



Thorpe Wood, Peterborough, Cambridgeshire

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1. Lowland mixed deciduous woodland

Climate change sensitivity: **Low**

Introduction

The greatest threat to woodlands from climate change is likely to be an increase in the frequency and severity of summer drought. There is a high likelihood that there will be impacts on drought-sensitive tree species, particularly on some soil types (e.g. shallow, freely-draining soils and clay soils), particularly in predominantly in southern and eastern England.

Stressed trees are more susceptible to insect pests and diseases, and the majority of insect pests that currently affect UK woodlands are likely to benefit from climate change as a result of increased activity and reduced winter mortality (Broadmeadow 2005). The impacts of both insect pests and diseases are therefore likely to increase with climate change. Deer and grey squirrel *Sciurus carolinensis* populations are also likely to benefit from climate change, representing a greater threat to woodlands and limiting the capacity for evolutionary adaptation through natural regeneration.

There are likely to be shifts in the distribution of the main tree species across much of the UK and, due to the low species diversity of high forest trees in England's woods; over a long time-frame this may result in widespread change to the composition and structure of woodland.

The risk of wind-throw may increase if the UK experiences more storms or if tree-root depth becomes restricted by increased rainfall and water-logging.

The likely responses of the forestry sector to climate change may change the character of broadleaved woodlands as new management approaches, including the planting of native and non-native species in locations outside their natural range, are adopted. However, the more widespread adoption of continuous cover systems of management could benefit some woodland biodiversity through improvements in stand structure.

Habitat Description

Mixed deciduous woodland is characterised by trees that are more than 5 m high when mature, and which form a distinct, although sometimes open, canopy with a canopy cover of greater than 20%. It includes stands of both native and non-native broadleaved tree species, as well as yew *Taxus baccata*, where the percentage cover of these trees in the stand exceeds 80% of the total tree cover. Deciduous woodland may be of ancient or recent origin, and can be either semi-natural arising from natural regeneration or planted.

Deciduous woodlands are widespread across England. Distinct patterns of woodland are often related to landscape history. Large gaps in the distribution of broadleaved woodland often correspond to former lowland wetlands, such as the Fens or Somerset Levels; linear woods along valley sides or rivers are typical of the uplands of Cumbria or Northumberland; clusters of large woods are often associated with former Royal Forests, such as Rockingham (Northamptonshire), or where there were extensive wood-using industries (such as The Weald and the Chilterns); while in prime farming counties such as Suffolk and Leicestershire woods are often small and scattered (Natural England 2008).

There are an estimated 961,000 ha of broadleaved woodland in England (Forestry Commission 2012).

Potential climate change impacts

Cause	Consequence	Potential impacts
Warmer winters		<ul style="list-style-type: none"> ■ Earlier bud burst, with potential for increased risk of frost damage. ■ Incomplete winter hardening, potentially resulting in more serious winter cold damage. ■ Reduced winter chilling, leading to reduced seed germination and natural regeneration of some species. ■ Greater survival of mammal pests (e.g. deer and grey squirrel), resulting in increased grazing pressure and decreased regeneration. ■ Greater overwintering survival of insect pests, leading to increased abundance and pressure.
Altered seasonal rainfall patterns	Increased fluctuation in water tables and winter flooding	<ul style="list-style-type: none"> ■ Increased infection by various soil and water-borne pathogens such as Phytophthora. ■ Reduced rooting depth for species intolerant of winter water-logging, exacerbating the effects of summer drought. ■ Increased likelihood of wind-throw if tree root depth becomes restricted by increased rainfall and water-logging.
Drier summers	Drought Fire	<ul style="list-style-type: none"> ■ Shifts in the composition of native woodland communities/types (Broadmeadow <i>et al</i> 2009a, 2009b). ■ Increased competition from invasive species and the potential establishment of species from further south in Europe e.g. holm oak. ■ Shifts in the regeneration patterns of trees. ■ A potential decline in canopy cover. ■ Changes in ground flora composition. ■ Rapid changes in canopy characteristics and composition on very dry sites.
Increased frequency of extreme events	High winds Extremes of soil temperature and moisture	<ul style="list-style-type: none"> ■ Increased frequency of wind-throw, leading to losses of mature and veteran trees. ■ The loss of specialist species associated with veteran tree habitat (primarily fungi, invertebrates and lichens). ■ Increased frequency of environmental stress. ■ Potential for widespread tree mortality in years of extreme drought.
In combination	Increased prevalence of pathogens Increased survival of disease vectors Increased survival of mammal pests such as deer and grey squirrel Changed patterns of woodland productivity	<ul style="list-style-type: none"> ■ Potential loss or significant reduction in the abundance of key canopy species. ■ Limited natural regeneration. ■ Introduction or increased levels of planting of non-native species.

Adaptation responses

Appropriate adaptation responses will differ across the country because the landscapes, woodland, what is expected of them, and the climatic pressures, differ. However, even within a single landscape, the critical factors may vary: changes in winter rainfall might be important for valley bottoms, whereas summer drought could be critical on adjacent south-facing slopes (Kirby *et al* 2009).

Management of existing woodland is likely to focus on the reduction of non-climatic pressures such as pests and diseases, increasing the species and genetic diversity of new and existing woodland to reduce the impact of changes in the abundance of single species, and encouraging natural regeneration (i.e. evolutionary adaptation) by reducing grazing pressures from deer and thinning to create canopy gaps. However, in many cases acceptance and management of change will also be a key adaptive response to climate change.

Measures that aim to reduce the impact of drought and ensure the availability of water are likely to be increasingly important in different woodland types across the country.

For new woodland planting and, in some cases restocking, species and provenance selection will increasingly need to reflect projected future climatic conditions.

Some of the potential adaptation options for this habitat are outlined below:

Existing woodland

- Reduce the impacts of other pressures, such as pests and diseases, pollutants, over-grazing and development. Reducing deer pressure, for example, allows more flowering and seed setting of ground flora such as primroses, so increasing the potential for populations to survive drought years.
- Undertake management interventions to encourage and protect regeneration.
- Assess future suitability of species present on the site using Ecological Site Classification; assess options for species diversification.
- Accept and encourage a greater mix of native trees and shrubs through active management, for example by accepting a greater component of oak in the canopy of 'beech woods'.
- Increase the age structure and structural heterogeneity of woodland, for example by reducing coupe size and encouraging continuous cover forestry rather than large-scale clear felling.
- In woodland managed for timber, continuous cover forestry approaches may become more advantageous because they are thought to be more wind-firm, maintain a more even carbon storage, show lower soil carbon losses during harvesting, and promote recruitment by maintaining higher humidity levels (Kirby *et al* 2009).
- Consider blocking artificial drainage channels within woodland in areas predicted to experience increased drying out.
- Manage veteran trees to reduce the crown-to-root ratio, and improve protection for individual veteran trees.
- Undertake contingency planning for outbreaks of new pests or major new disturbance events such as wildfire.

- Critically assess the ecological role of near native species and consider accepting as a component of semi-natural woodland beyond their current native range, e.g. sycamore.
- Reflect management changes and potential changes in native tree composition in conservation objectives and guidance.
- Review objectives for woodland in relation to the wider suite of ecosystem services that woodlands provide. For example, outside designated sites and ancient woodland, changes in species composition, including the retention of non-native/exotic species, may be acceptable if the services that the woodland provides, such as urban cooling, visual amenity or recreational opportunities, remain intact.
- When determining the optimal management of sites, consider the requirements of key species such as woodland birds to ensure minimum patch size is retained.
- Take positive steps in all woodland situations to increase the proportion and diversity of decaying wood throughout sites. This will ensure both resilience of dependent species and the replenishment of woodland soils' organic content and hence the capacity for moisture retention and provision of other essential ecological functions needed by trees and other species.

New planting

- Assess options for species choice on the site using Ecological Site Classification (ESC) and an understanding of soil types present.
- On more free-draining soils in southern and eastern England, select more drought-tolerant species.
- In the southern and eastern parts of the country, and in locations prone to drought, use new planting to increase the patch size of small woods and reduce edge effects. This will help reduce water loss and also the effects of spray drift from adjacent farmland.
- Develop woodland and semi-natural habitat networks through planting new woodlands in targeted locations.
- Include a greater mix of species within new native woodland planting, including less commonly planted native species and, where ecologically appropriate and likely to benefit from projected climate change, near-native species from outside their current natural range should also be considered.
- Encourage a variety of species that can occupy the same functional space within the woodland ecosystem.
- Identify locations for planting where the direct impacts of climate change on the suitability of individual species may be less than in the surrounding region. These could include north-facing or more sheltered slopes and areas with more secure water supply such as spring lines or low lying areas closer to the water table (though these may be valuable open features themselves).
- Consider the potential for tree planting to assist adaptation in other sectors, for example as shading for livestock, windbreaks, and flood alleviation.
- Consider higher density planting so that woodland can be economically managed in the future to maintain habitat condition and continue to adapt to progressive climate change.

- When establishing new woodland or restocking, consider the planting of more southerly provenances of native species where this is consistent with site objectives.
- Improve understanding of soil properties and heterogeneity across the site, including the requirements of individual species and how these may change as climate change progresses.
- Retain/encourage field layer (minimal use of herbicides and mowing regimes) in combination with the use of biodegradable mulch mats during establishment phase to minimise soil water loss and buffer soil temperature variation which make a significant contribution to losses.
- Consider promoting natural colonisation to generate new semi-natural woodland adjacent to existing woodland, allowing locally native species to develop resilience through natural processes.

Relevant Countryside Stewardship options

WD1 Woodland Creation - maintenance payments

This option aims to support the successful establishment of newly created woodland that provides environmental and/or social benefits including:

- Supporting wildlife, particularly where new woodland links habitats or provides a protective buffer.
- Help reduce flood risk, improve water quality and prevent soil erosion.
- To create woodland that is resilient and can adapt to climate change.
- Landscape enhancement.

WD2 Woodland improvement

This option aims to change the woodland structure or management regime to improve biodiversity or enhance resilience to climate change. Dependent on the operation, multi-annual agreements will show a gradual restructuring or improvement in the condition of the woodland.

Further information and advice

Forestry Commission, [Climate change impacts and adaptation in England's woodlands](#).

Forestry Commission (2017) [UK Forestry Standard](#).

Forestry Commission England (2010) [Managing Ancient and Native Woodland in England Practice Guide](#).

JNCC (2008) UK BAP habitat description [Lowland Mixed Deciduous Woodland](#).

Key evidence documents

UK National Ecosystem Assessment – [Chapter 8 Woodland](#).

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