NUTRIENTS AS A POTENTIAL DRIVER TO SUSTAIN A PERSISTENT BLOOM OF *ANADYOMENE* J.V. LAMOUROUX (ANADYOMENACEAE, CHLOROPHYTA) IN BISCAYNE BAY, FLORIDA.

Ligia Collado-Vides, Christian Avila, Steve Blair, Pamela Sweeney, Diego Lirman.

GEER-2015

Coral Springs, Florida

Acknowledgments

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- Biscayne Bay Aquatic Preserve for funding the study
- MMRL students for lab work, algal cleaning…. Tons of hours

MIAMI-DADE COUNTY

DEPARTMENT OF ENVIRONMENTAL PROTECTION
FLORIDA
Biscayne Bay Aquatic Preserves

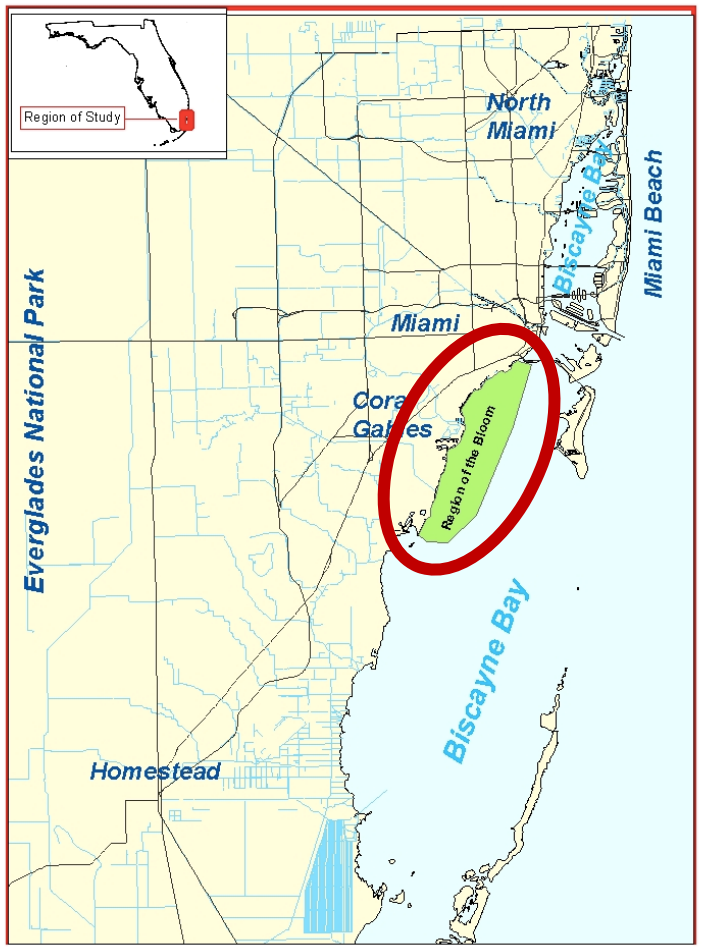
UNIVERSITY OF MIAMI

MARINE MACROALGAE RESEARCH LAB
Florida International University

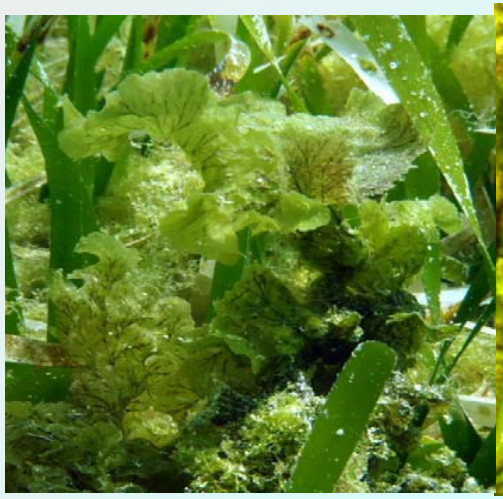
Outline

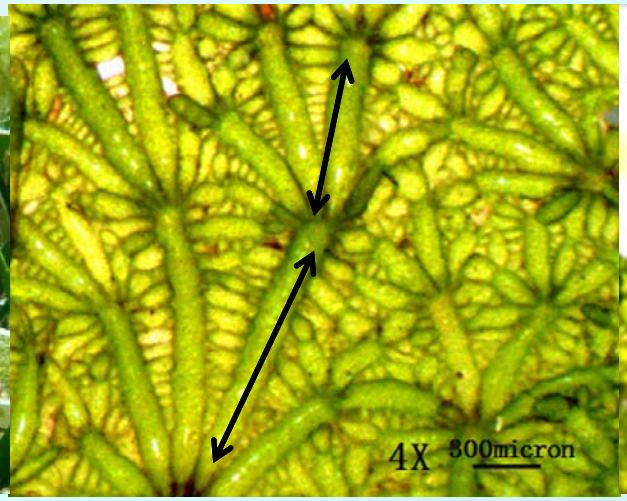
- The species.
- The nutrient tissue content as a proxy of status of the area.
- Sucralose: the smoking gun.
- The other species ---- shifting base-lines?

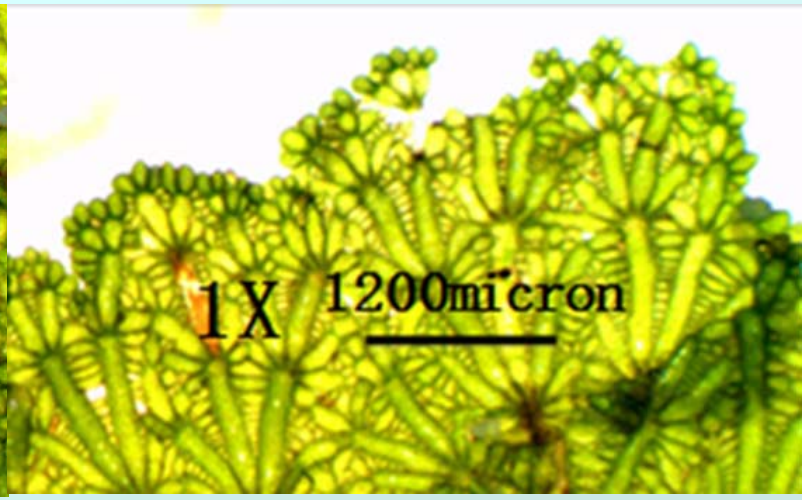
A green macroalgae bloom at Biscayne Bay FL

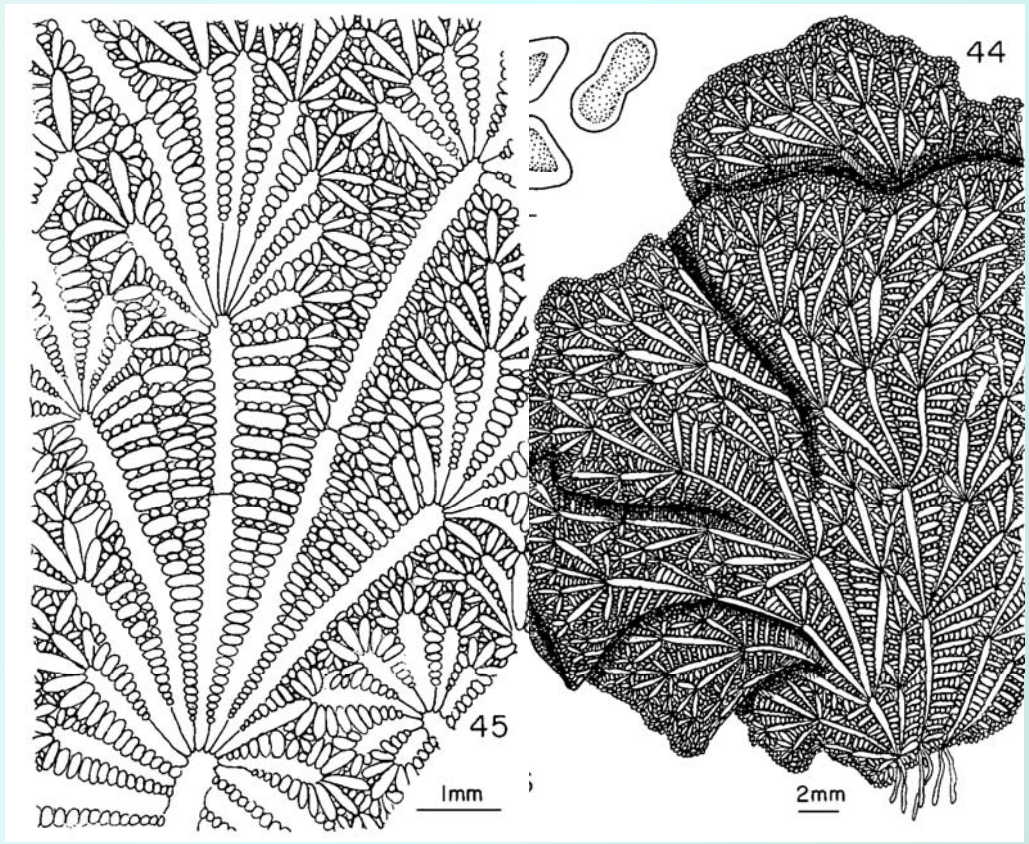


- A persistent harmful algal bloom of a green macroalgae species complex was detected in 2002.
- It is a massive growth of green macroalgae with blooming dimensions since 2005, and has persisted through 2015.





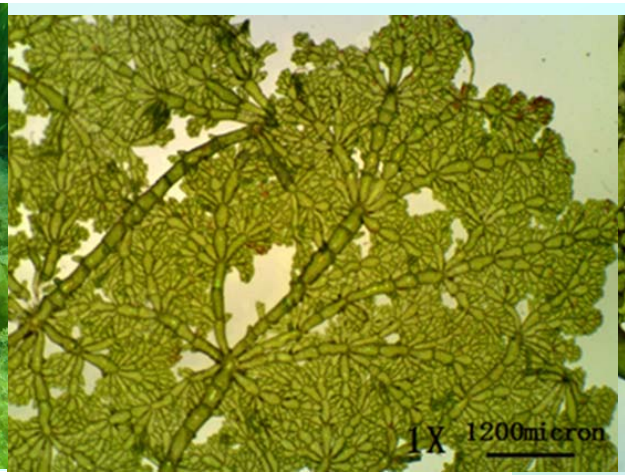


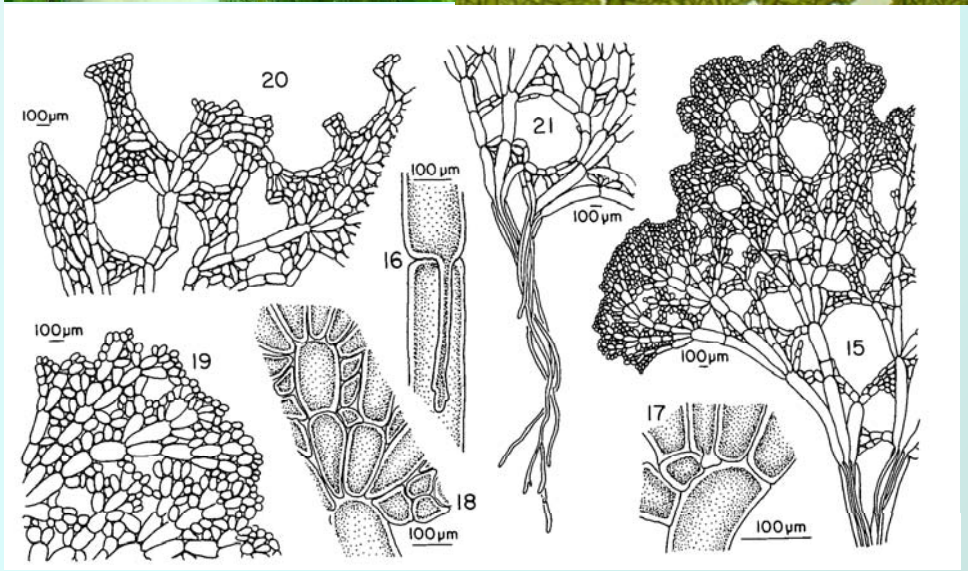


Anadyomene stellata

Thallus foliose up to 8 cm. Morphology and cell dimensions fit with original description by (Wulfen) C. Agardh in Littler and Littler 1991.

Native present in previous records

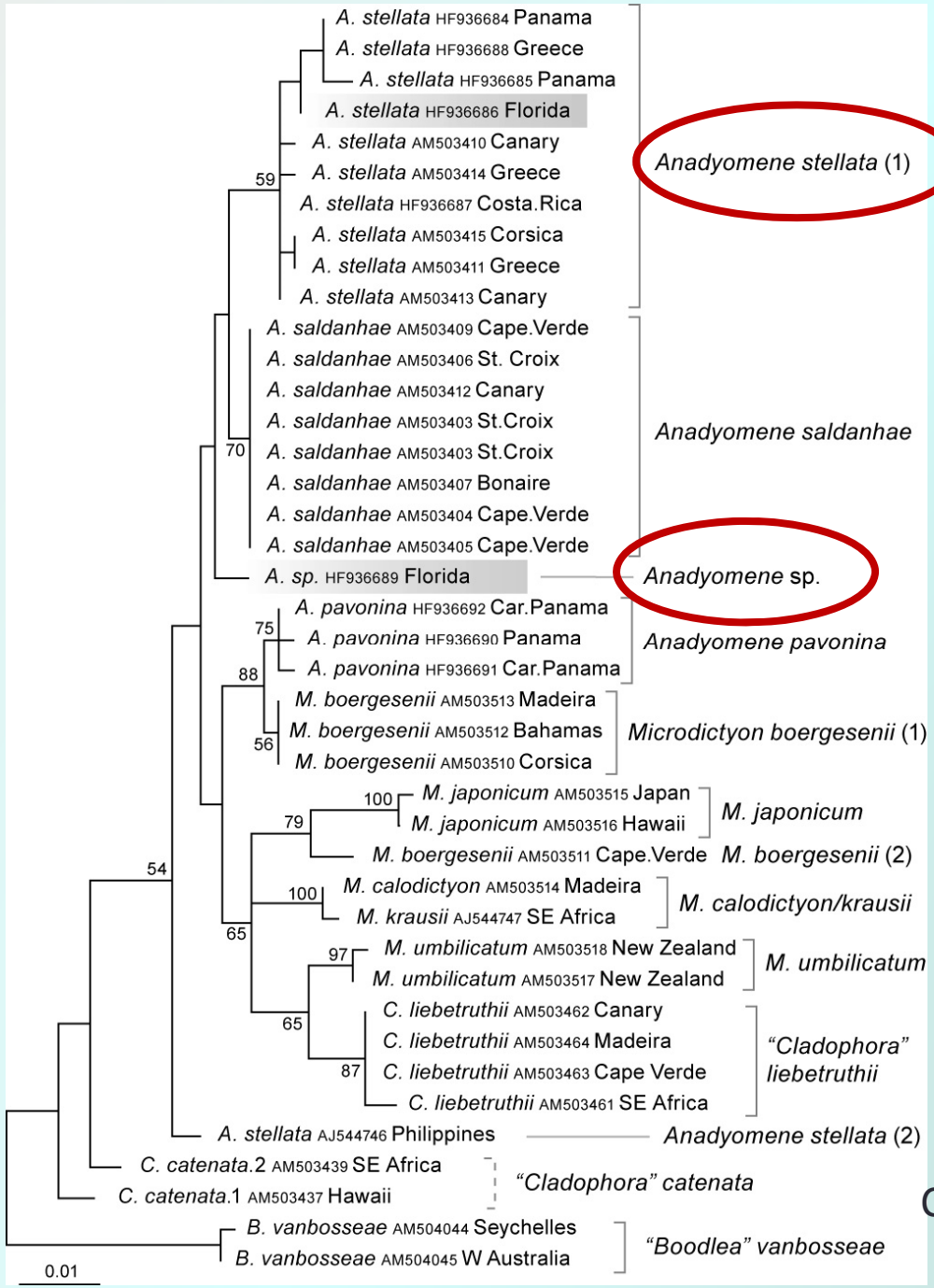


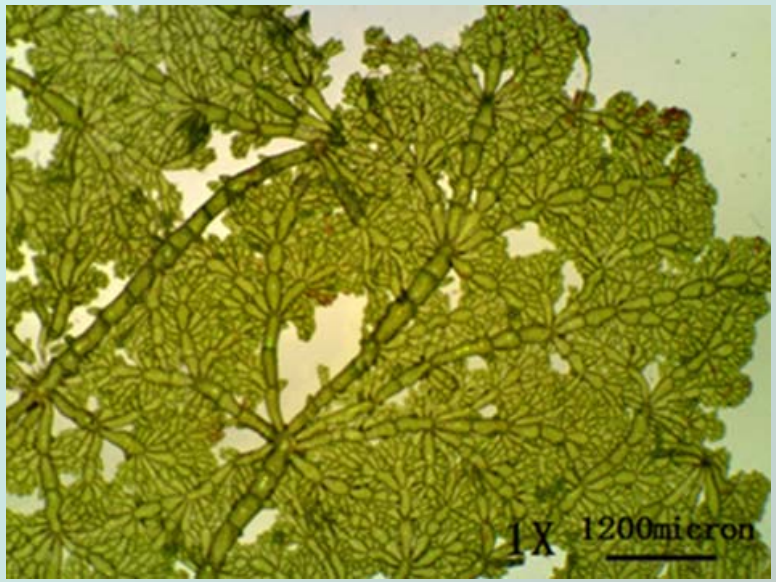


Anadyomene sp.
Thallus decumbent perforated up to 5 cm.

Best fit could be *A. linkiana.* But not all characters are present Littler and Littler 1991.
Work in progress

This is a new report for Biscayne Bay potentially introduced??????

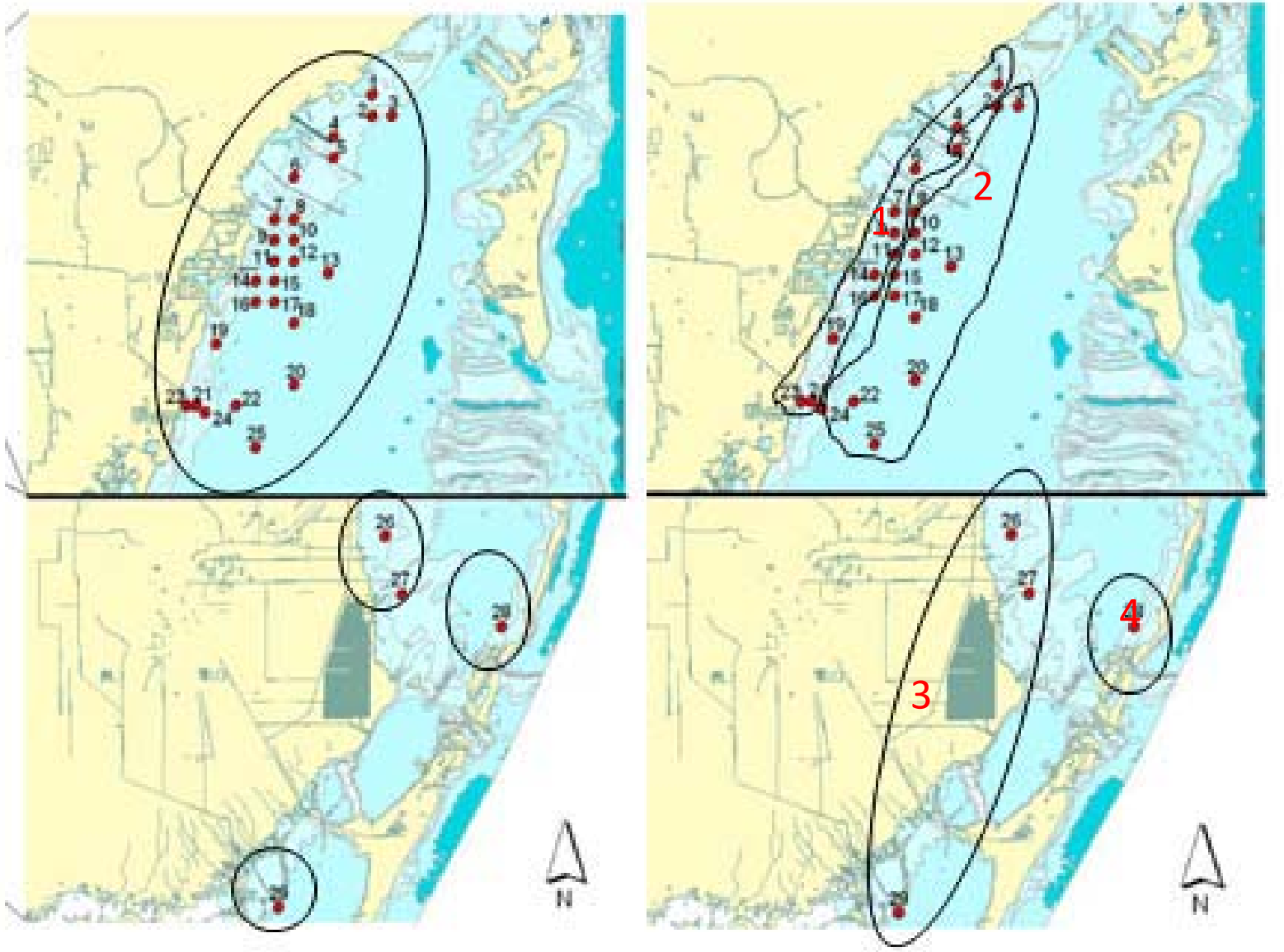




C1D2 region of the large subunit (LSU)nrDNA

Collado Vides *et al.* 2013 Aquatic Botany

Tissue nutrient content as indicator of nutrient status



Anadyomene stellata nutrient tissue content

	N	Min	Max	Mean
N	38	0.824	1.977	1.335
N15	38	0.780	**8.801**	5.992
P	38	0.009	0.036	0.016
N:P	38	103.433	369.867	193.571

General average accepted as non-limited. Duarte 1991

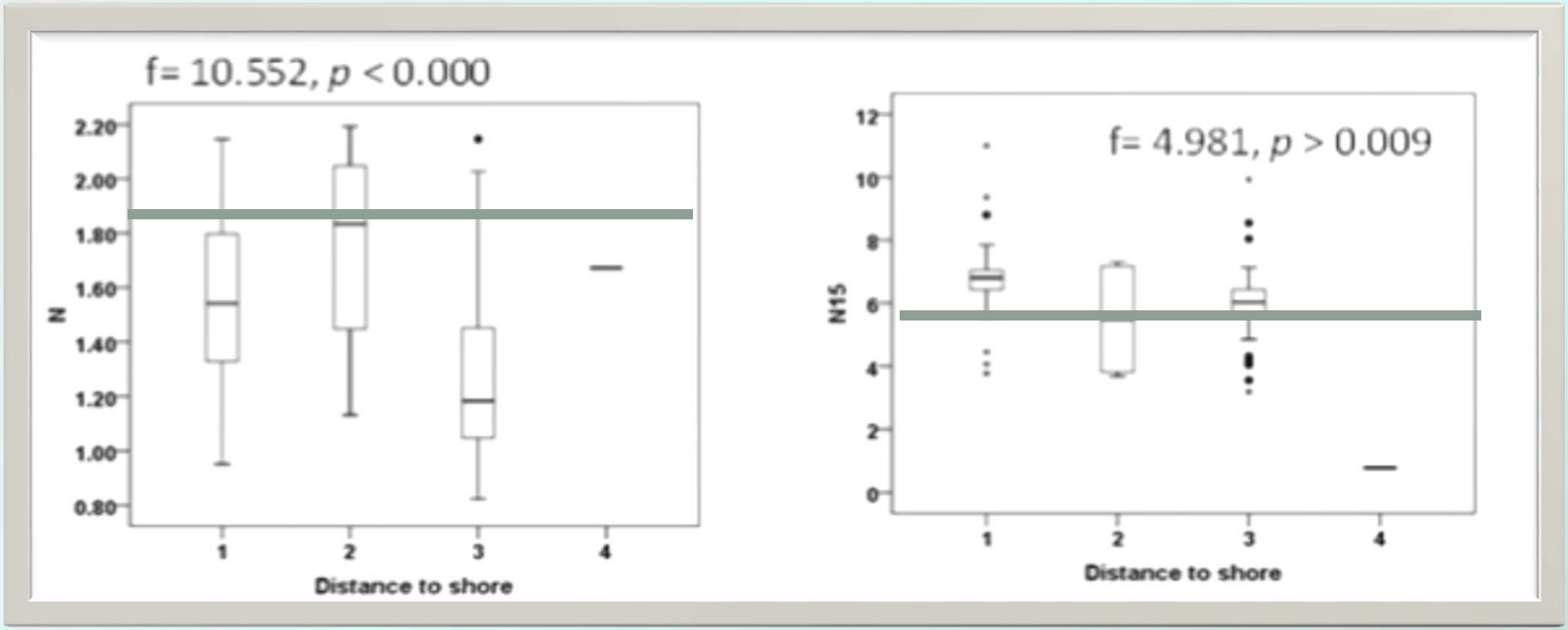
%N = 1.82
%P = 0.02

Anadyomene sp. nutrient tissue content

	N	Min	Max	Mean
N	65	0.893	**2.193**	1.487
N15	65	03.189	**11.000**	6.283
P	64	0.005	0.037	0.021
N:P	64	75.459	561.117	185.869

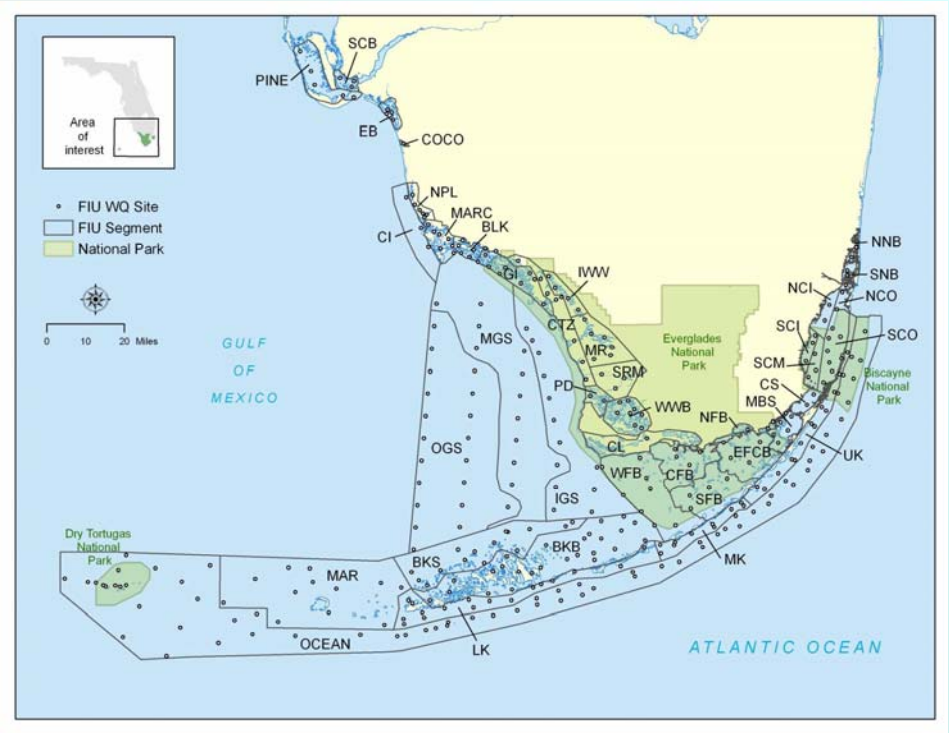
***Anadyomene* (% N 2.38)**
***Codium* (% N 1.33)**
***Ulva* (% N 2.26)**

Lapointe, 1997, 2005



No nutrient (nitrogen) limitation
High N values in general

High values of N 15 in the blooming area and close to land areas compared with coral reef control areas



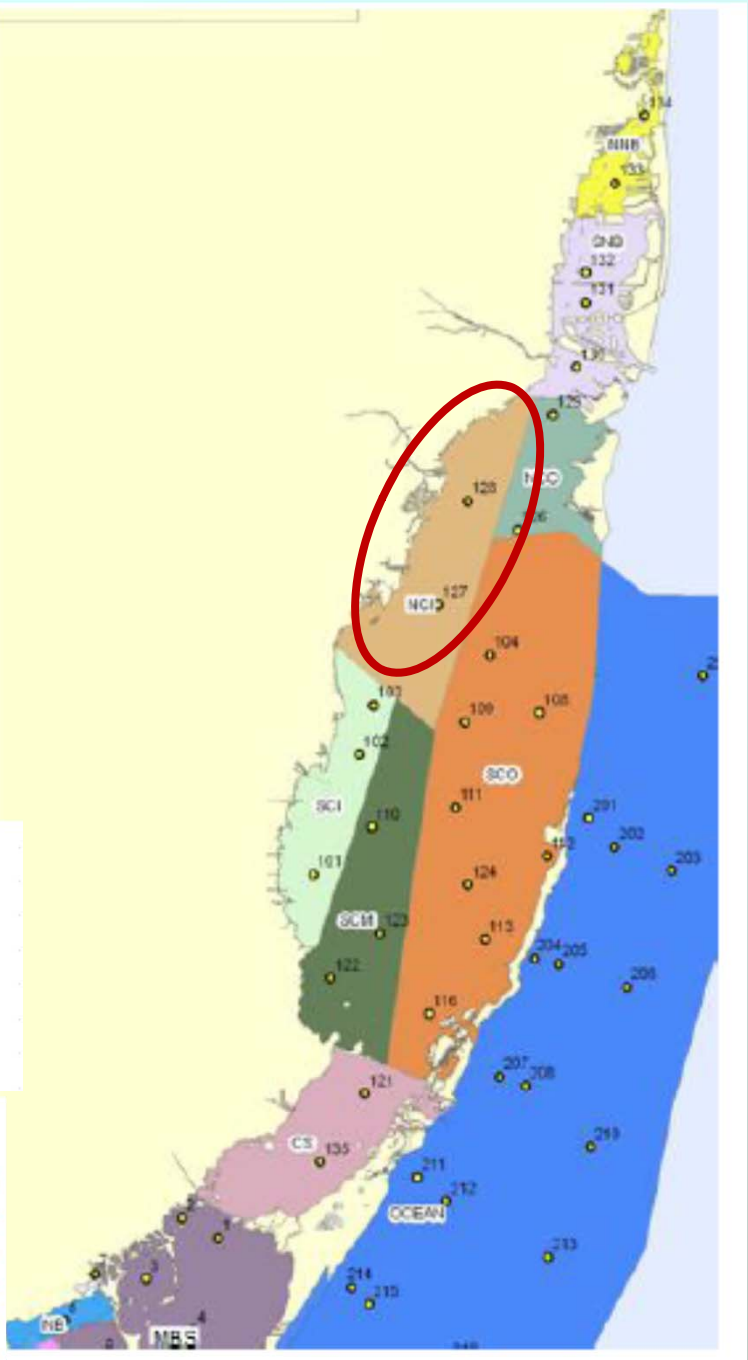
Water quality classification

Total Nitrogen

	CS	MBS	NCI	NCO	NNB	SCI	SCM	SCO	SNB
Mean	0.285	0.468	0.289	0.251	0.267	0.433	0.322	0.216	0.261
Median	0.273	0.447	0.267	0.227	0.237	0.405	0.288	0.199	0.242
Std. Dev.	0.121	0.164	0.184	0.122	0.132	0.204	0.155	0.106	0.121
Minimum	0.055	0.068	0.048	0.050	0.064	0.083	0.031	0.011	0.047
Maximum	0.760	1.085	2.185	1.129	0.869	1.560	1.066	1.313	1.011
Range	0.706	1.017	2.137	1.079	0.805	1.477	1.035	1.303	0.964

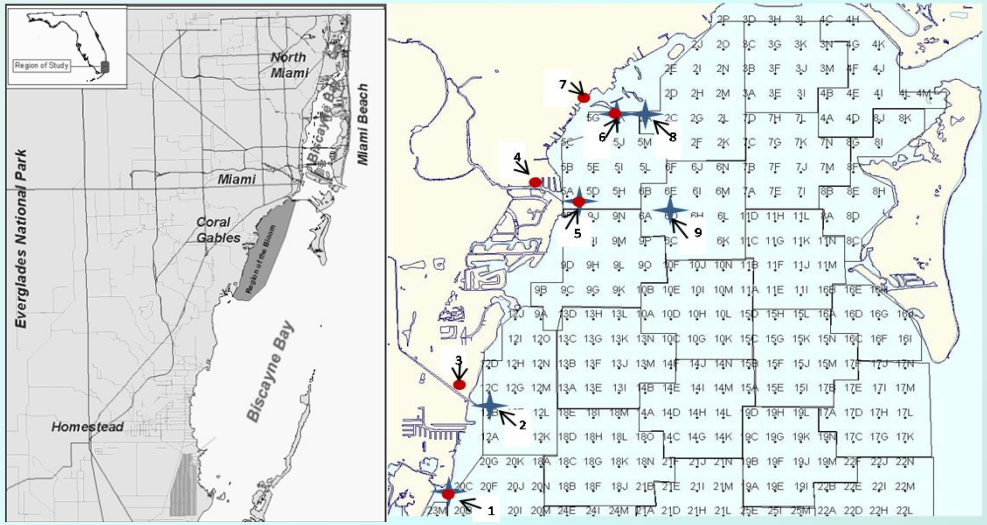
Total Phosphorous

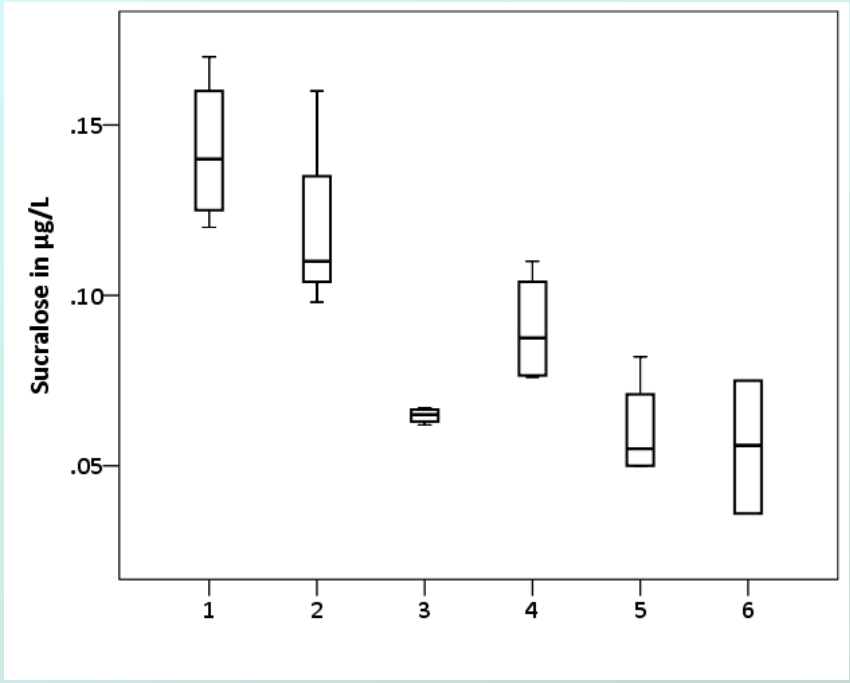
	CS	MBS	NCI	NCO	NNB	SCI	SCM	SCO	SNB
Mean	0.007	0.009	0.007	0.007	0.011	0.008	0.006	0.006	0.009
Median	0.006	0.006	0.005	0.006	0.010	0.006	0.005	0.005	0.008
Std. Dev.	0.005	0.008	0.005	0.005	0.006	0.007	0.005	0.005	0.005
Minimum	0.002	0.001	0.001	0.002	0.002	0.000	0.001	0.000	0.002
Maximum	0.030	0.097	0.037	0.045	0.053	0.052	0.059	0.049	0.058
Range	0.028	0.096	0.036	0.044	0.051	0.052	0.057	0.049	0.055



EPA-SERC 2011 Report

Sucralose as marker for anthropogenic sources





1= Deering Estate, Site 2= 12B, Site 3= Snapper Creek Inside Canal, Site 4= Coral Gables Inside Canal, Site 5= Coral Gables Canal Mouth, Site 6= Dinner Key Bay, Site 7= rocks at Dinner Key marina, 8= north central area of he bloom 9= east side of the bloom

Sucralose remarks

- The detected **values 0.04 to 0.17 µg/L** are in the range of those reported for Western Europe Impacted Waters (Loos *et al*. 2009).

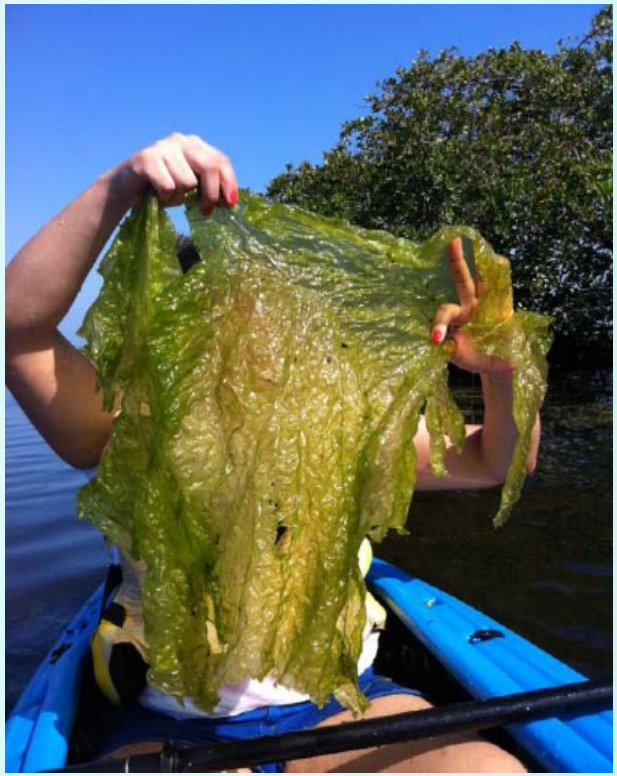
- Following Oppenheimer *et al.* (2011) classification Biscayne Bay falls in the category of **impacted by waste-waters (detectable values)**.

- Impacts are stronger at canals, with the highest values coming from **Deering Estate, Snapper Creek** and **Coral Gables**.

- These results are **consistent with the Swart *et al.* (2013)** research who suggest that the **possible sources** for N in Biscayne Bay could be local waste **water treatment plant**, and **septic systems** that are highly present in the area adjacent to the bloom

Other species

- Recently an incipient bloom was detected in the Deering Estate area

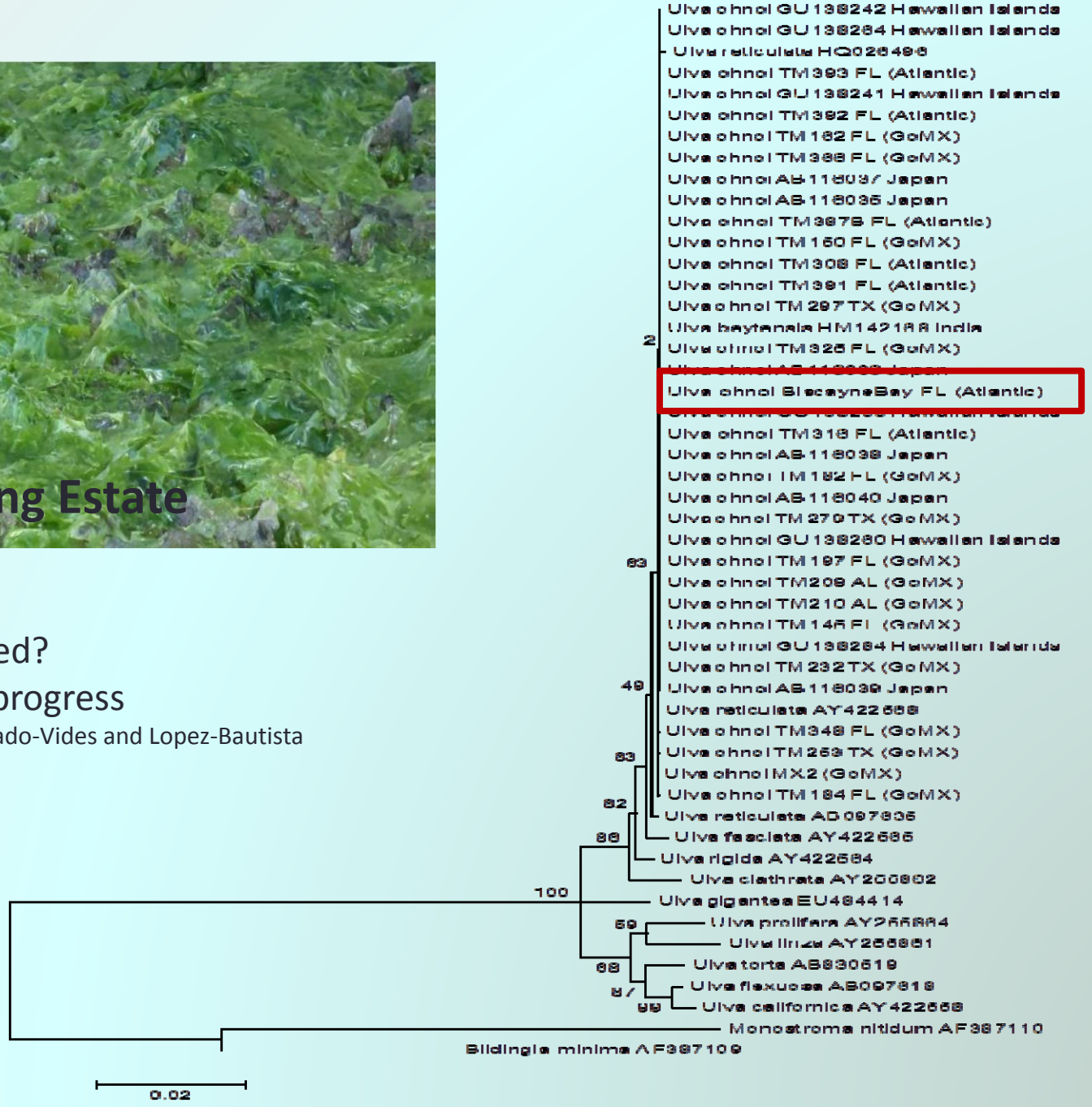


Ulva species are green macroalgae with many species responsible for the green tides around the world

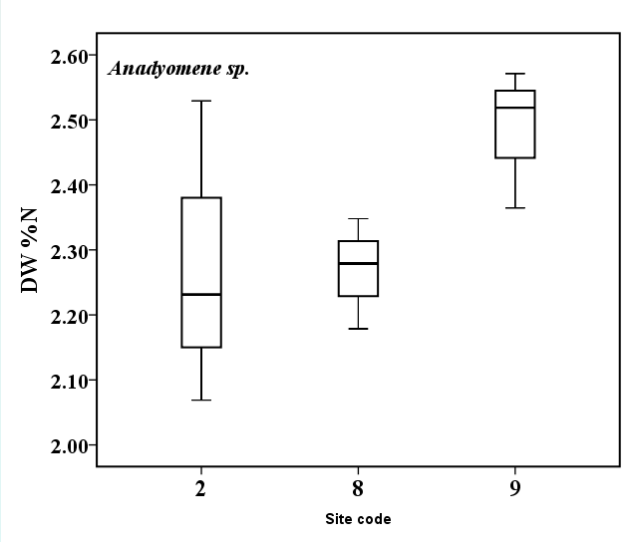
Introduced?

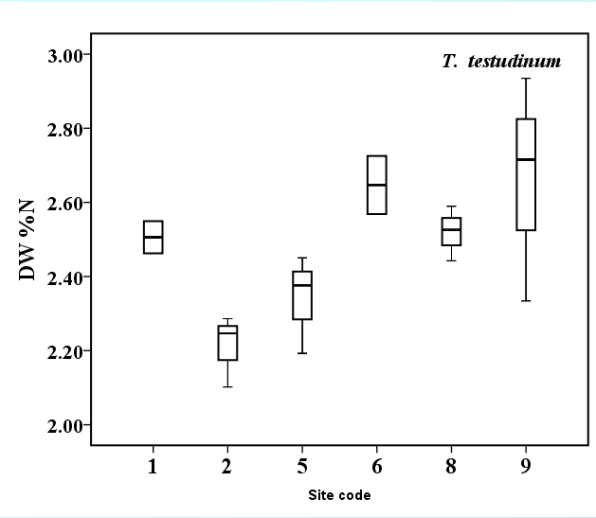
Work in progress

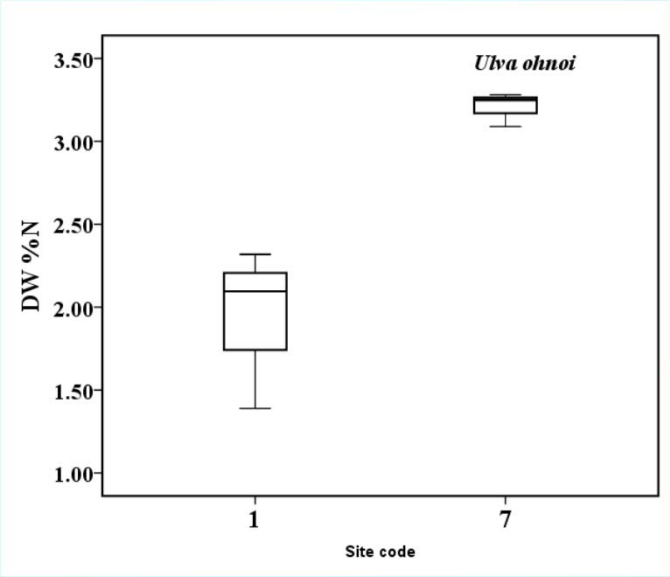
Melton, Collado-Vides and Lopez-Bautista



Nutrient tissue comparative analysis







Ulva ohnoi incorporate high levels of N. Highest values found on rock close to Dinner Key Marina

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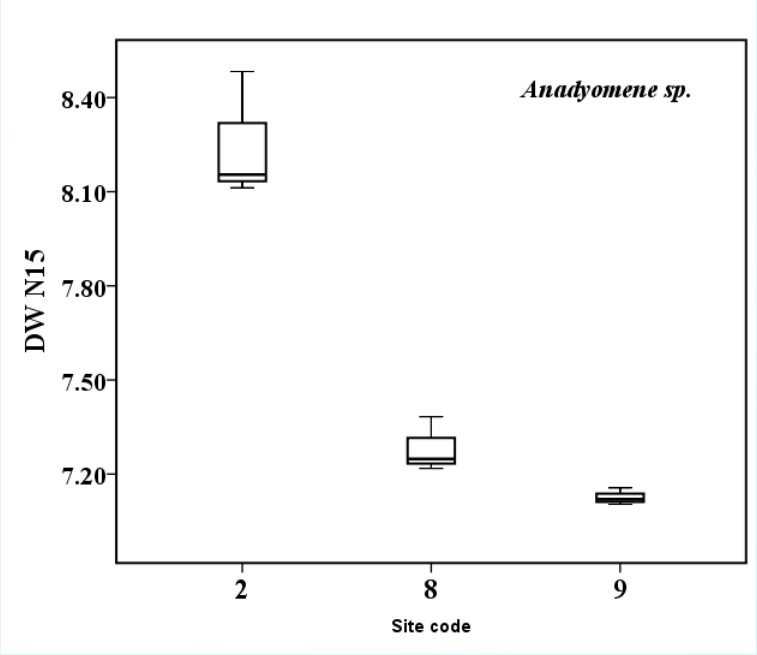

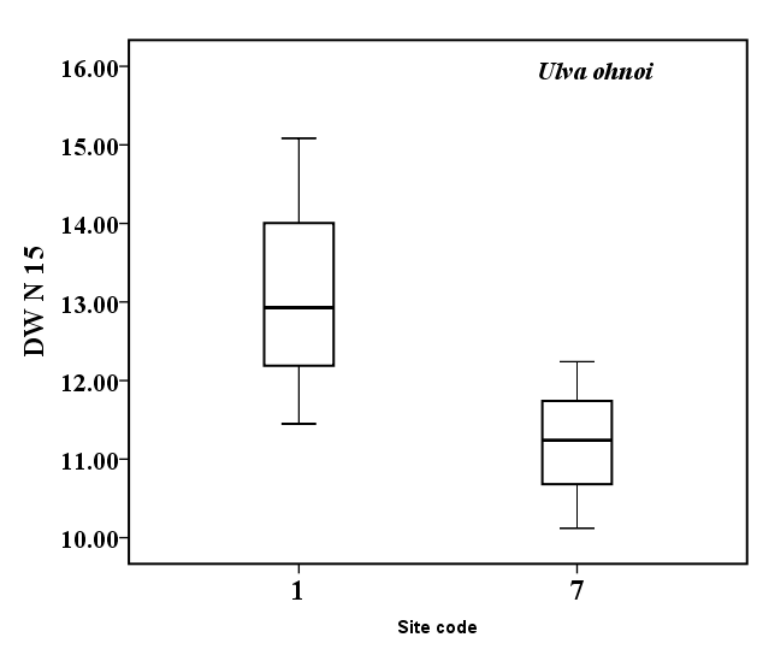

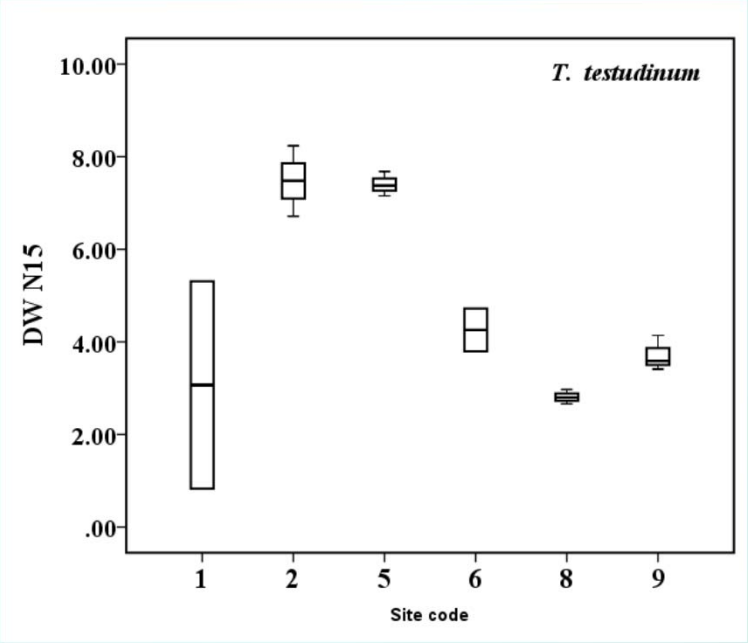

N15 are extremely high in *U. ohnoi* it has strong affinity for N15

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Closing remarks

- **We have a persistent green algal bloom**

- **1) Taxonomy requires revision, thin rapid growing green algae might be a new species. New arrivals such as *Ulva ohnoi* require a close monitoring.**

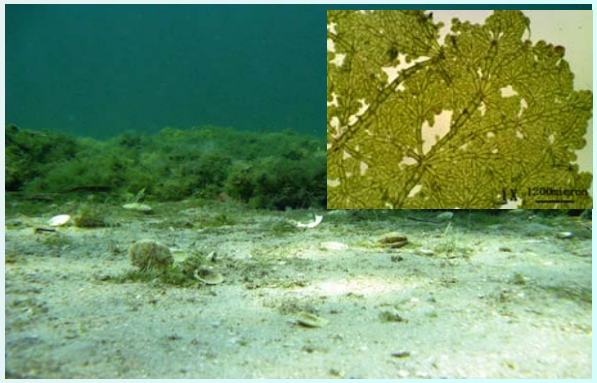
- **2) Sucralose indicates waste water impact**

- 3) **This bloom is indicating high levels of N15 in close to shore habitats. A clear signature of anthropogenic sources? Other potential nitrification processes need to be discussed: Swart et al 2013.**

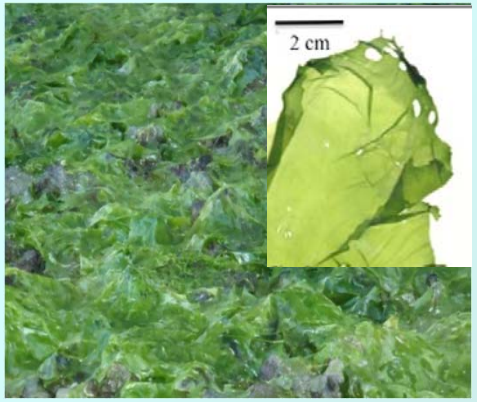
- **4) Other sites in the world are experiencing ephemeral green algal blooms.**

Green macroalgae are responding to high nutrients around the world.

Phase-shift and its consequences



Anadyomene complex



Ulva ohnoi

Red algae complex:
Laurencia/Digenia/Acanthophora

What are these opportunistic macroalgae telling us about Biscayne Bay status?

Which is the probability of the detected species to become a larger nuisance?

We need to understand their nutrient uptake capabilities in relation with nutrient availability in the bay.

Thank you for your attention.
Questions?

Contact me at **colladol@fiu.edu**