Drought and Construction Techniques Influence Ecosystem-Level Restoration of a Brackish Marsh

Anna R. Armitage, Chuan-Kai Ho, Eric N. Madrid, Michael T. Bell, Erin Kinney, Antonietta Quigg

Department of Marine Biology, Texas A&M University at Galveston

Results

Emergent plants:
- Classification success decreased from 88.9% in 2009 to 80.6% in 2011
- By 2011, there was more overlap among habitat types, but restored areas converged on each other and diverged from the reference site

In 2009, discriminant function 1 (70.0% of the variability) was most strongly related to plant cover, and function 2 (28.2%) was related to belowground biomass. In 2011, discriminant function 1 (64.7%) was most strongly related to belowground biomass, and function 2 (31.5%) was related to plant cover.

Soil characteristics:
- Classification success decreased from 87.5% in 2009 to 76.5% in 2011
- By 2011, there was more overlap among habitat types, but restored areas converged on each other and diverged from the reference site

In 2009, discriminant function 1 (59.0% of the variability) was most strongly related to soil phosphorus content, and function 2 (34.7%) was related to soil nitrogen, sand, and organic contents. In 2011, discriminant function 1 (64.1%) was only significant function, and it was most strongly related to benthic fucoxanthin and chlorophyll a concentrations.

Water characteristics:
- Classification success increased from 40.6% in 2009 to 70.4% in 2011
- Less overlap among habitat types; restored areas diverged from the reference site

In 2009, there were no significant discriminant functions. In 2011, discriminant function 1 (65.6% of the variability) was most strongly related to suspended solids and water column chlorophyll a concentration.

Conclusions & Implications
- At the emergent plant level, each construction approach successfully yielded at least some plant characteristics that were similar to the reference site, demonstrating that brackish marsh restoration is achievable on the short-term.
- As the suite of measured variables increased in complexity, the dissimilarity between the reference and restored sites increased.
- Marsh recovery does not appear to be on a trajectory towards reference conditions.
- At the ecosystem level, each of the restoration types was unique relative to the others, and none of them resembled the reference site.
- Drought impacts were minor for emergent vegetation, but caused high salinity and blooms of benthic and planktonic microalgae, possibly altering trophic pathways in the marsh.

Ecosystem-level analysis:
- Includes plant, soil and water characteristics
- 100% classification success throughout the study period
  - All habitat types were unique
  - None of the restored areas converged on the reference area
  - Even in drought conditions
  - Restored areas diverged from the reference site

Drought caused blooms of benthic diatoms in all habitat types, particularly the reference site

For detailed analysis of drought impacts on aquatic plants and animals, see Kinney et al., Thursday at 1:45pm, “Extreme Events” session

Acknowledgements

Many thanks to TGLO Research & Development and Coastal Management Programs for funding, Texas A&M for site access and logistical support, Omega-III for advice and guidance, and the crews of the Coastal Wetlands and Phytoplankton Labs at TAMUG for field assistance.