Assisted Colonization of Coastal Communities

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Restoration and Climate Change

- “Moving targets”
  - Rate of change
  - Direction of change
- Anticipatory or futuristic restoration
- Dispersal limitation and landscape fragmentation
- How far into future can we restore?
## Relative Ease of Anticipatory Restoration

<table>
<thead>
<tr>
<th>Trajectory of Change</th>
<th>Rate of Change</th>
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</thead>
<tbody>
<tr>
<td>Linear</td>
<td>Slow, High, Moderate</td>
</tr>
<tr>
<td>Non-linear</td>
<td>Moderate, Low</td>
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<tr>
<td>No-analogue</td>
<td>?</td>
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</tbody>
</table>

- **Gulf of Mexico**

- **Slow**
- **Fast**

- **Linear**
- **Non-linear**
- **No-analogue**
Study Questions

• With removal of biotic filters, can dominant species from seaward communities establish and survive when introduced into landward locations?

• Can assisted colonization enable successful futuristic restoration and if so, how futuristic?
Sea Level Rise – NW Florida, USA

Pensacola, FL  2.10 +/- 0.26 mm/yr

Source: NOAA
Study Site – East River, Eglin AFB

- Estuarine gradient East Bay along East River - 5 locations
- Transect perpendicular to the river at each location; 0-3 m elevation change
- August 2011 – plots stratified across gradient and elevation (n = 135)
Dominant Species of Coastal Vegetation Zones

- Salt marsh: *Spartina alterniflora*
- Brackish marsh: *Juncus roemerianus*
- Fresh marsh: *Cladium mariscus*
- Upland forest: *Aristida stricta*
Field Methods

- Aug. 2011 – plot setup
  - Nine 4m² plots in each gradient/elevation combination (n = 135)
  - 3 control, 6 removal plots
  - Brush cutter/chainsaw + herbicide

- Nov. 2011 – plants harvested
  - 1350 individuals, 4 species
Field Methods

- Each species (n=10) planted in randomly selected subplot in each plot
- Surveys of plant condition and survival
Results

- *Aristida* had low survival; replanted but still low
- No statistical differences between control vs. removal
- Herbivory on *Spartina*
  - Indication of protection from herbivores in control plots
  - Evidence of deer and rodent activity
Summer 2012 – *Spartina* Results

- No effects of vegetation removal
- Gradient position effect ($F = 5.81, p = 0.0003$)
- Elevation effect ($F = 12.51, p < 0.0001$)
Summer 2012 – *Juncus* Results

- No effects of vegetation removal
- Gradient position x elevation interaction
  \((F = 3.09, p = 0.0033)\)
Summer 2012 – *Cladium* Results

- No effects of vegetation removal
- Gradient position x elevation interaction $(F = 7.61, p < 0.0001)$
Summary

• High initial survival; removal of vegetation had little effect on establishment and early survival.

• All species survived in their original zone and landward.

• *Spartina* survived in upland habitats but appeared susceptible to terrestrial herbivory.

• *Juncus* had high survival across a broad range of conditions.

• *Cladium* survival had declined by the second survey.
  • Several individuals were flowering in June 2012 in the upland pine forest.
Prescribed Burns 2013 & 2014
Is anticipatory restoration feasible?

- Yes, but...
  - Differing degrees depending on species and background environmental change
  - Novel species interactions (e.g., terrestrial herbivores and *Spartina*)
  - Disturbances in the “new environments”

- Rate and direction of underlying abiotic change are key drivers
  - Communities that are sequentially arranged along strong environmental gradients may be easiest
  - Lack of spatial contiguity may require assisted colonization

- Use of common futuristic garden experiments at natural ecotones in the landscape
Acknowledgements

- Matthew Abbott
- Adam Chupp
- Jesse Fruchter
- Diane Harshbarger
- Shishir Paudel