Project summary and scope of work

Salt marshes are vital aquatic habitat for many fish species and are particularly important as nursery and foraging habitat for resident and transient fish species. However, these systems are threatened by more than 8 million people who have moved to coastal counties along the Gulf of Mexico since 1960, leading to an increase in low-intensity urbanization within 50km of the coastline (Wilson and Fischetti 2010, Xian et al. 2012). Increased coastal development is a significant driver of salt marsh loss (Bromberg and Bertness 2005, Gedan et al. 2009, Deegan et al. 2012). In addition to loss, freshwater runoff associated with urbanization changes the frequency and magnitude of salinity fluctuations and nutrient inputs to coastal areas thereby changing salt marshes and the habitats they provide (Lerberg et al. 2000, Holland et al. 2004, Sanger et al. 2008, Wedge and Anderson 2017).

In response to increasing coastal urbanization, a study is currently being conducted along coastal Alabama to evaluate the impact of residential development on small order tidal creeks and salt marshes common to the area. We will evaluate up to 12 tidal creeks and associated salt marshes across an urban density gradient to evaluate how residential development influences these areas.

Our **first hypothesis** is that increases in low-intensity urbanization within a watershed will lead to increases in the frequency and magnitude of salinity fluctuations in tidal creek salt marshes, in turn leading to reduced salt marsh habitat for resident fish. While the impacts of urbanization on aquatic habitats are well-recognized (Walsh et al. 2005), the relationship between land-use and land-change (LULC) and salinity regimes is poorly understood. By better understanding the LULC-salinity relationship, we can predict the impacts LULC will have on fish occupying tidal creeks and salt marshes.

To accomplish this, salinity will be measured in each creek and LULC will be quantified in each study watershed. Using the Soil and Water Assessment Tool and an Artificial Neural Network model, salinity within each creek will be predicted based on watershed characteristics.

Our **second hypothesis** is that increased nutrient loading in runoff associated with low-intensity urbanization will lead to increases in gross primary production and a shift of fish diet from primarily macroinvertebrates to primarily algae (Partyka and Peterson 2008, Weinstein et al. 2009, Washburn and Sanger 2011, Lowe and Peterson 2015). Fish found in more urbanized watersheds have been shown to have lower conditional measures, including lower caloric density (Wedge et al. 2015). Fluctuations in salinity associated with increased runoff lead to significant energy costs, as fish must osmoregulate with changing salinity conditions (Gonzalez et al. 2005). We hypothesize that the combination of diet shift and rapid salinity fluctuation will have a significant negative impact on fish condition.

To accomplish this, resident salt marsh fish will be sampled using minnow traps within, and along, the marsh. Volumetric stomach analysis will be conducted to determine the diet of the collected fish. To assess fish condition, we will use the liver somatic index as used in Wedge et al. (2015), which uses the ratio between liver mass and total fish mass. Gross primary production and ecosystem respiration will be estimated based on diel changes in measured dissolved oxygen in the water column.

Our **third hypothesis** is that changes in the frequency and magnitude of salinity fluctuations will lead to changes in various ecosystem processes, including primary production and nutrient transformation, that will result in changes in fish species assemblages and abundance (Valiela et al. 1973, Montague and Ley 1993, Brin et al. 2010, Nelson and Zavaleta 2012, Sin and Jeong 2015) . Salt marshes play a vital role as feeding and nursery habitat for prey fish of commercially important fish species. Understanding how urbanization may change resident fish species assemblages that are an important food source for game species is an important consideration.

To accomplish this, fish assemblage and community composition will be determined based on surveyed fish. To understand how nutrient transformation changes with increased urbanization, nutrient flux into and out of the salt marshes will be estimated based on water samples collected by hand and by automatic storm samplers throughout full tidal cycles.

Benefit to coastal wetlands

This project will quantify the level of land-use change within a watershed where changes in the frequency and magnitude of salinity fluctuation will be observed in tidal creek and fringing salt marshes dominated by *Juncus roemerianus* (black needle rush) and what effect these land-use changes have on the structure and function of these marshes and tidal creeks. *Juncus*-dominated salt marshes are prevalent along the northern Gulf of Mexico (GoM) coast, which will allow this project's findings to be applied throughout the region, giving watershed managers additional tools to understand and control the impacts of storm-water runoff on estuarine waters. Given the important ecosystem services provided by tidal creeks and salt marshes, particularly for economically important game-fish species, understanding the impacts of coastal development on these systems is critical.

Completed Work

A total of 12 sites have been selected and will be monitored/sampled this year for environmental/fish data. Previous research on some of these creeks, was completed in 2013 and the results can be found in Wedge et al (2015) and Wedge and Anderson (2017). Based on six creeks (3 urban- and 3 forested-watersheds), they consistently found that resident salt marsh fish in more urbanized creeks exhibited lower caloric density and lower liver somatic index (LSI) scores indicating poorer overall condition. Salinity changes were also more frequent and of greater magnitude at the more urbanized sites than

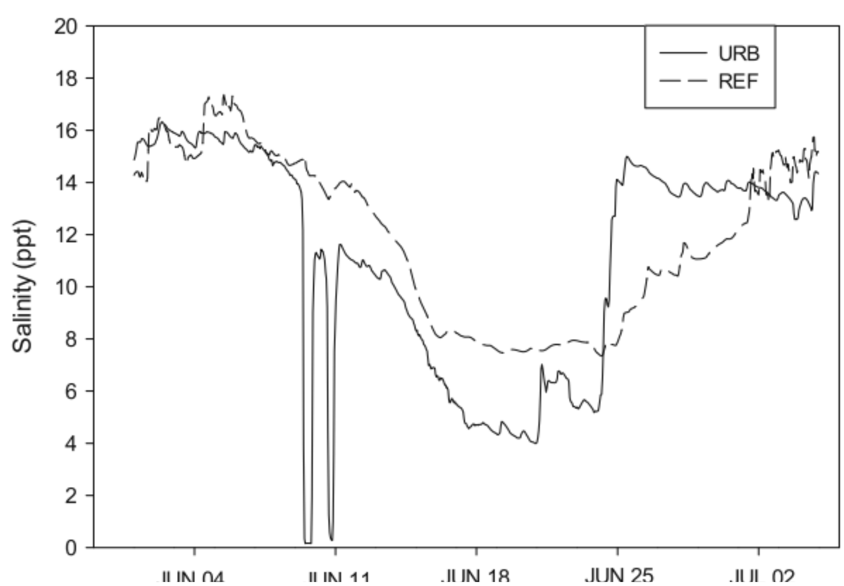

Figure 1. Mean hourly salinity at an urban and reference creek during a 26 cm rain event. From Wedge and Anderson 2017.

reference sites (Figure 1). In addition to fish conditional differences and differences in salinity, fish assemblages also changed along the urbanization gradient (Walsh et al. 2005). Because previous data exists at 6 of the 12 sites, we will be able to analyze change over time for certain measures at these sites.

How funds will be used

Funds from this grant will be split between travel costs and the purchase of additional dissolved oxygen sensors. Travel costs would include gas/mileage, fuel for a boat, per diem, and lodging. Additional dissolved oxygen sensors are needed to measure diel changes in dissolved oxygen in the water column, allowing for the estimation of gross primary productivity and ecosystem respiration (Odum 1956, Caffrey 2003). At this time, we only have funding to purchase sensors for 6 of 12 sites. Purchasing additional sensors would allow forconcurrent data collection at more sites. This would allow for better comparisons between sites, without having to take into account that dissolved oxygen data may have been collected at different times and under differing environmental conditions.

Sharing of results

Before field-work even begins, we will engage local stakeholders through a project kickoff meeting in spring 2019. The purpose of this meeting is to inform those already working in out study watersheds about our project's goals and to gain a better understanding of how our results can be used by watershed and storm-water managers, and those involved with tidal creek restoration efforts. This meeting will be in partnership with several identified partners and stakeholders. We expect 25-35 participants to attend out project kickoff meeting.

Near the end of this project, a tidal creek/storm water symposium will be organized to share our results. The target audience will be those who attended the kickoff meeting and any new municipal stakeholders, managers, and organizations interested in our results. The purpose of this symposium will be to not only share results, but to discuss with managers and stakeholders the management implications of our findings and how they can be used to better manage runoff and restore tidal creek habitat. We expect our findings, and the discussin generated at the symposium, to be applicable to in similar habitats in Mississippi, Alabama, and west Florida. We will also work with the Alabama Cooperative Extension Services to develop synoptic materials, including illustration and summaries of results, to distrubute before the symposium.

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