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:

S1327 - Serotine (*Eptesicus serotinus*)

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.

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NATIONAL LEVEL

1. General information

1.1 Member State	**UK (England information only)**
1.2 Species code	**1327**
1.3 Species scientific name	**Eptesicus serotinus**
1.4 Alternative species scientific name	
1.5 Common name (in national language)	Serotine

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	Based mainly on extrapolation from a limited amount of data
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

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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

Arnold, H., 1993. Atlas of Mammals in Britain. Institute of Terrestrial Ecology Research Publication no. 6, London.
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Boughey, K.L., Lake, I.R., Haysom, K.A., Dolman, P.M. 2011. Effects of landscape-scale broadleaved woodland configuration and extent on roost location for six bat species across the UK. Biological Conservation. 144(9):2300-10.
Boye, P., Dietz, M. 2005. Development of good practice guidelines for woodland management for bats. English Nature.
Catto, C., Hutson, A., Raccey, P., Stephenson, P. 1996. Foraging behaviour and habitat use of the serotine bat (Eptesicus serotinus) in southern England. Journal of Zoology. 238(4):623-33.
Catto, C. (1993). Aspects of ecology and behaviour of the serotine bat (Eptesicus serotinus), University of Aberdeen.
Dietz, C., Kiefer, A., 2016. Bats of Britain and Europe. Bloomsbury, United Kingdom.
Harris, S., Morris, P., Wray, S. & Yalden, D. 1995. A review of British Mammals: population estimates and conservation status of British mammals other than cetaceans. JNCC, Peterborough.
Joint Nature Conservation Committee. 2013. Third Report by the United Kingdom under Article 17 on the implementation of the Habitats Directive from January 2007 to December 2012.

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Mathews, F., Kubasiewicz, L.M., Gurnell, J., Harrower, C., McDonald, R.A., Shore, R.F. 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.
Mitchell-Jones, T.J. 2010. Bats in houses - the conservation challenge. Pp 365-378 in Species Management:challenges and solutions for the 21st century.
Moussy, C., Atterby, H., Griffiths, A., Allnutt, T., Mathews, F., Smith, G., Aegerter, N., Bearhop, S., Hosken, D, J. 2015. Population genetic structure of serotine bats (Eptesicus serotinus) across Europe and implications for the potential spread of bat rabies (European bat lyssavirus EBLV-1). Heredity. 115(1):83.
Robinson, M., Stebbings, R. 1993. Food of the serotine bat, Eptesicus serotinus-is faecal analysis a valid qualitative and quantitative technique? Journal of Zoology. 231(2):239-48.
Smith, G., Aegerter, J., Allnutt, T., MacNicoll, A., Learmount, J., Hutson, A., Atterby, H. 2011. Bat population genetics and Lyssavirus presence in Great Britain. Epidemiology & Infection.139(10):1463-9.
Speakman, J. 1991. The impact of predation by birds on bat populations in the British Isles. Mammal Review. 21, 123-142.
Tink, M., Burnside, N.G., Waite, S. 2014. A Spatial Analysis of Serotine Bat (Eptesicus serotinus) Roost Location and Landscape Structure: A Case Study in Sussex, UK. International Journal of Biodiversity. 2014: 9.
Vaughan N. The diets of British bats (Chiroptera). Mammal Review. 1997;27(2):77-94.

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)	78082
	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 a more accurate
5.11 Change and reason for change in surface area of range	Improved knowledge/more accurate data Use of different method The change is mainly due to: Use of different method
5.12 Additional information	Range is given by Mathews et al. (2018) as 78,100 km2 for England (area of suitable habitat within range). Range was not estimated for England in the previous Article 17 report (JNCC 2013). Habitable area was defined as all area within the range excluding montane habitat since this is unlikely to include suitable locations for maternity roosts. Because of the landscape-wide movements of bats and their dependency on a matrix of habitats and roosting locations, it is not currently possible to make more refined estimates of the area of suitable habitat within the range.

6. Population

6.1 Year or period	1995-2016	
6.2 Population size (in reporting unit)	a) Unit	number of map 1x1 km grid cells (grids1x1)
	b) Minimum	
	c) Maximum	
	d) Best single value	
6.3 Type of estimate	Best estimate	
6.4 Additional population size (using population unit other than reporting unit)	a) Unit	number of adults (adults)
	b) Minimum	6250
	c) Maximum	356000
	d) Best single value	
6.5 Type of estimate	95% confidence interval	
6.6 Population size Method used	Based mainly on extrapolation from a limited amount of data	
6.7 Short-term trend Period	2006-2017	
6.8 Short-term trend Direction	Stable (0)	
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		

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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	
6.15 Favourable reference population (using the unit in 6.2 or 6.4)	a) Population size b) Operator c) Unknown d) Method
6.16 Change and reason for change in population size	Improved knowledge/more accurate data Use of different method The change is mainly due to: Use of different method
6.17 Additional information	The difference in population size between reporting rounds is most attributable to a change in methodology, although more data are also available. The 1995 population estimate for Great Britain (Harris et al 1995) was based on very limited information, extrapolating from the known size of Pipistrellus pipistrellus colonies in relation to size of serotine colonies following the methods described by Speakman (1991). The new estimate, taken from Mathews et al (2018) is considered to be more robust.

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 expert opinion with very limited data	
7.3 Short-term trend Period	1999-2016	
7.4 Short-term trend Direction	Stable (0)	
7.5 Short-term trend Method used	Based mainly on expert opinion with very limited 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
Conversion from mixed farming and agroforestry systems to specialised (e.g. single crop) production (A03)	M

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
Use of other pest control methods in agriculture (excluding tillage) (A23)	H
Clear-cutting, removal of all trees (B09)	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

Threat	Ranking
Conversion from mixed farming and agroforestry systems to specialised (e.g. single crop) production (A03)	M
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
Use of other pest control methods in agriculture (excluding tillage) (A23)	H
Clear-cutting, removal of all trees (B09)	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

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
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)
Other measures related to agricultural practices (CA16)
Adapt/change forest management and exploitation practices (CB05)

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Prevent conversion of natural and semi-natural habitats, and habitats of species into agricultural land (CA01)

Reinstate appropriate agricultural practices to address abandonment, including mowing, grazing, burning or equivalent measures (CA04)

Reduce impact of transport operation and infrastructure (CE01)

Other measures related to residential, commercial, industrial and recreational infrastructures, operations and activities (CF12)

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. Serotine bats hunt over pastures and in deciduous or mixed woodland. Environmental land management schemes in the agricultural and forestry sectors are now widely used to ensure these habitats in the vicinity of roosts are well-managed and provide appropriate insect food at the correct time of year. Planning at landscape scale is required to conserve commuting routes and foraging areas.

10. Future prospects

10.1 Future prospects of parameters	a) Range b) Population c) Habitat of the species
10.2 Additional information	The range for serotine bats appears to have increased, although it is unclear how much of this is down to different methodology and data collection. The population appears to be stable as shown continuously through the National Bat Monitoring Programme trend data. There is insufficient data on any change in the level of suitable habitat or any change in the quality of habitat for the species so this has been categorised as unknown.

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	

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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 b) Minimum c) Maximum d) Best single value
12.2 Type of estimate	
12.3 Population size inside the network Method used	
12.4 Short-term trend of population size within the network Direction	
12.5 Short-term trend of population size within the network Method used	
12.6 Additional information	

13. Complementary information

13.1 Justification of % thresholds for trends
13.2 Trans-boundary assessment
13.3 Other relevant Information

Distribution Map

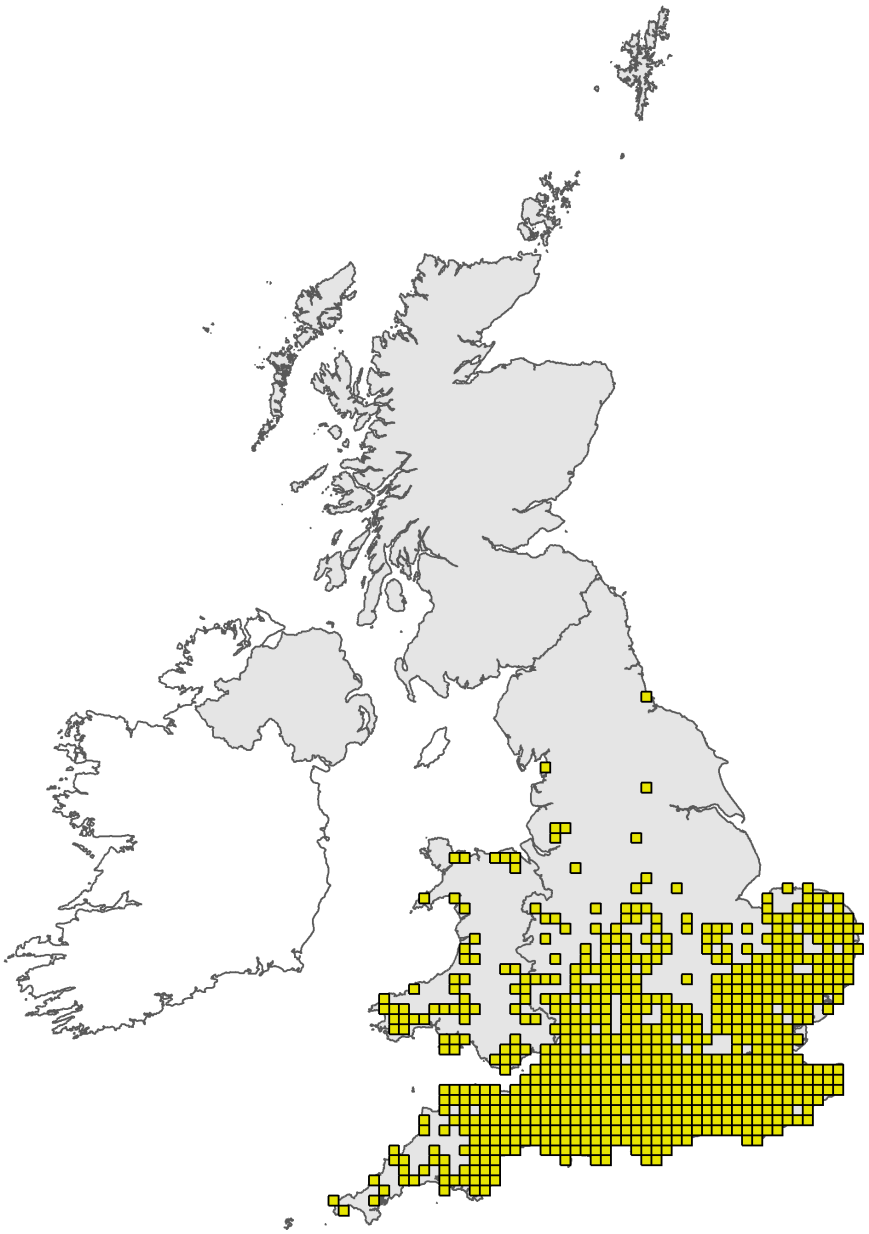

Figure 1: UK distribution map for S1327 - Serotine (*Eptesicus serotinus*). Coastline boundary derived from the Oil and Gas Authority's OGA and Lloyd's Register SNS Regional Geological Maps (Open Source). Open Government Licence v3 (OGL). Contains data © 2017 Oil and Gas Authority.

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

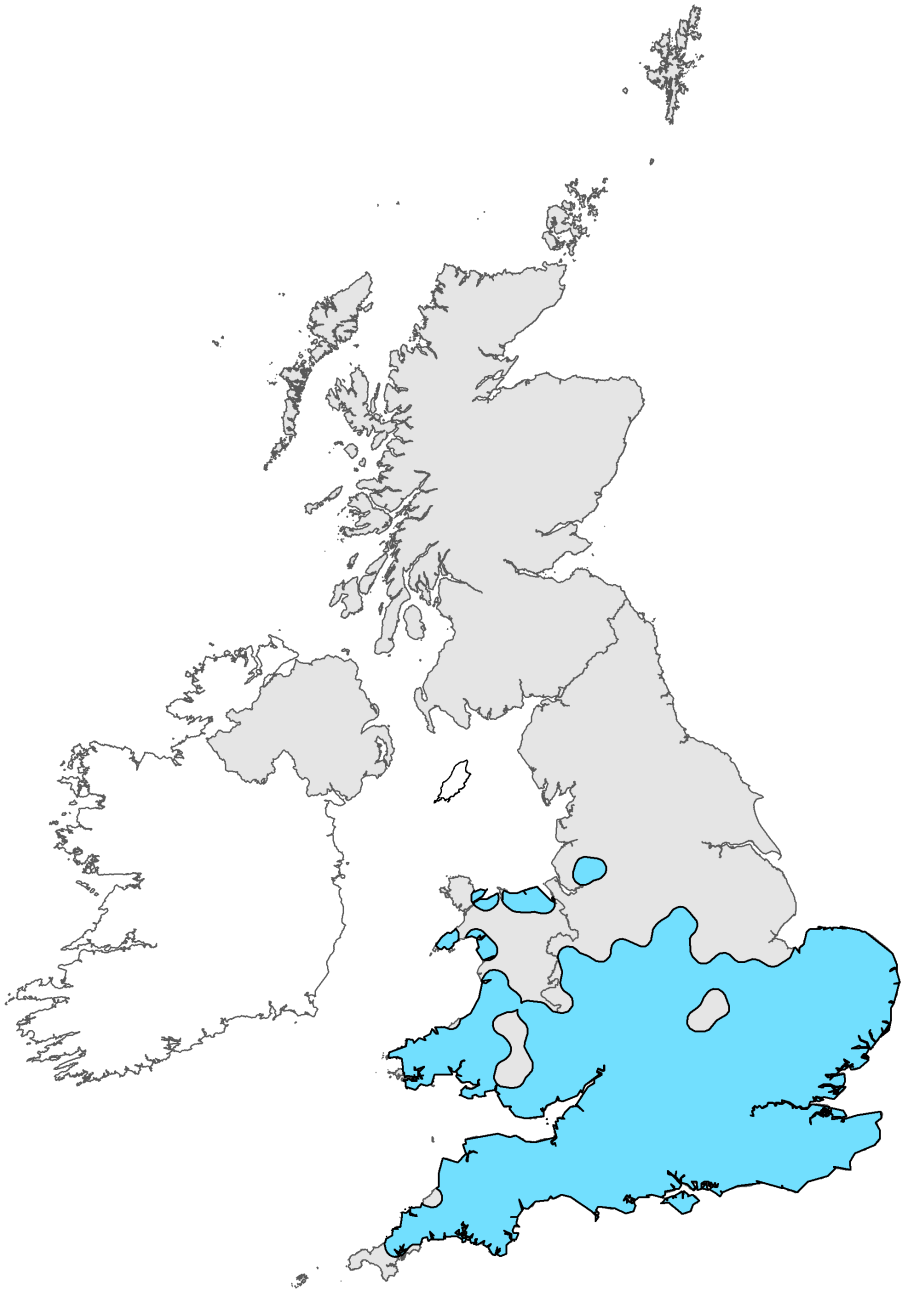

Figure 2: UK range map for S1327 - Serotine (*Eptesicus serotinus*).Coastline boundary derived from the Oil and Gas Authority's OGA and Lloyd's Register SNS Regional Geological Maps (Open Source). Open Government Licence v3 (OGL). Contains data © 2017 Oil and Gas Authority.

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: Eptesicus serotinus (1327)

Field label	Note
1.5 Common name	Serotine bats roost mainly in buildings and utilise a broad range of habitats for foraging. They have a distinctive highly manoeuvrable flapping flight with broad wings. They have a loud echolocation call and are easily picked up with bat detectors, although confusion between Nyctalus noctula and N. leiseri can occur if heterodyne detectors are used.
2.2 Year or Period	This time period has been selected as distribution has been calculated using data from Mathews et al 2018.
2.3 Distribution map	The Serotine occurs mainly south of a line drawn from the Wash in England to South Wales. Records come from a combination of reports of bats in houses and bat detector surveys as part of the National Bat Monitoring Programme. The greater use of bat detectors has extended the known distribution northwards in recent years, though few roosts are known in much of this area. There appears to be distinct structuring of the population in England, in contrast with continental Europe, based on population genetics data. Three populations in the South of England have been identified (East; West and Isle of Wight) and these have only low levels of gene flow (Smith et al. 2011, Moussy et al. 2015). There is some evidence for a westward expansion of the population, possibly corresponding with a population decline in the east (Moussy et al. 2015). Genetic evidence also suggests that there must be some gene flow across the English Channel (Moussy et al. 2015).
2.4 Distribution map; Method used	Range is based on presence data collected between 1995 and 2016. Areas that contain very isolated records may not have been included in the area of distribution

Species name: Eptesicus serotinus (1327) Region code: ATL

Field label	Note
5.3 Short term trend; Direction	The range has increased from that given for the last reporting round (JNCC 2013) and is considerably larger than that shown in Arnold (1993), with the range spreading west and north to now include south-west England, the Midlands, the Welsh borders and Merseyside. It is unclear how much of this change reflects a true range change rather than increased observer effort; and occupancy is thought to be low in some of these new areas. There are also expert opinion reports of declining populations in the East of England. The apparent increase in range has not been accompanied by a significant increase in population (BCT, 2018), although trends for this species are more difficult to detect as it is encountered relatively infrequently during surveys. The range reported here is likely to reflect the true distribution. The species is almost entirely dependent on building roosts and its droppings are distinctive. Therefore despite being inconspicuous at its roosts sites - colonies are small and individuals tend to be hidden in crevices -It is nevertheless well-recorded compared many bat species that are less dependent on buildings. It also has a loud echolocation call with fairly distinctive call parameters (though note that there is some potential for confusion with other Nyctaloid bats, particularly when using heterodyne detectors).
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.

6.4 Additional population size	Mathews et al (2018) calculated a population size of adult individuals of 117,000 for England with upper and lower confidence intervals of 6,250 - 356,000. There is uncertainty surrounding the population estimates for this species as demonstrated by the relatively wide confidence intervals. Population size was calculated using the median adult density in mixed habitat (bats/km2) * total habitable area within the range (km2) (for full details see Mathews et al 2018). Habitable area was defined as all area within the range excluding montane habitat since this is unlikely to include suitable locations for maternity roosts. Because of the landscape-wide movements of bats and their dependency on a matrix of habitats and roosting locations, it is not currently possible to make more refined estimates of the area of suitable habitat within the range. The density of maternity roosts accross England is uncertain as it is likely many roosts are unreported. The data available from studies were all conducted within known strongholds for the species, and are therefore likely to be somewhat higher than those expected elsewhere. The estimate given here is much higher than presented for the last reporting round, which was taken from Harris et al (1995), however that estimate was graded as having very poor reliablity.
6.8 Short term trend; Direction	The National Bat Monitoring Programme roost count data (BCT 2018) are suggestive of recent declines, however sample sizes are relatively small (n=95) and the trends are not statistically significant. Field survey data (n=379) show a slight increase, but again, the trends are not statistically significant. Overall, it is considered the population has been stable since the baseline year of 1999. However, this finding should be treated with caution as serotine is encountered relatively infrequently during surveys and therefore the level of uncertainty associated with these trends is relatively large, meaning trends for this species are more difficult to detect. In addition, it should be noted that serotine bats can be confused with other Nyctaloid bats when detection is based on heterodyne bat detectors, as used in the field survey.

7.1 Sufficiency of area and quality of occupied habitat	Boye & Dietz (2005) provide a good overview of this species habitat requirements. E. serotinus requires a complex mosaic of habitats to support foraging, roosting and commuting behaviour. It is often associated with pasture and parkland and has slow, highly manoeuvrable flight which allows it to fly very close to the ground as well as among the canopies of trees. It preys mainly on large Coleoptera (beetles) including Aphodius spp. (dung beetles) and Melonotha spp. (cockchafers), on larger Lepidoptera (moths) and midges (Robinson and Stebbings 1993, Vaughan 1997). A wide range of habitats are used for foraging such as open fields, woodland, woodland edges, river banks, parks, tree rows, gardens, amenity areas and around streetlights. The species is able to locate and exploit temporary feeding sites such as recently mown grass (Catto et al. 1996). The foraging range is relatively large, with average commutes of 6.5km being recorded in a pastoral region (Catto et al 1996) and 8km in a more arable region of southern England (Robinson and Stebbings 1997). The maximum distance recorded was over 41km, and the bats largely commuted along hedgerows and treelines and over pasture. Maternity colonies are thought to be almost exclusively formed by adult females, with males roosting separately or in small groups (Catto 1993, Moussy et al 2015). Radio-tracking data indicate that females are faithful to a roost during the breeding season whereas males use several alternative roosts (Catto et al 1996). Maternity roosts are almost exclusively located in buildings, particularly residential houses constructed in the late 19th and early 20th century and which have high gables and a substantial roof-space. They are found only very occasionally in bat boxes. Roosts are closer to woodland (particularly broadleaved woodland), water, pasture, and have higher proportions of improved grassland within than would be expected by chance - though there are differences between studies in the spatial scale at which these effects are seen (Battersby 1999, Boughey et al 2011, Tink et al 2014). Hibernation sites are relatively unknown, with very few individuals being found in underground sites. It is presumed that most remain in roof spaces and cavity walls (Dietz and Keifer 2016). There is thought to be a sufficient amount of habitat in the UK to support a viable population of the species.
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 noted as 78,082 km2, but it is unlikely that the entirety of this area forms suitable habitat. To obtain a proper estimate of suitable habitat used by the species, it would be necessary to first identify all of the foraging and roosting habitat located within the current range boundary; determine whether or not each of these features were being used; and subsequently calculate the combined area of all currently used habitats. This process would require very detailed habitat information at a fine scale across the UK. We do not currently have this level of information.
7.4 Short term trend; Direction	As this is a generalist species, using a mosaic of habitats across a large area and the population appeasr to be stable and there may be a slight increase in range the habitat is assumed to be stable.
8.1 Characterisation of pressures/ threats	Pressures can generally be divided into those that affect roosts and those that affect commuting and foraging (including prey availability). Although roosts are strictly protected, a small number of licences permitting exclusion or roost destruction is issued every year. In addition, changes in building practices to improve energy efficiency mean that new buildings may offer fewer roosting opportunities (Mitchell-Jones, 2010). Serotines forage over lowland farmland, parkland and woodland edges, Agricultural and forestry practices that remove or modify these habitats, or affect the biomass of suitable insect prey could negatively affect populations.