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CHARACTERIZATION OF WATER QUALITY AND ASSOCIATED FACTORS IN NATURAL AND CREATED WETLANDS OF THE TEXAS COAST

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Introduction

- Coastal wetlands are considered one of the most productive ecosystems
- Make up less than 5% of terrestrial land mass
- Provide nursery habitat
- Stabilize sediment
- Reduce coastal erosion and wave impacts
- Trap sediment
  - Nutrients, chemicals, and toxicants
Threats and Loss

- 70-75% of world's population lives within the coast region
- Conflict between wetlands and development
- Gulf of Mexico has most notable loss of wetland habitat in United States
- Galveston Bay has lost 21% of wetland habitat since 1950’s
- Most losses can be traced back to human impacts
  - Agriculture
  - Population pressure
  - Pollution
  - Water flow reduction
  - Habitat fragmentation
  - Subsidence
Created vs. Natural Marshes

- Section 404 of Clean Waters Act requires mitigation for wetlands that are destroyed for development
- Uncertainty regarding the function of created marshes in comparison with natural marshes
- No studies comparing water quality between created and natural salt marshes
  - Saltmarshes tend to be a sink for nutrients and sediment
- Soil chemistry studies have shown that natural marshes have higher carbon and nitrogen compared to created marshes (Lindau and Hossner 1981)
- Nekton studies have shown that created marshes have lower abundance and diversity than natural marshes (Minello and Zimmerman 1992)
Significance

- The EPA wants to develop water quality standards for wetlands
- There are no studies comparing created vs natural saltmarshes

Objectives

- Gather ambient water quality data of coastal wetlands to help fill knowledge gaps and have background data to help develop water quality standards
- Compare water quality between natural and created saltmarshes to determine if they are functioning differently
- Determine if there are difference in modifying characteristics to determine if our study sites follow previous studies in marsh development
Site Selection

- Surface water quality of 3 marsh types within Galveston Bay
  - 2 created saltmarshes
    - West Created-2001
    - Galveston Created-1994
  - 2 natural saltmarshes
  - 1 freshwater marsh
Methods

- 6 water sampling events from Nov. 2013 to Oct. 2014
  - YSI multiparameter meter – Temp, Sal, pH, DO.
  - Collected in-situ samples
  - NO$_3$, NO$_2$, TN, NH$_3$, & TP
  - Analysis completed using a Hach DR/890 colorimeter
- Soil samples were collected in June 2014 and November 2014
  - Analyzed by Texas A&M Soil Water Forage Lab using ICP and Nitric Acid Digestion
- Nekton collected via straight seine in June 2014 and October 2014
- Statistical analysis – Kurskal–Wallis($\alpha = 0.05$)
  - Dunn’s multiple comparison test
- NMDS of fish species abundance and Analysis of Similarity
Water Quality

![Box plots for water quality parameters: Temperature, Salinity, Dissolved Oxygen, pH.](image)

- **Temperature (°C):**
  - Water Temperature
- **Salinity (ppt):**
  - A
- **Dissolved Oxygen (mg/L):**
  - C
- **pH:**
  - E
Water Quality

- NH3
- NO2
- NO3

Concentration (mg/L)

- Created Saltmarsh
- Natural Saltmarsh
- Freshwater Marsh

- TP
- TN

Concentration (mg/L)

- A
- B
- AB
- C
- D
- D
- E
- E
- F
- G
- G
- H
- I
- I
- J
Soil Nutrients

The graph compares the concentrations of Soil Nutrients in Created Saltmarsh, Natural Saltmarsh, and Freshwater Marsh. The concentrations are measured in mg/L for TN (Total Nitrogen), TC (Total Carbon), and TP (Total Phosphorus). The graph illustrates a significant variation in nutrient levels across different types of saltmarsh environments.

- **TN (Total Nitrogen)**: The Created Saltmarsh shows a higher concentration compared to Natural Saltmarsh and Freshwater Marsh. The range for Created Saltmarsh is higher than the other two types.
- **TC (Total Carbon)**: The Natural Saltmarsh has a considerably higher concentration than the Created Saltmarsh and Freshwater Marsh, indicating a rich carbon content in Natural Saltmarsh environments.
- **TP (Total Phosphorus)**: The Freshwater Marsh has a notably higher phosphorus concentration compared to Created and Natural Saltmarsh, suggesting the importance of freshwater inputs in phosphorus dynamics.

The graph highlights the distinct nutrient profiles of each type of saltmarsh, with Natural Saltmarsh showing the highest concentration levels for all three nutrients.
Fish Assemblage - NMDS

The diagram illustrates the distribution of fish assemblages across different environments using Non-metric Multi-dimensional Scaling (NMDS). The points represent different types of marshes:
- Created Saltmarsh (circles)
- Freshwater Marsh (triangles)
- Natural Saltmarsh (squares)

The scatter plot shows the multidimensional scaling of these assemblages, with positions indicating similarity in species composition.
Discussion

- Significant differences in water NO$_3$ and NO$_2$ between created and natural saltmarshes may be attributed to development of nitrogen cycle.
- Significantly higher water TN and TP values in freshwater marshes may be due to increased total suspended solids and larger amounts of decaying detritus, from river discharge and excess organic waste from nesting birds.
- Significantly higher soil nutrients at the freshwater sites may be due to a higher percent of organic material found at these sites in comparison to saltwater marshes, though more analysis is needed.
- Although not statistically significant there is lower carbon and nitrogen in the created marsh similar to reported values in previous studies (Craft et al. 1988)
- Significant differences in fish assemblages between marsh types follows expectations based on previous studies and observed salinities. (Minello and Zimmerman 1992)
Conclusions

- Differences in water quality and soil nutrient levels between constructed and natural wetlands should be considered in future restoration projects.
- Further study is needed to determine difference in nitrogen cycling between created and natural marshes.
- Statistical analyses are ongoing, including evaluation of additional water quality parameters and influence of possible contributing factors.


