Linking hydroperiod with water use and nutrient accumulation in Everglades tree island habitats

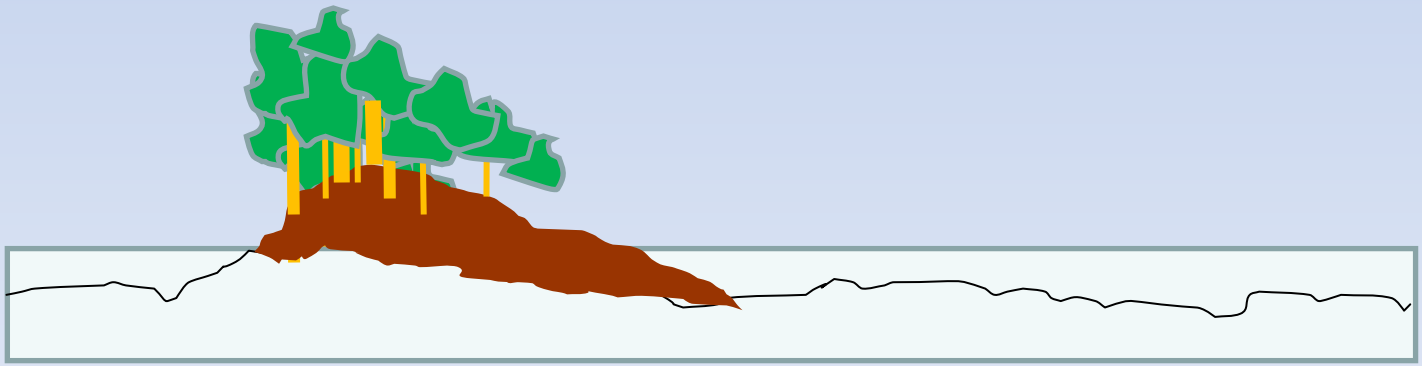
Xin Wang, Leonel Sternberg, Vic Engel, Mike Ross
University of Miami

Tree islands in the Everglades

- Tree island habitats are important feature in the Everglades ecosystem.

Tree island structure and

Upland hammock Lowland swamp Freshwater marsh

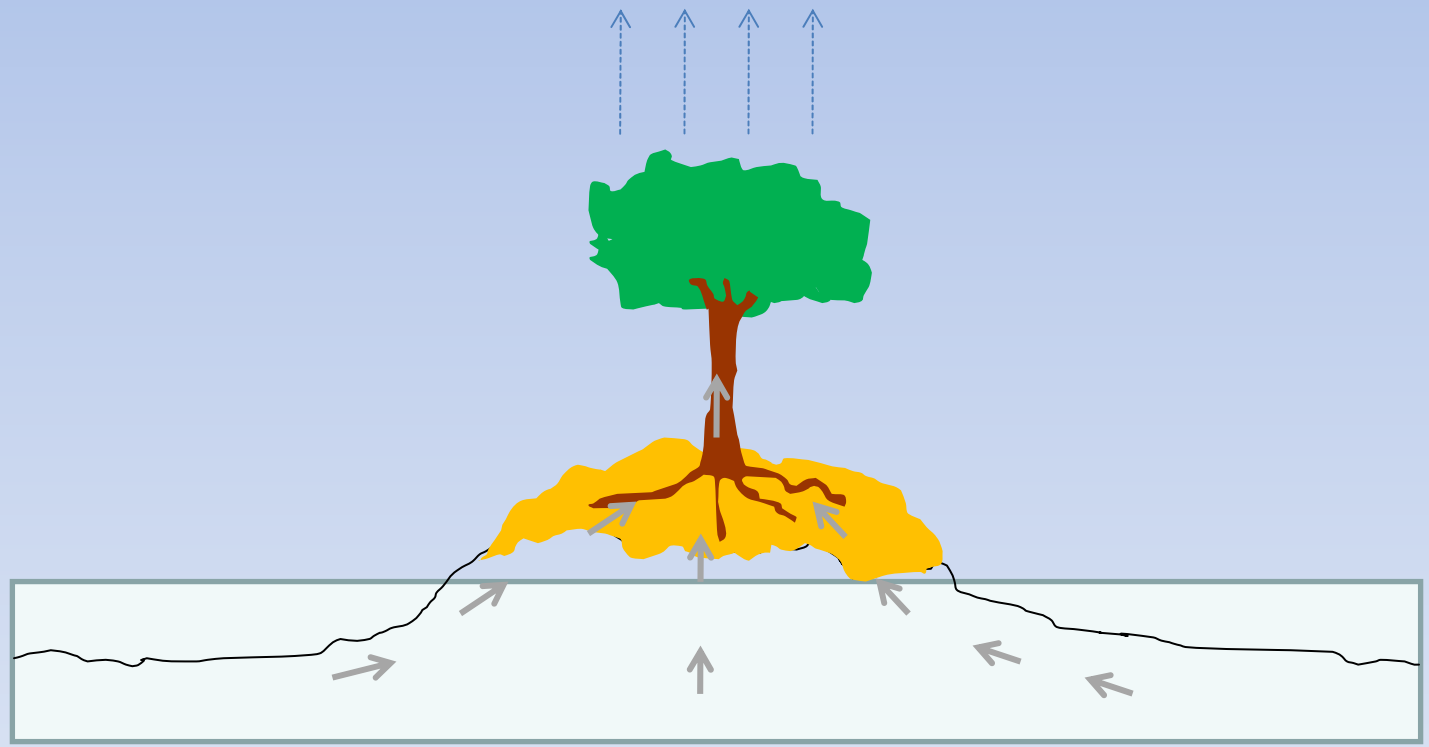


Tree island nutrients

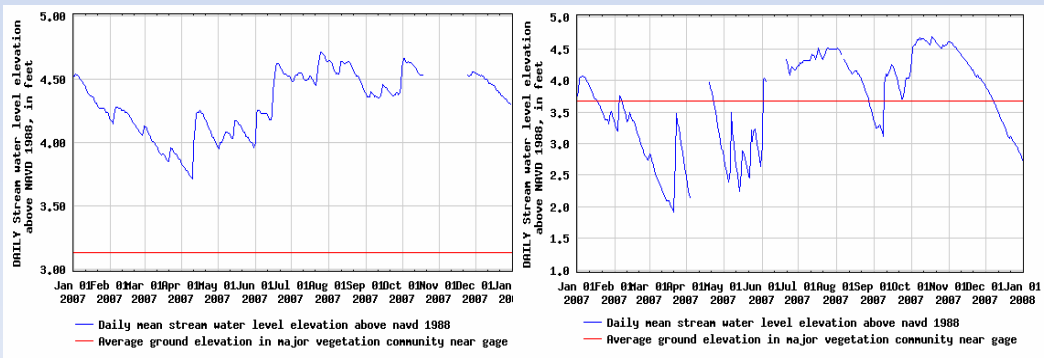
- Phosphorus concentration of tree islands can be up to 100 times higher than that of the surrounding marshes.
- Where are these nutrients coming from?
  - Bird guano theory
  - Transpiration driven theory

Bird guano theory – birds and other wildlife are the primary nutrient source of tree islands

Transpiration theory – plants pull up nutrients into tree islands from surrounding marsh water.

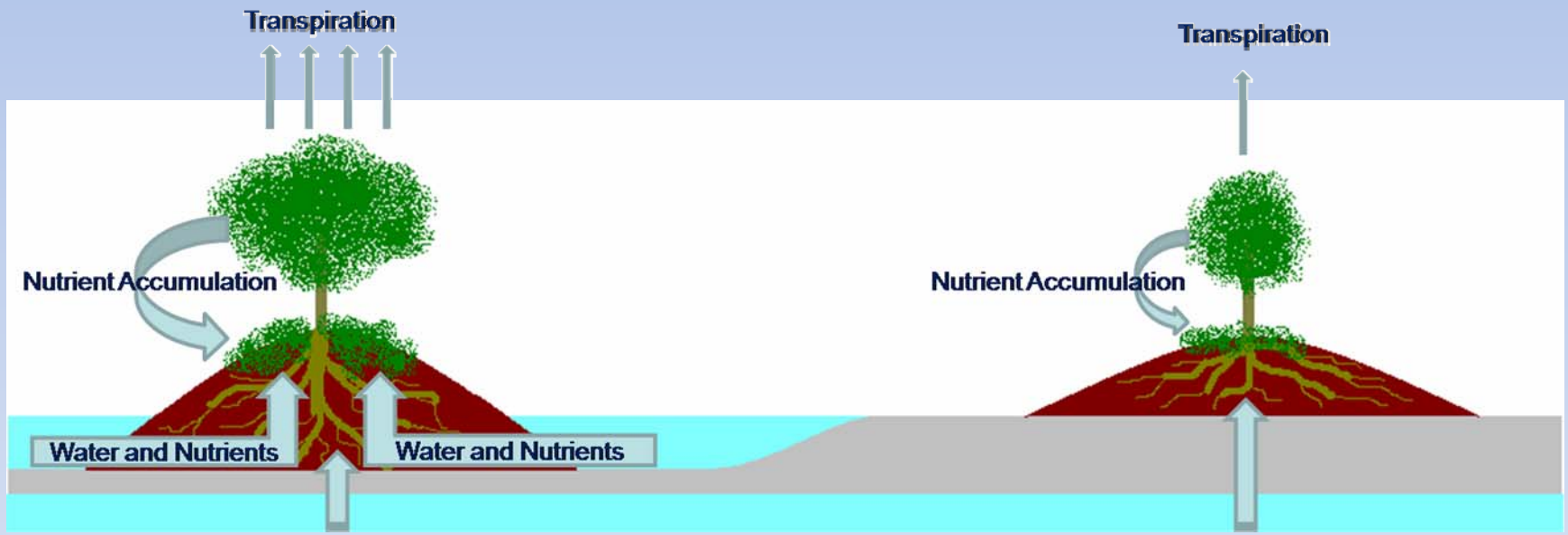


Study area – Shark River Slough and adjacent prairie landscapes



My hypothesis

Tree islands actively transpiring during the dry season can accumulate more nutrients than tree islands with lower dry season transpiration.



Tree islands located in the prairies would have limited water availability and lower P concentration than tree islands in the Shark Slough.

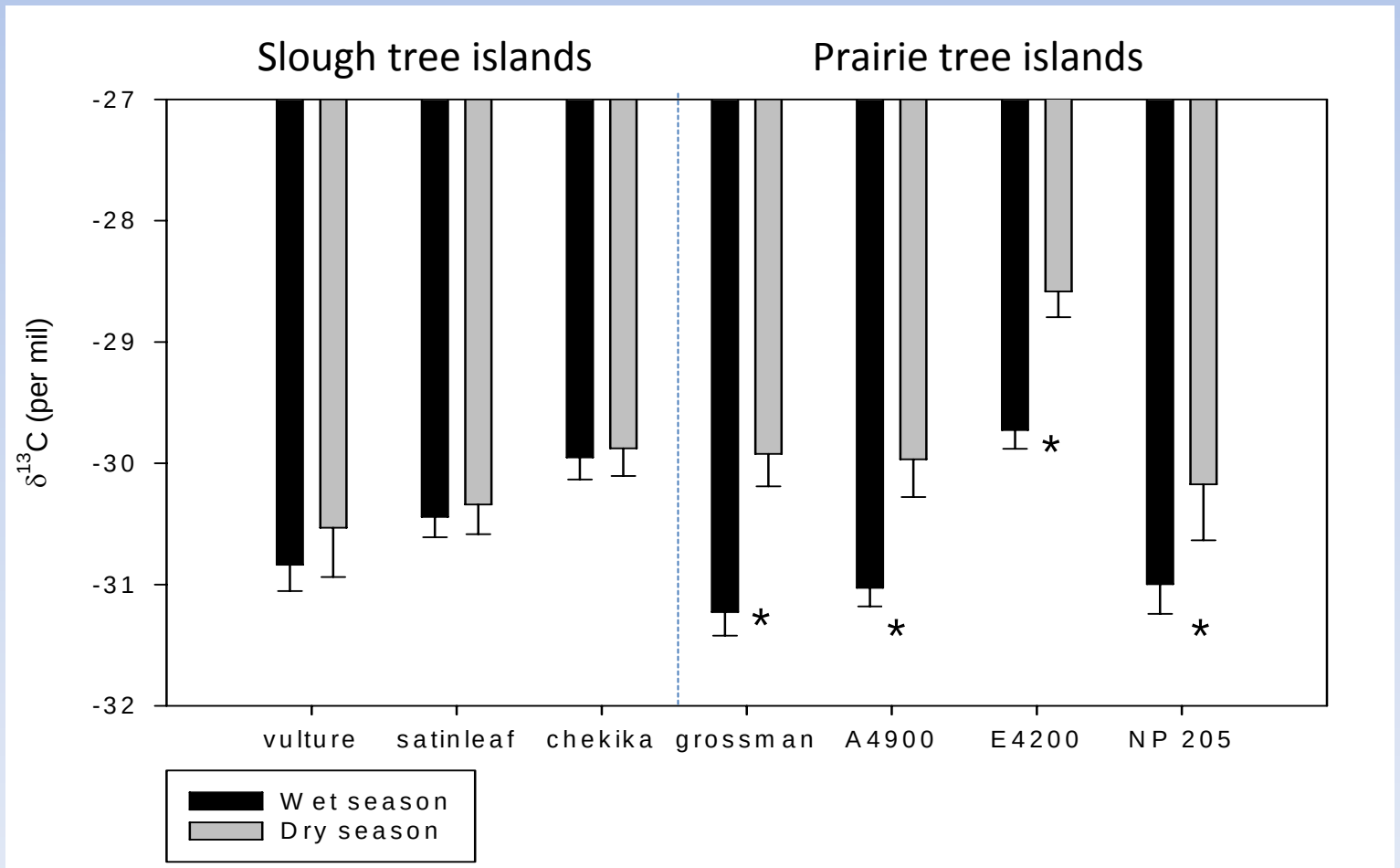
Two things we test

- Prairie tree islands transpire less than slough tree islands
  - Carbon isotope ratio as a proxy for water deficits
  - Satellite image remote sensing
  - Sap flux probes for direct measurement of plant water uptake
- Prairie tree islands accumulate less phosphorus than slough tree islands
  - Soil nutrient concentration
  - Nitrogen stable isotope ratio as a proxy for P availability
  - Leaf tissue nutrient concentration

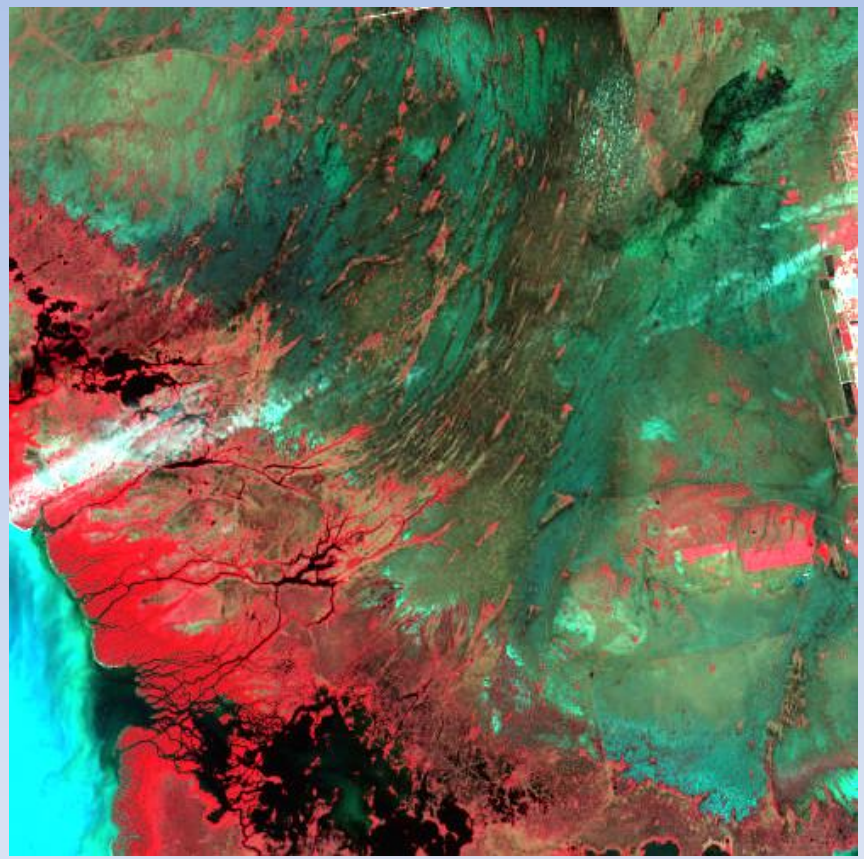
Water use tests

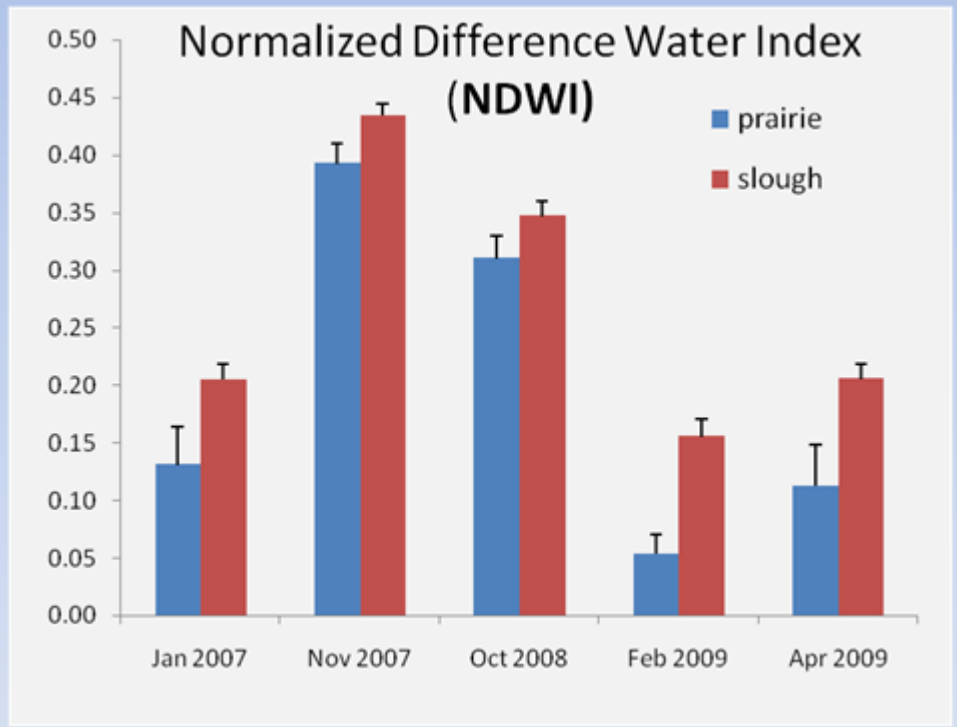
Carbon isotope ratio as a proxy for water deficits

Shift in Carbon isotope ratio from wet season to dry season means dry season water deficits in plants.



Satellite remote sensing

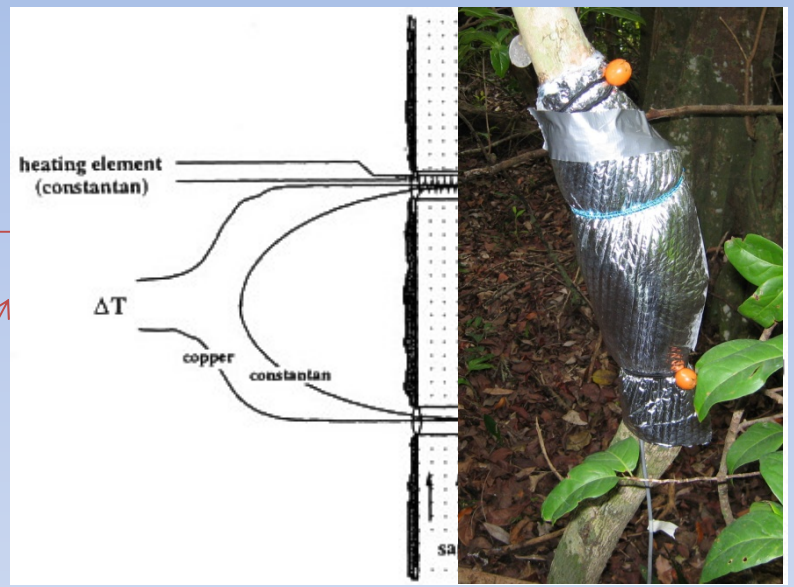




High NDWI means plenty of water in plant canopy.

Water uptake measured by sap flux probes

Data Logger

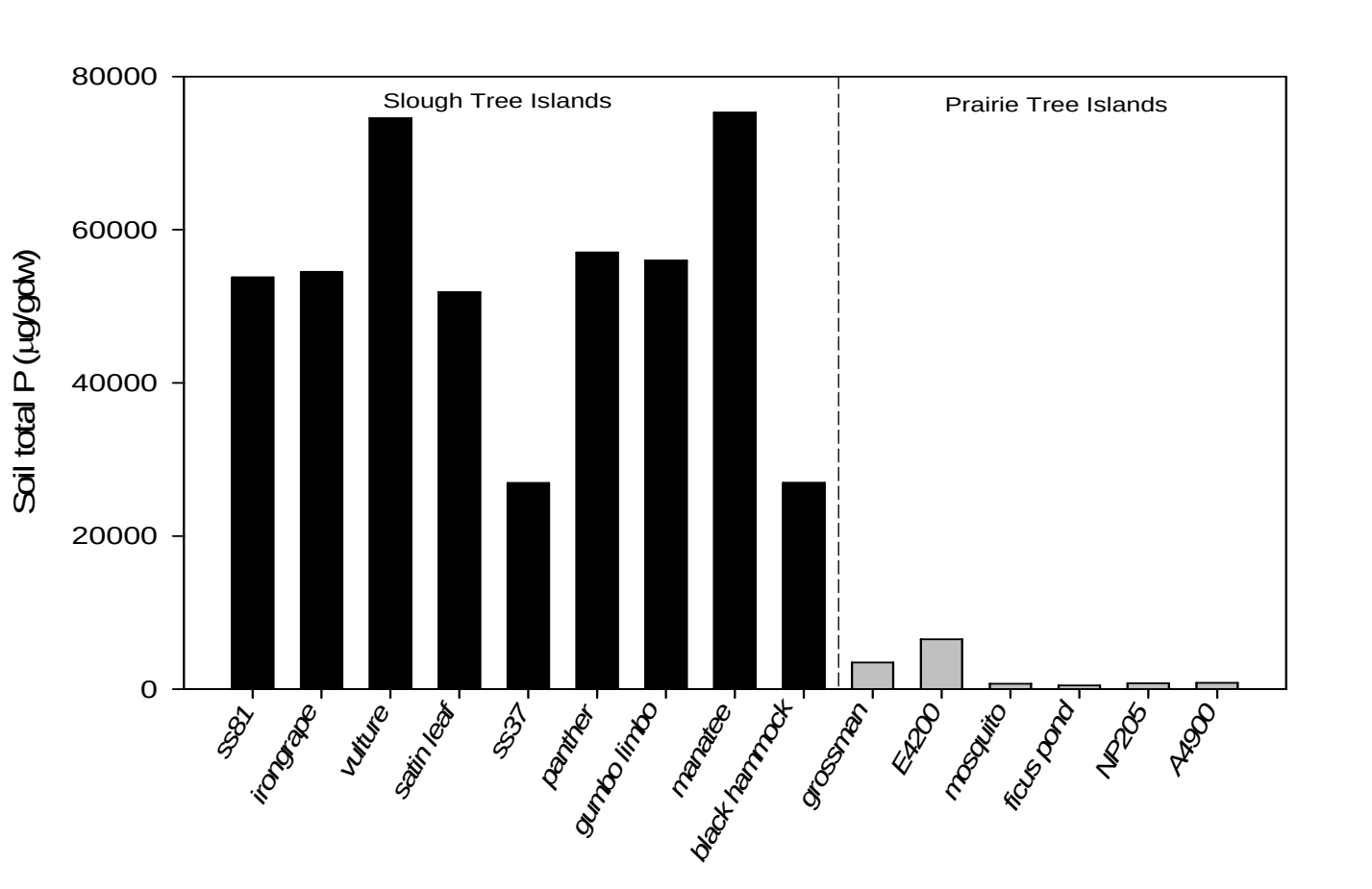


Rechargeable Battery

Solar Panel

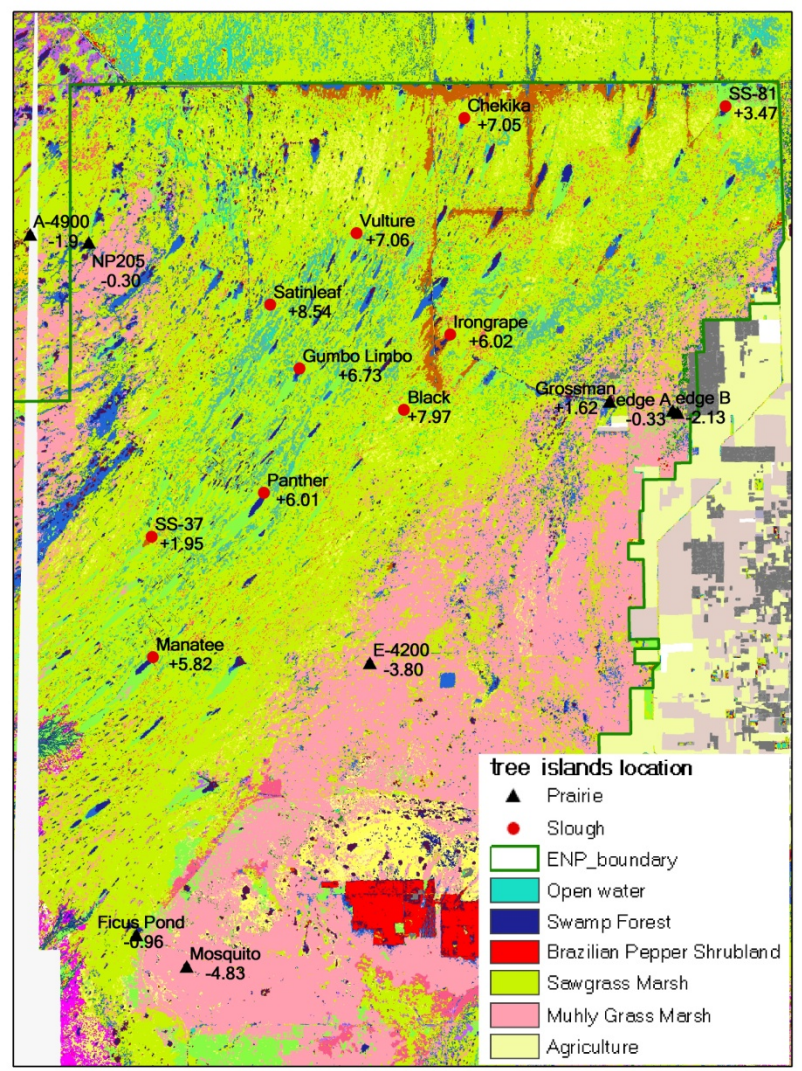
Nutrient accumulation tests

Soil total P concentration



Slough tree islands have much higher soil total P concentration than prairie tree islands.

Foliar N isotope ratio as a proxy for P availability

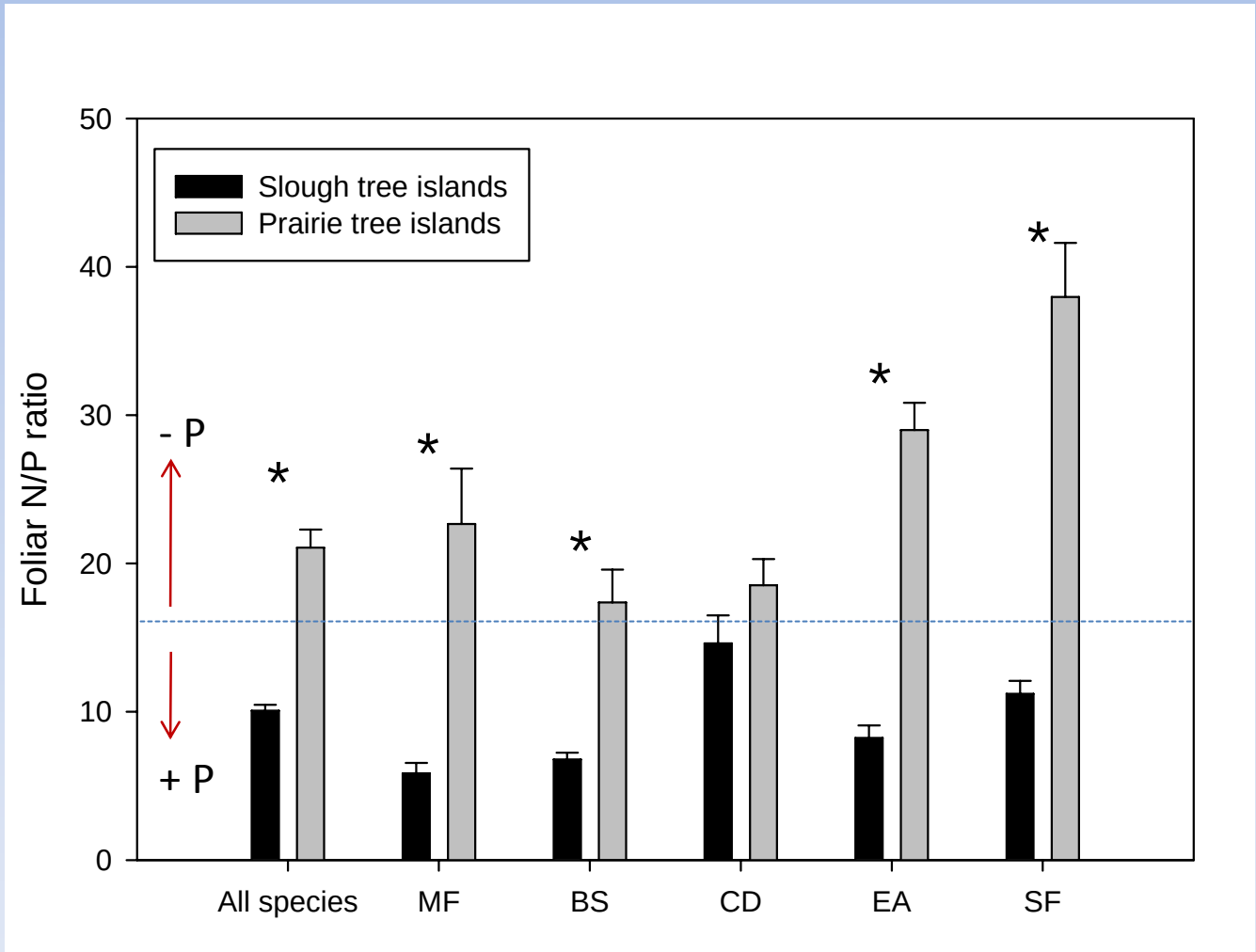


High foliar N isotope ratio means high P availability

Distinct foliar N isotope ratio:
Slough islands +6.06±1.89
Prairie islands -1.58±1.53

Slough tree island plants have more P available than prairie tree island plants.

Nutrient concentration in the leaf tissue



Application and significance of the study

- Links hydroperiod to tree island water use and nutrient accumulation status – important for tree island conservation and restoration
- Introduces useful tools for both observational study and long term monitoring
  - Stable isotope proxy
  - Satellite remote sensing
  - Sap flux system

Acknowledgements

Everglades Foundation
South Florida Water Management District
Everglades National Park