The role of plants, soil, and human disturbance in shaping tidal freshwater microbial community composition and function

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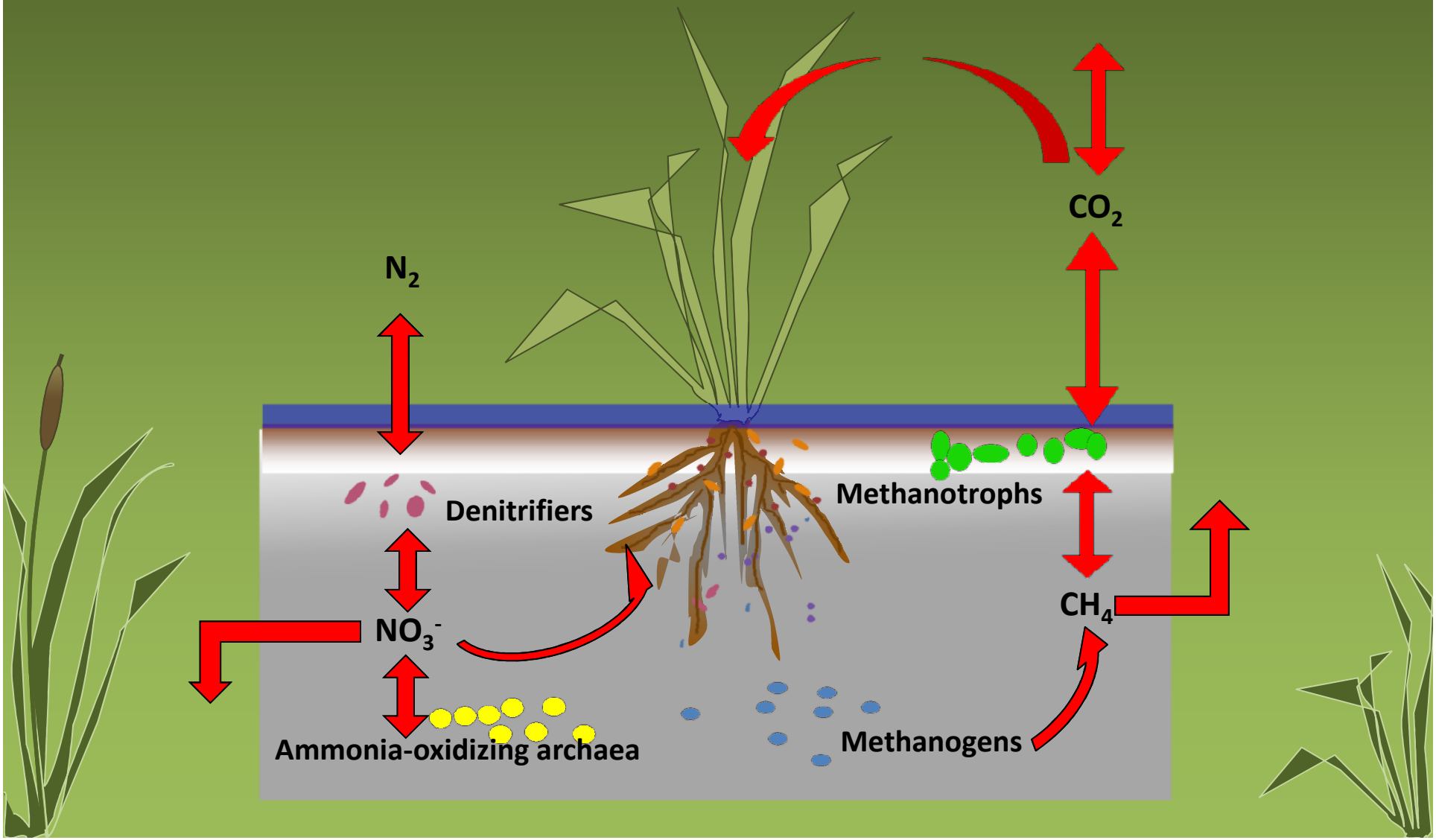
Delivery of Ecosystem Services

- Tidal freshwater marshes
  - Buffer zone for nitrogen and phosphorus runoff
  - Carbon sequestration
  - Wildlife habitat
- Restoration
  - <50% soil organic matter compared to reference locations after 50 years
  - Different plant community composition
    - Increased invasive plants
    - Un-vegetated areas
  - Persistent risk of erosion along waterways

Carbon and nitrogen cycling

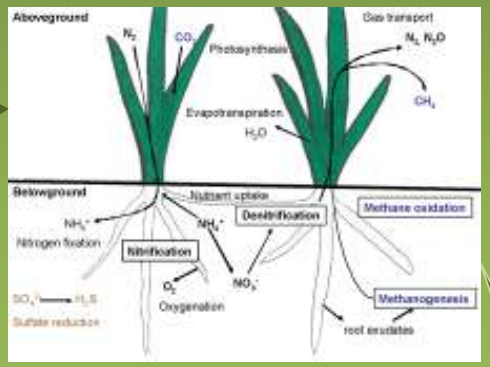


Linking Genetics to Metabolism

- Many microbial mediated processes
- High microbial diversity
- If there is a change in microbial composition, is there a change in function?

DNA sequence

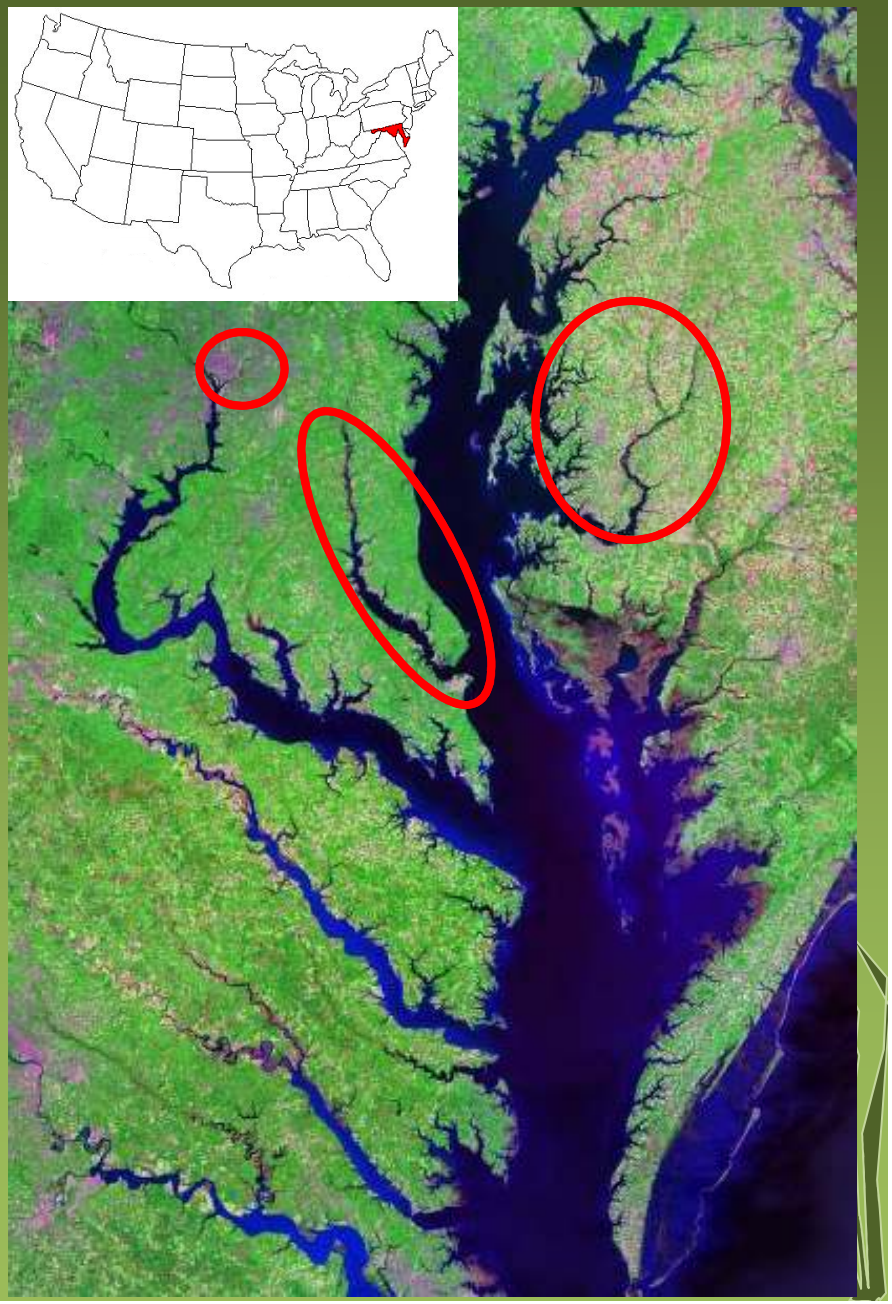
Biochemical pathway



Flux rates

Study Designs

- Watersheds
  - Anacostia
  - Patuxent
  - Choptank
- Comparisons
  - Natural vs. Restored
  - Natural sites across an urban gradient
  - Differences in plant species



Natural vs. Restored

Watershed	Restoration Year	Plant Diversity (Shannon's index)	% Soil organic matter	pH
Patuxent	Natural	1.26	15.5	4.6
	1992	0.54	6.7	6.0
Anacostia	Natural	0.96	6.1	6.0
	1992	0.46	5.0	6.4
	2000	0.37	2.5	6.3

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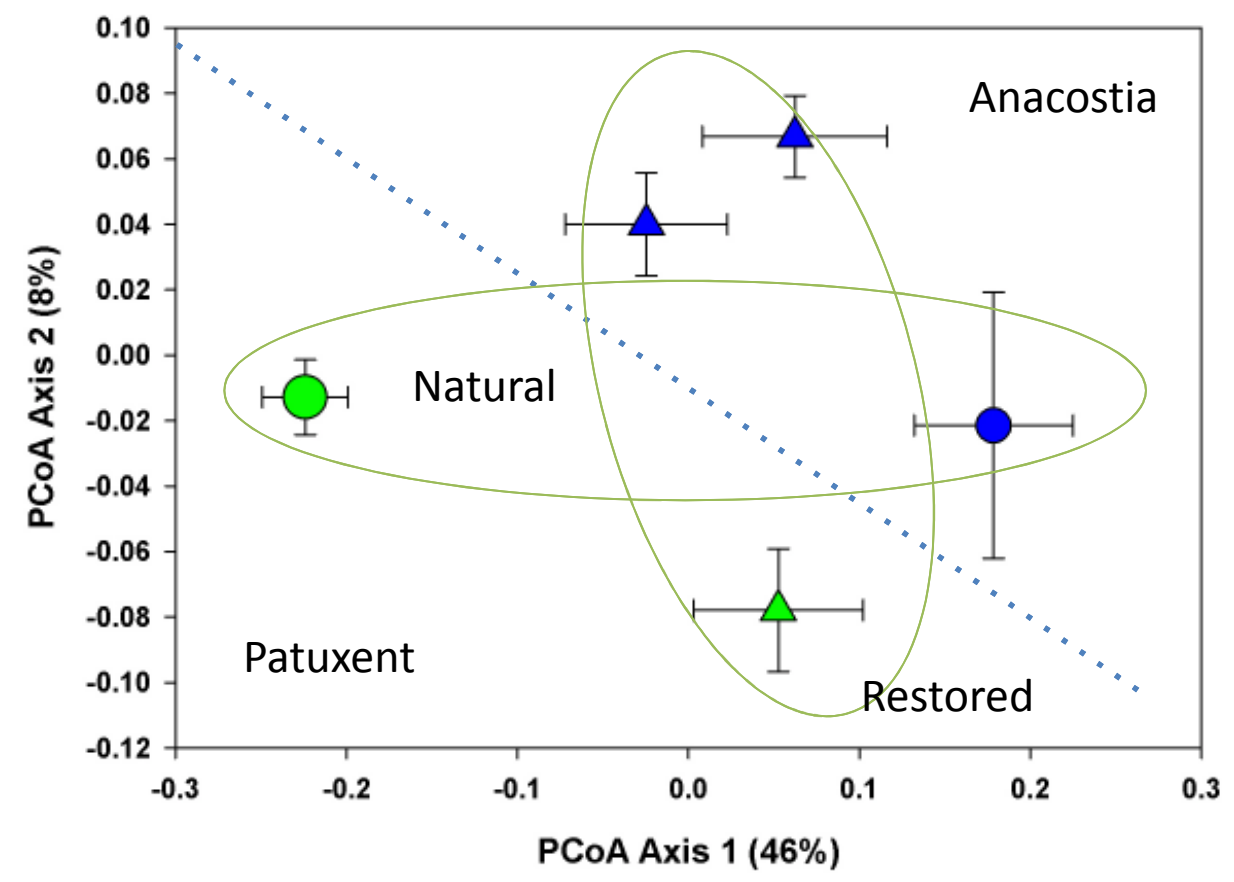
Natural vs. Restored Wetlands



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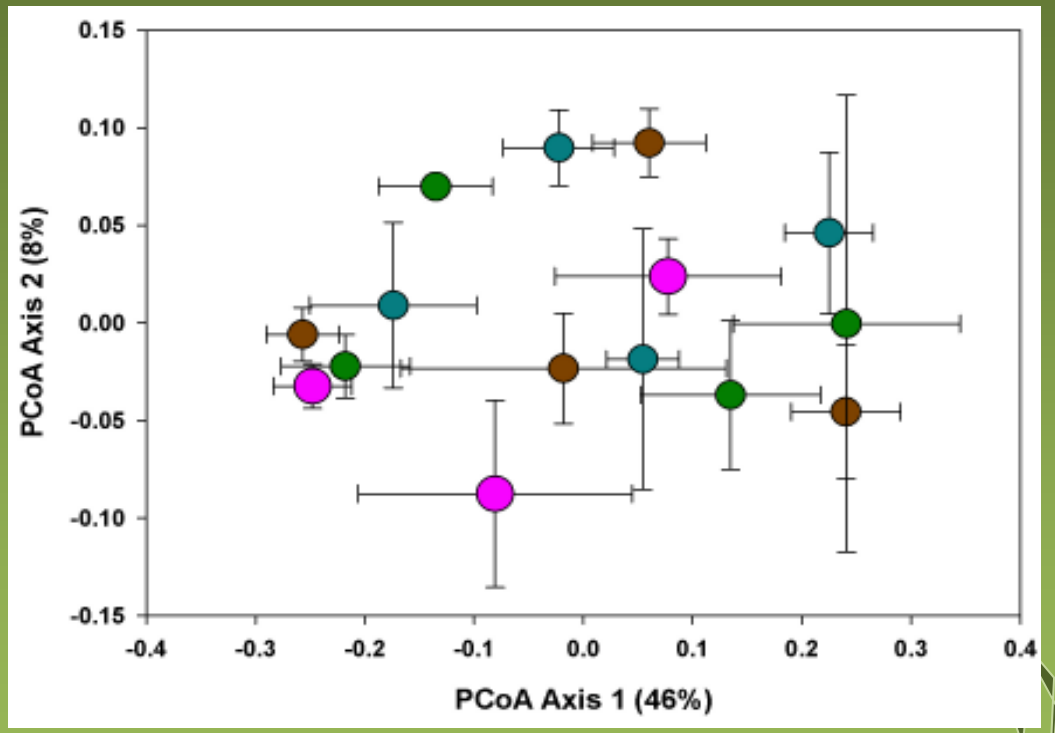
Rhizosphere of Different Plant Species

T. latifolia (Cattail)
P. virginica (Arrow arum)
L. salicaria (Loosestrife)
P. australis (Common reed)



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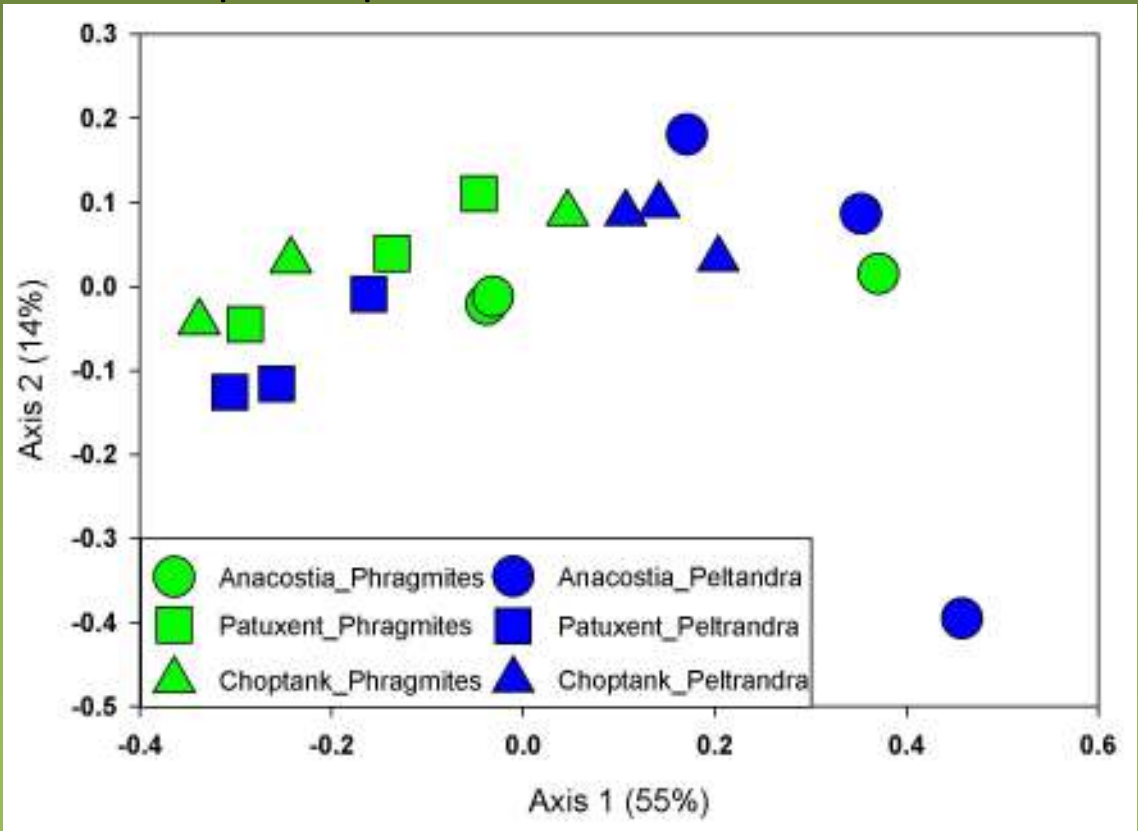
Plant species affect microbial composition in natural wetlands

- Putatively identified 117,000 “species” at 97% gene similarity
- No difference between watersheds, but . . .
  - Differences in plant species in natural sites



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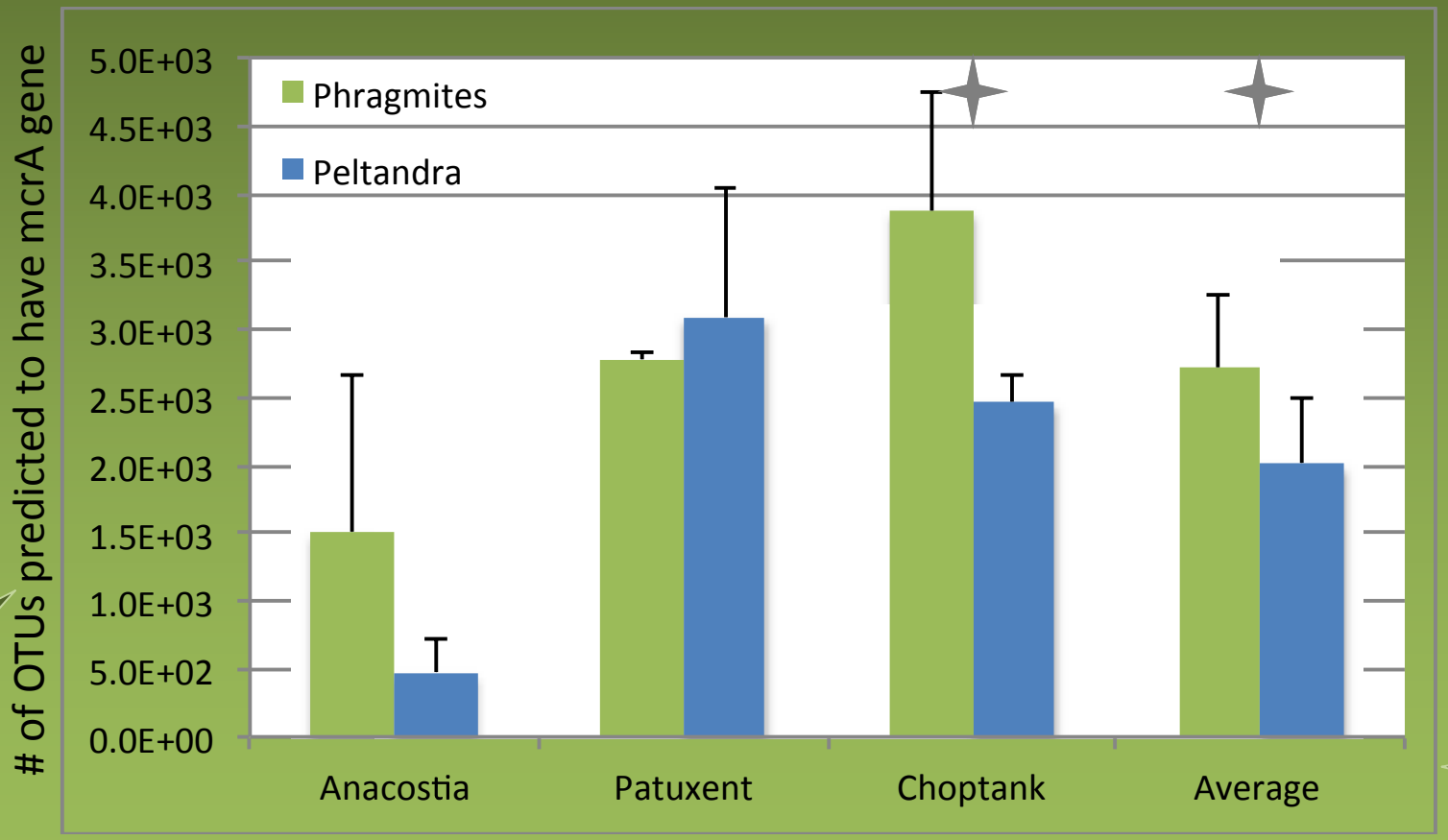
Methanogenesis: Methane Coenzyme A (*mcrA*)



Summary

- Bacterial and archaeal communities significantly differ between natural and restored tidal freshwater wetlands
- Good news—remnant wetlands may still contain microbial communities that look like larger less urbanized sites
- In natural wetlands microbes differ between plant species
  - More methanogenesis possible under *P. australis* compared to *P. virginica*

Future direction

- Connect predictive pathways directly to function (denitrification/methanogenesis)
- Examine the role of iron in carbon cycling

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