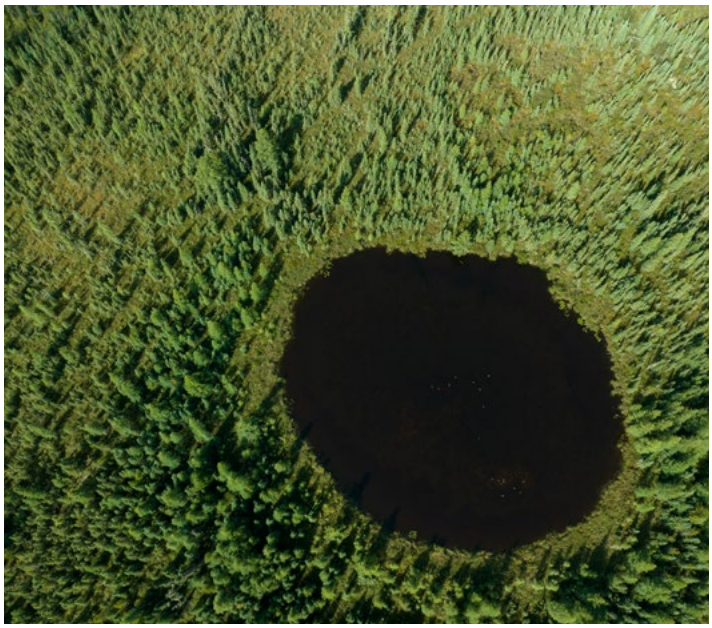
WETLANDS ON THE LANDSCAPE

Wetlands and Climate Change



Climate change refers to long-term changes in average temperatures and weather patterns, typically occurring over decades or more.[1] This phenomenon is distinct from climate variability, which encompasses all variations in climate that last longer than individual weather events but are shorter than multi-decade trends.[2] Research consistently shows that the current rate of climate warming is significantly accelerated by human activities.

Boreal ecosystems help control weather and climate directly through plant transpiration and sunlight reflection and indirectly by storing carbon and contributing fresh water to oceans. Intact wetlands play important roles in climate change mitigation and adaptation, from helping to buffer upland forests from impacts (e.g., by storing water during dry periods, serving as fire breaks) to storing large amounts of subsurface carbon (***Factsheet #6***).[3] However, climate change has the potential to alter wetland abundance and distribution across the western boreal, in turn affecting wetland functions and values (***Factsheet #1***). Understanding the cumulative effects of climate change and land use change is needed to take a whole landscape approach to ecosystem-based management.

Effects of Climate Change on Boreal Wetlands

Impacts to Water Resources

Many wetlands have variable water tables, which can change seasonally or annually depending on precipitation patterns. This variability makes it difficult to measure and predict long-term trends in wetting or drying. Overall, the boreal is expected to become drier due to increases in temperature and evaporation, which may impact wetland abundance. However, the western boreal is dominated by organic wetlands, which when undisturbed, are resistant to water loss through evaporation and may therefore persist even in a drying climate.[4] Due to their ability to adapt to climate change, managing these wetlands on the landscape is critical. For more information on water and wetlands, see ***Factsheet #3*** and ***Factsheet #4***.

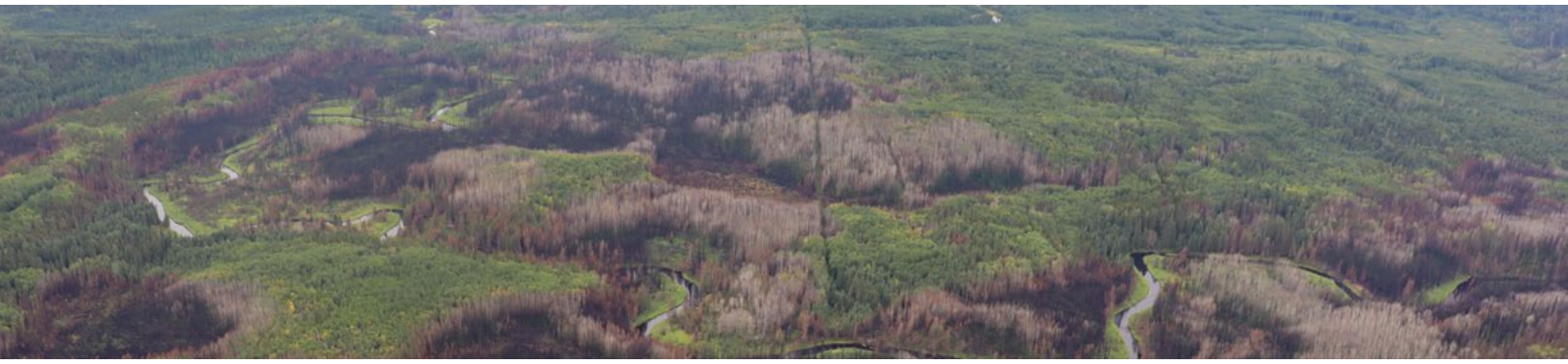
Impacts to Forest Transitions

Boreal wetlands are highly interconnected with upland forests (***Factsheet #2***) and climate change is expected to impact wetlands, upland forests and these connections. Upland western boreal forests are expected to face hotter and drier conditions, increased pressure from pests and diseases, and more frequent wildfires.[5] These factors are predicted to result in the loss of white spruce in upland forests and an expansion of grassland areas in the region.[6] This transition is expected to occur unevenly driven by events that cause the death of mature trees, such as fire, drought, heat stress and flooding.[7]

Impacts to Wildfire Vulnerability

In the western boreal forest, wetlands play an important role in regulating fire on the landscape. Kuntzemann et al. (2023) found that the presence of wetlands significantly decreased the likelihood of adjacent uplands burning during wildfire events. This effect was most pronounced with marshes, but having treed organic wetlands like fens, swamps, and bogs on a landscape also decreased the likelihood of uplands burning compared with landscapes with only uplands.

The wetter the wetland, the more effectively it acts as a fire break. However, disturbing wetland hydrology can lead to drying, making wetlands —especially treed organic wetlands —more vulnerable to burning.[9] Wetlands and wildfire are further explored in ***Factsheet #13*** and ***Factsheet #14***.



Impacts to Permafrost

Climate change is expected to reduce the depth and extent of permafrost globally. As permafrost only occurs in the northern portion of the western boreal forest, the northernly receding of permafrost could lead to a complete loss of permafrost from the western boreal. Permafrost thaw in organic wetlands has been shown to increase the hydrological connectivity of the landscape. This can result in:

- Drained water, previously locked away as ice, into rivers and streams;
- Wetland drying;
- Increased downstream runoff and flooding;
- Altered water quality;
- Altered habitat conditions;
- Increased decomposition; and,
- Increased greenhouse gas emissions.[10]

BOREAL WETLANDS AND THE GLOBAL CARBON CYCLE

Boreal organic wetland are one of the worlds largest organic carbon stores. In Canada, 150 billion tones of carbon is stored in organic wetland soils. These wetlands play an important role in climate change because of their capacity to remove and sequester greenhouse gases, such as methane and carbon dioxide, from the atmosphere, and store carbon in their above- and below-ground biomass. The role of wetlands in the global carbon cycle is explained in ***Factsheet #6***.

Impacts to Habitat and Biodiversity

Climate change is expected to impact the habitat and biodiversity of boreal wetlands. Rising temperatures and increased drought stress may weaken wetland health, making plants and animals more vulnerable to pests and diseases and causing biodiversity loss.

As climate change alters the temperature and moisture conditions of wetlands, their suitability as habitat may be affected, leading to shifts in vegetation composition and shrinking or northward movement of animal ranges. Species who cannot adapt fast enough could be at risk of extirpation or extinction.

Interacting effects of Climate Change and Anthropogenic Disturbance

Boreal wetlands are highly sensitive to disturbances that affect their hydrology (***Factsheet #5***), and the impacts of climate change may exacerbate these vulnerabilities. There is a lack of studies on the cumulative effects of climate change and anthropogenic disturbance on wetlands. However, anticipated climatic changes, such as increased temperatures, higher evaporation rates, and altered precipitation patterns, could interact with anthropogenic disturbances and potentially amplify the effect of each on wetlands.

Organic wetlands, for example, may persist in climates that over time become too dry for their natural establishment, making them especially susceptible to disturbance and challenging to restore if disturbed.[11] For more information on wetlands and anthropogenic disturbances, refer to ***Section 3***.

Boreal Wetlands in Climate Adaptation and Mitigation Strategies

Intact wetlands provide numerous ecosystem services that support climate change adaptation and mitigation, such as protection from flooding and drought, carbon capture and storage, and wildfire mitigation. Wetland conservation, management, and restoration are needed to support wetlands in continuing to provide climate adaptation and mitigation benefits to society.

A whole landscape approach to ecosystem-based management in a changing climate requires understanding where wetlands are located today (***Factsheet #3***) and how their abundance and distribution will change in the future. The Boreal Climate Change Modelling Study (currently underway, 2023 - 2026) is modelling future wetland abundance and distribution across Canada's western boreal forest. This study is engaging diverse groups affected by wetlands and climate change to understand how the results can be tailored and applied to support climate change adaptation and mitigation efforts.

Resources

- Boreal Wetlands and Climate Change
- Boreal Climate Change Modelling Study
- Predicting Wetland Change in the Prairies
- From Impacts to Adaptation: Canada in a Changing Climate
- Northern Peatlands in Canada Story Map

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