

**European Community Directive
on the Conservation of Natural Habitats
and of Wild Fauna and Flora
(92/43/EEC)**

**Fourth Report by the United Kingdom
under Article 17**

on the implementation of the Directive
from January 2013 to December 2018

Supporting documentation for the
conservation status assessment for the species:

**S1303 - Lesser horseshoe bat (*Rhinolophus
hipposideros*)**

ENGLAND

IMPORTANT NOTE - PLEASE READ

- The information in this document is a country-level contribution to the UK Report on the conservation status of this species, submitted to the European Commission as part of the 2019 UK Reporting under Article 17 of the EU Habitats Directive.
- The 2019 Article 17 UK Approach document provides details on how this supporting information was used to produce the UK Report.
- The UK Report on the conservation status of this species is provided in a separate document.
- The reporting fields and options used are aligned to those set out in the European Commission guidance.
- Explanatory notes (where provided) by the country are included at the end. These provide an audit trail of relevant supporting information.
- Some of the reporting fields have been left blank because either: (i) there was insufficient information to complete the field; (ii) completion of the field was not obligatory; (iii) the field was not relevant to this species (section 12 Natura 2000 coverage for Annex II species) and/or (iv) the field was only relevant at UK-level (sections 9 Future prospects and 10 Conclusions).
- For technical reasons, the country-level future trends for Range, Population and Habitat for the species are only available in a separate spreadsheet that contains all the country-level supporting information.
- The country-level reporting information for all habitats and species is also available in spreadsheet format.

Visit the JNCC website, <https://jncc.gov.uk/article17>, for further information on UK Article 17 reporting.

Report on the main results of the surveillance under Article 11 for Annex II, IV and V species (Annex B)

NATIONAL LEVEL

1. General information

1.1 Member State	UK (England information only)
1.2 Species code	1303
1.3 Species scientific name	Rhinolophus hipposideros
1.4 Alternative species scientific name	
1.5 Common name (in national language)	Lesser horseshoe bat

2. Maps

2.1 Sensitive species	No
2.2 Year or period	1995-2016
2.3 Distribution map	Yes
2.4 Distribution map Method used	Complete survey or a statistically robust estimate
2.5 Additional maps	No

3. Information related to Annex V Species (Art. 14)

3.1 Is the species taken in the wild/exploited?	No	
3.2 Which of the measures in Art. 14 have been taken?	a) regulations regarding access to property	No
	b) temporary or local prohibition of the taking of specimens in the wild and exploitation	No
	c) regulation of the periods and/or methods of taking specimens	No
	d) application of hunting and fishing rules which take account of the conservation of such populations	No
	e) establishment of a system of licences for taking specimens or of quotas	No
	f) regulation of the purchase, sale, offering for sale, keeping for sale or transport for sale of specimens	No
	g) breeding in captivity of animal species as well as artificial propagation of plant species	No
	h) other measures	No

Report on the main results of the surveillance under Article 11 for Annex II, IV and V species (Annex B)

3.3 Hunting bag or quantity taken in the wild for Mammals and Acipenseridae (Fish)

a) Unit

b) Statistics/ quantity taken	Provide statistics/quantity per hunting season or per year (where season is not used) over the reporting period					
	Season/ year 1	Season/ year 2	Season/ year 3	Season/ year 4	Season/ year 5	Season/ year 6
Min. (raw, ie. not rounded)						
Max. (raw, ie. not rounded)						
Unknown	No	No	No	No	No	No

3.4. Hunting bag or quantity taken in the wild Method used

3.5. Additional information

BIOGEOGRAPHICAL LEVEL

4. Biogeographical and marine regions

4.1 Biogeographical or marine region where the species occurs

Atlantic (ATL)

4.2 Sources of information

Bat Conservation Trust (2018). The State of the UK's Bats 2017. Bat Conservation Trust, London. Available at (http://www.bats.org.uk/pages/results_and_reports.html)

Bat Conservation Trust (2017). The National Bat Monitoring Programme. Annual Report 2016. Bat Conservation Trust, London. Available at (www.bats.org.uk/pages/nbmp_annual_report.html)

Billington G, Rawlinson MD (2006). Report on horseshoe bat flight lines and feeding areas. CCW Science Report No. 75. CCW, Bangor

Boye P, Dietz M. 2005. Research Report No 661: Development of good practice guidelines for woodland management for bats. English Nature, Peterborough.

Fensome AG, Mathews F. (2016). Roads and bats: a meta-analysis and review of the evidence on vehicle collisions and barrier effects. Mammal Review, 46(4), 311-323.

Forestry Commission (2017). Forestry Statistics 2017. Forest Research. Edinburgh.

Forestry Commission (2016). Preliminary estimates of the changes in canopy cover in British woodlands between 2006 and 2015. National Forest Inventory, Edinburgh.

Knight T, Jones G. (2009). Importance of night roosts for bat conservation: roosting behaviour of lesser horseshoe bat *Rhinolophus hipposideros*. Endangered Species Research. Vol. 8: 79-86. www.int-res.com

Mathews F, Kubasiewicz LM, Gurnell J, Harrower C, McDonald RA, Shore RF. 2018. A review of the population and conservation status of British Mammals. A report by The Mammal Society under contract to Natural England, Natural Resources Wales and Scottish Natural Heritage.

McCracken DI (1993). The potential for avermectins to affect wildlife. Vet

Report on the main results of the surveillance under Article 11 for Annex II, IV and V species (Annex B)

Parasitol, 48 (1-4), 273-280

Ransome, R.D. (1989). Population changes of Greater horseshoe bats studied near Bristol over the past twenty-six years. Biological Journal of the Linnean Society, 38, 71-82.

Ransome, R.D. (1996). The management of feeding areas for greater horseshoe bats. English Nature Research Report No. 174. English Nature.

Schofield HW. (1984). The ecology and conservation biology of *Rhinolophus hipposideros*, the lesser horseshoe bat. PhD, University of Aberdeen.

Schofield HW, McAney K (2008). Lesser horseshoe bat *Rhinolophus hipposideros*. Pp. 306-310 in Harris S & Yalden DW. Mammals of the British Isles: Handbook, 4th edition. The Mammal Society, Southampton. 799pp.

Zaroso-Lacoste D, Jan PL, Lehnen L, Girard T, Besnard AL, Peuchmaille SJ, Petit EJ (2017). Combining non invasive genetics and a new mammalian sex-linked marker provides new tools to investigate population size, structure and individual behaviour: An application to bats.'

5. Range

5.1 Surface area (km²)

5.2 Short-term trend Period

5.3 Short-term trend Direction

Increasing (+)

5.4 Short-term trend Magnitude

a) Minimum

b) Maximum

5.5 Short-term trend Method used

5.6 Long-term trend Period

5.7 Long-term trend Direction

5.8 Long-term trend Magnitude

a) Minimum

b) Maximum

5.9 Long-term trend Method used

5.10 Favourable reference range

a) Area (km²)

33552

b) Operator

c) Unknown

d) Method

Range is based on presence data collected between 1995-2016. Areas that contain very isolated records may not have been included in the area of distribution. The range has been taken from Mathews et al 2018, whereby an alpha hull value of 20km was drawn around the presence records, which represented the best balance between the inclusion of unoccupied sites (i.e. where records are sparse but close enough for inclusion) and the exclusion of occupied areas due to gaps in the data (i.e. where records exist but are too isolated for inclusion). An additional 10km buffer was added to the final hull polygon to provide smoothing to the hull and to ensure that the hull covered the areas recorded rather than intersecting them. This differs from the approach taken in 2013 and 2007 whereby a 45km alpha hull value was used for all species with a starting range unit of individual 10km squares. The new method has led to much finer detail maps being produced underpinned by data gathered at a much finer resolution, leading to the production of this current FRR. The FRR was not set at an England level in the previous

Report on the main results of the surveillance under Article 11 for Annex II, IV and V species (Annex B)

Article 17 report (2007-2012), however, it is broadly in line with what would have been set independently for England when set in the UK context.

5.11 Change and reason for change in surface area of range

Genuine change
Improved knowledge/more accurate data
Use of different method

The change is mainly due to: Use of different method

5.12 Additional information

Further reasons for change include improved knowledge/more accurate data and in the case of England, there would appear to be a genuine change in range in recent years in the north and the midlands. The new method used, as described in field 5.10 d, has led to much finer detail maps being produced underpinned by data gathered at a much finer resolution, leading to the production of this current range.

6. Population

6.1 Year or period

1995-2016

6.2 Population size (in reporting unit)

a) Unit number of individuals (i)
b) Minimum 13900
c) Maximum 27700
d) Best single value 19400

6.3 Type of estimate

95% confidence interval

6.4 Additional population size (using population unit other than reporting unit)

a) Unit
b) Minimum
c) Maximum
d) Best single value

6.5 Type of estimate

6.6 Population size Method used

Complete survey or a statistically robust estimate

6.7 Short-term trend Period

2006-2017

6.8 Short-term trend Direction

Increasing (+)

6.9 Short-term trend Magnitude

a) Minimum
b) Maximum
c) Confidence interval

6.10 Short-term trend Method used

Complete survey or a statistically robust estimate

6.11 Long-term trend Period

6.12 Long-term trend Direction

6.13 Long-term trend Magnitude

a) Minimum
b) Maximum
c) Confidence interval

6.14 Long-term trend Method used

Report on the main results of the surveillance under Article 11 for Annex II, IV and V species (Annex B)

6.15 Favourable reference population (using the unit in 6.2 or 6.4)

- a) Population size
- b) Operator
- c) Unknown
- d) Method

x

The favourable reference population has not previously been set for this species at an England level. The Favourable reference population was set at 14,000 individuals at a UK level in 1994. The value was considered to be large enough for the population to be viable and no lower than the population estimate when the Habitats Directive came into force in the UK.

6.16 Change and reason for change in population size

- Genuine change
- Improved knowledge/more accurate data
- Use of different method

The change is mainly due to: Genuine change

6.17 Additional information

The National Bat Monitoring Programme (NBMP) includes 289 maternity sites and 308 hibernation roosts that have been monitored since 1990 and 1993 respectively. Increases have been seen in both the maternity and hibernation indices and these changes have been consistent over this reporting period. The drivers for this change include legislative protection of maternity roosts preventing destruction/disturbance, allowing interventions to improve thermal conditions which improve reproductive success and mild winters permitting population growth due to increased overwinter survival.

7. Habitat for the species

7.1 Sufficiency of area and quality of occupied habitat

- a) Are area and quality of occupied habitat sufficient (to maintain the species at FCS)?

Yes

- b) Is there a sufficiently large area of occupied AND unoccupied habitat of suitable quality (to maintain the species at FCS)?

7.2 Sufficiency of area and quality of occupied habitat Method used

Based mainly on extrapolation from a limited amount of data

7.3 Short-term trend Period

1995-2016

7.4 Short-term trend Direction

Stable (0)

7.5 Short-term trend Method used

Based mainly on extrapolation from a limited amount of data

7.6 Long-term trend Period

7.7 Long-term trend Direction

7.8 Long-term trend Method used

7.9 Additional information

8. Main pressures and threats

8.1 Characterisation of pressures/threats

Pressure	Ranking
Removal of small landscape features for agricultural land parcel consolidation (hedges, stone walls, rushes, open	H

Report on the main results of the surveillance under Article 11 for Annex II, IV and V species (Annex B)

ditches, springs, solitary trees, etc.) (A05)

Abandonment of grassland management (e.g. cessation of grazing or mowing) (A06)	H
---	---

Livestock farming (without grazing) (A14)	H
---	---

Conversion to other types of forests including monocultures (B02)	M
---	---

Logging without replanting or natural regrowth (B05)	M
--	---

Extraction of minerals (e.g. rock, metal ores, gravel, sand, shell) (C01)	M
---	---

Roads, paths, railroads and related infrastructure (e.g. bridges, viaducts, tunnels) (E01)	H
--	---

Construction or modification (e.g. of housing and settlements) in existing urban or recreational areas (F02)	H
--	---

Sports, tourism and leisure activities (F07)	M
--	---

Other natural catastrophes (M10)	M
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Threat	Ranking
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Removal of small landscape features for agricultural land parcel consolidation (hedges, stone walls, rushes, open ditches, springs, solitary trees, etc.) (A05)	H
---	---

Abandonment of grassland management (e.g. cessation of grazing or mowing) (A06)	H
---	---

Livestock farming (without grazing) (A14)	M
---	---

Conversion to other types of forests including monocultures (B02)	M
---	---

Logging without replanting or natural regrowth (B05)	M
--	---

Extraction of minerals (e.g. rock, metal ores, gravel, sand, shell) (C01)	M
---	---

Roads, paths, railroads and related infrastructure (e.g. bridges, viaducts, tunnels) (E01)	H
--	---

Construction or modification (e.g. of housing and settlements) in existing urban or recreational areas (F02)	H
--	---

Sports, tourism and leisure activities (F07)	M
--	---

Other natural catastrophes (M10)	M
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8.2 Sources of information

8.3 Additional information

9. Conservation measures

9.1 Status of measures

a) Are measures needed? Yes

b) Indicate the status of measures Measures identified and taken

9.2 Main purpose of the measures taken

Maintain the current range, population and/or habitat for the species

9.3 Location of the measures taken

Both inside and outside Natura 2000

Report on the main results of the surveillance under Article 11 for Annex II, IV and V species (Annex B)

9.4 Response to the measures

Medium-term results (within the next two reporting periods, 2019-2030)

9.5 List of main conservation measures

Restore small landscape features on agricultural land (CA02)

Adapt mowing, grazing and other equivalent agricultural activities (CA05)

Manage the use of natural fertilisers and chemicals in agricultural (plant and animal) production (CA09)

Adapt/change forest management and exploitation practices (CB05)

Reduce impact of transport operation and infrastructure (CE01)

Manage/reduce/eliminate noise, light and other forms of pollution from transport (CE05)

Manage conversion of land for construction and development of infrastructure (CF01)

Reduce impact of outdoor sports, leisure and recreational activities (CF03)

Improvement of habitat of species from the directives (CS03)

9.6 Additional information

Legal and administrative measures continue to be required to ensure that the protection provided by the legislation is effective and that protected habitats for the species are managed appropriately (CF03). This helps to address Pressures/Threats F02, L05, F07, C01. Road design, construction and operation need to take into account the likely impact on bats, e.g. in relation to the provision of safe crossing structures and the loss of and severance of bat habitat and lighting (CE01, CE05). This helps to address Pressures/Threats E01 & A05. *R. hipposideros* requires a complex mosaic of habitats to support foraging, roosting and commuting behaviour. Woodlands and semi or unimproved wet pasture bounded by hedgerows have been shown to be important foraging habitats for the species. Foraging areas are close to summer roosts (distances up to 4.2 kilometres) and the animals spend about half of their activity time within a radius of 600 metres. Roost sites are often in buildings that are subject to deterioration or to conversion to alternative use. There is good understanding of the roosting conditions and habitat required for the species (Schofield 2008). However, mitigation for developments affecting roosts and habitat is not always undertaken as proposed compromising its likelihood of success. Planning at landscape scale is required to conserve commuting routes and foraging areas along with effective management of habitats through agri-environmental schemes and sympathetic forest management plans. (CA09, CA02, CA05, CS03, CB05, CF01). This helps to address Pressures/Threats A06, A14, B05 & B02.

10. Future prospects

10.1 Future prospects of parameters

- a) Range
- b) Population
- c) Habitat of the species

10.2 Additional information

Increased interest in afforestation as part of climate change mitigation measures means that the total area of broadleaved woodland is likely to continue to increase. However, the current trajectory of increase is modest once the loss of existing woodlands is taken into account; and the available statistics do not adjust for woodland recently converted into another land use (Forestry Commission 2017, Forestry Commission 2016). The rate of new planting of woodland (conifer and broadleaved combined) has fallen over the past 20 years, whilst the rate of restocking has remained approximately stable in all countries.

Report on the main results of the surveillance under Article 11 for Annex II, IV and V species (Annex B)

The Bat Conservation Trusts - State of the UK's Bats shows a significantly significant increase in *R. hipposideros* populations over the period 2010-2015 of 22.7% at hibernation sites and 11.8% at maternity roosts. This positive trend is likely to continue into the future based on climate change predictions, boosting overwinter survival.

11. Conclusions

11.1. Range

11.2. Population

11.3. Habitat for the species

11.4. Future prospects

11.5 Overall assessment of Conservation Status

11.6 Overall trend in Conservation Status

11.7 Change and reasons for change in conservation status and conservation status trend

a) Overall assessment of conservation status

No change

The change is mainly due to:

b) Overall trend in conservation status

No change

The change is mainly due to:

11.8 Additional information

12. Natura 2000 (pSCIs, SCIs and SACs) coverage for Annex II species

12.1 Population size inside the pSCIs, SCIs and SACs network (on the biogeographical/marine level including all sites where the species is present)

a) Unit number of individuals (i)

b) Minimum

c) Maximum

d) Best single value

12.2 Type of estimate

12.3 Population size inside the network Method used

Insufficient or no data available

12.4 Short-term trend of population size within the network Direction

Increasing (+)

12.5 Short-term trend of population size within the network Method used

Based mainly on expert opinion with very limited data

12.6 Additional information

Although this species is widely studied, many of the SAC sites for this species are dangerous to access cave sites, as such not all sites are subject to regular monitoring. However, at the most recent assessment for the integrity of the sites, 96% (486ha) of the SAC area was considered to be in Favourable or Unfavourable Recovering condition. Where sites have been partially monitored there a continuing upward trend in population.

Report on the main results of the surveillance under Article 11 for Annex II, IV and V species (Annex B)

13. Complementary information

13.1 Justification of % thresholds for trends

13.2 Trans-boundary assessment

13.3 Other relevant Information

Distribution Map

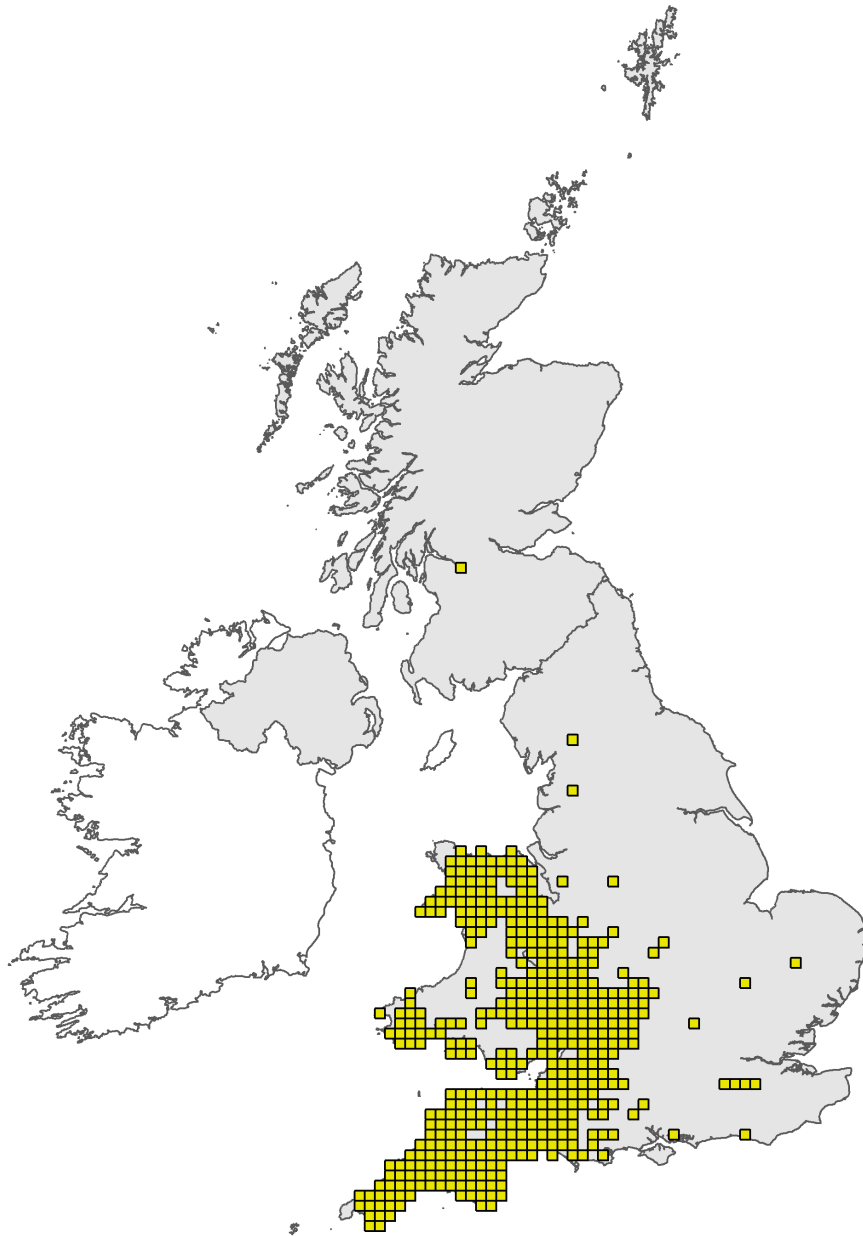


Figure 1: UK distribution map for S1303 - Lesser horseshoe bat (*Rhinolophus hipposideros*). Coastline boundary derived from the Oil and Gas Authority's OGA and Lloyd's Register SNS Regional Geological Maps (Open Source). Open Government Licence v3 (OGL). Contains data © 2017 Oil and Gas Authority.

The 10km grid square distribution map is based on available species records within the current reporting period. For further details see the 2019 Article 17 UK Approach document.

Range Map



Figure 2: UK range map for S1303 - Lesser horseshoe bat (*Rhinolophus hipposideros*). Coastline boundary derived from the Oil and Gas Authority's OGA and Lloyd's Register SNS Regional Geological Maps (Open Source). Open Government Licence v3 (OGL). Contains data © 2017 Oil and Gas Authority.

The range map has been produced by The Mammal Society applying a range mapping tool as outlined in Matthews et al. (2018), to the 10km grid square distribution map presented in Figure 1. The alpha value for this species was 20km. For further details see the 2019 Article 17 UK Approach document.

Explanatory Notes

Species name: *Rhinolophus hipposideros* (1303)

Field label	Note
1.5 Common name	<i>R. hipposideros</i> has a restricted distribution in Great Britain with populations found across south-west, southern and western England and the majority of Wales. <i>R. hipposideros</i> bats have specific roosting requirements, favouring undisturbed sites with large entrances that permit uninterrupted flight into the roost. Old buildings, particularly those with slate roofs tend to be used in the summer and underground sites including caves, quarries and cellars are used in the winter. Night roosts appear fundamental to the conservation of the species, particularly during pregnancy and lactation (Schofield, 1984, Knight and Jones, 2009). <i>R. hipposideros</i> bats forage largely in broadleaved woodland, wooded riparian corridors and mature treelines and hedgerows (Mathews et al, 2018). With the effects of climate change producing warmer and drier springs the species is likely to continue to increase in population size and range. Protection of roost sites and changes in agricultural patterns under agri-environment schemes are also responsible for positive shifts for the species. Linear infrastructure and associated lighting, changes in land use/management, unsympathetic development of buildings resulting in roost loss and roost degradation remain risks to the species long term.
2.3 Distribution map	The species has been subject to a high level of recording; coordinated monitoring of summer roosts in Wales and England has taken place since 1993 and 1998 respectively. Structured monitoring of some hibernation sites started in 1997, though some sites have been monitored on an ad hoc basis for many years. The distribution map is considered to accurately reflect the current distribution of the species and data quality is considered good.

Species name: *Rhinolophus hipposideros* (1303) Region code: ATL

Field label	Note
5.3 Short term trend; Direction	Mathews et al, 2018 notes the range of the species appears to be similar to previous estimates, though it is noted that there appear to be increasing numbers of records of hibernating individuals in the north of England and the Midlands. Increased survey effort and long term monitoring schemes combined with improved technology through improved acoustic detectors has increased our knowledge of the species range.
6.1 Year or Period	Presence data was collected between 1995-2016 at 10km resolution or higher, gathered from the NBN gateway, local records centres, individual species experts, national and local monitoring schemes and iRecord for each species for the 'Review of the Population and Conservation Status of British Mammals (Mathews et al, 2018) used to determine population status for the species for this report. However, the population was determined between 2016-2017 and only data that had been verified by the source organisation was included in the distribution maps.

6.3 Type of estimate	<p>Two main sources of error were identified in Mathews et al, (2018) with the estimates. The first source of potential error relates to estimates being derived from observed numbers of bats at 260 maternity sites; it's likely that there are other, unrecorded colonies leading to an under-estimation of population size. The second source of error relates to there being little information being available on the sex ratio within maternity colonies pre-breeding. The overall estimate is based on a single expert opinion of 70% of the colony being female, with other experts indicating that they had no additional directly measured data. Unpublished data from recent research conducted using genotyping at 6 roosts in the Republic of Ireland indicate that the proportion of adult males within a colony varies from 7% to 72% (median 37%) (Mathews et al 2018 - Harrington & O'Reilly pers com). This means that the median proportion of females would be expected to be 63% (range 28% to 93%). If applicable in GB, this would reduce the estimated size of the population. Recent genotyping work at 19 colonies in northern France also indicates the presence of significant numbers of adult males within pre-breeding colonies but here the median value was 25.8% with only 5 sites having values greater than the expert opinion used here (Zarzoso-Lacoste et al., 2017). It is notable that one of these was a large colony with >200 individuals, which implies that it is not just small or suboptimal colonies that may have large proportions of males. Given the large effect on the total population size, further research is needed to examine this issue in GB. In Mathews et al., (2018), it has been assumed that there are equal numbers of male and female bats in the population overall, given the lack of any contrary evidence in the literature or from expert opinion.</p>
6.8 Short term trend; Direction	<p>Monitoring data from the National Bat Monitoring Programme (NBMP) shows that <i>R. hipposideros</i> bat is increasing in numbers at known sites, so there is a genuine increase in the population. In addition, new maternity sites are discovered from time to time, so there is an improvement in knowledge.</p>
7.1 Sufficiency of area and quality of occupied habitat	<p>Habitable area has been taken from Mathews et al, 2018 as 33,552km which is larger than the previous reporting round as different methodology has been used. The area has been defined as all of the habitat within the range excluding montane habitat since this is unlikely to include suitable locations for maternity roosts. The area of habitat available for the species is considered to be sufficient and is allowing for range expansion, however, the quality of the habitat remains largely unknown, though agri-environment schemes are known to be responsible for the positive shifts seen with this species. <i>R. hipposideros</i> requires a complex mosaic of habitats to support foraging, roosting and commuting behaviour. Boye & Dietz (2005) provide a good overview of this species' habitat requirements. Woodlands play a predominant role as foraging habitats for the species, especially in spring when <i>R. hipposideros</i> almost exclusively forages there. Foraging areas are close to summer roosts (distances up to 4.2 kilometres) and the animals spend about half their activity time within a radius of 600 metres. Summer roosts are usually situated close to woodland or a park. If this is not the case a system of continuous linear elements, such as hedges or walls, provide guidance to the bats when flying to their foraging areas. Undisturbed hibernation sites in underground caves, mines or cellars must be available at a maximum distance of 30 kilometres from the summer roosts. Night roosts are important in extending the foraging area available to a colony and occasionally it may be advantageous for bats to remain in these satellite roosts during the day to conserve energy levels rather than return to the maternity roost in the same night. These night roosts appear to be particularly important during pregnancy and lactation (Schofield, 1984, Billington and Rawlinson 2006, Knight and Jones, 2009).</p>

7.2 Sufficiency of area and quality of occupied habitat; Method used

The habitable area has been taken from Mathews et al (2018), which defined all the area within the range as habitable excluding montane habitat since this is unlikely to include suitable locations for maternity roosts. The habitable area within the range is 33,552 km². As this is a generalist species using a mosaic of habitats, the area of distribution is used as an estimate of habitat area and is assumed to be sufficient given the increasing population and range of the species. However, a detailed analysis of all of the suitable habitat available for the species, where all of the foraging and roosting habitat has been located within the current boundary and assessed as to whether it has been used has not taken place. This process would require very detailed habitat information at a fine scale across the UK and we do not currently have this level of information.

7.4 Short term trend; Direction

The trend would appear to be relatively stable as the previous Article 17 report for this species calculated the habitat for the species at 28,500km². The two estimates appear to be broadly in line with each other with the latest estimate being 33,552km². The previous estimate was based on a simple calculation of the number of filled 10km squares on the distribution map. Whereas, the larger estimate presented here results from mapping species records at a finer scale, using an alpha hull value of 20km and adding an additional 10km buffer to the final hull polygon to provide smoothing to ensure that the hull covered the areas recorded. It is assumed that this species which can occupy a mosaic of habitat types could be present throughout the entire area, except for montane areas.

8.1 Characterisation of pressures/ threats

Pressures: A06: Abandonment of pastoral systems and lack of grazing, particularly of cattle grazing (Ransome, 1996) compounded by use of anthelmintics. (McCracken, 1993). Dung beetles form a key component of the species diet (A14). F02, A05: Increasing urbanisation results in loss of foraging habitat, severance of commuting routes and isolation of colonies. *R. hipposideros* commute and forage along linear features, over wet grassland and in woodland. Agricultural and forestry practices that remove or simplify these habitats, or affect the biomass of insect prey could negatively affect populations. F02: Demolition and conversion of buildings results in loss of roost sites. This species requires large open roof spaces with large access points which are easily lost when converted. Although roosts are strictly protected, *R. hipposideros* has quite specific summer roosting requirements that are not provided by most modern buildings. In addition, changes in building practices to improve energy efficiency mean that new buildings may offer fewer roosting opportunities. Roost sites are often in old agricultural buildings or large rural dwellings subject to deterioration or to conversion to alternative use. There is good understanding of the roosting conditions and habitat required for the species (Schofield 2008). However mitigation for developments affecting roosts and habitat is not always undertaken as proposed compromising its likelihood of success. E01: These pressures also act via construction of new, and widening/realignment of existing linear infrastructure projects. The species is low flying and likely to be vulnerable to mortality through direct collision with vehicles (Fensome & Mathews, 2016). Lighting from urbanisation and infrastructure can sever commuting routes, impact foraging areas and delay emergence times. F07 & C09: Use of underground sites for recreational purposes (e.g. caving, adventure trips, coasteering) cause disturbance to hibernating bats affecting their ability to survive the winter, or causing them to abandon sites. Modern mineral extraction methods are unlikely to create suitable mines and galleries for future occupation. B05 & B02: Loss/reduction in value of woodland habitat. Threats: M10: Regarding natural catastrophes, long-term research has shown that the greatest threat to populations is mass starvation in late cold springs (Ransome, 1989). The impact of these is being ameliorated by providing good quality habitat close to hibernation sites. F02: The rate of demolition and conversion of buildings resulting in loss of roost sites is unlikely to decrease. C01: Mine collapse and flooding and reopening of mines can all threaten the species. A06 & A14: Abandonment of pastoral systems and lack of grazing, particularly of cattle grazing compounded by use of anthelmintics is likely to remain a threat along with F02, demolition and conversion of buildings resulting in loss of roost sites, A05, loss of foraging habitat, severance of commuting routes and isolation of colonies, E01, during construction of new, and widening/realignment of existing linear infrastructure projects. F07, C09: the use of underground sites for recreational purposes and mineral extraction activities will continue. B05 & B02, loss/reduction in value of woodland habitat will also continue.

9.5 List of main conservation measures

Legal and administrative measures continue to be required to ensure that the protection provided by the legislation is effective and that protected habitats for the species are managed appropriately (CF03). This helps to address Pressures/Threats F02, L05, F07, C01. Road design, construction and operation need to take into account the likely impact on bats, e.g. in relation to the provision of safe crossing structures and the loss of and severance of bat habitat and lighting (CE01, CE05). This helps to address Pressures/Threats E01 & A05. *R. hipposideros* requires a complex mosaic of habitats to support foraging, roosting and commuting behaviour. Woodlands and semi or unimproved wet pasture bounded by hedgerows have been shown to be important foraging habitats for the species. Foraging areas are close to summer roosts (distances up to 4.2 kilometres) and the animals spend about half of their activity time within a radius of 600 metres. Roost sites are often in buildings that are subject to deterioration or to conversion to alternative use. There is good understanding of the roosting conditions and habitat required for the species (Schofield 2008). However, mitigation for developments affecting roosts and habitat is not always undertaken as proposed compromising its likelihood of success. Planning at landscape scale is required to conserve commuting routes and foraging areas along with effective management of habitats through agri-environmental schemes and sympathetic forest management plans. (CA09, CA02, CA05, CS03, CB05, CF01). This helps to address Pressures/Threats A06, A14, B05 & B02.
