



Definition of Favourable Conservation Status for Bechstein's bat

Defining Favourable Conservation Status Project

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Executive summary

This document sets out Natural England's view on favourable conservation status for Bechstein's bat in England.

Favourable conservation status is the situation when the species can be regarded as thriving in England and expected to continue to thrive sustainably in the future. The definition is based on the available evidence on the ecology of Bechstein's bat. Favourable conservation status is defined in terms of three parameters: natural range and distribution; population; extent and quality of habitat necessary for long-term maintenance of populations.

A summary definition of favourable conservation status in England follows. Section 1 of this document describes the species and its ecosystem context, Section 2 the units used to define favourable conservation status and Section 3 describes the evidence considered when defining favourable conservation status for each of the three parameters. Section 4 sets out the conclusions on the favourable values for each of the three parameters.

This document does not include any action planning, or describe actions, to achieve or maintain favourable conservation status. These will be presented separately, for example within strategy documents.

The guidance document [Defining Favourable Conservation Status in England](#) describes the Natural England approach to defining favourable conservation status.

Summary definition of favourable conservation status

Bechstein's bat is a long-lived woodland specialist, associated with old-growth broadleaved woodland, relying on a continuous, closed canopy and a high density of natural tree holes.

In Britain, maternity colonies are predominantly found in deciduous, oak-dominated, semi-natural ancient woodlands, often greater than 25 ha in extent, with a diversity of tree ages, a well-developed understorey and a diversity of vegetative structure. Colonies roost within natural cavities in old deciduous trees, mostly oak trees, tending to switch roosts every few days and using up to 60 tree roosts over a breeding period. They show fidelity to their place of birth. Optimal foraging habitat tends to be associated with the same types of woodland near water courses. The species tends to forage only short distances from the roost and is judged to be a low disperser, as it does not travel long distances to reach swarming sites, usually near potential hibernacula.

Bechstein's bat is found in southern England and breeds as far north as Herefordshire and Worcestershire. Its current range extends over 132 hectads (10 km grid squares). The favourable range and distribution, based on the full extent of suitable broadleaved woodland, is defined as 527 hectads (mapped in Figure 3).

The current population of Bechstein’s bat in England has been estimated as 21,600 individuals (CI:10,200-55,000). The favourable population has been calculated using habitat suitability modelling (areas of broadleaved woodland greater than 2.5 hectares) as 28,000 individuals (CI: 13,120–70,850).

The current area of suitable habitat available for the species is estimated to be 1,168 km² (Mathews & Harrower 2020). Favourable habitat, based on suitability models of climate and woodland cover, is 11,000 km² of potential habitat available for the species within its range (Figure 3).

Table 1 Confidence levels for the favourable values

Favourable conservation status parameter	Favourable value	Confidence in the favourable value
Range and distribution	527 hectads (Figure 3).	Low
Population	28,000 individuals.	Low
Supporting habitat	11,000 km ² of broadleaved woodland (Figure 3).	Low

As of October 2022, based on a comparison of the favourable values with the current values, Bechstein’s bat is not in favourable conservation status. Note, this conclusion is based solely on the information within this document and not on a formal assessment of status nor on focussed and/or comprehensive monitoring of status.

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About the Defining Favourable Conservation Status project

Natural England's Defining Favourable Conservation Status (DFCS) project is defining the minimum threshold at which habitats and species in England can be considered to be thriving. Our Favourable Conservation Status (FCS) definitions are based on ecological evidence and the expertise of specialists.

We are doing this so we can say what good looks like and to set our aspiration for species and habitats in England, which will inform decision making and actions to achieve and sustain thriving wildlife.

We are publishing FCS definitions so that you, our partners and decision-makers can do your bit for nature, better.

As we publish more of our work, the format of our definitions may evolve, however the content will remain largely the same.

This definition has been prepared using current data and evidence. It represents Natural England's view of favourable conservation status based on the best available information at the time of production.

1. Species definition and ecosystem context

1.1 Species definition

Bechstein's bat *Myotis bechsteinii*

1.2 Species status

Red list status

An assessment of the risk of extinction.

Global: Near Threatened (Paunović 2016)

European: Vulnerable (Temple & Terry 2007)

GB: Least Concern (Mathews and others 2018)

1.3 Life cycle

Bechstein's bat is a long-lived woodland specialist (individuals may exceed 20 years of age) showing fidelity to its place of birth. Males tend to be solitary or live in small groups, but females live in colonies of 15-50 (up to 90) individuals (Dietz & Pir 2011; Mathews and others 2018). All colony members tend to belong to one or two matrilineal groups (Kerth 1998) and there is no exchange of females between colonies. The colonies form in early April and regularly subdivide and recombine during the summer (fission-fusion behaviour; Kerth & König 1999) with young being mostly born in June.

From the end of August, the colonies tend to disperse and the bats swarm at underground sites at the entrance to which males and females from multiple colonies interact. Most of the mating and hibernation occurs at these sites, highlighting their importance for gene flow and winter survival (Furmankiewicz & Altringham 2007; Kerth and others 2003; Rivers, Butlin & Altringham 2005).

The species is judged to be a low disperser, in terms of both seasonal and nightly dispersal, as it a) does not travel long distances to reach swarming sites (~10-20 km; shorter distances than most swarming bat species who regularly reach sites 50 km from their maternity roosts) and b) forages over only short distances from the roost (rarely flying more than 1,500 m to feeding areas; Dietz & Pir 2011; Schofield & Morris 2000; BCT 2020).

1.4 Supporting habitat

Bechstein's bat populations in England require a combination of roosting habitat, including maternity roosts and hibernation sites, and foraging habitat.

Roosting ecology

Throughout its range Bechstein's bat is associated with old-growth broadleaved woodland, relying on a continuous, closed canopy and a high density of natural tree holes (Dietz & Pir 2011; Napal and others 2009). In Britain, maternity roosts are predominantly found in deciduous semi-natural ancient woodlands, often greater than 25 hectares in extent, with a high proportion of oak in the canopy, a well-developed understorey and a diversity of tree ages and vegetative structure (Schofield & Morris 2000). However, it is not uncommon to find roosts in small woodlands, hedgerows or isolated trees in areas where broadleaved woodland is sparse (Damant & Cohen 2016). On the continent, the species appears to be less restricted to such woodlands and can also be found in oak stands within areas of extensive beech woodland with little understorey.

Roosting requirements seem to be constant throughout the species' range (Dietz & Pir 2011), with colonies found principally in woodpecker-made cavities or natural cavities in old deciduous trees, mostly oak trees (Dietz & Pir 2011; Napal and others 2009). Such crevices are typically dome-shaped and provide stable microclimatic conditions (Dietz & Pir 2011; Kerth, Weissmann & König 2001).

The bats tend to switch roosts after a few days and can use up to 60 tree roosts over a breeding period (Dietz & Pir 2011). Regular switching is thought to reduce parasite load and provide more favourable microclimatic conditions (Kerth and others 2001; Reckardt & Kerth 2007). Over summer, maternity colonies frequently split into subgroups and re-form, occupying different roosts (Kerth & König 1999).

Males tend to roost singly or in small groups inside crevices for periods of up to 2 weeks. In comparison to the woodlands utilised by females, males are more likely to be found in sub-optimal habitat, such as young or small, isolated woodlands. This is possibly due to the males' lower energetic demands (Dietz & Pir 2011; Schofield & Morris 2000).

Bechstein's bats swarm in late summer near potential hibernacula, such as caves, but also possibly at other sites, such as woodland glades (Kerth and others 2003). Although rarely recorded in hibernation, they are typically found in underground sites, with some records in trees, mostly in early winter (Andrews 2018; Greenaway & Hill 2004).

Foraging ecology

Bechstein's bats rarely fly more than 1,500 m to feed (Dietz & Pir 2011; Schofield & Morris 2000), with much shorter foraging distances (as short as 300 m) in good quality habitat. The longer movements tend to be made by bats associating with smaller forest fragments. (Kerth, Mayer & Petit 2002). After lactation, bats may forage further from their roosting sites - in orchards, meadows and barns (Dietz & Pir 2011). Each breeding female will

usually have its own foraging area of approximately 2-3 hectares and will make repeated returns to their roosts (Bayerl 2004; Brinkmann, Niermann & Steck 2007; Schofield & Morris 2000; BCT 2020). The foraging areas of mature females tend to be closer to roosting areas, while younger individuals forage further away (Dietz & Pir 2011). Bechstein's bats glean prey from vegetation and in Britain optimal foraging habitat is mature broadleaved woodland with a well-developed understorey near water courses (Schofield & Morris 2000). Colonies have also been found foraging in sparse woodland cover, coniferous woodlands and open 'riparian corridors' (Damant & Cohen 2016).

Confidence: Moderate

1.5 Ecosystem context

The Bechstein's bat is an ancient woodland specialist. It is non-migratory and widespread throughout central and western Europe, ranging from the Iberian Peninsula to southern Scandinavia, with populations in the Caucasus and Iran (Dietz & Pir 2011; Vergari, Dondini, & Ruggieri 1998).

Genetic analysis of samples from across the species' range has shown high levels of genetic diversity and little inbreeding. Some clear mitochondrial divergence has been observed between Europe, the Caucasus and Iran (van Schaik and others 2018).

However, in Britain genetic diversity is significantly lower than in continental Europe. These differences do not necessarily indicate any bottlenecks and may simply be representative of an edge of range and/or island population both of which are known to result in reduced genetic diversity. Genetic structuring, a difference in the genetic makeup, between the south-western population and the rest of Britain has also been identified (Wright and others 2018; Wright and others in prep) along with a genetically and geographically isolated population in Buckinghamshire (Wright and others 2018). These latter differences are likely to result from large areas with reduced woodland cover near Berkshire and Oxfordshire, resulting in reduced gene flow between populations (Wright and others in prep).

2. Units

2.1 Natural range and distribution

Hectads (10 km x 10 km grid squares)

2.2 Population

Number of individuals

2.3 Habitat for the species

Km²

3. Evidence

3.1 Current situation

Natural range and distribution

Records of the species are rare using standard survey methods, as it spends much of its time foraging high up in the canopy and produces low intensity echolocation calls which are challenging to record and identify on a bat detector. However, acoustic lures have proved to be effective in identifying the presence of this species (Hill & Greenaway 2005) and they were successfully used to determine the species' distribution more accurately during the Bat Conservation Trust (BCT) Bechstein's Bat Survey (2007 to 2011). This identified 37 new sites and extended the species' known range (Miller 2011).

The species' core range in Britain is in southern England, from Gloucestershire to Sussex, although individuals have recently been found breeding as far north as Herefordshire and Worcestershire. There are also records from Kent in the east and Devon in the west (Schofield & Morris 2009).

The extent of occurrence of the species encompasses 134 hectads and 23,500 km² of Britain (England: 132 hectads and 23,300 km²; Figure 1).

The range may be more extensive than currently estimated as the selection criteria (ancient oak woodland with dense hazel understorey) used to target survey effort reduced the number of sites deemed suitable for survey in some areas of south-west England and Wales. These areas are now thought to be suitable for Bechstein's bat (Mathews and others 2018).

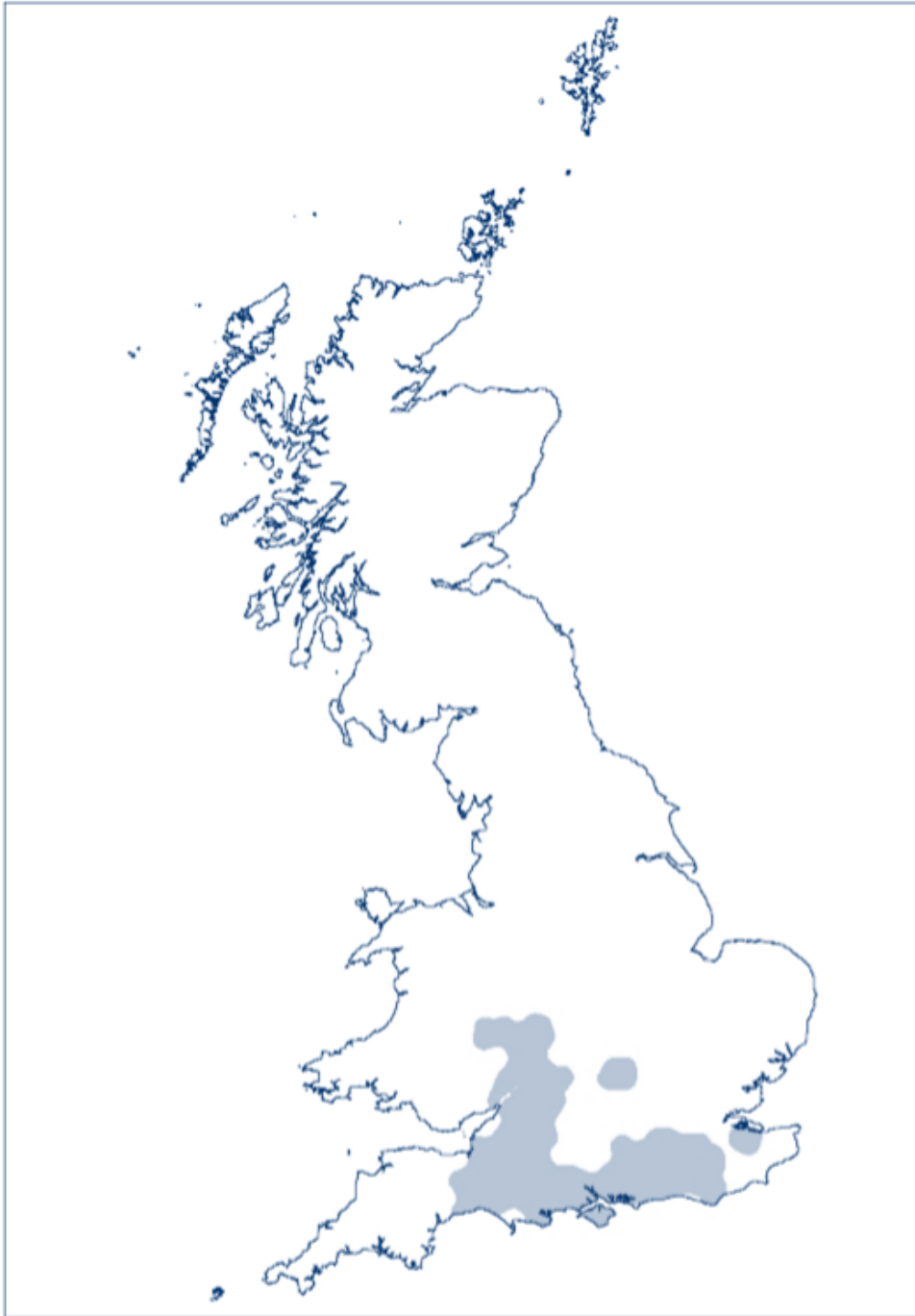


Figure 1 Distribution of Bechstein's bat across Britain (Mathews and others 2018)

Confidence: Moderate

Population

In 2018, the adult population of Bechstein's bat in England was estimated at 21,600 (10,200-55,000) individuals by Mathews and others. These estimates were entirely derived from expert opinion: information from 75 roosts was used to calculate roost size, sex ratios and roost density and these parameters used to estimate population size within the species' range in broadleaved woodland, a key habitat for the species. It was assumed that all bats in pre-breeding maternity colonies were female, and males would be in equal numbers in the surrounding habitat, but on their own or in small groups. However, no

consulted expert in this study had information on the sex ratio of the population. Neither was this information available from Harris and others (1995). While these estimates have large confidence intervals, alternative approaches provide estimates within this range. The 2019 Article 17 report therefore advises that the lower and upper confidence intervals should be treated as minimum and maximum estimates of the population (JNCC 2019).

Other sources: Alcalde & Juste pers. comm. 2006

Confidence: Low

Habitat for the species

When determining habitat for the species both roosting opportunities and the habitats to support foraging and commuting around roosts should be considered. Bechstein's bats are considered to utilise a core sustenance zone around a roost of 3 km (BCT 2020).

There is currently insufficient information on the percentage of potentially suitable habitat within the range that is occupied. Studies assume 100% occupancy, leading to an overestimation in habitat availability and extent (JNCC 2019). The current number of suitable roost sites is also unknown.

The area of occupancy (km²) was calculated using confirmed presence records, home and core range and habitat data by Mathews & Harrower (2020) as 1,168 km².

Confidence: Low

3.2 Historical variation in the above parameters

Post-glacial fossil deposits suggest that the species was once more widespread and numerous in Britain, with the subsequent decline in numbers associated with Neolithic forest clearance and changes in climatic conditions (Yalden 1999).

Natural range and distribution

The species' range has been significantly underestimated in the past with just 84 records from 14 sites available before 1989 (Figure 2), with the majority from underground sites (Miller 2011; Stebbings 1989; Wright 2018). Arnold (1993) reported that there were only 19 hectads with accepted records. It was not until the late 1990s that the first maternity colonies were found (Schofield & Morris 2000; Stebbings 1989) and a better understanding of range developed.

Given the low number of historical records there is no evidence of a change in the range and distribution.

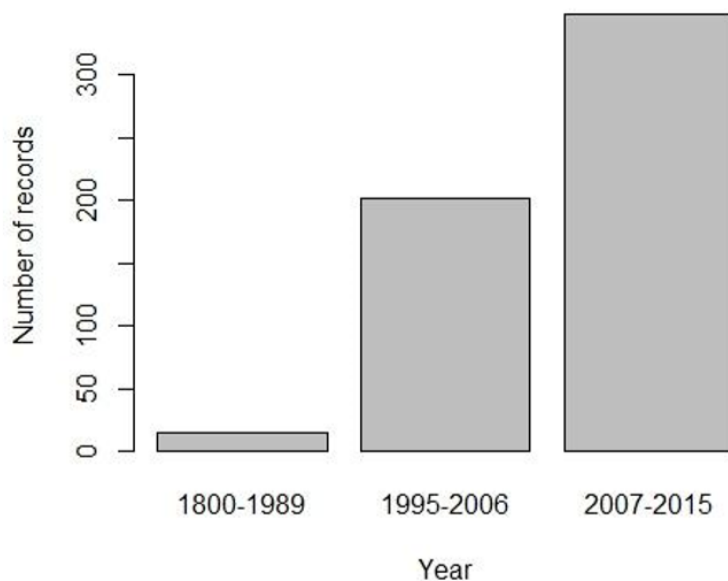


Figure 2 Bar plot from Wright (2018) summarising the total number of *M. bechsteinii* records in Britain from 1800 to 2015 using records from Stebbings (1989) and the records used by Wright (2018). © Patrick Wright. Reproduced with permission.

Confidence: Low

Population

The historical population size of the Bechstein’s bat is unknown. Across its global range, the species is assessed as Near Threatened, with evidence of colony loss due to disturbance in continental Europe (Alcalde & Juste, pers. comm. 2006).

In Britain, the population estimates made before those of Mathews and others (2018) are of approximately 1,500 individuals (JNCC 2013; Harris and others 1995). However, there is limited confidence in these estimates as the data available to inform them was sparse. It follows that comparison with the estimates made with the data available now are not feasible. However, considering the fossil record and that it is likely that historically there would have been greater availability of suitable habitats for Bechstein’s bat, it can be inferred that there have been significant declines.

Confidence: Low

Habitat for the species

There is no historical information on roost availability and foraging habitat. However, it is possible that historical changes during the 20th century resulted in a decrease in availability of supporting habitat and structural complexity. The species may be particularly susceptible to habitat loss because of its highly sedentary behaviour. See Table 2.

Table 2 Principal management changes affecting Bechstein's bat habitat

Historical change	Impact	Reference
Changes in woodland cover	7% of ancient woodland cleared	Spencer & Kirby (1992)
Changes in woodland management	38% of semi natural stands converted to plantations	Spencer & Kirby (1992)
Changes in management of unimproved grassland	97% of semi natural grassland lost	Fuller (1987)
Removal of hedgerows	20% of hedgerows lost	Staley and others (2020)

Confidence: Low

3.3 Future maintenance of biological diversity and variation of the species

Several pressure and threats may affect the Bechstein's bat:

- Climate change
- Management of woodlands, which will influence insect populations and the number of mature and over mature trees, potentially reducing availability of insect prey and roosts. Insect populations are globally declining (van Klink and others 2020). Management may also lead to increased disturbance and direct threats to roosts.
- Tree diseases may have a significant impact by modifying the landscape (for example, ash dieback *Hymenoscyphus fraxineus*).
- Increased urbanisation and transport infrastructure may result in the loss of roosting and foraging habitat through its destruction or fragmentation. Secondary impacts such as disturbance through traffic noise (Finch and others 2020) or increased artificial lighting levels will result in isolation of populations, leading to reduced genetic diversity. This is particularly so if isolation occurs between breeding populations, swarming and hibernation sites.
- The further industrialisation of agriculture is likely to further reduce food availability and roosting habitat (Heim and others 2017) and lead to the isolation of local populations.

Climate change is expected to lead to a northern range expansion of the Bechstein's bat (Razgour, unpublished data). It is uncertain, however, if the British population will be able to adapt to the warm and dry conditions experienced by the species in the Mediterranean, as conditions in south-east England will likely become unsuitable.

Bechstein's bat is a woodland specialist with a limited tendency to disperse (see Section 1.4) and so is unlikely to disperse across extensive areas of unsuitable habitat (that is, those areas devoid of woodland) to reach new habitat (Wright 2018). For this reason, the species may be unable to colonise woodlands, even those which have become suitable, leading to isolated populations which would experience increased levels of inbreeding and a higher risk of extinction, especially if it is unable to adapt to new climatic conditions. Such a situation may already exist in Buckinghamshire where an isolated population, with very little habitat available and lower levels of genetic diversity, is under increasing pressure from habitat destruction and climate change (Wright and others 2018).

Ancient woodlands offer a unique and essential habitat for the species, providing both foraging and roosting opportunities. The removal of woodland habitat, old or dead trees or conversion of woodland to monocultures are significant threats to Bechstein's bat (JNCC 2019). In addition, changes in woodland management affecting the total woodland area, amount of standing deadwood or the structure of the understorey, impacting in turn on roost and foraging availability, are expected to be important issues as they are known to affect other woodland bats (Mathews and others 2018; Boughey and others 2011; Murphy and others 2012). Woodland management and policy will likely be key drivers behind the success of any form of positive change. For example, future tree planting to mitigate climate change will need to be driven equally by carbon sequestration and biodiversity to be beneficial for wildlife.

The impact of the changes brought by tree disease is unknown but is likely to be detrimental where it results in the loss of foraging and roosting habitat. In addition, the increased risk of the spread of diseases, resulting from habitat loss and degradation, may result in the emergence of new diseases for bats (Gryseels and others 2020).

Although there is little or no data available, the cumulative effects of changes in land use and urban/lighting encroachment is expected to have serious detrimental effects on the species as these result in increased habitat fragmentation (Mathews and others 2018; Dietz and others 2020). In Germany, home ranges are known to be smaller close to roads, and the species tends to avoid flying over roads (Kerth & Melber 2009).

Habitat suitability models have identified approximately 11,030 km² of potential roosting and foraging habitat using the Maximum Training Sensitivity and Specificity (MTSS) occupancy rule (Figure 3; Wright and others in prep). These models identified temperature and precipitation along with woodland cover, specifically broadleaf woodlands managed for biodiversity, as important variables. The models do contain certain biases and may, in this case, overestimate the amount of habitat available for the species as they treat all types of broadleaved woodland equally (except for ancient woodland) and do not take into account woodland structure or species assemblages. Sex-related differences in habitat selection must also be considered, as female maternity roosts are almost exclusively found in mature oak woodlands, while males are known to use a broader range of woodland habitat.

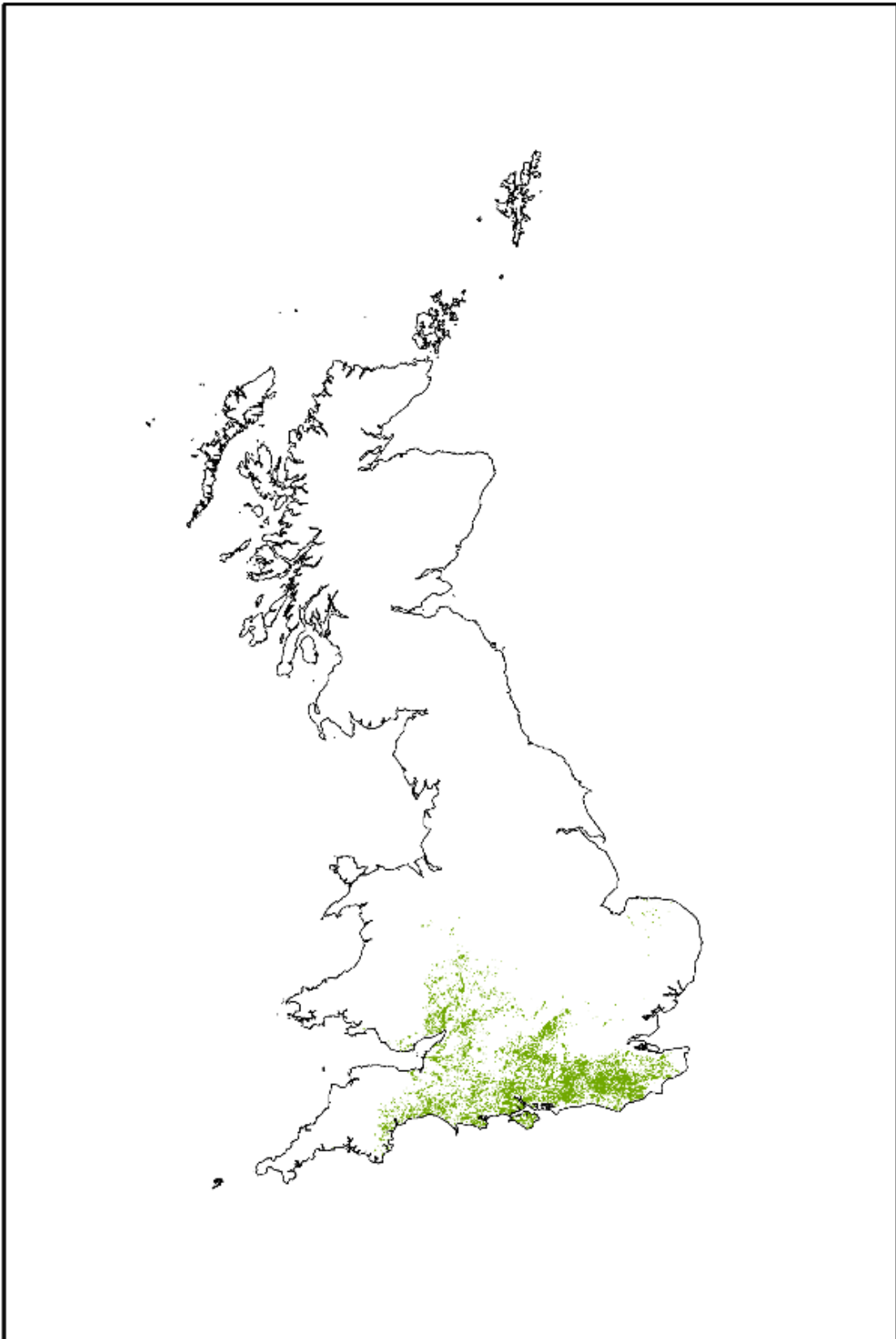


Figure 3 Habitat suitability model representing the potential habitat for the Bechstein's bat (green) using the Maximum Training Sensitivity and Specificity (MTSS) occupancy rule

Natural range and distribution

The habitat suitability modelling (Figure 3 above) indicates that there are 527 hectads with suitable habitat for Bechstein's bat.

Confidence: Low

Population

The population required for favourable conservation status is uncertain given the wide confidence limits around the current population estimate of 21,600 (CI: 10,200-55,000) individuals.

The population in England is currently assessed as Least Concern (Mathews & Harrower 2020). This is largely because there is no evidence of recent declines in population and no evidence of a contraction in range. Rather, there has been a consistent increase in the number of records, which is likely due to increased survey effort and the growing use of tools such as acoustic lures. Therefore, the Least Concern assessment should be treated with caution.

Whilst the national population is thought to be large enough to avoid inbreeding, the viability of small genetically isolated populations is at risk where they experience habitat loss or stochastic events. More emphasis on genetic monitoring in the future may help fill any knowledge gaps.

A favourable population size has been calculated using the potential habitat identified through the habitat suitability modelling. Taking an area of broadleaved woodland of at least 25 hectares as potentially suitable habitat and using the average number of individuals in a maternity colony (42.5; Mathews and others 2018) produced an estimate of 14,320 individuals (CI: 6,740 – 36,400). This estimate is likely to be more representative of the female population as 25 hectares is thought to be the minimum woodland size for maternity colonies. To provide a figure for the total number of individuals including the male population, an estimate was calculated based on suitable broadleaved woodlands of at least 2.5 hectares. This minimum woodland patch size is based on expert opinion but is thought to rule out woodlands that are unlikely to support a population of Bechstein's bat. This produced a population estimate of 27,900 (CI: 13,120–70,850).

Given the proposed increase in range for favourable conservation status, a favourable population level of 28,000 is proposed which is in line with the potential habitat identified through the habitat suitability modelling. This figure has been rounded up to account for the uncertainties in the data.

Confidence: Low

Habitat for the species

Based on the habitat suitability modelling a favourable area of supporting habitat of 11,000 km² is proposed. This figure has been rounded up.

Confidence: Low

3.4 Constraints to expansion or restoration

Climate change, habitat loss and woodland fragmentation are amongst the constraints likely to affect the expansion or restoration of the Bechstein's bat's range, population and habitat.

Climate change could also produce a population increase if a network of suitable habitat allows the species to shift range and adapt to warmer conditions. However, there is currently no evidence that the population will successfully adapt to climate change.

While attention is placed on planting schemes to create more habitat for this species, action needs to focus on the maintenance of existing habitat. Whilst much suitable habitat is ancient woodland, which cannot be recreated, other woodland types also provide suitable conditions and new planting can eventually provide habitat which might be colonised. This is most likely by expanding current sites rather than by creating isolated new ones. These measures will provide additional foraging opportunities for colonies and create a larger network of connected habitat favouring gene flow (considering the species' low dispersal abilities). Such measures in the western part of the species' range, for example, should make populations more resilient.

Confidence: Low

4. Conclusions

4.1 Favourable range and distribution

Figure 3 shows the potential broadleaved woodland habitat available for Bechstein's bat, as calculated using a habitat suitability model, which considers climate and the cover of broadleaved woodland as important variables. This is considered to represent the favourable range and distribution of the species, which is 527 hectads.

4.2 Favourable population

Favourable population for the species has been calculated based on potential habitat availability within the favourable range. This gave a favourable population of 28,000 adult individuals.

4.3 Favourable supporting habitat

The favourable area of supporting habitat is 11,000 km². This is the area of potential supporting habitat identified using the habitat suitability model.

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