CARBON BIOGEOCHEMICAL PROCESSES ALONG A MANGROVE-SALT MARSH ECOTONE

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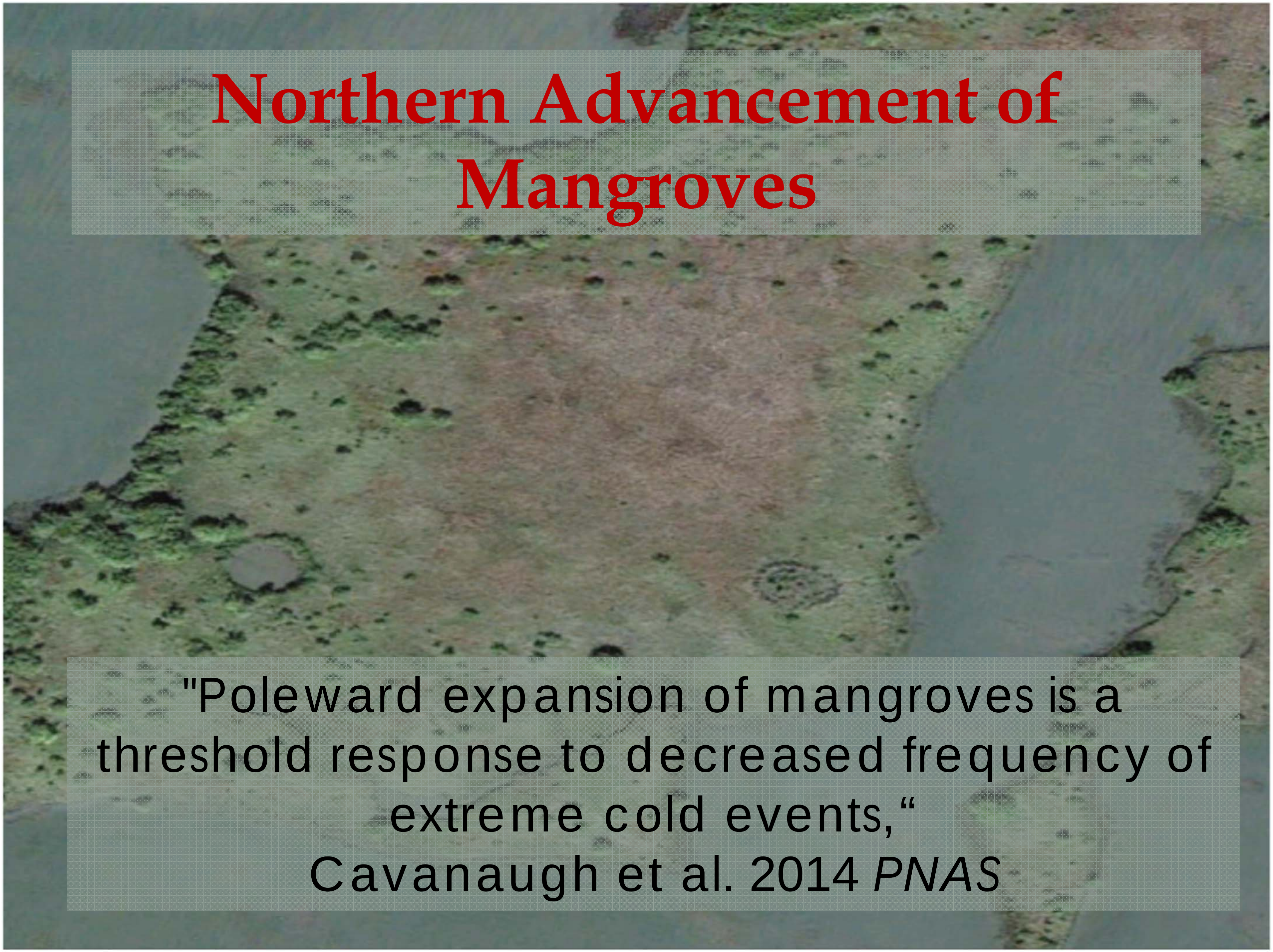
Northern Advancement of Mangroves

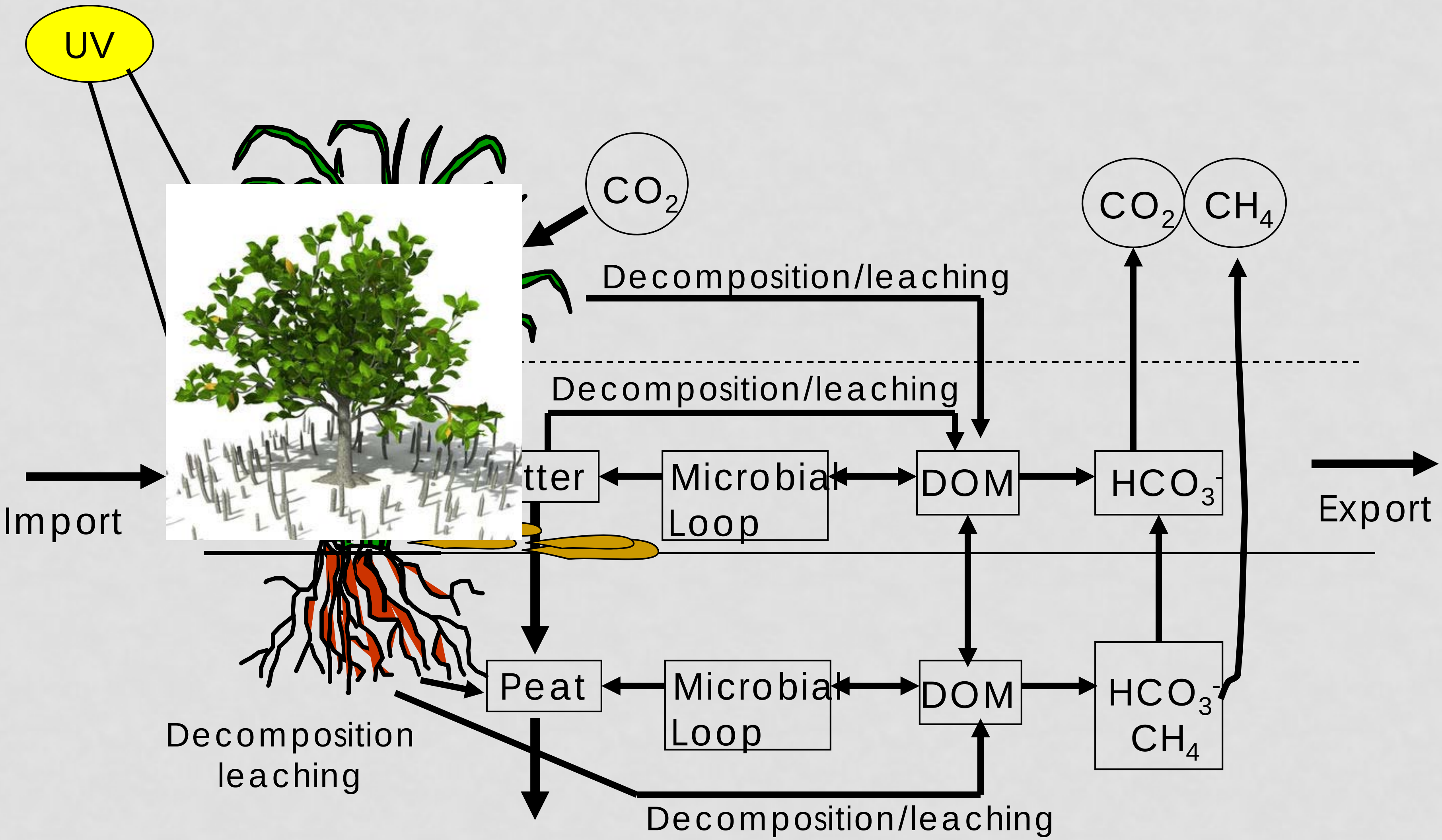


"Poleward expansion of mangroves is a threshold response to decreased frequency of extreme cold events,"
Cavanaugh et al. 2014 *PNAS*

QUICK RECAP

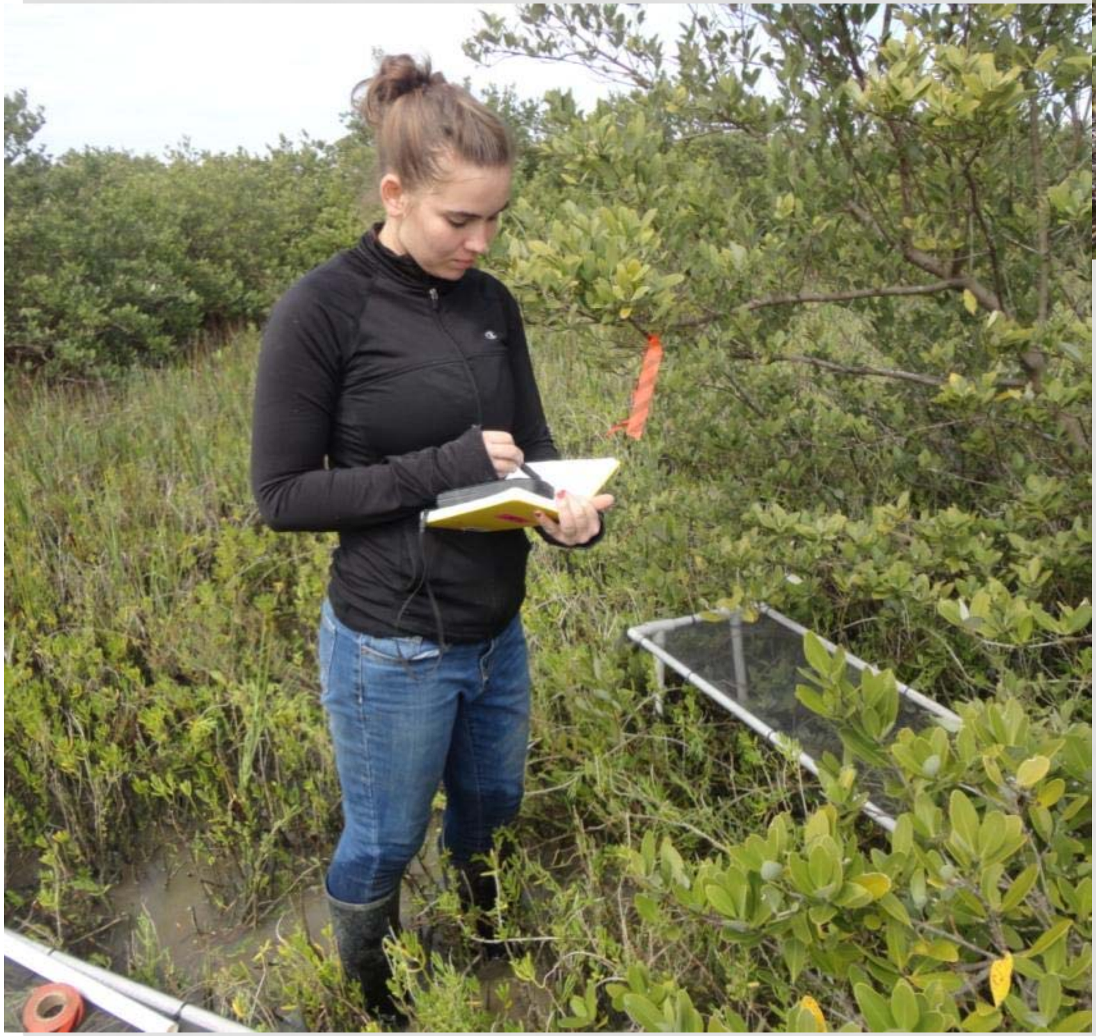
- Dynamics of mangrove expansion (S. Bell, M. Osland, K. Cavanaugh)
- Biomass and soil organic matter greater under mangrove coverage and ecotone (L. Simpson)
- Belowground decomposition accelerated (S. Chapman)
- Physical aspects of vegetation can alter detrital dynamics via trapping (S. Pennings)
- Detrital inverts more prevalent in salt marsh (R. Smith)
- I need to look into SIAR!!! (R. MacKenzie)
- **Much** more (unless you snuck out for cookies)

Carbon Cycle in Wetlands



Reddy & DeLaune 2008

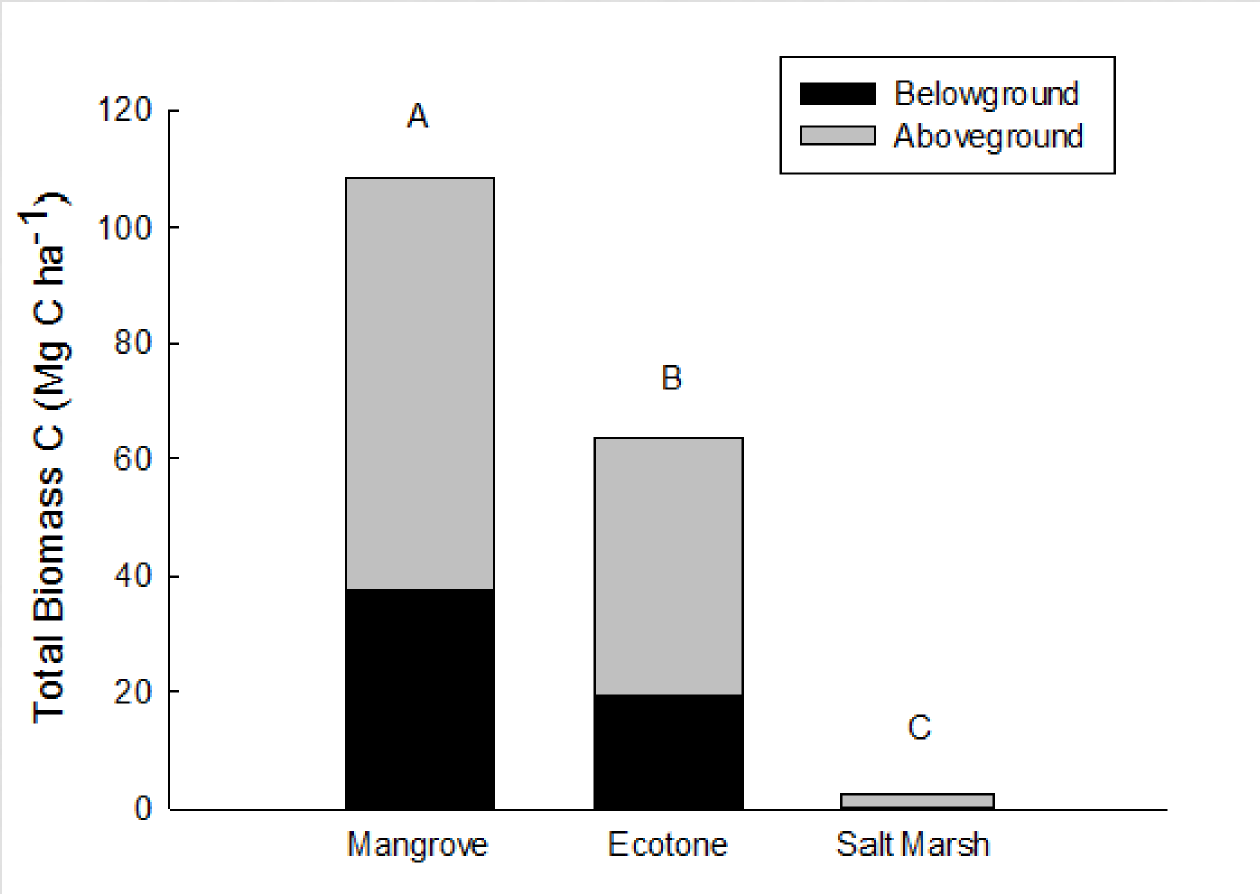
Implications of Mangrove advancement into salt marsh



Spartina* vs *Avicennia

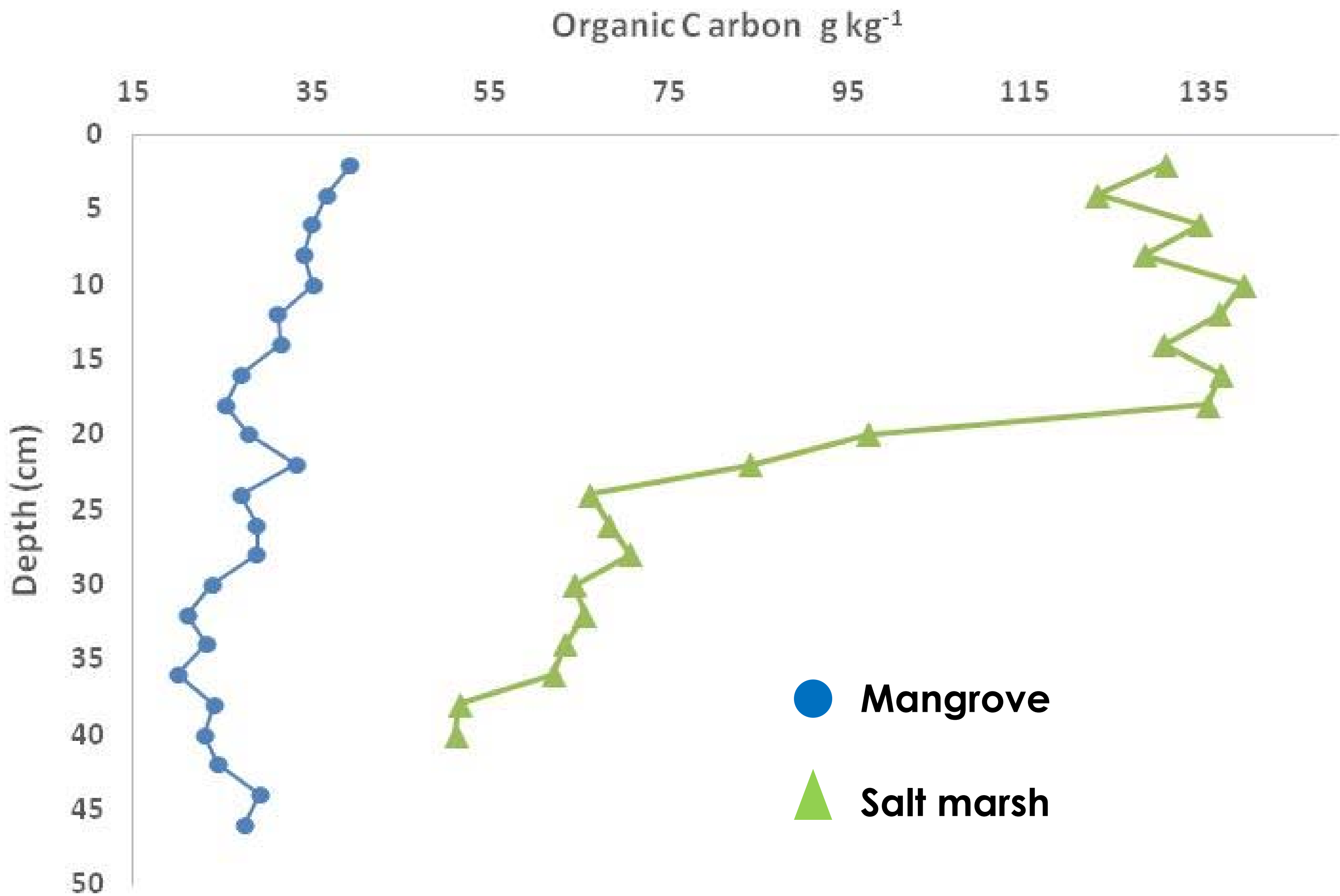
-Decomposition
-Foodweb dynamics

STANDING STOCK BIOMASS

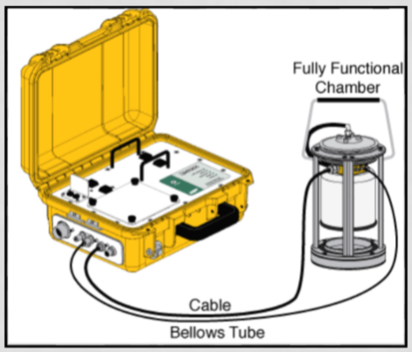


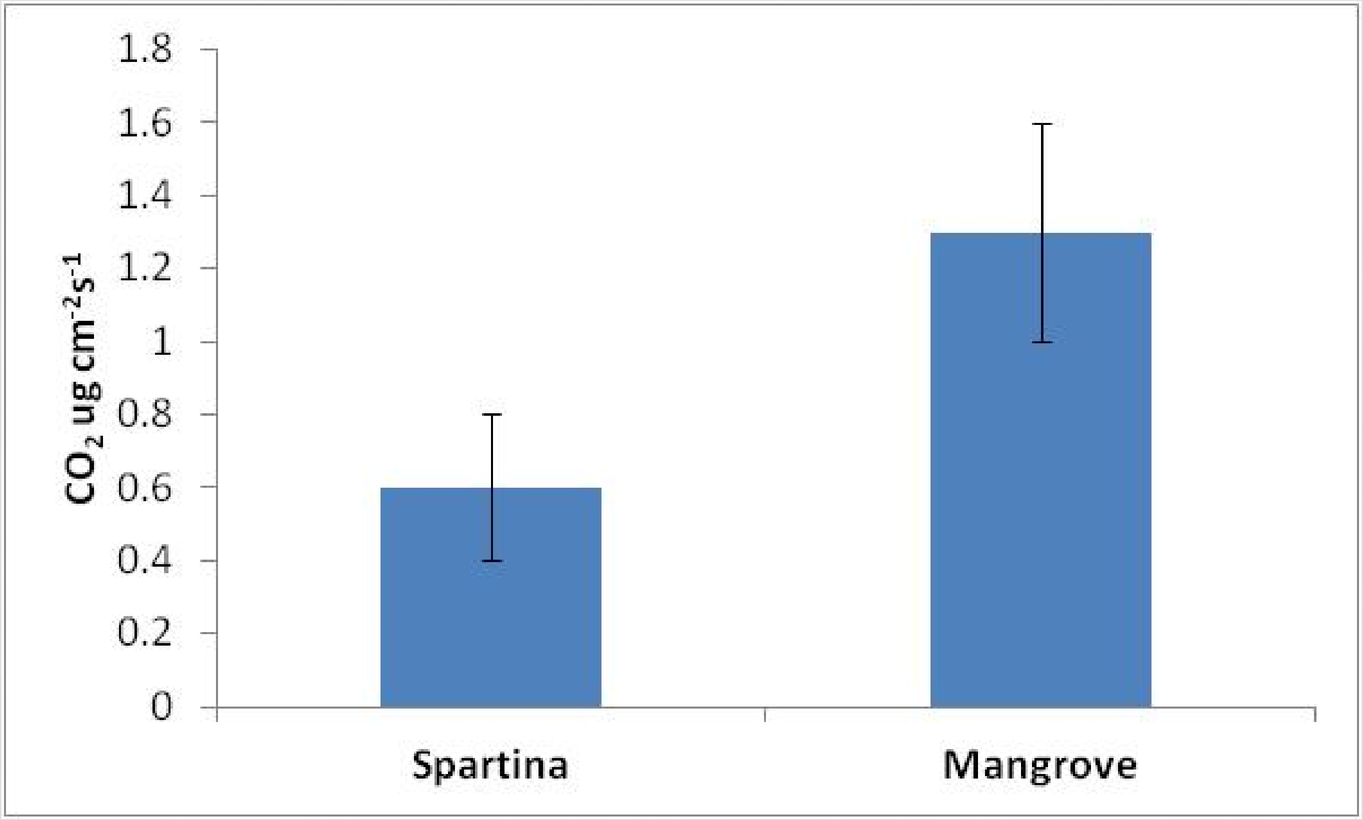
L.T. Simpson

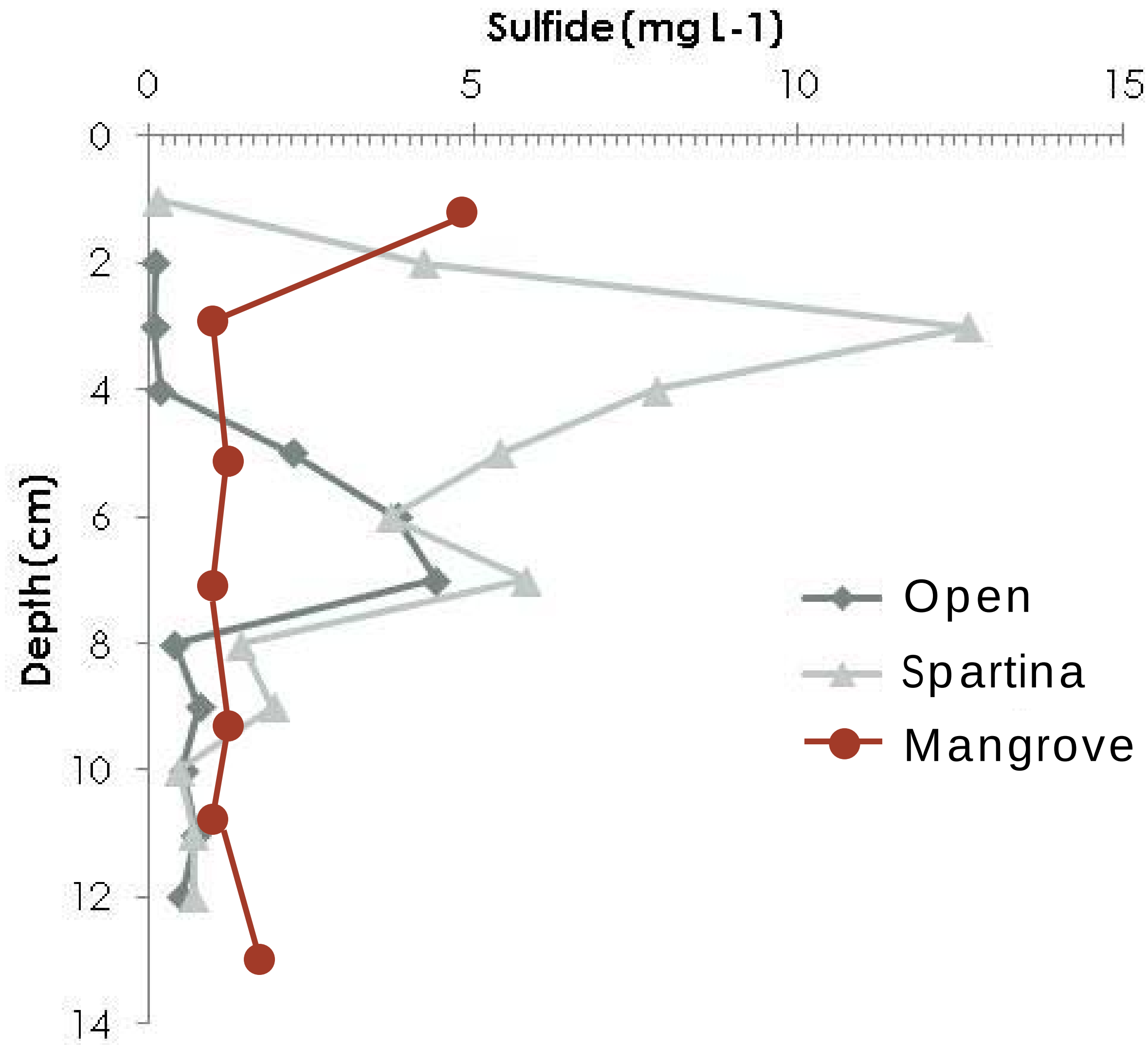
Soil Organic Carbon

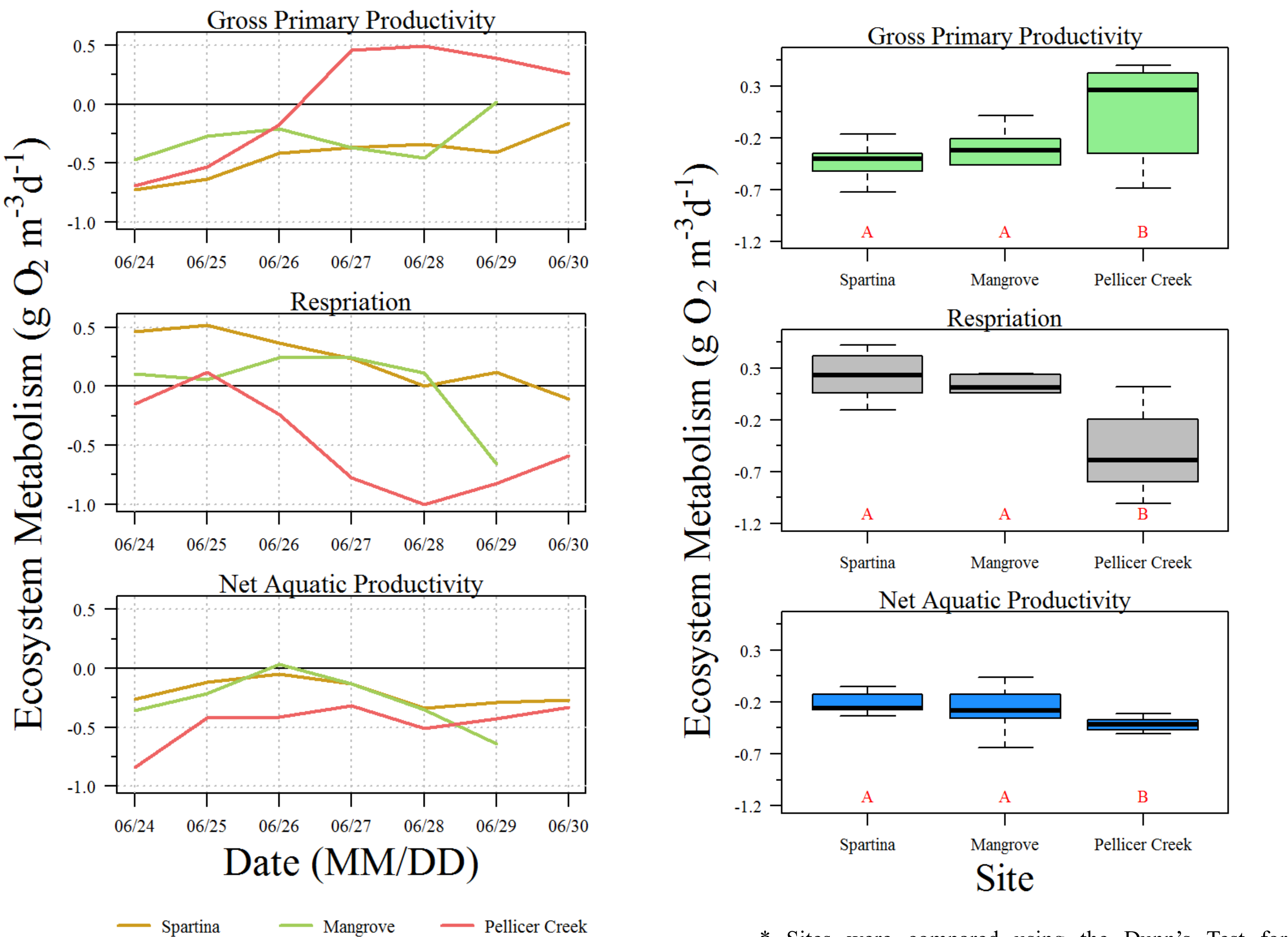


SOIL RESPIRATION

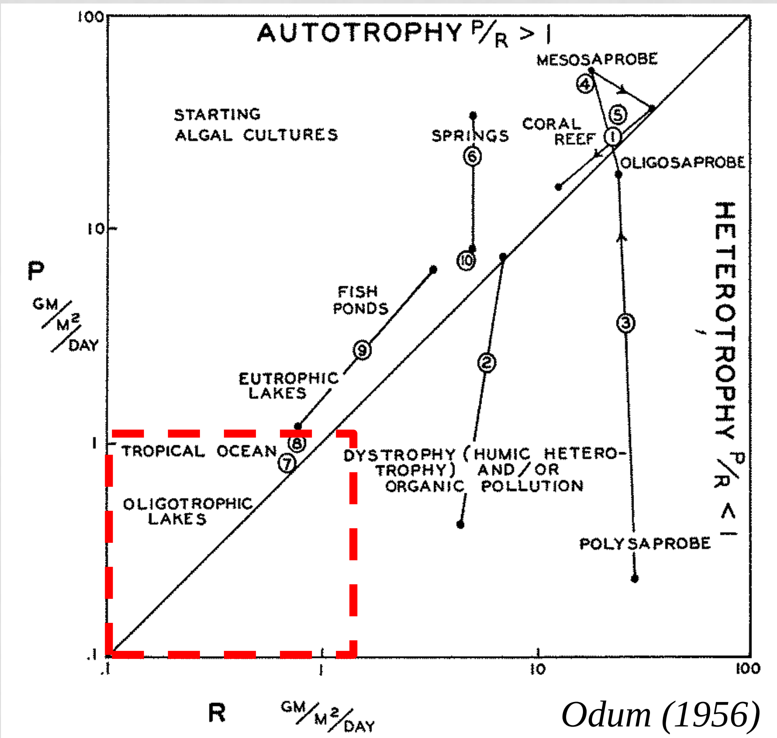


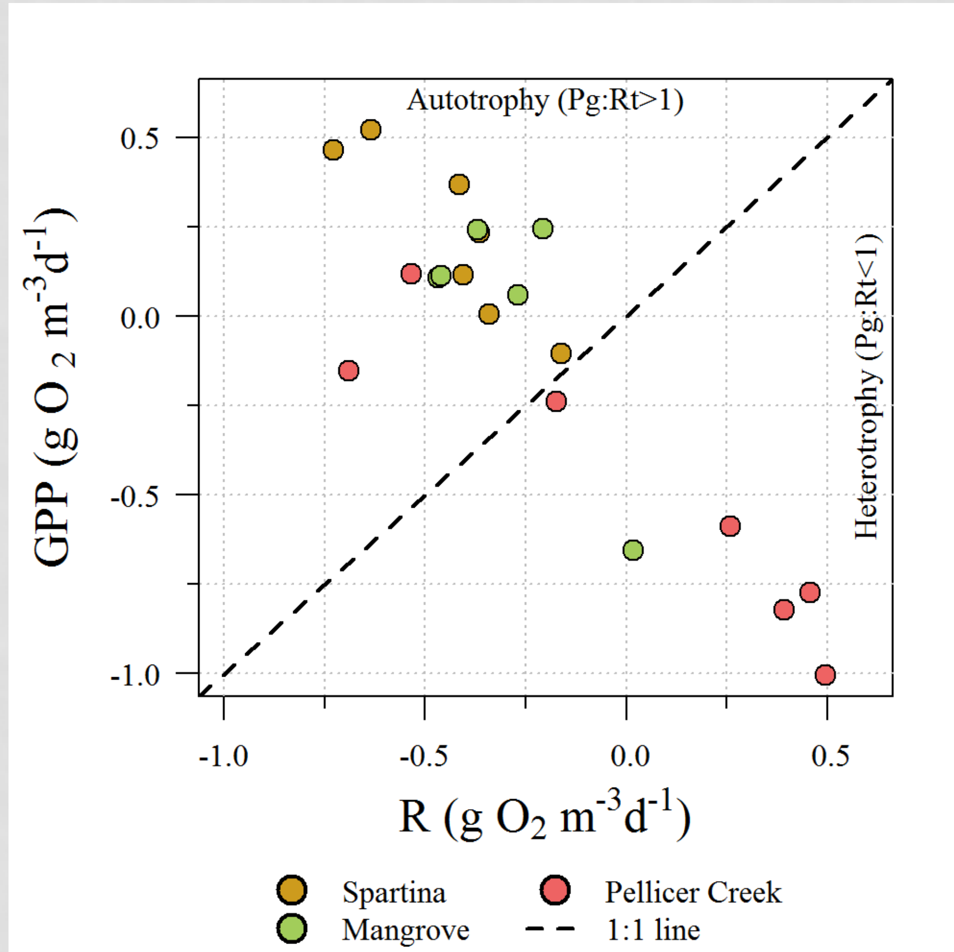



Sulfide (mg L-1)
0
5
10
15
0
2
4
6
8
10
12
14
Depth (cm)
Open
Spartina
Mangrove



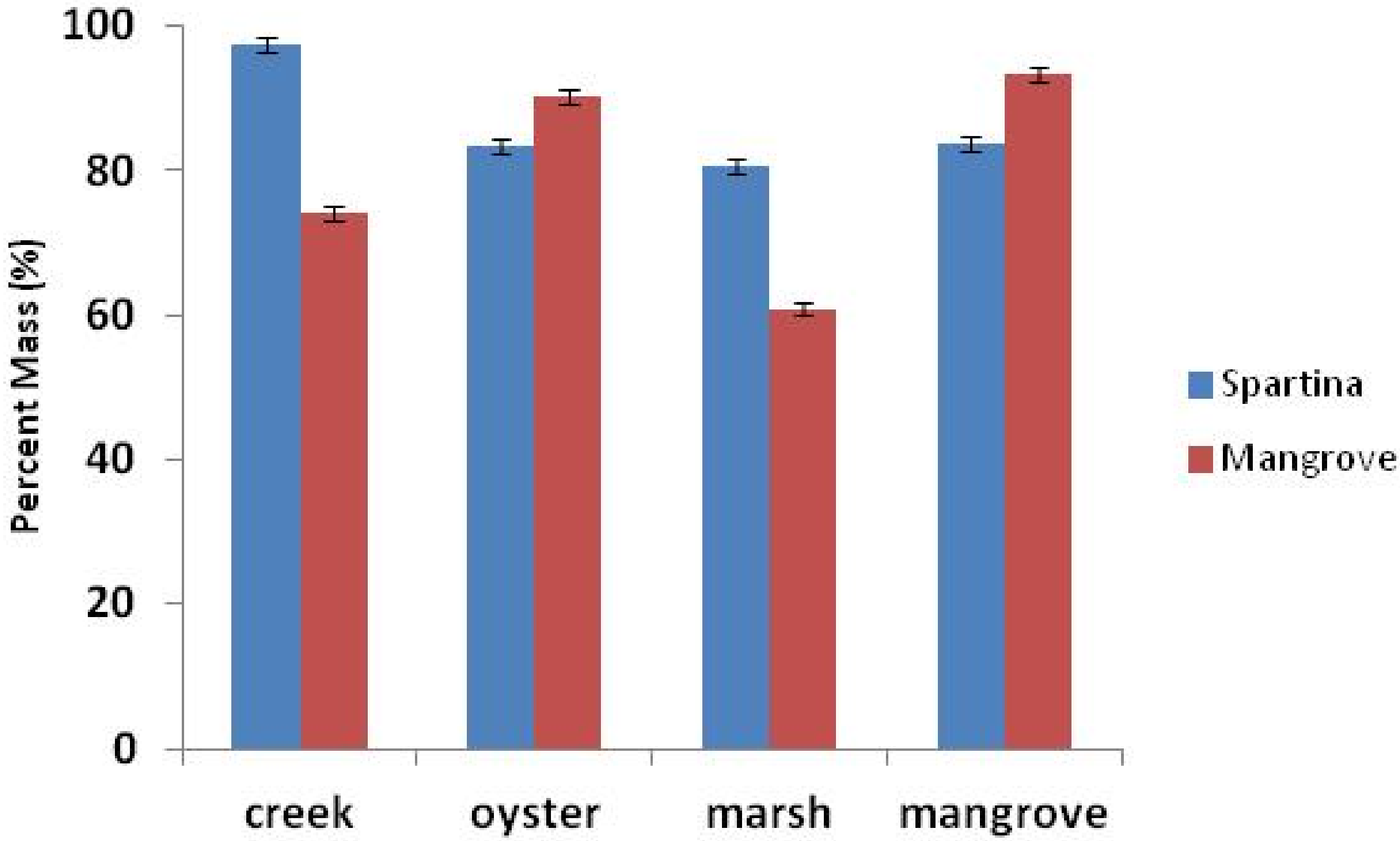
* Sites were compared using the Dunn's Test for multiple comparisons ('dunn.test' r-package). The critical level of significance was set to $\alpha = 0.05$

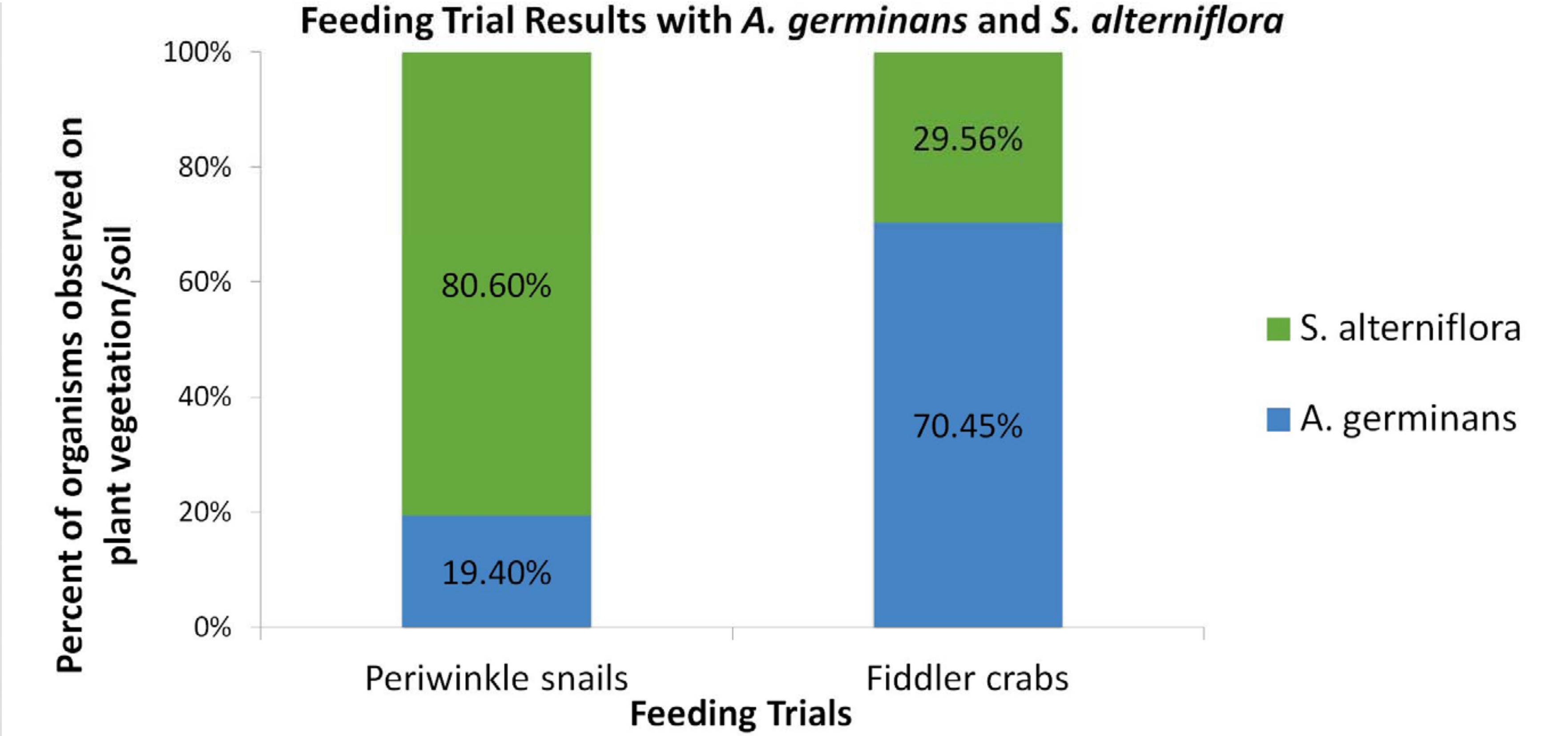




Odum, H. T. 1956. Primary production in flowing waters. Limnol. Oceanogr **1**: 102–117.

Mass Loss of Litter -180 days

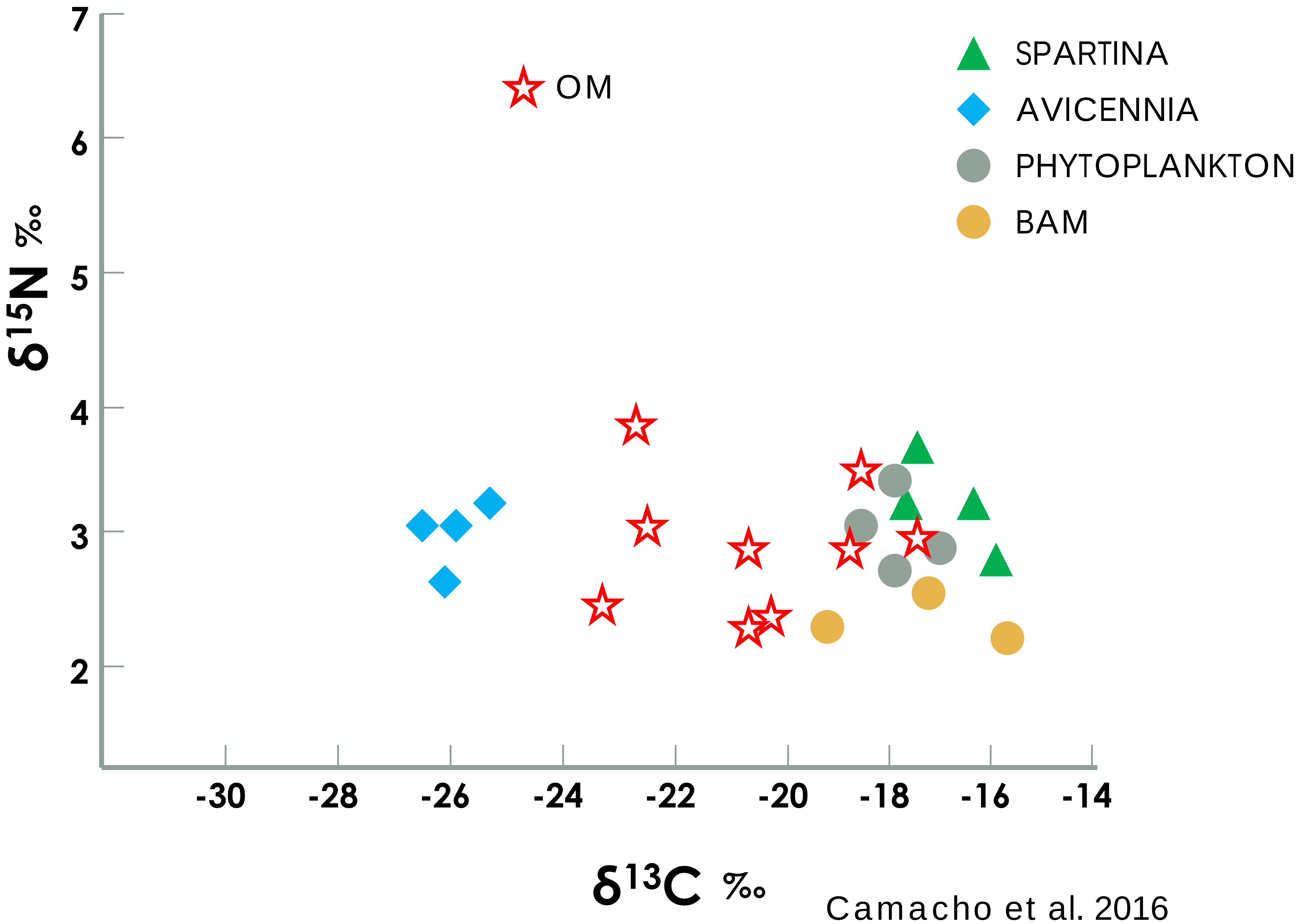




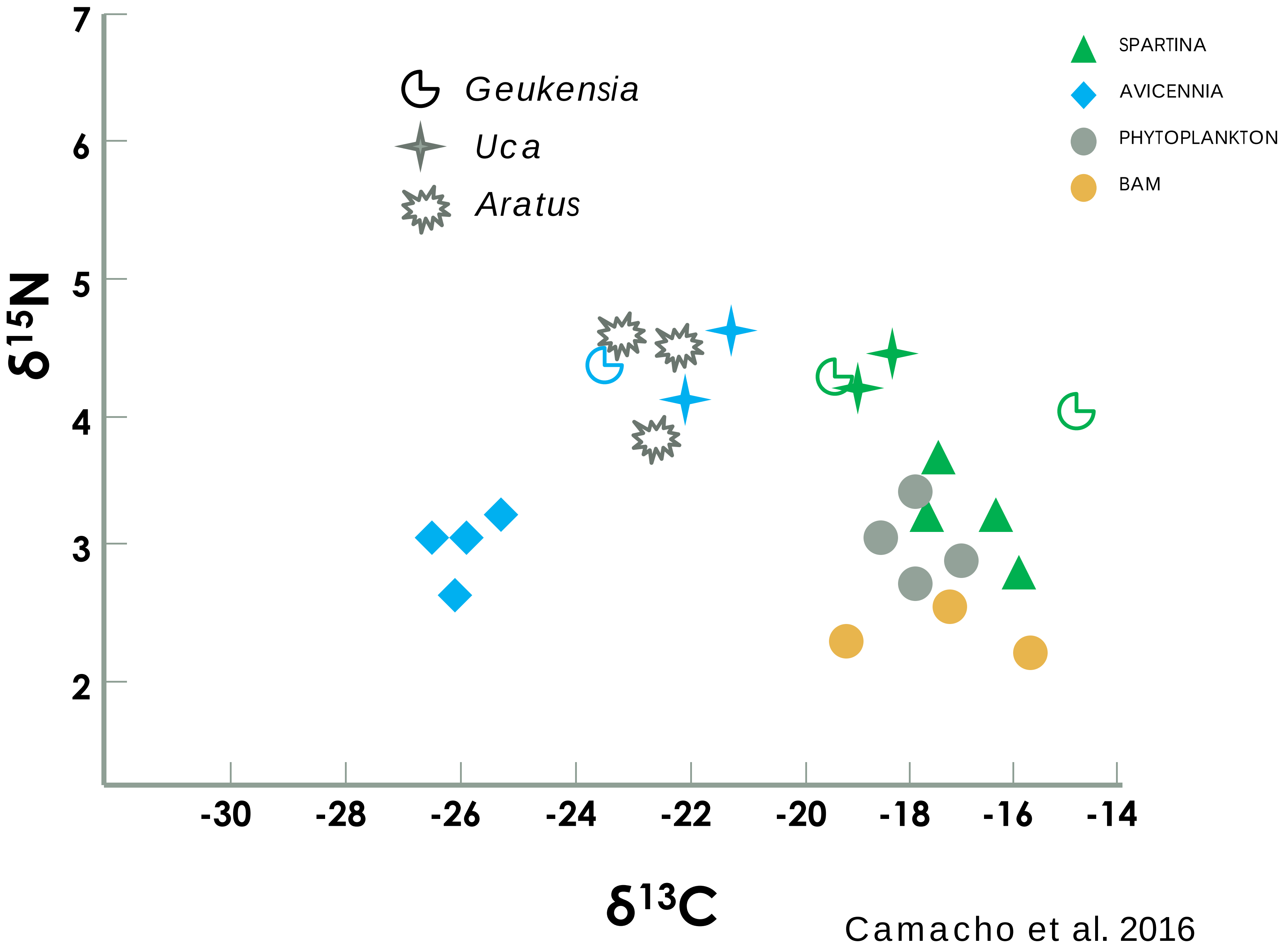
A. germinans

S. alterniflora

Camacho et al. 2016



7
6
5
4
3
2
δ15N ‰
OM
SPARTINA
AVICENNIA
PHYTOPLANKTON
BAM
-30
-28
-26
-24
-22
-20
-18
-16
-14
δ13C ‰
Camacho et al. 2016



7
6
5
4
3
2
δ15N
-30
-28
-26
-24
-22
-20
-18
-16
-14
δ13C
Geukensia
Uca
Aratus
SPARTINA
AVICENNIA
PHYTOPLANKTON
BAM
Camacho et al. 2016

INITIAL CONCLUSIONS

- *Avicennia* may be initially depleting soil OC
- Both systems water column net autotrophic (what about shade?)
- Mangrove derived C is cycling through the system
  - Sediment SIA
  - Consumer SIA
- Preferential feeding suggest some species may be able to utilize mangrove C (at least temporarily)
- There is a lot more to do….

MORE QUESTIONS?!?!?

- How long will it take for soil C to build up again?
- N cycling accelerated?
- Will net ecosystem primary productivity decline- secondary- tertiary….?
- Will foodweb structure shift to more tropical species- temperate species displaced?
- Many More?????

ACKNOWLEDGEMENTS

- Osborne Lab
  - members:
    - Fran Batt
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- Dr. Nikki Dix

THE WHITNEY LABORATORY for MARINE BIOSCIENCE

MARINE SCIENCE & ENGINEERING WITH PLYMOUTH UNIVERSITY

Smithsonian Institution

GTM RESEARCH RESERVE

UF UNIVERSITY of FLORIDA

Methods

- 15 minute DO and surface water temperature data was used to estimate gross primary productivity (GPP), respiration (R) and net aquatic productivity (NAP).

- Within a 15-minute interval it is assume that the change in DO is equality to sum of the respiration rate and oxygen diffusion rate minus the rate of photosynthesis (Equation 1).

- The rate of oxygen uptake by diffusion across the air-water interface (D) is regulated by the difference in O2 in the water column from atmospheric equilibrium and the temperature-dependent gas exchange coefficient for oxygen. Wind produces turbulence in the stationary water bodies, facilitating gas exchange processes driven by wind speed (Equation 2).

$$\frac{dC}{dt} = P - R + D \qquad (1)$$

C = Dissolved oxygen concentration (mg L^{-1})
t = time (h)
P = rate of photosynthesis (mg L^{-1} h^{-1})
R= respiration rate (mg L^{-1} h^{-1})
D = rate of oxygen uptake by diffusion across the air-water interface (mg L^{-1} h^{-1})

$$D = k_a(C_s - C) \qquad (2)$$

D = rate of oxygen uptake by diffusion across the air-water interface (mg L^{-1} h^{-1})
k_a= volumetric reaeration coefficient (h^{-1})
C_s= Dissolved oxygen saturation concentration (mg L^{-1})
C = Dissolved oxygen concentration (mg L^{-1})

SALT MARSH INVERTEBRATES

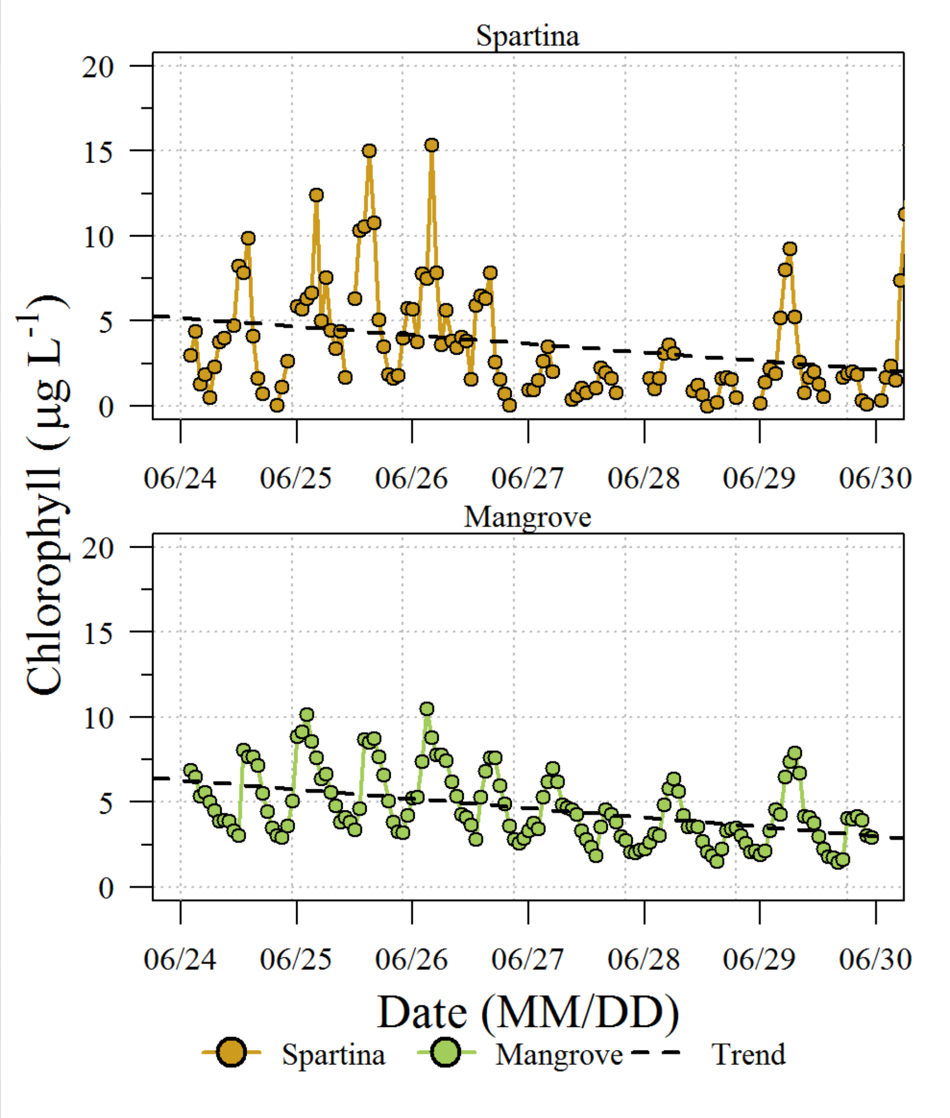
Littoraria irrorata- Salt Marsh Periwinkle

Geukensia demissa- Ribbed Mussel

Sesarma reticulatum- Marsh Crab

Uca spp.- Fiddler Crab

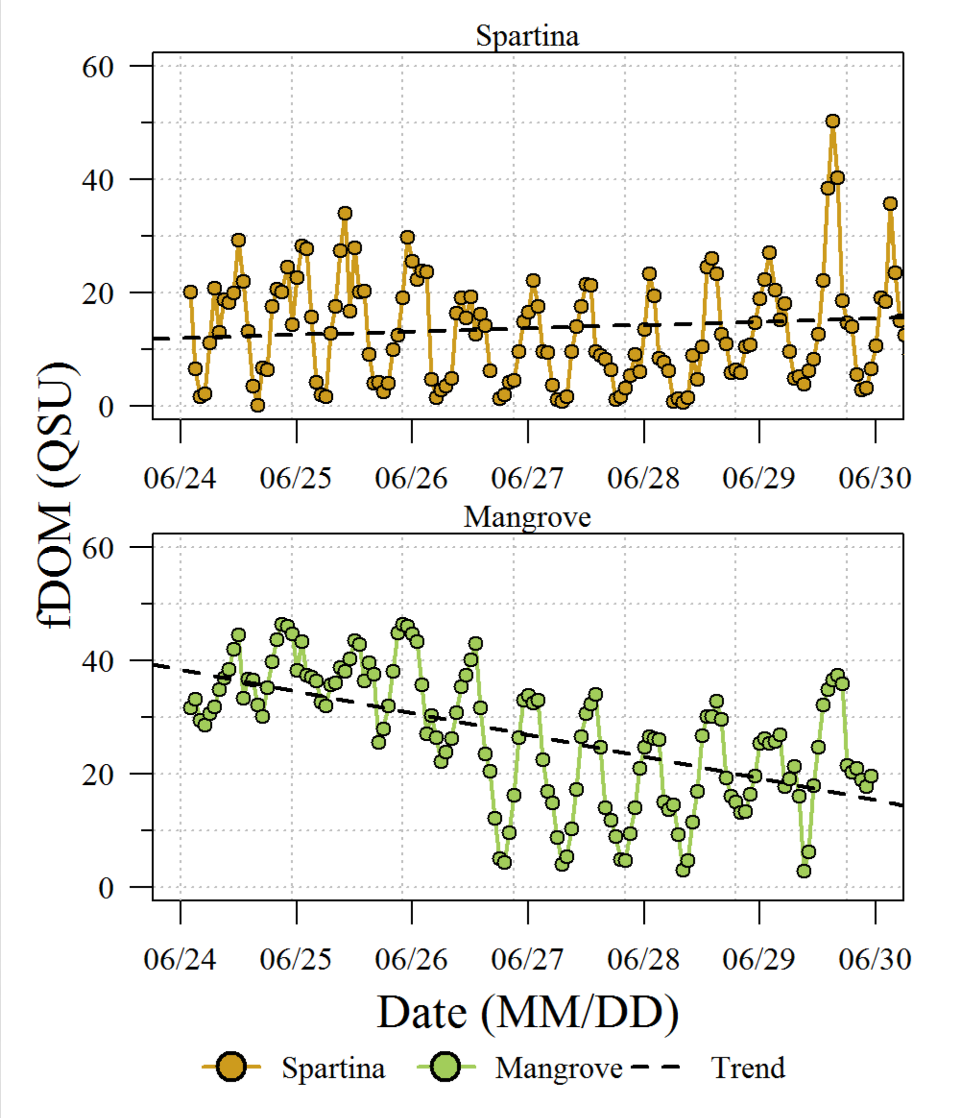
Callinectes sapidus - Blue Crab



Spearman's Rank Correlation Analysis

Site	Kendall τ	ρ-value
Spartina	-0.27	<0.001
Mangrove	-0.37	<0.001

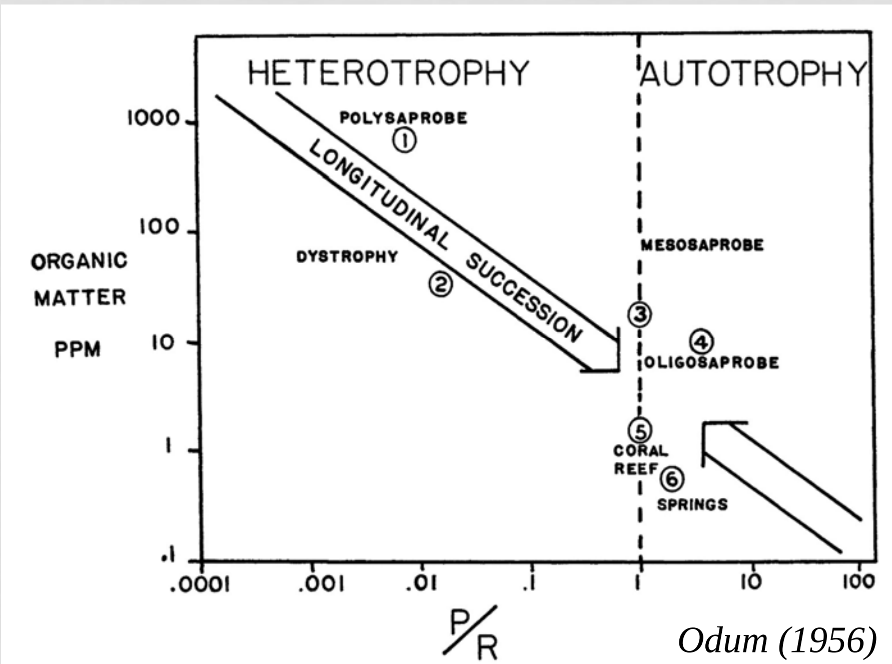
Hourly Mean Data

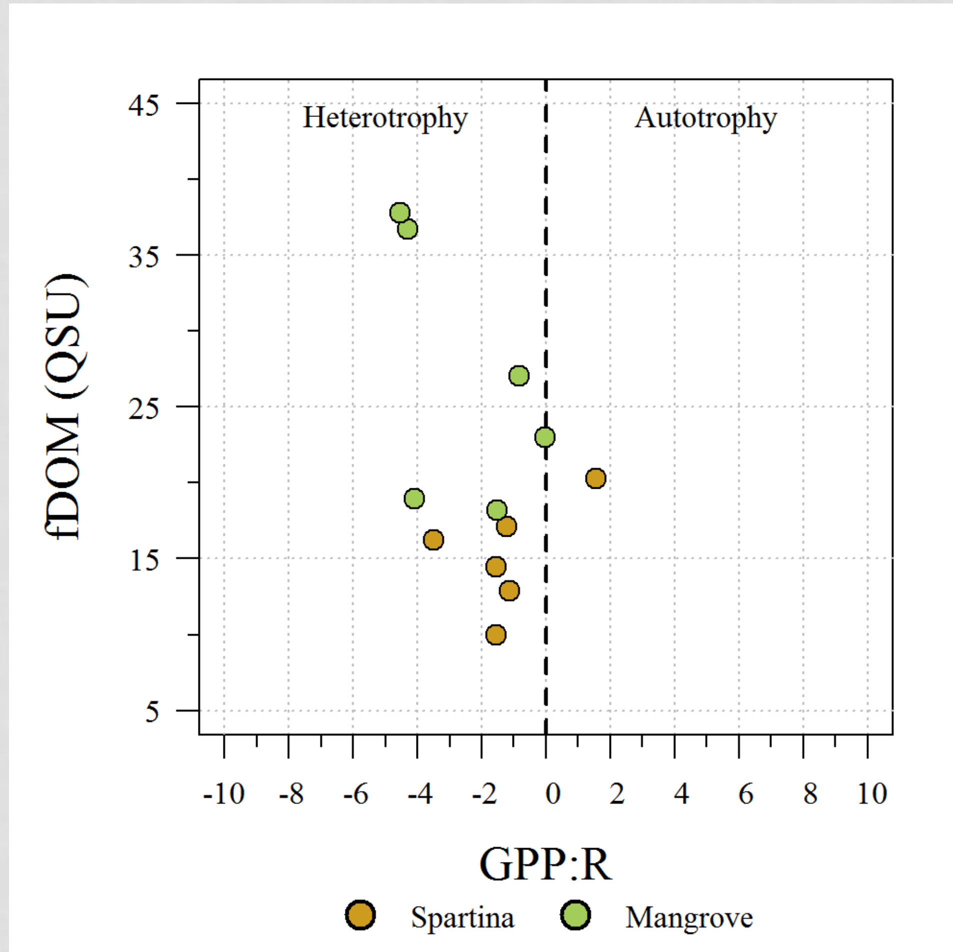


Spearman's Rank Correlation Analysis

Site	Kendall τ	ρ-value
Spartina	-0.01	0.82
Mangrove	-0.38	<0.001

Hourly Mean Data





* Daily Mean fDOM values.

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