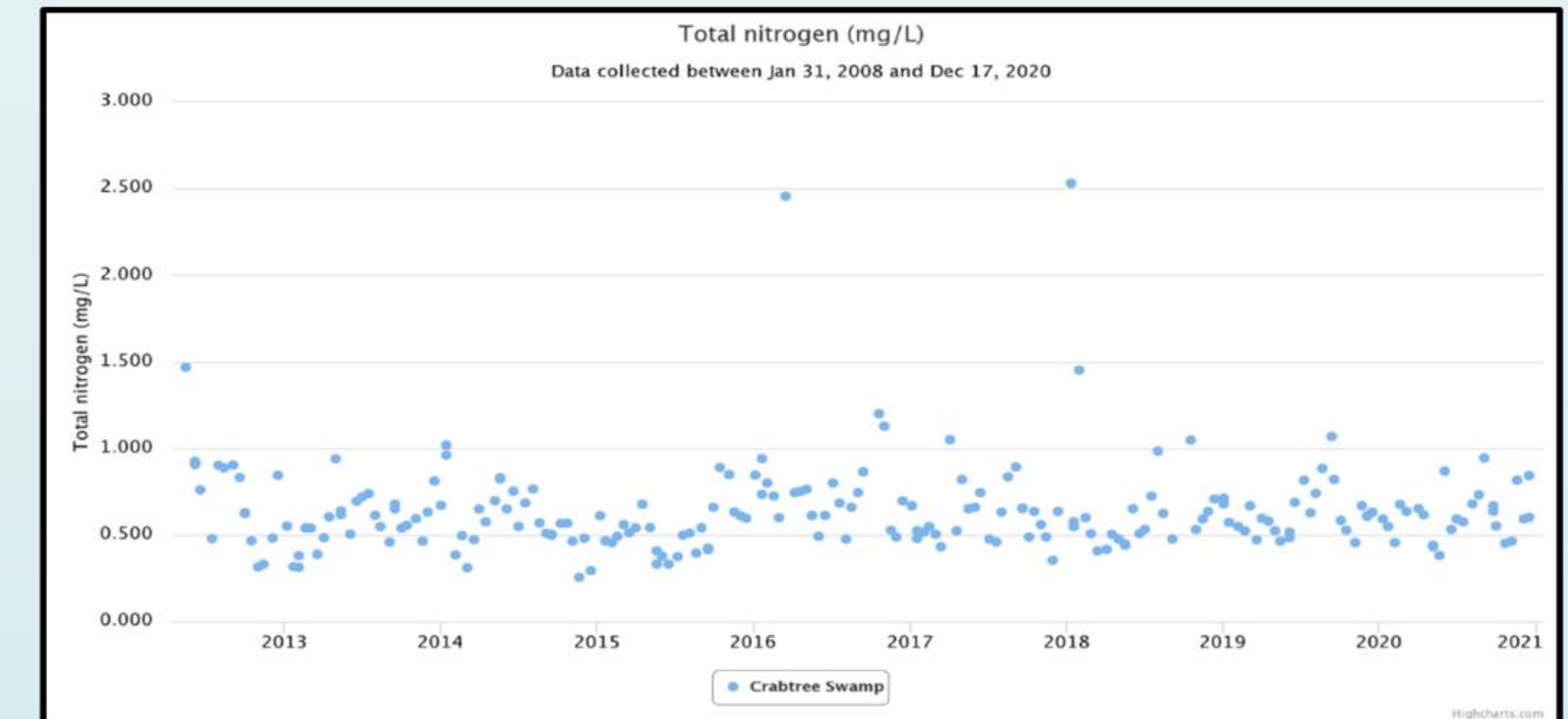


Figure 4: Total Nitrogen time trend.

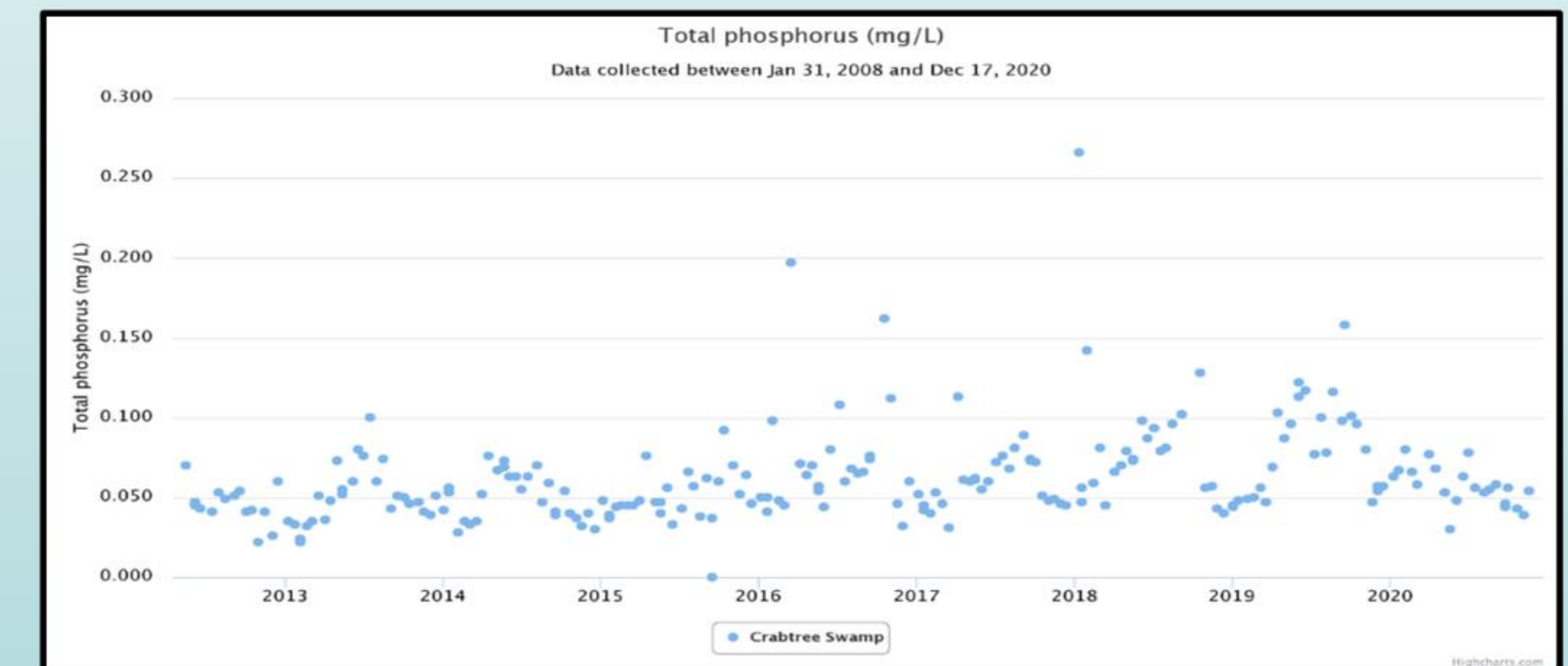


Figure 5: Total Phosphorus time trend.

- Time trends show the values measured over a period of time. These charts show each measured value over the course of the study. This allows the team to see each individual measurement and when it happened. This could show a correlation between nitrogen and phosphorus
- In both graphs there is only a handful of points that were measured above their respective DHEC regulations. The outlying points can be seen as a spike in the nitrogen or phosphorus values for that specific date or time. By using the time trend, we can see when the spike in values happened and try to correlate that with an event that could have caused the spike, like excess rain, runoff, or construction nearby.

Conclusions

- From all the tests and samples done in this study it is shown that the collective average of both nitrogen and phosphorus values are below their respective regulations. This is good for the Crabtree Swamp ecosystem because it means that there are not harmful amounts of these elements in the water.
- Although there are some observed outliers, the overall trend is steady and below regulations. These outliers are useful information when trying to determine what caused a spike in values, whether it was human activity or natural water runoff

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