Salinity and Phosphorous concentrations and their effect on the abundance of Chlorophyll *a* in Charleston Harbor, South Carolina

Jenna J Schmidt & E. B. Lund

Department of Biology, College of Charleston, South Carolina

Background:

- Changes in salinity, nutrients, and temperature occur with the fluctuations of the tides in estuarine environments.
- Charleston Harbor is a coastal estuary system that is affected by three river systems (Cooper, Ashley, Wando rivers- Figure 6).
- As part of the BIOL 342 Oceanography class, hydrographic observations were made in Charleston Harbor to describe tidal changes in salinity, temperature and phosphate concentration.
- We attempted to determine if any of these variables are linked to the abundance of phytoplankton in the harbor.
- Tidal circulation sharpens density gradients and promotes frontal zones. Phytoplankton concentrations are known to increase in frontal zones (Pickney and Dustan, 1989) Higher concentrations of phytoplankton should occur during flooding tides.
- An ebbing tide should discharge suspended matter and soil from the rivers which are full of nutrients (phosphate). This abundance of phosphate would source an increase in phytoplankton (Tanaka and Choo, 2000).
- It has been suggested by Qasim et al. (1972) that phytoplankton may require a certain salinity to grow. An estuary system has a wide range in salinity changes. Qasim et al. (1972) found waters with low salinity to support a greater abundance of phytoplankton. From this information, we predict higher abundance of phytoplankton during an ebbing tide.

Methods:

- Five sites of the Charleston Harbor were sampled (Figure 6).
- The water was sampled on March 12, 2007 at ebbing tide and sampled again on March 19, 2007 at flooding tide.
- Water samples were manually collected using Grice Marine Laboratory vessels: Silver Crescent on March 12, 2007 and The Chamberlain on March 19, 2007 (Figure 7).
- A fluorometer was used to read the light transmission at a given wavelength to calculate the concentration of chlorophyll *a* (Figure 8). Chlorophyll *a* measurements indicate the amount of phytoplankton present in the water.
- A spectrophotometer was used to read the light transmission at a given wavelength to measure both phosphate & turbidity.
- A refractometer was used to measure salinity levels of the water samples.

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Results:

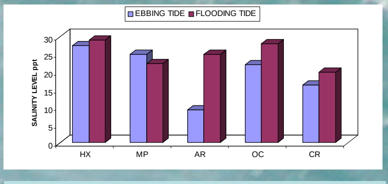

Figure 1. Salinity levels at each site during flood and ebb tide.

Salinity levels are highest during the flooding tide, except for Mount Pleasant.

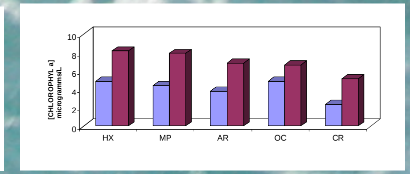

Figure 2. Chlorophyll *a* concentrations at each site during flood and ebb tide.

Chlorophyll *a* concentrations are clearly higher during flooding tide.

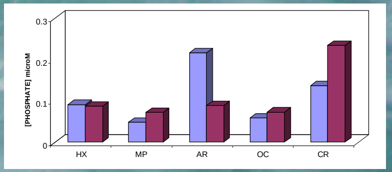

Figure 3. Phosphate concentrations at each site during flood and ebb tide.

Although most sites show high phosphate concentrations occurring during flood tide, no clear trend between the two tides is evident.

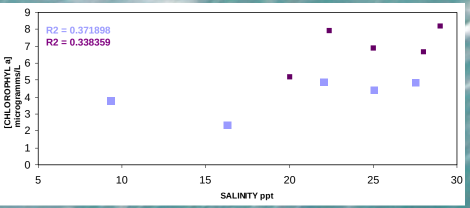

Figure 4. The relationship between chlorophyll *a* concentration and salinity level.

No significant correlation between salinity and chlorophyll *a* concentration.

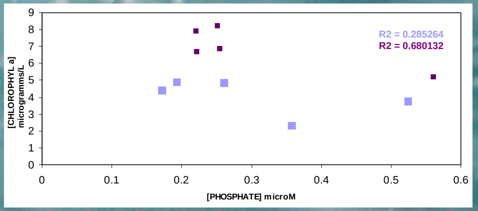

Figure 5. The relationship between chlorophyll *a* concentration and phosphate concentration.

No significant correlation between chlorophyll *a* and phosphate during ebbing tide. However, the flood tide R^2 value does indicate a significant negative correlation between chlorophyll *a* and phosphate concentration.

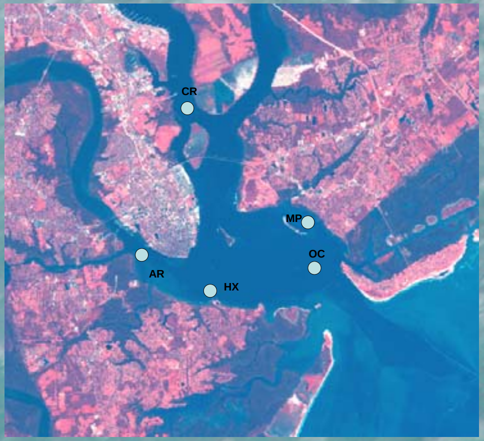

Figure 6. Arial image of Charleston Harbor with the five sample sites labeled.

Figure 7. One of the GML vessels used to collect water samples

Figure 8. Using the fluorometer to measure chlorophyll concentration

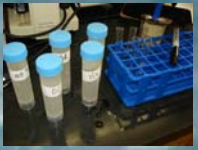

Figure 9. A few of the water samples collected

Conclusions:

- The higher concentration of chlorophyll *a* during the flood tide does not support the idea that river discharge provides nutrients to promote a higher abundance of phytoplankton.
- High levels of salinity during a flood tide were expected, since our sampling sites were in the Harbor and no significant rain events occurred during sampling. Incoming tides provide a higher salinity input into the harbor.
- The lack of correlation between chlorophyll *a* and salinity suggests abundance of phytoplankton might not be influenced by salinity differences found in Charleston Harbor.
- The unexpected negative correlation between phosphate and chlorophyll *a* during a flood tide does not indicate that a higher phosphate concentration is needed to support phytoplankton abundance.

Figure 11. Grinding up filters

Figure 10. Filtering a water sample through a glass fiber filter.

References:

- J. Pickney and P. Dustan (1989). *Tidally induced estuarine phytoplankton patchiness.* Limnology of Oceanography 34: 410-419
- K. Tanaka and P. Choo (2000). *Influences of Nutrient Outwelling from the Mangrove Swamp on the Distribution of Phytoplankton in the Matang Mangrove Estuary, Malaysia.* Journal of Oceanography 56: 69-78
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