

Ebullitive and Diffusive Greenhouse Gases from Flooded Impoundments of New Brunswick and Nova Scotia (Canada)

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In the 17th and 18th centuries, Acadian settlers dyked and drained salt marshes along the Bay of Fundy in Eastern Canada, transforming them into agricultural fields. Over the last 50 years, impoundments have been created by building dykes to contain freshwater. These impoundments are freshwater wetlands underlain with agricultural soils developed from tidal marsh sediments, making them potentially unique wetlands. This study examines 5 impoundments, ranging from 15 to 54 years since their creation. The impoundments are primarily fed by precipitation, and their water levels are maintained throughout the year with weirs. Assessment of their value as Natural Climate Solutions, i.e., their impact on climate, requires measurement of greenhouse gas fluxes from their waters. Greenhouse gas fluxes were measured in the open water areas of the impoundments using the headspace equilibrium method and inverted bubble traps, for diffusive and ebullitive fluxes, respectively. Sampling occurred monthly from August to November 2024, and in February 2025 (beneath the ice), representing 3 distinct seasons. Total CH₄ and CO₂ emissions ranged from -0.9 to 373 and -676 to 1566 mmol/m²/d, respectively. Diffusive N₂O emissions ranged from -334 to 0.4 μ mol/m²/d. Approximately 46% of CH₄ emissions were through ebullition which is a low ratio compared to previous studies, likely due to the presence of submerged macrophytes affecting the rates of ebullition. Dissolved greenhouse gas concentrations in the winter were significantly related to impoundment age, presumably a result of greater accumulated organic matter in the older impoundments. Concentrations and fluxes of greenhouse gases correlated to environmental variables air, water, and soil temperatures, and pH.