Definition of Favourable Conservation Status for Hedgehog, *Erinaceus europaeus*

Defining Favourable Conservation Status Project

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Executive summary

This document sets out Natural England's view on favourable conservation status for hedgehog *Erinaceus europaeus* in England.

Favourable conservation status is the minimum threshold at which we can be confident that the species is thriving in England and is expected to continue to thrive sustainably in the future.

This definition has been produced following the Natural England approach to defining favourable conservation status described in the guidance document Defining Favourable Conservation Status in England.

Section 1 of this document describes the species covered by this definition and its ecosystem context.

Section 2 specifies the units used to describe the three favourable conservation status parameters. These are:

- Natural range and distribution (where the species occurs).
- Population (how many there are of the species).
- The extent and quality of habitat supporting the species population.

Section 3 outlines the evidence considered when developing the definition. This definition is based on the best available evidence on the ecology of hedgehog**.** The evidence covers the current situation, historical changes and possible future changes.

Section 4 sets out the conclusions on the favourable values, that is the value for each of the three parameters when the species has achieved favourable conservation status.

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.

Summary definition of favourable conservation status

The hedgehog is Britain's only spiny mammal. It is a solitary, generally nocturnal species associated with rural habitats such as woodland edges, hedgerows, meadowlands and pastures up to 600 metres above sea level (masl) in England. They require areas which include dense cover for refuge and nesting, as well as open grassland for foraging. Hedgehogs feed primarily on invertebrates and, in turn, are preyed upon by badger, *Meles meles* and fox, *Vulpes vulpes*. The relative importance of urban and sub-urban parks and gardens is increasing as the wider countryside becomes increasingly unsuitable.

The favourable range and distribution for hedgehog is 1,487 hectads, nearly all of mainland England. There is evidence that hedgehogs have declined by 73% between 1995 and 2018 and its current range extends over 1,299 hectads (10 km grid squares), with an estimated 846 hectads occupied.

The current population is estimated to be 597,000 individuals, with a recommended favourable value of a minimum of 2,211,000 individuals. The value was derived from population estimates in different habitat types, literature reviews and expert opinion. The attainment of the favourable value assumes growth in numbers in both rural and urban/sub-urban areas.

The favourable value for supporting natural and semi-natural habitat is 70,000 km^2 , although a further 53,000 km2 of low-quality habitat (including that which is neither natural nor semi-natural), is currently available to hedgehogs in England (Mathews and others 2018). The favourable value places an emphasis on the improvement of habitat quality and connectivity over increasing its extent.

Table 1 Confidence levels for favourable values

Favourable conservation status parameter	Favourable value	Confidence in the favourable value
Range and distribution	1,487 hectads	**Moderate**

Favourable conservation status parameter	Favourable value	Confidence in the favourable value
Population	2,211,000 individuals in England	**Low**
Supporting habitat	70,000 km^2 natural and semi-natural habitat; at least 123,000 km^2 if inclusive of urban/sub-urban	**Low**

There is uncertainty in the reliability of these figures. Caution should therefore be taken in their interpretation. However, as this document is based on the best available current evidence, it provides a foundation as additional data becomes available.

As of June 2024 based on a comparison of the favourable values with the current values, hedgehog 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.

Through setting our ambition and aspiration for species and habitats, our definitions will inform decision making and actions to achieve and sustain thriving wildlife.

Our FCS definitions will be embedded into delivery of the 25 Year Environment Plan, through the Nature Recovery Network, biodiversity net gain and environmental land management schemes (ELMS).

Conservation bodies will use them to inform their work, including management planning for the land they own. Businesses will have a clear understanding of how their work impacts nature recovery and how they can help contribute to achieving thriving nature.

By considering the evidence for FCS, decisions will be more confident and strategic, with an understanding of their contribution to, or impact on, the national ambition.

1. Species definition and ecosystem context

1.1 Species definition

West European hedgehog, *Erinaceus europaeus*

(also known as European hedgehog and common hedgehog)

1.2 Species status

Red list status

An assessment of the risk of extinction.

Global: Least Concern; Source: IUCN 22. IUCN Red List of Threatened Species. Version 2021-3. https://www.iucnredlist.org

European: Least concern; Source: Temple & Terry (2007)

GB and England: Vulnerable; Source: IUCN – compliant Red List for Britain's Terrestrial Mammals (Mathews & Harrower, 2020).

Conservation status

Hedgehog is listed on Annex III of Appendix II of 'Convention on the Conservation of European Wildlife and Natural Habitats' (Bern Convention 1979); offering special protection, including all forms of deliberate capture and killing, deliberate damage to or destruction of breeding or resting sites and deliberate disturbance (NBN Atlas 2024).

It is a Species of Principal Importance under Section 41 (S41) of the Natural Environment and Rural Communities (NERC) Act 2006.

1.3 Life cycle

Hedgehogs are medium-sized (less than 1.2 kg), insectivorous, nocturnal mammals that reach sexual maturity in their second year. They are solitary, non-territorial animals (Glasby & Yarnell 2013; Dowding and others 2010). They shelter and breed within nests that are usually above ground and often, but not always, specially constructed (Morris 1973; Reeve & Morris 1985). Two types of nests are used: small and often insubstantial day/summer nests and sturdy hibernation nests (Morris 1969). In the UK, nests are usually made from leaves and/or grass and are constructed in a supporting structure of log piles, dense thorny or stinging vegetation, usually under bramble, *Rubus fruticosus* agg., holly, *Ilex aquifolium*, hawthorn, *Crataegus* sp., or nettle, *Urtica dioica* (Reeve & Morris 1985).

Hedgehogs may use up to ten nests in close proximity to each other during a single summer and tend to use each nest for, on average, 10 days before moving to the next (Reeve & Morris 1985; Morris 1988). They tend to use one or two nests per winter (Rasmussen and others 2019; Yarnell and others 2019) though as many as five may be used in any one winter (Bearman-Brown and others 2020; Morris 1969).

In the UK, hibernation usually starts around mid-November and lasts until mid-March, though the exact timings vary with local weather conditions and most individuals will become active for short periods over winter, typically in response to warmer temperatures (Bearman-Brown and others 2020; Morris 1969, 2018; Yarnell and others 2019).

Hedgehogs are promiscuous (Jackson 2006; Moran 2009), with mating occurring from May to September and with hoglets being born 30 – 39 days later (Morris 2018). Females give birth to one litter each year in England, typically consisting of four hoglets. Second litters born in August to September have been reported, but survival rates for late-born juveniles over winter is thought to be low (Morris 1973; Jackson 2006) as they struggle to reach a suitable weight to survive hibernation (Couzens and others 2017). Females rear the young alone with the majority of female hedgehogs breeding for the first time in their second calendar year (for example, after one successful hibernation, as sub-adults). Sub-adult females have been reported to have lower breeding success compared to adults (Jackson 2006). Females are capable of breeding into their fifth or sixth year (Morris 1969).

Hoglets are altricial, born helpless and requiring prolonged parental care. Their spines appear after a few hours (Rasmussen and others 2019), and their eyes open at around two weeks. Hoglets feed on their mother's milk for four weeks and leave the nest to forage with their mother after that time. They independently forage and build their own nests at six weeks old (Morris 2018). There is a 16% mortality rate amongst hoglets before they reach independence (Morris 1977). There is little evidence of juvenile dispersal away from the natal nest site (Doncaster and others 2001).

The average life span for wild hedgehogs in England is three years, with some surviving until 6 years (into their 7th summer) (Morris 1969). A maximum of nine years has been recorded in Ireland (Haigh and others 2014) and recent findings from remains of an individual taken into care indicate that hedgehogs could live up to 16 years old (Rassmussen and others 2023).

Badgers are significant predators of hedgehogs, although the relationship between the two species is complex (see section 3.2). Foxes and pet dogs, *Canis familiaris,* also kill hedgehogs, particularly juveniles, with various mustelids and birds of prey occasionally taking them (Hof 2009; Mammal Society 2023). Other direct forms of mortality include vehicle collisions, gardening accidents (Reeve and Huijser 1999; Burroughs and others 2013), agricultural machinery (Yarnell and others 2019) and potential exposure to artificial chemical substances such as pesticides and heavy metals (Rasmussen and others 2024).

1.4 Supporting habitat

The habitat required to maintain hedgehogs in England is a combination of the habitat used for nesting and that required for foraging. As such, hedgehogs require heterogenous, diverse landscapes with a mix of open grassland and dense cover. Edge habitats, notably hedgerows, are an important habitat for foraging, movements and refuge, particularly in rural landscapes (Doncaster 1992; Hof & Bright 2010a; Moorhouse and others 2014). They are found in virtually all lowland habitats up to 600 masl in England, in mosaics of grassland, pasture, arable land, woodland margins and residential areas. Although not a natural habitat, hedgehog populations have increased within urban areas (Young and others 2006; Parrott, Etherington & Dendy 2014; Trewby and others 2014; Wembridge and others 2022) as rural habitats have become less suitable.

In rural landscapes, hedgehogs tend to be closely associated with villages surrounded by farmland (Pettett and others 2017b). They appear, anecdotally, to be scarce where the soil is poor or the habitat provides limited cover (as in marshland or moorland) (Hof 2009; Roos and others 2012), though given the low numbers it is generally unsafe to infer their absence in such areas.

Hedgehogs are principally insectivores, feeding on beetles, earwigs and caterpillars, though slugs, snails and earthworms are also common prey items (Pettett and others 2017a; Dickman 1988; Wroot 1984). Hedgehogs forage in leaf litter and short vegetation in open spaces such as grass verges, pastures and gardens (Schaus and others 2020), where invertebrates are easily accessible. They are also opportunistic and take a wide range of more unusual food items, including birds' eggs, small mammals, amphibians, carrion, and occasionally fruit. In residential areas, they also take supplementary food intentionally left by people, such as wet or dry pet food (Pettett and others 2017a; Gazzard and others 2022).

Hedgehogs consistently nest in proximity to hedgerows, roads, woodlands, often near human habitation (Bearman-Brown and others 2020). Hedgehogs can also nest under sheds, wooden terraces and at the base of hollow trees (Rasmussen and others 2019). In summer, they may simply shelter in shrubbery or long grass such as tussocks (Reeve & Morris 1985). The cover and composition of vegetation are important characteristics of nests for protection during the day, survival during winter hibernation and security when giving birth to young.

Hedgehog home ranges (the area used by but not necessarily used by an individual) vary by sex, season and habitat type. but they include the resources needed for shelter, reproduction and foraging. Nightly home range refers to the area regularly occupied by individuals in a single night to carry out these activities. The annual home range refers to the area used by individuals throughout the year. Estimates of the size of mean home ranges within urban and rural areas are given in Table 2.

Table 2 Hedgehog home ranges

Type of home range	Sex	Urban areas	Rural areas
Average nightly home range	Male	1.5 ± 1.3 ha	2.6 ± 1.9 ha
-	Female	0.6 ± 0.8 ha	1.1 ± 0.9 ha
Annual home range	Male	Not yet estimated	21.6 ± 5.8 ha
-	Female	Not yet estimated	12.4 ± 2.7 ha

Sources: Schaus 2021, Dowding 2007 and Pettett and others 2017b.

1.5 Ecosystem context

The west European hedgehog is restricted to Europe, its range extending from the Iberian Peninsula and Italy northward into Scandinavia and westwards to Ireland. It is the only wild hedgehog species in the UK and most of the UK population resides in England. The hedgehog has been introduced to the Outer Hebrides, Orkney, Shetland, the Isles of Scilly and Lundy.

Genetic analyses conducted on populations across Europe found differentiation in haplotypes, a group of genes inherited from a single parent, with those in England distinct from populations throughout much of mainland Europe, excluding France (Santucci, Emerson and Hewitt 1998).

Nests created by hedgehogs create unique micro-habitats which, once vacated, are a useful resource for other nesting animals, including field vole, *Microtus agrestis*, wood mouse, *Apodemus sylvaticus* and ground nesting bees and wasps (Morris 1969).

Introduced hedgehogs on the Hebridean island of South Uist prey upon ground-nesting birds and have a negative effect on the success of waders' nests (Jackson 2001). Their impact on prey species within their native range has not been studied.

2. Units

2.1 Natural range and distribution

Occupied hectads (10 km x 10 km squares)

2.2 Population

Number of individuals

2.3 Habitat for the species

km^2

3. Evidence

All blocks of evidence are assigned one of three confidence levels (High, Moderate, Low), based on the quality of the evidence, its applicability and the level of agreement.

The matrix in Figure 1 is used to assess the confidence level assigned to blocks of evidence. White = High confidence; Light blue = Moderate confidence and Dark blue = Low confidence.

Limited evidence Strong agreement	Medium evidence Strong agreement	Robust evidence Strong agreement
Limited evidence Medium agreement	Medium evidence Medium agreement	Robust evidence Medium agreement
Limited evidence Weak agreement	Medium evidence Weak agreement	Robust evidence Weak agreement

Figure 1 Matrix used to assign confidence to blocks of evidence (after IPCC 2010).

Quality of evidence is defined as follows:

- Robust evidence is that which has been reported in peer-reviewed literature, or other reputable literature, from well-designed experiments, surveys or inventories that shows signs of being applicable generally.
- Medium evidence is that reported from well-designed experiments, surveys or inventories but from only one or a small number of sites, with uncertainty over its more general applicability, or is correlational or circumstantial evidence.
- Limited evidence includes ‘expert opinion’, based on knowledge of ecological factors that plausibly suggest an effect, but there is no circumstantial or direct evidence available.

Agreement is defined as follows:

- Strong agreement is consensus across the literature and amongst those with expertise on the habitat or species.
- Medium agreement is common consensus across the literature and amongst experts but there are some differing papers or reports and/or some differences of opinion.

- Weak agreement is little consensus across the literature and amongst experts and, possibly, many different findings and/or opinions.

3.1 Current situation

Natural range and distribution

Hedgehogs have an estimated Extent of Occurrence embraced by 1,299 English hectads. This equates to 58.04% of the total occupied in Great Britain (2,238 hectads) (Mathews and others 2018) and 87% of the total number of hectads in England (1,487 hectads). The extent of occurrence (EOO) is the area contained within the shortest continuous imaginary boundary that can be drawn to include all the known, inferred or projected sites of present occurrence, excluding cases of vagrancy (IUCN 2001).

Within the EOO, hedgehogs occupy (known as area of occupancy) - the AOO, 846 hectads (Mathews and others 2018). Occupancy varies between habitats and regions (Pettett and others 2018) and detection is subject to recording bias, not least that associated with the distribution of recorders. Hedgehog occupancy at a $1km^2$ scale was 22% in rural landscapes of England and Wales in 2014 and 2015 (Williams and others 2018a) and the distribution is thought to be more heterogenous than previously (Yarnell and others 2014).

There is considerable conjecture and a lack of confirmed data concerning hedgehog distribution. The estimates of the hedgehog's English range given here use data from Mathews and others 2018), which currently offers the best estimate available. The National Hedgehog Survey data from 2014-2015 and The State of Britain's Hedgehogs 2022 (SOBH) (Wembridge and others 2022) are not as complete or as comprehensive.

Confidence

Low

Population

Density estimates for different habitats are not robust. The best estimate of current population size in England is 597,000 individuals, some 68% of the 879,000 individuals in Britain (95% confidence interval not available) (Mathews and others 2018). Their estimate was derived using population density estimates for different habitat types within a review of the literature between 1995 and 2015, as well as expert opinion.

Confidence

Low

Habitat for the species

What is the current extent of the habitat?

Generally absent from upland areas, wetlands, coniferous forests and city centres (Crawley and others 2020), hedgehogs can be found in virtually all other lowland habitats and as such, the extent of habitat for this species is assumed to be almost equivalent to its range. It is increasingly clear that the majority of hedgehogs are found within residential areas (Williams and others 2018b) with densities in urban areas 7.5 times higher than rural landscapes in England and Wales (Schaus and others 2020) (See Appendix 1) and nine times higher in France (Hubert and others 2011). Where hedgehogs exist in the rural landscape, they are more often closely associated with villages surrounded by farmland (Pettett and others 2017b).

Mathews and others (2018) estimate the area of suitable hedgehog habitat in England as 123,000 km^2, using the Land Cover Map (LCM2007) land-use layer. This equates to some 94% of England, and the full extent of the species' range. Hedgehogs do not currently occupy this entire range, and not all habitat within this range will be suitable and used by hedgehogs. The following habitats are utilised in order of priority: sub-urban, mixed farmland, pasture-land and arable farmland. The use of uplands and other smaller scale habitats is largely unknown.

Confidence

Low

3.2 Historical variation in the above parameters

Evidence of hedgehogs has been found in the south of England (Hampshire basin, Isle of Wight) from the Eocene and Oligocene (55 to 24 mya), with additional evidence found steadily northward over time in Wiltshire, Norfolk, Yorkshire, Derbyshire and Oxford dated between the late glacial (115,000 – 11,700 years ago) and the 15th century (Yalden 1999). An agricultural landscape would not have existed during much of this period and hedgehogs would likely have accessed a broad range of habitats and been widespread, even as land was brought into mixed agricultural use (Pettett and others 2017a; Trewby and others 2014).

The cessation of mixed farming in the 20th century and the use of pesticides are both likely to have been highly detrimental to hedgehogs with the widespread removal of hedgerows, a decline in the quality of those which remain and a decline in the structural complexity of important foraging and nesting habitats in England (Battersby 2005). Nevertheless, the species' range has changed little and it remains widespread throughout Britain and recorded in most (approximately 84%) of the 1,492 hectads in England within the last decade (Croft, Chauvenet & Smith 2017b).

The change to a far more homogeneous landscape as agricultural management has intensified and likely affected the finer-scale distribution of hedgehogs, which are no longer ubiquitous across occupied hectads (Williams and others 2018a; Wembridge and others 2022). There is strong evidence of a serious and continued decline in population (Crawley and others 2020).

The populations of key invertebrate prey have also been affected by agricultural intensification, particularly the use of pesticides, and this will likely have impacted the density at which hedgehogs can persist (Hof & Bright 2010a). Various opinions have been offered concerning the relationship between hedgehogs and badgers, one of their more significant predators and some, such as Judge and others (2014), have pointed to an inverse correlation between badger and hedgehog numbers. Whilst predation by badgers and competition for resources may have some impact on hedgehogs (Wembridge and others 2022), there is no indication that badgers are the primary cause of the national decrease in hedgehog numbers. The limited evidence provided by the Mammal Society (2023) suggests that the significance of predation by badgers may be overestimated. Hedgehog occupancy can be low in areas from which badgers are absent and the species coexist at the 1 km^2 scale in many areas. Their co-existence is likely dependent on habitat heterogeneity providing sufficient food to support both of these generalist terrestrial species (Williams and others 2018a). The abundance and distribution of foxes may also have an impact on hedgehogs (Pettett and others 2018) but their population level impact on hedgehogs is no better understood than that of badgers.

Hedgehogs have increasingly been found within areas of human habitation (Bearman-Brown and others 2020), being associated with gardens, parks and allotments (Hof and Bright 2009; Turner and others 2021). It is likely that gardens have remained a stronghold for hedgehogs as numbers elsewhere have declined (Wembridge and others 2022).Gardens offer high structural complexity with diverse vegetation, supplementary food and an absence or low density of predators such as badgers (Pettett and others 2017b, 2017a). Camera trap surveys in gardens across South London report high trapping rates of hedgehogs, suggesting that gardens may be an important refuge for hedgehogs, particularly where predators have colonised nearby public parks (Scott-Gatty and Carbone 2020). Not all gardens may be suitable, with only 37% of gardens in Reading visited by hedgehogs over 5 days (Williams and others 2018b).

Natural range and distribution

The range of hedgehogs in England appears to have been relatively stable between the two Mammal Atlas periods (1960-1992 and 2000-2016)., though the direction of change within this period may have varied over time. For example, both Callcutt and others (2018) and Hof (2009) estimated a decline in England between 1960 and 1975, whilst Mathews and others (2018) suggest that there was a 10% increase in range between 1993 and 2015.

Confidence

Low

Population

We lack sound estimates of Hedgehog numbers, let alone estimates of the scale and pace of change in numbers. Many historical estimates of hedgehog numbers or density are based on the total numbers of animals caught in areas smaller than the average hedgehog home range. They provide relative indices of abundance that do not account for imperfect and variable detection, the use by hedgehogs of landscapes surrounding the study areas, or population closure. We thus have low confidence is estimates prior to 2014, when more robust methods such as Spatial Capture Recapture and Random Encounter Models started to be used. Estimates of population size and change should thus be interpreted with caution and we place limited reliance upon them in this document (Appendix 1).

Hedgehogs are thought to have been plentiful throughout Great Britain in the early 20th century. Based on one observation at one site, Burton (1969) estimated hedgehog density at 247 per km^{-2} in the 1950s, far greater than more recent estimates (Appendix 1). When extrapolated, Burton's density estimate produces a population of 36,500,000 individuals in Britain (Burton 1969), suggesting an English population (some 68% of that of Britain) of 24,820,000 individuals in the 1950s. Battersby (2005) provides a convincing case that this is likely to be a substantial over-estimate of the 1950s population. Croft and others 2017 have estimated the 1995 British population at some 1.5 million individuals, though confidence intervals are very large (731,546 to 11,979,363).

The best estimate of current population numbers is 597,000 in England, following a decline in numbers of some 35%, although the decline may be as great at 46% over three generations (Mathews and others 2018). This estimate was derived using population density estimates in different habitat types. As illustrated in Table 3, there is considerable uncertainty in the reliability of the figures. Caution should therefore be taken interpreting these trends as the current and historical estimates are both unreliable.

Table 3 illustrates the range of estimates and variable confidence levels from previous studies.

Table 3 Hedgehog population estimates for England per study and confidence in data reliability.

ǂ Denotes where figures provided were for Britain as a whole and have been adjusted to estimate the proportion of the population in England (at an estimated 62% of the total based on land area of different countries). *Denotes updated figure since publication.

Study	Estimated population	Confidence
Burton (1969) – 1950s	ǂ 24,820,000	Likely a substantial overestimate

Study	Estimated population	Confidence
Harris and others (1995)	1,100,000	Low-involves expert opinion rather than empirical data
Roos & others (2012), Hof and Bright (2016)	Number of individuals not specified; 40% decline in 10 years (timeframe not specified)	Uncertain – trends unreliable
Croft and others (2017)	ǂ 930,000	Reliable estimates limited; involves expert opinion rather than empirical data
Mathews and others (2018)	*597,000 A decline possibly >35% between 1995 and 2016 *Updated correct figure	Uncertain, but most reliable given use of more robust methods after 2014

In more recent times, national monitoring schemes that count hedgehogs on roads and in gardens provide an index of hedgehogs with which to assess relative trends in population size. The monitoring programmes have shown a steady decline in its count index between the baseline year of 2002 and 2017, with counts of hedgehog road casualties recorded in the People's Trust for Endangered Species (PTES) Mammals on Roads survey falling by between a third in urban areas and by a half across rural areas in Britain (Wilson & Wembridge 2018). A recent analysis suggests that population decline in urban areas may be slowing (Wembridge and others 2022).

Appendix 1 provides a comparative illustration of changes in hedgehog density estimates for different habitats using varied data collection methods.

Confidence

Low

Habitat for the species

It is thought that the area and quality of habitat available to hedgehogs is declining (Mathews and others 2018). The species has traditionally been associated with woodlands and rural landscapes, where area and quality are in decline due to intensive agriculture, increasing fragmentation, poor connectivity associated with hedgerow destruction and poor management, lack of woodland edge habitats and declining prey availability. Other factors include road mortality caused by rural roads often having higher speed limits than urban roads and reduced lighting, as well as hedgehogs being more at threat from predation in rural habitats.

Habitat loss and degradation may also be responsible for reducing population size. There has been a decline in habitat heterogeneity on farmland over recent decades, which has likely had a negative effect on habitat connectivity, nesting site availability and may have

contributed to the widespread reduction of invertebrate abundance in the UK. Trends among UK insects show that 30-60% of species per order have declining ranges (Dirzo and others 2014). However, the reliability of this data is uncertain.

Following World War 2, rural hedgerow length reportedly declined from 662,500 km in England in 1946 to 547,000 km in 2007, a reduction of 17.4% (Stalet and others 2020). Moreover, between 1998 and 2007, there has been a 1.7% decline in total woody linear features (Carey and others 2009), causing a loss of heterogeneity. These declines lead both to loss of nesting habitat and dispersal corridors for hedgehogs, reducing connectivity of the landscape.

There is additional unsubstantiated speculation around the loss of hedgerows, with some authors believing it to be closer to 30%, even 50% (Wright 2016). No information appears to be available on changes in the length of urban hedgerows.

Staley and others (2020) posit that restoration of hedgerows to Favourable Conservation Status requires an increase in extent and density, as well as an increase in the proportion of hedgerows that are in good condition. However, the definition stresses that the lack of active management may be the reason for the biggest change in quality of this habitat.

There has been a 4.7% increase in the area of broadleaved woodland cover between 1990 and 2007 (Young and others 2006). Kirby (2022) notes, however, that various species associated with this new woodland have been declining over the last 40-60 years (when the area of the woodland habitat has been increasing), suggesting that habitat extent is less critical for many species, including hedgehogs, than habitat quality.

A 4.5% increase in extent of urban areas between 1990 and 2007 may have increased the availability of relatively suitable habitat (Pettett and others 2017a,b). This should not be taken to indicate, of course, that increasing the area of urban and sub-urban habitats is the means by which hedgehogs ought to attain FCS.

Confidence

Moderate

3.3 The future for the species and its conservation

Hedgehogs remain widespread throughout England, but their distribution is fragmented, not least because large areas of agricultural land are now unsuitable. We have limited confidence in our estimates of the number of hedgehogs in England and we are unsure whether numbers have increased, remained stable or declined. There is also a lack of evidence concerning hedgehog interactions with humans and other species.

However, it seems at least plausible that a resurgence in our native invertebrate populations will underpin both a rise in hedgehog numbers and an increase in their range. As ecosystems are restored, any imbalance in predator and prey populations might be corrected. Habitat connectivity is likely to continue to diminish range and numbers in the

long-term, with Becher and Griffiths (1998) suggesting that hedgehog populations, at least in their rural Oxfordshire study area, were already genetically distinct from one another, indicative of isolation, low genetic connectivity and perhaps fragmentation.

The growing road network in the UK poses a likely constraint given that hedgehogs avoid major roads, which likely act both as barriers to movement (Rondinini and Doncaster 2002) and increase mortality (Bearman-Brown and others 2020; Pettett 2017b). Continuing urban expansion, in-filling within existing urban areas and the increasing area of gardens converted to hard standing, patios, decking and artificial lawns (Sanchez-Sotomayor and others 2023) also reduces the area of suitable habitat and connectivity between that which is suitable.

Notwithstanding such changes, areas in and around towns and villages can provide satisfactory habitat for hedgehogs as the suitability of the wider agricultural landscape declines still further (Wilson & Wembridge 2018), although scope for them to offer more habitat is limited; urban habitats are highly fragmented and wildlife-friendly gardening is unlikely to be a consistent feature of gardens in the long-term.

The impact of climate change is uncertain. Warmer winters may increase hedgehog activity, and if prey availability then also increases, the overall impact may be neutral. Increased activity in winter may lead to higher mortality rates, given that hedgehogs will be more active and therefore exposed to more dangers. And if prey fails to respond or responds at a different rate to warmer winter weather, then hedgehog survival will likely decline. Summer droughts may lead to food and water shortages and, as a result, hedgehog malnutrition, which may have population-level impacts.

Natural range and distribution

As a minimum, the existing range (1299 hectads) should be maintained to ensure thriving populations in the future. By excluding the areas where the species is not native, largely Scilly and Lundy, the favourable range is defined as 1,487 hectads, approximately the entirety of mainland England.

Confidence

Moderate

Population

We propose that the favourable population is 2,211,000 individuals, reversing the 73% decrease observed over the past 21 years (Mathews and others 2018). Although there is a lack of reliable evidence, achievement of favourable conservation status will likely be dependent on population growth in rural areas.

Confidence

Low

Habitat for the species

It is likely that the 123,000 km^2 currently available to hedgehogs (Mathews and others 2018) is of insufficient quality to maintain the population. Both habitat connectivity and quality must be improved in order for the English population to attain FCS. Moorhouse and others (2014) modelled hedgehog movement across a range of landscapes and found that doubling the length of hedgerow would result in substantially more movement of hedgehogs in agricultural landscapes.

Hedgehog densities vary considerably between habitats, but densities in urban areas and in and around rural towns and villages are currently far higher than in the wider countryside. Calculated at varying spatial scales from 0.9 km2 to 57 km2 from Moorhouse and others (2014) and converted to 1 km^2 for clarity, we know that densities in urban areas can attain 35 individuals/km^2. A population at this density, at FCS (2.211 million hedgehogs), would require 63,171km2 of suitable habitat. Densities in rural areas are slightly less, at some 32 individuals/km^2, requiring 69,093 km^2 of favourable supporting habitat. It is therefore proposed that a key emphasis is placed on ensuring at least 70,000km^2 is high quality, naturally functioning, connected habitat in rural areas.

There is an extensive range in conditions that are encompassed by the definition of both “rural” and “urban” habitats. Caution should be applied when interpreting these results as many of the demographic variables used are uncertain. Emphasis is placed on enhancing the quality of supporting habitats as much as on quantity.

Confidence

Low

3.4 Constraints to expansion or restoration

There do not appear to be immovable constraints to the achievement of favourable conservation status for this species. This will require the re-establishment of sympathetic land management in rural, urban and sub-urban landscapes to provide the habitat mosaic hedgehogs require. There is a lack of evidence regarding the effectiveness of what are believed to be positive conservation management actions. Even in landscapes where arable land is entered into agri-environment schemes hedgehogs appear to prefer the local rural village habitats (Pettett and others 2017b). Feasibility is likely to depend on improving connectivity for hedgehogs at the local and landscape scale.

The improvement and re-establishment of natural habitats can be achieved by adding suitable hedgerows, field margins and edge habitats, as well as the reducing pesticides and insecticide use. However, empirical evidence of the effectiveness of such actions for hedgehog remains scarce (Hof and Bright 2010). Climate change may have negative impacts for hedgehogs, particularly with regard to hibernation and in areas where food availability is already low.

The maintenance of a mosaic of natural habitats with good connectivity at the landscape scale will also be beneficial to many other species in England, including birds and invertebrates. Hedgehogs are a natural pest invertebrate predator and increased numbers may help keep invertebrates such as slugs and snails in check.

Confidence

Moderate

4. Conclusions

4.1 Favourable range and distribution

Hedgehogs are currently present in 1,299 hectads within England. Allowing for habitat preferences and that the species is not native to certain offshore islands, the favourable value for range and distribution is 1,487 hectads. This covers most of England.

4.2 Favourable population

FCS will be achieved when the 73% decrease in population recorded over the previous two decades (Mathews and others 2018) has been reversed, and in the absence of any other more accurate data, the recommended favourable value for population is 2,211,000 individuals.

4.3 Favourable supporting habitat

Based on data provided by Matthews and others (2018), hedgehogs are present in rural and urban/sub-urban lowland habitats, ranging from broadleaved woodlands to city centres. As habitat quality is currently insufficient, suitable and better-quality resting and foraging habitats will need to be made available, notably through connectivity. This species uses a variety of habitat features, with hedgerows figuring prominently.

There is low confidence concerning accurate density figures. Taking the favourable population as 2,211,000 and applying the average rural density of 32 per square kilometre (Moorhouse 2014) gives a favourable figure of 70,000 km^2 of high-quality, semi-natural habitat. If the favourable value was to include urban/sub-urban habitats, the figure would potentially be at least the current value of 123,000 km^2.

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Appendices

Appendix 1

Source	Time period	Density (Hedgehogs km^{-2}) (95% CI)	Habitat	Method	Study area and survey length	Analytical method	Confidence
Burton (1973)	1950s	247	Nationwide	Observation	Unspecified	Estimation of the number of hedgehogs divided by study area	Low
Reeve (1981)	1977-1979	83	Suburban golf course	Spotlight survey	0.4 km^2, unspecified number of nights	Relative Index of Abundance (RIA) - Minimum number alive divided by study area	Low
Micol (1994)	1991 - 1992	3.9 ±0.8 per field	Playing fields	Spotlight survey	31 sites across 0.6 km^2 (mean 0.02 km^2), 3 nights	RIA - total number of hedgehogs caught divided by area of field	Low
		0.7 ±0.2 per field	Pasture field	Spotlight survey	58 sites across 1.4 km^2 (mean 0.02 km^2), 3 nights		Low
Young and others (2006)	2000 - 2002	9±7	Pasture	Spotlight survey	10 sites *c.*100km, 3 nights,	RIA - total number of hedgehogs caught divided by field area	Low
		154 ± 44	Amenity grassland	Spotlight survey			Low
Trewby and others (2014)	2000 - 2005	20 – 40	Amenity grassland	Spotlight survey	12 sites *c.*100km, 9 nights per site	RIA - total number of hedgehogs caught divided by field area	Low
Parrott and others (2014)	2006	0.57 ±0.19	Amenity grassland	Spotlight survey without marking	0.49 km^2, 2 nights	RIA - maximum number of hedgehogs counted on each site on either survey divided by study area/field	Low
		0.41 ±0.21	Amenity grassland	Spotlight survey without marking	0.60 km^2, 2 nights		Low
		0.33 ±0.12	Amenity grassland	Spotlight survey without marking	0.88 km^2, 2 nights		Low
		0.54 ±0.19	Amenity grassland	Spotlight survey	0.41 km^2, 2 nights		Low

				without marking			
		0.04 ±0.04	Pasture	Spotlight survey without marking	0.66 km², 2 nights		Low
		0.10 ±0.09	Pasture	Spotlight survey without marking	0.79 km², 2 nights		Low
Hof (2009)	2009	7.3	Rural	Radio tracking and night-time searches	0.61 km², 10 nights	Number of hedgehogs caught divided by study area	Medium
Schaus and others (2020)	2016 - 2019	31.5 (18.8 – 52.9)	Urban town	Spotlight surveys	0.67 km², 11 nights	Spatial capture recapture (SCR)	High
		23.2 (13.2 – 40.6)	Urban town	Spotlight surveys	0.79 km², 8 nights	SCR	High
		43.9 (24.1 – 79.9)	Urban town	Spotlight surveys	0.53 km², 6 nights	SCR	High
		16.7 (9.9 – 27.9)	Urban town	Spotlight surveys	0.85 km², 15 nights	SCR	High
		31.6 (18.6 – 53.7)	Urban city	Spotlight surveys	0.62 km², 10 nights	SCR	High
		25.9 (19.1 – 33.3)	Urban town	Camera traps	0.67 km², 746 nights	Random Encounter Model (REM)	High
		15.7 (10.1 – 23.3)	Urban town	Camera traps	0.79 km², 632 nights	REM	High
		88.6 (56.9 – 134.5)	Urban town	Camera traps	0.53 km², 711 nights	REM	High
		17.5 (11.3 – 24.5)	Urban town	Camera traps	0.85 km², 774 nights	REM	High
		13.9 (6.9 – 24.1)	Urban city	Camera traps	0.62 km², 708 nights	REM	High
		12.5 (5.9 – 26.2)	Rural	Spotlight surveys	0.63 km², 10 nights	SCR	High
		9.4 (3.7 – 23.4)	Rural	Spotlight surveys	0.65 km², 13 nights	SCR	High
		12.9 (6.1 – 27.2)	Rural	Spotlight surveys	0.61 km², 17 nights	SCR	High
		2.7 (0.7 - 10.9)	Rural	Spotlight surveys	0.77 km², 20 nights	SCR	High
		6.8 (5.6 – 8.1)	Rural	Camera traps	0.63 km², 660 nights	REM	High

		3.9 (1.8 – 7.1)	Rural	Camera traps	0.65 km², 723 nights	REM	High
		5.3 (2.6 – 8.8)	Rural	Camera traps	0.61 km², 308 nights	REM	High
		1.2 (No CI)	Rural	Camera traps	0.77 km², 754 nights	REM	High
Lee (2021)	2018 - 2019	4.73 (SD 2.18)	Mixed farm	Camera traps	0.53 km², 20 nights	REM	High
		12.05 (SD 3.19)	Mixed farm	Camera traps	0.70 km², 10 nights	REM	High
		4.05 (SD 1.94)	Pasture/Live stock farm	Camera traps	0.60 km², 11 nights	REM	High
		0.96 (SD 1.41)	Pasture/Live stock farm	Camera traps	0.40 km², 10 nights	REM	High
		3.81 (SD 0.48)	Mixed farm	Camera traps	0.84 km², 10 nights	REM	High
		1.71 (SD 0.78)	Mixed farm	Camera traps	0.77 km², 10 nights	REM	High
		7.08 (SD 2.61)	Mixed farm	Camera traps	0.67 km², 10 nights	REM	High
		3.91 (SD 0.23)	Mixed farm	Camera traps	0.69 km², 10 nights	REM	High
		2.88 (SD 0.92)	Pasture/Live stock farm	Camera traps	0.50 km², 10 nights	REM	High
		7.61 (SD 2.78)	Mixed farm	Camera traps	0.79 km², 12 nights	REM	High
		0.30	Pasture/Live stock farm	Camera traps	0.63 km², 10 nights	REM	High
		8.37 (SD 4.74)	Mixed farm	Camera traps	1.10 km², 10 nights	REM	High
		2.05 (SD 0.40)	Mixed farm	Camera traps	0.96 km², 10 nights	REM	High
Moore and others	2020-2021	55.7 (43.8 – 70.8)	Urban village	Spotlight surveys	1 km², 10 nights	SCR	High
		35.7 (24.5 – 52.1)	Urban town	Spotlight surveys	0.71 km², 10 nights	SCR	High
		14.9 (8.7 – 25.7)	Rural village	Spotlight surveys	0.90 km², 10 nights	SCR	High
		5.4 (1.9 – 16.0)	Rural village	Spotlight surveys	0.82 km², 10 nights	SCR	High

About Natural England

Natural England is here to secure a healthy natural environment for people to enjoy, where wildlife is protected and England's traditional landscapes are safeguarded for future generations.

Further Information

This report can be downloaded from the Natural England Access to Evidence Catalogue. For information on Natural England publications or if you require an alternative format, please contact the Natural England Enquiry Service on 0300 060 3900 or email enquiries@naturalengland.org.uk.

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