Effects of hydrology on carbon cycling in a restored subtropical wetland

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Restoration of wetlands is globally important to reestablish functions such as carbon (C) sequestration. Despite this, however, little is known about the biogeochemical regulation of C loss and storage during the restoration process. In this study, we compared microbial biomass, enzyme activity (ß-glucosidase), and gaseous C loss (CH_4 and CO_2 potentials) during two contrasting seasons (dry and wet) in soils of reference wetland sites and those sites which had been restored by complete soil removal followed by natural re-vegetation. We hypothesized restored sites would exhibit higher microbial activity and elevated anaerobic and aerobic respiration potentials when compared to the reference site. Gaseous C loss potentials from all sites were minimal during the dry season. In contrast, during the wet season, potentials were significantly greater from restored sites when compared to the reference site. Similarly, restored sites exhibited higher rates of enzyme activity ($P<0.05$), organic C content ($P<0.001$), aerobic CO_2 ($P<0.02$) and anaerobic CO_2 & CH_4 ($P<0.05$) potentials. Correlations between total phosphorus (P) and enzyme activity ($P<0.001$) suggest P availability may limit enzyme activity reducing respiration potentials ($P<0.005$). Higher ratios of total nitrogen:total P and organic C:total P in the reference site ($P<0.001$) compared to the restored sites suggests P limitation in the reference soils could be inhibiting decomposition. Biogeochemical cycling of P is thus important in the process of restoration as a regulator of decomposition rates and gaseous C loss. For this reason, additional monitoring may help to better understand restoration success relating to shifting nutrient limitation with soil development. Seasonal differences in gaseous C loss from restored sites also has implications for restoration efforts in the context of global climate change.

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