Soil nutrient and organic matter patterns in an aridland constructed treatment wetland

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Introduction:

- Constructed treatment wetlands (CTWs) are increasingly used to remove nutrients found in treated municipal wastewater.
- Aridland CTWs have been found to perform differently in plant nutrient uptake and hydrology than their mesic counterparts (Sanchez et al. 2016; Weller et al. 2016).
- How aridland CTW soils contribute to system performance and biogeochemical processing is relatively unknown.

Goals:

- Characterize aridland CTW soil biogeochemistry.
- Investigate whether soil biogeochemistry varies along depth, whole system and within marsh gradients.
- Continue to study arid land CTW soils over time to understand long-term patterns and variability.

Experimental design and methods:

- Soil cores were collected annually from 2011-2016 in November at both shore and water edge of identified transects (Figure 1).
- Soil cores were sectioned at 0-2cm, 2-5cm, and 5+cm.

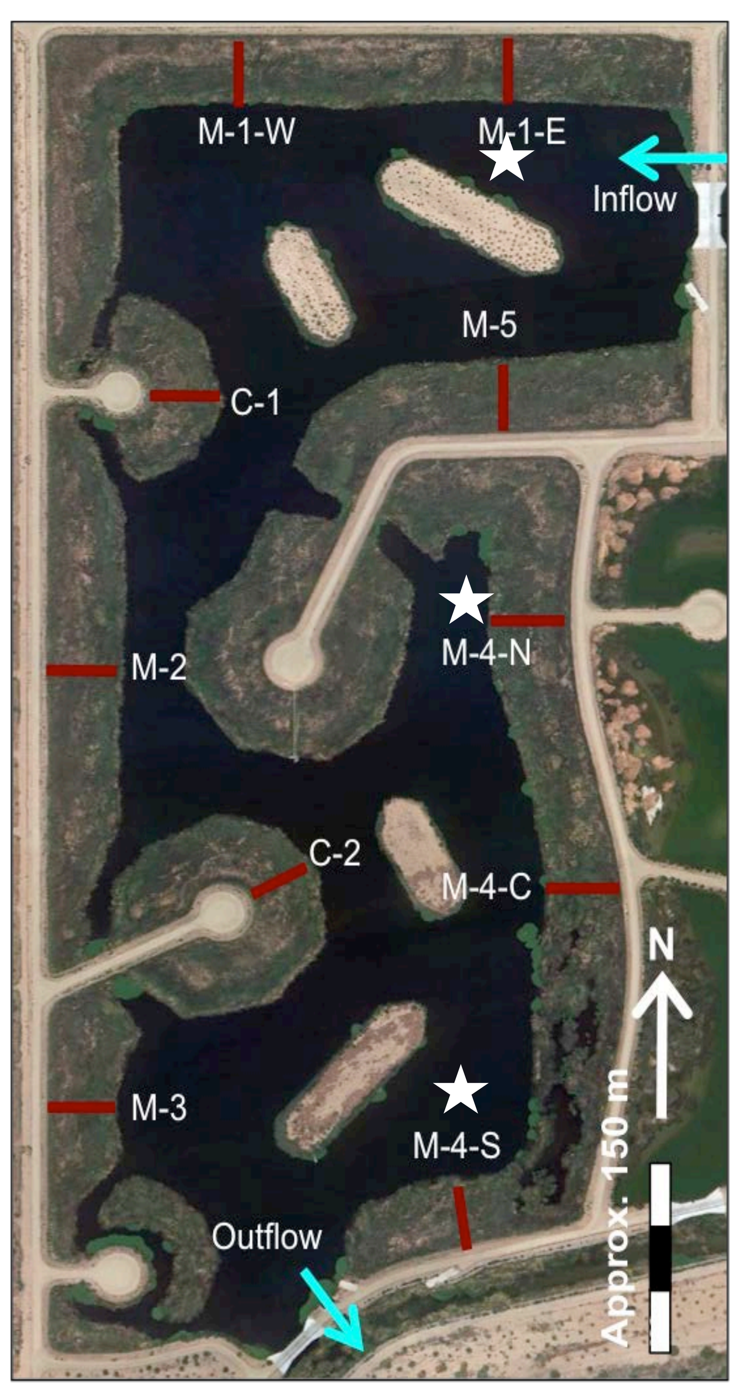

Figure 1. Constructed wetland study cell with approximate locations of 3 annually sampled transects (denoted by white stars; see also Figure 3).

- Core sections were dried and weighed to determine bulk density.
- Subsamples were then ashed and weighed to determine organic matter content.
- Additional subsamples were ball milled and analyzed for carbon and nitrogen.
- Carbon and nitrogen were analyzed using a Perkin Elmer Series II CHNS/O.

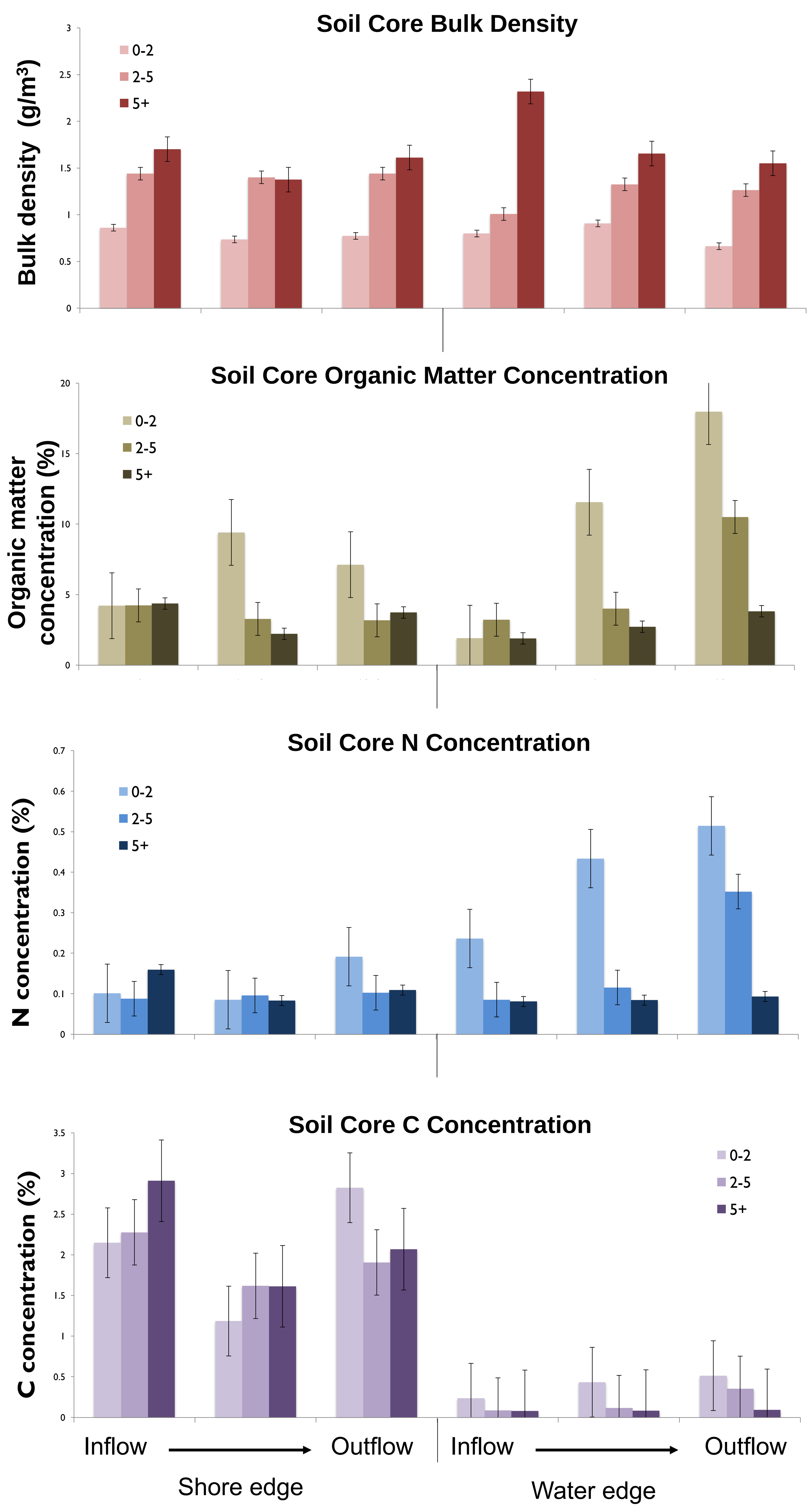

Figure 2. Measurements of various soil characteristics along three major gradients. These include a depth gradient along the length of soil cores, a gradient along marsh transects (water edge to shore edge), and a gradient along whole-system water flow (whole-system inflow to outflow). Note: legend represents depths of core sections in cm.

Results:

- Data presented here represents samples from 2011, 2013 and 2014 (Figure 2); statistics will be run when the data are complete.
- Soil core bulk density appears to increase with depth, and follows this pattern throughout the whole system.
- Across the whole system organic matter and nitrogen concentrations appear to be greater at water edge of transects.
  - Organic matter and nitrogen also appear to increase from inflow to outflow along sampled water edge transects.
- Carbon concentration appears to be higher at shore edge of transects.

Figure 3. A typical shore edge of one of the marsh transects where soil cores were harvested.

Discussion:

- Organic matter concentration decreases with depth. As inorganic matter is more dense than organic matter, this potentially explains increases in bulk density as depth increases.
- We have previously documented high evaporation and transpiration rates in the Tres Rios vegetated marsh, as well as potential evaporative concentration of ions and various inorganic minerals (Sanchez et al. 2016).
  - Higher rates of carbon at shore edge of marsh transects may be a result of evapoconcentration and deposition of inorganic carbon in these soils.
- Water nutrient availability, namely nitrogen, is closely tied to potential decomposition rates. Soil organic matter and nitrogen concentrations at water edge of transects increase with distance from whole-system inflow, potentially signaling higher decomposition near the nutrient source (the inflow).

Conclusion and future directions:

- We plan to analyze remaining samples to further validate spatial and temporal trends and conclusions.
- We will continue annual sampling of Tres Rios soils as part of CAP's long-term ecological monitoring effort.

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