- *Provenance trial results in Ireland have shown that Washington and Oregon sources of Sitka spruce (*Picea sitchensis*) are more productive than Queen Charlotte Island (QCI) sources in all parts of the country.*
- *Based on a comparison of the ecological conditions best suited for Washington and Oregon sources, recommendations as to where each should be planted are provided.*
- *These recommendations support the belief that there are no good ecological reasons for the widespread planting of QCI Sitka in Ireland.*

Where should Washington and Oregon sources of Sitka spruce be planted in Ireland?

***David Thompson*[1]**

Introduction

A summary of more than 40 years of provenance trial results with Sitka spruce (*Picea sitchensis*) in Ireland was presented by Thompson et al. (2005). The main conclusion of this work was that there are no good reasons for the continued widespread planting of Queen Charlotte Island (QCI) sources because they provided no protection against frost, produced no better quality wood, were no more stable or had less lammas growth than Oregon and Washington sources, and yet QCI sources produce a lower volume of wood per hectare. As a result, in the spring of 2006 the Forestry Division of Coillte decided to phase out any further planting of QCI in the Coillte forest estate. The objective of this report is to provide simple and clear guidelines on where Oregon and Washington sources should be planted in Ireland.

Background

Sitka spruce ranges from Alaska in the north to northern California in the south along the north-western coast of North America (Figure 1). Because of their slow, poor growth rates, Alaskan sources are not economic for plantation timber production. Material from QCI provides on average about one Yield Class (2 m^3/ha/year) less timber production than Washington sources and provides no benefit over Oregon or Washington sources (see Thompson et al. 2005 for a full discussion). Northern California sources have been tested on a limited basis, but in general show both a

▲ Sitka spruce seedling.

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Figure 1. Species range of Sitka spruce (from Lines, R. 1987. *Choice of seed origins for the main forest species in Britain.* Forestry Commission Bulletin 66, 61 pp.)

decrease in wood production and wood quality compared to Oregon and Washington sources (Treacy et al. 2000). Thus, Washington and Oregon sources provide increased timber production without any significant risk compared to QCI in Ireland. The situation is different in the UK where QCI is best suited to upland sites in Scotland, while Washington material is now recommended for coastal western Scotland, Wales and southern England, and even Oregon material in selected locations in Cornwall.

However, the locations where Oregon and Washington can be used in Ireland require further definition, which will be provided here.

Methods

Based on work in British Columbia, Canada to define the ecological characteristics of site types a Biogeoclimatic Ecosystem Classification system has been developed (Pojar et al. 1987). More recently this concept has been applied to the UK and has led to the development of an Ecological Site Classification System (Pyatt et al. 2001). The objective of this system is to help forest managers select tree species that are best matched to the site based on the ecological characteristics of that site. This concept is based on the ideas that Anderson (1950) originally put forward in his *Selection of Tree Species - an Ecological Basis for Site Classification for Conditions found in Great Britain and Ireland*, more than half a century ago.

The Ecological Site Classification (ESC) system depends on assessing four main characteristics of the site which are warmth, wetness, continentality and windiness (Pyatt et al. 2001). However, warmth and wetness factors are the most important and are combined to define the overall climatic zones which are important in the selection of species. The factors continentality and windiness are used to further refine species selection within these climatic zones and also consider the timber production potential of the site.

Warmth ranges from warm to cool and finally to sub-alpine, whereas wetness ranges from wet to moist and finally to dry (see Pyatt et al. 2001 for details). The ESC system identifies a total of seven climatic conditions based on the factors of warmth and wetness which define all the climatic conditions found in the UK. Each species (conifer and broadleaf) is rated as very suitable, suitable or unsuitable for each of these climatic conditions. By matching the species to the site conditions the most suitable species can be identified.

If the seven climatic conditions found in the UK are applied to Ireland, the entire country falls into only three of the climatic conditions, but unlike the UK, all three of the climatic conditions are very suitable for growing Sitka spruce.

In a further refinement of the recommendation for planting Sitka spruce, specific provenance recommendations have been developed based on response curves that have been generated depending on warmth, wetness, windiness, continentiality, soil moisture and soil nutrient factors (Figure 15 in Pyatt et al. 2001). These same response curves can also be adopted to apply to Irish conditions to define where QCI, Washington and Oregon material should be planted.

Results

The response curves for soil nutrient levels show what most foresters already know. Do not plant Sitka spruce on very nutrient poor or carbonate rich soils. Similarly, planting Sitka on very wet, or moderately to very dry soils should be avoided. The windiness (exposure) scale entitled Detailed Aspect Method of Scoring (DAMS) says that on windier sites Sitka will suffer, which is also widely appreciated. Therefore soil nutrient levels, very wet or dry soils or very exposed sites are not particularly useful in selecting or defining the best seed sources for specific sites.

Soil moisture deficit will affect performance, but the levels at which this significantly affects Sitka growth (greater than 80 mm soil moisture deficit) are generally not experienced in this country. Therefore soil moisture deficit is not a determining factors regarding provenance selection.

Continentality (which is the converse of oceanicity) is the influence of the European continent on climate, which results in greater extremes of climate (cold winters and warm summers) than would normally be expected at a given latitude. It also results in a much wider fluctuation in temperature and moisture patterns than would normally be expected. This takes place mainly at higher elevation and along the eastern and south-eastern part of the UK. Because of Ireland's location further west of the European mainland we are less subject to the effect of continentality and therefore its effect can be mostly ignored.

As a result, the main factor in the ESC system that affects seed source selection for Sitka spruce in Ireland is warmth. In the ESC system warmth is measured by a factor called Accumulated Temperature (AT), which is defined as the cumulative number of days above a threshold temperature of +5°C. In the ESC system the differences in the AT for four locations within the natural range of Sitka spruce (Alaska, QCI, Washington and Oregon) have been recorded. The results are shown in Table 1.

This information can be used to try and match the AT of the original sources of Sitka to the AT experienced in this country, which define where specific seed sources are best suited. In Ireland maps for Accumulated Temperatures are available which show the differences in AT across the country (Figure 2.)

Table 1. Accumulated Temperatures (AT) experienced at the original locations of the different Sitka seed sources (from Pyatt et al. 2001).

Source	Accumulated Temperature (AT) (degree-days)
Alaska	400 to 600
QCI	600 to 1,400
Washington	1,400 to 1,800
Oregon	1,800 to 2,000

Based on the AT requirement, the area best suited for planting Oregon sources is the area south of the 1,800 degree-day line that runs from the mid Wexford coast across the southern part of the country to the southern shore of the Shannon estuary (Figure 2). While it is recommended that

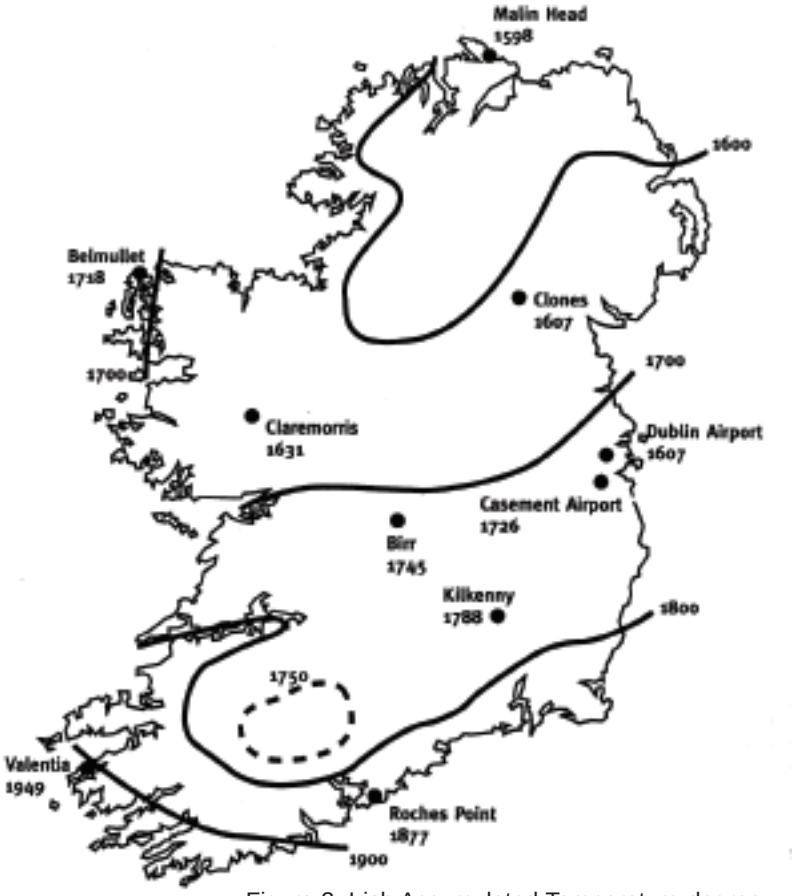

Figure 2. Irish Accumulated Temperature degree-days (°C days reduced to mean sea level) above 5.6°C (from Collins and Cummins, 1996).

Oregon sources will do best in this area it is also important to appreciate that Washington material will also do well in this area, although it may be slightly less productive.

Based on the AT requirement for QCI sources in Table 1, QCI sources do best at ATs of less than 1,400. However, the most northerly point on the island, Malin Head, has an AT value of almost 1,600. Therefore the need to plant QCI at any location on the island is questionable.

The AT requirement for Washington sources of between 1,400 to 1,800 makes it suitable for planting in most locations in Ireland. It is interesting to note that this is the same conclusion reached previously, based on the performance of the different seed sources in progeny trials in this country (Thompson et al. 2005).

▲ A mature stand of Sitka spruce of Washington origin in Shillelagh Forest.

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Recommendations

- Oregon material can be planted south of the 1,800 degree-day line from the mid Wexford coast to the southern shore of the Shannon estuary.
- For all areas of the country (including the area south of the 1,800 degree-day line) the planting of Washington sources of Sitka spruce is recommended.
- There are no good climatic reasons for planting QCI in Ireland.

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