FKNMS
Benthic Habitat Monitoring Program

FKNMS Steering Committee Meeting, March 2, 2016, Marathon, FL

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

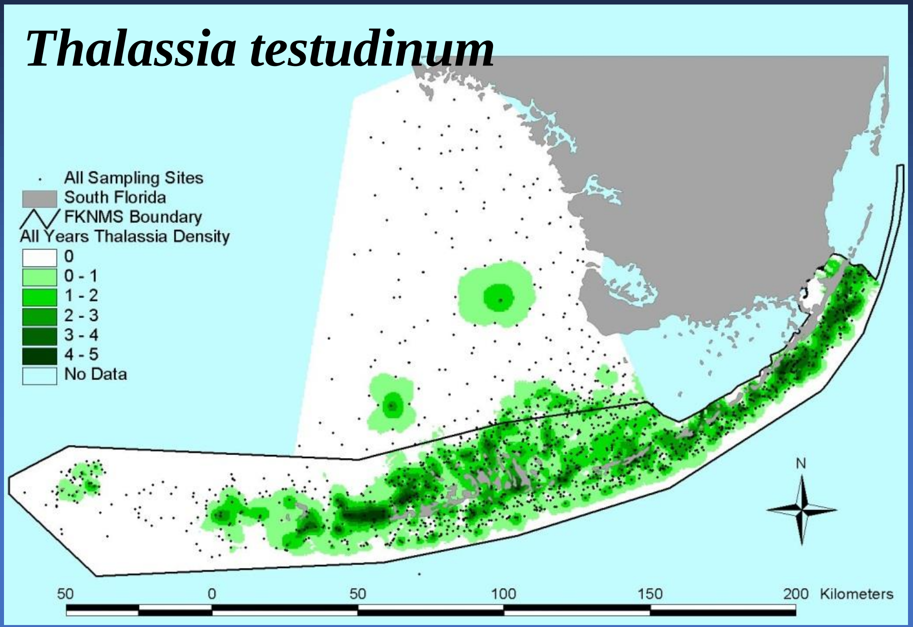
- Seagrass nutrient availability using tissue concentration assays and stable isotopic analyses
  - 40 permanent sites 2 times a year
  - Ca. 200 mapping sites/year

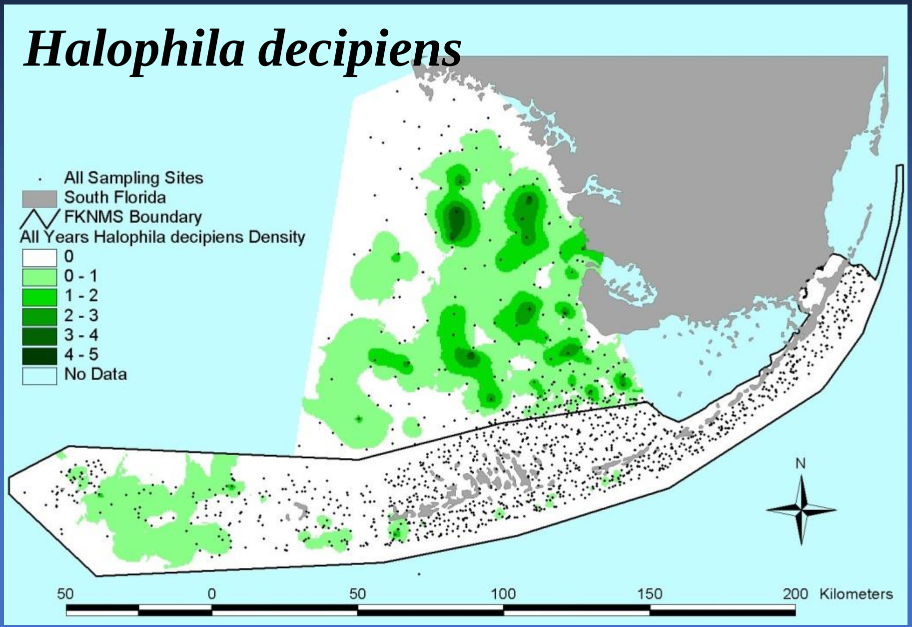
- Water column physicochemical data
  - Sites co-located with water quality sites
  - 40 permanent sites 2 times a year in addition to quarterly water quality sampling (Briceño)

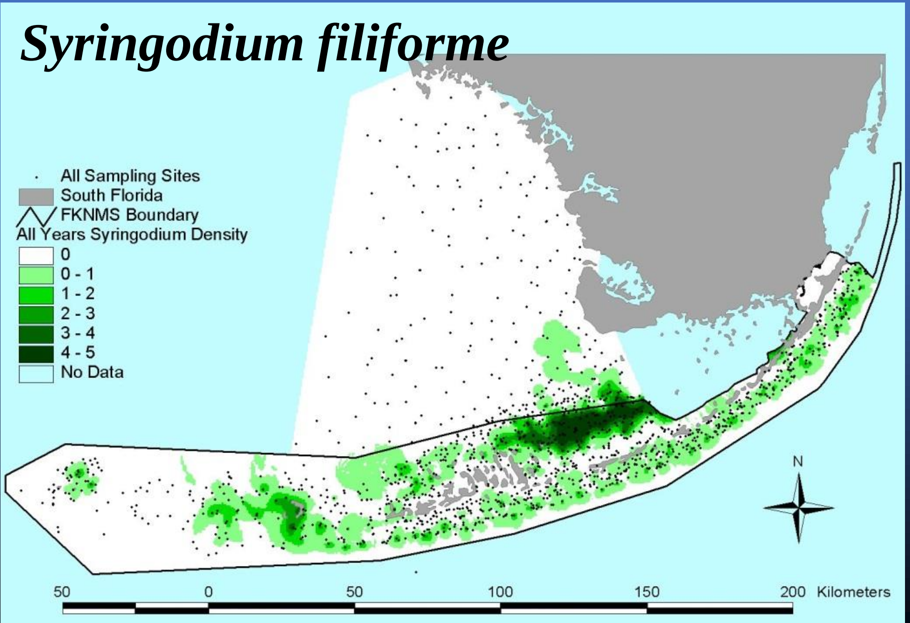
Major project accomplishments:

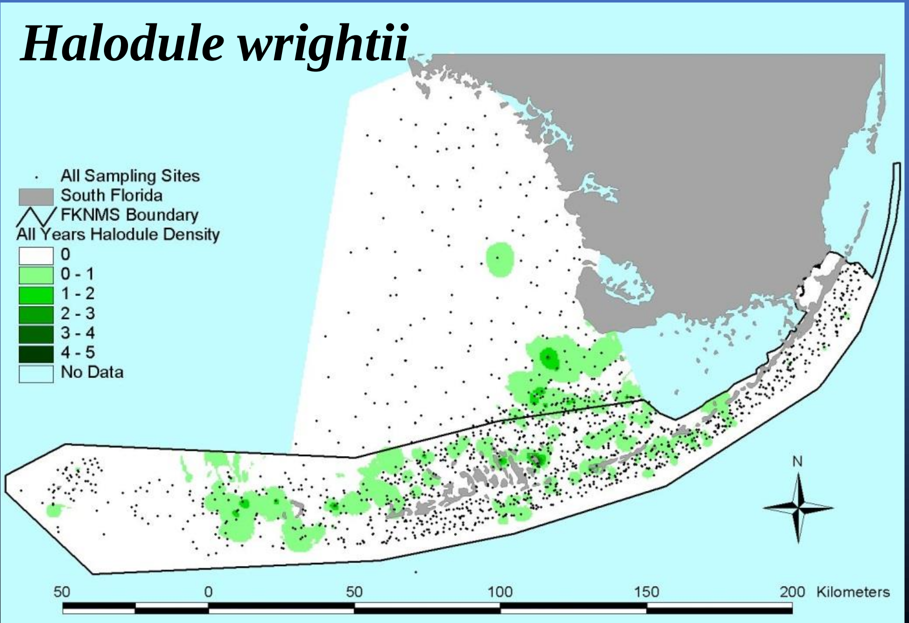
- We have defined the spatial extent and species composition of the largest documented seagrass bed on earth, and solidly defined a baseline to assess change.
- We have defined the spatial and temporal pattern of seagrass community dynamics in the FKNMS and made predictions about future trajectories.
- 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

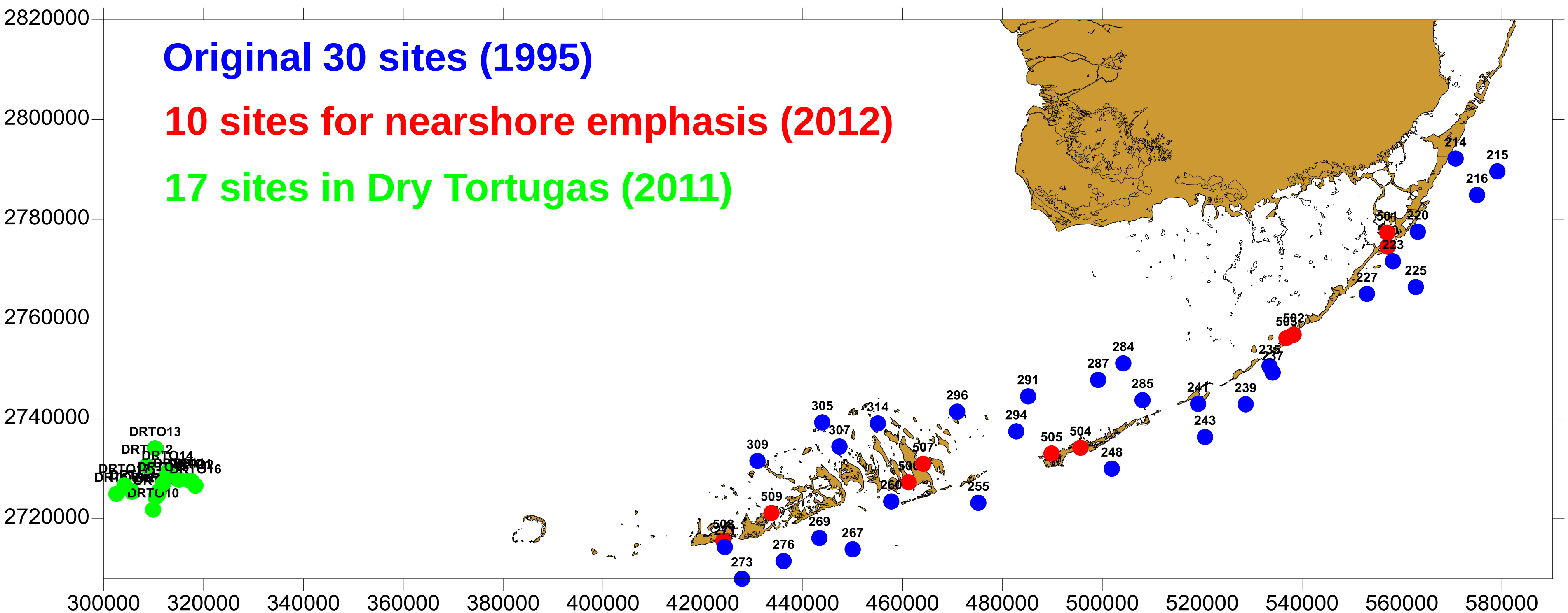




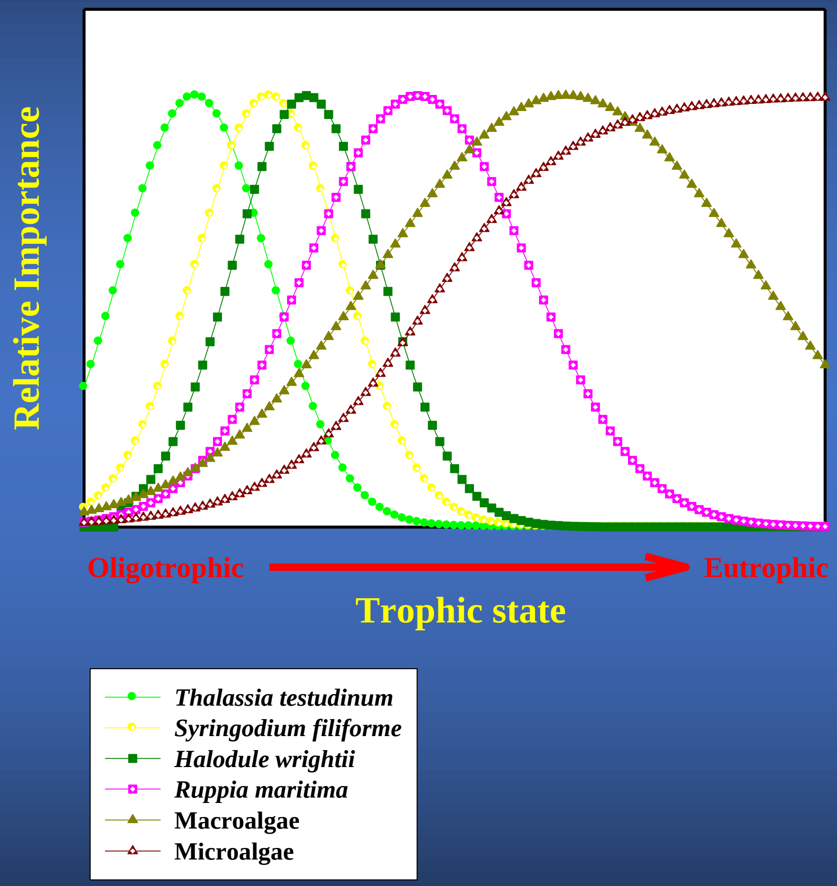




Benthic Habitat Permanent Monitoring Sites



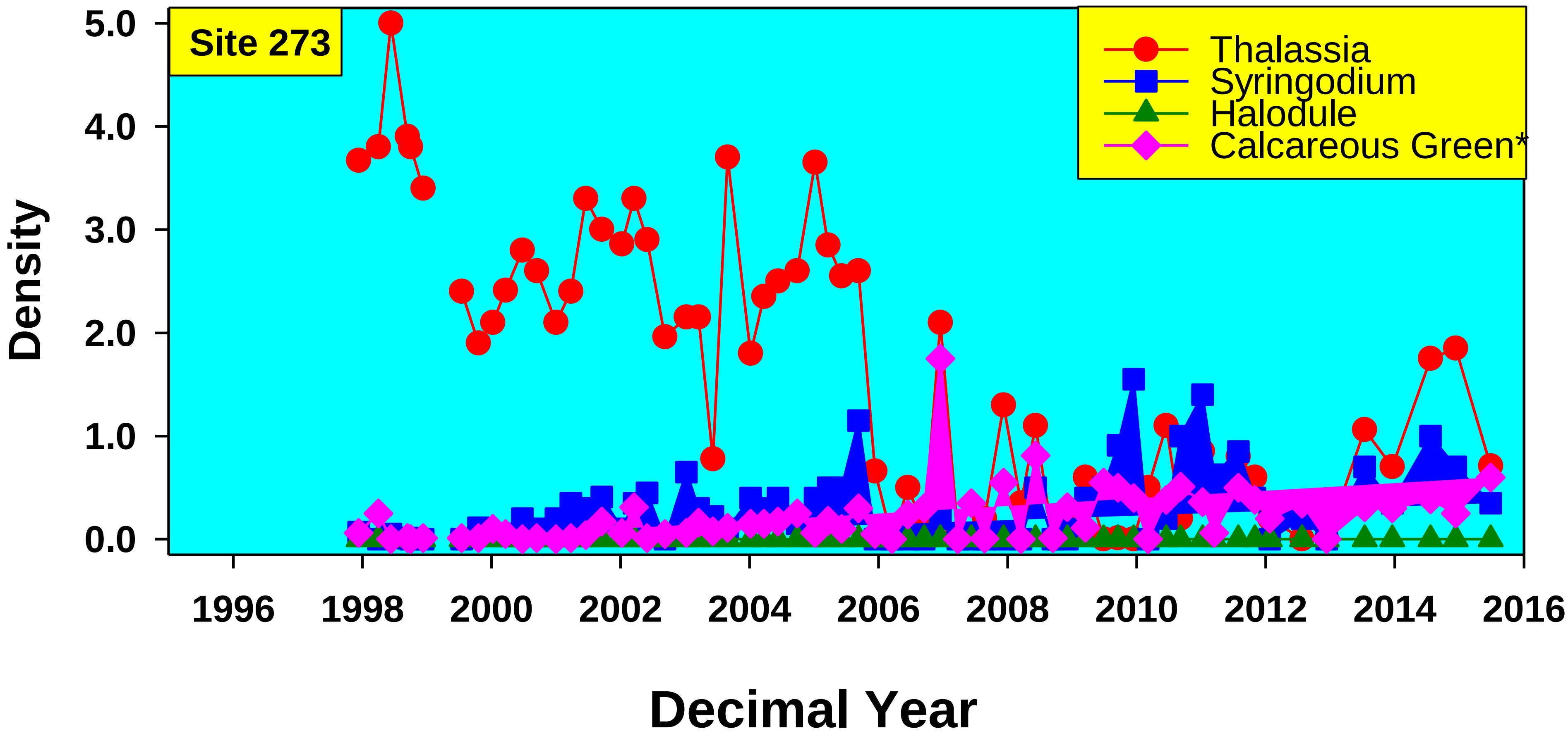
Eutrophication model



Explicit model of ecosystem behavior #1

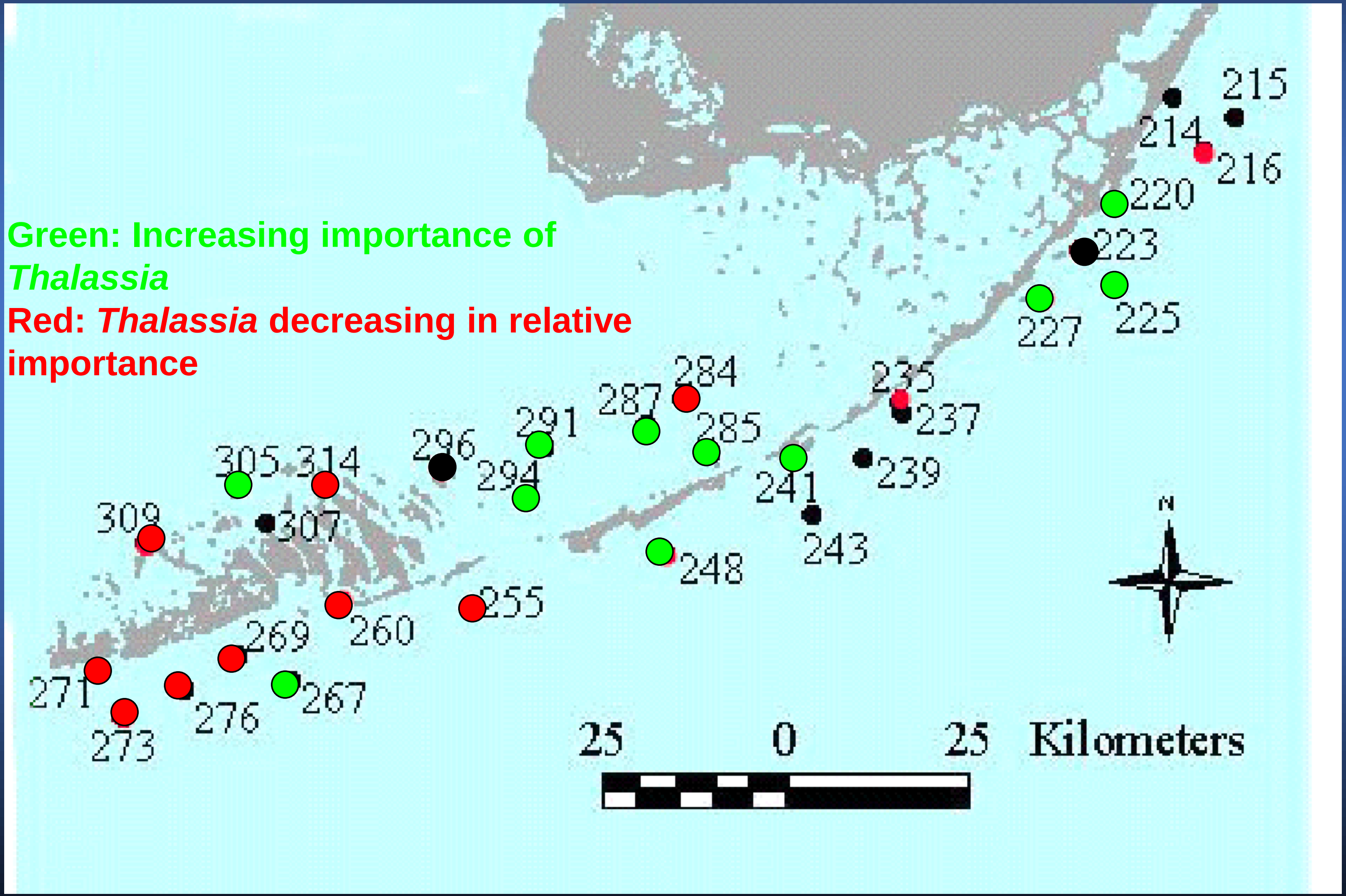
Nutrient pollution will lead to changes in relative abundances of primary producers in a predictable way.

Changes in relative abundance of primary producers



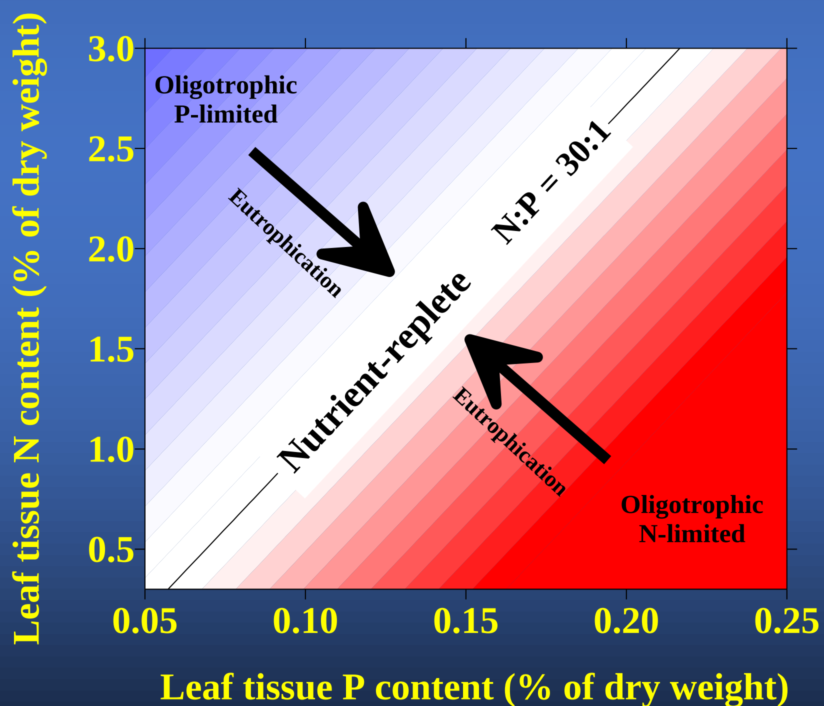
Changes in relative abundance of primary producers

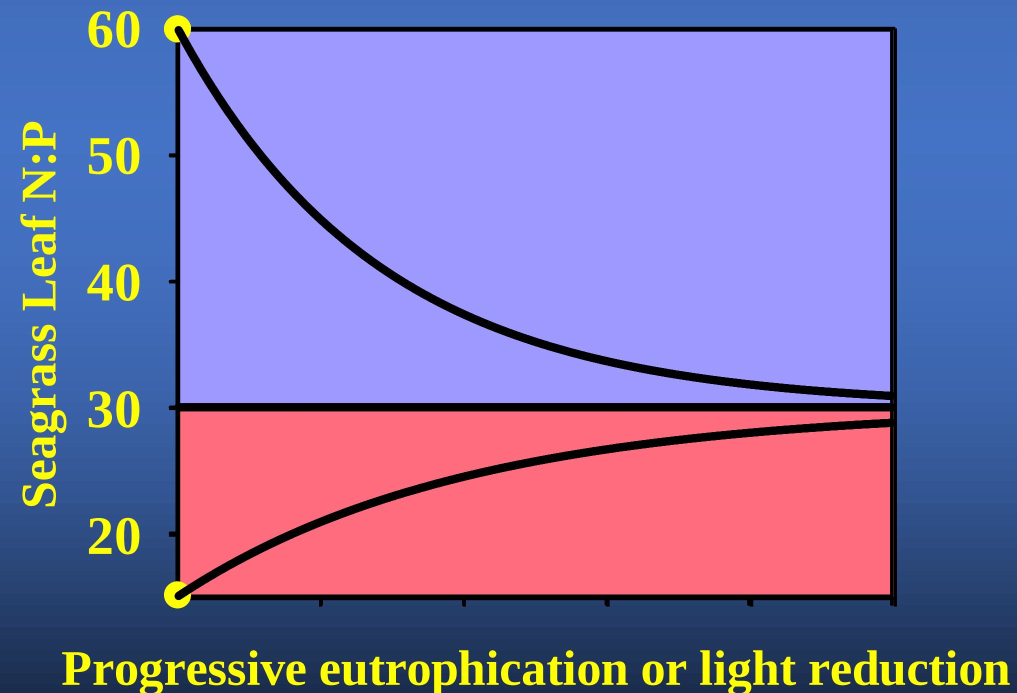
At 22 of 30 sites, species composition has shifted in a manner consistent with increased nutrient availability



Explicit model of ecosystem behavior #2

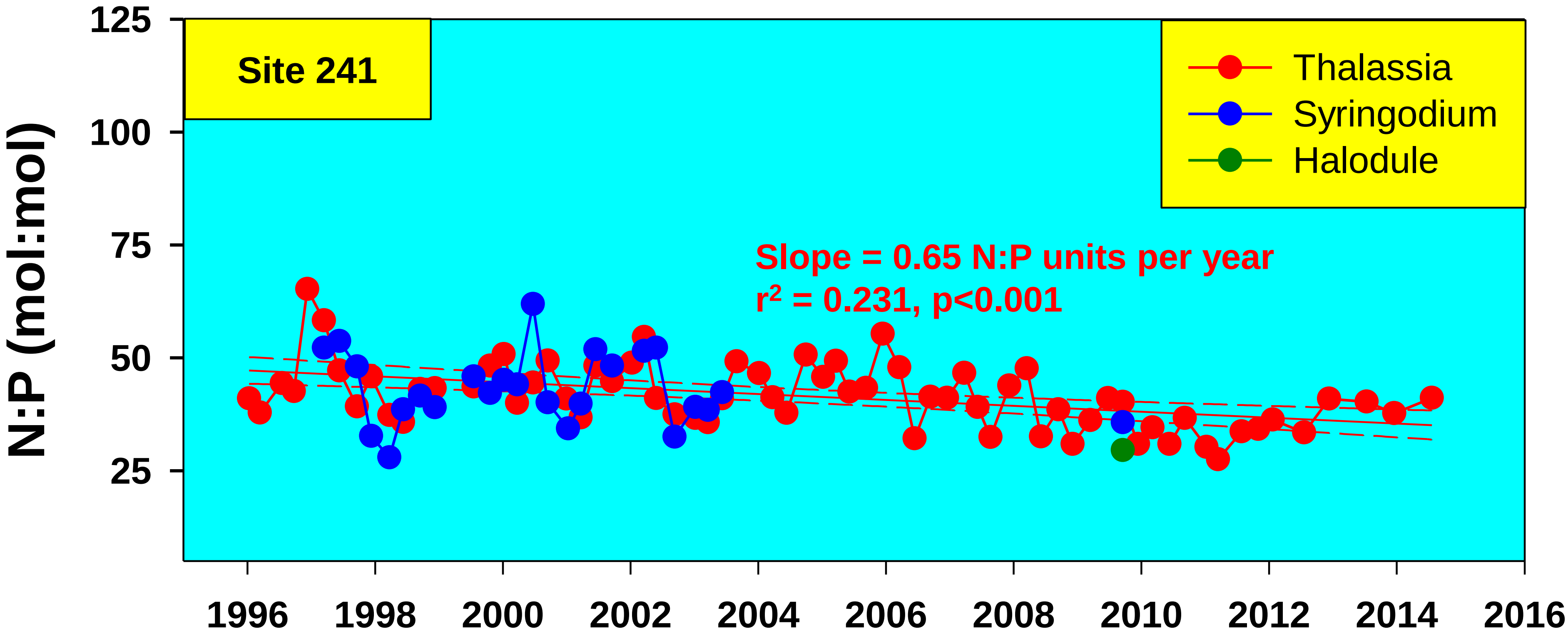
Nutrient pollution will shift N:P ratios of primary producers towards a taxon-specific "Redfield ratio"



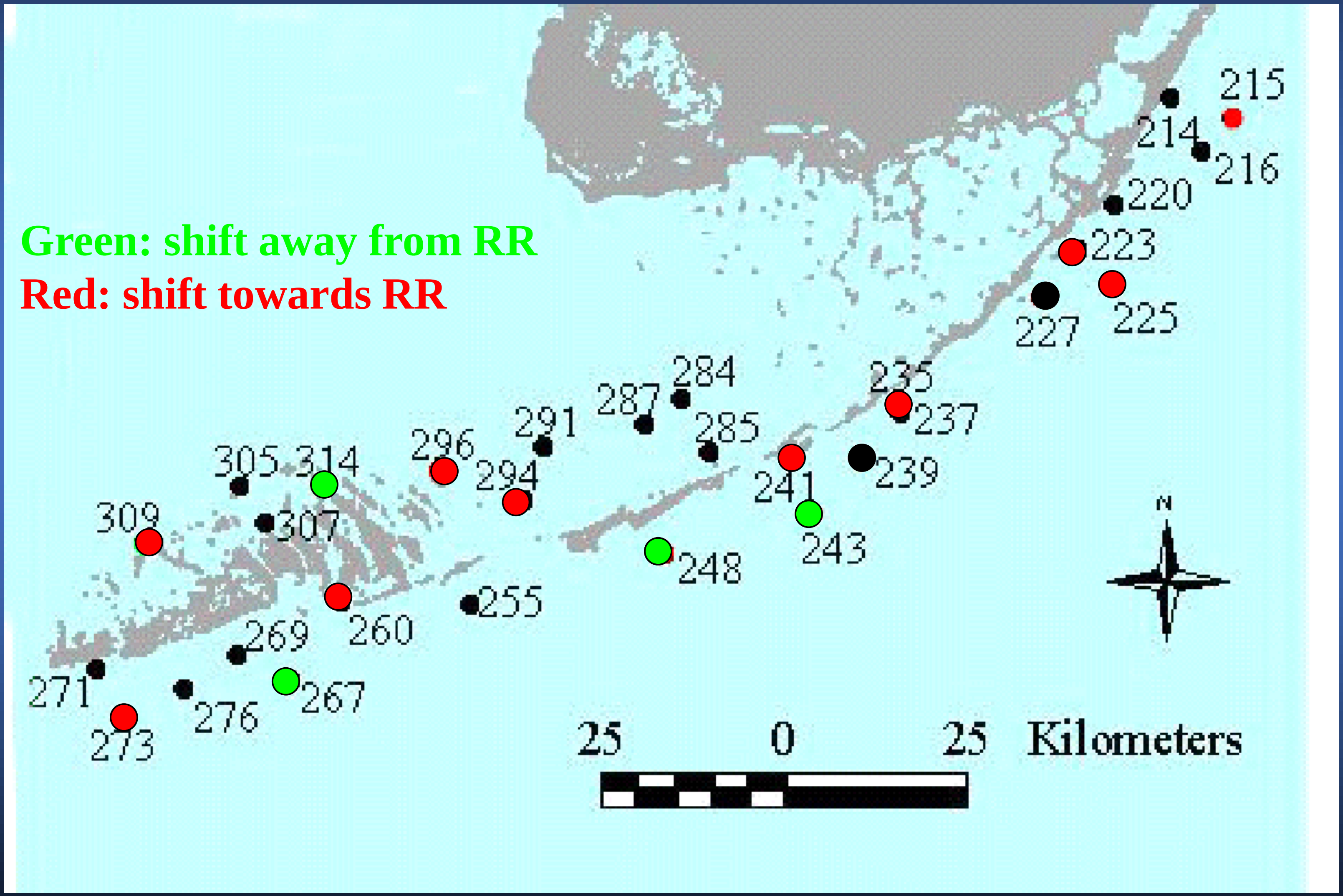


Changes in N:P of primary producers

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

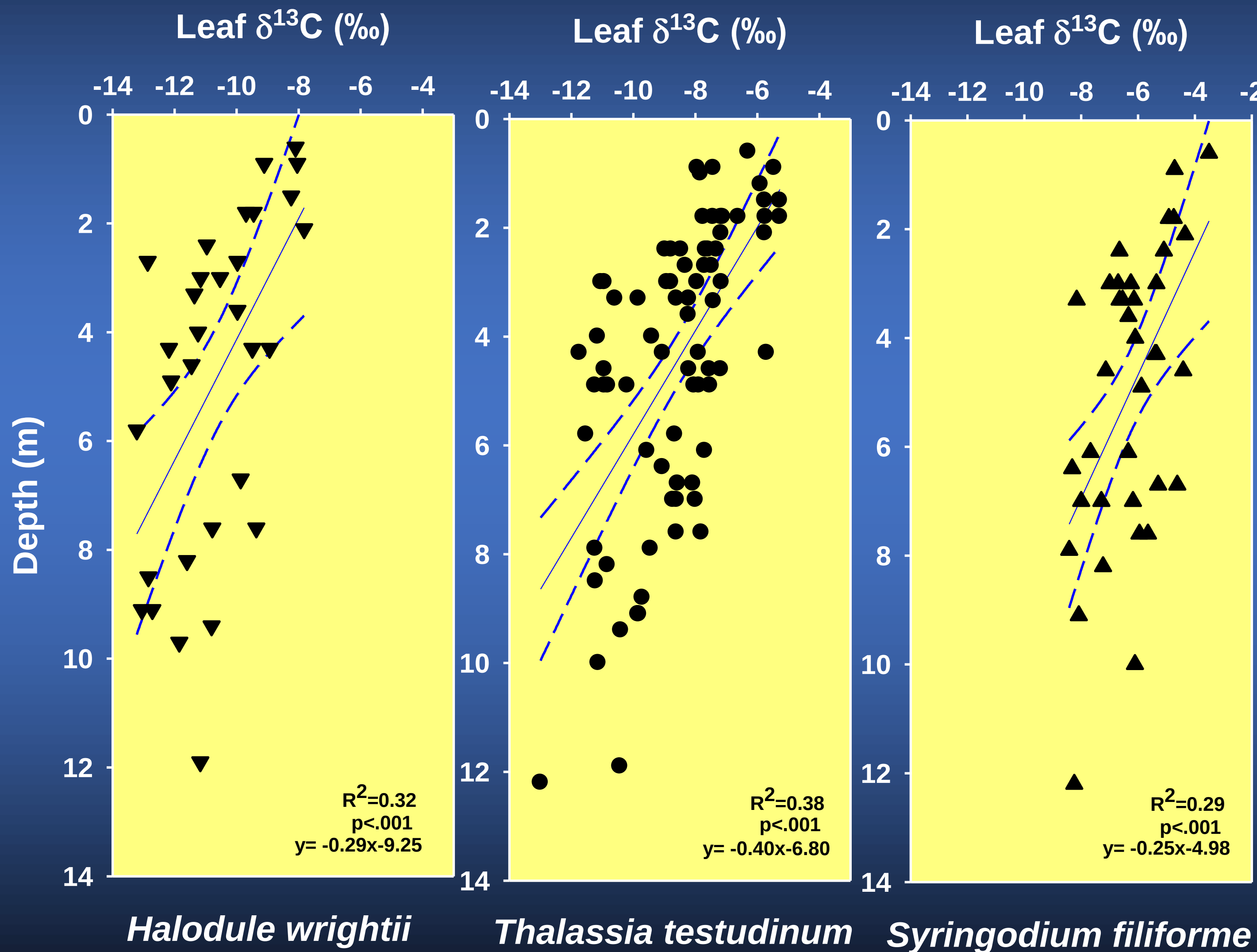


Changes in N:P of primary producers



Explicit model of ecosystem behavior #3:

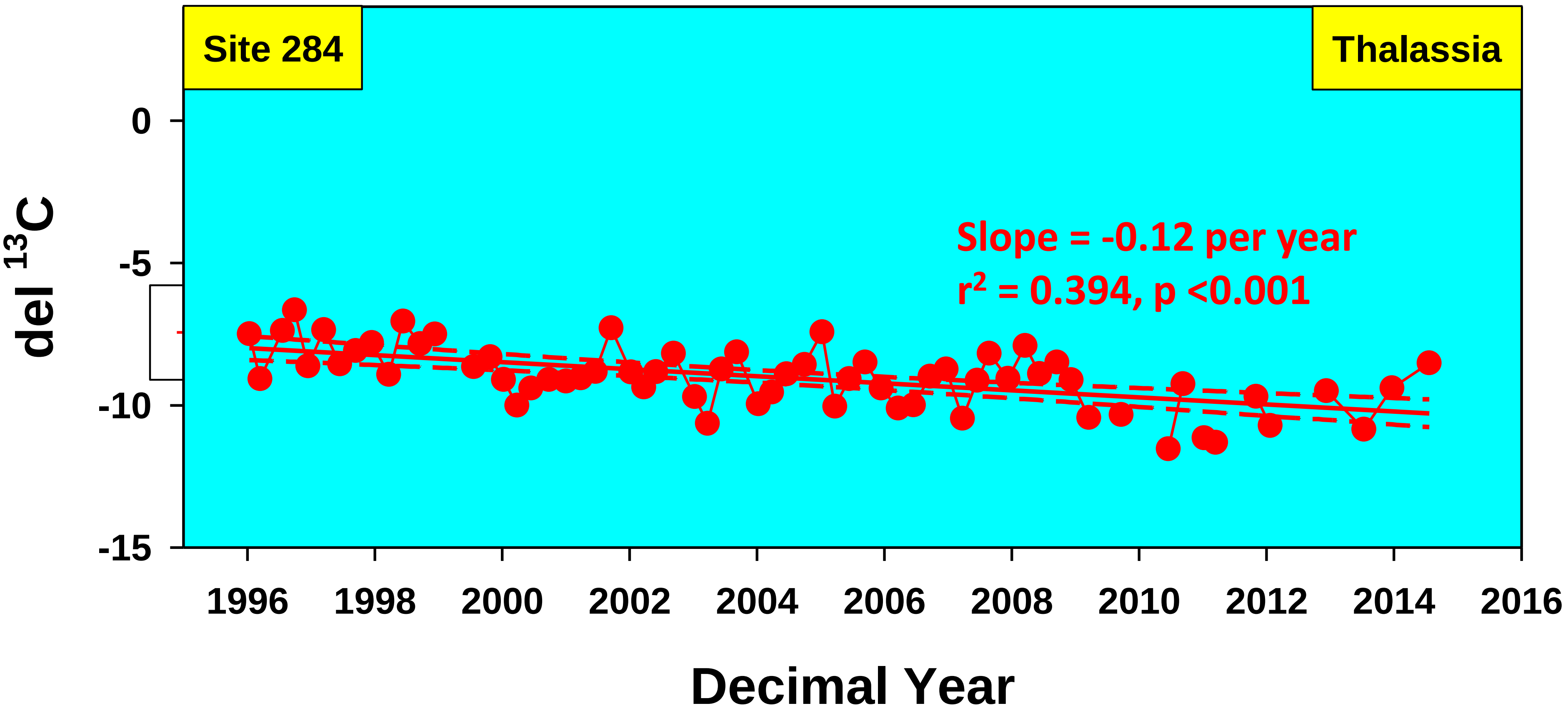
As light decreases with depth, $\delta^{13}C$ decreases



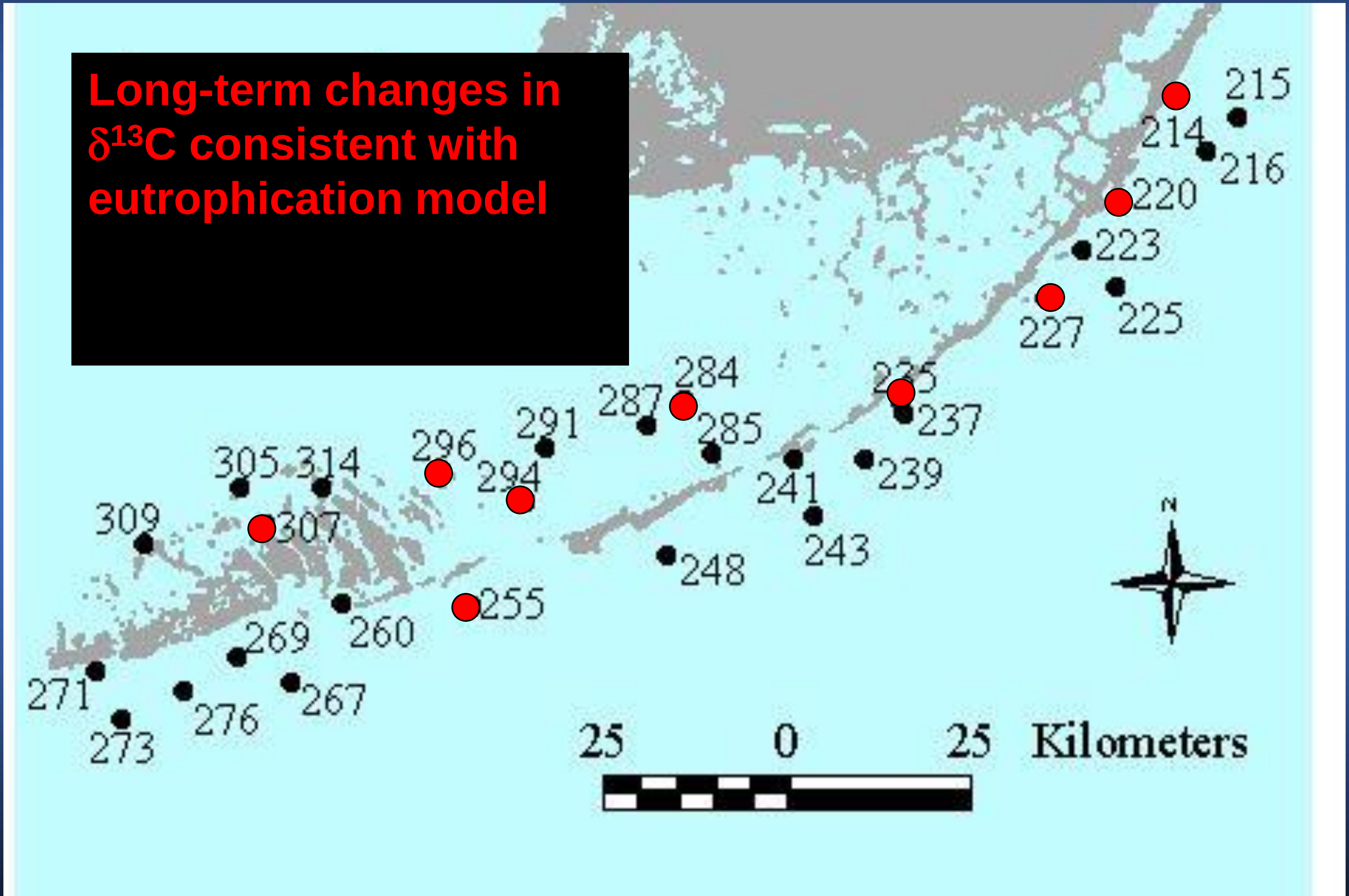
Campbell and Fourqurean, 2009, MEPS

Changes in δ13C of primary producers

At 7 of 30 sites, significant δ13C trends consistent with eutrophication (7 of 30 last year)



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



Site-specific indicator summary

Significance of linear trends, 1995-2015

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

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

FKNMS Seagrass Status Criteria

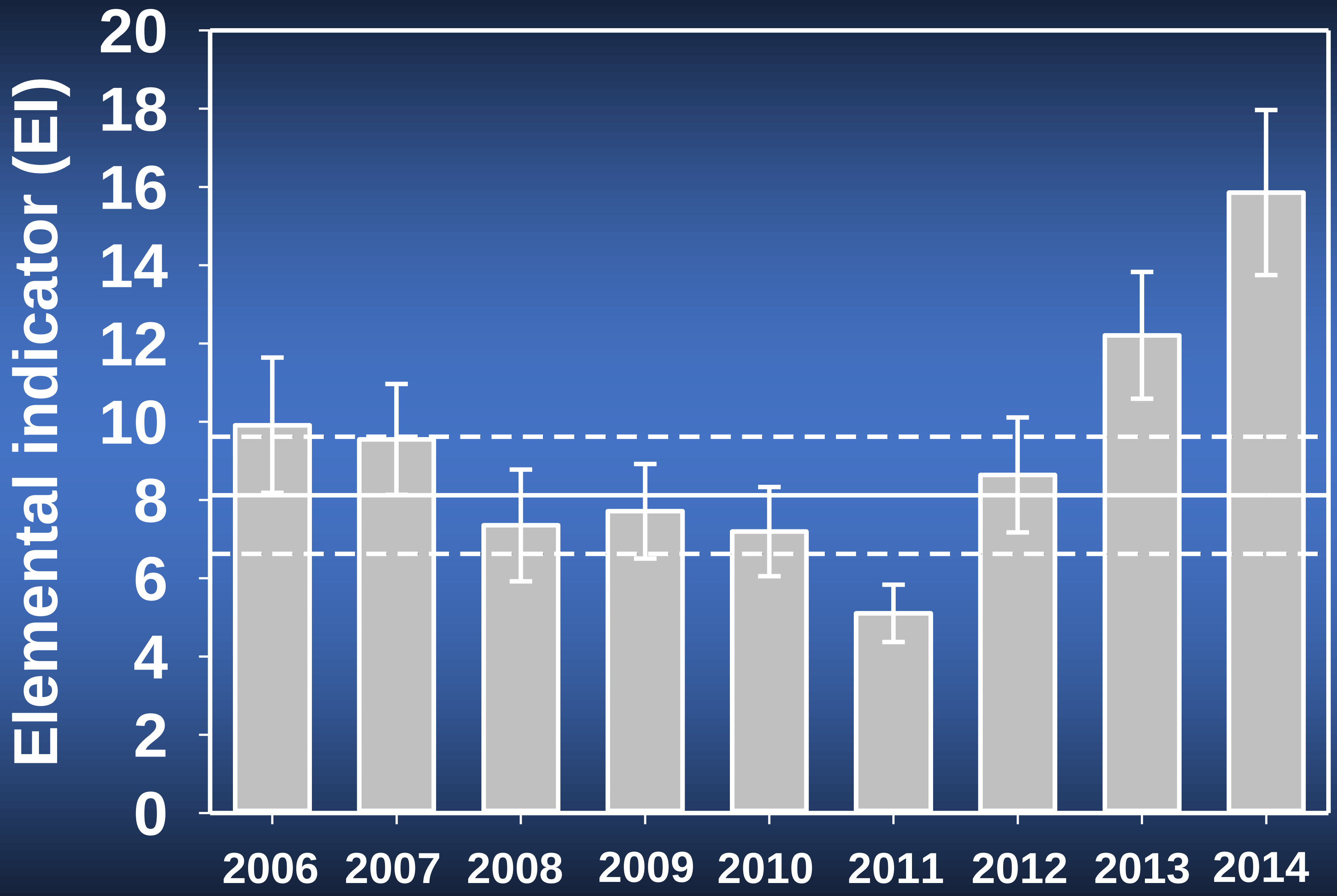
- We have defined 2 criteria to track the status of seagrasses Sanctuary-wide, based on our conceptual models
- The first is based on the relative dominance of slow-growing species:

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

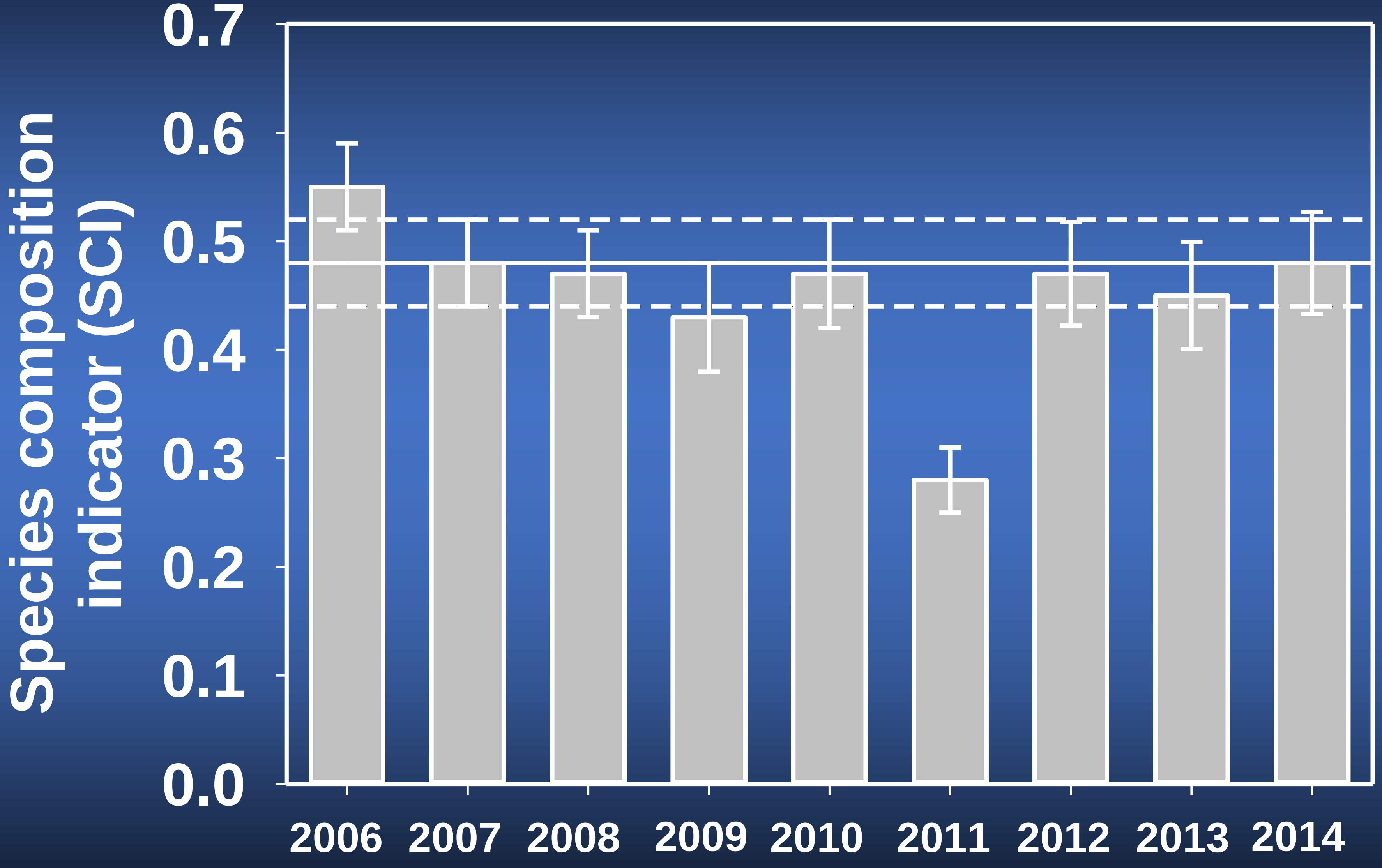
- The baseline SCI, calculated from data collected between 1995-2005, was 0.48 ± 0.04. Any decrease in SCI indicates declining water quality
- The second is based on nutrient content of the slowest growing species:

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

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

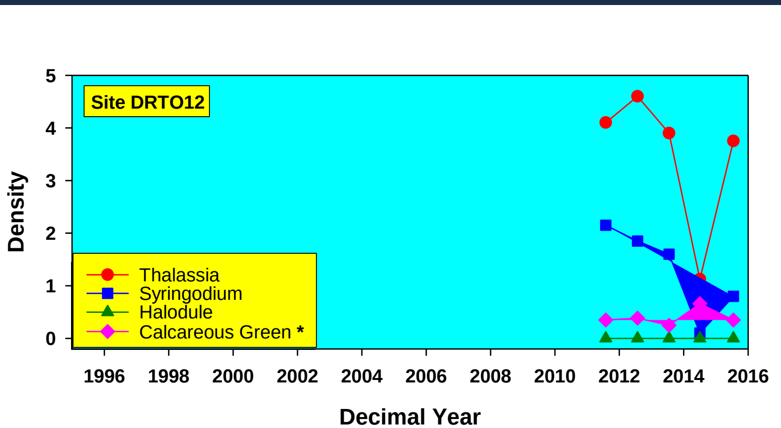


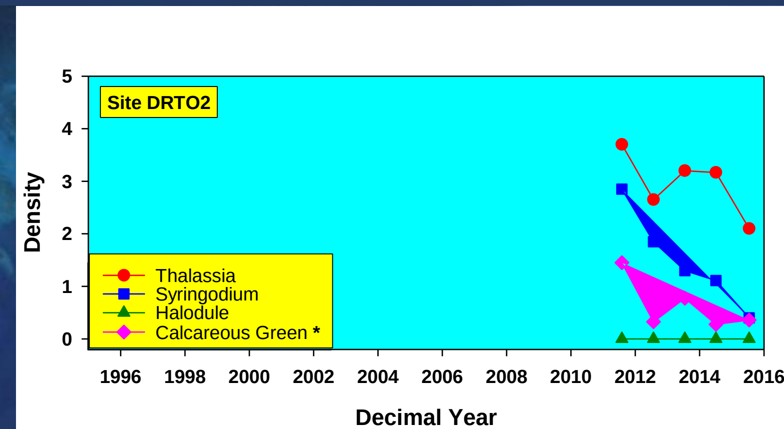
Elemental indicator (EI)
20
18
16
14
12
10
8
6
4
2
0
2006
2007
2008
2009
2010
2011
2012
2013
2014



Species composition indicator (SCI)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2006
2007
2008
2009
2010
2011
2012
2013
2014

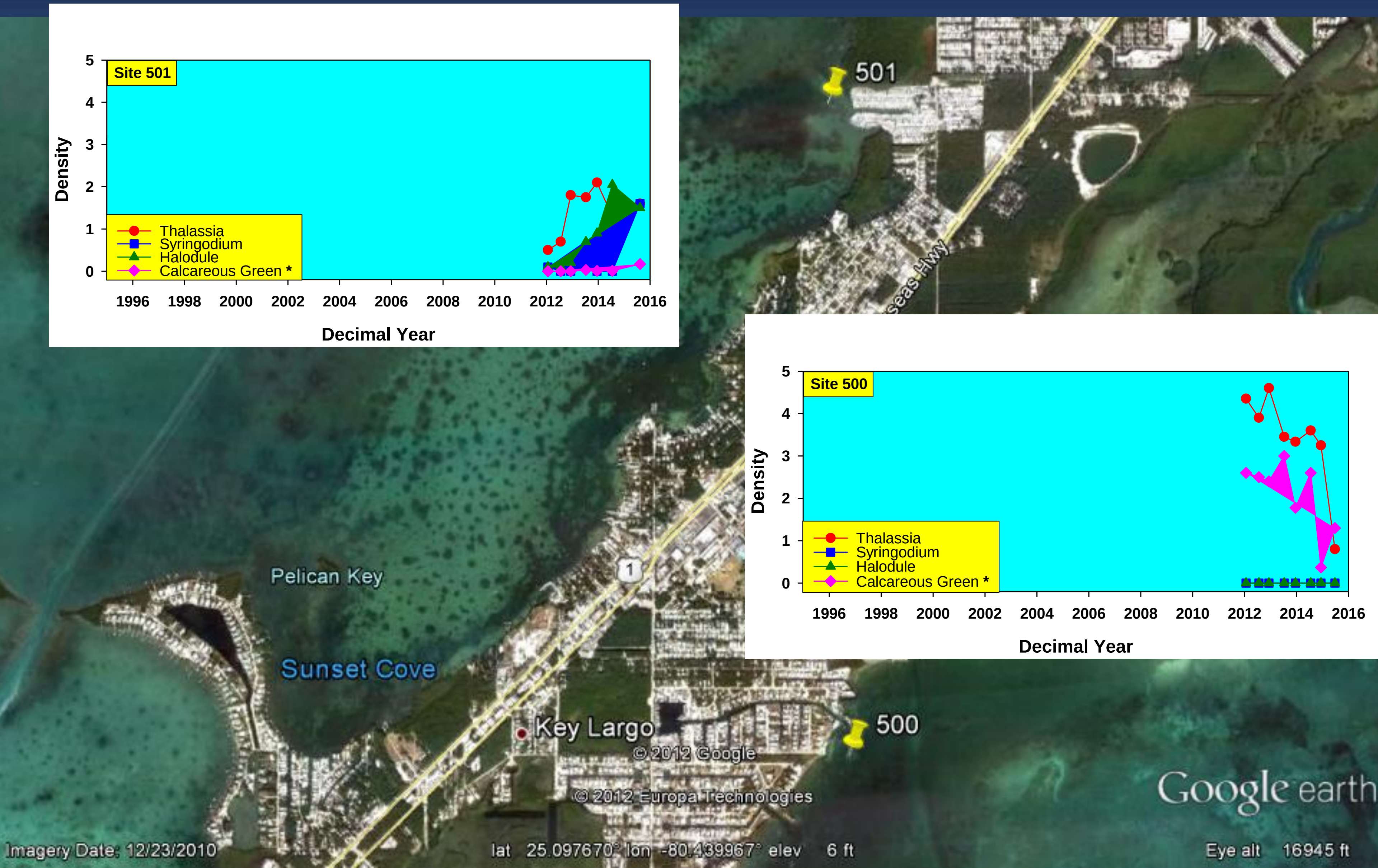
Dry Tortugas Sites



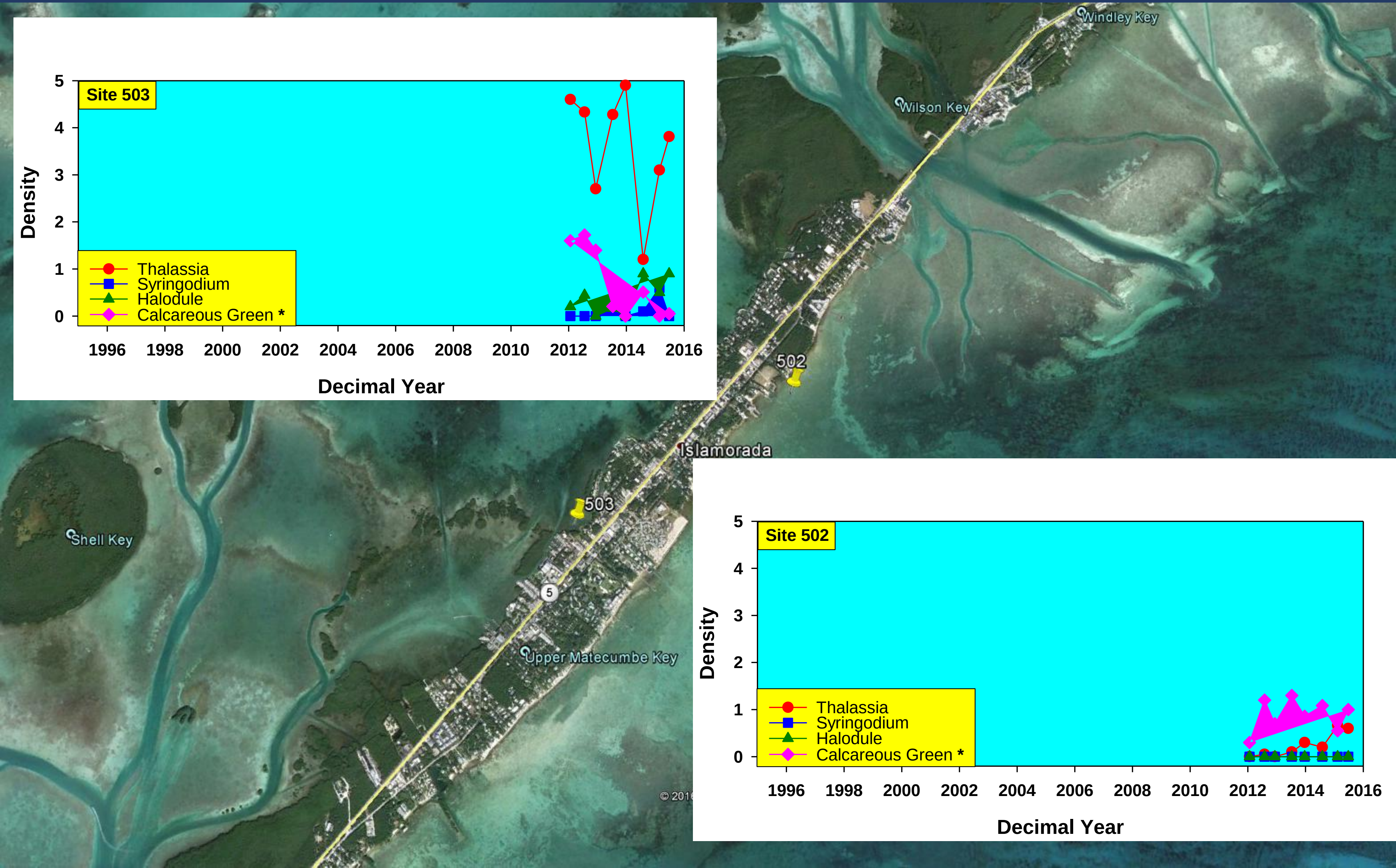


- Not all environmental threats can be monitored in a given monitoring program
- The original monitoring program design was regional in scope

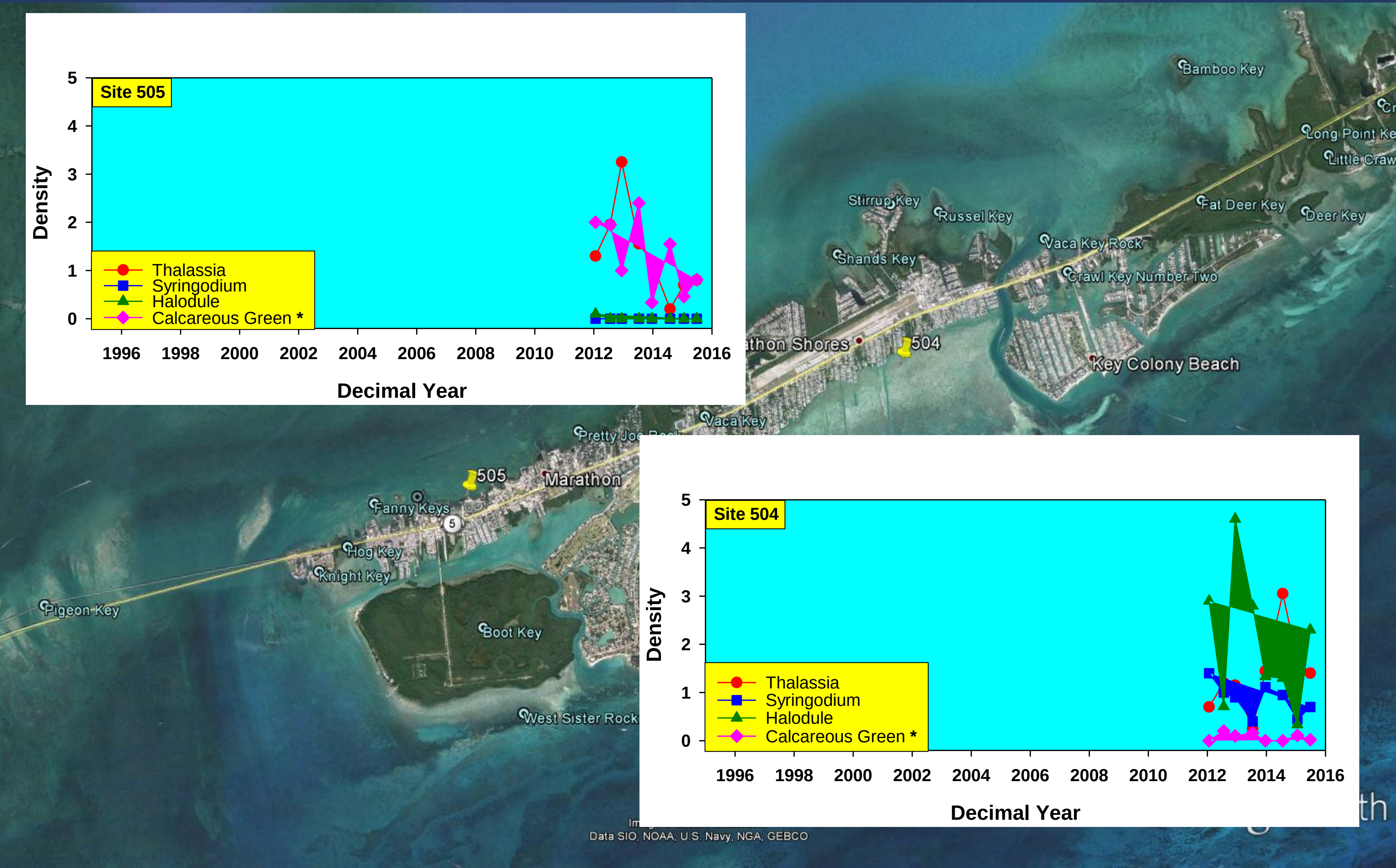
Nearshore sites – Key Largo



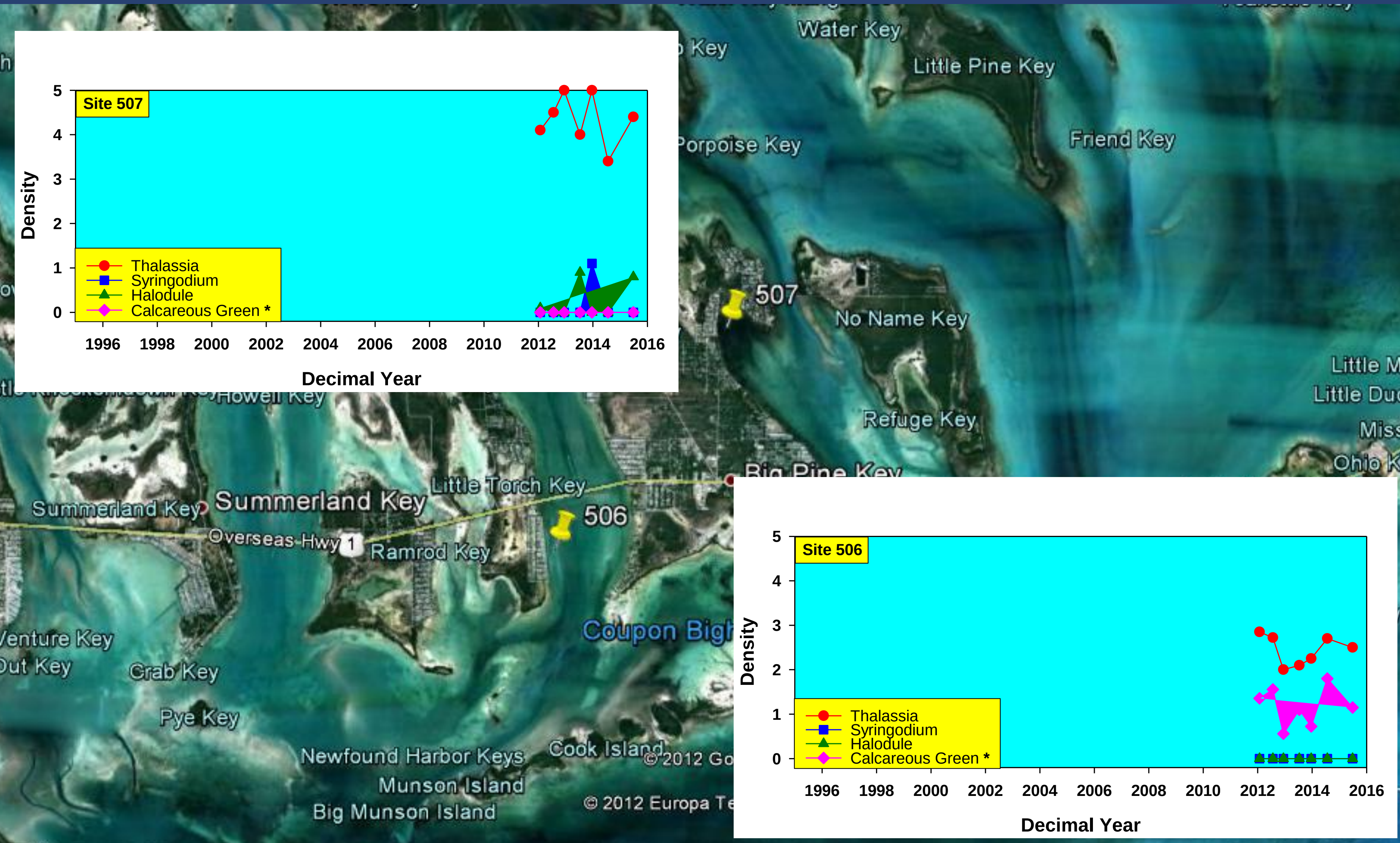
Nearshore sites – Islamorada



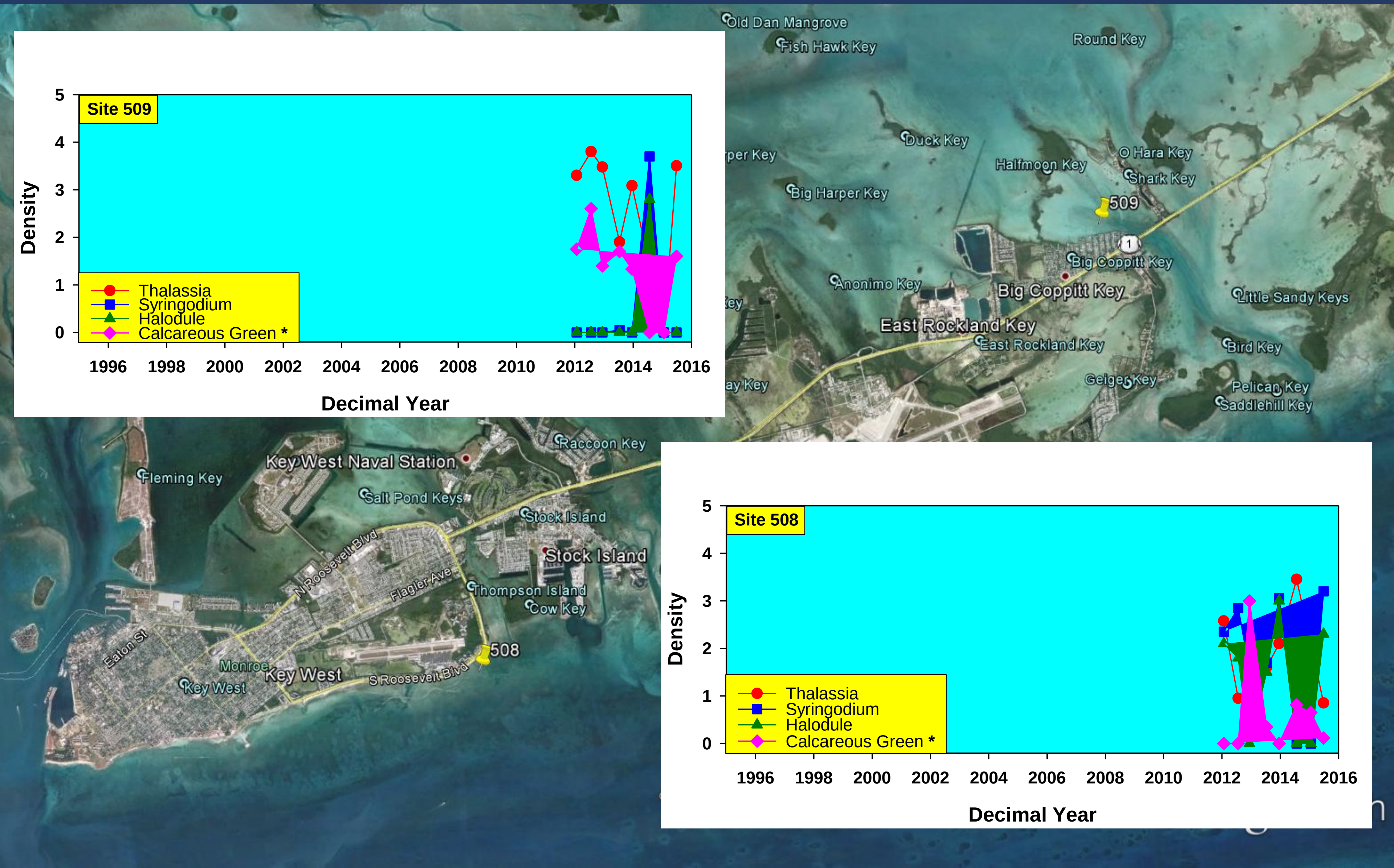
Nearshore sites – Marathon



Nearshore sites – Big Pine



Nearshore sites – Key West



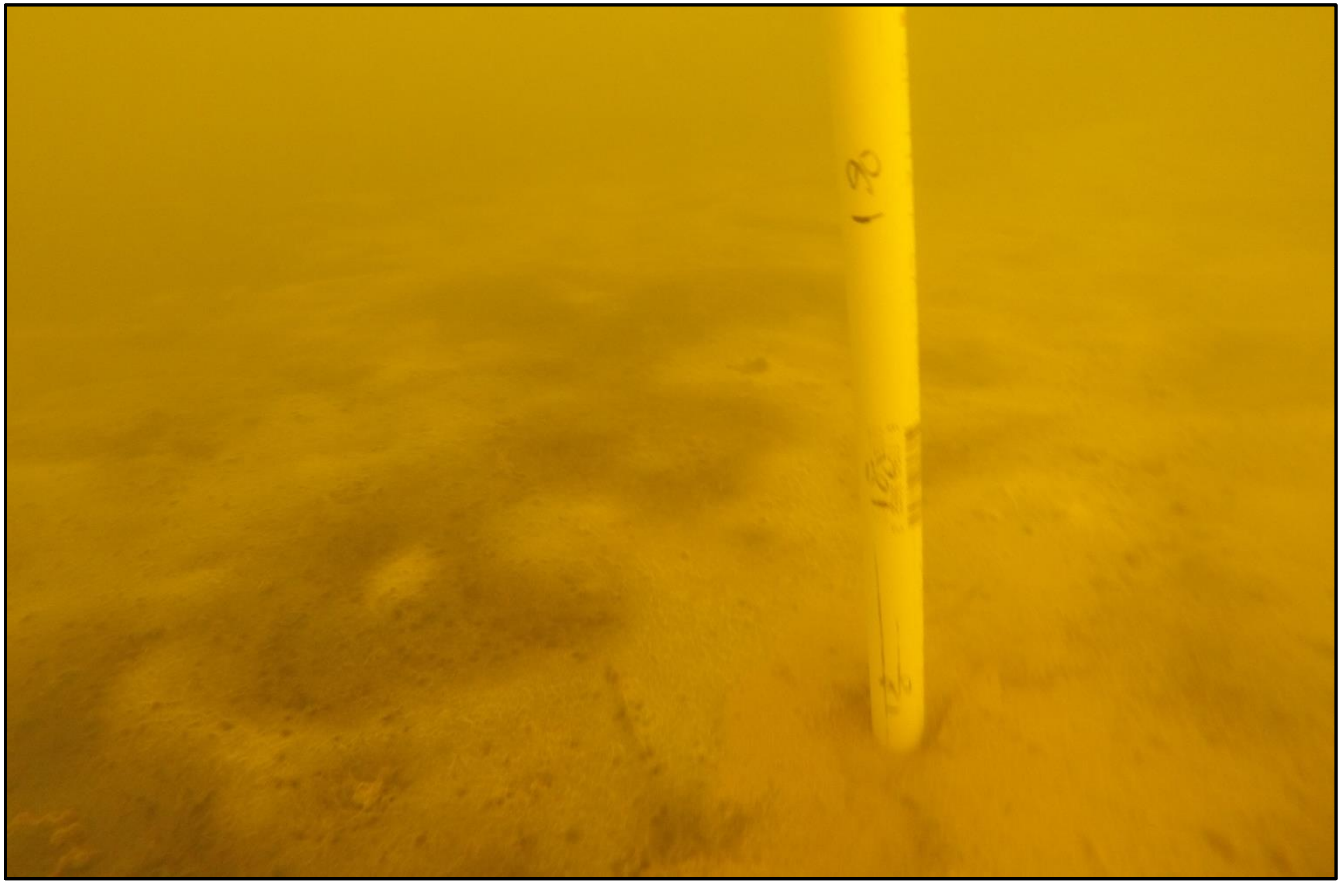
Summary points

- 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 form 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

WATER QUALITY PROTECTION PROGRAM CANAL RESTORATION ADVISORY SUBCOMMITTEE
Feburary 26th, 2016

Made possible by

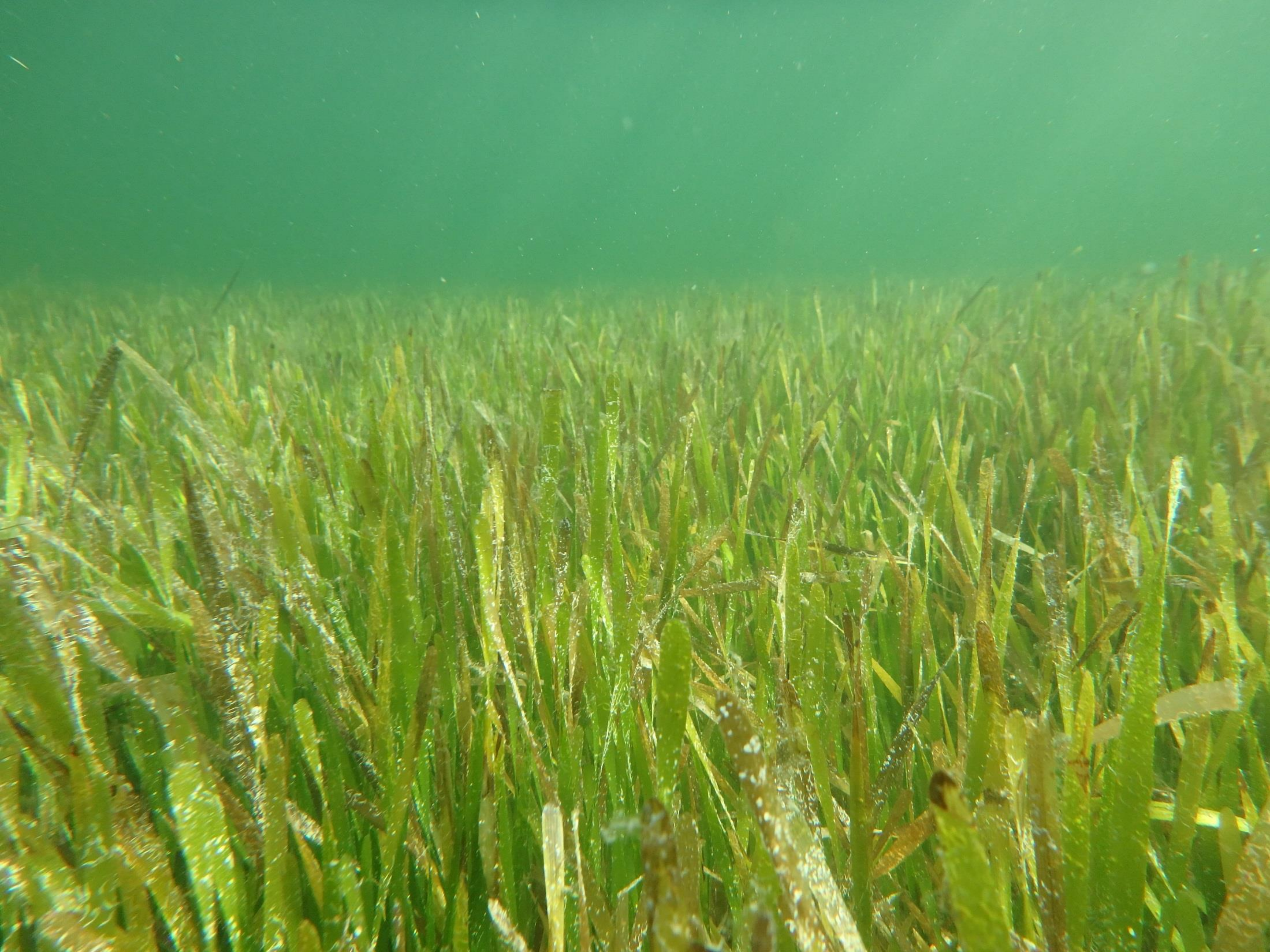
MONROE COUNTY
1823
SOUTHERNMOST COUNTY IN THE UNITED STATES

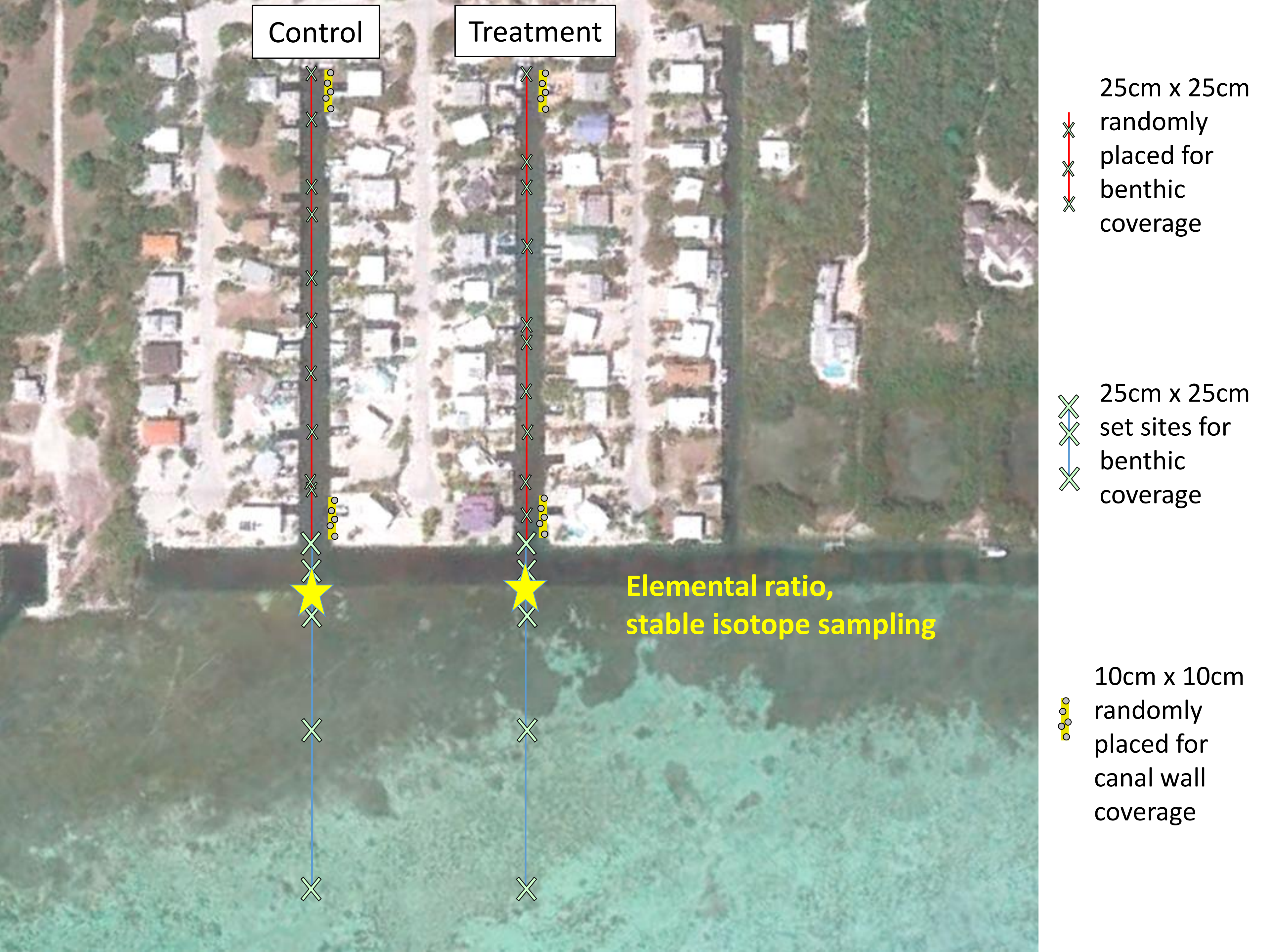
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Townships
Homeowner Organizations
Individuals

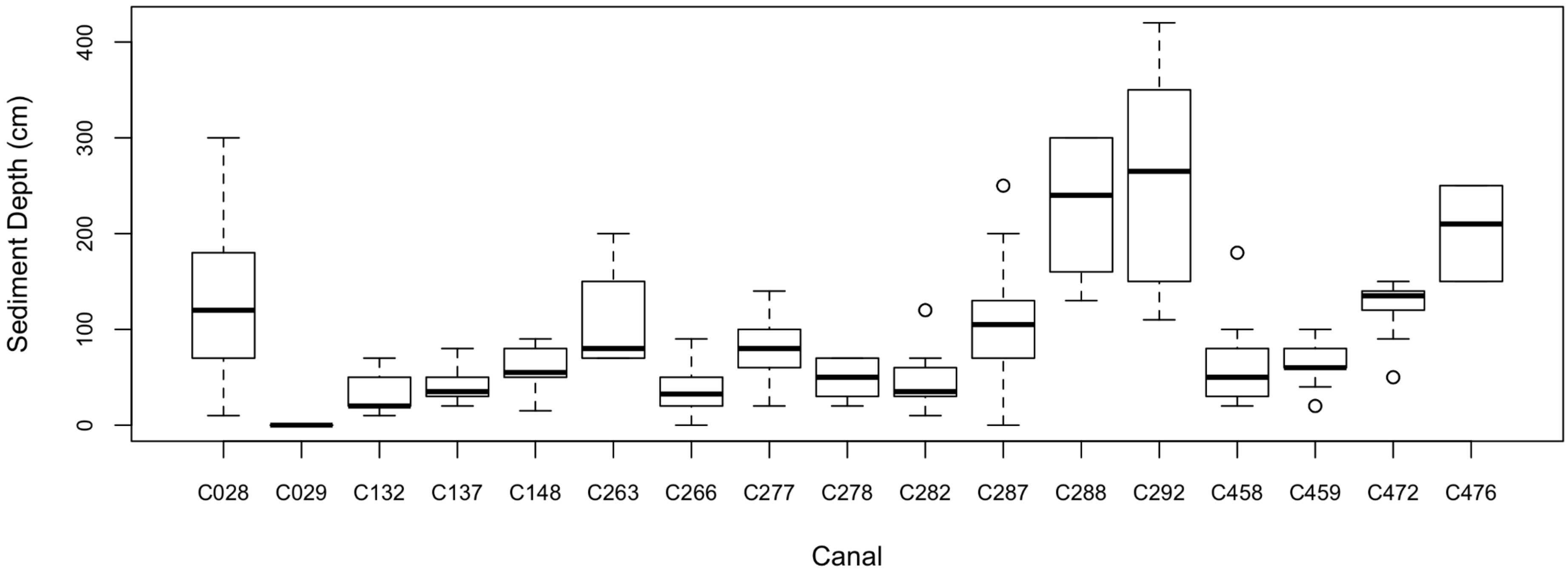
FIU
FLORIDA INTERNATIONAL UNIVERSITY
Miami's public research university

Seagrass Ecosystems Research Lab
Florida International University



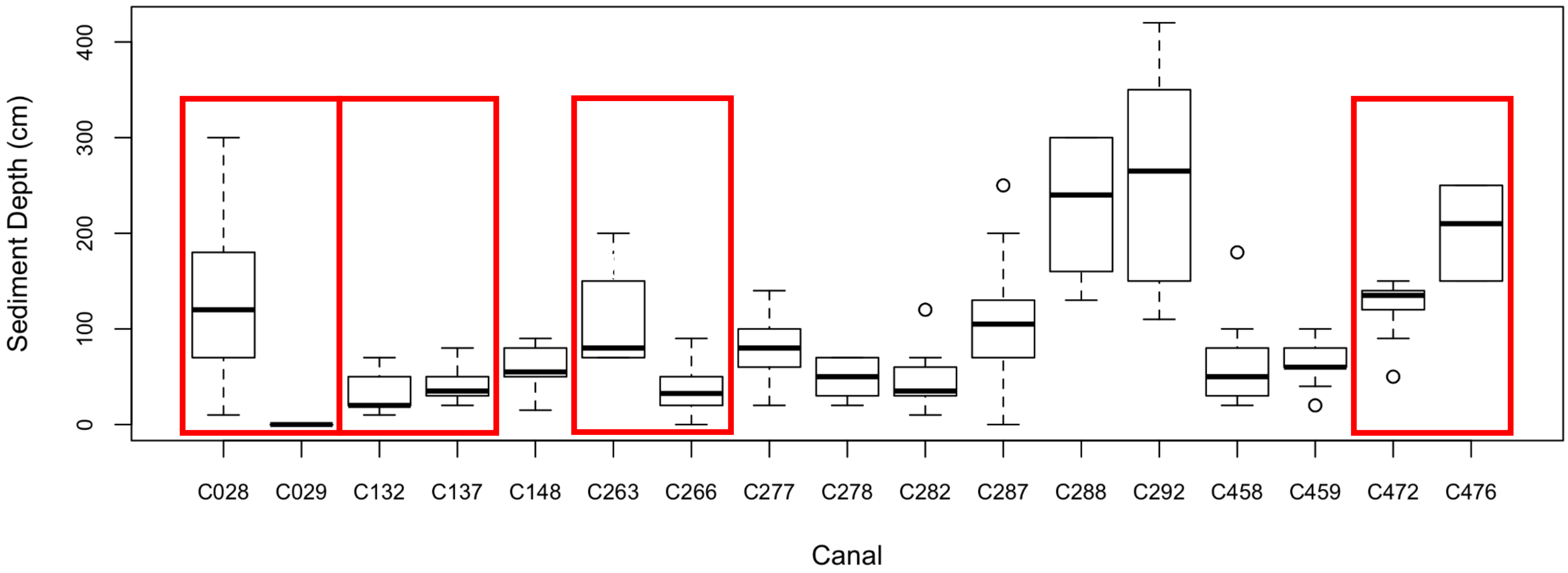

Control
Treatment
Elemental ratio, stable isotope sampling
25cm x 25cm randomly placed for benthic coverage
25cm x 25cm set sites for benthic coverage
10cm x 10cm randomly placed for canal wall coverage

Muck Depth

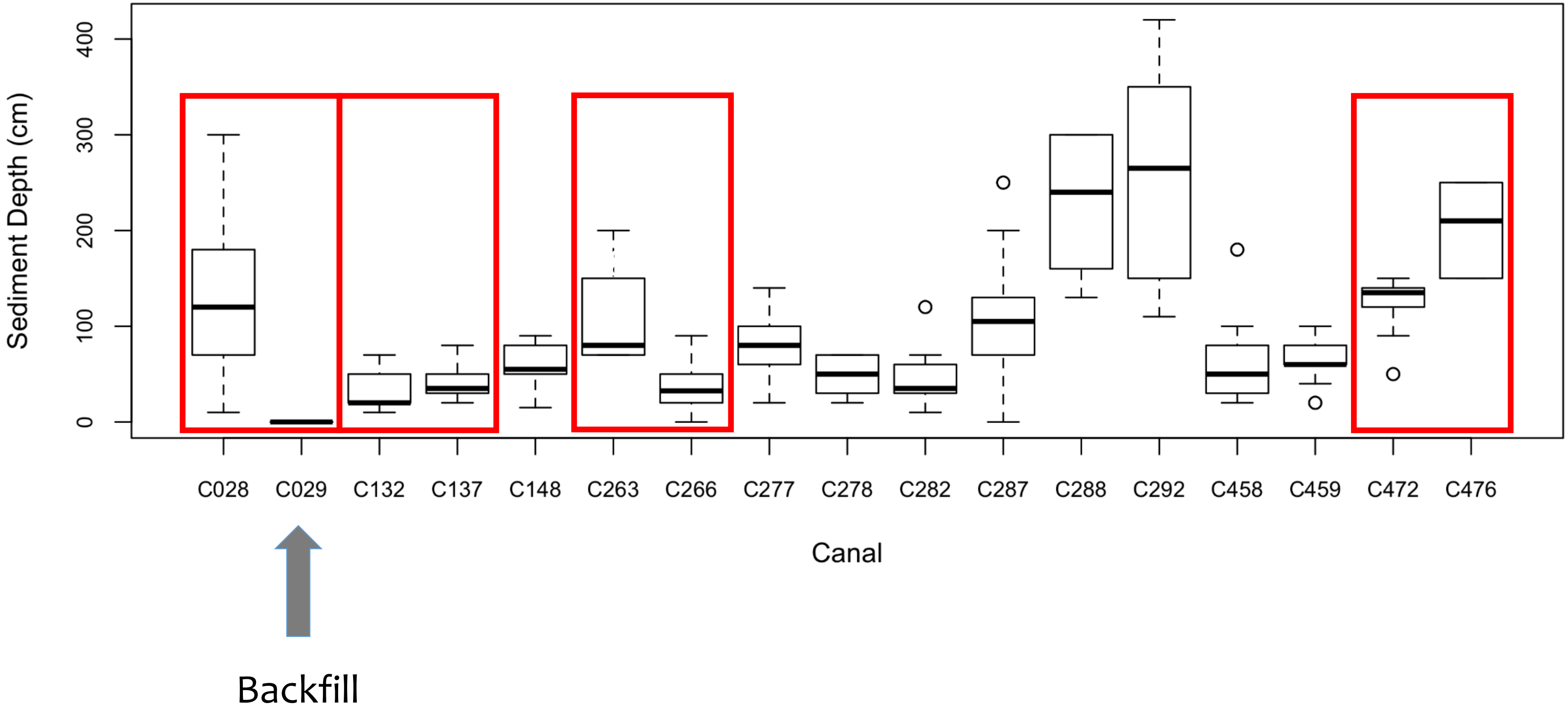


Sediment Depth (cm)
0
100
200
300
400
C028
C029
C132
C137
C148
C263
C266
C277
C278
C282
C287
C288
C292
C458
C459
C472
C476
Canal

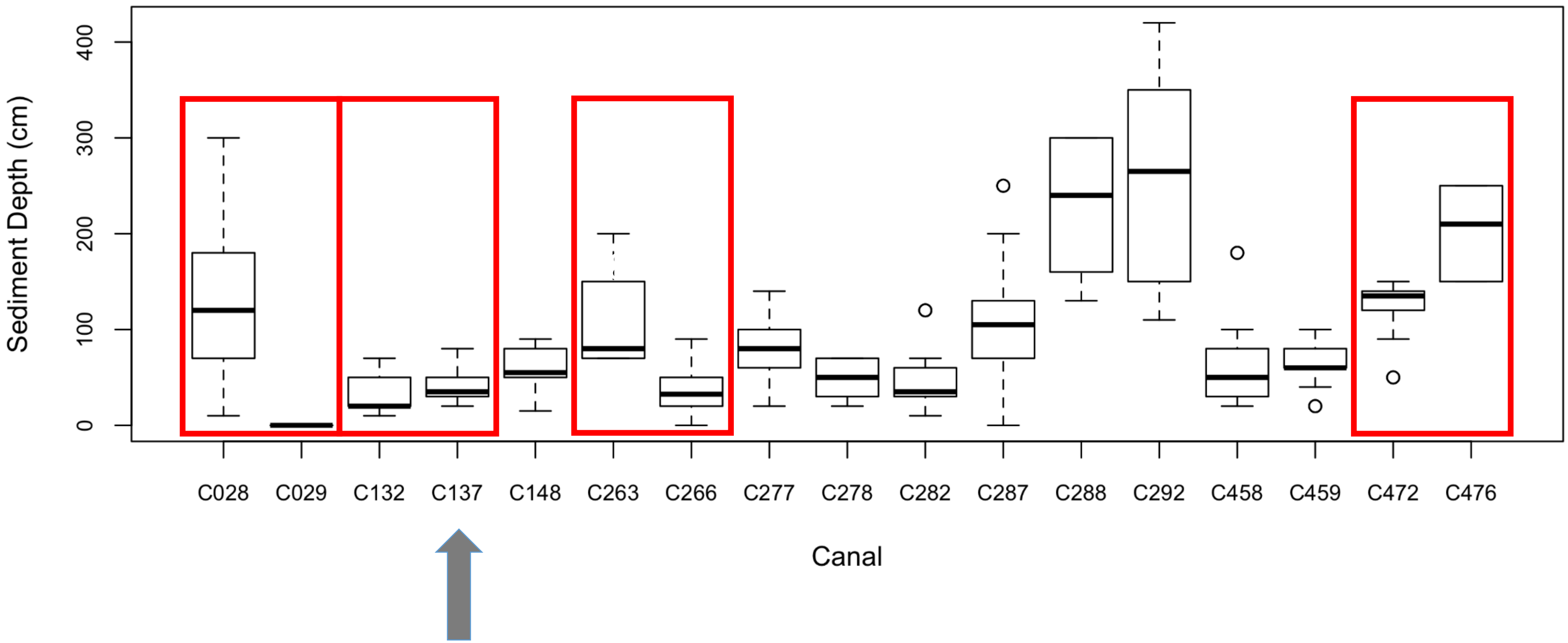
Muck Depth


Sediment Depth (cm)
0
100
200
300
400
C028
C029
C132
C137
C148
C263
C266
C277
C278
C282
C287
C288
C292
C458
C459
C472
C476
Canal

Muck Depth

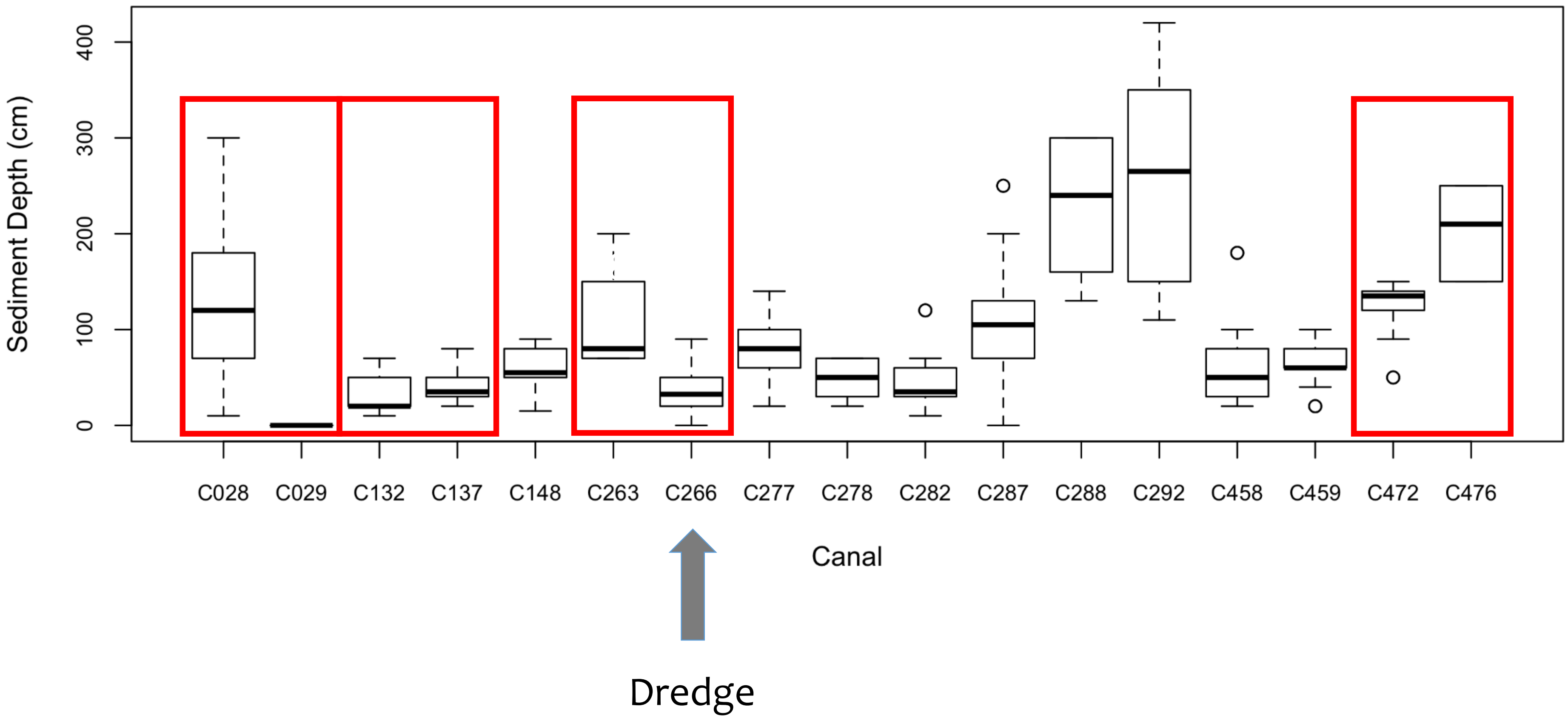

Sediment Depth (cm)
0
100
200
300
400
C028
C029
C132
C137
C148
C263
C266
C277
C278
C282
C287
C288
C292
C458
C459
C472
C476
Canal
Backfill

Muck Depth

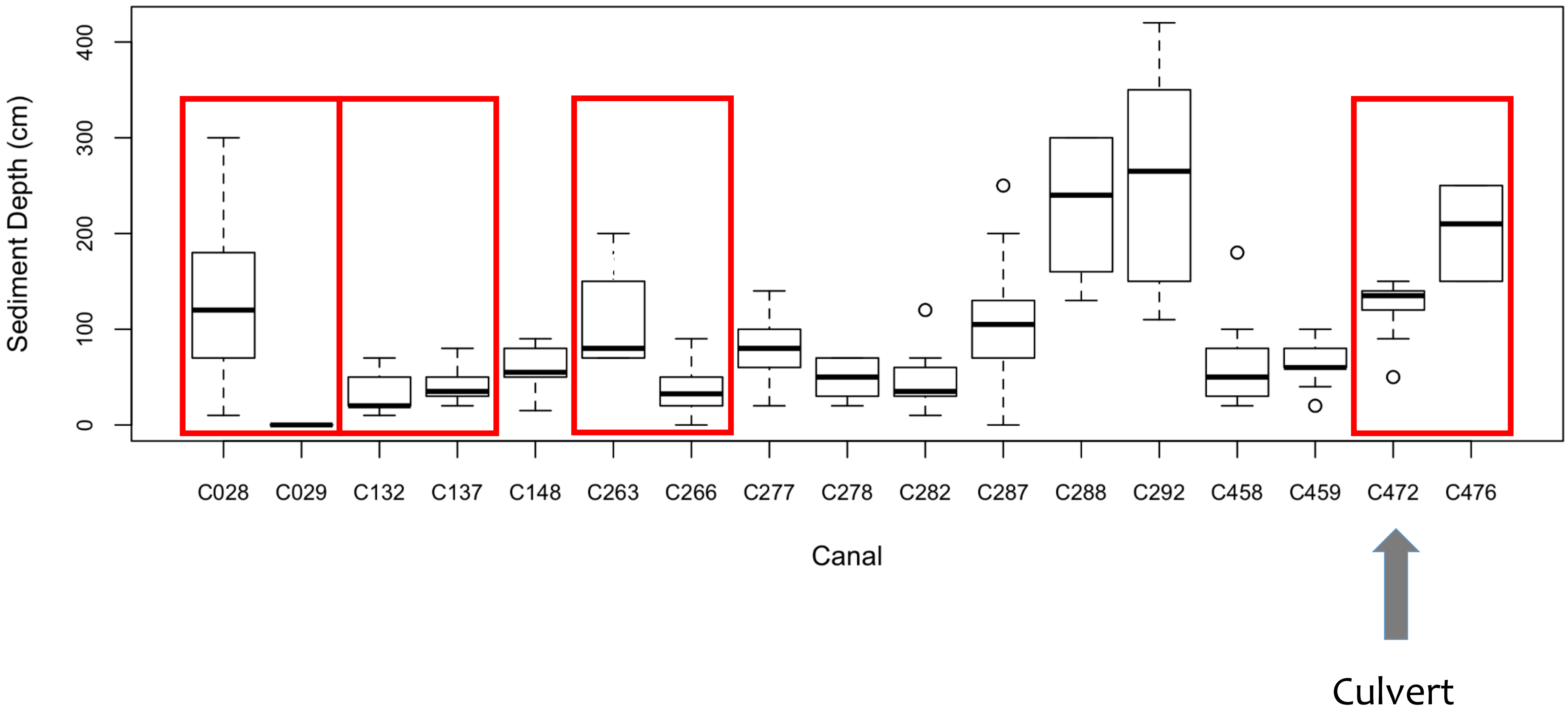


Weed Gate and aerator

Muck Depth

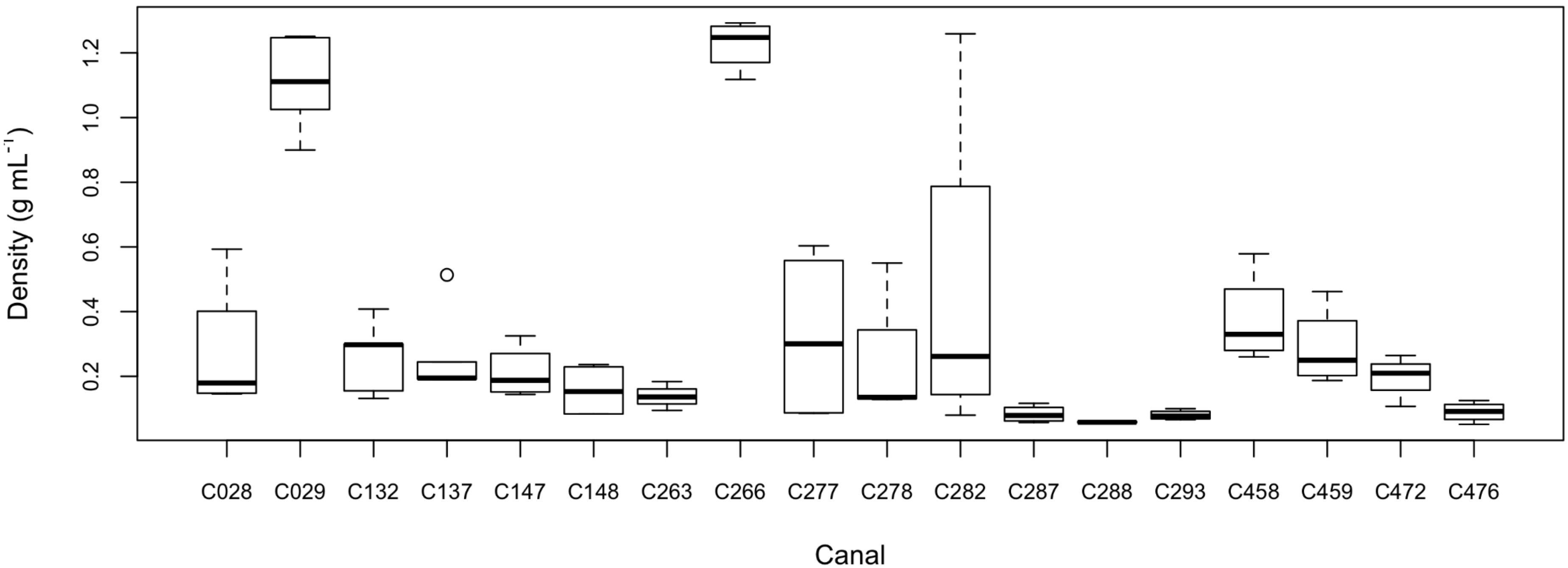

Sediment Depth (cm)
0
100
200
300
400
C028
C029
C132
C137
C148
C263
C266
C277
C278
C282
C287
C288
C292
C458
C459
C472
C476
Canal
Dredge

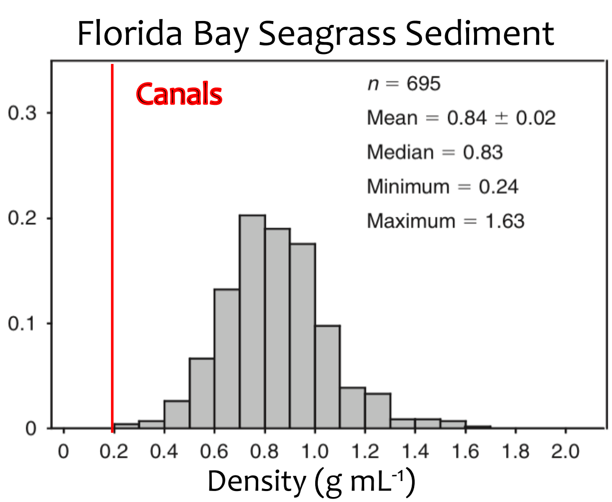
Muck Depth

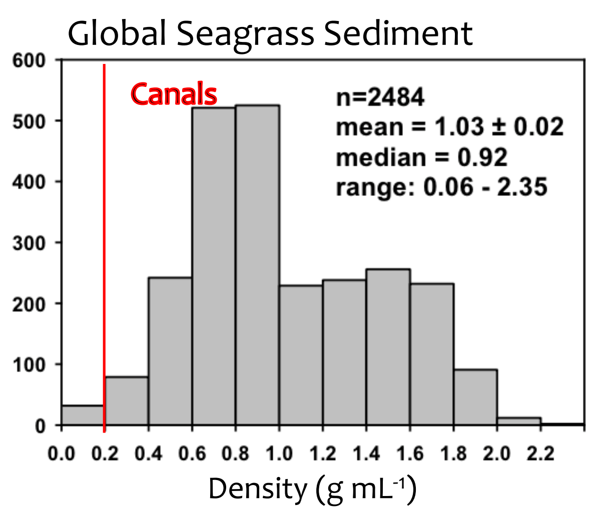


Sediment Depth (cm)
0
100
200
300
400
C028
C029
C132
C137
C148
C263
C266
C277
C278
C282
C287
C288
C292
C458
C459
C472
C476
Canal
Culvert

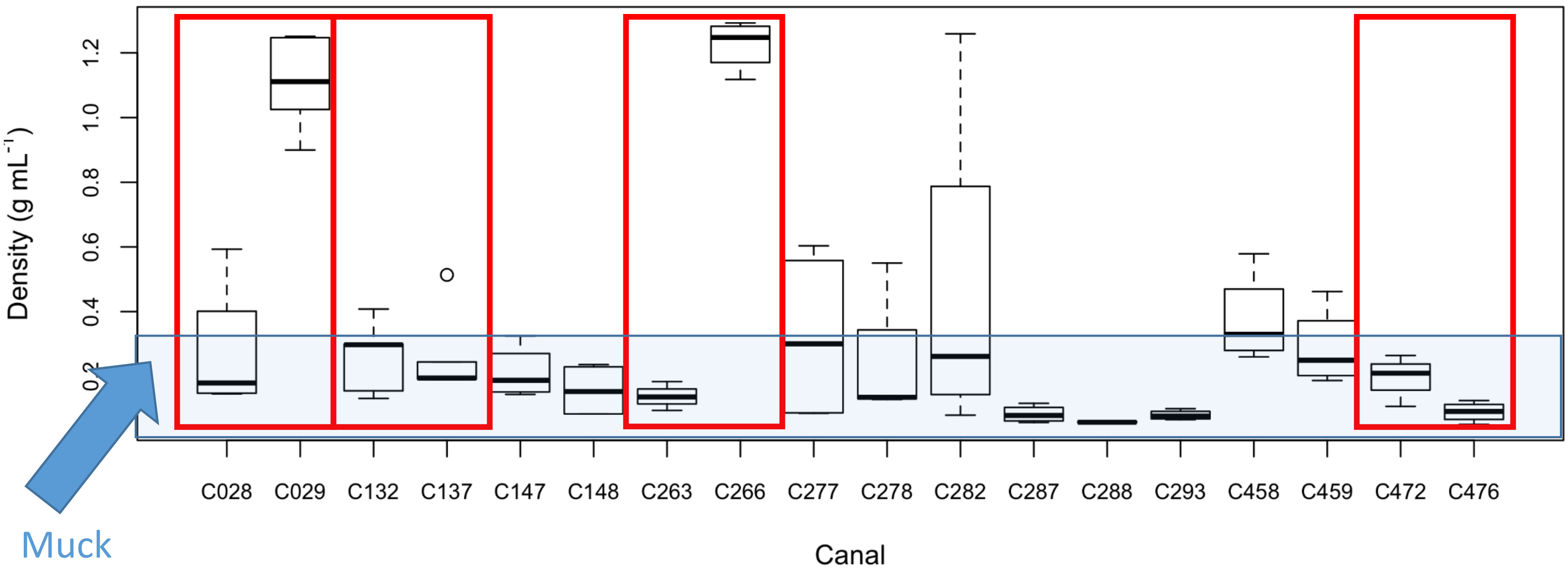
Sediment Density

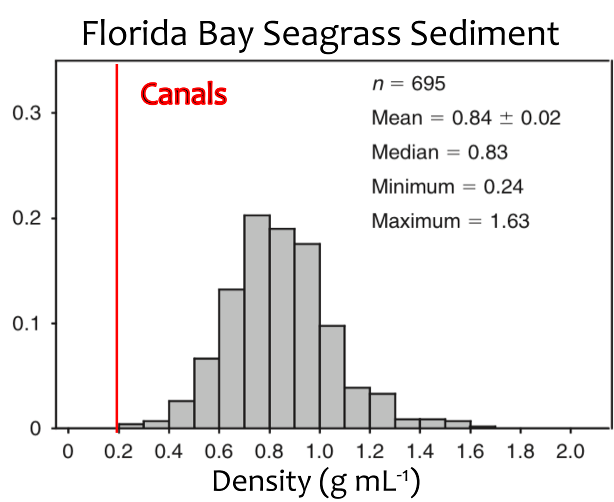


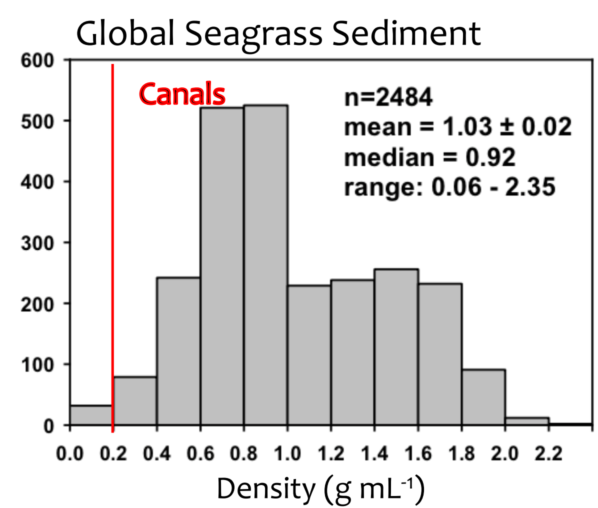




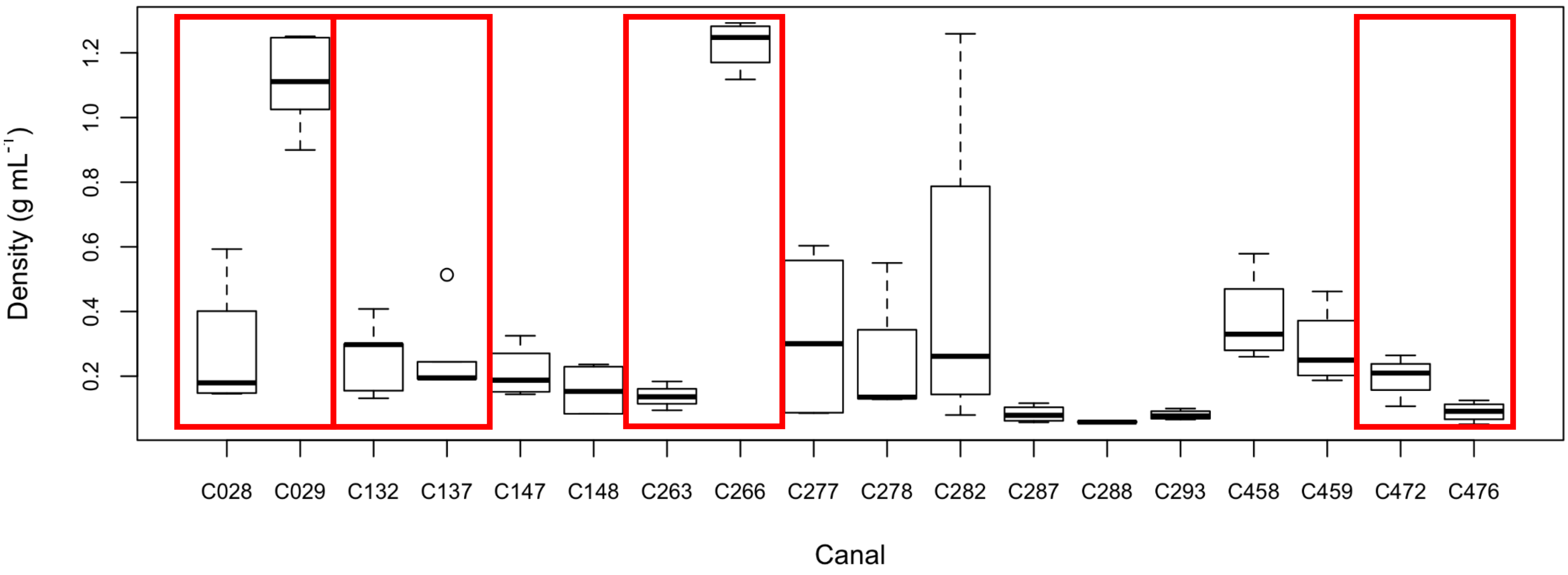
Sediment Density





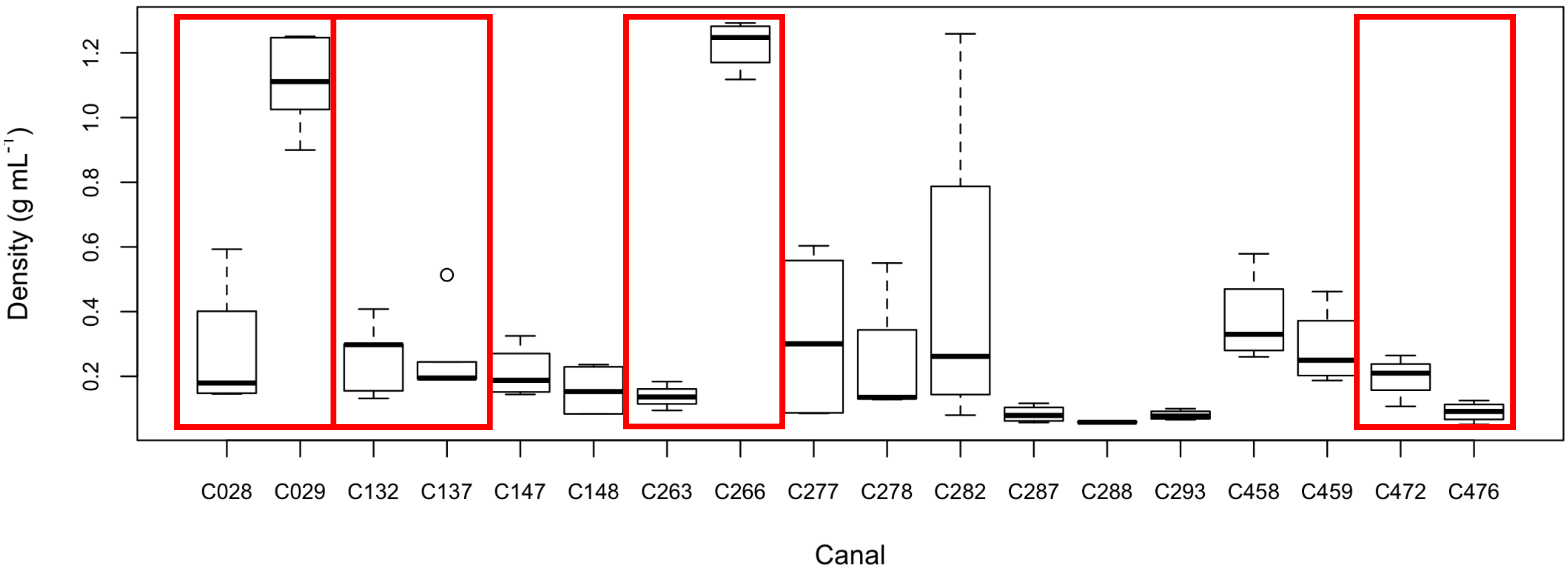


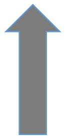
Sediment Density



Backfill

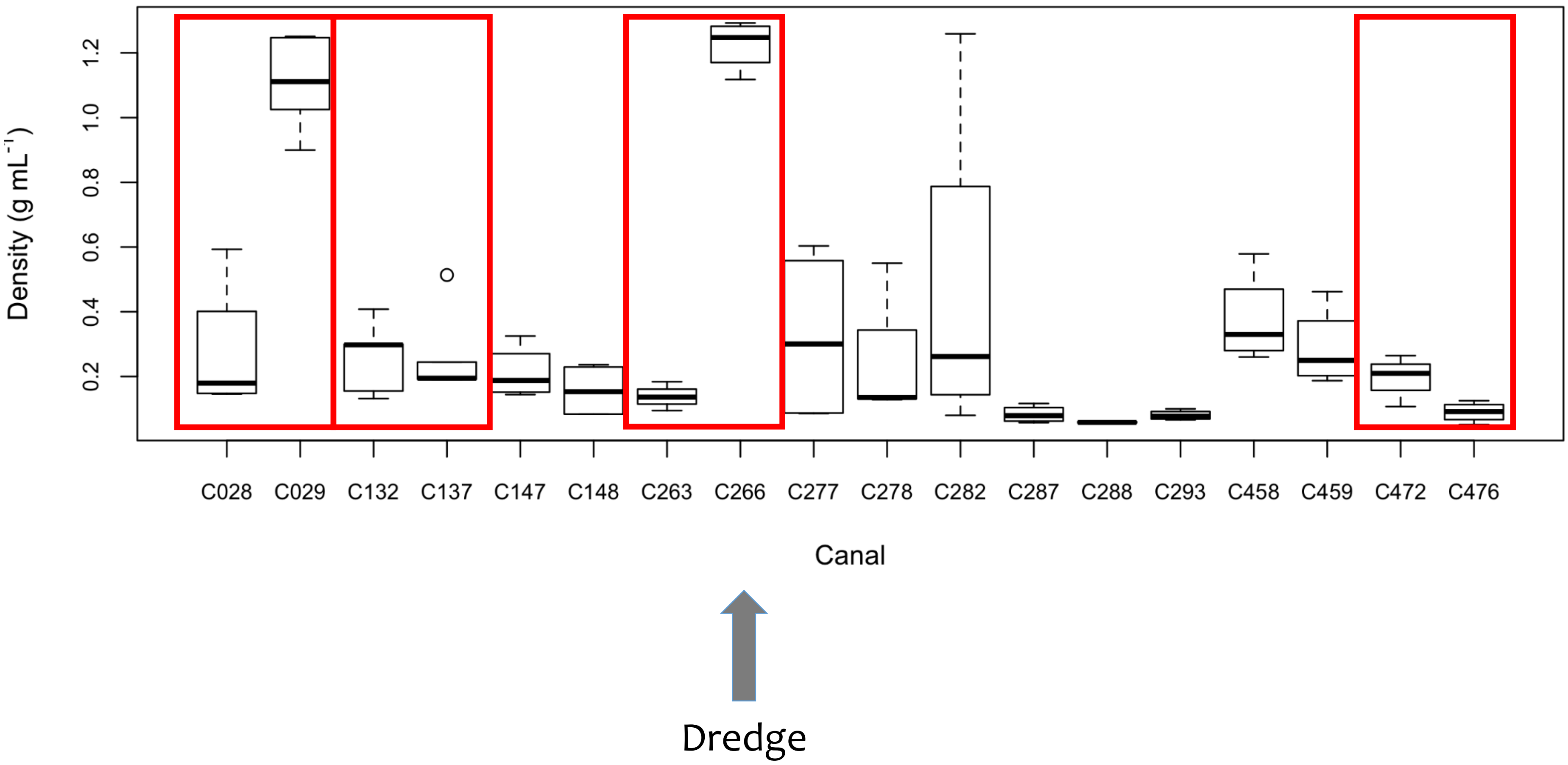
Sediment Density



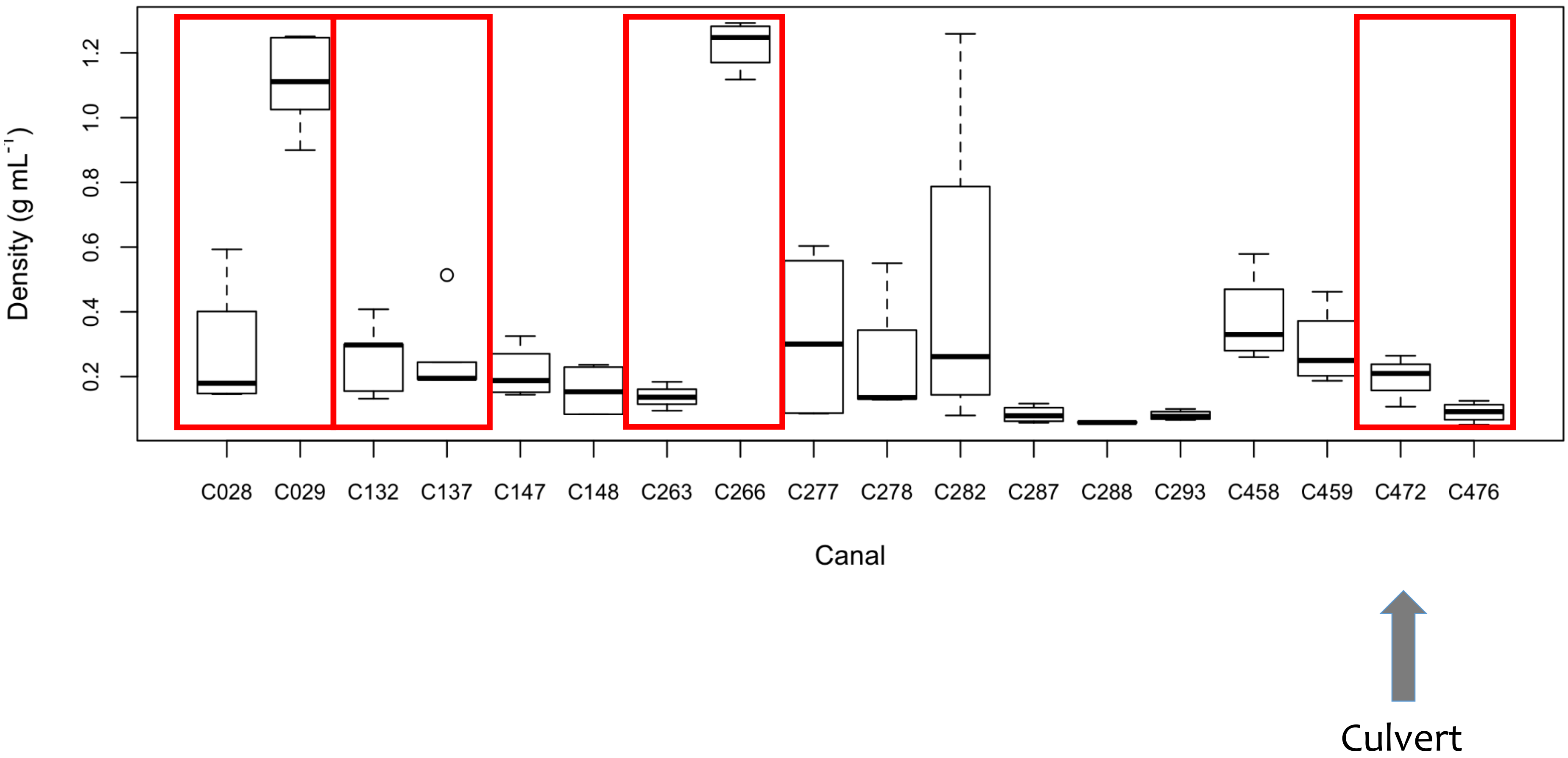


Weed Gate and aerator

Sediment Density



Sediment Density

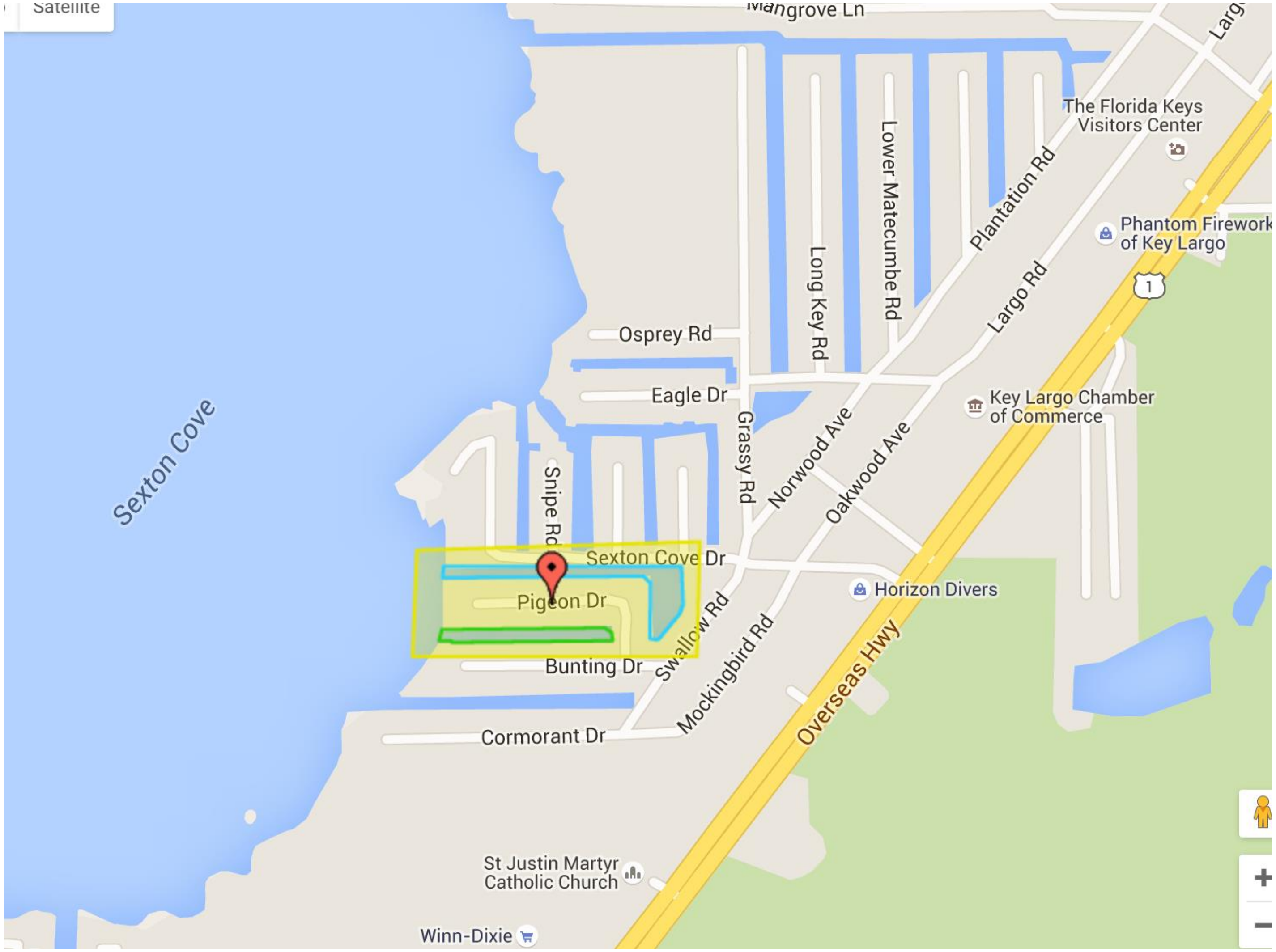


Effect on Seagrasses

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

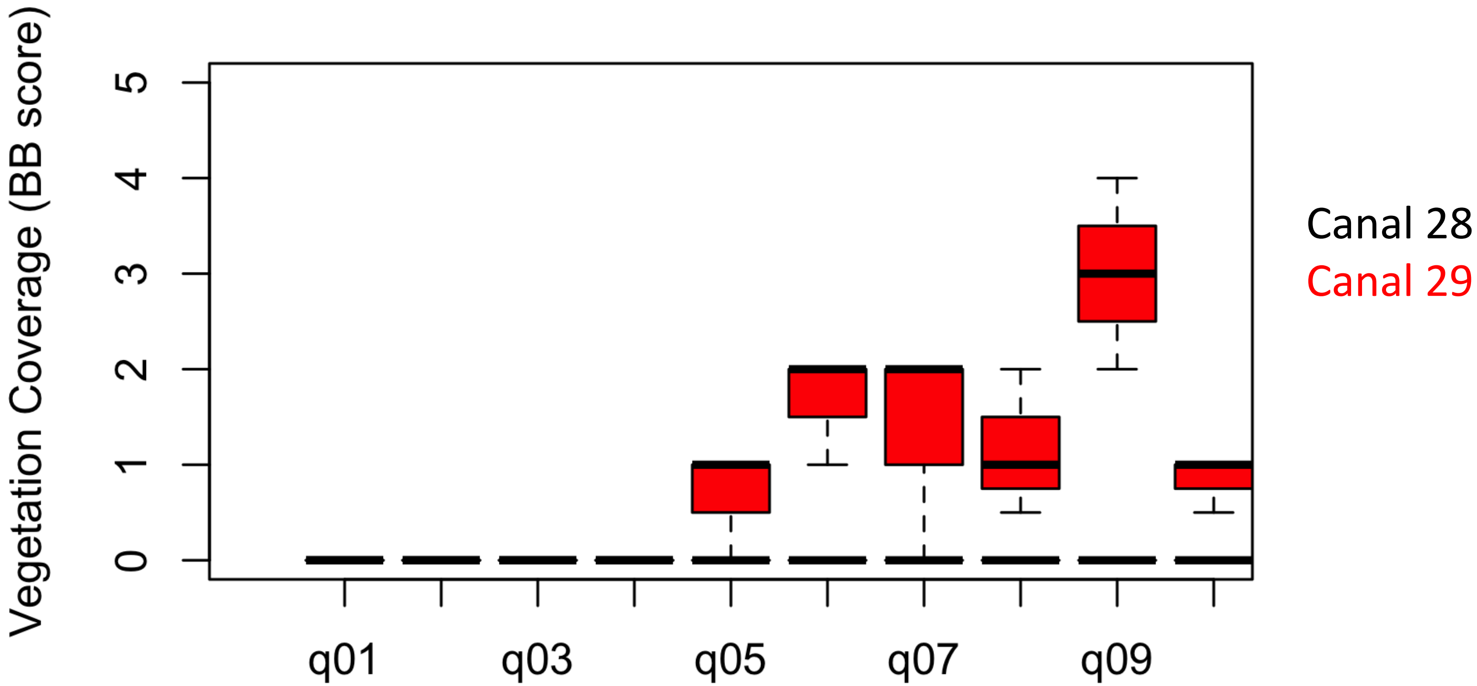
Canal	Distance from Canal Mouth (m)				
	0	10	50	100	250
Halodule wrightii					
28	2	2	2	0	0
29	0	0	0	0	2
132	0	0	0	0	0
137	0	0	0	1	0
147	1	0	4	3	3
148	2	0	0	0	0
263	0	0	0	0	0
266	0	3	0	0	0
277	2	3	2	4	0
278	5	3	5	4	0
282	0	0	3	2	0
287	0	0	0	0	0
288	0	0	0	0	0
290	0	0	0	0	0
293	0	0	0	0	0
472	0	2	2	1	0
476	0	0	1	0	0

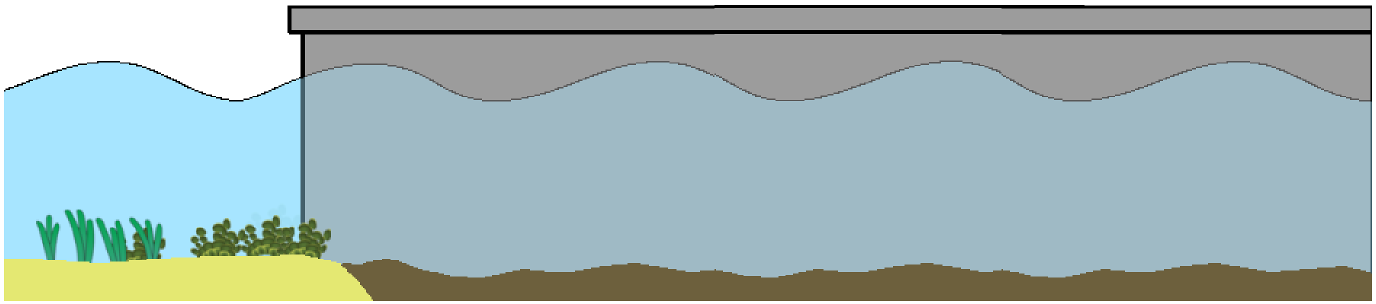
Canal 28 and 29



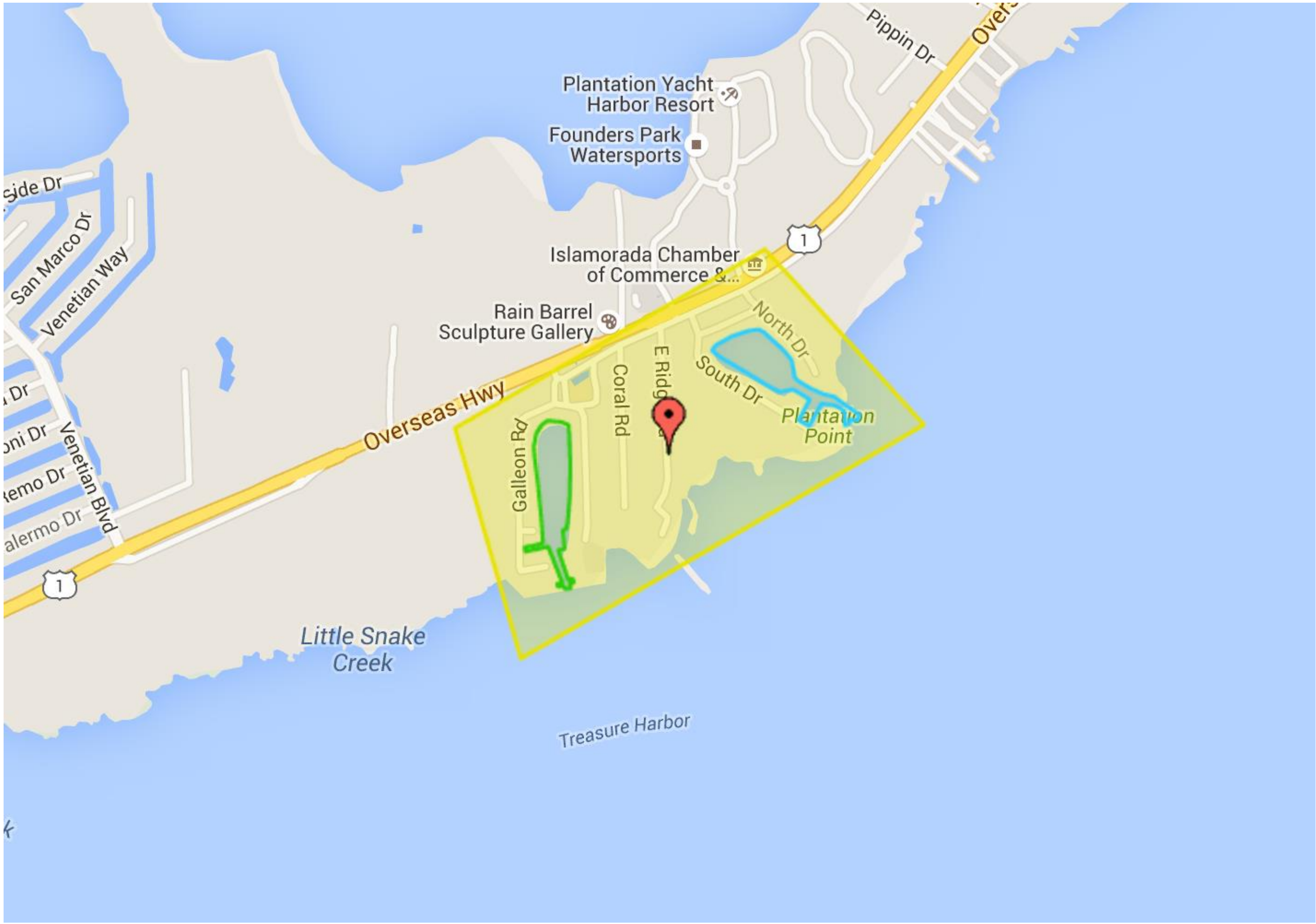
L28
Q4
Nasco WHIRL-PAK
Nasco WHIRL-PAK
Nasco WHIRL-PAK
YAMAHA
150

Canals 28 and 29

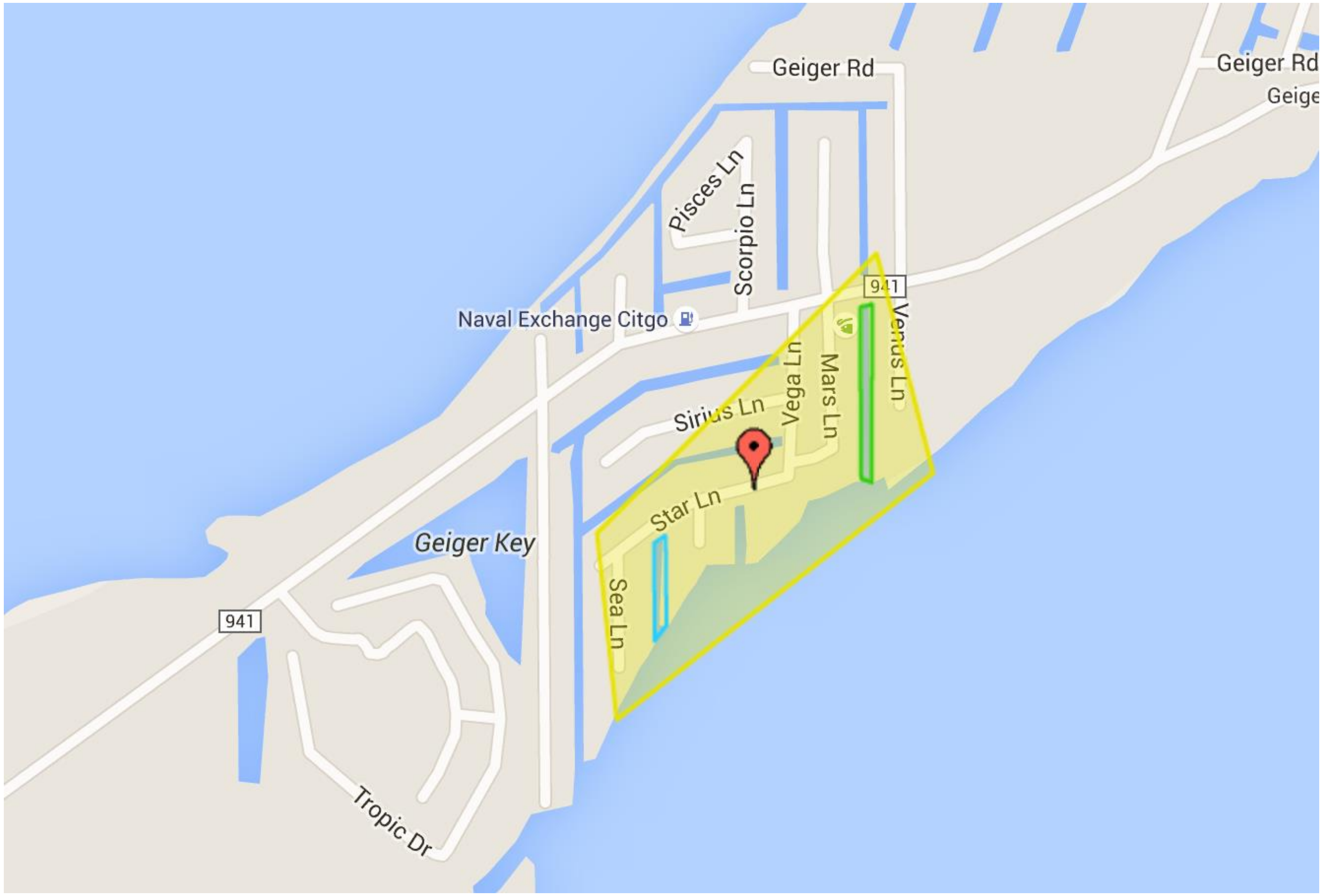




Canal 132 and 137



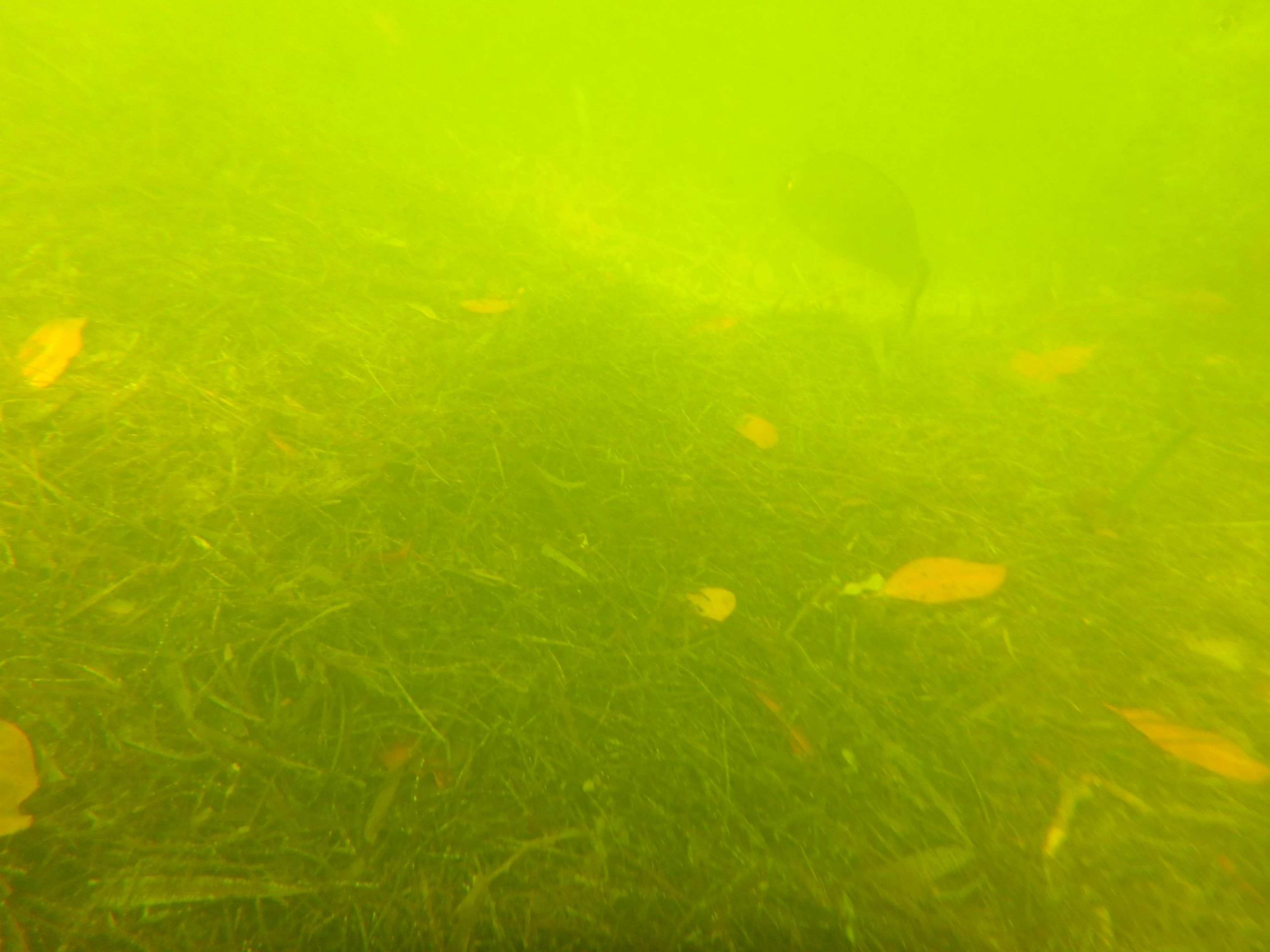
Canal 472



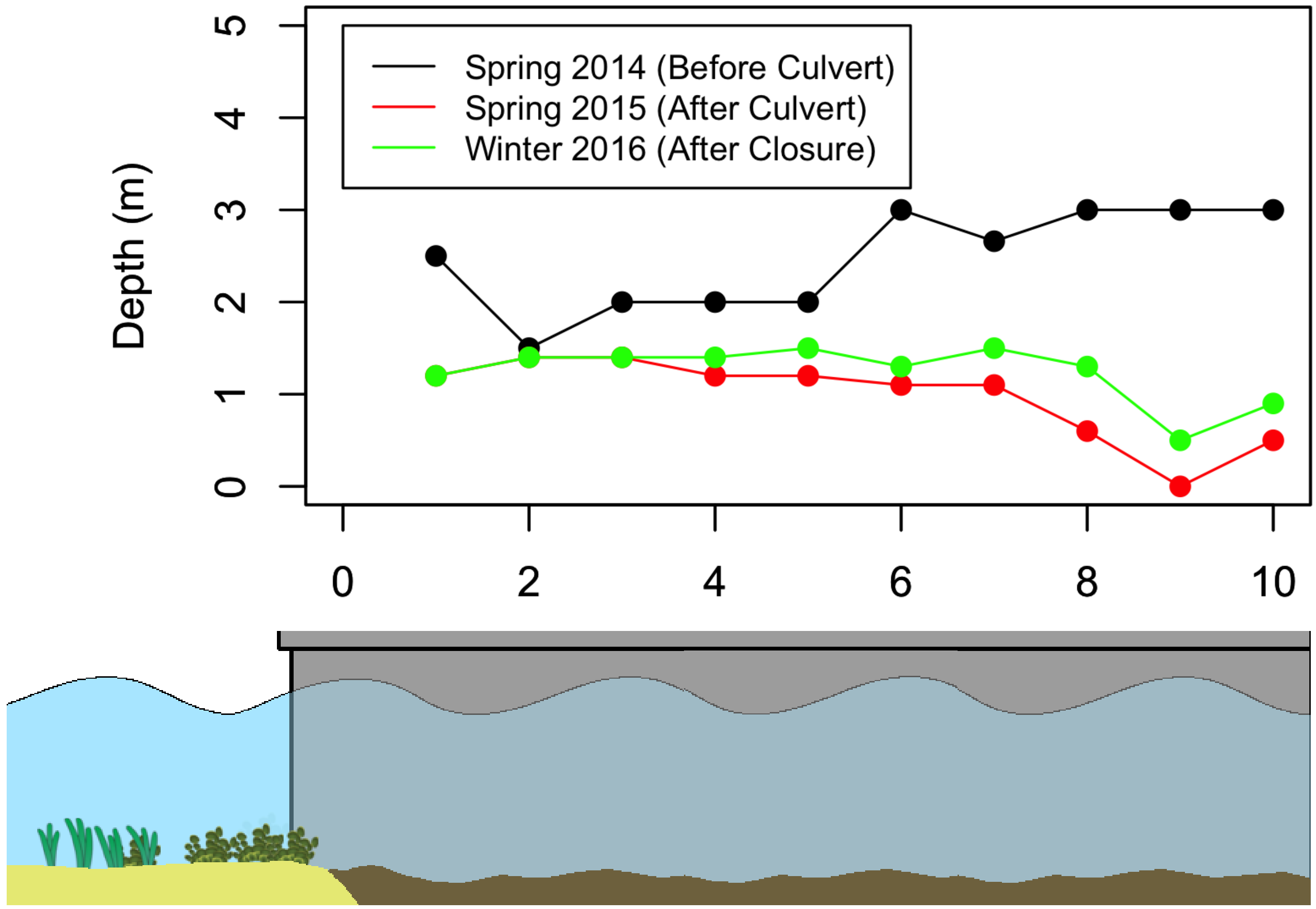
Geiger Rd
Geiger Rd
Pisces Ln
Scorpio Ln
941
Naval Exchange Citgo
Venus Ln
Mars Ln
Vega Ln
Sirius Ln
Star Ln
Geiger Key
Sea Ln
941
Tropic Dr


SALTY TOO
CENTURY


CENTURY
B10

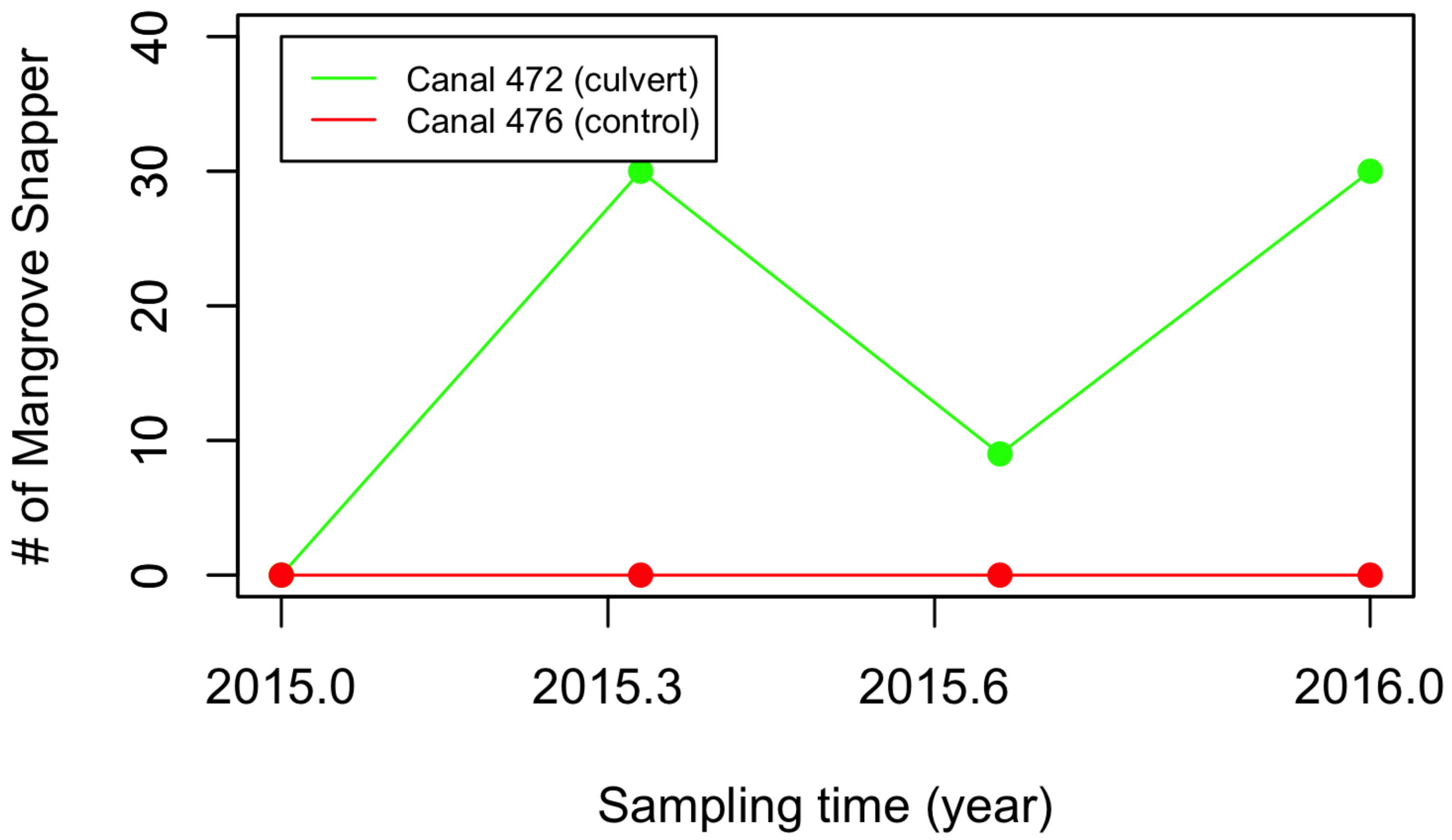


Canal 472



Spring 2014 (Before Culvert)
Spring 2015 (After Culvert)
Winter 2016 (After Closure)
Depth (m)
0
1
2
3
4
5
0
2
4
6
8
10

Canal 472


Canal 472 (culvert)
Canal 476 (control)
# of Mangrove Snapper
0
10
20
30
40
2015.0
2015.3
2015.6
2016.0
Sampling time (year)

Conclusions

-Most remediation Techniques are showing positive results on sediments

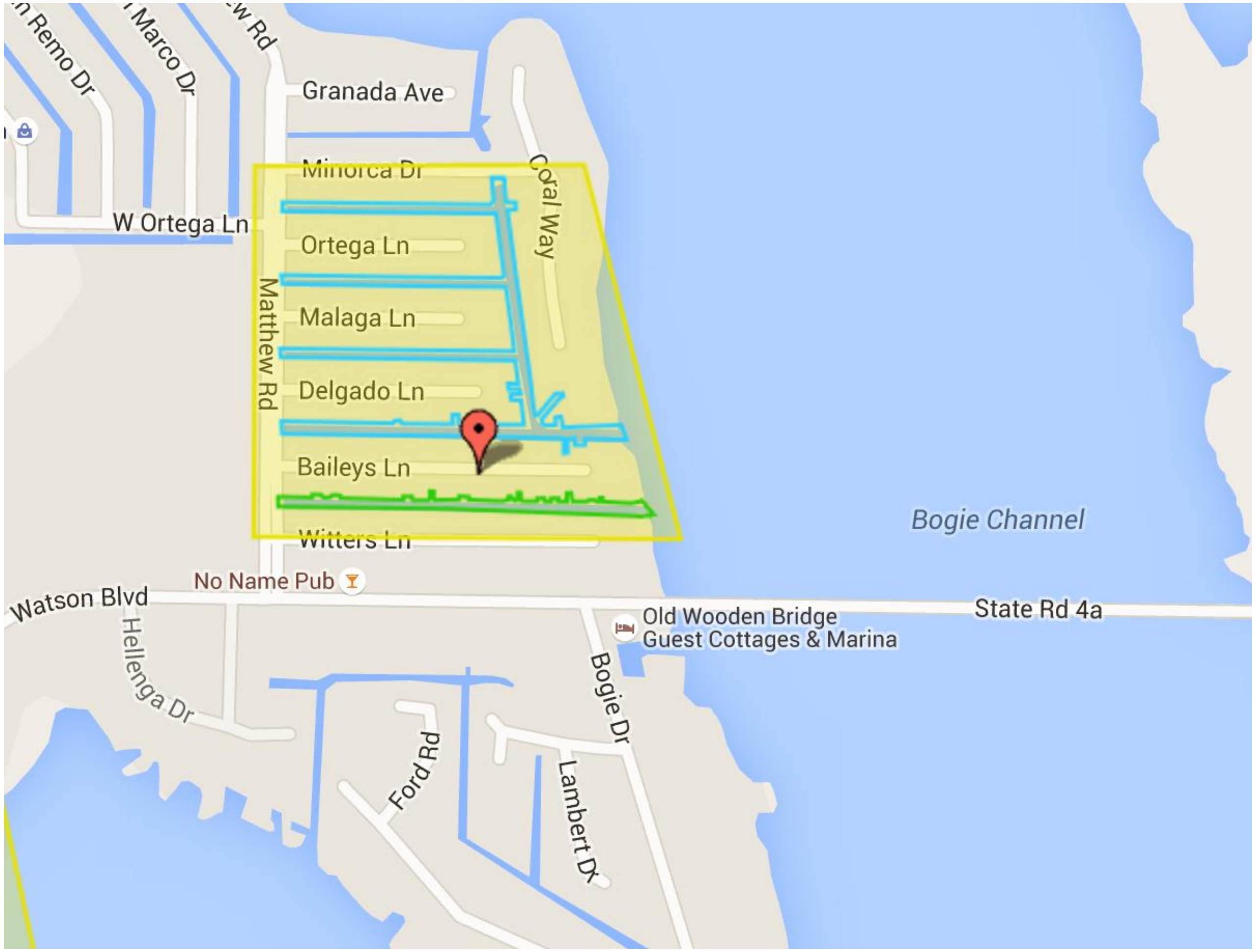
-Plant responses are delayed from remediation

-Canals are affecting adjacent waters

Further sampling required to assess the effects of remediation on adjacent waters

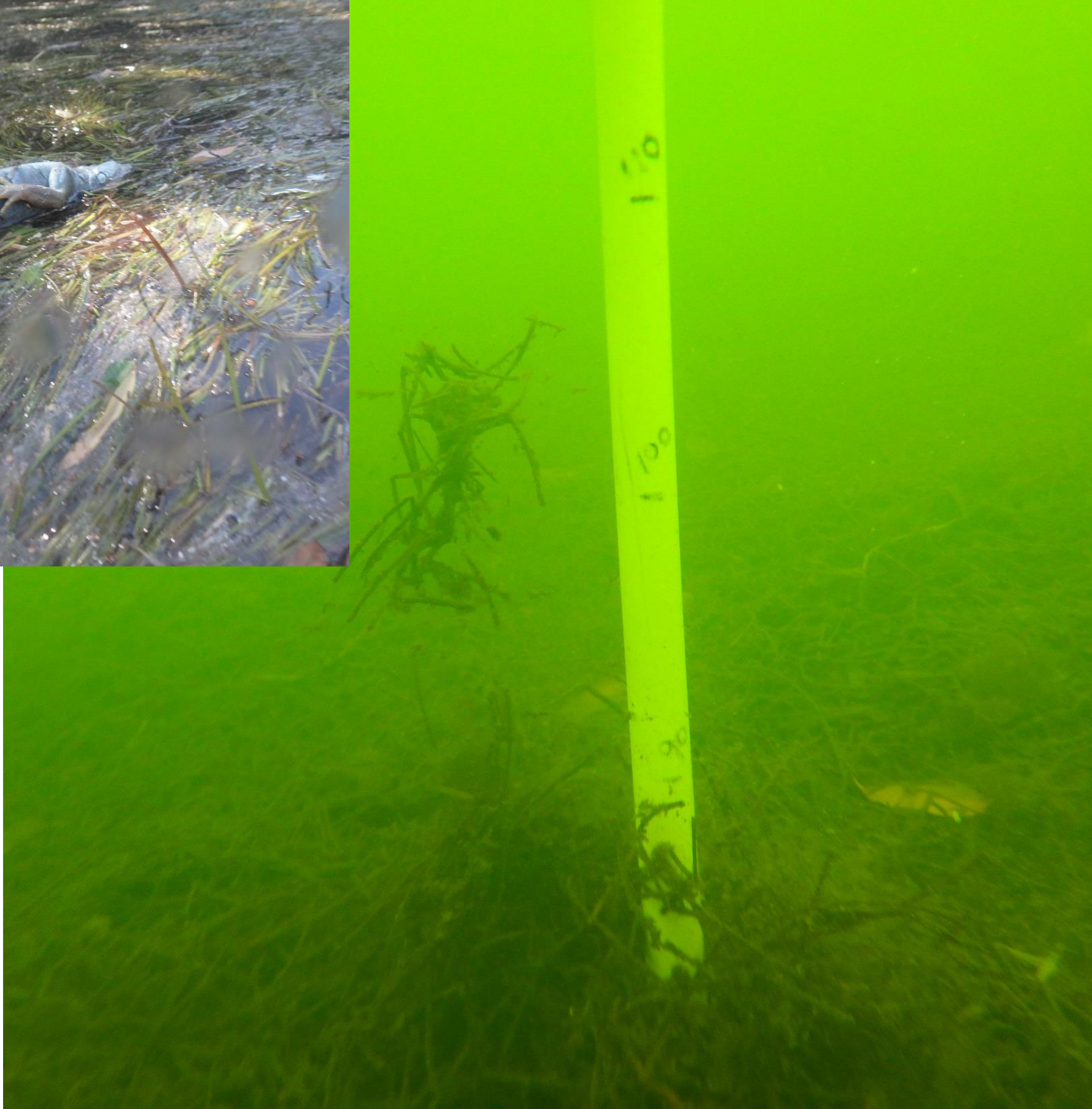
http://seagrass.fiu.edu
jhowa033@fiu.edu

Canal 266



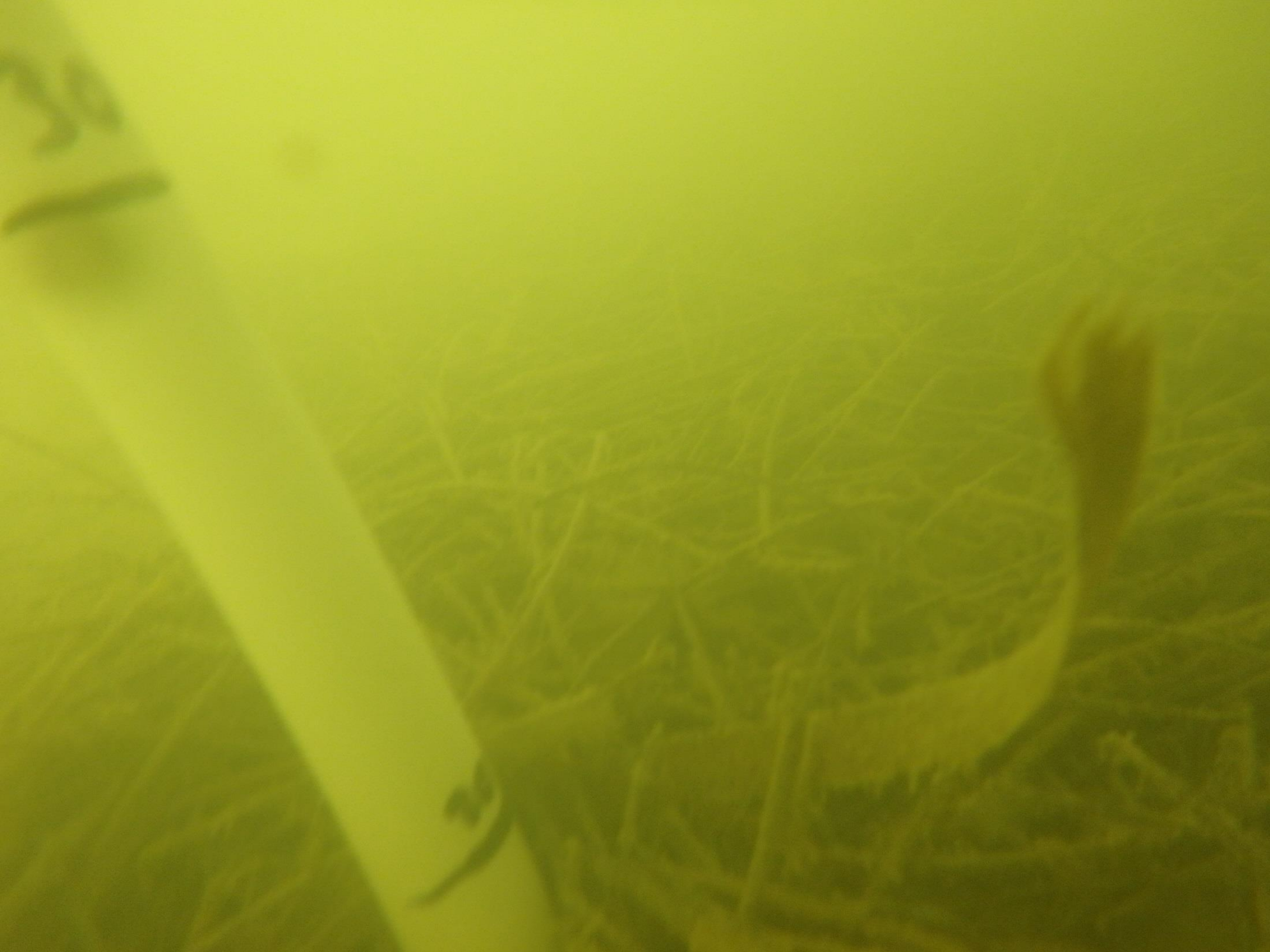
Granada Ave
Minorca Dr
Coral Way
W Ortega Ln
Ortega Ln
Matthew Rd
Malaga Ln
Delgado Ln
Baileys Ln
Witters Ln
Bogie Channel
No Name Pub
Watson Blvd
Old Wooden Bridge
Guest Cottages & Marina
State Rd 4a
Hellenga Dr
Bogie Dr
Ford Rd
Lambert Dr

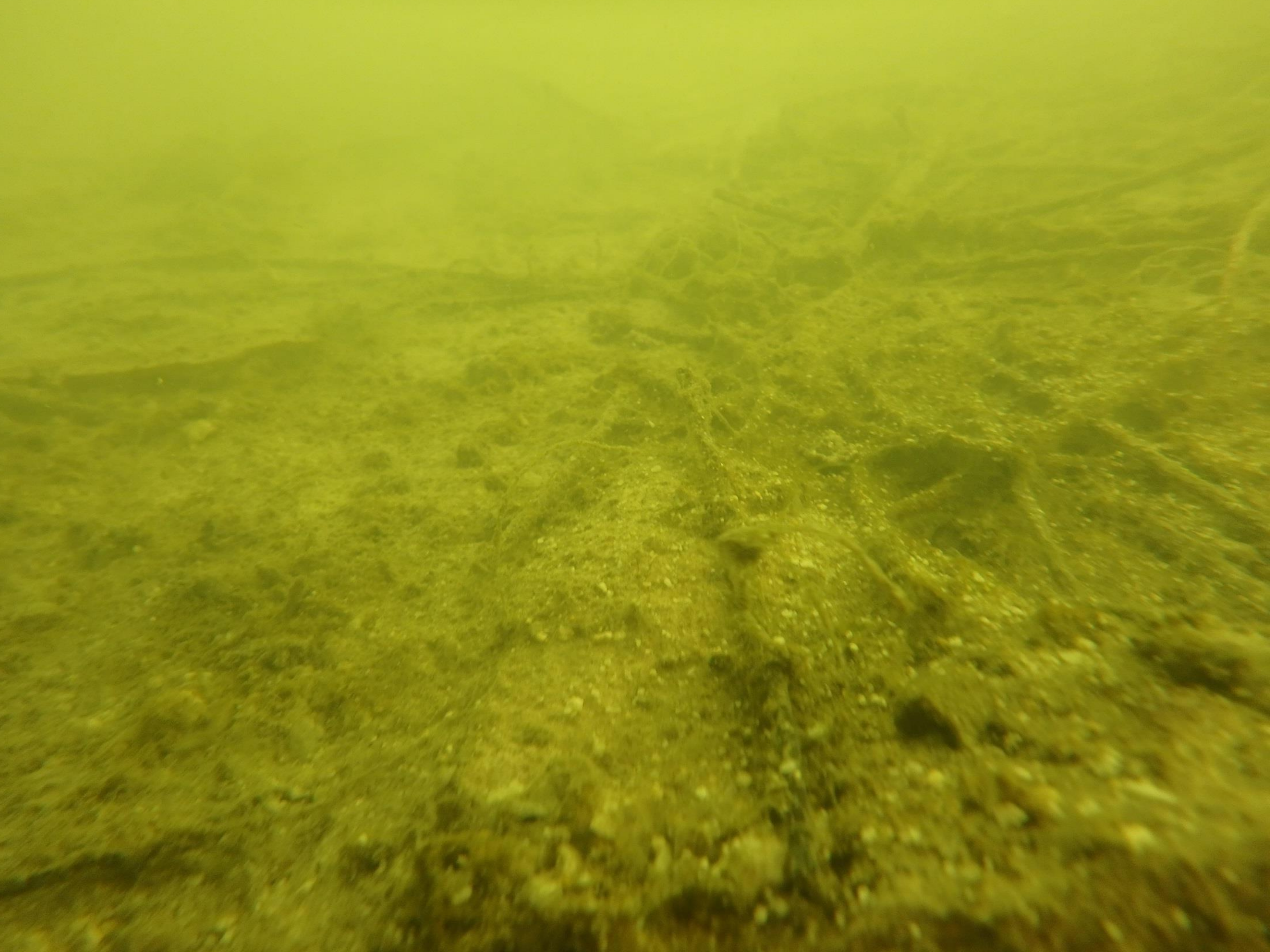
Canal 266- Before Dredging



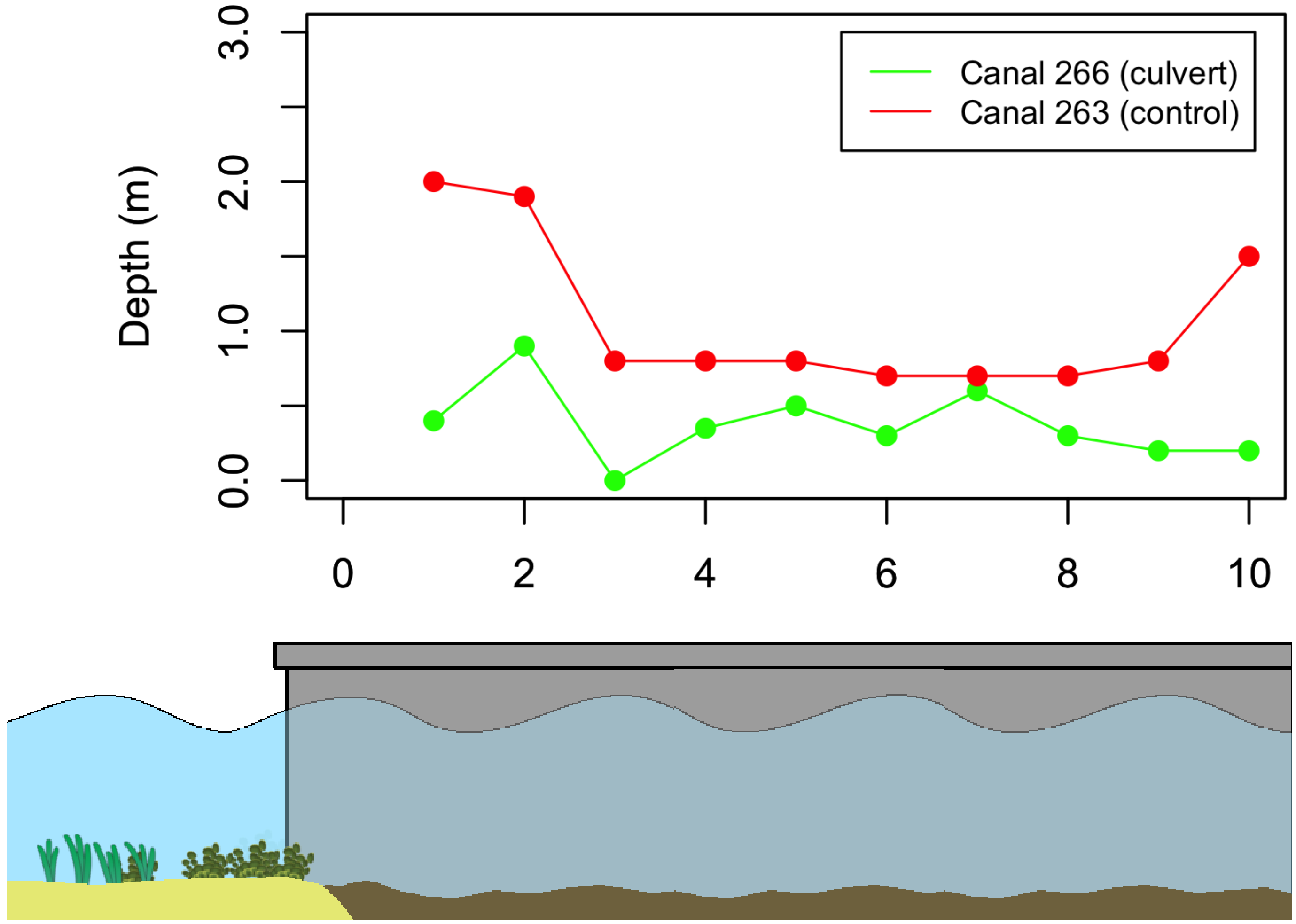
Canal 263- Control

Canal 266- After Dredging

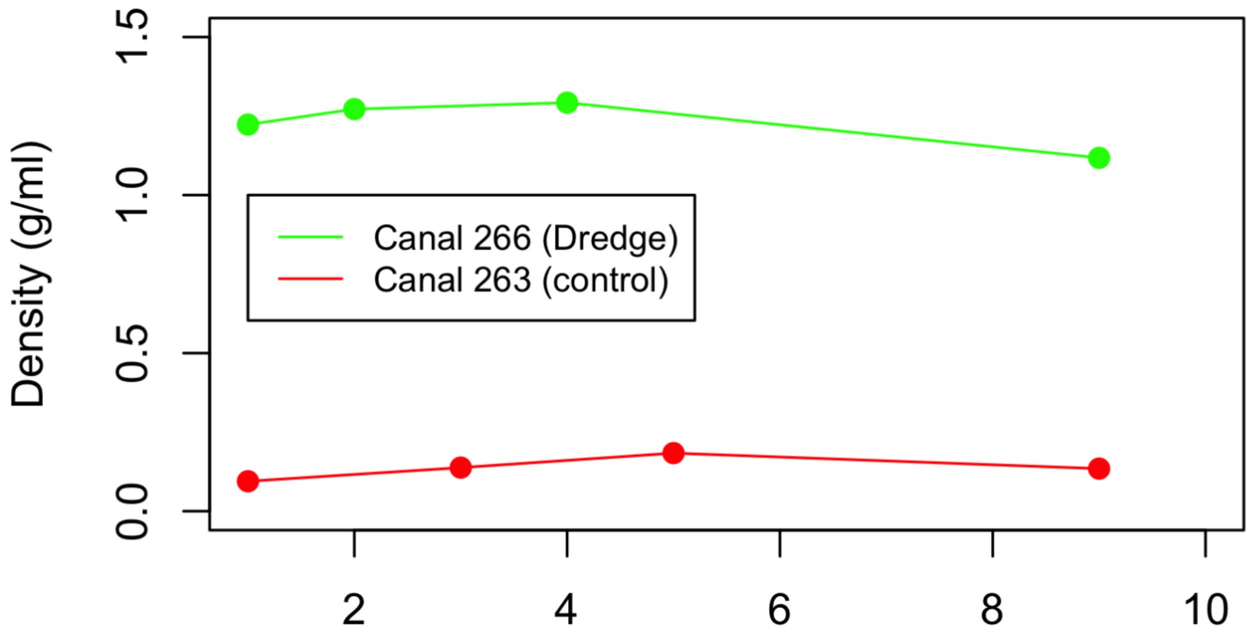


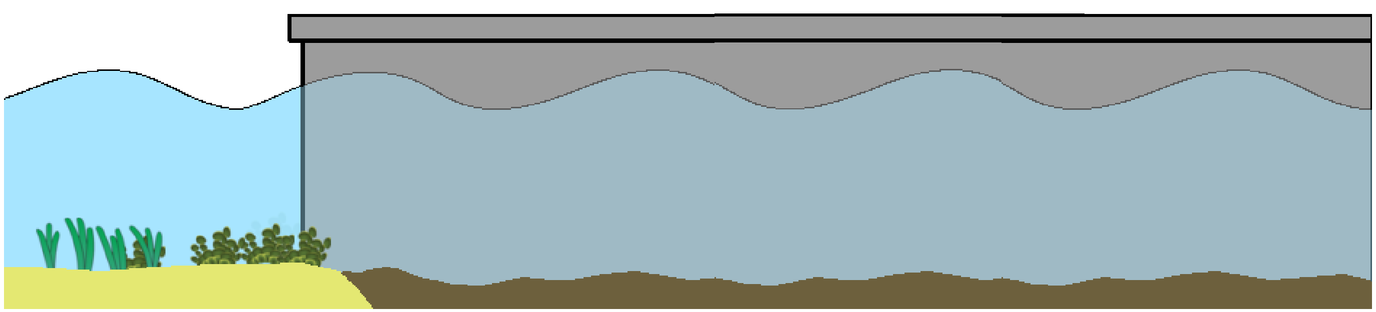


Canal 266


Canal 266 (culvert)
Canal 263 (control)
Depth (m)
0.0
1.0
2.0
3.0
0
2
4
6
8
10

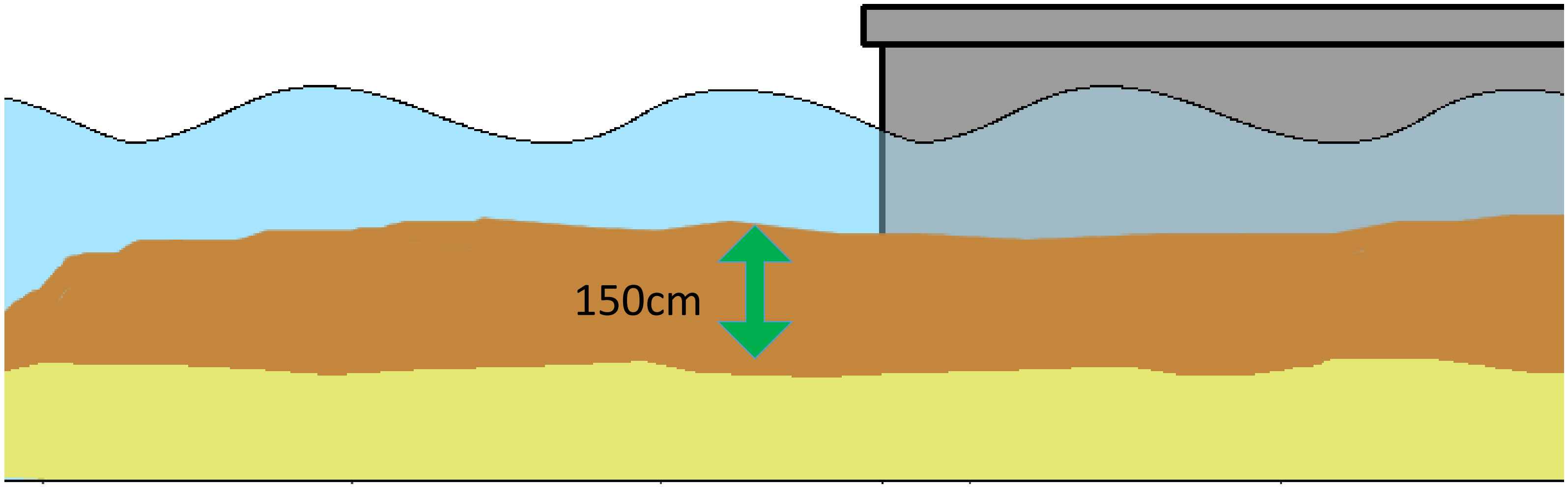
Canal 266


Density (g/ml)
0.0
0.5
1.0
1.5
2
4
6
8
10
Canal 266 (Dredge)
Canal 263 (control)



Canal 266

Before Dredging



After Dredging