

1 Peatlands and the Boreal Forest

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“Eos shared love’s bed with Astraeus
and bore him the mighty-spirited winds,
bright Zephyrus and gusty **Boreas** and Notus.”

From the poet Hesiod, *Theogony*

Peatland ecosystems, in the simplest definition, are terrestrial environments where over the long term, on an areal basis, net primary production exceeds organic matter decomposition, leading to the substantial accumulation of a deposit rich in incompletely decomposed organic matter, or peat. Under this very broad definition, peatland ecosystems can be found in arctic, boreal, temperate, or tropical climates (Gore 1983; Immirzi et al. 1992; Gignac and Vitt 1994; Lappalainen 1996; Charman 2002), although 80 % of the world’s peatlands are found in the boreal region (Joosten and Clarke 2002). We have chosen to focus this book on boreal peatlands.

The word boreal derives from Boreas (Βορέας), Greek god of the north wind, one of the four children of Eos, goddess of the dawn, whom Aphrodite had cursed with nymphomania, and the Titan Astraeus, god of the night sky and father of the stars. Boreas’s siblings, Eurus, Zephyrus, and Notus, gods of the east, west, and south winds, respectively, generally were portrayed as gentler than Boreas. Boreas was envisioned as a bearded, curly-haired, and winged god who wore boots and a tunic to protect him against the cold. In some portrayals, Boreas held a spiral conch shell that he could blow to herald the advent of the winds under his command. Boreas was a powerful god of blustery temperament. Boreas’s daughter was Chione, the goddess of snow. Boreal regions, however defined, are characterized by cold climates.

One of the most straightforward climatically based definitions of the boreal zone was provided by Walter (1973), who divided the world into nine zonobiomes, of which the eighth was the “zonobiome of the cold-

temperate boreal climate.” According to Walter (Breckle 2002), “the true boreal zone commences at the point where the climate becomes too unfavorable for the hardwood deciduous species, i.e, when summers become too short and winters too long.” Walter defined the southern limit of the boreal zone climatically, as occurring where the duration of the period with a mean daily temperature of more than 10 °C drops below 120 days and the cold season lasts longer than 6 months. The northern limit of the boreal zone, above which arctic tundra prevails, occurs where the duration of the period with a mean daily temperature of more than 10 °C drops below approximately 30 days and the cold season lasts longer than 8 months. The terms boreal forest and taiga are often used interchangeably, although taiga is sometimes reserved for Russian and/or European regions. Taiga is commonly referred to as having subarctic climate, a term that is synonymous with boreal climate. According to the Köppen–Trewartha system (Köppen 1931; Trewartha and Horn 1980), boreal/subarctic climate gives way to polar climates to the north when the mean monthly temperature for the coldest month drops below 10 °C, and gives way to temperate climates to the south when the average temperature exceeds 10 °C for more than 4 months.

Holdridge (1947) introduced an objective system to differentiate “the vegetation of dry land areas of the world into 100 closely equivalent formations separated by temperature, precipitation, and evaporation lines of equal value.” According to the Holdridge life zone classification system, cold or boreal regions of the earth can be found where the mean annual biotemperature (mean annual temperature calculated with all temperatures less than 0 °C set to 0 °C) is between 3 and 6 °C (Fig. 1.1). On the basis of Gignac and Vitt’s (1994) superimposition of the distribution of the world’s peatlands onto the Holdridge life zone diagram (Fig. 1.1a), boreal peatlands can be found where mean annual precipitation is between 500 and 3,000 mm, where the potential evapotranspiration ratio is between 0.125 and about 0.800, and where mean annual biotemperatures are between 3 and 6 °C (Fig. 1.1b). The spatial distribution of these conditions across the northern hemisphere provides a climatically based view of where boreal peatland ecosystems potentially could be found (Fig. 1.2; data from Leemans and Cramer 1990).

The boreal region has also been defined by its characteristic vegetation (Fig. 1.3), rather than by climate, as consisting of extensive conifer-dominated forest – the boreal forest or taiga. “The flora of boreal regions is impoverished, and the dominant arboreal element is particularly poor in genera and species” (Hare and Ritchie 1972). At its northern limits, the boreal forest gives way to treeless tundra, yet the boundary to the south is defined by the replacement of conifer-dominated forests with deciduous broadleaf forest, parkland, or grassland, depending on the prevailing regional climate (Larsen 1980).

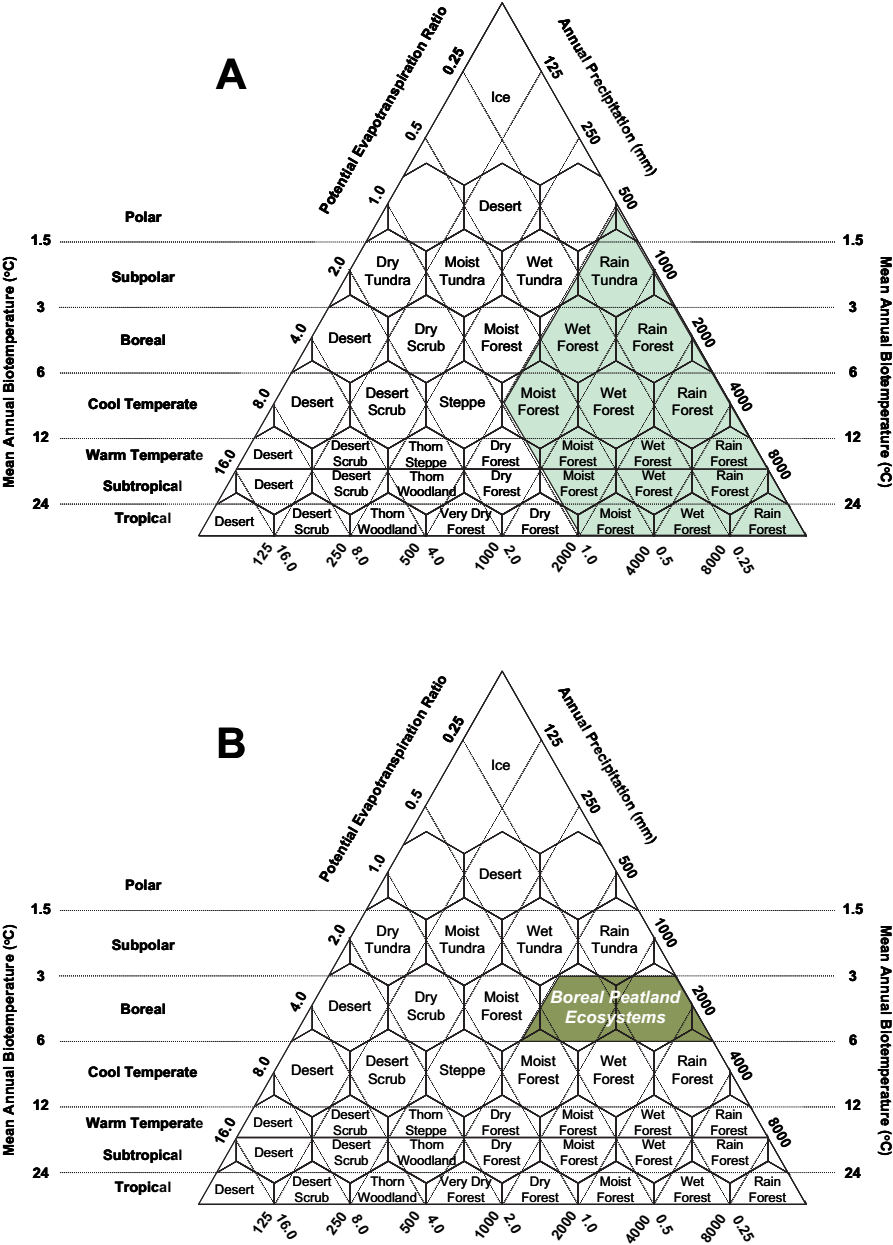


Fig. 1.1. A The Holdridge life zone approach (adapted from Hartshorn 1988) to delineating the global climatic distribution of peatland ecosystems and B the climatic distribution of boreal peatland ecosystems (a adapted from Gignac and Vitt 1994)

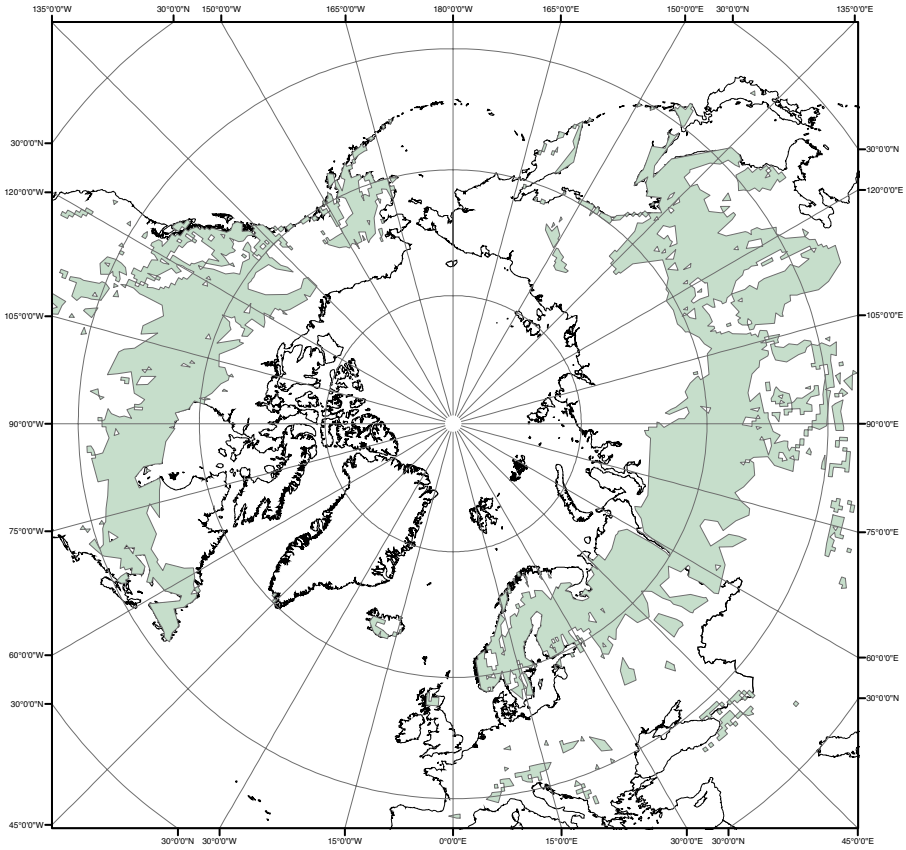


Fig. 1.2. Distribution of the earth's land surfaces where boreal peatlands potentially can be found based on the Holdridge life zone system (Fig. 1.1b)

More recently, interest in biodiversity has led to an effort to map the ecoregions of the world on the basis of floristic, faunistic, and vegetation information (Olson and Dinerstein 1998). Within this scheme, biome is a broad term that refers to ecoregions with similar climate, vegetation structure, biodiversity patterns, flora and fauna with similar guild structures and life histories, similar thresholds for maintaining biodiversity, and similar sensitivities to human disturbance. Boreal forests/taiga (Fig. 1.4) is one of 14 recognized biomes in this scheme.

All of these schemes for classifying boreal environments (Figs. 1.1–1.4) produce similar global distributions of the boreal zone, reflecting the strong relationship between climate and vegetation. Boreal forests cover 1.4×10^9 ha, or one third of the global forested areas (IPCC 2000). However, it is important to note that while most of the boreal forest is occupied by upland forests underlain by mineral soils, about 24 % of the boreal for-

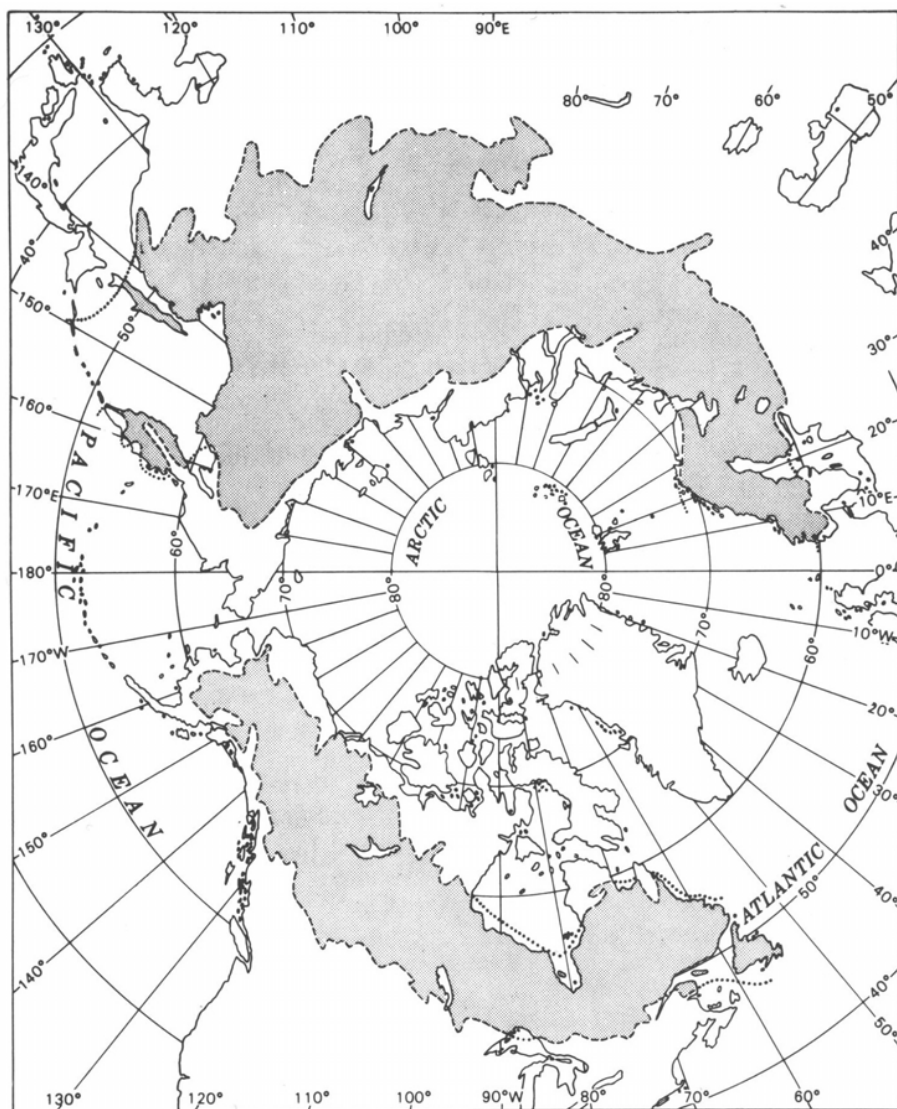


Fig. 1.3. Geographical distribution of the boreal forest in the northern hemisphere (from Hare and Ritchie 1972, adapted from Sjörs 1963)

est region is occupied by peatlands (the percentage was calculated from peatland areas for Norway, Sweden, Finland, Russia, and Canada given in Joosten and Clarke 2002 and for Alaska given in Immirzi et al. 1992, which collectively represent 330×10^6 ha).

Boreal and peatland ecosystems cover only about 2–3 % of the earth's land surface, but their overall ecological and societal importance is pro-

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