

REPORT OF A WORKSHOP ON CONSERVATION OF FOREST GENETIC RESOURCES IN THE UK

Held at the Millennium Seed Bank, Royal Botanic Gardens Kew at Wakehurst Place, West Sussex, on 14-15 March 2017

This report has been written by Clare Trivedi with input from workshop attendees.

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EXECUTIVE SUMMARY

This workshop convened a group of invited experts to consider the activities related to understanding, conservation and use of Forest Genetic Resources (FGR) in the UK.

A series of presentations raised awareness and built common understanding amongst the group. The workshop heard from those already involved in FGR activities and gained insight into the status of ongoing genetic studies, designation of *in situ* dynamic Genetic Conservation Units, *ex situ* collections, tree improvement activities and initiatives to improve sustainable seed supply of UK native trees and shrubs. The extent of connectivity between ongoing activities was also covered. Presentations from French and American national experts provided insight into ongoing programmes in these countries and a presentation on EUFORGEN set the European context.

Through interactive sessions, the workshop developed an analysis of the strengths, weaknesses, opportunities and threats for the status quo of FGR activities in the UK. It then considered how to develop future work in this area.

The workshop agreed that a UK FGR Strategy needs to be developed. This should include: *in situ* conservation via gene conservation units, *ex situ* conservation including the UK National Tree Seed Project, tree improvement via a link to the National Tree Improvement Strategy, sharing knowledge and co-ordinating genetic studies including via a database of studies, the Sustainable Seed Sourcing Project and outreach activities.

It is vital that the Strategy develops a shared vision for UK FGR management, but it should also seek to find practical mechanisms to change behaviour and genuinely better integrate current activities, identify gaps, and facilitate new collaboration. It is hoped that such a Strategy might also facilitate joint fund raising for work in this area.

The process should be taken forward in the first place through the establishment of a small UK FGR Steering Group, comprising representatives of Centre for Ecology and Hydrology, Royal Botanic Gardens, Kew, Woodland Trust, Forest Research and Future Trees Trust. This group will aim to develop a UK FGR Strategy with significant formal endorsement and buy in from all stakeholders.

Development of this strategy will be a pragmatic way to integrate different activities, develop joint understanding across sectors, and provide simple, consistent messaging to policy makers and public.

The workshop agreed that action to designate Gene Conservation Units in the UK is a priority, not only to protect UK FGR, but to ensure we don't fall behind the rest of Europe in terms of monitoring and other pan-European activities. This activity could be taken forward by a sub-group of the UK FGR Steering Group, in parallel to the wider activities and strategic planning.

The workshop further suggested that an agreed priority top ten species list would be useful in order to galvanise stakeholders, better integrate activities across the sector and capture public awareness.

CONTEXT AND ISSUES

Forestry policy is a devolved matter in the UK, but all four countries have adopted policies to increase tree planting and area of woodland cover in order to provide a range of ecosystem goods and services, including increased timber and non-timber forest products, carbon sequestration, flood defences, biodiversity conservation and human health and wellbeing.

However, climate change and increasing numbers of new tree pests and pathogens mean forest managers face uncertainty. We need to ensure Britain's forests and woodlands have the capacity to adapt to future conditions.

Partly in response to these issues, there is a movement to increase the use of native species in planting for both restocking and new sites, sometimes in association with non-native species especially where productivity is a key driver. Depending on the circumstances, UK or locally sourced planting material can be preferable, and there is an increasing desire from the forest industry to use UK grown planting material in order to reduce biosecurity risks. However, there can be problems with sustainable supply of such seed for some species.

The UK's native Forest Genetic Resources (FGR) are currently poorly characterised for most species. The drivers of local adaptation and the roles of genetic diversity, gene flow and natural selection in delivering resilient forests are not widely understood. Forest Genetic Resources (FGR) need to be understood at a range-wide level to properly recognise the global significance (or otherwise) of local genetic resources. European countries are well-networked to identify, characterise and conserve forest genetic resources (see EUFORGEN, EUFGIS), however work in the UK is fragmented and ad hoc.

A joined up FGR Programme for the UK would underpin solutions to the many challenges facing our trees and woodlands. It would identify, conserve, and direct use of our genetic diversity for the future, and it would promote access to that material for planting.

Elements of such a programme might comprise:

- Characterisation of native FGR (namely research into pattern, spatial scale and drivers of local adaptation and genetic diversity), and how they may be maintained and exploited. This might include links to the new UK National Tree Improvement Strategy.

- Establishment of living dynamic Gene Conservation Units (GCUs) in line with those set up across Europe through EUFORGEN. Such conservation can help to adapt forest genetic resource for an uncertain future.

- Seed Banking the genetic diversity of the UK woody flora – with associated research into storage, germination and propagation, and the genetics underpinning sampling strategy. This is already underway through Kew's UK National Tree Seed Project.

- Other *ex situ* methods for certain species e.g. clone banks
- Registration of more Forest Reproductive Material (FRM) seed stands plus establishment of high quality seed orchards which take into account the genetic diversity of the material to be conserved. This is under development through the Sustainable Seed Sourcing initiative.
- Establishment of coordinating and information sharing mechanisms.
- Promotional activities to raise awareness.

WORKSHOP AIMS

The workshop brought together professionals involved in all aspects of FGR characterisation, conservation and use in the UK, to explore the opportunities for more joined up working. The specific aims of the workshop were:

- to raise the profile of the issues.
- to build awareness of the need for more joined up approaches.
- to learn from actions taken in other countries.
- to start to identify and develop tangible, realistic, actions to make the current approaches more joined up in the GB/UK context.
- to identify next steps to build momentum in taking these issues forward.

SESSION ONE: SETTING THE CONTEXT

Chair Kathy Willis

Welcome – by Kathy Willis, Royal Botanic Gardens, Kew.

Professor Willis gave an overview of Kew, Kew's Science Strategy, the Millennium Seed Bank Partnership and the Millennium Seed Bank UK Programme. She noted that a detailed Kew Collections Strategy was currently under development, with accessibility of collections as a key consideration.

EUFORGEN and the Pan-European strategy for genetic conservation of forest trees - by Michele Bozzano, European Forest Genetic Resources Programme (EUFORGEN)

The goal of EUFORGEN is conservation and appropriate use of FGR in Europe (currently in a phase which runs to 2019). It helps implement national commitments under the Convention on Biological Diversity and the UN Global Plan of Action for FGR. Jason Hubert, is the UK representative, with national experts Joan Cotrell and Stuart A'Hara.

Publications available through the EUFORGEN website include a Pan European Strategy for Genetic Conservation of trees, Approaches to Conservation of FGR in the Context of Climate Change, Genetic Monitoring of GCUs, Guidance on Use and Transfer of Forest Reproductive Material, and Implications of global, EU and national policies for conservation and use of FGR.

There are three current EUFORGEN Working Groups covering FRM Guidelines, Decision support tools for management of GCUs, and Genetic diversity indicators.

A key focus is the identification and designation of GCUs which seek to conserve at a minimum the threshold amount of forest to maintain adaptive and neutral genetic diversity. GENTREE is an associated project which seeks to contribute genetic knowledge. Key issues include how to describe GCUs, how to manage for long term conservation, sharing data via EUFGIS. There are 3200 GCUs, covering 4000 tree populations, and 100 tree species. Although the UK has been a very active partner in EUFORGEN, it has not yet assigned any GCUs, mostly due to fragmented woodlands not meeting minimum population size, and difficulty assigning formal status.

EUFORGEN uses bioclimatic zones developed by Metzger et al 2013 and aims to develop a network of GCUs across Europe in which there is at least one GCU per species per bioclimatic zone per country.

Overview of the Current State of Knowledge & Management of UK FGR: the Need for Coordinated Action – by Stephen Cavers, Centre for Ecology and Hydrology

UK FGR is threatened by climate change and novel pests and diseases. UK tree populations are highly fragmented and disturbed (e.g. by grazers) meaning they are not dynamic in terms of regular cycles of natural regeneration. There is a need to maintain diversity, population sizes, reproductive processes, and population turnover.

It is important to conserve the UK portion of European FGR, but we also need to recognise and understand the infra-specific diversity within the UK. There is evidence that local adaptation within the UK has occurred in response to a range of drivers (day length, climate, topography, soil) but this varies across species. The UK may contain particularly unique adaptive variation as it is located at the northwestern edge of distribution for several native tree species and conservation of this resource may be particularly important

At present characterisation studies are carried out piecemeal and at different scales. There is no policy for selection and designation of GCU's. This needs to be taken forward as part of the EUFORGEN approach.

Note, the IUCN process now recognises the conservation status of forest GCUs (cat IV – Habitat / Species Management Area).

A UK FGR Programme should include *in situ* dynamic GCUs, *ex situ* local/regional seed stands, *ex situ* GCUs, UK National Tree Seed Project, and tie in with National Tree Improvement Strategy.

The EUFORGEN approach based on Metzger environmental stratification creates 5 environmental zones within the UK. Further criteria to select GCUs would be; evidence that zones match genetic differences, zone occupation, co-occurrence of species, site ownership, and site management.

In discussion following the following points were raised.

Most genetic studies in the UK has been carried out on Oaks.

Non-native species are relatively more important economically in the UK than elsewhere in Europe, but it may be best to prioritise UK native FGR in the first place.

The Metzger bioclimatic zones don't exactly match the current FC seed zones.

The French National FGR Programme and the GENTREE project. Bruno Fady, INRA and Project Leader for GENTREE

Current adaptive variation in tree populations is important for dealing with contemporary stresses. In order to best manage adaptation for the future, it is important to consider how fast populations can evolve; how genetic diversity can be maintained, and how woodland management can help evolutionary processes.

In France the Commission on Forest Genetic Resources has been established to oversee these issues. It comprises around 30 partners and meets twice each year. It uses social media and other platforms to widely share advice on how to achieve these scientific aims in practice. The starting point is understanding that evolution and conservation of FGR needs to be included in biodiversity conservation policy and planning. Note that the recently approved IUCN decision #40 (Integrating autochthonous forest genetic diversity into protected area conservation objectives) means FGR conservation can be integrated with protected area designations, though the details of implementation need sorting out.

The main focus of CRGF is on *in situ* conservation. In order to adequately conserve FGR, it is important that GCUs encompass the entire diversity, and allow natural processes to take place (selection and drift). The GCUs should promote local adaptation under diverse environmental constraints. Typically in France, the central zone of a GCU is autochthonous forest, 500 seed trees minimum, 60 seed tree/ha, with natural regeneration (or assisted with local seeds). This is surrounded by a buffer zone. The GCUs have the same legal standing as registered seed stands.

Ex situ plantations are used when pressures in the wild are extreme (e.g. elms, black poplar). Dynamic *ex situ* conservation, where trees are allowed to reproduce in plantations, is preferred over static conservation. Seed collection and analysis is understood as a way to monitor the dynamics of *in situ* and *ex situ* strategies.

GENTREE is an EU project optimising the management and sustainable use of FGR in Europe. There are 22 Partners, including CEH in the UK, focusing on 12 species.

Aims

- Better characterisation of GCUs (*in situ* and *ex situ*).
- Better scientific knowledge on how genetic diversity, phenotypic trait diversity and environmental diversity co-vary over multiple spatial scales.
- New tools and models for efficient management and sustainable use of FGR in the context of environmental change and evolving societal demands.

In discussion it was noted that in most cases GCUs are in public ownership, either state owned or owned by the local community. They play an important role in awareness raising.

SESSION 2: CURRENT UK FGR ACTIVITIES

CHAIR: COLIN CLUBBE

***Ex situ* conservation of UK FGR, Clare Trivedi, Royal Botanic Gardens, Kew**

The range of types of *ex situ* conservation include, both static conservation in gene banks (Seed banks, *in vitro* tissue cultures, DNA banking, pollen banks) and dynamic conservation in living collections (*ex situ* GCUs, clone banks, seed orchards, botanic gardens and arboreta).

There is no national report or register of *ex situ* conservation of FGR in the UK. The following, probably incomplete list of *ex situ* activities was presented:

- over 100 clones in the Forestry Commission Forest Reproductive Material (FRM) register
- 45 seed orchards in the FRM register
- small number of collections in Kew's DNA bank
- some *in vitro* collections in the Forest Research Tree Tissue Culture Unit (mainly sitka spruce).
- 1230 accessions of UK native trees and shrubs in gardens and arboreta (112 species) but it is not clear how many individuals are in each accession or what is the country of origin.

The single biggest UK *ex situ* activity is the UK National Tree Seed Project, led by the Millennium Seed Bank, Kew. This is making seed collections from native populations, sampling from at least 1 population from each FC seed zone in which a species occurs. The project collecting manual recommends that each target collection should be made from >15 individuals, with seed collected from across the canopy of the tree. Each mother tree is tagged and geo-referenced, and seed of each maternal progeny is banked separately. There is no selection for any traits to ensure the maximum genetic diversity is captured. The aim is for each target collection to comprise 10,000 seeds. The project phase 1 has 680 target collections, of which 454 are already completed (716 accessions in total).

Genetic studies are seeking to test the efficiency by which the project is capturing the UK diversity of target species.

Field data and experience from the project can help identify sites which may be appropriate candidates for *in situ* GCUs, and as registered seed stands. The collections can provide seed to establish seed orchards and *ex situ* GCUs.

In discussion it was noted that it can be difficult to be certain that seed collections are made from native, unplanted woodlands. Also discussed how necessary it really is to sample from across the canopy, but agreed in absence of evidence this was good practice.

Using UK FGR – the UK National Tree Improvement Strategy – Steve Lee, Forestry Commission and Jo Clark, Future Trees Trust

In the UK tree breeding has been mostly undertaken by Forest Research and the Future Trees Trust.

For around 60 years Forest Research has been mostly working with exotic conifers. In 2014 work on Sitka spruce passed to the Conifer Breeding Co-op.

The Future Trees Trust has been breeding trees for 25 years, with a focus on broadleaves including oak, ash, birch, sycamore, sweet chestnut, cherry, and walnut. This has resulted in the establishment of seed orchards for improved Sycamore, Birch, Ash and Cherry. Almost 100% of Sitka spruce planted is improved and almost 100% Scots Pine in plantations is sourced from seed orchards.

Tree breeding seeks to increase the economic value of a species by selecting superior individuals for certain traits which then inter-mate to form an elite deployment population. To what degree this reduces the genetic diversity compared to an unselected population is unknown. The theory is that

diversity is greatest in the full, wild population, reduced somewhat in the selected breeding population and reduced further in the production (deployment) population. To what degree this actually occurs is unknown and in some circumstances, seed orchards containing large numbers of parents may have equal or even more variation than native stands, for example by breaking down localised inbreeding depression.

The new UK National Tree Improvement Strategy (NTIS) is supported by a consortium including Future Trees Trust, Forest Research, Conifer Breeding Co-op, seed producers and nurseries, and timber users, NGOs and academics. It will be launched at the Future Trees Trust supporters' day in Cirencester 25th May. It is the intention of the NTIS to have a FGR representative on the Steering Group.

Key elements covered by the UK NTIS are research, governance, funding, intellectual property and communication. The vision of the NTIS is: 'Through selection and breeding of a wide range of tree species capable of thriving in UK conditions – broadleaves and conifers, native and exotic – to promote economic value, genetic diversity, and species resilience to produce trees with good vigour and timber quality, showing resistance to known pests and diseases, and able to withstand the seasonal and longer-term climatic variations, whilst ensuring all improved planting material is available to all interested parties.'

In discussion, participants acknowledged the potential conflict between tree breeding, which seeks to select certain traits and produce large numbers of individuals displaying the desired trait, and conservation of FGR which seeks to maximise genetic diversity.

Post meeting note: Clare Trivedi will present the outcomes of this workshop at the UK NTIS launch on 25th May, and will sit on the UK NTIS Steering Group.

Making UK FGR available – Sustainable Seed Sourcing Project – Karen Russell, consultant to Future Trees Trust and Woodland Trust, and Rob Lee, Forestart

Forestart is the largest supplier of UK native seed. Forestart supplies over 500 native collections across Great Britain each year, from all seed zones except 101 & 103. Most collections are from source-identified stands. Around 95% of seed supplied comes from *in situ* stands but there is some use of seed orchards. They also have a large seed store. Forestry Commission also supply large quantities of planting material.

The Sustainable Seed Sourcing Project, is an ongoing project to create a more resilient and sustainable supply of British tree seed. It covers native and non-native broadleaf trees and shrubs of productive and/or conservation interest.

Phase 1 comprised an audit of the selected seed stands of nine broadleaf species on the national Forest Reproductive Materials Register. It highlighted the uneven distribution of stands across Britain, and that some species are poorly represented. It recommended investment in better stand management in order to increase productivity and aid seed collection. This would ensure a more reliable and resilient supply of seed even in poor crop years.

Phase 2 comprised gathering and analysis of data in order to identify potential seed sources for 16 species for which there is likely to be future demand, but for which there are very few seed stands. The National Inventory database, plus additional data provided by Woodland Trust and a range of other organisations was reviewed. For 9 species, good data on seed sources was available, but for

others it was limited. Strategies were proposed to develop sustainable seed sources for all 16 species, including identification of potential seed stands (selected and source identified), and establishment of seedling and clonal seed orchards (selected for timber production or conservation needs).

Phase 3: The preparation of costed project proposals to enable implementation of species strategies. These are split into those with timber production interest (alder, black walnut, field maple, hornbeam, small-leaved lime, wild service tree) and those of conservation interest (crab apple, yew, blackthorn, hawthorn, hazel, privet).

Phase 4: the identification of new seed sources for small-leaved lime

Phase 5: Assessment of native seed stands for hornbeam, and establishment of seed orchards for blackthorn and hawthorn.

In discussion participants highlighted the low tree planting rates in England due to poor grant schemes, and noted the difficulty this presented for nurseries. Nurseries need to source seed now for planting in 2019-20 but grant schemes are as yet unknown. This has impacts on biosecurity because when UK sourced material isn't available, nurseries buy in non-UK material.

SWOT Analysis of UK FGR Research, Conservation and Use, in the Context of Current Threats to UK Trees and Woodlands.

The workshop split into three groups, each of which produced a SWOT analysis of the current UK activities and frameworks for activities on UK FGR. The three groups presented their ideas back to plenary and an overall SWOT analysis for the workshop was compiled as follows.

Strengths

A high level of motivation within the sector

High levels of engagement across sectors in the value of native trees and high quality seed
Passion and willingness from a range of organisations/individuals to work in this area
Desire to work together

Strong UK capacity for action

Strong UK contributions already through EUFORGEN – financial and intellectual
Several active on-going projects
Strong intellectual expertise within UK
Extensive local knowledge
Detailed distribution and GIS resources, reasonable marker data
Woodland Trust is a custodian for UK native trees across UK
MSB is globally significant facility for seed banking
Forestry Commission arboreta
Well connected community of researchers/NGOs/government agencies
Open dialogue
Link to government via Kew and Forestry Commission

Strong European context

EUFORGEN provides a European Framework and resources for action
Datasets and evidence already in place at European level

UK gaps clearly identified through this process

Identified value of UK FGR

Highly adaptive capacity of most UK forest tree species

Unique north/western edge of range/distribution for many species

Weaknesses

Low public and political interest

Very niche topic

Poor communication on importance of FGR

Long term needs of forestry vs short term politics

Ignorance over how forestry operates over long time

No central national strategy or policy

Lack of clarity in defining FGR

Poor integration of initiatives and resources

No central database

No national policy for FGR conservation

No payment mechanisms

Weak links between science and management of FGR

No central agency leading on FRM and FGR

Devolution of 4 nations

Unclear IP and finance mechanisms – who owns FGR?

How to cover the costs, and co-ordinate, this complicated, time-consuming work?

Low level of FGR activity

No Gene Conservation Units

Few organisations collecting seeds

FC tree collection group focused on exotics

Reduced FGR resource

Low level of forest resource, fragmented woodlands, low genetic turnover

Hybridisation has occurred

Different agendas and perspectives

Poor understanding of how breeding and biodiversity conservation fit together

Some different objectives between forestry/FGR and wider biodiversity conservation

Mixed messages from different sectors working with FGR

Nursery perspective not represented at meeting

Lack of knowledge

Low understanding of distribution of adaptive variation across Britain for tree species

Lack of knowledge of sustainable forestry

Patchy genetics knowledge

What is native?

Poor practical forestry knowledge, especially ecology

Opportunities

High level of motivation for collaboration amongst stakeholders

The urgent threats from *Chalara*, and the Climate Change Accord, have already fostered greater collaboration and networking

Joint funding applications are stronger and more likely to be successful

A joint voice gives stronger message to policy makers

Joint strategic thinking allows clearer messaging to the public and will engage more people in gene conservation

Can demonstrate best practice, especially to government

Good political and financial context

Broadleaves can make money

There is a strong market for biomass crops

Infrastructure projects with ambition for zero net biodiversity loss

Brexit provides an opportunity to review payments

Desire to use UK seed and UK grown plants

Desire to improve biosecurity

Technology and methodologies are in place

Genomic technologies could enable catching up on lack of knowledge

EUFORGEN framework already in place for identifying conservation units

Some UK structures already in place

Sites are available and held with long term agreements that could be designated FGR Conservation Units

Ancient Tree inventory already in place

Action on UK FGR could achieve multiple benefits

Reduced imports and less risk of importing disease – reduces biosecurity risks

Increase species diversity/increase no species being used

Increase use of UK FGR seed sources

Designate gene conservation units

Protection of FGR

Improved knowledge

Better knowledge on provenance of planting stocks

European sources of several species could be good for the UK

Threats

Threats to UK FGR

Climate Change

Pests and diseases, especially due to increased long distance movement of plants

Infrastructure projects

Introduction of new species of trees can change ecology

Lack of public support and unclear government strategy

Lack of long term government vision for forestry

Forestry policy and programmes constantly changing
How many people really care about forestry?
Inconsistent funding
Brexit likely to lead to devolved governments, changes to trading regulations/more open trade, inconsistent funding
Devolved government but widespread species
Lack of government support for tree planting
Poor grant structure with short lead times makes planning difficult for nurseries

Different agendas within the sector

Conflict between objectives productive forestry and conservation could lead to competition rather than collaboration
Lack of clarity about objectives, and differing understanding of what is meant by genetic resources

SESSION 3: TAKING FORWARD A UK FGR STRATEGY

CHAIRS CLARE TRIVEDI AND STEPHEN CAVERS

An example of integrated FGR conservation and use - by Gary Man, USDA Forestry Service

Gary Mann outlined the role of the USDA Forest Service and the threats facing US trees and forests, particularly from pests and diseases. There are over 700 tree species in USA. USDA FS have developed an integrated strategy which includes gene conservation through *ex situ* conservation and genetic studies on pathogen resistance. The success of this strategy for using genetics to tackle tree health issues depends upon research, tree improvement, management commitment over time and reforestation activities all working together. The Dorena Genetics Resource Center works at the interface of research and reforestation to facilitate the development of resistance in a useable form. Success in this area relies on urgency, passion, public support, team work, vision and continuity. Gene conservation activities are mostly based on seed banking. Project CAPTURE (Conservation Assessment and Prioritisation for forest Trees at Risk of Extirpation) prioritises species for seed banking. For recalcitrant species they have established formal collaboration with gardens and arboreta to increase living collections.

Building on the SWOT Analysis to Identify Future Possibilities

The workshop split into four groups and considered how to build on the current situation in light of the SWOT analysis. After each group had reported back, a plenary discussion considered the ideas raised. This session focused on five key points:

- Existing activities to include in a future FGR strategy
- New mechanisms to maximise the impact of existing activities
- Identification of new projects or activities required
- New ways to be more joined up
- What stakeholders should be involved in taking work forward

The key outcomes of this discussion are as follows.

Agreed it would be useful to form a small UK FGR Steering Group

This group could co-ordinate and steer future work on UK FGR. It would provide oversight in order to map and better integrate existing and future UK FGR activities. This would include all the projects and activities covered by the workshop. The group should include work on both trees and shrubs, recognising the key characteristic is that these species are long-lived. It should be linked into EUFORGEN through the UK National Co-ordinator, and take advantage of existing knowledge and structures.

It was agreed that it would be difficult for this group to attain formal national status with UK Government and devolved administrations, but that if it was endorsed by a strong consortium of organisations it would achieve a level of authority that would be useful. A key task for the Steering Group should be to develop a UK FGR Strategy which all stakeholders could sign up to, in the same way that the National Tree Improvement Strategy has been developed. This would be a pragmatic way to integrate different activities, develop joint understanding, diffuse tensions, and provide simple, consistent messaging to policy makers and public. Later the group could consider becoming more formalised, for example through a MoU.

Agreed it was important to build public support and understanding in the UK for FGR

Noted that the term 'forest genetic resources' is not appealing in terms of public engagement and that effort is required to find more user-friendly messaging. Good public information around designated GCUs would be vital. Noted that Woodland Trust could play a key role in this area. Public engagement should then be an element of a UK FGR Strategy overseen by the UK FGR Steering Group. Terms such as adaptation and banking are more user-friendly.

Acknowledged the potential risks related to objectives of biodiversity conservation compared to tree improvement/forestry.

Those working in biodiversity conservation are seeking to maintain the genetic diversity of trees in the UK, and ensure that the process of natural selection is able to work on this genetic diversity to allow adaptation to environment change. Those working in tree improvement and commercial forestry are seeking to artificially select from the existing genetic diversity to improve populations for important commercial traits. These two objectives are not mutually exclusive and indeed need to operate together since genetically improved material also needs to be adapted to changes in the environment. Agreed that effort is required to better integrate these two approaches and avoid conflict and mixed messages to the public and policy makers.

Agreed that action to designate Gene Conservation Units is a priority and might be integrated with existing biodiversity conservation strategies

Designation of GCUs is required, not only to protect UK FGR, but to ensure we don't fall behind the rest of Europe in terms of monitoring and other pan-European activities. Noted there is already a Forestry Commission Briefing Note on Establishing and Managing Gene Conservation Units (see [https://www.forestry.gov.uk/PDF/FCPN021.pdf/\\$FILE/FCPN021.pdf](https://www.forestry.gov.uk/PDF/FCPN021.pdf/$FILE/FCPN021.pdf)) which is a good starting point.

Use of existing biodiversity designations might be more pragmatic than establishing a whole new system for assigning GCUs. However, it is important to ensure such sites would meet the requirements for a GCU. There will be appropriate ancient woodland sites which do not have conservation status at present. It is vital to work with owners.

This activity could be taken forward by a sub-group of the UK FGR Steering Group, in parallel to the wider activities and strategic planning.

Agreed that a wider group of stakeholders should be engaged in order to take the initiative forward.

Noted the need to engage statutory agencies (SNH, NE, NRW, JNCC, FC) and also NGOs such as the Wildlife Trusts who manage large areas of land for biodiversity conservation. In the context of reducing funding for government agencies NGOs may be better placed to raise money and undertake lobbying. Government agencies are likely to be preoccupied with devolution and Brexit in coming years and not have the capacity to establish a governmental approach to this issue so NGO involvement will be vital.

Also agreed that it is vital to engage with private landowners.

Agreed a priority Top Ten species list would be useful

This would galvanise stakeholders, better integrate activities across the sector and capture public awareness. Lessons might be learned from the CAPTURE approach used by US Forestry Service as outlined by Gary Mann.

Noted Operation Oak, an idea from Prince Charles, which is in the early stages of development by Defra, Duchy of Cornwall, Woodland Trust and others. It is likely to have a focus on oak tree health research that can inform action, and cover all aspects of management of oak in the landscape. It is aiming for a public launch later this year and has an ambition for a 5 year programme of around £10M. Agreed the UK FGR Strategy should be linked up with Operation Oak.

Summary and Next Steps

The workshop agreed that a UK FGR Strategy needs to be developed. This should include the following activities: *in situ* conservation via gene conservation units, *ex situ* conservation including the UK National Tree Seed Project, tree improvement via a link to the National Tree Improvement Strategy, sharing knowledge and co-ordinating genetic studies including via a database of studies, the Sustainable Seed Sourcing project and outreach activities.

The Strategy should be taken forward in the first place through a UK FGR Steering Group. This group is unlikely to have formal recognition at the governmental level in the short to medium term, but will aim to develop a UK FGR Strategy with significant buy in from all stakeholders.

Noted that, while it is vital to develop a shared vision, the Strategy should also seek to find practical mechanisms to change behaviour and genuinely better integrate current activities, identify gaps, and facilitate new collaboration. It is hoped that such a Strategy might also facilitate fund raising for work in this area.

One option for funding the ongoing work of the Steering Group might be a NERC Knowledge Exchange Fellowship.

The Steering Group might comprise 1 representative each from CEH, Kew, Woodland Trust, Forest Research and Future Trees Trust. The meeting agreed to the composition and establishment of this initial UK FGR Steering Group and requested that Clare Trivedi and Stephen Cavers should take the first steps to convene this group.

Agreed that, in order to share the outcomes of the workshop and future work, Clare Trivedi would develop a mailing list which includes a wider range of stakeholders, including those that were not able to attend the workshop. Clare Trivedi would write the meeting report and circulate it to this group. Clare Trivedi could also write a Kew Science Blog or Kew Science news item, which would provide a short, general overview of the meeting, its aims and its outcomes, which other organisations could share the link to.

One option to share more widely the summary of current activities would be to publish the individual presentations. Clare Trivedi reported that she planned to further develop her presentation into a publication on *Ex Situ* Conservation of UK FGR.

Agreed that once the Steering Group had developed a draft Strategy it would be appropriate to hold a larger conference/stakeholder consultation and this would be the appropriate time to develop wider outreach and PR around the initiative.

ATTENDEES

Amanda Campbell	Forestry Commission
Andy Heald	CONFOR
Bruno Fady	INRA
Charlotte Petersen	Defra
Chris Jones	Natural Resources Wales
Chris Reid	Woodland Trust
Clare Trivedi	Royal Botanic Gardens, Kew
Colin Clubbe	Royal Botanic Gardens, Kew
Jason Hubert	Forestry Commission Scotland
Jo Clark	Earth Trust/Future Trees Trust
Joan Cottrell	Forest Research
John Mackay	Oxford University
John Weir	Forestry Commission England
Karen Russell	Future Trees Trust
Kathy Willis	Royal Botanic Gardens, Kew
Michele Bozzano	EUFORGEN
Mike Fay	Royal Botanic Gardens, Kew
Nick Atkinson	Woodland Trust
Pete Hollingsworth	Royal Botanic Gardens, Edinburgh
Richard Buggs	Royal Botanic Gardens Kew

Richard Ennos	Edinburgh University
Robert Lee	Forestart
Sian Atkinson	Woodland Trust
Simon Kallow	Royal Botanic Gardens, Kew
Stephen Cavers	Centre for Ecology and Hydrology
Steve Lee	Forest Research
Stuart A'Hara	Forest Research
Tim Rowland	Future Trees Trust