Development of a macroalgal indicator of salinity patterns in Biscayne Bay.

GEER 2010-Naples

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Outline

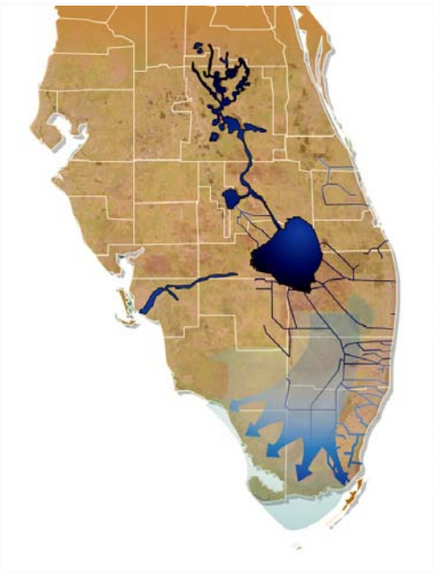
- Seasonal and spatial patterns of macroalgal community composition and abundance
- Relationships between macroalgae and physical parameters at Black Point, Biscayne Bay.
- Species associations that could be used as indicators
- Proposed conceptual model

The Comprehensive Everglades Restoration Plan (CERP): The big experiment

Historic Flow

Current Flow

CERP Flow



- Important component of SAV
- Sensitive to environmental conditions = good bio-indicators

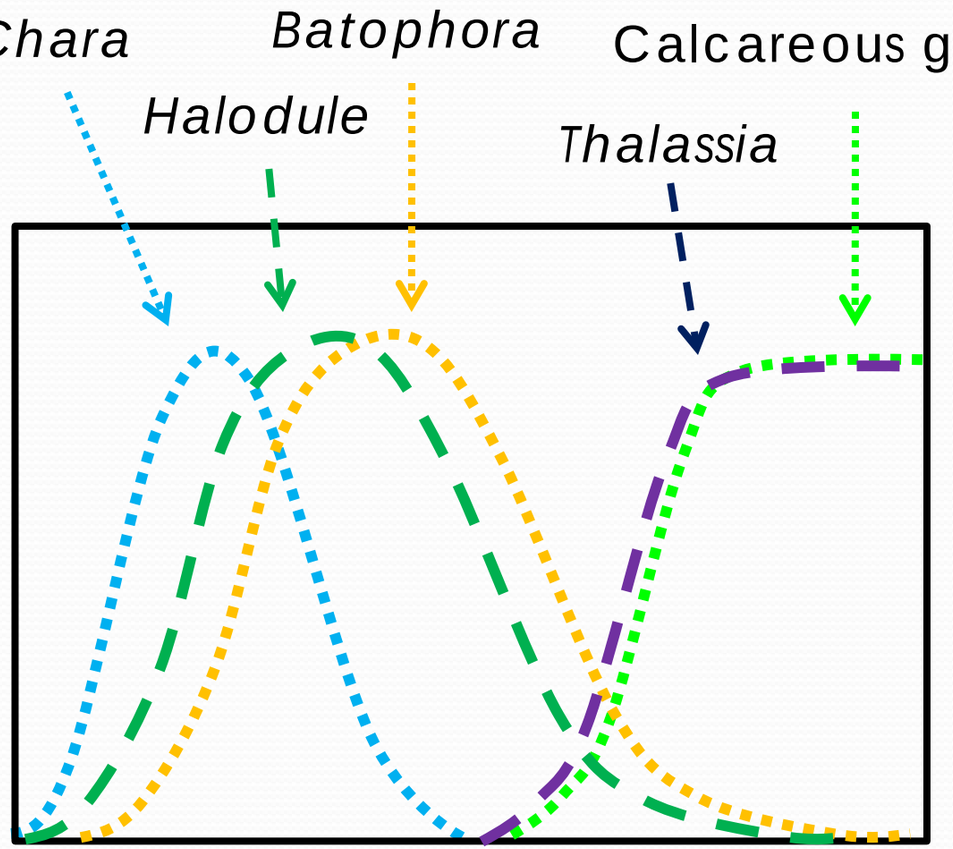
Macroalgae ????

Everglades Mangroves *Halodule* *Thalassia*

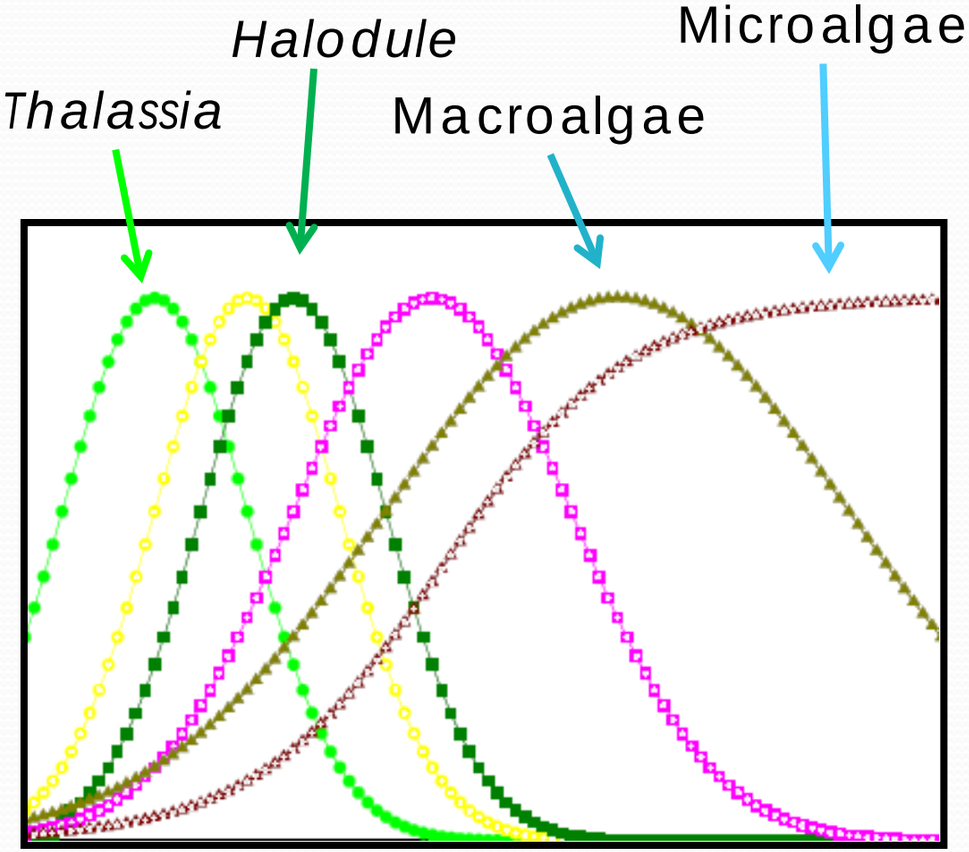
Salinity Gradient

http://www.evergladesplan.org/education/flowmaps.html

Salinity-Nutrient Gradients as drivers of SAV



Salinity Gradient



Oligotrophic

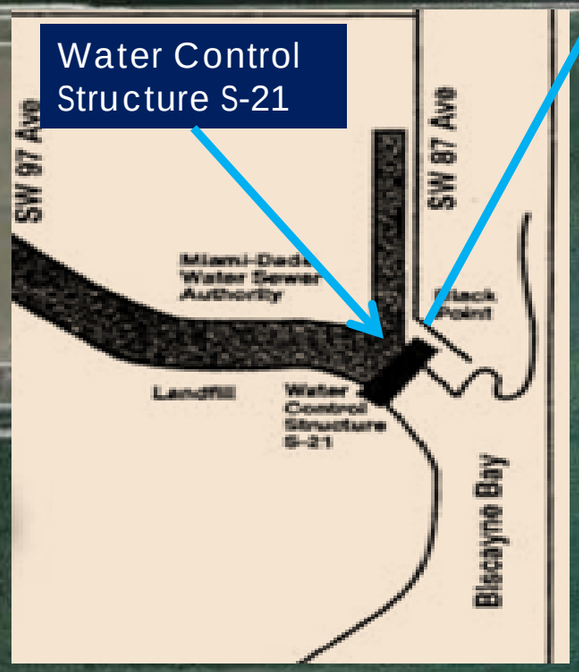
Eutrophic

Modified from http://www.fiu.edu/~seagrass/

Freshwater input from Black Creek canal

Black Point Marina

Water Control Structure S-21



0 1 2
3 4 5 6
7 8 9 10 11
12 14 15 16 17 18
19 20 21 23 24 25
26 27 28 29 30 31
32 33 34 35 36
37 38 39 40
41 42 43

North

South

0020 0026 0027 0028
0032
0031 0029 0030

Marine

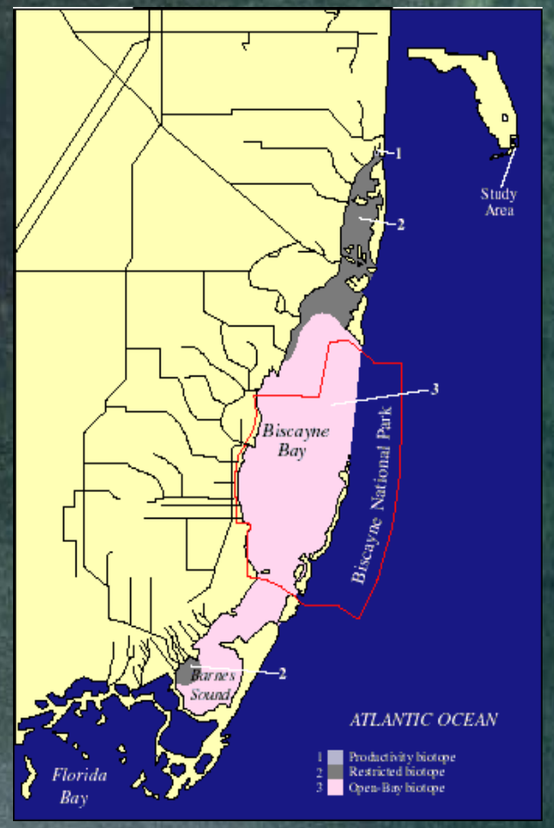


Image U.S. Geological Survey
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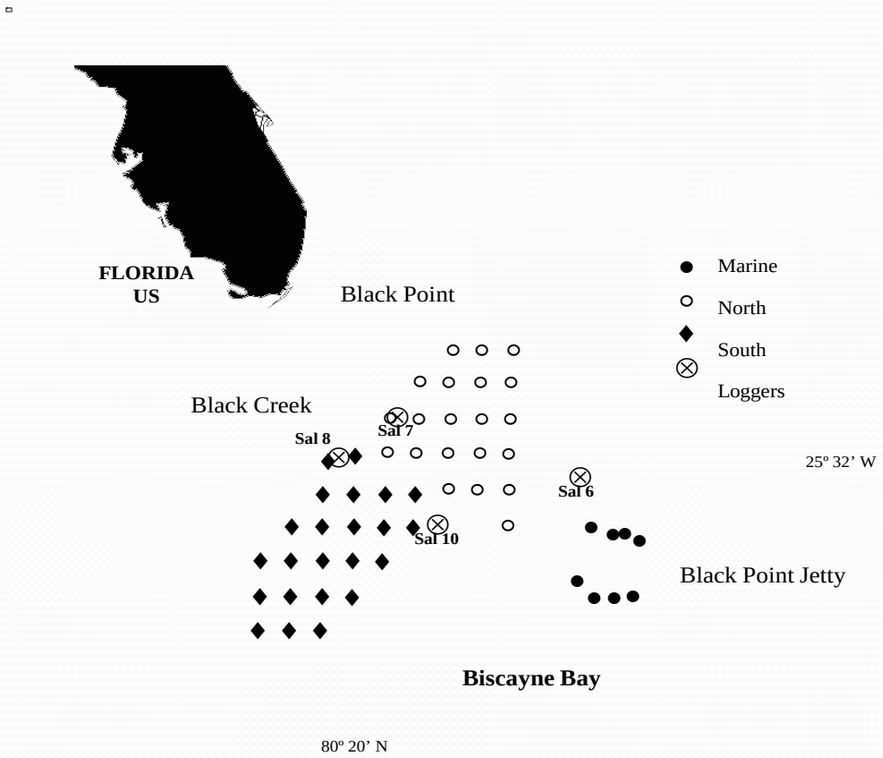
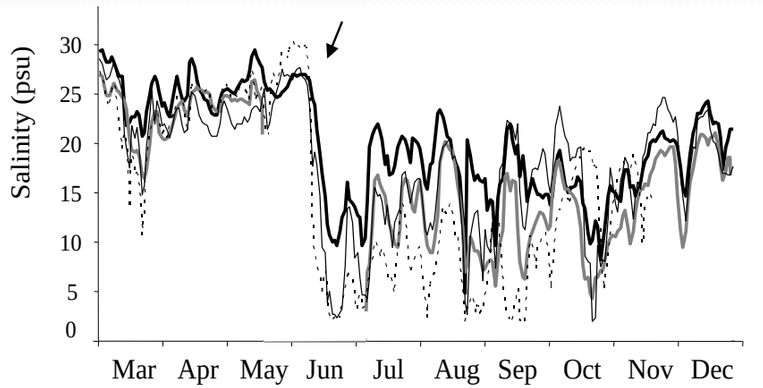
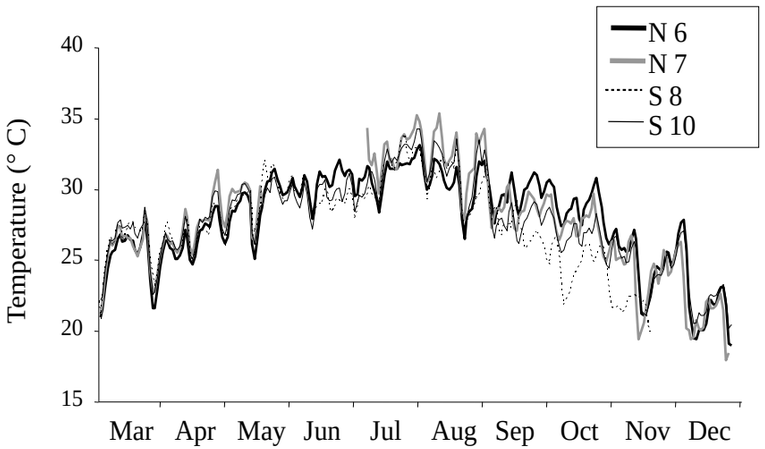
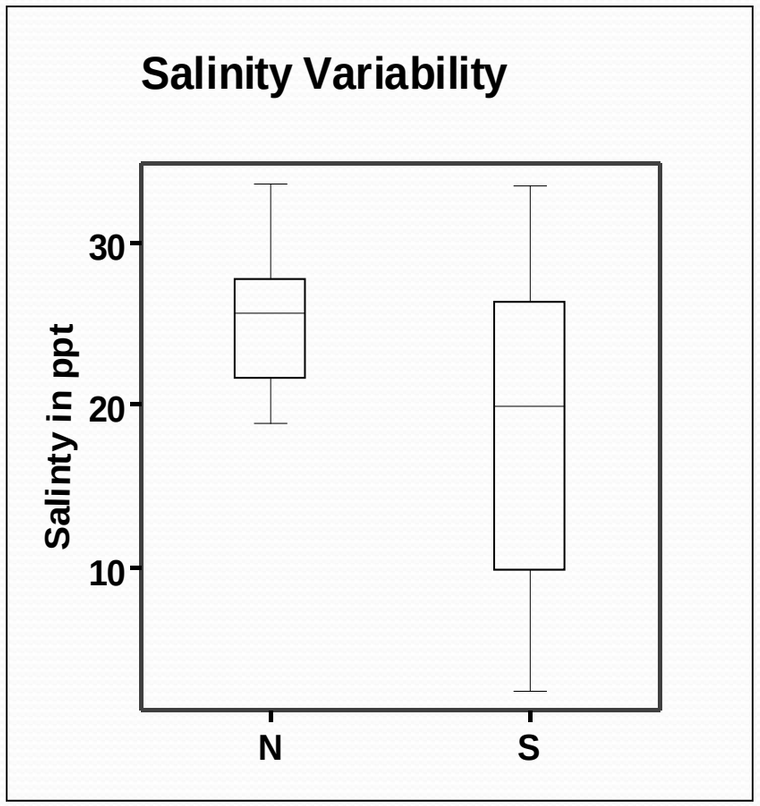
Salinity and Temperature variability



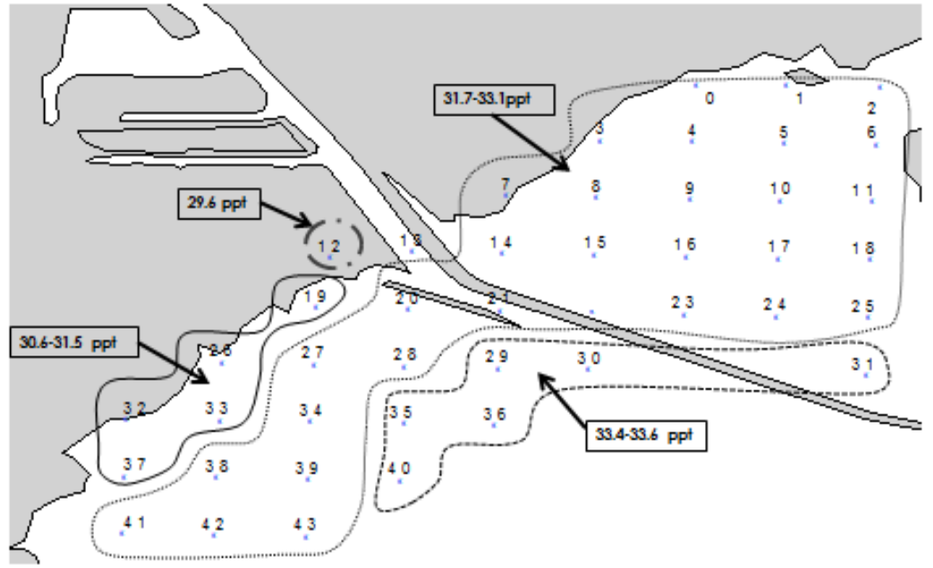




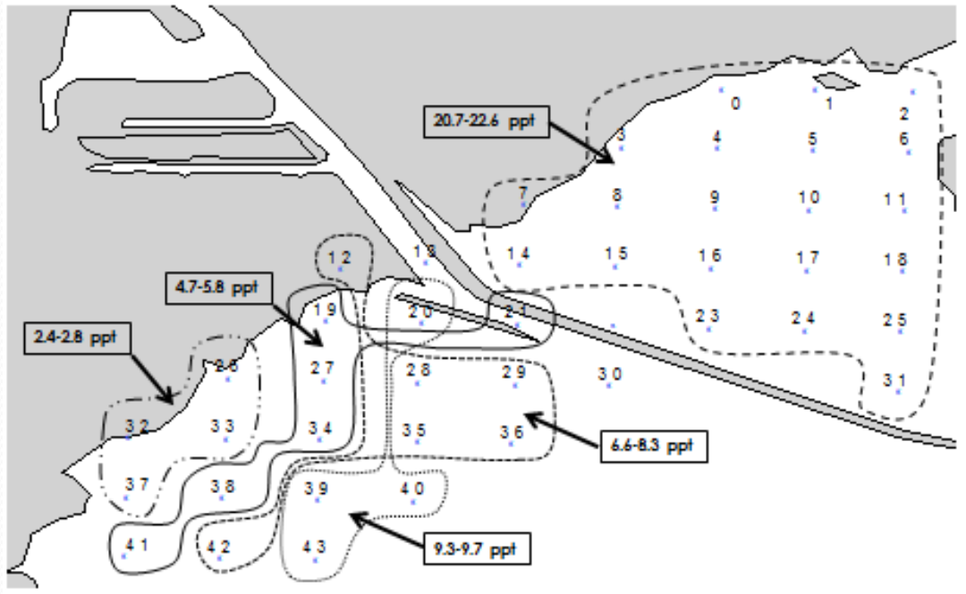
Salinity seasonal patterns



Dry season



Wet season



Dominant species

Rhodophyta

Laurencia intricata
Palisada poiteauii
Polysiphonia echinta

Chlorophyta

Acetabularia schenckii
Anadyomene stellata
Batophora oerstedii
Halimeda incrassata
Chara hornemanii
Penicillus capitatus

Heterokontophyta

Sargssum fluitans
Sargassum natas

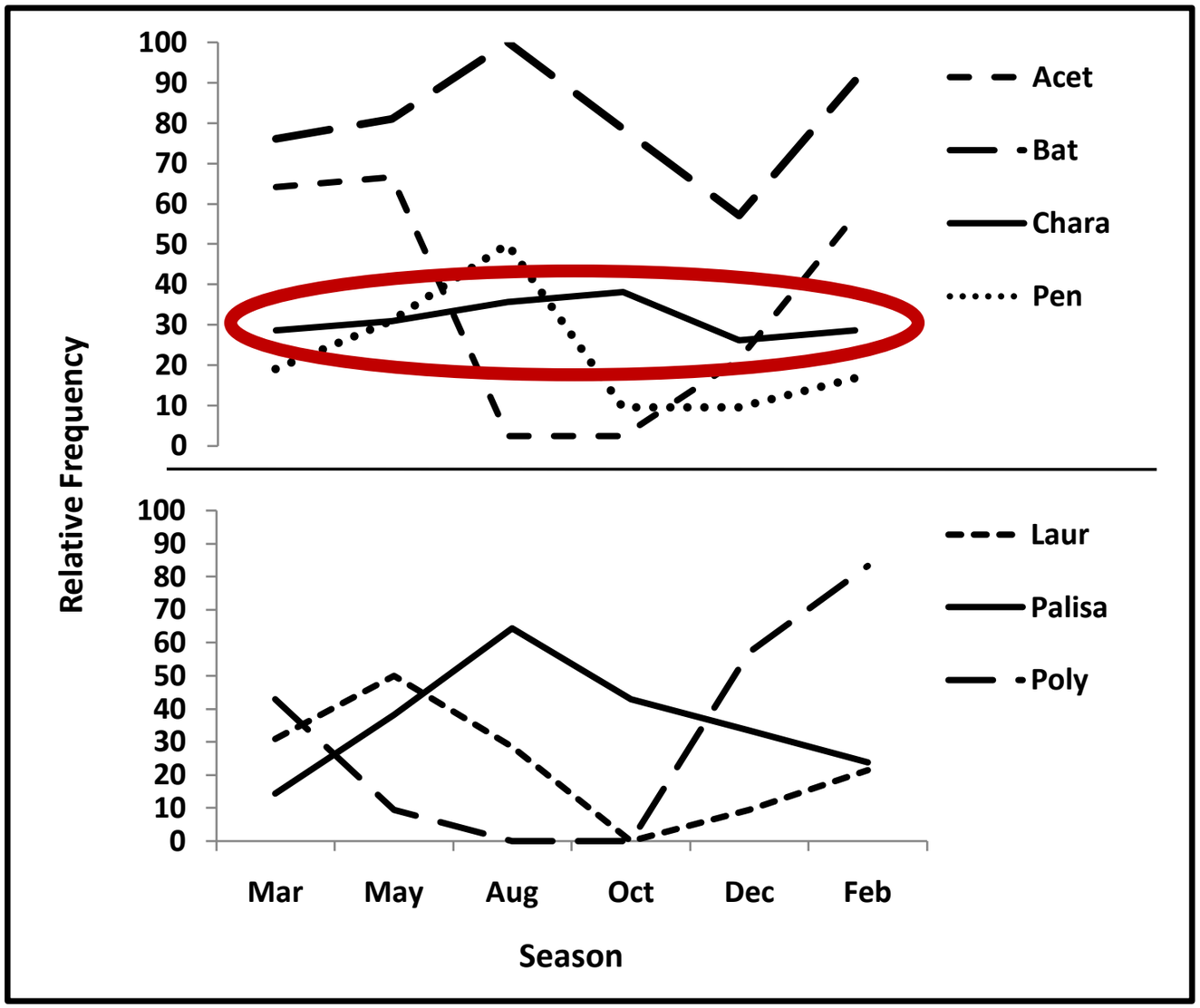
- **30 species total**
  - 12 Chlorophyta
  - 16 Rhodophyta
  - 2 Phaeophyta

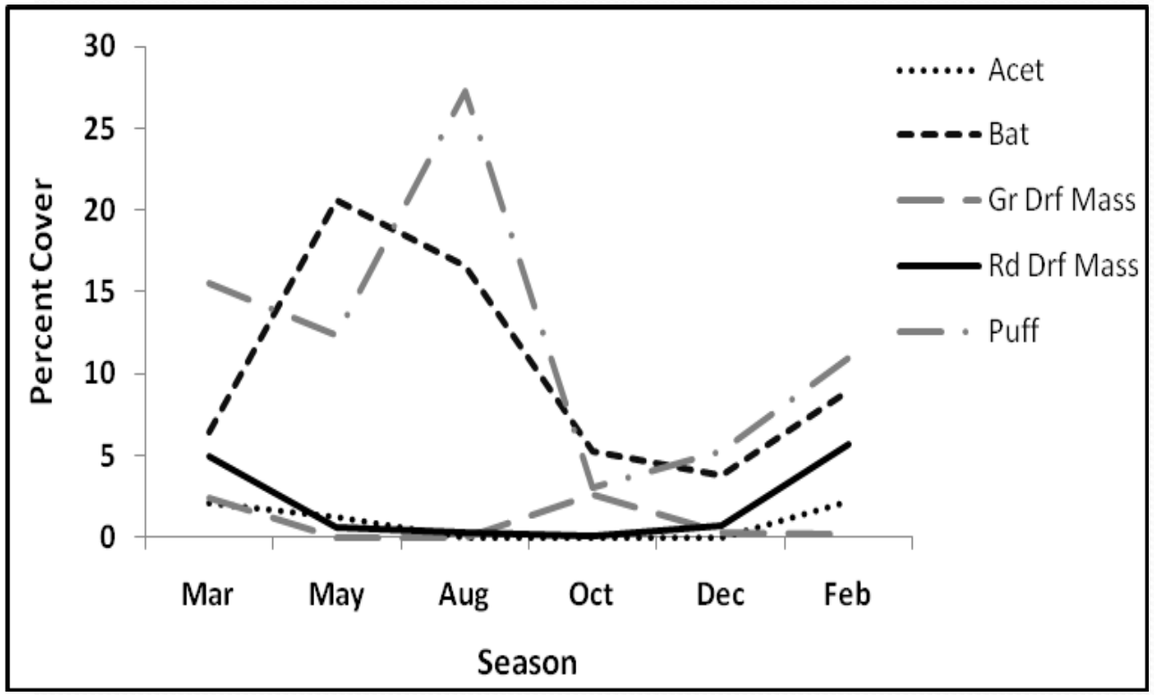
- **Growth Forms and genus**
  - Drifting Red Masses
  - PUFF (cyanobacteria, diatoms, filamentous algae)
  - Penicillus
  - Chara
  - Acetabularia

Chara

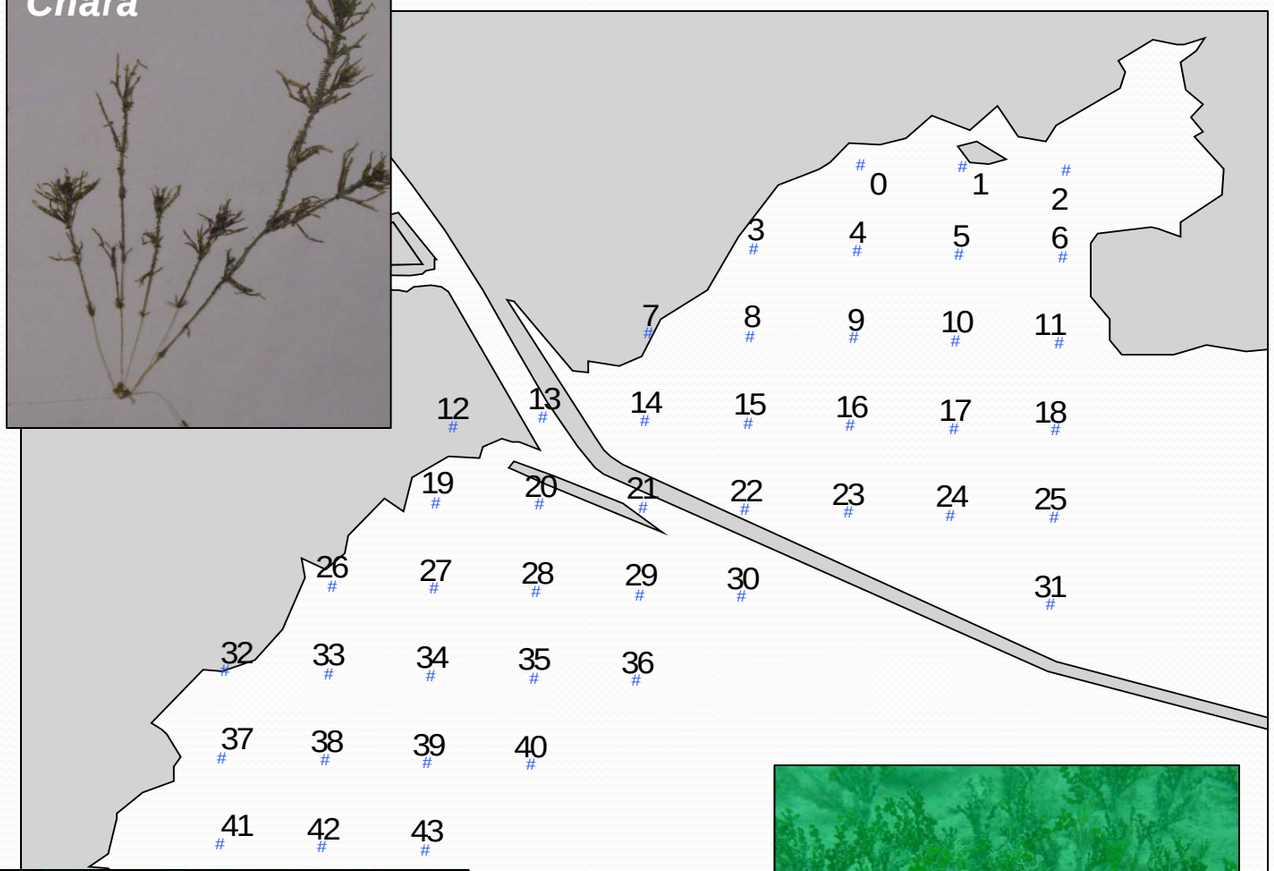
Puff on *Halodule*

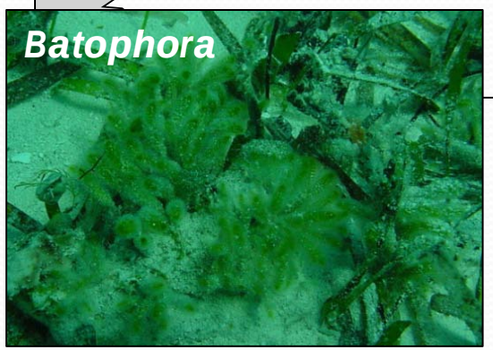
Macroalgal Seasonality

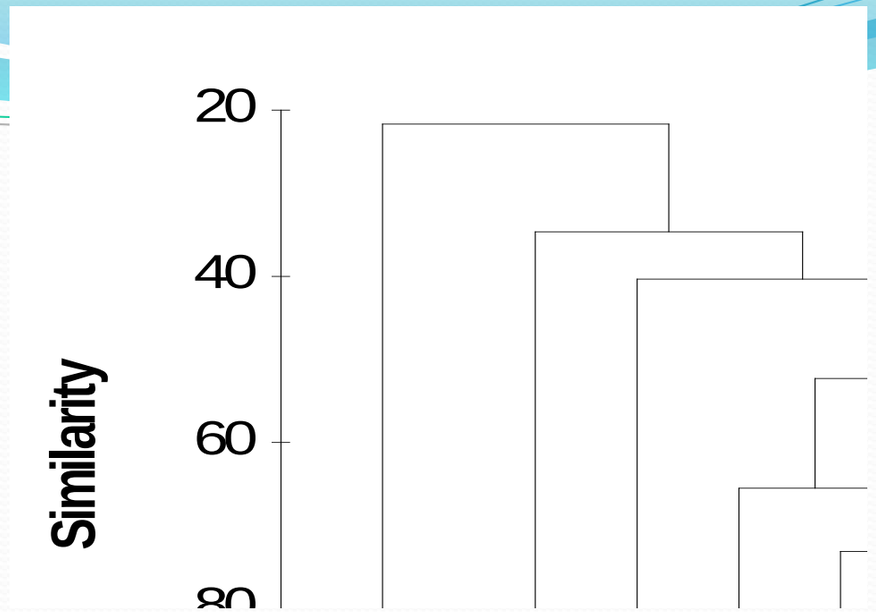




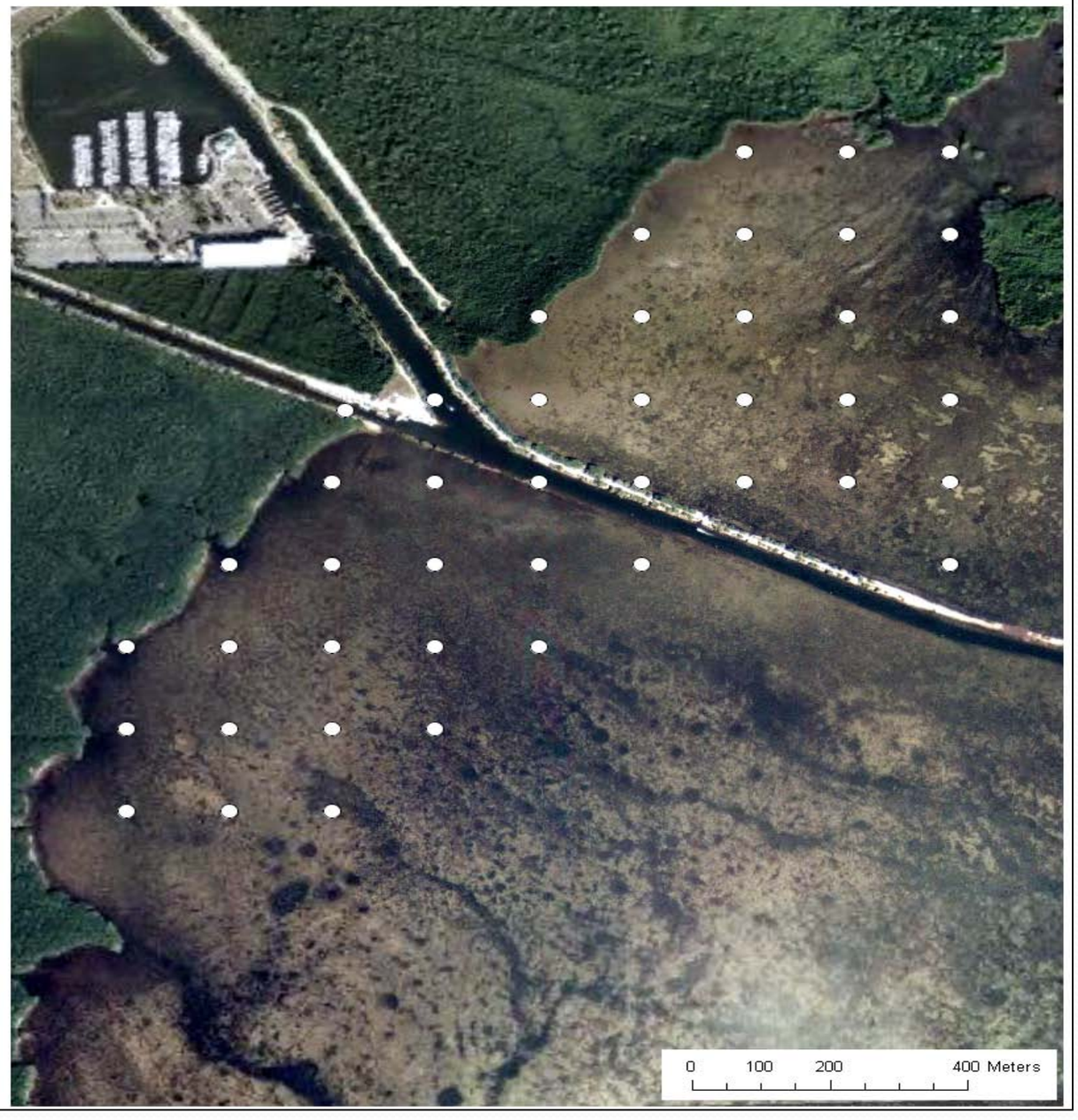
Species Associations

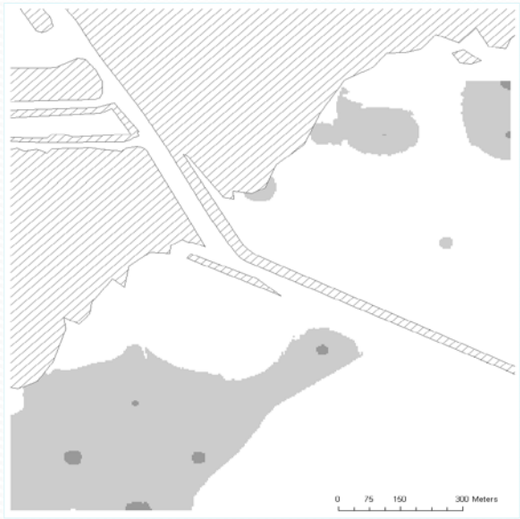






SWaPS Wet Season 2005 Canal Survey
Black Creek





Halodule wrightii

Thalassia testudinum

Mean % Cover

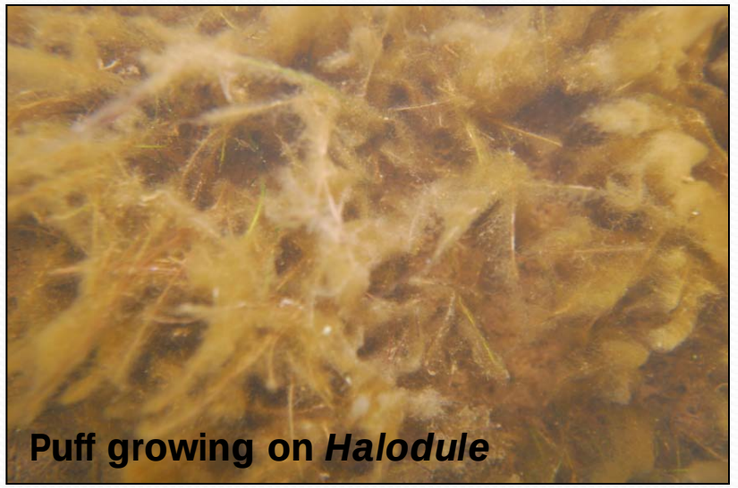
- 0 - 10
- 10 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 100

Logistic non-linear regression between species presence-absence and environmental and biological variables.

	Batophora	*Chara*	*Penicillus*
Salinity	ns	**neg**	**pos**
Temperature	ns	**pos**	ns
Thalassia cover	ns	**neg**	**pos**
Halodule cover	ns	**pos**	**neg**

Non-parametric correlation (Kendall tau-b coefficient) between growth form abundance and environmental and biological variables.

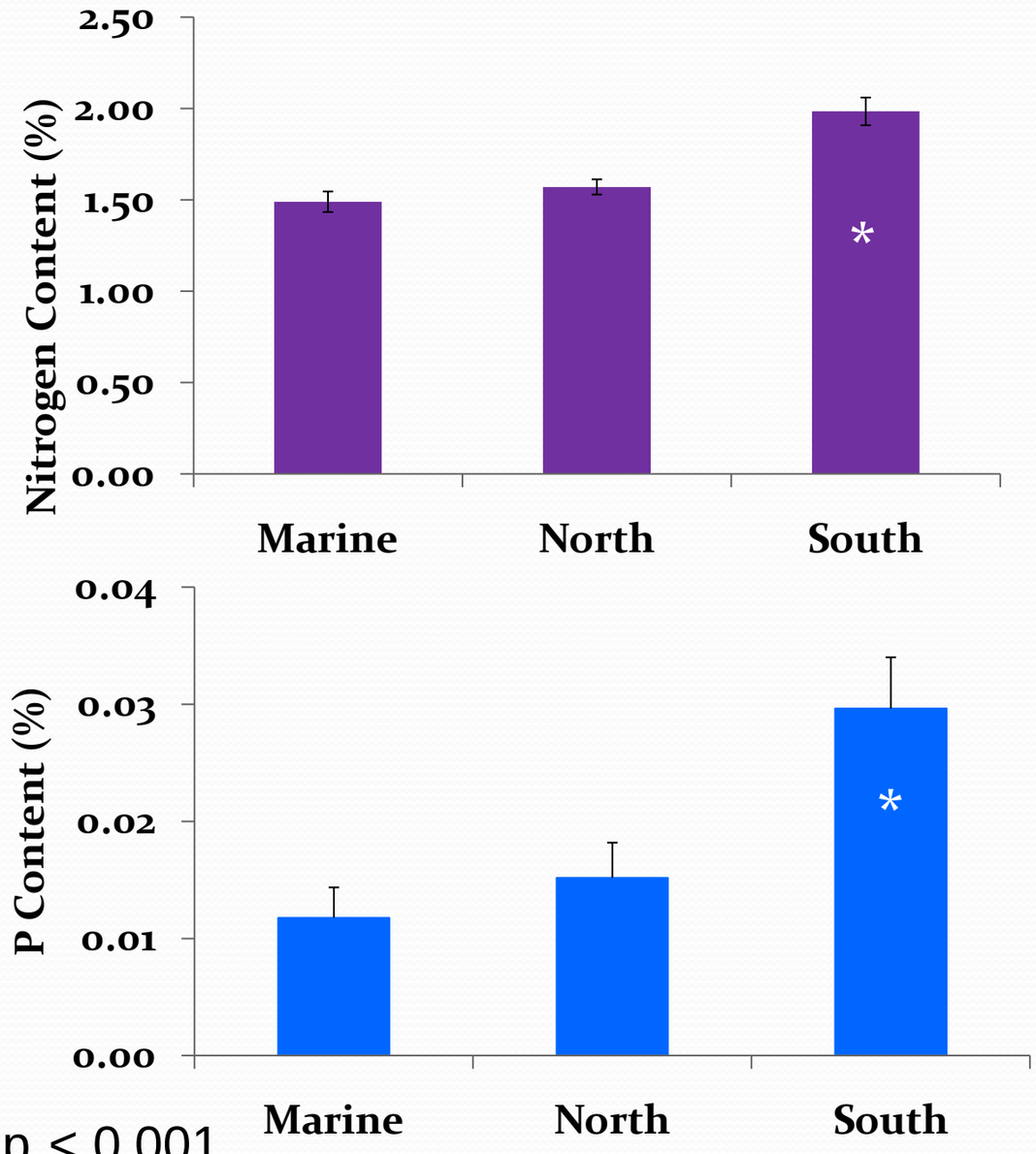
	Thalassia	*Halodule*	Temperature	Salinity
ACET	**-0.38**	NS	NS	**0.35**
BAT	**-0.41**	**0.16**	**0.31**	NS
DRM	**0.20**	NS	**-0.15**	**0.22**
PEN	**0.20**	**-0.17**	**0.16**	**0.21**
PUFF	**-0.37**	**0.15**	**0.23**	NS


Puff growing on *Halodule*

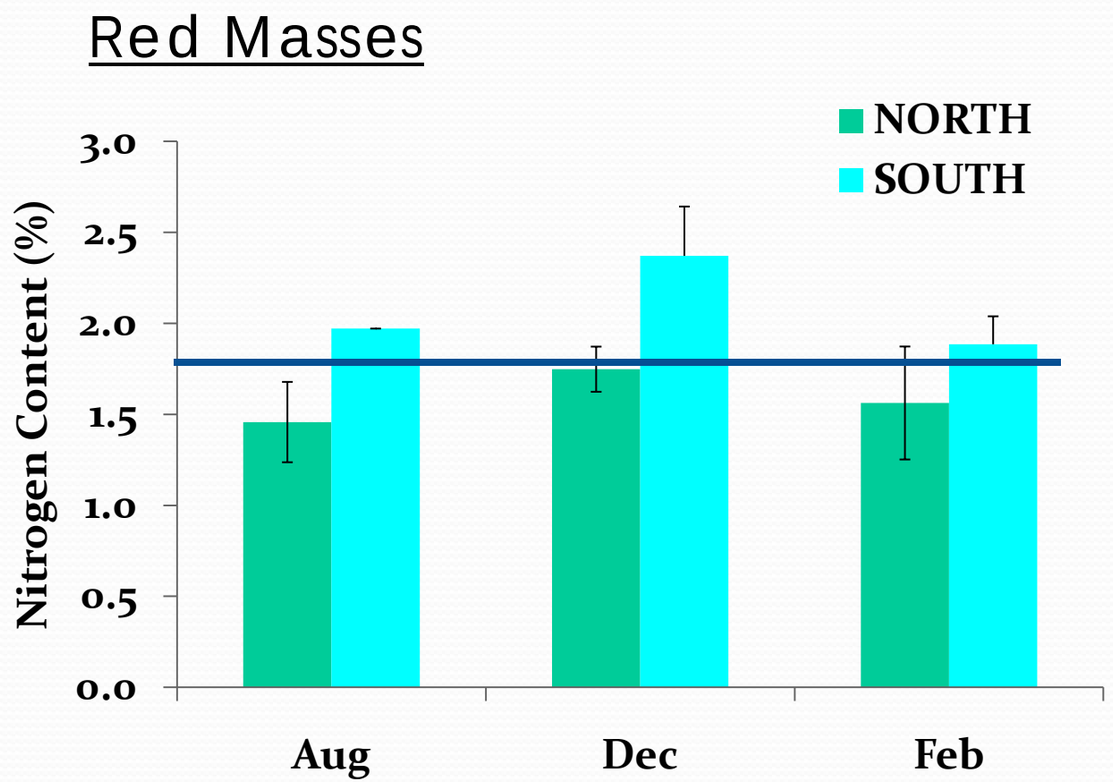
Macroalgae and nutrients

Species/group	N	C	P	N:P
Anadyomene	1.69	28.92	0.03	122.78
Batophora	1.81	37.02	nd	nd
Chara	2.02	30.05	0.05	91.99
Digenia	2.03	38.58	0.11	41.88
Green Mat	2.23	29.62	0.05	90.30
Laurencia	1.60	33.73	0.01	262.43
Polysiphonia	1.88	36.30	0.01	348.40
Red Mass	1.84	32.97	0.02	245.33
Red Mat	3.45	42.05	0.02	384.76
Sargassum	1.54	28.46	0.04	86.70
Average	1.86	32.88	0.03	118.78
Median	1.84	32.97	0.03	162.11

Macroalgae and nutrients



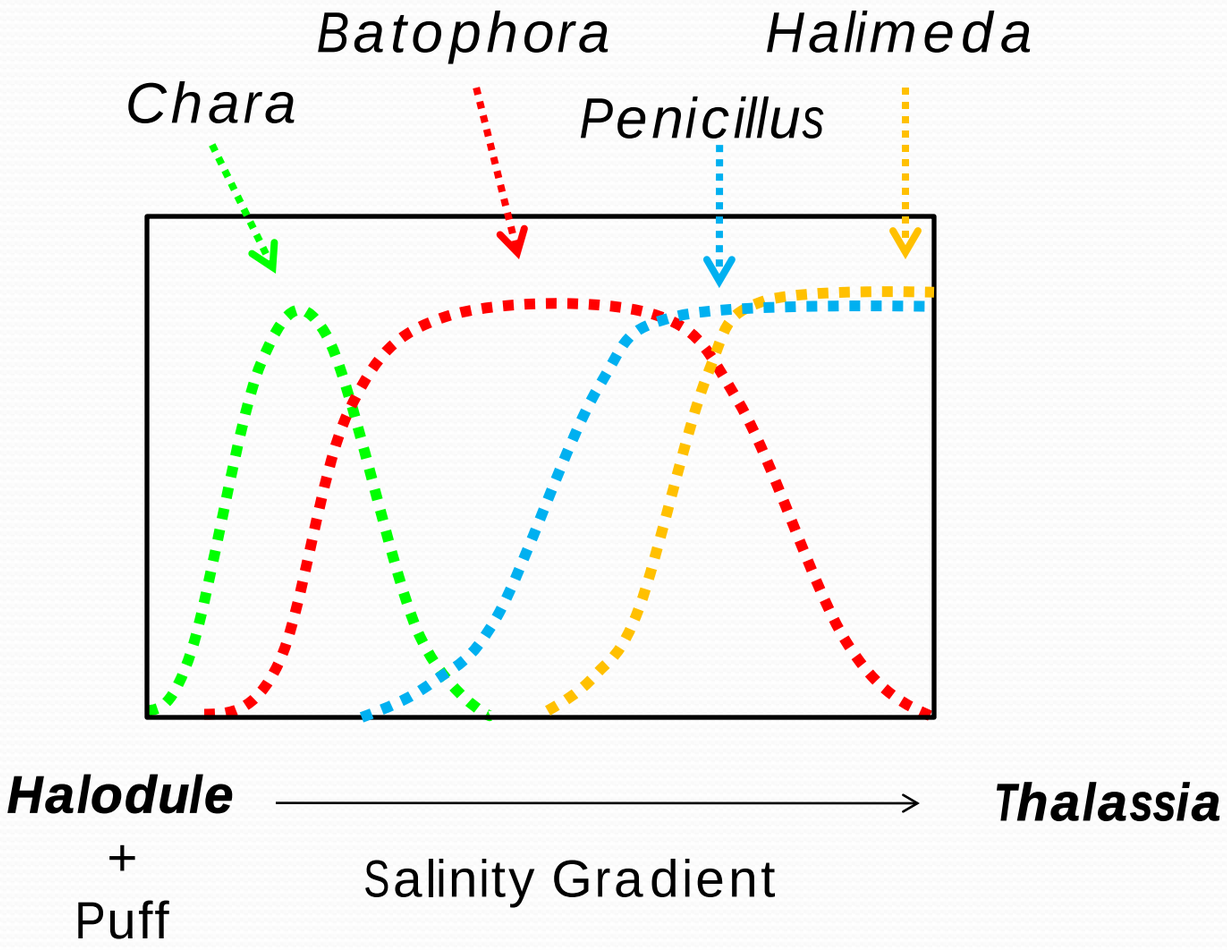
* = p < 0.001



General threshold limitation
1.8 % N and 0.20 % P, DW

Duarte 1999

Potential species distribution



Increasing freshwater input may also **increase nutrient** loading.

If nutrient increases beyond a certain threshold, Puff will shade out *Halodule*.

Chara and *Halodule* appear to have similar resource requirements....if *Halodule* is absent *Chara* could become the dominant component of nearshore, low salinity areas.

Salinity gradient

N
P

Potential nutrient gradient

N
P

Low *Halodule* Low *Thalassia*	High *Halodule* Low *Thalassia*	Low *Halodule* High *Thalassia*	Marine High *Thalassia*
Batophora-Acetabularia ***Chara***	Puff, ***Chara*** *Batophora*, *Acetabularia*	*Penicillus* DRM: *Polysiphonia* *Laurencia,* *Palisada*	*Anadyomene* *Penicillus* *Halimeda*

- The north and south sections of Black Point are significantly different in their salinity and nutrient content.

  - South having lower and more variable salinity, as well as higher nutrient concentration due to the direct influence of the Black Creek canal.

Potential indicators of differential salinity tolerant communities

- **Marine**→ *Halimeda* + *Thalassia* beds
- **Estuarine** → *Penicillus* + *Halodule* + *Thalassia*
- **Low Salinity** → ***Chara*** + *Halodule*

- *Puff indicator of high nutrients associated with Halodule*

- Increasing freshwater into the bay will result in a macroalgal community dominated by low salinity tolerant species in the near-shore areas (<500 m from shore).
  - The dynamics of this community will be influenced by nutrient levels.

- **Presence and abundance of *Chara* is our best choice for an indicator of salinity levels.**
  - The use of Chara as an indicator of nutrient enrichment needs to be explored.

- Red masses are sensitive to nutrient concentration variability, but they are not good indicators because they are drifting.

Acknowledgments

- Funding for this research was provided by the National Park Service (CESI-Program), The Army Corps of Engineers, and the MAP RECOVER program.

- All students that helped in the field and lab. James Harlen, Janelle Benito, Jaime Salgado, Amanda Torres and Jorge Bello