



**Defining restoration success:
Development of the plant canopy
and ecological functions
in a restored
brackish marsh**

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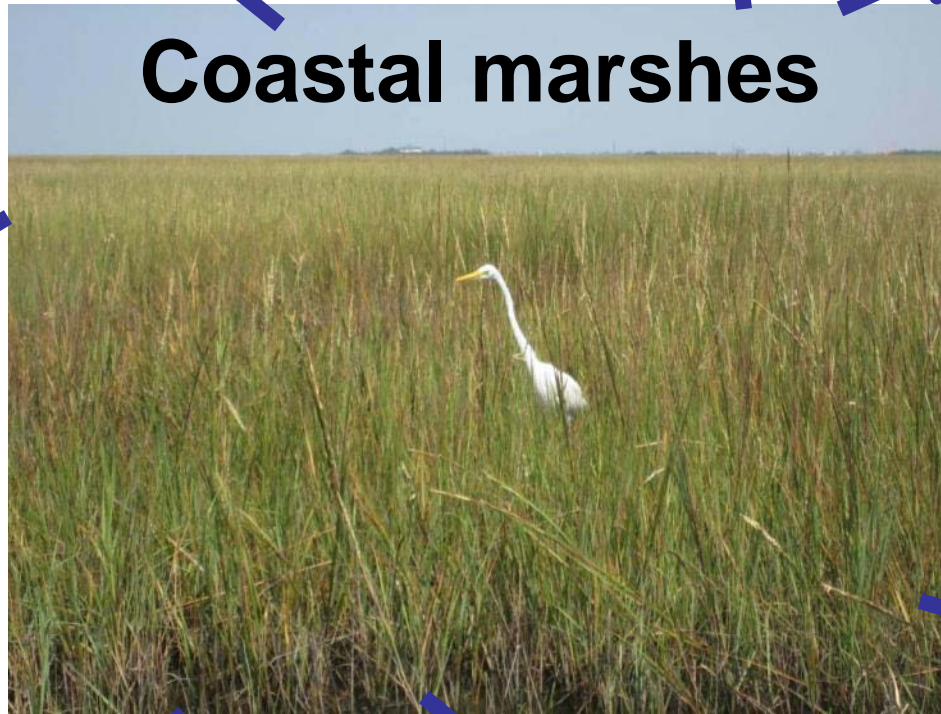
Photo from National Geographic

Unique plants and animals

Nursery habitat



Filter pollutants, recycle nutrients

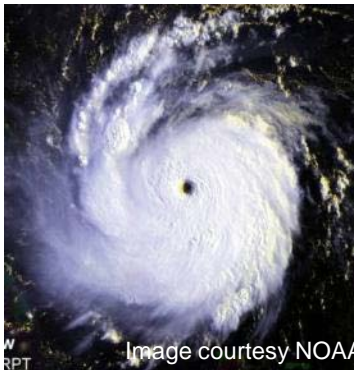


Coastal marshes



Carbon sinks

Control erosion



Buffer storm and surge impacts

Recreation: bird watching, fishing



Restoration two-step



1. Create appropriate elevation



2. Add plants



Then what?

Hope that everything will stay alive

Apply the “Field of Dreams” policy: Build it and they will come

Does the field of dreams policy work?

1998

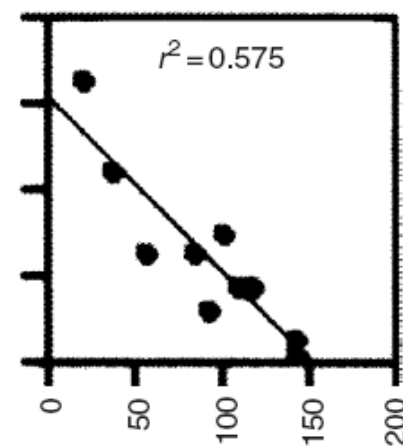
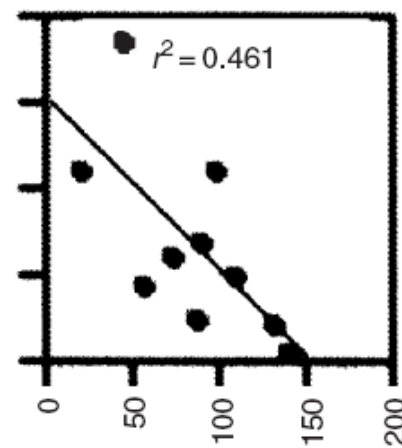
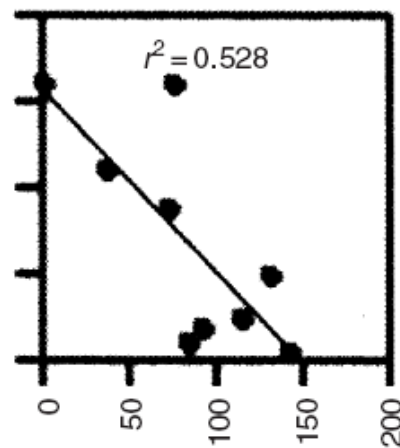
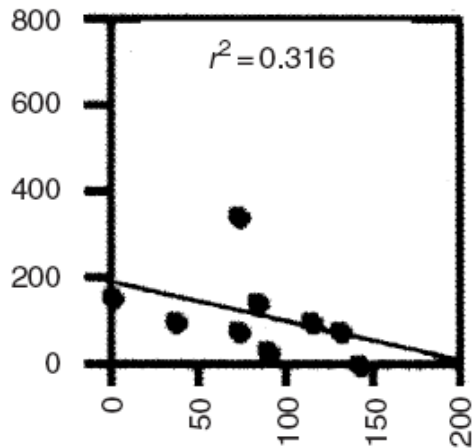
1999

2000

2001

Mudflat

Snails (m²)



Distance from the reference marsh (m)

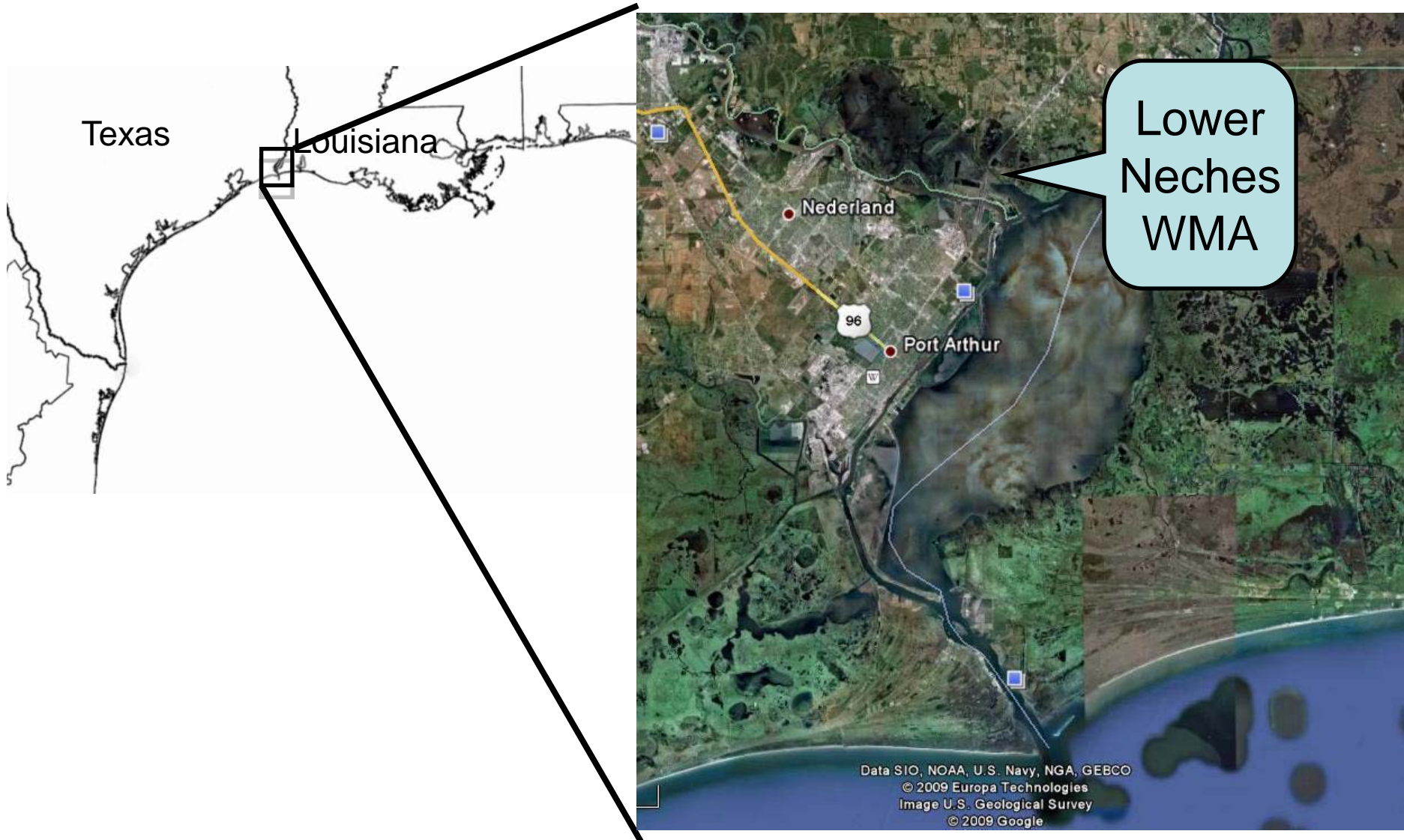
How can we design restoration projects to be more ecologically successful?

Approach: Modify construction design

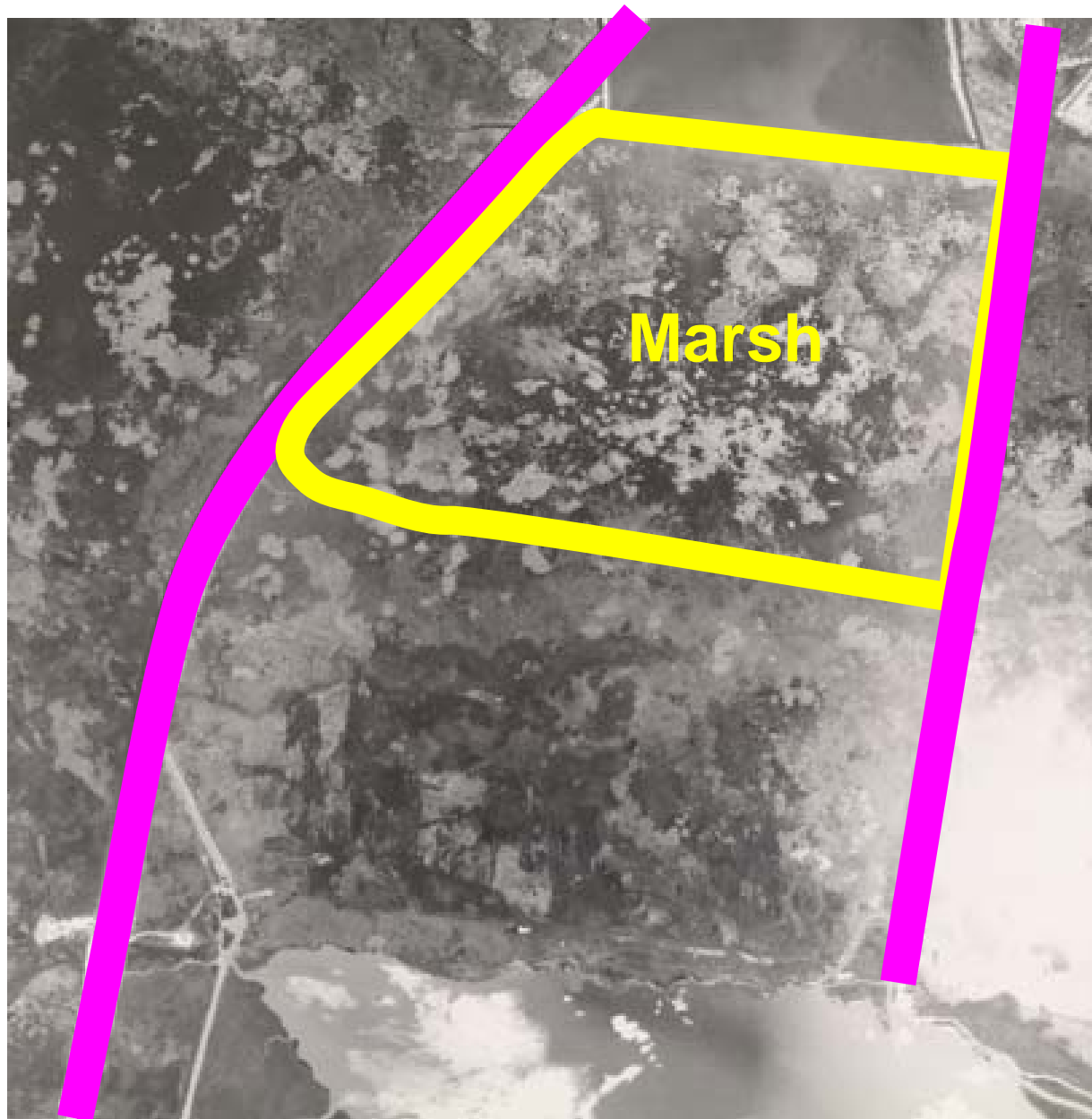
Objective: Evaluate the ecological success of different construction approaches



Lower Neches Wildlife Management Area



Lower Neches Wildlife Management Area



1953

Lower Neches Wildlife Management Area



2006

Lower Neches Wildlife Management Area



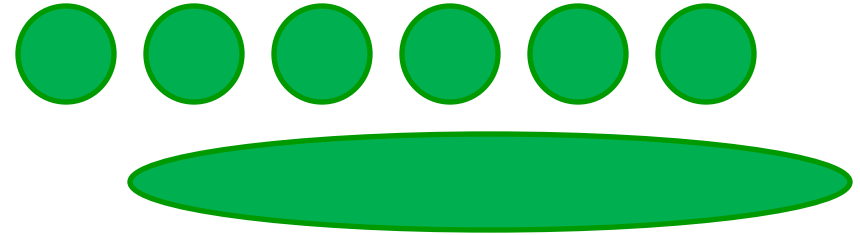
**Restored
marsh**

**Reference
marsh**

2008

Two structural designs:

- Heterogeneous
- Homogeneous



Three soil sources:

- Adjacent benthic soil
- Upland dredge material
- Recent benthic dredge material

Three water depths:

- <0.5 m
- ~1 m
- ~2m

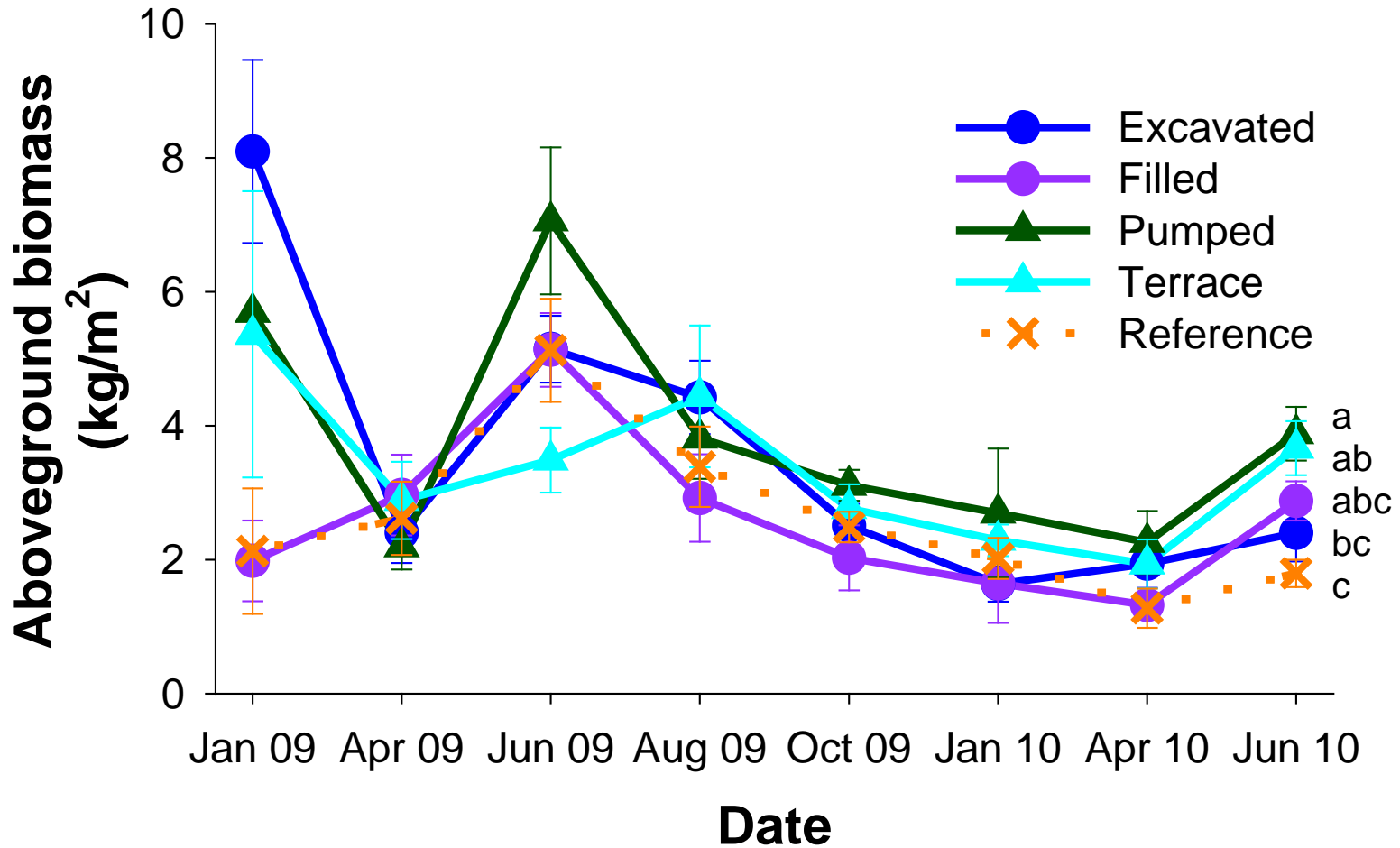
- All structures were planted with the Vermilion strain of *Spartina alterniflora*
 - Vigorous growth
 - Genetically identical
 - Low seed germination success
- Why this species?
 - Goals included:
 - Rapid development of sustainable plant canopy
 - Resistance to salt (to withstand tidal inundation and storm surges)
- Monitoring program – how do construction designs perform at community and ecosystem levels?



Vegetation established quickly

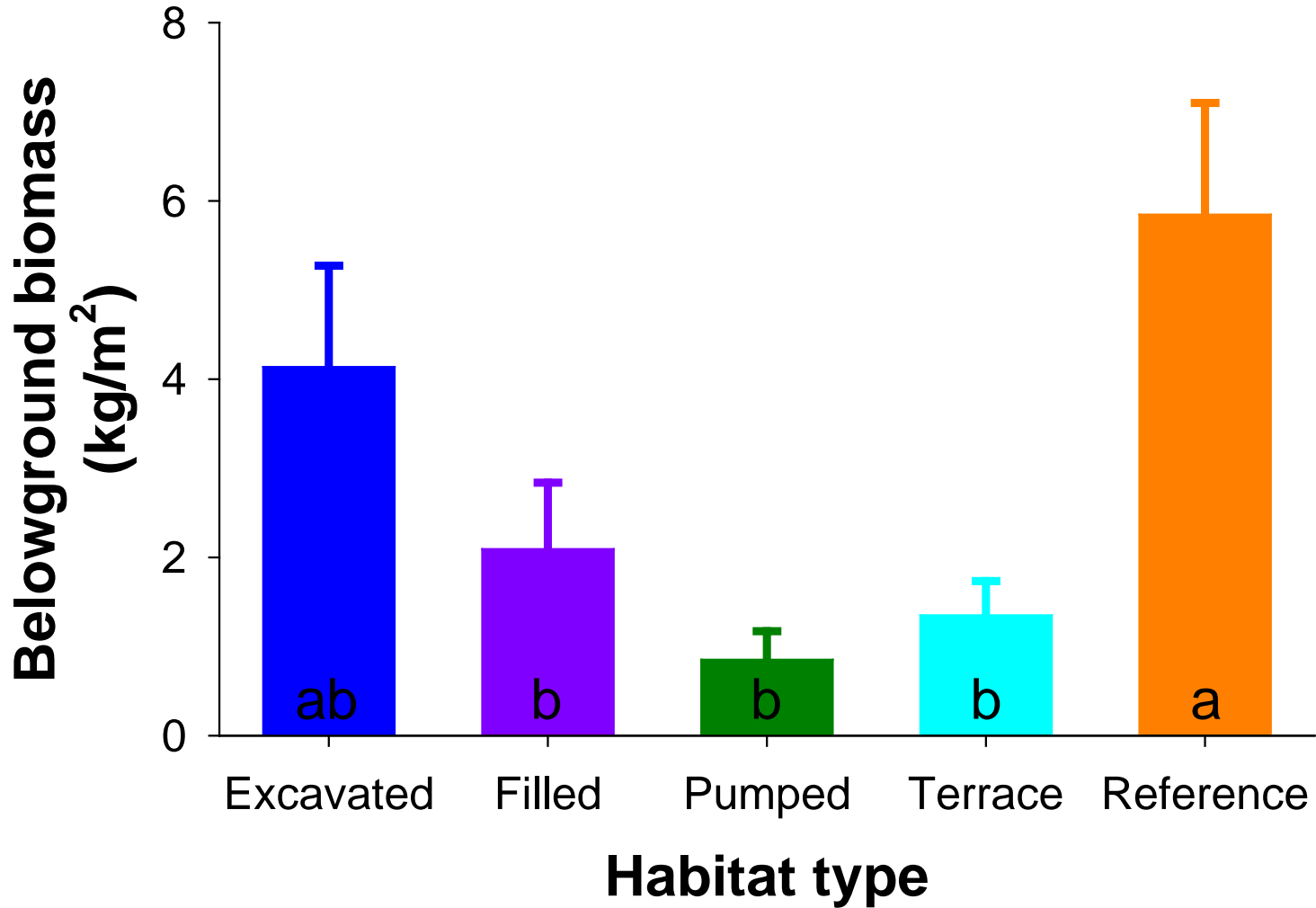


Restored marshes are similar to reference marshes in some ways

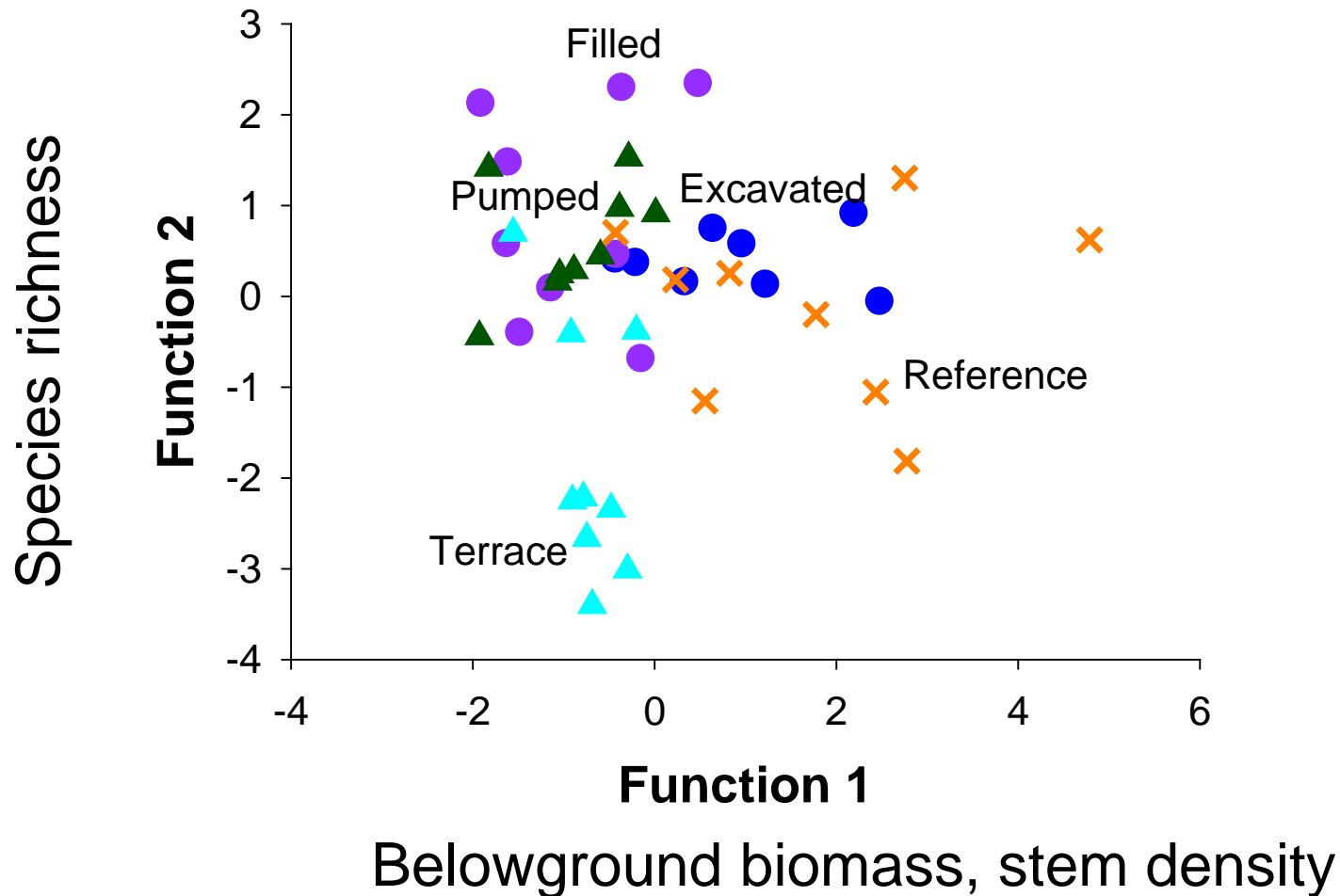


Similar to percent cover and *Spartina* leaf nitrogen: phosphorus ratios

One important difference...

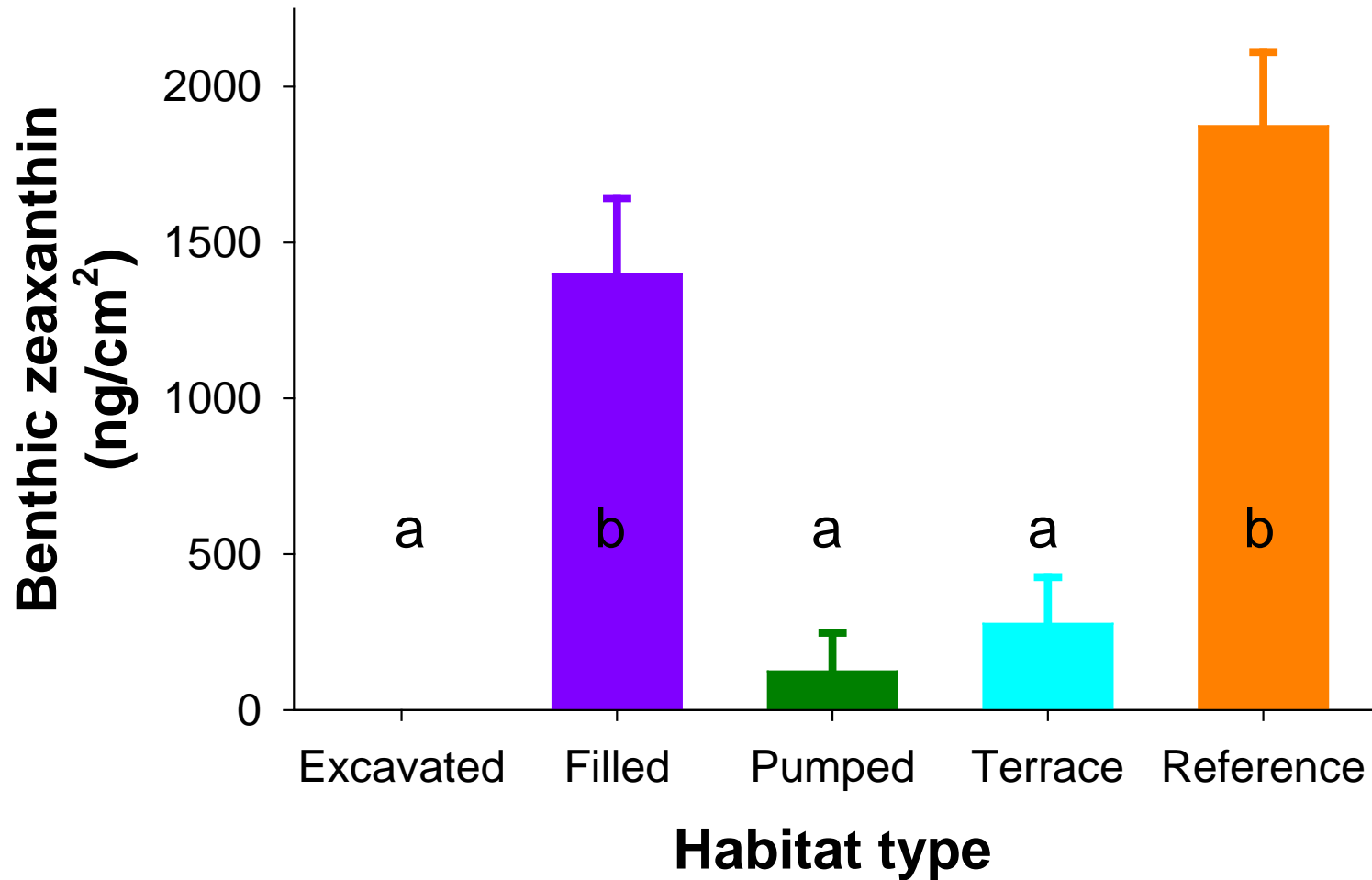


Emergent plant metrics suggest reference and restored areas are similar

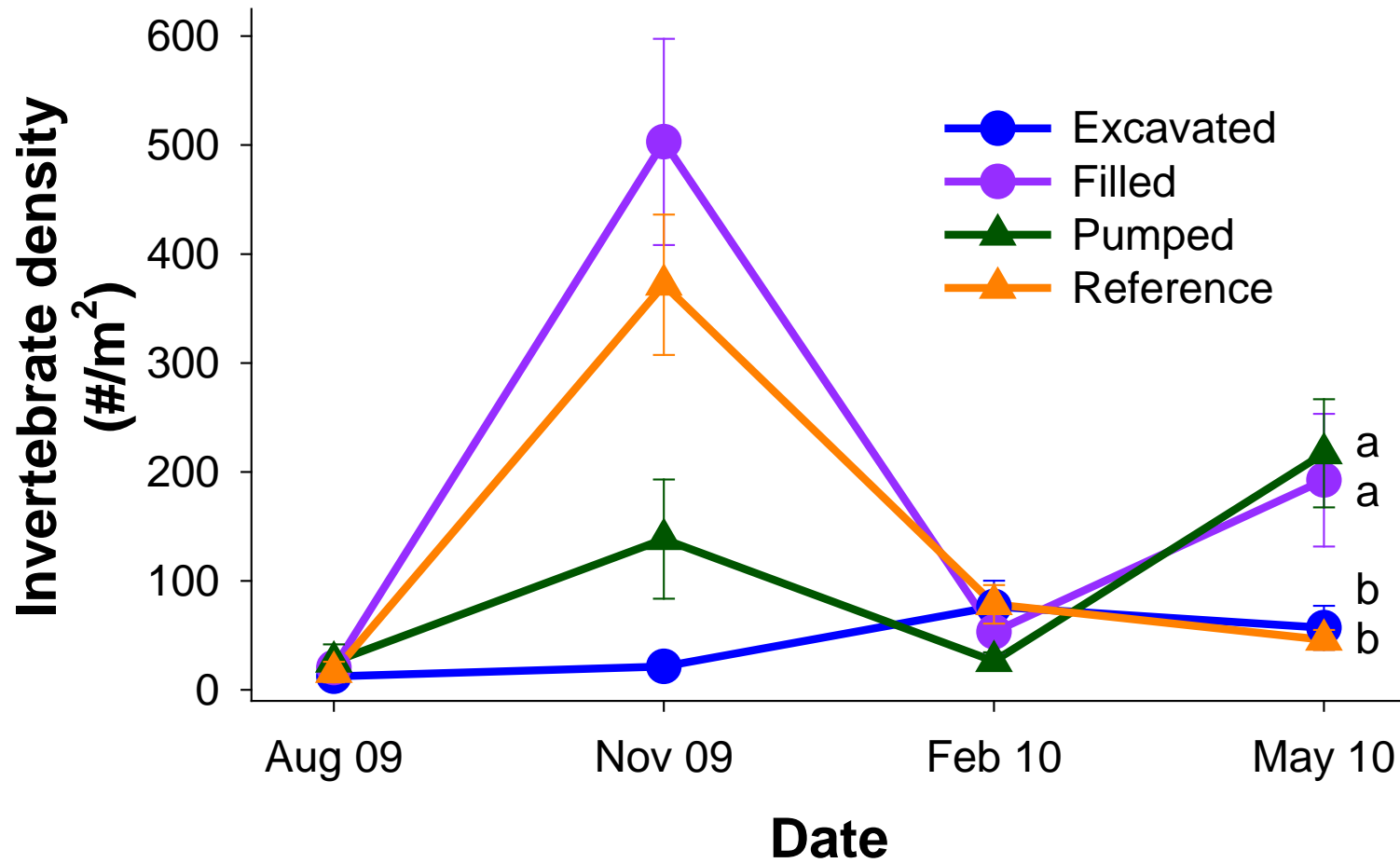


Looking a little closer...

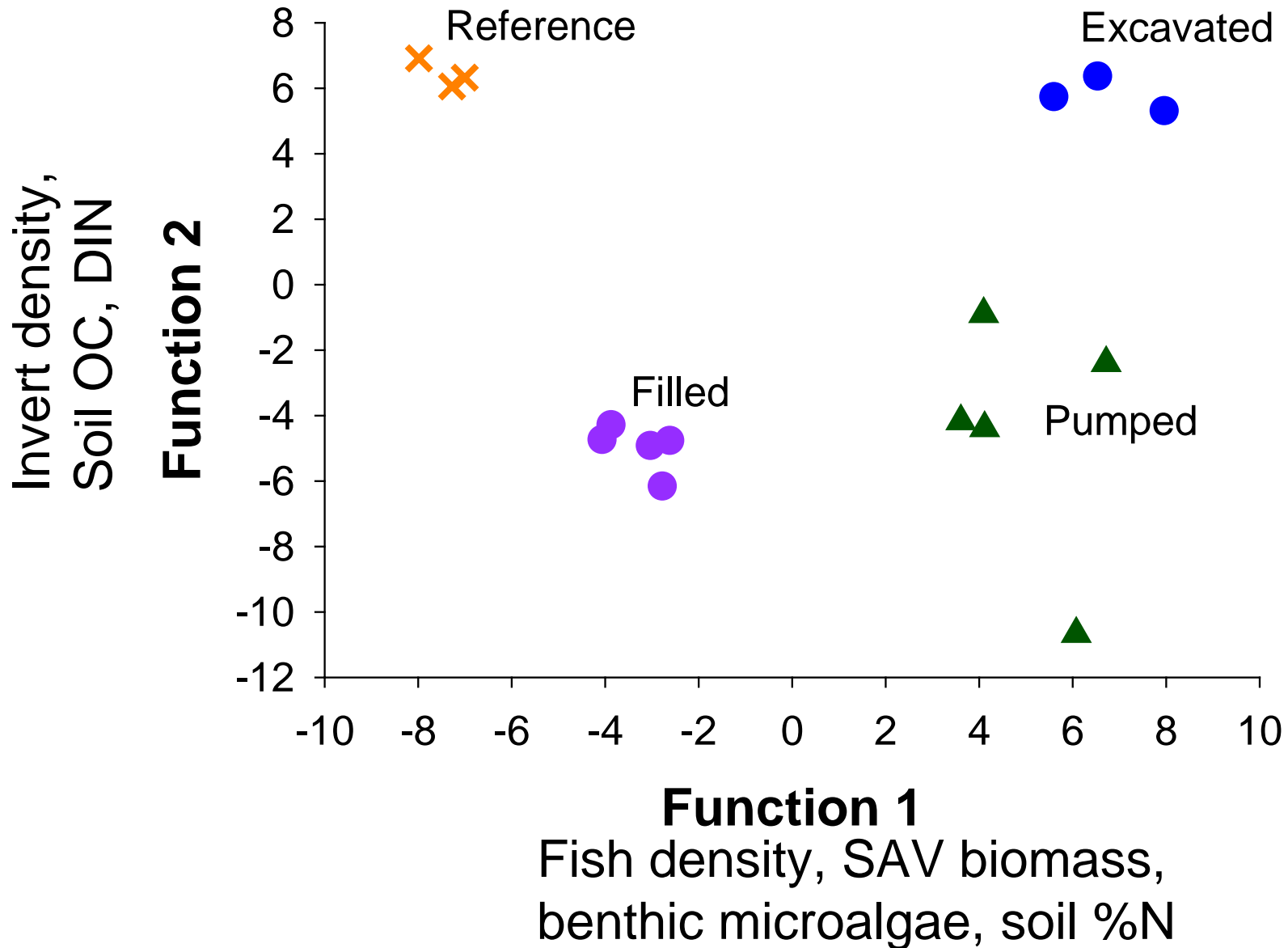
Soil characteristics are different



The aquatic community introduced further complexity



The aquatic community was unique in each area



So far...

- At the emergent plant level, all restoration methods performed similarly to each other and to the reference site.
- As the suite of measured variables increased in complexity, the dissimilarity between the reference and restored sites increased.
- At the ecosystem level, each of the restoration types was unique relative to the others, and none of them resembled the reference site.

Is there an interaction between planting and construction approaches?





Excavated mounds:
Cordgrass stems
up to 2 m tall

Late summer 2008:
Mound shape can't
sustain tall plants →
widespread mortality
in winter 2008



October 2008



April 2010

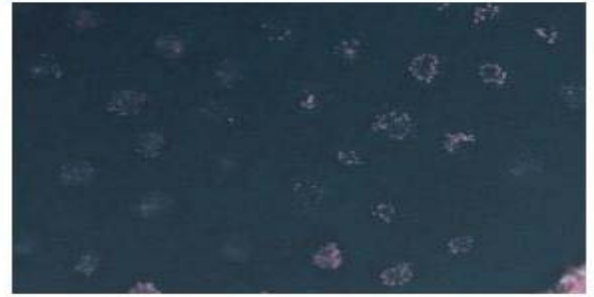
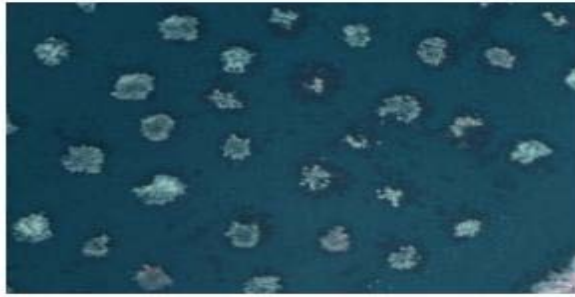
Erosion along sides
of mounds?

Intense intraspecific
competition for light
or nutrients?

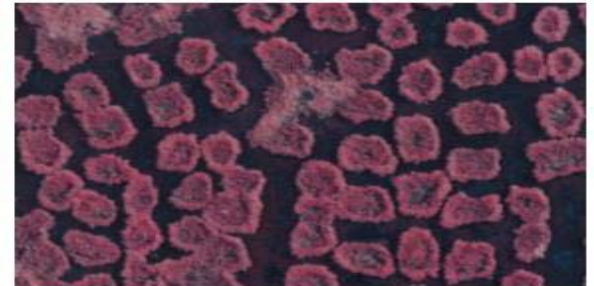
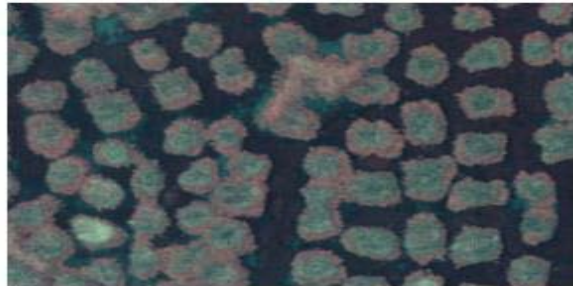
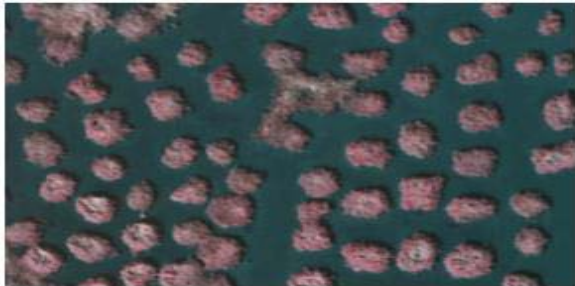


Plant mortality varied among construction approaches

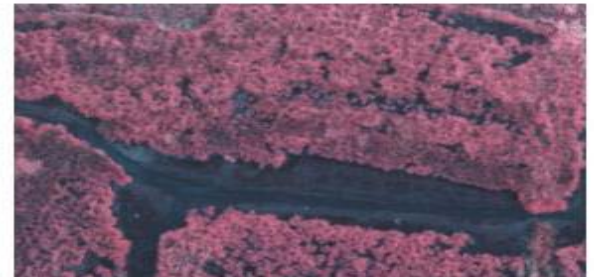
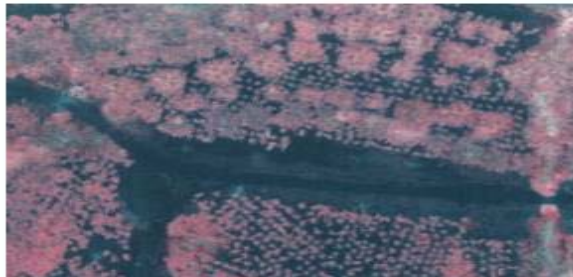
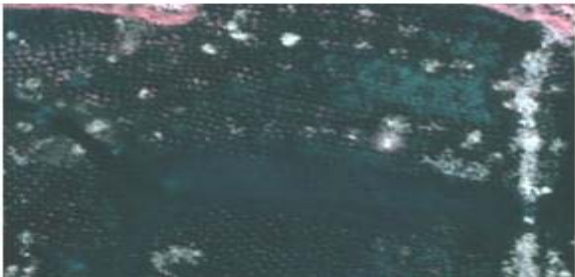
Excavated mounds: steep sides, deep water



Filled mounds: gradual slopes, shallow water



Pumped mounds: small and large mounds, shallow water



2008

2009

2010

Implications

- Planting and construction approaches are both influential
- Rapid plant recovery may not lead to reference marsh composition
 - Some structural attributes approach reference values, others fall short
 - What functional aspects are altered? Food web support? Carbon sequestration?
 - Continue monitoring to document temporal patterns + experiments to evaluate functional developments
 - Add a site with natural plant recruitment later this year

Thanks!

Any questions?

- The Coastal Wetlands team at TAMUG
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- Chevron: Jim Myers and Jerry Hall

