Beech in mature woodland

Beech *Fagus sylvatica* L.

Note: This species account should be read alongside that for Beech and Yew Woodland habitat

Climate Change Sensitivity: **MEDIUM (HIGH FOR DROUGHT)**
Ability to Manage: **MEDIUM**
Non climatic threats: **LOW**
Vulnerability: **MEDIUM**

Summary

Beech is vulnerable to the increased threat of drought with climate change in the south and east of its range, but it has the potential to grow well in north western areas. Adaptation will depend on the management objectives for a site and the area of the country. Where conservation is the priority, it is likely to be possible to maintain beech under moderate levels of climate change even in drought prone areas, but there will be a risk of mortality following hot dry summers. Diversification with other native species less vulnerable to drought is likely to be desirable to reduce risks of large scale loss of canopy cover in southern and eastern areas. Where timber harvesting forms part of site objectives, ensuring a diversity of species with a higher degree of drought tolerance will be even more important. In northern and western areas, beech is likely to remain viable for both biodiversity and production; the practice of removing beech as a non-native species is not recommended in these areas.

Description

Beech is a large, shallow rooted, deciduous tree, native to southern England. Mature beech can grow to a height of more than 40m. Within closed canopy woodlands, beech forms a dense canopy and casts a deep shade. Solitary beech trees have a wide, dense crown and low branches which hang down and also create shady conditions. Beech seeds survive better than those of many other tree species in strong shaded conditions and seedlings are able to survive and grow below the canopy of established trees (Rodwell 1991).

Beech trees normally come into leaf in April or May and after senescence retain dry, coppery foliage late into winter.

Beech is monoecious with separate male and female flowers on the same tree, in April and May. The tassel-like male catkins hang from long stalks at the end of twigs, while female flowers grow in pairs, surrounded by a cup. Beech is wind pollinated.

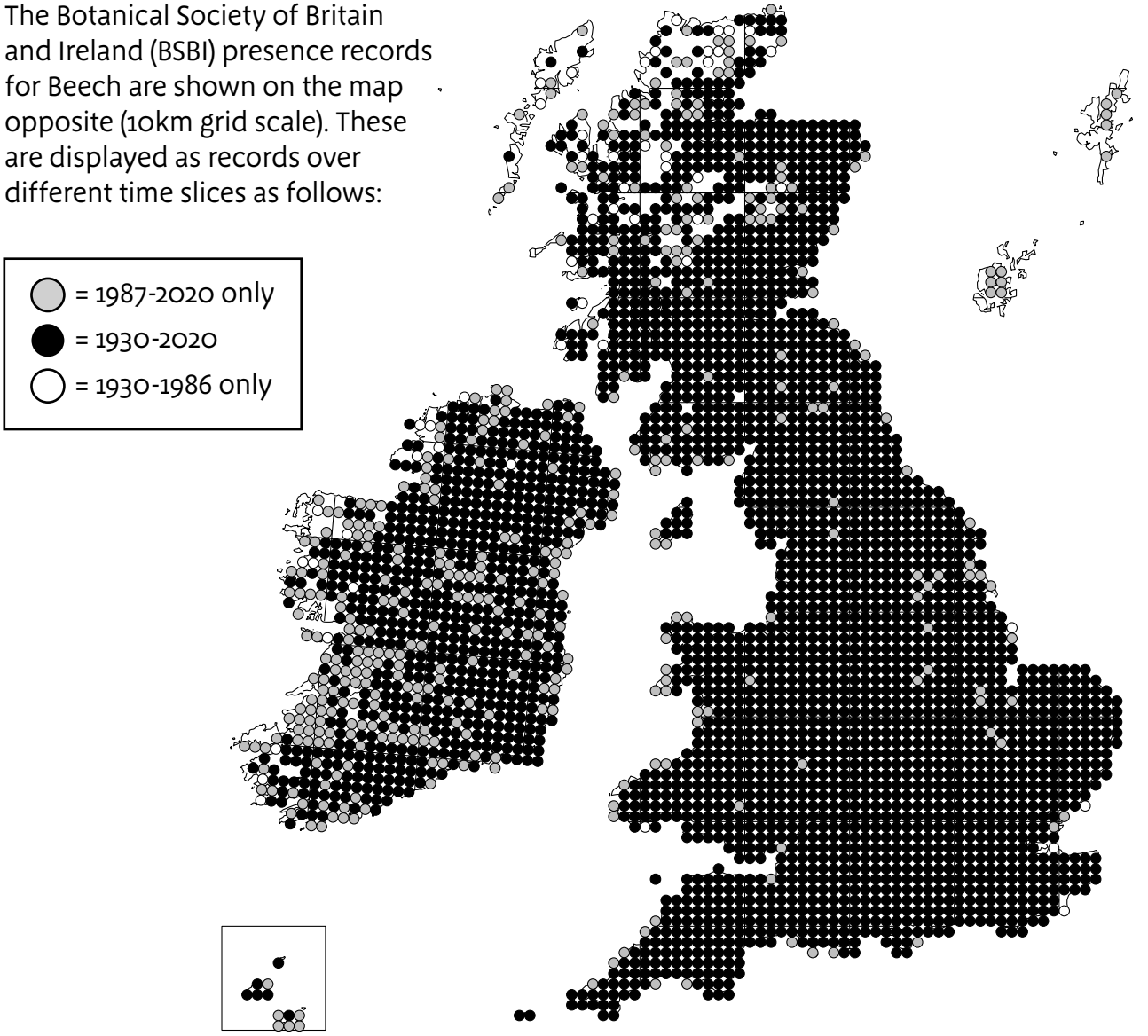
Ecology and distribution

Beech grows best on base rich soils, but tolerates any well-drained soil. It does not grow well on heavy clay soils. It often grows in single species stands, although this partly reflects past management, for example to produce wood for the furniture industry in the Chilterns. It is also widely found as pollards in wood pasture. Beech was present in southern Britain when the country became an island after the last Ice Age, and subsequently spread northwards to an approximate line between the Wash and the Bristol Channel, limited by summer drought in parts of East Anglia (Packham *et al* 2012). Beech also grows well further north: it has been widely planted and can naturally regenerate; it may well have spread naturally to the north of Britain without human intervention.

Beech is a common species across much of Europe and is a commonly grown timber tree in central Europe. The importance of the UK for beech will increase under climate change, with the species expected to be lost or decline from parts of its range in southern and central Europe.

Presence of Beech records at 10km^2 scale provided by the BSBI and are based on records collected mainly by BSBI recorders.

The Botanical Society of Britain and Ireland (BSBI) presence records for Beech are shown on the map opposite (10km grid scale). These are displayed as records over different time slices as follows:



Confidence in climate change impacts[18]

Distribution change: **HIGH CONFIDENCE** Mechanism: **HIGH CONFIDENCE**

Beech is vulnerable to a range of potential impacts, particularly drought (Cavin and Jump, 2017; van der Maaten-Theunissen *et al* 2016). Effects of other changes on growth characteristics and competitive ability may also become apparent over a period of decades.

Due to its shallow rooting, beech is sensitive to drought leading to reduced water and nutrient availability (Peterken & Mountford 1996). This leads to the suppression of growth and sometimes the death of mature trees (Cavin *et al* 2013) and seedlings. The incidence of beech decline linked to the *Phytophthora* fungus may also increase as summer drought stress becomes more frequent and severe (Broadmeadow & Ray 2005).

18 An assessment of the strength of evidence that distributions are changing and the mechanisms causing change are understood. Refer to Part B, section 5 of the species section introduction for more information.

At higher altitude and at the northern margin of its range where temperature controls growth, warming has been shown to increase the growth rate of beech (Dulamsuren *et al* 2017), to advance spring bud burst, and extend the growing season in the autumn (Schieber, Kubov & Janík 2017).

In the south and east, climate change is likely to lead to a reduction in its competitive ability within mixed woodland compared to species such as sessile oak *Quercus petraea* (Cavin *et al* 2013, Mette *et al* 2013). At its southern range margin in Europe, climate change is resulting in a progressive replacement by Holm oak *Quercus ilex* in the higher parts of the Pyrenees (Penũelas & Boada, 2003). The main causes are reduced recruitment and increasing defoliation of beech. Other studies have shown that long-term drought stress has reduced the productivity of beech forests at the southern range edge (Jump *et al* 2006).

Whilst beech is clearly sensitive to drought in the Southern England (Cavin and Jump 2017), local factors, including soil and geology can reduce risk in some locations. There is evidence that beech growing in shallow soils on chalk can access water in the chalk itself as a result of its hydrological properties (Roberts and Rosier, 2005), making it less vulnerable than might otherwise be expected.

Beech is also sensitive to water-logging and flooding (Geßler *et al* 2007, Packham *et al* 2012), suggesting that across its entire range it will be susceptible to changes in the pattern of rainfall and the frequency of extreme rainfall events. Higher water tables reduce the penetration of roots, making the tree more susceptible to drought. Seasonal shifts in rainfall (increased winter rainfall and decreased summer rainfall) may therefore increase the sensitivity and exposure of beech to drought.

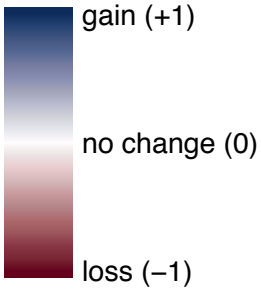
The flowering and subsequent seeding of beech is adversely impacted by late frosts (Packham *et al* 2012) and climate change driven warming may reduce this effect, leading to increased seeding.

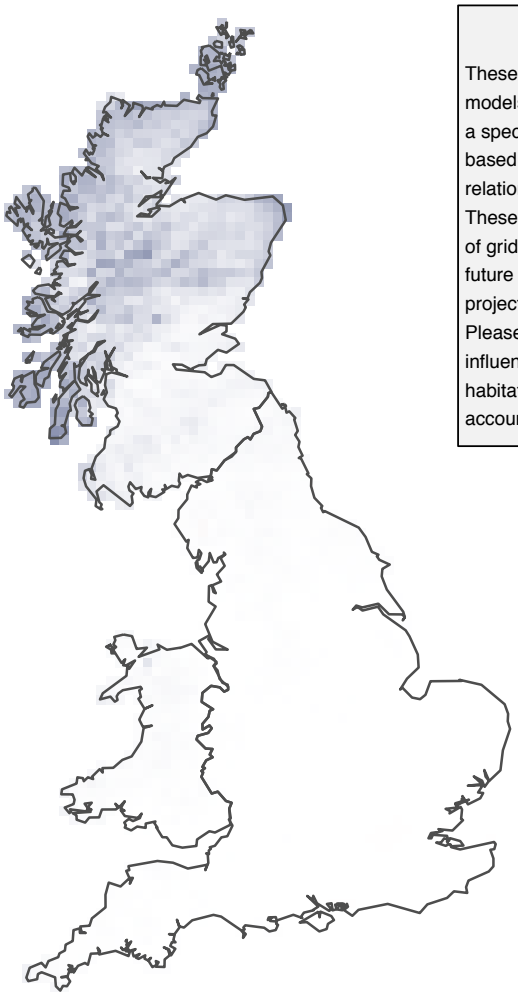
Due to its ability to grow on shallow soils, beech is vulnerable to strong winds (Packham *et al* 2012) and therefore may be adversely impacted by any increase in storminess. The thin bark of beech makes it vulnerable to fire, the threat of which is likely to increase under climate change, at least in the south.

Beech regeneration is adversely impacted by high numbers of squirrels (Packham *et al* 2012), populations of which could increase due to reduced mortality during milder winters and increased summer food supply. As with many species of trees, climate change induced stress may increase the susceptibility to plant diseases such as *Phytophthora*.

In experimental trials, saplings from populations of beech in drier areas of their range were less sensitive to drought (Alarcon 2017). Genetic variation along temperature gradients have also been shown (Kramer *et al* 2010), suggesting that genetic variation within the population may provide some element of tolerance to climate change. However, the ability of beech to adapt is unlikely to keep pace with the rate or extent of climate change.

Projected change in potential distribution of beech in the UK with a temperature rise of 2°C (Pearce-Higgins *et al* 2015)





Climate suitability

These maps are created using statistical models which describe the probability that a species will be found in a 10 km grid square, based on its current distribution and its relationship to a number of climatic variables. These can be used to model the suitability of grid squares for a species under possible future climates when climate change projections are taken into account.
Please note that other variables that influence species distributions, such as habitat and land–use change, are not accounted for in the modelling process.

Confidence of change

This species was not included as part of Natural England's Research Report NECR175 assessing the risks & opportunities for species in England as a result of climate change, so no assessment of confidence has been made for this species

Current climate scenario

Climate suitability

Low (2°C change) climate scenario

Created by: University of York Created for: Natural England Created on: August 18 2016

Further information on these projections can be found in the introduction to the species section (Part A, Section 3 and Part B Section 5). Note that this is a guide to where a species may be able to survive, it does not capture reductions in growth or canopy cover, which may be large in parts of southern England – see above text for further details. Contains public sector information licensed under the Open Government Licence v3.0. Please also see acknowledgement and copyright at the beginning of this manual.

Please read this case study alongside the relevant habitat sheets.

Adaptation options

As with many tree species, the approach to adaptation for beech will depend on whether it is being managed for conservation, timber production or a combination of objectives. This section focuses on the species' ecological status and its role within the woodland community; further information on adaptation in relation to timber production is available elsewhere (Ray *et al* 2010).

There are two broad approaches to adaptation: building resilience and adjusting objectives in response to inevitable changes. Both of these are important with beech and different approaches are appropriate in more drought prone areas of the south and eastern, where beech is considered native, compared to wetter areas in the north and west.

In drought prone areas:

- Promote increased diversity of native tree species to prevent the loss or degradation of the woodland habitat due to the loss or decline of beech.
- Promote natural regeneration to take advantage of natural genetic variation in populations in existing woodland managed for conservation.
- Where maintaining the survival of existing beech trees is a priority, consider direct management to reduce other pressures e.g. competition.
- Use planting or natural regeneration to increase the size of woodland patches to increase the area of woodland with cool, damp microclimate away from the edge.
- Encourage closed canopy management including continuous cover forestry to promote shade and cool microclimates and reduce vulnerability to drought and desiccation.
- Implement management that promotes natural hydrological function and retains water within soils, including ditch blocking.
- Consider planting or promoting deep-rooting trees such as oak alongside beech in drought prone areas, to improve the water balance of the soil via hydraulic lift of water from deeper aquifers.
- Control other threats in as much as this is possible, including the risks of herbivory by deer and squirrels.
- When planting new woodlands consider including provenances from warmer, drier conditions. See Whittet *et al* 2019 for a discussion of the relative merits of this compared to local seed sourcing of seed, in different circumstances.
- Ensure fire contingency plans are in place.

In the north and west

- Accept beech as a native species in areas that are now within its climate envelope and reflect in conservation objectives for sites, so long as this doesn't compromise other objectives.
- Consider planting beech as part of species mixtures in new woodlands.

Relevant Countryside Stewardship options

WD1 Woodland creation - maintenance payments

WD2 Woodland improvement

References and further reading

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