Investigating Impacts of Seedling Removal on Soil and Ground-level Vegetation Respiration (CO2 and CH4) in a Restored Peatland Ecosystem

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Table of contents

Others:

Peatlands cover an estimated 24% of the boreal region, and boreal peatlands represent 80% of the world’s peatlands ([Wieder et al., 2006](https://journals.sagepub.com/doi/10.1177/0959683614523803#bibr45-0959683614523803)).

## 1 Introduction

Peatlands are significant terrestrial stocks of C, which encompass 3% of the world’s land area but storing more than 30% of Earth’s soil carbon in the form of peat (Gorham 1991; Topcuoğlu and Turan 2018).

### 1.1 Peatlands Ecosystem Components

#### 1.1.1 Peatland Classification

Northern peatlands are commonly classified as fens and bogs based on water sources and chemistry, peat and vegetation composition (Bonn, Cambridge Core All Books, et al. 2016; Damman 1987; Edvardsson et al. 2016). Fens receive their nutrients and water from groundwater influx and atmospheric deposition, leading to higher pH levels and nutrient availability. Conversely, bogs are primarily sustained by precipitation, leading to more acidic conditions and lower nutrient concentrations (Bonn, Cambridge Core All Books, et al. 2016; Damman 1987; Rydin and Jeglum 2013). Compared to fens, bogs are more efficient at storing C, attributable to slower decomposition rates stemming from their limited nutrient content and reliance on precipitation for water input (Bonn, Cambridge Core All Books, et al. 2016). The geochemical distinctions between fens and bogs lead to distinct plant compositions: fens mainly host vascular plants, like sedges, and brown mosses from the Amblystegiaceae family, while bogs are primarily occupied by peat mosses from the Sphagnaceae family with fewer vascular plants (Rydin and Jeglum 2013).

**Check -** Bogs comprise two layers: a porous, less decomposed surface layer called the acrotelm, and a saturated, more decomposed deeper layer called the catotelm. This two-layer structure regulates the movement and storage of water and nutrients in the bog (Nungesser, 2003). During precipitation, the water table rises, and water starts to flow laterally and can flood the peat surface. During moisture deficits, water levels drop, and little to no water moves from the saturated underlying catotelm to the upper acrotelm due to the low hydraulic conductivity of peat (Nungesser, 2003).

#### 1.1.2 Bog Vegetation

The acidic and low-nutrient environment in bogs provides the ideal conditions for Sphagnum moss to grow, which is the primary peat-forming vegetation in bogs. The capillarity

Sphagnum mosses store water in their spongy forms, which helps prevent moisture deficits in the acrotelm layer during the dry season, thereby inhibiting the decay of dead plant material (Nungesser, 2003).

Sphagnum - capillarity and water storage ability

#### 1.1.3 Peat and Peat Processes

Peatlands are wetlands ecosystems with the presence of naturally accumulated peat layers (at least 30-40 cm thick) at the surface (Frolking et al. 2011). Peat is an organic material composed the incomplete and partially decomposed plant and animal material. In an undisturbed peatland, peat is composed of 88-97% water, 2-10% dry matter and 1-7% gases.

Peat formation is a slow geologic process where partially decomposed plant material accumulates in waterlogged conditions. The high water content creates an anaerobic environment, limiting the activity of decomposing microorganisms and thus slowing down decomposition. This leads to the accumulation of organic matter, primarily from mosses like Sphagnum, along with other vegetation and sometimes animal material. Over time, layers of this organic matter compress and form peat, which is rich in carbon and can vary in depth. Peatlands, as a result, become significant carbon sinks, contributing to long-term carbon sequestration and playing a vital role in the global carbon cycle (Bonn, Allott, et al. 2016). Northern peatlands have been documented to accumulate peat at a rate of 1 mm/year.

Peat is a highly concentrated stockpile of C that forms and accumulates due to the slow decay of organic matter caused by the anaerobic and waterlogged environment that characterizes these ecosystems (Bonn, Allott, et al. 2016).

Peatlands are significant terrestrial stocks of C, storing more than 30% of Earth’s soil carbon despite only covering 3% of the world’s land area (Topcuoğlu & Turan, 2018). Peatlands are wetland ecosystems with naturally accumulated peat layers (at least 30-40 cm thick) at the surface (Glaser, 1987).

Peat is a highly concentrated stockpile of C that forms and accumulates due to the slow decay of organic matter caused by the anaerobic and waterlogged environment that characterizes these ecosystems (Bonn et al., 2016).

#### 1.1.4 Microtopography

#### 1.1.5 Bog Hydrology

### 1.2 The Carbon Cycle in Peatlands

#### 1.2.1 Land-atmosphere Exchanges of Carbon Fluxes

#### 1.2.2 Biophysical Controls of Reco and FCH4

### 1.3 The Impacts of Fires in Peatlands

#### 1.3.1 Types of Peat Fires

#### 1.3.2 Impacts of Peat Fires

### 1.4 Restoration

### 1.5 Burns Bog

#### 1.5.1 Vegetation

#### 1.5.2 Drainage

#### 1.5.3 Disturbances and Restoration

#### 1.5.4 Carbon Fluxes

### 1.6 Research Objectives

#### 1.6.1

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