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## Background

The term “provenance” is used to describe the location of the population from which a seed or individual is collected. In practice, “origin” is more important as this term is used to describe that part of the natural range from which it was originally derived. However, as the origin of individual trees or stands in the UK is often unknown, the focus has been to promote use of seed of local provenance from semi-natural woodland, although it may be difficult to tell if it has been derived from a previously planted generation. “Local” generally implies that it is from a similar site within the same or neighbouring region.

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. In line with guidelines on the sustainable management of forests in Europe from the Ministerial Conference on the Protection of Forests in Europe (MCPFE) (1993)<sup>i</sup>, the UK Forestry Standard (1998)<sup>ii</sup> encourages the use of local provenance for planting native species especially in existing and new native woodlands. The UK Woodland Assurance Standard also encourages its use<sup>iii</sup>. The Forestry Commission promotes local provenance for planting<sup>iv</sup>. It is considered in Environmental Impact Assessments for Environmental Statement approval with regard to relevant new woodland projects, more than 2ha in sensitive areas and 5ha elsewhere<sup>v</sup>, and is a requirement for grant-aid and for planting on the national forest estate.

The European Union Directive on the marketing of forest reproductive material by suppliers was adopted in 1999<sup>vi</sup> and implemented in Great Britain and Northern Ireland by the Forest Reproductive Material Regulations, 2002<sup>vii</sup>. These provide a regulatory framework, 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.

Policies and practice in relation to provenance have become more sharply honed in an effort to maintain local adaptations (i.e., characteristics that make individuals suited to the local environment) and protect and isolate populations from cross-breeding with genetic stock from elsewhere. Meantime, climate change has sparked substantial debate among geneticists, conservationists and foresters. This has arisen because of growing appreciation that exchange of genetic material between populations is now both more likely and desirable, as it will result in greater genetic diversity within populations, thereby making them more adaptable to change.

The debate was addressed in October 2005 by an international workshop on genetic conservation funded by the UK Population Biology Network and hosted by the Joint Nature Conservation Committee (JNCC), the University of Sheffield and the Woodland Trust. Leading conservation geneticists and representatives of government agencies and environmental NGOs attended. Proceedings of the workshop have been published as a JNCC report<sup>viii</sup>.

The workshop reached broad consensus on some of the principles of genetic conservation that can be communicated to policy-makers and practitioners with a high degree of confidence. These include the following generalisations:

- *“High levels of genetic diversity within populations are almost always desirable to ensure that they are genetically sustainable*
- *Adaptability is correlated with diversity and should be an important driver for conservation in response to environmental change*
- *Genetic diversity is broadly correlated with population size, hence conservation should seek to maintain or create large populations*
- *Low levels of genetic diversity are detrimental to populations when they lead to reductions in reproduction or survival due to inbreeding. However, they can be of special scientific interest and may indicate ongoing evolution, divergence of populations, reproductive isolation and development of new species.*
- *The transfer of genes between populations is desirable but care may be required where small populations have been isolated for a long period and local adaptation may be swamped*
- *Actions to increase the ability of one species to move across landscapes may be bad for another but what is good for most species should take precedence”.*

Other important conclusions of the workshop were that:

- The transfer of genes between populations is measured in terms of individuals that establish successfully rather than simply in relation to the movement of genetic information, e.g. as pollen, seeds or individuals. By definition, local adaptation occurs within a generation unless populations are isolated and selection pressures are unchanging. Many species in the UK have continuous populations, so determination of locally adapted units is arbitrary. For trees, there is evidence that even in very fragmented landscapes transfer of genes between populations is extensive<sup>ix</sup>.
- Natural selection (i.e. the process by which individuals with favourable traits are more likely to survive and pass on heritable components of traits to their offspring resulting in them becoming more common in the next generation) is not an optimising force; it can only select between those individuals that are present. There may, therefore, be others elsewhere whose genetic composition would be better adapted. For example, this is evidenced by a study of ash<sup>x</sup>. It suggests that there is no home advantage for trees of local origin with the same best performers, sourced from anywhere, growing well on most soils. This would not be the case if natural selection produced local adaptations that were optimal, as individuals of local origin would always out-compete those from elsewhere<sup>xi</sup>
- There is poor evidence of a reduction in reproductive success or the survival of offspring due to cross-breeding between genetically differentiated populations or sub-species.

There is growing evidence that the balance between differently adapted populations in contrasting local environments and reproductive contact through long distance movement of pollen maintains genetic diversity and adaptability in tree species at a European scale. The planting of native trees of non-local provenance should, therefore, pose little risk to existing tree populations locally, particularly as it is likely to only form a small proportion of the total resource.

The idea of promoting use of wider provenances from the perspective that the genetic diversity of trees plays a key role in maintaining the resilience of woodland ecosystems has been suggested by a pan-European meeting in relation to a resolution by the MCPFE on climate change and sustainable forest management in Europe<sup>xii</sup>. It called for development of pan-European guidelines for the transfer of forest reproductive material in Europe on the basis of scientific knowledge in

order to accelerate the adaptation of trees to climate change<sup>xiii</sup>. Some people go further and suggest that conservation should advocate the planting of non-native trees in line with climate change projections, for example, at a conference in 2005 on *Trees in a changing climate*, organised by the Royal Horticultural Society, The Tree Council, Forest Research, UK Climate Impacts Programme and Notcutts Ltd<sup>xiv</sup>.

### **The Woodland Trust's view**

Over the years, the Woodland Trust has championed use of local provenance and developed rigorous planting specifications, as we, like others, have assumed it is important to conserve local adaptations. Climate change has forced us to re-evaluate our position. While knowledge continues to grow, there is a need to adopt a precautionary approach. It is vital that, in our efforts to try and ensure that the rate of environmental change allows the widest biodiversity to adapt and evolve, we do not inadvertently reinforce genetic restrictions on species capacity to respond.

#### *Use of wider provenances*

A less stringent approach is needed than the current complex and arbitrary rules around planting trees of local provenance. There is a need to expand upon the Forestry Commission's Voluntary Scheme for the Certification of Native Trees and Shrubs and associated incentives. Faced with uncertainty, it seems prudent to continue to plant trees of local provenance but supplemented by trees of other provenances from a range of seed sources. There is little value in attempting to select provenance on the basis of climate change projections, particularly at a regional scale.

#### *Natural regeneration or tree planting*

From a genetic standpoint, regardless of other considerations, the debate over whether woodland creation is best achieved through natural regeneration or tree planting is of little consequence, given rapid environmental change.

#### *Planting of non-native trees*

However, genetic conservation does not provide evidence to support the planting of non-native trees in ancient and native woods. Such action may increase the rate of environmental change and compound pressures on woodland ecosystems rather than enhance their resilience.

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## **References**

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