

Diversifying native pinewoods using artificial regeneration

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Little is known about broadleaf establishment within the native pinewoods of Scotland, yet such information is critical to current restoration initiatives. A 2-year held trial was set up to assess the growth and performance of seedlings of four broadleaved species within different developmental stages of *Pinus sylvestris* (Scots pine) woodland in the Scottish Highlands. The developmental stages included stem initiation (establishment stage), stem exclusion (thicket/pole stage) and canopy break up (told-grow the canopy), providing sites of varying shade and resource availability. It was predicted that differences in establishment between sites would occur due to species-specific differences in 'tolerance' of shade, low-nutrient availability and poor soil drainage. Analysis of trial results showed high survival but growth rates (relative stem height and basal diameter growth) declined rapidly in year two. In year two, *Ilex aquifolium* achieved the highest mean growth rates in the stem exclusion stands (average 15 per cent light) where there was a lower percentage of *Pbytnmyza rllris* (holly leaf miner) infection and frost damage. *Sorbus aquaparia* exhibited generalist behaviour with similar growth and performance across all stand treatments. *Betula pubesceus* maintained similar growth rates across stand types but was more susceptible to insect damage in deeper shade. Overall, *Aluus glutinosa* grew more successfully than the other species and achieved highest mean growth rates in canopy break tip (average 44 per cent light) and stand initiation (average 71 per cent light) stages. Broadleaf establishment within pinewood stands is challenging on account of acidic nutrient-poor soil regimes, and in places, poor drainage, aggressive understorey competition and canopies that restrict light availability and insect herbivore. Forest restoration techniques, including matching species to site, accelerating establishment and using framework species (individuals of high field performance that are able to restore site productivity and nutrient cycles), are discussed.

Introduction

There is much evidence to suggest that broadleaved trees were formerly more important constituents of the oceanic boreal native pinewoods of Scotland (Steven and Carlisle, 1959; Rodwell

1991). Analysis of pollen cores has shown that pinewoods like Abernethy Forest (O'Sullivan, 1977) and East Glen Affric (Wolff and Tipping, 1999; Shaw and Tipping, 2003) had a higher percentage of broadleaved trees up until the nineteenth century than they do today. Broadleaf

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