EFFECTS OF FALL VEGETATION DIE OFF ON WATER QUALITY PARAMETERS IN THE OGLETHORPE ELEMENTARY SCHOOL WETLAND

Summer G. Wright and James B. Deemy

AFFILIATION: Environmental Science Program, College of Coastal Georgia, 1 College Drive, Brunswick, GA 31520

REFERENCE: *Proceedings of the 2019 Georgia Water Resources Conference,* held April 16-17, 2019, at the University of Georgia.

Abstract. Wetland water quality is a function of concomitant physicochemical conditions and biological processes. Precipitation, runoff, atmospheric conditions, flora, and fauna all contribute to wetland water quality. Relative to larger waters, aquatic vegetation and algal communities can disproportionately drive biogeochemical cycles in small depressional features. Seasonal patterns in aquatic vegetation and algal community growth drive cycles in photosynthetic activity, which drives dissolved oxygen, carbon dioxide, and pH through time. Fall leaf senescence and spring leaf out may drive water quality changes due to an increase of decaying organic matter during the fall and decreased light penetration after spring leaf out. In comparison to nearby charismatic salt marshes, small coastal freshwater wetlands are highly understudied. Accordingly, our objectives are to 1) establish a baseline water quality dataset for a small semi-isolated wetland on St. Simons Island, GA; 2) quantify changes in water quality related to fall senescence and leaf-out; and 3) determine monitoring potential water quality parameters. Weekly water quality measurements were collected between 10/19/2018 through 2/22/2019. Dissolved oxygen, pH, specific conductivity, and temperature were measured with a Hydrolab MS5 multiparameter probe and turbidity was measured with a Hach 2100Q turbidimeter. Dissolved oxygen increased during plant die off in October and November, but began fluctuating in the winter, potentially due to precipitation and increased organic matter decomposition post plant senescence. Specific conductivity increased, which may be caused by increased runoff and hydraulic soil water inputs during early winter. Turbidity decreased which may be a response to decreased water column algal growth. No observable changes in pH occurred through the sampling period. Future studies will be more inclusive of other water quality parameters and factors.

INTRODUCTION

Aquatic vegetation is a biological indicator of water quality in wetlands (Zhang et al. 2016). Aquatic plants can provide dissolved oxygen, sequester carbon levels, and absorb nutrient pollution. During high peaks of plant productivity, photosynthesis increases, causing an increase in dissolved oxygen, and a decrease of carbon dioxide levels in the water. Increased dissolved oxygen is important in sustaining other wetland species. Decreased carbon dioxide levels increase the pH, making the wetland less acidic.

Wetland water budgets are driven by precipitation, evapotranspiration, interaction between the wetlands and groundwater as well as surface inflows and outflows (Eisenlohr 1972, Sloan 1972). Water movement through pore space upwards through the ground could supply a small percentage of water to isolated wetlands (Winter & Rosenberry, 1995). Groundwater provides water with less turbidity and higher conductivity. Semi-closed wetlands rely heavily on precipitation inputs for recharge. Rainfall inputs provide dissolved oxygen to the wetland as well.

Aquatic vegetation alters the amount of carbon dioxide and oxygen in wetlands through the process of photosynthesis. Aquatic vegetation can sequester nutrients, leading to a healthier water system (Marton et. al. 2015). Runoff with pollutants brings in an excess of nutrients. Plants take up nutrients from the water column and substrate. Sediments from runoff are a major pollutant as well; however, vegetation has shown to be effective in removing sediment from surface runoff according to a number of studies (Gilliam, 1994).

Objectives

The objectives of this research is to objectives are to 1) establish a baseline water quality dataset for a small semi-isolated wetland on St. Simons Island, GA; 2) quantify changes in water quality related to fall senescence and leaf-out; and 3) determine monitoring potential water quality parameters.

METHODS

Sampling

Our study site is a freshwater semi-isolated forested wetland dominated by *Nyssa biflora*, *Pontederia cordata* (10%), *Saururus cernuus* (15%), *Osmundastrum cinnamomeum* (10%), Various Algae (30%), and Grasses (35%) making up the understory vegetation.

Approximate diameter of the wetland is 128-m and is divided by a walkway bridge (Figure 1). We used this walkway as our water quality sampling transect. The wetland is located next to the Oglethorpe Elementary School on St. Simons Island.

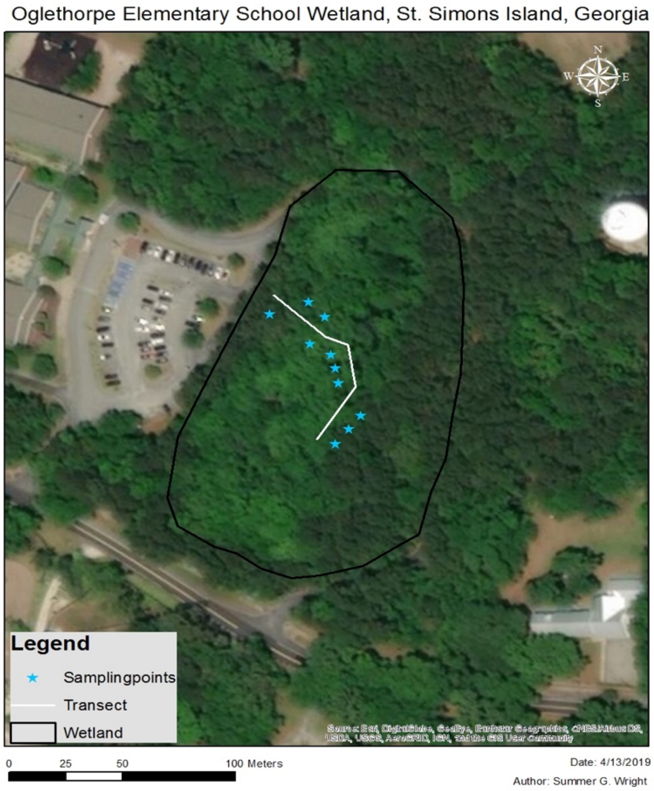

Figure 1. Study area of freshwater semi-closed wetland next to Oglethorpe Elementary School. Transect and sampling points are drawn.

At each point, we measured pH, water temperature (ºC), specific conductivity (µS/cm), and dissolved oxygen (mg/L) with a Hydrolab MS5 multiparameter sonde; we also measured turbidity (NTU) at each point as well using a Hach Turbidimeter. We began sampling on October 19th, 2018 and completed sampling on Feb 22nd, 2019.

Analysis

Time series plots were generated with parameter means. scatter diagrams show the correlations between each water quality parameter and water temperature. Correlations between each water quality parameter were used identify potential monitoring parameters (Zeng and Rasmussen 2005). ANOVA with a Tukey HSD post hoc test was used to determine if the wetland was well mixed or poorly mixed.

RESULTS

Mixing

No significant differences were observed among sampling locations within the wetland across parameters (Figure 2). Therefore, this semi-isolated wetland seems to be well mixed.

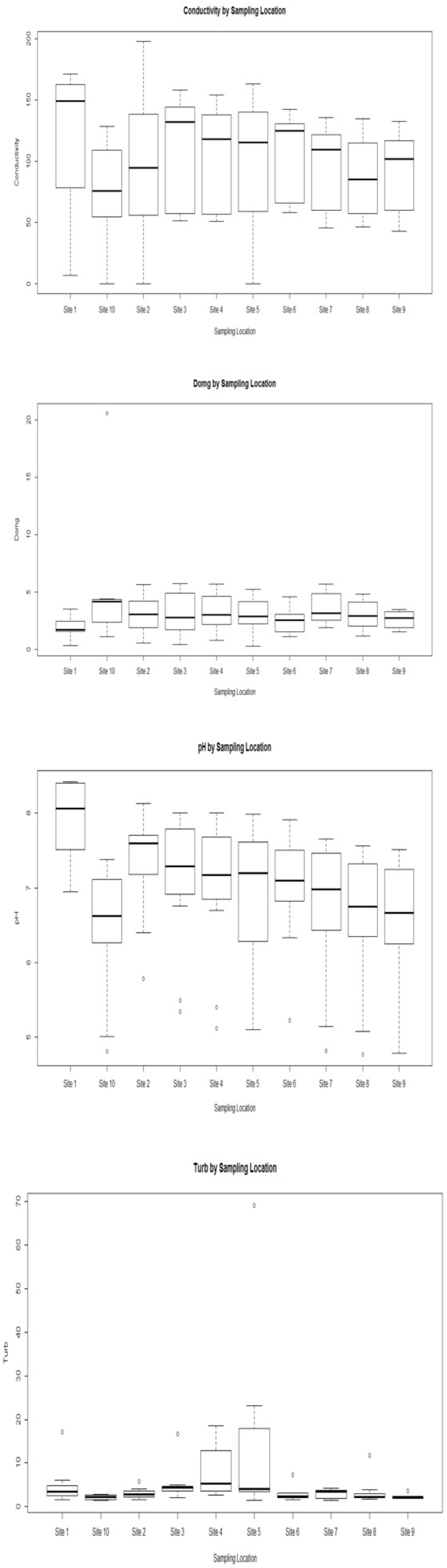

Figure 2. Box plot diagrams of each water quality parameter.

Table 1. Correlation between water temperature and water quality parameters.

Parameter	R-value	p-value
Specific Conductance	-0.52	< 0.001
pH	-0.36	< 0.001
Turbidity	-0.27	< 0.05
Dissolved Oxygen	-0.57	< 0.001

Time Series

Conductivity increased over time with one sharp decrease (Figure 3). pH levels showed moderate variation through time. Dissolved oxygen showed relatively large increases and decreases over time. Turbidity continually increased through time

Monitoring Parameters Correlations

Conductivity had a negative moderate correlation with water temperature. Dissolved oxygen, pH, and turbidity had negative weak correlations with water temperature. Dissolved oxygen fluctuated over time. Conductivity and turbidity increased, and pH remained relatively steady.

DISCUSSION

Increasing conductivity could have been attributed runoff from a nearby parking lot or potential soil water discharge to the wetland. The low variation in pH could have been due to various rainfall events causing a balance between the acidic wetland water and basic rain water. Dissolved oxygen appeared to follow expected trends associated with temperature but despite a lack of significant relationship. Turbidity increases were most likely due to an increase in phytoplankton activity during warmer intervals.

Our data indicate that while likely a factor vegetation senescence is not the most probably primary driver water quality in this semi-isolated freshwater wetland. Groundwater inputs as well as precipitation and surface runoff may influence wetland water quality.

Expected patterns for dissolved oxygen and pH were not observed potentially due to rainfall inputs and colder temperatures. Expected patterns were observed for turbidity and specific conductivity; however, these seemed to have been affected by factors other than aquatic plant senescence.

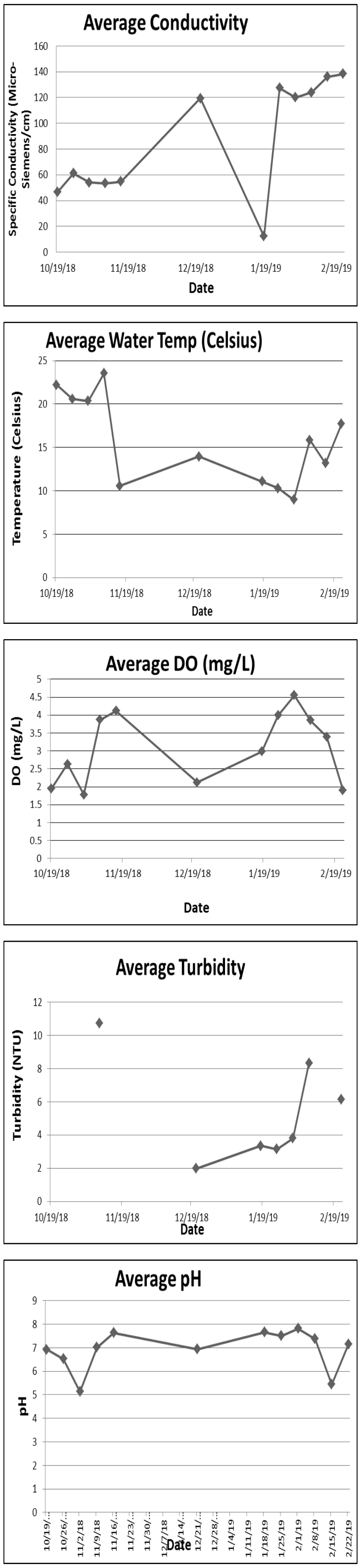

Figure 3. Turbidity and conductivity increased. DO fluctuated and pH remained relatively steady. Water temperature decreased.

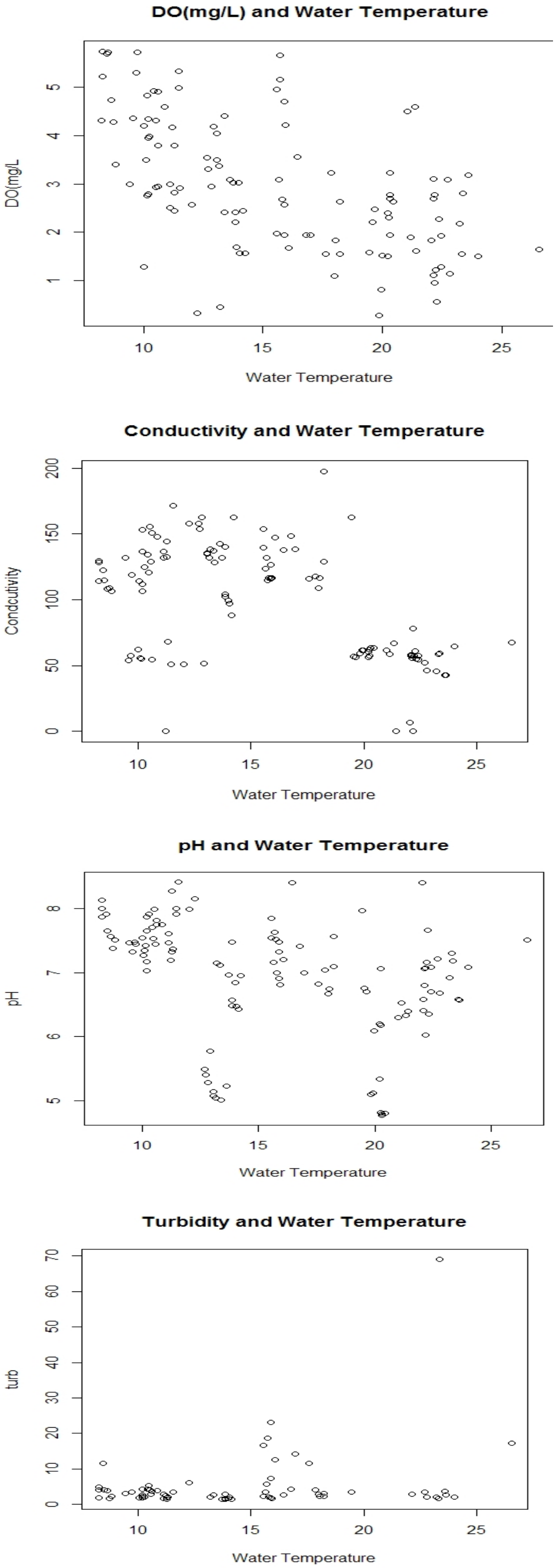

Figure 4. Parameter relationships with water temperature.

CONCLUSIONS

The data revealed that we cannot conclusively confirm the impact that aquatic plant senescence has on semi-isolated freshwater wetlands. Relationships were not strong enough to conclude any relationship between the sampled water quality parameters and water temperature (Celsius) (Table 1). However, it was discovered that the wetland is a well-mixed system because parameters were similar throughout the wetland. Future research will include measuring nitrogen and phosphorous levels in order to understand how nutrients were influenced during plant senescence. Rainfall inputs and groundwater inputs will also be included in future research to determine their influence on water quality of this wetland.

ACKNOWLEDGEMENTS

We thank the Georgia Environmental Protection Division for allowing us to borrow equipment, without which our research would not have been possible. A special thank you goes to the College of Coastal Georgia spring 2019 geomorphology class for assistance on plant surveys. Thanks also go to the CCGA water resources lab member for reviewing drafts of this manuscript and the associated poster.

LITERATURE CITED

Eisenlohr, W.S. Jr. 1972. Hydrologic investigations of prairie potholes in North Dakota, 1959–1968. U.S. Geological Survey Professional Paper 585-A.

Gilliam, J.W. 1994. Riparian wetlands and water quality. J. Environ. Qual., Vol 23.

Marton, J. M., Creed, I. F., Lewis, D. B., Lane, C. R., Basu, N. B., Cohen, M. J., & Craft, C. B. 2015. Geographically Isolated Wetlands are Important Biogeochemical Reactors on the Landscape. BioScience,65(4), 408-418. doi:10.1093/biosci/biv009.

Rado, B.Q. 1980. Soil Survey of Camden and Glynn Counties, Georgia. Soil Conservation in cooperation with the University of Georgia. College of Agriculture, Agriculture Experiment Stations; U.S. Government Printing Office, 81 p.

Semlitsch, R. D. and J. R. Bodie. 1998. Are small, isolated wetlands expendable? Conservation Biology 12:1129–1133.

Sloan, C.E. 1972. Ground-water hydrology of prairie potholes in North Dakota. U.S. Geological Survey Professional Paper 585-C.

Whigham, D.F. and Jordan, T.E. (2003) Isolated Wetlands and Water Quality. Wetlands, 23(3), 541-549. doi:10.Winter, T. C. and D. O. Rosenberry. 1995. The interaction of ground water with prairie pothole wetlands in the Cotton Lake area, East-Central North Dakota, 1979–1990. Wetlands 15:193–211.

Zeng, X., and T. C. Rasmussen. 2005. Multivariate statistical characterization of water quality in Lake Lanier, Georgia, USA. Journal of Environmental Quality. 34(6): 1980-1991.

Zhang, Y., Liu, X., Qin, B., Shi, K., Deng, J., & Zhou, Y. (2016). Aquatic vegetation in response to increased eutrophication and degraded light climate in Eastern Lake Taihu: Implications for lake ecological restoration. *Scientific reports*, *6*, 23867. doi:10.1038/srep23867