Assessing Invertebrate epifaunal habitat preference in a shallow coastal bay

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Background Information

- Macroalgae are known to contribute to habitat complexity in shallow coastal systems; habitat enhancement is dependent on the specific macroalgal species (Norkko et al. 2000) (Fig. 1).
- Biscayne Bay, localized close to a metropolitan area in South Florida, undergoes heavy management and restoration activities impacting adjacent coastal communities (Morrison, 2015). Freshwater pulses in the area cause fluctuations of salinity and temperature, leading to changes in macroalgal species composition and invertebrate epifaunal distributions (Alleman et al. 2013, Brooks 1982, Charkhian 2014, Collado-Vides et al. 2011)
- Epifaunal species abundances on other Floridian coastal areas (e.g. Indian River Lagoon and Tampa Bay) varied between the drift algae and seagrass beds, yet have similar species composition between habitat types. The dominance of specific epifaunal species between habitats differ between coastal areas (Knowles and Bell, 1994, Virnstein and Howard 1982).
- Here we test if invertebrate epifauna display habitat preference within Deering Estate at Biscayne Bay. Understanding epifaunal habitat preference between macrophyte habitats provides insight in how coastal communities function and provide a baseline to evaluate environmental disturbances such as potential consequences of water management strategies.
- We hypothesize that differences in epifaunal communities exist due to structural differences between macrophyte habitats.

Figure 1: A red macroalgal mat embedded within a seagrass bed

Objectives

- Characterize the red macroalgal mat (RAM) and benthic seagrass (BSG) habitats based on macrophyte species composition.
- Determine if there is habitat preference among invertebrate epifaunal groups between the two habitat types.
- Determine if epifaunal community distributions is based more on habitat selection or generalized environmental factors.

Methods

- Sampling was conducted at four different sites in Deering Estate, Biscayne Bay once every two to three months (October 2017, December 2017, and March 2018) (Fig 2)

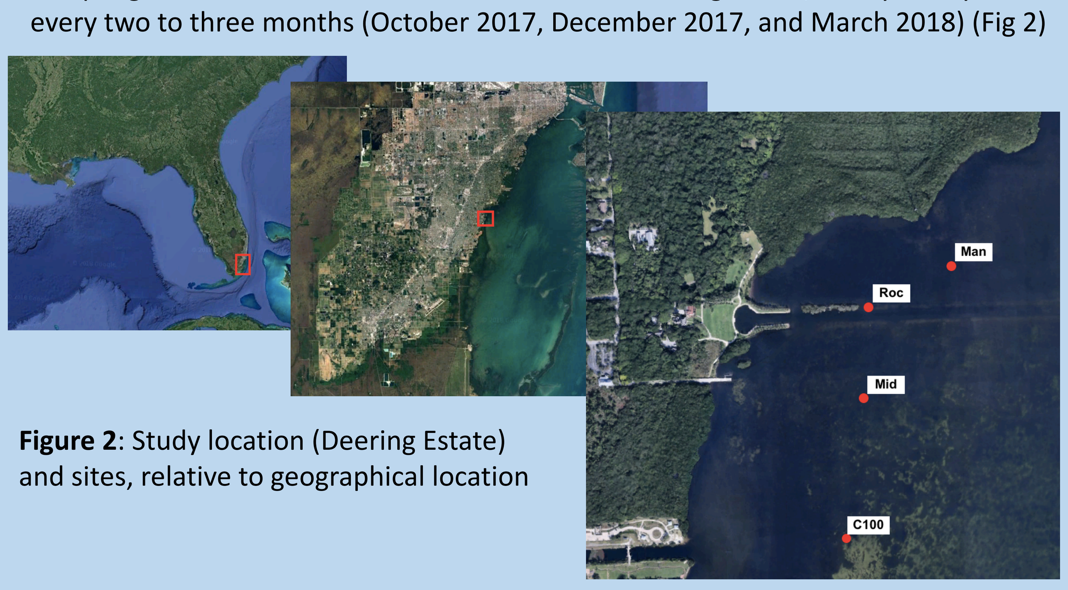


Figure 2: Study location (Deering Estate) and sites, relative to geographical location

- Five samples of BSG and RAM habitats were collected per site by encircling a plastic bag over the macrophyte habitat to ensure capture of invertebrate epifauna.
- Once samples were returned to the lab, all macrophyte species per sample are separated based on species or genus (table 1), and are weighed for wet and dry biomass.
- Invertebrate epifauna within that same sample were sorted into broad taxonomic levels (table 2) and were counted for abundance.
- Wilcoxon Rank Sum tests were used to compare epifaunal species richness and total macrophyte biomass between habitats. Student's t-test were used to compare log-transformed total epifaunal abundances between habitats
- Multivariate analyses (PERMANOVA) were used to compare epifaunal and macrophyte species composition between three factors (habitat, sampling date, and site).

Table 1: Species list of macrophytes between habitats

			Habitat			
			RAM		BSG	
Species	Abbr.	Phylum	Present?	Avg. Wet Biomass	Present?	Avg. Wet Biomass
Thalassia testudinum	Thal	Tracheophyta	X	5.139	X	19.836
Halodule wrightii	Halo	Tracheophyta	X	1.268	X	1.759
Diatoms	Diat	Bacilliophyta	X	0.005	X	0.878
Penicillus capitatus	Penc	Chlorophyta	X	0.026	X	0.032
Batophora occidentalis	Bato	Chlorophyta	X	0.529		
Anadyomene stellata	Anad	Chlorophyta	X	0.085	X	0.000056
Digenea simplex	Dige	Rhodophyta	X	6.866	X	0.00349
Chondria sp.	Chond	Rhodophyta	X	4.941	X	0.201
Laurencia sp.	Laur	Rhodophyta	X	15.739	X	0.283
Spyridia filamentosa	Spyr	Rhodophyta	X	5.657	X	0.00356
Acanthophora spicifera	Acan	Rhodophyta	X	1.504		
Polysiphonia sp.	Plys	Rhodophyta	X	0.147	X	0.04
Ceramium sp.	Cera	Rhodophyta	X	0.006	X	0.000056
Jania sp.	Jani	Rhodophyta	X	0.11	X	0.00005
Centroceras sp.	Cntr	Rhodophyta	X	0.021		
Sargassum sp.	Srgs	Ochrophyta	X	0.004		
Misc. leaves and Bark	LvsBk	Tracheophyta	X	0.272		

Figure 3: An example area with a dominant benthic seagrass habitat (left) and a mixed benthic seagrass – red macroalgal mat habitat (right)

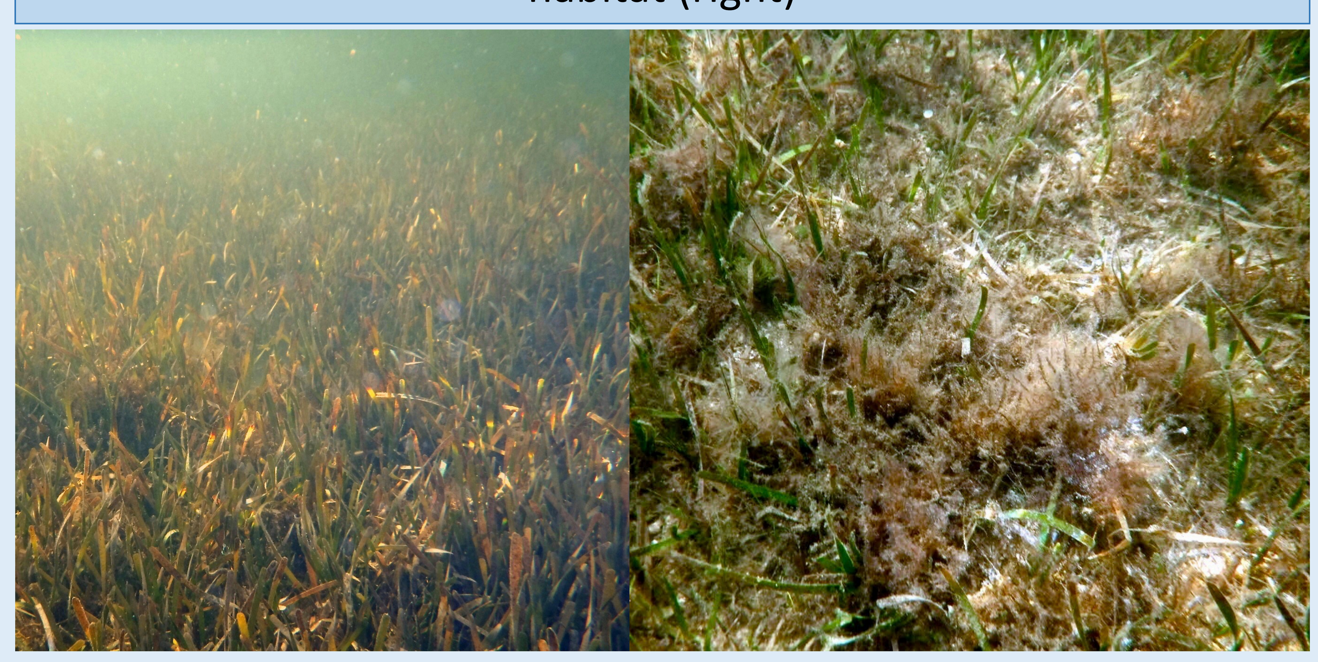


Table 2: List of invertebrate epifauna between habitats

			Habitat			
			RAM		BSG	
Group	Taxon	Abbr.	Rel. Freq.	Total Abundance	Rel. Freq.	Total Abundance
Amphipod	Amphipoda	Amph	0.97	2670	0.89	239
Isopod	Isopods	Isop	0.74	378	0.22	6
Tanaid	Tanaidacea	Tana	0.18	34	0.28	77
Bivalve	Bivalva	Biva	0.97	5162	0.72	86
Gastropod	Gastropoda	Gast	1.00	3024	0.94	157
Chiton	Polyplacophora	Chit	0.11	4	0.22	10
Caridean Shrimp	Caridea	Shri	0.29	17	0.17	3
Hermit Crab	Paguroidea	Herm	0.42	98	0.17	7
Crabs	Brachyura	Crab	0.32	25	0.00	0
Starfish	Asteroidea	Aste	0.08	4	0.00	0
Polychaete Worms	Polychaeta	Polyc	0.79	179	0.78	246
Insect	Insecta	Inse	0.08	14	0.00	0
Ostracod	Ostracoda	Ost	0.05	6	0.06	8
Sipunculid Worms	Sipuncula	Sipu	0.05	5	0.11	2
		Total		11620		841

Figure 4: Relative frequencies of epifaunal groups between habitats

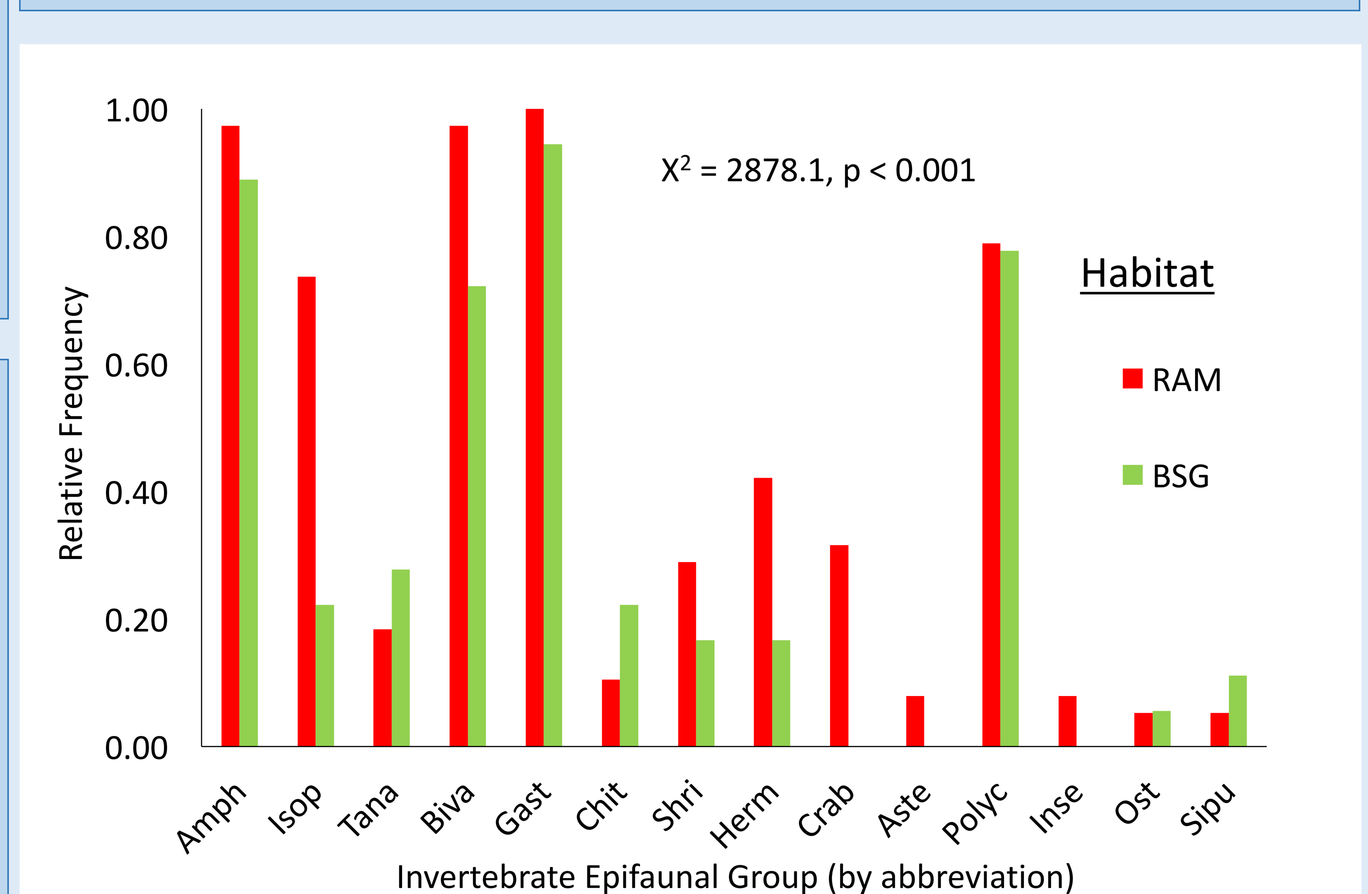


Figure 5 Comparison of total invertebrate abundance (left) and species richness (right) between habitat types

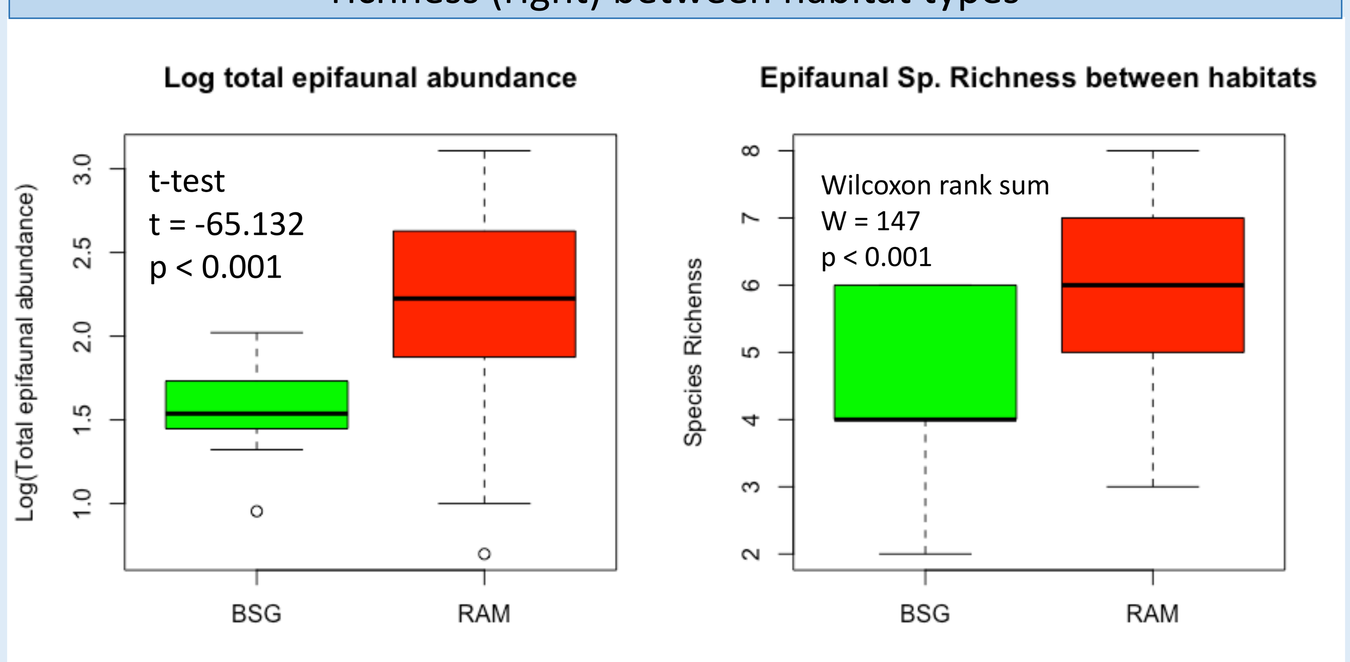
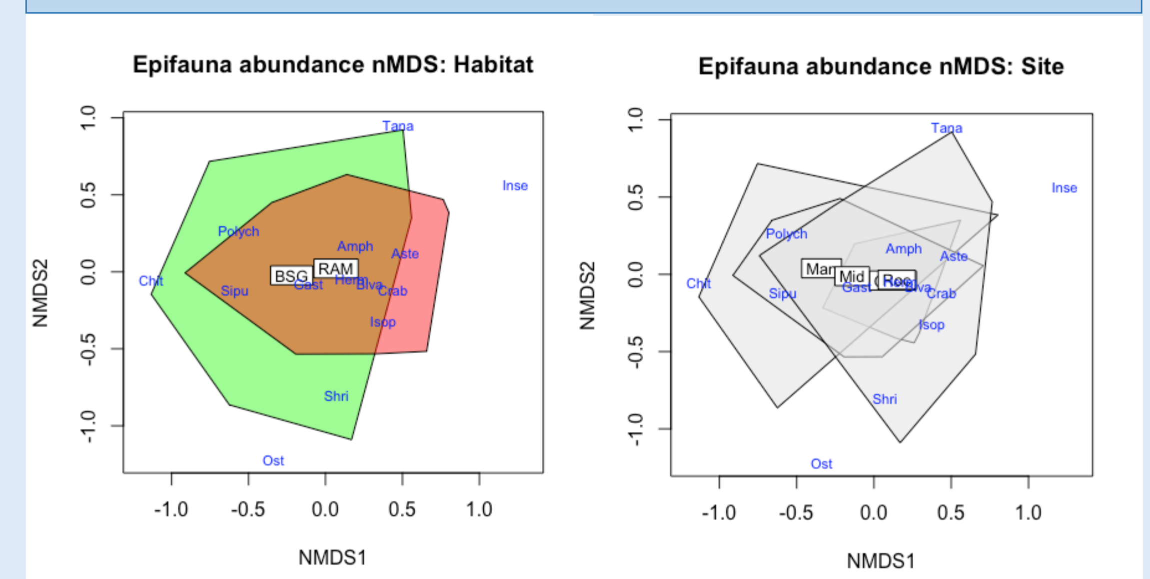
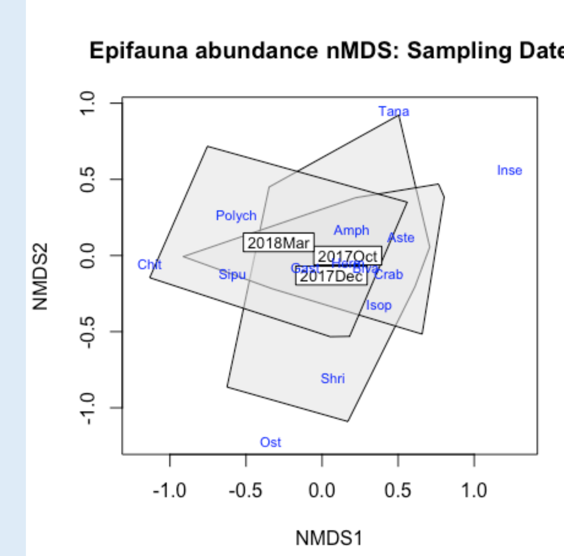


Figure 6: Epifaunal abundance nMDS Multivariate analyses





Results of PERMANOVA

Predictor Variables: Habitat, site, sampling date

Response Variable: Epifaunal abundance

Factor	R^2	p
Habitat	0.090	0.001***
Site	0.150	0.001***
Date	0.100	0.001***
Habitat:Site	0.060	0.11 NS
Habitat:Date	0.020	0.234 NS
Site:date	0.090	0.319 NS
Residuals	0.490	

Conclusion

- BSG habitats are dominated by *Thalassia testudinum* and *Halodule wrightii*, while RAM habitats are dominated by rhodophytes such as *Laurencia* sp. and *Digenea simplex*
- RAM Habitats show higher species richness, relative frequency, and abundance of epifauna compared to BSG habitats.
- Epifaunal species composition seem to not only be determined by habitat choice, but also by other environmental factors that could arise from seasonality (date) and site-specific conditions.
- Differences in salinity exist between months, but not between sites, suggesting salinity may not be one factor contributing to invertebrate habitat preference,

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