



National
Trust

Climate Change Adaptation – Gardens and Parks

Trees in the Designed Landscape

Climate change vulnerability: high

Trees in the designed landscape – introduction

Trees – both native and ornamental species – shape our historic parks, gardens, arboretums, pinetums, pleasure grounds and designed landscapes. They may be remnants of old avenues, parts of significant collections or simply magnificent individual specimens that stand out against a skyline or frame a view.

Trees give distinctive character to places and act as living relics of the past, revealing much about historic land use and horticultural fashions. Many trees also perform important ecological functions by supporting a wealth of insects and other animals, as well as casting shade and stabilising the soil.

Climate change is already having a marked effect on our trees. Prolonged drought or flooding are having adverse impacts on root health; more frequent and intense storms are causing instability; and milder winters are enabling new pests and diseases to become established. As a result, many trees in National Trust gardens, parks and landscapes are showing signs of stress.

The need for more frequent tree inspections and tree work, as well as management for pests and diseases, is also increasing the cost of maintenance significantly.

Particular care must be given to ancient and veteran trees, which have great ecological significance; specialist advice from ancient tree experts should be sought when considering these.

Image credit:

Large, characterful cedar tree at Killerton, Devon (© National Trust Images/Mel Peters).



Trees in the designed landscape – why do they matter?

The loss of mature trees means the loss of habitats, shade, shelter, character, sense of place, and the opportunity for current and future generations to understand the designed landscape. Climate change could even bring about the loss of entire species in certain regions. This would significantly alter the look of our landscapes and have a negative impact on the biodiversity of the United Kingdom.

Deciding if and when to replant lost or declining trees requires a good understanding of the natural and cultural significance of a site, as well as the soil conditions and microclimate.

Selecting species suitable for replanting is challenging. Trees are very long-lived, which means that any tree planted now will need to tolerate a wide range of conditions over its lifetime. Current climate projections suggest that within this century, the climate of southern England will be more like that experienced by southern Europe now. However, we cannot simply opt for Mediterranean species because spring frosts remain likely for many years to come and we will have much wetter winters, as well as extreme fluctuations. Few species are adapted to these factors.

When thinking about new species, it is important to consider their form and growth habit, their appropriateness to the history and character of a place, and also their ecological function (particularly what fauna they can support). There are mixed views about whether native trees of local provenance have the best capacity to adapt to changing conditions, or if the same species grown from seed collection further south is more likely to thrive. There are also a range of views on where and when planting exotic species may be appropriate. The best solution will vary greatly from place to place depending on local objectives and, in some cases, a combination of approaches may be advisable.

Image credit:

A dead tree left standing at Attingham Park, Shropshire (© National Trust Images/John Miller).



Trees in the designed landscape – hazards, impacts and options

Hazard	Impact	Options
Drought and heat	<p>Stress leading to summer leaf loss and limb drop.</p> <p>Slow growth/loss of vigour/decline of established trees.</p> <p>Susceptibility to pests and disease or weakness leading to failure in storms.</p> <p>Failure of young trees to establish.</p> <p>Damage from wildfires.</p> <p>Loss of individual trees, whole species or historic features such as pinetums.</p>	<p>Plant trees as whips/young stock which will establish better than semi-mature stock. Mulch trees after planting.</p> <p>Increase tree inspections in areas of high usage.</p> <p>Keep people and animals away from the base of veteran or weak trees with long grass, mulch or fencing.</p> <p>Replace failing trees with tougher selections of the same species (this may require seed collection and propagation programmes).</p> <p>Replace failing/failed trees with more drought-resilient species if appropriate.</p> <p>Accept retrenched or declining trees or standing deadwood.</p> <p>If possible, allow natural regeneration in wooded areas to encourage adaptation within local populations.</p>
Waterlogging/flooding	<p>Increase in root rots (especially <i>Phytophthora</i>).</p> <p>Increased compaction in areas of high usage.</p> <p>Decline or death of established trees.</p> <p>Failure of new trees to establish.</p>	<p>Keep people and animals away from the base of veteran or weak trees with long grass, mulch or fencing.</p> <p>Relieve compaction with airspade or similar (not suitable for veteran trees).</p> <p>Address water catchment issues across the site.</p> <p>Choose species adapted to waterlogging (on former wetland sites, deep soil samples may reveal which species were once present).</p>
Storms	<p>Limb loss.</p> <p>Changes in prevailing wind (for instance, north-easterly winds in the west) can destabilise established trees.</p>	<p>Increase tree inspections in areas open to the public.</p> <p>Consider appropriate staking for newly planted specimen trees.</p> <p>Plant windbreaks.</p>
Milder winters	<p>Establishment of new pathogens/ increase in existing ones.</p> <p>Increase in tree growth (where summer drought does not restrict it).</p>	<p>Introduce good plant biosecurity standards (e.g. staff training and minimal procurement from overseas).</p> <p>Increase pest and disease management practices.</p> <p>Opportunity to experiment with new species where appropriate.</p>



Image credit:

Coast Redwood at Bodnant Garden, Conwy, lost in Storm Arwen (© National Trust Images/Annapurna Mellor).



Image credit:

Parkland trees in floodwater at Beningbrough Hall, Park and Gardens, North Yorkshire (© National Trust Images/Annapurna Mellor).

Trees in the designed landscape— options and thresholds

When trees are damaged as a result of storms, drought, prolonged waterlogging or pathogens – or a combination of all these factors – you will need to make decisions about their management.

The right solution will depend on whether the site is primarily significant as a historic landscape or as a natural habitat, and in many places it will be both. Any decision to remove a mature tree – even in decline – should be taken in the context of the climate and nature crises we face.

Specific options for adaptation measures include:

Increased maintenance – mulch, relieve compaction, protect the root zone from foot or vehicle traffic, implement pest/disease control.

Review specimen trees/collections to understand which trees are most significant and which are most vulnerable. This will inform priorities and also provide clues to successful species.

Allow tree(s) to decline in situ – appropriate where the risk to the public from limb drop is low, the biodiversity benefits of deadwood are desired, and the aesthetics of declining trees are acceptable. Some veteran trees will retrench naturally into a smaller form which is acceptable.

Replant with the same species, using genetic material from more southerly provenance – for example, use *Quercus robur* from the edge of current range or from 2 to 5 degrees further south. This approach (known as assisted migration) may increase drought resilience but trees may be less adapted to the local soil, less tolerant of winter wet or may come into leaf earlier, which puts them at risk of late frosts.

Replant with the same species but select a different cultivar – one that is bred for disease resistance or tolerance of certain extremes. This is only possible for some species. The form of the new variety may differ.

Replant with a different species which offers a similar character in the landscape but is likely to be more resilient to future conditions – for example, use Italian hop (*Ptelea trifoliata*) in place of hornbeam. This will only be appropriate in some situations and will have an impact on the fauna that can be supported.

Propagate tree and relocate – unique specimens of cultural significance or those rare in cultivation may need to be propagated for replanting in more suitable locations within the site or, if appropriate, at another site where conditions are likely to remain more suitable in the future.

Thresholds & tipping points

At what point might you diverge from your current maintenance/management strategy? What are the events/things that may trigger this change of approach (action/philosophy)?

Tree safety management procedures take priority in areas open to the public (e.g. where there is increased limb drop).

- Frequency of storms.
- Aesthetics in key views.
- Failure of young trees.
- Loss/decline of particular species/collections.
- Introduction of a pest or disease.

The role of exotic species

Non-native tree species collected from around the world (such as cedars and Wellingtonias) are a feature of many historic gardens and parks in the United Kingdom. As with our native species, some of these are showing greater ability to cope with the effects of climate change, while others are highly susceptible to drought, waterlogging, high winds or new pests and disease.

It is likely that climate change may present opportunities to experiment with more exotics. Species from New Zealand, Japan, Chile, Korea or Madeira, for example, may thrive in the north and west of the United Kingdom where summer rains are more likely to continue. Experimentation like this will only be appropriate in certain situations where species are relevant to a site's history and character.

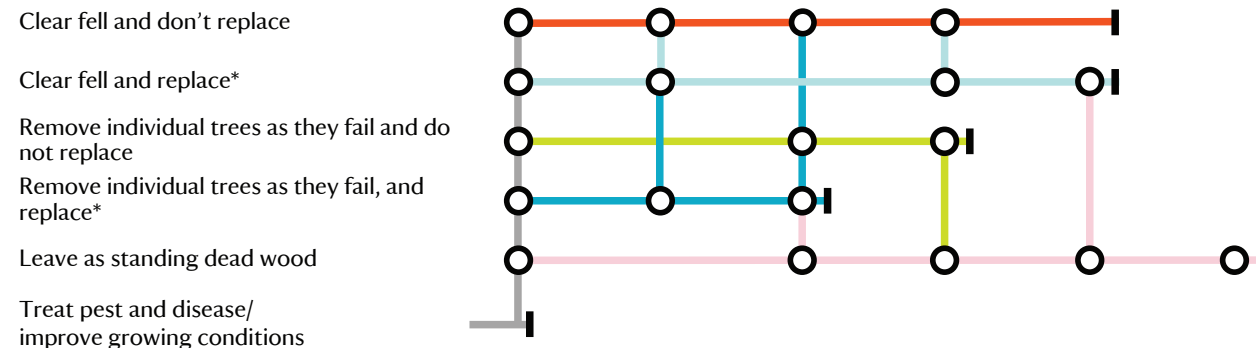
It is often suggested that establishing tree species from southern Europe may mean they will be able to support insects and birds altering their ranges in the future, but this is a complex subject which it is hard to predict and plan for.

Trees in the designed landscape – worked pathway example

This page outlines some options and thresholds for adaptation, and shows how site managers might respond to a climate hazard and move between the different options.

A multi-disciplinary team will be needed to assess the cultural and ecological value of specific trees or planted features, the original plant palette of the site (including lost specimens), the likely impact of their loss or decline, and what management approach to take. This team should include historic landscape experts, tree specialists, ecologists and site managers. Conservation management plans will need to be closely consulted, where available.

The worked pathway example below¹ is based on a historic avenue in which mature trees are failing as a result of drought, compaction, high winds and disease. Depending on the site, only some of the options below will be appropriate.



Response thresholds are most likely to be based on health and safety, risk associated with limb/tree fall, aesthetics and significance. The prevalence of pests and diseases and frequency of extreme weather events are likely to be compounding factors. These are balanced by site operational behaviours and requirements such as access. Specific trigger points would need to be agreed by the operations decision-maker and relevant consultants and consultees such as the gardeners and rangers working at a site. Design and significance of the asset might impact the thresholds and options within the Dynamic Adaptive Policy Pathway.

***Species selection for replacements will have a major impact on outcome.**

¹Dynamic Adaptive Pathways Approach ([Haasnoot, Kwakkel, Walker & Ter Maat, 2013](#)).

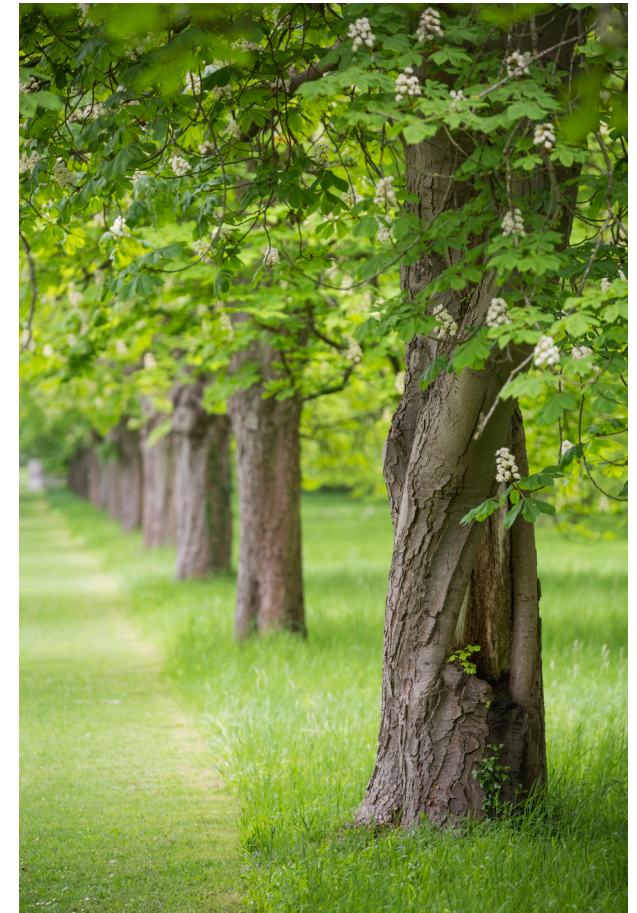


Image credit:

The Coronation Avenue at Anglesey Abbey, Cambridgeshire (© National Trust Images/James Dobson).

Case studies, signposting and references

Many garden teams have extensive experience of selecting suitable tree species for historic designed landscapes to replace specimens lost due to neglect, disease, land use change or natural senescence. Climate change puts new pressure on our designed landscapes and requires even longer-term thinking.

The Serpentine walks and other lost avenues at **Lodge Park, Gloucestershire** have been recreated using the elm cultivar 'New Horizon', which is resistant to Dutch elm disease and is drought-tolerant. Like English elm, which is known to have grown extensively on the site but is now lost, it is thought to host the endangered white-letter hairstreak butterfly. *Tilia cordata* 'Greenspire' (a variety of lime), which is thought to be more drought-resistant than *Tilia x europaea* 'Pallida' but has a similar shape, has been planted in the Great Avenue. Choosing two species (a double row with one species in each row) might not be traditional but helps spread risk.

A very large cedar tree in **Bodnant Garden, Conwy** is affected by Sirococcus blight, to which it may have become more susceptible as a result of both compaction from foot traffic over the root zone and prolonged drought. This mature specimen is critical to the character of the garden, so all attempts to improve its health are being tried, including reducing compaction of the root zone by limiting access and using an airspade as well as experimental techniques such as injections of nutrients into the root zone and stem. (To date, this is not proving effective.)

At **Mount Stewart in Northern Ireland**, many species within the windbreaks that protect the garden from the sea are failing due to salt water ingress. Non-native scrub is also colonising the gaps. A range of new species more suitable for a windbreak in saline conditions are now being planted, including oaks collected from coastal sites in Northern Ireland and more exotic species from Australasia such as *Metrosideros robusta*.

Cobham Wood, Kent is an SSSI wood pasture on historic parkland. Trees there are failing due to ash dieback and acute oak decline, exacerbated by drought and waterlogging. A number of approaches are being taken to maintain the wood's natural and cultural significance, including planting with sessile oaks and wild service trees (to provide habitat for some species previously reliant on ash) and trialling the elm cultivar 'Lutèce' which shows good resistance to Dutch elm disease and has the right stately habit.

A 140-year-old champion giant redwood tree at **Sheffield Park in East Sussex**, which was struck by lightning in November 2022, is being retained. Fallen wood has been removed and used but the dramatic, damaged crown has been retained in situ. The root zone has been mulched and roped off to relieve compaction and promote regeneration. Signage has been put up to help engage visitors with climate change.

Deep soil analysis at **Slimbridge Wetland Centre (Wildfowl and Wetlands Trust) in Gloucestershire** identified aspen as the main species present when the site was regularly inundated with water thousands of years ago. This species is therefore suitable for replanting as the site is expected to become increasingly flooded with sea level rise.

Resources to help with species selection:

National Trust staff planting woodlands should consult [internal policy](#) on choosing tree species and provenance.

[The Woodland Trust Tree Species Handbook](#) contains information about tolerances and associated wildlife of different native species.

Forest Research's [Ecological Site Classification](#) and [Climate Matching](#) tools. Suggested species are mostly those used in UK woods and forestry.

The [BGCI Climate Assessment Tool](#) allows you to enter location, species and climate change scenario to get predictions about species range and suitability for predicted conditions. The tool includes a wide range of native and exotic plants.

[Tree Species Selection for Green Infrastructure](#) – mainly focussed on species suitable for urban planting.

Note that all climate modelling tools should be treated with some caution, as climate hazards should not be equated with impacts.

Other useful resources:

Forestry Research: [Pests, Disease and Climate Change](#)

Forestry Commission: [Managing England's Woodlands in Climate Emergency](#)

Forest Research paper on [sourcing from southerly provenance](#)

Woodland Trust [position on tree provenance](#)

Historic England's guide to [Tree management, consents and controls](#)