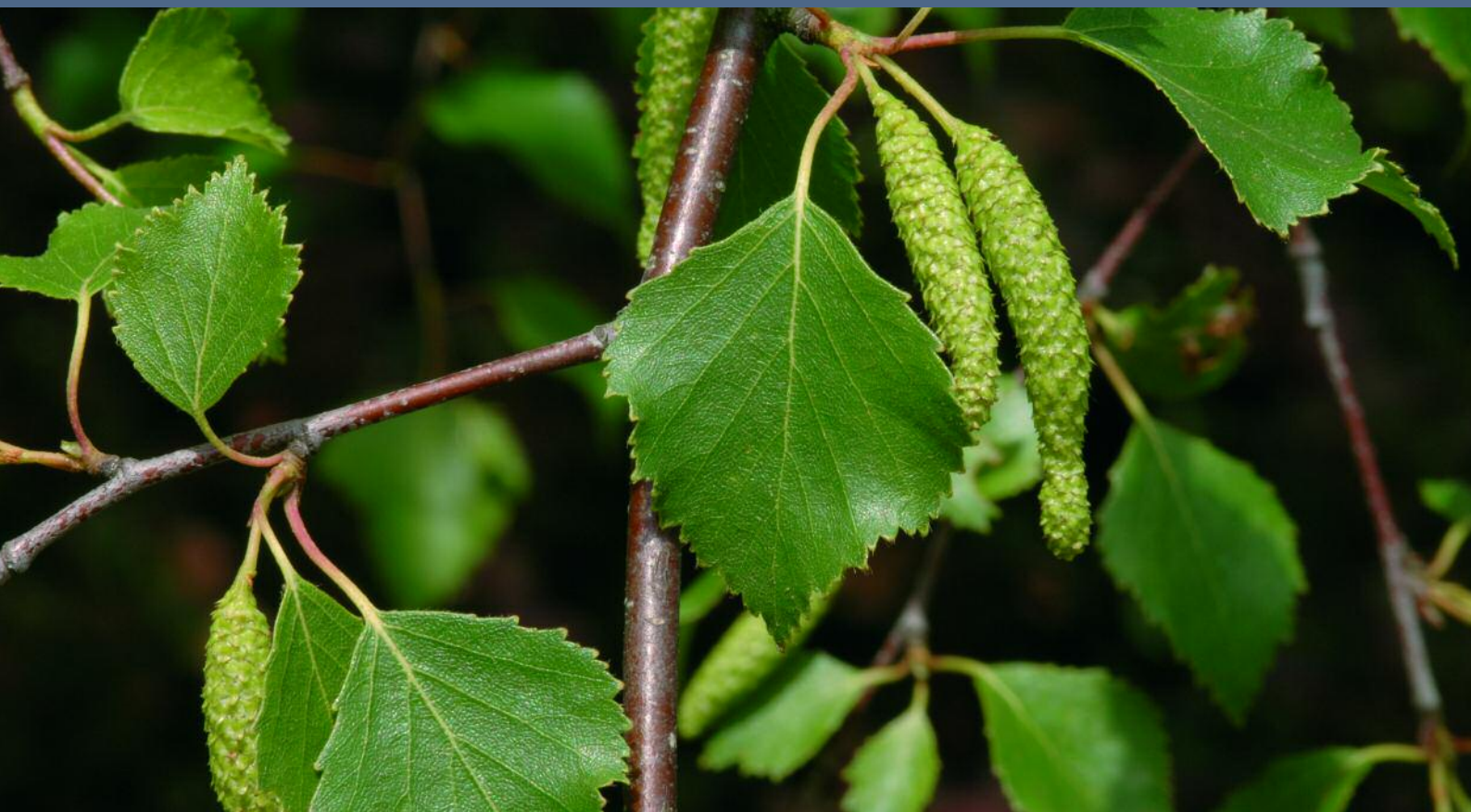


Seed Sources for Planting Native Trees and Shrubs in Scotland



Introduction

This guidance note sets out Forestry Commission Scotland (FCS) policy for selecting suitable origins, provenances, and categories of planting material for planting native species of trees and shrubs in Scotland. The policy will apply both to FCS support for private woodlands and to the management of the national forest estate.

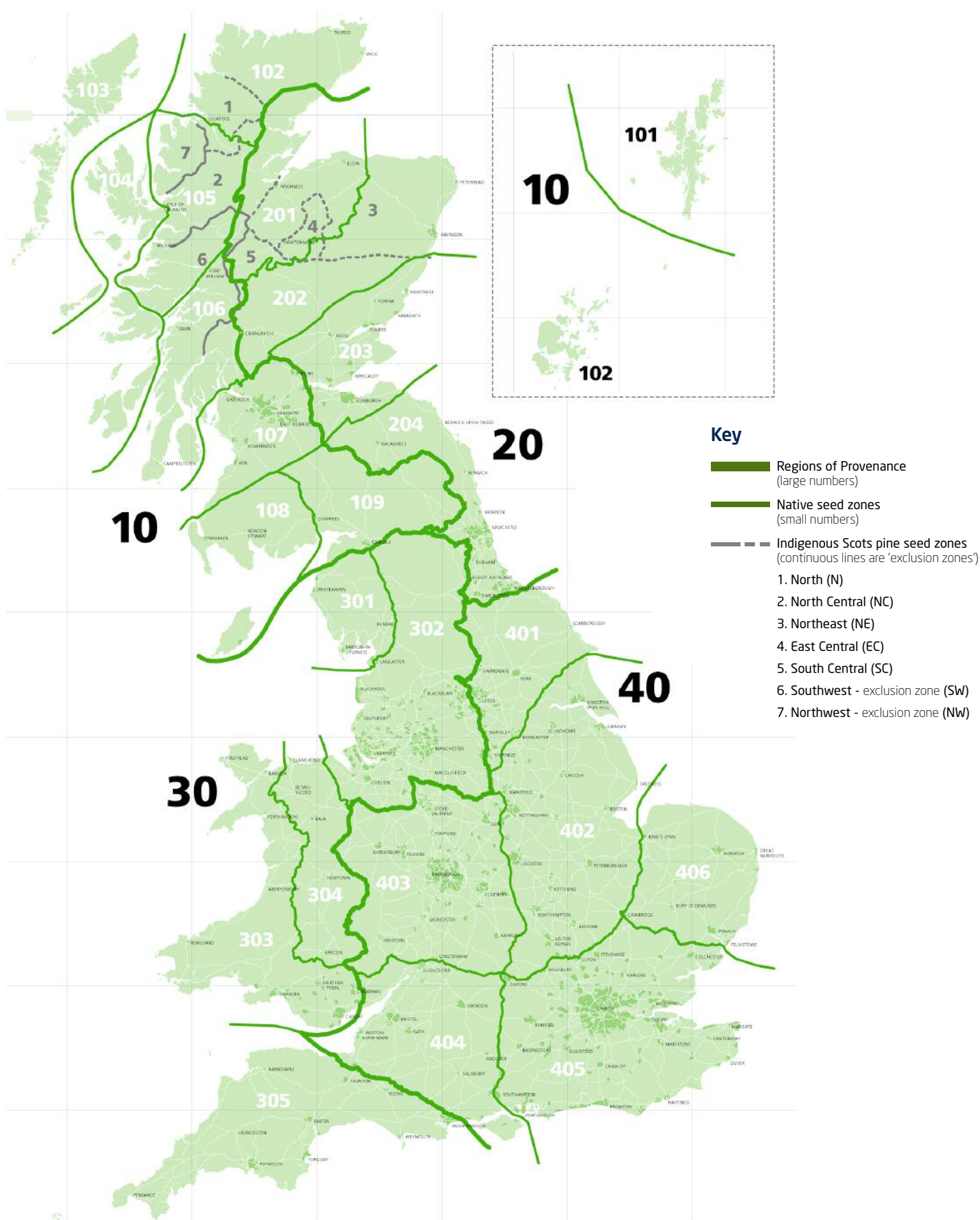
It is primarily intended for those planting species that are native to Scotland, both within their native range and in other parts of Scotland (see Table 1). The guidance may also be used to help source suitable provenances of species that are native to other parts of Britain, but have been introduced and become naturalised in Scotland.

Background

1. Choosing suitably adapted seed sources has always been important in forestry. Broad regions of provenance were defined for Britain in the 1970s, when most planting used introduced species. Scotland is divided into 2 provenance regions (Figure 1).
2. In line with international sustainable forestry guidelines, the UK Forestry Standard (Forestry Commission, 2004) encourages the use of local stock for planting native

species, especially in existing and new native woodlands. The UK Woodland Assurance Scheme (UKWAS, 2000) also encourages use of local provenance in certified woodlands. FCS promotes local stock for planting of native and riparian woodlands as a requirement for grant-aid, and also for planting on the national forest estate. Since 1989 we have specified locally sourced material for all planting under our native pinewoods grant schemes, using 7 zones defined from research on genetic variation in native Scots pinewoods (Figure 1).

Figure 1 Map of local seed zones



3. FC Practice Note 8 (Herbert et al, 1999) set out a labelling system for identifying local stock for planting native species throughout Britain, especially in semi-natural and new native woodlands. It introduced a map of seed zones (reproduced in Figure 1) based on a climatic and geological subdivision of provenance regions. The note is available at www.forestry.gov.uk/publications
4. The Forest Reproductive Material (FRM) Regulations, 2002 provide a regulatory framework throughout the UK, which is mandatory for marketing some native species and can be extended to others as required. It allows users to specify and identify the sources and types of planting material. For full guidance on the FRM Regulations see www.forestry.gov.uk/frm
5. This note explains how to use the seed zones system and FRM Regulations for sourcing native species for woodland planting in Scotland.

FCS policy for sourcing planting material for native species of trees and shrubs

6. The sourcing of planting stock should help achieve both the conservation and sustainable use of genetic resources, in accordance with the UK's international commitments.
7. FCS will promote the availability and use of planting stock that will:
 - be both fit for purpose and ecologically adapted* to the planting site;
 - maintain or enhance both genetic adaptation/fitness of our tree and shrub populations, and their capacity to adapt to changing environmental conditions;
 - sustain sufficient genetic variation to provide for future uses of trees for all purposes;
 - help to maintain and restore natural genetic processes in tree populations, especially gene flow and natural selection;
 - help conserve patterns of the genetic structure of tree populations that reflect their evolutionary history.

*Ecologically adapted means well adapted to the site type and prevailing environmental conditions, including pests and diseases; and capable of establishing a population and growing and reproducing successfully.

A precautionary approach with flexible implementation

8. Our understanding of genetic matters and issues such as the adaptability of tree populations to climate change is limited. This guidance therefore takes a **precautionary but pragmatic approach**. The seed zone and elevation labelling system in FPN 8, together with the FRM Regulations, give us tools that we can adapt as our understanding grows.



Dieback of young birch is a common problem, that may be partly caused by unsuitable provenance choice (GREEN, 2005).

9. FCS recognises that this policy will take time to implement. We will adopt a flexible approach to implementing the policy which takes account of constraints and we will work with key stakeholders to overcome them.

Key issues and principles

Genetic adaptation

10. There is evidence (summarised in Ennos et al, 2000) that genetic adaptation to environmental conditions has developed over millennia, and to some degree in naturalised species over a few generations. Adaptation patterns are not yet well understood and may also vary between species according to rates of gene-flow. Research is underway to explore adaptation for several tree species with a range of reproductive traits, but will take several years to reach full conclusions. Meantime judgements on best practice are needed based on current knowledge.
 - In general increasing the movement of planting material either south/north or east/west beyond 1-2 seed zones is likely to carry an increasing risk of reduced adaptation to the planting site due to climatic and/or daylength differences, although there are a number of cases where more distant provenances of some species have been shown to perform well in trials.

- Local adaptation is likely to be greater where environmental gradients are stronger, eg in the north and west.
- Elevation is important as a selection pressure and should be given more prominence than it has so far.
- Soil-type adaptation may also occur, but information on soil type in source sites is not usually available. Matching the elevations of source and planting site should reduce the risk of poor adaptation.



Distant view of high elevation planting of Caledonian Scots pine, Glen Affric

Genetic variation and capacity to adapt to environmental change

11. Even small isolated tree populations contain high levels of genetic variation and adaptive capacity. Linking and expanding native woods, and planting well-adapted stock of native species more widely in the countryside, will increase gene flows and strengthen the capacity of tree populations to adapt to future environmental change and sustain various uses.
12. There is no clear evidence yet of the degree of the genetic selection pressures that may be generated by **climate change**, or whether they might exceed the ability of native tree populations to respond to them. A possible strategy is to introduce more southerly provenances to anticipate predicted changes, but this could risk increase susceptibility to unseasonal frosts, and is vulnerable to the high degree of uncertainty of predicting how climate change will affect any given area.
 - To maintain genetic variation and capacity to adapt in future, it is vital to plant seed or cuttings collected from a wide enough range of parent trees in the source population(s).
 - There appears to be no strong case at present in Scottish conditions to plant different genotypes to anticipate predicted climatic conditions for 50-100 years ahead, but this will be kept under review.
 - We are participating in research to improve our ability to predict how tree populations will adapt to climate change, and we will monitor and respond to changes in species range and performance.

The importance of semi-natural woodlands for genetic conservation

13. As well as their value as habitats, semi-natural woods contain indigenous gene-pools which are important for genetic conservation, especially the larger woods. By retaining their semi-natural character, natural selection processes will be maintained, and the historic genetic patterns of tree populations will also be conserved as far as possible.
 - Natural regeneration should therefore continue to be preferred in and around semi-natural woodlands.
 - Where planting is needed it should use indigenous origin planting stock from well-matched sites in the locality.



Natural regeneration expanding a semi-natural woodland in Skye

Sources for timber production

14. Where high timber quality is the primary objective, selected or improved planting material is preferable.
15. Although there still needs to be evidence that it is ecologically suited to the planting site, a somewhat wider geographic range of sources can be used for this purpose than for general native species planting to allow the selection of suitable planting stock of proven vigour and form.
16. This wider range is based on the assumption that any increased risks from using the more distant material, eg increased frost susceptibility, can be offset by a suitably intensive management regime and careful selection of sites to suit timber production. It also recognises the current shortage of sources of selected/improved material in Scotland which may take many years to remedy for some species.

Origin and Provenance and types of reproductive material-some definitions

Origin of a seed source refers to the part of the species natural range from which the material originally came. *Provenance* refers to the location where the seed source trees are growing. Provenance may not be the same as origin in cases where the seed source trees were planted or had regenerated from planted parents. Origin is more useful information but is often unknown, in which case the choice of planting material needs to be based on knowledge of the provenance.

The FRM Regulations allow the *origin* of basic material of native species to be registered as *indigenous*, *unknown*, or *non-indigenous* (to Great Britain). *Indigenous origins* can be:

- *natural stands* that have regenerated naturally since the existing woodland on the site became established (no evidence of planting the original woodland);
- *planted stands* deriving from seed collected at known natural stands as above: the origin quoted is the location of the natural stand(s);
- *tree selection and breeding programmes* where the individual parent trees are of indigenous origin.



Young birch grown at Northern Research Station, Bush, Mid Lothian

All marketable material is included in the National Register and information on both the provenance and origin is included, normally to seed zone/elevation band or native pine seed zone level for native species. Indigenous origin material is identified with the code 'N' in the National Register.

There are 4 categories of reproductive material under FRM Regulations:

- Source identified FRM- from general or specific locations in a seed zone/altitude band, or region of provenance.
- Selected FRM – individual stands showing superior form/growth rate/health.
- Qualified FRM – from untested selection of superior individual trees.
- Tested FRM- from selection of superior individual trees or stands that have been shown to be genetically superior for growth/form.

Guidance to identify suitable planting material

17. This section, together with Tables 2 and 3, sets out the sources and types of reproductive material for species native to Scotland that FCS will use in planting on the national forest estate and that we will accept for use in grant schemes or in setting replanting conditions for felling licences. The guidance is based on 3 planting scenarios:

A. Planting native species in and adjacent to semi-natural woodlands, where the primary objective is normally biodiversity and/or other non-timber benefits.



B. Planting native species mainly for biodiversity or multiple benefits, in areas not in or adjacent to semi-natural woods. The main objectives are environmental, amenity, or shelter etc. rather than high yield or quality timber.



C. Planting native species mainly for timber quality or yield, in areas that are not in or adjacent to semi-natural woods.



General guidance

18. We will apply some general requirements to all planting scenarios:

- **Collect from sufficient parent trees -** Collections should be made from at least 20-30 well dispersed parent trees: more complete guidance is given in Forestry Practice Note 8. In some cases, this may require mixing of very small seed lots from several small populations in the same locality and elevation band.
- **Elevation -** For British sources, the elevation of seed source and planting site must be in the same elevation band (above or below 300 metres), except for boundary cases- below. For continental sources these elevation bands are less reliable and other evidence will be needed to identify suitable provenances.
- **Boundary cases -** We may accept modest transfers across elevation band or seed zone boundaries where both the planting site and the source population are close to a boundary.
- **Scots pine native seed collection zones -** These 7 seed zones, (Figure 1), are based on 1980s research into historic genetic variation patterns in native pinewoods. Although they differ from the general seed zones, the pine zones are well established and should continue to be used to identify seed collected from native Scots pine sources (often called Caledonian Scots pine).

Detailed guidance for each planting scenario

A. Planting native species in and adjacent to semi-natural woodlands.

19. Any planting should normally use indigenous origin material originating from the same seed zone, to best conserve genetic patterns and adaptation. We will apply the following criteria for semi-natural woodlands, Caledonian Pinewoods Inventory sites, and also in sites designated as woodland Sites of Special Scientific Interest (SSSIs) or Special Areas of Conservation (SACs) (subject to case by case requirements advised by Scottish Natural Heritage (SNH)).
- Natural regeneration will be strongly preferred wherever practicable.
 - Where planting is agreed within or adjacent to semi-natural woodlands (ie within about 300 metres), *indigenous origin* sources will be normally be required from the same seed zone/pine zone.
 - Delay in planting or reversion to natural regeneration may be required where material from the same zone is not currently available.



Planting next to mature pinewood

- *Source identified material* stands should normally be used, but *selected*, *qualified* or *tested* stock for timber production will also be acceptable, provided it meets origin criteria.

20. We may accept **alternatives**:

- where lack of local indigenous origin stands and/or erratic seed production is expected to cause prolonged shortage;
- where there is a more important biodiversity priority requiring urgent planting to expand the woodland, and no local origin stock is available;
- where most stands of the same species in the semi-natural woodland are planted with material of unknown or distant origins; or
- for species in small semi-natural woods (under 5ha), that are surrounded by stands of the same species that were planted using unknown or distant origins.

In all these cases *indigenous origin material from adjacent seed zones* is the preferred alternative (Use column B in Tables 2 or 3). Where this is not available, *local provenance material sourced from the same seed zone* will usually be acceptable if it is from stands which appear well adapted.

21. To define semi-natural woods, we will use a combination of Ancient Woodland Inventory and Scottish Semi-natural Woodlands Inventory datasets, and the Caledonian Pinewoods Inventory for native pinewoods. We will accept exceptions to these where good evidence is presented, and we will use information from the new Native Woodlands Survey of Scotland to update these sources over the next 5 years.

B. Planting native species elsewhere mainly for biodiversity or multiple benefits:

22. This includes planting of new native woods to meet Habitat Action Plan targets. Any category of FRM can be used but either *source identified* or *selected* material will normally be suitable. FCS will accept material of *indigenous origins*, or *provenances of unknown origin*, preferably from

collections in the same seed zone, but also from the adjacent zones listed in column B in Tables 2 and 3.

23. We may accept alternative sources, eg. where there is a current scarcity of these types of material, in the order:
- Scottish or British Isles material with good evidence of local suitability from provenance trials or evidence of good performance on similar sites in the locality;
 - material from other Scottish/British Isles locations with similar conditions to those at the planting site;
 - north-west continental European sources where there is evidence from provenance trials of suitability for the proposed planting site and Scottish conditions in general.
24. We will take advice from Forest Research where necessary to help us to assess exceptions.

C. Planting native species mainly for timber in areas away from semi-natural woods.

25. We will use the following criteria:
- We will prefer selected, qualified or tested material from the same zone, or nearby zones without large north/south or east/west movement from source to planting area. See column C of Tables 2 and 3 for list of zones;
 - Where source seed zone is not known, eg material selected from many parents across the country, we will prefer material mainly or entirely from the same Region of Provenance.
26. We will accept alternative sources where there is evidence that they will be sufficiently adapted to the planting site, in the order of preference:
- more distant Scottish or British sources;
 - Continental European sources with good evidence of reasonable performance;
 - Continental European sources with a theoretical match to planting site.
27. We will seek advice from FR as for scenario B.

Planting native species outside their native range

Significant adaptation to the local environment may have developed over a few generations where species have been introduced and become naturalised beyond their current native range. This includes species native to Scotland which have been planted outside the native zones in Table 1, (eg Scots pine planted outside the Highlands), and also species native to other parts of Britain that have long been introduced to Scotland, such as beech. For planting such species outside their native zones, we will prefer the use of regional provenances selected under scenarios B or C.



Beech planted in the Tweed Valley

We will also encourage a similar approach to sourcing plants of *introduced naturalised* species (not native in Britain at all) that have been present here for long enough for significant adaptation to Scottish conditions to be likely, eg. sycamore.

How will FCS help to implement this policy?

28. Limited availability of Scottish-sourced planting material, either in general or for particular seed zones, is a problem for some species at present. It will take time for seed collectors and nurseries to develop the capacity to supply planting material for native species from all seed zones. We will be flexible in implementing this guidance and we will work with the nursery trade, seed collectors, woodland owners, and others to stimulate greater production and use of local stock, for example by:
- developing an inventory of indigenous origin populations, and encouraging woodland owners to register and manage them for seed production;
 - exploring measures to encourage collection and production of Scottish sourced planting material;
 - promoting use of the FRM Regulations system to enable suitable seed sources to be identified and the characteristics of planting material to be traced.

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Table 1a Large and medium sized tree species native to seed zones in Scotland

Species			Native seed zones												Site types					
			101	102	103	104	105	106	107	108	109	201	202	203	204	a	b	c	d	e
agl	<i>Alnus glutinosa</i>	common alder																		
msy	<i>Malus sylvestris</i> ssp <i>sylvestris</i>	crab apple																		
fex	<i>Fraxinus excelsior</i>	ash																		
ptr	<i>Populus tremula</i>	aspen																		
bpu	<i>Betula pubescens</i>	downy birch																		
bpe	<i>Betula pendula</i>	silver birch																		
ppd	<i>Prunus padus</i>	bird cherry																		
pav	<i>Prunus avium</i>	gean (wild cherry)																		
ugl	<i>Ulmus glabra</i>	wych elm																		
qro	<i>Quercus robur</i>	pedunculate oak																		
qpe	<i>Quercus petraea</i>	sessile oak																		
psy	<i>Pinus sylvestris</i>	Scots pine																		
sac	<i>Sorbus aucuparia</i>	rowan																		
sca	<i>Salix caprea</i>	goat willow																		
tba	<i>Taxus baccata</i>	yew																		

Table 1a and 1b lists the tree and shrub species native to Scotland (excludes 3 very rare whitebeams not recommended for planting, plus creeping and montane willows).

Shaded species are subject to EU FRM regulations.

Native Zones are shown with a shaded square: a zone is included if a species is native to any part of it within Scotland.

(Note some of these species may have been introduced and naturalised in other zones, and some may have been more widely distributed naturally in the early post-glacial period)

Information on native ranges is drawn from New Atlas of the British and Irish Flora. (Preston C.D., Pearman D.A., and Dines T.D.(eds), 2002)

Key to:

a = wet sites

b = light, dry soils

c = heavy soils

d = acid soils

e = neutral or alkaline soils

f = exposed sites

Table 1b Small tree and shrub species native to seed zones in Scotland

Species			Native seed zones												Site types							
			101	102	103	104	105	106	107	108	109	201	202	203	204	a	b	c	d	e	f	
psp	<i>Prunus spinosa</i>	blackthorn																				
bna	<i>Betula nana</i>	dwarf birch																				
csc	<i>Cytisus scoparius</i>	broom																				
sni	<i>Sambucus nigra</i>	elder																				
ueu	<i>Ulex europaeus</i>	whin (gorse)																				
vop	<i>Viburnum opulus</i>	guelder rose																				
cmo	<i>Crataegus monogyna</i>	common hawthorn																				
cav	<i>Corylus avellana</i>	hazel																				
iaq	<i>Ilex aquifolium</i>	holly																				
jco	<i>Juniperus communis</i>	juniper																				
rcn	<i>Rosa canina</i>	dog rose																				
rce	<i>Rosa caesia</i>	hairy dog rose																				
rmo	<i>Rosa mollis</i>	soft downy rose																				
rru	<i>Rosa rubiginosa</i>	sweet briar																				
rsh	<i>Rosa sherardii</i>	Sherard's downy rose																				
eeu	<i>Euonymus europaeus</i>	spindle																				
spe	<i>Salix pentandra</i>	bay willow																				
sau	<i>Salix aurita</i>	eared willow																				
sci	<i>Salix cinerea</i>	grey willow (sallow)																				
sph	<i>Salix phylicifolia</i>	tea-leaved willow																				
smy	<i>Salix myrsinifolia</i>	dark-leaved willow																				
spu	<i>Salix purpurea</i>	purple willow																				
Key to: a = wet sites b = light, dry soils c = heavy soils d = acid solis e = neutral or alkaline soils f = exposed sites																						

Table 2 Suitable sources for each planting scenario

Planting Zone (see map in PN8)	A: Semi-natural woods and extension	B: General planting, various objectives	C: Primary objective timber yield/quality
	Source Zone *1	Source Zones *2	Source Zones *3
101	101	101 , 102, 103	101 , 102, 103, 104, 105
102	102	102 , 101, 103, 105	102 , 101, 103, 104, 105, 106, 201 (for use in NE part of zone 102)
103	103	103 , 102, 101, 104, 105	103 , 101, 102, 104, 105, 106
104	104	104 , 103, 105, 106	104 , 102, 103, 105, 106, 107
105	105	105 , 102, 104, 106	105 , 102, 104, 106, 107, 201
106	106	106 , 107, 104, 105	106 , 104, 105, 107, 108, 109, 301, 201 west, 202 west
107	107	107 , 106, 108, 109, 203 west, 204 west	107 , 106, 108, 109, 301, 302 north, 203, 204
108	108	108 , 107, 109, 301	108 , 106, 108, 109, 301, 302 north, 203, 204
108	108	108 , 107, 109, 301	108 , 106, 107, 109, 301, 302 north, 204 west
109	109	109 , 107, 108, 301, 302 north, 204	109 , 107, 108, 203, 204, 301, 302, 401
201	201	201 , 202, 102 east	201 , 202, 203, 102 east, 105 east, 106 east
202	202	202 , 201, 203 north, 106 east	202 , 201, 203, 204 north, 106 east
203	203	203 , 204 north, 107 east	203 , 202, 204, 109, 107, 302 north
204	204	204 , 203, 109	204 , 203, 107, 108, 109, 401, 302 north

*1 Use planting material that is registered as of *Indigenous origin from this zone*.

*2 Use *Source Identified* or *Selected* material normally. *Indigenous origins* are preferred; second choice is *provenances of unknown origin*.

*3 Use *Selected*, *Qualified* or *Tested* material. *Indigenous origins* are ideal but *provenances from these zones* are alternatives. Where the material is mixed, eg seed orchards, we will prefer material that is mainly or entirely from the listed zones or from the same Region of Provenance as the planting site.

See text for details and exceptions.

Table 3 Seed sources for planting Scots pine in its native range

Planting Zone (Scots pine zone)	Source pine zones A: Semi-natural pinewoods and extension (CPI areas) *1	Source pine zones B: Scots pine planting for mixed objectives *2	Source pine zones C: Primary objective timber yield/quality
North (N)	N	N, NC	Zones as for B for material from Selected stands. Also mixed Qualified and tested material from same Region of Provenance (10 or 20), Highland origin if known.
North-central (NC)	NC	NC, N	
North-west (NW)*3	NW*	NW*	
South-west (SW)*3	SW*	SW*	
South-central (SC)	SC	SC, EC	
East-central (EC)	EC	EC, SC, NE	
North-east (NE)	NE	NE, EC	

*1 Use registered *Indigenous origin* sources from this zone

*2 Use Source Identified or Selected material. Registered *Indigenous origins* are preferred; second choice is *provenances of unknown origin*.

*3 Exclusion Zones due to distinct population history

See text for details and exceptions.

For planting Scots pine outside its native range, eg southern Scotland, use Table 2

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serves as the forestry department
of the Scottish Executive, and
is responsible to Scottish Ministers

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