Restoration of oyster reefs and their ecological services in the Big Bend of Florida

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Big Bend oysters
reefs parallel to coast
mostly intertidal
low energy coast
low sediment supply
no barrier islands
Do coastwise reef chains keep nearshore salinities low?

YES! See Kaplan et al. Thursday 2:40 pm
2010
Lone Cabbage Reef
88% loss of offshore reefs
61% loss of nearshore reefs
50% loss of inshore reefs
In 30 years
3,000 year history
Degraded bars are still eroding

17 cm in 2 years
7 inches
Tolerance for brief periods of high growth and reproduction. Typical annual range of salinities:

- 0 = Fresh
- 5 psu
- 15 psu
- 20 psu
- 35 psu = Ocean

Feeding stops for brief periods. Predation and disease risk increase with salinity.
Trend towards less discharge per drop of rainfall in Suwannee basin

Annual discharge/annual rainfall
Suwannee River

1950 1970 1990 2010
Oyster reef feedback loops

Upstream freshwater usage

Increased salinity

Episodic mass mortality

Loss of substrate

No recruitment

1995

2010
We have lots of larvae and spat from inshore.

The spat cannot survive without places to hide.

They cannot recolonize a degraded oyster bar without added structure.
**Restoration hypothesis:** Durable substrate allows repeated recolonization of reefs following episodic mass mortality events, leading to increased resilience.

“Build it and they will come…… and go, and come, and go…..”
Limerock boulders installed
September 2013
Oyster Reef Building Blocks

Estimated 8,000 live oysters in a “damaged” clam bag and 0.15 yd$^3$ of cultch material
Oyster density

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Before/after</th>
<th>Treatment effect</th>
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</thead>
<tbody>
<tr>
<td>Control</td>
<td>64X increase</td>
<td></td>
</tr>
<tr>
<td>Restoration</td>
<td>157X increase</td>
<td>9.2X increase over control</td>
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Oyster- cemented seam between rocks
Restoration Success - oyster density

Historic

Restored

Data from LaPeyre et al. 2014
Ocean & Coastal Management 89:20-28

Bags: 25% of area, 52% of oysters
Elevations

- **Before**
- **After**

Control

- CNT3
- CNT4
- CNT7
- CNT8

Treatment

- TRT1
- TRT2
- TRT5
- TRT6
Birds/hour based on *tide-standardized* observations

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Control</th>
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<tbody>
<tr>
<td>Osprey</td>
<td>large</td>
</tr>
<tr>
<td>small</td>
<td>Gulls</td>
</tr>
<tr>
<td>Cormorants</td>
<td>eagles</td>
</tr>
<tr>
<td>Pelican</td>
<td>Terns</td>
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</table>

Oysters not yet established

Higher sites ARE more valuable
Monitoring blue crabs

7.5X increase in blue crab Density

Poor detection probabilities!

Trail cameras on poles
Conclusions

- Restoration with local materials can be accomplished in 1.5 years.

- Freshwater detention appears to be a major, novel ecosystem service of linear chains of reefs – see Kaplan et al. Thursday 2:40 pm.

- Building evidence that restoring reefs affects multiple trophic levels.

- Clear evidence of substrate limitation in the short term.

- Long term resilience in response to droughts?
Long term goal –

Rebuild reef chains

Retain fresh water

Increase estuarine resilience to reduced freshwater discharge