Assessing the Spatial and Temporal Aspects of Buffer Capacity in Lake Wateree, SC

Stephanie LaPlaca, Marine Science & Dr. Dan Tufford, Biological Sciences

UNIVERSITY OF SOUTH CAROLINA

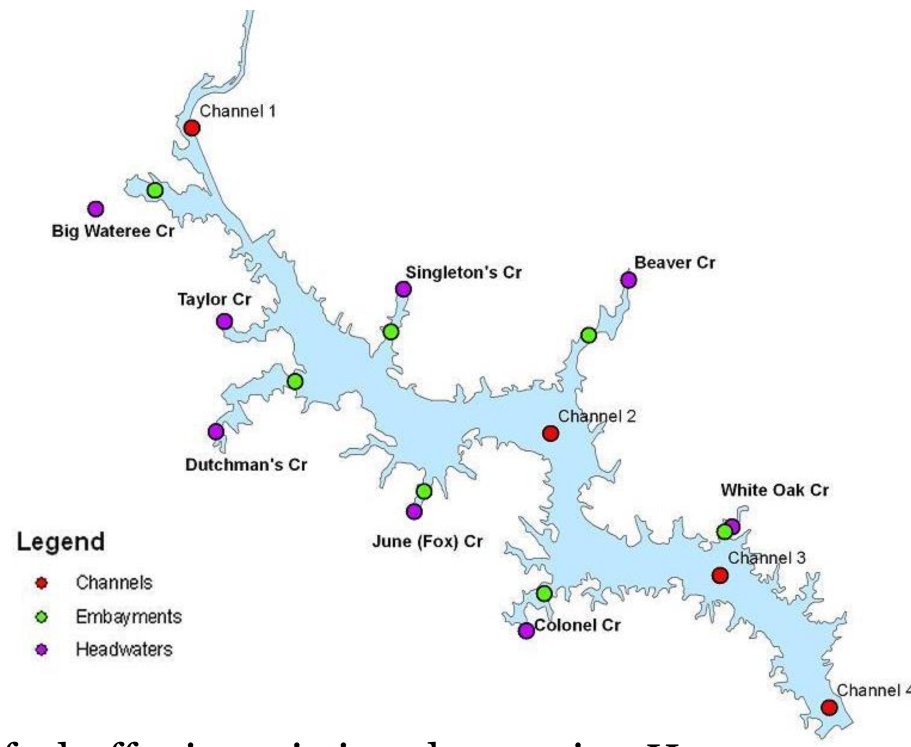
Introduction:

Historical Water Quality Monitoring:

- USC and Lake Wateree WaterWatch volunteer committee monthly water quality analysis testing from 1999 to 2003 and from 2008 to the present.
- Examine twenty locations on the lake testing dissolved oxygen, pH, turbidity, temperature, and specific conductance at various depths.
- Historically high pH values in Singleton embayment led to special sampling event in 2013. The results indicated Singleton embayment had more nutrients than nearby Taylor Creek embayment. Chlorophyll A levels were high in both locations during the growing season. Singleton pH values were higher than Taylor pH values.

Goals:

- Expand on current water quality knowledge for Lake Wateree
- Understand pH variability during the growing season
- Provide lake associations and resource managers with additional environmental context for interpreting sampling results



What Is Buffer Capacity?

- A measure of the efficiency of a buffer in resisting changes in pH.
- Quantified by measuring alkalinity (the ability of water to neutralize a strong acid)

Hypothesis:

The buffer capacity of Lake Wateree is low, making it susceptible to large variability in pH during the growing season of phytoplankton.

Methodology:

Two sites: Singleton Creek embayment & Taylor Creek embayment

↓

24-hour sampling period, once per month from May to August

↓

YSI multiparameter sonde – collect dissolved oxygen and pH data every 15-minutes

↓

Water samples collected in 8-hour intervals analyzed for chlorophyll A, ammonium, phosphate, and alkalinity

- Water samples kept on ice and analyzed in the lab within 24 hours
- Alkalinity measured by titration (APHA 2012) and calculated using:

$$Total\ Alkalinity\ (mg\ CaCO3\ per\ L) = \frac{A * N * 50{,}000}{mL\ sample}$$

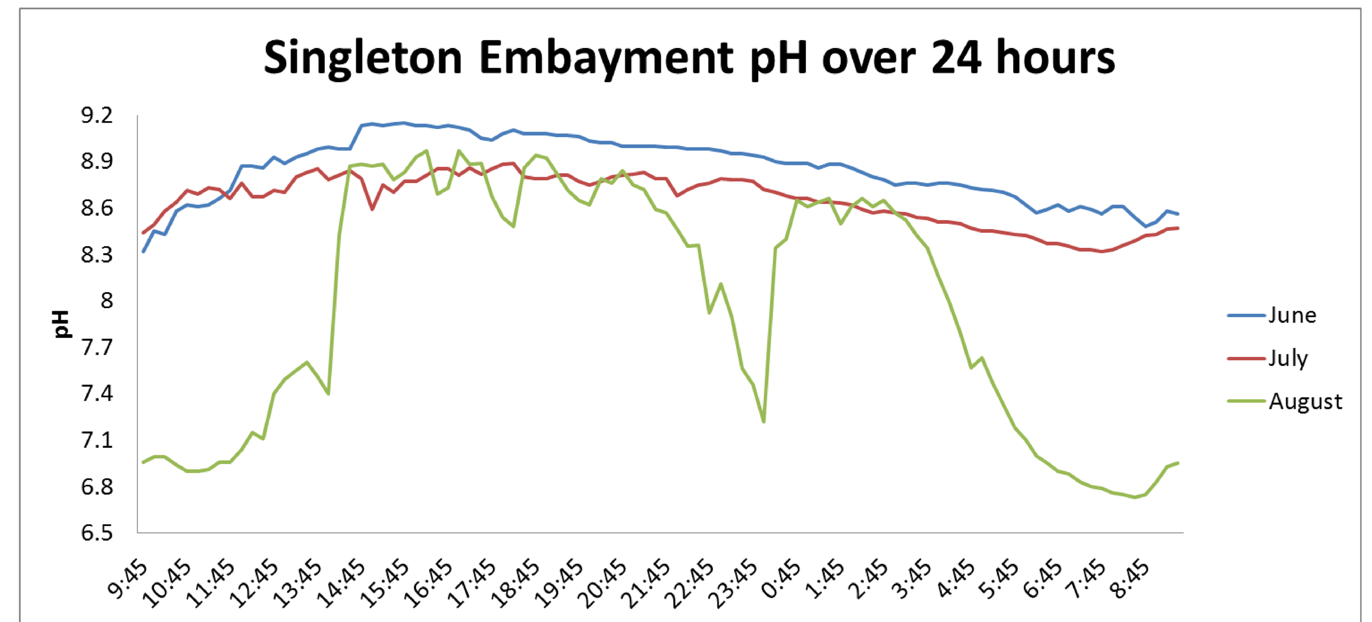
where A = mL standard acid used
N = normality of standard acid

- Water samples filtered in lab, chlorophyll A extracted with 90% acetone, and analyzed using a fluorometer (EPA 2004)

For further information, contact: Stephanie LaPlaca, laplaca@email.sc.edu or Dan Tufford, tufford@biol.sc.edu

Results:

- Diurnal variability observed in pH and DO in Singleton embayment and Taylor embayment
- Low pH at night accompanied by low DO



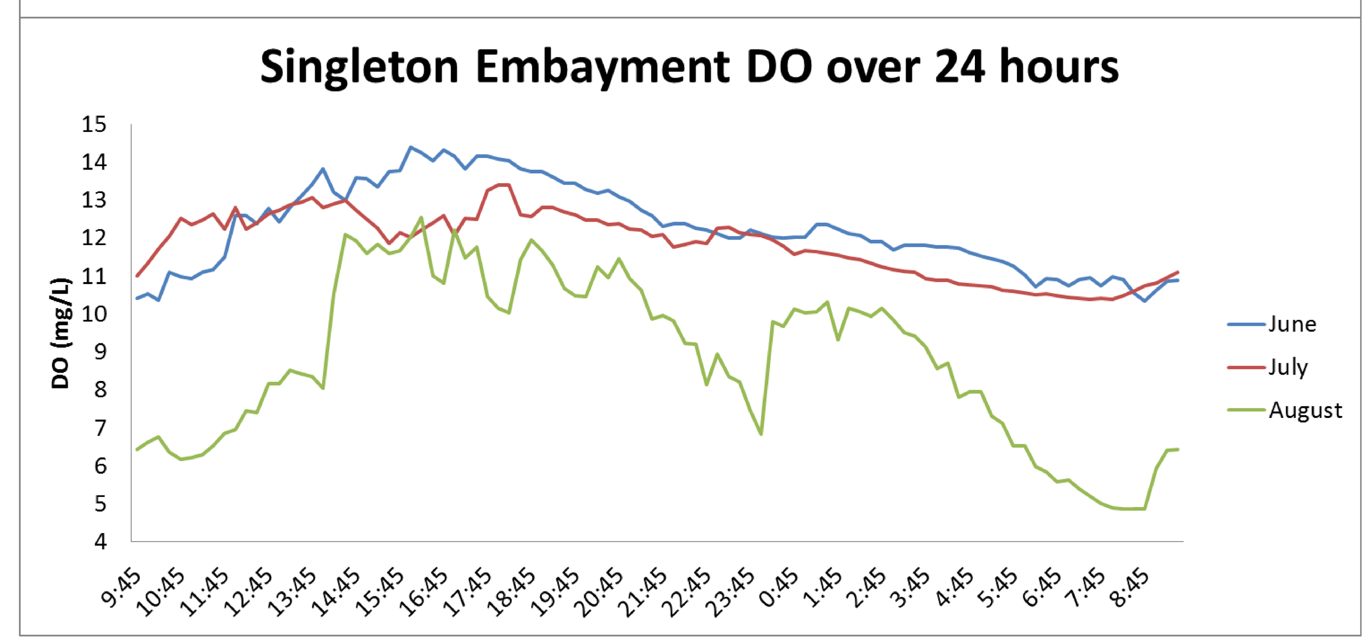
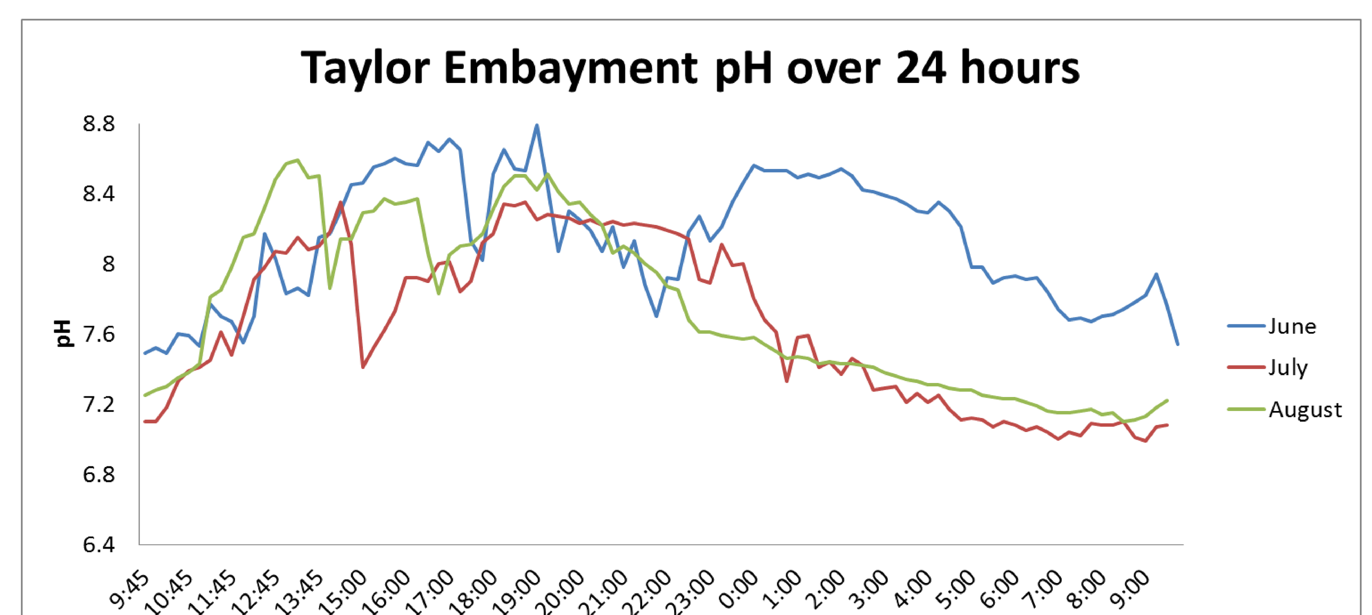


Figure 1 & 2: pH and dissolved oxygen profiles in Singleton embayment over 24- hours for June, July, & August



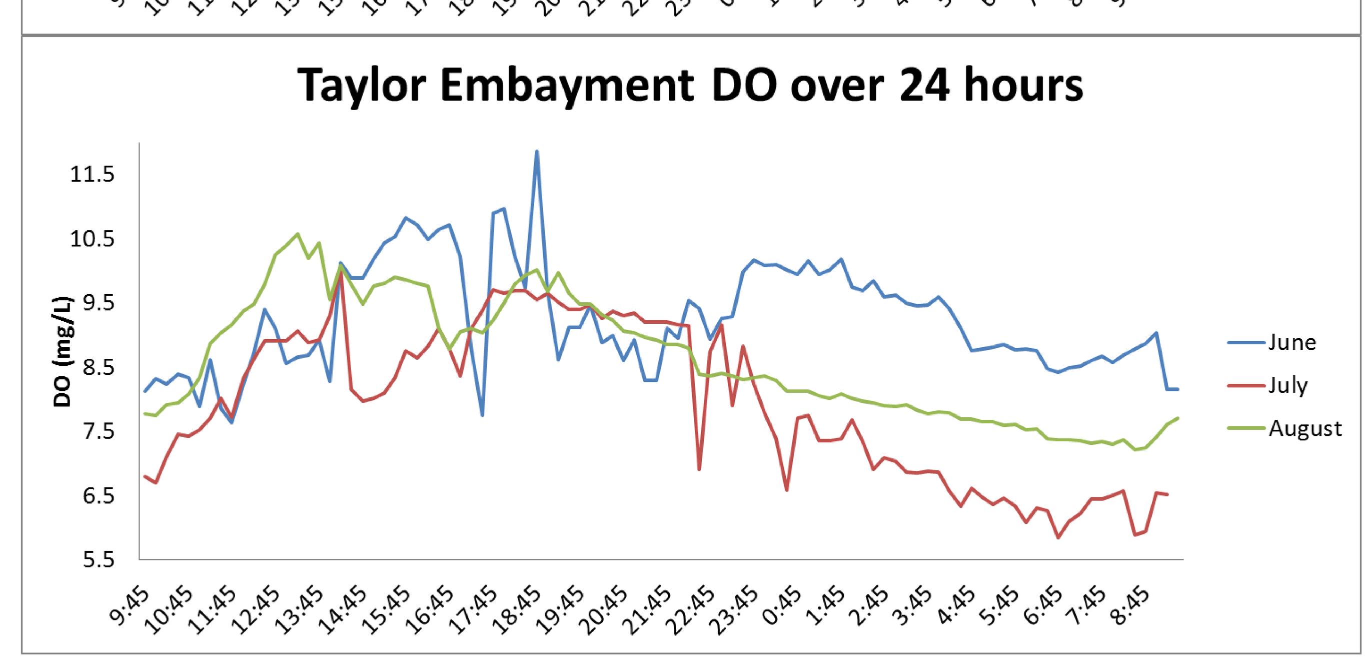


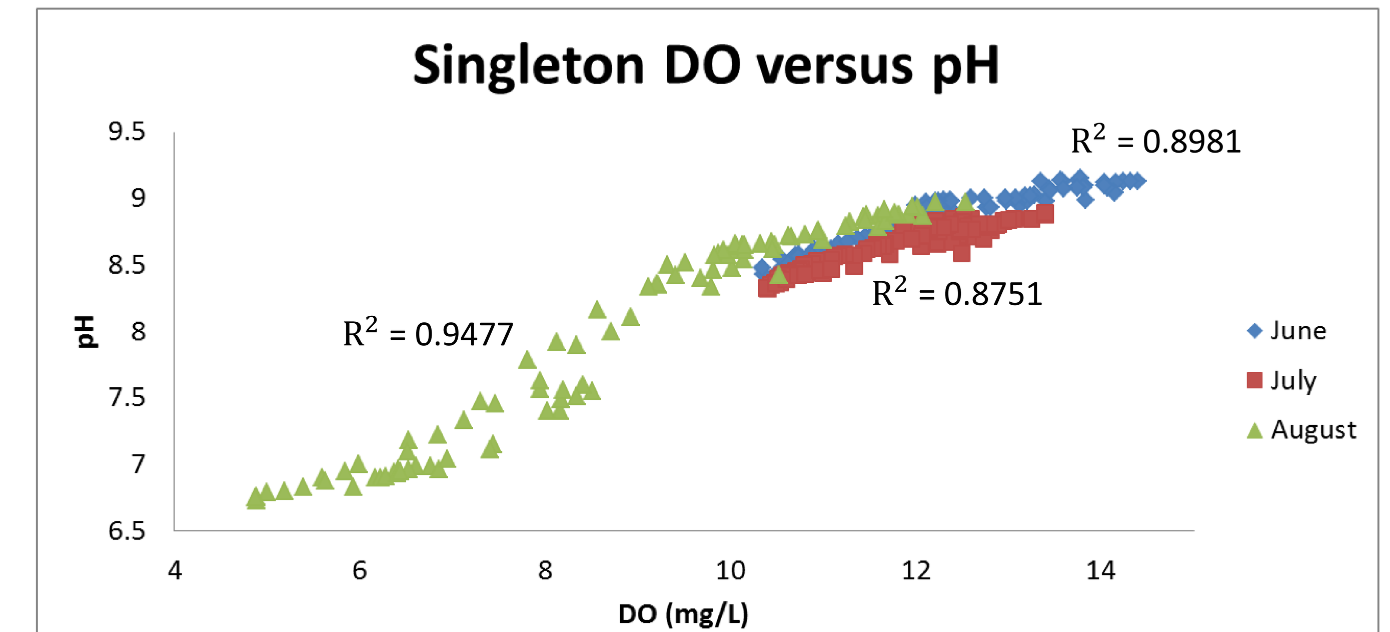
Figure 3 & 4: pH and dissolved oxygen profiles in Taylor embayment over 24-hours for June, July, & August

	Average Alkalinity (mg CaCO3/L)		Average Chlorophyll (ug/L)	
	Singleton	Taylor	Singleton	Taylor
May	26.13	31.85	10.70	9.05
June	32.34	32.67	18.66	11.27
July	34.50	33.91	21.82	12.82
August	25.97	25.97	12.35	9.48

- Alkalinity varies monthly but little spatial variation
- Lowest alkalinity during August
- Chlorophyll A varies monthly but higher in Singleton embayment

Results (continued):

- DO and pH were highly correlated in both Singleton and Taylor embayments through out the study (*Figs. 5, 6*)
- DO peaks during daylight (*Figs. 2, 4*) indicate the primary source of DO was from phytoplankton photosynthesis
- The high R^2 of DO with pH suggest phytoplankton activity was the primary driver of pH variability during the study



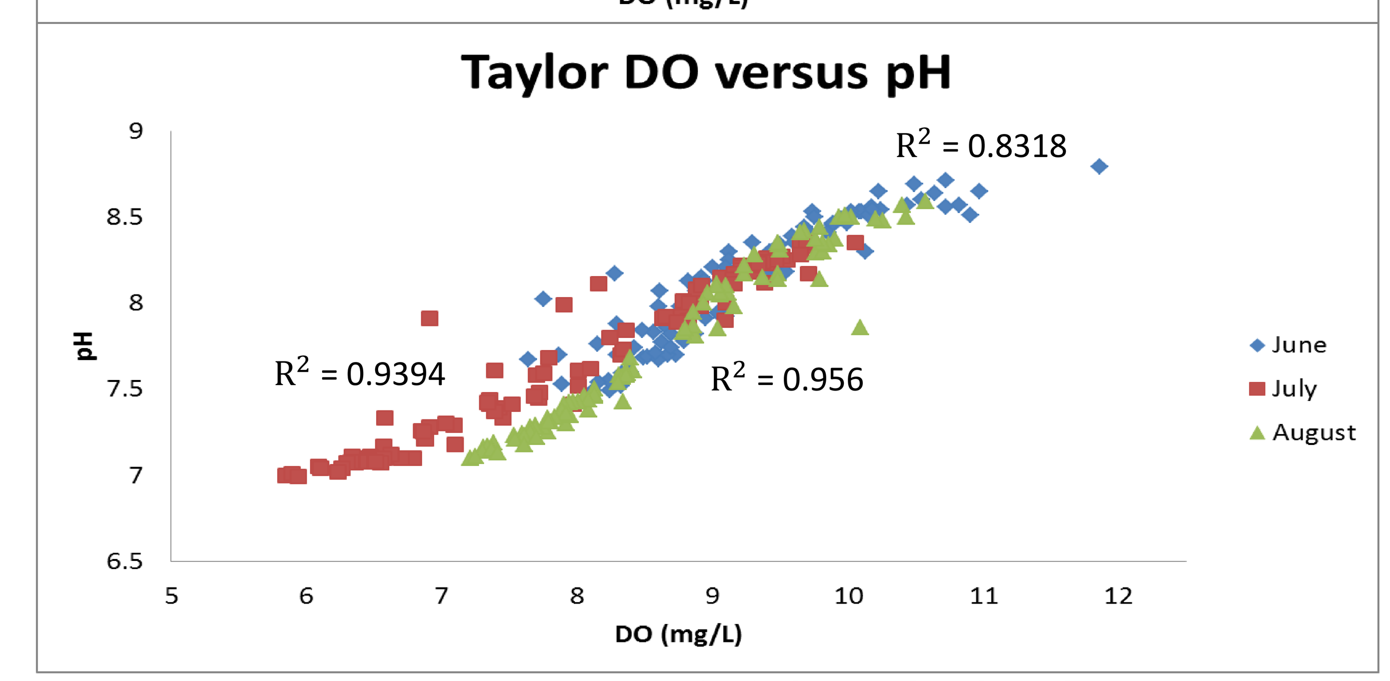
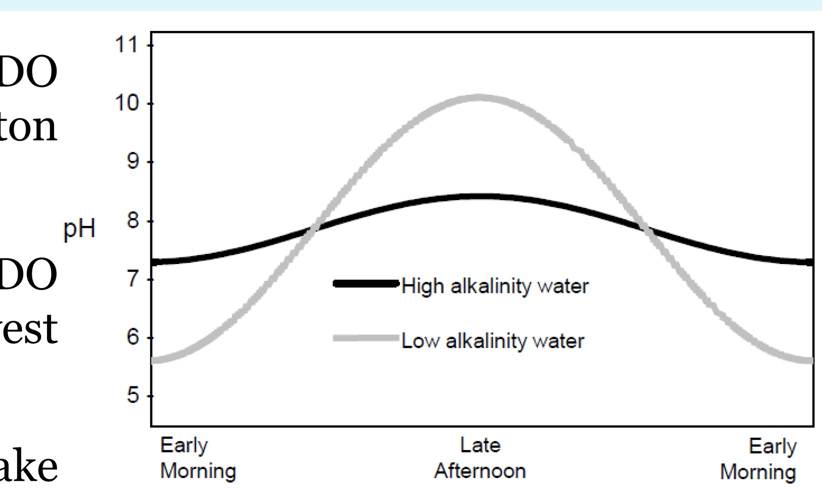


Figure 5 & Figure 6: DO versus pH in Singleton and Taylor embayments

Discussion & Conclusions:

- Diurnal variability in pH and DO explained by phytoplankton photosynthesis & respiration
- Greatest variation in pH and DO during August due to lowest alkalinity
- The buffer capacity of Lake Wateree is **low**



Typical pH versus time curves for high and low alkalinity waters (Wurts & Durborow 1992)

- Data suggests major factor influencing alkalinity and pH/DO monthly variation is due to seasonal growth of phytoplankton and blooms of benthic filamentous algae
  - Known algae blooms in mid- and late- summer on lake
  - Future research needed to assess bloom extent and impact on DO/pH, carbonate, and alkalinity dynamics in Lake Wateree

References:

1. American Public Health Association (APHA). 2012. Standard Methods for the Examination of Water and Wastewater, 22nd edition.
2. EPA 2004. Standard Operating Procedure for In Vitro Determination of Chlorophyll *a* in Freshwater Phytoplankton by Fluorescence. http://www.epa.gov/glnpo/monitoring/sop /chapter_4/LG405.pdf
3. Wurts, W. A. and Durborow, R. M. 1992. Interactions of pH, Carbon Dioxide, Alkalinity, and Hardness in Fish Ponds. *Southern Regional Aquaculture Center* .

Acknowledgements:

This work was funded by a Magellan Scholarship from the University of South Carolina. Thanks to Dr. Dan Tufford for his advice, support, and knowledge through out the project. I would like to thank to Warren Hankinson for his assistance in analyzing the samples, Chair of the Lake Wateree Water Watch Advisory Committee - Randy Kelley for his hospitality and assistance in the field, Dr. Tammi Richardson for allowing us access to her fluorometer, and Dr. James Morris for access to his lab.