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SUSTAINABLE MANAGEMENT OF SCOTS PINE IN THE NORTHERN PERIPHERY

SILVICULTURAL GUIDANCE NOTE 5 - Stand management of Scots pine forests

HIGHLAND BIRCHWOODS Coille Beithe na Gàidhealtachd
skog+landskap
METLA
SKOGSSTYRELSEN
NORTH KARELIA POLYTECHNIC
Forest Research An agency of the Forestry Commission

Introduction

This Guidance Note is one of a series produced as part of the **Northern Periphery Programme** (NPP) "**Developing Scots Pine**" project. These Notes seek to add value to the future Scots pine resource by encouraging growers to invest in economically effective and ecologically sustainable forest management leading to the production of high quality timber. The publication "Growing Scots Pine for Quality Timber" (Worrell and Ross, 2004) provides a useful overview of the issues involved.

This note covers stand management operations from the post-establishment phase through to felling, focusing on the primary objective of producing high quality timber. Guidance is given on respacing natural regeneration, pruning, thinning and choice of felling age/rotation length.

Respacing

Respacing (or pre-commercial thinning) of natural regeneration is undertaken to reduce stocking density in a stand, at a stage when trees are too small to produce marketable timber. Decisions regarding the potential benefits of respacing must be made bearing in mind the specific site and stand circumstances, particularly the density of regeneration and the windthrow risk on the site. A recent **Forestry Commission Practice Note** (Mason, 2010) provides comprehensive guidance on the issues to be considered when respacing naturally regenerated conifers in the UK.

The advantages of respacing include:

- *Increased diameter growth on the remaining trees, resulting in a greater volume of marketable produce in early commercial thinnings;*
- *The opportunity to select the best stems at an early stage;*
- *Improved future stability of the stand, which may be important on sites with a high windthrow risk;*
- *Access routes through the stand are established at an early stage and form the basis for future thinning operations;*
- *Dead and dying trees that may hamper future harvesting operations are removed;*
- *There may be the opportunity to sell material removed into the biomass market.*

Set against these potential benefits there are also some disadvantages to be considered, including:

- *Cost of the operation – this is likely to be between £500 and £1000 per hectare, depending on tree size and the methods used. Incurring these costs early in the life of a stand can have significant implications for profitability;*
- *Respacing too heavily when trees are young can result in many of the problems associated with wide initial spacing, i.e. increased stem taper, bigger knots, reduced average density, higher grain angle, a greater proportion of juvenile wood[1] and poorer stem straightness;*
- *In very dense natural regeneration it may be difficult to see stems clearly enough to select those with better form.*

[1] Juvenile wood can be defined as the zone of wood extending outward from the pith where wood characteristics undergo rapid and progressive changes in successively older growth rings (Larson et al., 2001). It is characterised by low density, thin cell walls, short tracheids with large lumens, high grain angle and high microfibril angle, resulting in low stiffness and strength and poor dimensional stability.

In Sweden, where natural regeneration of Scots pine is widely practised and respacing is a routine operation, recommendations are to respace stands to 4000 stems/ha at 1-2m height, with a further respacing to 2000 – 2500 stems/ha when trees are 4-5 m in height. This approach is broadly in accordance with the advice of Mason (2010), who suggests that where timber quality improvement is a goal respacing should be delayed until trees are at least 3-4 m tall: this will allow better choice of trees with good stem form and suppression of branches in the lower canopy.

Financial support for respacing natural regeneration is currently available within the **Scotland Rural Development Programme,** (SRDP) under the **Improving the Economic Value of Forests** option. 50% of the net actual costs of respacing in stands where the initial stand density exceeds 4000 stems/ha will be paid, up to a maximum of £300/ha (i.e. total net cost of £600/ha). Where density of regeneration is less than 4000 stems/ha, and stability considerations allow, respacing can be delayed until the first commercial thinning stage.

Pruning

Pruning (Figure 1) is the removal of branches from the lower part of the stem in order to improve timber quality by limiting the extent and size of knots, producing a small knotty core and maximising the amount of clear timber formed. Studies have shown that pruning of Scots pine improves the quality characteristics and value of logs and sawn timber (e.g. Ikonen *et al.*, 2009).

Pruning is not widely practised in conifer crops in the UK: operational costs are high, the investment period is long and there is no established market for the knot-free timber produced from pruned stems. However, if forest managers wish to invest in future timber quality by pruning, Scots pine is one of the conifer species (together with Douglas fir and larch) where a market for high quality clear timber may be found in the future, for example for internal joinery or window manufacturing. Only well stocked stands of good stem form that are growing well should be considered for pruning. Financial support for pruning (50% of net costs) is now available in Scotland, under the **Improving the Economic Value of Forests** option of SRDP.

Figure 1: Pruning Scots pine

Guidance on pruning techniques can be found in two technical notes on the subject that are available online (**Philips, 2004; Simpson and Jacyna, 2007**). Pruning is generally carried out on about 300 – 600 stems in the stand, selected for their stem form and growth as the final crop trees. The operation is normally done in two stages, or "lifts": firstly to about 3.5 m height, and then (a few years later) to about 6m height (although pruning can be carried out to up to 10m height). Care must be taken not to remove too much of the live crown during pruning, as this will slow growth. A general guide is that up to about one third of the lower live crown can be removed without affecting growth. Marking and recording of final crop trees is essential to ensure that the pruned individuals can be appropriately marketed when they are harvested.

Thinning

Selective thinning is a key silvicultural tool used to improve stands by removing poor stems of poor form and concentrating increment on superior trees. Depending on stand characteristics and market conditions it can also provide an early economic return. Compared to no-thin regimes, thinning will result in:

- *An improvement in stem form and branching through selection of the best trees*
- *A lower proportion of juvenile wood*
- *More uniform growth*

In British conditions thinning has been shown to result in an increase in the total volume of sawlog sized material that is produced and an increase in the proportion of higher value green logs (Methley, 1995).

Comprehensive guidance on thinning practice is available in Rollinson (1999) and in the Forestry Commission's Operational Guidance Booklet No. 9, (Forestry Commission, 2010). Where high quality timber production is a key objective timing and intensity of thinning is important. Very heavy, early thinning can result in retention of a deep living crown, leading to large knots in logs, increased stem taper and possible stem form problems.

In a standard "intermediate" type of selective thinning, widely practised in the UK, most of the suppressed and sub-dominant trees are removed and groups of competing larger trees are broken up to stimulate growth in the better individuals. The result is a more uniform stand with evenly spaced trees of a similar size and an overall improvement in the stem quality of the stand.

Mason et al. (2004) suggest that a modified "crown thinning" system can be used to increase structural diversity in Scots pine stands while still improving the timber quality of the final crop trees. 100-200 high quality trees per hectare are identified at an early stage and favoured in subsequent thinnings by removal of competing neighbours. This type of approach produces a larger average tree size in early thinnings and in Scandinavia has been shown to be associated with improved stem quality in the residual stand (Jähagen and Lageson, 1996). An additional advantage of this type of thinning is that the favoured high quality trees can be retained as seed trees, if natural regeneration is the selected restocking method.

Rotation length

Where trees are grown on a longer rotation there is an opportunity to produce high quality timber, provided stem form and branching in the stand are acceptable. Regular selective thinning will concentrate increment on final crop trees of good form and maintain an even growth rate. Logs produced from larger diameter, older trees will have a lower proportion of juvenile wood, resulting in a greater volume of mature wood with more desirable wood properties in terms of mechanical performance and drying stability (higher density, lower microfibril angle, lower grain angle). There is also the potential to produce a significant amount of knot-free timber in the valuable sawlog part of the stem, once branches have self-pruned.

A recent survey of timber quality in Scots pine forests in northern Scotland found that increased stand age had a significant positive impact on log quality, as measured by stem straightness assessments and the height of the lowest dead branch (Macdonald *et al.*, 2010). Models developed from the survey data suggest that extending rotation length from 61 years to 81 years could increase the proportion of trees in a stand meeting the criteria for the production of better quality logs from 15% to 58%. A survey of silvicultural practice in Scots pine stands in north Scotland (Macdonald *et al.*, 2008) found that the average rotation age was 57 years for stands managed by the Forestry Commission and 74 years for those that were privately owned, with an overall average of 63 years. This suggests that there is scope for improving the quality of timber produced from Scots pine stands by extending rotations beyond the current norms.

Figure 2: Mature (83 years), thinned Scots pine stand (Tomvaich Wood, Strathspey)

Decision Support System

To support the establishment and management of Scots pine forests in the Northern Periphery area of Scotland, Forest Research has developed the "Scots Pine Management Support System". This programme links existing decision support tools (**Ecological Site Classification (ESC)**, **Establishment Management Information System (EMIS)** and **ForestGales**) with newly developed Scots pine timber quality models to evaluate the impact of site factors and management alternatives on the volume and quality characteristics of Scots pine timber.

The Scots Pine Management Support System is an online tool that users can access either from a link on the project web-page (**www.pineinfo.eu**) or by following this link: **https://www.eforestry.gov.uk/forestdss/?app=spdss.** Use of the DSS is free, although users are required to register when they access the programme for the first time (in this way registered users can be informed of any updates to the programme).

Users can choose from two initial options:

1. **Establishing Scots pine forests** - for guidance on planting a new area of Scots pine woodland or restocking an existing, mature forest by replanting or natural regeneration.
2. **Managing Scots pine forests** - for guidance on management of existing Scots pine forests.

Throughout the programme the user is provided with links to relevant sources of additional information, including these silvicultural guidance notes.

Scots pine stand management - summary of key points

- Selective respacing of dense (>4000 stems/ha) natural regeneration can improve timber quality, stand stability and the financial viability of future thinning
- Where possible respacing should be delayed until trees are 3-5 m in height, to allow for suppression of lower branches and to facilitate selection on the basis of stem form
- Pruning improves the timber quality and value of Scots pine logs and sawn timber: it should be concentrated on the best 300-600 stems/ha
- Financial support for respacing and pruning is available within the Scotland Rural Development Programme
- Selective thinning is a key tool for improving timber quality in Scots pine stands: crown thinning may be beneficial where increased structural diversity ***and*** improved timber quality are sought
- Extending rotation lengths in stands with good stem form and slender branching can improve timber quality in terms of external log characteristics and sawn timber mechanical properties
- Decision support tools are available to help forest managers to evaluate the impact of site factors and management alternatives on the volume and quality characteristics of Scots pine timber.

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For further information about the "Developing Scots Pine" project, visit: www.pineinfo.eu

Enquiries relating to this guidance note should be addressed to:

Elspeth Macdonald
Forest Research,
"Woodlands",
Fodderty Way,
Dingwall,
Ross-shire,
IV15 9XB

elspeth.macdonald@forestry.gsi.gov.uk
www.forestry.gov.uk/fr/timberproperties