Ecosystem Services & Educational Opportunities Provided by an Aridland Urban Treatment Wetland in Phoenix AZ

part of the
Central Arizona-Phoenix Long-Term Ecological Research Program (CAP LTER)

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The Wetland Ecosystem Ecology Lab (WEEL) @ ASU

We seek to understand wetland ecosystem dynamics and services, particularly in human-dominated systems such as cities

WEEL

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Urban Wetlands

Urban wetlands occur in many types & sizes:

- Constructed for stormwater or groundwater management;
- Associated with urban [built] water features;
- Associated with urban streams and rivers;
- Sometimes natural, but more often designed, constructed, restored, or rehabilitated.

Urban wetlands perform numerous ecosystem services (some by design, some serendipitous):

- Flood control and stormwater management;
- Groundwater recharge;
- Surface water filtration;
- Wildlife and bird habitat;
- Biodiversity;
- Recreational, cultural, aesthetic, and spiritual values;

The Tres Rios Constructed Wetland - City of Phoenix

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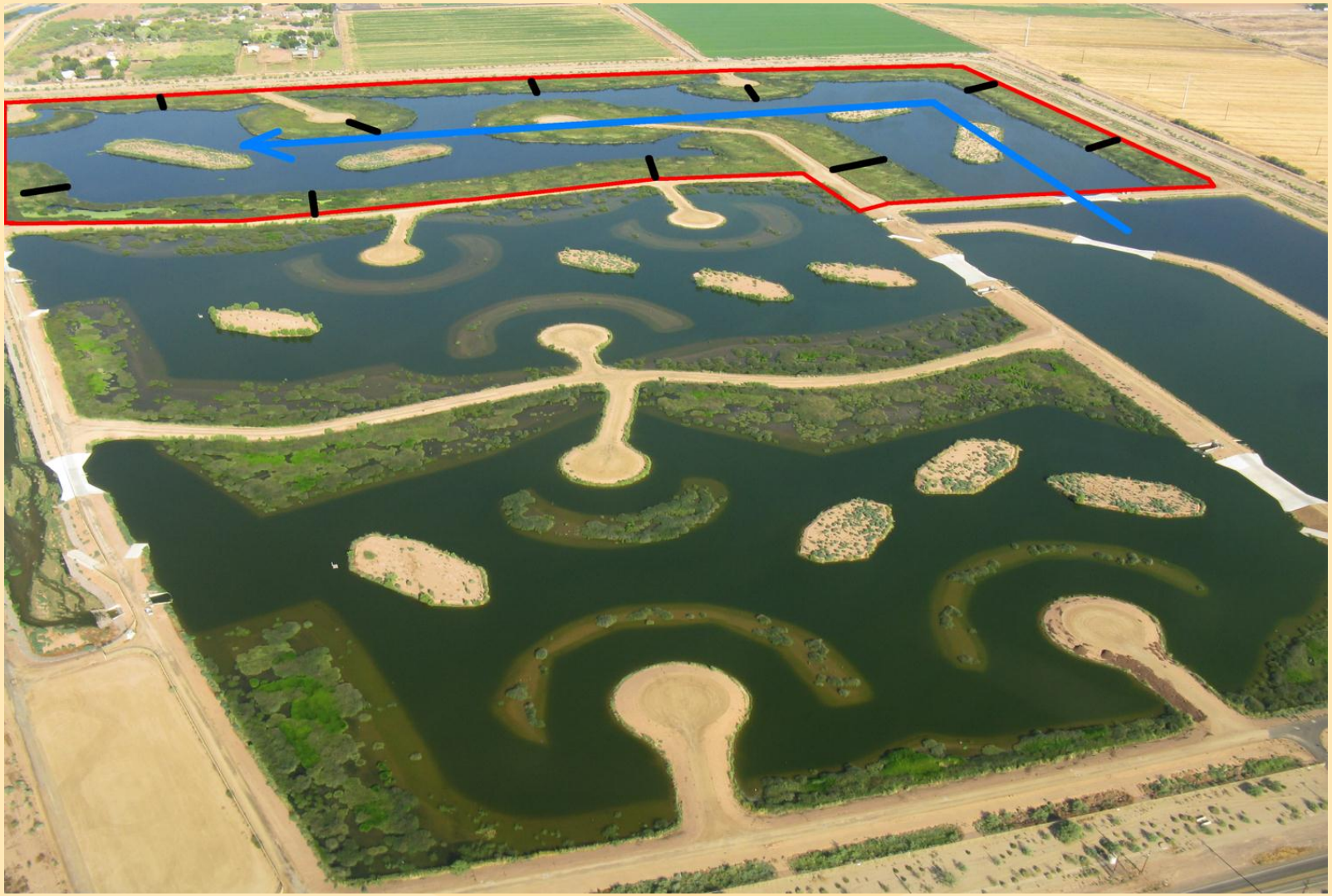
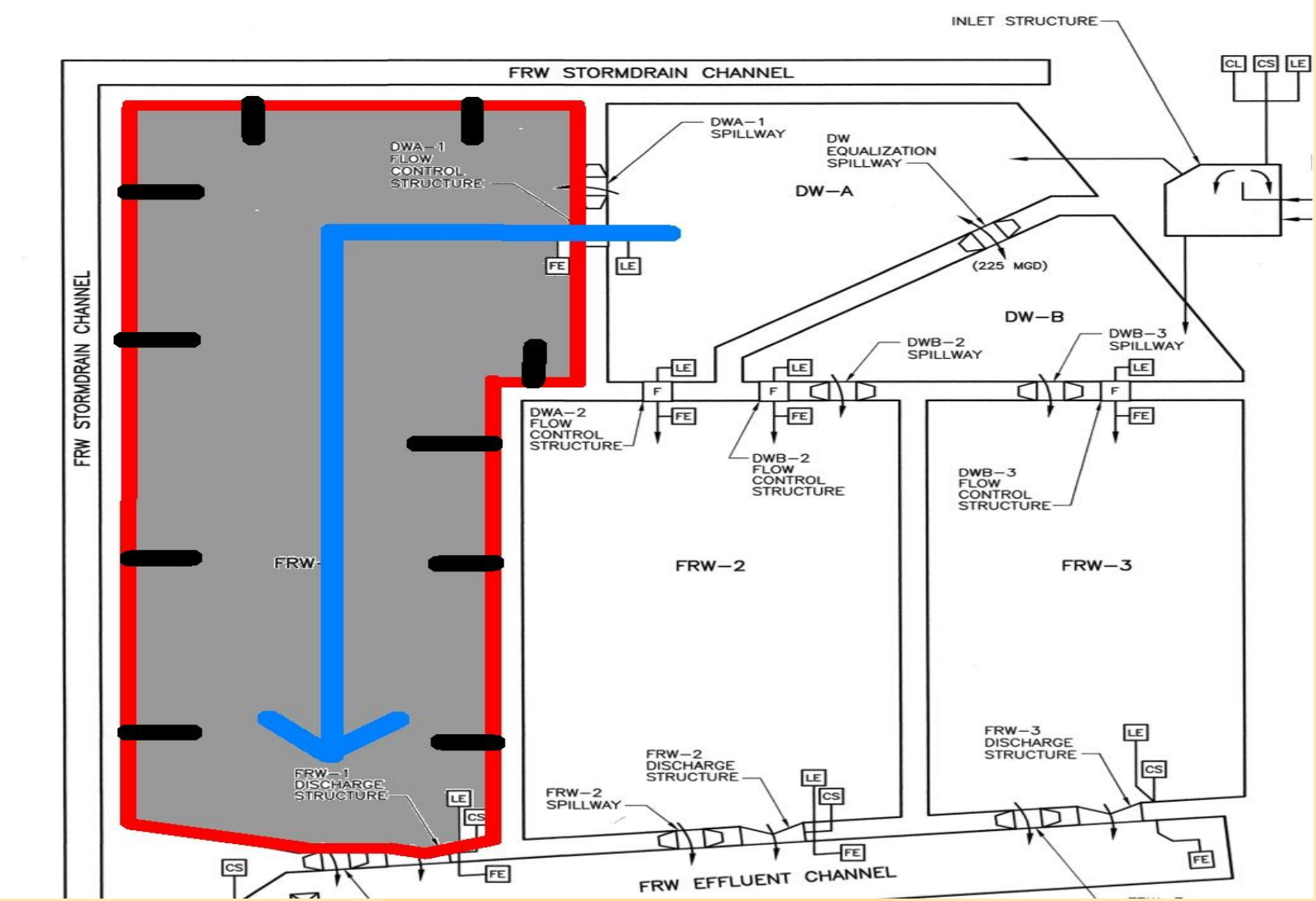


Experimental Design: 10 marsh transects located along the inflow-outflow gradient



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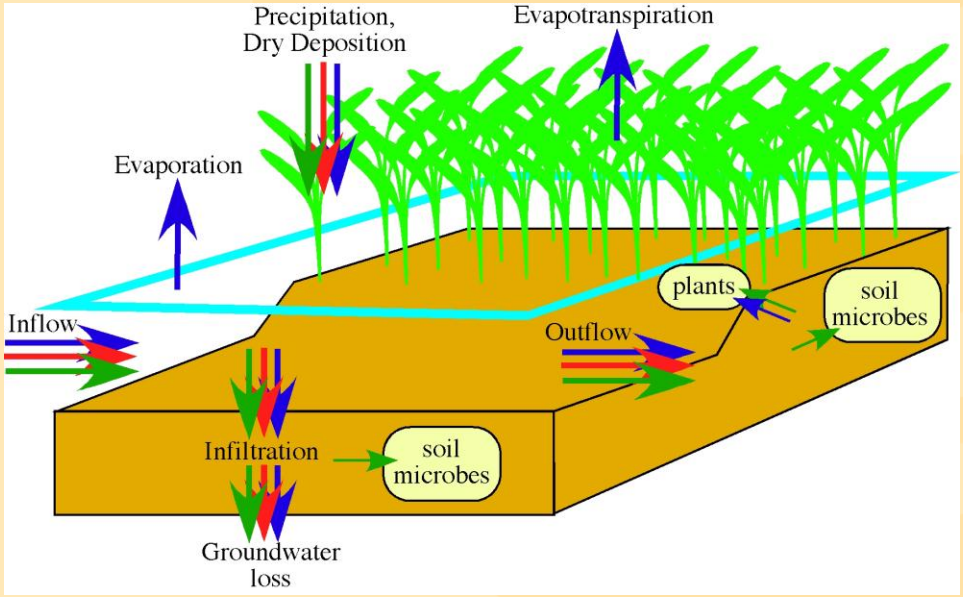
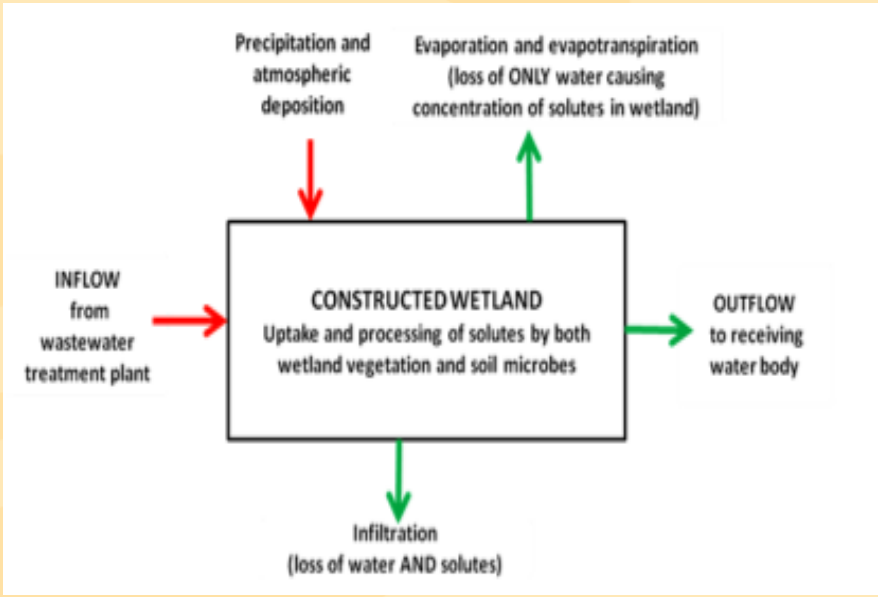
The Challenge: Evapotranspiration and evapoconcentration of solutes vs. ecosystem uptake and processing
or
“ecology vs. hydrology”





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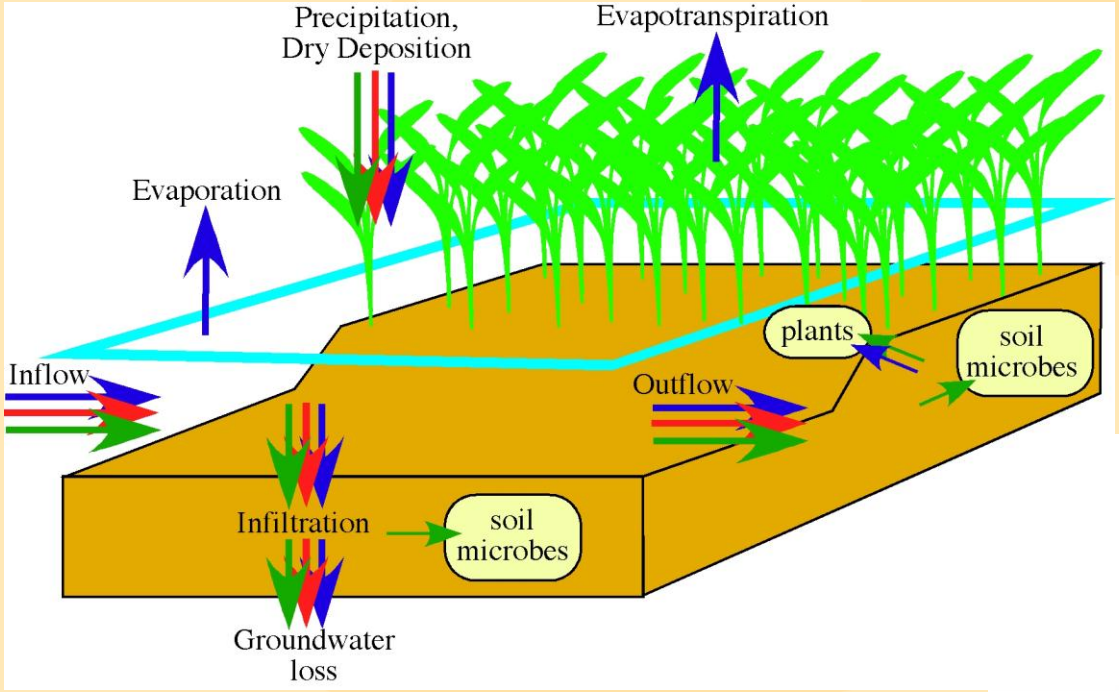
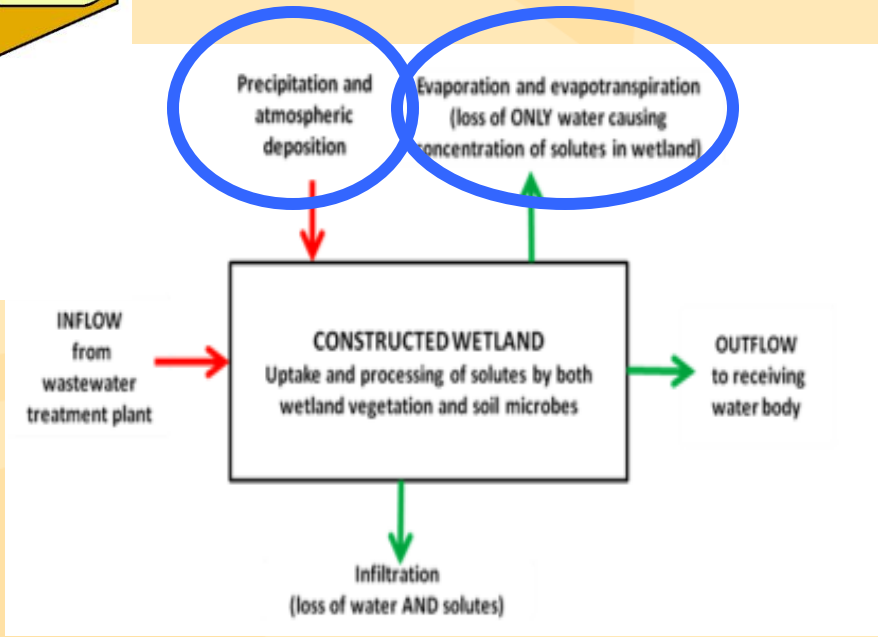
Simplified: It is all about the whole-system water budget, particularly during the hot summer months





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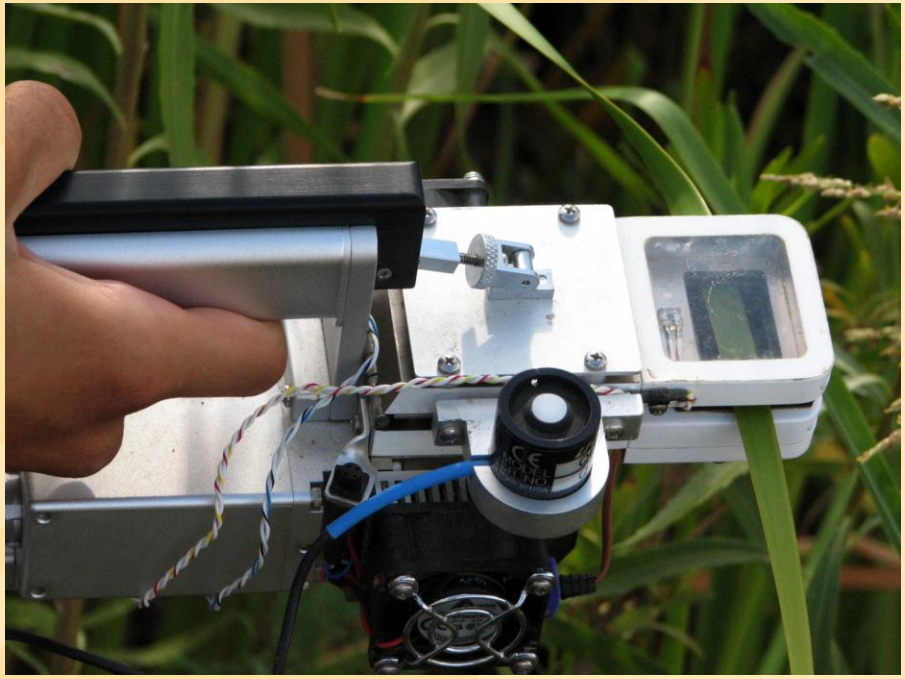
Methods

1. Plant biomass estimates
2. Plant transpiration (ET) and evaporation rates
3. Time-series meteorological data
4. Whole-system model to estimate daily water loss
5. Nutrient budgets for water, plants, and soils



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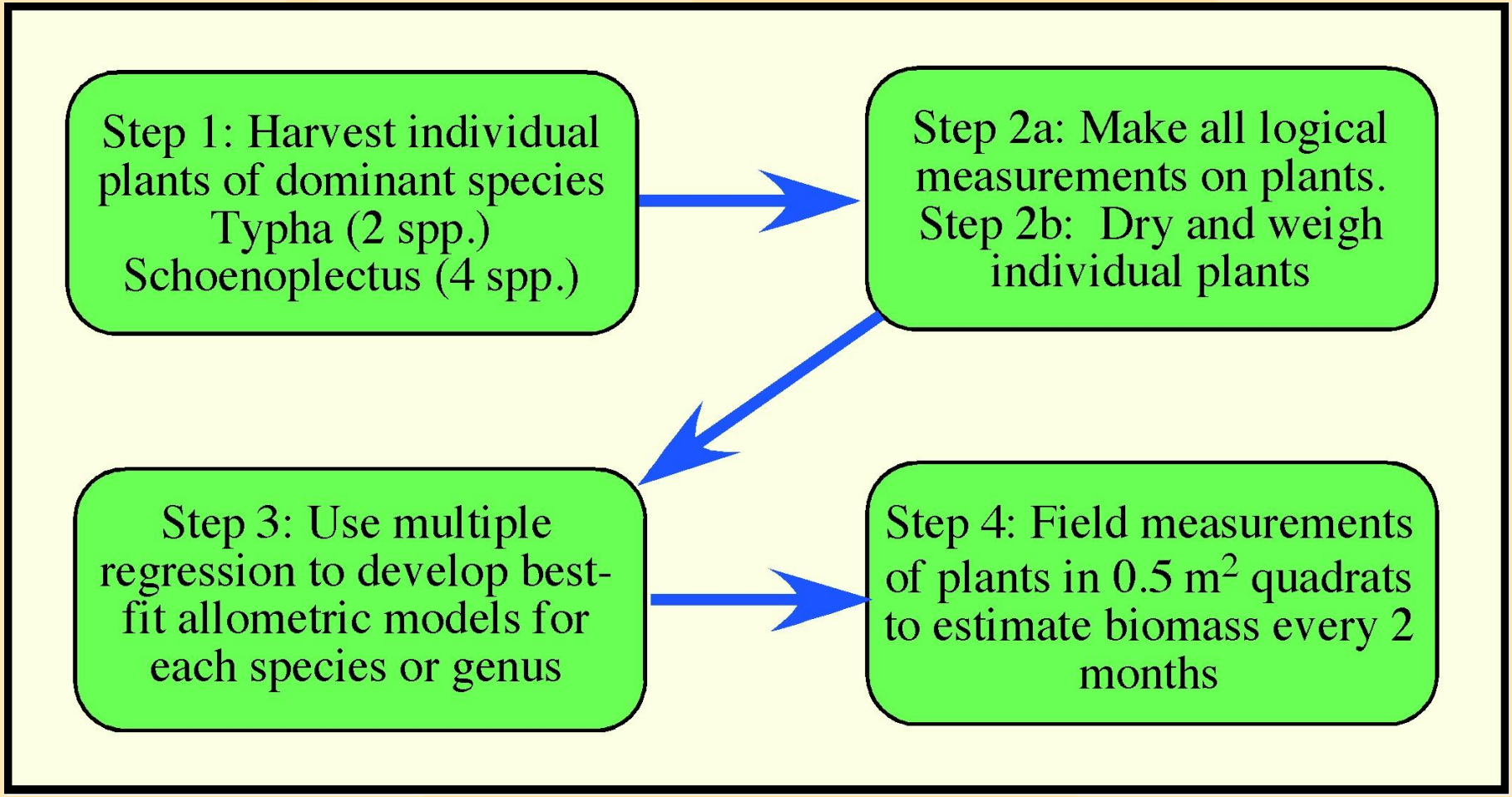
Methods

1. Plant biomass estimates: non-destructive allometric models and measurements



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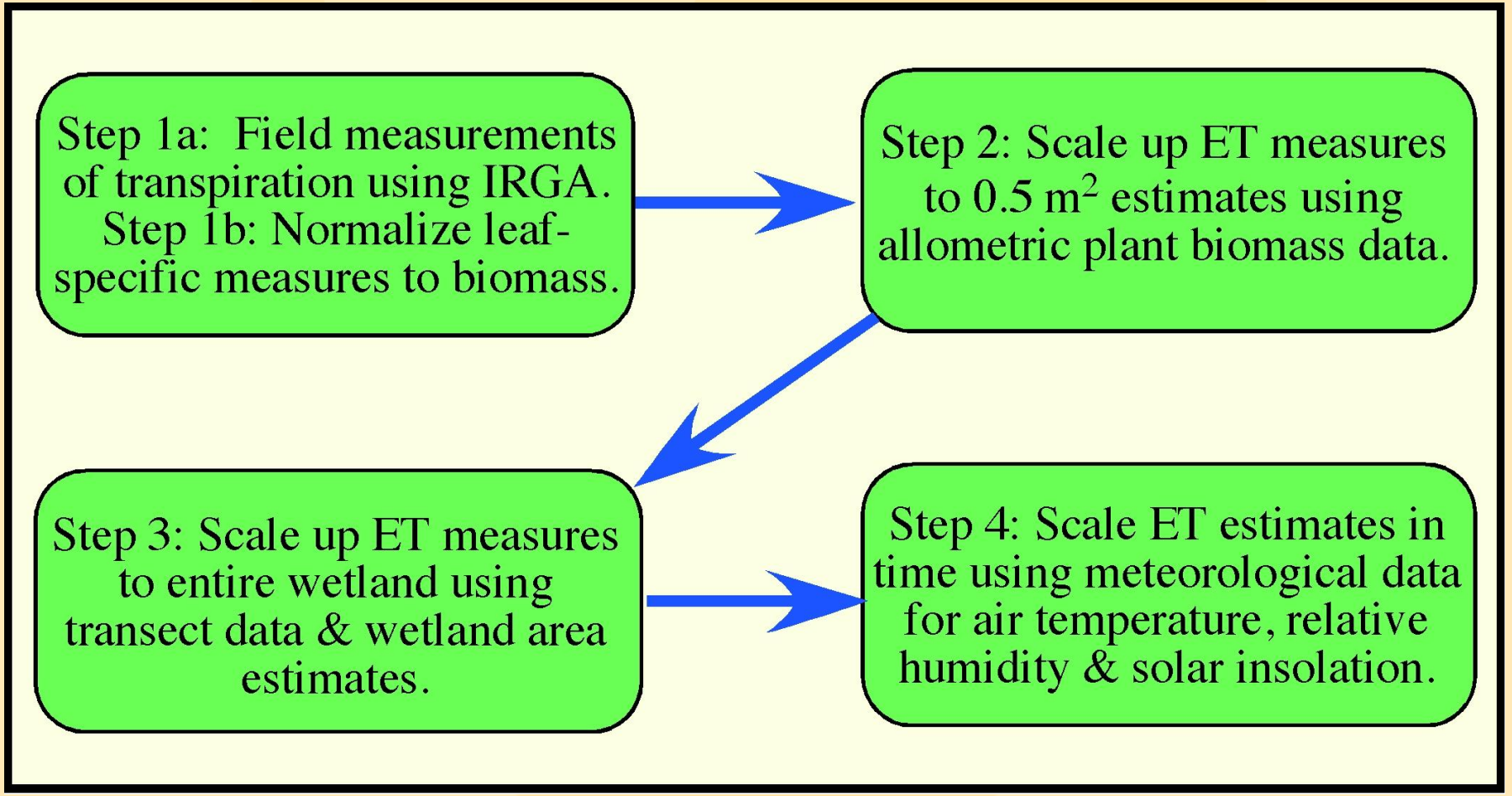

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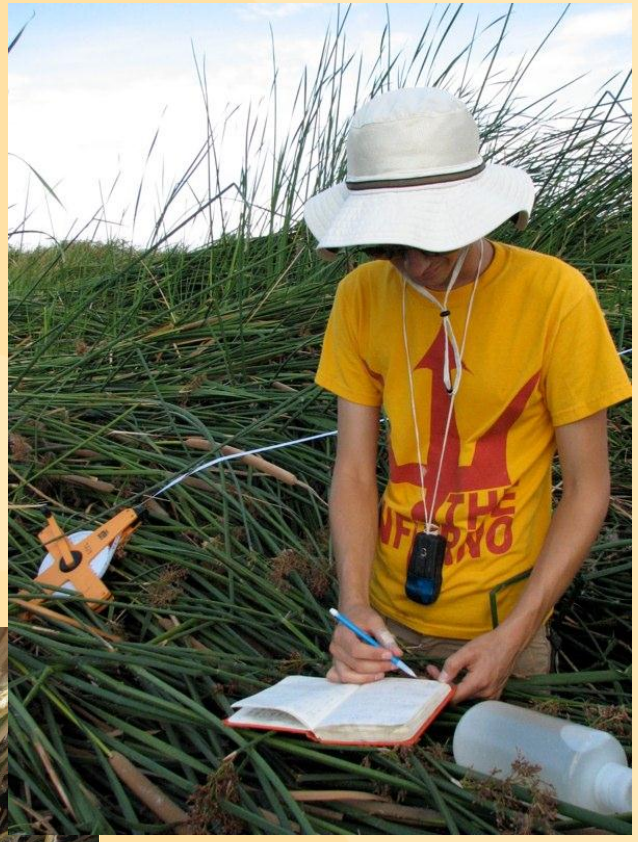

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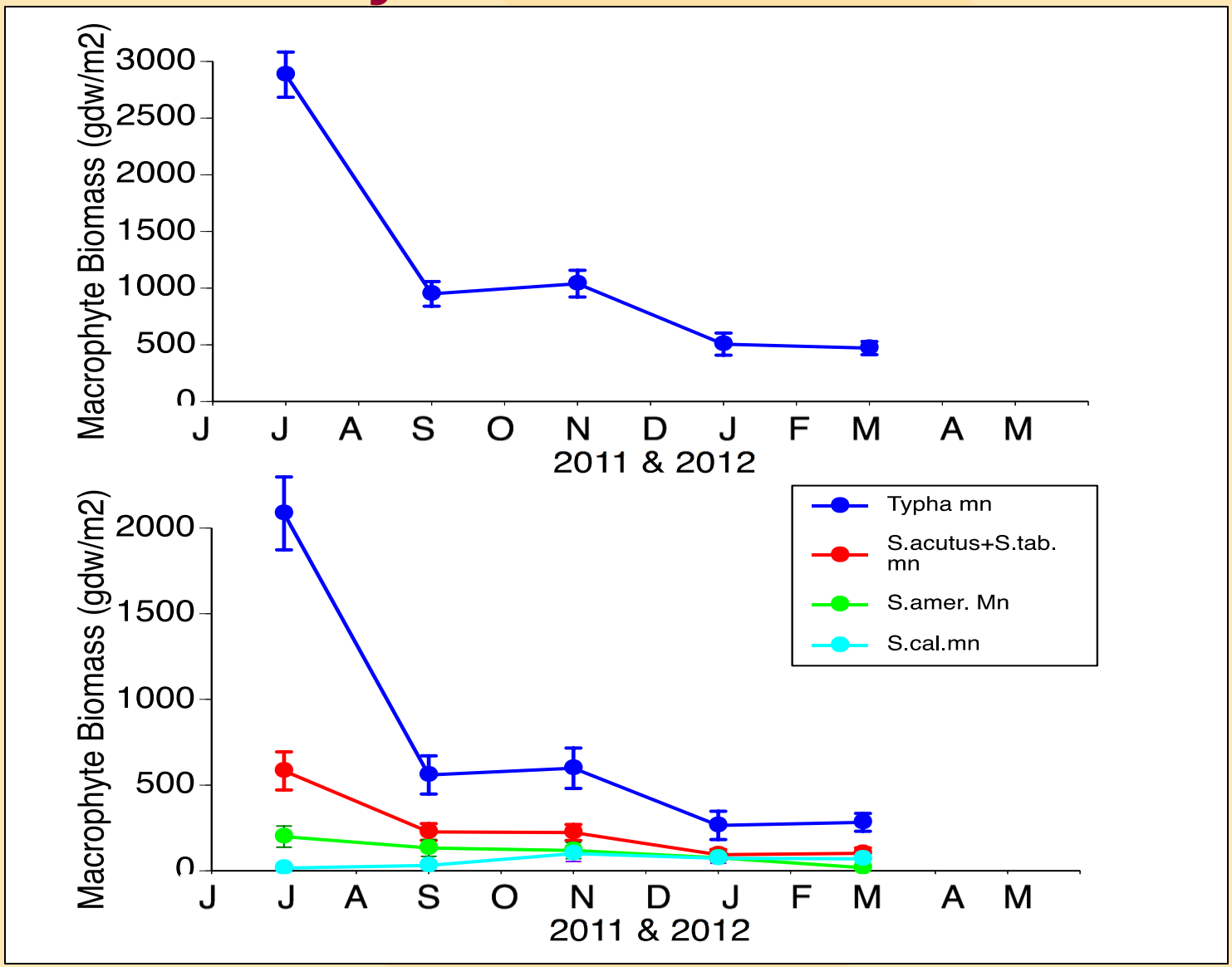
Preliminary Results: Plant biomass



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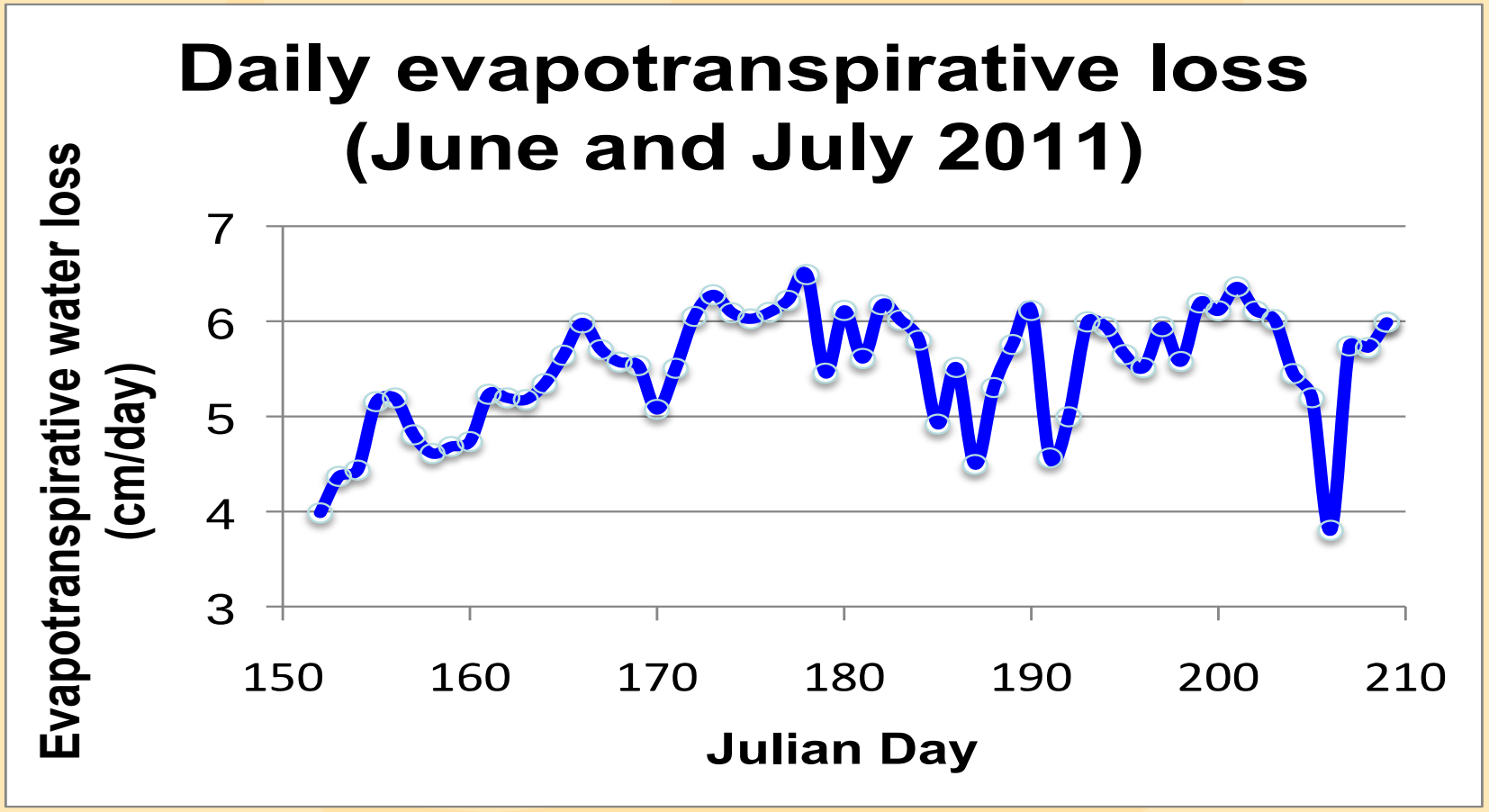
Preliminary Results: Plant transpiration

(Full annual water budget will be constructed this summer)



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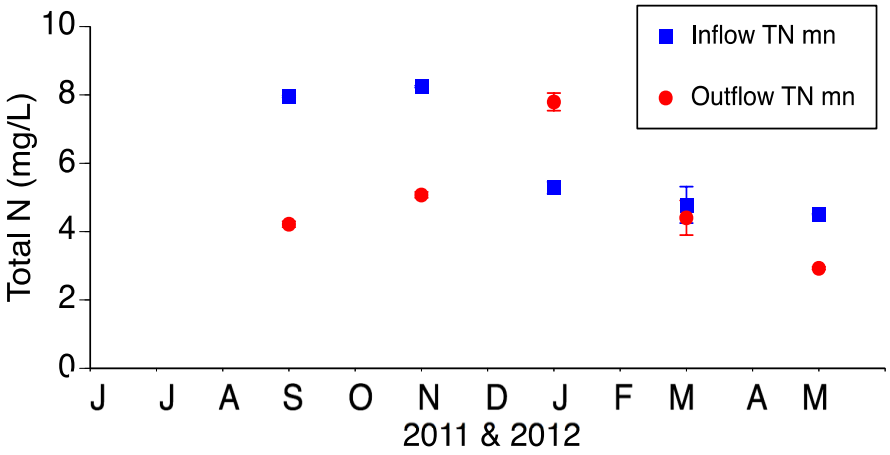
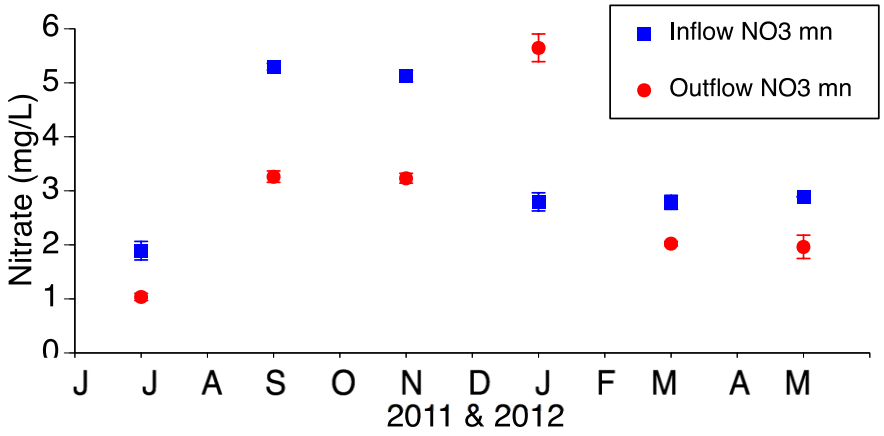
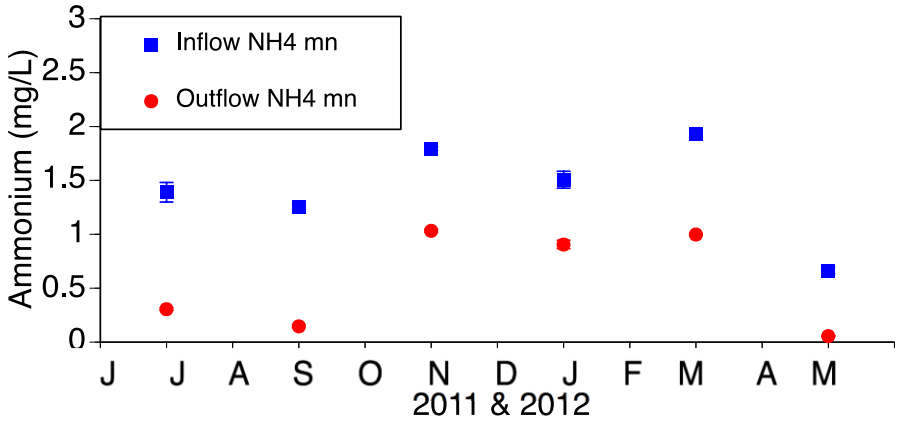
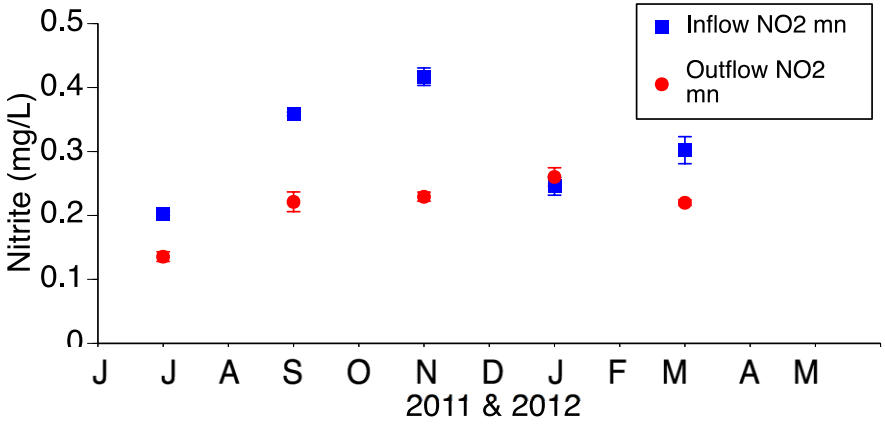
Preliminary Results: Whole cell nutrients - Nitrogen









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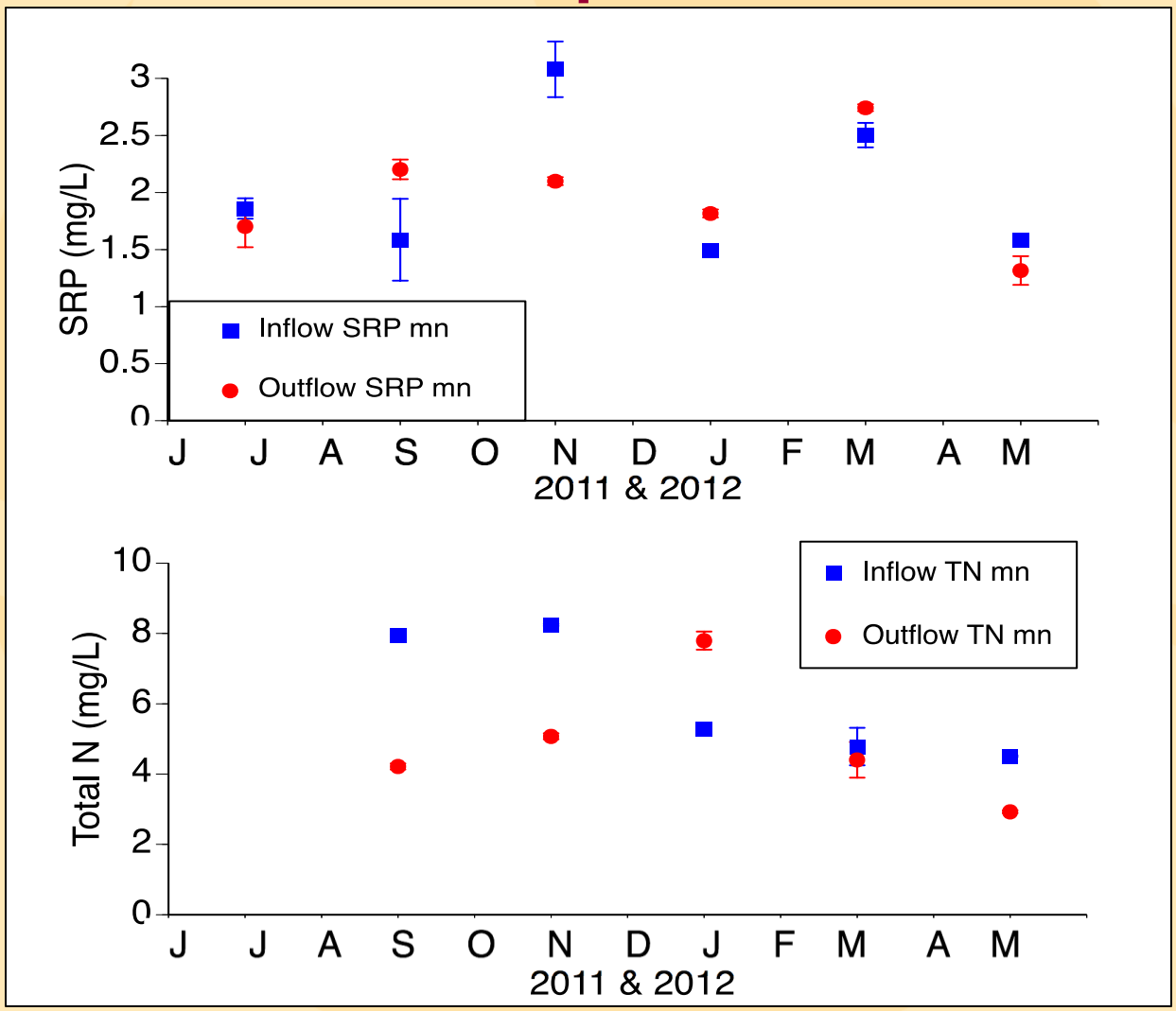
Preliminary Results: Whole cell nutrients - Phosphorus



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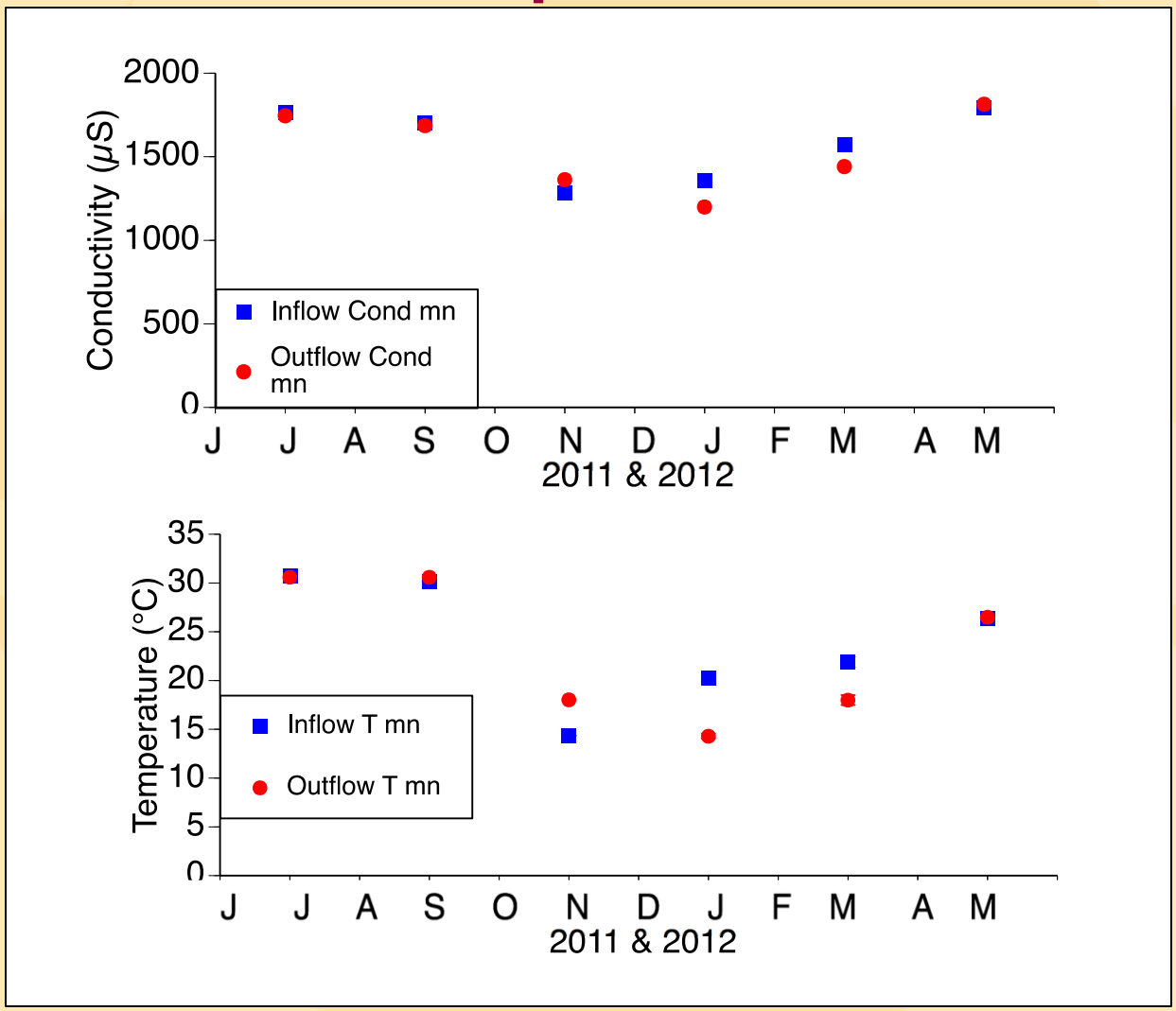
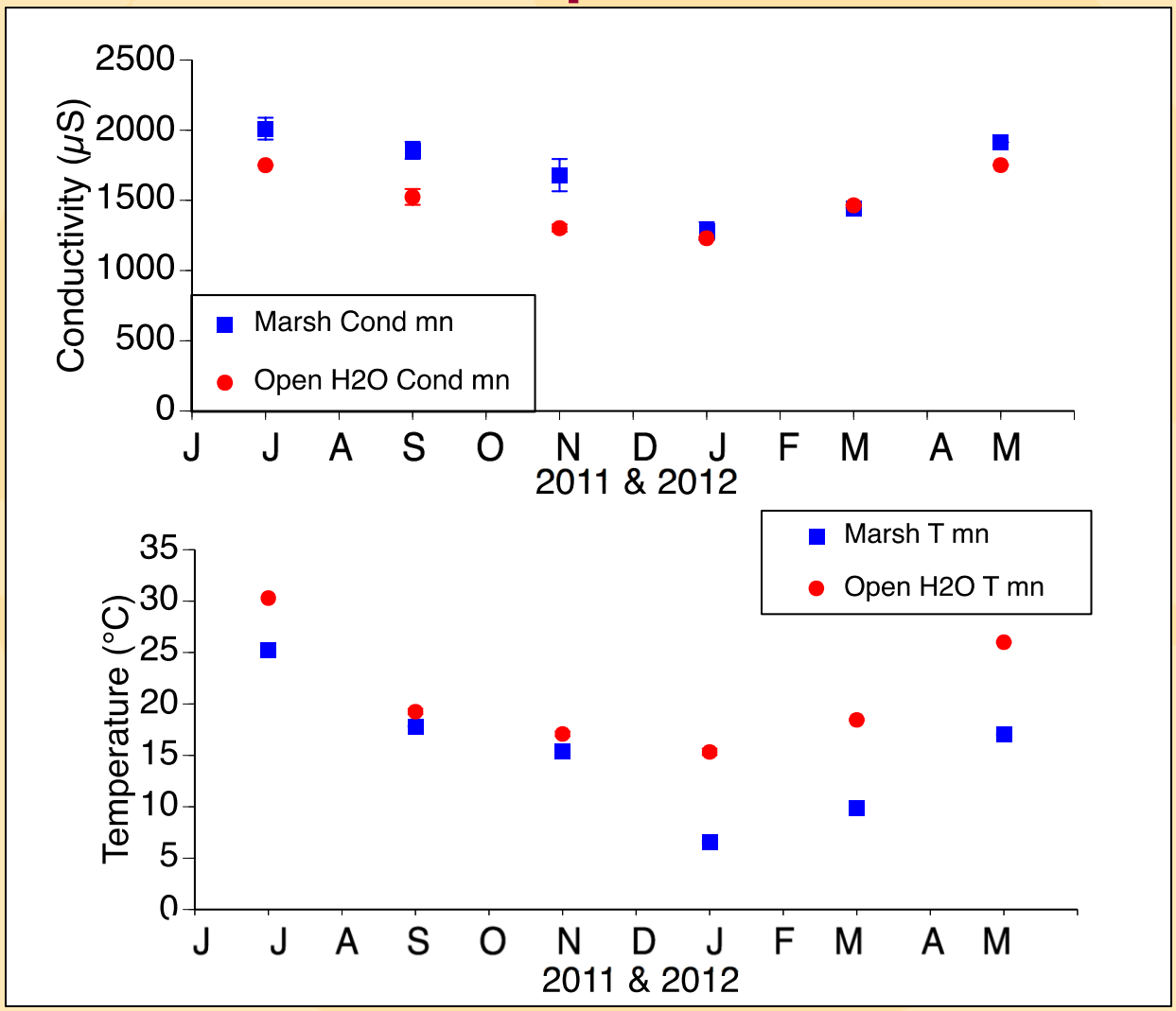
Preliminary Results: Whole cell conductivity & temperature



Preliminary Results: Marsh Transects - conductivity & temperature



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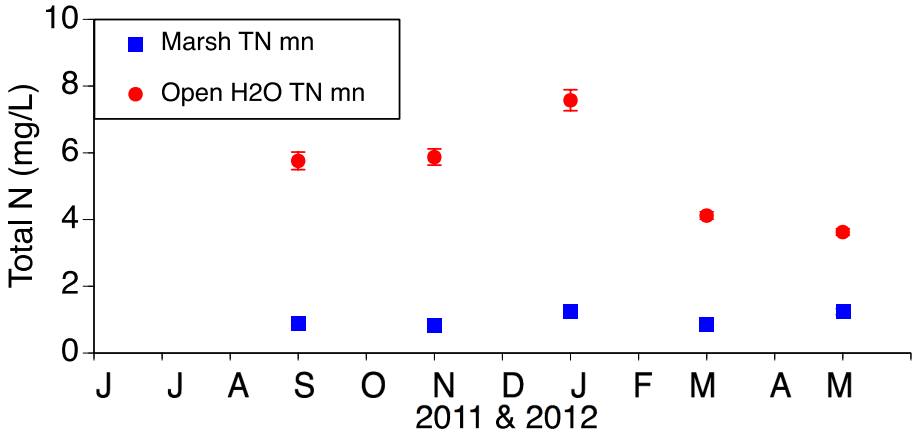
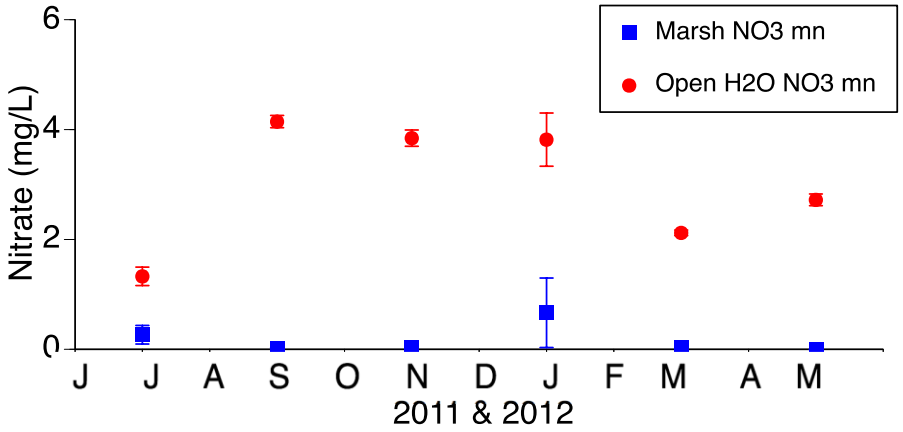
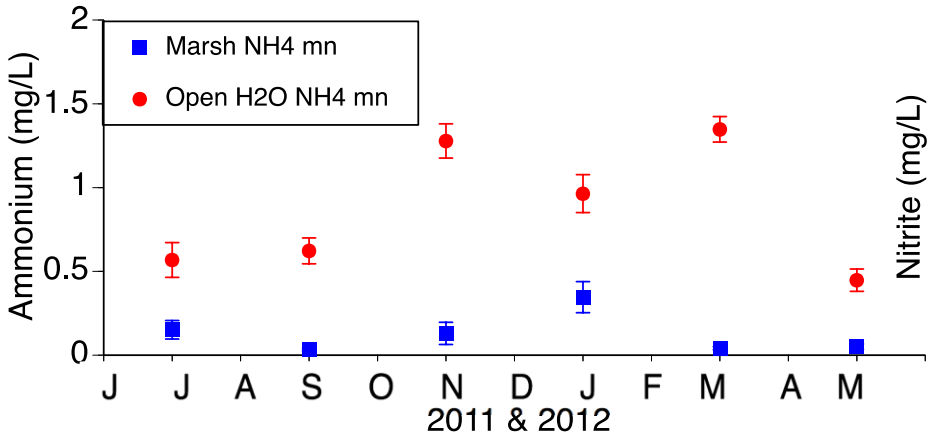
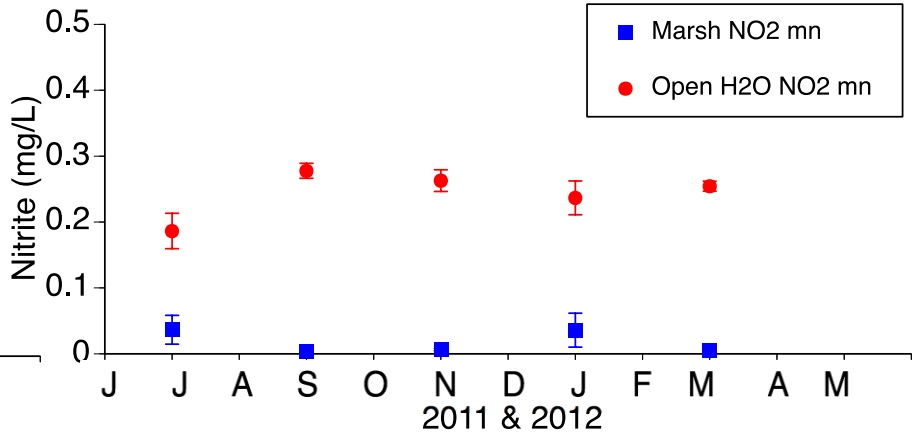
Preliminary Results: Marsh Transects - Nitrogen

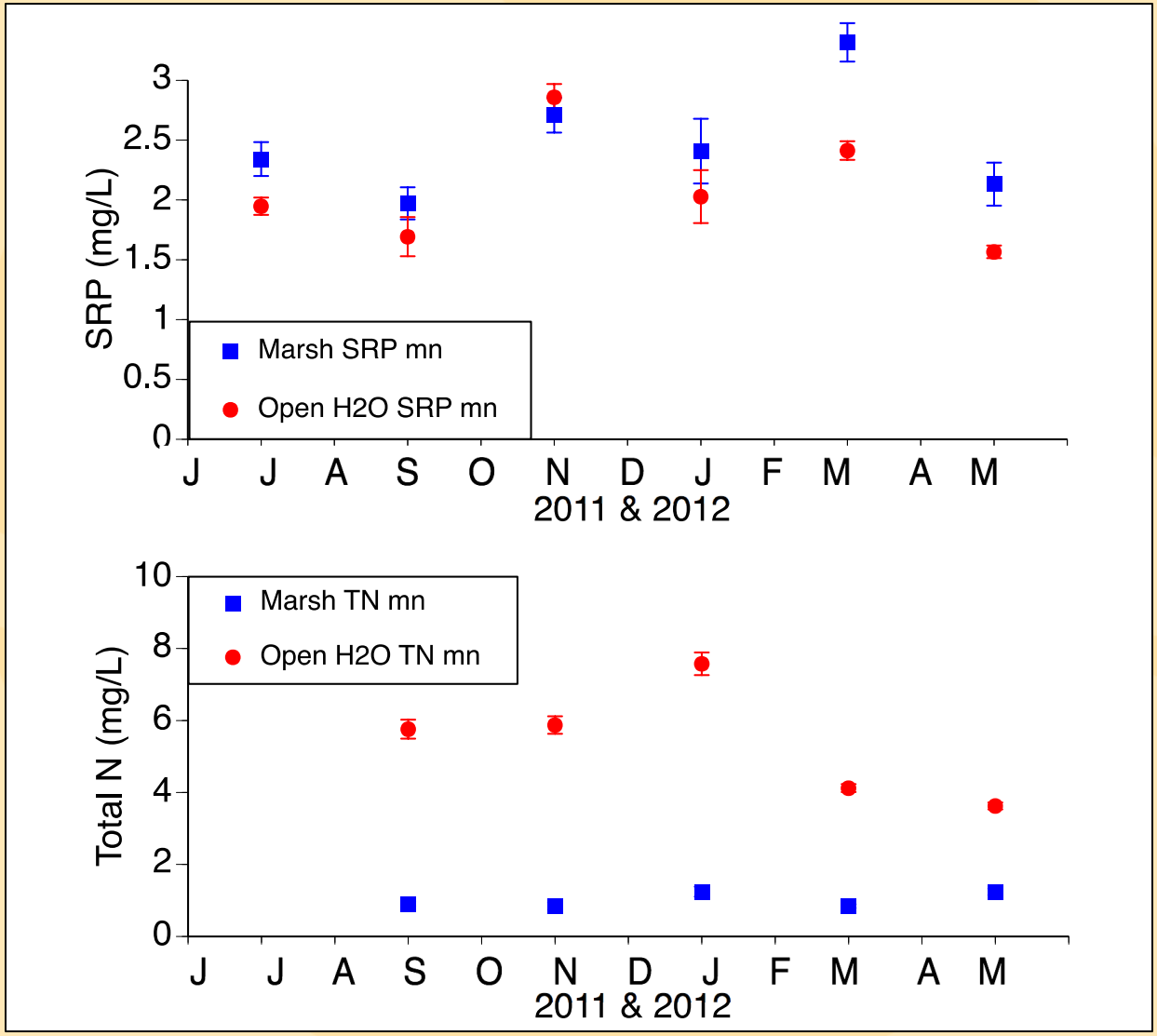








Preliminary Results: Marsh Transects - Phosphorus



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Preliminary thoughts

In-progress conclusions:

- Marsh transpiration is concentrating solutes, particularly during hot months (May – September)
- Regardless, the entire cell/system is a sink for nitrogen and…
- the vegetated marsh is a major sink for nitrogen
- The marsh and entire system are sometimes a source of inorganic phosphorus

Questions and head-scratchers:

- How can the marsh and the entire system be a sink for N and a source of P?
- What processes are responsible for the N uptake? Is N being transformed or merely sequestered?
- How much of the cell's water comes in contact with marsh vegetation? What is the advection rate into the marsh and is it driven by plant transpirative water losses?
- How can we help the City of Phoenix to manage this system to optimize the ecosystem services it provides (both designed and serendipitous)?

Urban wetlands are excellent field laboratories for educational research experiences