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### **Nature of the Problem**

Tidal wetlands provide many functions that can be valuable to both humans and animals. Some of these functions are not limited to but include improving water quality by trapping suspended sediment, helping in storm abatement, and acting as habitat and food source for birds, mammals, fish, and invertebrates. Tidal marshes are formed and maintained by a number of factors including the unique balance between freshwater inflow and the tidal flushing of saline water (Kennish 2001; Baldwin et al. 2001; Jassby et al. 1995; Odum 1988) commonly found in estuaries. These salinity levels, along with temperature and dissolved oxygen, vary seasonally and annually, and can significantly affect the plant, animal, and planktonic communities (Kennish 2001; Gough and Grace 1998; Jassby et al. 1995; Odum 1988).

Anthropogenic activities have been cited as a threat to the well being of coastal wetlands; such activities include draining for agricultural, domestic or industrial development, diversion of natural waterflow by building structures or canals, and other destructive activities. Because of an increased demand for freshwater for human consumption, agricultural purposes, and other uses, there has been a decrease in freshwater inputs into Texas estuaries. This reduced freshwater input, in conjunction with rising sea level, and seasonal variability, may result in significant changes in the salinity gradient. The upper end of estuarine marshes are dominated by fresh and low-salinity tolerant plants; further down in the estuary, the vegetation is made up of halophytes, species physiologically adapted to salinity (Odum 1988). Studies have shown that reduced freshwater flow can adversely affect the vegetation community, especially in the estuarine transition zones (McKee and Mendelssohn, 1989).

Salinity has been cited as one of the most important factors influencing biological activity (Fitch and Armstrong 1982). Plant and animal species that habitate estuaries are adapted to a salinity range; however, there are limits this salinity range, and changes that exceed this range may reduce or eliminate these adapted species (Fitch and Armstrong 1982). Both the plant and animal communities may shift to species more suited to the altered salinities (Fitch and Armstrong 1982). While animals are mobile and can migrate seaward or upstream to the desired salinity, plants, because they are rooted, may experience death allowing other more fresh or salt tolerant species to germinate.

Changes in the saltwater balance have been shown to cause physiological stress to plant communities, resulting in intraspecific competition, and in extreme cases, death, which in turn decreases the wetlands ability to trap sediment, accumulate organic matter, and offset flooding (Kennish 2001). Greenhouse studies (McKee and Mendelssohn 1989) have shown increased salinity leading to decreased aboveground biomass of fresh and brackish species. However, these results varied depending on species, the extent of salinity change, and the duration of change (Howard and Mendelssohn 2000; McKee and

Mendelssohn 1989). Pennings and Callaway (1992) examined the importance of competition and physical factors in salt marsh zonation. They found that flooding, salinity levels, and competition were all important in determining plant zonation, but their relative importance was a function of elevation.

It is conservatively estimated that 53% of tidal saltwater marshes in the United States occur around the Gulf of Mexico (Mitsch and Gosselink 2000). The Guadalupe Estuary is located along the Gulf of Mexico between Galveston and Corpus Christi, TX, where the Guadalupe and San Antonio Rivers empty into San Antonio Bay. The Guadalupe Estuary, like many estuaries in Texas, is being threatened by gradual reduction in freshwater input. A Texas A&M study estimated that this region generated \$20 million and 497 jobs in 1995 in the fishing industry, and an additional \$154 million recreationally (TPWD, AUG 13, 2001).

The coastal Gulf of Mexico is also home to a number of endangered species, most known as the wintering grounds for the only migrating population of the endangered Whooping Crane (*Grus americana*). There are approximately 8,500 acres of wetlands on Aransas Refuge, 1,500 freshwater and 7,000 acres saltwater wetlands that provide food and habitat to close to 200 Whooping Cranes (McAlister and McAlister 1995).

### **Research Objectives**

My project will focus on the effects of changes in reduced freshwater inputs on the vegetation communities in the Guadalupe Estuary. Sea level rise, along with subsidence, and also reduced freshwater input may have an affect on the water levels and water quality. My study will consist of initial surveying, monitoring, and also an experimental project. We will perform an extensive elevation survey where we will identify which wetland plant communities exist at which elevation. Three long monitoring sites will consist of automated water samplers that will sample every 18 hours, and mini-sondes which measure and log pH, temperature, conductivity, and salinity every hour. Permanent vegetation quadrats will be established at these water quality sites, in order to determine how the vegetation communities will be affected with changes in water quality.

A large portion of the vegetation monitoring will focus on the Carolina Wolf-berry (*Lycium carolinianum*) a plant that produces berries that are part of the Whooping Crane diet. The experimental aspect of this project will also focus on the Wolf-berry. The specifics for this portion have not yet been determined due to the complicated matter of working with endangered species and their food sources. Because the presence of the Whooping Cranes, the experimental will probably consist of a small field and a larger greenhouse portion.

This project will help to develop an understanding about the effect of various proposed and ongoing perturbations of freshwater inflow in estuarine systems that can be applied in other estuarine watersheds that are facing the same increases in fresh water need. More specifically, this study will help predict the changes in the marsh macrophyte community that may occur as population growth and freshwater diversion continues in the Guadalupe

Estuary.

## **References**

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## **Academic Qualifications**

I have learned an incredible amount of skills and knowledge in my research and coursework. My overall My first summer here I enrolled in Tropical Coastal Ecology offered in Belize, where we focused on dynamics in mangrove forests and sea grass beds. During the fall semester in Wetland Plant Taxonomy, I learned to identify and key more wetland plants than I even knew existed. Wetland Ecology taught theoretical and applied aspects of wetland ecosystems; this class included a lab aspect where we sampled various aspects of local and coastal wetlands and presented out findings in lab reports. This most recent semester I had two very interesting classes concerning water resources, one focusing on science and the other on management. In Ecology and Bioassessment of Freshwater Environments, I learned how to use invertebrate and fish populations, along with water quality and habitat parameters to determine the health and quality of streams. The other class from this past semester, Planning for Coastal and Marine Protected Areas was a truly interdisciplinary class; students were from Planning, Geology and Geophysics, Transportation, and Wildlife and Fisheries departments. I expect my research project to get started in full this summer, and am looking forward to starting my work at Aransas National Wildlife Refuge.

### **Intended Career Path Statement**

In the future I want to work for the government in a research agency. One benefit of the federal employment is that it offers more opportunities to get involved in long term monitoring projects vs. brief studies common to consulting firms and other smaller groups. Working in aquatic resources is also attractive because it has the potential to involve field, lab, and office components.