Phosphorus and Chlorophyll a Concentration Variability in the Charleston Harbor

Brooke Anderson, Erin Euler, Sarah Forsyth

Remley's Point : Wando River

Cooper River Marina: Cooper River

County Farm Boat Landing: Ashley River

Grice Marine Laboratory: Grice Cove

Methods:

- Samples were obtained from the Ashley, Cooper, and Wando Rivers, and Grice Cove at high and low tide on 3/3/07, 3/9/07, and 3/17/07.
- Temperature and Salinity were measured in the onshore samples using a thermometer and refractometer.
- 50 mL of all of the samples were filtered and frozen in -80°C for a minimum of 24 hours
- Filtered samples were then processed for measurement in the fluorometer
- 100 mL of the samples were then processed for measurement in the spectrophotometer and all data recorded.

Acknowledgements:

- We would like to thank Dr. Gorka Sancho for giving us the opportunity to broaden our oceanographical knowledge and to sharpen our experimental skills.
- We would also like to thank Miss Adair Dempsey for her guidance and support.
- Finally, we would like to thank our parents and classmates.

INTRODUCTION:

Background Information

- Natural Sources of Phosphate (Figure 5)
- Human Sources of Phosphate (Figure 6)
- Importance of Studying Nutrient Levels:
  - Concerns about eutrophication of estuaries, which can result in large algal blooms and lowered dissolved oxygen concentrations (Painting et al., 2007)
  - Nutrients are necessary for the growth of phytoplankton (Vitousek and Howarth, 1991)
  - Phytoplankton are the base for most marine tropic cycles
- Marine phytoplankton have molar rations of C:N:P following the lines of the Redfield ratio; 106:16:1 (Howarth, 1988)
- Most phytoplankton contain chlorophyll-a
- Nutrients may limit primary production in marine ecosystems (Vitousek and Howarth, 1991; Falcae et al., 2006; Howarth, 1988)
  - Phosphate limiting
  - Nitrogen Limiting
  - Phosphate and nitrogen simultaneously limiting
  - Seasonal change between phosphate and nitrogen limiting
- Definition of Nutrient Limitation: "(a) the limitation of the growth rate of phytoplankton populations currently present in a water body, (b) the limitation of the potential rate of net primary production, allowing for possible shifts in the composition of phytoplankton species, (c) the limitation of net ecosystem production" (Howarth, 1988)
- Estuaries receive more nutrient input than any other ecosystem (Howarth, 1988)

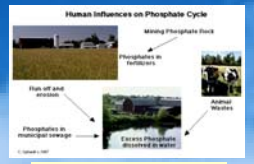


Figure 5: Human Influences

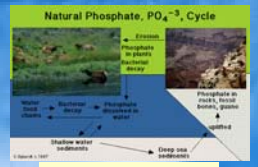


Figure 6: Natural Sources

Summary of Project

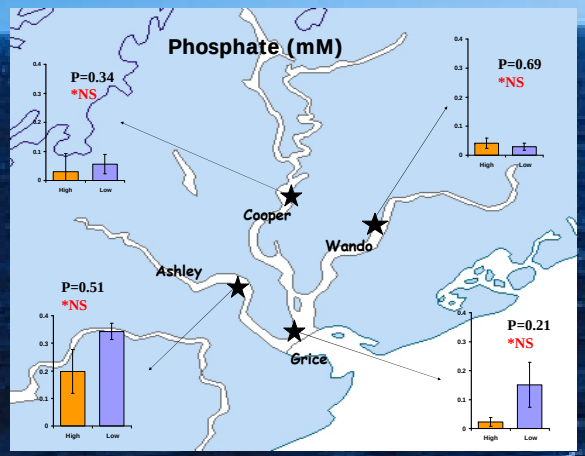
- Examined phosphate and chlorophyll-a levels at 4 samples in the Charleston Harbor area
- Sample Sites (Figure 1)
  - Grice Marine Laboratory
  - Wando River
  - Cooper River
  - Ashley River

Predictions

- During low tide, there will be higher phosphate concentration due to the higher proportion of fresh water.
- Areas of high phosphate will have high Chlorophyll-a

QUESTION: Do the concentrations of phosphorus vary with tide in the Cooper, Wando, and Ashley Rivers and Grice Cove?

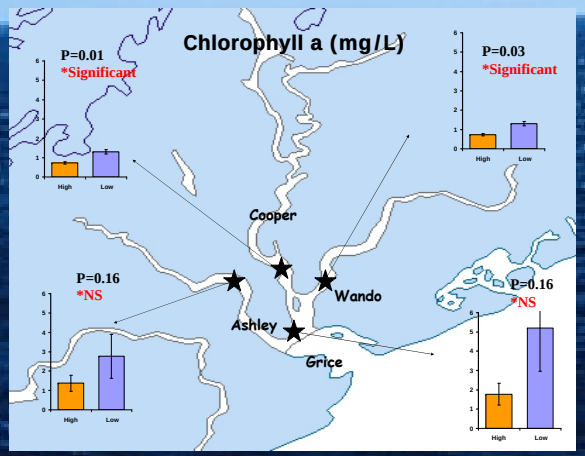
Figure 1: Average phosphate concentrations at high and low tides in the Wando, Cooper, and Ashley Rivers, and Grice Cove. *estimation of sample location



RESULTS: Phosphorous concentration does not vary significantly with the tidal changes in the Ashley, Cooper, Wando, and Grice Cove.
Discussion: No significant variation between tides or salinity, and phosphate may exist because phosphate is often absorbed by sediments particles, instead of remaining suspending in the water column (Pereira-Filho, 2001). Further, testing only surface waters with a small sampling size may have eliminated variation from tidal mixing.

QUESTION: Does the concentration of chlorophyll-a vary with tide in the Cooper, Wando, and Ashley Rivers and Grice Cove?

Figure 2: Average chlorophyll-a concentrations at high and low tides in the Wando, Cooper, and Ashley Rivers, and Grice Cove. *estimation of sample location



RESULTS: Chlorophyll-a concentration varies significantly in the Cooper and Wando Rivers. It does not vary significantly in the Ashley River or Grice Cove.
Discussion: Environmental factors in the Cooper and Wando Rivers, such as higher nitrogen concentration may exist at low tides; creating a higher abundance of phytoplankton at low tide. Further, a "primary productivity belt" could exist in the mouth of the Cooper and Wando Rivers (Pereira-Filho et. al, 2001).

QUESTION: Does the concentration of chlorophyll-a correlate to the varying concentrations of phosphorus in the four sample locations?

Figure 3: Relationship between phosphate and chlorophyll-a at low tide

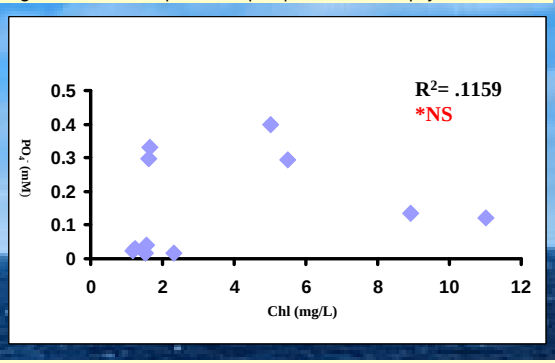
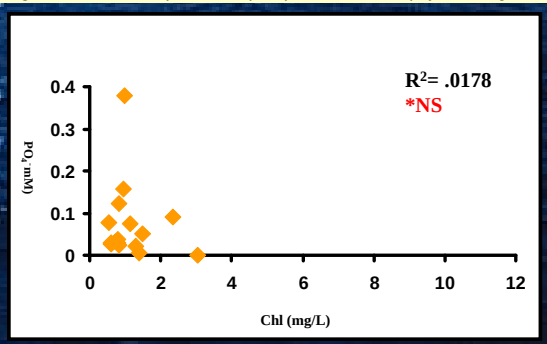


Figure 4: Relationship between phosphate and chlorophyll-a at high tide



RESULTS: Concentration of Chlorophyll-a is not significantly correlated to phosphorus concentrations at high or low tides.
Discussion: The lack of correlation between chlorophyll-a and phosphate indicates that phytoplankton abundance is not limited by phosphate concentration. Nitrogen may be the limiting factor (Falcae et. al, 2006).

Broad Impact: Modern techniques accompanied by poor irrigation, run-off, and soil erosion have led to changes in levels of nitrogen and phosphorus in marine systems (Bellos et al., 2004). Analyzing rivers and their input of nutrients can assist in the awareness of the anthropogenic impact and the corresponding state of the related estuarine system (Aslan-Yimaz et al., 2004).