Coastal change and ecosystem services: towards a better understanding of ecosystem service resilience

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Watershed inputs

- Point sources
  - pervious (groundwater)
- Non-point sources
  - impervious (runoff)

increased nutrient and sediment delivery
The big question:

How can we keep people happy (i.e. continue to populate coastal watersheds) and at the same time preserve the health of our coastal waters?

1) understand changes in the system
2) characterize impacts on system’s health
3) develop cost-efficient ways to manage/palliate those impacts
4) educate people about all these problems
5) reach out to managers
Resiliency of coastal ecosystem services under human pressure

Kee’s Bayou, Big Lagoon, Florida
(Picture by Jason Stutes)
Nutrient loading
(Kg N ha\(^{-1}\) yr\(^{-1}\))

- State Park: 4.2 ± 0.6
- Kee’s Bayou: 25.7 ± 4.1
- Gongora: 27.7 ± 3.9

Dredging

- % shoalgrass: 64.5 ± 1.0
- 4.2 ± 0.4
- 0

Measurements of gross primary production, respiration, and net community production
Gross primary production

Respiration

Net production

System Integrated Benthic Rate (mg C m⁻² hr⁻¹)

Stutes et al. MEPS (2007)
Northern Gulf of Mexico
Semi-sheltered environment

Point Aux Pins

Gulf of Mexico

As shading increases and seagrasses are replaced with bare bottoms: not so-big-changes in net carbon uptake by the system?
Nutrient enrichment

Resiliency in habitat provision despite seagrass loss?
### Study Sites

<table>
<thead>
<tr>
<th>Site</th>
<th>Range</th>
<th>Mean (± SE)</th>
<th>Seagrass species</th>
<th>Fraction of perimeter bordered by marsh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spanish Cove</td>
<td>66.7 - 100.0</td>
<td>97.3 (± 1.9)</td>
<td>Tt, Hw</td>
<td>0.52</td>
</tr>
<tr>
<td>Kee's Bayou</td>
<td>66.7 - 100.0</td>
<td>92.0 (± 2.9)</td>
<td>Hw, Rm</td>
<td>0.67</td>
</tr>
<tr>
<td>State Park</td>
<td>33.3 - 100.0</td>
<td>83.3 (± 5.0)</td>
<td>Hw</td>
<td>0.44</td>
</tr>
<tr>
<td>Langley Point</td>
<td>33.3 - 100.0</td>
<td>83.0 (± 5.3)</td>
<td>Tt, Hw</td>
<td>0.83</td>
</tr>
<tr>
<td>Joe's Site</td>
<td>0.0 - 60.0</td>
<td>17.7 (± 4.2)</td>
<td>Hw</td>
<td>0.53</td>
</tr>
<tr>
<td>Gongora</td>
<td>0</td>
<td>0</td>
<td></td>
<td>0.41</td>
</tr>
</tbody>
</table>
Seine Abundance

Pinfish: High seagrass-association

<table>
<thead>
<tr>
<th>Date</th>
<th>Lagoon</th>
<th>D x L</th>
</tr>
</thead>
<tbody>
<tr>
<td>n.s.</td>
<td>n.s.</td>
<td>≤ 0.001</td>
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<tr>
<td>n.s.</td>
<td>n.s.</td>
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</tr>
<tr>
<td>≥</td>
<td>LP=SP=JS=G</td>
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</tr>
</tbody>
</table>
Similar outcome for all other species with reported high/moderate benthic structure association:

- Blue crab
- Grass shrimp
- Clown goby
- Spotfin mojarra
- Rainwater killifish
- Darter goby
- Code Goby
- Inland silverside
Resiliency in habitat provision despite seagrass loss?...may be the case
Other studies have found species associated with submerged benthic structure also on marsh platforms and escarpments.

Point aux pines
- Species
  - Blue crab
  - Penaeid shrimp
  - Spot
  - Bay anchovy
  - Darter goby
  - Killifish

Little Bay
- Species
  - Pinfish
  - Bay anchovy
  - Inland silverside
  - Killifish
  - Darter Goby
  - Blue crab
  - Penaeid shrimp
  - Grass shrimp

West et al. (In prep)  Sharma et al. (In prep)
Increasing watershed development

sometimes not big reductions in habitat value and net carbon uptake?
The big question:

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Coastal ecosystem service resiliency despite seagrass loss
The big question:

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Coastal development and seagrass loss do not have to be necessarily “bad”: more amplitude for management actions \(\rightarrow\) compromise decisions for greater good (or lesser evil)
and a bunch of thanks to:

- many, many people
- the benefactors