Rangia decline and resource management: how freshwater inflows influence ecology in Galveston Bay, Texas

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Introduction

- Numbers of the brackish-water clams *Rangia cuneata* and *R. flexuosa* (*Rangia* spp.) have been declining in Galveston Bay (GB) since 1983 according to Texas Parks and Wildlife Department (TPWD) sampling data (**Figure 1**).
- Previous analyses comparing TPWD *Rangia* spp. data with Texas Commission on Environmental Quality (TCEQ) water quality data showed no strong relationships between individual physical stressors and *Rangia* spp. decline in GB[1].
- *Rangia* spp. are filter feeders dependent on chlorophyll *a* (chl *a*) concentrations (used as a proxy for phytoplankton biomass) [2,3]. Chl *a* is influenced by nutrient availability which may shift with changes in FWI [3,4].
- The current study examines the cumulative influence of physical and chemical factors on biological parameters in GB and their impacts on *Rangia* spp. Changes in the rates of freshwater inflow (FWI) in conjunction with changes in nutrient concentrations and chl *a* levels in GB since the 1980s are observed to form a better understanding of the stressors affecting *Rangia* spp.
- Learning more about the sensitivity of *Rangia* spp. to natural and anthropogenically influenced environmental changes can provide insight on ecological requirements which help to inform management strategies regarding FWI.

Hypothesis

H_A: Changes in FWI affect nutrient compositions which in turn affect chl *a* levels that influence *Rangia* spp. numbers and distribution.

Objectives

- Describe Trinity River (TR) discharge from 1982-2010 to observe long term patterns in FWI
- Compare TR discharge with nutrient concentrations and chl *a* levels in GB from 1982-2010
- Map numbers and distribution of *Rangia* spp. in GB from 1983-Present to compare to chl *a* data

Methods

- TR discharge data from 1982-2010 from the United States Geological Survey gauge at Romayor (08066500) (http://waterdata.usgs.gov/nwis/) were graphed using Microsoft Excel.
- GB nutrient data (including ammonium (NH_4^+), nitrite (NO_2^-), nitrate (NO_3^-) and total phosphorus (TP) concentrations in mg/L) along with chl *a* concentrations in µg/L from 1982-2010 were obtained from the Houston Advanced Research Center (HARC) via the TCEQ Surface Water Quality Monitoring Program. SigmaPlot software generated spatial heat maps of the nutrient and chl *a* concentrations.
- Decadal *Rangia* spp. distribution maps of TPWD sampling data from 1983-2010 were created using ArcMap software and compared to TR FWI graphs and nutrient and chl *a* concentrations in GB.

Results

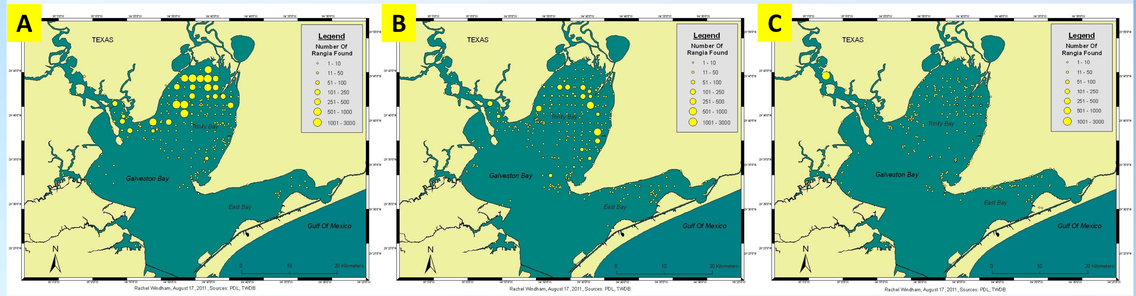


Figure 1: *Rangia* spp. numbers and distribution in GB 1983-2010; 1983-89 (A), 1990-99 (B) and 2000-10 (C)

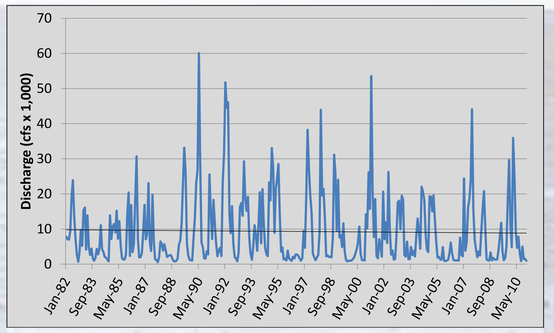


Figure 2: Mean monthly discharge from TR in cfs, 1982-2010

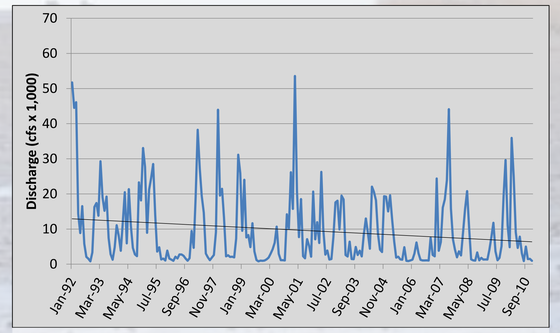


Figure 3: Mean monthly discharge from TR in cfs, 1992-2010

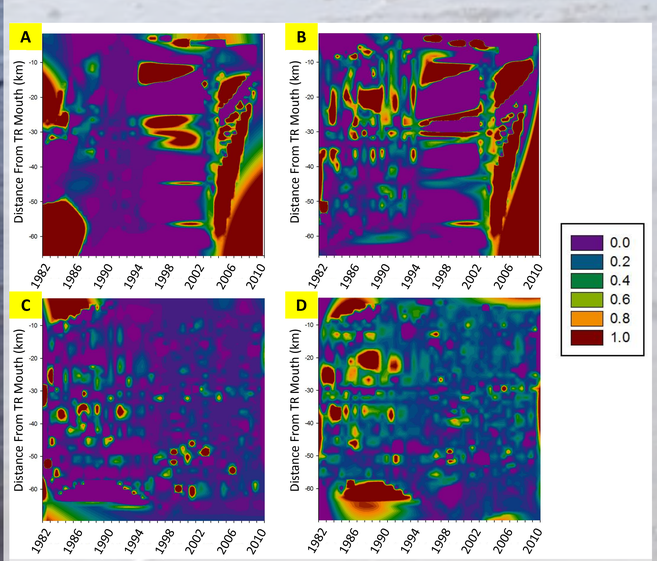


Figure 4: Nutrient concentrations (mg/L) in GB, 1982-2010; NO_2^- (A), NO_3^- (B), NH_4^+(C), and TP (D)

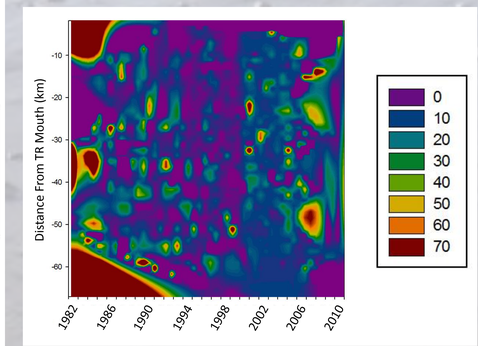


Figure 5: Chl *a* concentrations (µg/L) in GB, 1982-2010

Discussion

- *Rangia* spp. distribution in GB has shifted and numbers have decreased since 1983 (**Figure 1**).
- FWI from TR into GB decreased slightly since 1982 (**Figure 2**) with the decrease becoming more pronounced after 1992 (**Figure 3**).
- All nutrient concentrations decreased during 1992 (**Figure 4**). NO_2^- and NO_3^- returned to levels comparable to the 1980s at the turn of the millennium, but recent NH_4^+ and TP concentrations are relatively low (**Figure 4**).
- Chl *a* levels near the TR mouth were higher in the 1980s relative to recent concentrations with a noticeable decrease occurring in the early 1990s (**Figure 5**).

Preliminary Conclusions

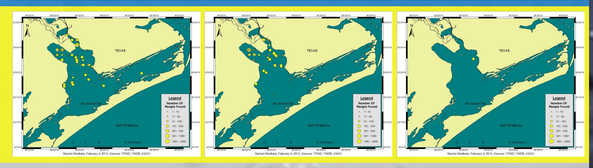
- As FWI from TR decreased, the nutrient composition of GB changed. This may have influenced the decrease in chl *a* levels throughout GB. Because chl *a* can be used as a proxy for phytoplankton biomass, this result could imply a decrease in the availability of primary producers in GB.
- Because *Rangia* spp. are filter feeders, a decrease in phytoplankton availability could imply that their diet was restricted enough to contribute to their decline.

Future Research

Further research for this study includes observing other bays along the Texas Coast to see if similar nutrient and chl *a* interactions are affecting *Rangia* spp. in these systems. Such information would help define the ecological FWI needs of these bays for resource managers.

Sabine Lake: 1990s, 2000s and Present

San Antonio Bay: 1990s, 2000s and Present



Acknowledgments

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References:

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