



National
Trust

Climate Change Adaptation Guidance – Gardens and Parks

Cultivated Plants

Climate change vulnerability: high

Cultivated plants — introduction

Gardens and parks in the United Kingdom contain magnificent plant collections. Those in National Trust care include historic introduced species and plants that are now rare both in the wild and in cultivation.

Cultivated plants give gardens and parks most of their structure, character and seasonal interest. They include long-lived trees and shrubs, clipped hedges and topiary, roses, exotics grown under glass, fruit and vegetables grown in kitchen gardens and orchards, climbers on walls and buildings, flower borders, annual bedding schemes and National Collections of specific genera. Some species occur naturally, but many have been selected and bred for unusual features such as variegated leaves or bi-coloured flowers.

Most of the plants grown in UK gardens originate from non-native species which have been collected from other parts of the world. The majority come from temperate regions such as East Asia where they are adapted to cold, dry winters and relatively cool, wet summers. The changing climate of the UK, with hotter, drier summers and milder, wetter winters, is becoming less suitable for many of these plants. Climate change is also bringing extremes to which few plants are adapted. For example, the sudden drop in temperatures in winter 2022–23 gave rise to plant losses in many UK gardens.

Our generally milder winters, combined with the global trade in plants, are increasing the number of new pests and diseases able to establish in the UK. Plants weakened by extreme weather conditions are more susceptible to plant health issues.

Climate change is also having an impact on the traditional gardening calendar. For example, drier springs make it harder to establish annual planting schemes without a great deal of irrigation.



Image credit:

The magnificent garden and plant collection at Mount Stewart, Northern Ireland, is under threat from climate change (R. Bevan).

Cultivated plants – why do they matter?

Historic gardens are defined by the plants they contain. Many reflect horticultural fashions such as rhododendron or fern collecting in the Victorian era, or box and yew shaping to make knot gardens and parterres. They may demonstrate the artful combination of perennials to create flower borders, or annuals to create bedding schemes. Continuing to grow these plants in historic gardens and parks ensures that the sites retain their original design intent and can be understood clearly by visitors.

Some historic gardens and parks contain specimen plants that were introduced by significant characters in horticultural history (for example, the plant collector Robert Fortune), and some species which may now be threatened in the wild (such as the Patagonian or Alerce cypress *Fitzroya cupressoides*). They may also contain varieties which are no longer commercially available, some of which may have been bred by former owners or head gardeners, or named after a place, for instance, rhododendron 'Bodnant Beauty of Tremough'. There may also be plants which help tell the story of a place: the apple tree in Isaac Newton's garden in Lincolnshire or the collection of historic *Narcissus* at Cotehele in Cornwall are examples of this.

Unlike items of furniture, jewellery or art, plants age and require sensitive succession planning to ensure the character of a place is retained as they outgrow their space, or decline and need to be replaced. Climate change puts a new pressure on this process because it may not be feasible to maintain or replant the original species. Identifying alternative species can be complicated as climate change is affecting different regions and soil types in different ways, bringing, for example, waterlogging, drought, new pests and diseases, or a combination of factors. In many parts of the country, summers are increasingly 'Mediterranean', yet we continue to experience sharp frosts and/or cold, wet soils in winter – conditions to which few Mediterranean plants are adapted. Replacing long-lived plants requires especially careful consideration, as some woody species may be expected to live for several centuries. In some cases, the solution may not simply be a change of species but a change in the overall design of a feature.

Image credit:

Azaleas and rhododendrons are key to the character of The Dell at Bodnant Garden, North Wales (© National Trust Images/Joe Wainwright).



Cultivated plants – hazards, impacts and options

Hazard	Impact	Options
Drought and heat	<p>Established plants decline and become more susceptible to pests and diseases and/or branch drop.</p> <p>Plants require more frequent irrigation impacting on staff time and water supplies.</p> <p>Annual plants including bedding displays and vegetable plants fail to establish.</p> <p>Scorch, temporary wilt and slow growth of plants affect presentation standards.</p> <p>Glasshouses overheat.</p>	<p>Increase water holding capacity of soil with mulch (ideally from own garden compost).</p> <p>Increase rainwater storage (highly recommended) and/or access to wells/boreholes (less sustainable in the long term).</p> <p>Consider irrigation for the most significant plants.</p> <p>Create swales along planted banks to slow water run-off.</p> <p>Alter the timing of planting new schemes and of lifting and dividing from spring to autumn where possible.</p> <p>Reduce annual schemes (e.g. bedding, containers and vegetables).</p> <p>Adapt planting schemes to more drought-tolerant species.</p> <p>Increase shading in glasshouses.</p>
Waterlogging/flooding	<p>Increase in root diseases such as <i>Phytophthora</i>.</p> <p>Death of plants underwater for periods in summer and winter (few plants are adapted to summer waterlogging).</p>	<p>Reduce compaction/improve soil health and drainage.</p> <p>Assess water movement across site and create soakaways, rain gardens and/or flood meadows to hold and absorb water in the landscape.</p> <p>Change planting to species more adapted to tolerate waterlogging.</p>
Milder winters	<p>Increase of pests and diseases and unwanted plant species.</p> <p>Increased use of pesticides.</p> <p>Increased plant growth during winter leading to increase in workload for gardeners and/or greater damage from spring frosts.</p> <p>No winter chill for fruiting plants which need it.</p> <p>Change in flowering times affecting nectar provision.</p>	<p>Improve plant biosecurity procedures (including staff training, quarantining new plants and reducing the number sourced from overseas).</p> <p>Increase management of introduced pests, diseases and invasive plants.</p> <p>Replace failing plants with more resilient species. For fruit, choose varieties that need less/no winter chill.</p> <p>Opportunity to explore placing plants sensitive to cold in areas that were previously unsuitable.</p>
Storms	<p>High winds (especially from the northeast) affecting health and stability of trees and other large woody plants.</p>	<p>Increase shelter using resilient species.</p> <p>Increase frequency of tree inspections. See the chapter of this guidance on <i>Trees in the Designed Landscape</i>.</p>
Reduction in availability of fossil fuels	<p>Affects glasshouse crops and propagation.</p>	<p>Reduce glasshouse displays or change to species requiring less/no heat.</p> <p>Install thermal blinds and alternative sources of heating (where cost allows).</p> <p>Reduce dependence on annual plants raised under glass.</p>



Image credit:

Milder, wetter winters can increase the prevalence of diseases such as *Phytophthora*, as seen on this rhododendron at Trengwainton Garden, Cornwall (© National Trust Images/Ross Hoddinott).



Image credit:

Flooding of the Rock Garden atSizergh in Cumbria is putting the plant collection under strain (Susan Rowley).

Cultivated plants – options and thresholds

Good horticultural practice, such as storing rainwater, using mulches, reducing compaction, improving drainage and altering the timing of planting, can increase the health and longevity of existing plants or planting schemes. These options should all be explored before making changes to significant schemes or collections.

Nevertheless, climate change will eventually require planting adaptations to be made in many gardens. Success in doing this will require a good understanding of the character and significance of the design style and planting, understanding of the site's soil and weather (including the changes being experienced and those which are predicted) and excellent plant knowledge. Most garden teams will require support with this.

Specific options for adaptation measures include:

Change annual bedding schemes to drought-tolerant perennials, retaining the overall shape and colours of the scheme. Consider introducing signage to explain the challenges posed by climate change.

Edit borders to remove struggling plants and add in those with similar qualities but greater resilience to soil conditions. Once established, some perennials (such as deep-rooted *Thalictrum*, *Eryngium* and *Euphorbia*) show far greater drought tolerance than others, but retain a traditional border aesthetic.

Trial alternative species that may provide a suitable plant palette for your garden in the future. Remember that different micro-climates within a garden will have a huge impact on which plants will grow.

Propagate vulnerable, significant plants for relocation to a more suitable microclimate within the site (for instance, lower ground or an area with more shade); or, if appropriate, another site where the plants have relevance.

Adapt collections/schemes to use the same genera of plants (such as apples or roses) but using varieties known to be more suited to drought or winter wet, or more resilient to pest and disease.

Accept the loss of some features based on species fundamentally unsuited to the site and soil conditions (for instance, rose gardens on light, sandy soil in full sun). Redesign areas with a sustainable scheme based on plants suited to the conditions (careful stakeholder engagement and employment of a designer is advised).

Create a succession plan for significant woody plant collections and/or incorporate succession planning for climate change into conservation and garden management plans.

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)?

- Outdoor plants requiring routine watering and/or pesticide treatment.
- Plants visibly declining year on year.
- Plants requiring frequent replacement.
- Insufficient water storage infrastructure/new infrastructure is prohibitively expensive.

Understanding the significance of plant collections

Assessing the significance of plants will inform your decision about whether to propagate them and whether there is any value in conserving them in a new location. (Significance may be lost if a plant is relocated.)

Within the National Trust, the Curator of Living Collections can support this work. Elsewhere, Botanic Gardens, Plant Heritage or the International Conifer Conservation Programme may be able to provide support.

Keeping good plant records will facilitate this process. Even records of lost plants will be useful for caretakers of the future.

Cultivated plants – worked pathway example

This page outlines some pathways and thresholds for a real site example, showing how site managers might respond to a climate hazard and move between options.

A multi-disciplinary group will be needed to think about the best solution for a site. This should include horticulturists, curators and site managers. For changes to garden features on registered sites it may be best to involve the Gardens Trust as early as possible. Additional plant expertise may also be needed. Within the National Trust, involving the regional Gardens Consultants and Senior National Consultant for Gardens and Parks is a crucial first step.

For significant collections of long-lived woody plants, teams are encouraged to monitor the health of plants, seek advice and explore options for some time before making changes. In some cases it may even be preferable to leave certain specimens in decline. For less significant collections or garden features containing fairly short-lived plants, changes may be made more readily, especially where maintenance has become unsustainable.

Selection of replacement species may require research, trials and external expertise. Where possible, new plants should provide a similar sense of character to those they are replacing, but where this is not possible, careful consideration may need to be given to the future direction of the garden's planting aesthetic. This decision-making must be recorded for the future.

The worked dynamic adaptive pathway¹ below is based on the options available for a parterre in which hedging plants are failing to thrive and annual bedding is proving unsustainable to grow, plant and maintain. The starting point is to increase irrigation (from rainwater storage) and improve soil health, then plant changes can be explored, ranging from more drought-tolerant annuals to perennials. If none of these options provide the effect required then a new scheme should be explored, or removal of the parterre may be appropriate in some places.

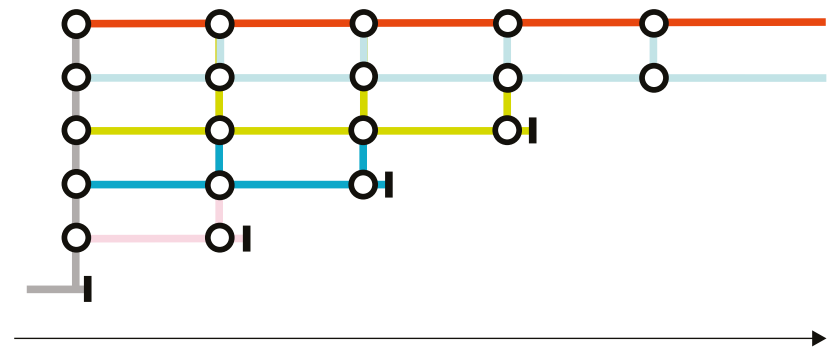


Image credit:

The parterre at Wimpole Hall, Cambridgeshire (© National Trust Images/Andrew Butler).

Remove parterre and do not replace
Re-design parterre/create garden feature
Change to drought-tolerant perennials
Change bedding plant selection
Improve soil and drainage
Increased irrigation and maintenance

Time/frequency and intensity of drought



(Response thresholds are most likely to be based on visitor complaints and survival of plants as well as the need to irrigate and the staff/volunteer resource required for maintenance. The 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 your thresholds and options within the Dynamic Adaptive Policy Pathway.)

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

Case studies, signposting and references

Even now, National Trust gardens are experiencing losses of specimen plants and are facing challenges in maintaining traditional schemes. A number of adaptations are already being made in response to these. Adaptations usually require consultation with a range of stakeholders, including volunteers, visitors and heritage experts.

Lower lying parts of the garden at **Mount Stewart in Northern Ireland** are at risk from saltwater ingress. The long-term strategy takes several approaches, including propagating unique species under threat of being lost, trialling species suitable for forming a windbreak in saline conditions, and planning for new garden features on higher ground. These new features would be created in the spirit of the current formal garden to maintain the visitor experience and keep the legacy of this quirky and experimental garden alive.

Sheringham Park in Norfolk is home to a large collection of rhododendrons, some of which are associated with the plant collector Ernest Wilson. These are currently struggling in the light soil and dry climate, particularly in areas where the tree canopy has been compromised. Good records of the collection do not exist so its full significance is hard to evaluate. However, the display is a huge part of the visitor offer and current thinking is to propagate the showiest specimens and plant the new plants on lower, more sheltered ground within the estate where visitors can continue to enjoy them.

The **parterre at Wimpole in Cambridgeshire** is a 1990s recreation of an 1850s design on the site of a much older formal parterre. Perennial plants are failing and annuals are hard to maintain in the clay soil and exposed site, where summer and winter temperatures fluctuate by as much as 50 degrees Celsius. Designers have been employed to produce a new design which is more sustainable and resilient, but pays homage to the history of the site and its parterres. Expert plant knowledge has been a key requirement.

Up to one third of the **woody plant collection at Sheffield Park in Sussex** is showing signs of stress and ill health, thought to be a result of climate change. The team there are proposing to review the collection's suitability for future climate conditions and create a long-term landscape succession strategy (along the lines of those produced for the Melbourne Botanic Garden and Royal Botanic Gardens Kew) so that the park continues to retain its character and deliver maximum public benefit for future generations.

At **Bateman's in Sussex**, the historic yew hedges are declining due to extremes of drought and flooding. Their loss would fundamentally change the character of the garden, so tree health specialists have been contracted to assess the soil profile and carry out an experimental 6-year remedial programme to boost the plants' health and resilience using mulches, fertilisers and other soil treatments.

Image credit:

The lavender at Ham House in London (right) is very drought-tolerant. Lavenders are also being planted in the parterre at Cliveden in Buckinghamshire which requires adaptations to cope with climate change (© National Trust Images/Chris Davies).

Signposting & additional guidance

Changes to registered gardens and parks will require consultation with the local [Gardens Trust](#) as well as [Historic England](#), [Cadw](#) or the Heritage Gardens Archive (NI). A heritage impact assessment may be required.

For checking resilience of existing woody species or selecting new ones, [the BGCI Climate Assessment Tool](#) allows you to enter location, species and climate change scenario to get predictions about suitability.

The Royal Horticultural Society's '[Gardening in a Changing Climate](#)' report (2017) contains some useful general guidance.

