

**FORESTRY COMMISSION
NATIONAL OFFICE FOR SCOTLAND
GUIDANCE NOTE NO 13**

TREELINE WOODLANDS AND THE WOODLAND GRANT SCHEME

1. Purpose of the Guidance Note

Treeline woodlands - ie woodland above the commercial treeline - comprises either new native woodlands, extensions to semi-natural woodlands or upper additions to commercial forests.

This note aims to provide guidance on the circumstances under which it is appropriate to use WGS to support the expansion of treeline woodlands. A basic principle is that grant aid for treeline woodlands is discretionary. In addition to matching species to site, applications will need to help meet Biodiversity Action Plan targets, or offer clear landscape design benefits.

2. Background

It is now widely accepted that extending woodland cover 'up the hill' enhances biodiversity and can create a softer visual boundary between forest and open hill. In encouraging treeline woodlands in Scotland, the aim is to create a continuum of woodland cover which reflects climatic and edaphic gradients from the valley floor to the biological limit of tree growth.

Although there is an increasing body of literature about the ecology and distribution of treeline woodland in other boreal countries, this information cannot be extrapolated easily to the Scottish situation because of differences in climate and soil fertility. Very little is known at present about the natural distribution of treeline woodlands and montane scrub in Scotland and there are few examples of such woodland types to provide models for restoration. In fact, the evidence suggests that treeline woodlands may not have been as widespread in Scotland as elsewhere. There is virtually no information in the UK or abroad about restoration techniques to convert moorland to treeline woodlands so until such information becomes available, we must apply caution to any operations grant aided under WGS.

3. Definitions

Since there is a wide range of terms which relate to woodland and scrub above the altitudinal limit for commercial forestry, there is a need for standardisation. Although there is little information on the composition and distribution of natural tree-lines, the following general descriptions should apply (see **Figure 1**).

Treeline woodlands refers to woodland over above the commercial treeline (or timber line). The timber line is the point where altitude and exposure prevent the growth of marketable timber other than firewood. This will vary depending on species and site. Much of the land

classified as F7 in the Macaulay Forest Land Classification is above the commercial treeline.

Montane scrub is a component of treeline woods. It comprises a range of shrub communities which occupy a span from the commercial treeline, becoming dominant above the natural treeline and finally continuing up to the scrubline. At lower altitudes montane scrub species can form understorey components of existing woodland: this is in fact the usual seed source for treeline scrub. At the highest elevations, true montane or dwarf species and sub species can be found, such as Betula nana, Juniper communis spp alpina, and the range of prostrate willows.

Beyond the natural treeline, shrub communities become predominant (where these communities occur naturally), although stunted birch, rowan and pine can also occur, first as scattered clumps and then as individual trees. The 'natural' picture would be a mosaic of tree and shrub vegetation continuing in altitude up to the biological limit of tree growth.

The scrubline is the biological limit of tree growth, occurring where tree and shrub growth gives way completely to montane heaths and grasslands.

Treelines are thus transition zones where woodland canopies begin to break up and montane habitats such as scrub, heath or grassland begin to dominate. All these zones vary in width and altitude across the country, relative altitudes becoming lower towards the north and west.

Treelines are estimated to vary from between 650m in the central (continental) region of Scotland to around 250m in exposed places close to the west coast (oceanic). However, since windiness is a primary influence on tree growth, there are very exposed parts of the north-west mainland and the Western and Northern isles where the natural tree-line will be much closer to sea level.

4. Creating Treeline Woodlands

New treeline woodlands should consist entirely of native species which are within their natural range. The conservation value of these treeline woodlands will depend upon suitability of the site and proximity to other woodland. The principles behind creating new native woodlands are described in FC Bulletin 112 and these principles should also be applied to the establishment of treeline woodlands, ie:-

- Take advantage of natural regeneration whenever acceptable results (stocking and species mix) are likely to be achieved within a reasonable timescale.
- Where planting is necessary, match locally native tree and shrub species to site type. Pay particular attention to the need to select seed sources appropriate to the elevation of the proposed planting. Plant at higher densities than permitted under WGS rules for new native woodlands to reduce the risk of unacceptable planting failure arising.
- Allow new native woodlands to become semi-natural in the long term by using minimal soil disturbance, little or no artificial drainage and by trying to mimic natural patterns of plant spacing and distribution.

In order to maximise biodiversity gains, woodland areas should be inter-connected in a matrix of woodland cover. It should be borne in mind that similar linkages must also be considered for moorland habitats in the montane zone. There may be a number of specific open moorland habitats at higher altitudes which need to be conserved (eg mire communities on calcareous flushes). Local SNH staff or specialist vegetation surveyors should be consulted at an early stage to advise on relative values of open moorland habitats.

Treeline woodlands may extend existing semi-natural woodland, comprise new native woodland, or provide an addition to a plantation.

4.1 Extending Semi-natural Woodlands

The preferred means of creating treeline woodlands is to encourage the expansion of existing semi-natural woodlands where upper margins have been limited artificially by grazing, burning or fencing. This will normally be achieved through natural regeneration. Results from natural regeneration at high altitude are likely to be more variable - and the timescale for successful establishment is likely to be longer - than at lower altitudes. Moreover, seed availability is a major obstacle to establishment more than a few hundred metres distance from mature trees (French et al, 1997).

Isolated remnants of truly montane species of woody shrub, such as the dwarf willows are often reduced to a small number of viable plants. As such, restoration of such populations is outwith the scope of WGS. However, SNH may be able to grant aid this restoration, or provide advice on other grant sources.

4.2 New Treeline Woodland

There is a temptation when creating new native woodlands to extend the planting to recreate extensive treeline zone at the same time. However, when restoring treeline woodlands through planting, it is possible to establish core patches of native species as future seed sources. These will be able to expand naturally over time, developing into a mosaic of habitats which relate to site fertility, drainage and exposure.

This implies protecting any planted patches and their future regeneration zone by culling deer, removal of sheep and - as a last resort - by fencing. It is possible to carry out ground preparation such as burning and scarifying to provide a seedbed and improve the chances of natural regeneration of treeline woodland occurring. However, this has been little tested as yet, and caution is necessary before intervening to this degree. (Details are given French et al 1997).

4.3 *Extending the Treeline in Commercial Plantations*

In many places non-native commercial species are regenerating 'up the hill', often in mixture with native species from scattered remnant trees. Developing a scrub zone above plantations will provide both conservation and landscape benefits by softening visually intrusive edges and creating a transition zone for flora and fauna. Positive management of these areas will have a significant benefit for the whole woodland. However, since clearfelling coupes within the plantation is likely to create visual problems, eg by leaving "pelmet" on the hillside, reference to the FC National Office for Scotland Landscape Architect may be necessary before the establishment of such treeline woodland is grant aided. There may be situations where an upper fringe of plantation has been retained due to extraction difficulties. This too can present visual problems that treeline woodland may help to alleviate.

A new type of ecosystem is likely to develop above commercial treelines consisting of mixtures of native and non-native species. We have yet to develop an understanding of how these ecosystems function and how they contribute to woodland biodiversity.

5. Restoring Treeline Woodlands

Where suppressed seedlings exist, grazing pressure should be reduced to facilitate seedling growth.

Existing seed trees should be allowed to regenerate, either from the semi-natural forest below, or from scattered seed trees above the woodland. A larger expansion zone should be allowed than for new native woodland - say 200-500 m.

Future seed sources should be established as relatively dense patches of tree shrub mixtures, matched to the site.

Planting entire new facsimile treeline woodland should not be encouraged except on a small scale. Larger patch planting as detailed above may be appropriate to the landscape scale, but in general large scale planting should be avoided. It will not produce the semi-natural habitat which treeline woodland, by definition, must comprise.

6. Assessing WGS applications for treeline woodlands

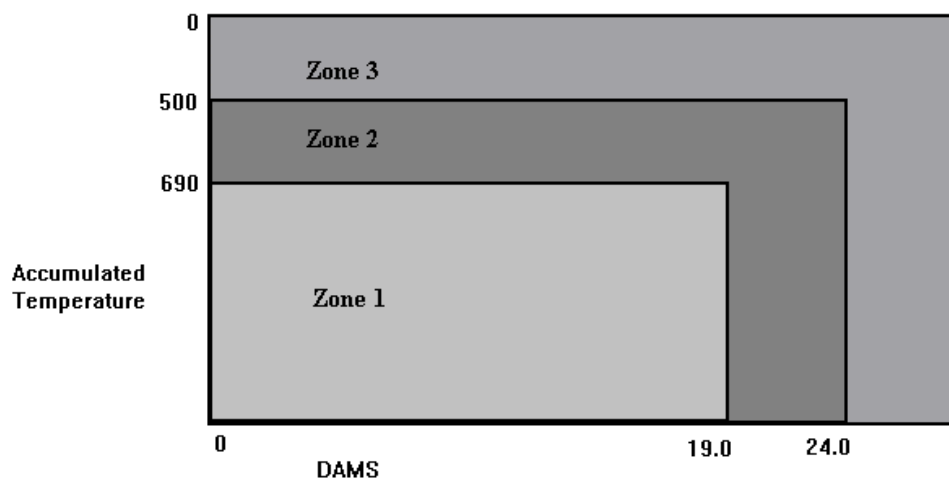
In order to assess the potential for grant aid, it is necessary to understand the factors which affect tree growth at high altitude. The position of the treeline in continental climates is known to be influenced strongly by summer temperatures. However in oceanic climates, such as the British Isles (characterised by a small annual temperature range, high rainfall and strong winds) it is thought that the exposure of a site exerts a large influence on where the treeline is located (Tranquillini 1979). Exposure varies rapidly with topography and also with regional location (Hale, Quine and Suarez 1997). Lack of soil oxygen, moisture or nutrients may also be limiting factors. The extent of grazing, and land management practices such as heather burning, will also influence the regeneration and survival of woodlands. Snow can help to protect small trees from the ravages of wind and grazing. Freezing of tree roots induces water stress, which restricts growth.

The complexity of the relationship between altitude and the treeline means that there is no definitive guidance about its optimal location. However, there are a number of management tools which can help inform decisions about the extent to which grant aid should be available.

7. Management Tools to Facilitate WGS applications

a. Windiness Scores - Detailed Aspect Method of Scoring - (DAMS)

DAMS data provide an indication of relative windiness (exposure) which has been applied to the whole of the UK using a digital terrain modelling technique (Bell, Quine and Wright). During 1996, Forest Research carried out a study which confirmed that both exposure and warmth influence the extent of woodland areas in upland Britain, but that neither factor alone was sufficient to define woodland limits. Using DAMS and Accumulated Temperature (AT) data, Scotland has been divided into 3 zones as shown in Appendix 2.



Zone 1 - Land capable of supporting commercial forestry

Zone 2 - Land capable of supporting non-commercial forestry

Zone 3 - Land unsuitable for tree growth

Figure 2. DAMS Scores - Potential Distribution of Woodland Area in Scotland

Within zone 2 (including the treeline woodlands) 90% of the sites sampled had an AT higher than 575 °C and a DAMS value of less than 22.5. The study concluded that if woodlands are established within these limits, they may extend by natural regeneration into colder, more exposed areas closer to the biological limits of tree growth. The study also indicated that there are no apparent differences between the upper exposure limits of Scots pine and birch woodlands.

Forest Research Agency* at the Northern Research Station can provide DAMS data at 250m resolution, for any site in Scotland. Information on how to use DAMS scores is provided in the Forestry Commission's Research Information Notes nos 230 & 231. Once Conservators have Ecological Site Classification (ESC) in disk form, they can easily access DAMS and other climatic data for any grid reference in Scotland.

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b. Ecological Site Classification (ESC)

The moisture and nutrient regimes of soils have also been identified as limiting factors to tree growth. The most effective way of assessing their influence is through ESC. Appendix 1 shows typical ESC grids reflecting the relative position of different woodland types. It is critical with treeline woodlands that the relatively better drained and relatively more fertile sites are selected for initial establishment. Woodland cover can subsequently regenerate to a more natural extent.

Information about ESC and how to use it is available in the Forestry Commission's Research Information Note No 260 and Technical Paper No 20.

c. Natural Vegetation Classification (NVC)

Britain has only a few good examples of natural treeline woodlands to act as role models for new treeline woodland. Woodland scrub NVC types are described in Rodwell (1991).

What is clear however is that only the most hardy tree and shrub species capable of surviving high exposure levels are likely from a component of any new treeline woodlands. These are: Scots pine, Downy and Dwarf Birches, Rowan, Juniper, Eared Willow and certain prostrate Willows.

Thus, most new treeline woodlands are likely to be scrubby extensions of pinewood (W18) and upland birch (W17 and W4) woodland. Juniper can develop into a scrub community of its own (W19) both at treeline elevations and on more base rich soils in, for example, the Border hills. More commonly, juniper is found as a component of upland pine and birch woodland. Juniper (spp.alpina), along with pine seedlings and dwarf willows can be found as components of montane heaths - above the normal scrub line, and as high as 800m in the Cairngorms.

Finally, a number of dwarf willows can form montane willow scrub communities (W20), usually confined to base rich soils in areas with low grazing pressure, such as crags. Since base rich soils are not widespread in the Scottish Highlands (unlike say parts of Norway where willow scrub thrives), there is actually little scope to extend these communities on any scale.

Upland pine/birch/juniper (say W19) will be the main focus for WGS aided new treeline woodlands.

8. Information Requirements for WGS Applications

The following guidance should be noted by Woodland Officers when considering WGS applications for treeline woodlands:-

Applications which provide input to Biodiversity Action Plans should be regarded favourably.

- Since the rationale for grant aiding treeline woodlands is to enhance biodiversity and soften visual boundaries, any application will normally enjoy positive support from SNH staff.
- The applicant must supply the Forestry Commission with adequate information about the site to enable the woodland officer to consider an application for grant aid. In particular, information on DAMS, ESC, current soils and vegetation and target woodland NVC categories will be essential. This information will assist an applicant to design an appropriate scheme.
- Site survey information required for new native woodlands is outline in FC Guidance Note "Site Survey Requirements for New Native Woodland WGS Applications 1996". Such information is of particular importance when deciding the design and extent of woodland to be grant aided at high altitude.
- An applicant should supply information about existing tree cover and existing regeneration which is visible or has been suppressed.
- The DAMS score for any area to be grant aided should not exceed 22.5 and the AT value should be higher than 575 °C.
- Upward expansion of an existing semi natural woodland is the preferred option for creating treeline woodlands. Due to increased naturalness/decreased degree of intervention, a more relaxed distance from seed source rule should be allowed than in the case of other new native woodlands.
- Because of the increased uncertainty of results and timescale for achieving them, a review date in the WGS contract is essential.
- Where a proposed new native woodland includes a treeline woodland component, then this should not exceed 20% of the total area of the scheme, depending on the levels of lower level woody shrubs (WSH) and open ground (OG). A DAMS score of 19 (AT of 690 °) is a good indicator of where treeline woodlands begin, but on-site verification will be essential.
- Planting should be targeted at the more fertile, better drained soils and seedlings should be sourced from a suitable matching region and altitude.
- A mosaic of woodland should be established which will allow natural expansion over time. Species should be matched to site in accordance with the vegetation indicators and soil conditions.
- Native tree species, such as birch and pine, will reduce in height with altitude and will become more windswept, but they should continue to be treated as trees for grant

purposes. However, where scrub species such as juniper are planted they will be part of the scrub component of the new native woodland.

- Where patches of trees are established as seed sources, the stocking densities should be in excess of 2500 trees per hectare. Woodland Officers may specify higher densities. Some variation in spacing should be encouraged and may result in slightly lower average stocking densities.
- Treeline woodlands above plantations can be considered but the view of the FC National Office for Scotland Landscape Architect must be sought in assessing potential design aspects where visual problems could arise at time of felling. Applicants should demonstrate how the proposals integrate the design of the plantation with that of the treeline woodland.

FURTHER READING

Bell P D, Quine C P and Wright J A, (1995). The use of digital terrain models to calculate windiness scores for the windthrow hazard classification *Scottish Forestry* 49, 4, 217-225.

French D D, Miller G R and Cummins R P, (1997). Recent development of High-altitude *Pinus sylvestris* scrub in the Northern Cairngorm Mountains, Scotland. *Biological Conservation* 79, 133-134.

Gilbert D, Horsfield D, Thompson D B A, (1997). The ecology and restoration of montane and subalpine scrub habitats in Scotland. SNH Review Paper (in press).

Hale S E, Quine C P, Suarez J C, (1997). The location of climatically defined treelines in new native woodlands. FCRA Report (unpublished).

Pears N V, (1967). Present treelines of the Cairngorm Mountains, Scotland. *J Ecol* 55, 815-829.

Pears N V, (1988). Scots pine (*Pinus Sylvestris L*) seedling survival above the treeline in the Cairngorm Mountains, Scotland, *Forestry* 61, 1, 61-71.

Pyat, D G, (1995) An ecological site classification for forestry in Great Britain. *Forestry Commission Research Information Note No 260*, Forestry Commission, Edinburgh.

Pyatt D G and Suarez J C, (1997). An ecological site classification for forestry in Great Britain, with special reference to Grampian, Scotland. *Technical Paper No 20*, Forestry Commission.

Quine C P and White I M S, (1993). Revised windiness scores for the windthrow hazard classification. The revised scoring method. *Forestry Commission Research Information Note No 230*, 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.

Rodwell J S, (editor), (1991). *British Plant Communities Vol 1 Woodlands and Scrub*. CUP Cambridge.

Rodwell J S and Patterson G, (1994). *Creating New Native Woodland*. FC Bulletin 112. HMSO.

Worrell R and Malcolm D C, (1990). Productivity of Sitka spruce in northern Britain. 1. The effects of elevation and climate. *Forestry* 63, 2, 105-118.