



Effect of the latitude of seed origin on moose (*Alces alces*) browsing on silver birch (*Betula pendula*)

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Abstract

Moose is a major cause of damage in young plantations of silver birch (*Betula pendula* Roth) in Finland, as they break stems and browse twigs and leaves. Damage by moose was measured in a provenance trial of silver birch situated at Loppi, southern Finland. The trial includes stand seed origins from Finland, Sweden, Estonia, Scotland and Russia, ranging in latitudes from 53 to 67°. The trial was established on a typical, southern Finnish moist upland clear-cut area that had been protected against moose by fencing. After the break-down of the fence, at the age of 5–11 years, the trial was frequently visited by moose. The effects of browsing were measured in early spring 2001 when the trees were 11 years old. The average proportion of trees browsed by moose varied between 6 and 86% among the seed origins. Browsing by moose decreased with increasing latitude of seed origin and sapling height. Seed origins transferred from more southern latitudes (southern Estonia, southern Sweden, Scotland, Russia) had a higher proportion of browsed trees than the more northern native ones. A similar pattern was also seen in the proportion of trees with stem breakage and the proportion of repeatedly browsed trees. Latitude of seed origin and sapling height covariate had a significant effect on moose browsing. The moose browsed more branches per browsed tree of southern origins, whereas sapling height had no significant effect. It is suggested that the variation in moose browsing among the seed origins was related to differences in their annual physiological rhythm, i.e. timing of growth cessation, leaf discoloration and abscission, and related changes in digestibility and palatability. It was concluded that importing birch regeneration material to Finland from more southern latitudes should be avoided because of the risk of browsing damage.

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1. Introduction

Silver birch (*Betula pendula* Roth) is an important species for the mechanical and chemical forest industry in Finland. Interest in the cultivation of silver birch arose in the 1960's (Raulo, 1978), but it was not until the 1980's that the planting of silver birch increased significantly. Planting peaked in the beginning of 1990's, when nurseries delivered 23 million birch seedlings yearly for planting, but since then planting has steadily decreased. In 2002, only 6 million seedlings were produced (Aarne and Peltola, 2003).

The high risk of moose damage is one reason why interest in birch cultivation has declined (Heikkilä and Raulo, 1987). Moose (*Alces alces* L.) has been shown to cause significant damage in young birch plantations (Heikkilä and Raulo, 1987; Tomppo and Joensuu, 2003), including stem breakage, twig

browsing and leaf stripping (Kangas, 1949; Löyttyniemi and Laaperi, 1988). The damage, depending on severity, may reduce growth or lower stem and timber quality (Laysund, 1987; Heikkilä et al., 1993; Lilja and Heikkilä, 1995). Moose prefer to feed on planted silver birch saplings compared to naturally regenerated ones (Heikkilä, 1991), and it is often practically impossible to regenerate silver birch by planting (Löyttyniemi and Laaperi, 1988).

Moose is a generalist ruminant-herbivore, feeding on several plant species (Cederlund et al., 1980). However, birch forms an important part of their diet, especially in summer, when the

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