# Effects of Salinity and Phosphates on Chlorophyll Concentration

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## Introduction

Tides strongly affect many properties of estuary habitats including salinity, temperature, turbidity, and nutrient concentration. Additionally, the tidal range impacts the variation of these properties as well as physical, chemical, and biological processes. Charleston Harbor in Charleston, SC, the estuary of concern for this study, has a tidal range of 1.6 meters [2]. In the past, humans have greatly altered the harbor, changing the Cooper River flow and creating, and later deepening, the boating channel in order to increase the port's productivity [3]. These changes have altered salinity levels and consequently, the harbor ecosystem as a whole. It has recently been elected to further deepen the harbor in order to accommodate the significantly larger cargo ships that will result from the expansion of the Panama Canal [1]. By looking at the salinity, temperature, chlorophyll, and phosphates in four different locations, the recent changes to the harbor can be recorded and sampling can occur at a later date, after the channel has been modified again.

***Objectives:***

- Analyze the effect of salinity and nutrient concentration on phytoplankton abundance

## Methods

- In order to evaluate salinity, nutrient concentration, and phytoplankton abundance, two samples a week are taken for four weeks in the Charleston Harbor and up the Ashley River. Four locations are sampled [Fig. 6]: **Patriot's Point**, **Melton Peter Demetre Park (MPD Park)**, **Brittlebank Park**, and **Ashley River**.
- Two 50mL samples are collected for phosphate analysis and salinity measurement, 50 mL of seawater are filtered using a GF/D filter for chlorophyll analysis, and temperature is measured. Phosphate and chlorophyll samples are both frozen after collection to prevent degradation, while salinity samples are stored in a cool, dark refrigerator.
- Rainfall and other atmospheric conditions are monitored in an effort to avoid sampling error during collection.
- Salinity is measured in the laboratory using a hand refractometer.
- Nutrient concentration is analyzed using standard spectrophotometry techniques. (linear regression: y=0.2143x+0.0144 at 885 nm)
- The chlorophyll samples undergo fluorometric analysis which measures chlorophyll-a fluorescence.

## Results

**Salinity vs. Chlorophyll** **Phosphates vs. Chlorophyll**

**High Tide**

**Low Tide**

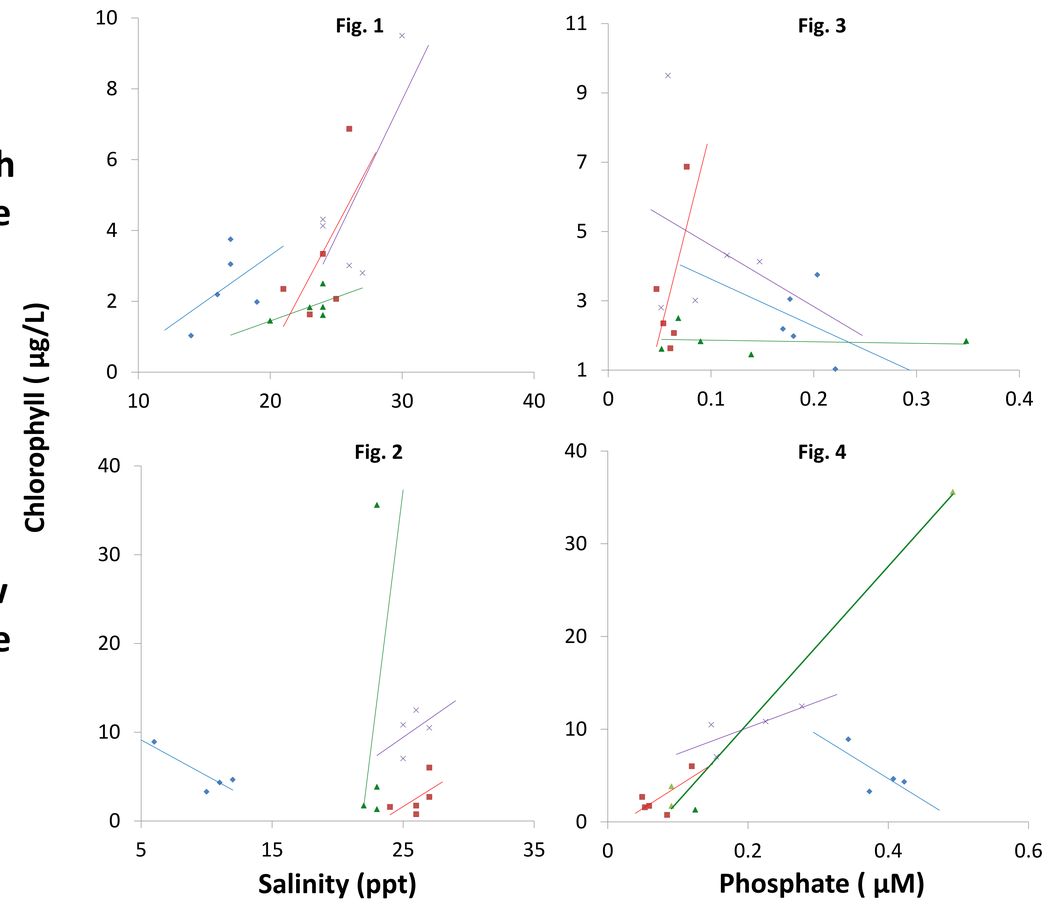


**Fig. 6**


**Figure 6.** Satellite image of sampling area; locations correspond with colors in figures 1-4.

**Fig. 5**

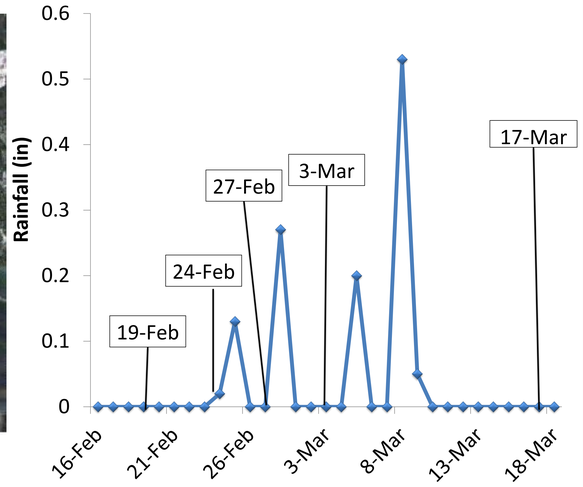


**Figure 5.** Rainfall during collection period as well as surrounding days. Shows no significant rain events near collection days.

## Discussion

- As expected, there is a positive correlation between salinity and chlorophyll as well as phosphate and chlorophyll for the three locations which are most impacted by the seawater during tides: Brittlebank Park, MPD Park, and Patriot's Point.
- However, there is a negative correlation for three out of the four graphs for the Ashley River location [Fig. 2,3,4]. This is likely due to the impact of freshwater. At high tide, the salinity is much higher as a result of saltwater intrusion whereas at low tide, the main source is fresh water. The average difference in salinity between low and high tide at this location is considerable, 6.25 ppt, which makes the correlation between salinity and chlorophyll positive.
- Because there were no significant rain events near collection days, rainfall and surface temperature do not appear to have an effect on salinity. Low rainfall, however, likely had an effect on phosphate concentration. Nutrients are flushed from rivers during heavy rain events, constantly refreshing nutrient levels in the estuary. Because very little rain fell during collection, nutrient levels were likely slightly lower than normal.

## Acknowledgements

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## References

[1]Bird, Allyson. "U.S. Rep. Jim Clyburn promises port results." Post and Courier 25 Feb 2011, Print. http://www.postandcourier.com/news/2011/feb/25/clyburn-promises-results/

[2]Kjerfve, B., Magill, K.E. 1990 Salinity Changes in Charleston Harbor 1922-1987. *Journal of Waterway, Port, Coastal and Ocean Engineering* **116**, 153-168.

[3]Kjerfve, B. 1989 Physical Processes in Charleston Harbor. *Charleston Harbor: issues, resources status, and management NOAA Estuary-of-the-month seminar series* **16**.