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# Influence of Freshwater Inflow on the Occurrence of Water Celery and the Abundance and Health of Atlantic Rangia in the Trinity River Delta, Galveston Bay, Texas

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## Introduction

- The State of Texas is in the process of validating environmental flow recommendations in an effort to maintain sound estuarine ecological environments.
- The Atlantic Rangia (*Rangia cuneata*) and Water Celery (*Vallisneria americana*) are recommended native indicator species for Galveston Bay.
- There is significant knowledge limits about the abundance and spatial coverage of these two bioindicators in the Trinity River delta (Galveston Bay system).
- Objectives of this study were to:
  1. Establish current geographic distribution of Atlantic Rangia and Water Celery in the Trinity River delta.
  2. Examine the potential relationships between freshwater inflow and the abundance of Atlantic Rangia
  3. Examine the potential influences of salinity and freshwater inflow on Atlantic Rangia health.

## Study Area

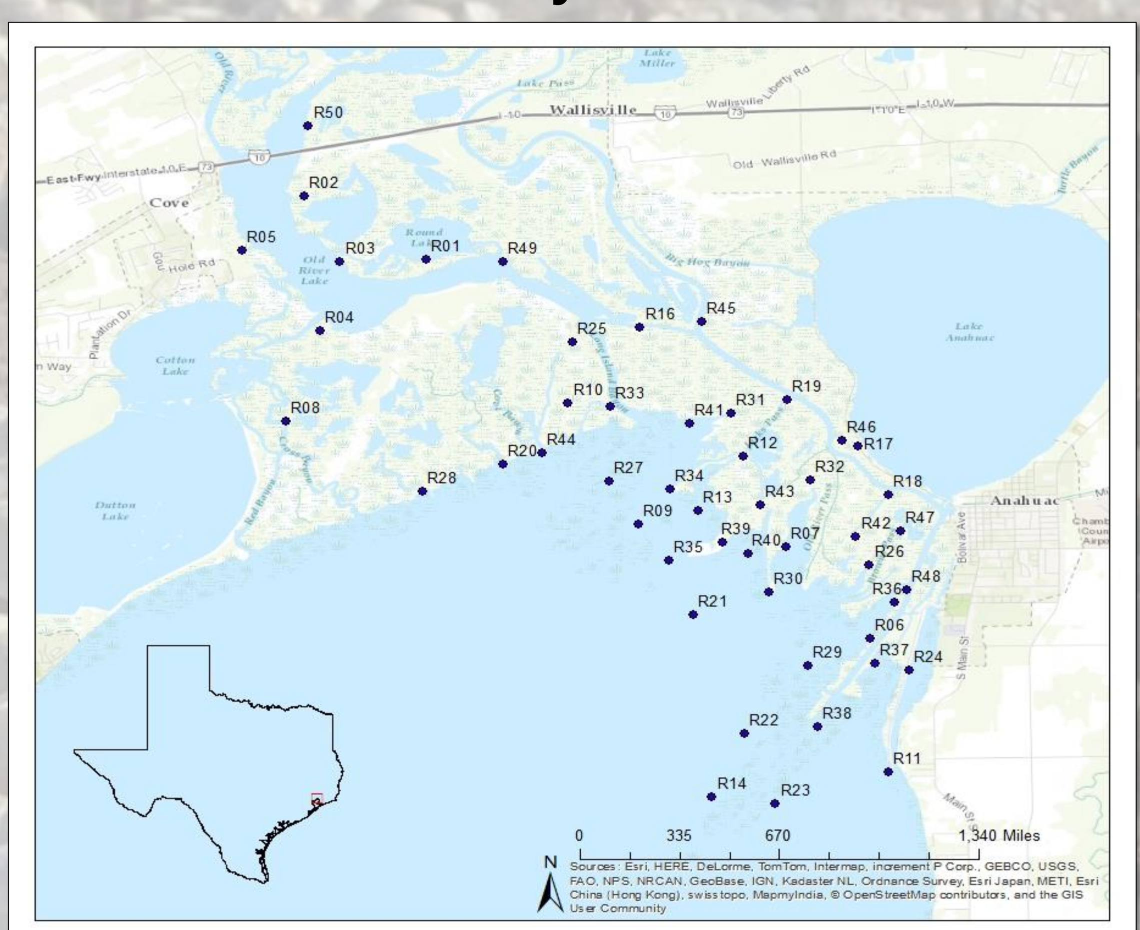

**Figure 1**:Site map of the Trinity River delta Atlantic Rangia and Water Celery monitoring study.

## Methods

- Sampled from January – September 2016
- 50 sites - combination of historical and random sample sites (Figure 1).
- Water Quality
  - Ambient Conditions – Water depth (m), salinity (psu), dissolved oxygen (mg/L), temperature (C), secchi depth (m), sediment type and % fines.
  - Rangia Sampling (Figure 2)
    - Benthic grabs (2 replicate grabs) either a core, Ekman, or petite ponar depending on substrate.
    - Clam rake (3 replicate 30 second rakes) for sites with average depth <1m
    - Clam dredge (3 replicate 30 second tows) for sites with average depth ≥1m
- Lab Analysis
  - 20 Rangia from each site measured (length, width, and height) (Figure 2)
  - 10 Rangia from each site weighed for health assessment.
    - Meat index: ratio of soft tissue to total weight. Considered a basic health index that measures the amount of soft tissue somatic growth and gonad condition.

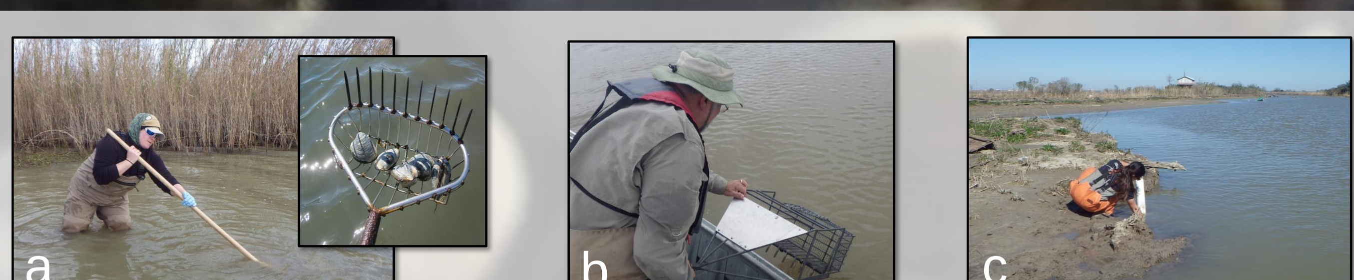


**Figure 2**:Rangia collection methods a) clam rake, b) clam dredge, c) benthic grab.

## Results

### Water Celery Occurrence

- Water celery was observed at three sites (R13,R15,and R31)
- Grazed blades observed with large nutria population present in the area
- First recent study to document water celery occurrence; likely supported by sustained freshwater discharge into the delta (Figure 3).

### Rangia Abundance and Distribution

- Live Rangia detected at 37 out of 50 sites (74%)
- No obvious spatial pattern detected
- Environmental Variables found to have a significant relationship with Rangia abundance were water depth (p-value=0.0022) and salinity (p-value = 0.306). (Negative binomial generalized linear model R 3.3.1)

### Rangia Morphometrics

- 231 Rangia shells retained for size (20/site, if less than 20 live were found, whole dead shells were collected).
- Shell length exhibited bimodal distribution. (Figure 4) Note: sampling techniques were biased towards larger individuals.
- Using a von Bertalanffy growth model (Wolfe and Petteway 1968), a) represents 2-3 year old, and b) 4+ year old cohorts. (Figure 4)

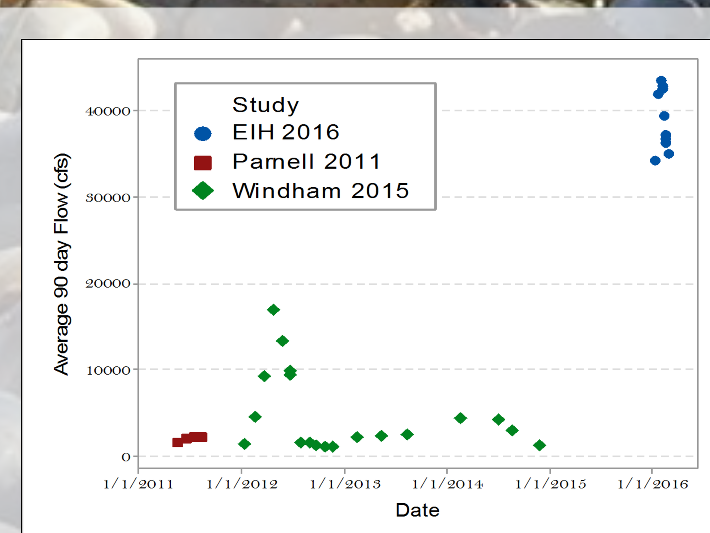


**Figure 3**: Ninety day average discharge from the Trinity River from January 2011 through February 2016.

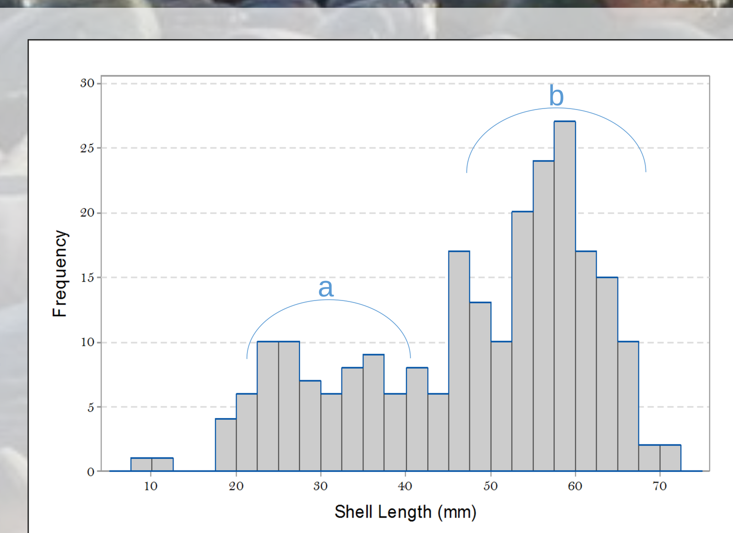


**Figure 4**: Frequency distribution of Atlantic Rangia shell lengths. Blue lines illustrating likely bimodal distribution

### Rangia Health

- 162 individuals were dissected to calculate health metrics.
- Average meat index observed during this study was 30.3 ±0.5%
- Significant decrease in the health of Rangia exposed to higher salinities. (p-value < 2.2e-16) (Generalized least squares fitted model - R 3.3.1) (Figure 5)
- The sites with the lowest mean meat index values were found in the downstream, most tidally influenced portion of the delta. (Figure 6)

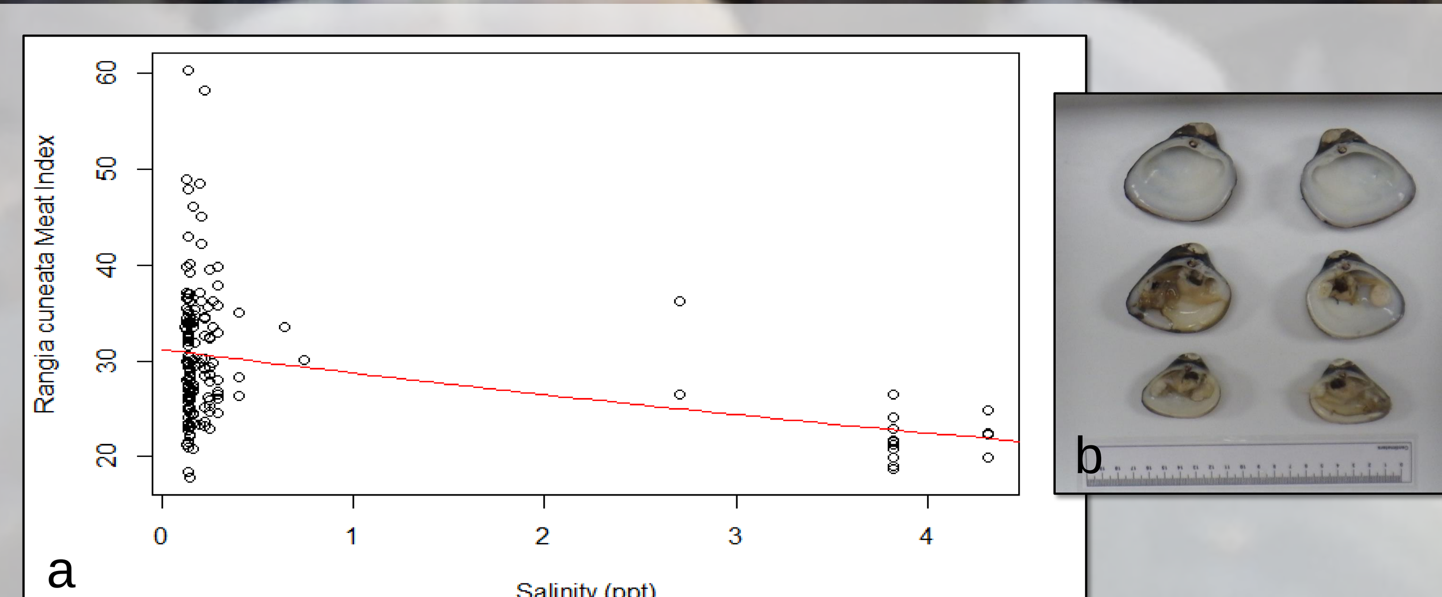


**Figure 5**: a) Meat index by salinity for Rangia sampled in Trinity River delta, Galveston Bay, TX. b) examples of Atlantic Rangia shucked and ready to be weighed.

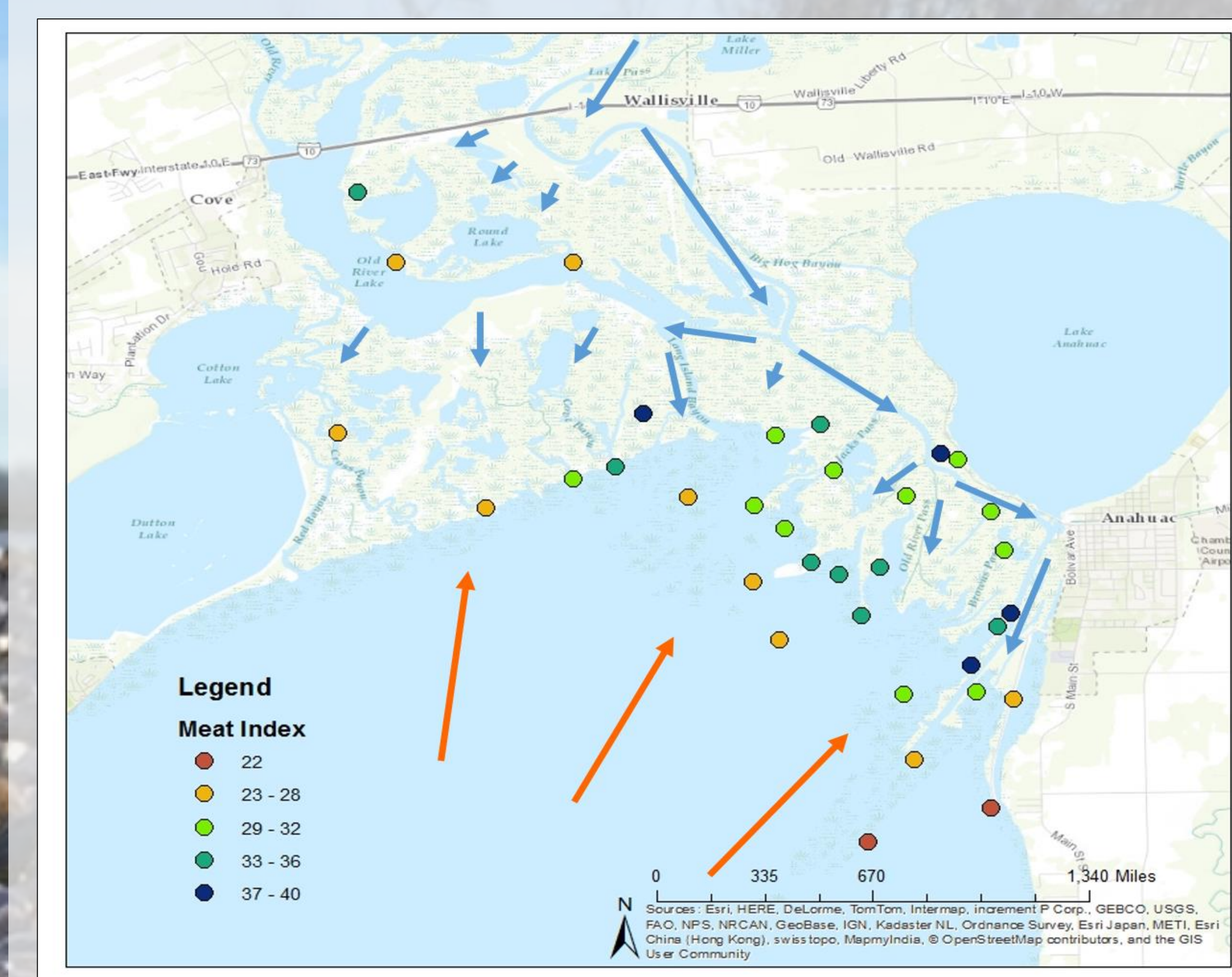


**Figure 6**: Mean meat index by site for Rangia collected in the Trinity River delta Galveston Bay, Texas. Blue arrows illustrates example of freshwater discharge into delta while orange arrows illustrate tidal influence.

## Conclusions

- Previous recent attempts to document water celery in this area have been unsuccessful. Higher sustained river discharge which reduced salinities supported colonization and survival of water celery.
- Previous studies reported meat index values of 12.5% and 12% (Parnell et al. 2011, Windham 2015). The sustained freshwater discharge of 2015 through the sampling in 2016 likely contributed to reduced stress, changes in food quality due to nutrient fluxes, and increased feeding activity resulting in greater tissue biomass for Rangia.
- This study illustrated the positive relationship between increasing freshwater inflows with the occurrence of water celery and the health of Rangia.

## Future Work

- Compare benthic community diversity and composition between sites.
- Investigate nekton communities that utilize water celery beds.
- Continuous salinity monitoring at sites throughout the delta to better understand relative influence of river discharge on salinity and other environmental factors.
- Expand spatial range of sampling to identify minimum and maximum salinity requirements to sustain a reproducing population of Rangia.

## Literature Cited

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