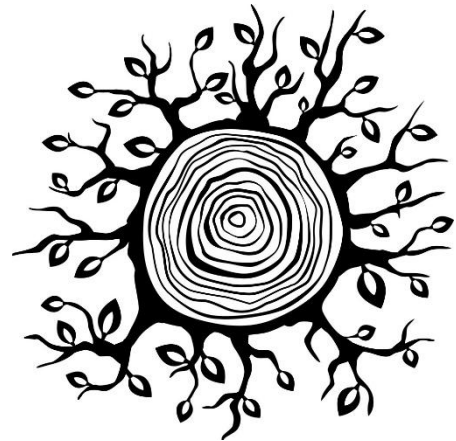


Ancient Tree Nursery

White paper: November 2025

ancienttreenursery.com/wp1125



Executive summary

Ancient trees present a snapshot of historical genetic variation that might otherwise be lost from the wider population. This is especially the case against a government policy encouraging significant uplift in woodland cover and other tree planting activity. The Ancient Tree Nursery (ATN) has been established to ensure that ancient tree genetic materials are incorporated into mainstream woodland creation.

Wooded habitats are persistent features of the landscape. Woodlands created today are likely to still be in existence centuries from now and, given the anticipated changes in environmental conditions that seem likely, it is vital that they have the highest possible capacity to adapt.

The current demand for trees has potential to narrow the gene pool because of the way that tree seed is procured to supply the nursery sector. Policymakers are aware of the issue and steps are being taken to address it through the identification of greater numbers of seed sources. We also believe that ancient trees can play an important role in contributing to the solution.

The ATN will establish a proof of concept for the collection of seeds from ancient trees, growing to whip stage, and supply to mainstream woodland creation and tree planting initiatives. This will include development of a system for tracking individual plants from seed through to deployment of saplings. This system is integral to our aims to better understand the process of gene flow through the landscape and to address emerging issues in a timely manner.

Mission

TO MAXIMIZE ADAPTIVE POTENTIAL IN THE UK'S TREE POPULATION BY USING THE GENETIC VARIABILITY THAT RESIDES WITHIN ITS OLDEST INDIVIDUALS. WE WILL PROMOTE THE IMPORTANCE OF THIS APPROACH IN SECURING LONG TERM ECOLOGICAL RESILIENCE THROUGH PRACTICAL ACTION, POLICY ENGAGEMENT AND PUBLIC EDUCATION. SCIENTIFIC RESEARCH IS FUNDAMENTAL AND WE SUPPORT INITIATIVES TO UNDERSTAND THE ROLE OF ANCIENT TREES IN THE WIDEST CONTEXT.

Ultimately, we would like to establish seed orchards populated by clones of ancient trees. There are two major advantages in this approach: first is to bring trees to one place to improve seed collection and other management efficiencies. The second is that enabling ancient tree clones to interbreed will produce novel genetic combinations that might yield additional adaptive potential. There are considerable technical challenges to overcome to make this a workable reality.

Only a small percentage of all trees planted need to originate from ancient sources, enough to ensure survivorship to the following generation. However, given the scale of government policy ambition for trees this would still result in large numbers being required. We firmly believe that this is best achieved through partnership working, especially in relation to volunteer and community tree nurseries. Our aim is to augment existing efforts, not to compete with them.

We have established the ATN as a Community Interest Company in the hope of fostering this collaborative approach to working. We are similarly hopeful that it will help to focus attention on the wider role that ancient trees have in delivering benefits to human society and the wildlife that we coexist with.

November 2025

Introduction

The Ancient Tree Nursery is a Community Interest Company incorporated in October 2025. It has two company directors, Dr Nick Atkinson and Dr Helen Atkinson. It is headquartered in Leicestershire with a satellite facility in Northumberland.

The aims of the ATN are to produce saplings from the UK's ancient native trees to use in wider tree planting and woodland creation efforts. This will ensure that genetic variation residing in the ancient tree population is incorporated into the following generation.

This is simply a precautionary approach to woodland creation. By ensuring that the genetic characteristics of the oldest trees in the population are carried through to the current generation, the UK's trees and woods will have the best potential to adapt to conditions as they change in the future. Only a small percentage of the total number of trees being planted need to be from ancient sources for this strategy to be effective, assuming they are planted in sufficient quantities for at least some to survive to fruiting age.

In the first phase of development effort will be concentrated on collection of seed from ancient trees and production of saplings using standard growing techniques. Subsequent attention will turn to clonal propagation of ancient trees and the establishment of clonal seed orchards. In time, these will produce seed that represents new combinations of ancient genomes.

When introduced into mainstream woodland creation and tree planting, saplings of ancient origin will broaden the genetic pool and enhance adaptive potential, making the future more resilient to environmental change, in particular climate.

Rationale

Ancient trees have, as evidenced by their survival, tolerated environmental change over long periods. The lives of the very oldest individuals span the Medieval Warm Period and Little Ice Age. There is undoubtedly an element of luck involved in survivorship, most notably in terms of a tree having escaped both human attention and random mortality, such as pathogens, browsing, lightning strikes and drought. However, those individuals that do survive into the extremes of their species' normal lifespan have shown themselves capable of living through a range of different conditions. This makes them interesting from a genetic perspective: there is at least a possibility that they are somehow different from the rest of the population.

Old trees also present a genetic snapshot of past populations. In the time since they germinated, various types of selection might have caused population genetic traits to shift. There is at least the possibility that ancient trees harbour genetic variation that has otherwise been lost. From a precautionary perspective there is little harm including

progeny from ancient trees in tree planting practice. Conversely there could be significant benefits should they confer the adaptive capacity required to cope with changing environmental and climatic conditions.

Definition of ancient

An ancient tree has attained an age that is unusually great *for its species*. Species such as yews and oaks are relatively long-lived and ancient individuals might live for well over a thousand years. Conversely, an ancient birch might only be 150 years old.

Ancient trees exhibit characteristics that only accumulate with great age. These include the formation of wounds, rot-holes and hollowing. Such features increase the capacity for the tree to support other species as the diversity of niches increases. Veteran trees also exhibit these features but are not necessarily old: all ancient trees are veterans but not all veteran trees are ancient.

Ancient trees are disproportionately important for wildlife and their continued presence in the landscape is vital. This presents a significant conservation challenge as the following “middle aged” cohort of trees has suffered greatly as a result of intensive agriculture and urban expansion over the last 150 years. The loss of hedgerow trees is of particular concern due to the vital roles they play in supporting other species and in facilitating gene flow.

Efforts are underway to help create a functional next generation of ancient trees through the process of deliberate veteranisation. This is where trees are deliberately damaged in ways that encourage the formation of the types of features mentioned above. It is not yet known whether this strategy will succeed.

From the perspective of the ATN, ancient trees have three main features of particular interest. The first is that they have lived through a range of changing environmental conditions, having been exposed to pests and pathogens over that period. This is at least some grounds to suspect they might harbour a genetic constitution that makes them more resilient than most conspecifics.

A changing environment

While climate change presents a major challenge to biodiversity over the coming decades, some of our oldest trees have lived through two significant extremes already.

MEDIEVAL WARM PERIOD: the period from the 10th to the 13th Centuries was unusually warm through Western Europe.

LITTLE ICE AGE: the period from the 14th to the 19th Centuries was colder than the underlying trend.

Second, they normally pre-date commercial tree nurseries. This makes them likely to be more locally distinctive, including the possibility that they have traits that have otherwise been selected against (deliberately or otherwise) through commercial production methods.



Figure 1. The yew in the churchyard at Fortingall, Scotland, is considered to be the oldest tree in the UK. Estimates for its age vary but there is a general view that it is several thousand years old.

Finally, they are the closest we now have to the “wild type” for their species. Even where they have been deliberately planted they are likely to have been grown from seed collected locally at the time and thus represent what might be considered the original lineage in their locality.

We accept that there is some conjecture here. Records of historical tree planting are seldom kept, and we make assumptions about the way that desirable traits (from a human utility perspective) might have been

propagated. There is strong evidence that people have moved tree seed around for centuries: this is especially the case where species were valued for their food, fibre or fuel properties.

However, the central point is that from a precautionary perspective, no harm would arise from the integration of genetic material from these old trees into the wider population. By not including them we risk narrowing genetic variability of the UK’s native tree species, which will not help future adaptation needs.

This is especially the case at a time when there is a UK-wide policy towards significantly increasing woodland cover, for climate mitigation (i.e. carbon drawdown) and adaptation (e.g. water management) and the restoration of biodiversity and ecological function. Relatively little practical consideration is given to the population genetics of trees at the level of individual planting schemes: the sum total effect across the country could be that we are introducing genetic vulnerability to woodlands that will persist for centuries.

We advocate that only a small number of trees planted need to be of ancient tree origin. Enough should be planted to ensure that some survive to maturity (i.e. pollen and seed production), but it would be counterproductive to rely too heavily on them because they are inevitably taken from a small number of parent trees. Our hypothesis is that the use of ancient tree progeny is akin to the well known effects of immigration on population

persistence and maintenance of genetic diversity, except in a temporal rather than spatial context.

Genetic variation and adaptive potential

Species useful to humans have been subject to selective breeding for centuries. Attention focuses on a set of traits that are of interest, selecting those individuals from each generation that exhibit the most desirable forms of those traits, breeding from them to “improve” the phenotypes of the following generation.

Trees are no exception to this process and have been subject to deliberate selection for at least several hundred years. The selected traits are usually those that affect the production of high quality timber or fruit, such as their germination and establishment success, growth and form. As a result those species have far greater utility than their wild-type ancestors, usually being more productive and/or easier to manage.

Conversely, traits that might be of benefit from a conservation perspective have been almost entirely ignored. Given the majority of native trees being planted in the UK are not for timber production it might be prudent to include planting stock that has not been selected for timber or other utilitarian traits. In the absence of a specific selection

Ancient vs wild type

WE USE THE CONCEPT OF ANCIENT TREES AS A PROXY FOR WILD TYPE. THAT IS, WE ARE NOT CONSTRAINED BY THE DEFINITION OF ANCIENT BEYOND THE IDEA THAT IT IS THE BEST THAT CAN BE DONE TO PRE-DATE COMMERCIAL (INTENSIVE) TREE NURSERY ACTIVITY.

program for conservation traits the next best alternative is to look to trees that have been least likely to have been subjected to past human selection.

Commercial nursery impacts

Historically, most native tree planting activity would have used locally produced stock. Recent

decades have seen increasing reliance on commercial tree nurseries for the provision of woodland creation planting stock. Nurseries require reliable sources of tree seed and as a consequence have come to depend on a relatively small number of registered seed stands and orchards.

While selective breeding of trees can bring benefits in terms of immediate human utility it also has the effect of narrowing the overall gene pool, exposing tree populations to changing environmental conditions and novel pathogens. This makes them vulnerable to unknown future challenges.



Figure 2. Ancient rowan in Northumberland. Many ancient trees show remarkable resilience to damage -- this one has partially collapsed but continues to thrive.

This would not be an issue of concern outside commercial forestry were it not for the fact that the nurseries that grow forestry trees also supply woodland creation projects that focus primarily on biodiversity benefits. Current UK government woodland creation policy is seeing the majority of broadleaf woodland creation for

purposes other than production. This hints at a potentially serious genetic vulnerability in the future.

Trees often exhibit remarkable phenotypic plasticity. Because they remain rooted to the same place for decades if not centuries, they must have the capacity to adapt to inevitable change. This to some degree will mitigate – but not entirely – the impact of selection by the nursery process. Many species are resistant to genetic erosion due to their ability to cast pollen over large distances (especially relative to the small area of the UK). However, the increasing dependence on a relatively small number of seed sources, coupled with increased demand for trees to plant, risks narrowing genetic diversity and potentially losing traits that could be helpful for adaptation in the future.

The Ancient Tree Inventory

Since 2004 a citizen science project has been running in the UK that aims to locate as many ancient and veteran trees as possible. Beginning as the Ancient Tree Hunt, the project rebranded as the Ancient Tree Inventory (ATI) and now lists around 200,000 trees. These are categorised as Ancient, Veteran or Notable, with further subdivisions also used according to form, health and accessibility.

Tree records are collected by members of the public and verified by trained volunteers, with the hope that the verified record provides a reliable source of information. Although many years can elapse between records for any given tree, the record is generally sufficiently detailed to enable individual trees to be located and re-visited.

The ATI has proven useful in convincing policymakers of the ecological and heritage value of old trees, especially in relation to planning and development. There is undoubtedly greater awareness of both the importance and plight of ancient trees since the data have been collated, and some success has been had in challenging planning decisions that would have harmed individual trees.

The data are not evenly distributed and reflect a combination of search effort and habitat. Effects are visible for certain (volunteer) super-contributors and for places such as National Trust properties that provide access to the types of habitats in which ancient trees are more likely to be found.



Figure 3. Extract from database of verified ancient and veteran trees. Trees are often located along field boundaries, which have historically been places of relative security. Agricultural practices over the last century have changed that.

Surprisingly little analysis of this large data set has been carried out. A PhD project at the University of Nottingham produced several papers on the nature of the distribution of records, the headline of which being that the current dataset probably represents around one tenth of the UK's ancient and veteran trees.

The ATN uses a subset of the ATI to locate only verified ancient trees. This is the current starting point for the collection of seeds and other

forest genetic materials. Attempts to combine this dataset with collections from the Forestry Commission's provenance zones (see below) further demonstrates the patchy nature of the records. A clear future research thread will be to look at the underlying causes for this and how they might be addressed through focused volunteer effort and use of modern technologies, such as AI-driven search of satellite imagery.

Forest reproductive materials

The collective term for seeds and other parts from which trees can be propagated is Forest Reproductive Materials (FRM). There is an established process for the collection of FRM that will be either marketed or traded. This process has been developed for large scale production and is not well suited to the use of individual trees as sources of FRM. The ATN will follow procedure as far as possible and attempt to influence future developments through discussions with Defra and Forestry Commission as required.

Seed collection

Whether land is publicly accessible or not it is always owned. We consider landowner permission to be essential for the legitimate collection of seeds, not least because we also need to maintain a register of individual ancient trees being used as seed sources.

Seed collection dates will vary by species and individual tree seed production will be a significant source of variation. This is one of the main practical challenges that we face: travelling to individual trees throughout the country in anticipation that they will be bearing mature seed is potentially a highly inefficient process.

We intend to mitigate this as far as possible through working with local volunteer and other stakeholder groups. This will leverage local knowledge and time availability: seeds can be germinated and grown either locally or centrally. There is also the potential for the exchange of tree seed by centres within provenance zones.

Many community tree nurseries already exist and the ATN is not looking to reinvent processes. However, there is a lack of overall coordination and in particular a missed opportunity in data collection. Our central aim is to address this through the development of a simple to use system that tracks the entire journey from seed collection to sapling deployment.

Provenance

The Forestry Commission (FC) devised a set of provenance zones for tree species within the UK. We accept these uncritically at this stage, acknowledging that the entire forestry sector uses this system. We might in the early stages of establishment grow trees outside their home zone but will ensure that they are ultimately deployed to it, as per the accepted current practice.

There is an argument that the provenance zones approach needs reappraisal in light of current understanding of the impacts of climate change. Species range shifts are anticipated over the coming century, with a general movement north and to increased altitude, although this oversimplifies the likely pattern.

We will seek to engage in debate and policy formulation regarding this subject. Part of our rationale is that ancient trees are likely to be as phenotypically flexible as any others of their species and so will benefit less from deliberate human-facilitated range shifts. However, the picture is complex and needs to account for the fact that, as foundation species, trees host many other organisms that might be more responsive to climate change impacts.

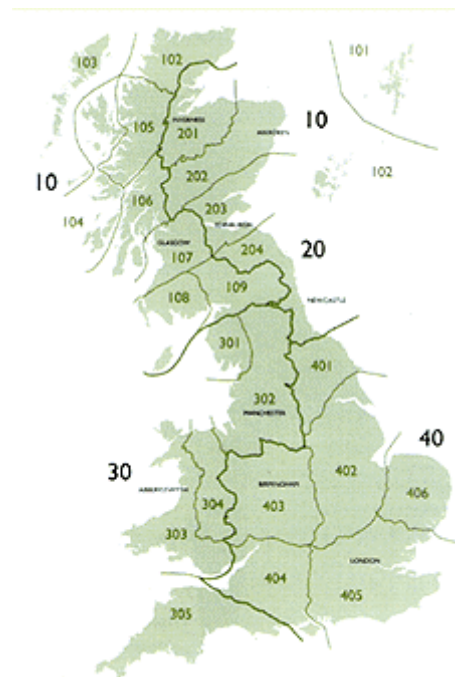


Figure 4. Forestry Commission tree seed provenance zones.

The logic around human-mediated range shifts, or indeed the introduction of novel species, is curious. No one knows either how rapidly climate change will happen in the future, or what the climate will be like at a specific point in time. Indeed there is always a possibility that a technical solution will be found that enables a reversal in global warming.

Tree mortality patterns are very different to those in humans. In humans, and most large mammals, mortality is generally low until old age, at which point there is a rapid acceleration. For trees the opposite is the case: mortality rates are very high during germination and establishment, after which they are very low. Therefore to be selecting trees for some anticipated (but actually unknown) future climate suitability ignores the fact that this means they must endure their early years in sub-optimal conditions.

Furthermore, there has been a tendency to simplify climate change to a single variable, mean annual average temperature. In fact trees are likely to be far more susceptible to stochastic point events, such as heat waves or floods, rather than longer term chronic changes. The exception to this relates to the movement of pathogens, which might overwhelm local populations that have not evolved immunity or the ability to resist.

The subject of seed provenance is one of active ongoing debate and the ATN will follow developments with interest.

FRM registration

It is important that all saplings produced can be traced back to the tree from which the seed or clonal material was collected. In addition to our own database, we will ensure that all actions comply with current legislation.

The Forest Reproductive Material (FRM) regulations provide a system of control for the collection of tree seed, cuttings and planting stock used for woodland planting. We will ensure, where necessary, that trees used by the ATN are registered on the Forestry national register of basic material, either by us or directly by the landowner.

Permission will always be gained prior to seed collections and in order to sell saplings commercially we have registered as an FRM supplier. We are currently working to obtain master certificates for all material collected.

Land designations

Ancient trees are often found in areas that carry land designations, such as Sites of Special Scientific Interest (SSSI). The collection of biological materials in these areas is against the law without prior written permission from the relevant government agency. This is Natural England in England, NatureScot in Scotland, Natural Resources Wales in Wales and DAERI in Northern Ireland.

Wherever such restrictions apply beyond obtaining landowner permission to collect FRM, we will seek the necessary approval to do so from the appropriate agency.

Prioritisation exercise

There is no firm estimate for the number of native tree species in the UK, but it is somewhere between 30 and 60, depending on the definition of species. They are employed to varying degrees in tree planting in different parts of the country according to multiple factors, including the extent of their range, local conservation objectives and their human utility as food, fuel or fibre.

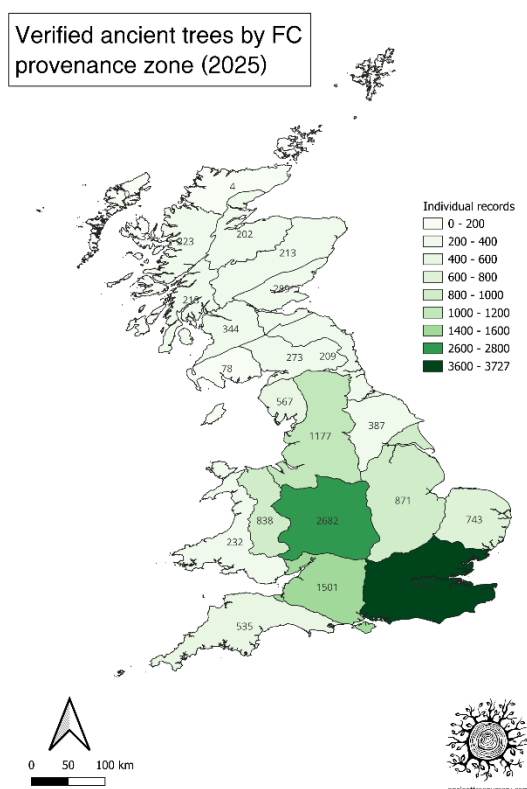


Figure 5. The distribution of known ancient trees is skewed towards a small number of provenance zones, suggesting a need to search for more trees in certain parts of the country.

This suggests that the demand for each species within each of the FC provenance zones needs to be understood. This information needs to be balanced with the current capacity to supply a percentage of planting stock from ancient tree FRM, which will reflect the distribution of known ancient trees.

Our policy is that 1% of all saplings planted should be sourced from ancient trees. Demand needs to be matched to the capacity to supply. At present the centres of tree planting activity do not map well to the distribution of known ancient trees.

As the figure opposite shows there is a significant bias in the distribution of recorded ancient trees on the ATI. One of the many challenges we face is how to reconcile this with the concentration of woodland creation activity currently underway. However, we are not constrained

to new planting: there is no reason for ancient tree saplings not to be planted into existing treed habitats. We will work with landowners and other stakeholder groups to understand how this might be usefully achieved.

Species strategy

For each native species we intend to conduct analyses that will take into account the current and predicted suitable ranges, planting demand, number of known ancient trees (by FRM zone) and issues relating to propagation of saplings from ancient stock.

This will involve a significant research undertaking as the objective is to understand the balance between the demand for each species within each FC provenance zone and the capacity for known ancient trees to supply sufficient stock. It would be

counterproductive to be overly reliant on too few ancient tree seed sources so where there is an obvious deficit the immediate focus would be on locating additional ancient trees and securing permission to collect from them.

Once the theoretical situation is understood it should be possible to implement practical activities. These would lend themselves well to being tasked to volunteer groups. In particular, the quest to identify more ancient trees within any given area would provide additional purpose and focus and might help to reinvigorate the search effort.

Stakeholders

For a far-reaching, national scale project such as this there are inevitably a large number of stakeholders. These range across local communities, non-government organisations, private landowners, government bodies, the business sector and funding agencies.

There is a complex interplay between these stakeholders and their interests. We are carrying out an internal mapping exercise to help understand this better with the aim of enabling the delivery of our conservation aims.

Non-governmental organisations

Conservation NGOs such as the Wildlife Trusts and National Trust are of particular interest because they own and manage large areas of land that often host old trees. They also have stretching non-forestry tree planting targets. As such they are significant potential partner organisations in both the supply and delivery of ancient tree saplings.

Propagation of ancient trees is in fact already taking place at many of the sites owned by NGOs, often through the actions of local volunteer groups. We think that the ATN can add value through the provision of a coordinated approach and standardised system that would enable these local efforts to extend their reach beyond their home nature reserve or property.

We are also interested in the potential to engage with hard to reach groups through this project. The well-defined nature of the activity and direct, positive conservation outcomes make for a compelling story that should appeal to a wide audience. Activities also provide training opportunities across a range of disciplines, possibly even employment further down the line.

Private landowners

Private landowners account for the overwhelming majority of the UK land mass, so are obviously a key stakeholder group. We have made several approaches and have so far met universal enthusiasm for the project. A major concern is how to protect landowner

privacy where required while at the same time offering transparency in relation to seed collection. This is something that we will address in the coming months.

Government departments

We will engage with relevant government departments, arm's length bodies and agencies to ensure that:

- Our activities are conducted within the terms of the law, particularly in relation to collection of FRM from protected areas and compliance with FRM registration requirements;
- Policymakers are aware of our conservation case and that it is being given due consideration; and
- The UK's population of ancient and veteran trees are treated in a manner that recognises their role, not just in terms of heritage value but also in the potential that they have to contribute to the genetic constitution of the trees and woods of the future.

Funding bodies

We are aware that we are not making a business case that will generate financial profits. Indeed our view is that our work will be best facilitated as a non-profit organisation, in terms of helping to engage with the private sector and other NGOs. This leads to the conclusion that we will need to seek funding to support our work.

In the early stages this will be through small philanthropic donations from individuals and organisations, leading to applications for larger more ambitious levels of funding. Ultimately we would like to see a blend of finance sources, including the potential for corporate sponsorship of activities.

Research

Ancient trees are generally poorly understood. Little research has been conducted on their heritage and cultural roles, their ecological value or their potential for genetic contribution. This is strange, as they clearly resonate strongly with people (think Tolkien's Ents, for example) and are often the subject of public interest, such as when they become embroiled in a planning application.

The ATI provides a valuable starting point for further research. Some work has already been done to understand the observed distribution of recorded trees, using mathematical models to take what is already known and extrapolate the potential for future discoveries. This work pointed towards the kinds of habitats that might harbour more trees but there is much more to do beyond that.

We see our role in helping to shape the direction of future research through the identification of critical questions and supporting academic partners in their work. This is a key area that will be developed in the short to medium term.

Partnerships

We have considerable previous experience in the formation of successful research partnerships and seek to bring this to the work of the ATN. We will help catalyse research to unlock the conservation ancient trees and the promotion of their following generation.

We are already in active dialogue with several research institutions on different aspects of ancient tree biology, ecology and genetics. This work will be consolidated and extended as we seek to raise awareness in this under-researched area.

Programme

Our current research programme has three broad themes:

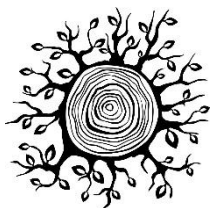
- Culture and propagation challenges
- Survival and future environmental responses
- Collection and deployment

Each of these is further subdivided and we are currently undertaking a prioritisation exercise to map relevant timelines.

Future directions



Through all our work we will promote the importance of ancient trees across the full gamut of their influence: heritage and cultural, ecological and genetic. We will engage relevant stakeholders, including the wider public, to foster recognition and rally support for the conservation and study of old trees. We will also seek to foster partnerships that promote these objectives, working together with others wherever this is possible to achieve commonly shared outcomes. Above all our interest lies in the future resilience of the UK's trees and woods and the biodiversity they support.



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