The Influence of Nutrients on the Sustainability of Coastal Wetlands

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That photo of the cutgrass from the eastern side of 4 that I remember being open water 3 years ago.
When flood durations in the Atchafalaya exceeded 50%, wetlands converted to mudflats (Shaffer et al. 1992. J. Ecology 80, 677-687)

Caernarvon Diversion
Nutria
Nutrients Bad for Wetlands

Morris and Bradley 1999

Darby and Turner 2008a,b

Swarzinsky et al. 2008

Wigand et al. 2009

Deegan et al. 2012

Kearney et al. 2011
Nutrients Good for Wetlands

Haines and Dunn 1976
Valiela et al. 1976
Haines 1979
Buresch et al. 1980
Craft et al. 1995
Stevenson and Day 1996
Shipley and Meziane 2002
Shaffer et al. 2003, 2009
Daoust and Childers 2004
Day et al. 2004, 2006
Ravit et al. 2007
Taylor et al. 2007
Hunter et al. 2009
Hillmann 2011
Priest 2011
Anisfield and Hill 2012
Zhang et al. 2013
Fox et al. 2012
Nyman 2014
Merino et al. 2010
15 Sources, see Morris et al. 2013

\[ Y = aX^{-b} \]

\[ Y = 100 \left( \frac{X_{\text{max}}}{X} - 1 \right) \]

where \( X_{\text{max}} = 2500 \)
Water Quality

Total Aboveground Biomass (g/m²)
Did Nutrient-Loading Have a Negative Impact on Belowground Biomass?
Root to Shoot by Water Quality

**F**$^{3,132}$ = 16.92  p < 0.001
Linear contrast F$^{1,132}$ = 44.52  p < 0.001

- **0 ppt**
- **0F**
- **3 ppt**
- **6 ppt**
Below Ground Biomass Production by Water Quality

Below Ground Biomass (g/m²)

<table>
<thead>
<tr>
<th>Water Quality</th>
<th>Biomass (g/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh</td>
<td>A</td>
</tr>
<tr>
<td>Fert</td>
<td>B</td>
</tr>
<tr>
<td>3ppt</td>
<td>A</td>
</tr>
<tr>
<td>6ppt</td>
<td>A</td>
</tr>
</tbody>
</table>

F = 36.811, P = 0.000001
Elevation Change Across Water Quality

- Water Quality: 0 ppt, 3 ppt, 6 ppt
- Elevation Change (cm): -2, 0, 2, 4, 6, 8

Statistical Analysis:
- $F_{3,130} = 32.48 \quad p < 0.001$
- Linear contrast $F_{1,130} = 18.52 \quad p < 0.001$
0 ppt with Nutrients, Throughput vs. 6 ppt, Mesic
Effect of fertilization on cypress

Production (g/m²)

Fertilizer Level (gN m⁻² yr⁻¹)

F = 8.104  p < 0.0001

Above tree production
Below tree production
Bonnet Carré Floodway
- Cs-137 Accretion
- 2.8 cm/yr
- Bulk density 1.0

LaBranche Wetlands
- Cs-137 Accretion
- 0.38 cm/yr
- Bulk density 0.2-0.3
Core EL06N (Bonnet Carré)

2.3 mm/yr, mean height 22 m

Core LB02E (LaBranche)

1.4 mm/yr, mean height 17 m
Caernarvon 1927

SEDIMENTATION FROM THE GREAT 1927 MISSISSIPPI FLOOD: IMPLICATIONS FOR DELTAIC SUSTAINABILITY
Soil Cores

Post-1927 flood

Pre-1927 flood

1927 clay layer
The layer ranges up to 74 cm thick and extends over 10 km into the basin covering approximately 180 km².

Changes in sedimentation rates were 0.20 cm/yr before the flood and 0.05 cm/yr thereafter.
PEARL RIVER – (EYE OF KATRINA)

INTACT CYPRESS

FALLEN OAKS
## Diameter Increase of Mature Baldcypress at Different Locations

<table>
<thead>
<tr>
<th>Location</th>
<th>Diameter Increase (cm/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maurepas</td>
<td>0.0</td>
</tr>
<tr>
<td>Outfall</td>
<td>0.2</td>
</tr>
<tr>
<td>Joyce Edge</td>
<td>0.4</td>
</tr>
<tr>
<td>Joyce Interior</td>
<td>0.6</td>
</tr>
</tbody>
</table>

\[ F = 111.378, \ P < 0.000001 \]
PUT IN PHOTO OF CURRENTLY HOW NURSERY LOOKS HERE!!!!!!

Admit that we didn’t know what was up on our first deployment and this is now how we do it!!!

Better to state that we use adaptive management on a weekly basis to combat weeds and alter hydrology.
Construct ten large sediment diversions; open two per year.

Construct assimilation wetlands in degraded marshes.

Plant freshwater portions of both with cypress and tupelo to convert carbon sources to huge carbon sinks.
Acknowledgements

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Wood Density Across Tree Species and Fertilizer Application

Fertilizer Dosage (g N m\(^{-2}\) yr\(^{-1}\))

<table>
<thead>
<tr>
<th>Density (g/cm(^3))</th>
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<tbody>
<tr>
<td>0.00</td>
</tr>
<tr>
<td>0.05</td>
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<tr>
<td>0.10</td>
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<tr>
<td>0.15</td>
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<tr>
<td>0.20</td>
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<td>0.25</td>
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<tr>
<td>0.30</td>
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<tr>
<td>0.35</td>
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<tr>
<td>0.40</td>
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<tr>
<td>0.45</td>
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<tr>
<td>0.50</td>
</tr>
<tr>
<td>0.55</td>
</tr>
<tr>
<td>0.60</td>
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</tbody>
</table>

baldcypress

tupelo

F\(_{5,132}\) = 3.38 \(p = 0.007\)

Fertilizer Dosage (g N m\(^{-2}\) yr\(^{-1}\))
Nutria Control!
Belowground Biomass (g/m²)

\[ F_{3,557} = 14.69, \ p < 0.00001 \]
a) "Reference Sites"
N uptake @ 40% of $V_{\text{max}}$

Tissue Weight (g)

Roots

Shoots

Time (days)

b) "Fertilized Sites"
N uptake @ 100% beginning on day 50

Tissue Weight (g)

Shoots

Roots
Belowground Biomass by Nitrogen Load

<table>
<thead>
<tr>
<th>Nitrogen Load (g N yr(^{-1}))</th>
<th>Belowground Biomass (g m(^{-2}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0)</td>
<td>0</td>
</tr>
<tr>
<td>(10)</td>
<td>200</td>
</tr>
<tr>
<td>(50)</td>
<td>400</td>
</tr>
<tr>
<td>(100)</td>
<td>600</td>
</tr>
<tr>
<td>(200)</td>
<td>800</td>
</tr>
<tr>
<td>(400)</td>
<td>1000</td>
</tr>
</tbody>
</table>

\[ F_{5,130} = 2.30 \quad p = 0.049 \]
Linear contrast \[ F_{1,130} = 9.33 \quad p = 0.003 \]
Hammond Assimilation Wetland

4- to 6-million gallons per day of disinfected, secondarily treated wastewater
Over 2,000 nutria killed