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Multi-year net ecosystem carbon balance at a horticulture-extracted restored peatland

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Restoration of previously extracted peatlands is essential to minimize the impact of drainage and peat removal. Best practices restoration methods have been developed that include ditch blocking, site leveling and reintroducing bog vegetation using the moss layer transfer technique. A long term goal of restoration is the return to a peat accumulating ecosystem. Bois-des-Bel is a cool-temperate bog, located in eastern Quebec, Canada, that was vacuum harvested until 1980 and restored in 1999. While several studies have used discrete (chamber) methods to determine the net carbon exchange from rewetted or restored peatlands, ours appears to be the first to have multiple complete years of net ecosystem carbon exchange from a restored northern peatland. An eddy covariance flux tower instrumented with a sonic anemometer and open-path CO_2/H_2O and CH_4 analyzers was operated continuously over three years to produce a robust estimate of net carbon sequestration. Our initial results indicate that this restored peatland was a consistent moderate annual net sink for CO_2, a moderate source of CH_4 and had low losses of dissolved organic carbon compared to undisturbed northern latitude peatlands. Closed chambers combined with a fast response CO_2/H_2O/CH_4 analyzer were used to investigate ecohydrological controls on net ecosystem exchange of CO_2 (NEE) and CH_4 flux from the restored fields and remnant ditches at the site. CH_4 release was found to be an order of magnitude higher in the ditches compared to the fields, with non-vegetated ditch showing a greater range in flux compared to areas invaded by *Typha latifolia*. Bubble magnitude and count were highest in the non-vegetated ditch, followed by Typha plots and were undetectable in the restored fields. The latter may be partially attributed to the high cover of *Eriophorum vaginatum* in the restored fields, plants that have aerenchymous tissue, as well as a much deeper water table level. While the non-vegetated ditch areas were a steady small source of CO_2, NEE in the *Typha* plots showed significantly greater CO_2 uptake capacity relative to any other restored plant community. High productivity combined with reduced CH_4 flux suggests that *Typha* may be playing a key role in reducing the overall impact of the remnant ditches on the net ecosystem carbon balance. A preliminary footprint analysis suggests that ecosystem-level CH_4 flux is being primarily driven by release from hotspots while the majority of the tower source area is a very small source of methane.