EVALUATING INFLUENCES ON THE HYDROLOGY AND WATER QUALITY OF AN URBAN WETLAND

<student names>

PROJECT DESCRIPTION

OBJECTIVES

Globally, urbanization is occurring faster than ever before. In the 1950's, about 30% of the world's population lived in cities, and by the middle of this century more than 50% of the global population is expected to reside in cities. Such rapid urbanization causes loss and fragmentation of valuable ecosystems, including wetlands (McInnes, 2014). As urbanization progresses, urban preserves will become increasingly important for their ecosystem and societal services. Some services that urban natural areas provide include enhanced recharge of groundwater, improvements in water quality, reduction of flooding, niche habitats for the survival of native species, and climate change mitigation. Despite the value of urban preserves, there has been relatively little research conducted on the hydrology and ecology of small, isolated urban preserves. In light of this research gap and the pace at which urbanization is occurring, "[l]ong-term studies are essential to understanding the effects of urbanization on wetlands and the effectiveness of management actions" (Kentula et al., 2004).

Hydrology is arguably the most important factor to monitor and understand in wetland studies because of its key role in the development and maintenance of wetlands (Winter and Woo, 1990; Carlson, 2008). Minor shifts in wetland hydrology alter chemical and physical properties which then cause changes in plant species composition, compromising the productivity of the ecosystem as a whole (Mitsch and Gosselink, 1993; Carlson, 2008)

The proposed research is the continuation and expansion of a long-term study to monitor and evaluate the hydrology of a constructed wetland ecosystem on a county-owned environmental preserve in Boca Raton, Florida. The pre-wetland construction hydrology of the site has been characterized by previous graduate students and independent study students. In recent years, wetland construction has been completed and there have been significant changes to the surrounding land use. Specifically, this is a proposal to address the following questions

1. How has groundwater flow at the site been affected by wetland construction?

2. How do wetland, groundwater, and lake levels in the man-made lakes next to the site vary seasonally?

3. How do fluctuations in lake levels and pumping from recently installed municipal wells near the site influence wetland water levels?

4. What are the temporal variations in groundwater-wetland interaction at the site?

5. How do nutrient concentrations differ between the wetland, groundwater, and lakes?

The results of this study will shed light on what factors influence the depth of water and quality of water in the constructed wetland and will assist managers in deciding what actions need to be taken in order to ensure that the wetland hydrology is adequate to support the Florida endemic vegetation and wildlife at the site.

BACKGROUND

Pondhawk Natural Area is a 78 acre environmental preserve in Boca Raton, Florida that is managed by the Palm Beach County Department of Environmental Resource Management (ERM). Old aerial photos show that prior to urbanization a portion of the site was occupied by a wetland. However, coincident with urbanization and construction of canals the wetlands on the site disappeared in the late 1950's. The site supports hydric hammock, dry prairie, and mesic

flatwoods vegetation communities. The occurrence of preserved flatwoods with adjacent dry prairie is unusual in the county. Additionally, Pondhawk is the southern-most known occurrence of cutthroat grass, an endangered, Florida endemic species (Kuhn and Root, 2012). Between 2009 and 2010, ERM reconstructed wetland conditions on the site by excavating to the water table in areas that were known to historically be wet. The primary aim of the wetland reconstruction was to re-establish the hydrologic conditions necessary to support native vegetation (Root and Carlson, 2007). Prior to the wetland reconstruction, one of Dr. Root's master's students characterized the hydrologic and water quality conditions on the site for his thesis research (Carlson, 2008). Since this previous research was completed, not only has the wetland been constructed, but there has been extensive land use change adjacent to the natural area; a park with a large man-made lake has been constructed across the street; another existing lake adjacent to the site has been connected to the new lake in the park via a canal; and three municipal wells have recently been installed near the natural area. Undoubtedly, these activities have significantly altered the hydrology of the area. Independent study students working with Dr. Root and some of the Dr. Root's classes have continued to periodically monitor water levels since wetland construction was completed. However, these water level data have not been interpreted and there has not been a focused effort to characterize how the recent land use changes have impacted the hydrology of the constructed wetland.

METHODS

We propose to address the above objectives by collecting and interpreting water level data, water quality data, and stable isotopes of water.

Water level data

Students will go to the field twice monthly to download groundwater level data from already-installed pressure transducers that are continuously recording water levels in wells. While in the field, students will also take manual readings of water levels in the Pondhawk wetland and the two lakes adjacent to the site. Students will construct graphs of water levels vs time to evaluate the seasonal variability of water levels. Students will also compare changes in wetland water levels to precipitation data, groundwater levels, lake levels, and pumping data from the nearby municipal wells to determine how the wetland and groundwater-wetland interactions are influenced by precipitation, lake levels and pumping. Additionally, students will compare the data they collect with historical water level data to determine if recent land use changes have had an obvious influence on the hydrology of the area.

Water quality and water isotope data

Students will collect samples of precipitation (if any), groundwater, wetland water, and lake water twice monthly. These samples will be analyzed for basic water quality parameters (major ions and nutrients) and water isotopes in Dr. Root's lab. Using these data and basic principles of mass balance, we can estimate the exchanges of water that take place between the groundwater and the wetland, the wetland and the lakes, and the groundwater and the lakes. Students will have the opportunity to observe and help with the laboratory analyses and will work with Dr. Root on the mass balance calculations and data interpretation.

ANTICIPATED OUTCOMES

The results of this proposed research will shed light on what factors influence the depth and water quality of the Pondhawk wetland and the local hydrology. This information will be invaluable to managers in deciding what policies to set in order to maintain adequate water levels in the wetland to support the native vegetation communities. Additionally, this research will help us determine what data are most useful for assessing the local hydrology and thus will inform our plans for long term monitoring at the site.

TIMELINE

- March 2015 – January 2016
    - Twice monthly field work to collect samples and water level data (all of the necessary field equipment is already installed)
    - Analysis of water samples
    - At least monthly meetings with Dr. Root to discuss field work and initial results
- March 2015 – April 2015
    - Review and organize existing data
- May 2015 – January 2016
    - Continually add new data to existing database
    - Preliminary interpretation of results
- January 2016 – March 2016
    - Final interpretation of results
    - Preparation and presentation of poster for Undergraduate Research Symposium (students will also be encouraged to present a poster at a regional conference of a professional society, such as the spring meeting of the Southeastern Section of the Geologic Society America).

BUDGET

Items needed	Vendor	Quantity	Price	Budget Justification
Travel to field site and lab	n.a.	5 miles/field work day x 2 days/month x 11 months = 110 miles 50 miles round trip from field site or Boca Campus to Davie lab x 5 trips to lab = 250 miles Total miles = 360 miles	$0.445 /mile x 360 miles = $160	Student's mileage for doing field work and lab work
Filter membranes	Fisher Scientific	2 packs of 100 (10 water quality samples per field day x 2 field days per month x 11 months = 220 water quality samples)	$250	Water quality samples need to be filtered to remove particulates before analyzing them
O-rings for filter holders	Fisher Scientific	1 pack of 100	$100	O-rings for the filter holders. They are re-usable but need to periodically be replaced. (Pack of 100 is smallest available)
Analyzer sample cups	SEAL	1 pack of 1000	$43	Cups that the samples have to go in to be analyzed (Pack of 1000 is smallest available)
Analyzer reaction segments	SEAL	1 pack of 100	$89	These are containers in the analyzer where the reagent gets mixed with the sample
Pump head tubing	In-situ	10ft	$30	The tubing for the pump that will be used for sampling needs periodic replacement
Sample tubing	In-Situ	100ft	$25	The tubing that connects to the pumping needs to periodically be replaced
Syringe for Water isotope analyzer	Picarro	2	$300	Analyzer uses a syringe to inject the sample. Syringes break frequently and need to be replaced.
TOTAL			**$997**	

BUDGET JUSTIFICATION

The first line item above is mileage for the students to travel to and from the field site and between the Boca campus where the field equipment is housed and Dr. x's lab on the Davie campus. Students will likely go together to the field and lab so the amount requested is for all three students. The remainder of the budget items are consumables associated with sampling and analysis. Dr. x has other supplies, such as sample bottles, already available.

CONTRIBUTIONS OF GROUP MEMBERS

Three Geosciences undergraduate students are participating in this project: <student names>. All three students have taken or are enrolled in Dr. x's hydrogeology course and all of them have a keen interest in gaining hands on practical experience outside of the classroom. <student> is enrolled in DIS credits with Dr. x this semester and as a part of his DIS, he has already been to the field with Dr. x to get oriented to the sampling sites and methods and he will continue participating in the field work and preliminary data analysis for the rest of the semester. <student> graduates at the end of this semester so <student> and <student> will continue the data collection and analysis. Dr. x also has a graduate student who is assisting with some of the field work for this project (outside of their thesis research). Dr. x will work out a sampling schedule with <students>, her graduate student, and herself to ensure that sampling gets done every two weeks. Monthly meetings will be held to discuss any issues that arise with sampling and to discuss how to approach the data analysis. In the spring of 2016, the students will work together and consult with Dr. x to prepare a poster to present at FAU's undergraduate research symposium.

REFERENCES

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