Nutrient limitation in restored and natural reference wetlands of the Florida Everglades

Xiaolin Liao, Benjamin A. Hogue, Cassandra A. Medvedeff, Kanika S. Inglett, and Patrick W. Inglett
Soil and Water Science Department, University of Florida, Gainesville, Florida, USA.

Abstract:
Limitation of nitrogen (N) versus phosphorus (P) is a critical consideration in ecosystem restoration, especially for calcareous wetlands like those of the Florida Everglades. In this study, we measured soil biogeochemical properties (i.e., nutrient concentrations and ratios, enzyme activities) and periphyton N_2 fixation rates in wetland soils from a 6-year-old restored, 10-year-old-restored, and a native reference wetland in the wet (October, 2009) and dry season (February, 2010) in the Florida Everglades. Soil biogeochemical parameters (TP, TN:TP, organic matter) were highly correlated with measured enzyme activities (phosphatase, N-acetyl glucosaminidase -NAG and Leucine-aminopeptidase-LAP, and nitrogenase). A higher molar ratio of soil TN:TP was observed in reference site (109±4) relative to the 6 (26±1) and 10 year old (14±5) restored sites, indicating P limitation in the reference site. Significantly higher phosphatase activities was observed in reference relative to restored soils in the wet and dry seasons($P<0.05$), suggesting that microbes were limited in inorganic P. Enzymes involved in N cycling were 2 to 3 times higher in the 6 year old restored site relative to reference site, suggesting that N limitation declines with the age of soils. In addition, the areal N_2 fixation of periphyton, was significantly lower in the reference (0.07g N m^{-2} y^{-1}) relative to the two restored wetland sites (in the range from 0.1 to 0.3 g N m^{-2} y^{-1}) ($p<0.001$), which further supported this result. The findings of this study have important management implications for the restoration of this and similar ecosystems.

Keywords: nitrogen limitation, phosphorus limitation, wetland restoration, nitrogen fixation, enzymes