Hydrological Restoration of Rincon Bayou, Nueces Marsh

Paul Montagna, Crystal Chaloupka, Elizabeth DelRosario, Amanda Gordon, Terry Palmer, and Evan Turner

Drought - 4 Apr 96

Flood - 2 Jul 97
Prelude

- Data presented here originates from many projects funded by BOR, CCC, CBBEP TWDB, and HRI
- This presentation is based on Final Reports to CBBEP and TWDB:
Nueces Estuary

- Near Corpus Christi, Texas
- Semi-arid climate, water shortages in dry years
- Reverse estuary
Nueces Basin is about 4.3 million ha
1982: Choke Canyon Dam (CC)

700,000 acre-ft storage capacity
(Basin total of ~1,000,000 acre-ft).
Hydrologic Restoration

- 1996-2000 – Nueces Overflow Channel
  - Small bit of water decreased salinity and increased estuary structure and function
- 2000 – Channel closed
- 2001 – Channel opened

Salinity Gradient in Components After Channel Closure:

- **Delta**: 21-28
- **River**: 0-1
- **Bay**: 15-30
- **Gulf**: 30-36
2009 - City of Corpus Christi completed construction to pass-through the first 3,000 acre-ft (3,700,440 m³) per month from the Calallen Pool to Rincon Bayou
Conversion to a Positive Estuary

- The salinity gradient = upstream (NUDE2) - downstream (SALT03)
- Negative estuary condition
  - Salinity at SALT03 < Salinity at NUDE2
- Positive estuary condition
  - Salinity at SALT03 > Salinity at NUDE2
Pumping, Flow, Salinity

- Initially flow went upstream
- Backflow preventer added July 2014
- Washed out July 2015
Long-Term Salinity Change

- Previous hypersaline conditions reduced since 2009 when pump began operation.

Rincon Pipeline Pumping
Benthic Epifauna Diversity

- Diversity is low because of frequent salinity swings, which cause disturbances
Epifauna Communities

- Push nets used to sample fish and invertebrates
- Salinity gradient from left to right
  - Skipjack at lowest salinity and sheepshead at highest

A-917= *Elops saurus* (skipjack), B-912= *Brevoortia patronus* (menhaden),
C-910= *Menida beryllina* (silverside), D-915= *Cyprinodon varigatus* (sheepshead minnow)
Benthic Infauna Diversity

- Sediment cores for infauna
- Only 12 infauna species total, compared to 100’s in the bay
- Average about 4 per sample date
Infauna Community Structure

- Chironomid larvae dominate when salinity is low, and *Streblospio benedicti* dominate when salinity is high.
Benthic Infauna Diversity

Turner and Montagna (2016) Max Bin Method

- Diversity peaks with salinity between 4 psu and 10 psu
- Diversity peaks with water depth around 10 cm
Calculate Optimal Salinities

Turner and Montagna (2016) Max Bin Method
IN PRESS

<table>
<thead>
<tr>
<th>Metric</th>
<th>Chironomidae larvae</th>
<th>Streblospio bendicti</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abundance</td>
<td>1.3 psu, 9 cm</td>
<td>13.5 psu, 12 cm</td>
</tr>
<tr>
<td>Biomass</td>
<td>1.8 psu, 8 cm</td>
<td>14.1 psu, 12 cm</td>
</tr>
</tbody>
</table>
Modelling Benthic Communities

- Predicting species responses from physical changes in Rincon Bayou
- 65% to 81% accuracy
Calculate Flow Needed to Maintain Salinity
Optimal Pumping

- Pumping controls salinity and water depth
- Based on indicators, 0.41 m³/s (29 ac-ft/day) would maintain optimal salinity and depth for bioindicators
Conclusions

- Rincon Bayou is a disturbed environment exhibiting low diversity and constant community state shifts with wet and dry periods.

- While hydrological restoration has helped Rincon Bayou, more changes are necessary:
  - Inflows should be a trickle, not a flood.
  - Releases should be continuous and not haphazard.
  - Specifically:
    - Only one pump should be used at a time, which will take about 24 days (at 126 ac-ft/d) to deliver 3,000 ac-ft/month.
    - Releases should not be timed for end of month because that requires 3 pumps over a short time period making floods worse.
    - Releases should not be dependent on pass-through requirements because you need them most during dry periods.
Acknowledgements

- Coastal Bend Bays & Estuaries Program
- Texas Water Development Board
- Harte Research Institute
- Too many colleagues, students, postdocs, and technicians to mention since 1994