Canal Restoration in Monroe County
Benthic Monitoring Report

Jason Howard and James Fourqurean
Seagrass Ecosystems Research Lab
Florida International University

FKNMS Steering Committee Meeting
September 7th, 2016
Made possible by

Christian Lopes
MSc student

Sara Wilson
SERL Lab Manager
Made possible by

Townships
Homeowner Organizations
Individuals
About Us

http://seagrass.fiu.edu
jhowa033@fiu.edu
Quantifying species of seagrass, algae, sponges, corals
Eutrophication model

Explicit model of ecosystem behavior #1

Nutrient pollution will lead to changes in relative abundances of primary producers in a predictable way.
Using Seagrasses Tissue

C:N:P

$^{13}\text{C}/^{12}\text{C}$

$^{15}\text{N}/^{14}\text{N}$
Benthic Monitoring for Water Quality

Explicit model of ecosystem behavior #2

Nutrient pollution will shift N:P ratios of primary producers towards a taxon-specific “Redfield ratio”
Original 30 sites (1995)
17 sites in Dry Tortugas (2011)
10 sites for nearshore emphasis (2012)
5 sites for Everglades LTER (2000)
Sea wall
Animal surveys
Sediment Characteristics
Control

Treatment

25cm x 25cm randomly placed for benthic coverage

25cm x 25cm set sites for benthic coverage

10cm x 10cm randomly placed for canal wall coverage

Elemental ratio, stable isotope sampling
Monitoring Canals

19 canals (w/ 7 treatments)
5 Islamorada canals
## Effect on Seagrasses

### Thalassia testudinum

<table>
<thead>
<tr>
<th>Canal</th>
<th>0</th>
<th>10</th>
<th>50</th>
<th>100</th>
<th>250</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>29</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>132</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>137</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>147</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>148</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>263</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>265</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>277</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>278</td>
<td>1</td>
<td>0</td>
<td>0.5</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>282</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>287</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>288</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>290</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>293</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>472</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>476</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

### Halodule wrightii

<table>
<thead>
<tr>
<th>Canal</th>
<th>0</th>
<th>10</th>
<th>50</th>
<th>100</th>
<th>250</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>29</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>132</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>137</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>147</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>148</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>263</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>266</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>277</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>278</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>282</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>287</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>288</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>290</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>293</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>472</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>476</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Effect on Seagrasses

N:P
Effect on Seagrasses

Higher $^{15}\text{N}/^{14}\text{N}$ $\rightarrow$ More anthropogenic influence

<table>
<thead>
<tr>
<th></th>
<th>$\delta^{15}\text{N}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>South FL</td>
</tr>
<tr>
<td>Mean</td>
<td>2.0</td>
</tr>
<tr>
<td>$n$</td>
<td>78.0</td>
</tr>
<tr>
<td>SE</td>
<td>0.2</td>
</tr>
<tr>
<td>Median</td>
<td>1.8</td>
</tr>
<tr>
<td>Minimum</td>
<td>-2.2</td>
</tr>
<tr>
<td>Maximum</td>
<td>5.4</td>
</tr>
</tbody>
</table>
Sediment Density

Florida Bay Seagrass Sediment

Global Seagrass Sediment

Canals

$n = 695$

Mean = 0.84 ± 0.02

Median = 0.83

Minimum = 0.24

Maximum = 1.63

Canals

$n=2484$

mean = 1.03 ± 0.02

median = 0.92

range: 0.06 - 2.35
Sediment Organic Carbon

The image presents a box plot showing the distribution of total organic carbon (% of dry weight) for various locations, represented by codes such as C028, C029, C132, C137, C147, C148, C263, etc. Each box plot provides a visual representation of the range, interquartile range, and outliers for the organic carbon content at each location. The red line indicates the FL Bay Avg. (Florida Bay Average) for comparison.
Canal 29 – Key Largo
Canals 28 and 29

Two months after Opening

Vegetation Coverage (BB score)

q01 q03 q05 q07 q09

Canal 28
Canal 29
Canals 28 and 29

Density (g/ml)

FL Bay Median

Canal 28
Canal 29
1 yr after
Canals 28 and 29

Canal 28
Canal 29
3 mo. after
Canals 28 and 29

Canal 28
Canal 29
1 yr after
One year after Opening
Canal 266 - Before Dredging
Canal 266- After Dredging
Canal 266

![Graph showing depth changes in Canal 266 and Canal 263 (control).]
Canal 266

Density (g/ml)

- Canal 266 (Dredge)
- Canal 263 (control)
Canal 266

% Organic Carbon

- Canal 266 (Dredge)
- Canal 263 (control)
Canal 266

Before Dredging

After Dredging

150cm

150cm

40cm
Conclusions

-Most remediation Techniques are showing positive results on sediments
  -some on seagrass, algae and animals

-Care must be taken to preserve remediated canals

-Canals are affecting adjacent waters
  Further sampling required to assess the effects of remediation on adjacent waters
http://seagrass.fiu.edu
jhowa033@fiu.edu