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The Influence of Freshwater Inflow on Water Quality & Nekton Communities of the Brazos River Estuary, Texas

George Guillen[1], Mandi Gordon[1], Stephen Curtis[2] and Jenny Oakley[1]

[1]Environmental Institute of Houston, University of Houston-Clear Lake, Houston, TX;
[2]Texas Parks & Wildlife Department, River Studies Program, San Marcos, TX
*direct questions/comments to Guillen@uhcl.edu

Introduction

- The State of Texas is in the process of validating environmental flow recommendations in an effort to maintain sound estuarine ecological environments.
- It is assumed that the primary mechanism regulating production in estuaries is the discharge of freshwater, creating an optimal salinity, nutrient & sediment gradients.
- This salinity gradient operates on a dynamic linear scale influenced by freshwater inflow & tidal forces.
- The objective of this study was to characterize the flow regime and assess the influence of freshwater inflow and tidal movement on water quality & nekton communities in the lower Brazos River

Study Area

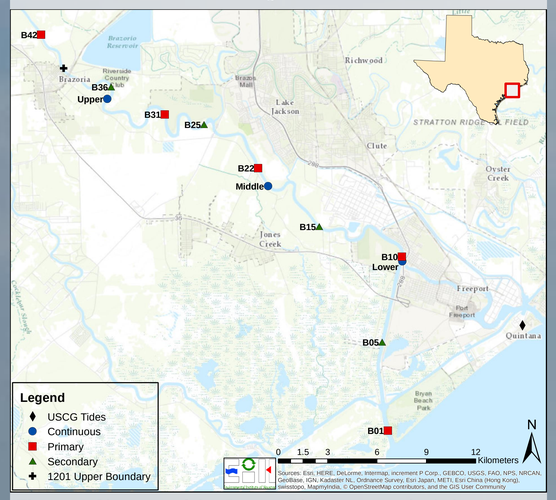

Figure 1:Site map of the Brazos River estuary depicting location of the upper boundary of segment 1201 (black cross), USCG tidal station (black diamond), and continuous, primary, & secondary sampling sites (blue circle, red square, & green triangle, respectively).

Methods

- Sampled from Nov 2014 – May 2015
- Discharge & Tides
  1. Freshwater inflow: USGS Gage #08116650
  2. Flow tiers: Brazos River BBEST/SB3 defined
  3. Tidal patterns: NOAA USCG station #8772447
- Water Quality
  1. Continuous monitoring – HOBO conductivity dataloggers at 3 sites (Upper, Middle, Lower)
  2. Water quality sampling – YSI multiprobe sonde
     - 8 events at 5 primary (B01, B10, B22, B31, B42) & 4 secondary sites (B05, B15, B25, B36)
     - Salinity & dissolved oxygen – depth profile @ surface, 25%, 50%, 75% & bottom (thalweg)
- Nekton Communities
  1. 8 events at 5 primary sites (Fig. 1)
  2. Four methods: electroshocking (ES), beam trawl (BT), otter trawl (OT), zooplankton tow
  3. Calculated: total # (N) & relative abundance (RA)

Results

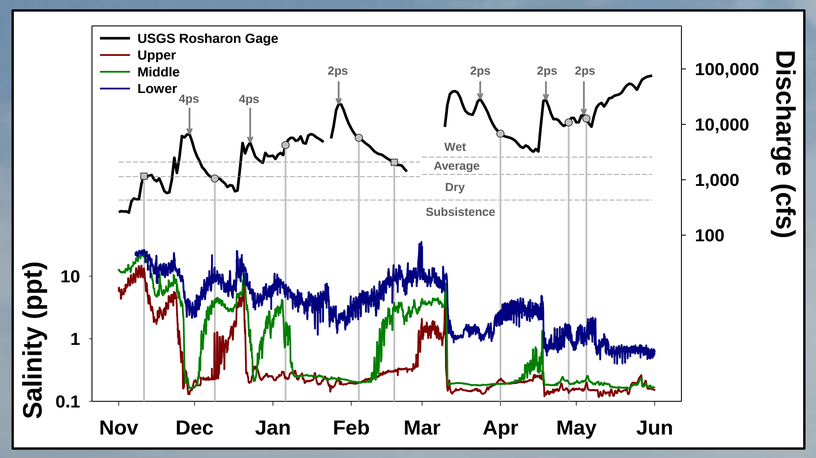

Figure 2: Continuous salinity (ppt) & discharge (cfs) monitoring on the upper, middle, & lower reaches of the Brazos River estuary from Nov 2014 – Apr 2015. SigmaPlot (ver. 11.2))

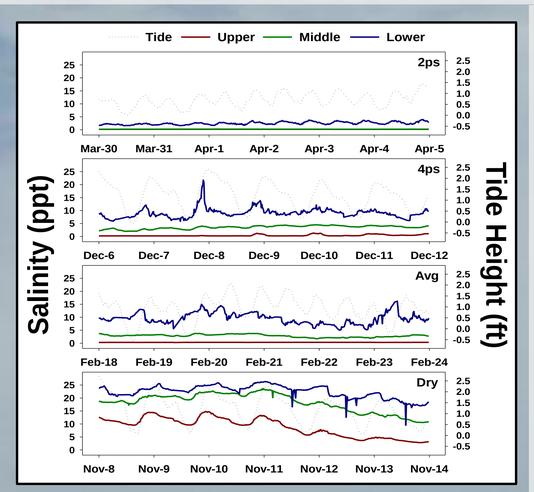

Figure 3: Continuous salinity (ppt) & tide height (ft) by flow tier on the upper, middle, and lower reaches of the Brazos River estuary (Nov 2014–Apr 2015). SigmaPlot (ver. 11.2)

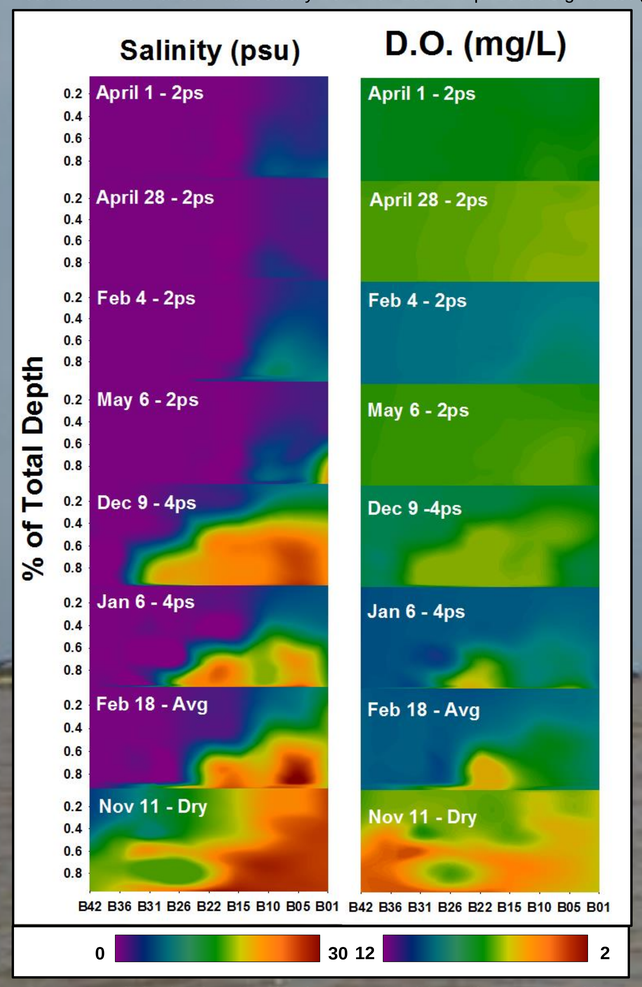

Figure 4: Salinity (psu) & dissolved oxygen (mg/L) profiles organized by flow tier for all sampling events at primary and secondary sites along the Brazos River estuary from Nov 2014 – May 2015. SigmaPlot (ver. 11.2).

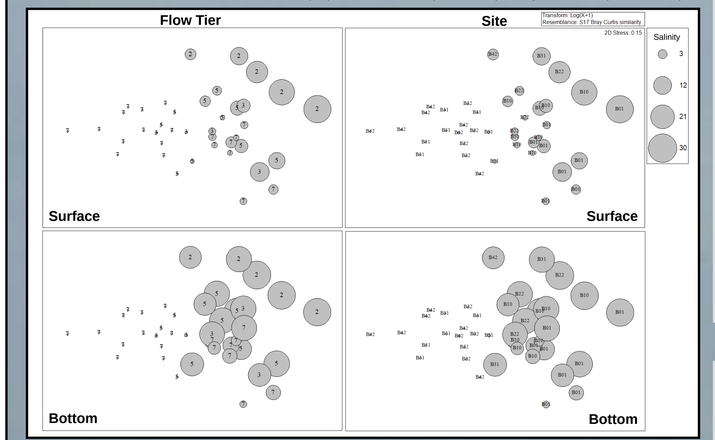

Figure 5: NMDS plots for nekton abundance from Nov 2014 – Apr 2015 (log+1 transformed w/ Bray-Curtis resemblance). Includes data for all sampling methods overlaid w/ 2D bubble using surface (top figures) & bottom (bottom figures) salinity (psu). Points labeled by flow tier category (left figures; 2 = dry base, 3 = avg., 5 = 4ps, 7 = 2ps events) & site number (right figures). PRIMER 6.

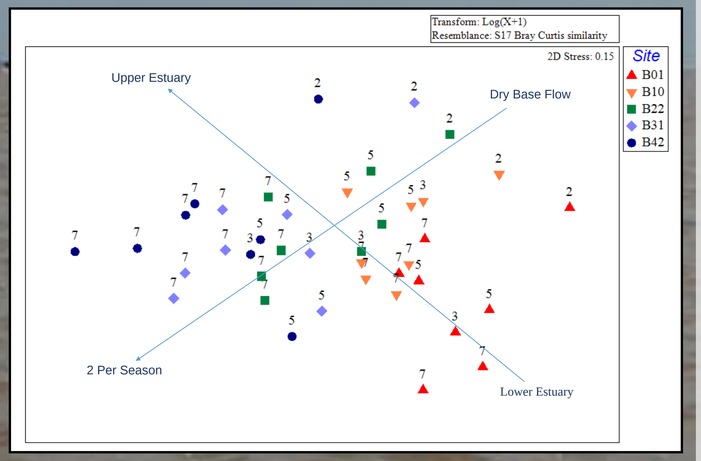

Figure 6: NMDS plots for nekton abundance from Nov 2014 – Apr 2015 (log+1 transformed w/ Bray-Curtis resemblance). Includes data for all sampling methods Points labeled by flow tier category (2 = dry base, 3 = avg., 5 = 4ps, 7 = 2ps events) & site number. Relationships by flow tier (top right to bottom left) and site location (bottom right to top left) are shown w/ general trend lines. PRIMER 6.

Flow & Tidal Continuous Monitoring

- In the upper & middle portions of the estuary, flows exceeding 2-3,000 cfs & 3-4,000 cfs, respectively, were sufficient to prevent tidal influence (Fig. 2)
- During dry base flow observed tidal fluctuation was greatest, during 2ps events observed fluctuation was smallest (Fig. 3)

Water Quality Sampling

- Surface and bottom pH readings at all sites remained relatively stable, though lowest values recorded during 4ps flow conditions (bottom) and highest values recorded during avg. flow conditions
- Dissolved oxygen values from all depths differed across all four flow tiers and did not exhibit significant differences between sites, but, levels of concern were observed during the Nov 2014 dry event (Fig. 4)

Nekton Communities

- Collected a total of 21,024 individuals from 79 species
- Most abundant species: *Micropogonias undulatus* (N = 8,194; RA = 39%) & *Brevoortia patronus* (N = 5,463; RA = 26%)
- Total catch highest during winter/spring sampling events & lowest immediately after 4ps & 2ps flow events
- The majority of species captured (65%) were classified as estuarine dependent
- Proportion of estuarine species differed by flow tier & site and exhibited significant interactions
- Nekton MDS plots overlaid w/ surface & bottom salinities documented salinity thresholds existed by depth (Fig. 5)
- NMDS plots of abundance showed clear trends for flow tier & site w/ factors clustering in opposing linear gradients (Fig. 6)

Conclusions & Future Work

- Broad-scale patterns in water quality depended upon timing, magnitude & duration of freshwater inflow.
- Salinity levels responded predictably to high flow events along the sampling reach; tidal influence most evident on tapered end of the salinity wedge.
- Location of the salinity wedge relative to size of inflow event and timing within the hydrograph; depressed DO conditions usually occurred on the bottom near the leading edge of the salinity wedge.
- Increased catch in winter/spring events may be due to winter spawning and recruitment of *M. undulatus* and delayed spawning of *B. patronus.*
- Assemblages sampled under higher flows (4ps/2ps) tended to exhibit greater spatial gradients while communities sampled on the low end of hydrograph appeared more similar across the estuary likely due to many influences, including location of the salt wedge, “flushing” effects of high flows, or nekton seeking refugia to avoid higher velocities.
- This study illustrates that the combination of freshwater inflow & spatial distribution affect nekton communities and emphasizes that these two factors cannot be considered independently.
- Continued monitoring of flow, water quality, & nekton communities ongoing & scheduled through July 2017.

Acknowledgments

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