16 Disturbance in Boreal Peatlands

MERRITT R. TURETSKY and VINCENT L. ST. LOUIS

16.1 Introduction

Over the past several hundred years, approximately 50% of wetlands globally have been degraded (IUCN 2000), largely owing to agricultural intensification, pollution, energy and forestry practices, and urban development. Wetland loss has occurred over the past several centuries in Europe (Immirzi et al. 1992; Jones et al. 1993), more recently since settlement in North America (Tiner 1984; National Wetlands Working Group 1988; Dahl 1990), and may be intensifying today in many less industrialized nations (Brinson et al. 2002).

Disturbances are particularly important to the boreal forest biome, where the structure and function of the boreal forest both determines and is influenced by its disturbance regime. In pristine boreal forest, disturbances such as fire and insect outbreaks are common and alter landscape structure and species composition. In many boreal regions, however, human activities also influence ecosystem structure and function, and can alter natural disturbance regimes. Fires, for example, are a function of both natural conditions and human activities. The increasing area burned in Canada is most likely due to a combination of changing climate and increased human activities in formerly remote areas (Podur et al. 2002; Stocks et al. 2003). Most of our knowledge on disturbances in boreal regions is based on upland ecosystems, while less attention has been devoted to the role of disturbance in poorly drained landscapes, especially peatlands that cover significant areas of the boreal forest region.

As noted in other chapters in this volume, peatlands play a significant role in many ecosystem services, including C sequestration, water storage and supply, and species and landscape diversity. Changes in disturbance regimes could compromise these ecosystem functions. Here, we briefly review the most common disturbances that influence boreal peatlands, focusing on disturbance impacts on plant structure, hydrology, and bio-
geochemical cycling in peatlands. Similar to well-drained ecosystems, disturbances in peatlands are a function of both natural conditions and human activities. We classify disturbances into perturbations that involve (1) herbivory and grazing, (2) biomass burning, (3) flooding or inundation, (4) water table drawdown, and (5) pollution.

Disturbance can be defined as discrete events in space and time that disrupt ecosystem structure (Pickett and White 1985) or induce widespread mortality of dominant species in an ecosystem (Aber and Melillo 1991). These definitions distinguish disturbances from more chronic stresses or variability present in many ecosystems. However, as noted throughout this chapter, determining whether a perturbation is discrete or is caused by an external versus an internal agent (Pickett et al. 1989) can be difficult and is often influenced by the temporal or spatial scale being considered.

16.2 Herbivory/Grazing

16.2.1 Herbivory

The high phytomass production ratios of bryophytes and lichens are consistent with low levels of herbivory (Longton 1992). Low herbivory of peatland vegetation such as lichen and Sphagnum spp. likely is due to a combination of low nutrient content and the production of defensive chemicals (Clymo and Hayward 1982; Lawrey 1986; Davidson et al. 1990). However, certain species of bryophytes and lichens do serve as food sources for animals and insects (Lawrey 1986). Depending upon its history and severity, herbivory may represent an intrinsic perturbation rather than a disturbance (see definition earlier). For example, caribou (Rangifer tarandus) periodically use treed peatlands throughout the year (Bradshaw et al. 1995; Rettie and Messier 2000) for protection against wolf predation and food availability. Individual caribou can graze over 2,000 m² during winter months, consuming up to 2 kg dry weight of lichen daily (Slack 1988). Because lichens are generally slow-growing, caribou consumption will influence plant structure and inputs to soil organic matter in treed peatlands. However, because lichens often preferentially decompose in peat profiles, lichen consumption by caribou is not likely to influence long-term trends in peat accumulation.