Site Assessment and Species Choice

This Guidance Note is one of a series summarising information presented at a seminar on "Improved Conifer Timber Quality through Plant Selection and Silviculture", held in February 2009, as part of FC Scotland's Timber Development Programme. It provides an outline of a presentation given by Bill Rayner of Forest Research, covering the factors that should be considered when determining the suitability of a site for growing different conifer species and highlighting relevant publications and decision support tools. The presentation itself is available for download through the seminar web page.

Site Characteristics Affecting Tree Establishment

Site characteristics affecting the establishment and early growth of conifer tree species are summarised in Table 1. Promoting an environment for early tree growth which meets the requirement of the "likes" column will enhance establishment success, encourage rapid early growth and deliver improved timber quality.

Table 1: Tree Establishment Characteristics – "Likes & Dislikes"

Likes	Dislikes
Shelter	Exposure
Free drainage	Waterlogging
Deep rooting	Very poor nutrition
Poor nutrition	Cold soil temperatures
Warm soil temperatures (>5°C)	Cold soil temperatures (<5°C)
Minimal root competition	Root competition
Full sunlight	Shade

The factors which affect tree growth can be considered in two groups – those which cannot be modified and those which can. The assessment of some factors can be conducted as a desk-based exercise, using relevant maps and decision support tools, such as Ecological Site Classification (Pyatt *et al.*, 2001) and the Establishment Management Information System (EMIS), which can both be accessed through the FR Decision Support Services portal. The information presented below is largely summarised from these sources.

Factors limiting tree growth which cannot be modified

These factors can generally be assessed before visiting the site. Values for 1-4, calculated for a site on the basis of grid reference, are available through The Ecological Site Classification Decision Support System (ESC-DSS). Information about underlying geology is now available online through the British Geological Survey OpenGeoscience facility.

1. Accumulated Temperature

Growing season warmth, which is a major determinant of tree growth rate, can be expressed as Accumulated Temperature above 5°C (AT5), which ranges in Britain from 0 – 2000 day-degrees. The Ecological Site Classification Decision Support System (ESC-DSS) calculates AT for sites on the basis of grid reference and provides an indication of species suitability (very suitable, suitable or unsuitable) for different ranges of AT. For example, for a site to be classed as very suitable for Douglas fir an AT value of >1200 day-degrees is required. For Sitka spruce, suitability for different seed origins is suggested, with Washington suitable for warmer sites (>1200 day degrees), Queen Charlotte Islands across the middle range and Alaskan for cooler sites (< 575 day degrees).

Recent climate change projections, based on a high-emissions scenario, suggest a doubling of AT for some areas of the eastern lowlands of Scotland by the latter part of the century, with Caithness receiving as much warmth for tree growth as the south-eastern lowlands received on average between 1961 and 1990 (Ray, 2008).

2. Moisture Deficit

Moisture deficit (MD) is the monthly maximum accumulated excess of evapotranspiration over rainfall in the summer months – a higher value indicates a greater frequency of summer droughts. Species suitability for different ranges of MD are given in the ESC-DSS. Of the commercial conifer species Sitka spruce is least tolerant of summer drought, being classed as very suitable only where there is an MD value of <120 mm, and suitable where MD is 120–180 mm. Scots pine is classed as very suitable up to MD values of > 200 mm, but is less tolerant of wetter sites being classed only as suitable where the MD value is < 90 mm.

Climate change projections show a predicted increase in MD in south and eastern Scotland, and a reduction in western Scotland by the latter part of the century. These changes are likely to affect the geographical pattern of species suitability, with declining suitability of Sitka spruce in the east (Ray, 2008).

3. Windiness

Wind is the most likely limiting factor to tree growth at higher elevations and near many coasts in Britain (Pyatt *et al.*, 2001). It also has a significant impact on stand stability and therefore limits management options. Windiness in British forestry is assessed using the DAMS system (Quine and White, 1994), which is based on tatter flag data collected across the country. DAMS scores, which range from 3 to 36, have been shown to give a good indication of mean wind speed and the frequency of strong winds. DAMS score for a site can be obtained from the ESC-DSS or from the ForestGALES DSS.

The ESC-DSS can be used to indicate the suitability of different species in relation to DAMS score. Of the commercial conifers commonly grown in Scotland, ESC suggests that Douglas fir has the greatest requirement for shelter from the wind, (being classed as very suitable only where DAMS score is 12 or less) and Sitka spruce can stand greatest levels of wind exposure being classed as very suitable up to a DAMS score of 16.

4. Continentality

Continentality is used as a measure of the seasonal variability of climate, including the annual range of temperature, length of growing season and distribution of precipitation. Within Britain the range of Continentality is relatively limited (compared, for example, to a European scale) but it has been shown to influence the distribution of plants and plant communities. The range of values is from 1 to 13, although for practical purposes these twelve categories are grouped into four classes. Continentality is one of the factors that the ESC-DSS takes into account when assessing a site's suitability for a particular tree species.

5. Site geology – soil lithology

The underlying geology of a site defines its topography, determining the incidence of ridges, hollows, outcrops etc. The soil parent material is the rock from which the soil is formed, which is not necessarily the bedrock of a site. The soil parent material and its geographic position, determine the texture, fertility and water holding capacity of a soil. Information about geology and soil lithology can be obtained from relevant maps.

Factors limiting tree growth which can be modified

The assessment of these factors will require a site visit during which soil and vegetation assessments should be made in accordance with standard procedures as set out, for example, in Pyatt *et al.* (2001). Decision support tools such as ESC-DSS and EMIS, together with existing knowledge about previous tree crops on the site or adjacent crops on similar sites, can

then be used to inform decisions regarding species choice, ground preparation techniques, fertiliser regimes and weed control.

1. Soil compaction
2. Soil Moisture
3. Soil nutrients
4. Soil temperature
5. Vegetation competition
6. Available Light

Conclusions

- In order to grow productive conifers that produce high quality timber it is essential to assess the suitability of a site, including variations in conditions across the site, for different species;
- An initial desk-based assessment of site factors which cannot be changed, using readily available online sources of information, will provide a preliminary indication of the potential of a site;
- A site visit to gather soil and vegetation data, and to interpret the desk-study data, is then required;
- The Ecological Site Classification Decision Support System provides guidance on the suitability of different species on the basis of the site data described above;
- The Establishment Management Information System integrates ESC with other decision support systems to provide advice on all aspects of tree establishment.

References

Pyatt, D.G., Ray, D. and Fletcher, J., (2001). An Ecological Site Classification for Forestry in Great Britain. Forestry Commission Bulletin 124. Forestry Commission, Edinburgh.

Ray, D. (2008). Impacts of climate change on forestry in Scotland – a synopsis of spatial modelling research. *Forestry Commission Research Note 101.* Forestry Commission, Edinburgh.

Quine, C. P. and White, I. M. S. (1994). Using the relationship between rate of tatter and topographic variables to predict site windiness in upland Britain. Forestry, 67(3), 245-256

Links to further information

British Geological Survey OpenGeoscience: www.bgs.ac.uk/opengeoscience/

Ecological Site Classification: www.forestresearch/ESC

Establishment Management Information System (EMIS): www.forestresearch.gov.uk/fr/HCOU-4U4JE4

ForestGALES Decision Support System: www.forestresearch/forestgales

FR Decision Support Systems Portal: www.eforestry.gov.uk/forestdss/