TREE SPECIES AND PROVENANCE CHOICE IN HIGH-VALUE CONSERVATION SITES

Where is it important that only local material is planted in woods important for nature conservation and where might a wider range of provenances and species be accepted, given future changes in environment and the threat from tree diseases? **Keith Kirby** looks at a simple scoring system that may help managers address this issue.

In nature conservation management a high priority is often given to maintaining the native trees and shrubs in our woods; they may provide a link to original natural conditions and may be more likely to create or support conditions needed by other woodland species. In the guidance on setting conservation objectives for woodland Sites of Special Scientific Interest the generic target is 95% native tree and shrubs, although this can be varied for particular sites (Kirby et al., 2002). A similar approach is often taken in other sites of high nature conservation value.

A common assumption is that trees and shrubs that have regenerated naturally in a wood may be genetically distinct or particularly adapted to local conditions. This became reflected in best practice advice with respect to planting materials. For example, "*The UK Forestry Standard* and the associated Forestry Practice Guides *The management of semi-natural woodlands* 1–8 recommend using plants of local provenance, preferably from semi-natural parent trees, where planting is to be undertaken in semi-natural woodlands or where native woodlands are to be created by planting." (Herbert et al., 1999).

Criticisms have been raised (e.g. Boshier, 2007) that there is only limited evidence for British trees and shrubs that local material is distinct or more suited to the particular conditions at a site. Local selection pressure may be swamped by long distance gene flow through pollen; adaptation to local average climates may be counteracted by the need for a population to maintain variability to cope with extreme events; environmental selection pressures may be off-set by those imposed through management.

Furthermore, how 'local' does local have to be to maintain any local distinctiveness? What is 'local' for a wind-pollinated species such as oak, will be very different to 'local' for an insect-pollinated tree. Should the material be from the same wood, the same county, the same country, the same continental region? Where is similarity in terms of environmental situation (altitude, soil type, etc) more critical that geographical proximity? The Forestry Commission's provenance regions and local provenance zones were inevitably therefore somewhat arbitrary. Even if local material is locally adapted, that adaptation will be to the conditions under which the current tree crop has grown, e.g. selection for regeneration conditions of perhaps 100 years ago. Will local material continue to be the most appropriate under the changing environmental conditions (a warmer climate change, or soils that have been enriched by nitrogen deposition)?

The Forestry Commission on its website now notes that a warmer climate may provide conditions for a wider range of species that were considered not cold-hardy in the past. "Results from a very limited number of European wide provenance trials suggest that material from 2 degrees of latitude south of a site should be better adapted to a warmer climate, and that by adding a wider range of provenance into woodlands an improvement in resilience to the

effects of climate change will occur, and improved productivity might be achieved. Recent advice suggests that in addition small amounts of provenance material from up to 5 degrees of latitude of a site may be mixed in woodlands." (http://www.forestry.gov.uk/fr/INFD-88VJZZ).

Separate from, but in some cases linked to, climate change impacts (Read et al., 2009) there are conservation concerns about the future of native trees as a consequence of new and emerging pests and diseases (Kirby, 2010). Developing more mixed woodland, both in species and genetic terms, may create woods that are more diverse in their composition and structure, which may help to minimise the effects of future outbreaks.

We should not ignore the possibility that some populations of trees and shrubs do contain local variations that play an important part in adaptation to local conditions or to which associated species may be adapted – for example in terms of the timings of bud-burst. However ancient semi-natural woodland, particularly in England, is highly fragmented, covering only a few percent of the land surface (Spencer and Kirby, 1992). A very strict use of local material and a narrow definition of what counts as local might end up limiting the available genetic variability in future populations and hence their ability to adapt to future changes.

The factors described below might help in setting a balance between where the potential risks of introducing new species or genotypes outweigh potential benefits.

Judging whether use of local material is critical?

The decision on the use, or not, of local provenance or of native species depends on the context: the nature conservation value of the site and its surroundings; the extent to which the tree species in question may have been planted or subject to strong selection in the past; how much of the site may be affected by the proposal; the current resilience of the crop; the vulnerability of the current crop to climate change and/or disease; and the genetic or phylogenetic difference between what it is proposed to plant and what is there at present. For each of the above factors there is spectrum, from situations where the benefits of trying to use local provenance outweigh the risks to ones where any benefits are marginal.

Value of the site

There is a stronger case for arguing for the use of solely native species and local provenance on high-value conservation sites, such as ancient semi-natural woodland, than in other woodland or where new afforestation is concerned. In ancient semi-natural woods there is a greater likelihood that the tree and shrub population, often consisting of old stools or pollards, may contain local adaptations to the site. There is more likelihood that other parts of the woodland system are geared into the particular local genotypes of the trees and shrubs. However the desirability of allowing for future adaptation of this local gene pool to future conditions must also be considered.

An additional factor, although the information is not always available, is whether there are significant species or groups of species that depend strongly on a particular tree species at that site.

Past planting/selection

If the current crop of trees is known to be derived from planting from non-local sources there is little case for arguing against future introduction of stock from elsewhere. Even if the trees have not been planted, there may have been strong selection for a particular species and tree form such that, again, arguments against future genetic diversification are weak. Past planting and deliberate selection are most likely with the main timber species such as oak and beech, and with hazel in the under-storey. It is less likely to apply to minor crop species and hence the case for using local stock for these is stronger.

Proportion of the site affected

If the area to be planted is only a small proportion of the total extent of the wood then any impact on the genetic composition of the local stock is likely to be small. The pollen and seed from the small area planted should be

swamped by that from the rest of the stand. An exception to this rule would be if an undesirable but highly invasive species were proposed for introduction. This assessment must look at the cumulative effect of past plantings and possible future proposals, not just the immediate scheme,

Current resilience

There is likely to be less benefit from introducing new provenances or species if the structure and composition of the stands are already diverse and the trees are well-suited to the site. Many of our trees and shrubs have a relatively wide amplitude in their site requirements and so, if currently well-suited, may still stay within their range of tolerance even under changed conditions.

Table 1. Some factors to consider from a conservation perspective

Factors		Score
Value of the site for conservation	SSSI woodland	7
	Ancient semi-natural woodland	6
	Plantation on ancient woodland site	5
	Other semi-natural woodland	4
	Other woodland	3
	New afforestation – linked to semi-natural woodland	2
	New afforestation – not linked to semi-natural woodland	1
Evidence for past planting/selection of main tree species on site	Past crop planted of non-local provenance	1
	Past planting of local/unknown provenance	2
	No indication of past planting, but strong selection for a species	3
	No indication of past planting and little selection for the species	4
Proportion of site affected by proposal, taking account also of past and likely future plantings	More than 80%	5
	61-80%	4
	41-60%	3
	21-40%	2
	1-20%	1
Current resilience	Species well-suited to site, mixed age, mixed species stands	5
	Intermediate between the above	3
	Uniform age and species composition, poorly suited to site	1
Vunerability of crop	Tree species not particularly susceptible to pest/disease in the area	5
	Tree vulnerable but pest/disease not in the area	3
	Pest/disease in area but tree species not particularly vulnerable	3
	Pest/disease in the area and tree species vulnerable	1
Genetic difference	Same species, adjacent provenance zones in Britain or adjacent parts of the continent	1
	Same species more distant provenance origin (e.g. southern Europe)	2
	Closely related species, performing ing similar ecological function	3
	Unrelated tree, but similar function type (broadleaved, conifer etc)	4
	Totally different tree form	5

Vulnerability of the current crop
Unfortunately most of our major trees do seem to be under some sort of threat at present, whether from grey squirrels (beech particularly), acute oak decline, ash dieback, Phytophthora (alders). Nevertheless some stands are likely to be more vulnerable than others depending on whether the threat is actually in the vicinity or not.

A possible 'score chart'
Each proposal is unique but the 'score chart' opposite may clarify where changing species or provenance is more or less likely to be an issue. In each box a high score goes against introduction of new species or provenance, while a low score suggests introduction might incur less risk/more benefits. The same approach might be taken with judging how specific to be in terms of 'localness'. The higher the score the more desirable it might be to match the environmental conditions of the source and receptor sites, rather than going with whatever native stock the nursery has or using somewhat arbitrary geographic boundaries.

This has not been tested and I do not suggest that the scores for the different factors are simply added up to give the answer. They are meant more as a trigger for discussion between managers and advisors around a particular proposal.

Future state of our woods
Conserving biodiversity includes conserving genetic variability as well as species-level variations. The dilemma is over where long-term genetic conservation is best achieved by keeping current populations separate and distinct, as against where encouraging greater gene flow and mixing is desirable. In most cases we do not have sufficient data to judge this directly. Instead we must rely on a mix of conservation approaches:

- Sites (or parts of sites) where the aim is to maintain the past native tree and shrub composition as closely as possible.
- Sites (or parts of sites) where some change of tree species or provenance is accepted alongside conservation of the other main features of interest.
- Sites (or parts of sites) that are managed or allowed to develop towards a new state, which may contain different suites of species.

Regardless of how we manage them, a hundred years hence our protected sites and our ancient semi-natural woods will not look the same as they do now, albeit they are still likely to be our richest woodland sites. Depending on how extreme future climate and disease-induced changes prove to be, so we will have to shift more and more to the second and third elements in the bullet points above, because the first will almost certainly become impractical. For example, Natural England (and the other conservation agencies) already recognise that species distributions are likely to shift under climate change. They are encouraging the development of habitat networks and increased landscape permeability, to allow species to move between sites, which ultimately could include spread to areas where they do not currently occur (i.e. are not currently locally native) (Natural England, 2009).

Species and provenance choice will often affect the economics of the subsequent stands whether in existing woods or new afforestation. There may be increased costs with use of local provenance or species, for example because the nursery prices are higher, or because planting has to be delayed while the local material is bulked up; or reduced income if local species and provenances grow less well, have poorer form or are more susceptible to future climate/disease impacts. This may mean that fewer schemes go ahead or that they are smaller than if less stringent species and genetic conditions were applied. There may therefore be a trade-off for nature conservation between the extent of activity and its 'quality' (in terms of the species/provenance origin).

As the current ash dieback outbreak has demonstrated any introduced material must also be free of any potential pests and diseases, which points to bringing in seed and growing it on in Britain. As we have found to our cost specifying local provenance may not avoid the risks of importing disease if local seed is grown on abroad and the saplings subsequently imported.

There is not a simple answer to the question posed in my title, because it will vary with the site and species. Our woods will change in future, whatever we do. We can however adjust our levels of intervention such that in high value conservation sites such changes are more likely to maintain and develop that value.

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