National Bat Monitoring Programme

Annual Report 2022

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Bat Conservation Trust
www.bats.org.uk

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Cover photo: Greater Horseshoe Bat by Daniel Hargreaves

Executive summary

This report presents the results of the National Bat Monitoring Programme (NBMP) up to summer 2022.

The NBMP is a world-leading citizen science programme which produces population trends for British bat species. This information is used by Government and conservation bodies to inform evidence needs, address policy questions and provide metrics of bat population status, change and distribution.

Data from four long-term monitoring surveys are used to produce population trends: Roost Count, Field Survey, Waterway Survey and Hibernation Survey. After its suspension in winter 2020/21 due to COVID-19, the Hibernation Survey resumed in winter 2021/22 following new protocols to reduce the risk of transmitting SARS-CoV-2 from humans to bats. Under these new protocols not all sites could be surveyed, and this has prevented us from updating Hibernation Survey trends for some species.

Volunteers taking part in these long-term monitoring surveys contributed approximately 13,679 hours of their time, representing an in-kind contribution to the NBMP of £197,836. Across our four long-term monitoring surveys and the Woodland Survey; 7,084 sites have been surveyed since the inception of the programme in 1996 (the Sunset/Sunrise survey is excluded from this total as sites in this survey are not precisely defined). In 2022 1,502 sites were surveyed by 946 volunteers.

At present sufficient data are collected by the NBMP to produce population trends for 11 of Great Britain's 17 breeding bat species. Of these species, all are considered to have been stable or to have increased since the baseline year of monitoring (1999 for most species).

Based on trends updated to 2022, species considered to have increased in Great Britain when compared to the baseline year of monitoring are greater horseshoe bat, lesser horseshoe bat, common pipistrelle, soprano pipistrelle and Natterer’s bat.

Based on trends updated to 2022, species considered to be stable in Great Britain when compared to the baseline year of monitoring are Daubenton’s bat, whiskered/Brandt’s bat, serotine, noctule and brown long-eared bat. However, this assessment should be treated with caution for whiskered/Brandt’s bat as it combines data from two species with potentially differing conservation status. Serotine is encountered infrequently during surveys and there is a high level of uncertainty associated with its trends.

No species for which we produce population trends are considered to have declined significantly since the baseline year of monitoring. For some species, survey indices calculated from Roost Count data are declining; however, we believe these indices to be negatively biased by some species’ frequent ‘roost switching’. These indices are therefore not considered a reliable measure of population change for these species. We are currently investigating the causes of this negative bias and exploring ways to correct it.

While data from the National Bat Monitoring Programme indicate that populations of the bat species we monitor are stable or recovering, it should be remembered that these trends reflect relatively recent changes in bat populations (since 1999 for most species). It is generally considered that prior to this there were significant historical declines in bat populations dating back to at least the start of the 20th century. This suggests that current legislation and conservation action to protect and conserve bats is being successful, and it is vitally important that this continues.

Contents

Introduction

The National Bat Monitoring Programme (NBMP) is an annual series of bat surveys undertaken by thousands of dedicated volunteers, which allow us to monitor changes in British bat populations. The data we collect are used by the Government and conservation organisations to monitor the health of our environment, inform policy and improve the conservation of bats.

This report provides population trends for 11 of Great Britain's 17 breeding bat species, derived from data collected up to and including summer 2022. Trends are provided at GB level and also at UK and country level where sufficient data are available. Trends are calculated for 11 species in England, five species in Scotland, nine species in Wales, one species in Northern Ireland and one species at UK level. This report also provides information on our survey methods. For the majority of species we currently have insufficient data from Northern Ireland to provide trends to enable Northern Ireland or UK-wide trends to be calculated. Bat Conservation Ireland runs a number of bat monitoring schemes across Ireland and publishes Irish bat population trends and distribution data.

The next set of bat population trends, incorporating data collected up to and including summer 2023, are due to be published in May 2024.

Official Statistics: These statistics have been produced to the high professional standards set out in the Code of Practice for Official Statistics.

The NBMP is run by the Bat Conservation Trust, in partnership with the Joint Nature Conservation Committee, and supported and steered by Natural England, Natural Resources Wales, NatureScot and Northern Ireland Environment Agency. We are extremely grateful to all the dedicated volunteers who have taken part in the NBMP since its inception in 1996, without whom the programme could not continue. Bat Conservation Ireland contributes Northern Ireland bat records collated by the Irish Bat Monitoring Programme which is funded by the National Parks and Wildlife Service of the Department of Arts, Heritage and the Gaeltacht, Republic of Ireland and Northern Ireland Environment Agency. Data are shared on the NBN Atlas and GBIF.

Impact of COVID-19

Hibernation surveys resumed in winter 2021/22 after having been suspended in winter 2020/21 in line with guidance from the IUCN Bat Specialist Group which assessed that there is a credible risk of SARS-CoV -2 (the virus that causes COVID-19) being passed from humans to bats.

Revised IUCN guidance required risk assessments to be carried out in winter 2021/22 based on the epidemiological status of the survey team and study area (prevalence of COVID-19 and vaccination status of the survey team). BCT put together an additional risk assessment to assess the size and airflow characteristics of each site and the minimum number of surveyors required to survey the site safely and effectively. If the site characteristics did not enable surveyors to remain at least two metres from bats when not briefly examining them for identification purposes then it was recommended that the site should not be surveyed.

As a result, many smaller sites were not surveyed in winter 2021/22 and the total number of sites surveyed was only 294, compared with 521 in winter 2019/20. While the sample sizes have been sufficient to update the GB and Wales Hibernation Survey trends, the sample size for Scotland was not large enough for Scotland Hibernation Survey trends to be updated this year. As a result, the Hibernation Survey trends for Scotland in this report include data only up to winter 2019/20 (these trends were also published in last year's report in lieu of an update), although they are becoming increasingly out-of-date.

Furthermore, if the number of sites surveyed across Great Britain each winter continues to be constrained by measures to limit the transmission of SARS-CoV-2 from humans to bats, this may weaken our ability to produce robust trends from Hibernation Survey data. In anticipation of this potential problem, we are exploring alternative methods to collecting data from hibernation sites where internal counts are not currently being carried out (see *Developments and future directions,* page 90).

Following COVID-19 restrictions in 2020, participation in summer surveys began recovering in 2021 but has not recovered further in 2022. This indicates that there is work still to be done to encourage more volunteers to resume monitoring sites they last surveyed before the pandemic.

Bat monitoring in the UK

Effective conservation requires monitoring of underlying population trends to detect population declines; to ensure scarce conservation resources are targeted appropriately; to measure the effectiveness of conservation interventions; and to inform policy.

The NBMP collects data to deliver this information and to enable us to understand more about the drivers of bat population change. The NBMP delivers some of the key information needs for UK and country biodiversity strategies.

Bats are widely distributed through the range of landscapes and habitats in the UK. They are valuable indicators of the health of the environment due to their reliance on insect prey, dependence on a range of habitats, and sensitivity to climate, land and site management changes. Since 2008, NBMP data have contributed to the suite of UK biodiversity indicators which are used to help measure progress towards the Government's target of halting biodiversity loss.

Monitoring approaches

The NBMP is an integrated programme that uses a number of survey methods appropriate for different UK bat species. This approach means that most of the species monitored are surveyed at more than one stage of their annual life cycle. The NBMP includes four long-term monitoring surveys (Roost Count, Field Survey, Waterway Survey and Hibernation Survey). Data from these surveys are used to produce species population trends. The features of our long-term monitoring surveys, and the other surveys administered as part of the NBMP, are summarised in Table 1.

Photo: Shirley Thompson

Table 1. NBMP survey details

Survey	Species monitored	Start year	Survey period	Site selection, survey method and volunteer experience level required
Long-term monitoring surveys				
Roost Count	• greater horseshoe bat • lesser horseshoe bat • Natterer's bat • common pipistrelle • soprano pipistrelle • serotine • brown long-eared bat	1997 (Natterer's bat: 2000; brown long-eared bat: 2001)	6th - 25th June (lesser horseshoe bat: 9th May - 27th June; greater horseshoe bat: 7th - 21st July)	Known roosts. Roost emergence counts. Anyone who knows of a roost they can count can take part.
Field Survey	• noctule • serotine • common pipistrelle • soprano pipistrelle	1998	1st July - 30th July	Stratified-random 1km squares. Walked transect with heterodyne bat detector. Experience needed of using a heterodyne bat detector to identify the target species.
Waterway Survey	• Daubenton's bat	1997	1st August - 30th August	EA/NRW River Habitat Survey sites. Walked transect with heterodyne bat detector. Experience needed of using a heterodyne detector to identify the target species.
Hibernation Survey	• greater horseshoe bat • lesser horseshoe bat • Daubenton's bat • Natterer's bat • whiskered/Brandt's bat • brown long-eared bat	1997	December - March	Known or potential hibernacula. Internal hibernacula survey. Appropriate bat survey class licence is required to take part.
Other Surveys				
Sunset/ Sunrise Survey	Any species	2001	April - September	Volunteers explore an area of their choice and identify bat presence and other nocturnal wildlife. No experience required.
Woodland Survey	• barbastelle	2005	July - September	SAC sites for barbastelles (additional woodlands surveyed up to 2010). Walked transect with broadband detector.
National Nathusius' Pipistrelle Project	• Nathusius' pipistrelle	2014	Spring to autumn, avoiding key breeding period	Sites with known/likely Nathusius' pipistrelle presence. Harp trapping survey under project licence. Bat group with experience of harp trapping

Detecting population change

The purpose of the NBMP is to allow us to draw accurate conclusions about what is happening to our bat populations. We need to be able to identify any significant changes to these populations and, in particular, identify possible declines early on so that swift conservation action can be taken.

The NBMP uses an 'alert' system which is aimed at identifying problems at an early stage. The alert system follows that used by the British Trust for Ornithology, which identifies Red and Amber alerts for individual species population trends as follows:

Red alert: Severe decline of 50% or more over 25 years (equivalent to a 2.73% decline per year)
Amber alert: Moderate decline of between 25-49% over 25 years (equivalent to a 1.14% decline per year)

An assessment based on power analyses and the width of the confidence limits for the current trend estimates suggests that our sample sizes should be sufficient to detect both an Amber and Red Alert change for all monitored species at GB level.

Species coverage

Our four long-term monitoring surveys provide sufficient data to produce GB-level population trends for 9 individual species and one species group, together covering 11 of the UK's 17 breeding bat species (Table 2). At country-level we produce trends for nine individual species and one species group in England (11 species in total), five species in Scotland, seven individual species and one species group in Wales (9 species in total), and one species in Northern Ireland; a UK trend is produced for one species.

We are not able to provide population trends for the remaining GB breeding species: Bechstein's bat, Alcathoe bat, Nathusius' pipistrelle, Leisler's bat or barbastelle. However, information on the distribution of certain species is available from the Woodland Survey (barbastelle), National Nathusius' Pipistrelle Project and Bechstein's Bat Project (discontinued) (see the individual species accounts from page 73 onwards for more details).

Barbastelles (Photo: Daniel Hargreaves)

Table 2. Species coverage and data provision from each NBMP survey: ✓ = enough data collected annually for trend, + = recorded, but insufficient data to produce trend

Species	Roost Count	Field / Waterway Survey	Hibernation Survey
Greater horseshoe bat	✓		✓
Lesser horseshoe bat	✓		✓
Common pipistrelle	✓	✓	+
Soprano pipistrelle	✓	✓	+
Daubenton's bat		✓	✓
Natterer's bat	✓		✓
Whiskered/Brandt's bat			✓
Noctule		✓	
Serotine	✓	✓	
Brown long-eared bat	✓		✓
Bechstein's bat			+
Alcathoe bat			
Nathusius' pipistrelle			+
Leisler's bat		+ (NI only)	
Barbastelle			+
Grey long-eared bat	+		

Value of volunteer contribution to the NBMP

In 2022, 747 volunteers took part in one or more core NBMP Surveys: Roost Count, Field Survey, Waterway Survey or Hibernation Survey. The distribution of these volunteers is shown in Figure 1. In 2022, volunteers taking part in these surveys contributed approximately 13,679 hours of their time, representing an in-kind contribution to the NBMP of £197,836 (Table 3). The equivalent cost of these surveys if they were undertaken by professional ecologists would be £499,459.

Table 3. Estimated volunteer hours, value and equivalent professional value in 2022. BCD = British Crown Dependencies (Channel Islands and Isle of Man)

Country	Total hours	Volunteer value	Equivalent professional value
England	9775.5	£145,483	£360,017
NI	405.5	£7,150	£15,770
Scotland	1320	£19,147	£48,240
Wales	1978.5	£24,423	£69,099
BCD	199	£1,633	£6,333
Total	13678.5	£197,836	£499,459

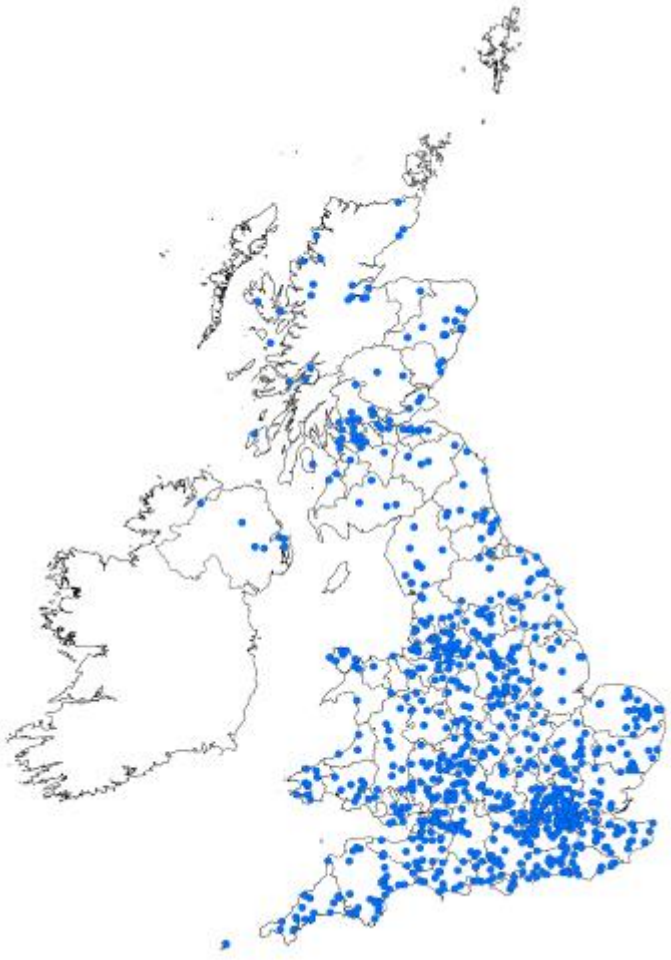


Figure 1. Locations of volunteers who took part in the four core NBMP surveys in 2022

Survey coverage

UK site network

In total up to 2022, 7,084 sites have been surveyed across all NBMP surveys (excluding the Sunset/Sunrise Survey where sites are less clearly defined). In 2022, 747 NBMP volunteers completed surveys at 1,489 core survey sites (core surveys are those from which we produce species population trends: Roost Count, Field Survey, Waterway Survey and Hibernation Survey). This represents an overall increase of 24.7% on the number of sites surveyed in 2021 (Table 4). This increase is largely due to the Hibernation Survey resuming again after it was suspended in the previous year due to COVID-19. Including additional surveys, the Woodland Survey and Sunset Survey, 960 volunteers returned data in 2022.

We encourage new, less experienced volunteers to get involved in the NBMP by taking part in the Sunset Survey. Thanks to the engagement work carried out by our Volunteer Engagement Officer, in 2022 776 Sunset Surveys were completed by at least 353 volunteers, compared with 597 surveys carried out by at least 324 volunteers in 2021. Volunteers reported 28 bat roosts during this survey.

Repeat sites

In 2022, 91% of long-term monitoring sites (Roost Count, Field Survey, Waterway Survey and Hibernation Survey) had been surveyed in at least one previous year (1,355 'repeat sites', Table 4). This has increased from 1,011 in 2021, largely due to the Hibernation Survey resuming again after it was suspended in that year due to COVID-19.

A priority for NBMP is to maximise the number of sites surveyed for at least two years, as data from a site can only contribute to species trends when at least two years of data have been collected. Adding new sites to the site network is also valuable for increasing the geographic coverage of sites contributing to the species population trends.

NBMP volunteers carrying out the Field Survey (Photo: Michelle Parsons)

Table 4. UK NBMP survey coverage 2022. This shows for each survey the total number of sites surveyed to date, the number sites surveyed in 2022 and in the preceding year, and the proportion of sites surveyed in 2022 that have been surveyed in at least one year previously (aka 'repeat' sites). Sunset Survey sites are not included in these totals as a 'site' in this survey is not precisely defined.

Survey type	Total sites surveyed to date	Total sites surveyed 2022	Total sites surveyed 2021	% change in sites surveyed from 2021to 2022	Number of repeat sites 2022	% repeat sites 2022
Field Survey	1003	184	197	-6.6	166	90.2
Waterway Survey	1566	306	309	-1	268	87.6
Hibernation Survey	1255	294*	0	N/A	287	97.6
Roost Counts:						
Greater horseshoe bat	46	21	26	-19.2	20	95.2
Lesser horseshoe bat	376	162	140	15.7	157	96.9
Common pipistrelle	746	161	164	-1.8	143	88.8
Soprano pipistrelle	595	159	151	5.3	138	86.8
Unidentified pip sp.	774	46	59	-22	38	82.6
Natterer's bat	107	23	24	-4.2	22	95.7
Serotine	148	32	33	-3	32	100
Brown long-eared bat	245	55	45	22.2	53	96.4
Other species	169	46	46	0	31	67.4
Total long-term monitoring surveys only	**7030**	**1489**	**1194**	**24.7**	**1355**	**91**
Woodland Survey	54	14	15	-6.7	13	100
Total long-term plus woodland	**7084**	**1503**	**1209**	**24.3**	**1368**	**91.1**

*Hibernation Survey figure refers to winter 2021/22.

Country level site networks

The NBMP produces trends for Great Britain and at UK and country level where sufficient data are available. Power analyses were completed for the NBMP in 2001, and from these it was recommended that a core of 30 sites surveyed annually would be needed for any given survey to provide sufficient data to detect changes in populations effectively (BCT, 2001). More recent power analysis has indicated that the sample size required can vary between each species and survey. However, we currently use 30 sites as our annual target number of repeat sites for each survey at country, GB and UK-level.

Survey coverage at country level is given in Table 5. Typically, we exceed our target of 30 repeat sites in England for most surveys; in 2022 this target was not achieved for greater horseshoe bat and Natterer's bat in the Roost Count. In Wales, the target was exceeded only for the lesser horseshoe bat Roost Count and for Hibernation Survey, while in Scotland we were only able to achieve this target for the Waterway Survey and for the Soprano pipistrelle Roost Count.

Table 5. Country level NBMP survey coverage 2022. Number of sites surveyed, with number of repeat sites shown in brackets.

Survey type	England	Scotland	Wales	Northern Ireland	Channel Islands
Field Survey	161 (147)	16 (13)	5 (4)	2 (2)	-
Waterway Survey	215 (189)	48 (40)	14 (12)	27 (27)	2
Hibernation Survey	210 (204)	5(5)	79 (78)	-	-
Roost Counts:					
Greater horseshoe bat	17 (16)	-	4 (4)	-	-
Lesser horseshoe bat	63 (61)	-	99 (96)	-	-
Common pipistrelle	114 (99)	17 (16)	12 (12)	1 (1)	17 (15)
Soprano pipistrelle	113 (98)	31 (27)	12 (10)	2 (2)	1 (1)
Pipistrelle sp.	31 (25)	10 (8)	5 (5)	-	-
Natterer's bat	21 (20)	1 (1)	1 (1)	-	-
Serotine	31 (31)	-	1 (1)	-	-
Brown long-eared bat	37 (36)	7 (7)	4 (4)	6 (6)	1 (0)
Total for all surveys	**1013 (926)**	**135 (117)**	**236 (227)**	**38 (38)**	**21 (16)**

Survey coverage maps

Figures 2-5 show the distribution of sites surveyed as part of the Field Survey, Waterway Survey and Roost Count in 2022 and the Hibernation Survey in winter 2021/22 (light green circles); and also the distribution of sites surveyed for each survey to date (dark blue circles).

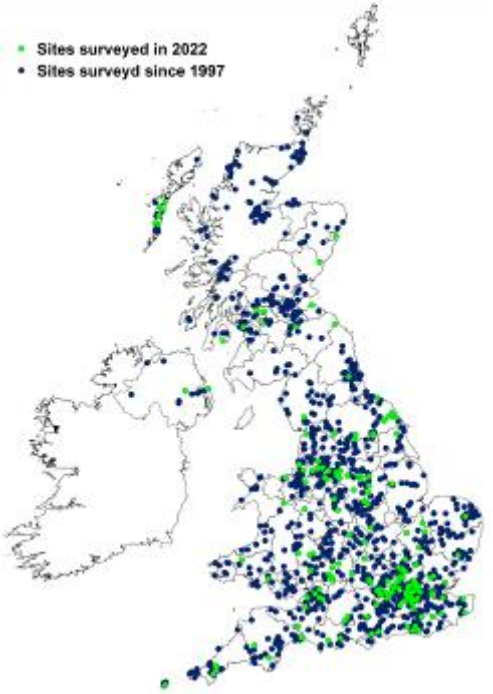


Figure 2. Distribution of Field Survey sites.
In 2022, 184 sites were surveyed, representing 18.3% of the total number of Field Survey sites surveyed to date.

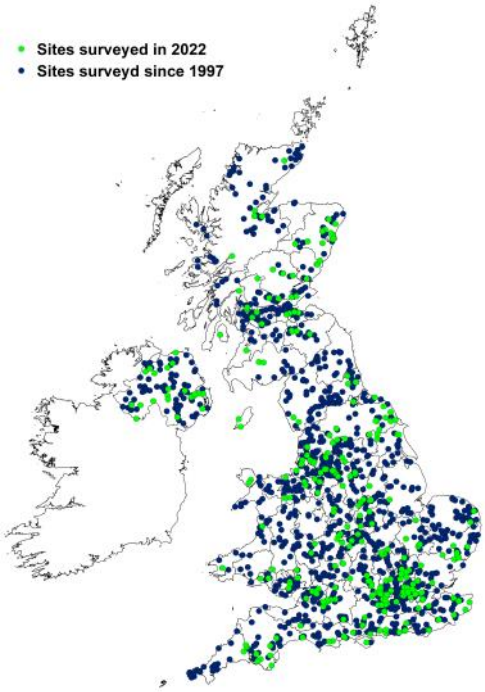


Figure 3. Distribution of Waterway Survey sites.
In 2022, 306 sites were surveyed, representing 19.5% of the total number of Waterway Survey sites surveyed to date. *Sites in Northern Ireland are monitored as part of the All-Ireland Waterway Survey, run by Bat Conservation Ireland.*

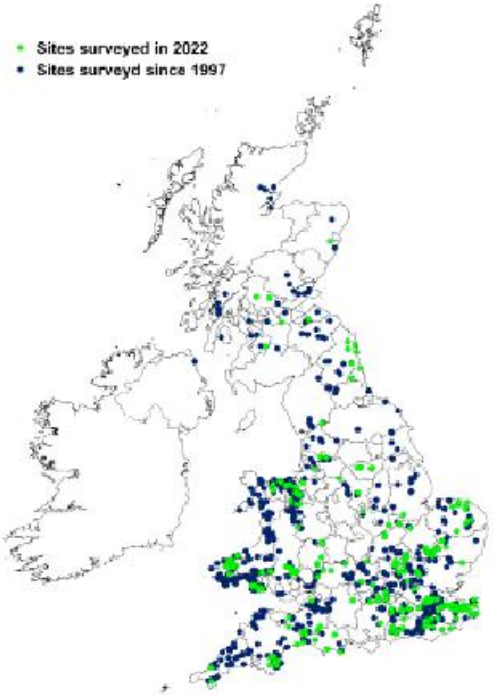


Figure 4. Distribution of Hibernation Survey sites.
In winter 2021/22, 294 sites were surveyed, representing 23.4% of the total number of Hibernation Survey sites surveyed to date.

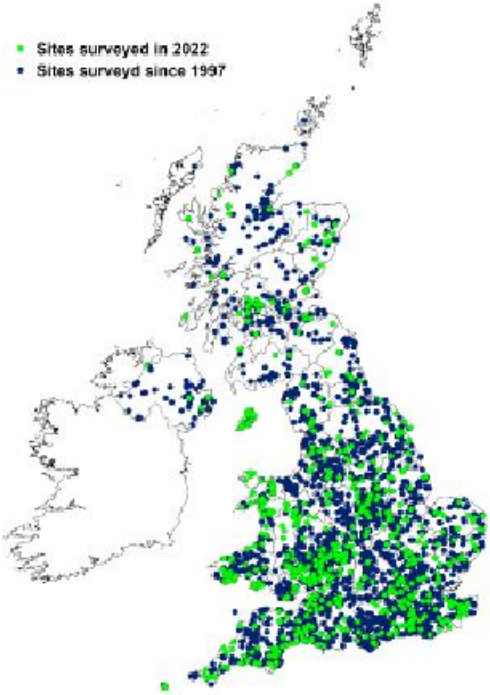


Figure 5. Distribution of all Roost Count sites.
In 2022, 705 sites were surveyed, representing 22% of the total number of Roost Count sites surveyed to date.

Robustness of monitoring data

Our long-term monitoring surveys have been designed to provide robust population trend estimates. However, no monitoring data can be entirely free of bias. On each survey we ask volunteers to record covariates that can influence the number of bats or levels of bat activity at the site, such as temperature, weather conditions, and site characteristics; or the ability to detect and identify the species present, such as bat detector model used and the volunteer's level of skill and experience. Sources of bias and the steps we take to address them are outlined in more detail below.

A sampling approach is used for all surveys, with the assumption that trends occurring at sample sites reflect trends occurring in the general population. Theoretically this assumption is strongest when sample sites are chosen at random and where a proportion of sites do not contain the species of interest. Monitoring sites where the species of interest is not present can help identify populations that are expanding into new areas. The nature of the NBMP as a citizen science programme means that we have greater survey coverage in areas of higher human population density (*Survey Coverage - Figure* 1), and in certain habitats.

Although monitoring began in 1997 for the majority of surveys, the baseline year for trends is 1999 for the majority of species. The base year for trend estimates should be chosen to be a year when there is a good sample size and when the survey has settled down and observers have become familiar with the methodology. In addition, where smoothed trends are used the first year is best avoided because it is subject to greater uncertainty. This means that 1999 is a good choice for the majority of species/surveys; for some species earlier years could be used but it adds complexity if different years are used for different species, plus in most cases sample sizes are small prior to 1998. The choice of base year is discussed by Steve Buckland and Alison Johnston (2017) and the NBMP is quoted as a positive example.

NBMP volunteer taking part in the Roost Count (Photo: Michelle Parsons)

Field and Waterway Surveys

Site selection

We have found that where participants can select any site, there is a tendency to select sites that support higher numbers of bats. This would give a distorted picture of how bats are faring across the UK, so one measure we take to account for this is to provide volunteers with a list of pre-selected survey sites from which to choose.

Field Survey sites are random-stratified 1km OS grid squares. Sites are stratified by ITE land class to help ensure a representative sample of UK land classes.

Waterway Survey volunteers select sites originating from the network of Environment Agency/Natural Resources Wales River Habitat Survey sites. As with the Field Survey, these sites are generated on a stratified random basis. They also have the added value of having river habitat data associated with them, which enables additional research to be carried out on associations between river habitat and bat activity levels (Langton et al, 2006).

The random selection of Field and Waterway survey sites incorporates sites where the species of interest may not occur at present but has the potential to do so in future. This provides a means of assessing change in distribution as a result of population expansion as well as change in relative abundance.

Serotine (Hugh Clark)

Geographical distribution of sites

Despite efforts to obtain data from an unbiased sample of sites giving a representative picture of how bats are faring in different habitats across the UK, this is skewed by geographical biases in the sites surveyed.

The chief causes of this are the uneven density of the human population across the UK, with larger numbers of volunteers in the South East resulting in much higher levels of sampling than in the North East, for example; and the relative inaccessibility of certain habitat types, with uplands being very under-represented compared to lowlands.

This is partially controlled by weighting data for Great Britain by country, in proportion to the ratio of non-upland area to number of sites surveyed (see *Appendix: Statistical methods,* page 96). However, the effectiveness of this approach is limited by the small sample size for many species in Wales and Scotland. We are currently investigating the implications of the non-random spatial distribution of survey sites, and testing methods to better control for this bias.

Bat detector model

A wide range of bat detector models are used on the Field Survey and Waterway Survey. Different detectors can have different levels of sensitivity across the frequency range, due largely to the frequency response of the type of microphone used. This will mean that some detectors may be more sensitive in the mid-frequency range and therefore will pick up pipistrelle calls, for example, at a greater distance. Others may be more sensitive at a lower frequency and therefore pick up noctule and serotine calls at a greater distance (Adams *et al.* 2012). Analysis of NBMP data has shown that detector type has a significant effect on the numbers of passes recorded across the four species recorded on the Field Survey (Barlow *et al.* 2015). Therefore, detector model is factored into the trend analysis in order to minimize the effect of this bias. This is particularly important given changes in the prevalence of different models of detector over time.

Volunteer skill and experience

On the survey form, volunteers are asked to categorise their levels of bat identification skill (qualitative) and experience (quantitative, as number of years). This information is requested on an annual basis, given that it will change over time, and is linked directly to the survey data the volunteers have collected in that year. Level of skill has been found to be highly correlated with numbers of bat passes confidently assigned to a species ID (as opposed to recorded as “unsure”). Therefore, volunteer self-assessment of skill is included as a covariate in the trend analysis in order to minimize the effect of this bias. As well as reflecting changes in skill over time for individual volunteers, this is important in the context of volunteer turnover, where surveying a site may be taken over by a volunteer with a different level of bat identification skills.

Weather conditions

Temperature and weather conditions have a strong influence on bat activity, with reduced activity expected in colder or wetter weather, and activity potentially restricted to more sheltered locations in windy weather. Terms for poor weather and stronger wind are included in the Field Survey and Waterway Survey species trends to adjust for these biases.

Hibernation Survey

Site selection

Hibernation Survey volunteers select a known or potential hibernation site to survey. This includes sites that are suitable for hibernating bats but have not previously been found to be occupied. This survey can therefore detect instances of bats moving into sites where they have not previously been recorded, as well as potential site abandonment and reoccupation.

Visibility of bats

A potential issue with counts of bats carried out in hibernation sites is that the relationship between the numbers of bats observed and the actual numbers of bats present is not well understood. Bats can hide in cracks and crevices and there is evidence that large numbers of bats can be present even when few are actually observed. However, if the proportion of bats seen remains constant over time at any given site, population trend estimates will be valid. The proportion of bats seen can be influenced by temperature which is addressed below.

Hibernating Natterer's bats (Photo: Shirley Thompson)

Temperature

Temperature can have a strong influence on the numbers of bats using a hibernaculum and where they are roosting within the site. Surveyors are asked to record the external temperature, the internal temperature at coolest point (usually near the entrance), and the internal temperature at the warmest point (usually the furthest accessible point). Some years ago, we received a suggestion from a bat worker that the temperature on the days preceding the survey is likely to have a strong influence. Since 2019 we have looked at this in detail using 1km gridded temperature data from the HadUK dataset supplied by the Met Office. We use daily minimum temperatures for the 13 days prior to the survey. This has revealed a significant effect on bat numbers for certain species. For example, a prolonged cold period immediately prior to the survey date substantially increases Natterers' bat numbers. Where the association between a temperature value and the number of bats observed is statistically significant, this is factored into the relevant species trend analysis to adjust for this bias.

Impact of Covid-19

In winter 2020/21 hibernation surveys were suspended in line with guidance from the IUCN Bat Specialist Group on avoiding the credible risk of passing SARS-CoV-2 (the virus that causes Covid-19) on to bats. In winter 2021/22 hibernation survey resumed but with risk assessments in place to assess the size, airflow and minimum number of volunteers required to safely survey each site, and whether these combined factors increased the risk to bats. Consequently, many sites were not surveyed in winter 2021/22 based on this risk assessment (294 sites were surveyed compared with 521 in winter 2019/20). There is also some tendency for fewer of the smaller sites to be revisited in 2022. The trend estimates are not distorted by this since they compare counts to previous counts at the same site. However, if this situation continues for several years then the reduced sample sizes are likely to reduce the precision of trends from hibernation survey data, or prevent the production of certain trends (it has not been possible to update hibernation trends for Scotland in this report due to very low numbers of sites surveyed in winter 2021/22). We are currently exploring alternative methods of collecting data from hibernation sites, such as acoustic and eDNA monitoring, to assess whether these are viable methods of monitoring bat numbers at sites that are not currently undergoing internal inspections.

Roost Count

Site selection

The Roost Count surveys known roosts that are self-selected by surveyors. Roost Counts are most effective for monitoring population change when a high proportion of existing roosts are counted and when the species tends to be faithful to its roost site between years. Since roosts are often discovered and first included in the NBMP when high numbers of bats are present, this can cause a strong imbalance in the data for species which commonly exhibit roost-switching behaviour. High numbers of bats in the first year can decline over time to low numbers or zero, and this is not counter-balanced by roosts with zero or few bats in the first year increasing to a much higher number over time, since roost monitoring rarely begins before bats have become more established at a site. Roost-switching behaviour is discussed in more detail next.

Brown long-eared bats roosting (Photo: John Haddow)

Roost fidelity

Many bat species will move between roost sites, either individually, in groups or as an entire roost. Bats may abandon a roost temporarily for several weeks, months or years before reoccupying it, or they may abandon it permanently. This is known as 'roost switching'. Roost switching may negatively bias Roost Count trends if monitoring ceases before a roost is reoccupied, as this results in a zero count being the final value entered into trend analysis for that site, and therefore a negative site trend being included in trend analysis. It is also possible for a roost to 'split' into two or more smaller roosts if it outgrows its original site, which will negatively bias the trend if bats occupying the new site(s) are not included in the count.

Species which switch or split roosts more frequently, in greater numbers or for longer periods of time are likely to be more strongly affected by this bias in Roost Counts. Common and soprano pipistrelle, Natterer's bat and serotine show a relatively high instance of roost switching, and therefore Roost Count trends for these species should be treated with caution. However, species that are highly faithful to their roost sites, such as greater and lesser horseshoe bat, will have less biased trends. For these species Roost Count trends appear robust and are supported by evidence from other surveys.

Research into potential sources of bias in the Roost Count dataset was published in a Citizen Science special edition of the Journal of Applied Ecology in 2020 (Observer retention, site selection and population dynamics interact to bias abundance trends in bats): https://besjournals.onlinelibrary.wiley.com/doi/10.1111/1365-2664.13760). Options for correcting these biases were identified in work funded by JNCC in 2021 and will inform future statistical approaches for producing trend from Roost Count data.

Volunteers counting at a greater and lesser horseshoe bat roost (Photo: Daniel Hargreaves)

Criteria for publishing trends

Various factors contribute to the decision of whether to publish a trend in the NBMP report. For example, we consider statistical elements such as sample size and confidence limits, but also monitoring frequency, the number of available sites in a region and a high proportion being monitored, geographic distribution and overall risk of bias in a trend, based on the underlying biology of a species. Ideally, trends should be based on data from a minimum of 30 core survey sites that are monitored annually, as described above. However, at the country level it is sometimes only possible to achieve a sample size of 30 repeat sites that have not all been repeated on an annual basis, due to challenges of recruiting enough volunteers in countries where large areas have relatively low populations (Scotland and Wales) and the limited distributions of some species. This sample size can still provide useful information on population changes but will have lower power than a core of 30 sites surveyed annually. In this report, trends are published that either meet this minimum target of data from 30 repeat sites or which have relatively narrow confidence intervals and other inclusion criteria are satisfied. Publishing trends that meet at least one of these minimum criteria can also enable us to highlight where monitoring of additional repeat sites is a priority for improving the statistical robustness of reporting on species at country level. In the species accounts we flag up which trends will particularly benefit from targeted action to increase sample sizes and we outline our strategy for achieving this in Developments and Future Directions.

A power analysis commissioned by NatureScot demonstrated that the trend for Daubenton's bat estimated from Waterway Survey data and the trends for common and soprano pipistrelle estimated from Roost Count data had low or medium levels of sample error and could therefore be considered statistically robust (although not necessarily free of bias, see *Robustness of monitoring data,* page 16). These trends were included in a Trend Note published by NatureScot in 2015 (https://www.nature.scot/trend-notes-bats-scotland). In this report we also present Scottish trends for common and soprano pipistrelle estimated from Field Survey data.

Of the survey methods used to monitor common and soprano pipistrelle, the Field Survey is considered to most reliably reflect the underlying population trend. However, the number of Field Survey sites monitored in Scotland is small and therefore the confidence intervals associated with these trends are wide, reflecting a high degree of uncertainty. Increasing the number of Field Survey sites monitored in Scotland is a priority and we have a strategy for improving sample sizes for Scotland and other under-recorded parts of GB in 2023 (see *Developments and future directions*, page 92). We have presented a Scotland trend for Natterer's bat from the Hibernation Survey since 2017, when this trend showed a statistically significant decline, though the low 18 sample size meant this result needed to be treated with caution; this trend did not show a statistically significant change when we were last able to update it in 2020. In 2019 for the first time we also presented a Roost Count trend for brown long-eared bat in Scotland and have been able to update this for 2022. Aside from Daubenton's bat monitored by the Waterway Survey, samples sizes in Northern Ireland are generally too small for species trends to be calculated.

Species population trends for Great Britain

Summary of species trends for Great Britain

The smoothed population indices derived from NBMP data in Great Britain to the end of summer 2022 are shown in Table 6. We are able to produce a UK trend for Daubenton's bat for the Waterway Survey as there are sufficient sites in Northern Ireland (data provided by Bat Conservation Ireland). For each species, the number of sites contributing to the 2022 trend calculation is given, as well as an approximation of the average annual percentage change in the index since the baseline year. It should be noted, however, that the average annual percentage change makes assumptions about the data analysis and is only genuinely appropriate for those species for which the trend line appears to be linear.

For the remaining UK breeding bat species (Bechstein's bat, Alcathoe bat, Leisler's bat, Nathusius' pipistrelle, barbastelle and grey long-eared bat) there are insufficient data available at present to allow the calculation of population trends.

In each species summary, population estimates from Mathews et al. 2018 are given at GB and country level where available. Each estimate has been given a reliability score based on the availability of data on roost density, roost size and sex ratio. A value of 1 indicates very poor reliability, and 4 indicates very good reliability.

Trends in context

These trends reflect relatively recent changes to bat populations since the 1990s. It is generally considered that prior to this there were significant historical declines in bat populations dating back to at least the start of the 20th century, although evidence is fragmented and few data were collected in a systematic way.

Daubenton's bat
(Photo: Daniel Hargreaves)

Table 6. GB bat species population trends summary table

Species	Survey	No. sites trend analysis	Base year	Last year	Long-term trend since base year (%)	Average annual change and 95% CI (%)
Greater horseshoe bat	Hibernation Roost Count	229 41	1999 1999	2022 2022	233.0* 217.5*	5.4 (3.4 to 9.0) 5.2 (3.6 to 6.2)
Lesser horseshoe bat	Hibernation Roost Count	351 318	1999 1999	2022 2022	186.7* 75.1*	4.7 (3.9 to 5.5) 2.5 (1.8 to 3.2)
Daubenton's bat	Hibernation Waterway (GB) Waterway (UK)	460 928 1005	1999 1999 1999	2022 2022 2022	10.0 3.6 4.0	0.4 (-0.7 to 1.5) 0.2 (-0.3 to 0.6) 0.2 (-0.3 to 0.6)
Whiskered/ Brandt's bat	Hibernation	265	1999	2022	7.0	0.3 (-1.3 to 2.1)
Natterer's bat	Hibernation Roost Count	565 90	1999 2002	2022 2021	112.7* -10.5	3.3 (1.4 to 5.1) -0.6 (-2.4 to 1.1)
Common pipistrelle	**Field** Roost Count	**690** 556	**1999** 1999	**2022** 2022	**83.3*** -69.6*	**2.7 (1.8 to 3.5)** -5.0 (-6.5 to -3.8)
Soprano pipistrelle	**Field** Roost Count	**688** 447	**1999** 1999	**2022** 2022	**57.9*** -62.2*	**2.0 (0.1 to 3.6)** -4.1 (-5.4 to -3.0)
Serotine	Field Roost Count	471 103	1999 1999	2022 2022	12.8 -4.9	0.5 (-1.7 to 3.3) -0.2 (-1.4 to 1.4)
Noctule	Field	686	1999	2022	42.2	1.5 (-0.1 to 3.2)
Brown long-eared bat	Hibernation Roost Count	496 172	1999 2001	2022 2022	-38.2 9.3	-2.1 (-4.3 to 0.1) 0.4 (-1.4 to 2.1)

Notes: * indicates statistically significant result at 5% level.

Bold indicates the survey method considered to be most robust in instances where survey indices show statistically significant but differing trends (see individual species accounts for further details).

Figures in red need to be treated with caution due to likely strong biases in the data due to roost-switching behaviour.

Hibernation years indicate the winter months at the start of the specified year plus December at the end of the previous year, e.g. base year 1999 = winter 1998/1999 and last year 2022 = winter 2021/2022.

Summary of trends for England, Scotland, Wales and Northern Ireland

Survey indices are produced at a country level for England, Scotland, Wales and Northern Ireland for species and surveys where sufficient data are available. Tables 7-10 show a summary of the bat species trends at country level derived from NBMP surveys to the end of summer 2022. For each species, the number of sites contributing to the 2022 trend calculations is shown as well as an approximation of the average annual percentage change since the baseline year. It should be noted, however, that the average annual percentage change makes assumptions about the data analysis and is only genuinely appropriate for those species for which the trend line appears to be linear.

All species showed similar trends at GB and country level based on data from summer surveys, with the following exceptions:

- Daubenton's bat shows a significant increase from the Hibernation Survey for England, but no significant change for GB or Wales
- Daubenton's bat shows a significant increase from the Waterway Survey for Wales, but no significant change for UK, GB, England or Scotland
- Common pipistrelle shows a significant increase from the Field Survey for GB and England, but no significant change for Scotland
- Soprano pipistrelle shows a significant increase from the Field Survey for GB and Scotland, but no significant change for England
- Brown long-eared bat shows a borderline significant decrease from the Hibernation Survey for England, but no significant change for GB and Wales

Hibernation Survey trends for Scotland were not updated for 2021/22 due the sample size of sites monitored being too low, as a result of measures to reduce the risk of passing SARS-Cov-2 on to bats (see *Impact of COVID-19* on page 7).

Soprano pipistrelle
(Photo: Daniel Hargreaves)

Table 7. England bat species population trends summary table (results up to 2022).

Species	Survey type	No. sites trend analysis	Base year	Last year	Long-term trend since base year (%)	Average annual change and 95% CI (%)
Greater horseshoe bat	Hibernation Roost	124 36	1999 1999	2022 2022	248.5* 191.7*	5.6 (3.3 to 9.4) 4.8 (2.6 to 6.1)
Lesser horseshoe bat	Hibernation Roost	166 127	1999 1999	2022 2022	126.7* 81.1*	3.6 (1.4 to 5.2) 2.6 (1.5 to 3.9)
Daubenton's bat	Waterway Hibernation	740 332	1999 1999	2022 2022	-4.0 22.6*	-0.2 (-0.7 to 0.3) 0.9 (0.1 to 1.9)
Whiskered/ Brandt's bat	Hibernation	174	1999	2022	13.8	0.6 (-1.5 to 2.7)
Natterer's bat	Hibernation Roost	401 77	1999 2002	2022 2022	140.2* 1.1	3.9 (1.5 to 5.4) 0.1 (-2.0 to 1.9)
Common pipistrelle	**Field** Roost	**566** 444	**1999** 1999	**2022** 2022	**81.0*** -60.8*	**2.6 (1.9 to 3.4)** -4.0 (-5.5 to -2.6)
Soprano pipistrelle	Field Roost	565 294	1999 1999	2022 2022	20.0 -52.5*	0.8 (-0.6 to 2.3) -3.2 (-4.9 to -1.8)
Serotine	Field Roost	432 101	1999 1999	2022 2022	6.9 -6.3	0.3 (-2.2 to 2.9) -0.3 (-1.7 to 1.4)
Noctule	Field	563	1999	2022	10.6	0.4 (-1.1 to 2.1)
Brown long-eared bat	Hibernation Roost	375 127	1999 2001	2022 2022	-28.1* -4.7	-1.4 (-3.2 to -0.1) -0.2 (-2.6 to 1.6)

Table 8. Scotland bat species population trends summary table (results up to 2022 except Hibernation).

Species	Survey type	No. sites trend analysis	Base year	Last year	Long-term trend since base year (%)	Average annual change and 95% CI (%)
Daubenton's bat	Waterway Hibernation	135 21	1999 1999	2022 2020	12.9 -10.6	0.5 (-0.5 to 1.7) -1.0 (-4.9 to 6.4)
Natterer's bat	Hibernation	23	2011	2020	23.5	2.4 (-5.5 to 8.3)
Common pipistrelle	Field Roost	75 72	1999 1999	2022 2022	-26.5 -82.5*	-1.3 (-3.8 to 1.6) -7.3 (-10.5 to -2.9)
Soprano pipistrelle	**Field** Roost	**75** 98	**1999** 1999	2022 2022	**197.2*** -77.5*	**4.9 (1.1 to 8.3)** -6.3 (-8.1 to –4.1)
Brown long-eared bat	Hibernation Roost	22 31	2008 2002	2020 2022	-1.2 66.5	-0.1 (-5.4 to 5.3) 2.6 (-2.0 to 6.6)

Notes: * indicates statistically significant result at 5% level.

Bold indicates the survey method considered to be most robust in instances where survey indices show statistically significant but differing trends (see individual species accounts for further details).

Figures in red need to be treated with caution due to likely strong biases in the data due to roost-switching behaviour.

Hibernation years indicate the winter months at the start of the specified year plus December at the end of the previous year, e.g. base year 1999 = winter 1998/1999 and last year 2022 = winter 2021/2022.

Table 9. Wales bat species population trends summary table (results up to 2022)

Species	Survey type	No. sites trend analysis	Base year	Last year	Long-term trend since base year (%)	Average annual change and 95% CI (%)
Greater horseshoe bat	Hibernation	104	1999	2022	371.2*	7.0 (3.9 to 11.5)
Lesser horseshoe bat	Hibernation Roost	183 182	1999 1999	2022 2022	211.5* 75.6*	5.1 (4.2 to 5.8) 2.5 (1.6 to 3.4)
Daubenton's bat	Hibernation Waterway	101 51	1999 2000	2022 2022	22.0 35.2*	0.9 (-1.5 to 3.3) 1.4 (0.3 to 3.0)
Whiskered/Brandt's bat	Hibernation	78	1999	2022	-16.6	-0.8 (-1.8 to 0.3)
Natterer's bat	Hibernation	140	1999	2022	107.6*	3.2 (1.0 to 4.2)
Common pipistrelle	Roost	39	1999	2022	-78.2*	-6.4 (-12.1 to -3.2)
Soprano pipistrelle	Roost	55	2002	2022	-86.7*	-9.6 (-12.9 to -7.4)
Brown long-eared bat	Hibernation	95	1999	2022	51.9	1.8 (-1.0 to 4.1)

Table 10. Northern Ireland bat species population trend summary table (results up to 2021).

Species	Survey type	No. sites trend analysis	Base year	Last year	Long-term trend since base year (%)	Average annual change and 95% CI (%)
Daubenton's bat	Waterway	76	2008	2022	17.1	1.1 (-0.9 to 3.2)

Notes: * indicates statistically significant result at 5% level.

Bold indicates the survey method considered to be most robust in instances where survey indices show statistically significant but differing trends (see individual species accounts for further details).
Figures in red need to be treated with caution due to likely strong biases in the data due to roost-switching behaviour.

Hibernation years indicate the winter months at the start of the specified year plus December at the end of the previous year, e.g. base year 1999 = winter 1998/1999 and last year 2022 = winter 2021/2022.

Daubenton's bat is the only species for which we currently have a sufficient sample size to enable a statistically robust trend to be produced for Northern Ireland. Most of the data are from the All-Ireland Waterway Survey which has been run by Bat Conservation Ireland since 2008. Further information on how bats are faring in Ireland can be found on the Bat Conservation Ireland website (www.batconservationireland.org/).

Rfer

Greater horseshoe bat

Rhinolophus ferrumequinum

Population trends are calculated for greater horseshoe bat for Great Britain and at a country level for England and Wales. This species is not found in Scotland or Northern Ireland.

Photo: R E Stebbings

Distribution and abundance

The greater horseshoe bat is rare in the UK with a distribution restricted to south-west England and south Wales. It is absent from Scotland and Northern Ireland.

Range of greater horseshoe bat in the UK
(Map taken from 4th Report under Article 17 on implementation of the Habitats Directive in the UK, JNCC 2019).

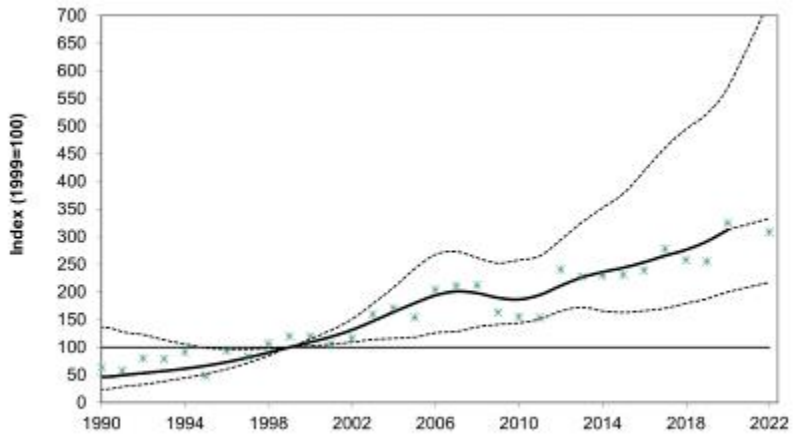
Population estimate

Country	GB	England	Wales	Scotland	N.Ireland
Number (plausible intervals in brackets)	12,900 (9,210 – 18,500)	10,200 (7,280 – 14,600)	2,700 (1,930 – 3,850)	Does not occur	Does not occur
	Reliability score: 4/5 (scores >3 most reliable)				
Source	Mathews *et al*. 2018				

Greater horseshoe bat | GB trends

Trends from the Hibernation Survey and Roost Count in Great Britain both show a significant increase in the smoothed index in comparison to the baseline year. The **population of greater horseshoe bat in Great Britain is considered to have increased since 1999**.

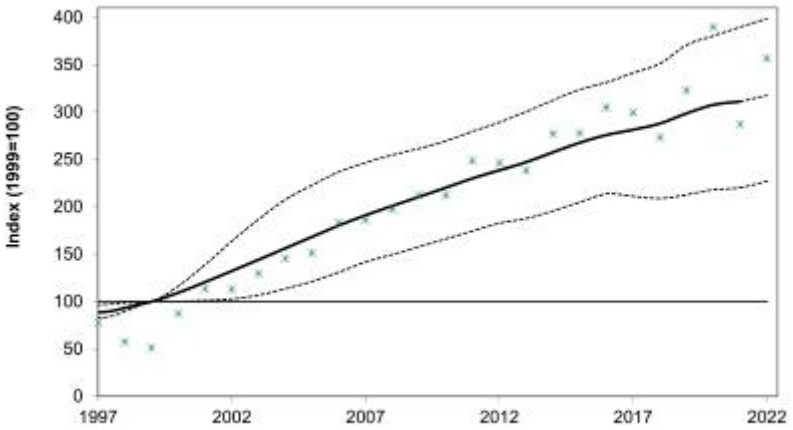
Hibernation Survey



The smoothed index is currently 233% above the 1999 base year value, equivalent to a mean annual increase of 5.4% (95% CI 3.4% to 9.0%). The value of the index has fluctuated since the 1999; however, it has always been significantly higher than the baseline value and is currently increasing. Overall, there has been a **significant increase in the smoothed index since 1999**.

From all years for which data are available (1990-2022), counts from 229 sites contribute to the trend analysis (sites surveyed in two or more years with greater horseshoe bat recorded in at least one year). The hibernation survey was suspended in 2021 due to COVID-19.

Roost Count



The smoothed index is currently 217.5% above the 1999 base year value, equivalent to a mean annual increase of 5.2% (95% CI 3.6% to 6.2%). The value of the smoothed index has increased steadily since the baseline year. Overall, there has been a **significant increase in the smoothed index since 1999.**

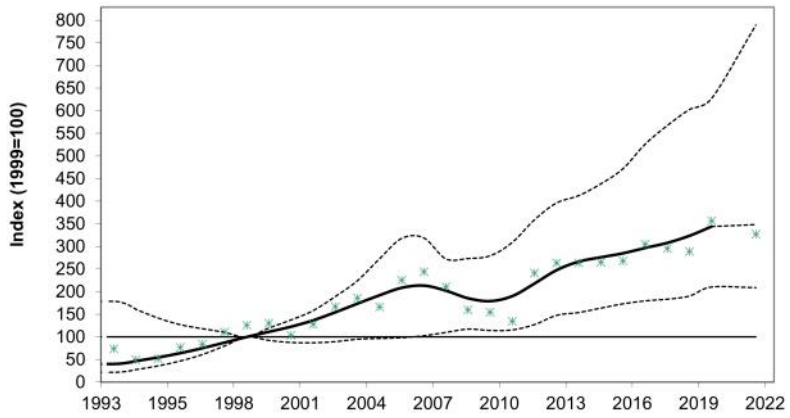
Data from 41 sites surveyed between 1997 and 2022 contribute to the trend analysis (sites surveyed in at least two years).

Fig 6. Hibernation Survey and Fig 7. Roost Count indices for Greater horseshoe bat in Great Britain, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Rfer Greater horseshoe bat | England trends

Trends from the Hibernation Survey and Roost Count in England both show a significant increase in the smoothed index in comparison to the baseline year. The **population of greater horseshoe bat in England is considered to have increased since 1999**.

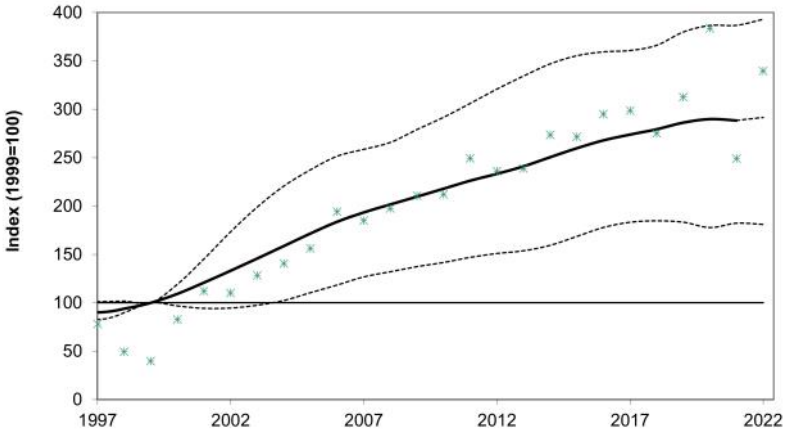
Hibernation Survey



The smoothed index is currently 248.5% above the 1999 base year value, equivalent to a mean annual increase of 5.6% (95% CI 3.3% to 9.4%). The smoothed index increased from 1999 to 2007. It declined for the next three years, but has increased in every year since 2010. It has significantly exceeded the baseline since 2007 and overall, **there has been a significant increase in the smoothed index since 1999.**

From all years for which data are available (1993-2022), counts from 124 sites contribute to the trend analysis in England (sites surveyed in at least two years).

Roost Count



The smoothed index is currently 191.7% above the 1999 base year value, equivalent to a mean annual increase of 4.8% (95% CI 2.6% to 6.1%). The smoothed index increased steadily from 1999 until 2019, after which it has levelled off. **Overall, there has been a significant increase in the smoothed index since 1999.**

From all years for which data are available (1997-2022), counts from 36 sites contribute to the trend analysis in England (sites surveyed in at least two years).

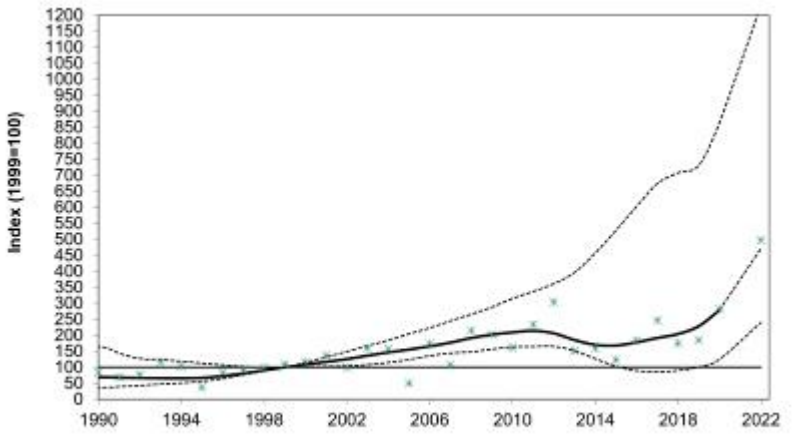
Fig 8. Hibernation Survey and Fig 9. Roost Count indices for Greater horseshoe bat in England, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Rfer

Greater horseshoe bat | Wales trend

The most recent index estimate from the Hibernation Survey in Wales show a significant increase in comparison to the baseline year. This suggests that the **population of greater horseshoe bat in Wales has increased since 1999,** however this finding must be treated with caution as the precision of recent estimates are low and the smoothed index has only recently become significantly higher than the baseline year, it could be revised down when future years of data are added. Sample sizes are too low to enable a trend to be produce from the Roost Count.

Hibernation Survey



The smoothed index is currently 371.2% above the 1999 base year value, equivalent to a mean annual increase of 7.0% (95% CI 3.9% to 11.5%). Initially the value of the smoothed index increased slowly from the baseline year, reaching a peak in 2011. It then declined and did not differ significantly from the baseline year between 2015 and 2019. In recent years it has been increasing again and overall **there has been a significant increase in the smoothed index since 1999.**

From all years for which data are available (1990-2022), counts from 104 sites contribute to the trend analysis (sites surveyed in two or more years with greater horseshoe bat recorded in at least one year). The hibernation survey was suspended in 2021 due to COVID-19.

Fig 10. Hibernation Survey index for Greater horseshoe bat in Wales, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Rhip

Lesser horseshoe bat

Rhinolophus hipposideros

Population trends are calculated for lesser horseshoe bat for Great Britain and at a country level for England and Wales. This species is not found in Scotland or Northern Ireland.

Photo: Daniel Hargreaves

Distribution and abundance

The lesser horseshoe bat is rare in the UK with a distribution restricted to south-west England and south Wales. It is absent from Scotland and Ireland.

Range of lesser horseshoe bat in the UK
(Map taken from 4th Report under Article 17 on implementation of the Habitats Directive in the UK, JNCC 2019).

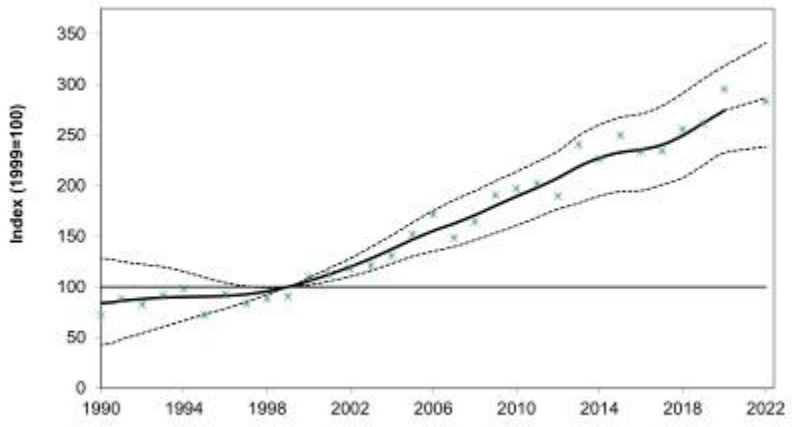
Population estimate

Country	GB	England	Wales	Scotland	N.Ireland
Number (Plausible intervals in brackets)	50,400 (36,000 – 72,000).	19,400 (13,900 – 27,700)	30,900 (22,000 – 44,100)	Does not occur	Does not occur
	Reliability score = 3 ((scores >3 most reliable)				
Source	Mathews *et al.* 2018				

Rhip Lesser horseshoe bat | GB trends

Trends from the Hibernation Survey and Roost Count survey in Great Britain both show a significant increase in the smoothed index in comparison to the baseline year. **The population of lesser horseshoe bat in Great Britain is considered to have increased since 1999.**

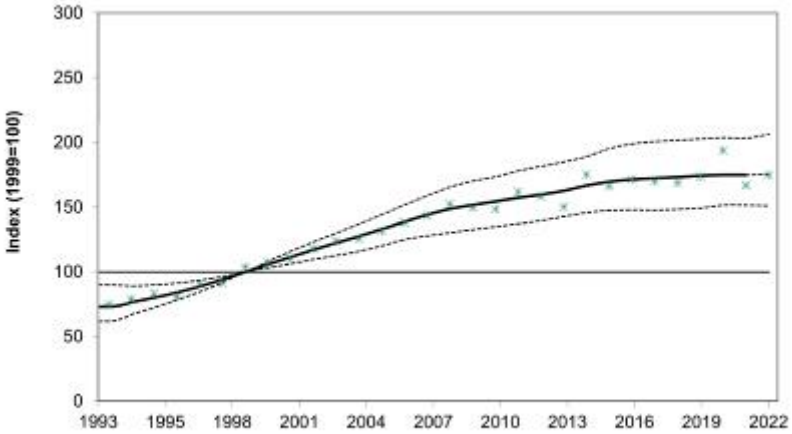
Hibernation Survey



The smoothed index is currently 186.7% above the 1999 base year value, equivalent to a mean annual increase of 4.7% (95% CI 3.9% to 5.5%). The value of the smoothed index increased steadily between 1999 and 2014; however, in recent years the rate of increase has varied. **Overall, there has been a significant increase in the smoothed index since 1999.**

From all years for which data are available (1990-2022), counts from 351 sites contribute to the trend analysis (sites surveyed in more than one year and with lesser horseshoe bat present in at least one year). The hibernation survey was suspended in 2021 due to COVID-19.

Roost Count



The smoothed index is currently 75.1% above the 1999 base year value, equivalent to a mean annual increase of 2.5% (95% CI 1.8% to 3.2%). The value of the smoothed index increased steadily between 1999 and 2008; however, from 2008 the rate of increase slowed and since 2016 there has been little change in it's value. **Overall, there has been a significant increase in the smoothed index since 1999.**

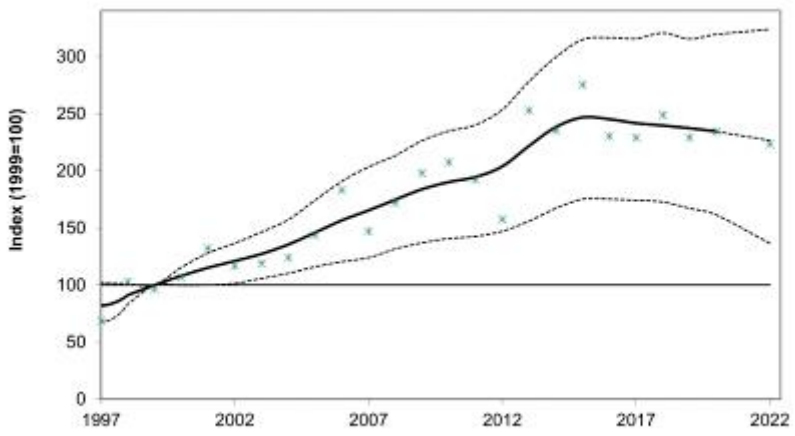
Data from 318 sites surveyed between 1993 and 2022 contribute to the overall trend analysis (sites surveyed in at least two years).

Fig 11. Hibernation Survey and Fig 12. Roost Count indices for Lesser horseshoe bat in Great Britain, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Rhip Lesser horseshoe bat | England trends

Trends from the Hibernation Survey and Roost Count survey in England both show a significant increase in the smoothed index in comparison to the baseline year. **The population of lesser horseshoe bat in Great Britain is considered to have increased since 1999.**

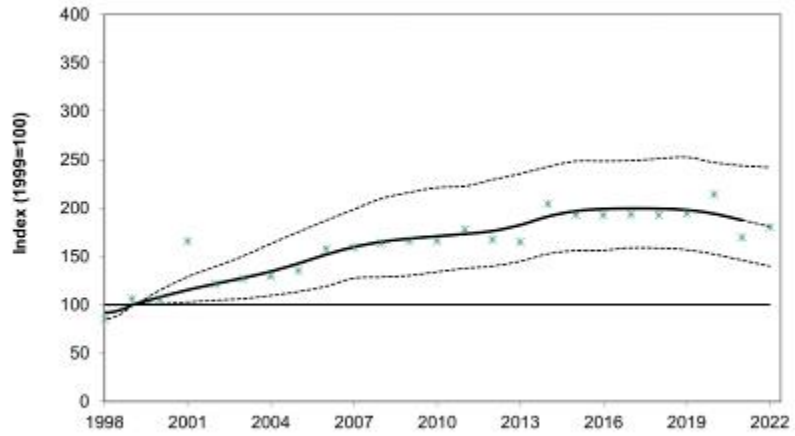
Hibernation Survey



The smoothed index is currently 126.7% above the 1999 base year value, equivalent to a mean annual increase of 3.6% (95% CI 1.4% to 5.2%). The smoothed index increased each year from 1999 to a peak in 2015. Since 2015 the smoothed index has been gradually declining, although **overall there has been a significant increase in the smoothed index since 1999.**

From all years for which data are available (1997-2022), counts from 166 sites contribute to the trend analysis in England (sites surveyed in more than one year and with lesser horseshoe bat present in at least one year). The hibernation survey was suspended in 2021 due to COVID-19.

Roost Count



The smoothed index is currently 81.1% above the 1999 base year value, equivalent to a mean annual increase of 2.6% (95% CI 1.5% to 3.9%). The value of the smoothed index increased steadily between 1999 and 2015; between 2015 and 2018 there was little change and since 2018 it has been gradually declining. **Overall, there has been a significant increase in the smoothed index since 1999.**

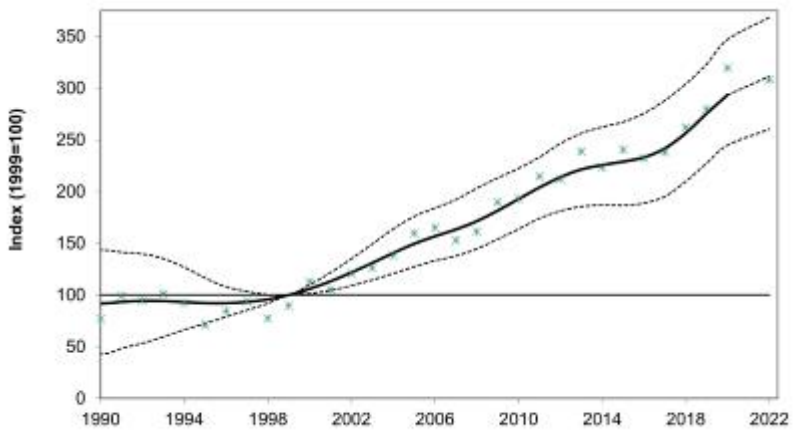
Data from 127 sites surveyed between 1998 and 2022 contribute to the trend analysis in England (sites surveyed in at least two years).

Fig 13. Hibernation Survey and Fig 14. Roost Count indices for Lesser horseshoe bat in England, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Rhip Lesser horseshoe bat | Wales trends

The trends from the Hibernation Survey and Roost Count in Wales both show a significant increase in the smoothed index in comparison to the baseline year. **The population of lesser horseshoe bat in Wales is considered to have increased since 1999.**

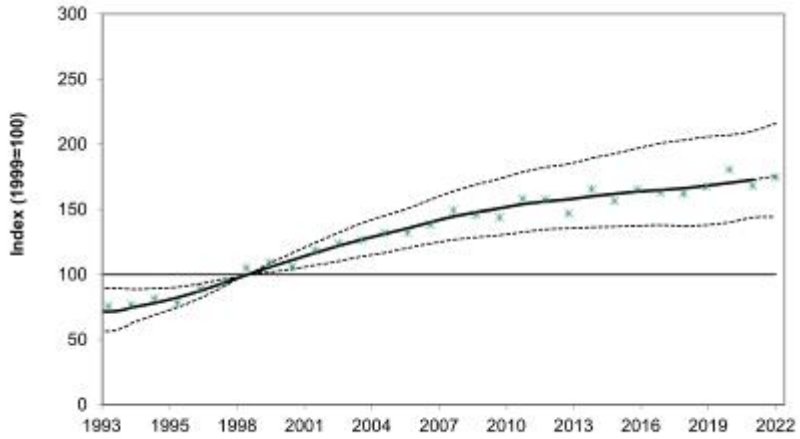
Hibernation Survey



The smoothed index is currently 211.5% above the 1999 base year value, equivalent to a mean annual increase of 5.1% (95% CI 4.2% to 5.8%). The smoothed index has increased every year since the baseline year, although over that period the rate of increase has varied. **Overall there has been a significant increase in the smoothed index since 1999.**

From all years for which data are available (1990-2022), counts from 183 sites contribute to the trend analysis in Wales (sites surveyed in two or more years with lesser horseshoe bat present in at least one year). The hibernation survey was suspended in 2021 due to COVID-19.

Roost Count



The smoothed index is currently 75.6% above the 1999 base year value, equivalent to a mean annual increase of 2.5% (95% CI 1.6% to 3.4%). The value of the smoothed index increased steadily between 1999 and 2011; since 2011 the rate of increase has slowed. **Overall, there has been a significant increase in the smoothed index since 1999.**

Data from 182 sites surveyed between 1998 and 2022 contribute to the trend analysis in Wales (sites surveyed in at least two years).

Fig15. Hibernation Survey and Fig 16. Roost Count indices for Lesser horseshoe bat in Wales, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Mdau

Daubenton's bat

Myotis daubentonii

Population trends are calculated for Daubenton's bat for Great Britain, England, Scotland, Wales and also (due to the availability of sufficient data from a comparable survey programme in Northern Ireland) Northern Ireland and the UK.

Photo: Daniel Hargreaves

Distribution and abundance

Daubenton's bat is widespread across England, Wales and Northern Ireland, and much of Scotland.

Range of Daubenton's bat in the UK
(Map taken from 4th Report under Article 17 on implementation of the Habitats Directive in the UK, JNCC 2019).

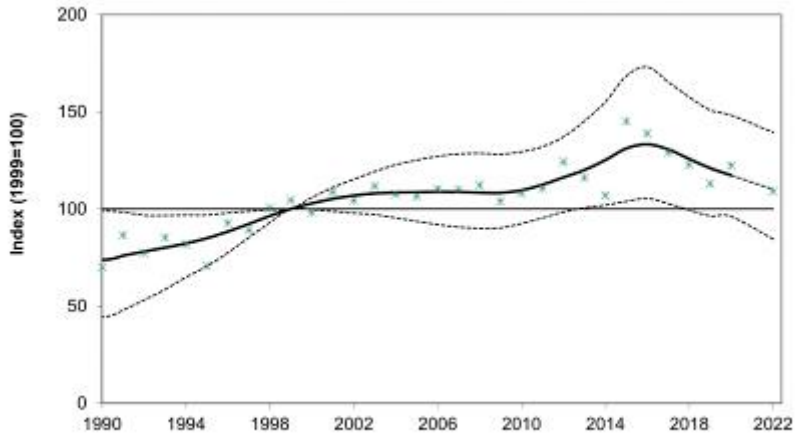
Population estimate

Country	GB	England	Wales	Scotland	N.Ireland
Number (plausible intervals in brackets)	1,030,000 (27,000 – 4,440,000)	682,000 (18,100 – 2,950,000)	108,000 (2,860 – 466,000)	235,000 (6,220 – 1,020,000)	410,000
	Reliability score = 1 (scores >3 most reliable)				
Source	Mathews *et al.* 2018				Russ 1999

Mdau Daubenton's bat | GB trends

Trends from the Hibernation Survey and the Waterway Survey in Great Britain show no significant difference in the smoothed index in comparison to the baseline year. Daubenton's bat is also recorded on the Roost Count but the sample size is too low to enable a statistically robust trend to be produced. **The population of Daubenton's bat in Great Britain is considered to have been stable since 1999.**

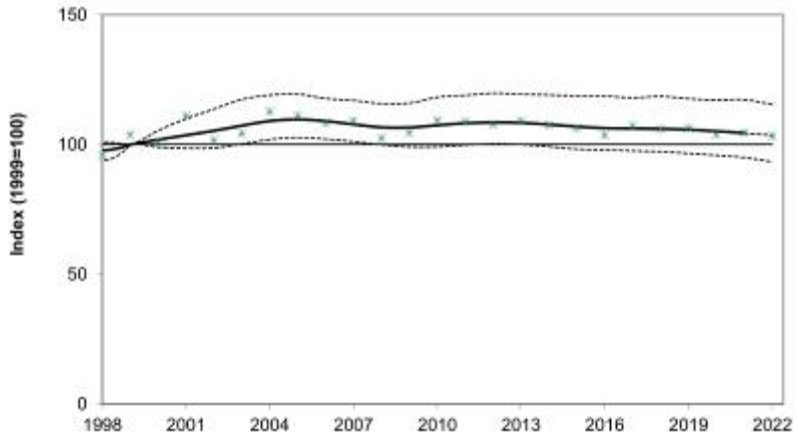
Hibernation Survey



The smoothed index is currently 10% above the 1999 base year value, equivalent to a mean average annual increase of 0.4% (95% CI -0.7% to 1.5%). The value of the smoothed index was relatively stable between 1999 and 2009. From 2010 it began to increase, reaching a peak in 2016, before falling again in recent years. The index was significantly higher than the baseline year between 2013 and 2017, but this is no longer the case. **Currently the smoothed index does not differ significantly from the 1999 base year value.**

From all years for which data are available (1990-2022) counts from 460 sites contribute to the overall trend analysis (sites surveyed in two or more years with Daubenton's bat present in at least one year). The hibernation survey was suspended in 2021 due to COVID-19.

Waterway Survey



The smoothed index is currently 3.6% above the 1999 base year value, equivalent to a mean average annual increase of 0.2% (95% CI -0.3% to 0.6). The value of the smoothed index has been relatively stable since the baseline year. **Overall, the smoothed index does not differ significantly from the 1999 base year value.**

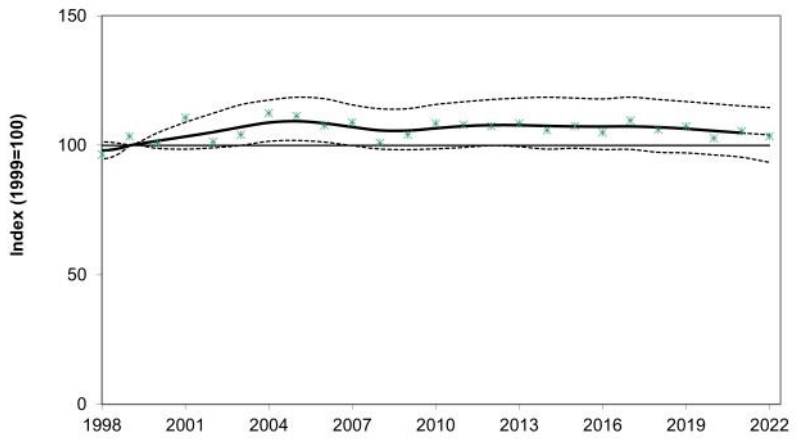
Data from 928 sites surveyed between 1998 and 2022 contribute to the GB trend (sites surveyed in at least two years).

Fig 17. Hibernation Survey and Fig 18. Waterway Survey indices for Daubenton's bat in Great Britain, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Mdau Daubenton's bat | United Kingdom trend

The trend from the Waterway Survey in the UK shows no significant difference in the smoothed index in comparison to the baseline year. **The population of Daubenton's bat in the UK is considered to have been stable since 1999.**

Waterway Survey



The smoothed index is currently 4.0% above the 1999 base year value, equivalent to a mean average annual increase of 0.2% (95% CI -0.3% to 0.6). The value of the smoothed index has been relatively stable since the baseline year. **Overall, the smoothed index does not differ significantly from the 1999 base year value.**

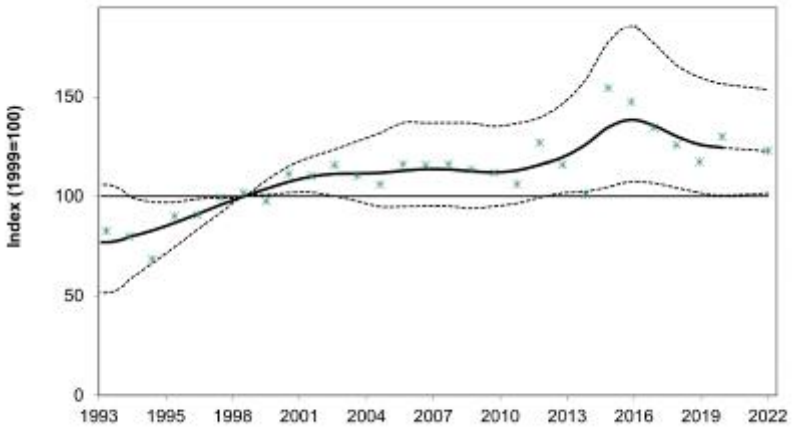
Data from 1005 sites surveyed between 1998 and 2022 contribute to the GB trend (sites surveyed in at least two years).

Fig 19. Waterway Survey index for Daubenton's bat in the United Kingdom, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Mdau Daubenton's bat | England trends

The trend from the Waterway Survey in England shows no significant difference in the smoothed index when compared to the baseline year. The trend from the Hibernation Survey in England is only just significantly higher than the baseline year, however this is based on a provisional estimate so should be treated with caution until confirmed by further years of monitoring data. Overall, **the population of Daubenton's bat in England is considered to have been stable in comparison to 1999**.

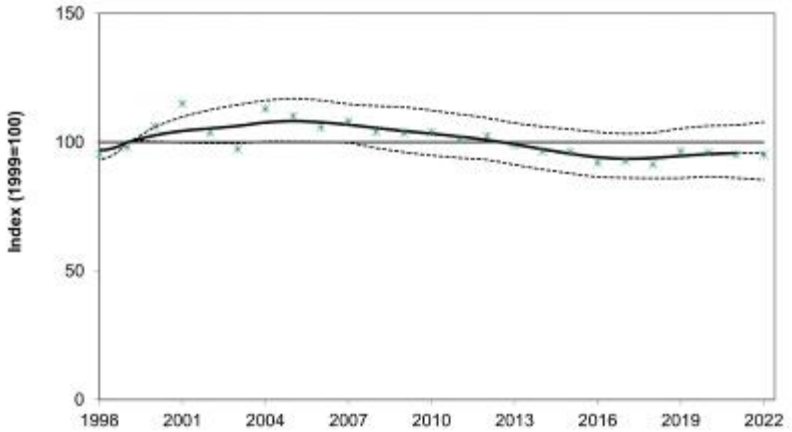
Hibernation Survey



The smoothed index is currently 22.6% above the 1999 base year value, equivalent to a mean annual increase of 0.9% (95% CI 0.1% to 1.9%). The index has been significantly higher than the baseline year from 2013 to the latest year of monitoring, though has fallen in recent years. **Currently the smoothed index is just significantly higher than the 1999 base year value**, however this result is provisional and could be revised up or down as further years of monitoring data are added.

From all years for which data are available (1993-2022), counts from 332 sites contribute to the trend analysis in England (sites surveyed in two or more years with Daubenton's bat present in at least one year). The hibernation survey was suspended in 2021 due to COVID-19.

Waterway Survey



The smoothed index is currently 4.0% below the 1999 base year value, equivalent to a mean annual decrease of 0.2% (95% CI -0.7% to 0.3%). Initially the value of the smoothed index increased slowly, reaching a peak in 2005. It was only just significantly above the baseline in 2000 and between 2004 and 2006. Since then it has declined slightly such that **overall, the smoothed index does not differ significantly from the 1999 base year value.**

Data from 740 sites surveyed between 1998 and 2022 contribute to the trend analysis in England (sites surveyed in at least two years).

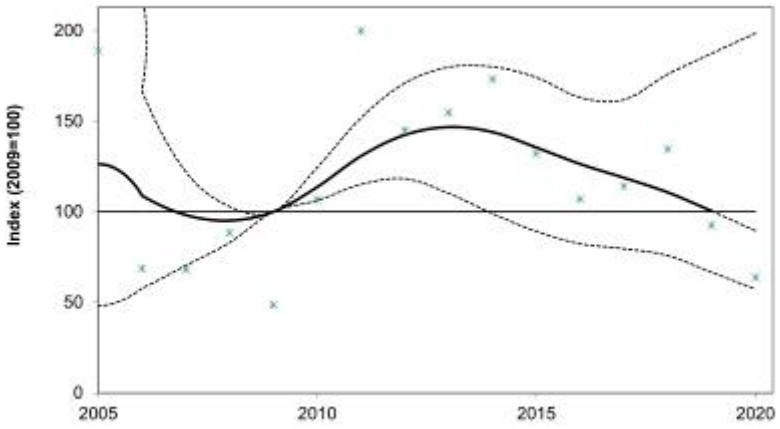
Fig 20. Hibernation Survey and Fig 21. Waterway Survey indices for Daubenton's bat in England, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Mdau

Daubenton's bat | Scotland trends

Trends from the Hibernation Survey and the Waterway Survey in Scotland show no significant difference in the smoothed index in comparison to the baseline year. Note that as a result of the suspension of the Hibernation Survey in winter 2020/21 and a low sample size of sites monitored in winter 2021/22 (see *Impacts of COVID-19* on page 7), it has not been possible to update the trend since 2020. The trend that was published in the 2020 Annual Report is repeated here for information. The population of Daubenton's bat in Scotland is considered to be stable in comparison to the 1999 baseline.

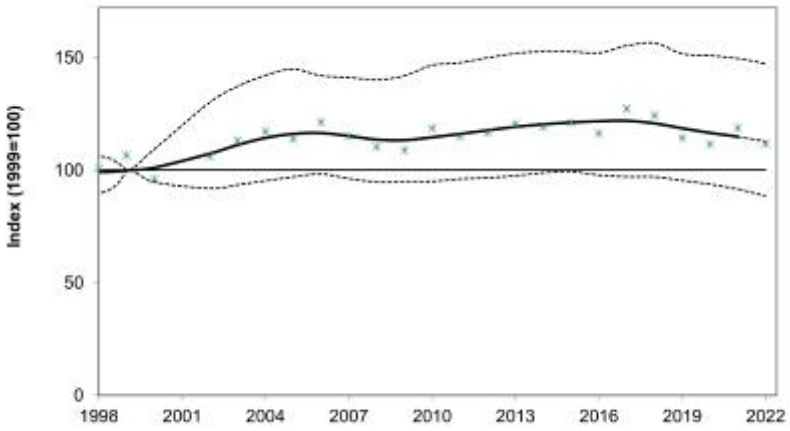
Hibernation Survey (**2020 trend**)



In 2020 the smoothed index was 10.6% below the 2009 base year value, equivalent to a mean annual decrease of 1.0% (95% CI -4.9% to 6.4%). The value of the smoothed index increased between 2009 and 2013, but since 2013 it fell in every year. It was significantly higher than the baseline year between 2010 and 2013 but in 2020 this was no longer the case. In 2020 the smoothed index did not differ significantly from the 2009 base year value.

From all years for which data are available (2005-2020), counts from 21 sites contribute to the trend analysis in Scotland (sites surveyed in two or more years with Daubenton's bat recorded in at least one year). This is fewer sample sites than would be ideal to produce trends and as such the results may be unreliable.

Waterway Survey



The smoothed index is currently 12.9% above the 1999 base year value, equivalent to a mean annual increase of 0.5% (95% CI -0.5% to 1.7%). The value of the smoothed index has never been significantly higher than the baseline year and has fluctuated only slightly since 2006. **Overall, the smoothed index does not differ significantly from the 1999 base year value.**

Data from 135 sites surveyed between 1998 and 2022 contribute to the trend analysis in Scotland (sites surveyed in at least two years).

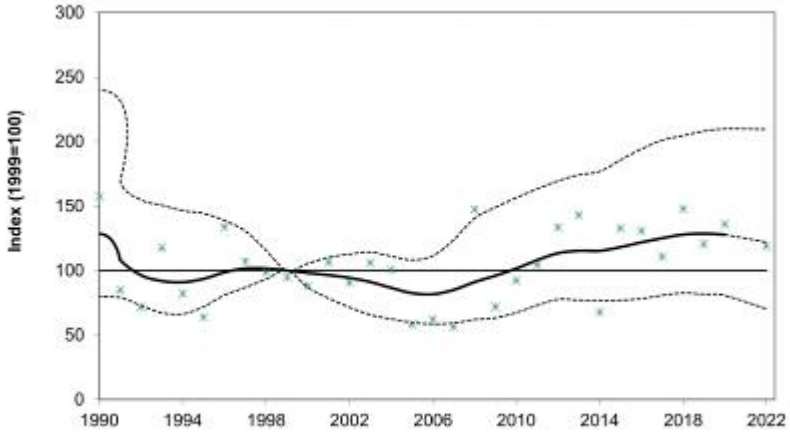
Fig 22. Hibernation Survey and Fig 23. Waterway Survey indices for Daubenton's bat in Scotland, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 (2020 for the Hibernation Survey) is shown as a dashed line to indicate that it is provisional.

Mdau

Daubenton's bat | Wales trends

The trend from the Hibernation Survey in Wales showed no significant difference in the smoothed index when compared to the baseline year. The trend from the Waterway Survey in Wales showed a significant increase in the smoothed index when compared to the baseline year. However, the most recent year's provisional value is only just significant, and may be revised up or down with the addition of future years of data, so currently **the population of Daubenton's bat in Wales is considered to have been stable since 1999.**

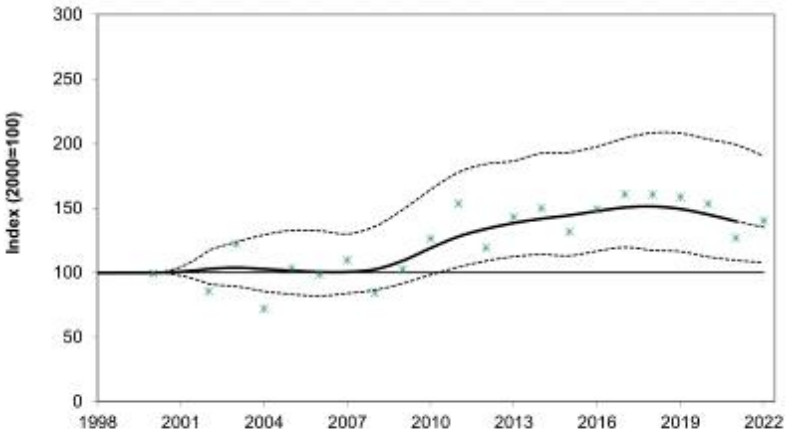
Hibernation Survey



The smoothed index is currently 22.0% above the 1999 baseline value, equivalent to a mean annual increase of 0.9% (95% CI -1.5% to 3.3%). The smoothed index fell between 1999 and 2006, then has increased in each year since apart from 2014. However it has not differed significantly from the baseline value in any year. **Overall the smoothed index does not differ significantly from the 1999 base year value.**

From all years for which data are available (1990-2022), counts from 101 sites contribute to the trend analysis in Wales (sites surveyed in two or more years with Daubenton's bat recorded in at least one year). The hibernation survey was suspended in 2021 due to COVID-19.

Waterway Survey



The smoothed index is currently 35.2% above the 2000 base year value, equivalent to a mean annual increase of 1.4% (95% CI 0.3% to 3.0%). **Overall, the smoothed index does not differ significantly from the 2000 base year value.**

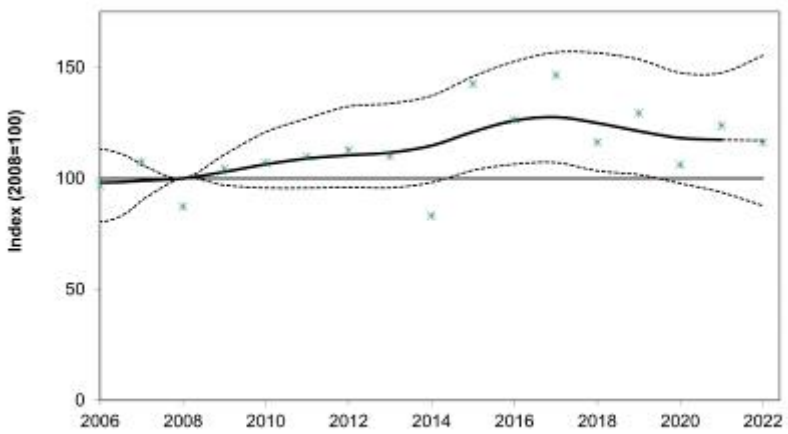
Data from 51 sites surveyed between 1998 and 2022 contribute to the trend analysis in Wales (sites surveyed in at least two years).

Fig 24. Hibernation Survey and Fig 25. Waterway Survey indices for Daubenton's bat in Wales, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Mdau Daubenton's bat | Northern Ireland trend

The trend from the Waterway Survey in Northern Ireland showed no significant difference in the smoothed index when compared to the baseline year. **The population of Daubenton's bat in Northern Ireland is considered to have been stable since 2008.**

Waterway Survey



The smoothed index is currently 17.1% above the 2008 base year value, equivalent to a mean annual increase of 1.1% (95% CI -0.9% to 3.2%). The smoothed index increased gradually between 2008 and 2017, after which it has declined. It significantly exceeded the baseline between 2015 and 2019 although **overall, the smoothed index does not differ significantly from the 2008 base year value**.

Data from 76 sites surveyed between 2006 and 2022 contribute to the trend analysis in Northern Ireland (sites surveyed in at least two years). Most data are from sites surveyed as part of the All-Ireland Waterway Survey which is run by Bat Conservation Ireland with funding from the National Parks and Wildlife Service and the Northern Ireland Environment Agency.

Fig 26. Waterway Survey index for Daubenton's bat in Northern Ireland, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Mmys/ Mbra

Whiskered/Brandt's bat

Myotis mystacinus/brandtii

A combined population trend is produced for these species for Great Britain and country levels due to the difficulty separating them with confidence in the field. These trends should therefore be interpreted with caution as they include data from two species with differing ecological requirements and potentially differing conservation status. This uncertainty has been compounded by the discovery of Alcathoe bat in the UK in 2010, a third cryptic species in this species group. It is likely under-recorded, but current knowledge suggests that it has a highly localised distribution, restricted to areas of North Yorkshire, Sussex, Surrey, Kent and Wiltshire. Based on current knowledge of this species' distribution, we believe it will be encountered too infrequently during monitoring of whiskered/Brandt's bats to include this species within the whiskered/Brandt's bat combined trend. We will review this as further data become available.

Whiskered bat (Sally-Ann Hurry)

Brandt's bat (Hugh Clark)

Distribution and abundance

Whiskered bat is widespread across much of England. It is patchily distributed across Northern Ireland and in Scotland occurs mainly in the south of the country. Brandt's bat is widespread across much of England and Wales, though it is more common in northern England than in the south. It is rarely found in southern Scotland and thought to be absent in Northern Ireland.

Population estimates

Country	**GB**	**N. Ireland**
Whiskered bat numbers	Not available (plausible intervals not available) Reliability score = 0 (scores >3 most reliable)	24,000
Brandt's bat numbers		Does not occur
Source	Mathews *et al.* 2018	Russ 1999

Range of whiskered bat (left) and Brandt's bat (right) in the UK

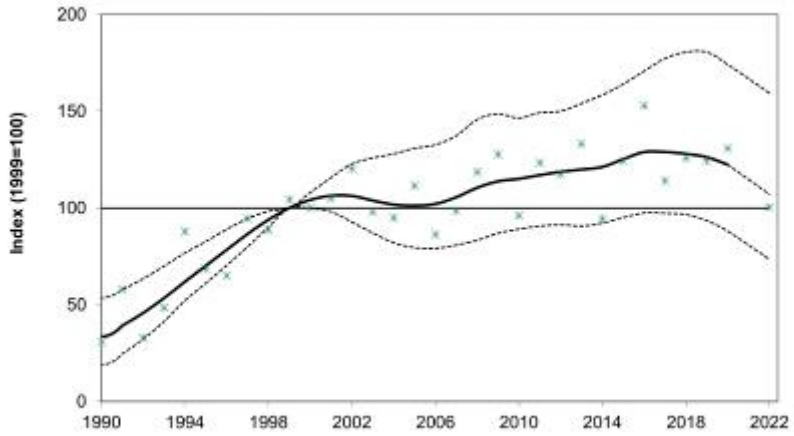
(Maps taken from 4th Report under Article 17 on implementation of the Habitats Directive in the UK, JNCC 2019)

Mmys/ Mbra

Whiskered/Brandt's bat | GB trend

The trend from the Hibernation Survey in Great Britain shows no significant difference in the smoothed index in comparison to the baseline year. Whiskered and Brandt's bat are also recorded as part of the Roost Count but sample sizes are not large enough to produce a statistically robust trend. **The combined population of whiskered and Brandt's bat in Great Britain is considered to have been stable since 1999**.

Hibernation Survey



The smoothed index is currently 7.0% above the 1999 base year value, equivalent to a mean annual increase of 0.3% (95% CI -1.3% to 2.1%). The smoothed index has fluctuated since the baseline year. It reached a peak in 2016 since when it has been slowly declining. It has not differed significantly from the baseline in any year. **Overall, the smoothed index does not differ significantly from the 1999 base year value.**

From all years for which data are available (1990-2022), counts from 265 sites contribute to the trend (sites surveyed in two or more years with whiskered/Brandt's bat recorded in at least one year). The hibernation survey was suspended in 2021 due to COVID-19.

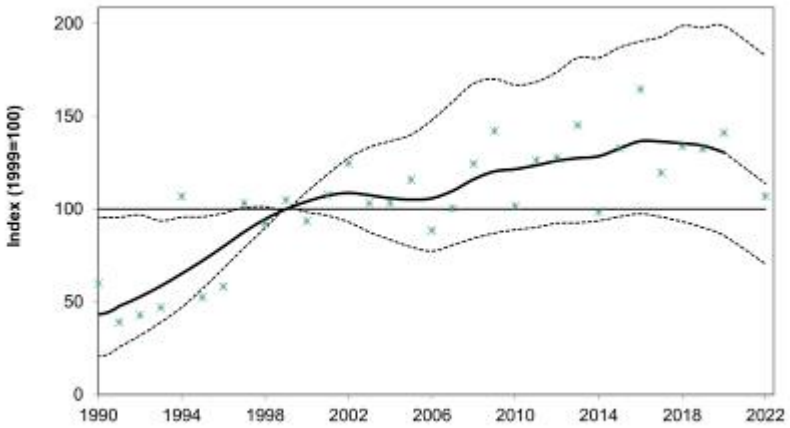
Fig 27. Hibernation Survey index for whiskered/Brandt's bat in Great Britain, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Mmys/ Mbra

Whiskered/Brandt's bat | England trend

The trend from the Hibernation Survey in England shows no significant difference in the smoothed index in comparison to the baseline year. Whiskered and Brandt's bat are also recorded as part of the Roost Count but sample sizes are not large enough to produce a statistically robust trend. **The combined population of whiskered and Brandt's bat in England is considered to have been stable since 1999**.

Hibernation Survey



The smoothed index is currently 13.8% above the 1999 base year value, equivalent to a mean annual increase of 0.6% (95% CI -1.5% to 2.7%). The smoothed index has fluctuated since the baseline year. It reached a peak in 2016 since when it has been slowly declining. It has not differed significantly from the baseline in any year. **Overall, the smoothed index does not differ significantly from the 1999 base year value.**

From all years for which data are available (1990-2022), counts from 174 sites contribute to the trend (sites surveyed in two or more years with whiskered/Brandt's bat recorded in at least one year). The hibernation survey was suspended in 2021 due to COVID-19.

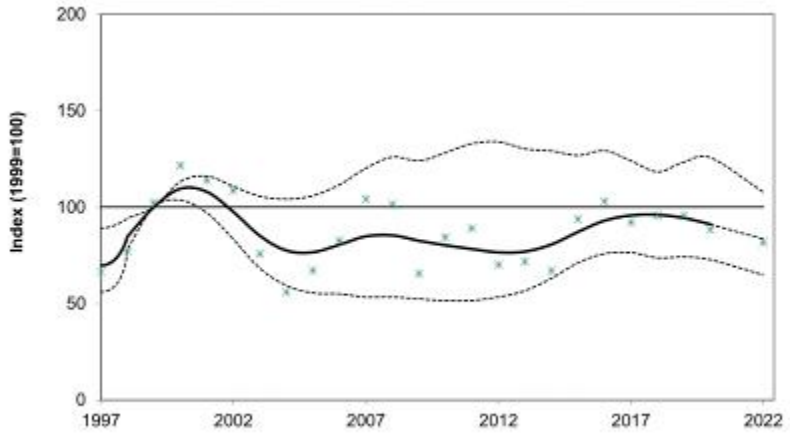
Fig 28. Hibernation Survey index for whiskered/Brandt's bat in England, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Mmys/ Mbra

Whiskered/Brandt's bat | Wales trend

The trend from the Hibernation Survey in Wales shows no significant difference in the smoothed index in comparison to the baseline year. Whiskered and Brandt's bat are also recorded as part of the Roost Count but sample sizes are not large enough to produce a statistically robust trend. **The combined population of whiskered and Brandt's bat in Wales is considered to have been stable since 1999**.

Hibernation Survey



The smoothed index is currently 16.6% below the 1999 base year value, equivalent to a mean annual decrease of 0.8% (95% CI -1.9% to 0.3%). The smoothed index has fluctuated since 1999; however, it only differed significantly from the baseline year in 2000. **Overall the smoothed index does not differ significantly from the 1999 base year value.**

From all years for which data are available (1998-2022), counts from 78 sites contribute to the trend analysis in Wales (sites surveyed in two or more years with whiskered/Brandt's bat recorded in at least one year). The hibernation survey was suspended in 2021 due to COVID-19.

Fig 29. Hibernation Survey index for whiskered/Brandt's bat in Wales, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Mnat

Natterer's bat

Myotis nattereri

Population trends are calculated for Natterer's bat for Great Britain and at a country level for England, Scotland and Wales.

Photo: Daniel Hargreaves

Distribution and abundance

Natterer's bat is widespread across England and Wales, with a patchier distribution in Scotland and Northern Ireland.

Range of Natterer's bat in the UK
(Map taken from 4th Report under Article 17 on implementation of the Habitats Directive in the UK, JNCC 2019).

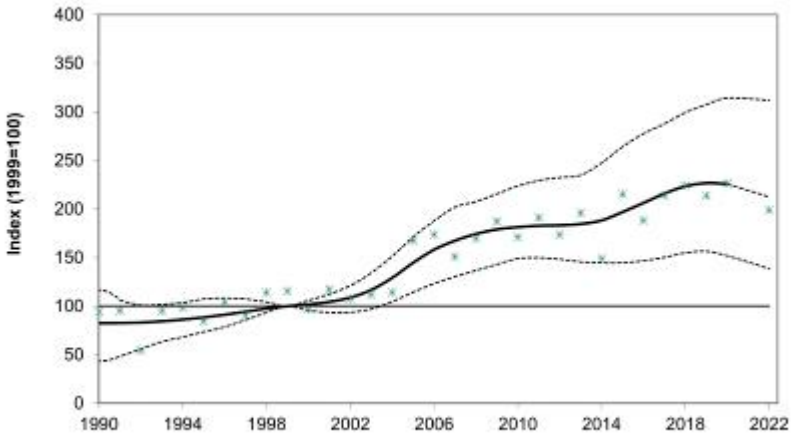
Population estimate

Country	GB	England	Wales	Scotland	N. Ireland
Number (plausible intervals in brackets)	414,000 (15,000–2,630,000	321,000 (11,700 – 2,040,000)	52,000 (1,900 – 332,000)	41,000 (1,490 – 260,000)	48,000
	Reliability score = 2 (scores >3 most reliable)				48,000
Source	Mathews *et al.* 2018				Russ 1999

Mnat Natterer's bat | GB trends

The trend from the Hibernation Survey for Great Britain shows a significant increase in the smoothed index in comparison to the baseline year, while the trend from the Roost Count shows no significant change. As Natterer's bats switch roosts frequently, the Roost Count trend is not considered a reliable measure of population change for this species (see *Robustness of monitoring data*, page 21). We therefore consider that the **population of Natterer's bat in Great Britain has increased since 1999**.

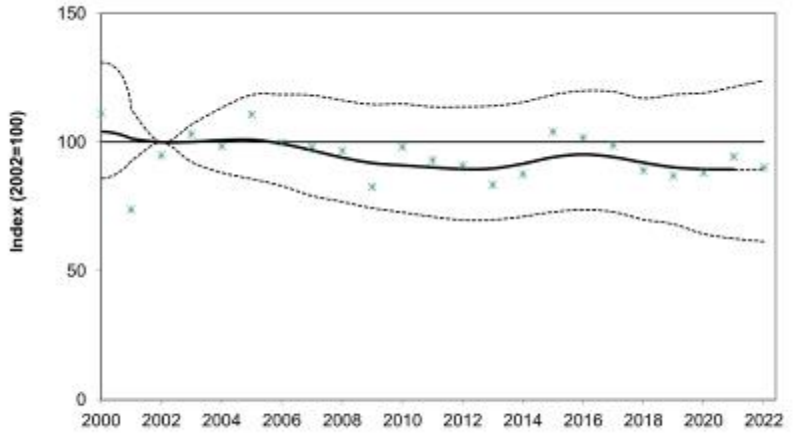
Hibernation Survey



The smoothed index is currently 112.7% above the 1999 base year value, equivalent to a mean average annual increase of 3.3% (95% CI 1.4% to 5.1%). The smoothed index increased between 1999 and 2019, although the rate of increase varied during that period. Since 2019 the trend has leveled out and the provisional value of the index in the most recent year shows a decline. However, **overall there has been a significant increase in the smoothed index since 1999.**

From all years for which data are available (1990-2022), counts from 565 sites contribute to the overall trend analysis (sites surveyed in two or more years with Natterer's bat recorded in at least one year). The hibernation survey was suspended in 2021 due to COVID-19.

Roost Count



The smoothed index is currently 10.5% below the 2002 base year value, equivalent to a mean annual decrease of 0.6% (95% CI -2.4% to 1.1%). **Overall the smoothed index does not differ significantly from the 2002 base year value**. It is likely that this species' frequent roost switching results in a negative bias in the Roost Count trend and this trend is not therefore considered a reliable measure of population change for Natterer's bat.

Data from 90 sites surveyed between 2000 and 2022 contribute to the trend analysis (sites surveyed in at least two years). The baseline year used to calculate this trend has been set at 2002 as very few roosts of this species were counted in earlier years.

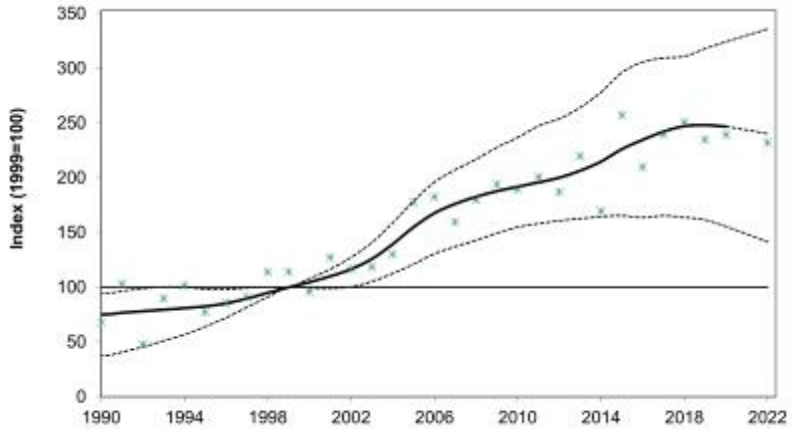
Fig 30. Hibernation Survey and Fig 31. Roost Count indices for Natterer's bat in Great Britain, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Mnat

Natterer's bat | England trends

The trend from the Hibernation Survey for England shows a significant increase in the smoothed index in comparison to the baseline year, while the trend from the Roost Count shows no significant change. As Natterer's bats switch roosts frequently, the Roost Count trend is not considered a reliable measure of population change for this species (see *Robustness of monitoring data*, page 21). We therefore consider that the **population of Natterer's bat in England has increased since 1999**.

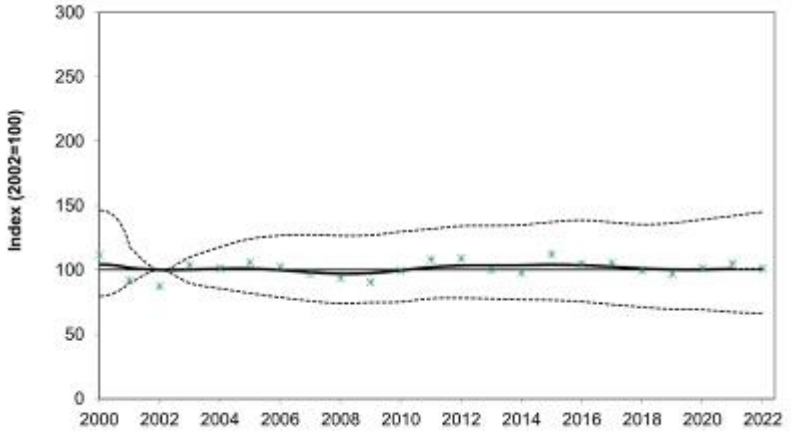
Hibernation Survey



The smoothed index is currently 140.2% above the 1999 base year value, equivalent to a mean annual increase of 3.9% (95% CI 1.5% to 5.4%). The smoothed index increased between 1999 and 2018, although the rate of increase varied during that period. Since 2018 the trend has leveled out and the provisional value of the index in the most recent year shows a decline. However, **overall there has been a significant increase in the smoothed index since 1999.**

From all years for which data are included (1990-2022), counts from 401 sites contribute to the trend analysis in England (sites surveyed in two or more years with Natterer's bat recorded in at least one year).

Roost Count



The smoothed index is currently 1.1% above the 2002 base year value, equivalent to a mean annual increase of 0.1% (95% CI -2.0% to 1.9%). The smoothed index has been relatively stable over the period monitored and overall, it **does not differ significantly from the 2002 base year value.** However, it is likely that this species' frequent roost switching results in a negative bias in the Roost Count trend (see *Robustness of monitoring data,* page 21) and this trend is not therefore considered a reliable measure of population change for Natterer's bat.

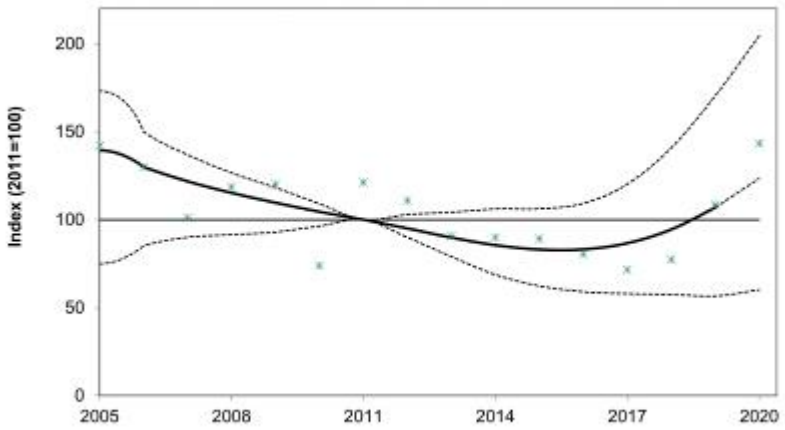
Data from 77 sites surveyed between 2000 and 2022 contribute to the trend analysis in England.

Fig 32. Hibernation Survey and Fig 33. Roost Count indices for Natterer's bat in England, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Mnat Natterer's bat | Scotland trends

Note that as a result of the suspension of the Hibernation Survey in winter 2020/21 and a low sample size of sites monitored in winter 2021/22 (see *Impacts of COVID-19* on page 7), it has not been possible to update the trend since 2020. The trend that was published in the 2020 Annual Report is repeated here for information. The trend from the Hibernation Survey in Scotland showed no significant difference from the baseline year. Natterer's bat is also recorded on the Roost Count in Scotland but the sample size is not large enough to produce a statistically robust trend. We therefore consider that **the population of Natterer's bat in Scotland has been stable since 1999**. However, this trend is based on relatively few samples and as such should be treated with caution.

Hibernation Survey (**2020 trend**)



In 2020, the smoothed index was 23.5% above the 2011 base year value, equivalent to a mean annual increase of 2.4% (95% CI -5.5% to 8.3%). The smoothed index declined from the baseline year until 2015, since when it has been increasing. However, it has not differed significantly from the baseline in any year. Overall, the smoothed index **does not differ significantly from the 2011 base year value.**

From all years for which data are available (2005-2020), counts from 23 sites contribute to the trend analysis in Scotland (sites surveyed in two or more years with Natterer's bat recorded in at least one year). **This is fewer sample sites than would be ideal to produce trends and as such the results may be unreliable**. Improving the sample size for this trend is priority (see *Developments and future directions, page 92*).

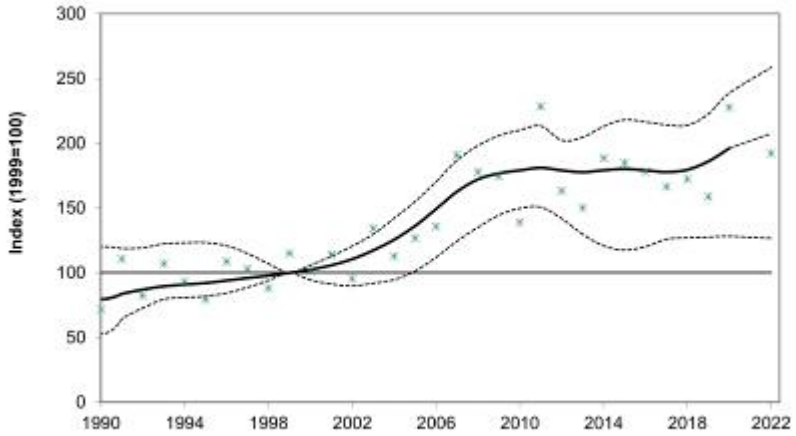
Fig 34. Hibernation Survey for Natterer's bat in Scotland, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

Mnat

Natterer's bat | Wales trends

The trend from the Hibernation Survey in Wales shows a significant increase in the smoothed index in comparison to the baseline year. Natterer's bat is also recorded on the Roost Count in Wales but the sample size is not large enough to produce a statistically robust trend. **The population of Natterer's bat in Wales is considered to have increased since 1999.**

Hibernation Survey



The smoothed index is currently 107.6% above the 1999 base year value, equivalent to a mean annual increase of 3.2% (95% CI 1.0% to 4.2%). The smoothed index increased every year between 1999 and 2011, although the rate of increased slowed after 2007. Between 2011 and 2018 it was relatively stable, and has been increasing again since 2018. It became significantly higher than the baseline in 2005 and **overall there has been a significant increase in the smoothed index since 1999.**

From all years for which data are available (1998-2022), counts from 140 sites contribute to the trend analysis in Wales (sites surveyed in two or more years with Natterer's bat recorded in at least one year). The hibernation survey was suspended in 2021 due to COVID-19.

Fig 35. Hibernation Survey for Natterer's bat in Wales, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Ppip

Common pipistrelle

Pipistrellus pipistrellus

Survey indices for common pipistrelle are produced for Great Britain, and at country level for England, Scotland and Wales (for Wales only a Roost Count trend is available, which is not considered a reliable measure of population change for this species). For Northern Ireland the sample sizes from the Field Survey and Roost Count are not large enough to produce statistically robust trends.

Photo: Hugh Clark

Distribution and abundance

Common pipistrelle is widespread across the UK.

Range of soprano pipistrelle in the UK
(Map taken from 4th Report under Article 17 on implementation of the Habitats Directive in the UK, JNCC 2019)

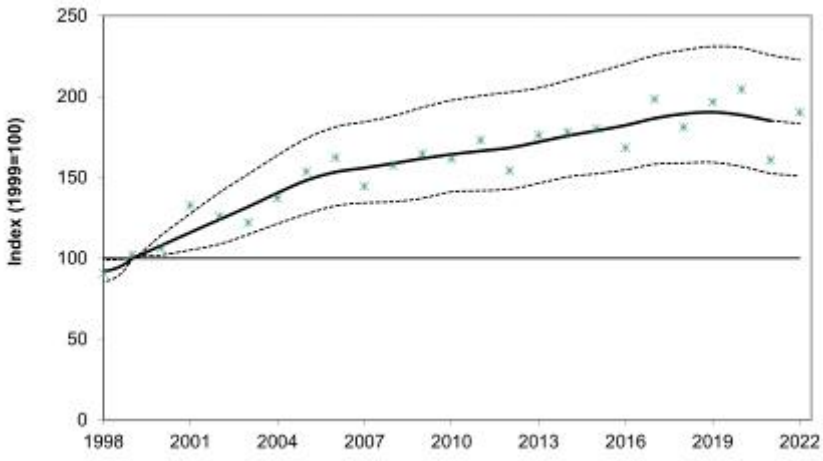
Population estimate

Country	GB	England	Wales	Scotland	N.Ireland
Number (Plausible intervals in brack-ets)	3,040,000 (991,000–7,510,000)	1,870,000 (609,000 – 4,620,000)	297,000 (96,600 – 732,000)	875,000 (285,000 – 2,160,000)	1,150,000
	Reliability score = 2 (scores >3 most reliable)				Russ 1999
Source	Mathews *et al. 2018*				

Ppip Common pipistrelle | GB trends

The trend from the Field Survey in Great Britain shows a significant increase in the smoothed index when compared to the baseline year, while the trend from the Roost Count shows a significant decline. As common pipistrelle switches roosts frequently the Roost Count trend is not considered a reliable measure of population change for this species (see *Robustness of monitoring data*, page 21), therefore **the population of common pipistrelle in Great Britain is considered to have increased since 1999.**

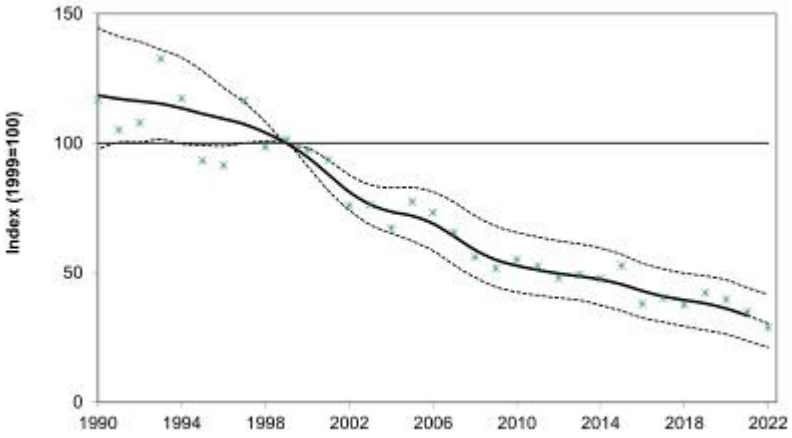
Field Survey



The smoothed index is currently 83.3% above the 1999 base year value, equivalent to a mean annual increase of 2.7% (95% CI 1.8% to 3.5%). The smoothed index increased consistently between 1999 and 2019, although the rate of increase slowed over that period. Since 2019 the index has declined slightly, however overall **there has been a significant increase in the smoothed index since 1999.**

Data from 690 sites surveyed between 1998 and 2022 contribute to the trend analysis (sites surveyed in at least two years).

Roost Count



The smoothed index is currently 69.6% below the 1999 base year value, equivalent to a mean annual decrease of 5% (95% CI -6.5% to -3.8%). **There has been a significant decline in the smoothed index since 1999**. However, it is likely that this species' frequent roost switching results in a negative bias in the Roost Count trend and this trend is not therefore considered a reliable measure of population change for this species. We are currently investigating the causes of this negative bias in more detail and exploring ways to correct it (see *Robustness of monitoring data*, page 21).

Data from 556 sites surveyed between 1997 and 2022 contribute to the trend analysis (sites surveyed in at least two years).

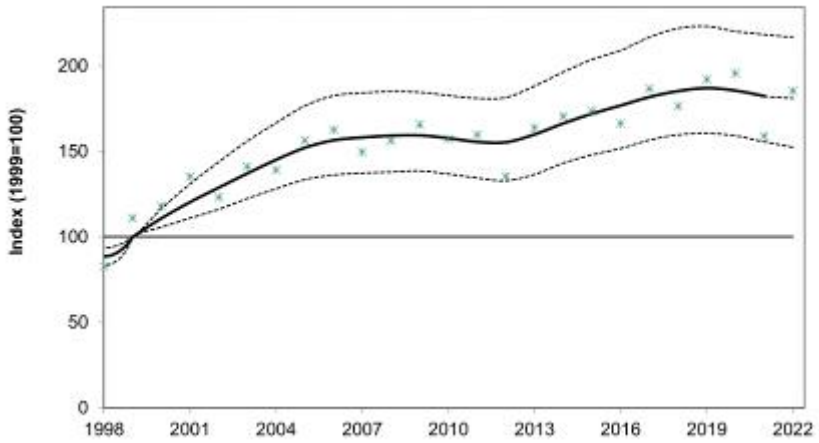
Fig 36. Field Survey and Fig 37. Roost Count indices for common pipistrelle in Great Britain, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Ppip

Common pipistrelle | England trends

The trend from the Field Survey in England shows a significant increase in the smoothed index when compared to the baseline year, while the trend from the Roost Count shows a significant decline. As common pipistrelle switches roosts frequently the Roost Count trend is not considered a reliable measure of population change for this species (see *Robustness of monitoring data*, page 21), therefore **the population of common pipistrelle in England is considered to have increased since 1999.**

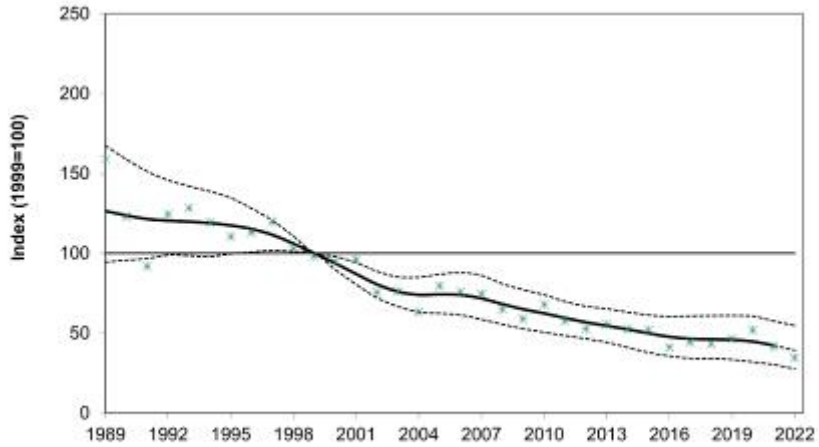
Field Survey



The smoothed index is currently 81% above the 1999 base year value, equivalent to a mean annual increase of 2.6% (95% CI 1.9% to 3.4%). From 1999 the smoothed index increased steadily each year, until 2006 when the rate of increase levelled off and the index eventually began to decline. It increased again between 2012 and 2019, but in recent years has shown a provisional decline once again. Overall, there has been a **significant increase in the smoothed index since 1999.**

Data from 566 sites surveyed between 1998 and 2022 contribute to the trend analysis in England (sites surveyed in at least two years).

Roost Count



The smoothed index is currently 60.8% below the 1999 base year value, equivalent to a mean annual decrease of 4.0% (95% CI -5.5% to -2.6%). The value of the smoothed index has fallen steadily since the baseline year and overall, there has been a **significant decline in the smoothed index since 1999.** However, it is likely that this species' frequent roost switching results in a negative bias in the Roost Count trend and this trend is not therefore considered a reliable measure of population change for common pipistrelle**.** We are currently investigating the causes of this negative bias and ways to correct it (see *Robustness of monitoring data,* page 21).

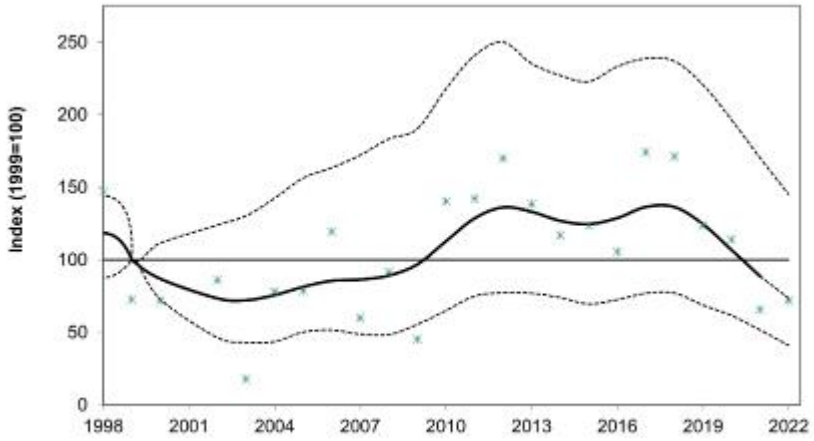
Data from 444 sites surveyed between 1988 and 2022 contribute to the trend analysis in England (sites surveyed in at least two years).

Fig 38. Field Survey and Fig 39. Roost Count indices for common pipistrelle in England, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Ppip Common pipistrelle | Scotland trends

The trend from the Field Survey in Scotland does not differ significantly from the baseline year, while the trend from the Roost Count shows a significant decline. As common pipistrelle switches roosts frequently the Roost Count trend is not considered a reliable measure of population change for this species (see *Robustness of monitoring data,* page 21), therefore **the population of common pipistrelle in Scotland is considered to have been stable since 1999.**

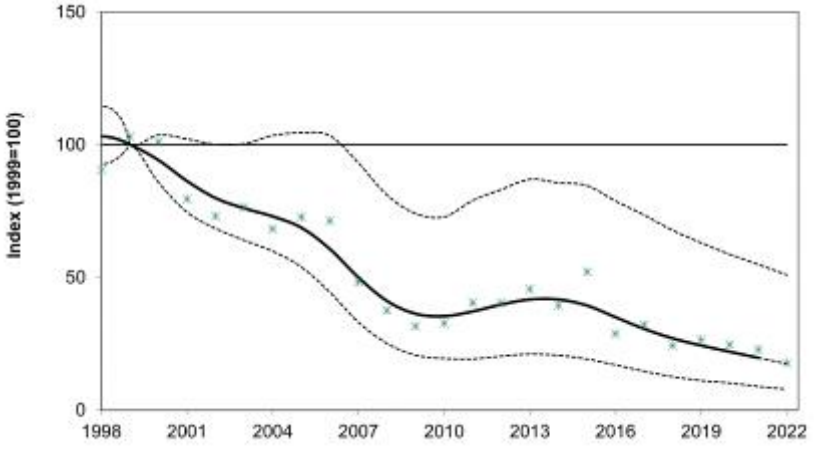
Field Survey



The smoothed index is currently 26.5% below the 1999 base year value, equivalent to a mean annual decrease of 1.3% (95% CI -3.8% to 1.6%). The value of the smoothed index has fluctuated considerably since the baseline year, however it has not differed significantly from the baseline in any year. **Overall, the smoothed index does not differ significantly from the 1999 base year value.**

Data from 75 sites surveyed between 1998 and 2022 contribute to the trend analysis in Scotland (sites surveyed in at least two years). Due to the wide confidence intervals, improving the sample size for this trend is a priority.

Roost Count



The smoothed index is currently 82.5% below the 1999 base year value, equivalent to a mean annual decrease of 7.3% (95% CI -10.5% to -2.9%). **Overall, there has been a significant decline in the smoothed index since 1999**. However, it is likely that this species' frequent roost switching results in a negative bias in the Roost Count trend and this trend is not therefore considered a reliable measure of population change for common pipistrelle. We are currently investigating the causes of this negative bias and ways to correct it (see *Robustness of monitoring data*, page 21).

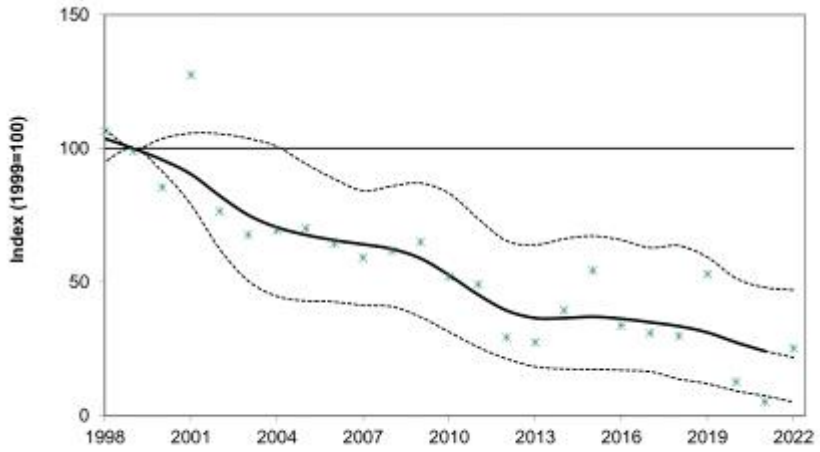
Data from 72 sites surveyed between 1998 and 2022 contribute to the trend analysis in Scotland (sites surveyed in at least two years).

Fig 40. Field Survey and Fig 41. Roost Count indices for common pipistrelle in Scotland, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Ppip Common pipistrelle | Wales trend

The trend from the Roost Count survey in Wales shows a significant decline. However, as common pipistrelle switches roosts frequently the Roost Count trend is not considered a reliable measure of population change for this species. As such **we are not able to assess the population status of common pipistrelle in Wales**. Common pipistrelle is also recorded on the Field Survey in Wales but the sample size is not large enough to produce a statistically robust trend.

Roost Count



The smoothed index is currently 78.2% above the 1999 base year value, equivalent to a mean annual increase of 6.4% (95% CI -12.1% to -3.2%). **Overall, there has been a significant decrease in the smoothed index since 1999**.

Data from 39 sites surveyed between 1998 and 2022 contribute to the trend analysis in Wales (sites surveyed in at least two years).

Fig 42. Roost Count index for common pipistrelle in Wales, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Ppyg

Soprano pipistrelle

Pipistrellus pygmaeus

Survey indices for soprano pipistrelle are produced for Great Britain, and at country level for England, Scotland and Wales (for Wales only a Roost Count trend is available, which is not considered a reliable measure of population change for this species). For Northern Ireland the sample sizes for both the Field Survey and Roost Count are not high enough to enable the production of statistically robust trends.

Photo: Daniel Hargreaves

Distribution and abundance

Soprano pipistrelle is widespread across the UK.

Range of soprano pipistrelle in the UK
(Map taken from 4th Report under Article 17 on implementation of the Habitats Directive in the UK, JNCC 2019)

Population estimate

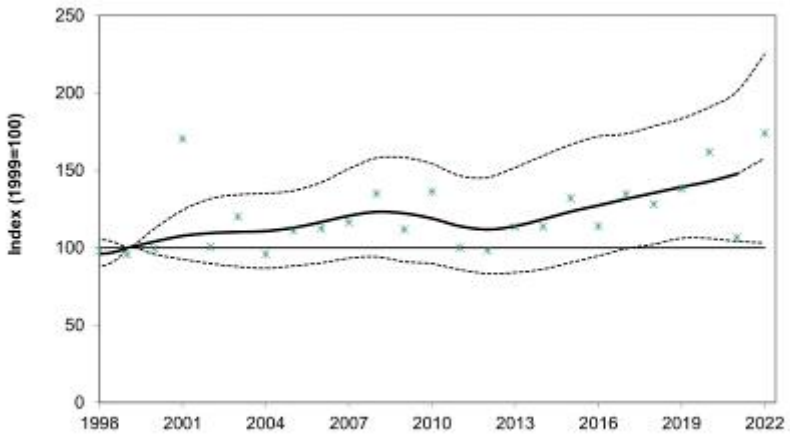
Country	GB	England	Wales	Scotland	N.Ireland
Number (Plausible intervals in brackets)	4,670,000 (1,970,000–8,400,000)	2,980,000 (1,260,000 – 5,360,000)	478,000 (202,000 – 862,000)	1,210,000 (512,000 – 2,180,000)	580,000
	Reliability score = 2 (scores >3 most reliable)				Russ 1999
Source	Mathews *et al. 2018*				

Ppyg

Soprano pipistrelle | GB trends

The trend from the Field Survey in Great Britain shows a significant increase in comparison to the baseline year, while the trend from the Roost Count shows a significant decline. However, as soprano pipistrelle switches roosts frequently the Roost Count trend is not considered a reliable measure of population change for this species (see *Robustness of monitoring data*, page 21). **The population of soprano pipistrelle in Great Britain is considered to have increased since 1999.**

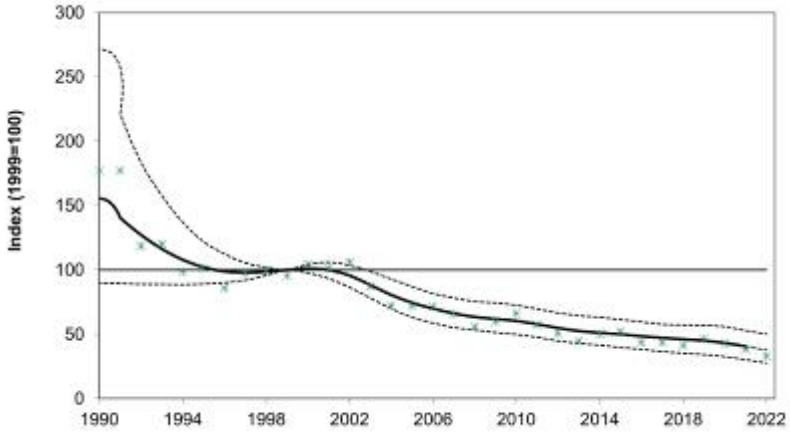
Field Survey



The smoothed index is currently 57.9% above the 1999 base year value, equivalent to a mean annual increase of 2.0% (95% CI 0.1% to 3.6%). The smoothed index remained slightly above the baseline value until 2012, when it began to increase steadily, and it has significantly exceeded the baseline value for the last five years. **Overall, there has been a significant increase in the smoothed index since 1999.**

Data from 688 sites surveyed between 1998 and 2022 contribute to the trend analysis in England (sites surveyed in at least two years).

Roost Count



The smoothed index is currently 62.2% below the 1999 value, equivalent to a mean annual decrease of 4.1% (95% CI -5.4% to 3.0%). **Overall, there has been a significant decline in the index since 1999.** However, it is likely that this species' frequent roost switching results in a negative bias in the Roost Count trend and this trend is not therefore considered a reliable measure of population change for soprano pipistrelle. We are currently investigating the causes of this negative bias and ways to correct it (see Robustness *of monitoring data*, page 21).

Data from 447 sites surveyed between 1997 and 2022 contribute to the trend analysis (sites surveyed in at least two years).

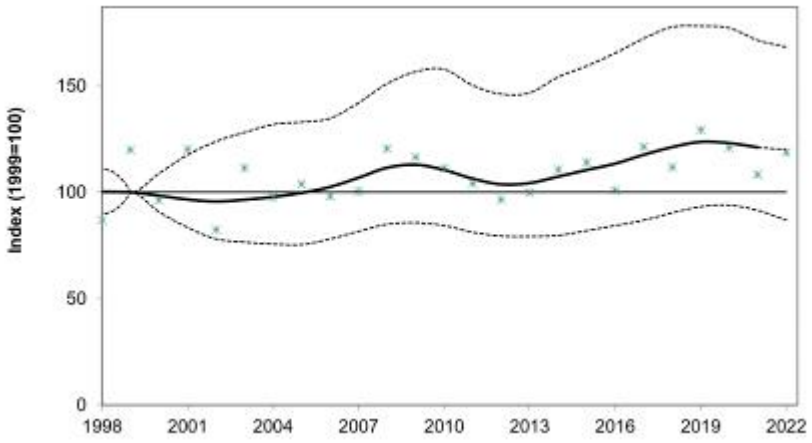
Fig 43. Field Survey and Fig 44. Roost Count indices for soprano pipistrelle in Great Britain, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Ppyg

Soprano pipistrelle | England trends

The trend from the Field Survey in England shows no significant difference from the baseline year, while the trend from the Roost Count shows a significant decline in comparison to the baseline year. However, as soprano pipistrelle switches roosts frequently the Roost Count trend is not considered a reliable measure of population change for this species (see *Robustness of monitoring data*, page 21). Therefore, the **population of soprano pipistrelle in England is considered to have been stable since 1999.**

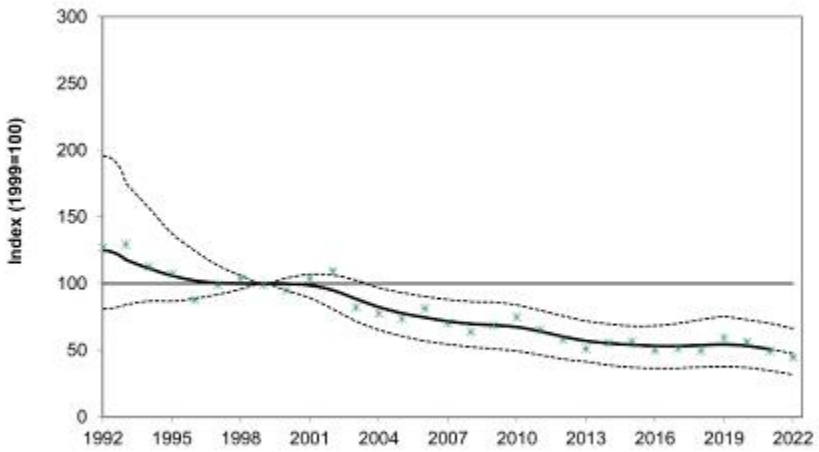
Field Survey



The smoothed index is currently 20.0% above the 1999 base year value, equivalent to a mean annual increase of 0.8% (95% CI -0.6% to 2.3). It has fluctuated at or slightly above the baseline value since the start of monitoring. **Overall, the smoothed index does not differ significantly from the 1999 base year value**.

Data from 565 sites surveyed between 1998 and 2022 contribute to the trend analysis in England (sites surveyed in at least two years).

Roost Count



The smoothed index is currently 52.5% below the 1999 base year value, equivalent to a mean annual decrease of 3.2% (95% CI -4.9% to -1.8%). **Overall, there has been a significant decline in the index since 1999**. However, it is likely that this species' frequent roost switching results in a negative bias in the Roost Count trend and this trend is therefore not considered a reliable measure of population change for soprano pipistrelle. We are currently investigating the causes of this negative bias and ways to correct it (see Robustness *of Monitoring data*, page 21).

Data from 294 sites surveyed between 1992 and 2022 contribute to the trend analysis in England (sites surveyed in at least two years).

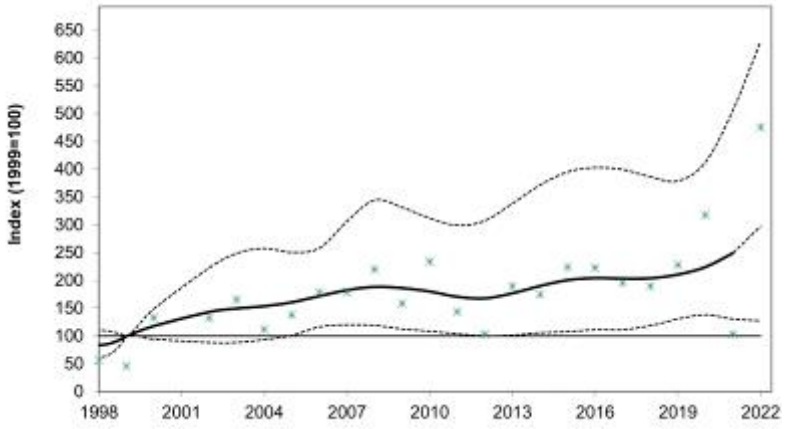
Fig 45. Field Survey and Fig 46. Roost Count indices for soprano pipistrelle in England, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Ppyg

Soprano pipistrelle | Scotland trends

The trend from the Field Survey in Scotland is significantly higher in comparison to the baseline year, while the trend from the Roost Count shows a significant decline. However, as soprano pipistrelle switches roosts frequently the Roost Count trend is not considered a reliable measure of population change for this species. We are currently investigating the causes of this negative bias and ways to correct it. **The population of soprano pipistrelle in Scotland is considered to have increased since 1999.** This finding should be treated with caution as the precision of the Field Survey trend in recent years has reduced due the small sample size.

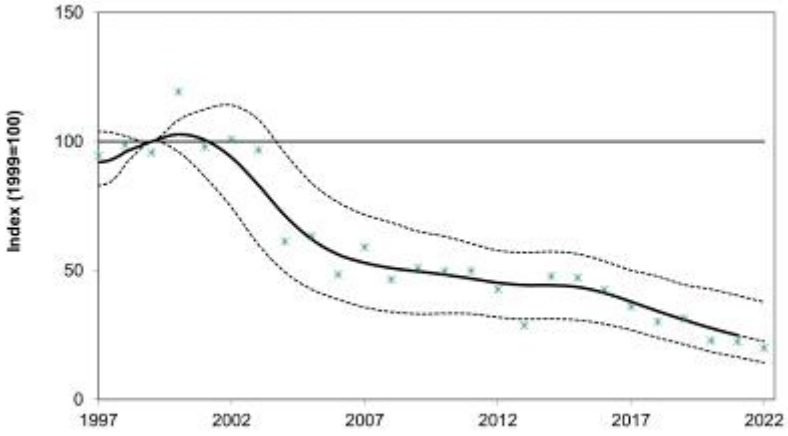
Field Survey



The smoothed index is currently 197.2% above the 1999 base year value, equivalent to a mean annual increase of 4.9% (95% CI 1.1% to 8.3%). The smoothed index has increased very gradually over the period monitored. It has been significantly higher than the baseline value between 2006 and 2011, and also for the last nice years, although in recent years the precision of the trend has reduced. **Overall, there has been a significant increase in the smoothed index since 1999.**

Data from 75 sites surveyed between 1998 and 2022 contribute to the trend analysis in Scotland (sites surveyed in at least two years). Due to the wide confidence intervals, improving the sample size for this trend is a priority.

Roost Count



The smoothed index is currently 77.5% below the 1999 base year value, equivalent to a mean annual decrease of 6.3% (95% CI -8.1% to -4.1%). **Overall, there has been a significant decline in the smoothed index since 1999.** However, it is likely that this species' frequent roost switching results in a negative bias in the Roost Count trend and this trend is therefore not considered a reliable measure of population change for soprano pipistrelle.

Data from 98 sites surveyed between 1997 and 2022 contribute to the trend analysis in Scotland (sites surveyed in at least two years).

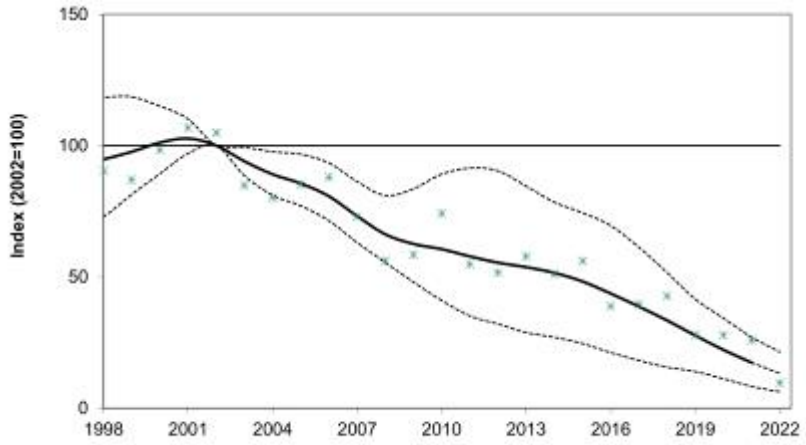
Fig 47. Field Survey and Fig 48. Roost Count indices for soprano pipistrelle in Scotland, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Ppyg

Soprano pipistrelle | Wales trend

The trend from the Roost Count survey in Wales shows a significant decline. However, as soprano pipistrelle switches roosts frequently the Roost Count trend is not considered a reliable measure of population change for this species (see *Robustness of monitoring data*, page 21). As such **we are not able to assess the population status of soprano pipistrelle in Wales**. Soprano pipistrelle is also recorded on the Field Survey in Wales but the sample size is not large enough to produce a statistically robust trend.

Roost Count



The smoothed index is currently 86.7% below the 2002 base year value, equivalent to a mean annual decrease of 9.6% (95% CI -12.9% to -7.4%). The smoothed index has fallen steadily since the baseline year, and overall, **there has been a significant decline in the smoothed index since 2002**. However, it is likely that this species' frequent roost switching results in a negative bias in the Roost Count trend and this trend is therefore not considered a reliable measure of population change for soprano pipistrelle. We are currently investigating the causes of this negative bias and ways to correct it (see Robustness *of monitoring data*, page 21).

Data from 55 sites surveyed between 1997 and 2022 contribute to the trend analysis in Wales (sites surveyed in at least two years).

Fig 49. Roost Count index for soprano pipistrelle in Wales, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Eser

Serotine

Eptesicus serotinus

Survey indices for serotine are produced for Great Britain, and at a country level for England. Serotine is only rarely recorded in Wales, therefore there are insufficient data to calculate a population trend for that country. This species does not occur in Scotland or Northern Ireland.

Photo: R E Stebbings

Distribution and abundance

Serotine occurs across southern England and parts of Wales. It is absent from Scotland and Northern Ireland.

Range of serotine in the UK
(Map taken from 4th Report under Article 17 on implementation of the Habitats Directive in the UK, JNCC 2019)

Population estimate

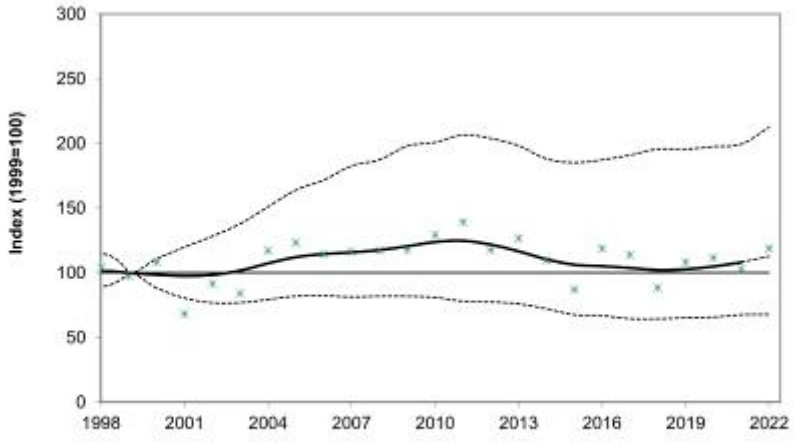
Country	GB	N.Ireland
Number	136,000 (PIs = 7,300–413,000). Reliability score = 3. (scores >3 most reliable)	does not occur
Source	Mathews *et al. 2018*	

Eser

Serotine | GB trends

Trends from the Field Survey and Roost Count survey in Great Britain show no significant difference in the smoothed index in comparison to the baseline year. The **population of serotine in Great Britain is considered to have been stable since 1999.** However, this finding should be treated with caution as serotine is encountered relatively infrequently during surveys. Therefore, the level of uncertainty associated with these trends is large, making trends for this species more difficult to detect.

Field Survey

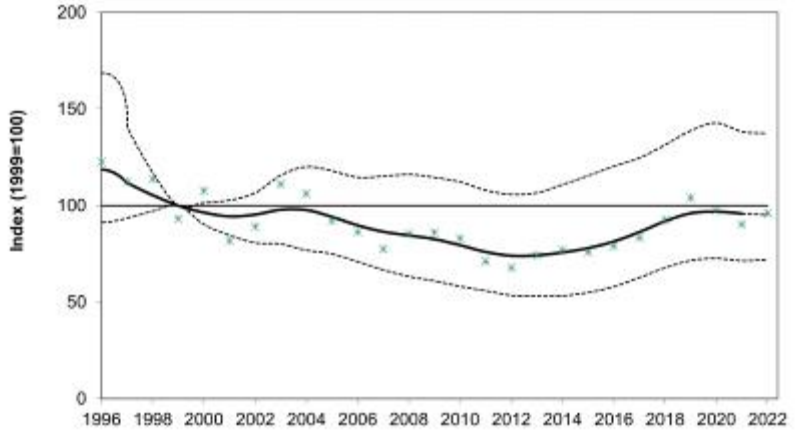


The smoothed index is currently 12.8% above the 1999 base year value, equivalent to a mean annual increase of 0.5% (95% CI -1.7% to 3.3%). It has fluctuated close to the baseline value but has not differed significantly from it in any year. **Overall, the smoothed index does not differ significantly from the 1999 base year value.**

Data from 471 sites surveyed between 1998 and 2022 contribute to the trend analysis (sites surveyed in at least two years).

Note: As serotine is restricted to southern parts of GB no geographic weighting has been applied to this analysis.

Roost Count



The smoothed index is currently 4.9% below the 1999 value, equivalent to a mean annual decrease of 0.2% (95% CI -1.4% to 1.4%). It has fluctuated at or below the baseline value but has not differed significantly from it in any year. **Overall, the smoothed index does not differ significantly from the 1999 base year value.**

Data from 103 sites surveyed between 1996 and 2022 contribute to the trend analysis (sites surveyed in at least two years).

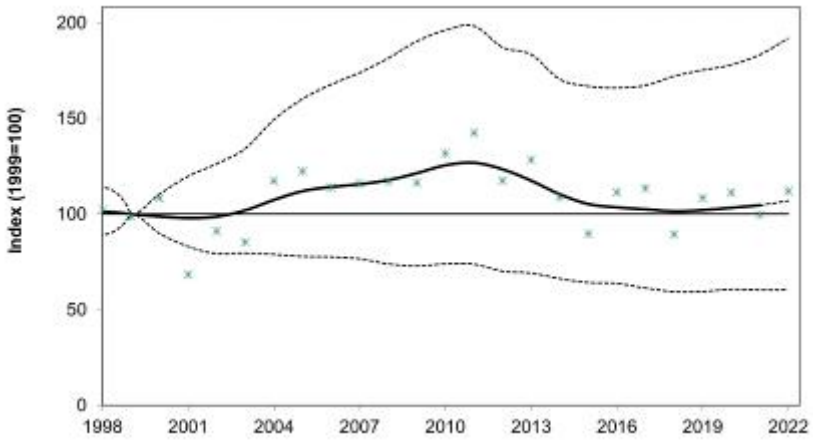
Fig 50. Field Survey and Fig 51. Roost Count indices for serotine in Great Britain, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Eser

Serotine | England trends

Trends from the Field Survey and Roost Count survey in England show no significant difference in the smoothed index in comparison to the baseline year. The **population of serotine in England is considered to have been stable since 1999.** However, this finding should be treated with caution as serotine is encountered relatively infrequently during surveys. Therefore, the level of uncertainty associated with these trends is large, making trends for this species more difficult to detect.

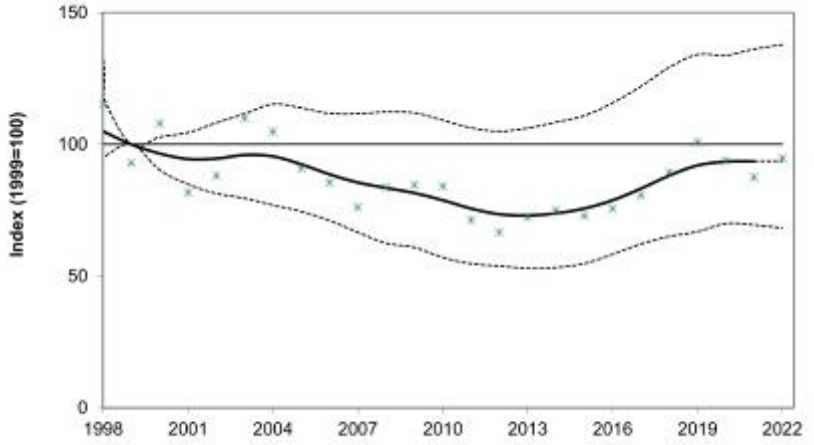
Field Survey



The smoothed index is currently 6.9% above the 1999 base year value, equivalent to a mean annual increase of 0.3% (95% CI -2.2% to 2.9%). It has fluctuated close to the baseline value but has not differed significantly from it in any year. **Overall, the smoothed index does not differ significantly from the 1999 base year value.**

Data from 432 sites surveyed between 1998 and 2022 contribute to the trend analysis in England (sites surveyed in at least two years).

Roost Count



The smoothed index is currently 6.3% below the 1999 base year value, equivalent to a mean annual decrease of 0.3% (95% CI -1.7% to 1.4%). It has fluctuated at or below the baseline value but has not differed significantly from it in any year. **Overall, the smoothed index does not differ significantly from the 1999 base year value.**

Data from 101 sites surveyed between 1996 and 2022 contribute to the trend analysis in England (sites surveyed in at least two years).

Fig 52. Field Survey and Fig 53. Roost Count indices for serotine in England, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Nnoc

Noctule

Nyctalus noctula

Survey indices for noctule are produced for Great Britain and at a country level for England. There are insufficient data to calculate population trends for this species in Wales, and it only rarely encountered in Scotland. It is not found in Northern Ireland.

Photo: Martin Celuch

Distribution and abundance

Noctule occurs across England, Wales and southern Scotland. It is absent from Northern Ireland.

Range of noctule in the UK
(Map taken from 4th Report under Article 17 on implementation of the Habitats Directive in the UK, JNCC 2019)

Population estimate

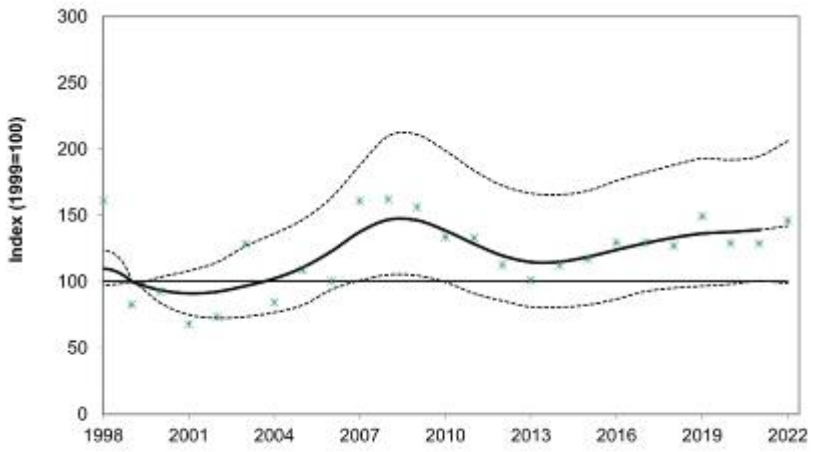
Country	GB	England	Wales	Scotland	N.Ireland
Number (Plausible intervals in brackets)	Not assessed	565,000 (17,700 – 1,872,000)	91,900 (2,880 –304,000)	Not assessed	Does not occur
	Reliability score = 0 (scores >3 most reliable)				
Source	Mathews *et al.* 2018				

Nnoc

Noctule | GB trend

The trend from the Field Survey in Great Britain shows no significant difference in the smoothed index in comparison to the baseline year. This species is also recorded on the Roost Count but the sample size is not large enough to produce a statistically robust trend. **The population of noctule in Great Britain is considered to have been stable in comparison to 1999.**

Field Survey



The smoothed index is currently 42.2% above the 1999 base year value, equivalent to a mean annual increase of 1.5% (95% CI -0.1 to 3.2%). The smoothed index has fluctuated during the period monitored, and significantly exceeded the baseline value briefly between 2007 and 2009. However, **overall, the smoothed index does not differ significantly from the 1999 base year value.**

Data from 686 sites surveyed between 1998 and 2022 contribute to the trend analysis (sites surveyed in at least two years).

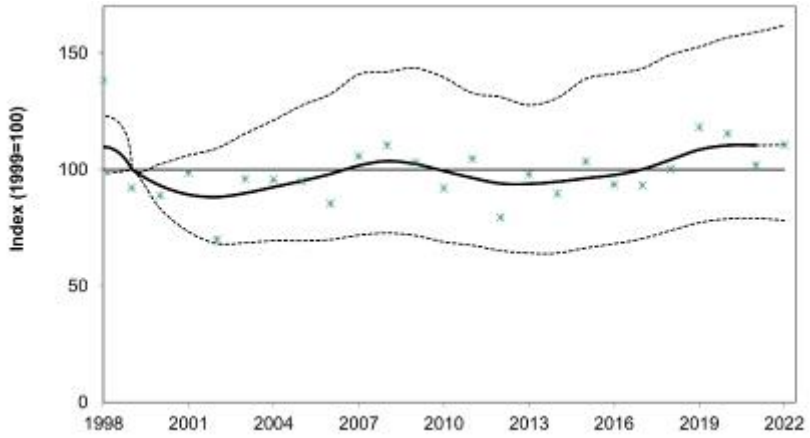
Fig 54. Field Survey index for noctule in Great Britain, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Nnoc

Noctule | England trend

The trend from the Field Survey in England shows no significant difference in the smoothed index in comparison to the baseline year. This species is also recorded on the Roost Count but the sample size is not large enough to produce a statistically robust trend. **The population of noctule in England is considered to have been stable in comparison to 1999.**

Field Survey



The smoothed index is currently 10.6% above the 1999 base year value, equivalent to a mean annual increase of 0.4% (95% CI -1.1% to 2.1%). The smoothed index has fluctuated around the baseline value; however it has not differed significantly from the baseline in any year and **overall it does not differ significantly from the 1999 base year value.**

Data from 563 sites surveyed between 1998 and 2022 contribute to the trend analysis in England (sites surveyed in at least two years).

Fig 55. Field Survey index for noctule in England, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Paur

Brown long-eared bat

Plecotus auritus

Survey indices for brown long-eared bat are produced for Great Britain and at a country level for England, Scotland and Wales. This species is also recorded on the Roost Count in Northern Ireland but the sample size is not large enough to produce a statistically robust trend.

Photo: Daniel Hargreaves

Distribution and abundance

Brown long-eared bat occurs across most of the UK.

Population estimate

Country	GB	England	Wales	Scotland	N.Ireland
Number (Plausible intervals in brackets)	934,000 (52,000–2,200,000)	607,000 (33,700 – 1,430,000)	96,600 (5,370 – 228,000)	230,000 (12,800 – 543,000)	45,000
	Reliability score = 2 (scores >3 most reliable)				
Source	Mathews *et al. 2018*				Russ 1999

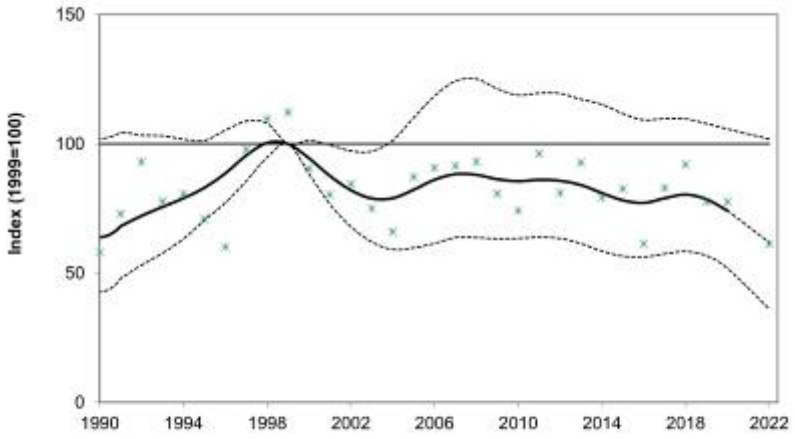
Range of brown long-eared bat in the UK
(Map taken from 4th Report under Article 17 on implementation of the Habitats Directive in the UK, JNCC 2019)

Paur

Brown long-eared bat | GB trends

Trends from the Hibernation Survey and Roost Count survey in Great Britain show no significant difference in the smoothed index in comparison to the baseline year. **The population of brown long-eared bat in Great Britain is considered to have been stable since 1999.**

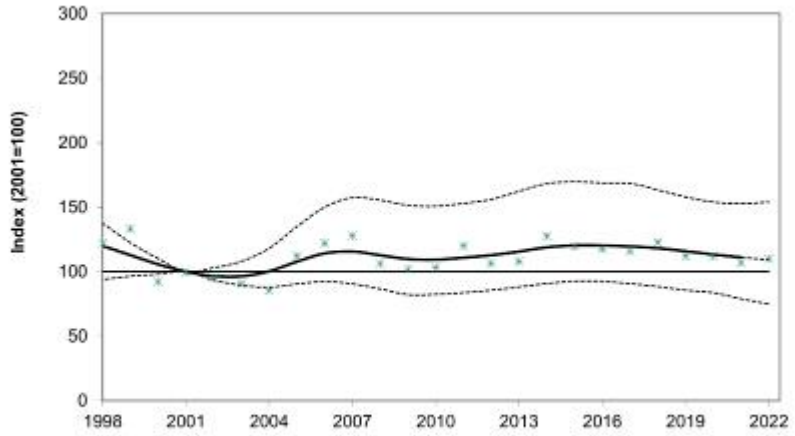
Hibernation Survey



The smoothed index is currently 38.2% below the 1999 base year value, equivalent to a mean annual decrease of 2.1% (95% CI -4.3% to 0.1%). The smoothed index has fluctuated below the baseline value during the period monitored. It was significantly lower than the baseline between 2001 and 2003, but has not differed significantly from the baseline in any other year. **Currently the smoothed index does not differ significantly from the 1999 base year value.**

From all years for which data are available (1990-2022), counts from 496 sites contribute to the trend (sites surveyed in two or more years with brown long-eared bat recorded in at least one year).

Roost Count



The smoothed index is currently 9.3% above the base year value, equivalent to a mean annual increase of 0.4% (95% CI -1.4% to 2.1%). The smoothed index has remained at or slightly above the baseline value since 2004; however, it has not differed significantly from the baseline in any year. **Overall the smoothed index does not differ significantly from the 2001 base year value.**

Data from 172 sites surveyed between 1990 and 2022 contribute to the trend analysis (sites surveyed in at least two years).

Note: the baseline year for calculation of this trend has been set at 2001 as very few roosts were counted in earlier years.

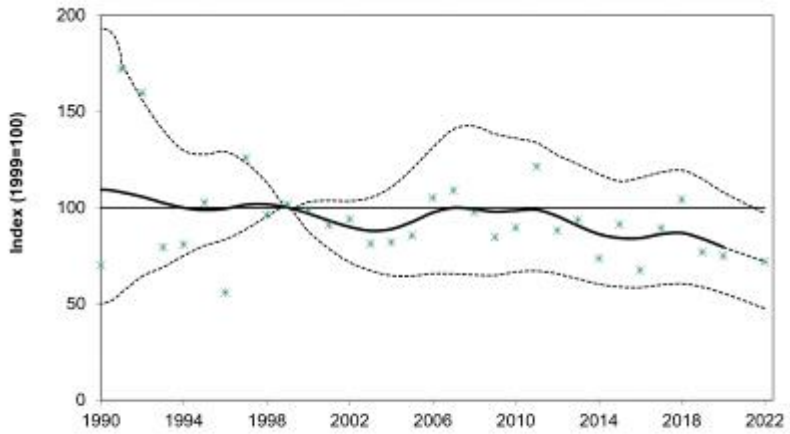
Fig 56. Hibernation Survey and Fig 57. Roost Count indices for brown long-eared bat in Great Britain, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Paur

Brown long-eared bat | England trends

The trend from the Roost Count in England shows no significant difference in the smoothed index when compared to baseline year. The most recent provisional smoothed value for the Hibernation Survey in England is significantly below the baseline value, however this may be revised when future years of data are added, so currently **the population of brown long-eared bat in England is considered to have been stable since 1999.**

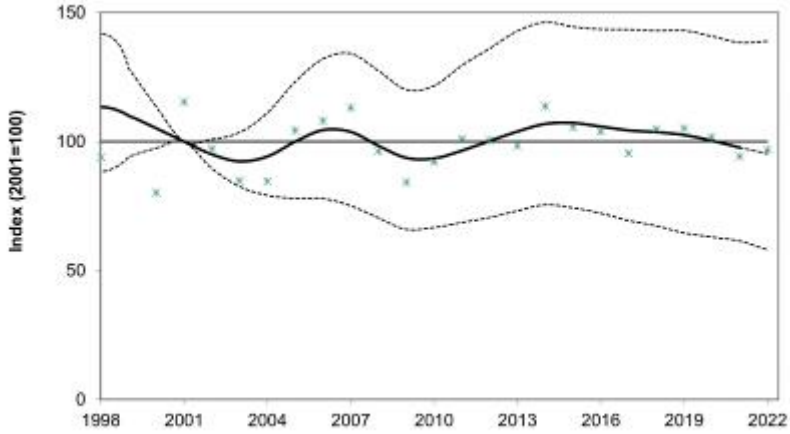
Hibernation Survey



The smoothed index is currently 28.1% below the 1999 base year value, equivalent to a mean annual decrease of 1.4% (95% CI -3.2% to -0.1%). The smoothed index has fluctuated at or below the baseline value since 1999, but it is only with the most recent provisional value that it has **fallen significantly below the 1999 base year value**, however this is a provisional value and may be revised up or down with the addition of future years of data.

For all years for which data are available (1998-2022), counts from 375 sites contribute to the trend analysis in England (sites surveyed in two or more years with brown long-eared bat recorded in at least one year).

Roost Count



The smoothed index is currently 4.7% below the 2001 base year value, equivalent to a mean annual decrease of 0.2% (95% CI -2.6% to 1.6%). It has fluctuated around the baseline value during the period monitored; however, **overall, the smoothed index does not differ significantly from the 2001 base year value**.

Data from 127 sites surveyed between 1998 and 2022 contribute to the trend analysis in England (sites surveyed in at least two years).

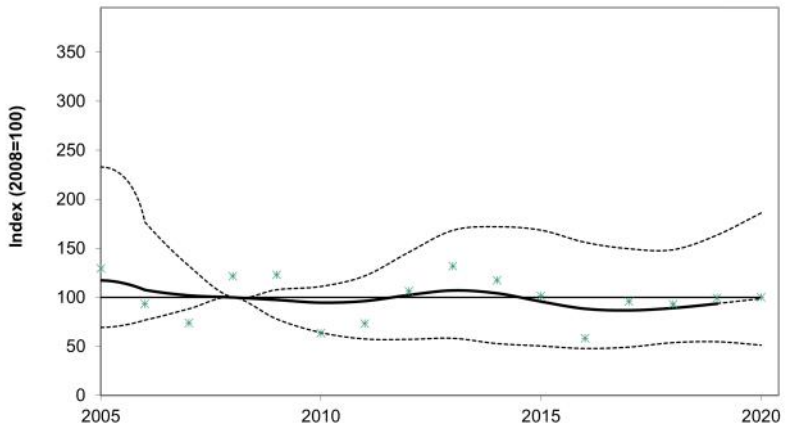
Fig 58. Hibernation Survey and Fig 59. Roost Count indices for brown long-eared bat in England, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Paur

Brown long-eared bat | Scotland trends

The trends from the Hibernation Survey and Roost Count in Scotland show no significant difference in the smoothed index when compared to the baseline year. Note that as a result of the suspension of the Hibernation Survey in winter 2020/21 and a low sample size of sites monitored in winter 2021/22 (see *Impacts of COVID-19* on page 7), it has not been possible to update the trend since 2020. The trend that was published in the 2020 Annual Report is repeated here for information. **The population of brown long-eared bat in Scotland is considered to have been stable since 2002.**

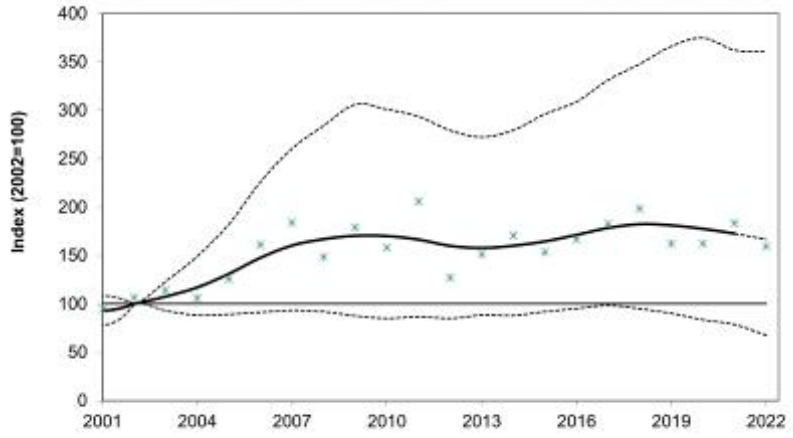
Hibernation Survey (**2020 trend**)



In 2022, the smoothed index was 1.2% below the 2008 base year value, equivalent to a mean annual decrease of 0.1% (95% CI -5.4% to 5.3%). The smoothed index has been relatively stable at or near the baseline value since the start of monitoring . **Overall, the smoothed index does not differ significantly from the 2008 base year value.**

From all years for which data are available (2005-2020), counts from 22 sites contribute to the trend analysis in Scotland. This is fewer sample sites than would be ideal to produce trends and as such the results may be unreliable. Improving the sample size for this trend is a priority (see *Developments and Future Directions*).

Roost Count



The smoothed index is currently 66.5% above the 2002 base year value, equivalent to a mean annual increase of 2.6% (95% CI -2.0% to 6.6%). Initially the smoothed index increased, however it has been relatively stable since 2008 and has not significantly exceeded the baseline value in any year. **Overall, the smoothed index does not differ significantly from the 2002 base year value.**

From all years for which data are available (2001-2022), counts from 31 sites contribute to the trend analysis in Scotland. Due to the wide confidence intervals, improving the sample size for this trend is a priority (see Developments and Future Directions).

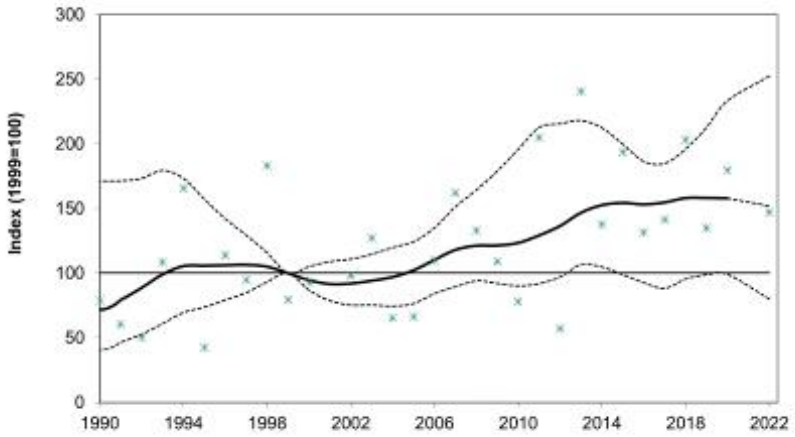
Fig 60. Hibernation Survey and Fig 61. Roost Count indices for brown long-eared bat in Scotland, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 (2020 for the Hibernation Survey) is shown as a dashed line to indicate that it is provisional.

Paur

Brown long-eared bat | Walestrend

The trend from the Hibernation Survey in Wales shows no significant difference in the smoothed index when compared to the baseline year. This species is also recorded on the Roost Count in Wales but the sample size is not large enough to produce a statistically robust trend. **The population of brown long-eared bat in Wales is considered to be stable in comparison to 1999.**

Hibernation Survey



The smoothed index is currently 51.9% above the 1999 base year value, equivalent to a mean annual increase of 1.8% (95% CI -1.0% to 4.1%). After a small decline the smoothed index increased each year between 2001 and 2015, however it only exceeded the baseline value significantly in 2013 and 2014. Since 2015 it has been relatively stable and **overall it does not differ significantly from the 1999 base year value.**

From all years for which data are available (1998-2022), counts from 95 sites contribute to the trend analysis in Wales (sites surveyed in two or more years with brown long-eared bat recorded in at least one year).

Fig 62. Hibernation Survey index for brown long-eared bat in Scotland, showing the baseline value (solid horizontal line), unsmoothed index value for each year (green crosses), smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2022 is shown as a dashed line to indicate that it is provisional.

Species for which population trends are not currently produced

Mmyo Greater mouse-eared bat

Myotis myotis

In recent years the greater mouse-eared bat has been considered to be a resident but non-breeding species in the UK. After being declared extinct in the UK in 1990, a single juvenile male was found during a Hibernation Survey in southern England in winter 2002/03 and was subsequently recorded every year until winter 2018/19. This individual's apparent absence in winter 2019/20 casted doubt on the species' continued status as a winter resident in the UK. COVID-19 restrictions meant that it was not possible to check for this species' presence at its usual hibernation site in winter 2020/21. Surveys in winter 2021/22 revealed that the UK's only known greater mouse-eared bat had again returned to its usual hibernation site, while winter 2022/23 brought the exciting news of a second individual hibernating in a nearby site.

Photo: David King

Range of greater mouse-eared bat in the UK (from NBMP data)

Population estimate
Only two known individuals currently recorded in the UK

Malc Alcathoe bat

Myotis alcathoe

Photo: Daniel Hargreaves

This species was first described in 2001 (von Helversen *et al.* 2001) and confirmed as a resident species in the UK in 2010 (Jan *et al.* 2010). It is likely under-recorded, but current knowledge suggests that it has a highly localised distribution restricted to areas of North Yorkshire, Sussex, Surrey, Kent and Wiltshire. It is very similar in appearance to whiskered and Brandt's bats and these three species cannot be distinguished acoustically or visually during NBMP surveys. However, based on current knowledge of this species' distribution, we believe it will be encountered too infrequently during monitoring of whiskered/ Brandt's bats to include this species within the whiskered/Brandt's bat combined trend. We will review this as further information becomes available.

Range of Alcathoe bat in the UK
(Map taken from 4th Report under Article 17 on implementation of the Habitats Directive in the UK, JNCC 2019)

Population estimate:
Numbers unknown for Great Britain. This species is not known to occur in Northern Ireland.

Mbec Bechstein's bat

Myotis bechsteini

This rare species is restricted to southern England and southern Wales and is associated with semi-natural woodlands. It is difficult to monitor using standard survey methods as it spends much of its time foraging high up in the canopy and produces low intensity echolocation calls which are challenging to record and identify on a bat detector.

Photo: Daniel Hargreaves

The Bechstein's Bat Project, which ran from 2007-2011, used survey techniques specifically designed for Bechstein's bat in order to establish baseline distribution data on this species in woodlands in southern England and South Wales, and to gather information to inform future conservation policy and woodland management.

Full details of the project, results and final report can be found on the Bechstein's Bat Project pages (www.bats.org.uk/our-work/national-bat-monitoring-programme/past-projects/bechsteins-bat-project). An article on the project and follow-on work was published in British Wildlife in 2013 (Barlow *et al.* 2013).

Range of Bechstein's bat in the UK
(Map taken from 4th Report under Article 17 on implementation of the Habitats Directive in the UK, JNCC 2019)

Population estimate

Country	GB	England	Wales	Scotland	N.Ireland
Number (Plausible intervals in brackets)	21,800 (10,300–55,600)	21,600 (10,200 – 55,000)	247 (116 – 626)	0	0
	Reliability score = 2 (scores >3 most reliable)				
Source	Mathews *et al. 2018*				

Nlei Leisler's bat

Nyctalus leisleri

Photo: Hugh Clark

This species is uncommon but widespread throughout England, Wales and Scotland. It is more abundant in Northern Ireland, as Ireland is a stronghold for the species. It is a mobile species and individuals move between roosts regularly; it is primarily a woodland species, but will also use buildings for roosting, although few building roosts are known.

A modification of the Field Survey for Northern Ireland was introduced in 2008 to allow for monitoring of Leisler's bats. Five sites in Northern Ireland have been surveyed using this modified methodology to date. A larger sample size is required before these data can be used to calculate species population trends. The new British Bat Survey has potential for delivering monitoring data for this species in future.

Range of Leisler's bat in the UK
(Map taken from 4th Report under Article 17 on implementation of the Habitats Directive in the UK, JNCC 2019)

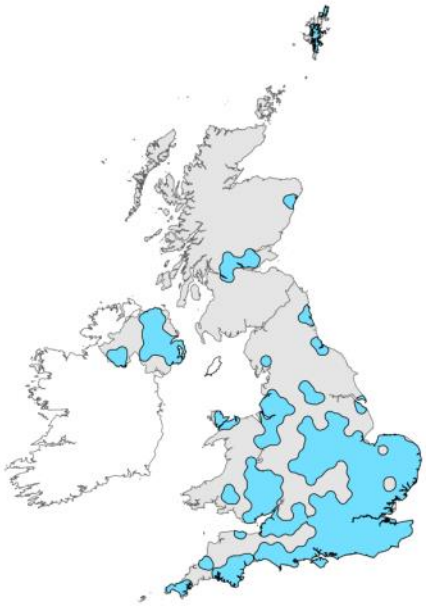
Population estimate:
Numbers unknown for Great Britain and Northern Ireland.

Pnat Nathusius’ pipistrelle

Pipistrellus nathusii

Photo: Daniel Hargreaves

Nathusius’ pipistrelle is rarer than other pipistrelle species in the UK, though records have increased in recent years. Distribution data on Nathusius' pipistrelle have been collected through the NBMP by the Nathusius' Pipistrelle Survey, a bat detector survey at waterbodies which ran from 2009-2014, and since 2014 by the National Nathusius' Pipistrelle Project (NNPP).



Range of Nathusius’ pipistrelle in the UK
(Map taken from 4th Report under Article 17 on implementation of the Habitats Directive in the UK, JNCC 2019)

Population estimate:
Numbers unknown for Great Britain and Northern Ireland.

National Nathusius' Pipistrelle Project (NNPP)

The NNPP resumed in 2022 after being suspended in 2020 and 2021 in line with guidance from the IUCN bat specialist group on minimising non-essential surveys which involve close contact with bats. This was a precautionary measure due to the unknown but credible risk of human-to-bat transmission of the SARS-CoV-2 (the virus that causes the disease COVID-19). The project resumed in 2022 with precautions in place informed by the latest IUCN guidelines.

The methodology of the NNPP involves capturing bats under licence using acoustic lures and harp traps in activity hotspots. Harp traps are the safest and least stressful method for trapping bats in the field. Bats are examined to ascertain their sex, age and breeding status. If a Nathusius' pipistrelle is caught then a dropping and a fur sample may be collected for analysis, and, if an experienced bat ringer is part of the project team, the bat is ringed before being promptly released.

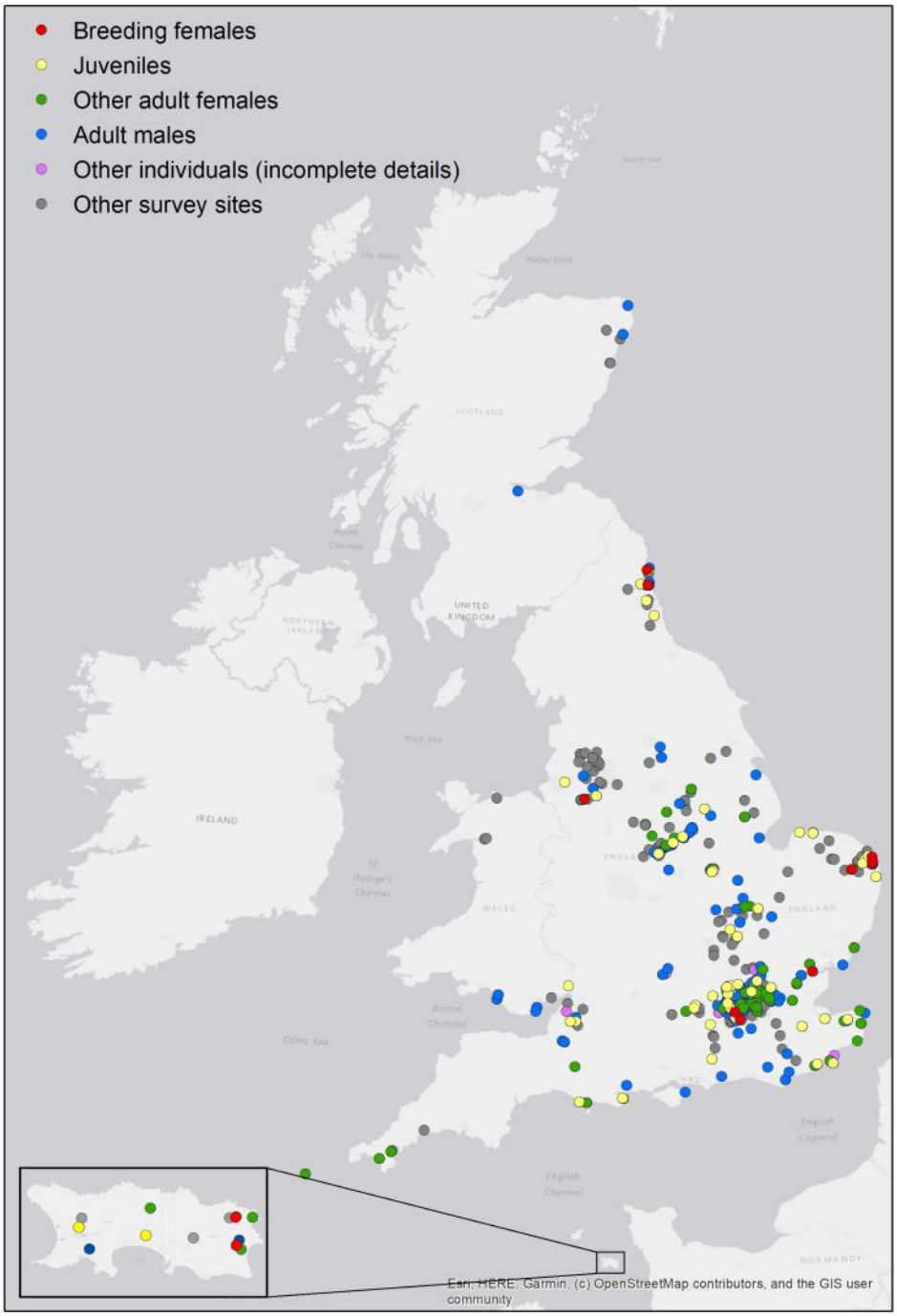


Fig 63. Nathusius' pipistrelle captures, April 2011 to October 2022. At each site there may be records falling into more than one category but the symbol indicates the level to which breeding or potential breeding has been identified: breeding females > juveniles (potentially born locally) > other adult females > males only caught.

The inset shows results for Jersey.

Key results:

- From 2011 to 2022, 29 bat groups have taken part in trapping surveys across 355 sites, resulting in 2,761 captures of Nathusius' pipistrelle (including recaptures of individual bats).
- Actual roost locations of maternity colonies have been discovered in Kent, Northumberland and on the Surrey/Greater London border.
- Nine long distant migratory records have been found:
    - one bat ringed in North Somerset was rediscovered in Holland in December 2013;
    - a bat from Latvia was recaptured in East Sussex in October 2015;
    - two bats from Lithuania were recaptured in Kent in August and October 2016;
    - two bats from Latvia turned up in Greater London in August and September 2017, and one bat from Latvia in Essex in September 2017;
    - one bat ringed in East Sussex was found in Belgium in September 2018;
    - one bat ringed in Northumberland was found in Poland in May 2019.
    - one bat ringed in London was found in Russia in August 2021.

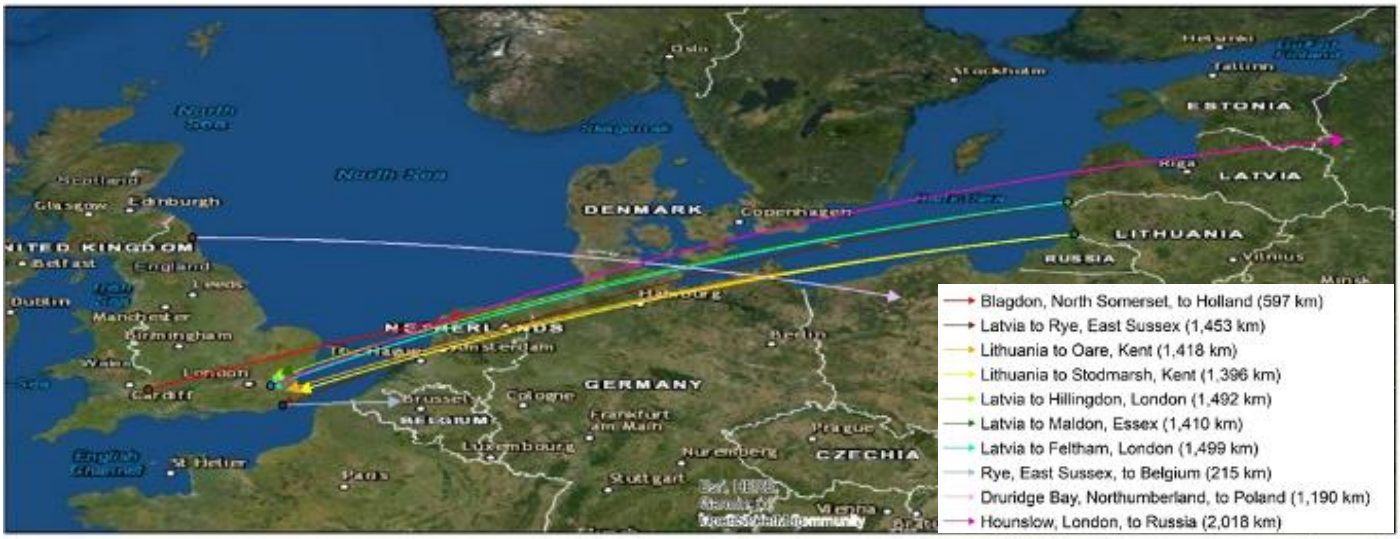


Fig 64. Movements of ringed Nathusius' pipistrelles from the National Nathusius' Pipistrelle Project

Planned future directions for this project include more extensive analysis of the data collected so far; expanding the surveys into parts of GB that are currently under-represented; targeted use of extensive passive acoustic monitoring to identify seasonal movements of migrating bats; and helping develop the Motus Wildlife Tracking System network, an international collaborative research network that uses a coordinated automated radio telemetry array to track the movement and behaviour of small flying animals fitted with radio tags, which could give us a more detailed picture of the migratory routes taken by Nathusius' pipistrelles.

A meeting was held in November 2022 between BCT and several bat workers from the UK and Europe who are doing important work on Nathusius' pipistrelle within the above work areas. The output of the meeting was a list of priority work areas for including in funding bids which BCT will be taking forward in 2023 with a focus on conservation priorities and knowledge gaps for Nathusius' pipistrelle and other migratory species.

Bbar

Barbastelle

Barbastella barbastellus

Special Areas of Conservation designated for barbastelle are monitored through the Woodland Survey funded by Natural England. Data on barbastelle are also collected from a small number of Hibernation Survey sites but currently there are insufficient data to produce a robust population trend.

Range of barbastelle in the UK

(Map taken from 4th Report under Article 17 on implementation of the Habitats Directive in the UK, JNCC 2019).

Population estimate:

Numbers unknown for Great Britain. This species does not occur in Scotland or Northern Ireland.

Results from the Woodland Survey

The NBMP Woodland Survey was piloted by BCT in 2004 and launched in 2005 to assess the presence and relative abundance of barbastelle (*Barbastella barbastellus*) at woodland sites. The survey and analysis methods were revised in 2006 and surveys have been completed using this revised methodology since then.

The surveys are completed in three periods:

- Period 1: 25th July to 8th August
- Period 2: 9th to 23rd August
- Period 3: 24th August to 7th September

Currently Natural England provide funding to monitor the presence of barbastelles using this survey methodology at five woodland Special Areas of Conservation (SACs) in England where the presence of barbastelle is a primary reason or qualifying feature for designation. An additional site is surveyed in Wales. The results across all survey years are summarised in Table 11.

Since 2005 a total of 49 transects have been surveyed. This includes transects in seven Special Areas of Conservation (SACs). From 2011 surveys have been entirely focused on the SAC sites.

Table 11. *Summary of Woodland Survey results from SAC sites monitored 2005-2022 (P = barbastelles present; N/S = not surveyed)*

Year	SAC Site / barbastelle recorded						
	Briddlesford Copses	Ebernoe Common	Eversden & Wimpole Woodlands	Exmoor & Quantock Oakwoods	The Mens	Mottisfont	North Pembrokeshire Woodlands/ Coedydd Gogledd Sir Benfro
2005	N/S	N/S	P	N/S	N/S	P	P
2006	N/S	N/S	P	N/S	N/S	P	N/S
2007	N/S	N/S	P	N/S	N/S	P	N/S
2008	N/S	N/S	P	N/S	N/S	P	N/S
2009	P	P	P	P	N/S	P	P
2010	P	P	P	P	P	P	P
2011	N/S	P	P	P	P	P	P
2012	N/S	P	P	P	P	P	N/S
2013	N/S	P	P	P	P	P	P
2014	N/S	P	P	P	P	P	P
2015	N/S	P	P	P	P	P	P
2016	N/S	P	P	P	P	P	P
2017	N/S	P	P	P	P	P	P
2018	N/S	P	P	P	P	P	P
2019	N/S	P	P	P	P	P	P
2020	N/S	P	P	P	P	P	P
2021	N/S	P	P	P	P	P	P
2022	N/S	P	P	P	P	P	P

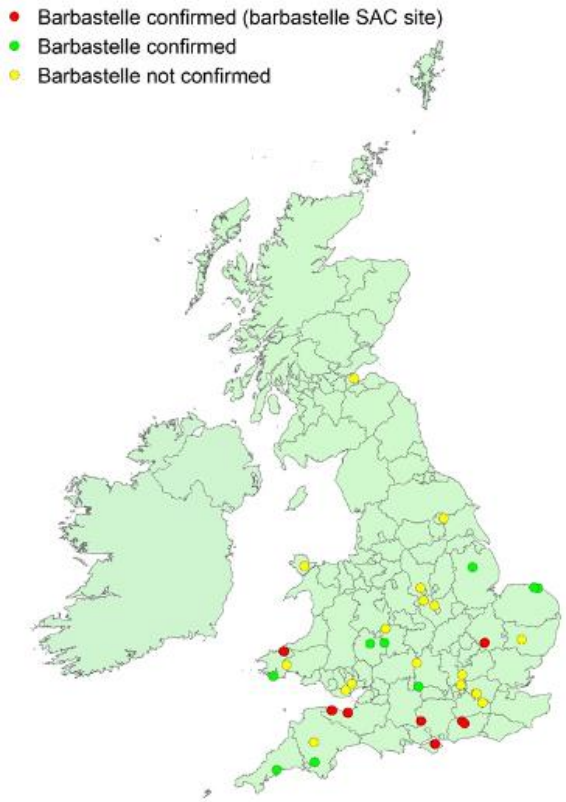


Fig 65. Distribution of Woodland Survey sites 2005-2022

Paus

Grey long-eared bat

Plecotus austriacus

Grey long-eared bat is the rarest breeding bat species in the UK, with a distribution largely confined to the southern edge of England. It is monitored on the Roost Count and, while the sample size is too small for producing a species population trend, the high importance of known roosts makes these a priority for ongoing monitoring.

Photo: Daniel Hargreaves

Population estimate

Country	England	Wales	Scotland	N.Ireland
Number	1,000 (Pls 400–3,000). Reliability score = 1. (scores >3 most reliable)	Does not occur	Does not occur	Does not occur
Source	Mathews *et al. 2018*			

Range of grey long-eared bat in the UK
(Map taken from 4th Report under Article 17 on implementation of the Habitats Directive in the UK, JNCC 2019)

Roost counts

As part of the “Back From the Brink” suite of projects (2017-2021) (https://naturebftb.co.uk/) BCT led on a project focused on grey long-eared bat which involves working with landowners to discover how to retain and enhance the precious habitats that the bats need. An aim of this project was to have eight maternity roosts monitored for the NBMP. Seven grey long-eared bat roosts are included in the NBMP, although two of these are not currently allocated to volunteers. Two roosts in Devon were monitored in 2022, both of which have been monitored since 2013. In 2023 we are working with the Isle of Wight Bat Group to get roosts monitored on the island.

NBMP Grey long-eared bat Project 2012

In summer 2012 the National Bat Monitoring Programme undertook the Grey Long-eared Bat Project with the aim of identifying grey long-eared bat roosts and so expand our knowledge of the distribution of this rare species. BCT enlisted the help of long-eared bat roost owners within the species' known range and asked them to collect and return droppings from their roosts. Many roost owners and other volunteers kindly participated and DNA analysis was used to confirm if the droppings came from a brown long-eared bat or were in fact from the similar, but rare, grey long-eared bat. Grey long-eared bat was identified at one of these roost sites. The full report is available at https://hub.jncc.gov.uk/assets/b7f26ada-87d3-445a-8407-ec006c0d0cc0.

Grey long-eared bat (Hugh Clark)

Sunset Survey

The Sunset/Sunrise Survey has been running since 2002 as an engagement survey designed to enable new volunteers to take part in a simple beginner level bat survey. This is ideal for anyone who does not have previous bat surveying experience. More experienced volunteers have also taken part as it is an effective technique for locating bat roosts. The survey encourages volunteers to get together with family or friends and discover bats and other wildlife in their local area. From 2002 to 2022, 2,327 volunteers have taken part in the survey.

***"Seeing and finding bats in my local area was a tremendous experience and an incredibly insightful time! Thank you so much!" Ivaylo Statelov—Sunset Survey volunteer* (2022)**

Volunteers are asked to spend the hour after sunset and/or the hour before sunrise in their garden or local open space and look for any bats or other nocturnal animals they can spot. A visual guide is provided to help beginners identify a few of the more common bat species. Results are submitted via a dedicated online recording page developed and hosted by iRecord.

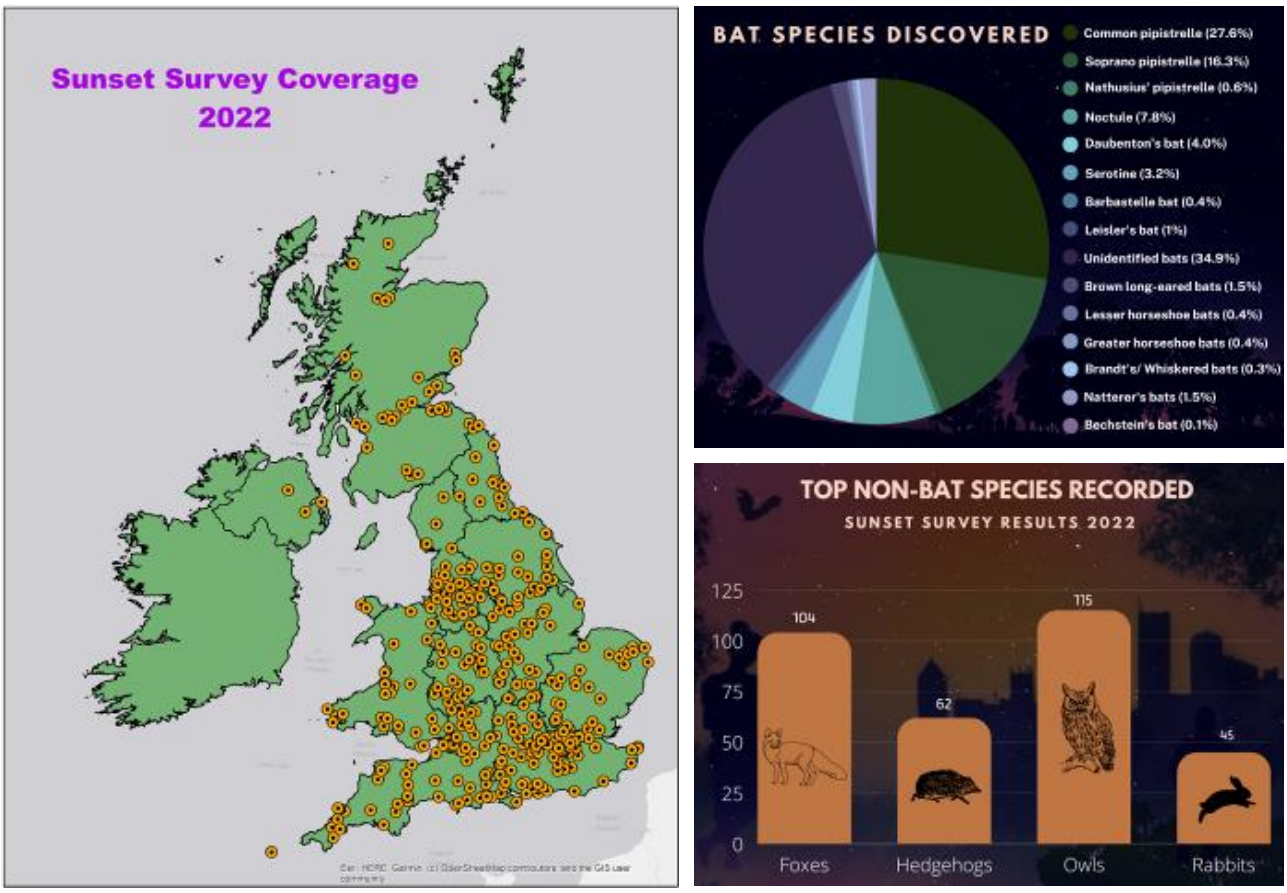


Fig 65. Three of the Sunset Survey results infographics shared with participants and on social media.

The survey can be carried out anytime from April to October. Between May and August is the best time to see bats swarming as they return to the roost. In 2022, 776 Sunset/Sunrise Surveys were completed by at least 353 volunteers. 28 bat roosts were reported through spotting dawn swarming. The infographics on this page were produced after the 2022 survey season to give feedback to volunteers who took part in the survey.

Volunteers can follow the steps of taking part in the Sunset Survey at www.bats.org.uk/our-work/national-bat-monitoring-programme/getting-started.

Research and conservation

Conservation action

Assessing the status of ecosystems and biodiversity

Data from the NBMP are used to calculate four UK Biodiversity Indicators: C8 Mammals of the Wider Countryside (bats); A2 Taking action for nature: volunteer time spent in conservation; C3b Status of UK species of European importance; and C4 Status of UK Priority Species (jncc.gov.uk/our-work/uk-biodiversity-indicators-2022/). These indicators form part of the UK's reporting on the Conservation on Biological Diversity Aichi Targets. NBMP data also contribute to three English Biodiversity Indicators: 4a Status of priority species - relative abundance; 5 Species in the wider countryside – farmland; and 14 Taking action for the natural environment. In 2022, a more limited set of biodiversity indicators was produced which did not include the bat indicator.

Data from the NBMP contribute to UK reporting on the conservation status of UK bat species including range, population status and future prospects. NBMP data are also used to assess the condition of protected areas, in particular Special Areas of Conservation and Sites of Special Scientific Interest notified for their bat populations.

National Bat Monitoring Programme data contribute to the Office of National Statistics (ONS) Natural Capital Accounts, which estimate the financial and societal value of natural resources to people in the UK. We contribute bat indicators for urban, woodland, enclosed farmland and freshwater habitats, and also for the composite semi-natural habitat class. The semi-natural bat indicator is one of our downloadable data products and can be accessed at www.bats.org.uk/our-work/national-bat-monitoring-programme/reports/nbmp-annual-report.

Data from the NBMP contribute to the State of Nature report, a healthcheck of how the UK's wildlife is faring. The previous State of Nature report in 2019 assessed 8,431 species assessed, of which 15% were at risk of extinction. An updated assessment is currently underway with a new report due to be published later in the year.

Research

Bats and Insects

BCT is project partner on a NERC-funded study investigating the drivers and repercussions of UK insect population declines, alongside the University of Leeds, UKCEH, University of Reading and Rothamsted Research. This project began in January 2021 and ends in Jan 2025. It will make the most comprehensive assessment to date of the state of the UK's insect populations, and link insect population changes to changes in insect predator populations (bats and birds).

BCT are also a co-supervisor of a PhD hosted by Rothamsted Research, investigating the long-term changes in the abundance and phenology of migrating insects as potential drivers of population change in insectivorous birds and bats. Hannah Romanowski started the South West Bio Doctoral Training Partnership (SWBio DTP) studentship PhD in Sept 2021. She completed her Rotation 1 project with BCT and the British Trust for Ornithology (BTO), as an introduction to the NBMP and bird datasets she will be working with during her PhD. Hannah completed her field-based Rotation 2 at the University of Bristol with supervisory input from BCT and will be collecting further bat activity data for comparison to insect trap data in 2023. Hannah presented her results from her Rotation 2 at the BES conference as a poster entitled 'Investigating the long-term change in the abundance and phenology of aerial insects as potential drivers of population change in UK bat species' and is due to present the same work at the BritBats conference in May 2023.

Brown long-eared bat with moth (Daniel Hargreaves)

Bats in Churches

Between 2019 and 2022, the Bats in Churches project ran an ambitious citizen science project to help better understand how bats are using churches across England. Working alongside church communities and bat groups, volunteers surveyed 714 churches across England for the National Bats in Churches Survey and Church Bat Detectives. The survey has now concluded. Early analysis has revealed that 55.8% of churches surveyed had evidence of bats. DNA analysis of bat droppings and acoustic surveys inside the church revealed that common pipistrelle, soprano pipistrelle and brown long-eared bat were the most frequently detected species. Further analysis of the data is ongoing. Many of the churches surveyed as part of the project continue to be monitored as part of the NBMP Roost Count.

Photo: Shirley Thompson

Species distribution modelling

NBMP data were used by PhD student Lea Dambly in a case study examining parameters affecting species distribution models that use integrated data (data from more than one source). Lea used integrated data from the NBMP and NBN for the serotine *Eptesicus serotinus* in Great Britain to create distribution models. In this study, Lea recommends caution when setting up the model, to avoid overfitting. The conclusion of the work is therefore that data integration is crucial if modellers are to utilise location data from the maximum number of sources, but caution is needed when doing so. Lea's study is an important step forward in highlighting the tools available for ecological researchers when modelling species' distributions. This research has been published as 'Integrated species distribution models fitted in INLA are sensitive to mesh parameterization' in the Journal of Applied Ecology (http://doi.org/10.1111/ecog.06391)

Data collected as part of the Bechstein's Bat Project were used by researchers at the University of the West of England to model species-specific sex differences in response to habitat (in and around woodlands) and connectivity of woodland patches. This work, entitled 'Sexual segregation occurs in bats within fragmented remnant woodlands in an agricultural landscape' has been published in Ecology and Evolution (https://doi.org/10.1002/ece3.9350). The main conclusions include that males and females of three species (*Myotis nattereri*, *Myotis mystacinus* and *Plecotus aurtitus*) differ in their responses to landscape features, the take-home message being that isolated remnant woodland patches are important to bats in fragmented agricultural landscapes.

Genetic approaches to monitoring bats

We are collaborating with researchers at the University of Exeter to explore whether genetic techniques can be used to provide evidence of historic bat population change. Analysis of samples from barbastelle populations in GB, Spain and Portugal demonstrated that genetic techniques can provide evidence of relatively recent population change (in genetic terms, e.g. within the last 1000 years). A paper describing these findings is currently in review. In 2022 we extended this analysis to include brown-long eared bat, with the support of JNCC and Natural England. The results of this analysis are currently being processed.

We are also collaborating with researchers from Queen Mary University of London who are carrying out research on eDNA, extracting DNA samples from the air using filtration units to detect the presence of different species. Studies have shown this technique can be very effective at correctly identifying a range of species within enclosed spaces and preliminary work on bats is very encouraging. In winter 2022/23 researchers joined bat workers on surveys at several hibernation sites that are included in the NBMP. One hour of airborne eDNA extraction was carried out at each site and the results of the analysis are due in the autumn. We will compare the eDNA results with results from the NBMP Hibernation Survey visits to examine how closely levels of eDNA correlate to species presence and numbers of individuals recorded during internal site inspections by volunteers. Depending on the results, collection of eDNA samples could potentially be an alternative approach to monitoring bats at sites that are not being monitored in the usual way due to the current measures to limit the transmission of SARS-CoV-2 from humans to bats. This could also enable monitoring at sites that are unsafe for internal inspections. In future we are looking to expand the use of airborne DNA sampling into open areas such as woodlands.

Hibernation survey at a site which also had eDNA sampling in winter 2022/23 (photo: Cindy Blaney)

Developments and future directions

The strategic aim of the NBMP is to deliver a world-leading, cost-effective citizen science programme supported by motivated volunteers, providing high quality data able to inform evidence needs, policy-relevant questions and metrics of bat population status, change and distribution. Here is a summary of some recent work to further this aim, and work planned for the future.

Passive acoustic monitoring

BBatS

The British Bat Survey (BBatS) is a structured passive acoustic monitoring survey of bats designed to provide populations trends for bat species found in GB, particularly for species not currently monitored within the NBMP. A second British Bat Survey (BBatS) pilot was launched in July 2022, funded by Joint Nature Conservation Committee (JNCC). BBatS is planned to be embedded within the NBMP by 2025 and as it grows will significantly improve our ability to monitor the conservation status of British bats.

The 2022 pilot collected data from 96 site surveys. Most surveys took place in England with 13 in Scotland and five in Wales. Planning for the beta year in 2023 is underway.

NightWatch

NightWatch is an unstructured passive acoustic bat survey designed to engage people with nature, particularly those from urban and ethnic minority communities while producing robust locally-focused biodiversity data. It is a community science/citizen science project which launched in 2021, with data collected in the summer and early autumn of 2021, 2022 and a third collection period planned for 2023. It is run by the Bat Conservation Trust and supported by Esmée Fairbairn Foundation and Joint Nature Conservation Committee (JNCC).

Data from both seasons have been analysed and shared with volunteers in the form of a personalised report for each site. Over the two years of the survey so far, 456 participants have taken part and 20-24% were from ethnic minority communities. We now have five NightWatch Champions, as a legacy of the project. Our 2023 Engagement Strategy is currently being finalised and we are currently co-creating a guide to night-time wildlife, anticipated to be complete May 2023.

We are in the process of collating and providing feedback on the beta version of the NightWatch online portal. The website can host multiple surveys and other BCT passive acoustic surveys can be added at any time. We are developing an upload app that will enable volunteers to upload their recordings directly to our cloud-based sound classification system. We plan to trial the app this coming survey season.

Nightwatch promotional graphic

Woodland Monitoring

In 2022 BCT continued our collaboration with Forest Research and Forestry England exploring the use of passive acoustic technology for monitoring bat populations and other metrics of ecosystem health in woodland. We conducted surveys in 36 National Forest Inventory plots and three Forestry England sites. As part of this project we are working with experts in the fields of machine learning, edge-processing, passive acoustics, and Internet of Things devices to develop and test a prototype solar powered semi-autonomous passive acoustic sensor. The sensor was field-tested in 2022 and in 2023 we will be developing its edge processing and communication capabilities further, together with further field tests in a woodland setting. We also continue to refine the algorithms we use to classify bat sound and forest soundscapes. In 2023 we will continue this work.

Photo: Sonia Reveley

Hibernation Survey

The Hibernation Survey resumed in winter 2021/22, following its suspension the previous winter due to the COVID-19 pandemic. The survey now includes risk assessments aimed at reducing the risk of passing SARS-Cov-2 on to bats (as described under *Impact of COVID-19*, page 7), which has resulted in many smaller hibernation sites not being surveyed in winter 2021/22. The total number of sites surveyed in 2021/22 was only 294, compared with 521 in winter 2019/20 (the year prior to the suspension of the survey). If the number of sites surveyed across Great Britain each winter continues to be constrained by these currently necessary measures, this may weaken our ability to produce robust trends from Hibernation Survey data. In anticipation of this potential problem, we are exploring alternative methods to collect data from hibernation sites where internal counts are not currently being undertaken. In winter 2022/23 we developed a protocol for passive acoustic monitoring at hibernation sites, in consultation with a few volunteers who have done previous work on this. We shared this protocol with all Hibernation Survey volunteers and as a result passive acoustic monitoring was carried out at around 16 sites throughout the winter months. The results will be analysed over spring/summer 2023 to assess whether there are any correlations between species/activity levels recorded through passive acoustic monitoring and species/numbers recorded on internal site inspections. It is anticipated that there will be challenges in identifying certain species from calls recorded in confined spaces, but it will be valuable to find out whether any species lend themselves to being monitored at hibernation sites using acoustic techniques. As described under *Genetic approaches to monitoring bats* (page 88) we have also taken the opportunity to have eDNA sampling carried out at hibernation sites to explore another potential approach to monitoring bats during the winter.

Sound Classification

Our Sound Classification System (SCS) underpins all BCT's passive acoustic monitoring (PAM) surveys. The SCS encompasses our data upload app (SoundDrop), our online volunteer portal (https://surveys.bats.org.uk), our automated classification system and bespoke reporting. It aims to streamline the data processing for NightWatch, BBatS and other PAM projects. Initial development work has been implemented and we have made good progress in refining different parts of the workflow. We are now embarking on a major development to our system in conjunction with a cloud development consultancy.

EchoHub

EchoHub is an open-source, community-built, sound library focusing exclusively on bat sounds. The goal of EchoHub is to make it easier to share and access recordings of bat sounds for diverse purposes such as scientific research, conservation, education, and the arts. The website's wireframe is completed. We have tested the website with initial users and collated feedback. We are currently editing the website to incorporate the users' feedback, for example the inclusion of the ability to download a .csv file with all the metadata associated with every call in the library. The main focus of development has been finding a way to implement a 'quality check' system of rating the calls, so that users can easily identify high quality recordings. We are currently investigating a suitable acoustic index calculation to act as a rating system. The next step will be to soft-launch the website with the collaboration of two or three bat groups.

Equality, Diversity and Inclusion

As in the previous year, in 2022 we hosted a part-time, six-month placement as part of the government's Kickstart scheme. The role was again a Volunteer Engagement Officer, with a focus on improving our outreach to younger and more diverse audiences. Through this role we were able to increase our social media presence across different platforms, do intensive engagement with under-represented audiences London borough in which the VEO was based, and create new resources including videos and infographics promoting the NBMP. From 2023, JNCC are providing funding for an annual work placement along similar lines to the Kickstart scheme. However, this year we were successful in applying for funding for a full-time, one-year placement through Groundwork's New To Nature project, funded by the Heritage Fund to coincide with the Queen's platinum jubilee. The JNCC funding for a part-time, six-month placement was used as required match-funding for this more substantial work placement. Recruitment through the New To Nature project was targeted at young people from diverse backgrounds. We recruited a Volunteer Engagement Officer who began in mid-April and will be building on work carried out by the previous person in the role as well as bringing in new ideas and experience.

Photo: Michelle Parsons

JNCC have also provided funding for a project designed to engage people from an under-represented group in the NBMP, by providing them with training in skills to develop a resource that will reflect their interests, experiences, and community while inspiring others to take part in the NBMP, particularly our beginner-level survey, the Sunset Survey. We have teamed up with Wanderers of Colour, a group that is committed to social justice through improving access to travel and the outdoors, and will be inviting their followers along to the sessions we are running. Our BCT ambassador Aruhan Galieva and her partner are providing training on techniques for telling stories through film-making and editing. The goal is for the participants to produce a video that can be included on the BCT website and social media. The NBMP team is partnering with the Nightwatch team to deliver this project which will also deliver a Nightwatch resource. Butterfly Conservation are also involved in helping engage the audience in nature, with a focus on learning about and appreciating moths. The new resources produced through this project are expected to be launched in June 2023.

Scottish Nathusius' Pipistrelle Project

For 2023/24, the focus of the Scottish Bat Project (funded by NatureScot) will be continuing the work with Scottish Bat Groups and other partner organisation to fill data gaps regarding distribution of the Nathusius' pipistrelle bat in Scotland, by continuing static and transect bat detector surveys. We will also continue the Scottish Nathusius' Pipistrelle Survey Skills Programme, which had a great uptake during the previous year, including online and in-person workshops with a focus on Nathusius' pipistrelle survey skills. Plans for the second half of the 2023 season are to survey 'hot-spots' of Nathusius' pipistrelle using advanced survey techniques, such as harp trapping, radiotracking and ringing in areas where Scottish bat groups have successfully identified survey locations.

Increasing sample sizes for country-level species population trends

We have been contacting volunteers who previously undertook counts at roosts that have not been monitored for several years, to ask if they are able to revisit their previous site in 2023. Carrying out repeat surveys at previously monitored sites is an effective way to improve the robustness of our species population trends, though where there are limited numbers of sites that are still suitable or accessible to survey then there is also a need to add new sites. We have focussed on species with lower sample sizes from Roost Counts (Natterer's bat, serotine and brown long-eared bats) and countries where increased sample sizes are needed for producing trends at country level (Scotland and Wales). We are also working with Northern Ireland Bat Group on improving sample sizes for that country. Responses from volunteers have been encouraging in several instances, with some optimism expressed that certain roosts can be surveyed again in 2023 after a gap of many years. We will also be doing more general communications to volunteers to encourage counts at lower priority (though still useful) roosts that have not been counted for some years. Similar exercises are underway for the Field Survey and Waterway Survey and for these surveys we have also been working with bat group NBMP Champions to encourage members of the groups to take on survey sites in their local areas.

NBMP staff and IT infrastructure

We have secured funding for a full-time work placement through Groundwork's New To Nature scheme, funded by the National Lottery Heritage Fund. This scheme provides opportunities for young people who are from ethnically diverse backgrounds, are disabled or who are economically disadvantaged. Through

Acknowledgements

NBMP volunteers

A huge thank you must go out to all our hard-working NBMP volunteers who have collected bat data that have contributed to this report. The NBMP relies on the ongoing efforts of hundreds of volunteers whose dedication allows us to produce population trends for UK bats. Without our volunteers the NBMP would not exist.

Many of our volunteers have received training from our volunteer Regional Bat Detector Workshop Leaders and we would like to thank them for their continuing dedication to helping us to train up volunteers to maintain the high standards of NBMP surveys. Workshop leaders include Mike Castle, Diana Clark, Ian Cornforth, Richard Crompton, Richard Dodd, Colin Edwards, Elisabeth Ferrell, Rich Flight, Andrea Hudspeth, Steve Lucas, Helen Lundie, Mhairi Mackintosh, Aidan Matthews, Steve Parker, Liz Probert, Clare Rawcliffe, Annette Smith, Natalie Todman, Nick Tomlinson, Denbeigh Vaughan, Edward Wells and Lisa Worledge. Many BCT staff have also contributed to the NBMP.

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Appendix: Statistical methods

In order to produce a clear picture of the long-term trend for each species, Generalised Additive Models (GAMs) are used to fit a smoothed line to each dataset, allowing for factors that could influence the means where appropriate (e.g. bat detector make, temperature, see Barlow *et al*. 2015 for more details). These smoothed curves are quite robust against random variation between years, except at the ends of the series where annual fluctuations and extreme outliers can have an unacceptably large impact on the first and last few years of the time series. To counteract this problem, it is best practice not to use the first year of a survey as the baseline year (where the index equals 100). In this report the year 1999 has been taken as the baseline year wherever possible. Most surveys start from 1997, although there are a few exceptions. The Field Survey starts from 1998, and some Hibernation Surveys and Roost Counts have earlier years of data for some species. Where these data are available and improve trend estimation, they have been included in the GAM analysis but as they comprise small amounts of data, the start year is still shown as 1997. In all cases, the estimate for the most recent year should be regarded as provisional and a dotted line is used in figures to indicate this.

The average annual percentage change is an approximation based on the assumption that the trend during the period considered is constant and linear. It is estimated by calculating the annual percentage change that would take the population from 100 in the base year to the index value in the current year.

Generalised Additive Models are based on the method described by Fewster et al. (2000). These involve fitting a log-linear generalised linear model (i.e. a regression model with a logarithmic relationship to the explanatory variables and a Poisson error distribution) to the counts on each survey. A site term is fitted in the model to allow for differences in abundance between sites and the time trend is modelled using the GAM framework to fit a smoothed curve. These GAM models are essentially a more sophisticated version of a polynomial curve and are less likely to display misleading trends at the extremes of the data than a polynomial. The degree of smoothing is controlled by specifying the degrees of freedom for the smoothing process; this may vary between 1 (equivalent to a simple linear trend) and one less than the number of years (a 'saturated model' equivalent to fitting individual annual means). For the results presented here the degrees of freedom are generally set to the default value suggested by Fewster et al. (2000), which is 0.3 times the number of years. However, curves for different degrees of freedom are always checked to ensure that the model provides an appropriate degree of smoothing to the annual means without being unduly influenced by individual outlying years. The index values are derived from the fitted curve, taking the base year to be 100. Annual means from the saturated model are also shown on the graphs in order to give a visual impression of any deviations from the smoothed curve.

The other feature of these models is that confidence limits based on standard theory will not be valid due to temporal correlations. In addition, NBMP data suffer from other complications not present in the data examined by Fewster et al. (2000) which also invalidate the usual method of calculating confidence limits. Firstly the data are much more variable than would be expected from a Poisson distribution. This phenomenon, known as 'overdispersion', is very common in biological data, but is particularly extreme in these datasets. Fewster et al. (2000) suggest a negative binomial distribution might be an alternative but

simulations suggest that, while it sometimes produces more precise results, this is not always the case, and it can lead to bias in some situations. Secondly the repeat counts in each year add a further complexity to the correlation structure of the data. All these problems are avoided by using the bootstrap approach recommended by Fewster in which the model is fitted to a large number of new datasets created by resampling sites with replacement from the original sites. At least 400 bootstrap samples are used for each model to ensure robust 95% confidence limits. The same bootstrapping approach can be used to produce confidence limits to other quantities of interest, including the short- and long-term assessments used in the Defra biodiversity indicators (http://jncc.defra.gov.uk/page-4271).

Data for Great Britain are weighted to allow for the different sampling rates in England, Scotland and Wales. This is achieved by weighting each site in proportion to the ratio of non-upland area to number of sites surveyed for the relevant country, thus ensuring that each country contributes equally to the trends based on lowland land area. Weighting is not applied to those species, such as serotine and horseshoe bats, which have a restricted range within the UK.

Overdispersion is a particular problem for the Field and Waterway Surveys, where a single bat repeatedly flying past the observer may give rise to a large count of bat passes. This results in wide confidence limits for Poisson or negative binomial GAM models and so we have instead presented results for a binomial model of the proportion of observation points on each survey where the species was observed. Apart from this difference in the response variable, the same GAM approach, with bootstrap confidence limits, is adopted. Simulations suggest that these binomial models have greater power to detect trends with the high levels of overdispersion seen in the Field and Waterway Surveys.

In order to test whether the smoothed curves differ between different countries or regions Fewster et al. (2000) suggest a deviance test. However, simulations have suggested that this test can produce too many significant results, and so the results presented here use a randomisation approach to obtain a probability value from the change in deviance.

Analyses were conducted in R (version 4.0.2) and Genstat (21st Edition).