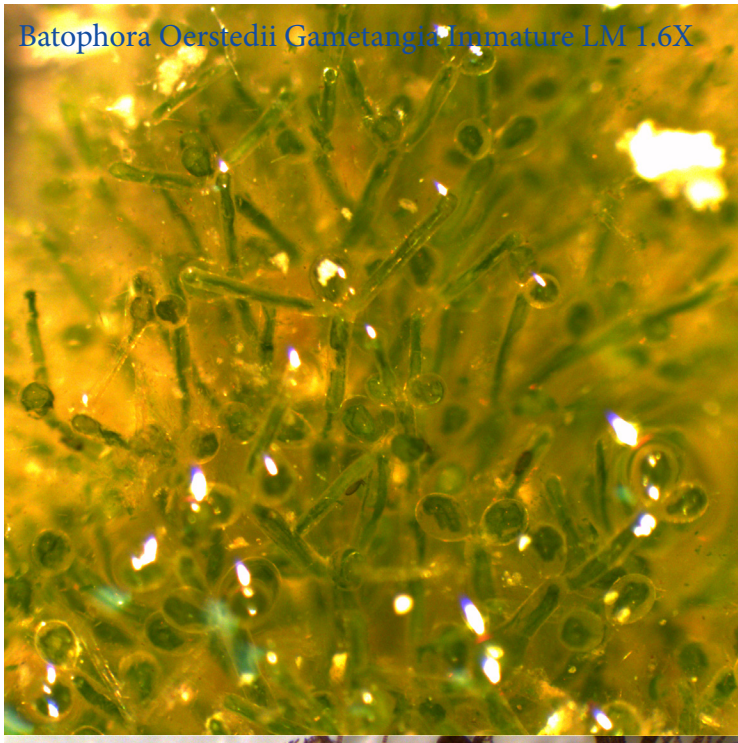
The Cutler Slough Rehydration Project: Seasonal variations in the marine macroalgae community of Deering Bay, Florida

Project Director: Teresa Casal & Nicholas Oehm, Jr.
Team Leader: Edmond Goldman
Consulting Scientists: Dr. Ligia Collado-Vides, Marine Macroalgae Lab, Florida International University

Problem Statement: Do salinity concentration in Deering Bay and the Cutler Creek vary as a function of season and water management?


Batophora Oerstedii Gametangia Immature LM 1.6X


Bostrychia Mic LM 3X

Background

The Comprehensive Everglades Restoration Plan (CERP) "provides a framework and guide to restore, protect, and preserve the water resources" of the Everglades. In 2005, the Cutler Slough Rehydration Project was initiated at the Charles Deering Estate in Miami, FL. The objective of the Cutler Project is to restore the historic flow of freshwater through the Cutler Creek and serve as model of the CERP.

This study monitors the seasonal composition of the marine macroalgae community along the salinity gradient of the Cutler Creek and Deering Bay. It is hypothesized that variations exist between the Open bay, Rockery, and canal environments due to varying amounts of fresh water. The data indicates a seasonal variation in salinity and community composition and these results will be used by the Natural Areas Management Staff at the Deering Estate to develop a future management plan for this are.

This location can be used as a small scale model of the Everglades for future reference considering that it has three different mini-ecosystems incorporated into such a small location which include: The canal, that can be viewed as a river system of the everglades in a small scale, the bay area, and the rockery which all show resemblance to the Everglades climate and wildlife. In these areas, a major factor that would contribute

Figure 1. Marine Macroalgae Community Composition and Distribution

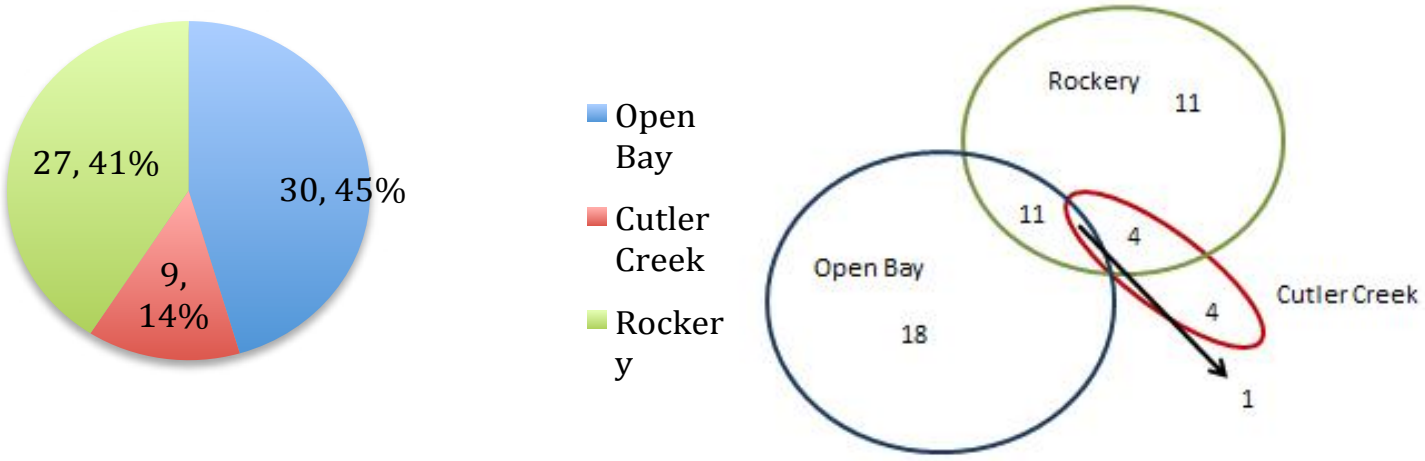


Figure 2. Salinity variation between sites

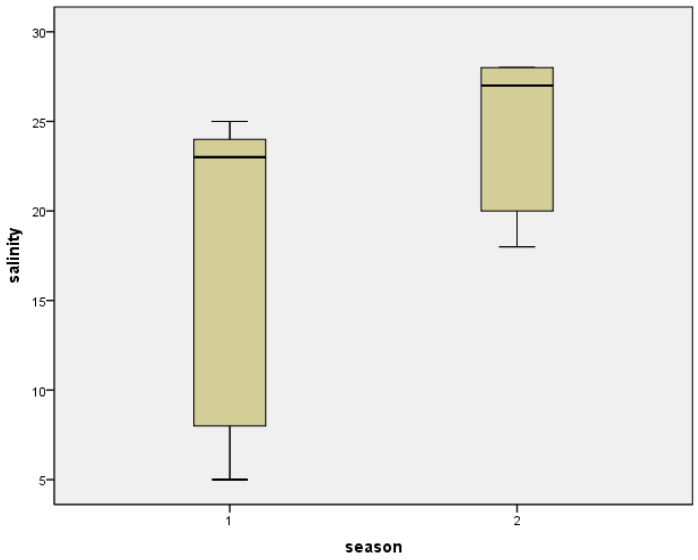
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Rockery	20	25.65	1.927	0.431	24.75	26.55	23	28
Open Bay	20	25.65	2.007	0.449	24.71	26.59	23	28
Cutler Cr.	20	13.15	6.483	1.45	10.12	16.18	5	20
Total	60	21.48	7.165	0.925	19.63	23.33	5	28

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Salinity is the same across categories of Habitat.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 3. Seasonal variation in salinity



Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of salinity is the same across categories of season.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

to the different species of algae that are the main producers in the food web at this location would be salinity. Salinity could affect the different types of algae grown here which can chain into the marine species that depend on them as a source of food and shelter. FCELTER is asking these questions in a much grander scale, in the sense that they want to know what would be the consequences of allowing more fresh water into the environment. For example in the summer we would expect a lot more green algae than what we would see in the fall.

Results

The 444 acre Deering Estate at Cutler encompasses pine rockland habitat, coastal tropical hardwood hammocks, mangrove forests, salt marsh, coastal dune island, and the marine community of Deering/Biscayne Bay. In this project, three marine sites were sampled to determine the community composition of the marine macroalgae at the mouth of Cutler Creek, Deering Rockery, and the Open Bay.

Salinity has a significantly different seasonal and spatial effect (Figure 2 & 3) that ranges from 8 ppt, during low tide, after a rainy period, in

Site: Deering Bay, Charles Deering Estate
Latitude: 25.6267712 **Longitude:** -80.30556
Site Location: Cutler Creek, Open Bay Area, Rockery
Watershed: Creek flows into sea out into open bay area
Vegetation: Seagrass, algae Community: Seagrass, Mangrove
Climatology: Subtropical with wet seasons being from (May-November) and dry seasons (December-May)

Cutler Creek, to 30 ppt, at high tide, in the Open Bay and Rockery. The substratum is variable between the three sites. In Cutler Creek, macroalgae are attached to the creekside prop roots of *Rhizophora mangle*. Although *R. mangle* is also present at the Rockery, *Acanthophora spicifera* was found growing on the oolitic limestone. The Open Bay is quite different with a mosaic of sand and *Thalassia testudinum* beds in the central bay that is replaced by *Halodule wrightii* near the mouth of Cutler Creek. Three types of macroalgal growth were found in the Open Bay: benthic growing in the sand; epiphytic on the seagrass; and drift algae.

In all, 51 total species were found—23 Division Chlorophyta; 26 Division Rhodophyta; and 2 Division Ochrophyta. Cutler Creek had the fewest species limited to the Bostrychietum community represented by Division Rhodoypyta, Genus *Caloglossa, Bostrychia* and *Catenella*. The Open Bay community consisted of Rhizophytic green macroalgae; genus *Halimeda, Penicillus* and *Uodtea*. Intermingled amongst the seagrasses were representatives of the genus *Laurencia-Palisada*. The Rockery had the largest number of species including red medullar algae such as Acanthophora spicifera and green algae including Acetabularia and Batophora.

There is a difference in the macroalgal community composition between at each of the sites (Figure 1). Four unique species were found at Cutler Creek, 18 in the Open Bay, and 11 at the Rockery. Of those species four were common between Cutler Creek and Rockery; 11 between the Open Bay and Rockery, and 1 species was common to all three.

Principal Component Analysis (PCA) reveals more variation in macroalgae community composition than expected requiring multidimensional analysis (Figure 4). PCA is a multivariate statistic that compresses variability into two axes: Principal Component 1 (PC1) and Principal Component 2 (PC2) that explains 70% of variation. Results reveal that the Open Bay has large difference between seasons, but the Rockery and Cutler Creek communities do not differ. Collecting macroalgae abundance will improve ability to use simpler statistical tests.

Conclusions

The macroalgae community composition is different between sites and it appears to be the result of differing salinity. Rhodophytes diversity is higher in the Rockery than Open Bay and Cutler Creek and this may be that the Rockery has more suitable substrate.

Open Bay has the largest number of unique species (n=18) which may be the layered substrate (rocks, sand, shells, sea grasses), whereas fewer are found in the Rockery (n=11) and the fewest at Cutler Creek (n=4) where substrate has been washed away by the current and is restricted to epiphytic prop root growth and a few floating masses of algae.

The Open Bay also has floating masses of Laurencia that flow in with the current and it is possible that these masses of algae come from the Rockery during the blooming stage of the algae's life cycle.

The Rockery is an ideal place for algae to bloom with bright sunlight, nutrients from both the creek and the ocean, and additional nutrients inputs (phosphate and nitrogen) from bird droppings from the mangroves that overhang the Rockery.

Importance

Different algal assemblages will provide different type of food, and refuge to animals that are in the base of the trophic web that support life in Biscayne Bay. Since lower salinity environments have fewer species, we expect species diversity to decrease as freshwater flow begins to increase with the Rehydration Project. Knowing the types of algal that will survive in different conditions will allow manager to plan better their strategies to protect and improve the environments of the Bay. This baseline study can be used by the Comprehensive Everglades Restoration Plan (CERP) to develop a water management strategy for the Cutler Slough and Deering Bay.

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Marine macroalgae sampling sites

MIAMI

LTER

Felix Varela Senior High School

Schoolyard FCE LTER

Reclamation Project
EcoArt by Xavier Cortada

my community, our earth
GEOGRAPHIC LEARNING
for Sustainable Development

NATIVE FLAGS
Eco-art by Xavier Cortada

NSF

Deering Estate At Cutler