



Freshwater and Seasonal Influences on Nutrient Concentrations and Primary Productivity

During a Spring Bloom Event within the Charleston Harbor

Kristen Jay, Michelle Hou, and Mark Adams

Department of Biology, College of Charleston



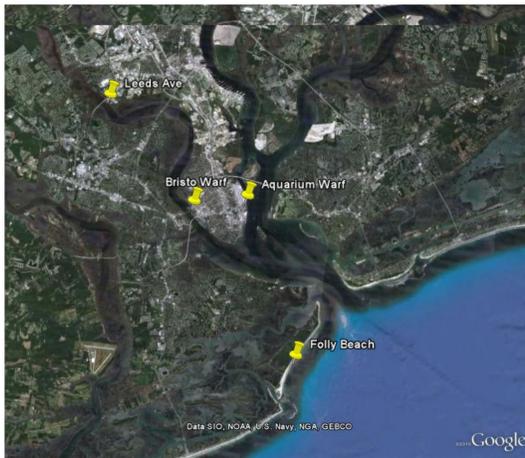
Introduction

- Centrally located on South Carolina's coast is the Charleston Harbor, which forms a complex estuarine system, where nutrient levels and phytoplankton concentrations are important to the health of the system.
- Phytoplankton are free-floating microscopic plants that play a crucial role in primary production, nutrient cycling, and food webs within the aquatic system.
- When there is a rapid increase in the accumulation of microscopic plants in the water it results in what is known as a Phytoplankton Bloom.
- Nutrient levels such as phosphate concentration play an important role the abundance and assemblages of phytoplankton blooms (Lopes, 2007).
- To better understand the health of the estuary, it is important to look at the spatial and temporal changes through out the system.
- The data will give us a better understanding of the freshwater impacts on estuarine water quality within the context of natural environment variability.

Methods

Salinity, chlorophyll a, phosphate and temperature will be measured at low tide from February 20rd, 2011 to March 31, 2011.

- Samples will be taken around the Charleston Harbor from the Ashley River Marina, the Cooper River, Leeds Avenue, and from the surf at Folly Beach.



Measurements were taken at low tide to get the maximum river effects compared to the more random mixing found at higher tides from the oceans influence.

Chlorophyll a was measured using a dilution 5mL of 90% acetone and then fluorescence was recorded using a fluorometer. Concentration for each sample was found and expressed as micrograms of chlorophyll per liter of seawater.

Phosphate was measured by using a 2.5 mL dilution of mixing reagent into a 25 mL sample of seawater. Absorbance was measured using a spectrophotometer and expressed as micrograms of phosphate per liter of seawater.

Chlorophyll data will be used to estimate abundance of phytoplankton and phosphate data will be used to estimate nutrient levels.

Data will be tabulated over the time scale of the experiment to analyze the changes in these factors as an indicator of the spring phytoplankton bloom.

Questions

What effects will seasonal changes, such as increased day length and temperature, have on chlorophyll concentration?

What effects will freshwater influence from rainfall and the Ashley River have on Phosphate concentration?

Predictions

- Seasonal changes occurring from February to March will show an increase in chlorophyll concentration, due to phytoplankton blooms.
- The site further up the Ashley River will have a greater concentration of phosphates
- Days following heavy rainfall will have higher phosphate concentrations.

Discussion

It is important to understand the impacts of freshwater input to estuaries when doing research in the Charleston Harbor.

The increase in freshwater allows for more runoff from the surrounding terrestrial areas of the estuary, which in turn increases nutrient availability.

Nutrient levels are important for estuary water quality because phytoplankton assemblages are extremely sensitive to nitrogen and phosphate ratios (Lopes, 2007).

Chlorophyll concentrations are effected by day length and temperature. As seasonal changes increase day length and temperature, the concentration of chlorophyll also increases.

Chlorophyll concentrations are a good indicator of the phytoplankton abundance. Therefore, a study that consistently measures chlorophyll over seasonal changes throughout the year will be able to infer when an estuary is most productive.

The effects of salinity on chlorophyll content have before shown that concentrations are higher in the middle ranges of salinity, while extreme high and lows can lower their salinity (Liu, et al, 1976).

Salinity did not serve as a useful indicator of chlorophyll or phosphate, perhaps because of the turbidity of the ocean and the dynamic nature of estuarine waters in response to rain, runoff and other factors affecting salinity.

Large-Scale Implications

Continued monitoring and research is crucial in understanding and maintaining the health of estuary ecosystems.

Estuaries provide both ecological and economical values to fin- and shellfish populations and the transformation of nutrients between freshwater and marine environments.

It is important to assure that the estuaries continue to filter watershed-derived natural and anthropogenic nutrients and toxic substances, thus minimizing any potential and detrimental effects on both coastal and oceanic water quality and fisheries resources.

Results

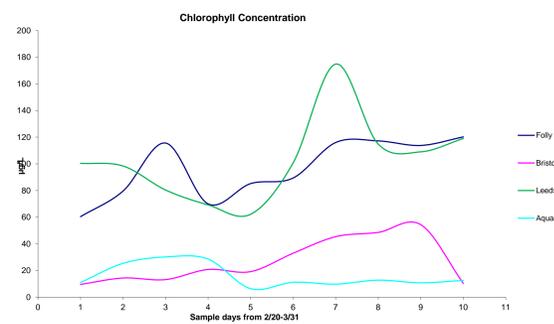


Fig.1 From sample day one, which began on 2/20, to sample day 10, which ended on 3/31, chlorophyll concentration had a steady rise at all sites except the aquarium wharf where there was little change over time. Chlorophyll was used to estimate the amount of phytoplankton in the water. As seasonal changes progressed from late winter to early spring, the phytoplankton concentration increased.

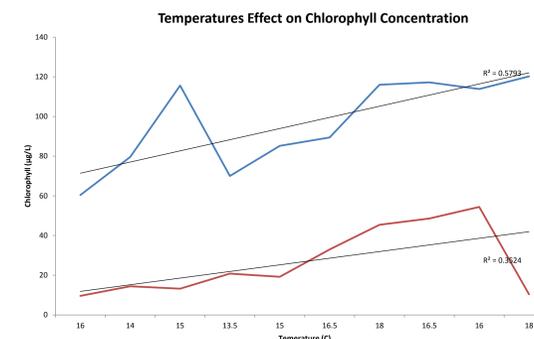


Fig.2 Chlorophyll concentration was plotted against temperature data for the Folly Beach and Bristol locations and show a positive correlation between temperature and chlorophyll concentrations. As temperature rises so does the concentration of chlorophyll, resulting in higher amounts of phytoplankton.

Chlorophyll concentrations increased as seasonal changes progressed from winter to spring which is expressed here as changes over time and changes in temperature. From sample 1 to sample 10 there was an increase in day length and temperature which showed to increase phytoplankton assemblage. Site location did not appear to be a determining factor in concentration.

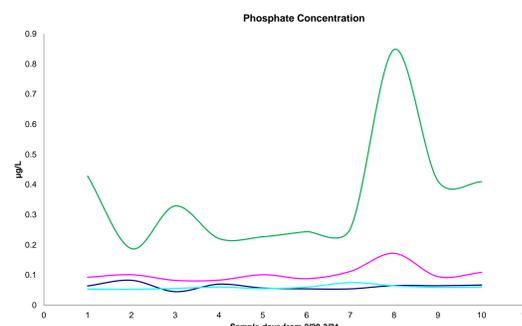


Fig.2 From sample 1 to sample 10, phosphate concentration had minor changes except from the Leeds avenue site. This site had an overall much higher concentration of phosphates and had greater fluctuations over time.

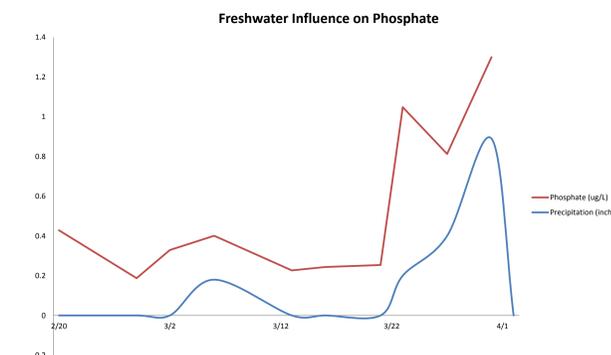


Fig.3 Rainfall data was taken from the North Charleston Airport and it's daily changes were plotted against the changes found in phosphate concentration at the Leeds Avenue site. From this graph it is apparent that on days when rainfall was present, there was an increase in nutrient concentrations.

Phosphate concentration were highest and varied the most at the Leeds Avenue site, which is the only site significantly influenced by freshwater from the Ashley River. Also, phosphate level rose and fell with the increase and decrease of rainfall. Phosphate concentration appears to be highly influenced by increases in freshwater and are fed in part by riverine sources.

References

- Lopes, C.B., Lillebo, A.I., Dias, J.M., Pereira, E., Vale, C., Duarte, A.C., 2007. "Nutrient Dynamics and seasonal succession of phytoplankton assemblages in a Southern European Estuary : Ria de Aveiro, Portugal." *Estuarine Coastal and Shelf Science*. 71: 480-490.
- Liu, M., Hellebust, S., Johan, A., 1976. "Effects of salinity changes on growth and metabolism of the marine centric diatom *Cyclotella cryptica*." *Canadian Journal of Botany* 54:930-937.