STRUTT & PARKER
BNP PARIBAS GROUP

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CHARTERED SURVEYORS & FORESTRY AGENTS

What trees to plant to protect financial returns in response to weather, pest & climate change risks

INTRODUCTION

Making returns from woodland and forestry in the UK is a long-term business and there are new risks that can affect financial returns from woodland.

There are also new opportunities. The area of new woodland planting needed in the UK to absorb carbon dioxide to reduce climate change is massive - over 1 million hectares – especially when compared with historical planting rates.

For any new planting, the starting point must be the economics of growing different species, which relates to length of rotation, growth rate and the expected value of the timber. This can all be planned in advance and monitored through the life of the planting. We should consider tree management in just as much detail as the best agronomists manage their crops.

This briefing note summarises how we, as woodland managers, can establish and manage woodland that will meet owners' financial objectives by being more resilient to the effects of climate change and the risks from pests and diseases. This will include changing what we plant and how we manage it.

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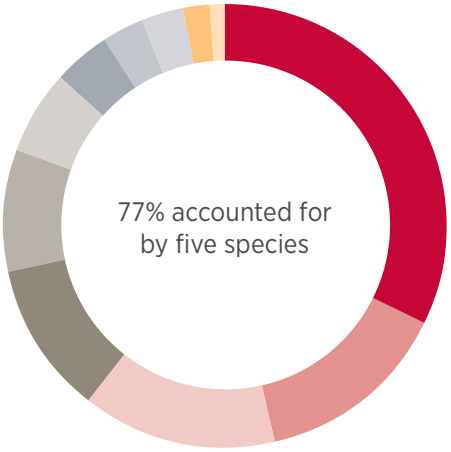
CURRENT RELIANCE ON A SMALL NUMBER OF SPECIES INCREASES VULNERABILITY

At present, both broadleaf and conifer woodlands are dominated by a small number of species, which makes them more vulnerable to pests, diseases and climate change impacts:

Figure 1: Species make up of broadleaved woodland in England

Climate-resilient species to consider:

Lime
Hornbeam
Service
Poplar
Cherry
Plane
Maples
Rowan



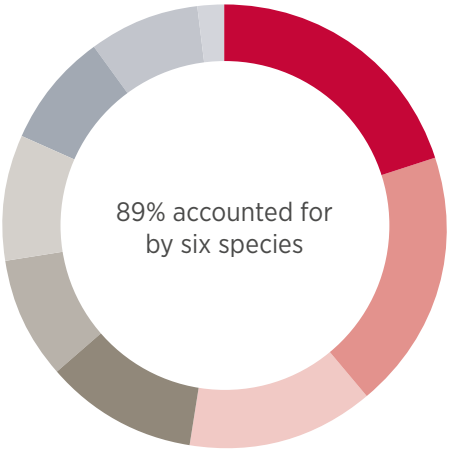
- 32% Oak (Acute Oak decline, Oak processionary moth)
- 14% Ash (Chalara)
- 14% Beech (Grey Squirrel, Deer, Drought)
- 11% Sycamore (Grey Squirrel, Deer, Drought)
- 9% Other
- 6% Birch
- 4% Sweet Chestnut (Chestnut blight)
- 3% Alder (Phytophora alni)
- 3% Hazel
- 2% Willow
- 1% Hawthorn

Figure 2: Species make up of conifer woodland in England

Lesser used natives:
Small-leafed lime, Hornbeam, Large-leafed lime, Wild and true service tree, Aspen.

Near natives:
Cherry, Rowan, Downy birch, Flowering ash, Oriental beech, Common walnut.

Exotics:
Italian alder, Robinia, Black Walnut.



- 22% Scot's Pine (Lappett moth, Dothistroma DNB)
- 21% Sitka Spruce (Spruce aphid, drought, Phytophthora ramorum)
- 15% Larches (Phytophthora ramorum)
- 12% Corsican Pine (Dothistroma DNB)
- 10% Norway Spruce
- 10% Unaccounted for by six species
- 9% Douglas Fir (Phytophthora ramorum)
- 9% Other Conifers
- 2% Lodgepole Pine (Dothistroma DNB)

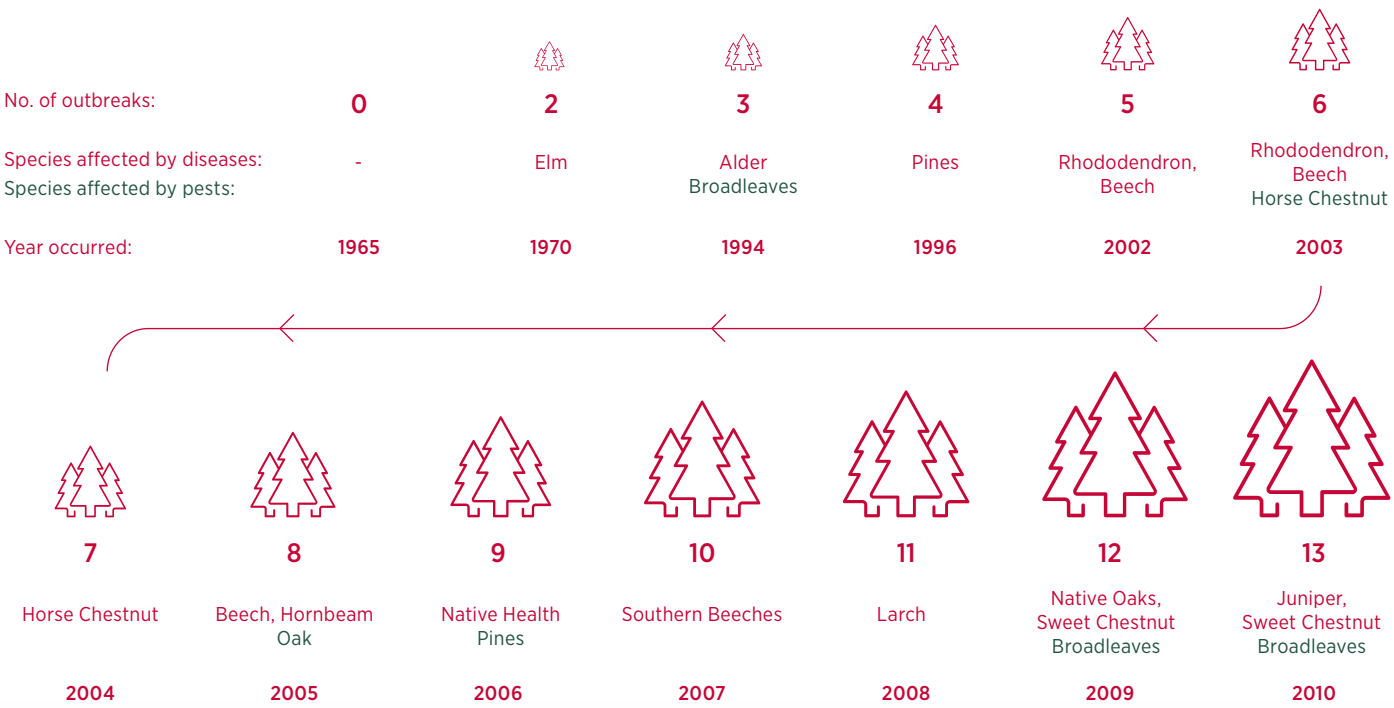
Fig.1 Source: Forestry Statistics 2013, Broadleaves, National Forest Inventory, Preliminary estimates of quantities of broadleaved species in British woodlands, with special focus on ash (2012). (pest and diseases to watch for in brackets)
Fig.2 Source: Forestry Statistics 2012, Conifers, National Forest Inventory, Standing timber volumes for coniferous trees in Britain (2012). (pest and diseases to watch for in brackets)

THE NUMBER OF NEW WOODLAND PESTS AND DISEASES HAS INCREASED RAPIDLY SINCE THE EARLY 1990S

As well as the numbers of pests and diseases increasing, they have also spread more widely.

Figure 3: Number of new disease and pests outbreaks in the UK is increasing over time

Source: based on Forestry Commission data.



THE UK'S CLIMATE IS ALREADY CHANGING, BY THE EQUIVALENT OF 40 FEET PER DAY

Global warming has already reached 1oC and could rise by 4oC by 2100. The UK's climate is changing and becoming more like that of mainland Europe. The speed of change is astonishing – the more southerly climate is advancing north by the equivalent of 40 feet per day.

Changes in the climate have led to the annual average number of 'warm spell' days more than doubling between 1961 – 1990 and 2008 - 2017. This extreme heat, combined with lower rainfall, and more extreme rain events, is already leading to millions of trees being weakened, becoming more susceptible to pests and diseases, and dying. For example, more than 110,000 hectares of German woodland have been destroyed in 2019 alone by heat and lack of water. The cost of replanting the trees is estimated at €660m[1].

In the UK, we can expect:

- Increased risk of multiple climatic hazards – this is likely to be the most significant impact on trees.
- Increase in heavy rain events.
- Increased risk of river and coastal flooding.
- Increased risk of damage from winter storms.

This table shows some of the most significant opportunities and threats to UK woodland from climate change.

	2020s	2050s	2080s
Opportunities			
Increase of potential yield of Sitka Spruce in Scotland			
Threats			
Forest extent affected by red band needle blight			
Decline in potential yield of beech trees in England			
Wildfires due to warmer and drier conditions			
Forest extent affected by green spruce aphid			
Loss of forest productivity due to drought			

Positive impact Neutral impact Negative impact (The darker the colour, the greater the expected consequences.)

N.B. The Forestry Commission has high confidence in the predictions of these consequences.

1. Financial Times. Germans devastated by grim future of fairytale forests. 16th August 2019.

GENETIC CONSIDERATIONS FOR PROVENANCE CHOICE OF NATIVE TREES UNDER CLIMATE CHANGE IN ENGLAND

The Forestry Commission's excellent advice note (two pages long)[2], while acknowledging that the evidence-base is incomplete, comes to some useful, practical findings. It says that a "portfolio approach" to restocking could help to spread the risks, compared with choosing stock from one provenance, and increase the likelihood that some trees will thrive:

- Using natural regeneration. Levels of within-population genetic variation in trees are very high, which provides the raw material for evolutionary adaptation.
- Using local planting stock.
- Using planting stock from appropriate, more southerly provenances.
- Using species matched to site characteristics and managers' objectives.

The research also found that the effect of the 'site' is often larger than the effect of 'provenance', which means that any unsuitable trees brought in through planting will usually fail before they reach reproductive age. Limiting the amount of any non-local provenance stock to only a small proportion addresses this risk.

Therefore, where it is possible with landscape priorities for the site, it may be safer to create mosaics of single-origin blocks or clumps within a planting site, rather than intimate mixtures throughout. This has the advantage not only of minimising the risks from solely using stock from more southerly provenances, but will also enable managers to monitor performance more closely over time and feedback results to the industry.

2. Whittet, R., Cavers, S., Ennos, R. and Cottrell J. (2019). Genetic considerations for provenance choice of native trees under climate change in England. Forestry Commission Research Report.

HOW CAN MANAGERS START ADDRESSING THE CHALLENGE

The Forestry Commission estimates that by the 2080s, 65% of its public forestry estate will be classed as 'unsuitable' without any adaptation with an associated 35% drop in productivity.

Addressing the challenge starts from agreeing suitable principles for woodland management[3]:

Principles Approaches to management that are flexible, reactive and anticipatory will help forests and woodlands adapt to the changing climate.	– Be confident and act now – otherwise it may be too late – Manage your woodland and leave a legacy for future generations – When planting, please speak to your nursery, buy contract grown stock – plan ahead – Look to source Grown in Britain – Use income from thinnings to fund the work – The plan should map out different species, length of rotation, growth rates and value of timber
Woodland design and contingency planning Forest design, structure and composition needs to be resilient to the effects of a changing climate and extreme weather events. Woodland and trees that are appropriately located can help to alleviate the impacts of climate change on society and the environment.	– Understand climate change projections and their effect on woodlands using tools like Forest Research's Ecological Site Classification tool (see section below) – Create fire, windstorm and flood contingency plans – Monitor and review – Create landscape and wildlife corridors, and think about replacing mature trees that characterise the landscape
Bring existing woodlands into management	– Manage deer, squirrels and invasive species – Thin to encourage regeneration – Enrichment planting to diversify species
Adapt choice of planting material Introducing diversity in tree species and origins will ensure some thrive should others decline.	– Understand your soils and the growing conditions to help choose the right species for the specific site – Diversity of species – including 'minor species' – Genetic diversity and more southerly origins – Species capable of withstanding hotter, drier climate
Transform to 'continuous cover forestry' Woodland and trees can be used to develop ecological connectivity between habitats to enhance the ability of woodland ecological communities to adapt to climate change.	– Landscape approaches – Link woodlands in the landscape – Enlarge existing woodlands – Build in usable access routes for forestry machinery and haulage

3. See The UK Forestry Standard. Forestry Commission, Edinburgh 2017 (Click here)

WHAT IT MEANS IN PRACTICE – DIFFERENT APPROACHES FOR DIFFERENT WOODLANDS

There is not a 'one size fits all' solution. Different approaches are needed for different types of woodland and for woodland with different management objectives.

For all woodlands	– Write a management plan (and implement it!) – Include climate change projections (and impacts on species present) – Acknowledge change may be inevitable – and match species to variation in topography, aspect and soil type
Existing semi-natural woodland	– Work with nature (under planting, diversify using minor native species) – Reduce other pressures (deer, squirrels, invasives) – Bring coppice into management (as it may be more resilient) – Use management intervention to encourage natural regeneration (such as thinning and deer management) – Use landscape approaches to expand habitat and reduce fragmentation
New native woodland	– Native species, but include more provenances from more southern latitudes – Primarily native species, but consider including near natives – A small proportion of exotics may be appropriate
Amenity woodland	– Similar to new native woodland, but more scope for exotics – Fast growing species may be considered to create a 'mature feel
Commercial plantations	– Diverse range of species (landscape or intimate) – Consider future wood products alongside species – Much scope for using provenance to increase resilience

PROVENANCE RISK ASSESSMENT, INCLUDING SOURCING SEED FROM FURTHER SOUTH

Maintaining genetic variation in our tree species is important; we don't know with certainty the environmental pressures our trees will face, but the greater the variation, the more likely it is that populations are able to survive and even thrive in the new and changing conditions.

As stated above, using natural regeneration is important but there are some circumstances where it might worth including species from more southerly places, for example where there is not enough seed.

There are a large number of considerations to take into account when deciding whether to use assisted migration, which is using provenances sourced from further south in a planting scheme. The Forestry Commission has outlined four hypothetical scenarios to explore how various considerations will influence the possible effects of sourcing seed from further south (which is often shortened to the acronym SSFS):

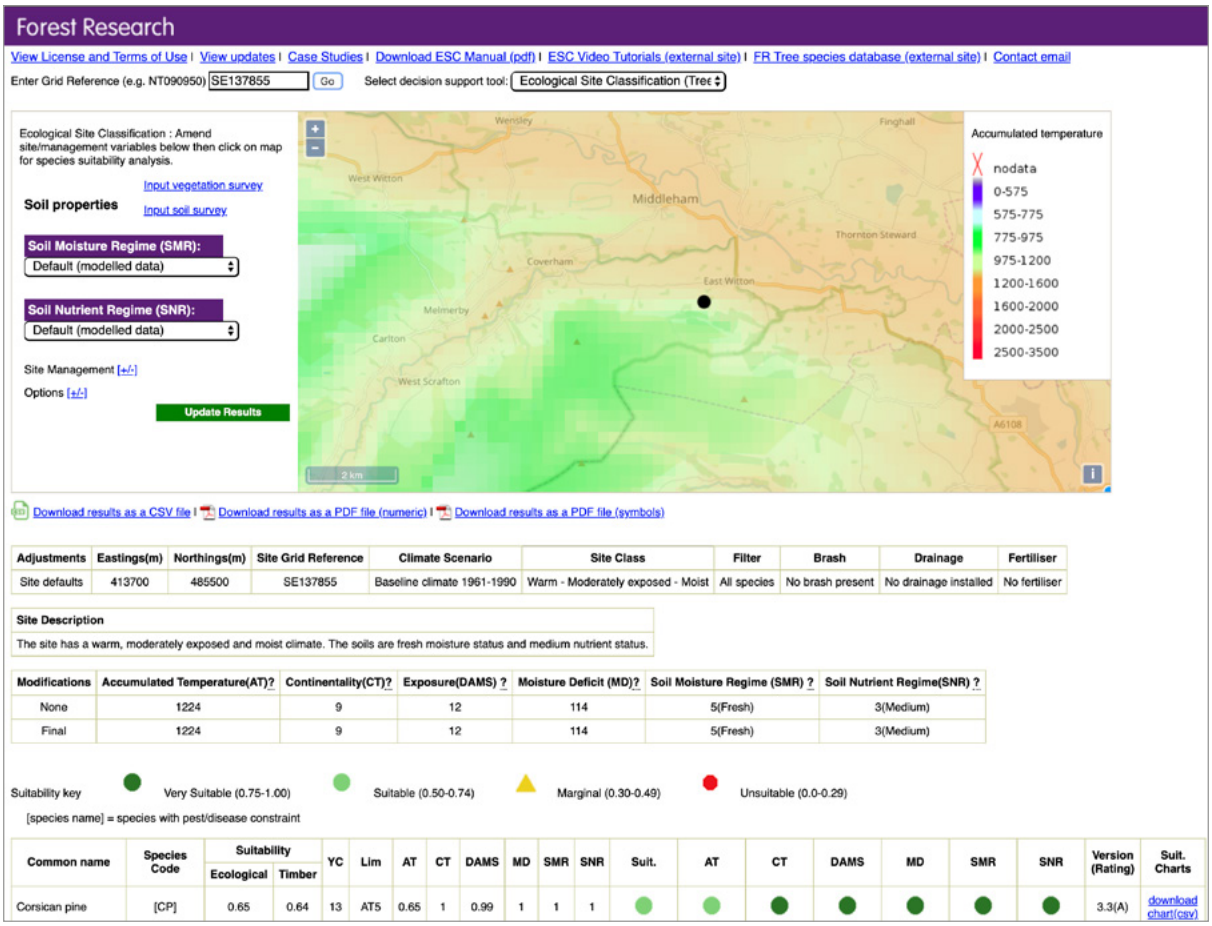
Hypothetical planting schemes and the way they may influence thinking about provenance choice:

Consideration	Scheme 1	Scheme 2	Scheme 3	Scheme 4
Primary motivation	Establishment of self-perpetuating woodland (reforestation)	Expansion or maintenance of small, chronically fragmented populations which are not regenerating naturally, and where strong inbreeding depression has been identified	Production of quality hardwood timber	Short rotation coppice/biomass
Landscape	Upland rough grazing/ unimproved grassland	Any	Lowland ex-agricultural	Lowland agricultural
Spatial scale	Tens to hundreds of thousands of trees	Few trees: tens to hundreds	Thousands of trees	Hundreds to thousands of trees
Temporal scale	Perpetual	Perpetual	Long term but with periodic selective felling and some retention or continuous cover	Short rotation crop
Management access	Limited, beating up but little aftercare	Fairly regular	Regular	Regular
Focal species/ species groups	Mixed native early successional species	Rare species	High forest hardwood species (oak, beech, sycamore and cherry)	Fast growing coppice/ biomass crops
Type of base material	Genetically variable source-identified or selected seedlots	Genetically variable source identified seedlots	Genetically variable selected or improved seed orchard material (but not full-sibling families or clones)	Clonal
Possible effect of SSFS	Risky, unlikely to be necessary, especially in areas which are not drought-prone	Risk remains but proportions of non-local material from ecologically similar sites may provide demographic support and increase genetic variation	Risk lower than in scheme 1; however, selected/improved local or regional may provide the same gain as selected from further south with lower risk (Hubert, 2005; Viherä-Aarnio and Velling, 2008; MacLachlan et al., 2017)	Low risk; advantageous to use the fastest growing material available, regardless of origin

CHOOSING SPECIES THAT SUIT THE SITE AND WILL BE CLIMATE RESILIENT

There are some excellent, helpful tools available to help make informed decisions about what species to plant, including the Forestry Commission's Ecological Site Classification tool. It is an on-line tool that matches the key factors on any site in the UK with the ecological requirements of different tree species and woodland communities under a range of climate change scenarios. At its most basic use, it just requires a grid reference for a site and information on soil type. The tool can provide more precise information if more detailed information on soils and the site are entered, which any experienced forest manager can do.

The output from the tool is an assessment of the suitability of all main tree species for the site, for timber production and ecologically. The output is very user-friendly but Forest Research recommends that it is used to help decision making by experienced forest managers. It does not give definitive answers!



FURTHER INFORMATION

- Forest Research's climate change resource (Click here)
- Ecological Site Classification Decision Support System (Click here)
- FCCWG (2018). Forestry Climate Change Adaptation Action Plan. Prepared by the Forestry Climate Change Working Group (FCCWG). (Click here)

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