

FKNMS

Benthic Habitat Monitoring Program



Goals for the project

As originally envisioned, the goal was to address these points at the regional scale:

- Define the present distribution of benthic communities within the FKNMS
- Provide high-quality, quantitative data on the status of the seagrasses within the FKNMS
- Quantify the importance of seagrass primary production in the FKNMS
- Define the baseline conditions for the seagrass communities of south Florida
- Determine relationships between water quality & benthic community status
- Detect trends in the distribution and status of the benthic communities

Information being collected

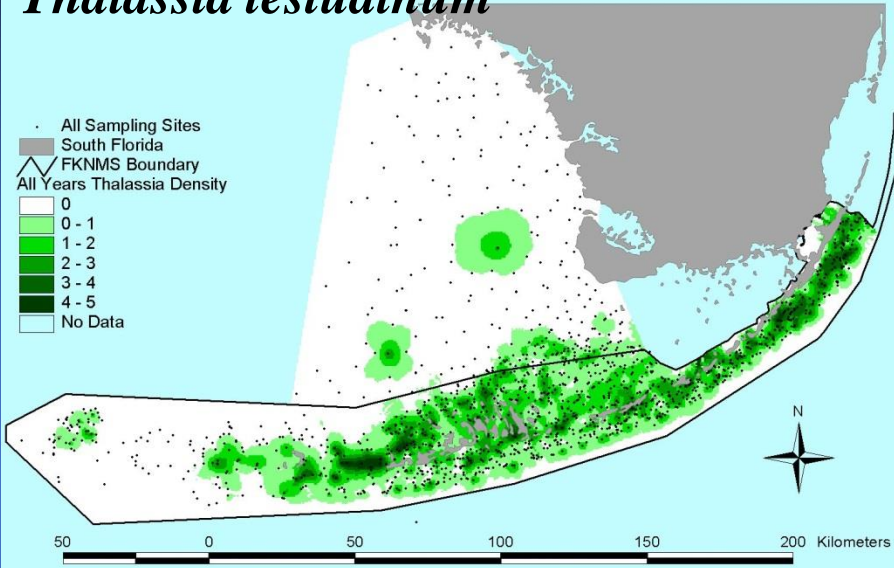
- **Distribution & abundance of seagrasses and associated fauna and flora using rapid assessment Braun-Blanquet surveys**
 - 40 permanent sites 2 times a year
- **Seagrass nutrient availability using tissue concentration assays and stable isotopic analyses**
 - 40 permanent sites 2 times a year
 - Ca. 200 mapping sites/year
- **Water column physicochemical data**
 - Sites co-located with water quality sites
 - 40 permanent sites 2 times a year in addition to quarterly water quality sampling (Briceño)

Major project accomplishments:

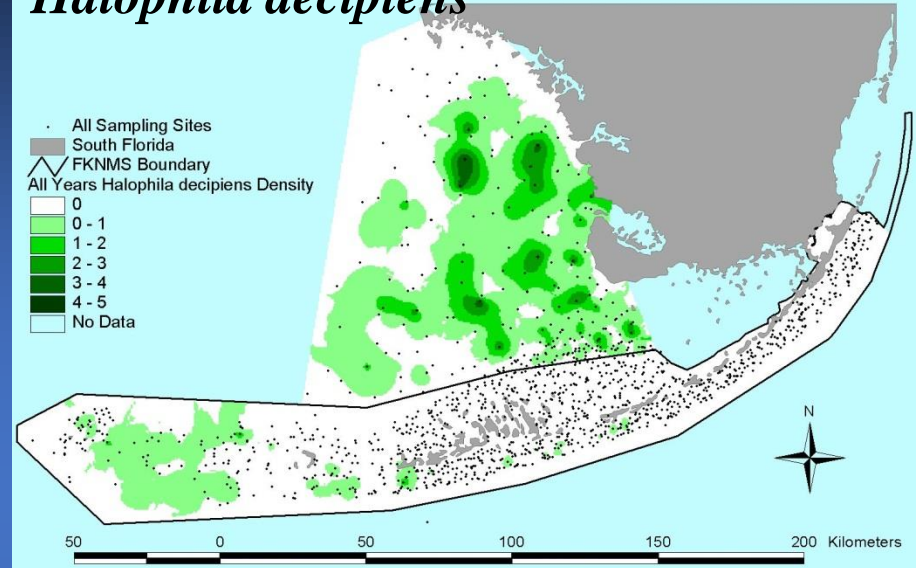
- **We have defined the spatial extent and species composition of the largest documented seagrass bed on earth, and solidly defined a baseline to assess change.**
- **We have defined the spatial and temporal pattern of seagrass community dynamics in the FKNMS and made predictions about future trajectories.**
- **We have identified long-term trends at stations in the FKNMS that are consistent with increases in nutrient availability.**
- **We have defined the effects of changing water quality on seagrass communities in south Florida**
- **We have documented the effects of storms on seagrass communities.**
- **We have experimentally confirmed the role of nitrogen, and of phosphorus near shore and in Florida Bay, in controlling seagrass bed structure and productivity near the reef tract in the FKNMS.**
- **We have provided data for the analysis of potential human impacts on benthic communities to other groups and agencies.**
- **25 scientific publications have resulted from this monitoring project to date.**

Synoptic Surveys: Species distributions

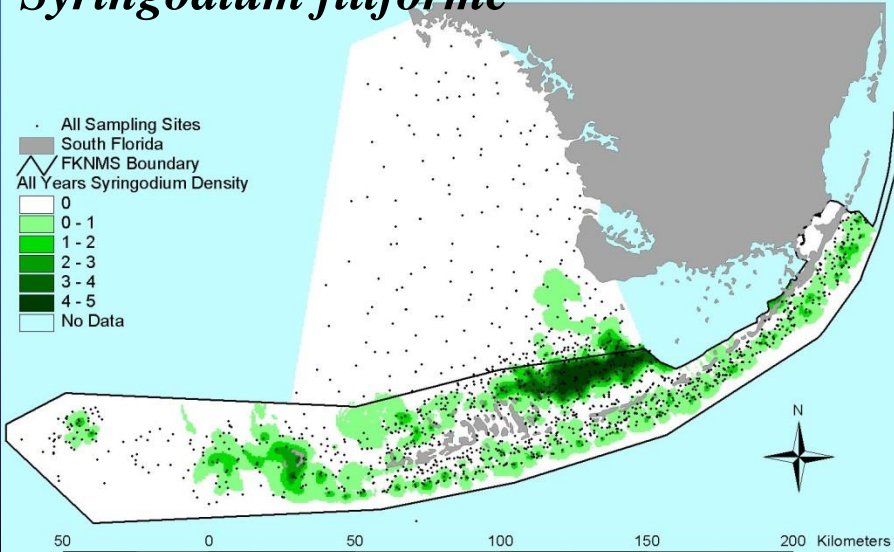
Thalassia testudinum



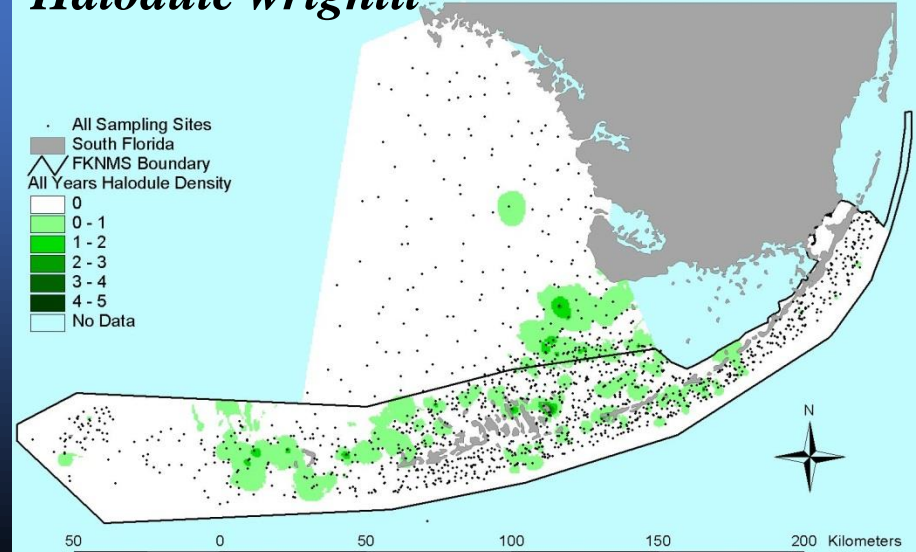
Halophila decipiens



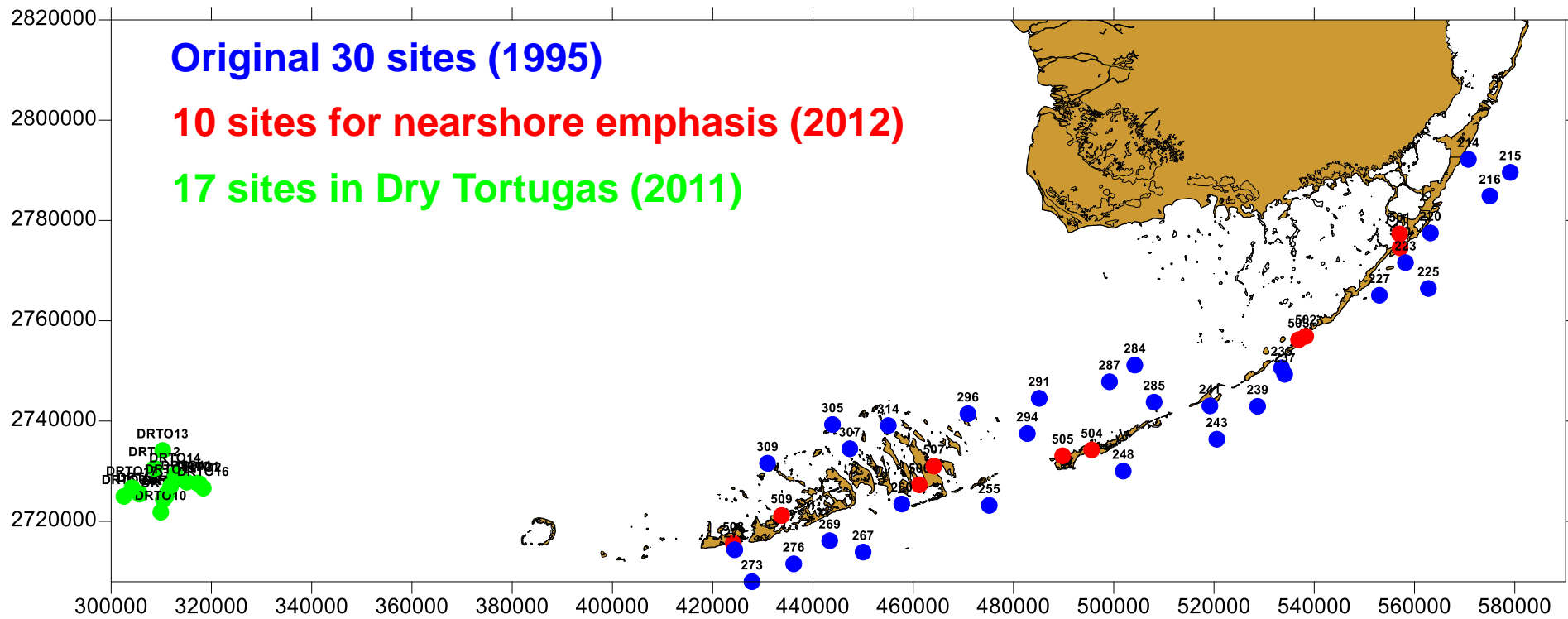
Syringodium filiforme



Halodule wrightii



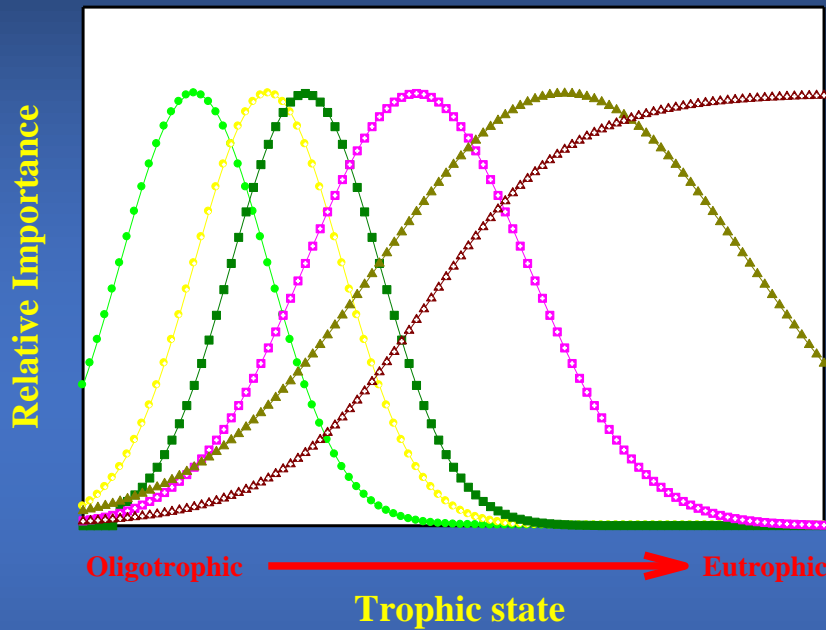
Benthic Habitat Permanent Monitoring Sites



Eutrophication model

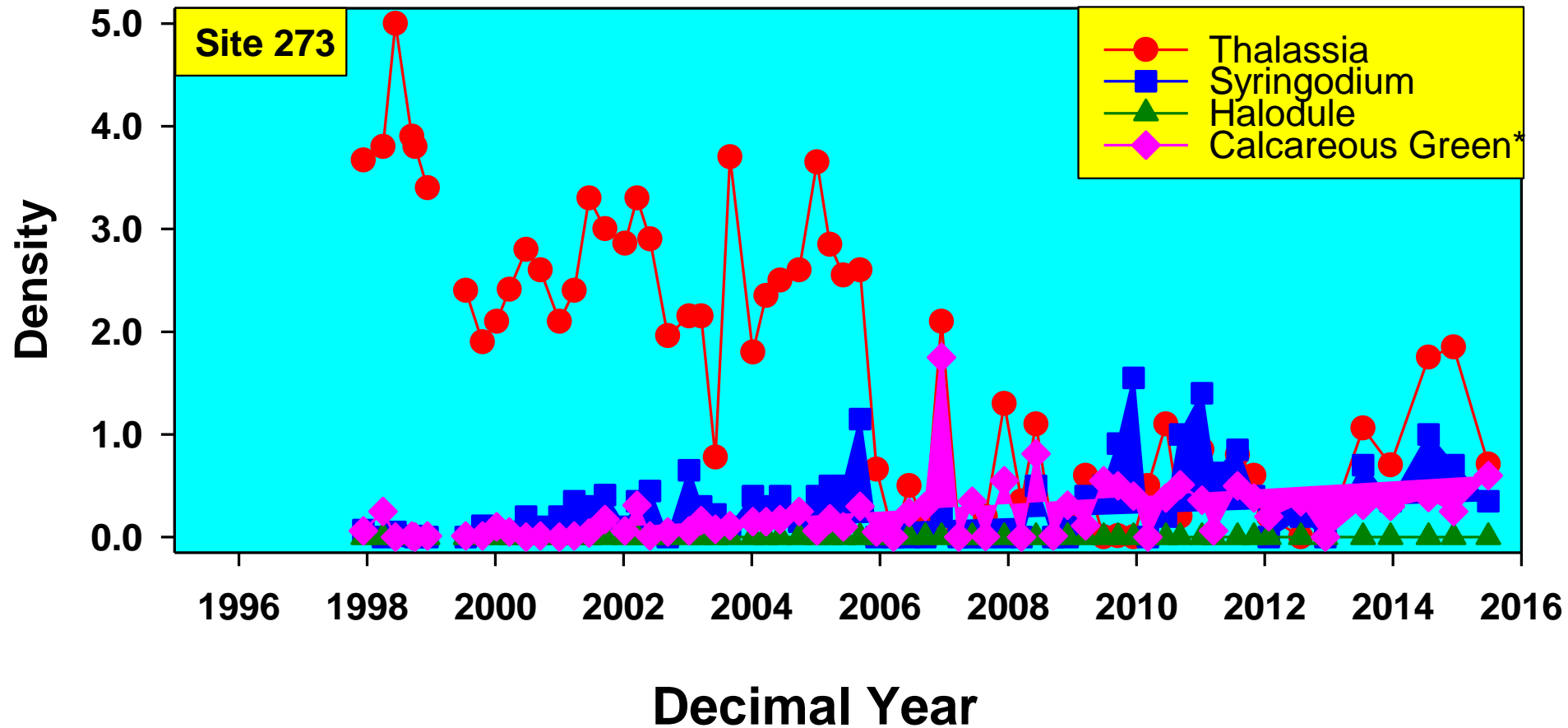
Explicit model of ecosystem behavior #1

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



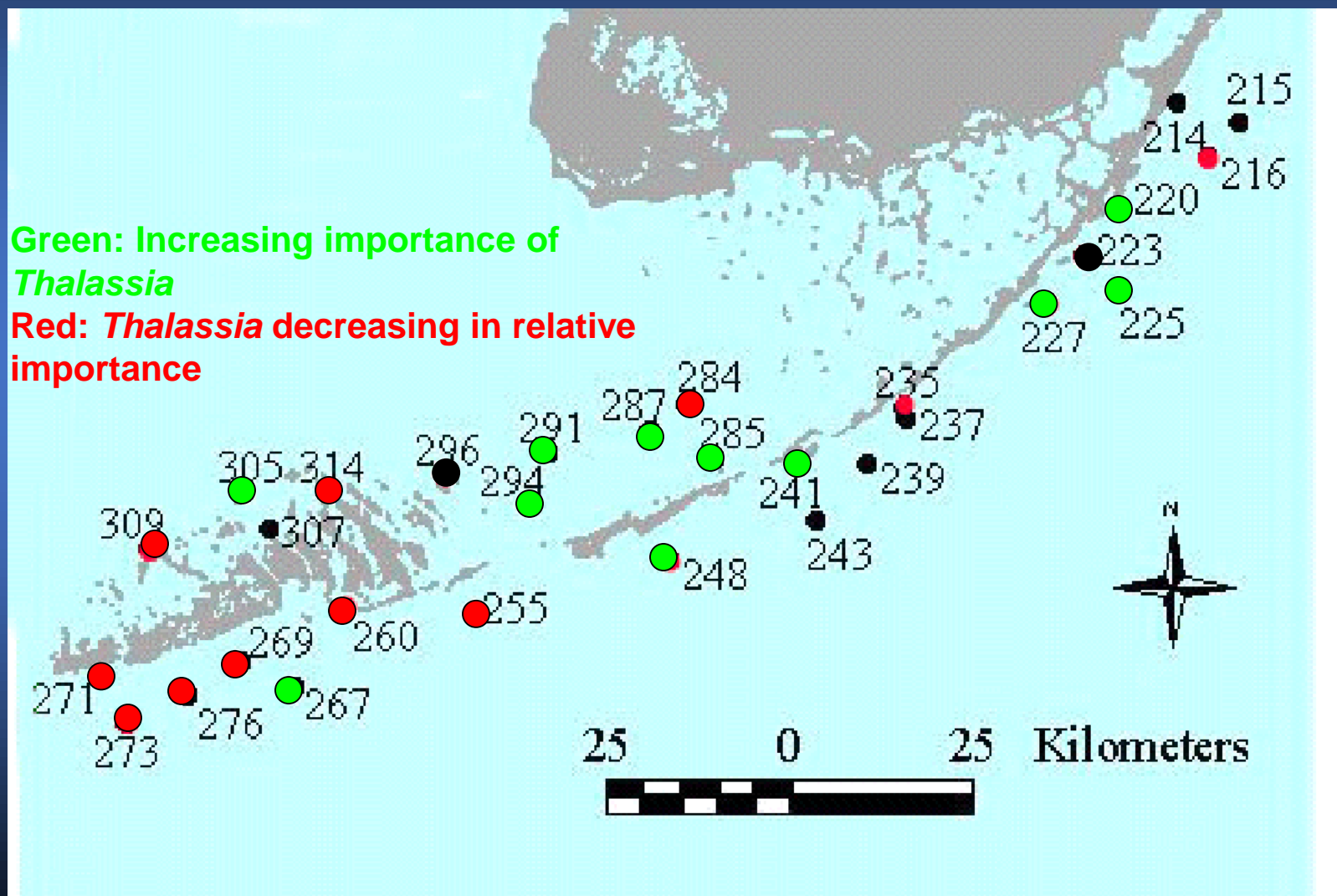
- *Thalassia testudinum*
- ◇— *Syringodium filiforme*
- *Halodule wrightii*
- *Ruppia maritima*
- ▲— Macroalgae
- △— Microalgae

Changes in relative abundance of primary producers



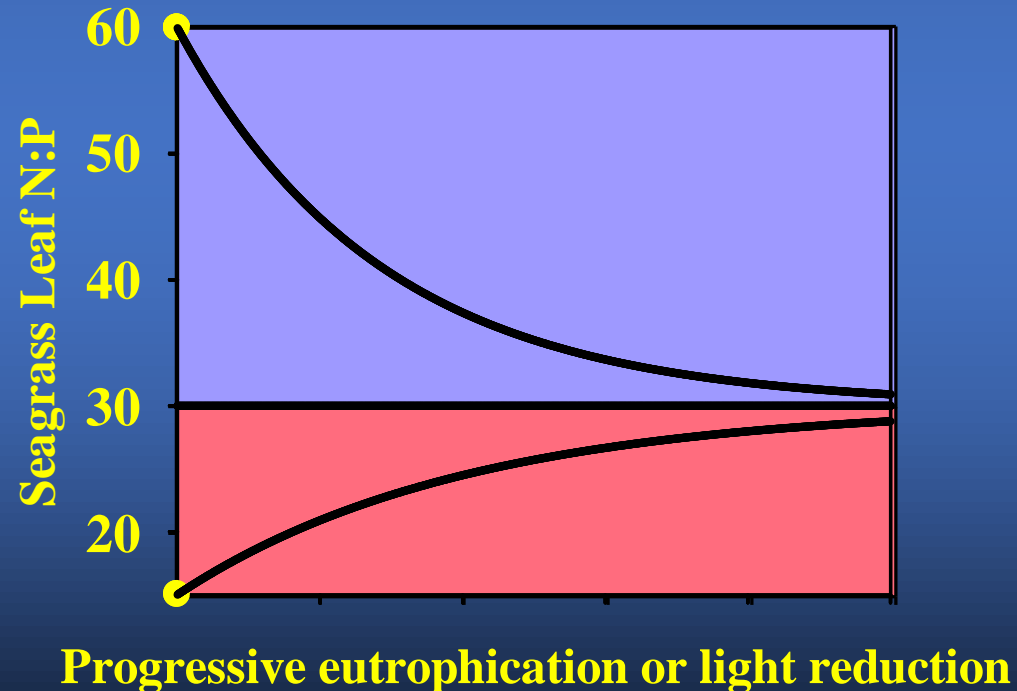
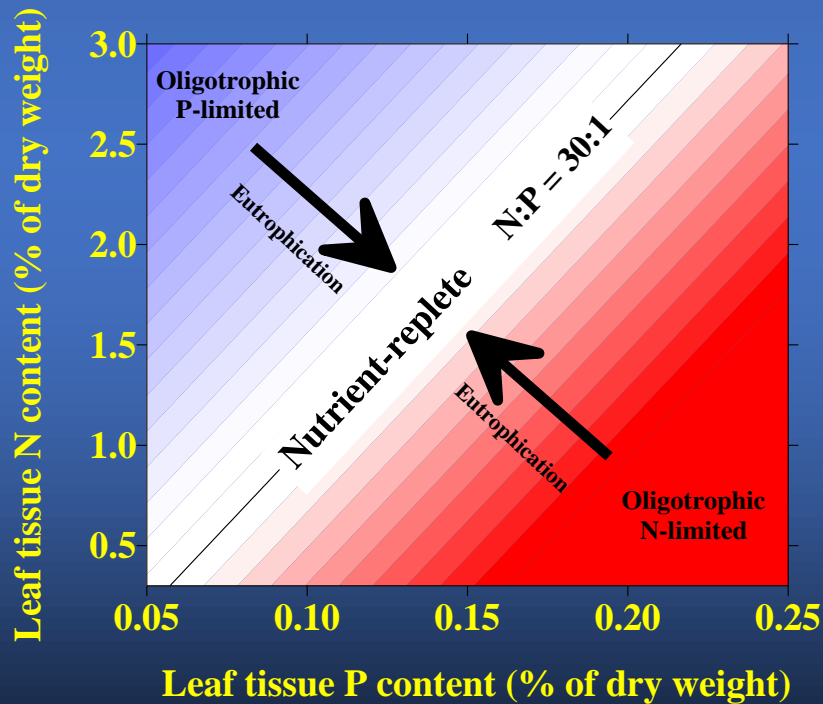
Changes in relative abundance of primary producers

At 22 of 30 sites, species composition has shifted in a manner consistent with increased nutrient availability



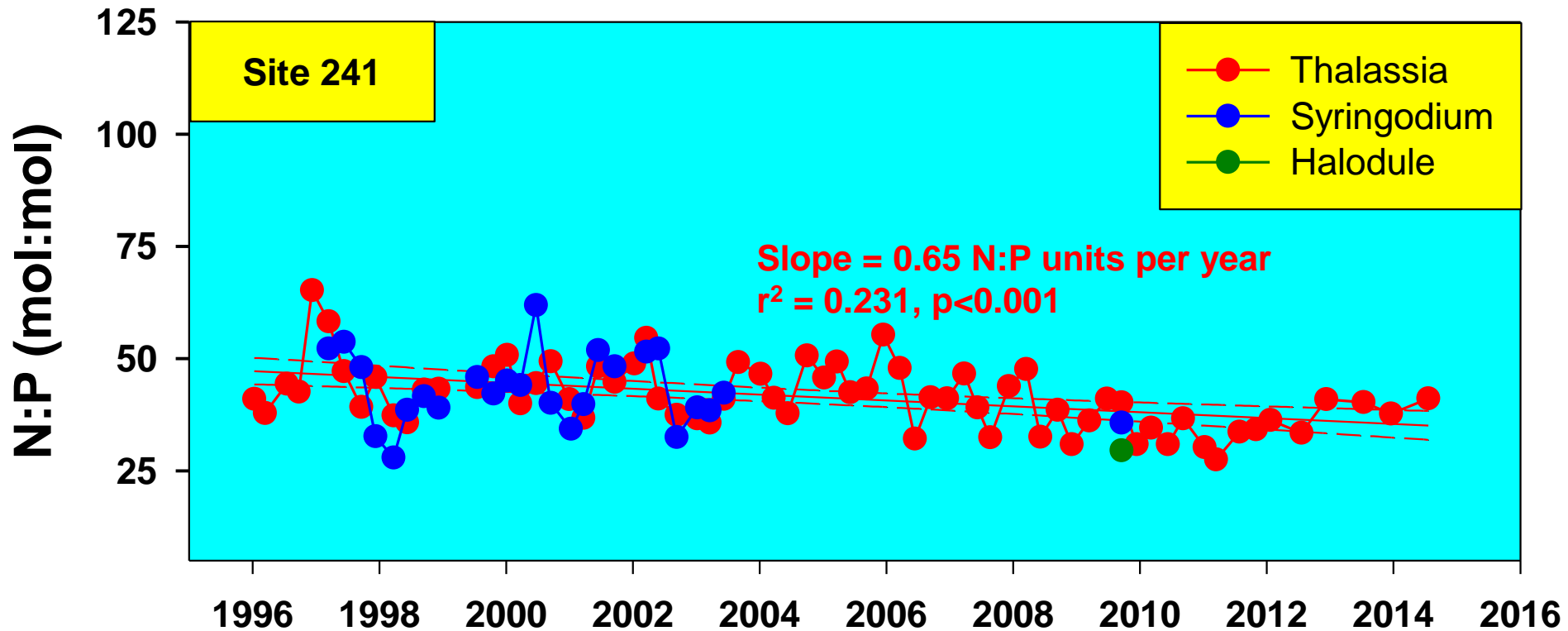
Explicit model of ecosystem behavior #2

Nutrient pollution will shift N:P ratios of primary producers towards a taxon-specific “Redfield ratio”

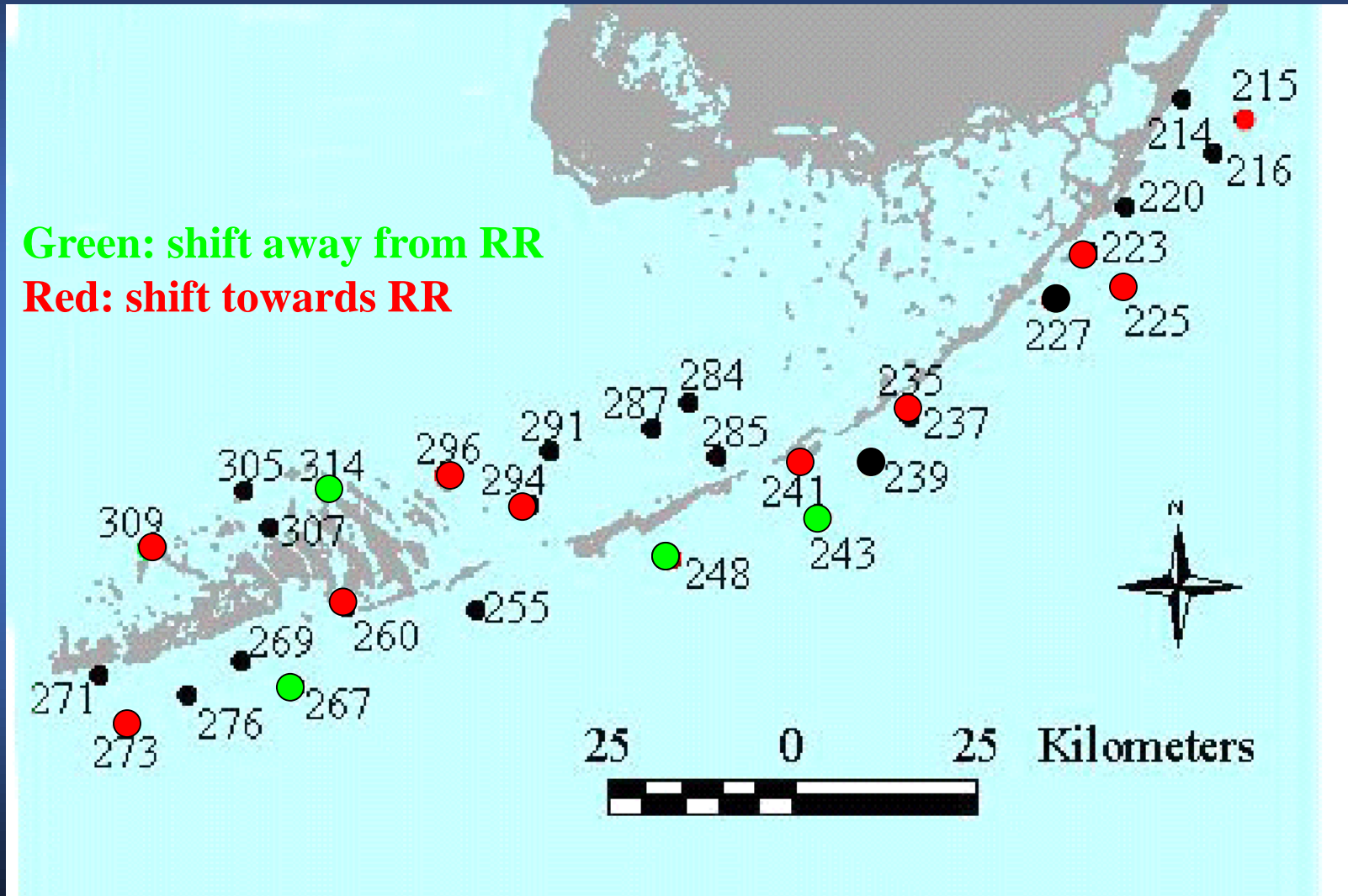


Changes in N:P of primary producers

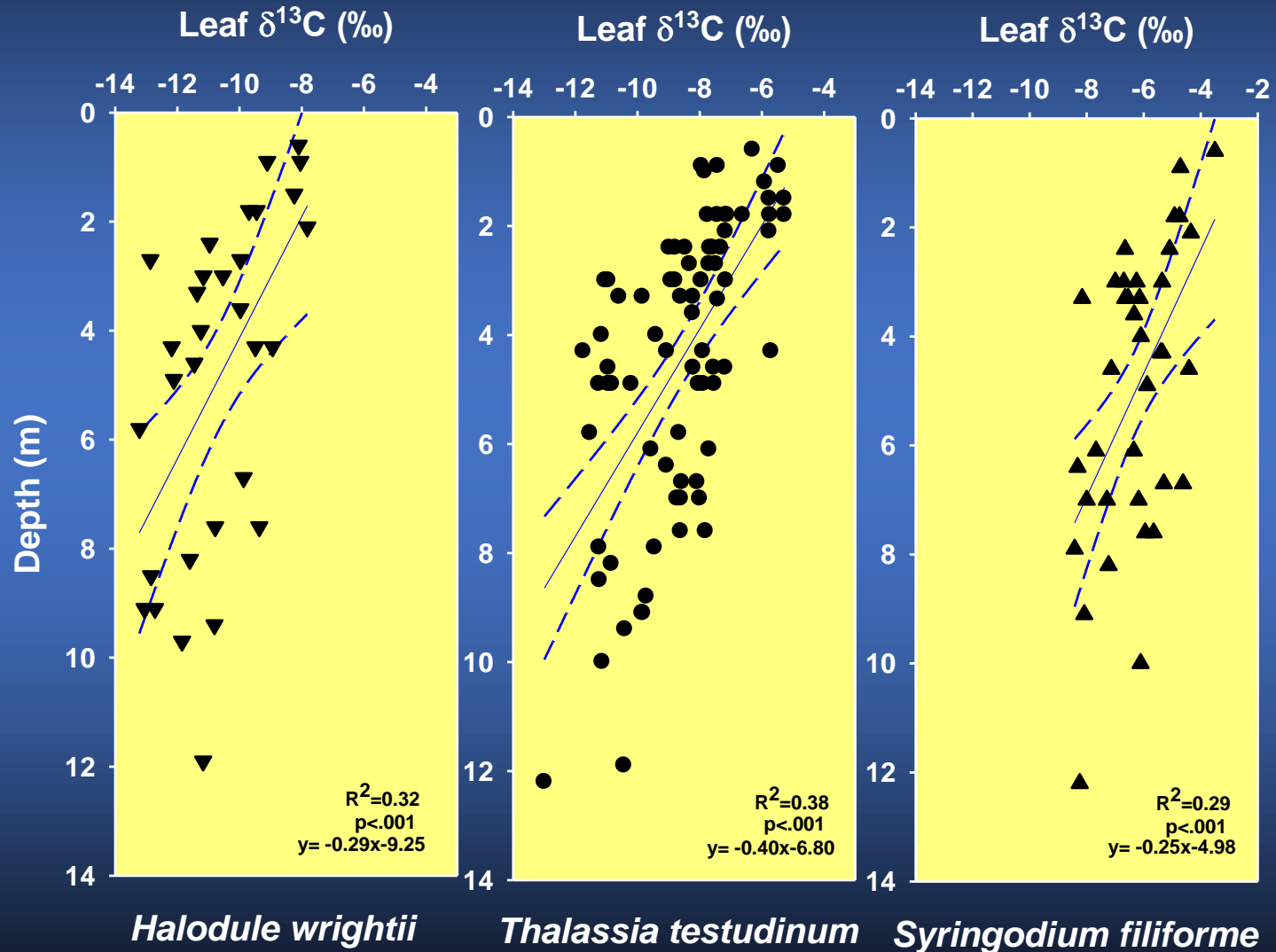
At 10 of 30 sites, N:P is trending towards “seagrass Redfield ratio”



Changes in N:P of primary producers

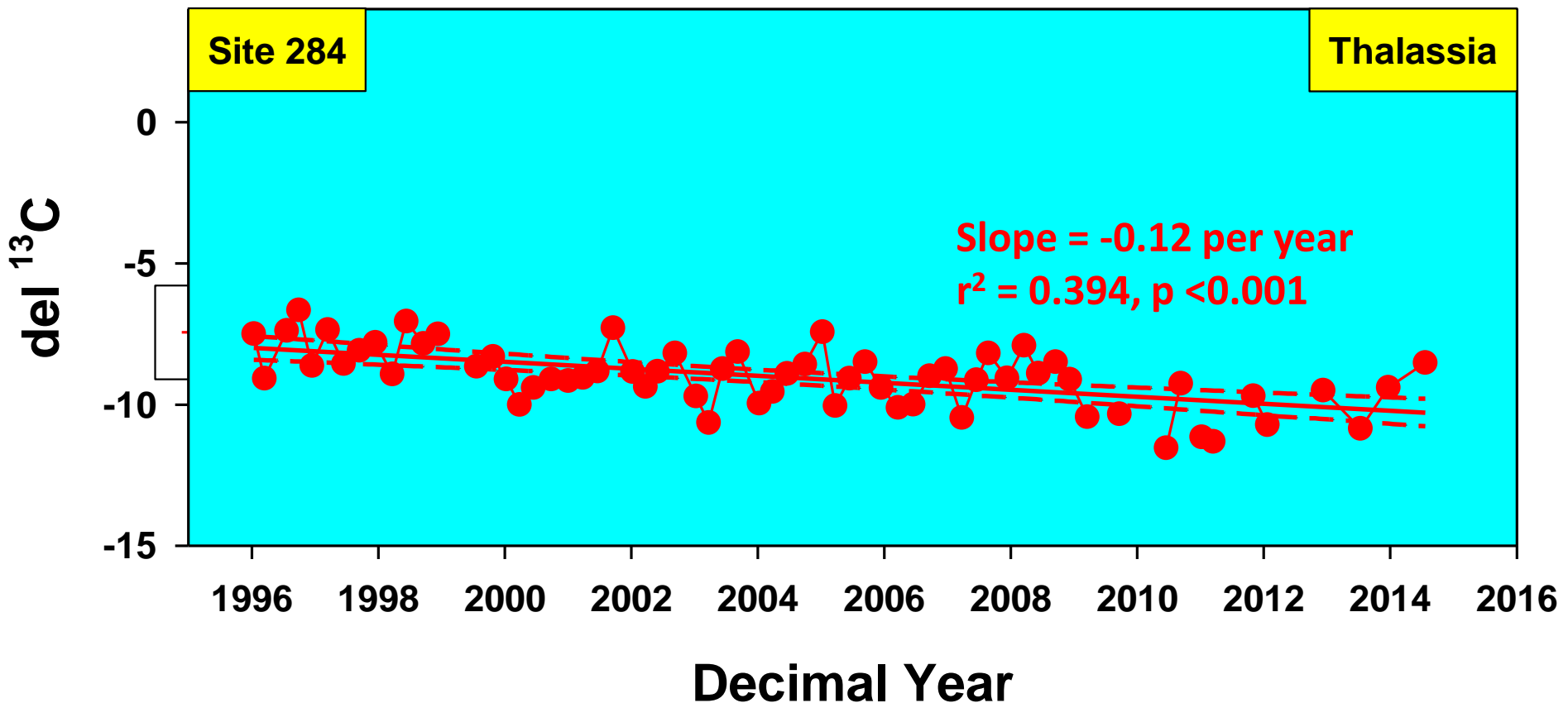


Explicit model of ecosystem behavior #3: As light decreases with depth, $\delta^{13}\text{C}$ decreases



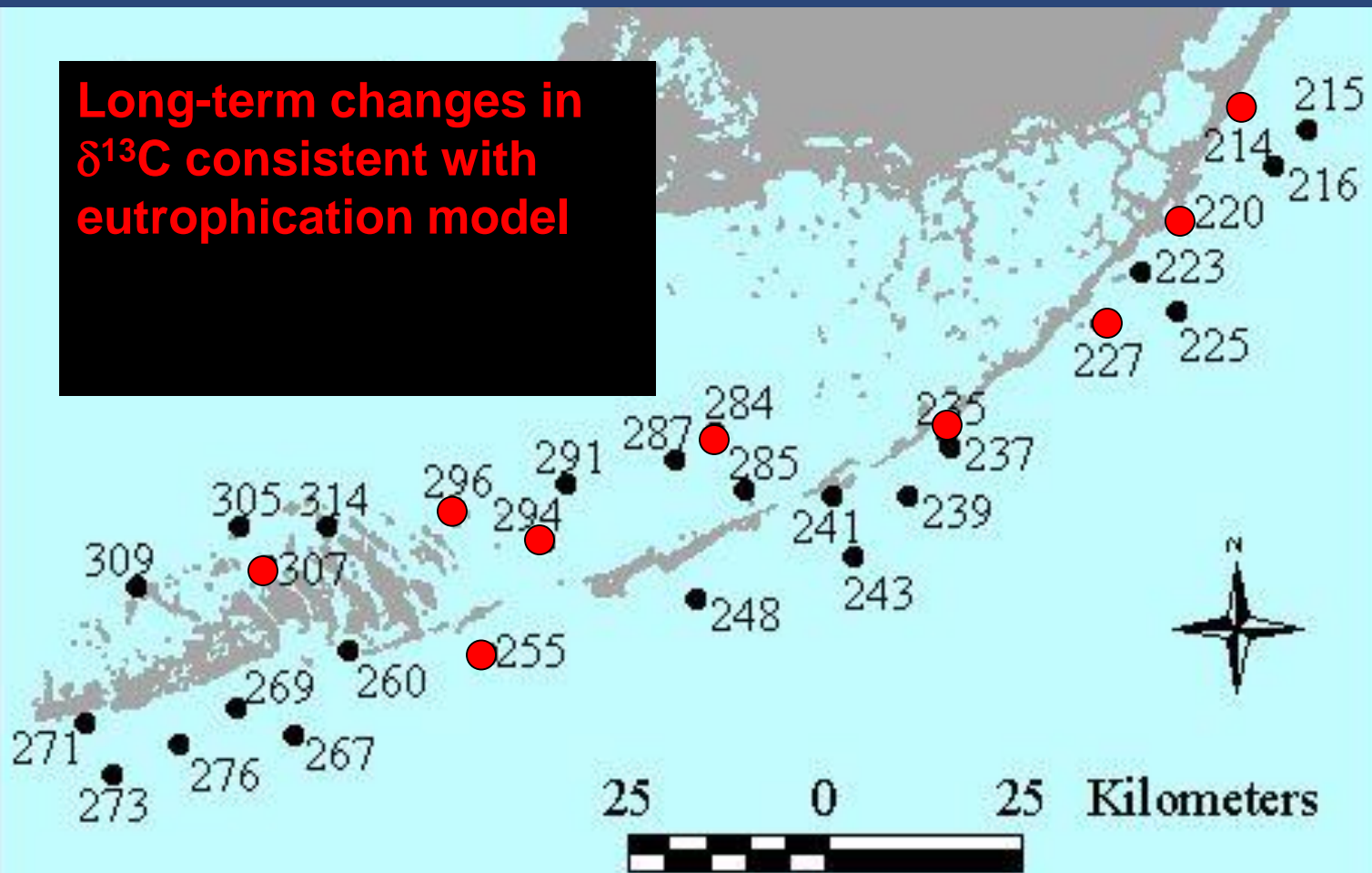
Changes in $\delta^{13}\text{C}$ of primary producers

At 7 of 30 sites, significant $\delta^{13}\text{C}$ trends consistent with eutrophication (7 of 30 last year)



Changes in $\delta^{13}\text{C}$ of primary producers #2

Long-term changes in $\delta^{13}\text{C}$ consistent with eutrophication model



Site-specific indicator summary

Significance of linear trends, 1995-2015

Site	N:P	SCI	$\delta^{13}\text{C}$	$\delta^{15}\text{N}$
214				
215				+
216				-
220			-	
223				+
225				
227				
235			-	
237				
239				
241				
243				
248				
255				
260				

Site	N:P	SCI	$\delta^{13}\text{C}$	$\delta^{15}\text{N}$
267				
269				+
271				
273				+
276				+
284			-	
285				+
287				
291				
294				
296				-
305				
307			-	
309				-
314	+			-

FKNMS Seagrass Status Criteria

- We have defined 2 criteria to track the status of seagrasses Sanctuary-wide, based on our conceptual models

- The first is based on the relative dominance of slow-growing species:

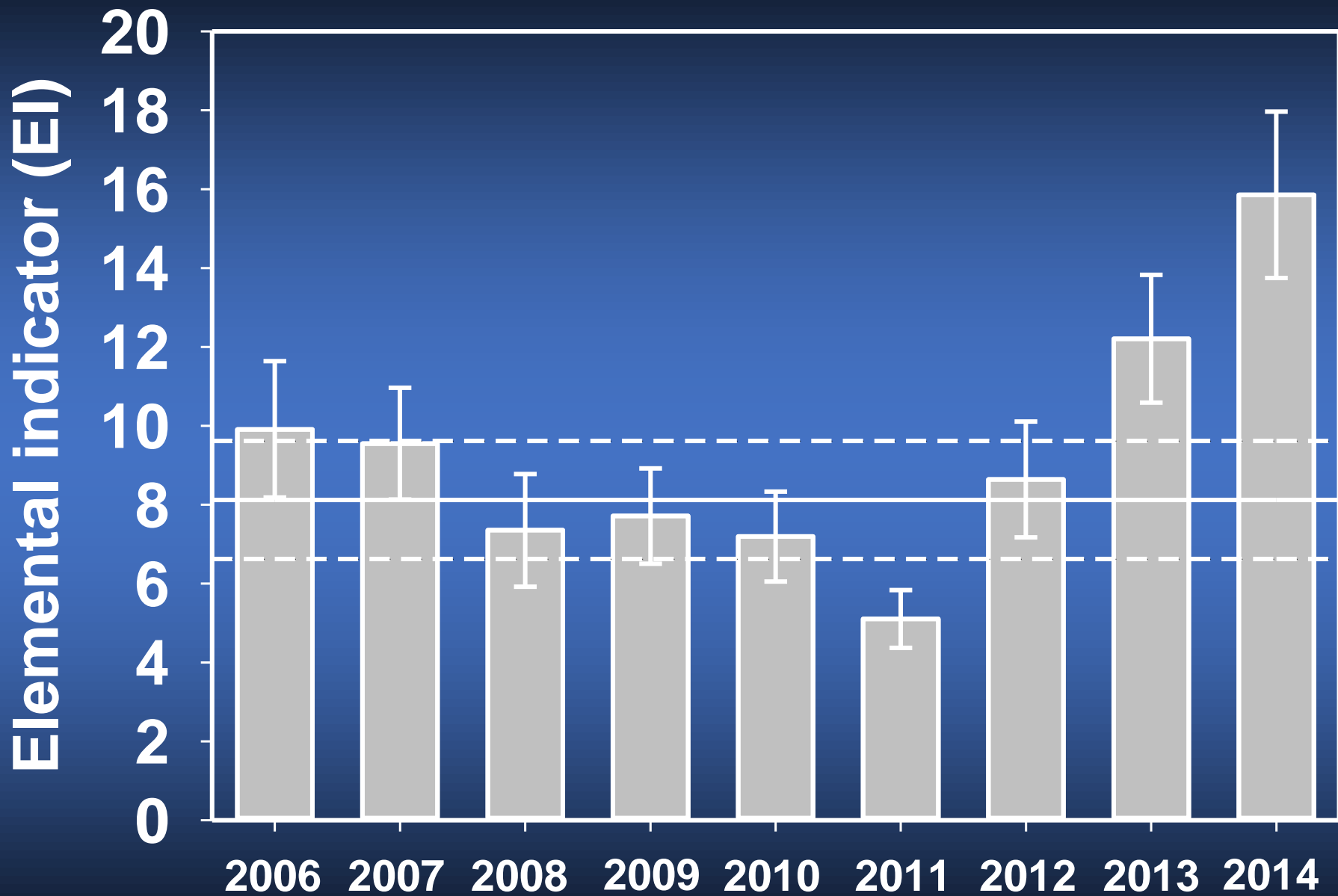
$$SLOW = \frac{A_{Tt}}{A_{Tt} + A_{Sf} + A_{Hw} + A_{Macroalgae}} \quad SCI = \frac{\sum_{i=1}^{30} SLOW_i}{30}$$

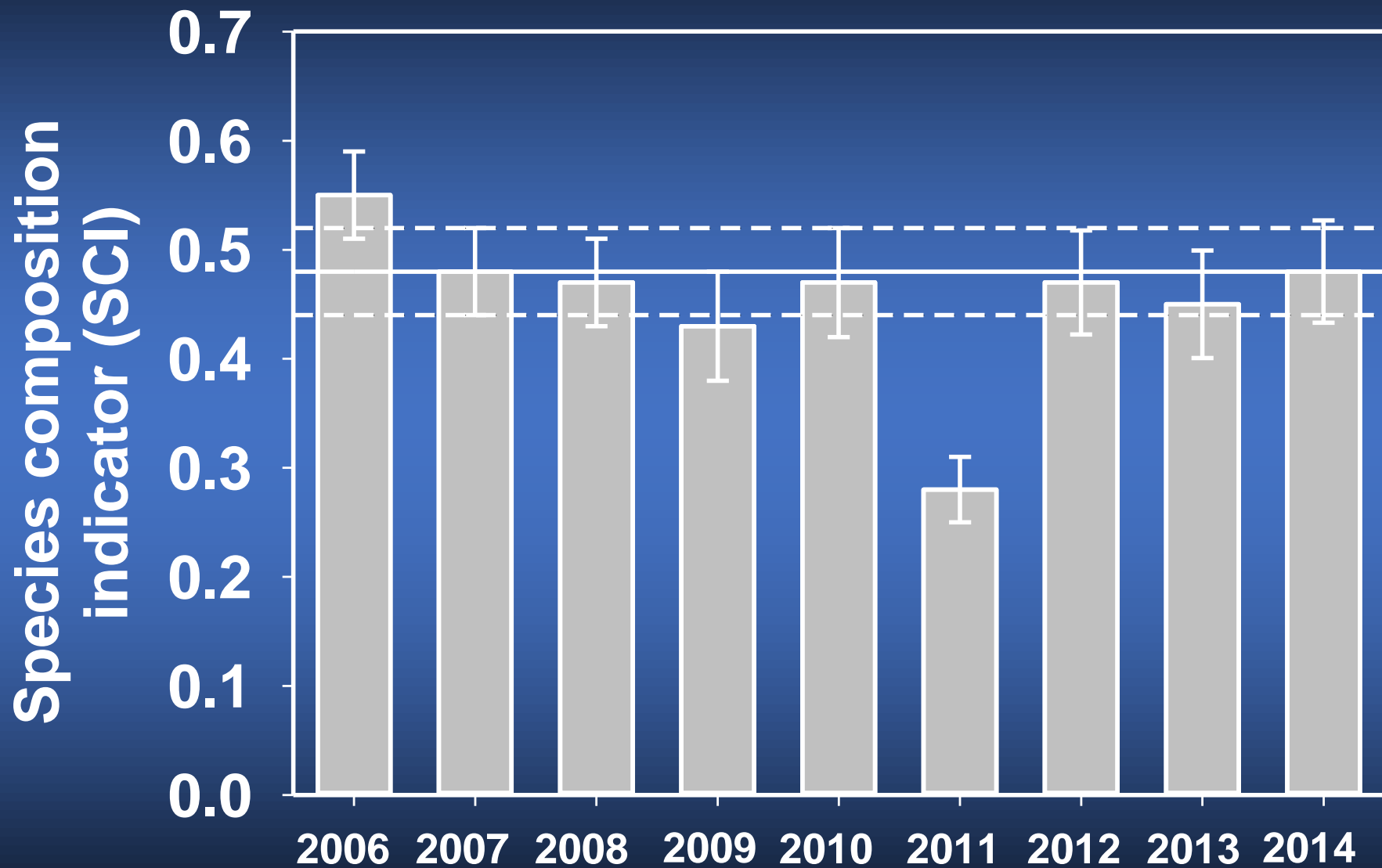
- The baseline SCI, calculated from data collected between 1995-2005, was 0.48 ± 0.04 . Any decrease in SCI indicates declining water quality

- The second is based on nutrient content of the slowest growing species:

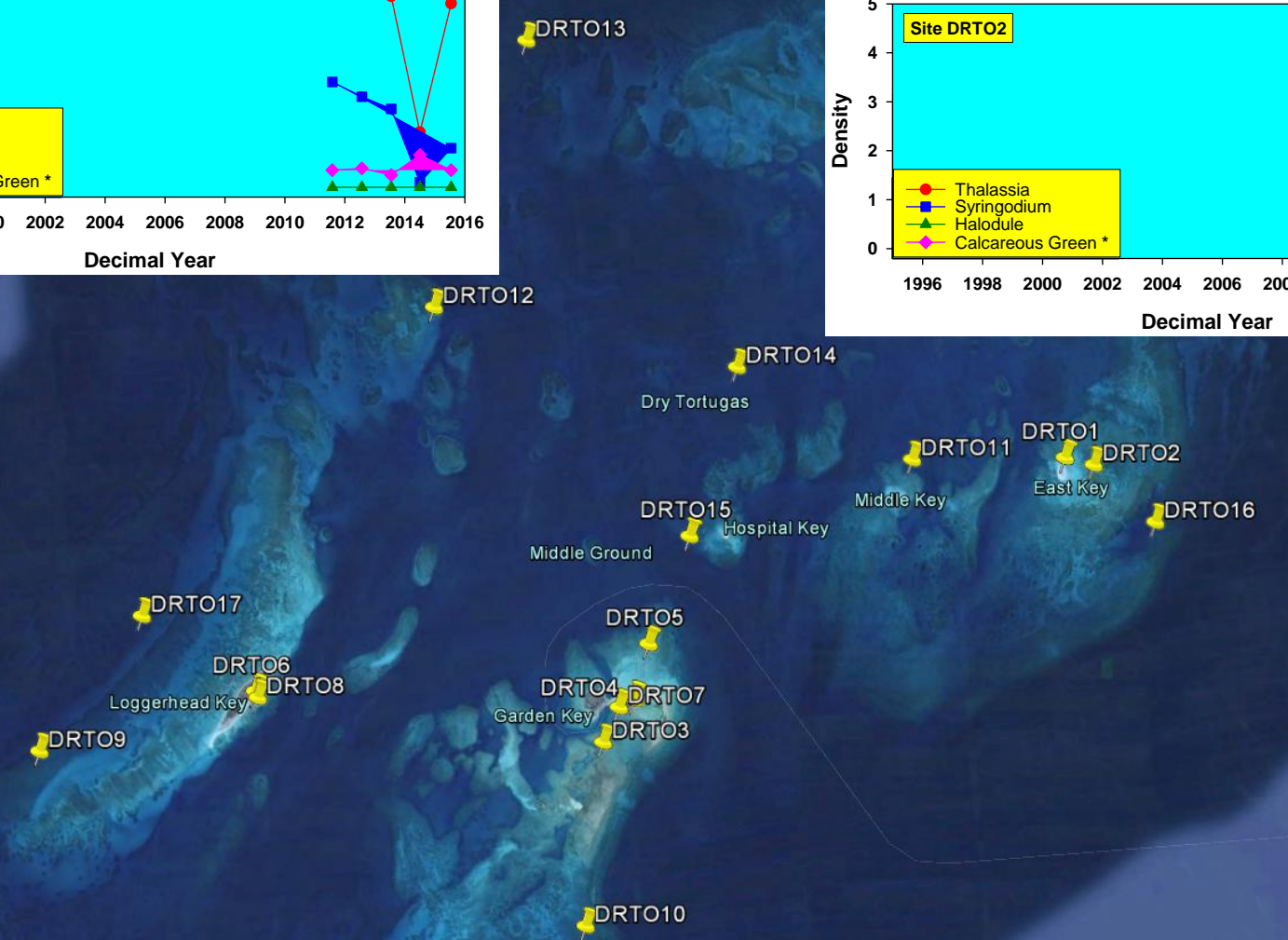
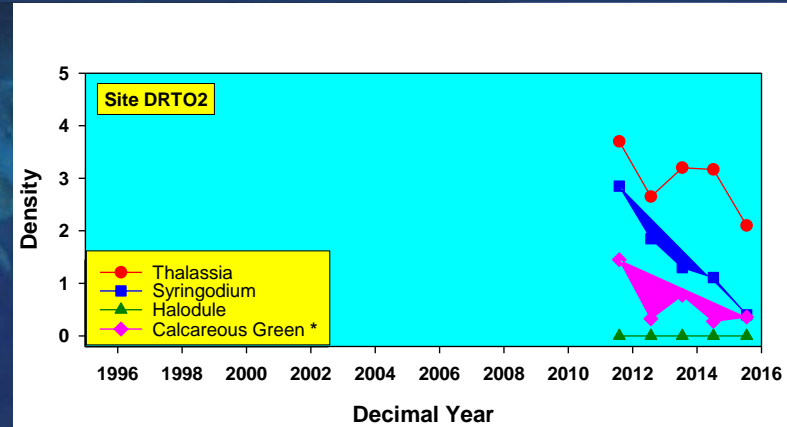
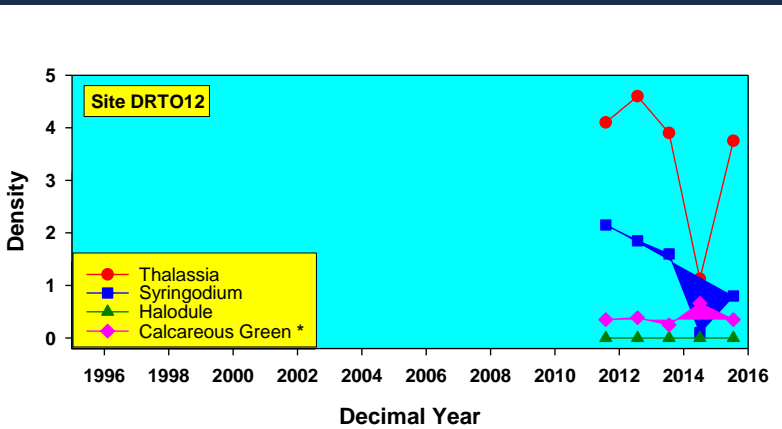
$$EI = \frac{\sum_{i=1}^{30} |NP_i - 30|}{30}$$

- The long-term average EI of *Thalassia* leaves at the 30 sites is 8.28 ± 1.47





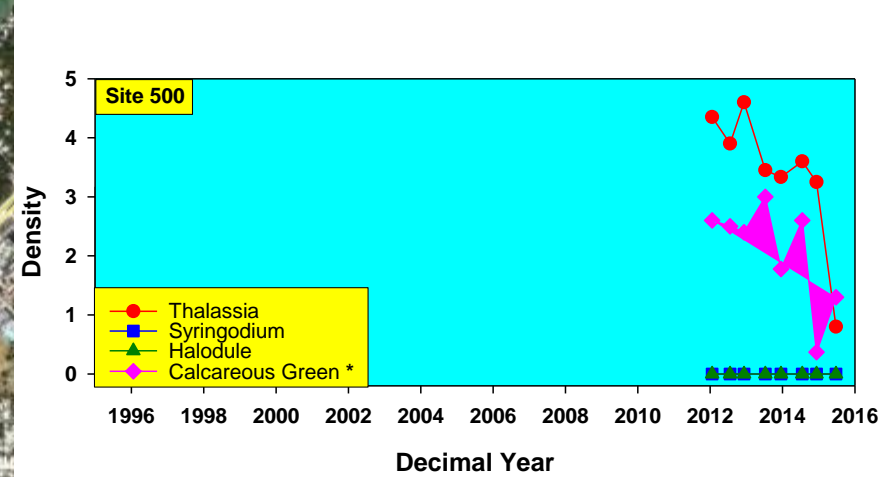
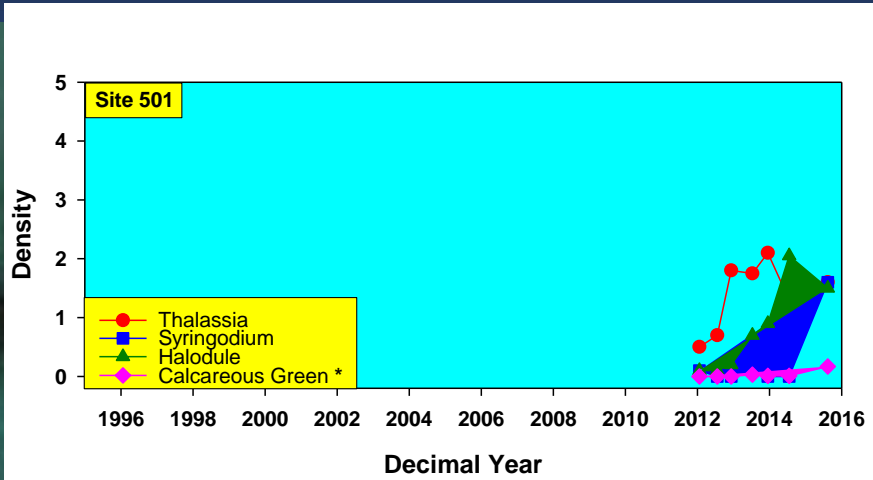
Dry Tortugas Sites



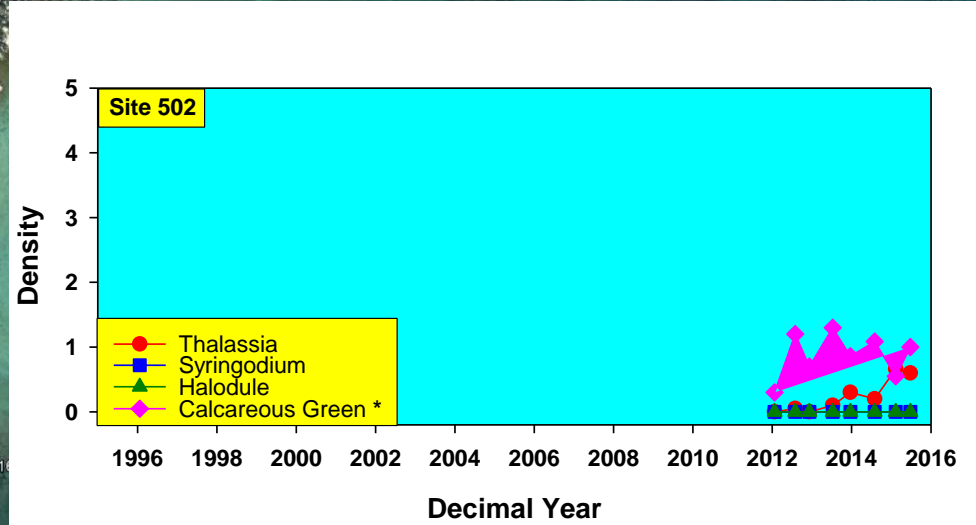
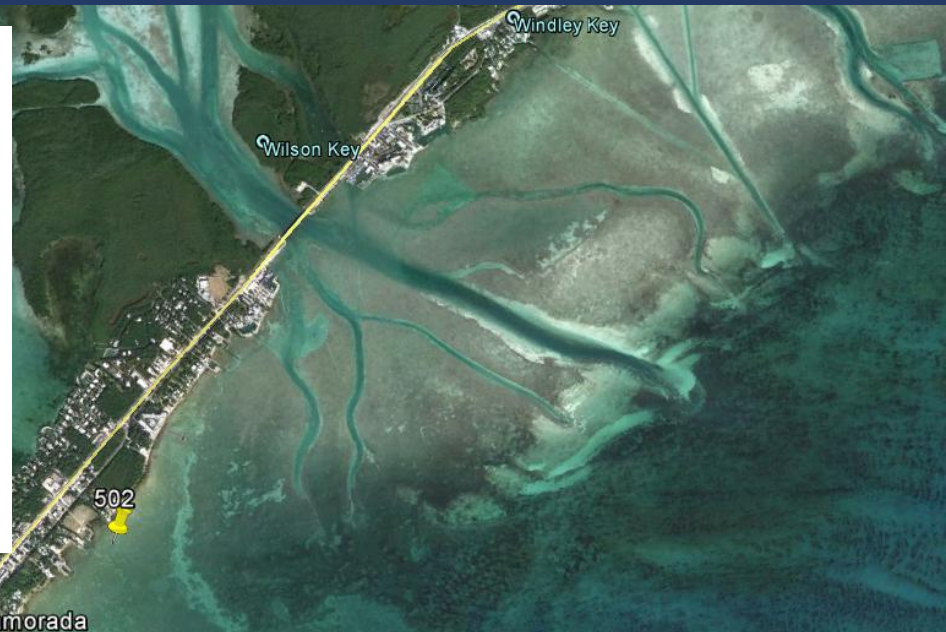
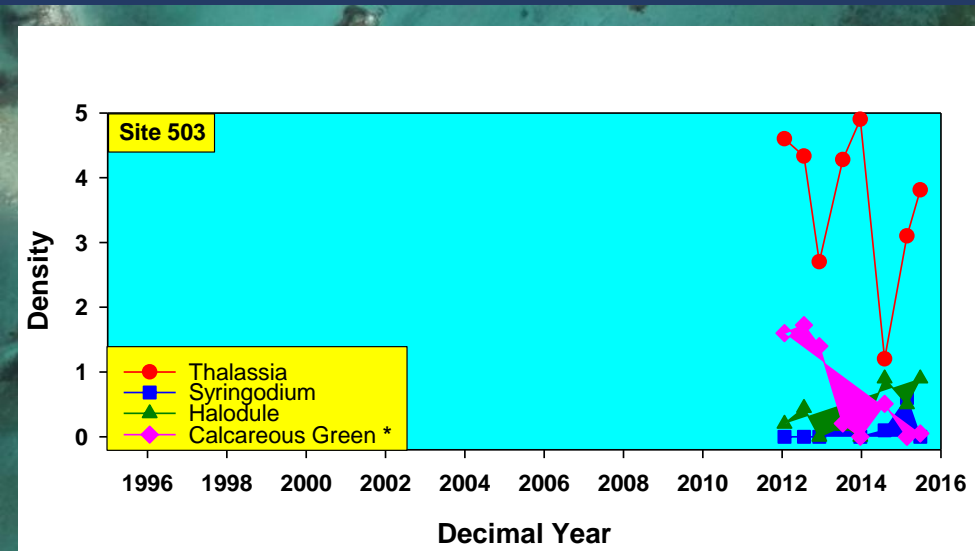


- **Not all environmental threats can be monitored in a given monitoring program**
- **The original monitoring program design was regional in scope**

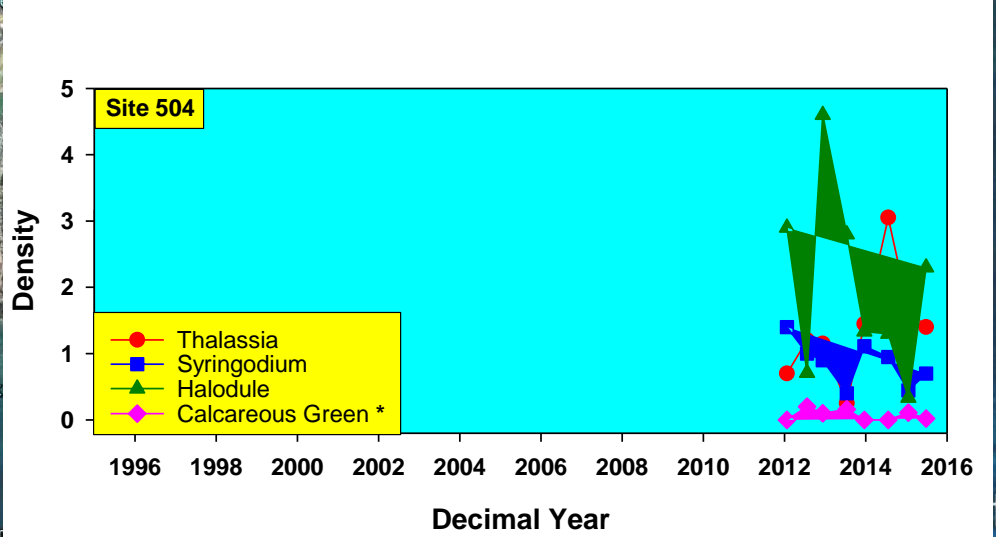
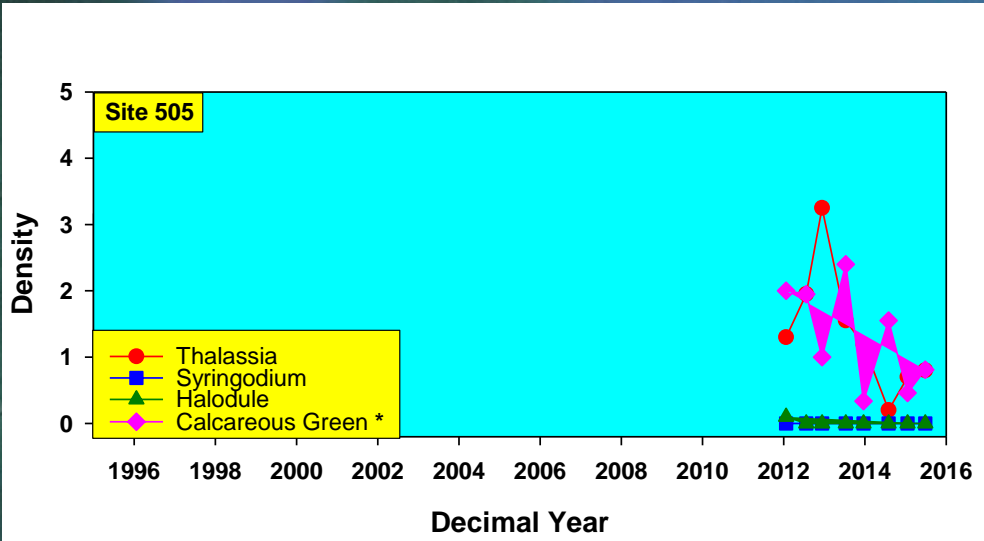
Nearshore sites – Key Largo



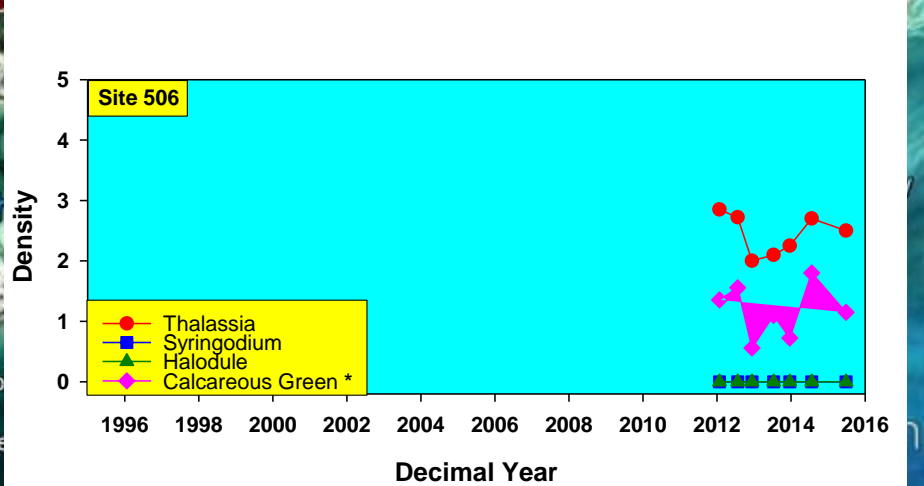
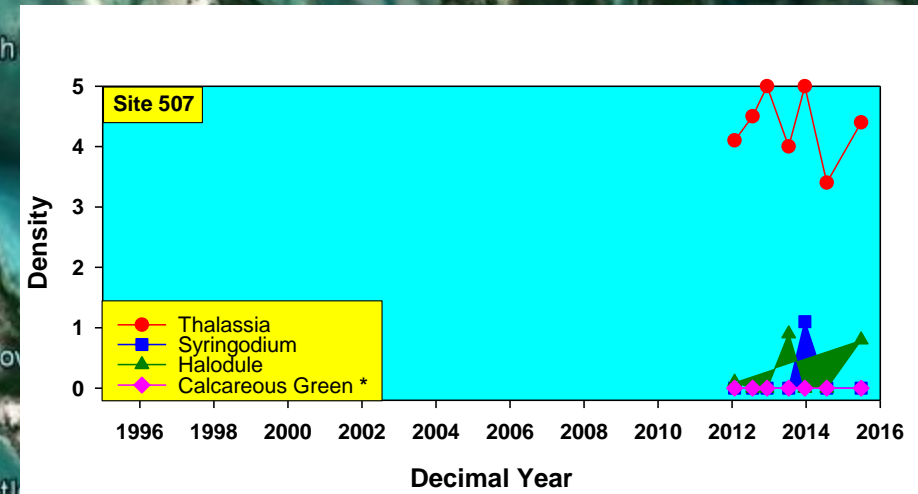
Nearshore sites – Islamorada



Nearshore sites – Marathon



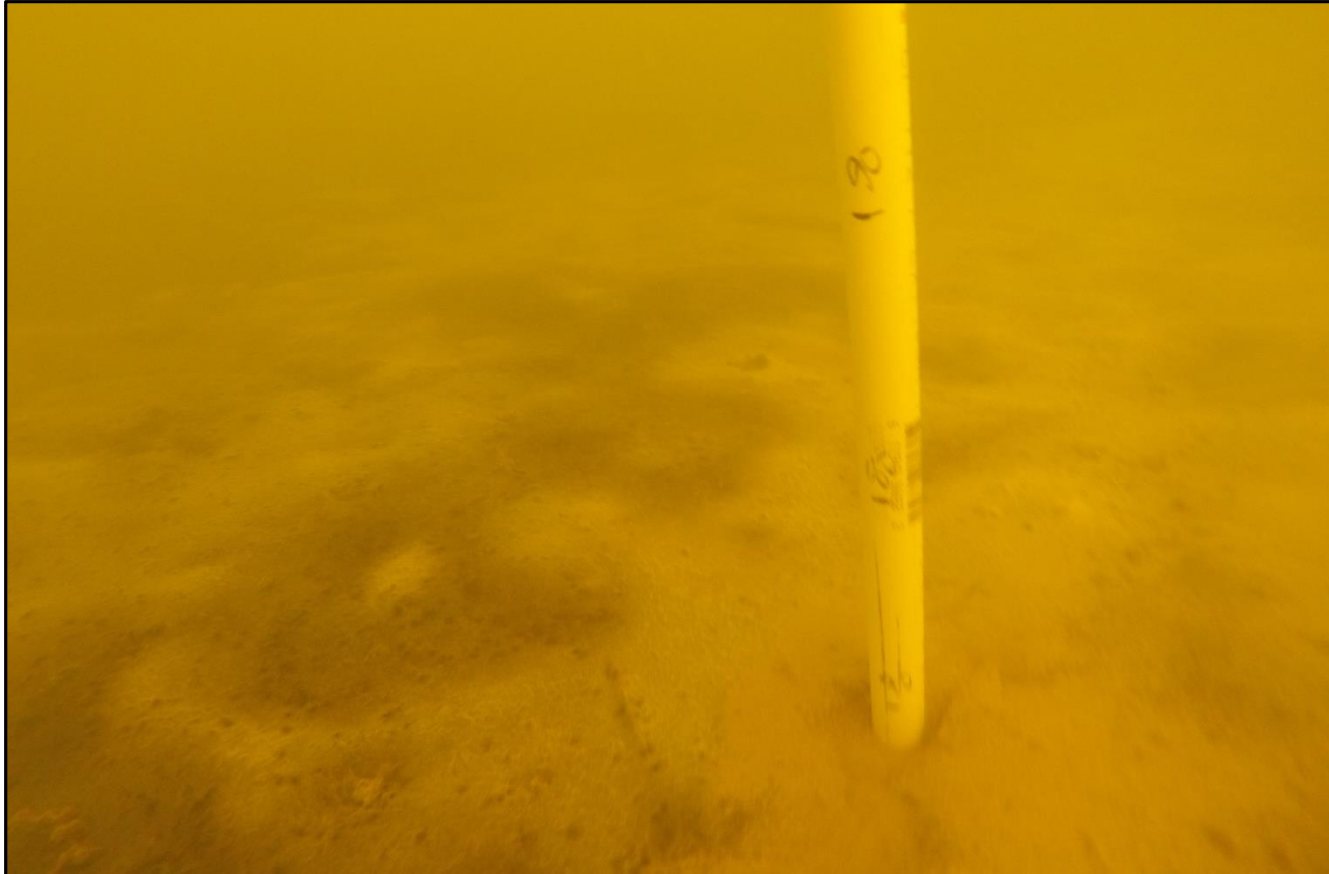
Nearshore sites – Big Pine



Summary points

- Long-term (1995-present) trends show changes in the region's seagrasses consistent with decreasing water quality and increasing nutrient availability
- More recently, our indicators of Sanctuary-wide status have rebounded, but these rebounds do not include data from very-near-shore sites.
- Our short time series from these nearshore sites have trends of decreasing seagrass cover, contrary to the rebound in the offshore sites that began in 2011

Canal Restoration in Monroe County Benthic Monitoring Report



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

Made possible by



Townships
Homeowner Organizations
Individuals

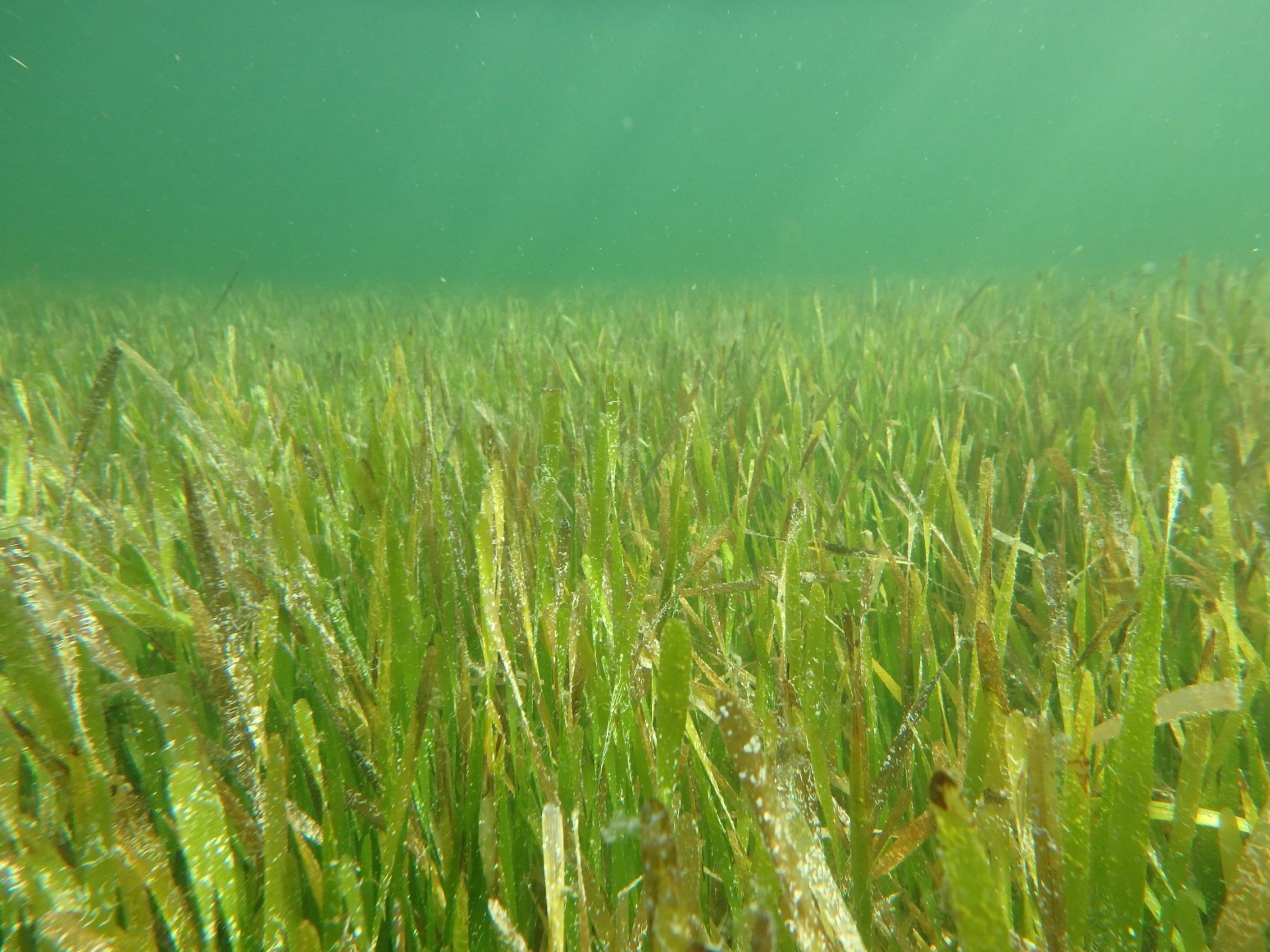


FIU

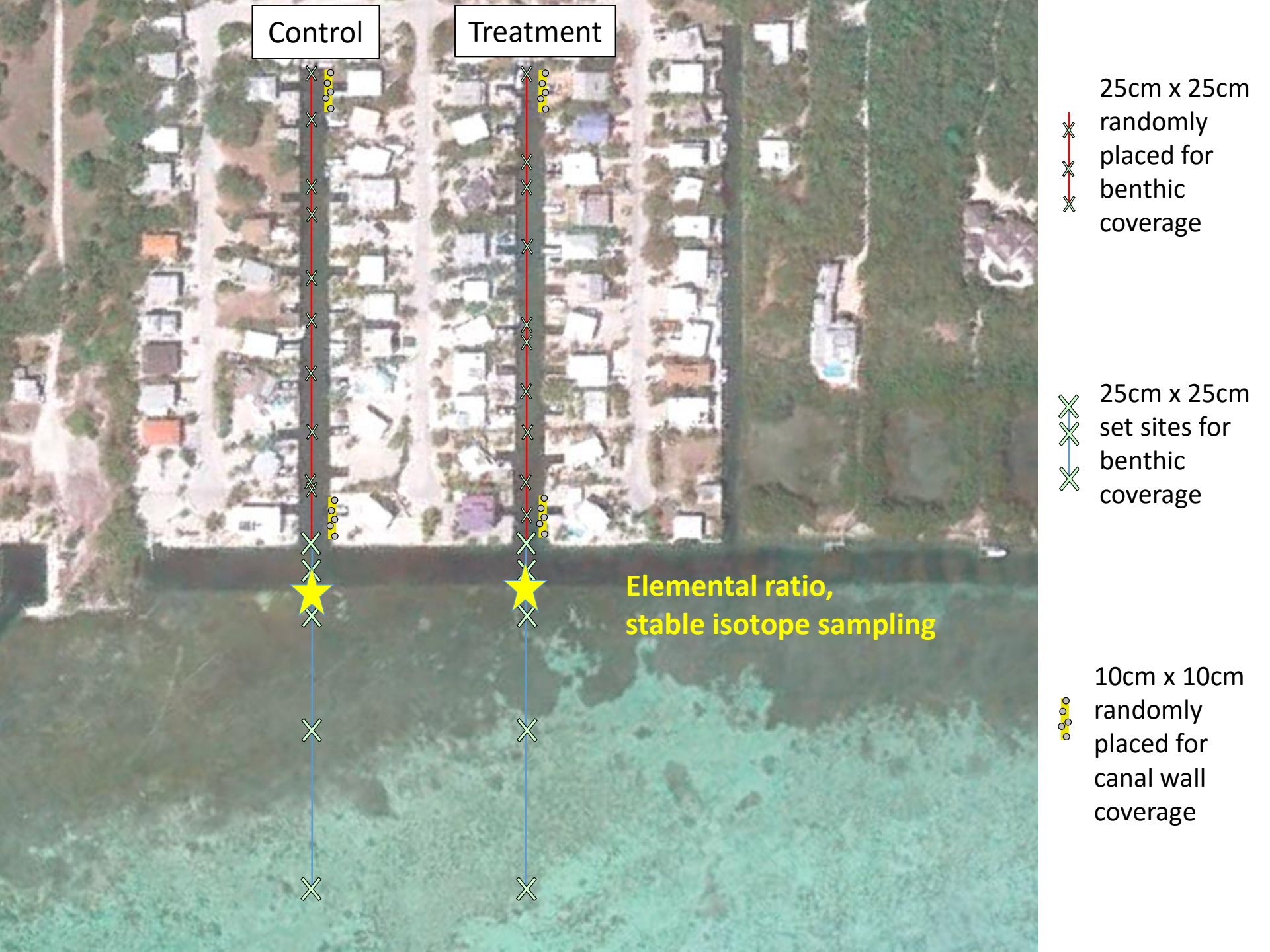
FLORIDA INTERNATIONAL UNIVERSITY
Miami's public research university

**Seagrass Ecosystems
Research Lab**
Florida International University









Control

Treatment

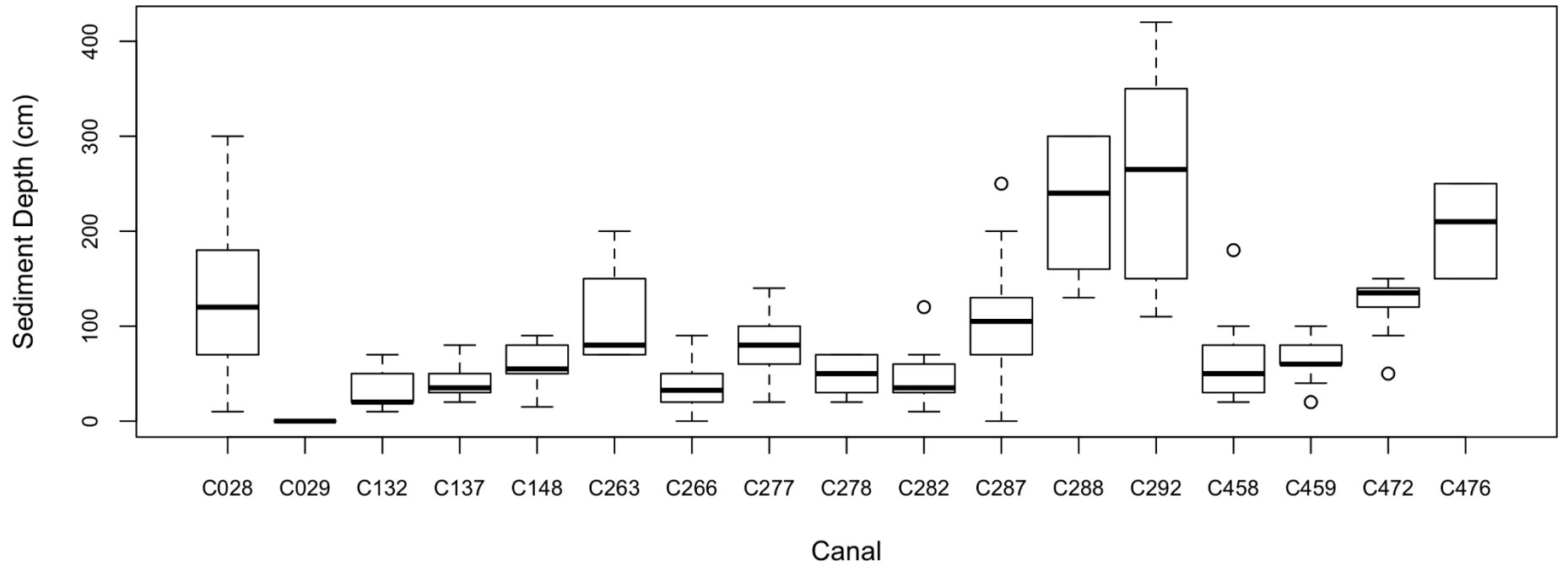
25cm x 25cm
randomly
placed for
benthic
coverage

25cm x 25cm
set sites for
benthic
coverage

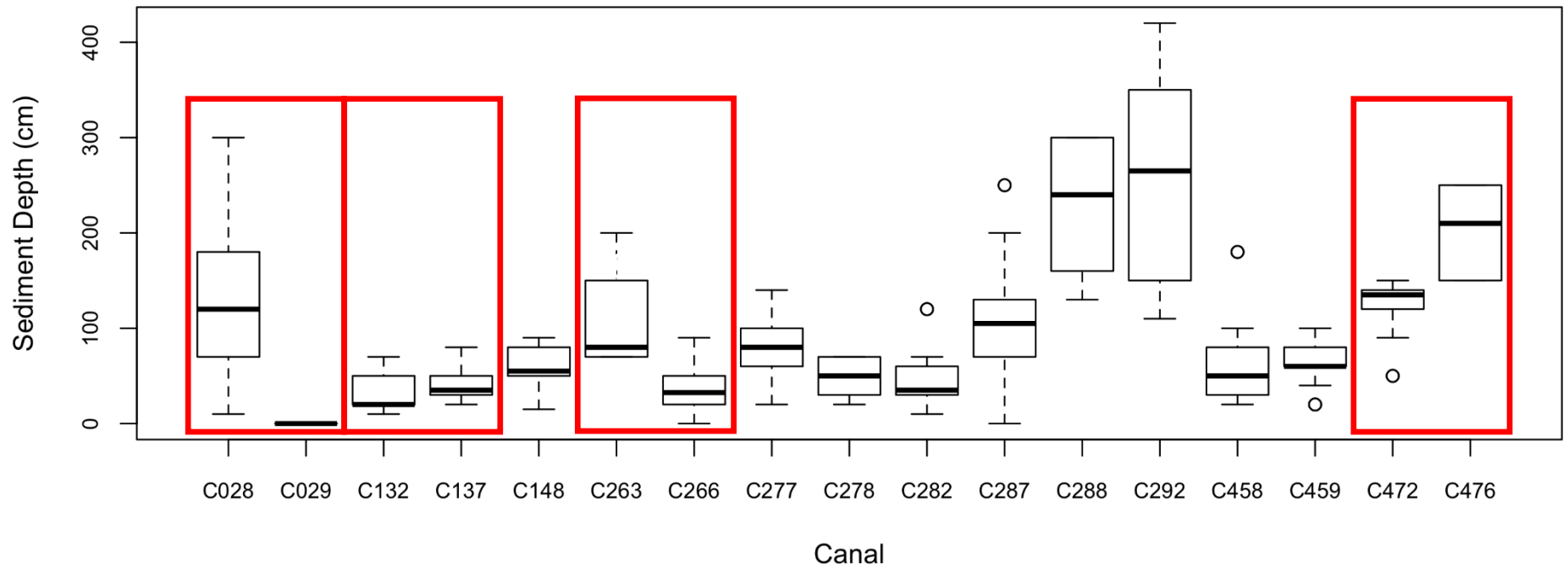
10cm x 10cm
randomly
placed for
canal wall
coverage

Elemental ratio,
stable isotope sampling

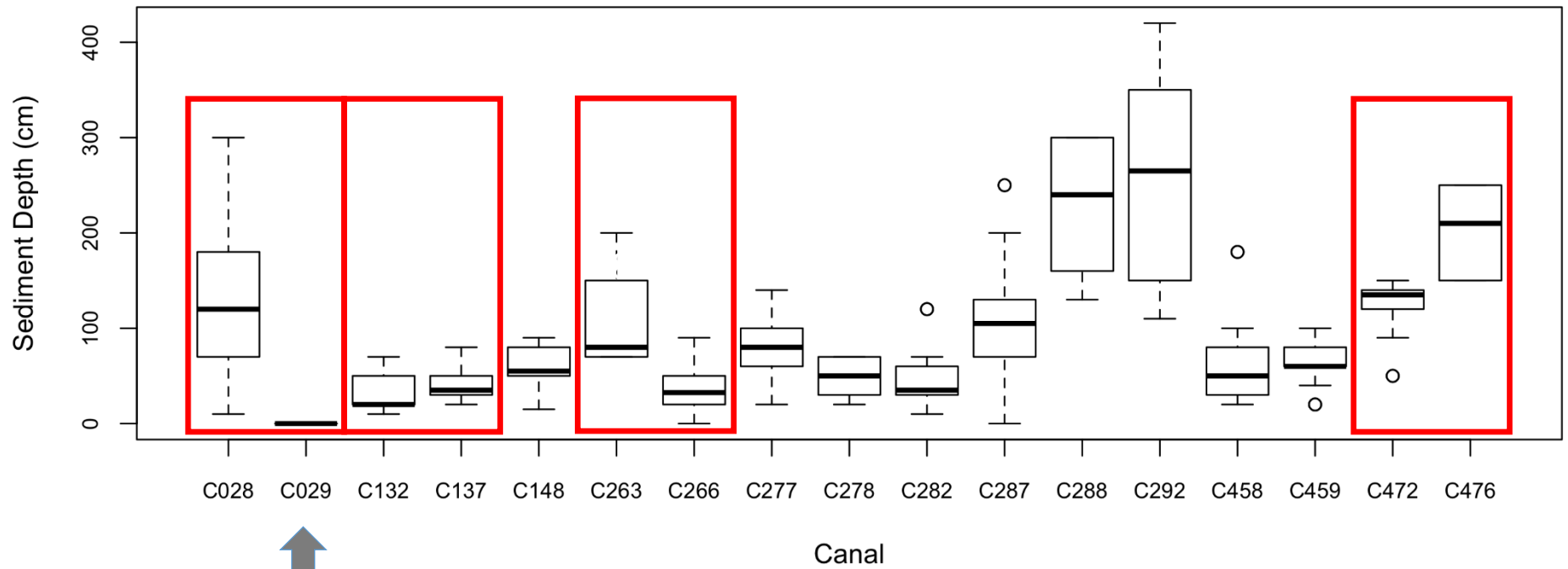
Muck Depth



Muck Depth

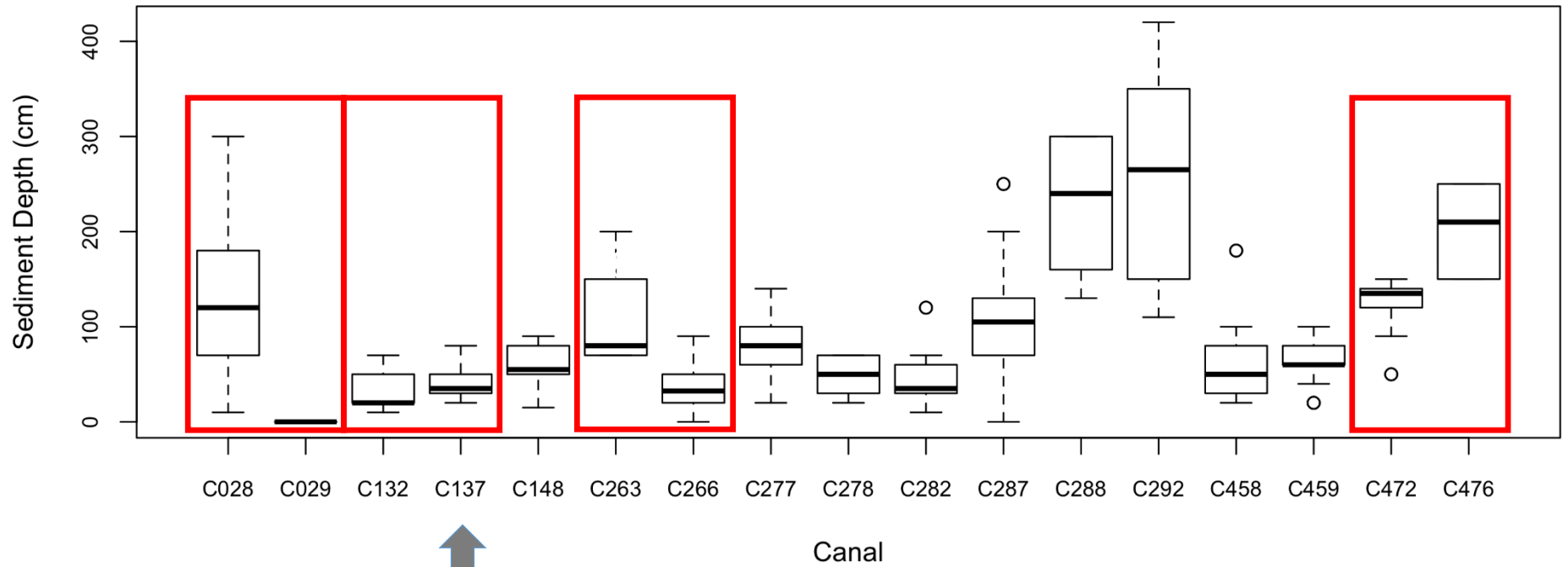


Muck Depth



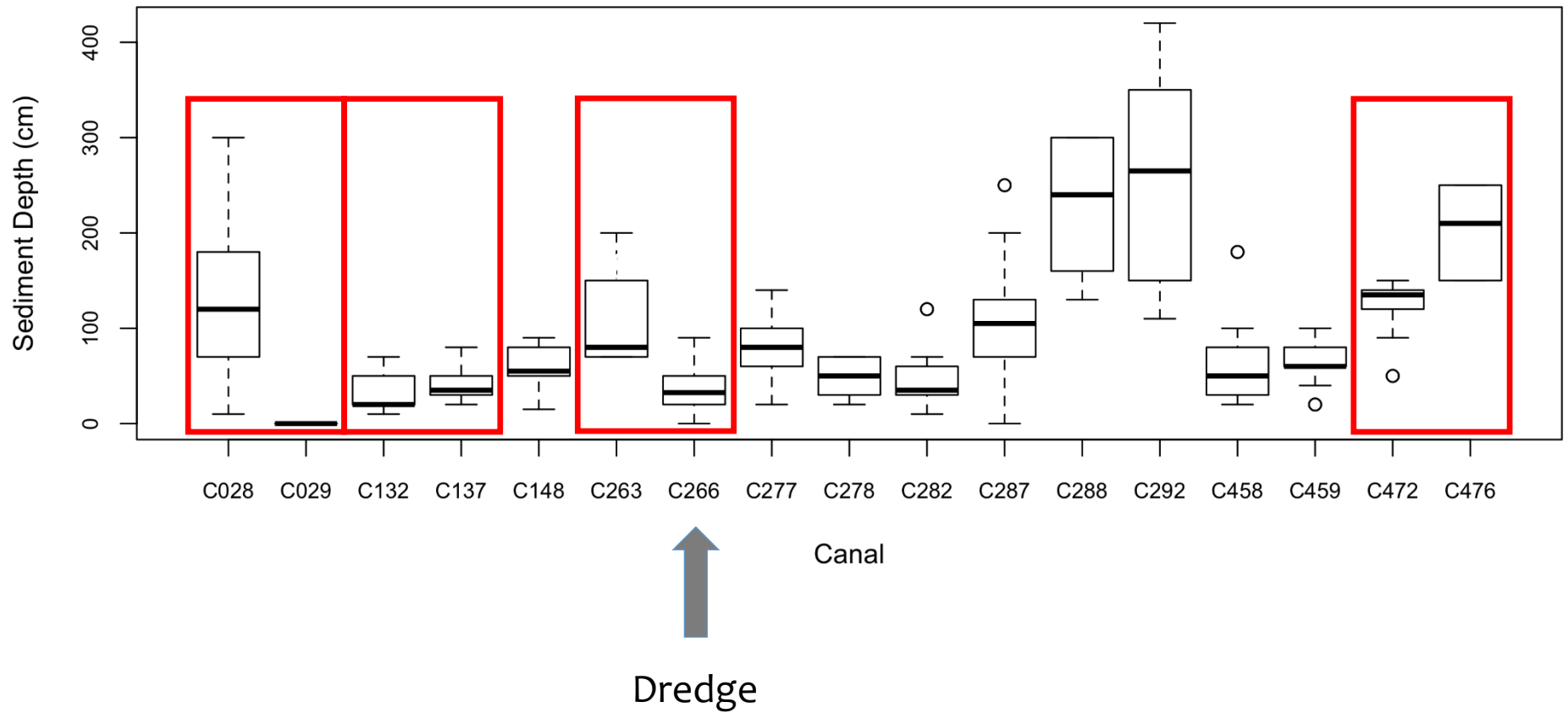
Backfill

Muck Depth

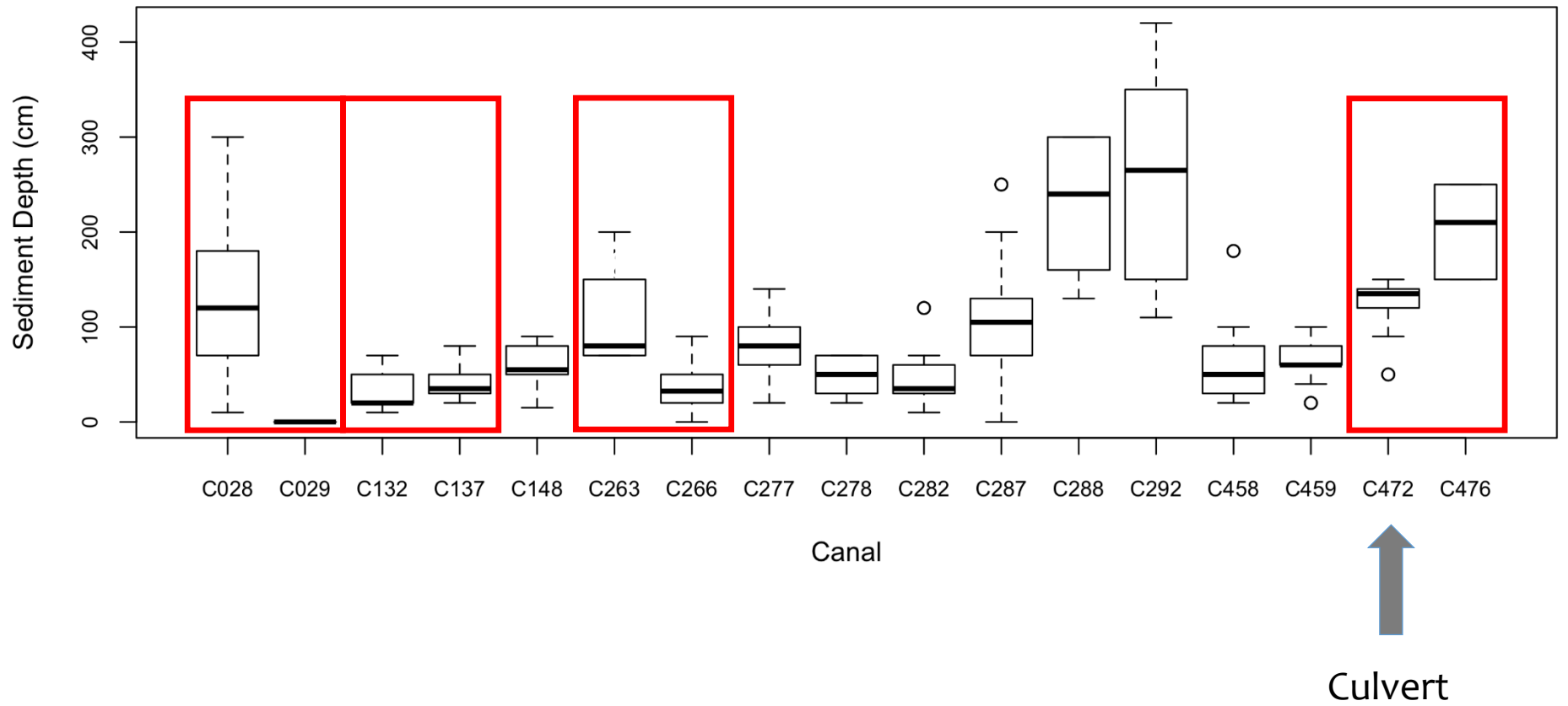


Weed Gate and aerator

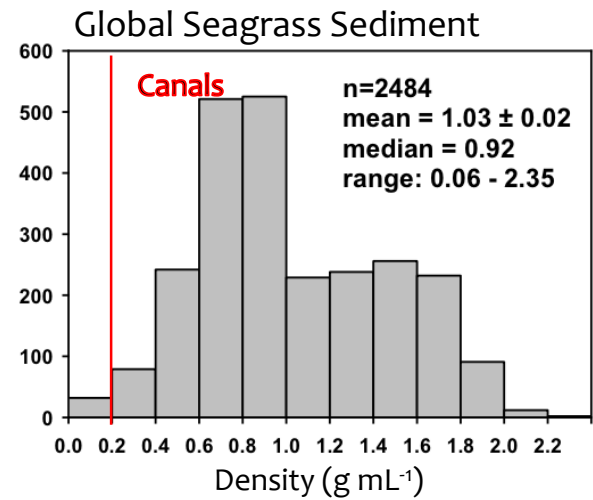
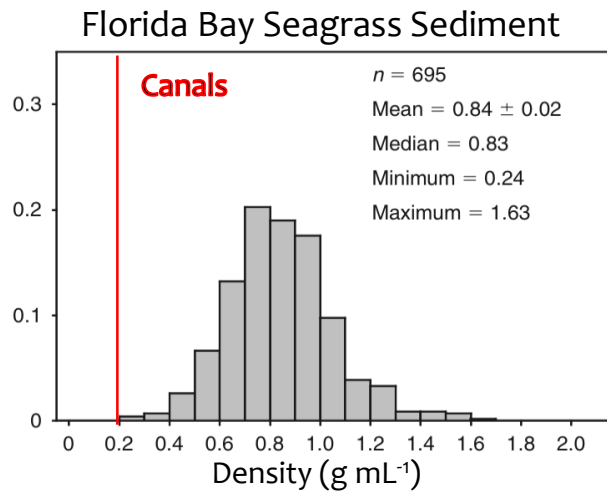
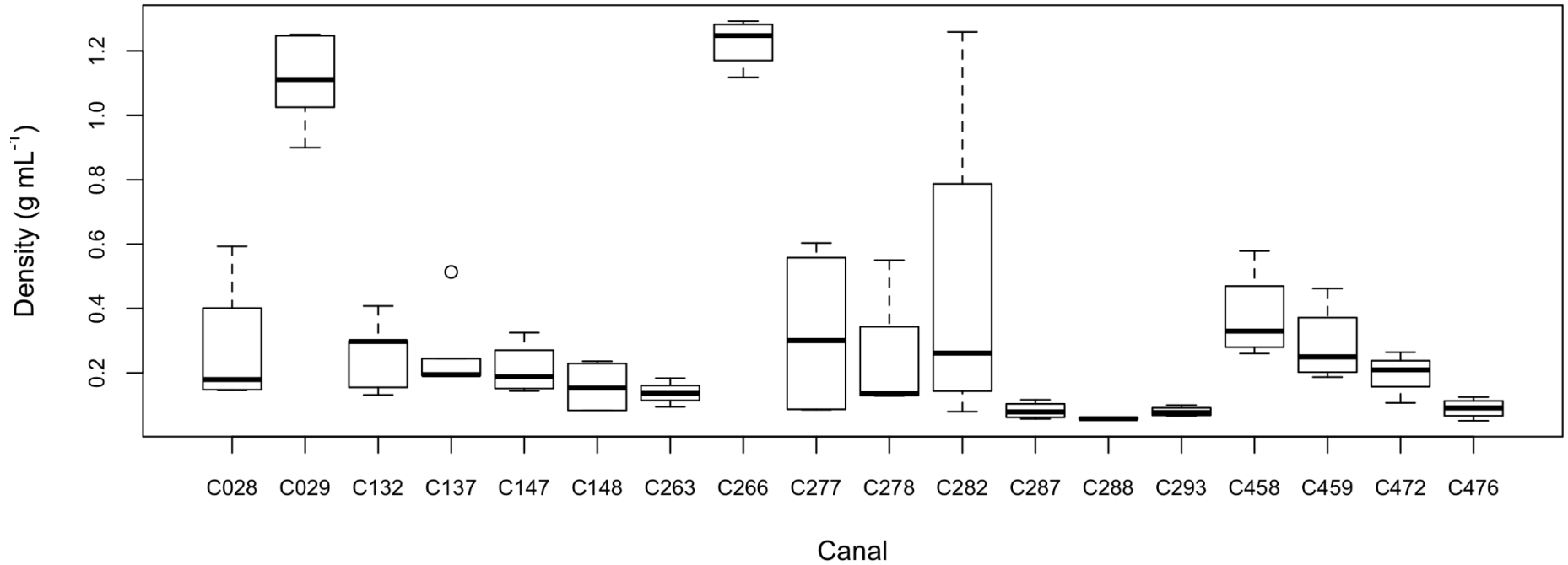
Muck Depth



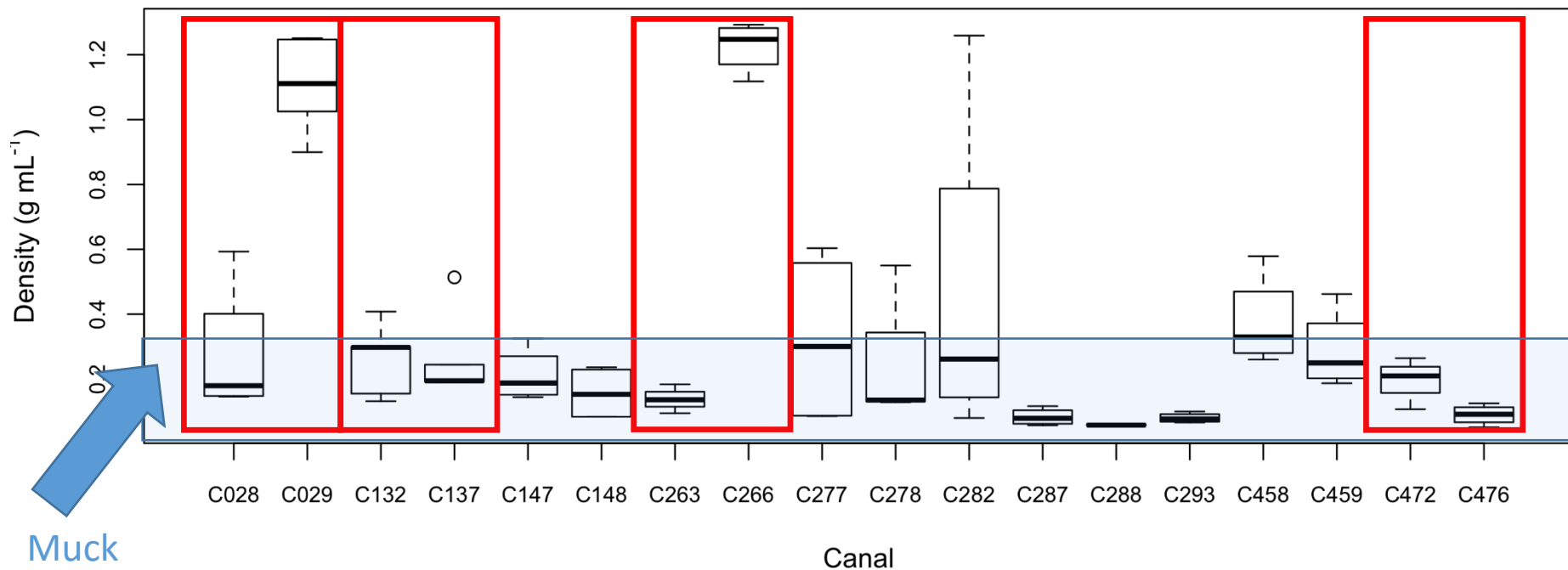
Muck Depth



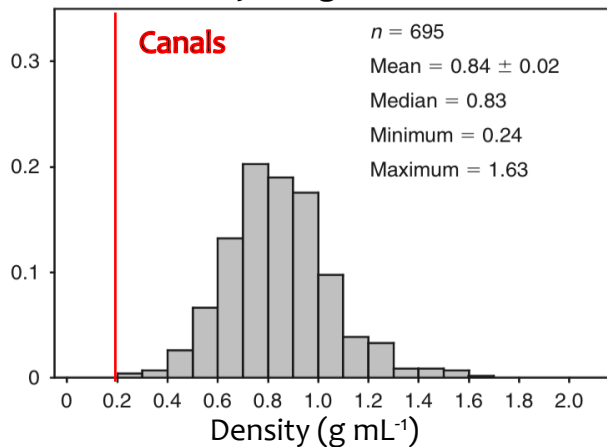
Sediment Density



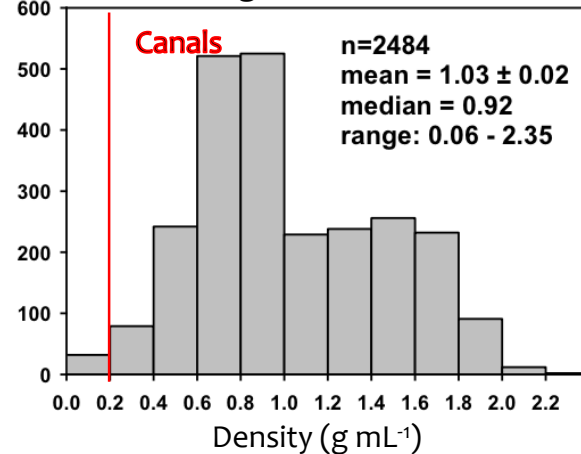
Sediment Density



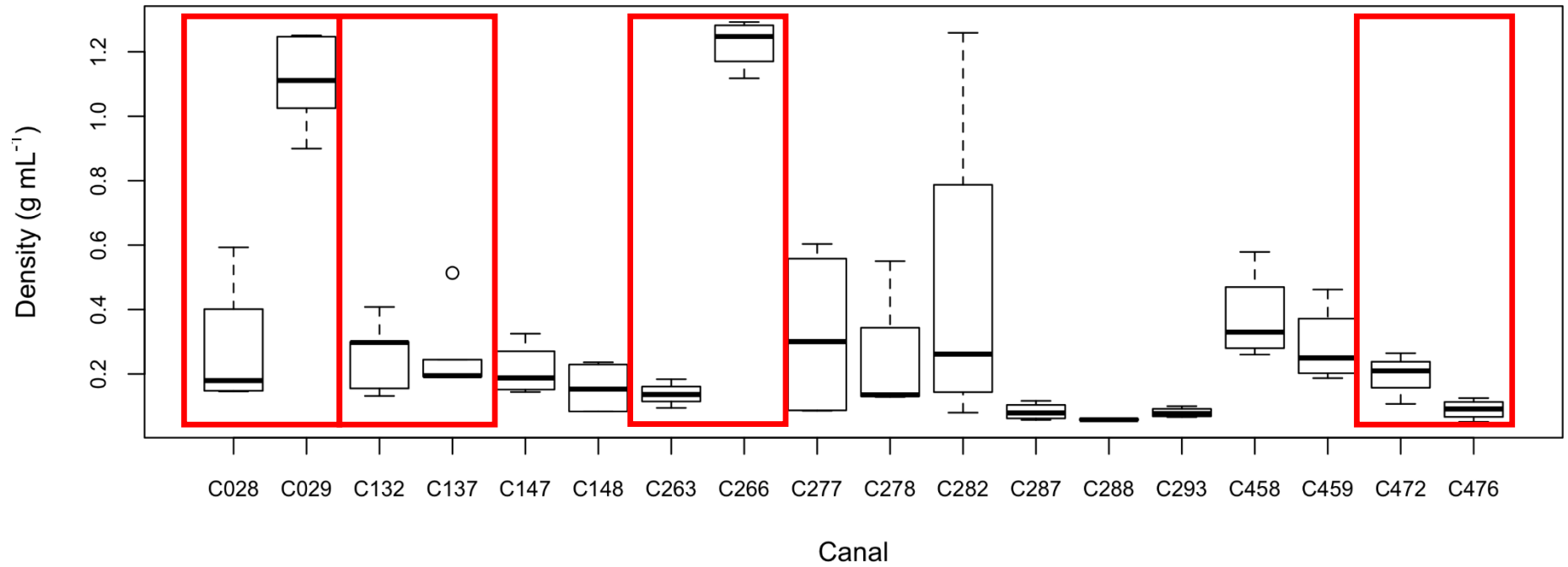
Florida Bay Seagrass Sediment



Global Seagrass Sediment

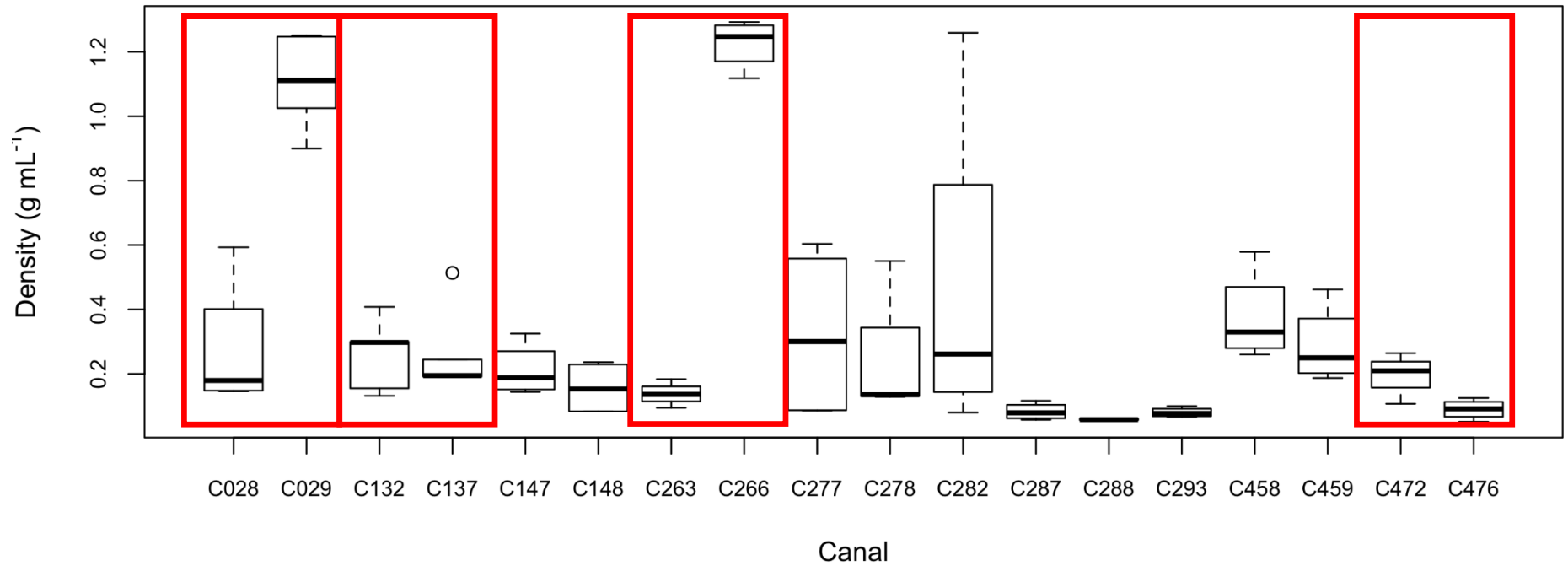


Sediment Density



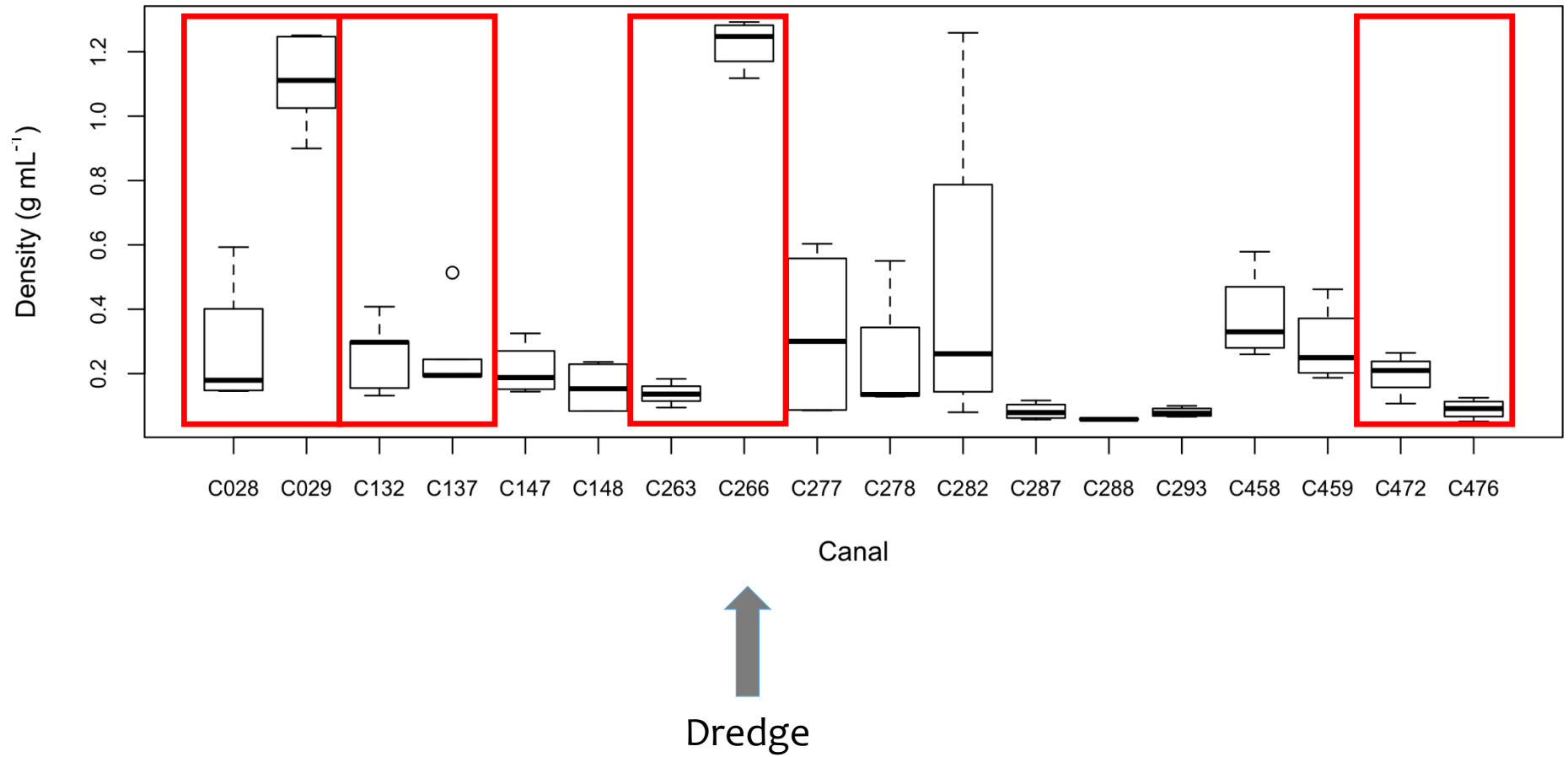
↑
Backfill

Sediment Density

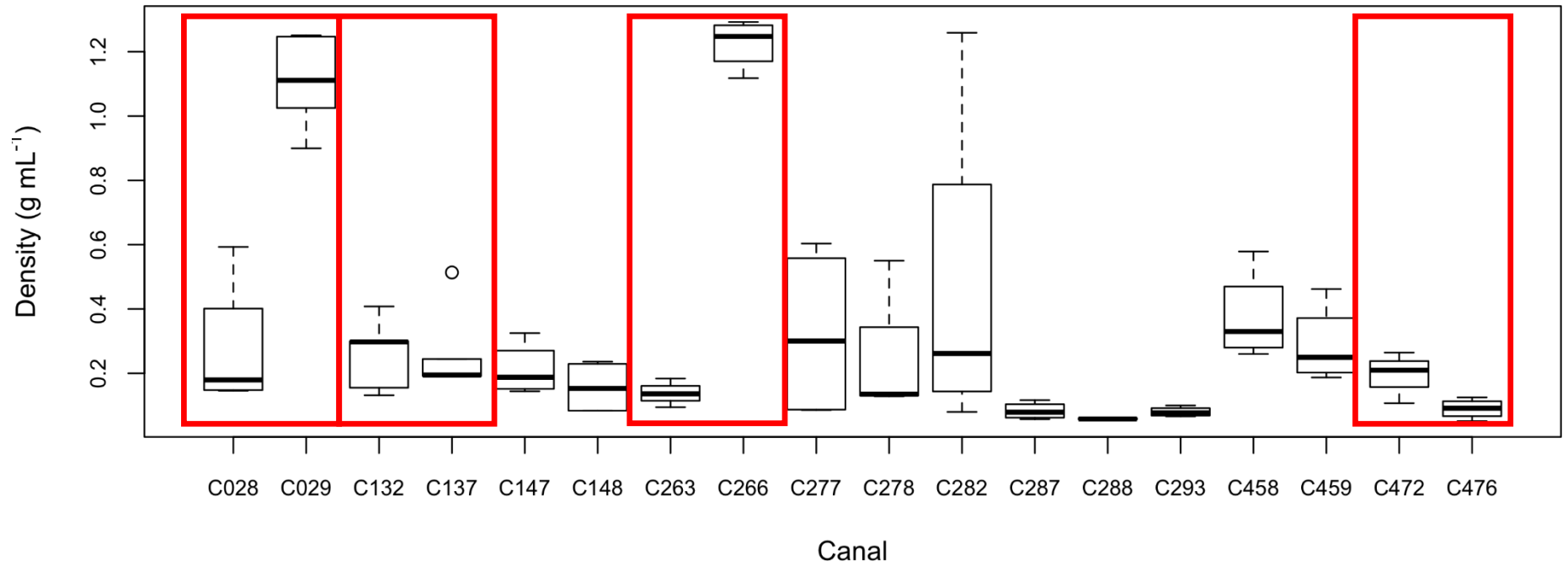


↑
Weed Gate and aerator

Sediment Density



Sediment Density



↑
Culvert

Effect on Seagrasses

Canal	Distance from Canal Mouth (m)				
	0	10	50	100	250

Thalassia testudinum

28	0	4	2	4	1
29	2	4	5	4	0
132	0	0	1	0	1
137	0	0	2	0	5
147	0	0	0	2	2
148	0	0	0	5	0
263	0	0	5	5	0
266	0	3	4	4	0
277	1	2	2	0	3
278	1	0	0.5	0	3
282	0	0	0	5	5
287	0	0	0	0	4
288	0	0	0	0	5
290	0	0	3	4	1
293	0	0	0	0	4
472	0	0	2	1	4
476	0	0	1	5	2



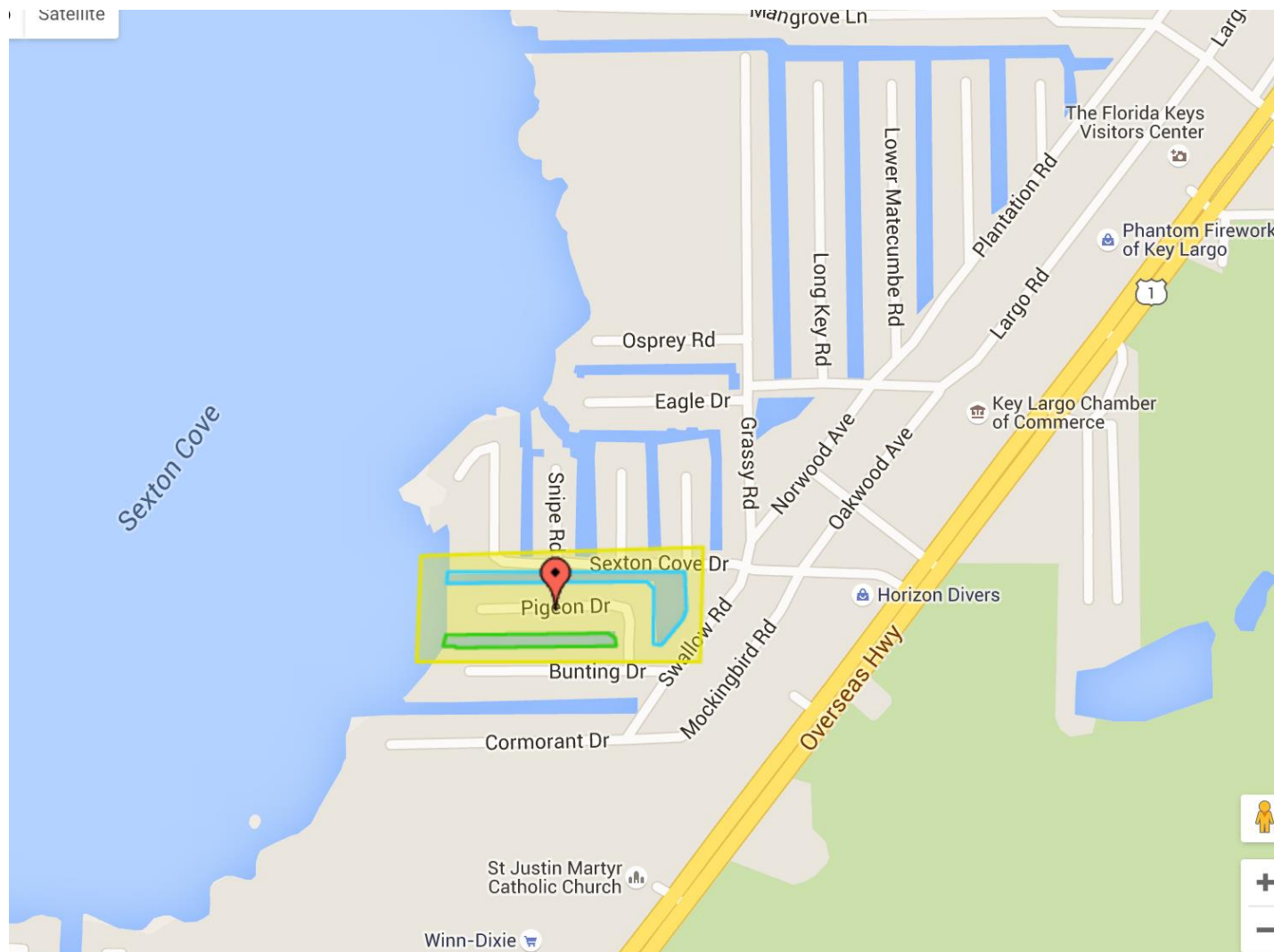
Canal	Distance from Canal Mouth (m)				
	0	10	50	100	250

Halodule wrightii

28	2	2	2	0	0
29	0	0	0	0	2
132	0	0	0	0	0
137	0	0	0	1	0
147	1	0	4	3	3
148	2	0	0	0	0
263	0	0	0	0	0
266	0	3	0	0	0
277	2	3	2	4	0
278	5	3	5	4	0
282	0	0	3	2	0
287	0	0	0	0	0
288	0	0	0	0	0
290	0	0	0	0	0
293	0	0	0	0	0
472	0	2	2	1	0
476	0	0	1	0	0



Canal 28 and 29





L28

Q4

WHIRL-PAK. Nisco WHIRL-PAK. Nisco WHIRL-PAK.

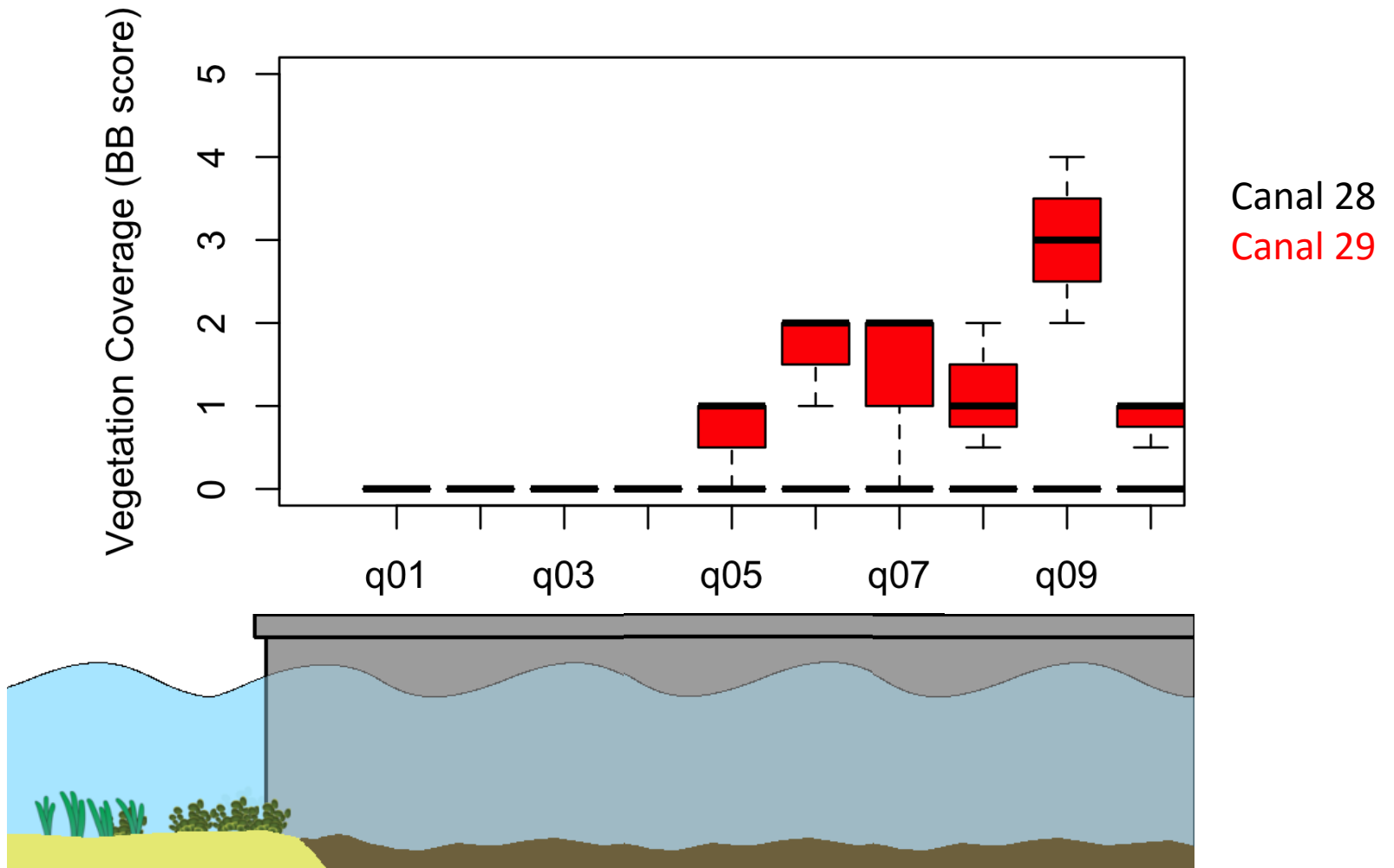
YAMAHA

150

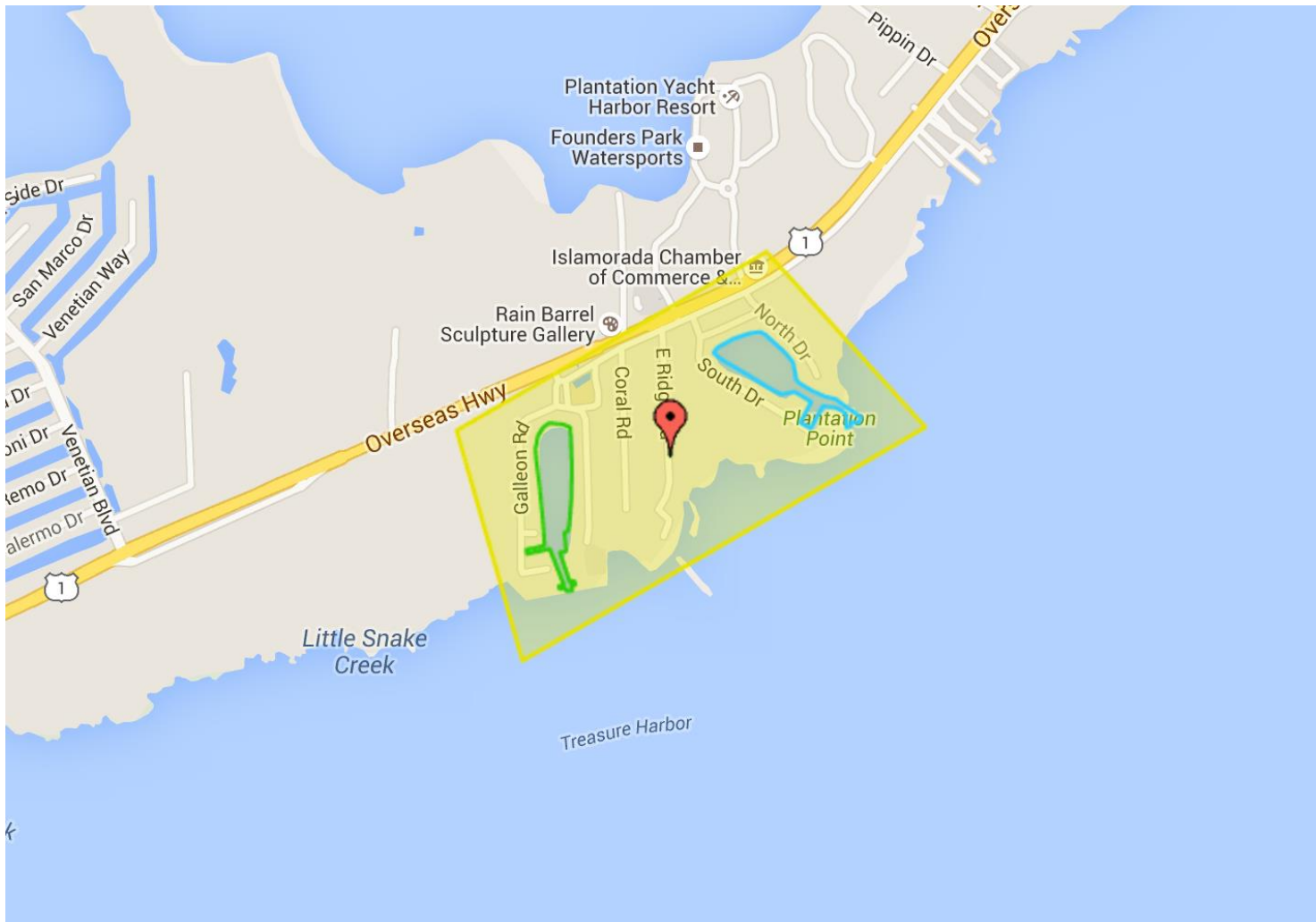




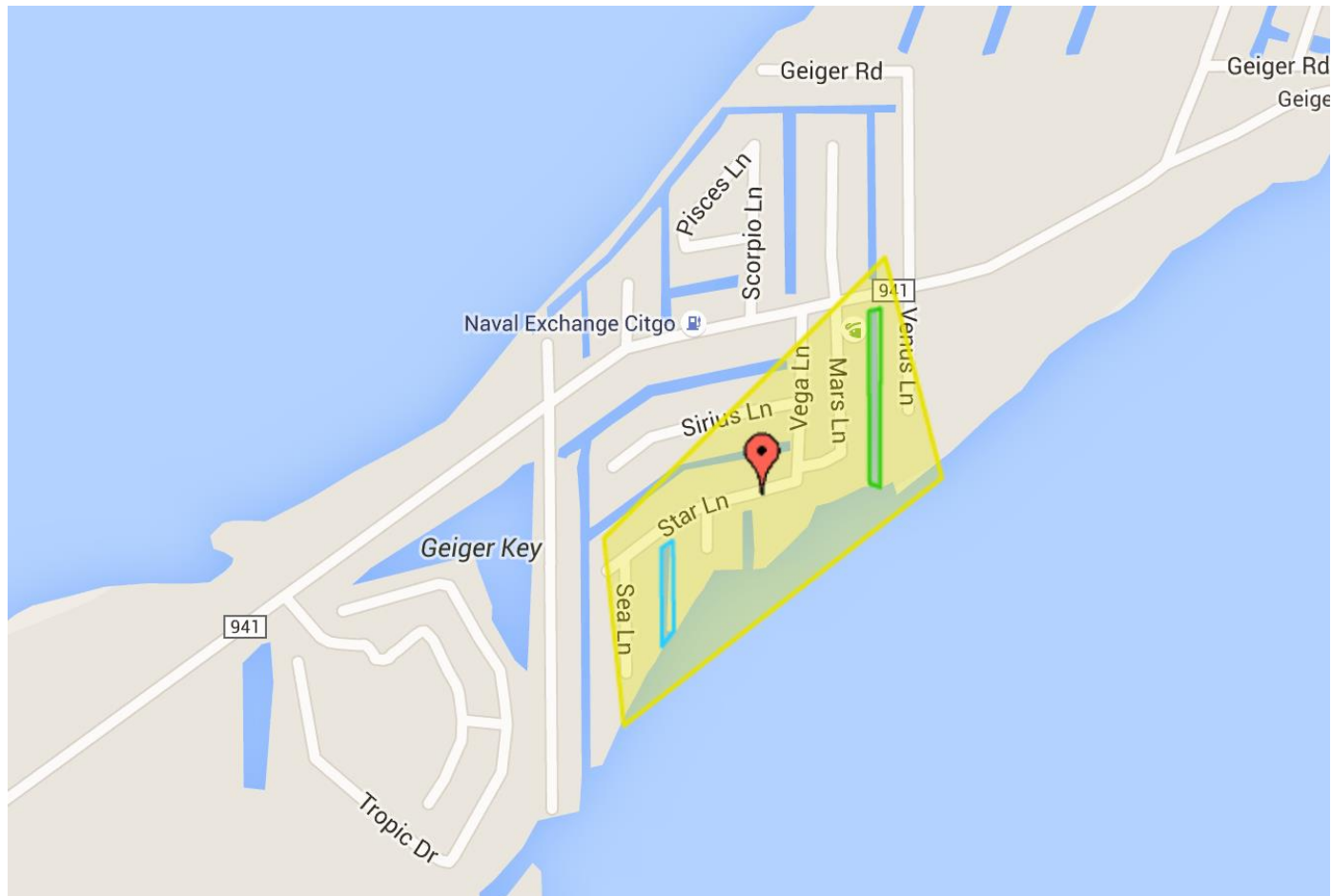
Canals 28 and 29



Canal 132 and 137



Canal 472

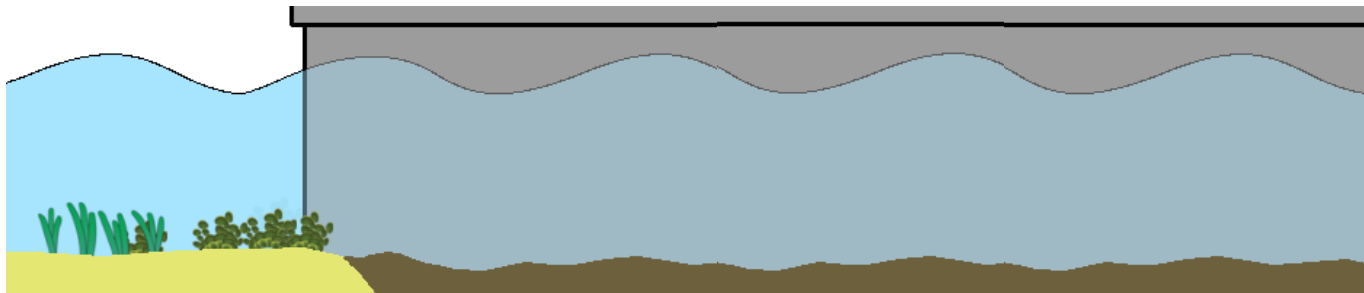
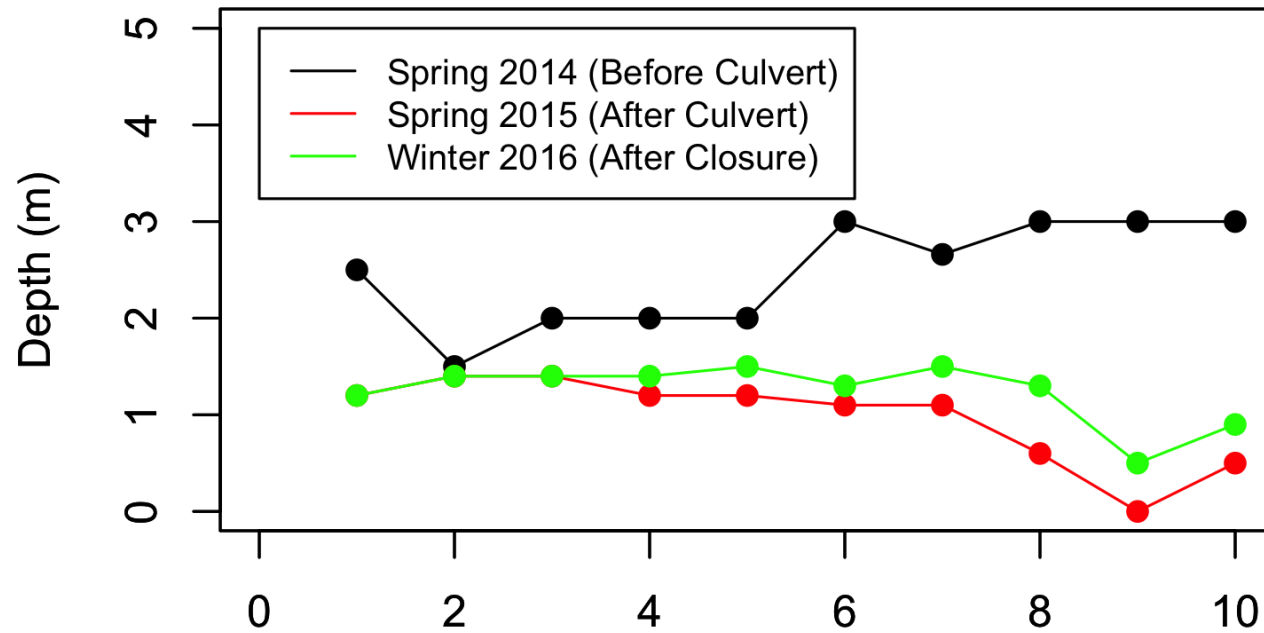




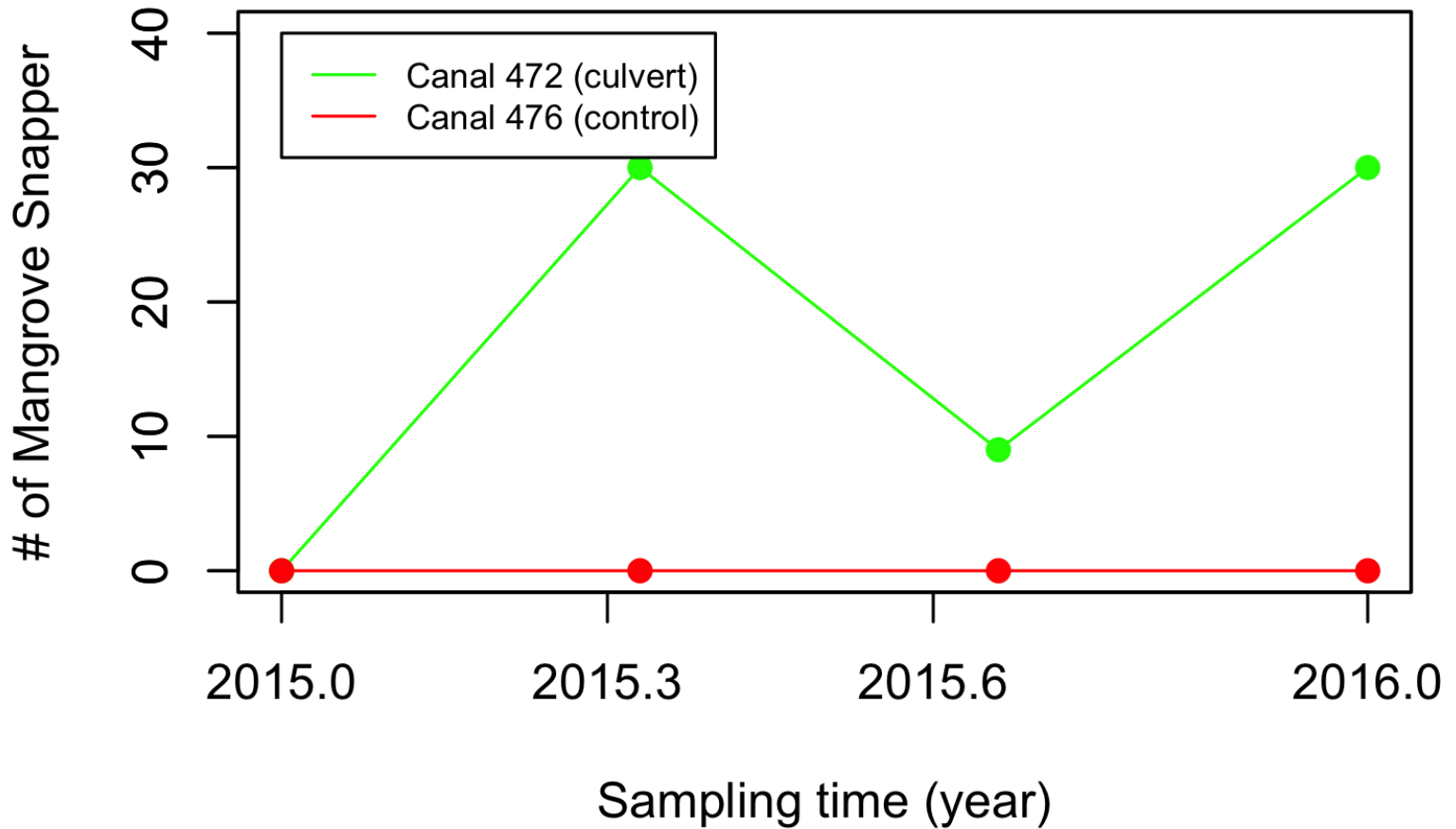




Canal 472



Canal 472



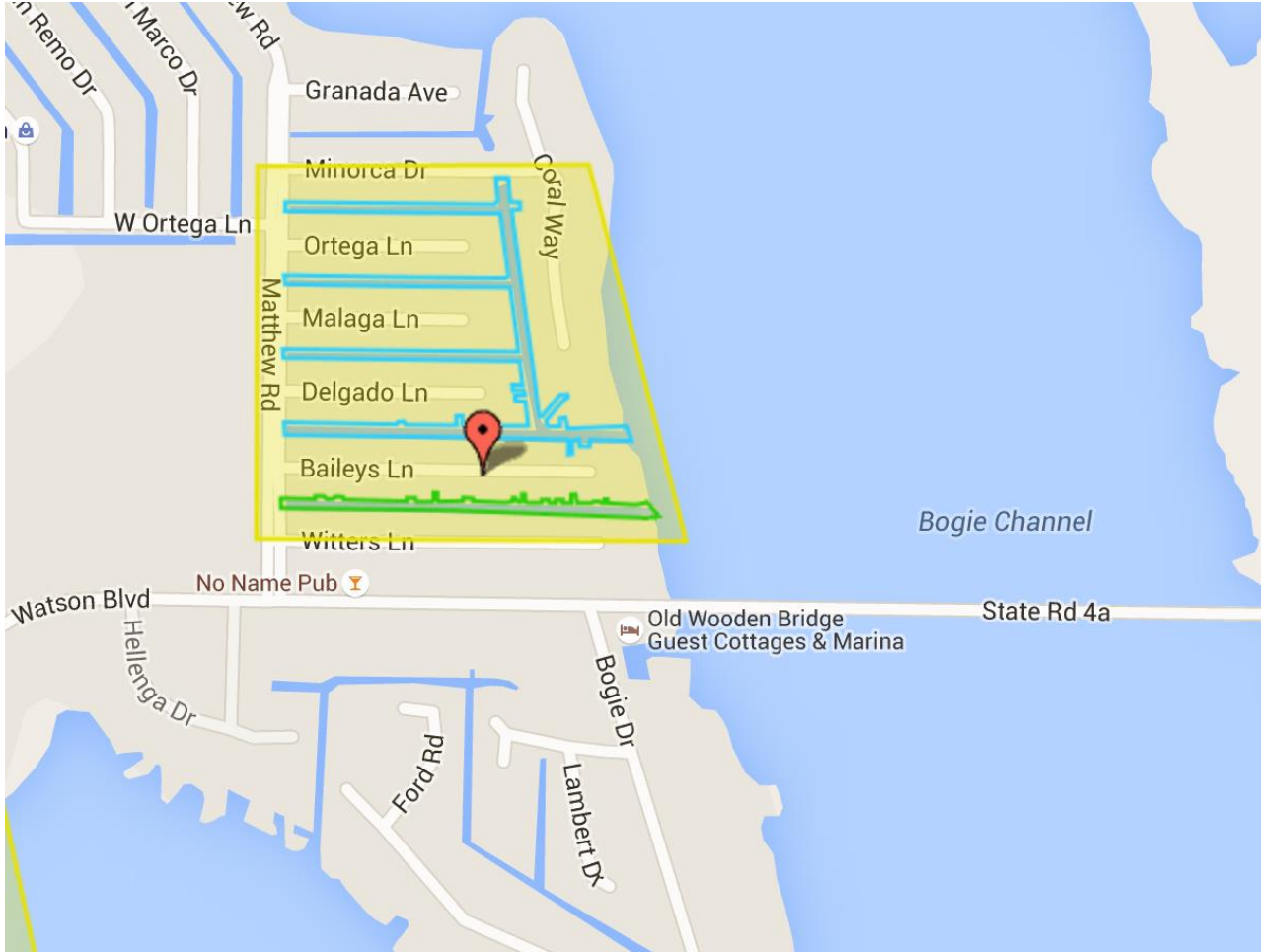
Conclusions

- Most remediation Techniques are showing positive results on sediments
- Plant responses are delayed from remediation
- Canals are affecting adjacent waters
Further sampling required to assess the effects of remediation on adjacent waters



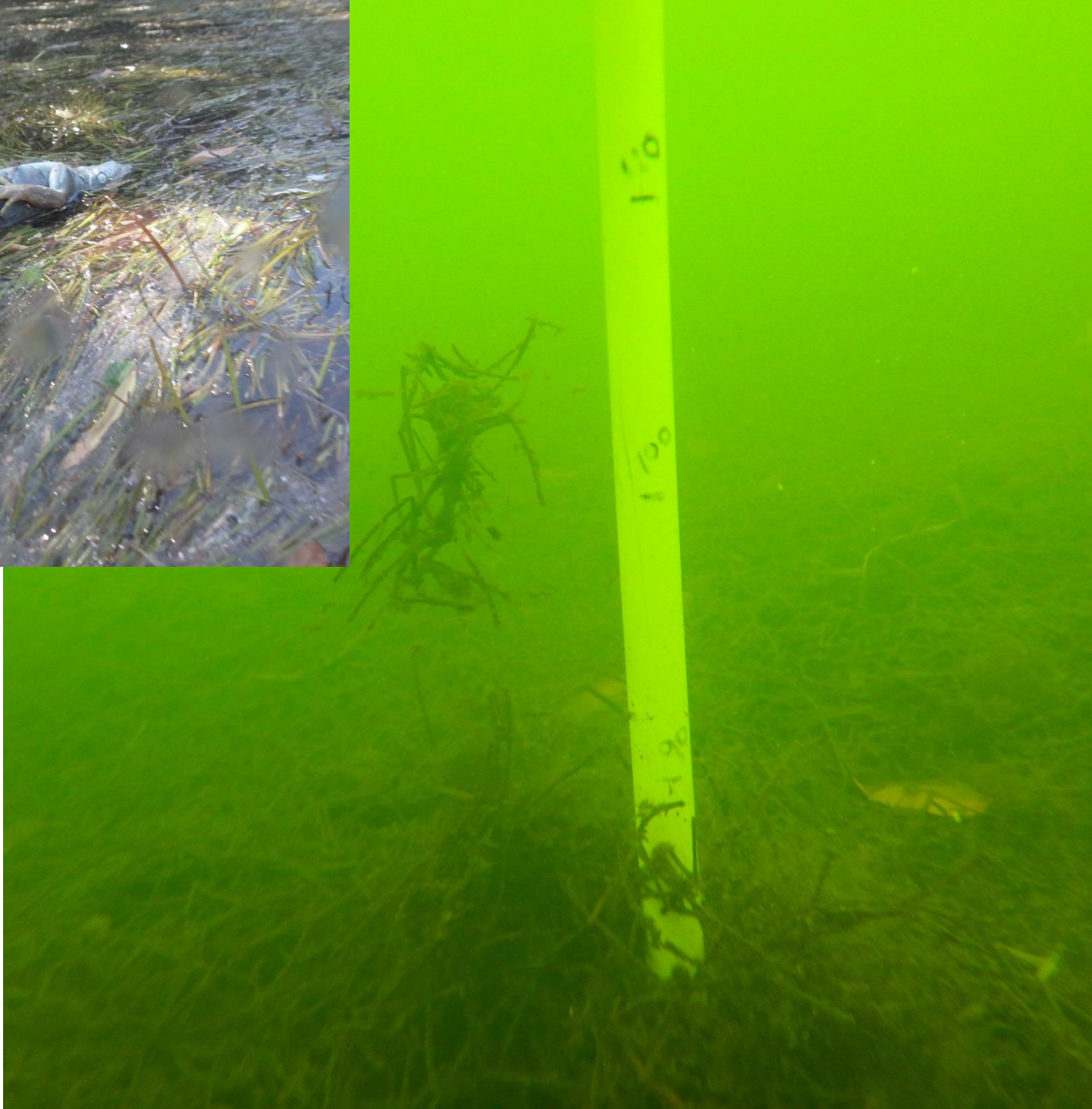
<http://seagrass.fiu.edu>
jhowa033@fiu.edu

Canal 266



Canal 266- Before Dredging

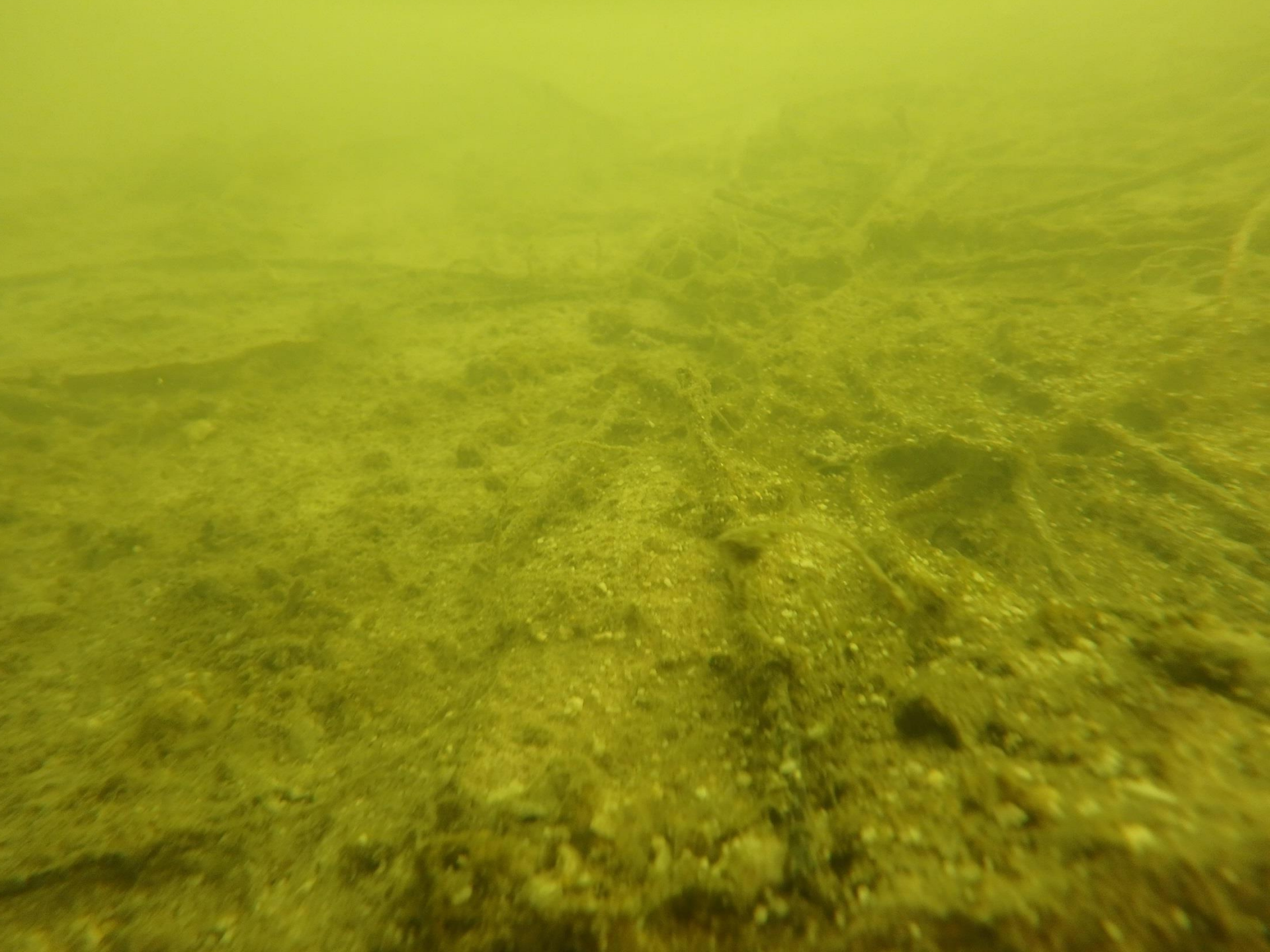




Canal 263-
Control

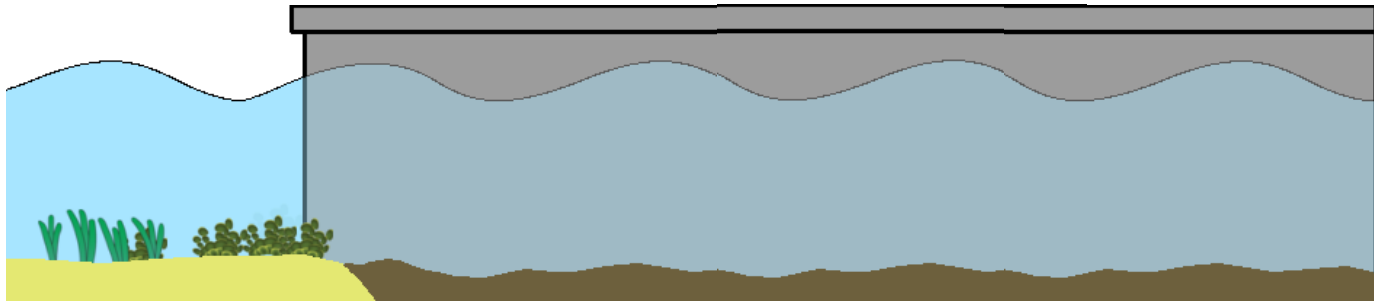
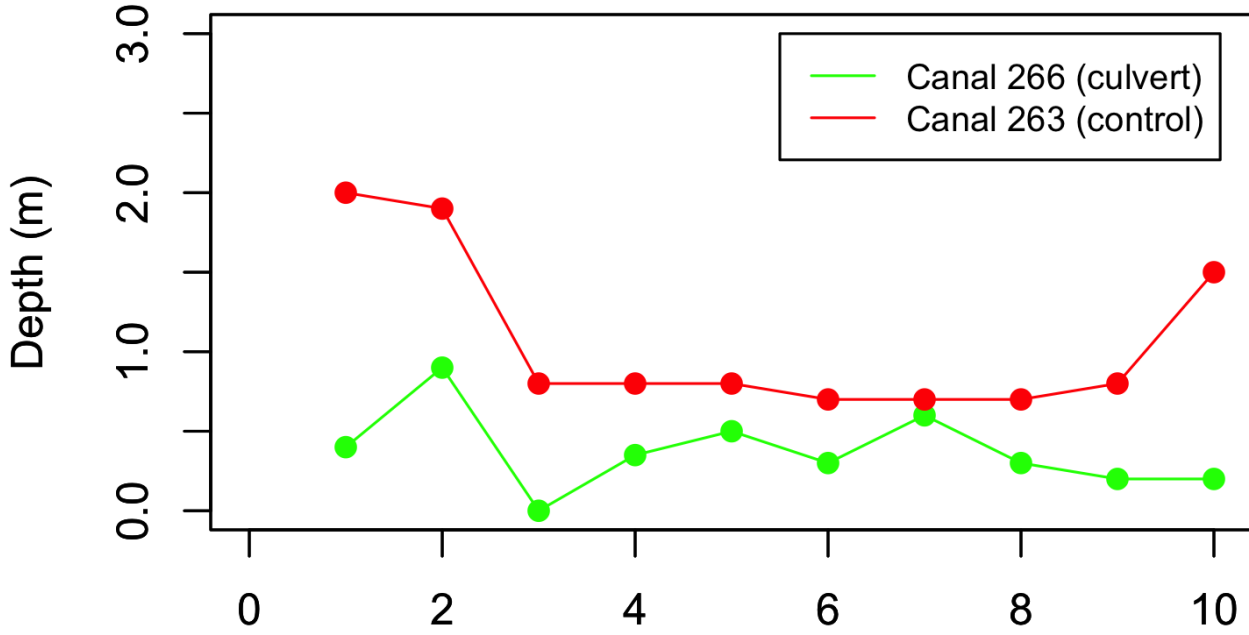
Canal 266- After Dredging



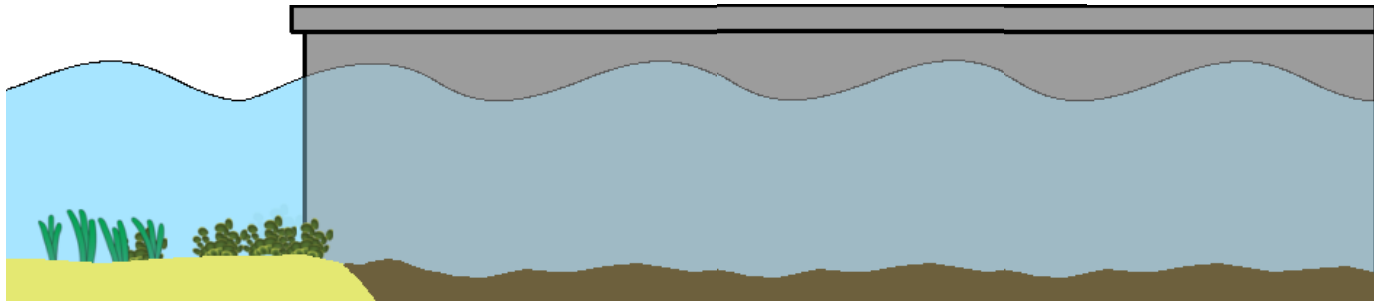
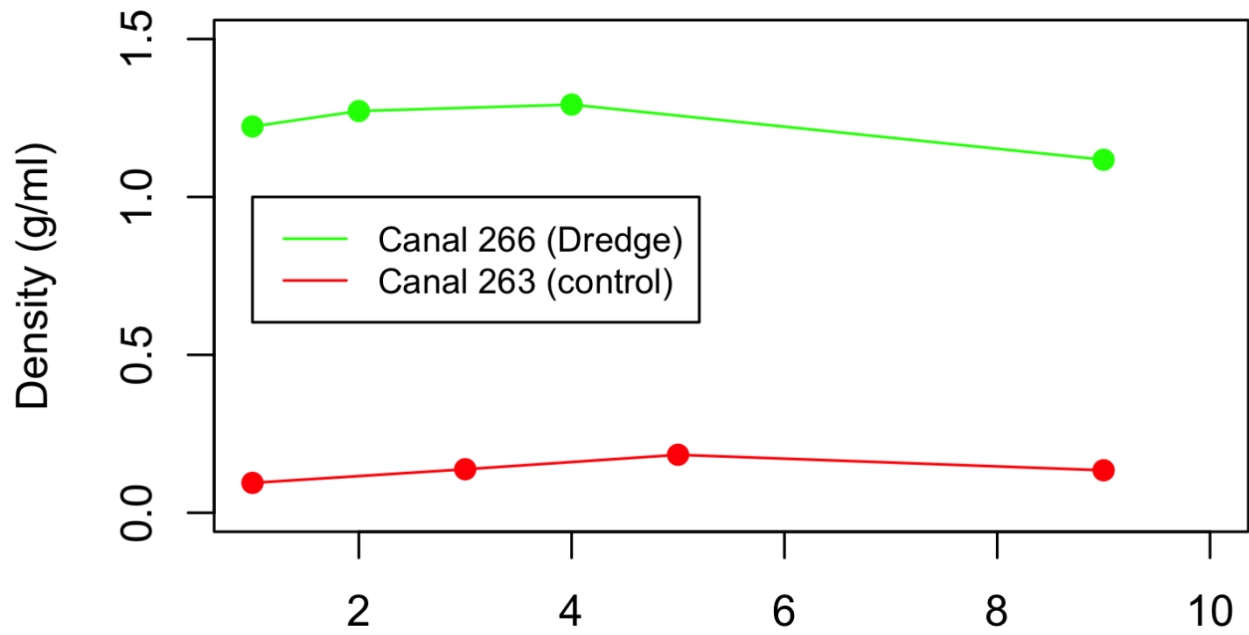




Canal 266

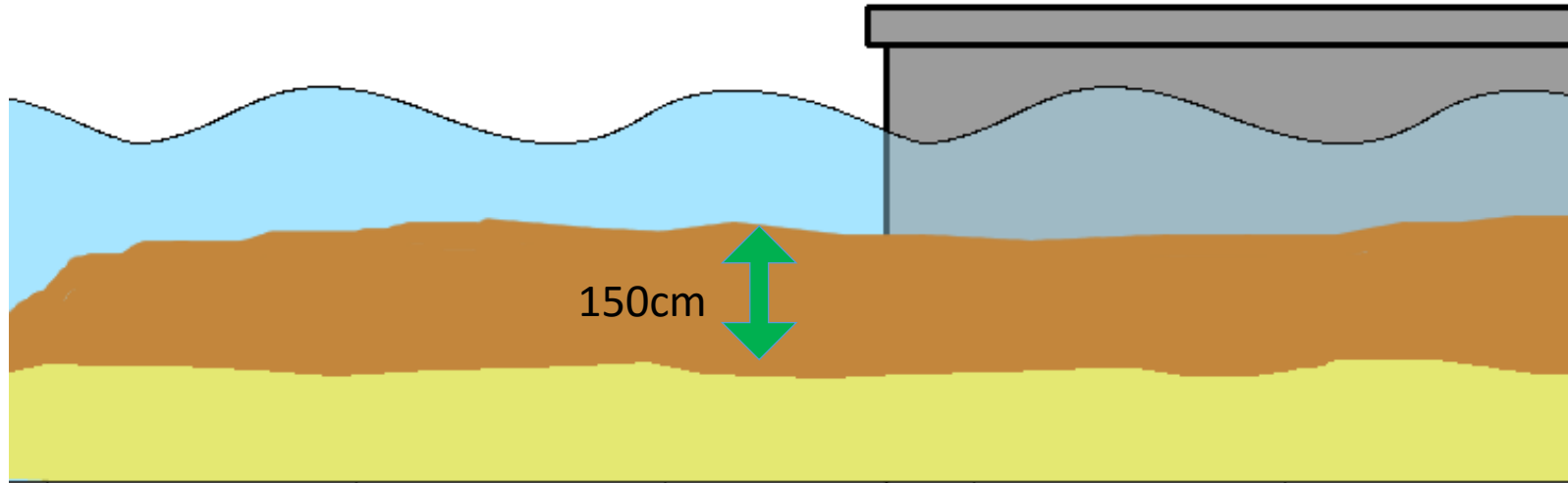


Canal 266



Canal 266

Before
Dredging



After
Dredging

