My Community, Our Earth

MIAMI

Comparing primary production and productivity of calcareous green algae along a salinity and trophic gradient

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Problem Statements:

1. How does the variability in salinity affect primary production of calcareous green algae found at Sprigger, Bob Allan, and Duck Keys?
2. How does the variability in salinity affect species diversity in calcareous green algae found at Sprigger, Bob Allan, and Duck Keys?

Daniel Camous overlooks Deering Estate visitors as they examine marine macroalgae at the Seafood Festival.

Abstract

A key to making future management decisions in Everglades restoration is understanding how the wetland responds to environmental changes and climate driven fluctuations in hydrology. The amount of freshwater inputs from the Everglades will affect salinity, water residence times, the sources, availability, and flux of organic and inorganic nutrients in Florida Bay. Marine macroalgae are an important component of primary producers in Florida Bay estuary and is dominated by species such as Halimeda and Penicillus.

The use of these macroalgae can be used to document trends in macroalgae productivity in the marine sites as well as the direct nutrient effects on macroalgal growth. The objective of this project is to determine the natural changing dynamics of macroalgae in Florida Bay by using primary producers to understand the change taking place in calcareous green algae community due to salinity and temperature. I hypothesize that if the three specific sites show changes in salinity and the temperature gradient, the subsequent analysis will reveal:

1. If the sites have high variability of salinity (refer to Salinity Table 1 below) then they will have lower levels of diversity.
2. The site (refer to Site descriptions in Table 2 below) has a lower value in salinity and high fluctuation in salinity then they will have lower levels of primary production.

In this experiment three randomly selected quadrats were sampled for biomass and species ID in order to survey the temporal and spatial variability in production and productivity of calcareous marine macroalgae. These quadrats were then used to measure growth rates and productivity levels.

Edmond Goldman explains the ecological role of marine macroalgae in Florida and Biscayne Bays.

Results and Conclusion

Surface water and tissue samples were collected at three locations to represent varying degrees of marine influence from the Gulf of Mexico. Bob Allan Key has the greatest freshwater influence from the Everglades and is somewhat protected by the upper Keys. Duck Key, in southwest Florida Bay, is under the greatest marine influence while Sprigger Bank has an intermediate level of marine exposure. Similar mean salinities are reported for Bob Allan and Sprigger Bank, while lower values are reported for Duck Key. However higher fluctuation is reported at Bob Allan and Duck compared with Sprigger Bank. The highest fluctuation is reported for Duck Key. (Table 1).

Lower primary production of calcareous green macroalgae (CGM) is reported at Bob Allan and Duck Key compared with Sprigger Bank (Table 3 and 4; Figure 1a,2a,3a) We document a decline in CGM production in Sprigger Bank, however a similar trend has not been identified at Bob Allan and Duck. (Figure 1a,2a,3a)

There does not appear to be a clear seasonality in the levels of production at the three sites, trends have been identified through the graphs (Figure 1a,2a,3a). However a wide variability can be found at Sprigger (Figure 1a,2a,3a) and biomass seems to have a positive relationship with salinity. (Figure 1a,2a,3a; Figure 1b,2b,3b)

The species of the genus *Penicillus* are abundant at a Bob Allan and Duck Keys and can be explained by their higher tolerance to fluctuations in salinity. On the other hand, *Halimeda* has a lower tolerance to such fluctuations and is found in higher abundance at Sprigger Bank. Other factors that may affect the higher abundance of CGM at Sprigger is the availability of light, nutrients, water quality, and depth.

We found lower species diversity and abundance at Bob Allan and Duck Key compared with Sprigger Bank (Table 5). As a general trend we document a higher CGM production towards the marine sites, consistent with the fact that the sites show an enhanced productivity toward the marine end of the Bay. Sprigger Bank has the highest amount of CGM production despite of the recent decline in the three sites.

Implications

This analysis can be used to understand the climatic changes taking place in the Everglades ecosystem. The findings from this analysis will help conserve the species in the sites by addressing the issue of freshwater input into the Everglades. Restoration projects might be created, in order to restrict the freshwater flow from reaching the marine estuary of Florida Bay. Maintain water quality is essential to tourism and South Florida's healthy environment and to revent unnatural shifts and migrations by species currently inhabiting Florida Bay.

Figure 1a. CaCO3 content of aboveground biomass at Sprigger

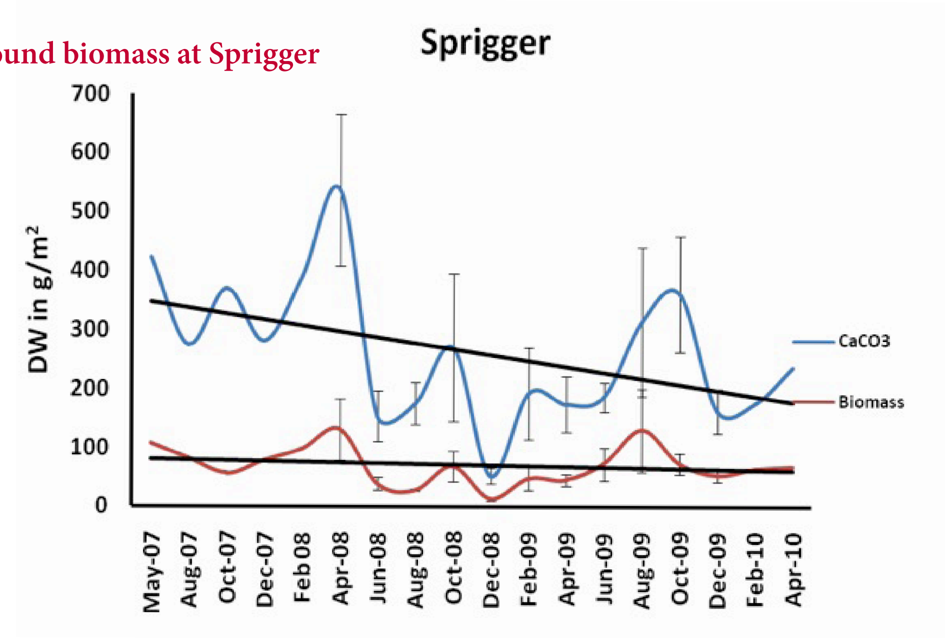

Figure 2a. CaCO3 content of aboveground biomass at Bob Allan

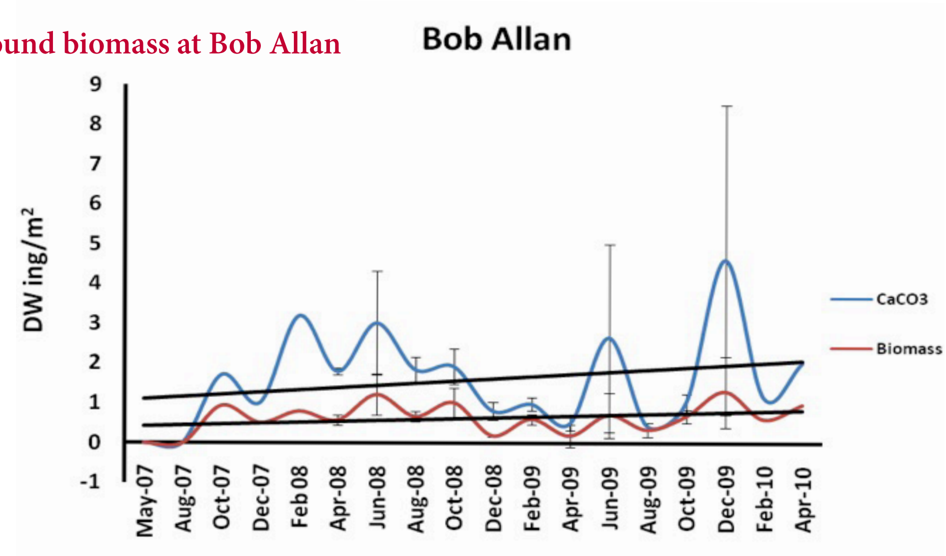

Figure 3a. CaCO3 content of aboveground biomass at Duck Key

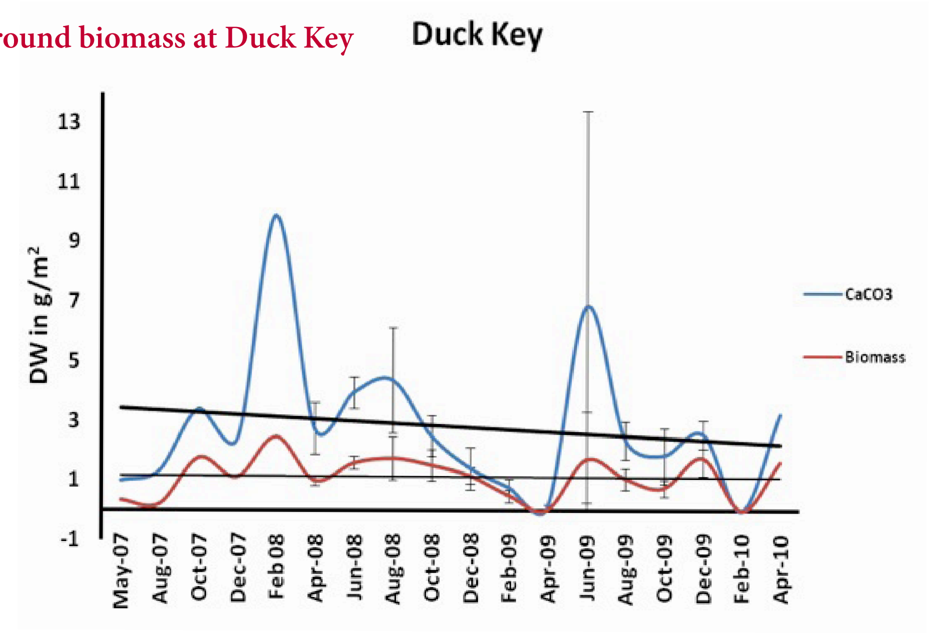

Figure 1b. Seasonal Salinity Variations at Sprigger

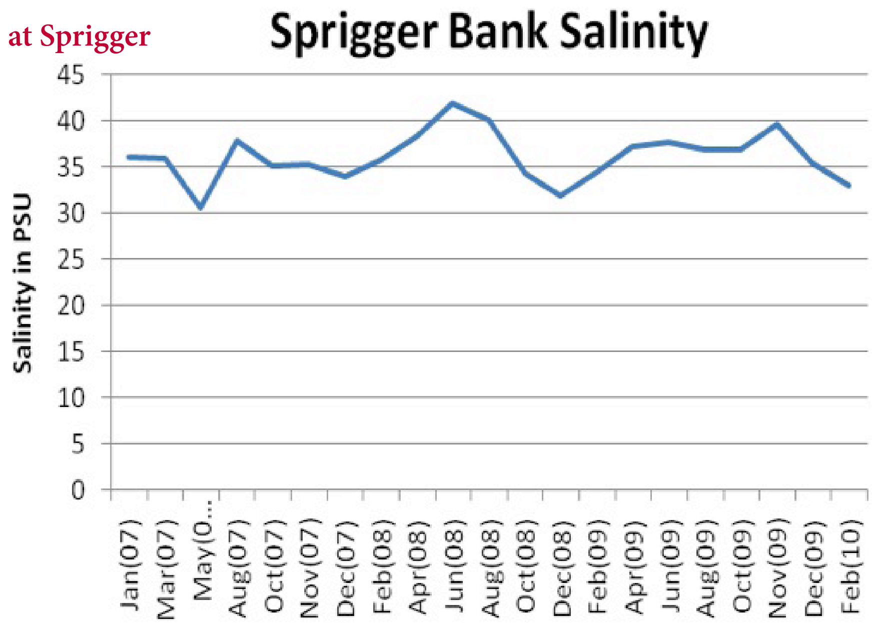

Figure 2b. Seasonal Salinity Variations at Bob Allan

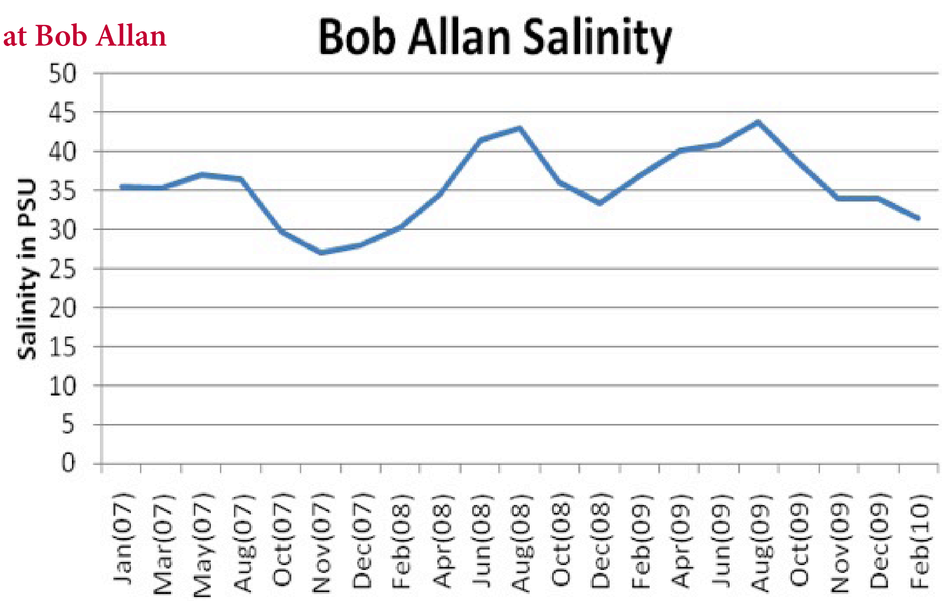

Figure 3b. Seasonal Salinity Variations at Duck

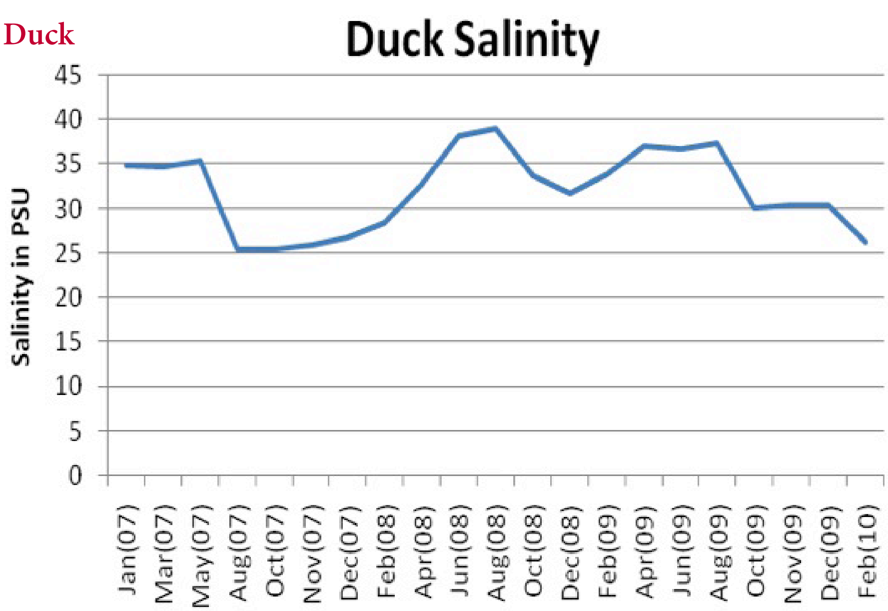

Table 1. Average Salinity Values

Salinity (psu)				
Sites	Average Salinity	Minimum	Maximum	Standard Deviation
Sprigger	35.4	24.8	43.4	2.98
Bob Allan	35.5	25.6	59.4	5.48
Duck	31.3	17	57.4	6.04

Table 2. Site Description

Sites	Latitude	Longitude	Watershed	Hydrography	Climatology
Sprigger	(+)24.91293492	(-)80.93798347	None	Estuarine (Average Tidal Energy, Some wind movement)	Subtropical moist
Bob Allan	(+)25.02476744	(-)80.68097374	Taylor Slough	Estuarine (Minimal Tidal Energy, wind-driven movement)	Subtropical moist
Duck	(+)25.17692874	(-)80.48978207	Taylor Slough	Estuarine (Minimal Tidal Energy, wind-driven movement)	Subtropical moist

Table 3. Calcium Carbonate (CaCO3) and Biomass Averages

$CaCO_3$ and Biomass Averages (g/m2)		
	$CaCO_3$	Biomass
Sprigger	270.35 ±69.06	70.80 ±22.77
Bob Allan	1.59 ±0.84	0.61 ±0.31
Duck	2.97 ±1.24	1.17 ±0.46

Table 4. Standing Crop

Standing crop as Dry Weight in g/m^2			
	AAverage Standing Crop	MMax Standing Crop	MMin Standing Crop
Sprigger	270.35 ± 69.06	339.41	201.29
Bob Allan	1.59 ± 0.84	2.43	0.75
Duck	2.97 ± 1.24	4.21	1.73

Table 5. Species Composition of Calcareous Green Algae

Species list	Sprigger	Bob Allan	Duck Key
Halimeda incrassata	x		x
Halimeda monile	x		
Halimeda opuntia	x		
Penicillus capitatus	x	x	x
Penicillis lamourouxii	x	x	x
Penicillus dumetosus	x		
Rhipocephallus phoenix	x		
Udotea sp	x		
Udotea flabellum			

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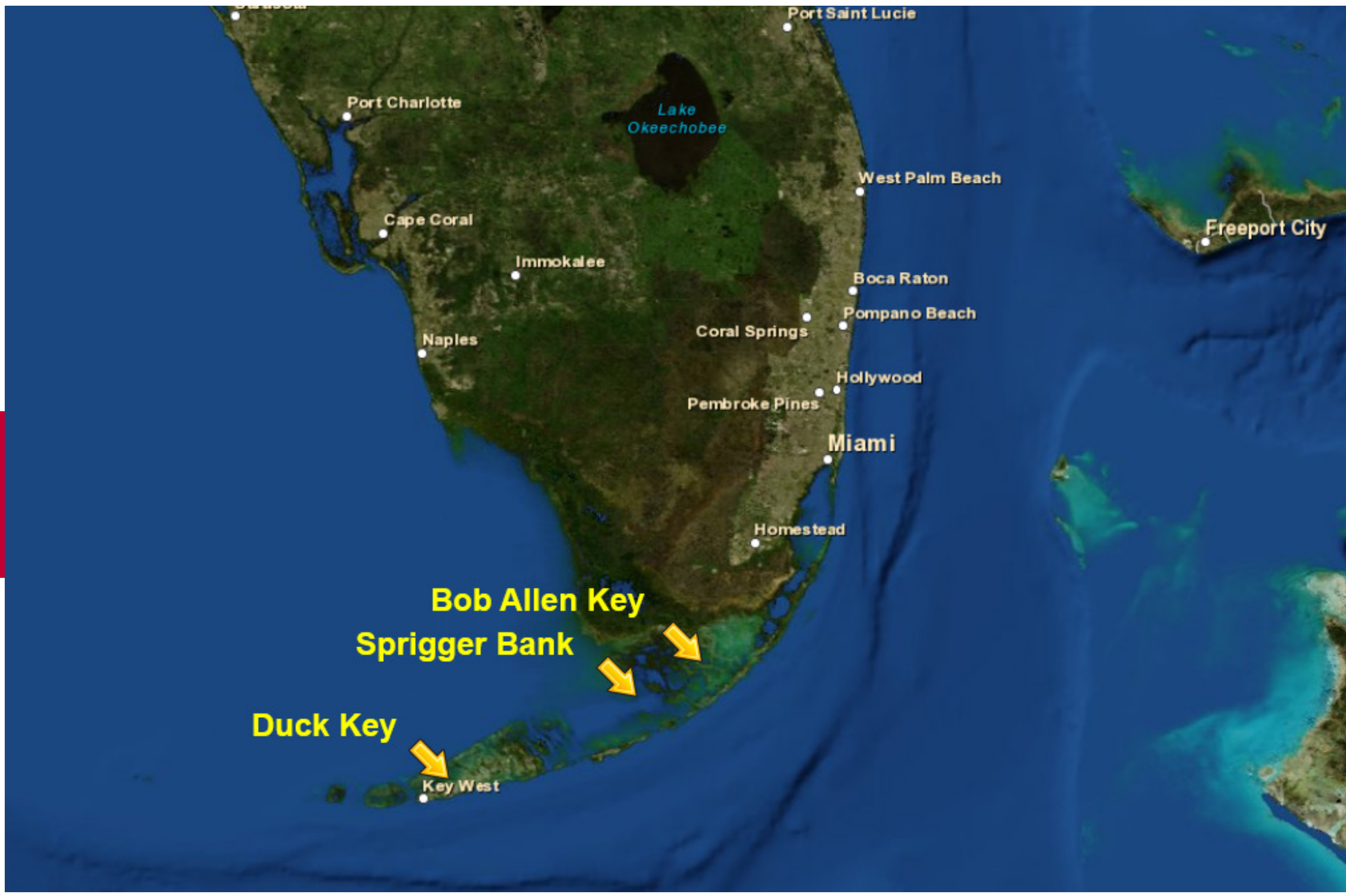
Sampling locations for calcareous green macroalgae.



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swissstopo and the GIS User Community

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