National Bat Monitoring Programme

Annual Report 2021

Executive summary

- This report presents the results of the National Bat Monitoring Programme (NBMP) up to summer 2021.
- 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, Hibernation Survey, Field Survey and Waterway Survey. The Hibernation Survey was suspended in winter 2020/21 due to COVID-19 and therefore it was not possible to produce updated trends from this survey. The trends to winter 2019/20 are reproduced in this report so that all the latest trends are available in one place.
- Volunteers taking part in these long-term monitoring surveys contributed approximately 11,304 hours of their time, representing an in-kind contribution to the NBMP of £152,790.
- Across all ongoing NBMP surveys (our four long-term monitoring surveys, plus the Woodland Survey; the Sunset/Sunrise survey is excluded as sites are not precisely defined) 6,928 sites have been surveyed since the inception of the programme in 1996. In 2021 1,202 sites were surveyed by 946 volunteers.
- We also encourage new volunteers to get involved in the NBMP by taking part in our Sunset/Sunrise Survey. In 2021, 597 Sunset/Sunrise Surveys were completed by at least 324 volunteers. Volunteers reported 27 bat roosts during this survey.
- At present sufficient data are collected by the NBMP to produce population trends for 11 of Great Britain's 17 breeding bat species, though trends for only nine species have been updated for 2021, due to one species group (whiskered/Brandt's bat) only being monitored on the Hibernation Survey which was suspended. 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 2021, species considered to have increased in Great Britain in comparison to the baseline year of monitoring are greater horseshoe bat, lesser horseshoe bat and common pipistrelle.** In the Annual Report 2020 we also reported an increase in Natterer's bat though it wasn't possible to update this trend for 2021 due to the suspension of the Hibernation Survey.
- **Based on trends updated to 2021, species considered to have been stable in Great Britain in comparison to the baseline year of monitoring are Daubenton's bat, serotine, noctule, soprano pipistrelle and brown long-eared bat.** In the Annual Report 2020 we also reported a stable trend for whiskered/Brandt's bat though it wasn't possible to update this trend for 2021 due to the suspension of the Hibernation Survey.
- From the latest results, findings should be treated with caution for the following species:
    - Serotine is encountered relatively infrequently during surveys. As such there is a high level of uncertainty associated with the serotine population trends, making population changes more difficult to detect for this species.
- 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.**

Cover image: Brown long-eared bat (Daniel Hargreaves)

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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 updated population trends for nine of Great Britain's 17 breeding bat species, derived from data collected up to and including summer 2021. Usually, trends are updated annually for 11 species or species groups but in winter 2020/21 the Hibernation Survey had to be suspended due to COVID-19 (see Impact of COVID-19, p.7). Therefore, it has not been possible to produce updated Hibernation Survey trends for the reporting period covered by this report. We have republished the previous year's Hibernation Survey trends (winter 2019/20) for reference, so that all the most recent species population trends can be found in one place.

All species for which trends are produced from Hibernation Survey data also have trends produced from other summer survey data, with the exception of whiskered/Brandt's bat. Therefore, these two species (grouped together into one trend as they are cryptic species that are difficult to separate on hibernation surveys) are the only two species for which we have not been able to produce any updated trends for this reporting period (winter 2020/21 to summer 2021).

Trends are provided at GB level and also at UK and country level where sufficient data are available. Updated trends are calculated for nine species in England, four species in Scotland, four 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[1]

The next set of bat population trends, incorporating data collected up to and including summer 2022, are due to be published in May 2023. These trends may be impacted where government restrictions to control the COVID-19 pandemic curtail survey activities.

Official Statistics: These statistics have been produced to the high professional standards set out in the Code of Practice for Official Statistics[2].

This report was compiled by Philip Briggs, Nathalie Cossa, Lia Gilmour, Sarah Scott and Parvathy Venugopal. Statistical analysis was completed by Steve Langton. The bat illustrations are by Tom McOwat.

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.

[1] See https://www.batconservationireland.org/

[2] see https://www.statisticsauthority.gov.uk/publication/code-of-practice/

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Impact of COVID-19

As in 2020, bat recording in 2021 was restricted by the COVID-19 pandemic, though the impacts were different.

Hibernation surveys were 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. It was therefore not possible to produce updated Hibernation Survey trends for 2021. The winter 2019/20 Hibernation Survey trends are reproduced in this report so that all the latest species population trends can be found in one place.

Participation in summer surveys, which had been impacted by the lockdowns in 2020, was less restricted in 2021. Table 3 (page 14) shows an increase in number of sites surveyed across all the summer surveys compared with 2020, though numbers weren't yet back up to 2019 levels. Sample sizes were high enough to update the species population trend indices for 2021 from summer surveys.

Bat Monitoring in the UK

Effective conservation requires monitoring of underlying population trends in order to detect population changes; to ensure scarce conservation resources are targeted appropriately towards sustaining bat populations and the habitats on which they depend; 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[3] 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 different survey methods. 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. 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.

[3] See http://jncc.defra.gov.uk/page-1824

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. Species identification is carried out via roost visits (where required), assistance from local bat groups, loan of recording equipment by BCT, or volunteer's own skills.
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

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. The robustness of data obtained from our four long-term monitoring surveys varies depending on how the data are collected. Sources of bias and the steps we take to address them are outlined 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 population density (*Survey Coverage - Figure* 1), and in certain habitats. 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 *Population Trend Analysis* for further details). We are currently investigating the implications of the non-random spatial distribution of survey sites, and testing methods to better control for this bias (see *Research and Conservation*).

Field and Waterway Surveys

Field Survey volunteers are assigned a random-stratified 1km OS grid square to survey, close to where they live. Sites are stratified by ITE land class to help ensure a representative sample of UK land classes. Waterway Survey sites are randomly selected from the network of Environment Agency/Natural Resources Wales River Habitat Survey sites. 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.

Factors that may affect the data collected include the use of different models of bat detector, changes in the prevalence of different models of detector over time, volunteer turnover and differing volunteer experience. These are included as covariates in the analyses to assess potential influence on the results. The covariates used are assessed periodically to ensure they remain appropriate.

Hibernation Survey

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. 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.

From its inception in 1997 the NBMP Hibernation Survey was designed to use counts from January and February, making it the first survey of the reporting year. Gradually it was recognised that many hibernacula were regularly monitored earlier and later in the winter period and from 2012 we decided to start including counts from December to March in the trend analysis, including historic counts from these sites. Therefore, on the Hibernation Survey graphs the index for 2020, for example, is in fact the index for winter 2019/20.

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 on to bats. Therefore, we have not been able to update species

population trends from the Hibernation Survey for the 2021 reporting period. Instead, we have republished the winter 2019/20 Hibernation Survey trends.

Roost Count

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.

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.

Population Trend Analysis

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).

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. It is also important to be able monitor increases as well to present evidence that a conservation measure is working and producing results.

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 typically provide sufficient data to produce GB level population trends for 11 of the UK's 17 breeding bat species (Table 2), and country level trends for 11 species in England, five species in Scotland, nine species in Wales 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).

Table 2. Species coverage and data collection from each NBMP survey.

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	+		

✓ = enough data collected annually for trend

+ = recorded, but insufficient data to produce trend

Bechstein's bat

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.

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).

Alcathoe bat

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.

Leisler's bat

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 (see *Developments and future directions*).

Greater mouse-eared bat

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 casts 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.

Survey coverage

UK site network

In total up to 2021, 6,928 sites have been surveyed as part of ongoing NBMP surveys (excluding the Sunset/Sunrise Survey where sites are less clearly defined). In 2021, 946 NBMP volunteers completed surveys at 1,202 sites. Long-term monitoring surveys were carried out at 1,189 sites, which across all surveys represents an overall decrease of 9.2% on the number of sites surveyed in 2020 (Table 3). This is due to the impact of the COVID-19 pandemic which included the suspension of the Hibernation Survey; however, trends for individual surveys vary.

We also encourage new volunteers to get involved in the NBMP by taking part in our Sunset Survey. This survey has proved particularly popular during the COVID-19 pandemic, being a particularly suitable activity to take part in during lockdowns. In 2021, 597 Sunset Surveys were completed by at least 324 volunteers, compared with 243 surveys carried out by at least 151 volunteers in the last pre-COVID year, 2019. Volunteers reported 27 bat roosts during this survey.

Value of the volunteer contribution to the NBMP

In 2021, 946 dedicated volunteers carried out long-term monitoring surveys (Figure 1). In 2021, volunteers taking part in these surveys contributed approximately 11,304 hours of their time, representing an in-kind contribution to the NBMP of £152,790[4]. The equivalent cost of these surveys if they were undertaken by professional ecologists would be £404,716[5].

[4] Volunteer contribution calculated using the daily rate given for unskilled and skilled volunteers by the Heritage Lottery Fund in their application guidance (Dec 2013), and assuming a 7.5 hour day (see note below).

[5] Equivalent professional contribution calculated using the mid-point of the daily rate range for an Assistant Ecologist (lowest level of experience) and Ecologist given by CIEEM in their guidance to members, and assuming a 7.5 hour day (see note below). Note – We use the unskilled/assistant ecologist rate to calculate contributions to the Roost Survey, as this can be carried out by volunteers with no formal bat survey training (e.g. householders who have bats in their property, although highly experienced bat surveyors also take part); the skilled/ecologist rate is used for surveys where previous experience is required (Field Survey, Waterway Survey and Hibernation Survey).

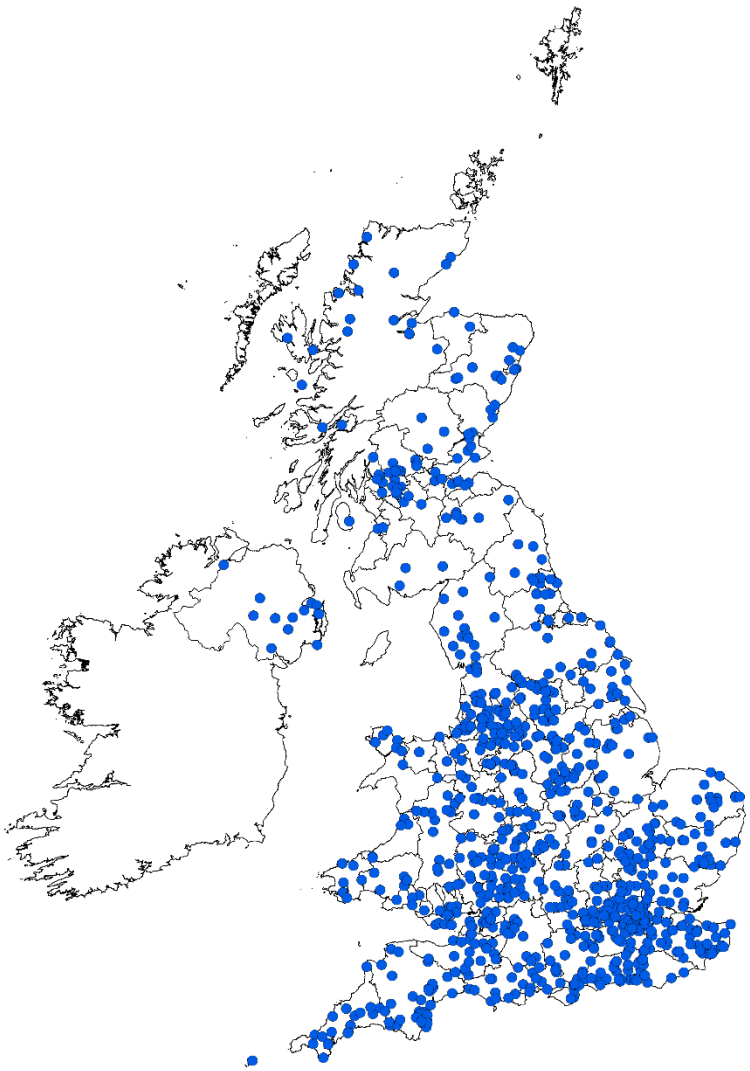


Figure 1. Locations of volunteers who took part in the four core NBMP surveys in 2021.

Repeat sites

Over 85% of long-term monitoring sites (Field Survey, Waterway Survey and Roost Count) surveyed in 2021 had been surveyed in at least one previous year (1,011 'repeat sites', table 3). This has decreased from 89% in 2020, though the latter figure also included sites monitored for the Hibernation Survey which was suspended in 2021 due to COVID-19.

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

Table 3 shows for each survey the total number of sites surveyed to date, the number sites surveyed in 2021 and in the preceding year, and the proportion of sites surveyed in 2021 that have been surveyed in at least one year previously (aka 'repeat' sites).

Table 3. UK NBMP survey coverage 2021

Survey type	Total sites surveyed to date	Total sites surveyed 2021	Total sites surveyed 2020	% change in sites surveyed from 2020 to 2021	Number of repeat sites 2021	% repeat sites 2021
Field Survey	985	197	149	32.2	158	80.2
Waterway Survey	1528	306	225	36	244	79.7
Hibernation Survey	1225	-	511*	-	-	-
Roost Counts:						
Greater horseshoe bat	45	25	19	31.6	22	88
Lesser horseshoe bat	370	139	41	239	132	95
Common pipistrelle	727	163	120	35.8	140	85.9
Soprano pipistrelle	571	148	94	57.4	133	89.9
Unidentified pip sp.	769	60	34	76.5	46	76.7
Natterer's bat	107	24	17	41.2	24	100
Serotine	148	33	30	10	32	97
Brown long-eared bat	243	45	27	66.7	44	97.8
Other species	157	49	42	16.7	36	73.5
Total long-term monitoring surveys	**6875**	**1189**	**1309**	**-9.2**	**1011**	**85**
Woodland Survey	53	13	12	8.3	12	92.3
Total surveys	**6928**	**1202**	**1321**	**-9**	**1023**	**85.1**

*For the Hibernation Survey, 2020 refers to winter 2019/20

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 use 30 sites as our basic annual target number of repeat sites for each survey at each geographical scale.

Survey coverage at country level is given in Table 4. The COVID-19 pandemic caused the suspension of the hibernation surveys, and had negative impact on sample sizes from the summer surveys, though this was not as severe as in 2020. Typically, we exceed our basic target of 30 repeat sites in England for all surveys; however, in 2021 this target was not achieved for greater horseshoe bat, Natterer's bat and brown long-eared bat in the Roost Count. In Wales, the target was exceeded only for the lesser horseshoe bat Roost Count, while in Scotland we were not able to achieve this target for any of the surveys.

Table 4. Country level NBMP survey coverage 2021. Number of sites surveyed, with number of repeat sites shown in brackets.

Survey type	England	Scotland	Wales	Northern Ireland	Channel Islands
Field Survey	163 (136)	19 (10)	7 (4)	4 (4)	4 (4)
Waterway Survey	222 (179)	38 (24)	15 (8)	31 (31)	-
Hibernation Survey	-	-	-	-	-
Roost Counts:					
Greater horseshoe bat	20 (17)	-	5 (5)	-	-
Lesser horseshoe bat	47 (42)	-	92 (87)	-	-
Common pipistrelle	119 (93)	15 (14)	12 (11)	1 (0)	16(10)
Soprano pipistrelle	107 (89)	19 (15)	14 (11)	7 (6)	1(1)
Pipistrelle sp.	42 (27)	7 (4)	5 (3)	4 (3)	2(1)
Natterer's bat	21 (20)	2 (2)	1 (1)	()	-
Serotine	32 (28)	-	1 (1)	-	-
Brown long-eared bat	30 (28)	5 (5)	4 (3)	6 (6)	4 (4)
Total for all surveys	**803 (659)**	**105 (74)**	**156 (134)**	**53 (51)**	**23 (16)**

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*). 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 2022 (see *Developments and Future Directions*). 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

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 2021. 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.

Survey coverage maps

These maps show the distribution of sites surveyed as part of the Field Survey, Waterway Survey and Roost Count in 2021 (light green circles) and the Hibernation Survey in winter 2019/20 (surveys were suspended in winter 2020/21) and also the distribution of sites surveyed for each survey to date (dark blue circles).

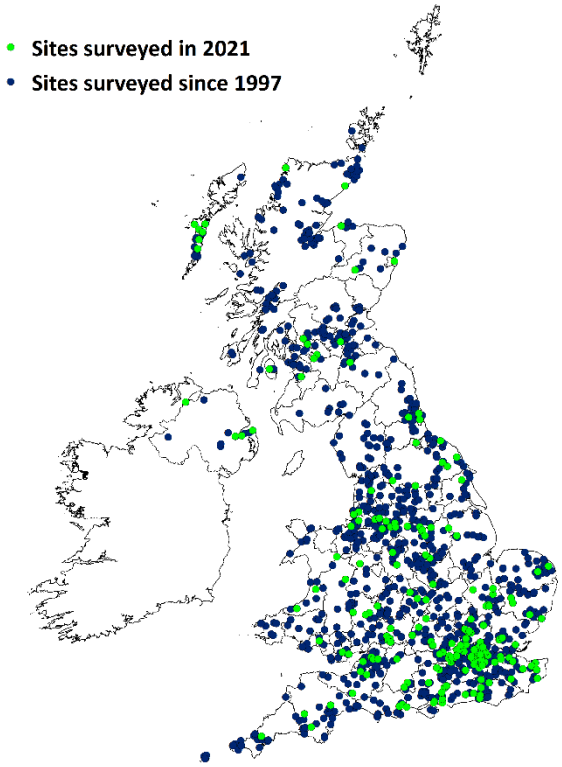


Figure 2. Distribution of Field Survey sites.

In 2021, 200 sites were surveyed, representing 17.6% of the total number of Field Survey sites surveyed to date.

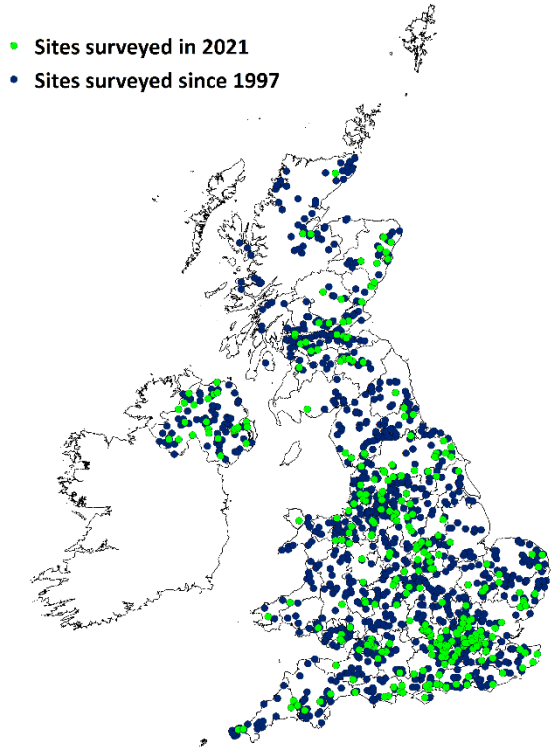


Figure 3. Distribution of Waterway Survey sites.

In 2021, 310 sites were surveyed, representing 20.3% 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.

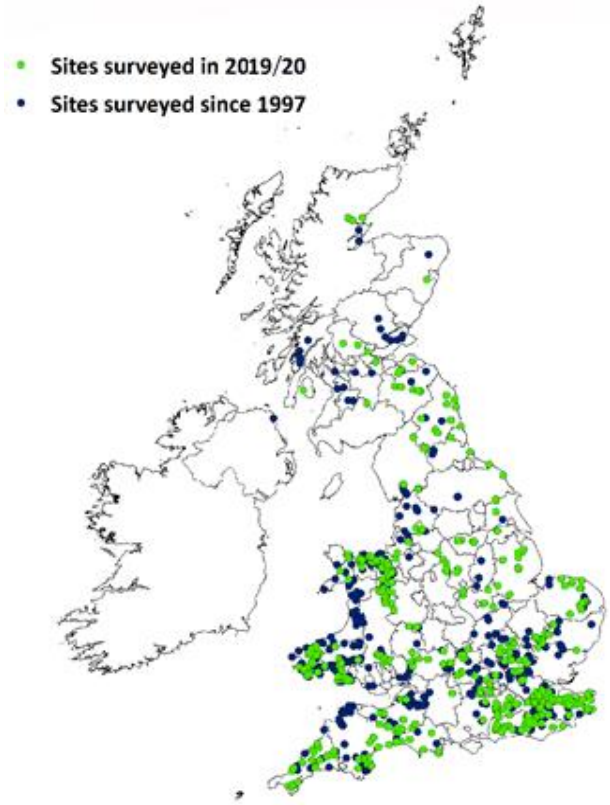


Figure 4. Distribution of Hibernation Survey sites.

In winter 2019/20, 513 sites were surveyed, representing 42.0% of the total number of Hibernation Survey sites surveyed to date. *NB The Hibernation Survey was suspended in winter 2020/21 due to COVID-19.*

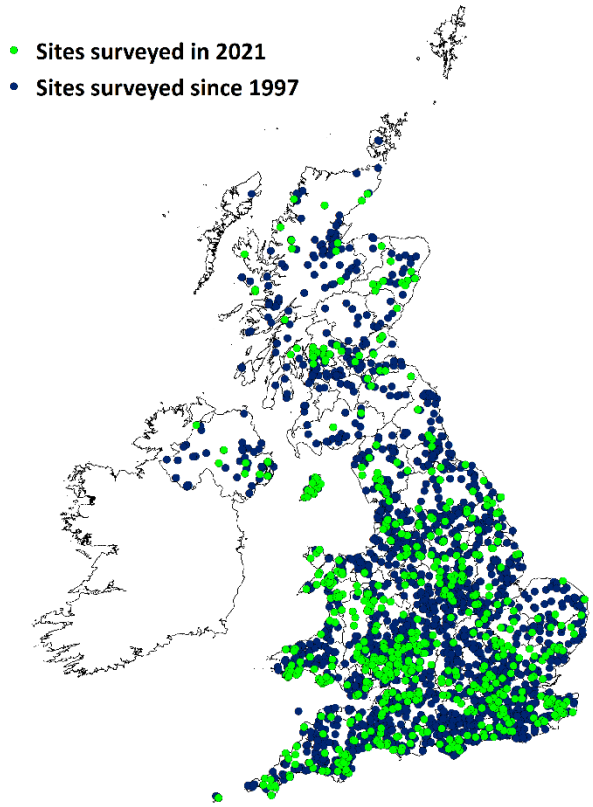


Figure 5. Distribution of all Roost Count sites.

In 2021, 749 sites were surveyed, representing 23.6% of the total number of Roost Count sites surveyed to date.

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 2021 are shown in Table 5. 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 2021 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.

Table 5. 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	223	1999	2020	221.6*	5.7 (3.0 to 9.0)
	Roost Count	41	1999	2021	157.9*	4.4 (2.8 to 5.9)
Lesser horseshoe bat	Hibernation	348	1999	2020	183.2*	5.1 (4.3 to 5.8)
	Roost Count	313	1999	2021	74.6*	2.6 (1.9 to 3.3)
Daubenton's bat	Hibernation	452	1999	2020	19.9	0.9 (-0.1 to 2.1)
	Waterway (GB)	898	1999	2021	4.2	0.2 (-0.3 to 0.8)
	Waterway (UK)	973	1999	2021	4.6	0.2 (-0.3 to 0.7)
Whiskered/Brandt's bat	Hibernation	262	1999	2020	29.2	1.2 (-0.4 to 3.1)
Natterer's bat	**Hibernation**	**560**	**1999**	**2020**	**135.1***	**4.2 (2.3 to 5.8)**
	Roost Count	89	2002	2021	-4.1	-0.2 (-2.2 to 1.6)
Common pipistrelle	**Field**	**673**	**1999**	**2021**	**76.8***	**2.6 (1.9 to 3.6)**
	Roost Count	550	1999	2021	-64.9*	-4.7 (-6.1 to -3.3)
Soprano pipistrelle	**Field**	**671**	**1999**	**2021**	**19.9**	**0.8 (-0.6 to 2.3)**
	Roost Count	437	1999	2021	-57.8*	-3.8 (-5.2 to -2.6)
Serotine	Field	457	1999	2021	2.4	0.1 (-2.4 to 3.0)
	Roost Count	102	1999	2021	-0.6	-0.03 (-1.5 to 1.8)
Noctule	Field	670	1999	2021	31.1	1.2 (-0.5 to 3.2)
Brown long-eared bat	Hibernation	491	1999	2020	-19.4	-1.0 (-2.5 to 0.4)
	Roost Count	168	2001	2021	9.2	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 *Robustness of Monitoring* and 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 2020 = winter 2019/2020.

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.

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 6-9 show a summary of the bat species trends at country level derived from NBMP surveys to the end of summer 2021. For each species, the number of sites contributing to the 2021 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: the common pipistrelle Field Survey trend showed a significant increase at GB level and in England, but no significant difference in Scotland; and the soprano pipistrelle Field Survey trend showed a significant increase at GB level and in Scotland, but no significant difference in England. Hibernation Survey trends were not updated for 2020/21 due the suspension of the surveys, but there were similar trends at GB and country level for the 2019/20 trends (republished in this report) with the following exceptions: the greater horseshoe bat Hibernation Survey trend showed a statistically significant increase at GB level and in England, but no significant difference in Wales; the Natterer's bat Hibernation Survey trend showed statistically significant increases at the GB level and in England and Wales, but no significant change in Scotland, although the sample size in Scotland is small and therefore the trend may be unreliable.

England

Table 6. England bat species population trends 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 (%)
Greater horseshoe bat	Hibernation	119	1999	2020	253.2*	6.2 (3.6 to 9.0)
	Roost	36	1999	2021	115.8*	3.6 (1.8 to 5.5)
Lesser horseshoe bat	Hibernation	164	1999	2020	133.4*	4.1 (2.4 to 5.8)
	Roost	124	1999	2021	85.0*	2.8 (1.8 to 4.0)
Daubenton's bat	Waterway	722	1999	2021	-4.**4**	-0.2 (-0.7 to 0.3)
	Hibernation	326	1999	2020	24.8	1.1 (0.01 to 2.5)
Whiskered/Brandt's bat	Hibernation	173	1999	2020	38.6	1.6 (-0.4 to 3.6)
Natterer's bat	**Hibernation**	**396**	**1999**	**2020**	**149.1***	4.4 (2.0 to 5.9)
	Roost	76	2002	2021	2.5	0.1 (-2.5 to 2.3)
Common pipistrelle	**Field**	**546**	**1999**	**2021**	**82.4***	**2.8 (1.8 to 3.6)**
	Roost	438	1999	2021	-55.7*	-3.6 (-5.2 to -2.1)
Soprano pipistrelle	**Field**	**545**	**1999**	**2021**	**14.8**	**0.6 (-0.9 to 2.4)**
	Roost	286	1999	2021	-47.1*	-2.9 (-4.5 to -1.6)
Serotine	Field	415	1999	2021	2.0	0.1 (-2.4 to 2.9)
	Roost	100	1999	2021	-3.1	-0.1 (-1.7 to 1.7)
Noctule	Field	544	1999	2021	**9.0**	0.4 (-1.4 to 2.4)
Brown long-eared bat	Hibernation	371	1999	2020	-20.8	-1.1 (-2.9 to 0.5)
	Roost	123	2001	2021	-5.41	-0.3 (-2.8 to 1.7)

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 *Robustness of Monitoring* and 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 2020 = winter 2019/2020.

Scotland

Table 7. Scotland bat species population trends 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	125	1999	2021	16.3	0.7 (-0.5 to 1.9)
	Hibernation	21	1999	2020	-10.6	-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**	**74**	**1999**	**2021**	**-5.6**	**-0.3 (-2.9 to 3.1)**
	Roost	72	1999	2021	-78.2*	-6.7 (-10.0 to -2.4)
Soprano pipistrelle	**Field**	**74**	**1999**	**2021**	**55.8**	**2.0 (-0.5 to 5.4)**
	Roost	96	1999	2021	-76.1*	-6.3 (-8.3 to -3.9)
Brown long-eared bat	Hibernation	22	2008	2020	-1.2	-0.1 (-5.4 to 5.3)
	Roost	31	2002	2021	84.1	3.3 (-1.2 to 8.3)

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 *Robustness of Monitoring* and 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 2020 = winter 2019/2020.

Wales

Table 8. Wales bat species population trends 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 (%)
Greater horseshoe bat	Hibernation	102	1999	2020	158.6	4.6 (-1.0 to 11.2)
Lesser horseshoe bat	Hibernation	183	1999	2020	206.4*	5.5 (4.5 to 6.3)
	Roost	180	1999	2021	73.9*	2.6 (1.6 to 3.5)
Daubenton's bat	Hibernation	99	1999	2020	32.8	1.4 (-1.1 to 4.1)
	Waterway	49	2000	2021	36.2	1.5 (-0.1 to 3.2)
Whiskered/Brandt's bat	Hibernation	76	1999	2020	-10.1	-0.5 (-2.0 to 1.8)
Natterer's bat	Hibernation	140	1999	2020	106.6*	3.5 (0.9 to 4.5)
Common pipistrelle	Roost	39	1999	2021	-80.9*	-7.3 (-11.3 to -4.3)
Soprano pipistrelle	Roost	55	2002	2021	-78.0*	-7.7 (-11.7 to -5.5)
Brown long-eared bat	Hibernation	94	1999	2020	63.2*	2.4 (0.1 to 5.0)

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 *Robustness of Monitoring* and 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 2020 = winter 2019/2020.

Northern Ireland

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/).

Table 9. 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	74	2008	2021	14.9	1.1 (-0.7 to 2.8)

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

Greater horseshoe bat trends | Great Britain

Rhinolophus ferrumequinum

Summary of survey results for Great Britain

Trends from both the Hibernation Survey and Roost Count in Great Britain show a significant increase in the smoothed index in comparison to the baseline year. Because of the suspension of the Hibernation Survey in winter 2020/21 due to COVID-19, it has not been possible to update the trend for the Hibernation Survey for this report. Instead, the trend that was published in 2020 Annual Report is repeated here for information. The **population of greater horseshoe bat in Great Britain is considered to have increased since 1999**.

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

Hibernation Survey

Republication* of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

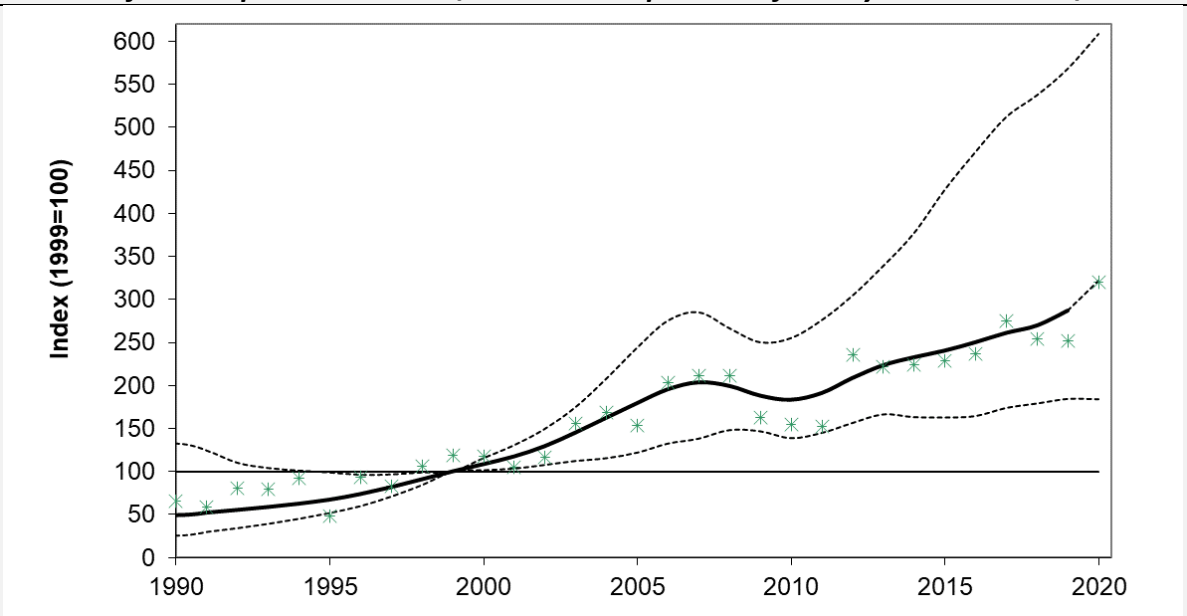


Figure 6. Hibernation Survey index for greater horseshoe bat in Great Britain, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 221.6% above the 1999 base year value, equivalent to a mean annual increase of 5.7% (95% CI 3.0% to 9.0%). The value of the index has fluctuated since the 1999; however, it has always been significantly higher than the baseline value. Overall, there has been a **significant increase in the smoothed index since 1999**.

From all years for which data are available (1990-2020), counts from 223 sites contribute to the trend analysis (sites surveyed in two or more years with greater horseshoe bat recorded in at least one year).

***This is a revised version of the trend published in the 2020 report. It was discovered that we only had partial counts for the last few years from by far the largest greater horseshoe bat hibernaculum. We now have the complete counts and this has turned around an apparent dip in the trend from 2018.**

Roost Count

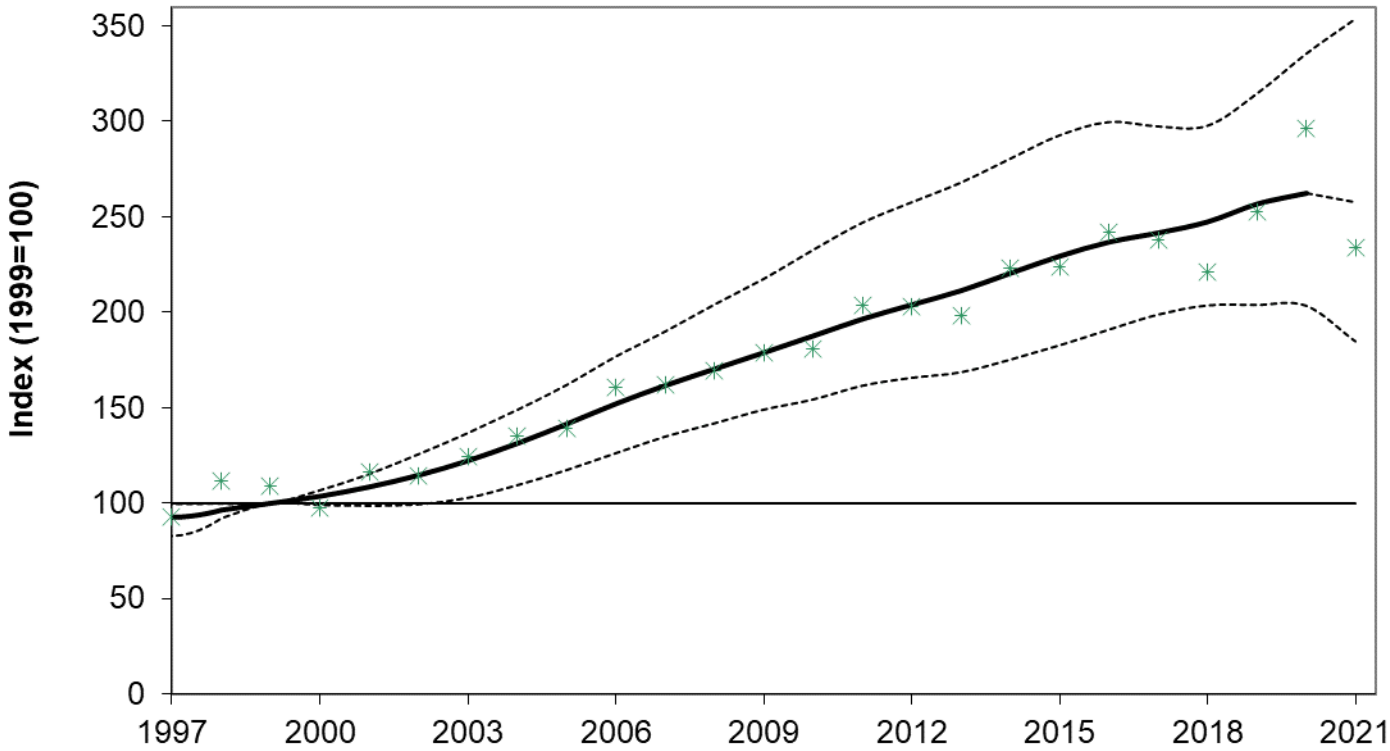


Figure 7. Roost Count index for greater horseshoe bat in Great Britain, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 157.9% above the 1999 base year value, equivalent to a mean annual increase of 4.4% (95% CI 2.8% to 5.9%). Overall, there has been a **significant increase in the smoothed index since 1999.**

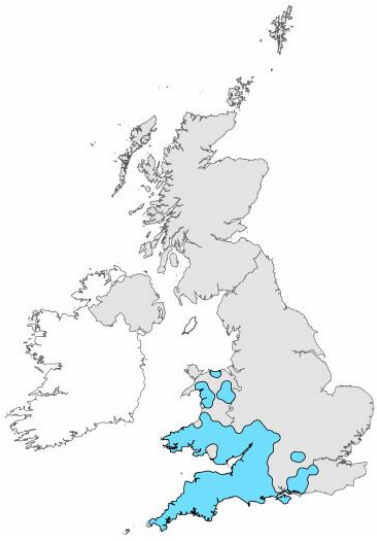
Data from 41 sites surveyed between 1997 and 2021 contribute to the trend analysis (sites surveyed in at least two years).

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.

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				
Source	Mathews *et al*. 2018				



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)

Greater horseshoe bat trends | England

Summary of survey results for England

Trends from both the Hibernation Survey and Roost Count in England show a significant increase in the smoothed index in comparison to the baseline year. Because of the suspension of the Hibernation Survey in winter 2020/21 due to COVID-19, it has not been possible to update the trend for the Hibernation Survey for this report. Instead, the trend that was published in 2020 Annual Report is repeated here for information. The **population of greater horseshoe bat in England is considered to have increased since 1999**.

Hibernation Survey

Republication* of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

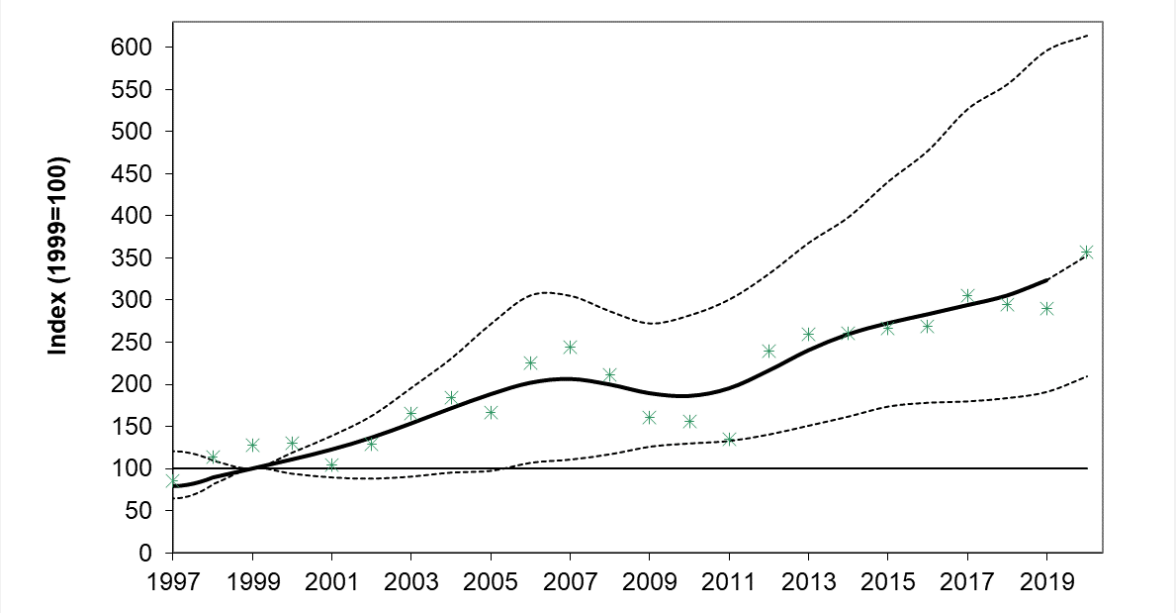


Figure 8. Hibernation Survey index for greater horseshoe bat in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 253.2% above the 1999 base year value, equivalent to a mean annual increase of 6.2% (95% CI 3.6% to 9.0%). The value of the smoothed index has fluctuated since 1999. It has been significantly higher than the baseline value since 2008. The provisional index estimate for 2020 is only just significantly higher than the baseline value, however this estimate may be revised up or down when further years of monitoring data are added. Overall, there has been a **significant increase in the smoothed index since 1999**.

From all years for which data are available (1990-2020), counts from 119 sites contribute to the trend analysis in England (sites surveyed in two or more years with greater horseshoe bat present in at least one year).

***This is a revised version of the trend published in the 2020 report. It was discovered that we only had partial counts for the last few years from by far the largest greater horseshoe bat hibernaculum. We now have the complete counts and this has turned around an apparent dip in the trend from 2018.**

Roost Count

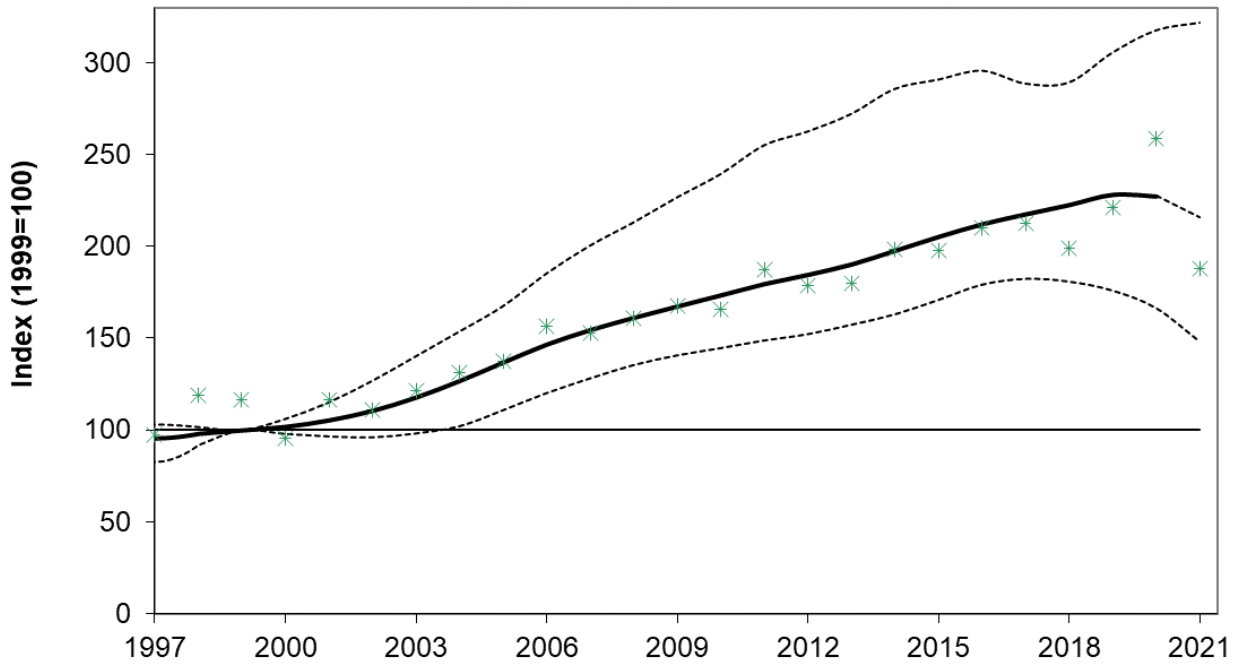


Figure 9. Roost Count index for greater horseshoe bat in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 115.8% above the 1999 base year value, equivalent to a mean annual increase of 3.6% (95% CI 1.8% to 5.5%). Overall, there has been a **significant increase in the smoothed index since 1999.**

From all years for which data are available (1997-2021), counts from 36 sites contribute to the trend analysis in England (sites surveyed in at least two years).

Greater horseshoe bat trend | Wales

Summary of survey results for Wales

The most recent index estimate from the Hibernation Survey in Wales does not differ significantly from the baseline year. This species is also recorded on the Roost Count in Wales but the sample size is too low to enable the production of a statistically robust trend. Because of the suspension of the Hibernation Survey in winter 2020/21 due to COVID-19, it has not been possible to update the trend for the Hibernation Survey for this report. Instead, the trend that was published in 2020 Annual Report is repeated here for information. **The population of greater horseshoe bat in Wales is considered to have been stable over the period monitored**, although the precision of index estimates from recent years is low.

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

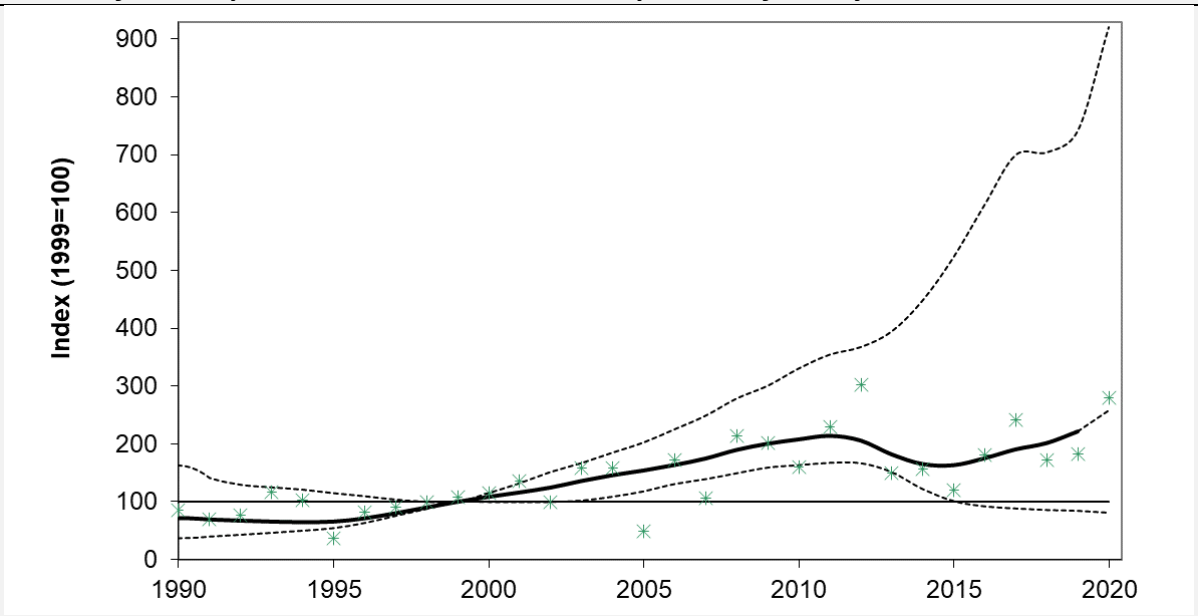


Figure 10. Hibernation Survey index for greater horseshoe bat in Wales, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

In Wales, the smoothed index is currently 158.6% above the 1999 base year value, equivalent to a mean annual increase of 4.6% (95% CI -1.0% to 11.2%). The value of the smoothed index increased steadily between 1999 and 2011, declined between 2011 and 2015, and is now increasing again. It was significantly higher than the baseline year in 2000 and between 2002 and 2015; however, since 2011 the precision of the trend has reduced markedly and as a result **the smoothed index is no longer significantly different from the baseline year**.

From all years for which data are available (1990-2020) counts from 102 sites contribute to the trend analysis in Wales (sites surveyed in two or more years with greater horseshoe bat present in at least one year).

Lesser horseshoe bat trends | Great Britain

Rhinolophus hipposideros

Summary of survey results for Great Britain

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. Because of the suspension of the Hibernation Survey in winter 2020/21 due to COVID-19, it has not been possible to update the trend for the Hibernation Survey for this report. Instead, the trend that was published in 2020 Annual Report is repeated here for information. **The population of lesser horseshoe bat in Great Britain is considered to have increased since 1999.**

Survey indices for lesser horseshoe bat are also produced at a country level for England and Wales. This species is not found in Scotland or Northern Ireland.

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

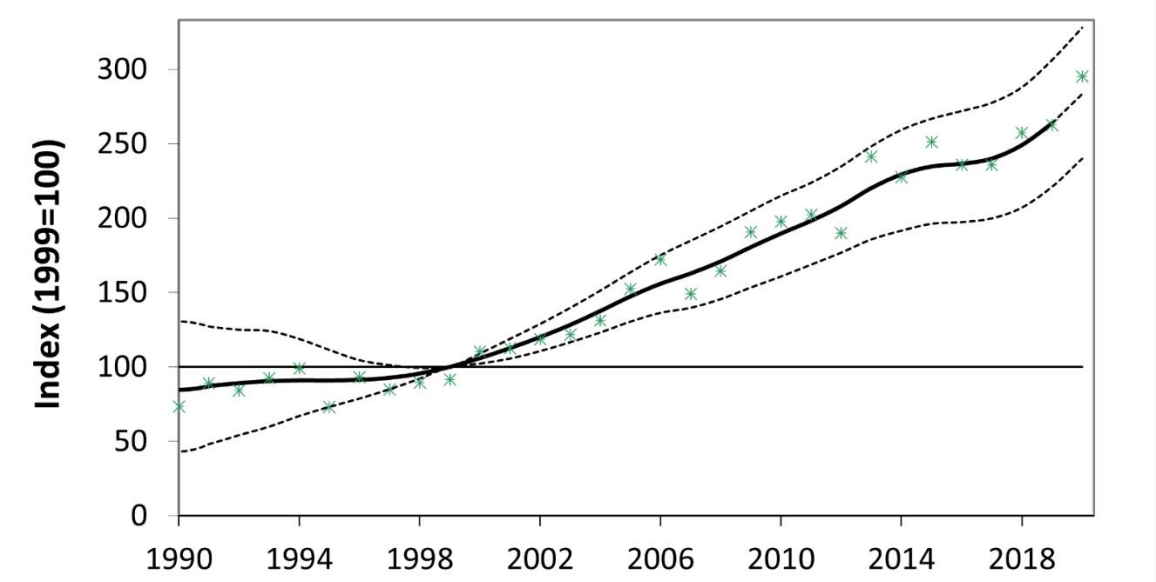


Figure 11. Hibernation Survey index for lesser horseshoe bat in Great Britain, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 183.2% above the 1999 base year value, equivalent to a mean annual increase of 5.1% (95% CI 4.3% to 5.8%). The value of the smoothed index increased steadily between 1999 and 2015; 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 (1990-2020), counts from 348 sites contribute to the trend analysis (sites surveyed in more than one year and with lesser horseshoe bat present in at least one year).

Roost Count

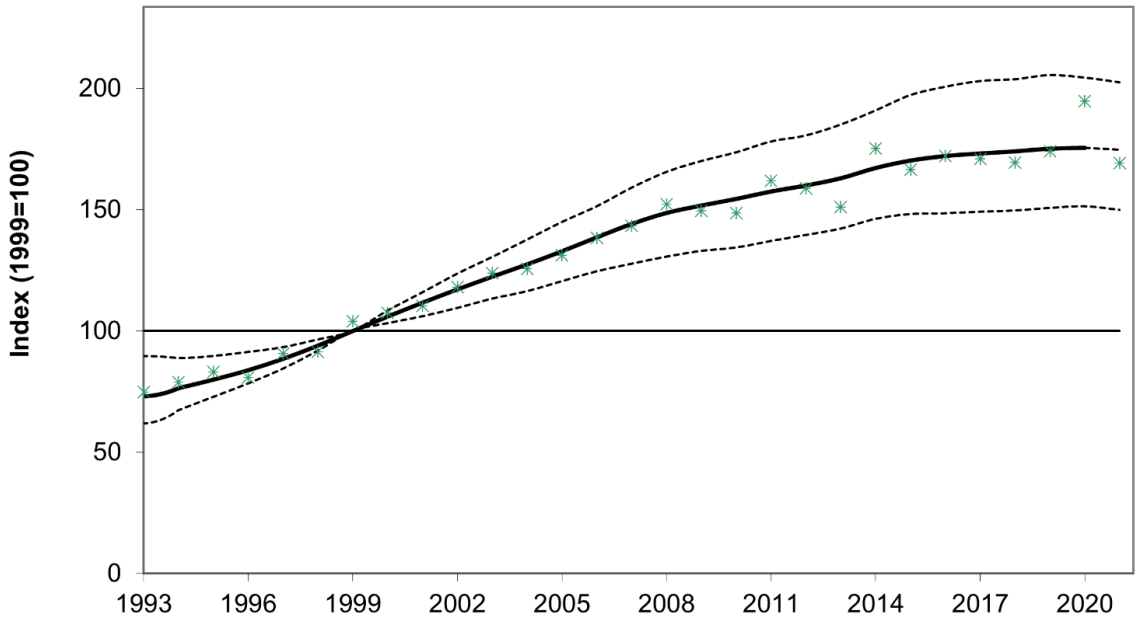


Figure 12. Roost Count index for lesser horseshoe bat in Great Britain, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 74.6% above the 1999 base year value, equivalent to a mean annual increase of 2.6% (95% CI 1.9% to 3.3%). Overall, there has been a **significant increase in the smoothed index since 1999.**

Data from 313 sites surveyed between 1993 and 2021 contribute to the overall trend analysis (sites surveyed in at least two years).

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				
Source	Mathews *et al.* 2018				

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)

Lesser horseshoe bat trends | England

Summary of survey results for England

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. Because of the suspension of the Hibernation Survey in winter 2020/21 due to COVID-19, it has not been possible to update the trend for the Hibernation Survey for this report. Instead, the trend that was published in 2020 Annual Report is repeated here for information. **The population of lesser horseshoe bat in England is considered to have increased since 1999.**

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

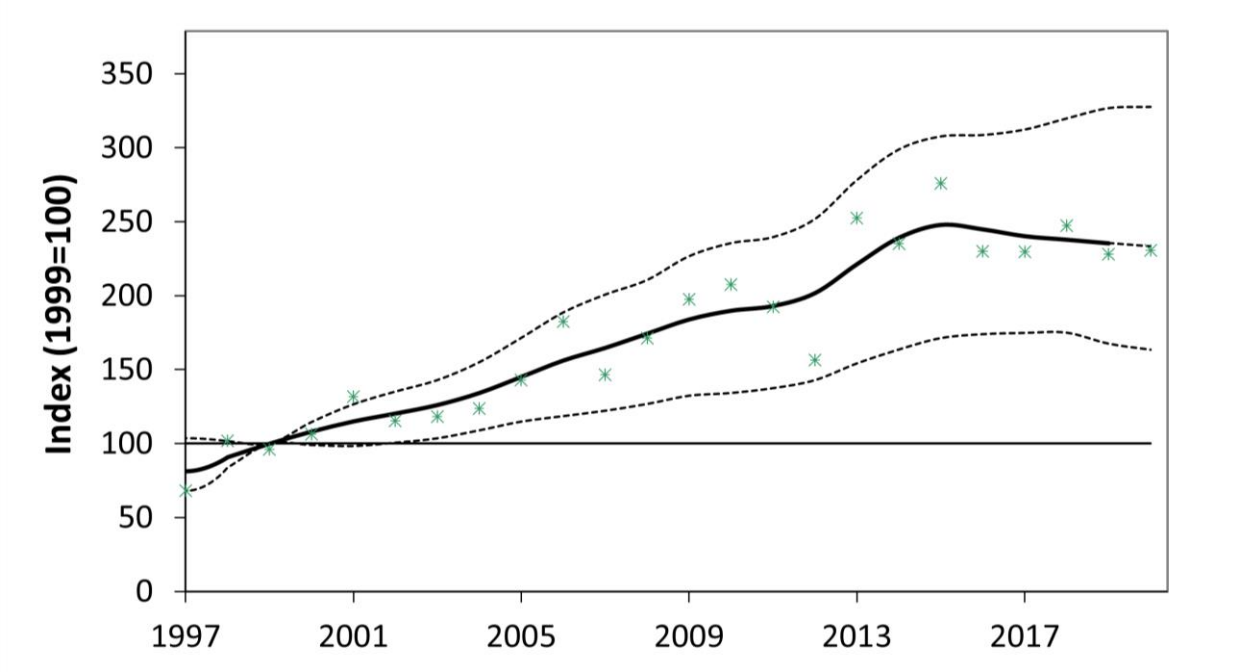


Figure 13. Hibernation Survey index for lesser horseshoe bat in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 133.4% above the 1999 base year value, equivalent to a mean annual increase of 4.1% (95% CI 2.4% to 5.8%). 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 (1997-2020), counts from 164 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).

Roost Count

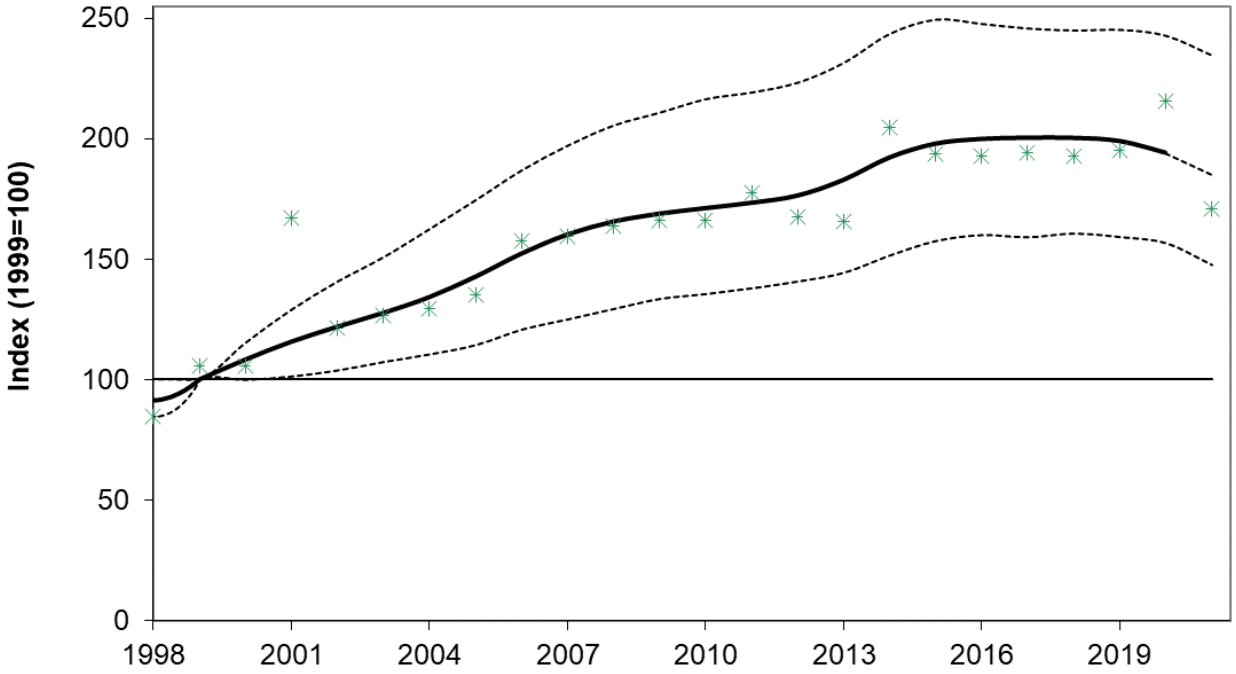


Figure 14. Roost Count index for Lesser horseshoe bat in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 85% above the 1999 base year value, equivalent to a mean annual increase of 2.8% (95% CI 1.8% to 4%). Overall, there has been a **significant increase in the smoothed index since 1999.**

Data from 124 sites surveyed between 1998 and 2021 contribute to the trend analysis in England (sites surveyed in at least two years).

Lesser horseshoe bat trends | Wales

Summary of survey results for Wales

The trends from the Hibernation Survey and Roost Count in Wales show a significant increase in the smoothed index in comparison to the baseline year. Because of the suspension of the Hibernation Survey in winter 2020/21 due to COVID-19, it has not been possible to update the trend for the Hibernation Survey for this report. Instead, the trend that was published in 2020 Annual Report is repeated here for information. **The population of lesser horseshoe bat in Wales is considered to have increased since 1999.**

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

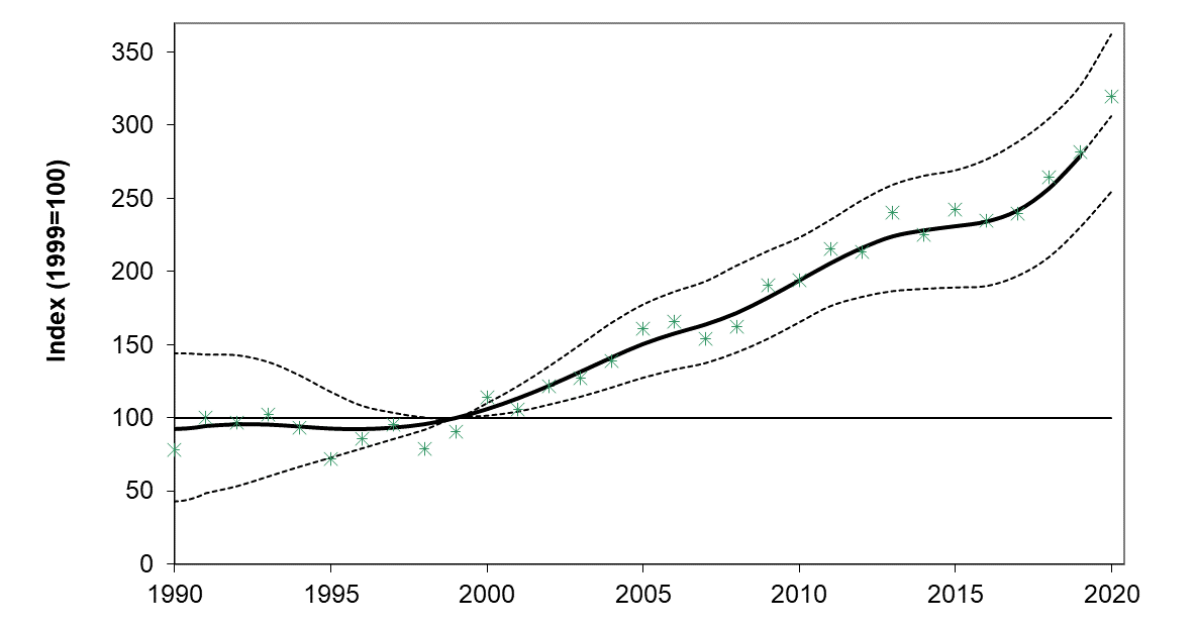


Figure 15. Hibernation Survey index for lesser horseshoe bat in Wales, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 206.4% above the 1999 base year value, equivalent to a mean annual increase of 5.5% (95% CI 4.5% to 6.3%). 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 (1990-2020), 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).

Roost count

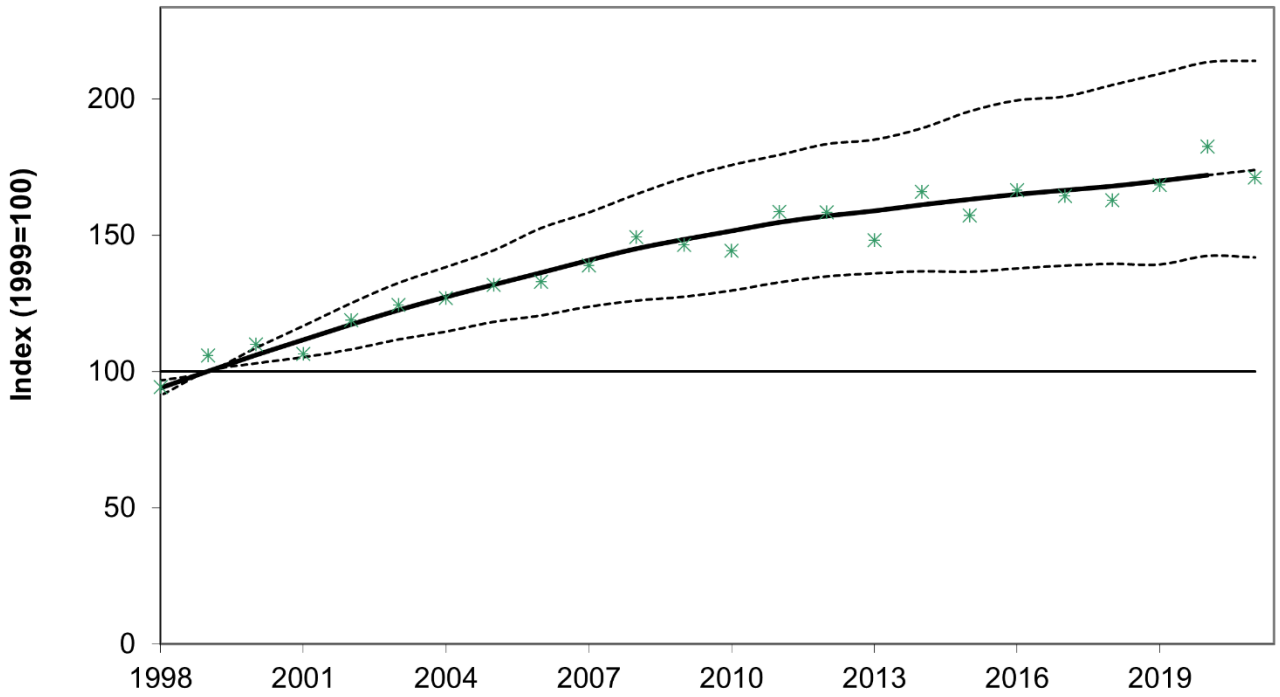


Figure 16. Roost Count index for Lesser horseshoe bat in Wales, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 73.9% above the 1999 base year value, equivalent to a mean annual increase of 2.6% (95% CI 1.6% to 3.5%). Overall, there has been a **significant increase in the smoothed index since 1999.**

Data from 180 sites surveyed between 1998 and 2021 contribute to the trend analysis in England (sites surveyed in at least two years).

Daubenton's bat trends | Great Britain

Myotis daubentonii

Summary of survey results for Great Britain

Trends from both 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. Note that as a result of the suspension of the Hibernation Survey in 2020/21 due to COVID-19, the trend published in 2020 Annual Report is repeated here for information. **The population of Daubenton's bat in Great Britain is considered to have been stable since 1999**.

Survey indices for Daubenton's bat are also produced for the United Kingdom, and at a country level for England, Scotland, Wales and Northern Ireland.

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

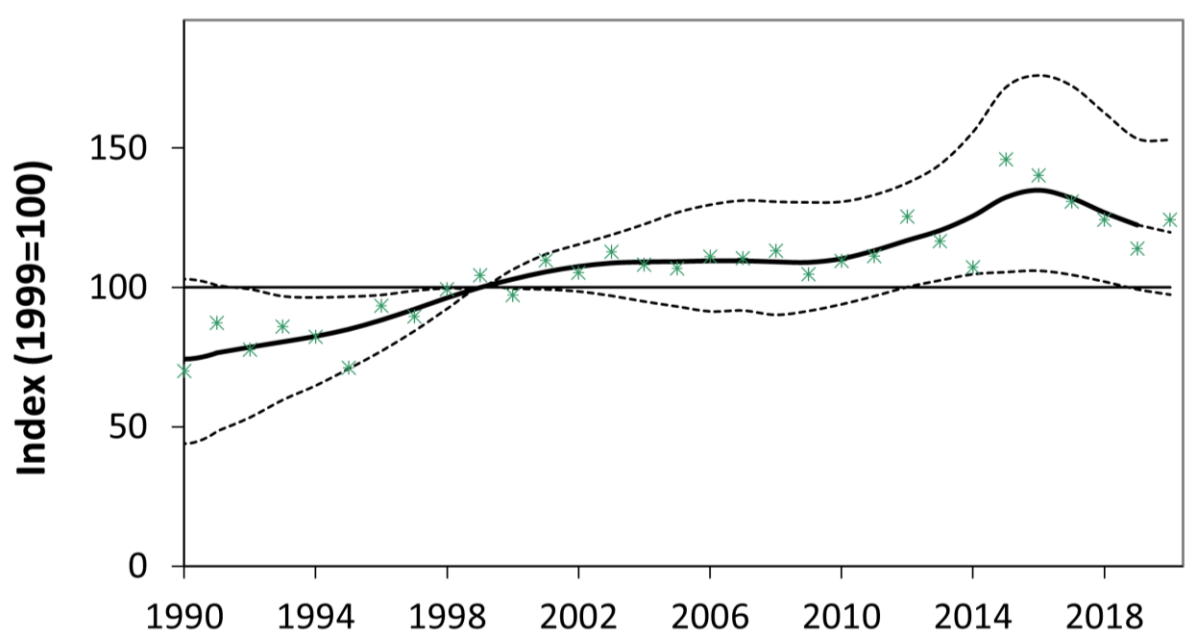


Figure 17. Hibernation Survey index for Daubenton's bat in Great Britain, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 19.9% above the 1999 base year value, equivalent to a mean average annual increase of 0.9% (95% CI -0.1% to 2.1%). 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 2012 and 2018, 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 (1990-2020) counts from 452 sites contribute to the overall trend analysis (sites surveyed in two or more years with Daubenton's bat present in at least one year).

Waterway Survey

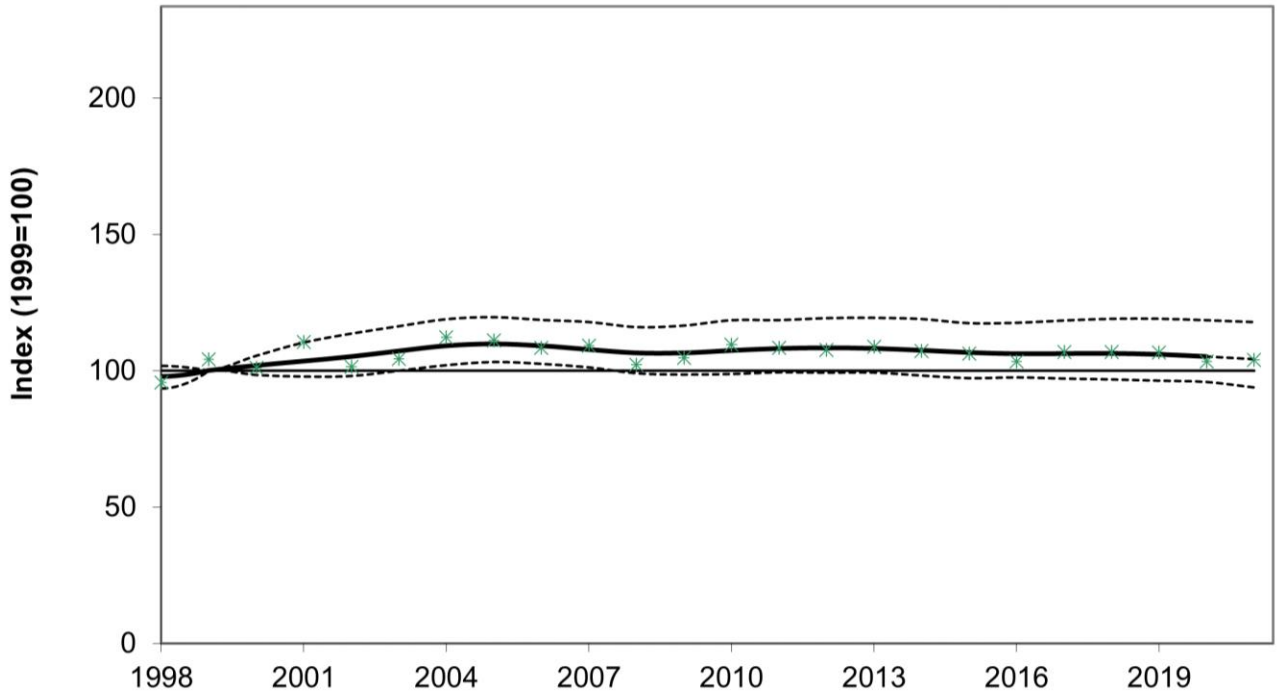


Figure 18. Waterway Survey index for Daubenton's bat in Great Britain, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 4.2% above the 1999 base year value, equivalent to a mean average annual increase of 0.2% (95% CI -0.3% to 0.8). Overall, the smoothed index **does not differ significantly from the 1999 base year value.**

Data from 898 sites surveyed between 1998 and 2021 contribute to the GB trend (sites surveyed in at least two years).

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				
Source	Mathews *et al.* 2018				Russ 1999

Daubenton's bat trend | United Kingdom

Summary of survey results for the United Kingdom

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

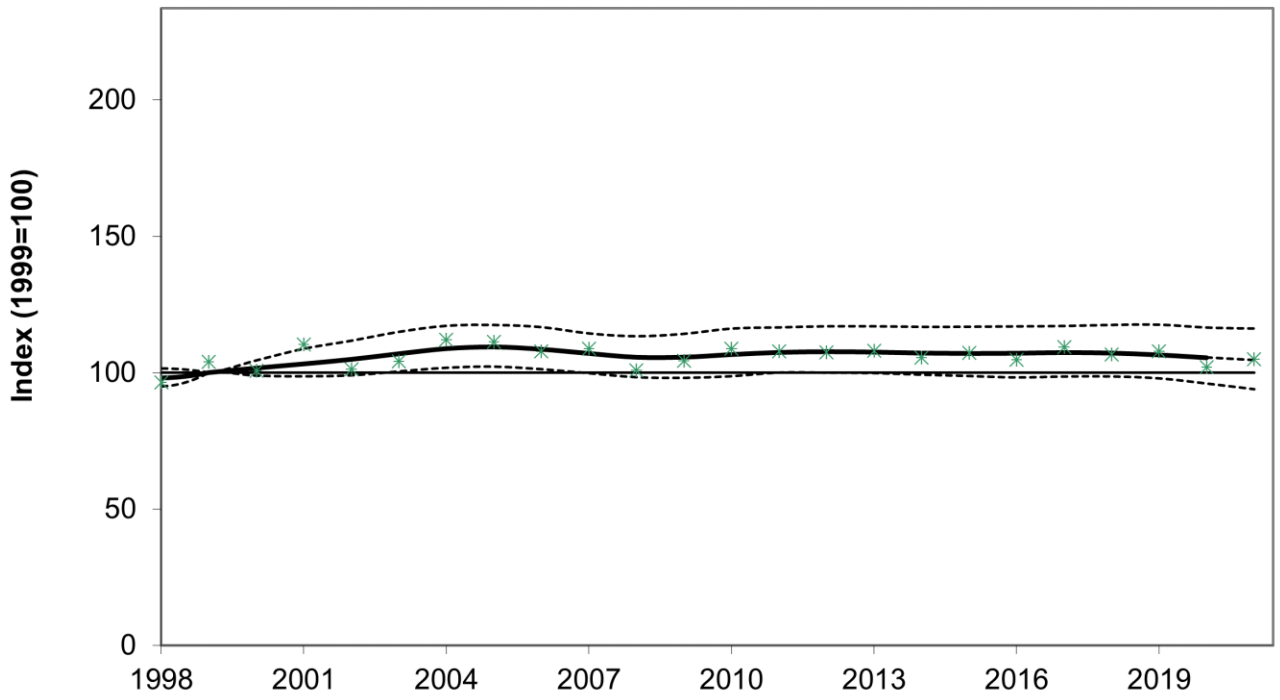


Figure 19. Waterway Survey index for Daubenton's bat in the UK, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 4.6% above the 1999 base year value, equivalent to a mean annual increase of 0.2% (95% CI -0.3% to 0.7%). Overall, the smoothed index **does not differ significantly from the 1999 base year value.**

Data from 973 sites surveyed between 1998 and 2021 contribute to the trend analysis in the United Kingdom (sites surveyed in at least two years).

Daubenton's bat trends | England

Summary of survey results for England

The trend from the Waterway Survey in England shows no significant difference in the smoothed index in comparison 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. Note that as a result of the suspension of the Hibernation Survey in winter 2020/21 due to COVID-19, the trend that was published in 2020 Annual Report is repeated here for information. Overall, **the population of Daubenton's bat in England is considered to have been stable since 1999**.

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

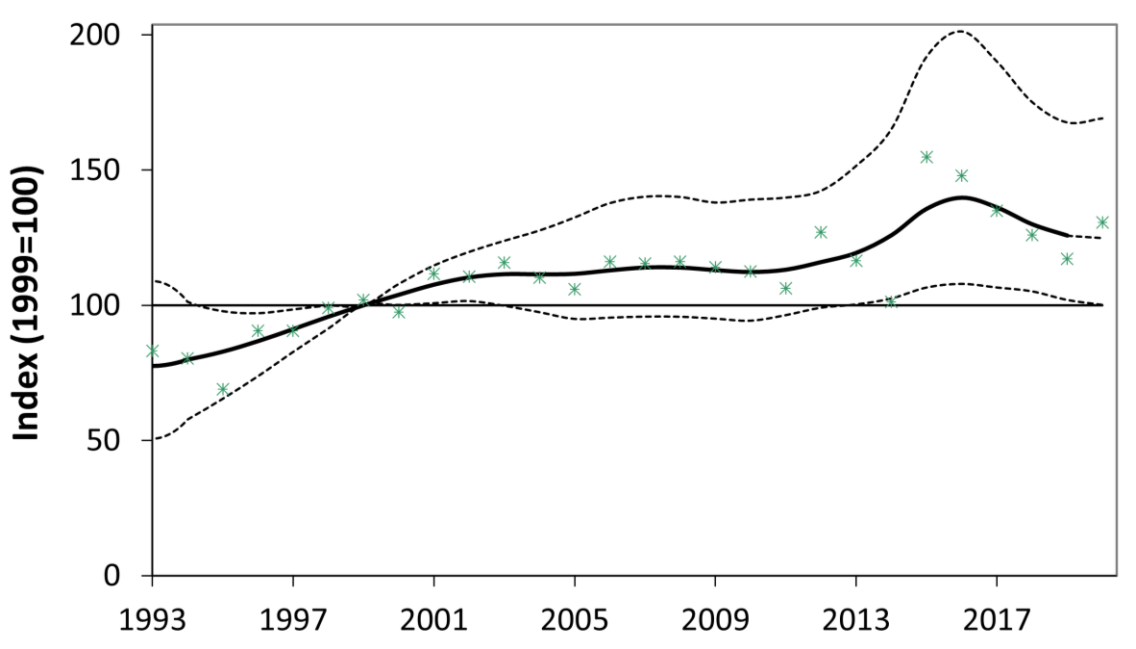


Figure 20. Hibernation Survey index for Daubenton's bat in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 24.8% above the 1999 base year value, equivalent to a mean annual increase of 1.1% (95% CI 0.01% to 2.5%). The value of the smoothed index was relatively stable between 1999 and 2011. From 2011 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 2000 and 2002, and again more recently from 2013. 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, so this finding should be treated with caution.

From all years for which data are available (1993-2020), counts from 326 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).

Waterway Survey

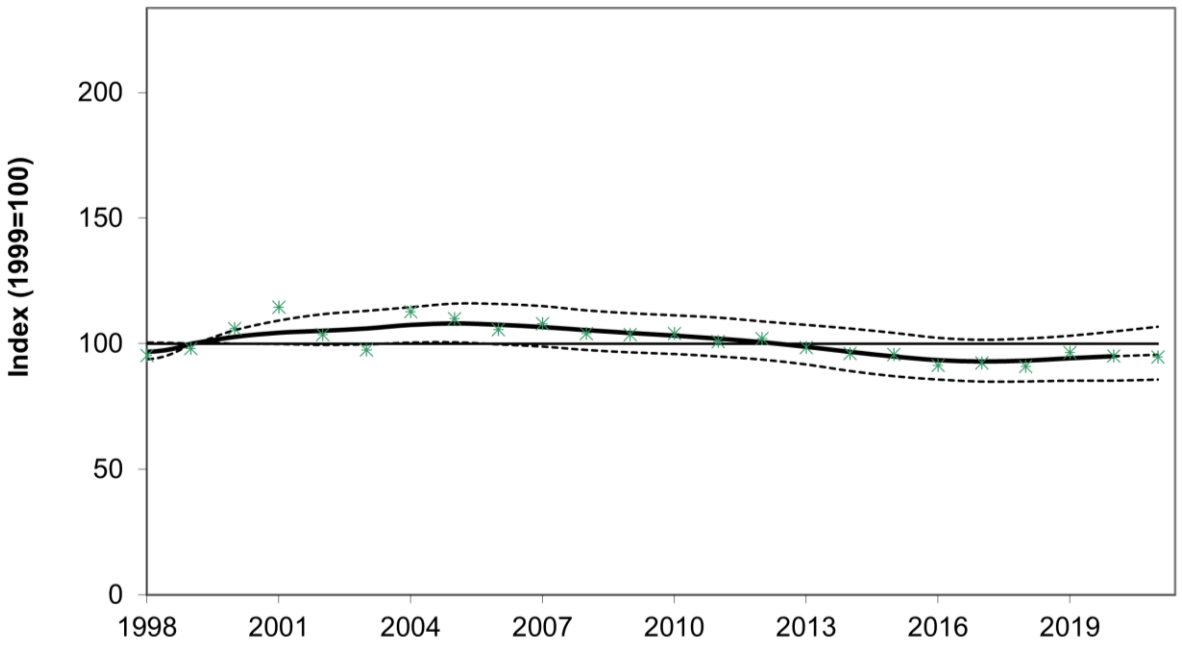


Figure 21. Waterway Survey index for Daubenton's bat in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 4.4% below the 1999 base year value, equivalent to a mean annual decrease of 0.2% (95% CI -0.7% to 0.3%). Overall, the smoothed index **does not differ significantly from the 1999 base year value.**

Data from 722 sites surveyed between 1998 and 2021 contribute to the trend analysis in the United Kingdom (sites surveyed in at least two years).

Daubenton's bat trends | Scotland

Summary of survey results for Scotland

Trends from both the Hibernation Survey and the Waterway Survey in Scotland show no significant difference in the smoothed index in comparison to the baseline year. Because of the suspension of the Hibernation Survey in winter 2020/21 due to COVID-19, it has not been possible to update the trend for the Hibernation Survey for this report. Instead, the trend that was published in 2020 Annual Report is repeated here for information. **The population of Daubenton's bat in Scotland is considered to have been stable since 1999**.

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

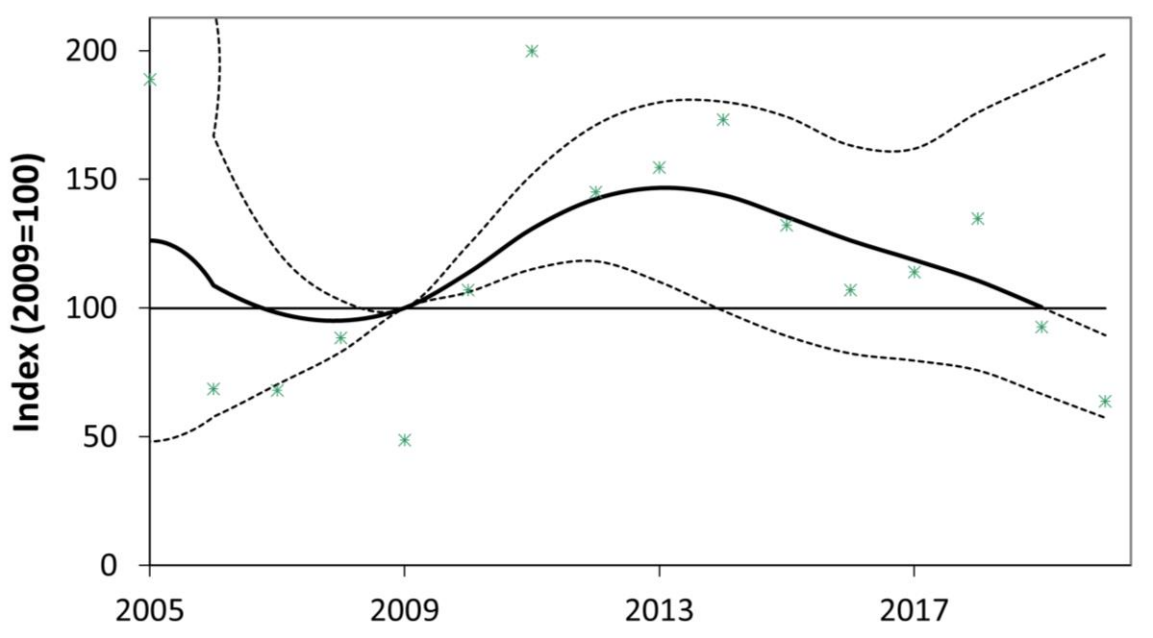


Figure 22. Hibernation Survey index for Daubenton's bat in Scotland, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 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 has fallen in every year. It was significantly higher than the baseline year between 2010 and 2013 but this is no longer the case. Currently the smoothed index **does 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.** Improving the sample size for this trend is one of the priorities outlined in our strategy for improving geographical coverage of repeat survey sites (see *Developments and Future Directions*).

Waterway Survey

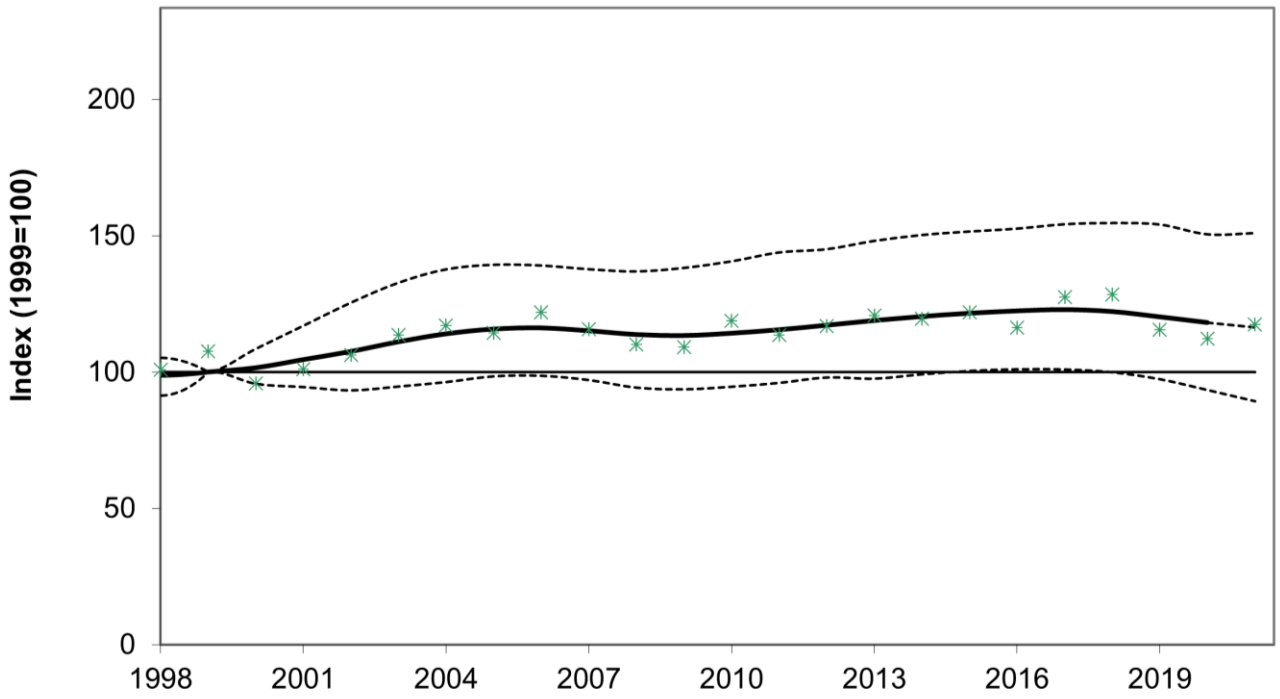


Figure 23. Waterway Survey index for Daubenton's bat in Scotland, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 16.3% above the 1999 base year value, equivalent to a mean annual increase of 0.7% (95% CI -0.5% to 1.9%). Overall, the smoothed index **does not differ significantly from the 1999 base year value.**

Data from 125 sites surveyed between 1998 and 2021 contribute to the trend analysis in Scotland (sites surveyed in at least two years).

Daubenton's bat trends | Wales

Summary of survey results for Wales

The trend from the Hibernation Survey in Wales showed no significant difference in the smoothed index in comparison to the baseline year. Because of the suspension of the Hibernation Survey in winter 2020/21 due to COVID-19, it has not been possible to update the trend for the Hibernation Survey for this report. Instead, the trend that was published in 2020 Annual Report is repeated here for information. **The population of Daubenton's bat in Wales is considered to have been stable since 1999**.

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

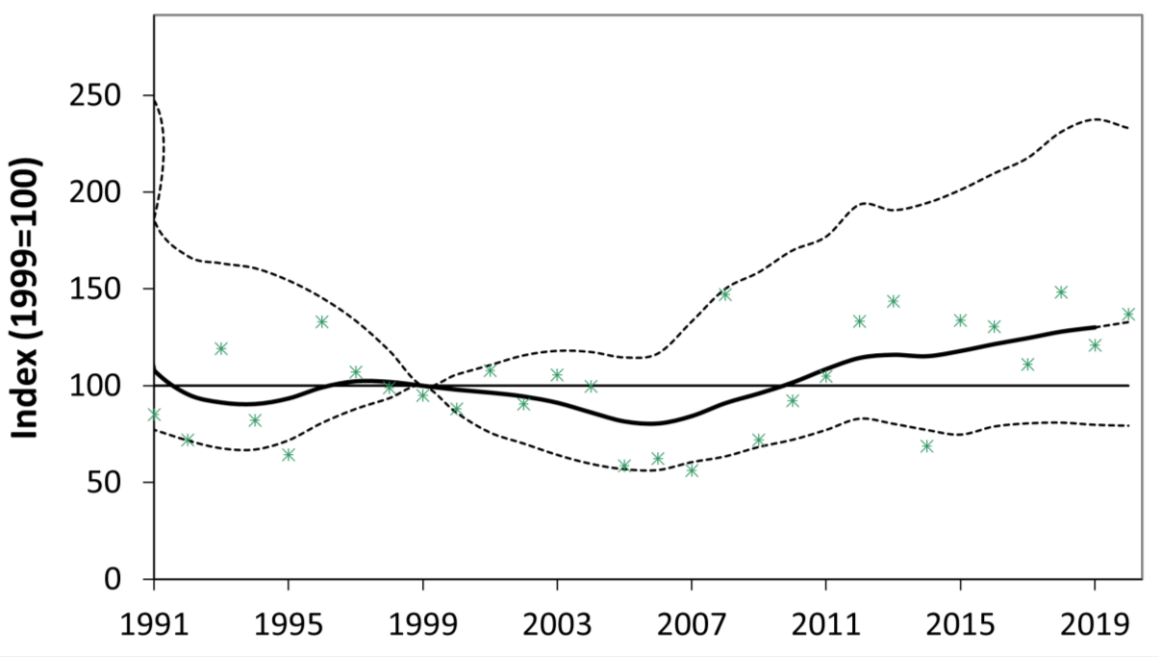


Figure 24. Hibernation Survey index for Daubenton's bat in Wales, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 32.8% above the 1999 baseline value, equivalent to a mean annual increase of 1.4% (95% CI -1.1% to 4.1%). 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 (1990-2020), counts from 99 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).

Waterway Survey

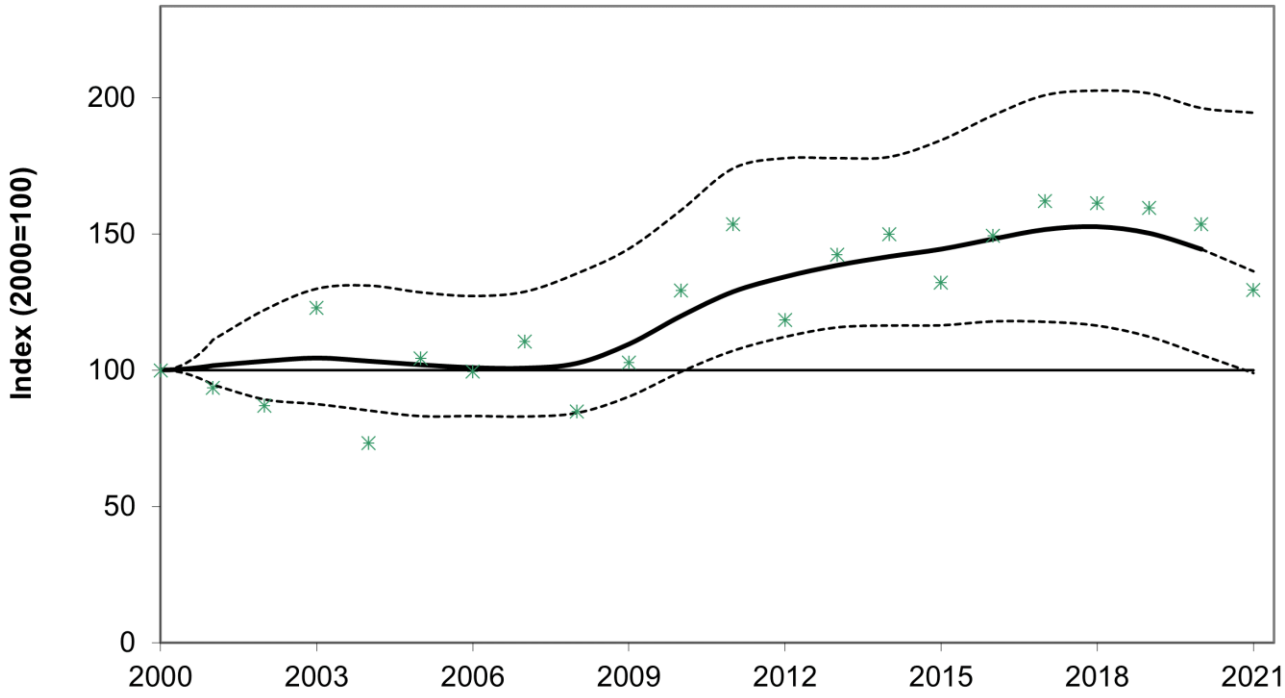


Figure 25. Waterway Survey index for Daubenton's bat in Wales, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 36.2% above the 1999 base year value, equivalent to a mean annual increase of 1.5% (95% CI -0.1% to 3.2%). Overall, the smoothed index **does not differ significantly from the 1999 base year value.**

Data from 49 sites surveyed between 1998 and 2021 contribute to the trend analysis in Wales (sites surveyed in at least two years).

Daubenton's bat trend | Northern Ireland

Summary of survey results for Northern Ireland

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

Waterway Survey

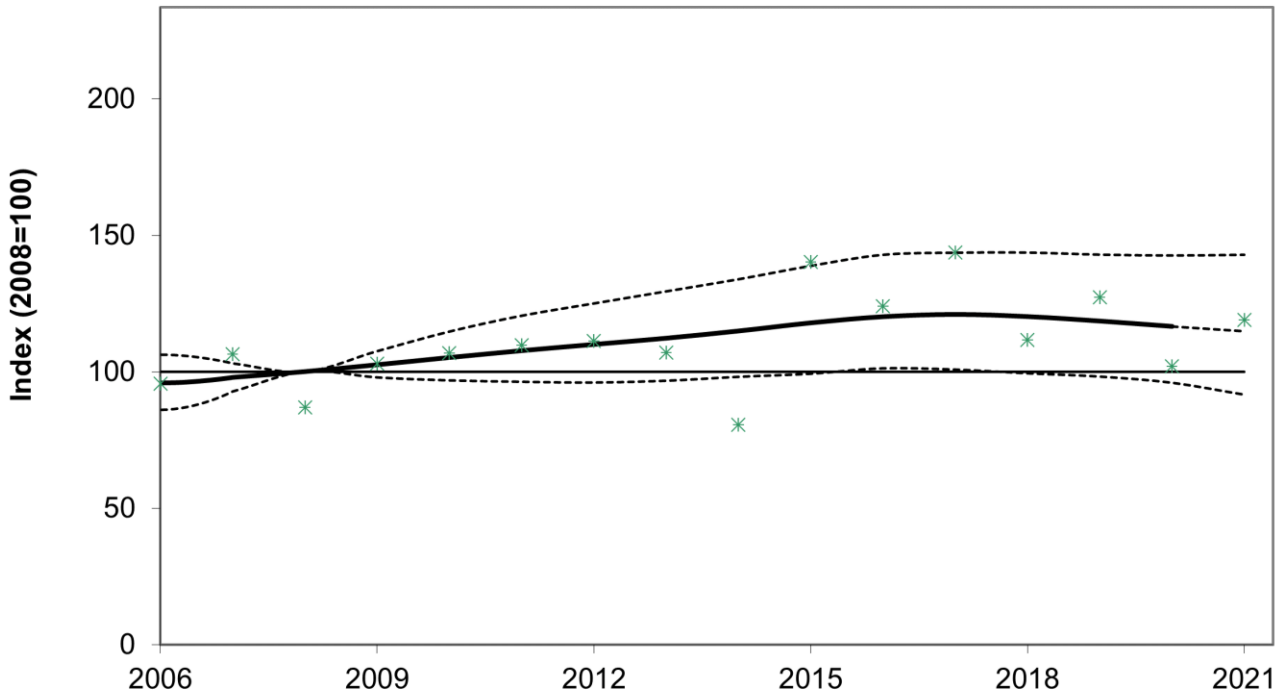


Figure 26. Waterway Survey index for Daubenton's bat in Northern Ireland, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 14.9% above the 2008 base year value, equivalent to a mean annual increase of 1.1% (95% CI -0.7% to 2.8%). Overall, the smoothed index **does not differ significantly from the 2008 base year value.**

Data from 74 sites surveyed between 2006 and 2021 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.

Whiskered/Brandt's bat trend | Great Britain

Myotis mystacinus / brandtii

Summary of survey results for Great Britain

It has not been possible to update the trend for whiskered/Brandt's bat as a result of the suspension of the Hibernation Survey in 2020/21 due to covid. Instead, the trend for 2019/20 is repeated here for information. 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 on the Roost Count but sample sizes are too low to enable the production of statistically robust trends. **Populations of whiskered and Brandt's bat combined are considered to have been stable in Great Britain since 1999**.

A combined population trend is produced for these species due to the difficulty separating them with confidence in the field. This trend should therefore be interpreted with caution as it includes 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.

A combined index for whiskered/Brandt's bat is also produced at a country level for England and Wales.

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

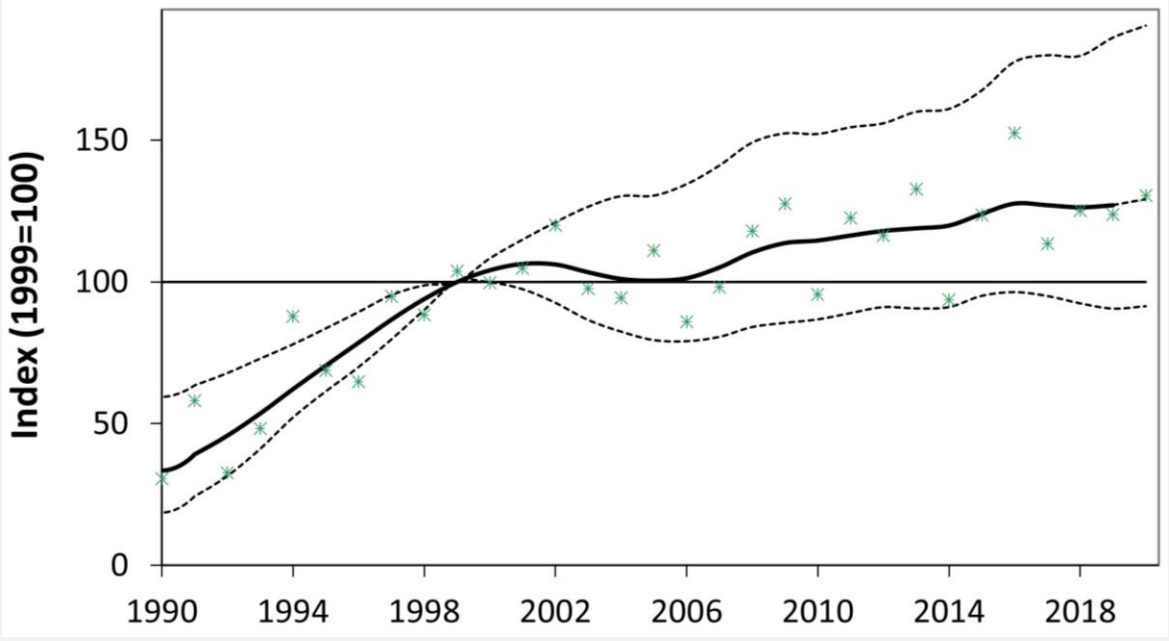


Figure 27. Hibernation Survey index for whiskered/Brandt's bat in Great Britain, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 29.2% above the 1999 base year value, equivalent to a mean annual increase of 1.2% (95% CI -0.4% to 3.1%). The smoothed index has fluctuated since the baseline year. It increased each year between 2005 and 2016, and since then has been relatively stable. 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.**

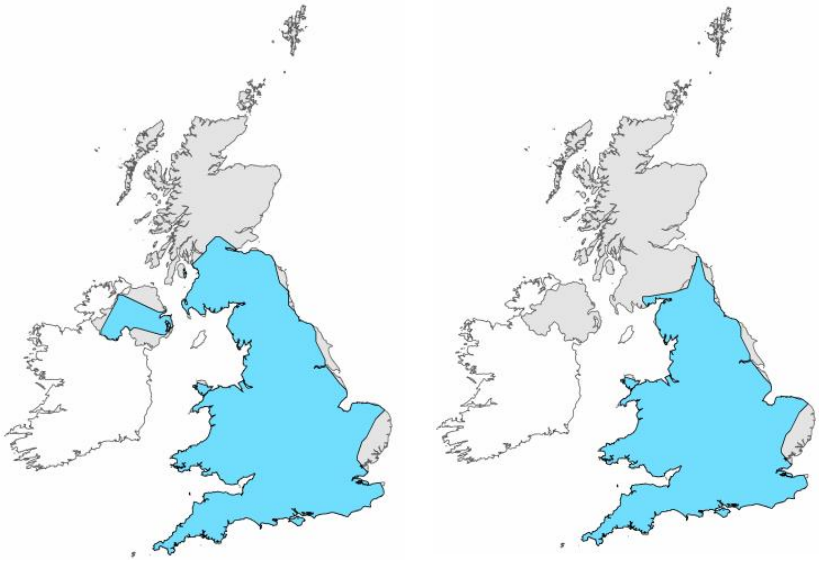
From all years for which data are available (1990-2020), counts from 262 sites contribute to the trend (sites surveyed in two or more years with whiskered/Brandt's bat recorded in at least one year).

Distribution and abundance

The two species are uncommon but widespread in England and Wales. Whiskered bat is rare in Scotland and Northern Ireland. There are only a few records of Brandt's bat in Scotland and this species is absent from Northern Ireland.

Population estimate

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



Whiskered bat Brandt's bat

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

Whiskered/Brandt's bat trend | England

Summary of survey results for England

It has not been possible to update the trend for whiskered/Brandt's bat as a result of the suspension of the Hibernation Survey in 2020/21 due to covid. Instead, the trend for 2019/20 is repeated here for information. The trend from the Hibernation Survey in England shows no significant difference in the smoothed index in comparison to the baseline year. **Populations of whiskered and Brandt's bat combined are considered to have been stable in England since 1999**.

A combined population trend is produced for these species due to the difficulty separating them with confidence in the field. This trend should therefore be interpreted with caution as it includes 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.

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

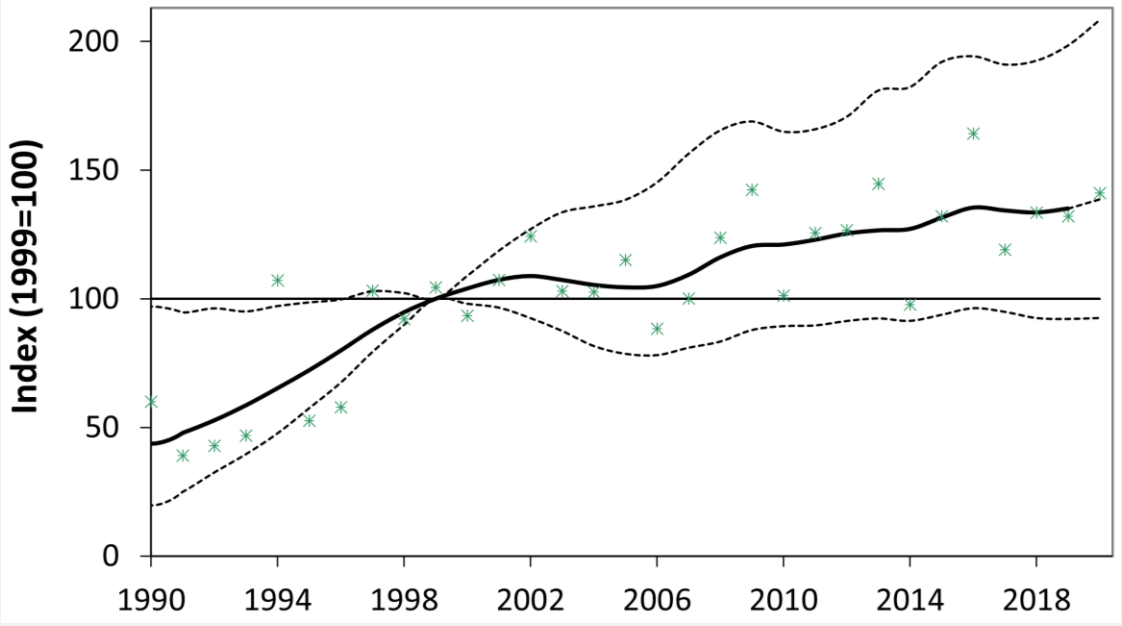


Figure 28. Hibernation Survey index for whiskered/Brandt's bat in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 38.6% above the 1999 base year value, equivalent to a mean annual increase of 1.6% (95% CI -0.4% to 3.6%). The smoothed index has fluctuated since the baseline year. It increased each year between 2005 and 2016, and since then has been relatively stable. 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.**

From all years for which data are available (1990-2020), counts from 173 sites contribute to the trend analysis in England.

Whiskered/Brandt's bat trend | Wales

Summary of survey results for Wales

It has not been possible to update the trend for whiskered/Brandt's bat as a result of the suspension of the Hibernation Survey in 2020/21 due to covid. Instead, the trend for 2019/20 is repeated here for information. The trend from the Hibernation Survey in Wales shows no significant difference in the smoothed index in comparison to the baseline year. **Populations of whiskered and Brandt's bat combined are considered to have been stable in Wales since 1999**.

A combined population trend is produced for these species due to the difficulty separating them with confidence in the field. This trend should therefore be interpreted with caution as it includes 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.

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

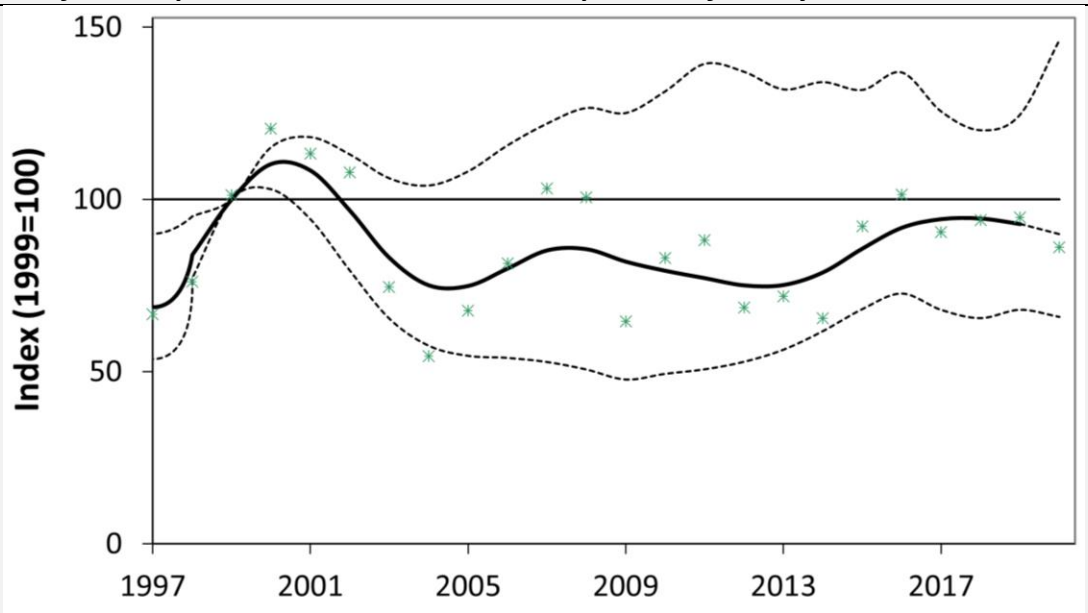


Figure 29. Hibernation Survey index for whiskered/Brandt's bat in Wales, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 10.1% below the 1999 base year value, equivalent to a mean annual decrease of 0.5% (95% CI -2.0% to 1.8%). The smoothed index has fluctuated considerably since 1999; 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.**

From all years for which data are available (1998-2020), counts from 76 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).

Natterer's bat trends | Great Britain

Myotis nattereri

Summary of survey results for Great Britain

The trend from the Hibernation Survey in 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 difference. 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*). **We therefore consider that the population of Natterer's bat in Great Britain has increased since 1999.** However, this finding should be treated with caution until the effect of this species' roost switching behaviour on the Roost Count trend is better understood. Because of the suspension of the Hibernation Survey in winter 2020/21 due to COVID-19, it has not been possible to update the trend for the Hibernation Survey for this report. Instead, the trend that was published in 2020 Annual Report is repeated here for information.

Survey indices for Natterer's bat are also produced at a country level for England, Scotland and Wales.

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

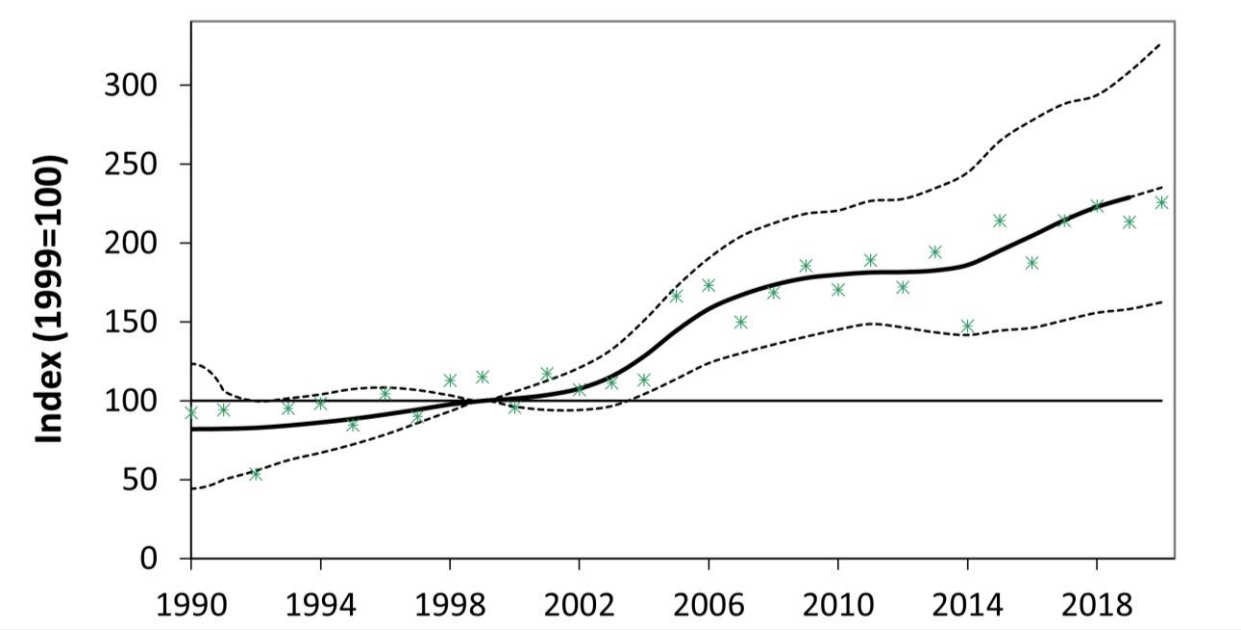


Figure 30. Hibernation Survey index for Natterer's bat in Great Britain, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 135.1% above the 1999 base year value, equivalent to a mean average annual increase of 4.2% (95% CI 2.3% to 5.8%). From the baseline year the smoothed index has increased in every year apart from 2012, when it remained essentially unchanged from the previous year. The rate of increase has varied considerably over this time. The smoothed index has been significantly higher than the baseline year since 2004 and overall there has been a **significant increase in the smoothed index since 1999.**

From all years for which data are available (1990-2020), counts from 560 sites contribute to the overall trend analysis (sites surveyed in two or more years with Natterer's bat recorded in at least one year).

Roost Count

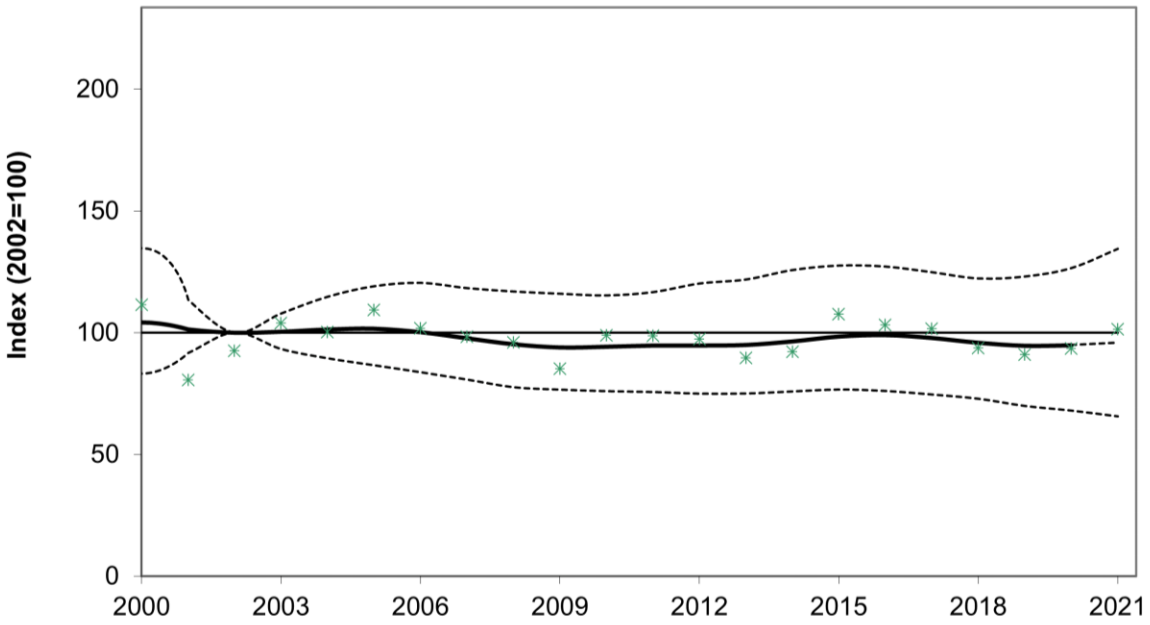
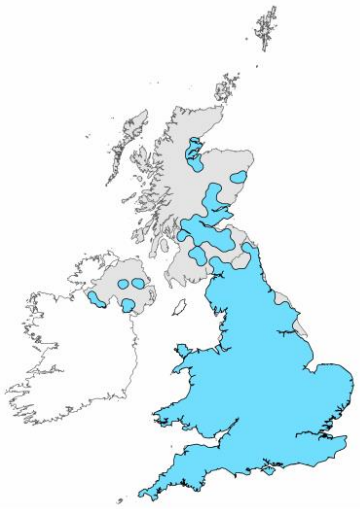


Figure 31. Roost Count index for Natterer's bat in Great Britain, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 4.1% below the 2002 base year value, equivalent to a mean annual decrease of 0.2% (95% CI -2.2% to 1.6%). 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. We are currently investigating the causes of this negative bias and ways to correct it (see *Robustness of Monitoring*).

Data from 89 sites surveyed between 2000 and 2021 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.



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)[6]	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				
Source	Mathews *et al.* 2018				Russ 1999

[6] This population estimate is extrapolated from estimated population density in mixed habitats. Mathews *et al.* 2018 also provide a higher population estimate extrapolated from estimated population density in woodland habitat.

Natterer's bat trends | England

Summary of survey results for England

The trend from the Hibernation Survey in 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 difference. 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*). **We therefore consider that the population of Natterer's bat in England has increased since 1999.** However, this finding should be treated with caution until the effect of this species' roost switching behaviour on the Roost Count trend is better understood. Because of the suspension of the Hibernation Survey in winter 2020/21 due to COVID-19, it has not been possible to update the trend for the Hibernation Survey for this report. Instead, the trend that was published in 2020 Annual Report is repeated here for information.

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

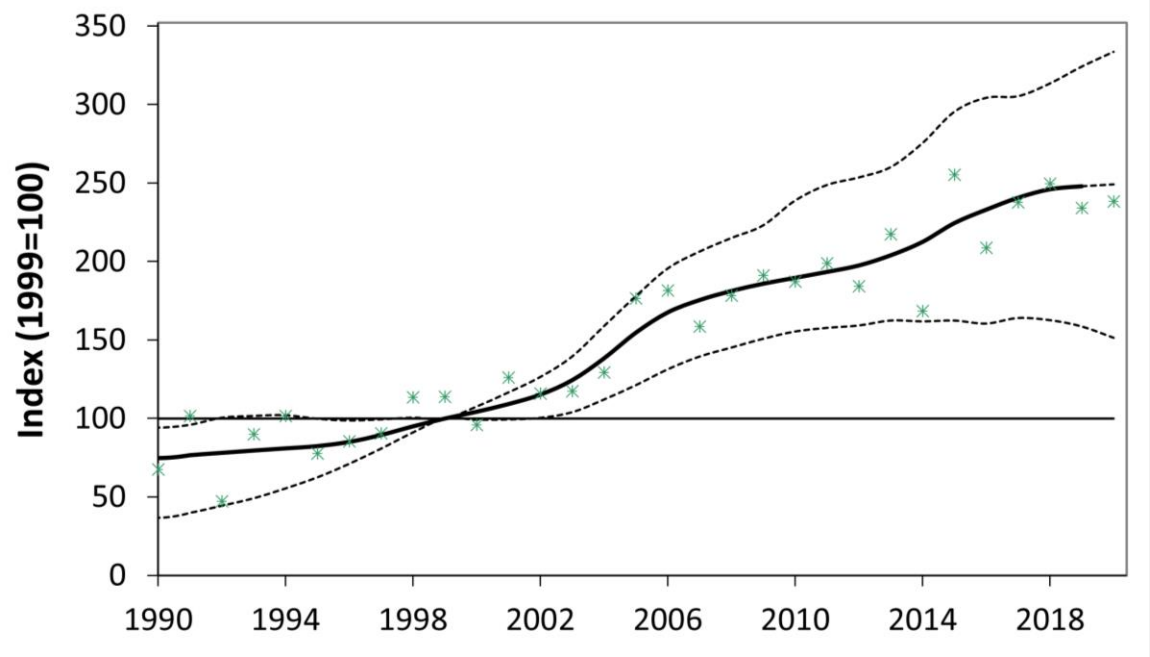


Figure 32. Hibernation Survey index for Natterer's bat in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 149.1% above the 1999 base year value, equivalent to a mean annual increase of 4.4% (95% CI 2.0% to 5.9%). The value of the smoothed index has increased in every year since the baseline year, however the rate of increase has varied considerably. Overall, there has been **a significant increase in the smoothed index since 1999.**

From all years for which data are included (1990-2020), counts from 396 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

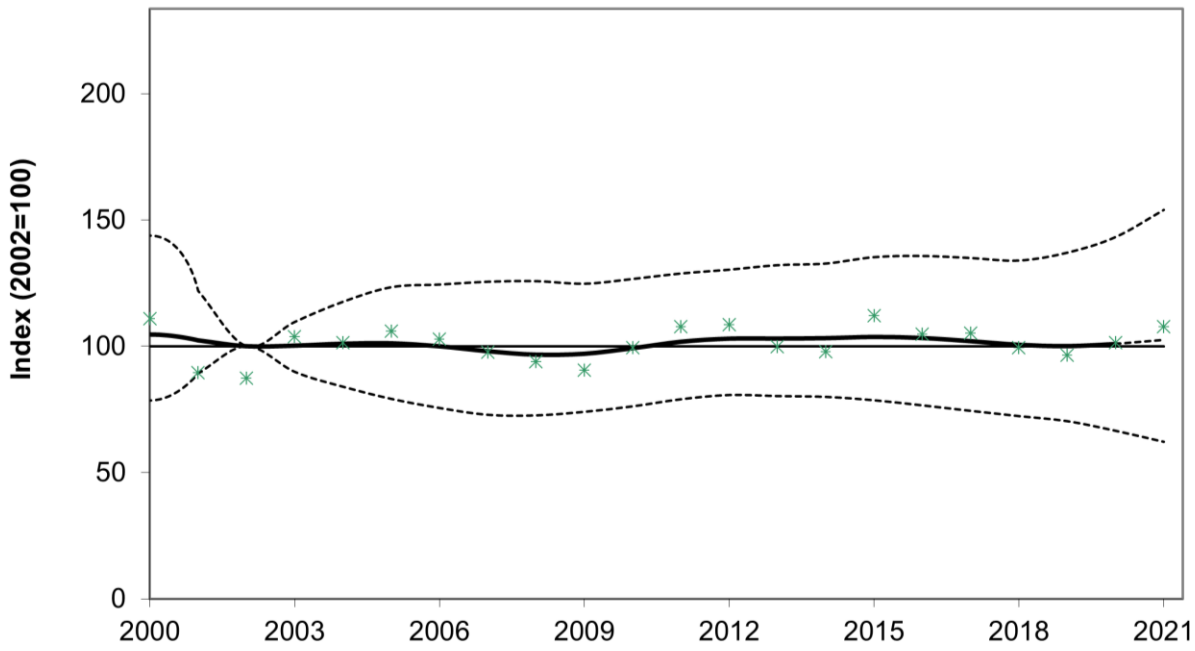


Figure 33. Roost Count index for Natterer's bat in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 2.5% below the 2002 base year value, equivalent to a mean annual decrease of 0.1% (95% CI -2.5% to 2.3%). 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*) and this trend is not therefore considered a reliable measure of population change for Natterer's bat.

Data from 76 sites surveyed between 2000 and 2021 contribute to the trend analysis in England (sites surveyed in two or more years).

Natterer's bat trend | Scotland

Summary of survey results for Scotland

The trend from the Hibernation Survey in Scotland shows no significant difference from the baseline year. Natterer's bat is also recorded on the Roost Count in Scotland but the sample size is too low to enable production of 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 the results may be unreliable. Note that as a result of the suspension of the Hibernation Survey in winter 2020/21 due to COVID-19, the trend that was published in 2020 Annual Report is repeated here for information.

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

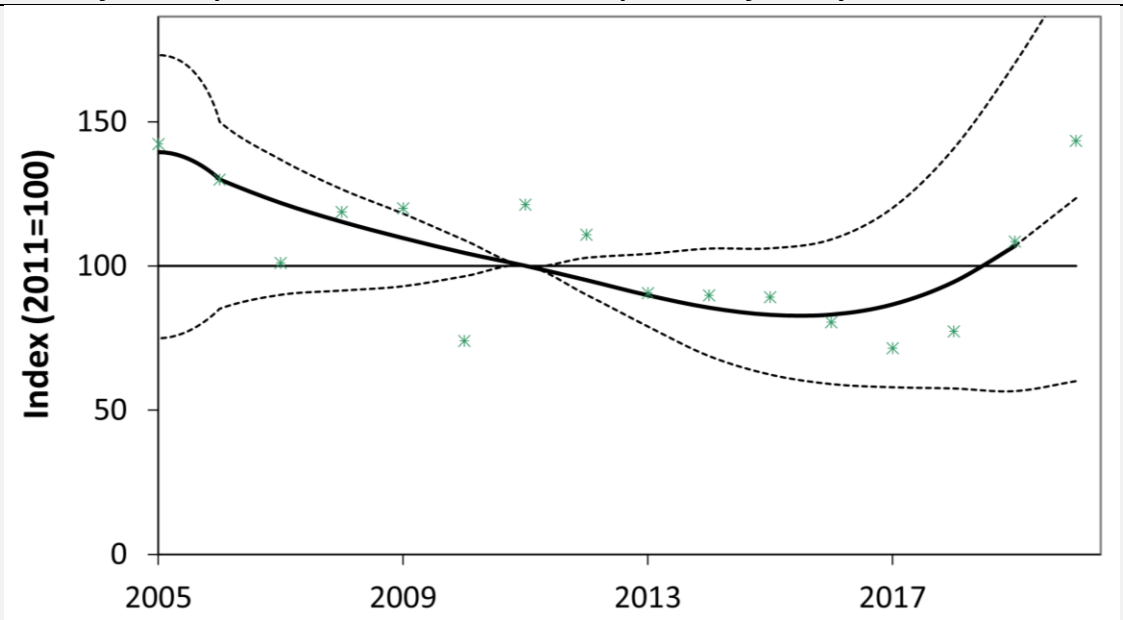


Figure 34. Hibernation Survey index for Natterer's bat in Scotland, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 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 gradually 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 one of the priorities outlined in our strategy for improving geographical coverage of repeat survey sites (see *Developments and Future Directions*).

Natterer's bat trend | Wales

Summary of survey results for Wales

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 too low to enable production of a statistically robust trend. **The population of Natterer's bat in Wales is considered to have increased since 1999.** Because of the suspension of the Hibernation Survey in winter 2020/21 due to COVID-19, it has not been possible to update the trend for the Hibernation Survey for this report. Instead, the trend that was published in 2020 Annual Report is repeated here for information.

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

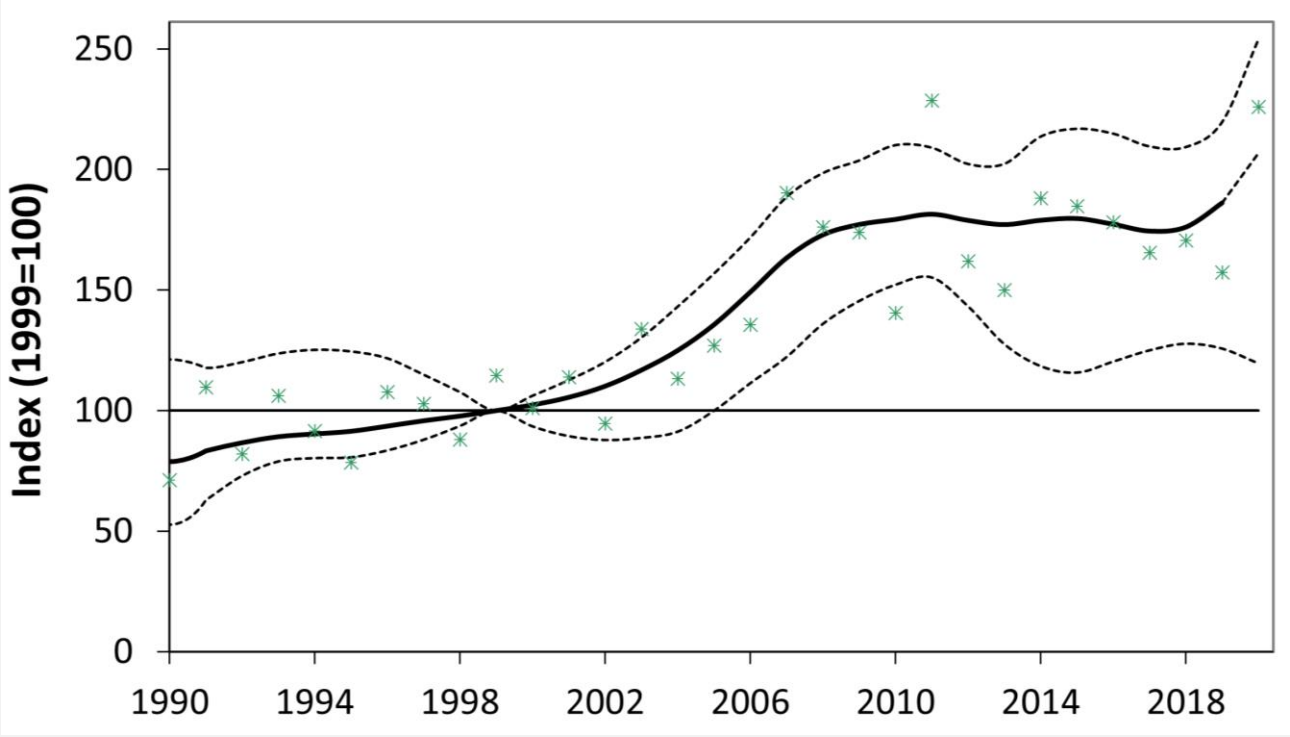


Figure 35. Hibernation Survey index for Natterer's bat In Wales, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 106.6% above the 1999 base year value, equivalent to a mean annual increase of 3.5% (95% CI 0.9% to 4.5%). 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 year in 2006 and overall there has been a **significant increase in the smoothed index since 1999.**

From all years for which data are available (1998-2020), 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).

Common pipistrelle trends | Great Britain

Pipistrellus pipistrellus

Summary of survey results for Great Britain

The trend from the Field Survey in Great Britain shows a significant increase in the smoothed index in comparison 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*), therefore **the population of common pipistrelle in Great Britain is considered to have increased since 1999.**

Survey indices for common pipistrelle are also produced at a 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.

Field Survey

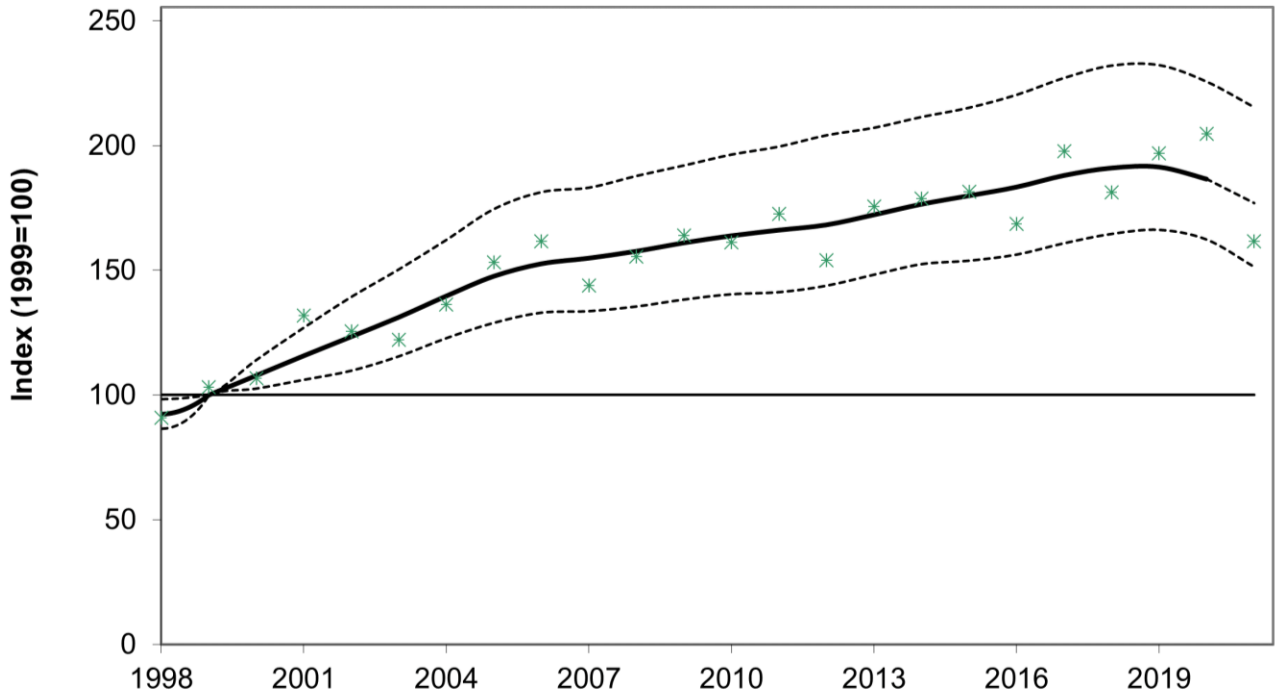


Figure 36. Field Survey index for common pipistrelle in Great Britain, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 76.8% above the 1999 base year value, equivalent to a mean annual increase of 2.6% (95% CI 1.9% to 3.6%). The smoothed index has increased consistently since the baseline year. There has been a **significant increase in the smoothed index since 1999.**

Data from 673 sites surveyed between 1998 and 2021 contribute to the trend analysis (sites surveyed in at least two years).

Roost Count

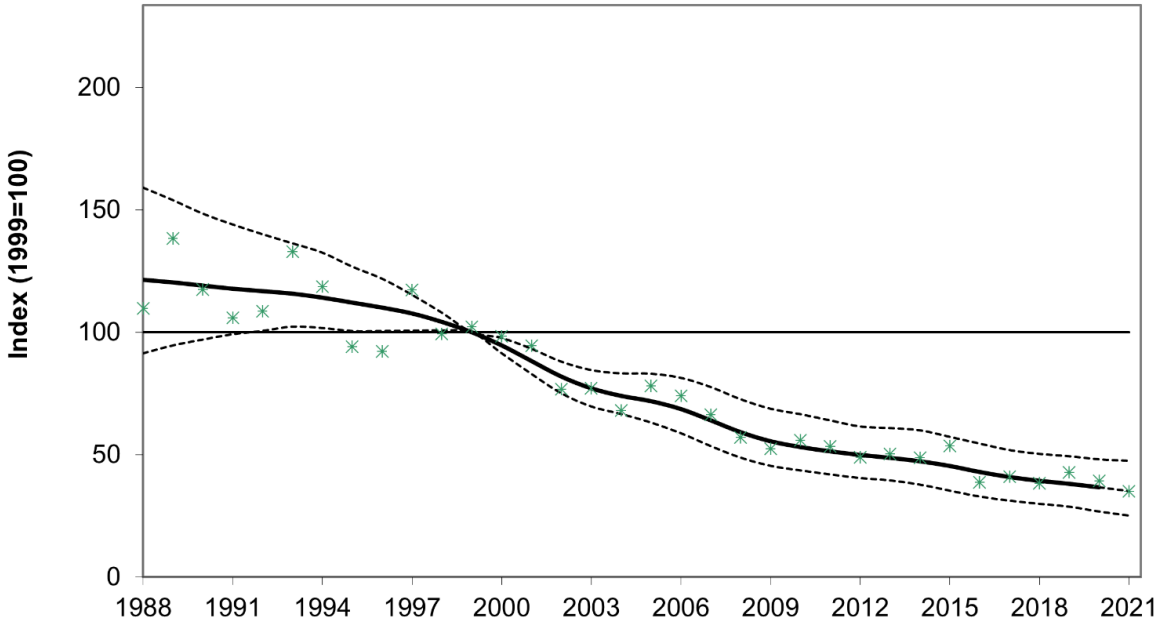


Figure 37. Roost Count index for common pipistrelle in Great Britain, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 64.9% below the 1999 base year value, equivalent to a mean annual decrease of 4.7% (95% CI -6.1% to -3.3%). 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 from 550 sites surveyed between 1997 and 2021 contribute to the trend analysis (sites surveyed in at least two years).

Population estimate

Country	GB	England	Wales	Scotland	N. Ireland
Number (Plausible intervals in brackets)	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.				
Source	Mathews *et al.* 2018				Russ 1999

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

Common pipistrelle trends | England

Summary of survey results for England

The trend from the Field Survey in England shows a significant increase in the smoothed index in comparison 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*), therefore **the population of common pipistrelle in England is considered to have increased since 1999.**

Field Survey

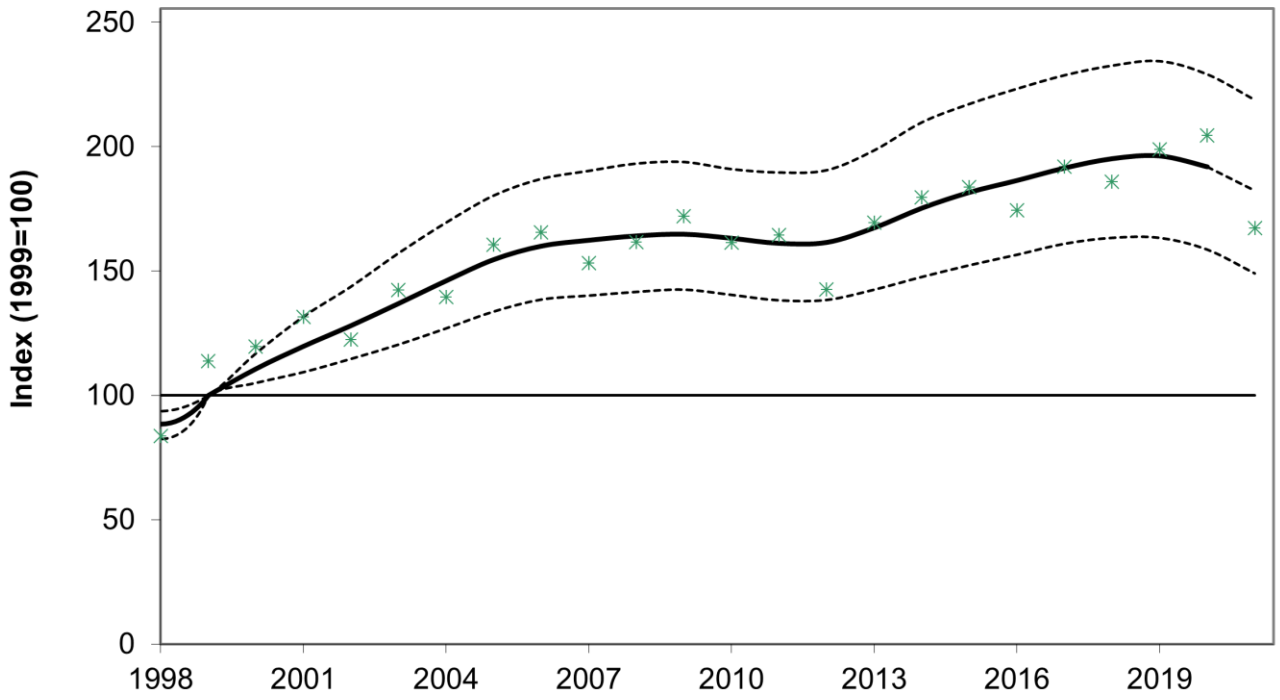


Figure 38. Field Survey index for common pipistrelle in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 82.4% above the 1999 base year value, equivalent to a mean annual increase of 2.8% (95% CI 1.8% to 3.6%). Overall, there has been a **significant increase in the smoothed index since 1999.**

Data from 546 sites surveyed between 1998 and 2021 contribute to the trend analysis in England (sites surveyed in at least two years).

Roost Count

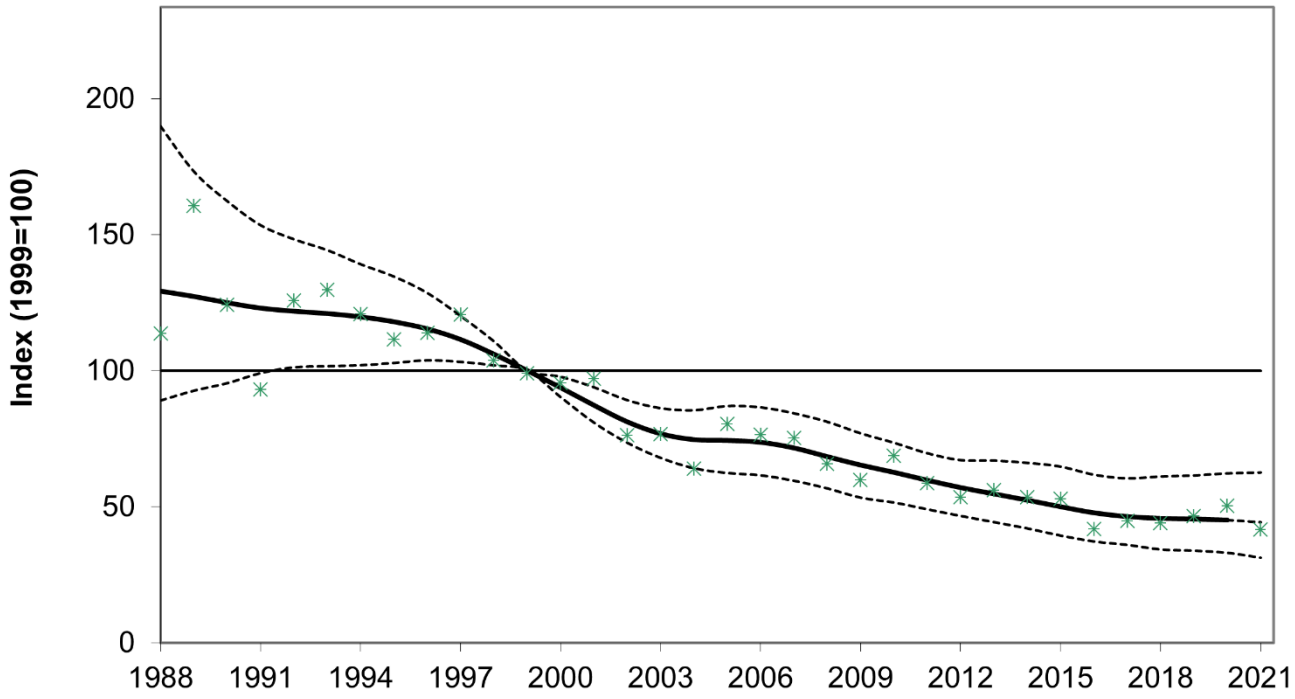


Figure 39. Roost Count index for common pipistrelle in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 55.7% below the 1999 base year value, equivalent to a mean annual decrease of 3.6% (95% CI -5.2% to -2.1%). 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 from 438 sites surveyed between 1988 and 2021 contribute to the trend analysis in England (sites surveyed in at least two years).

Common pipistrelle trends | Scotland

Summary of survey results for Scotland

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*), therefore **the population of common pipistrelle in Scotland is considered to have been stable since 1999.**

Field Survey

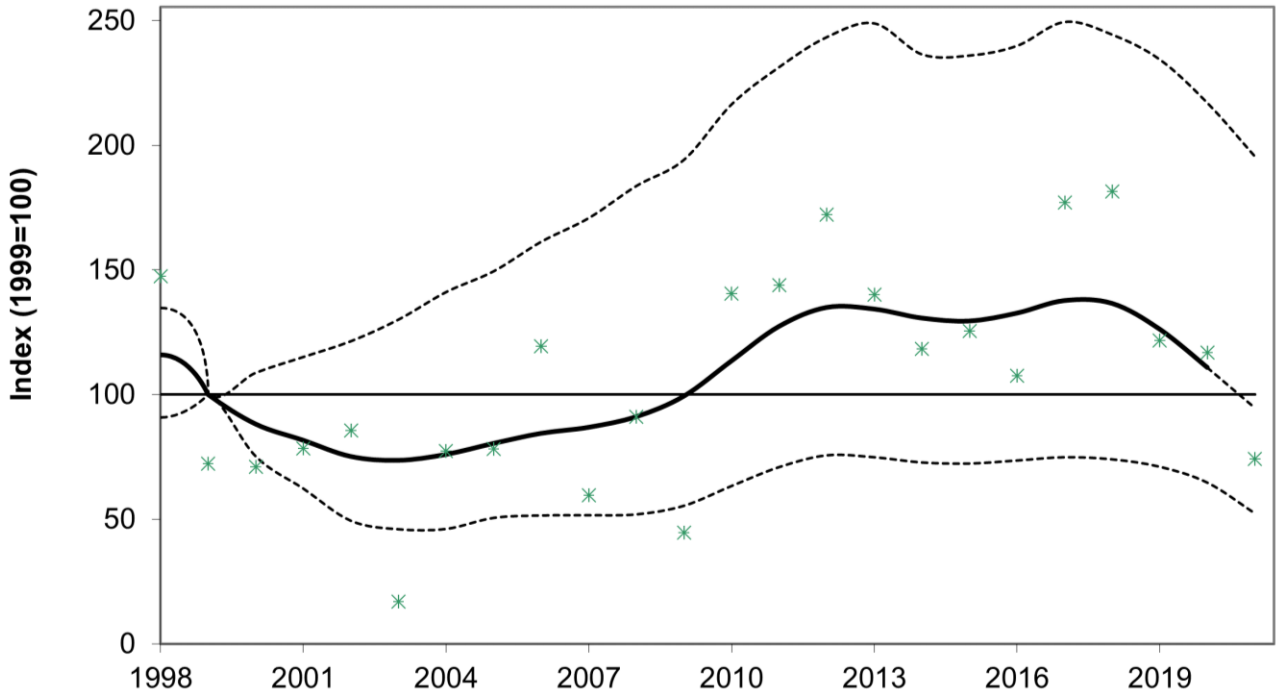


Figure 40. Field Survey index for common pipistrelle in Scotland, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 5.6% below the 1999 base year value, equivalent to a mean annual decrease of 0.3% (95% CI -2.9% to 3.09%). 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 74 sites surveyed between 1998 and 2021 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 one of the priorities outlined in our strategy for improving geographical coverage of repeat survey sites (see *Developments and Future Directions*).

Roost Count

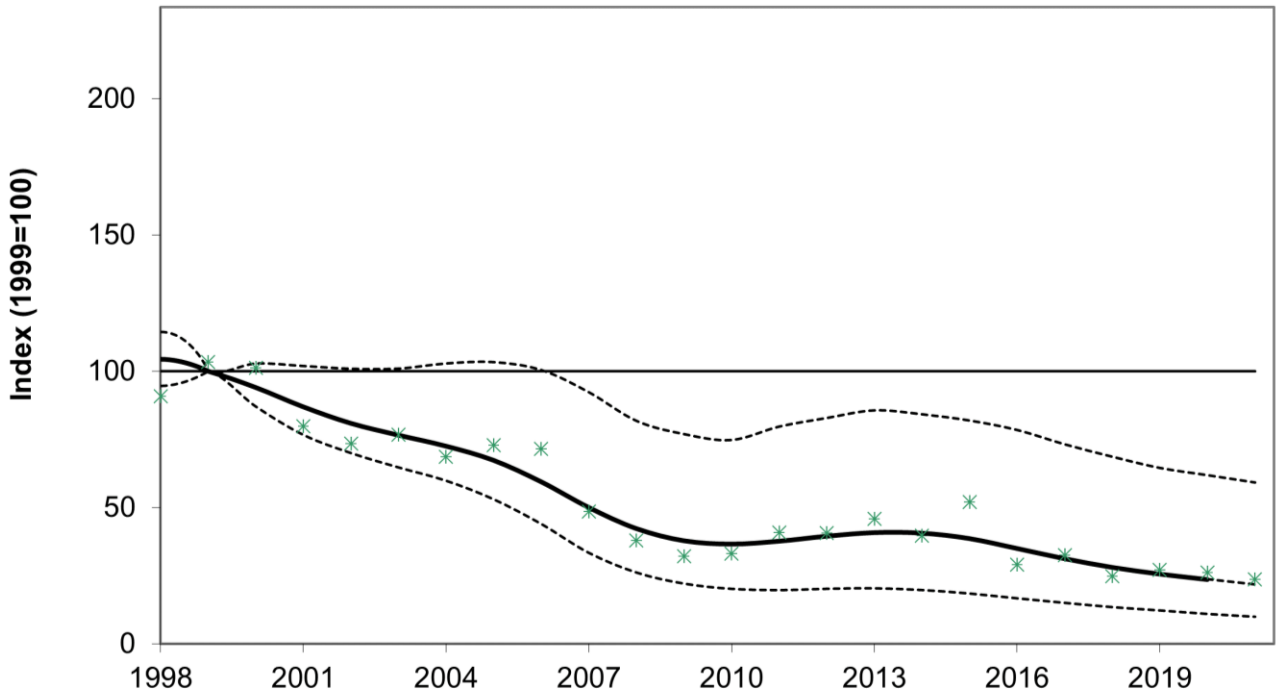


Figure 41. Roost Count index for common pipistrelle in Scotland, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 78.2% below the 1999 base year value, equivalent to a mean annual decrease of 6.7% (95% CI -10.0% to -2.4%). The value of the smoothed index fell steadily between 1999 and 2009. 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 from 72 sites surveyed between 1998 and 2021 contribute to the trend analysis in Scotland (sites surveyed in at least two years).

Common pipistrelle trend | Wales

Summary of survey results for Wales

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 too low to enable a statistically robust trend to be produced.

Roost Count

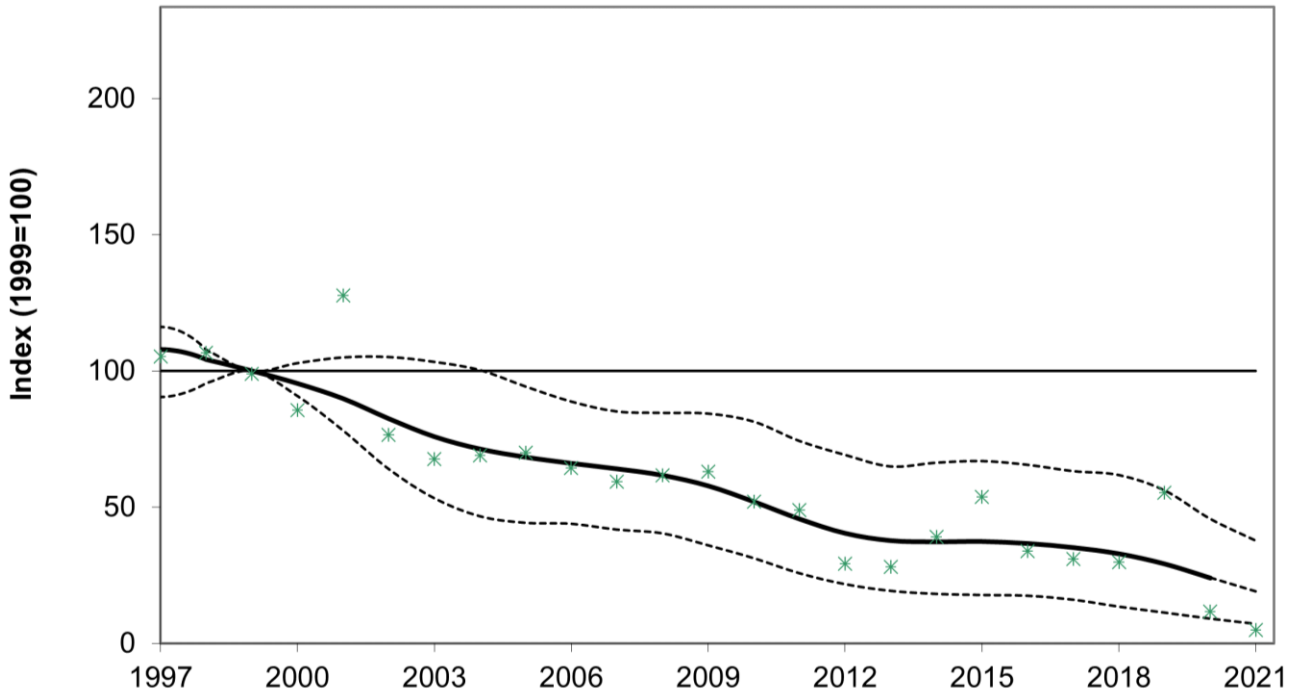


Figure 42. Roost Count index for common pipistrelle in Wales, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 80.9% below the 1999 base year value, equivalent to a mean annual decrease of 7.3% (95% CI -11.3% to -4.3%). The smoothed index has fallen since the baseline year, although the rate of decline has slowed considerably since 2013. 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 common pipistrelle**. We are currently investigating the causes of this negative bias and ways to correct it (see *Robustness of Monitoring*).

Data from 39 sites surveyed between 1997 and 2021 contribute to the trend analysis in Wales (sites surveyed in at least two years).

Soprano pipistrelle trends | Great Britain

Pipistrellus pygmaeus

Summary of survey results for Great Britain

The trend from the Field Survey in Great Britain does not differ significantly from 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. **The population of soprano pipistrelle in Great Britain is considered to have been stable since 1999.**

Survey indices for soprano pipistrelle are also produced 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.

Field Survey

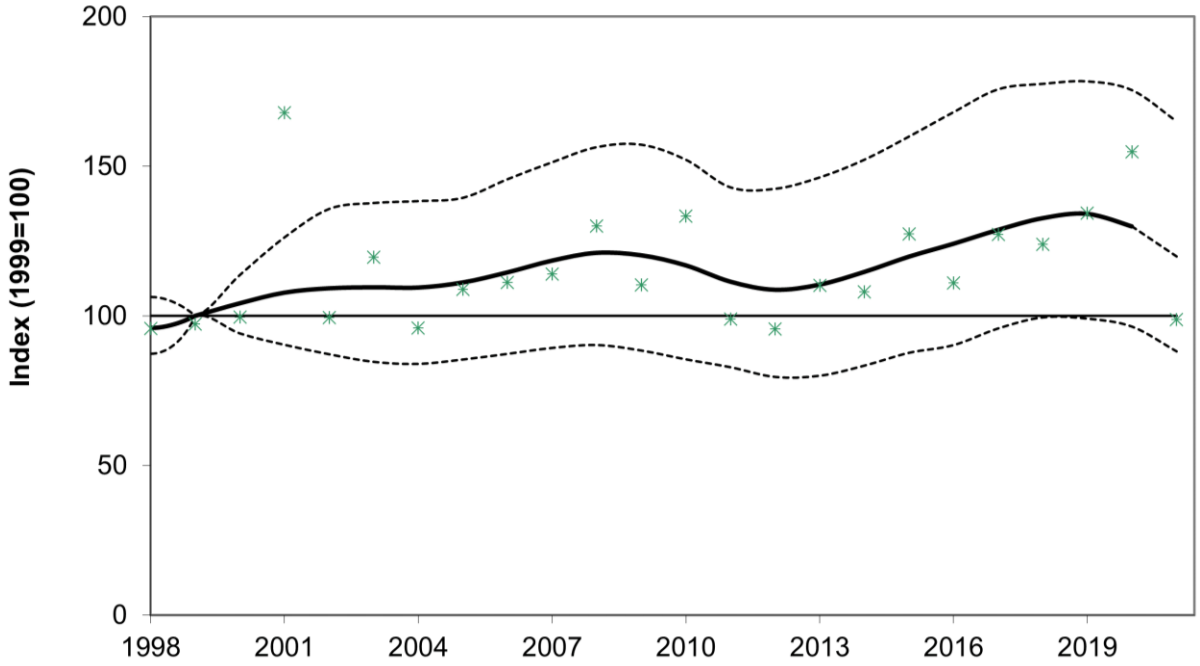


Figure 43. Field Survey index for soprano pipistrelle in Great Britain, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 19.9% above the 1999 base year value, equivalent to a mean annual increase of 0.8% (95% CI 0.6% to 2.3%). Overall, there has been **no significant change in the smoothed index since 1999.**

Data from 671 sites surveyed between 1998 and 2021 contribute to the trend analysis (sites surveyed in at least two years).

Roost Count

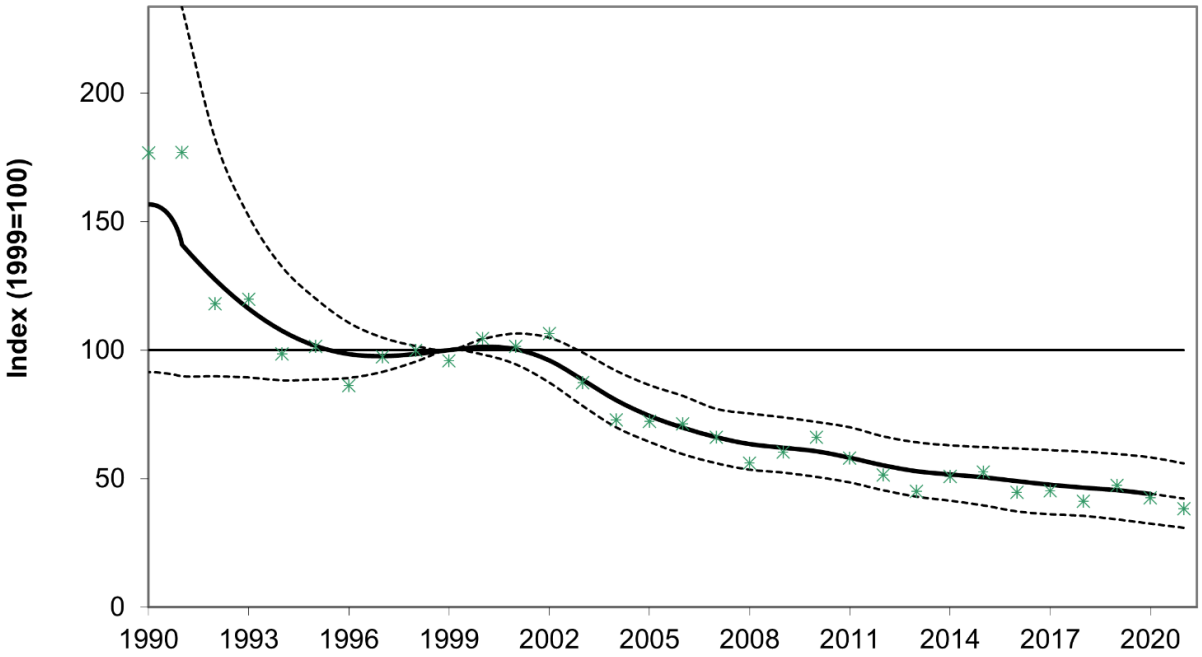


Figure 44. Roost Count index for soprano pipistrelle in Great Britain, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 57.8% below the 1999 value, equivalent to a mean annual decrease of 3.8% (95% CI -5.2% to 2.6%). The smoothed index had declined gradually since the baseline year, although the rate of decline has slowed considerably in recent years. **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 from 437 sites surveyed between 1997 and 2021 contribute to the trend analysis (sites surveyed in at least two years).

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				Russ 1999
Source	Mathews *et al. 2018*				

Soprano pipistrelle trends | England

Summary of survey results for England

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. Therefore, **the population of soprano pipistrelle in England is considered to have been stable since 1999.**

Field Survey

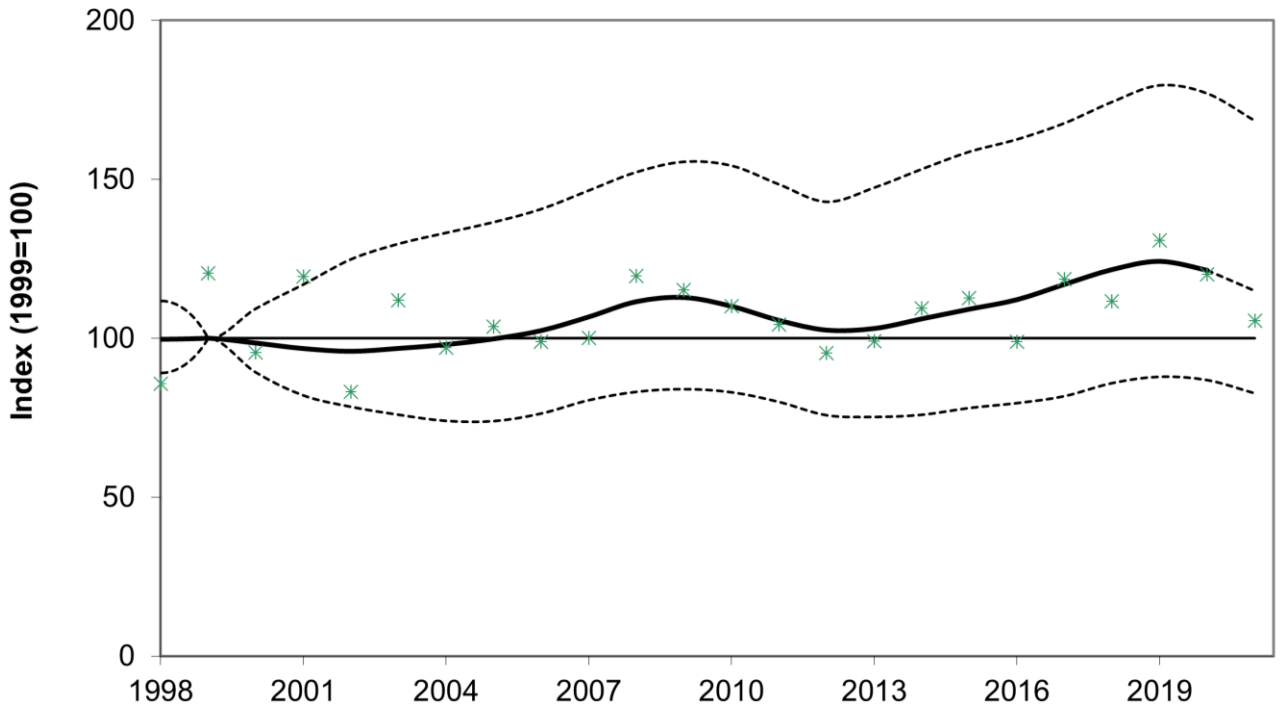


Figure 45. Field Survey index for soprano pipistrelle in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 14.8% above the 1999 base year value, equivalent to a mean annual increase of 0.6% (95% CI -0.9% to 2.4). Overall, the smoothed index **does not differ significantly from the 1999 base year value.**

Data from 545 sites surveyed between 1998 and 2021 contribute to the trend analysis in England (sites surveyed in at least two years).

Roost Count

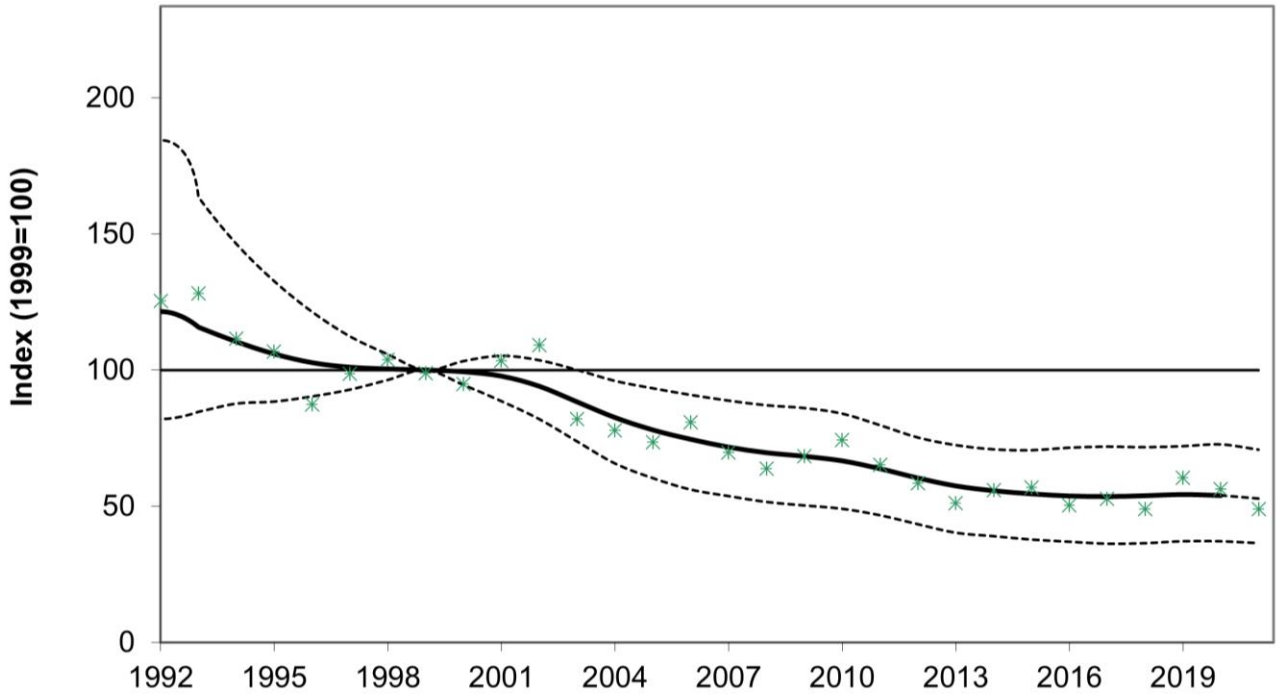


Figure 46. Roost Count index for soprano pipistrelle in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 47.1% below the 1999 base year value, equivalent to a mean annual decrease of 2.9% (95% CI -4.5% to -1.6%). The smoothed index fell steadily between the baseline year and 2016. Since 2016 it has been relative stable. 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 from 286 sites surveyed between 1992 and 2021 contribute to the trend analysis in England (sites surveyed in at least two years).

Soprano pipistrelle trends | Scotland

Summary of survey results for Scotland

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. **The population of soprano pipistrelle in Scotland is considered to have been stable since 1999.**

Field Survey

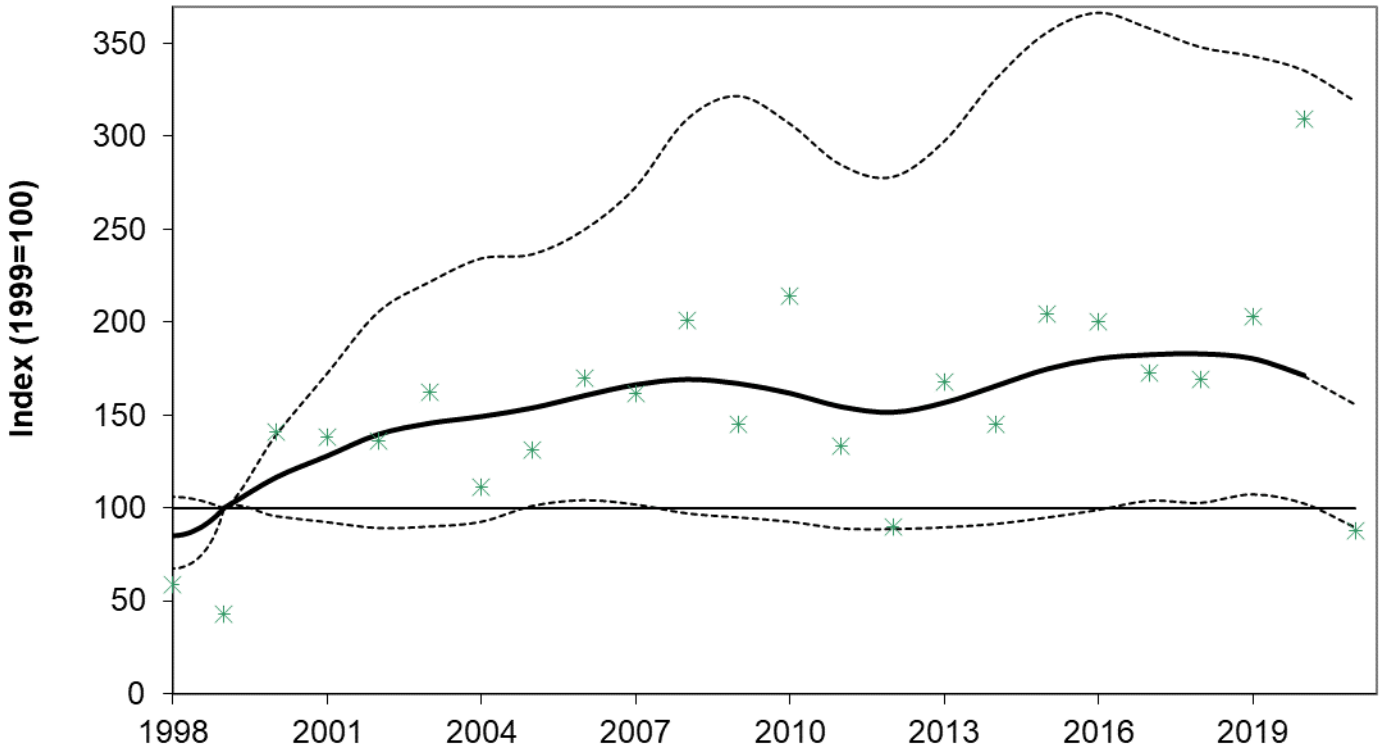


Figure 47. Field Survey index for soprano pipistrelle in Scotland, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 55.8% above the 1999 base year value, equivalent to a mean annual increase of 2.0% (95% CI -0.5% to 5.4%). Overall, there has been **no significant increase in the smoothed index since 1999.**

Data from 74 sites surveyed between 1998 and 2021 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 one of the priorities outlined in our strategy for improving geographical coverage of repeat survey sites (see *Developments and Future Directions*).

Roost Count

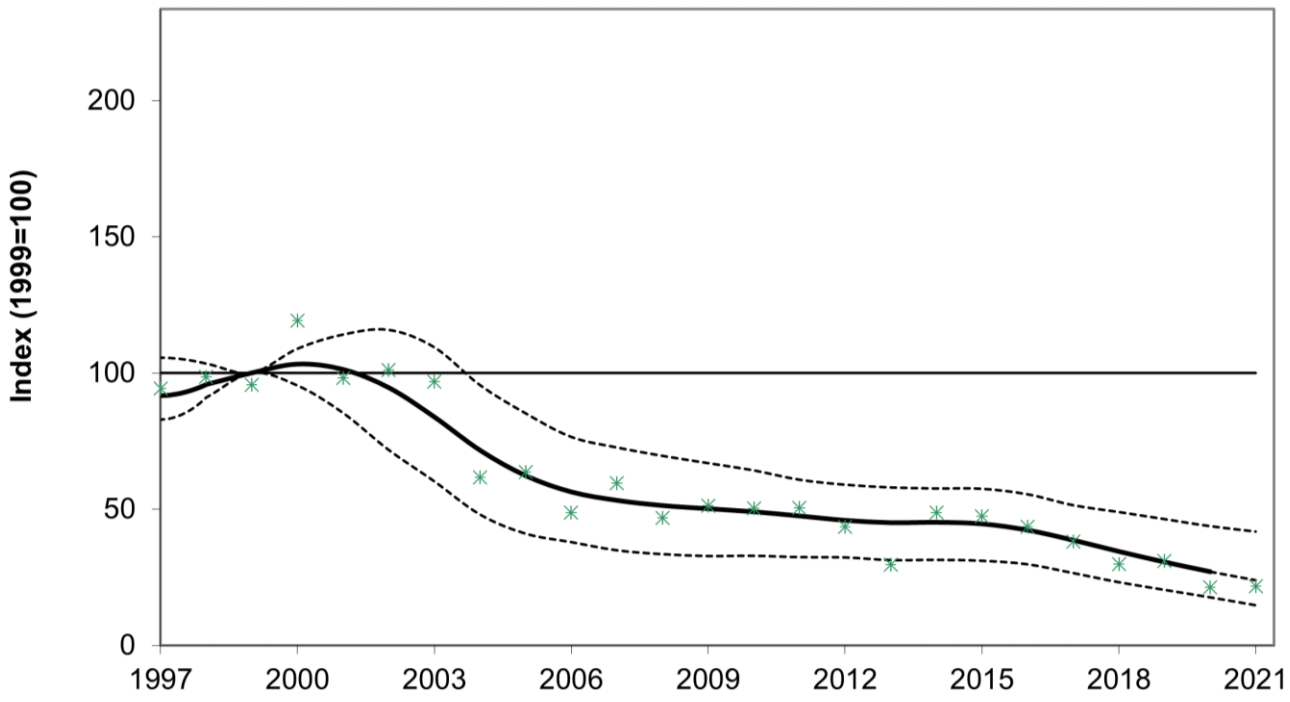


Figure 48. Roost Count index for soprano pipistrelle in Scotland, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 76.1% below the 1999 base year value, equivalent to a mean annual decrease of 6.3% (95% CI -8.3% to -3.9%). 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 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 from 96 sites surveyed between 1997 and 2021 contribute to the trend analysis in Scotland (sites surveyed in at least two years).

Soprano pipistrelle trend | Wales

Summary of survey results for Wales

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. 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 too low to enable the production of a statistically robust trend.

Roost Count

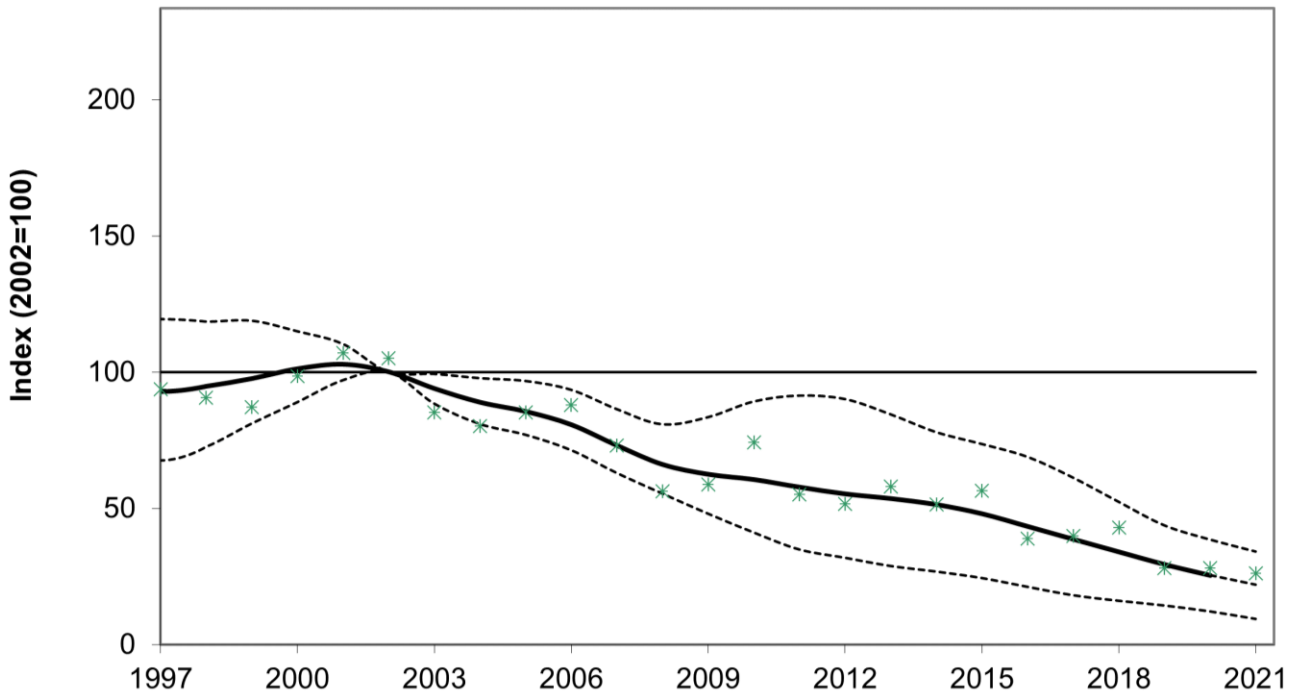


Figure 49. Roost Count index for soprano pipistrelle in Wales, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 78.0% below the 2002 base year value, equivalent to a mean annual decrease of 7.7% (95% CI -11.7% to -5.5%). 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 from 55 sites surveyed between 1997 and 2021 contribute to the trend analysis in Wales (sites surveyed in at least two years).

Serotine trends | Great Britain

Eptesicus serotinus

Summary of survey results for Great Britain

Trends from both 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.

Survey indices for serotine are also produced 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.

Field Survey

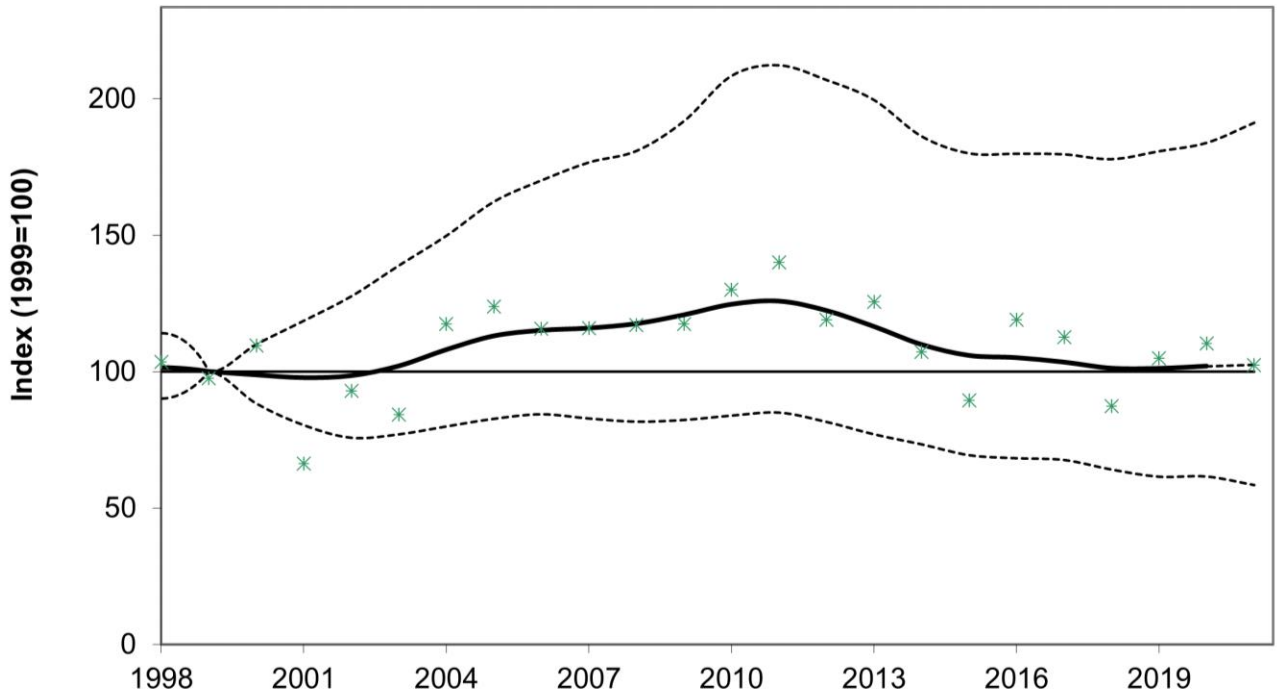


Figure 50. Field Survey index for serotine in Great Britain, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 2.4% above the 1999 base year value, equivalent to a mean annual increase of 0.1% (95% CI -2.4% to 3.0%). Overall, the smoothed index **does not differ significantly from the 1999 base year value.**

Data from 457 sites surveyed between 1998 and 2021 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

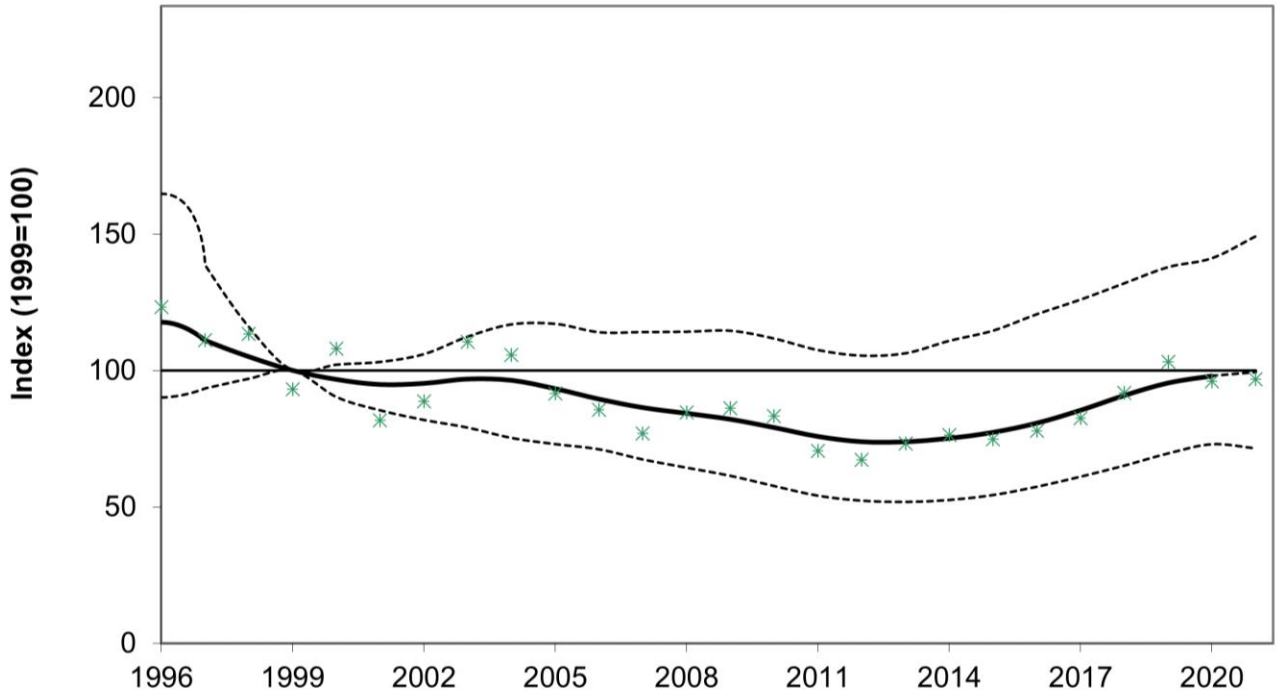
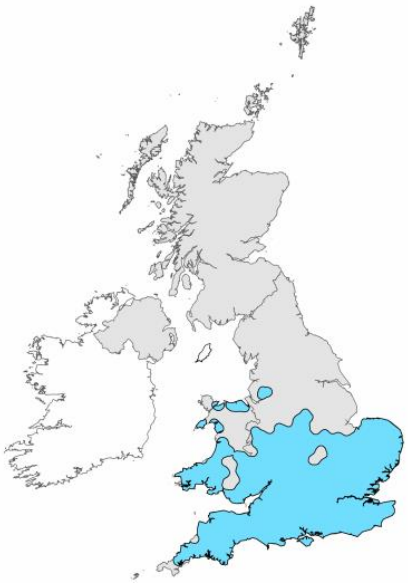


Figure 51. Roost Count index for serotine in Great Britain, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 0.6% below the 1999 value, equivalent to a mean annual decrease of 0.03% (95% CI -1.5% to 1.8%). Overall, the smoothed index **does not differ significantly from the 1999 base year value.**

Data from 102 sites surveyed between 1996 and 2021 contribute to the trend analysis (sites surveyed in at least two years).



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 (Pls = 7,300–413,000). Reliability score = 3.	does not occur
Source	Mathews *et al.* 2018	

Serotine trends | England

Summary of survey results for England

Trends from both 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

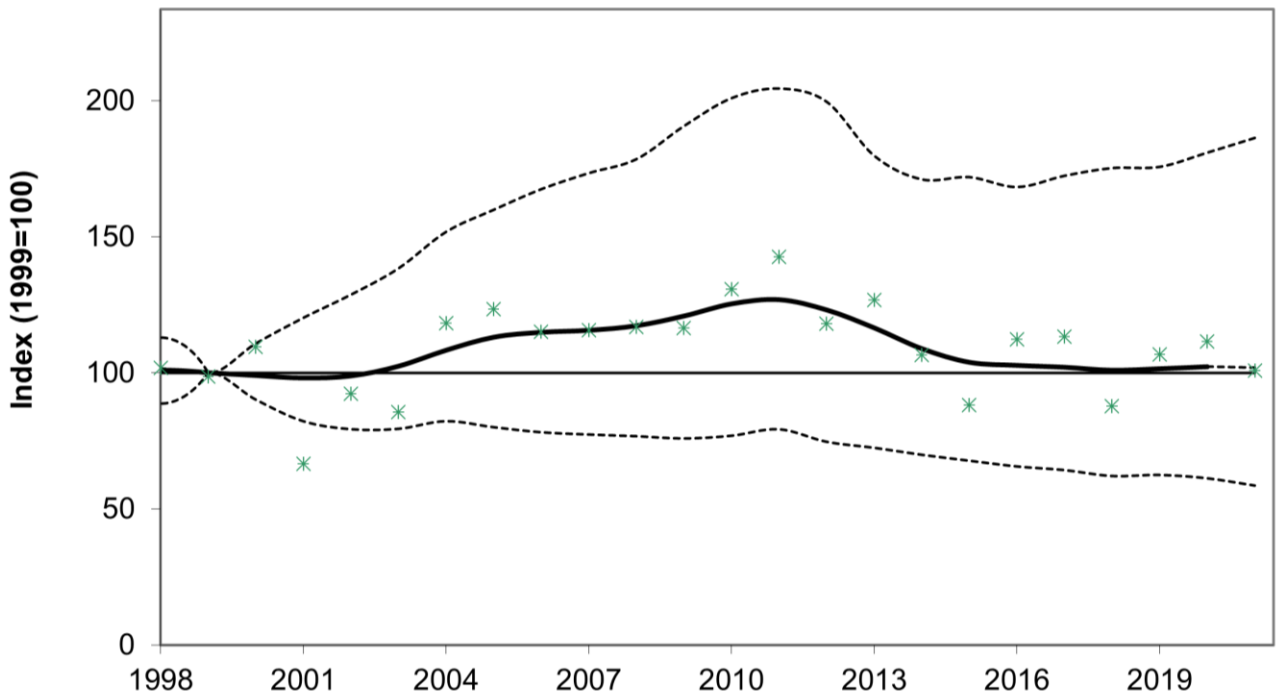


Figure 52. Field Survey index for serotine in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 2.0% above the 1999 base year value, equivalent to a mean annual increase of 0.1% (95% CI -2.4% to 2.9%). Overall, the smoothed index **does not differ significantly from the 1999 base year value.**

Data from 415 sites surveyed between 1998 and 2021 contribute to the trend analysis in England (sites surveyed in at least two years).

Roost Count

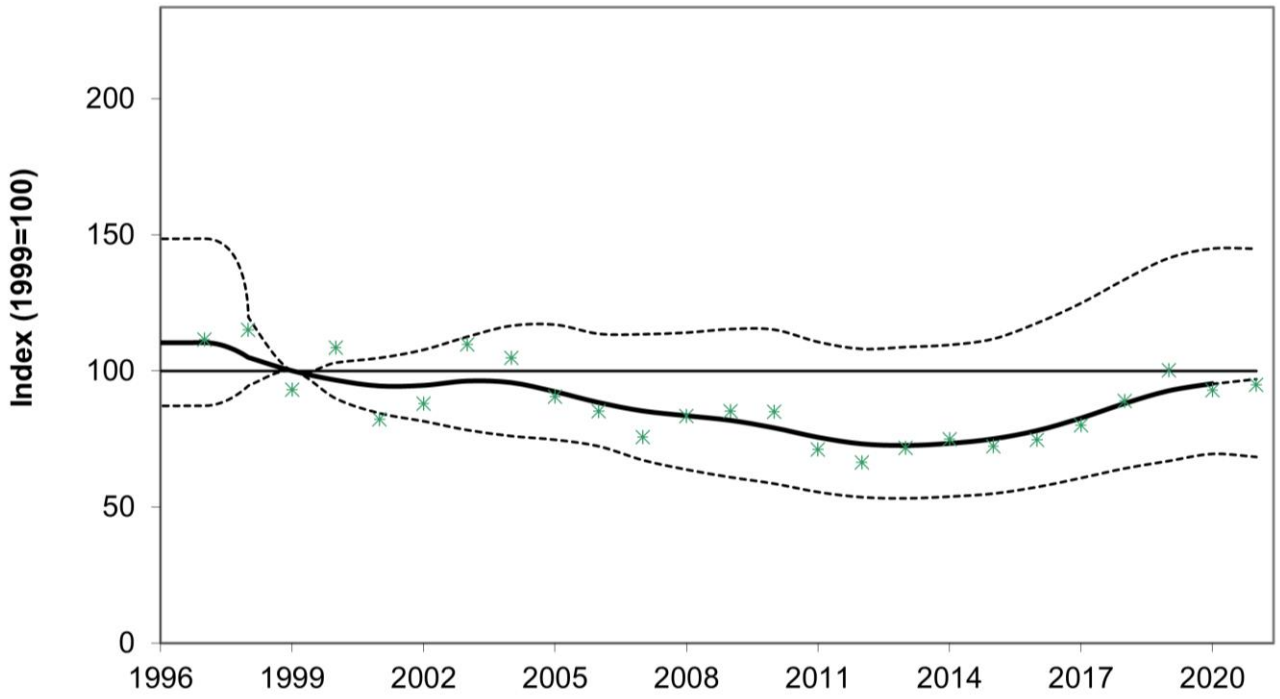


Figure 53. Roost Count index for serotine in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 3.1% below the 1999 base year value, equivalent to a mean annual decrease of 0.14% (95% CI -1.7% to 1.7%). Overall, the smoothed index **does not differ significantly from the 1999 base year value.**

Data from 100 sites surveyed between 1996 and 2021 contribute to the trend analysis in England (sites surveyed in at least two years).

Noctule trend | Great Britain

Nyctalus noctula

Summary of survey results for Great Britain

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 too low to enable the production of a statistically robust trend. **The population of noctule in Great Britain is considered to have been stable over the period 1999-2019.**

Survey indices for noctule are also produced 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.

Field Survey

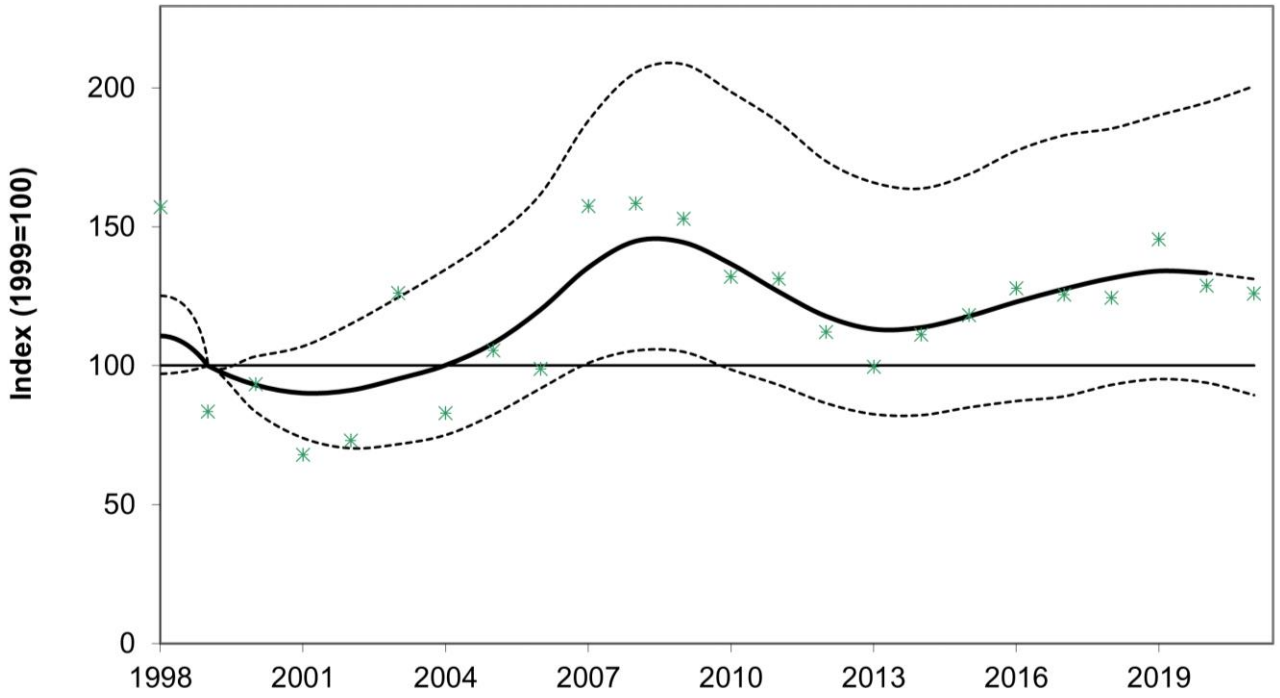


Figure 54. Files Survey index for noctule in Great Britain, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 31.1% above the 1999 base year value, equivalent to a mean annual increase of 1.2% (95% CI -0.5% to 3.2%). Overall, the smoothed index **does not differ significantly from the 1999 base year value.**

Data from 670 sites surveyed between 1998 and 2021 contribute to the trend analysis (sites surveyed in at least two years).

Distribution and abundance

Noctule is relatively common and widespread in England, Wales, and southern Scotland. It is absent from Northern Ireland.

Population estimate

The population estimates are considered to be poor and should be treated with caution. Estimates are based on limited population data and rely on expert opinion only.

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				
Source	Mathews *et al.* 2018				

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)

Noctule trend | England

Summary of survey results for England

The trend from the Field Survey in England shows no significant difference in the smoothed index in comparison to the baseline year. **The population of noctule in England is considered to have been stable over the period 1999-2019.**

Field Survey

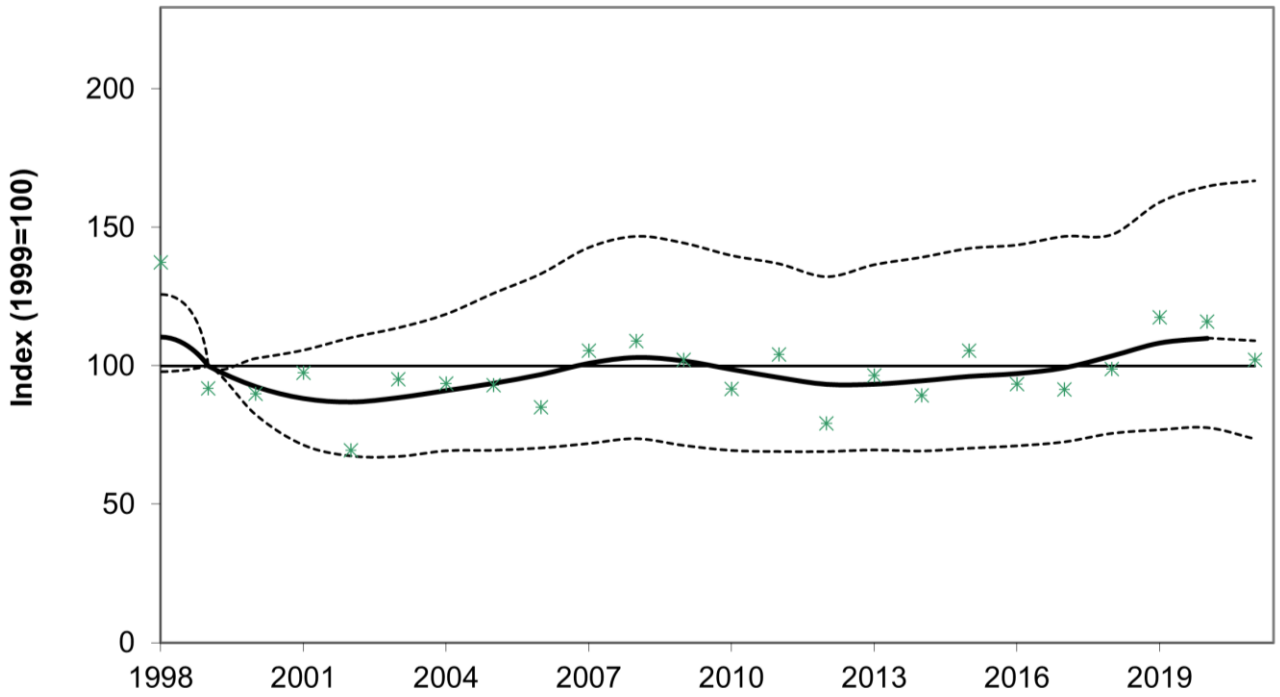


Figure 55. Field Survey index for noctule in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 9.0% above the 1999 base year value, equivalent to a mean annual increase of 0.4% (95% CI -1.4% to 2.4%). Overall, the smoothed index **does not differ significantly from the 1999 base year value.**

Data from 544 sites surveyed between 1998 and 2021 contribute to the trend analysis in England (sites surveyed in at least two years).

Brown long-eared bat trends | Great Britain

Plecotus auritus

Summary of survey results for Great Britain

Trends from both the Hibernation Survey and Roost Count survey in Great Britain show no significant difference in the smoothed index in comparison to the baseline year. Because of the suspension of the Hibernation Survey in winter 2020/21 due to COVID-19, it has not been possible to update the trend for the Hibernation Survey for this report. Instead, the trend that was published in 2020 Annual Report is repeated here for information. **The population of brown long-eared bat in Great Britain is considered to have been stable since 1999**.

Survey indices for brown long-eared bat are also produced at country level for England, Scotland and Wales. This species is also recorded on the Roost Count in Northern Ireland but the sample size is too low to enable the production of a statistically robust trend.

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

Figure 56. Hibernation Survey index for brown long-eared bat in Great Britain, showing the unsmoothed index value for each year (green crosses), the 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.

The smoothed index is currently 19.4% below the 1999 base year value, equivalent to a mean annual decrease of 1.0% (95% CI -2.5% to 0.4%). The smoothed index has fluctuated slightly since 1999 but has never exceeded the baseline value. 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 (1990-2020), counts from 491 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

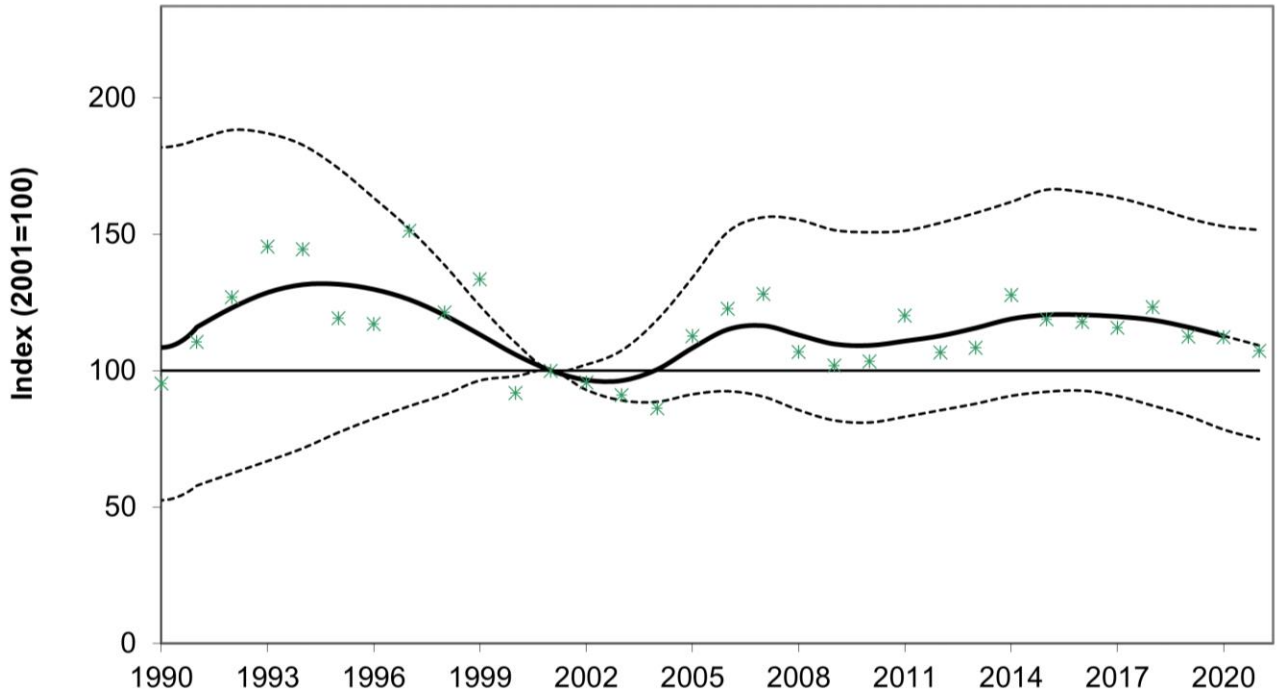
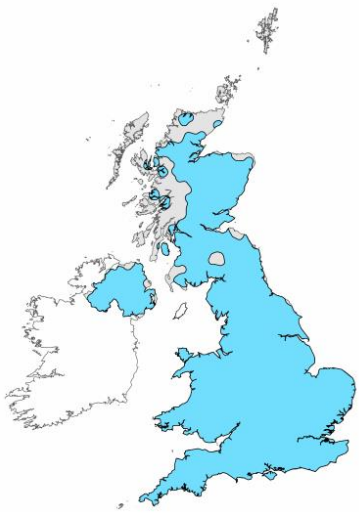


Figure 57. Roost Count index for brown long-eared in Great Britain, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 9.2% 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 fluctuated slightly since 2001; 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 168 sites surveyed between 1990 and 2021 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.



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)

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				
Source	Mathews *et al.* 2018				Russ 1999

Brown long-eared bat trends | England

Summary of survey results for England

Trends from both the Hibernation Survey and Roost Count survey in England show no significant difference in the smoothed index in comparison to the baseline year. Because of the suspension of the Hibernation Survey in winter 2020/21 due to COVID-19, it has not been possible to update the trend for the Hibernation Survey for this report. Instead, the trend that was published in 2020 Annual Report is repeated here for information. **The population of brown long-eared bat in England is considered to have been stable since 1999**.

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

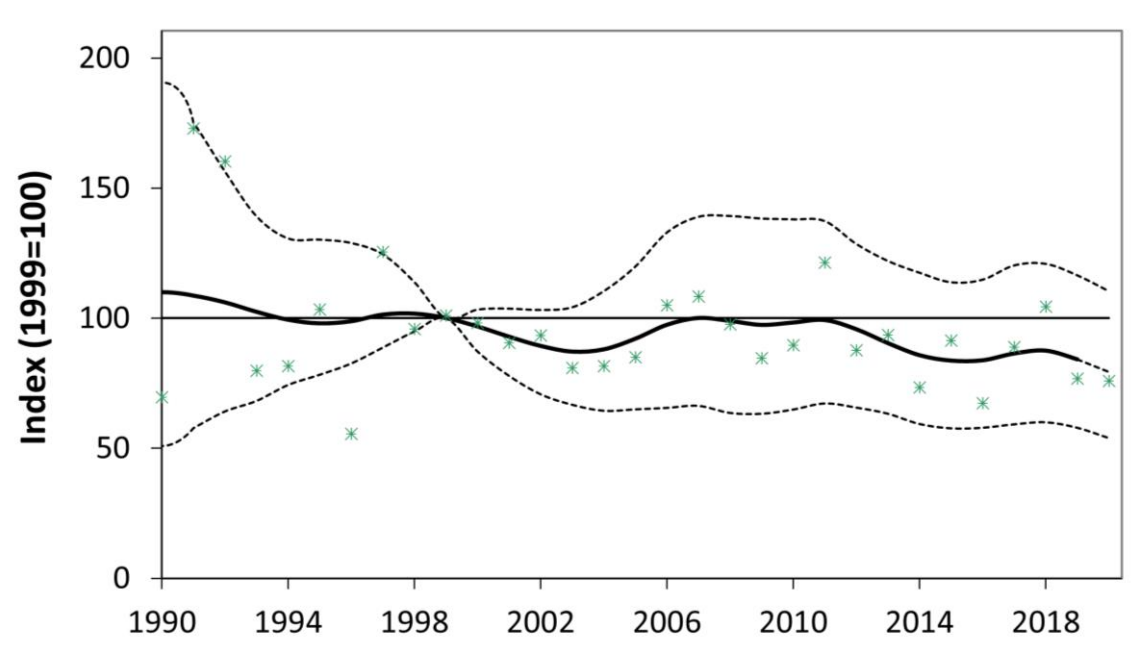


Figure 58. Hibernation Survey index for brown long-eared bat in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 20.8% below the 1999 base year value, equivalent to a mean annual decrease of 1.1% (95% CI -2.9% to 0.5%). The smoothed index has fluctuated since 1999, but has not differed significantly from the baseline in any year. Overall the smoothed index **does not differ significantly from the 1999 base year value**.

For all years for which data are available (1998-2020), counts from 371 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

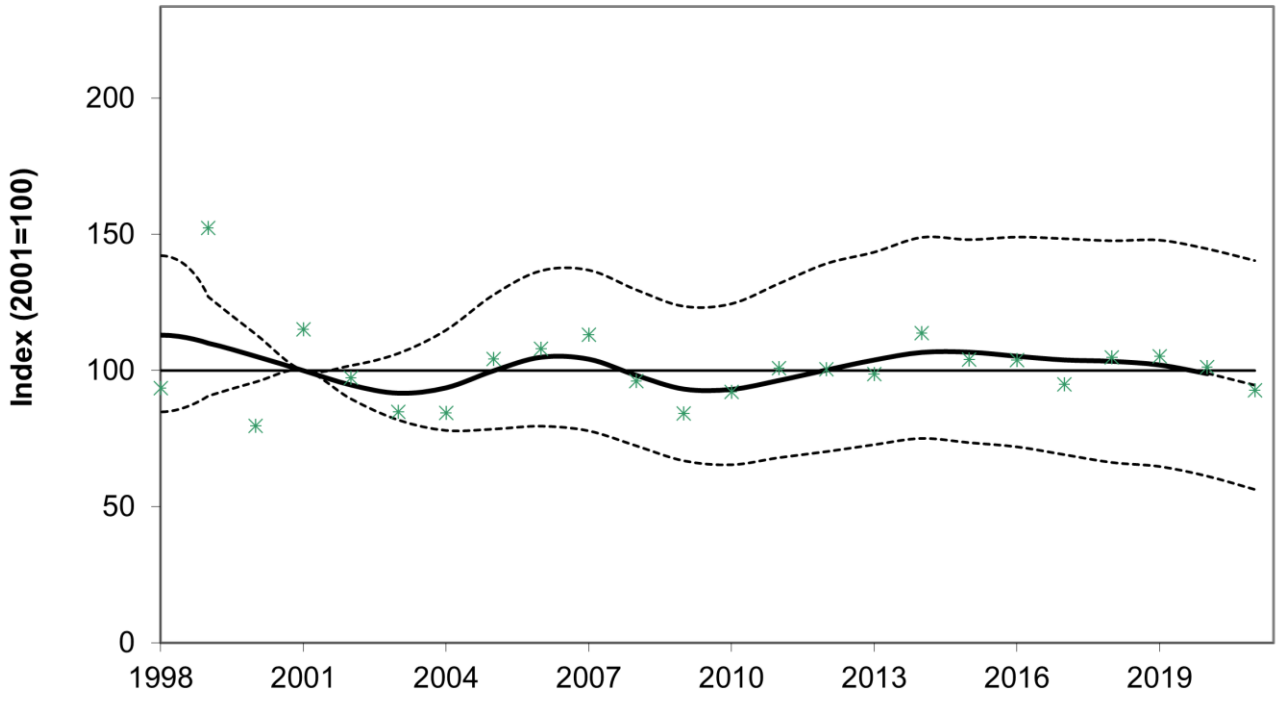


Figure 59. Roost Count index for brown long-eared bat in England, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 5.4% below the 2001 base year value, equivalent to a mean annual decrease of 0.3% (95% CI -2.8% to 1.7%). Overall, the smoothed index **does not differ significantly from the 2001 base year value.**

Data from 123 sites surveyed between 1998 and 2021 contribute to the trend analysis in England (sites surveyed in at least two years).

Brown long-eared bat trend | Scotland

Summary of survey results for Scotland

The trends from the Hibernation Survey and Roost Count in Scotland show no significant difference in the smoothed index in comparison to the baseline year. Because of the suspension of the Hibernation Survey in winter 2020/21 due to COVID-19, it has not been possible to update the trend for the Hibernation Survey for this report. Instead, the trend that was published in 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

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

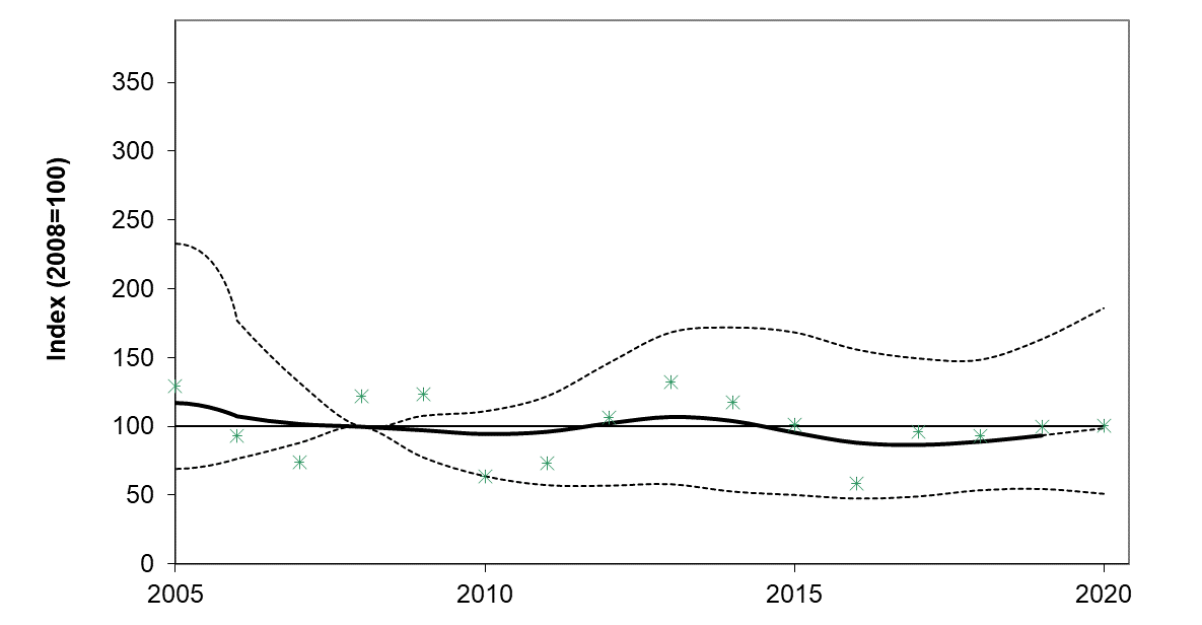


Figure 60. Hibernation Survey index for brown long-eared bat in Scotland, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 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 2007. 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 (sites surveyed in two or more years with brown long-eared 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 one of the priorities outlined in our strategy for improving geographical coverage of repeat survey sites (see *Developments and Future Directions*).

Roost Count

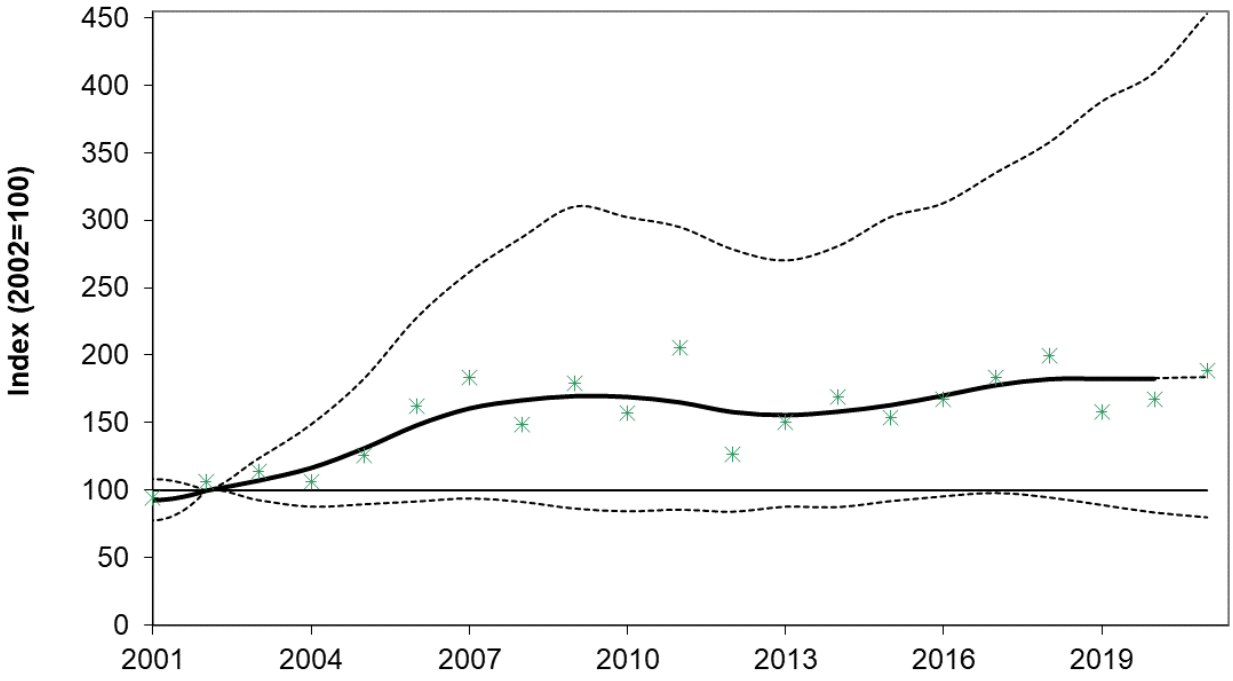


Figure 61. Roost Count index for brown long-eared bat in Scotland, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2021 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 84.1% above the 2002 base year value, equivalent to a mean annual increase of 3.3% (95% CI -1.2% to 8.2%). Overall, the smoothed index **does not differ significantly from the 2002 base year value.**

From all years for which data are available (2001-2021), counts from 31 sites contribute to the trend analysis in Scotland (sites surveyed in two or more years with brown long-eared bat recorded in at least one year). Due to the wide confidence intervals, improving the sample size for this trend is one of the priorities outlined in our strategy for improving geographical coverage of repeat survey sites (see *Developments and Future Directions*).

Brown long-eared bat trend | Wales

Summary of survey results for Wales

The trends from the Hibernation Survey in Wales shows a significant increase in the smoothed index in comparison to the baseline year. This species is also recorded on the Roost Count in Wales but the sample size is too low to enable the production of a statistically robust trend. Because of the suspension of the Hibernation Survey in winter 2020/21 due to COVID-19, it has not been possible to update the trend for the Hibernation Survey for this report. Instead, the trend that was published in 2020 Annual Report is repeated here for information. **The population of brown long-eared bat in Wales is considered to have increased since 1999**.

Hibernation Survey

Republication of trend up to winter 2019/20 due to suspension of survey in winter 2020/21

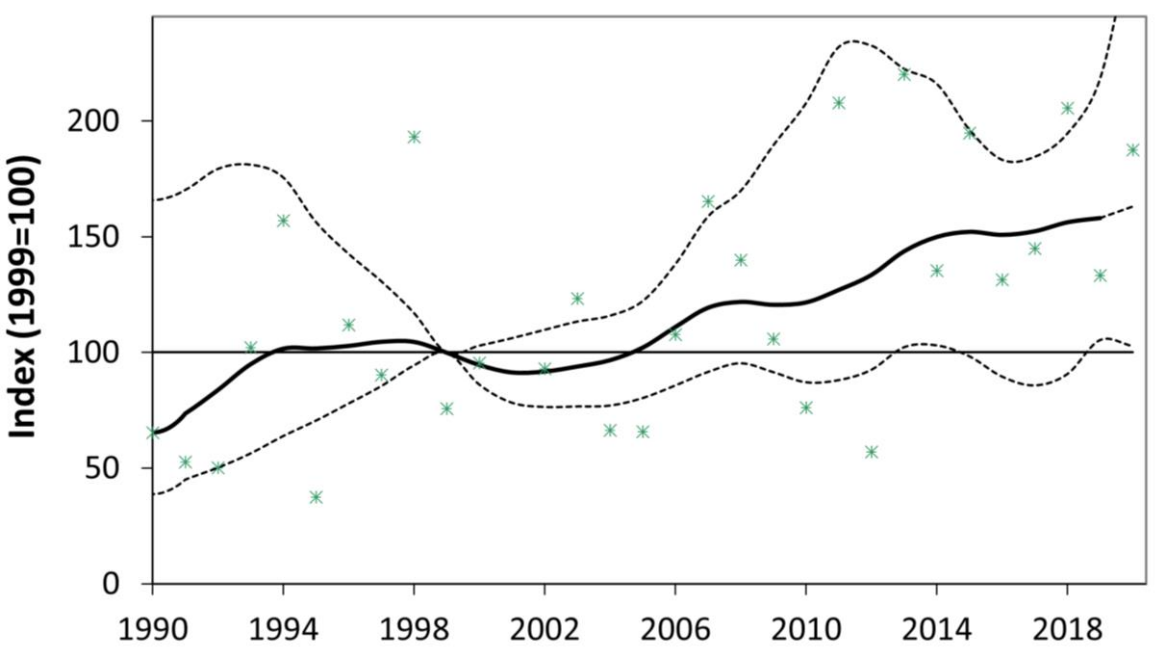


Figure 62. Hibernation Survey index for brown long-eared bat in Wales, showing the unsmoothed index value for each year (green crosses), the smoothed trend (solid line) and 95% confidence intervals (dotted lines). The smoothed trend for 2020 is shown as a dashed line to indicate that it is provisional.

The smoothed index is currently 63.2% above the 1999 base year value, equivalent to a mean annual increase of 2.4% (95% CI 0.1% to 5.0%). The smoothed index has fluctuated slightly since 1999, but overall the index has increased and currently it is **significantly higher than the 1999 base year value**.

From all years for which data are available (1998-2020), counts from 94 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).

Nathusius' pipistrelle

Pipistrellus nathusii

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). The NNPP was not able to go ahead 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 is 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 is resuming in 2022 with precautions in place informed by the latest IUCN guidelines. Results up to 2019 are summarised here.

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.

Key results from the National Nathusius' Pipistrelle Project include:

- From 2014 to 2019, 29 bat groups have taken part in trapping surveys across 347 sites, resulting in 2,689 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

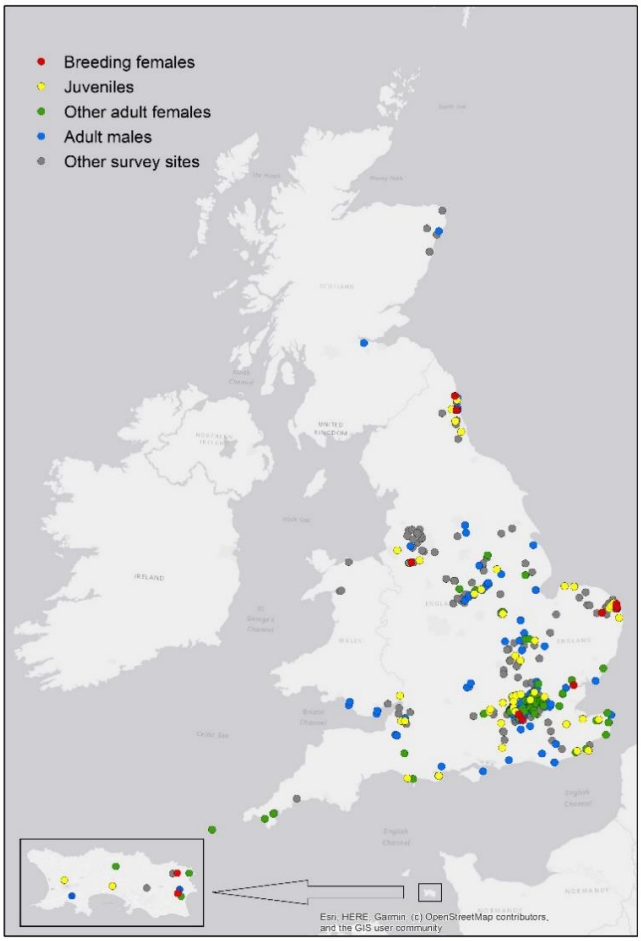
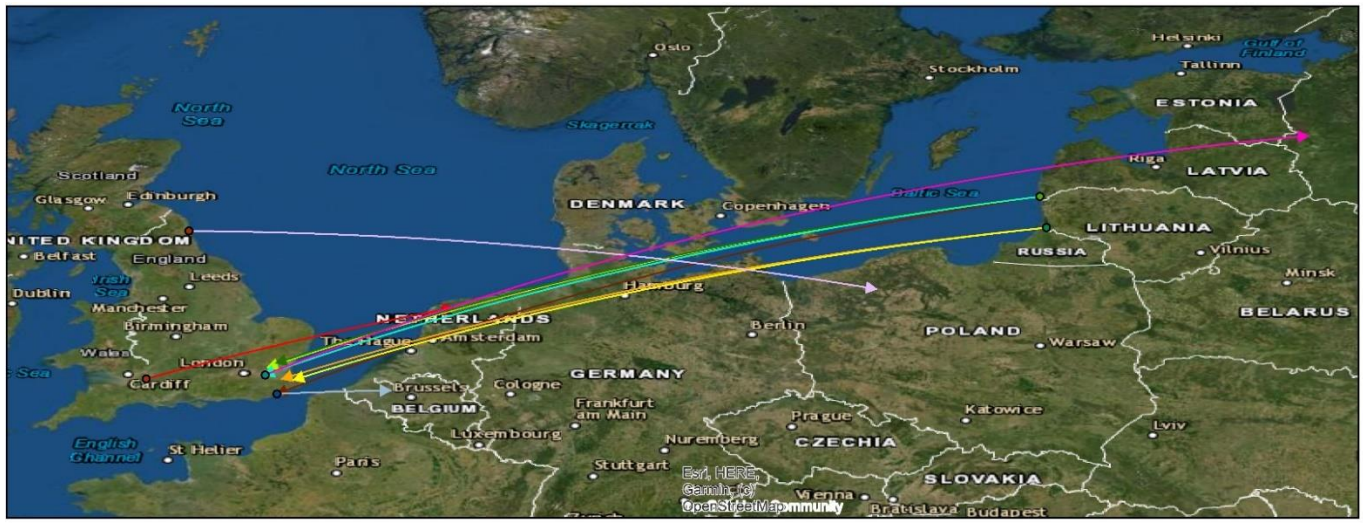


Figure 63. Nathusius' pipistrelle captures April 2011 to October 2019. At each site there may be records falling into more than one category but the symbol indicates the level to which breeding or potential breeding has been identified: breeding females > juveniles (potentially born locally) > other adult females > males only caught.



Blagdon, North Somerset, to Holland (597 km)
Latvia to Rye, East Sussex (1,453 km)
Lithuania to Oare, Kent (1,418 km)
Lithuania to Stodmarsh, Kent (1,396 km)
Latvia to Hillingdon, London (1,492 km)
Latvia to Maldon, Essex (1,410 km)
Latvia to Feltham, London (1,499 km)
Rye, East Sussex, to Belgium (215 km)
Druridge Bay, Northumberland, to Poland (1,190 km)
Hounslow, London, to Russia (2,018 km)

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

Rebecca Downey, an MRes student at UCL, has analysed data collected from the project, augmented by responses to a questionnaire sent out to project participants which collected information on known roosts, and a couple of additional extensive datasets kindly provided by bat workers. The analysis confirms that Nathusius' pipistrelles migrate from Eastern Europe to the UK when they head to their wintering grounds and that there is also a resident population in the UK. The high sex ratio skew towards male bats is interesting. It could be the result of capture bias (males may be more attracted to the calls used by the acoustic lure), or it could suggest that males predominate in the westerly periphery of the species' range. The proportion of bats caught which are females increases in the autumn.

Known roosts include 170 transitional roost records, 55 mating roost records, nine hibernacula and 12 maternity roosts. Eighty one percent of roosts were shared with another species, most frequently soprano pipistrelle, but also often with common pipistrelle. This may account for the apparent scarcity of Nathusius' pipistrelle roosts; perhaps many other common and soprano pipistrelle roosts that are being monitored contain small numbers of Nathusius' pipistrelles which are being overlooked.

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.

Distribution and abundance

Nathusius' pipistrelle is rare but widespread throughout Great Britain. It is more commonly recorded in Northern Ireland.

Population estimate

Numbers unknown for Great Britain and Northern Ireland

Barbastelle

Barbastella barbastellus

Special Areas of Conservation designated for barbastelle are monitored through the Woodland Survey. 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.

Woodland Survey Results

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 the table below.

Table 10. Summary of Woodland Survey results 2005-2020 (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

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 primarily focused on the SAC sites.

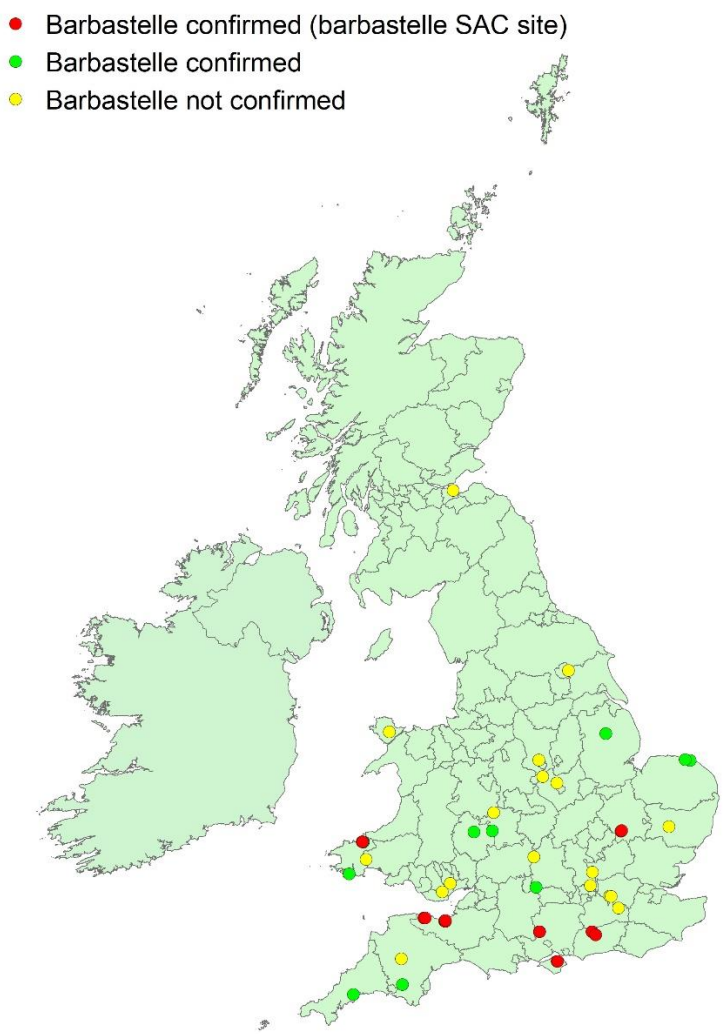


Figure 65. Distribution of Woodland Survey sites 2005-2021

Population estimate

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

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)

Grey long-eared bat

Plecotus austriacus

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. A roost in Devon has been monitored annually since 2013. Two new roosts were monitored for the first time in 2020. Two roosts were monitored in 2021 including one of the new roosts from 2020.

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.

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)

Population estimate

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

Sunset/Sunrise 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. More experienced volunteers have also taken part as it is an effective technique for locating bat roosts. From 2002 to 2021, 1,974 volunteers have taken part in the survey.

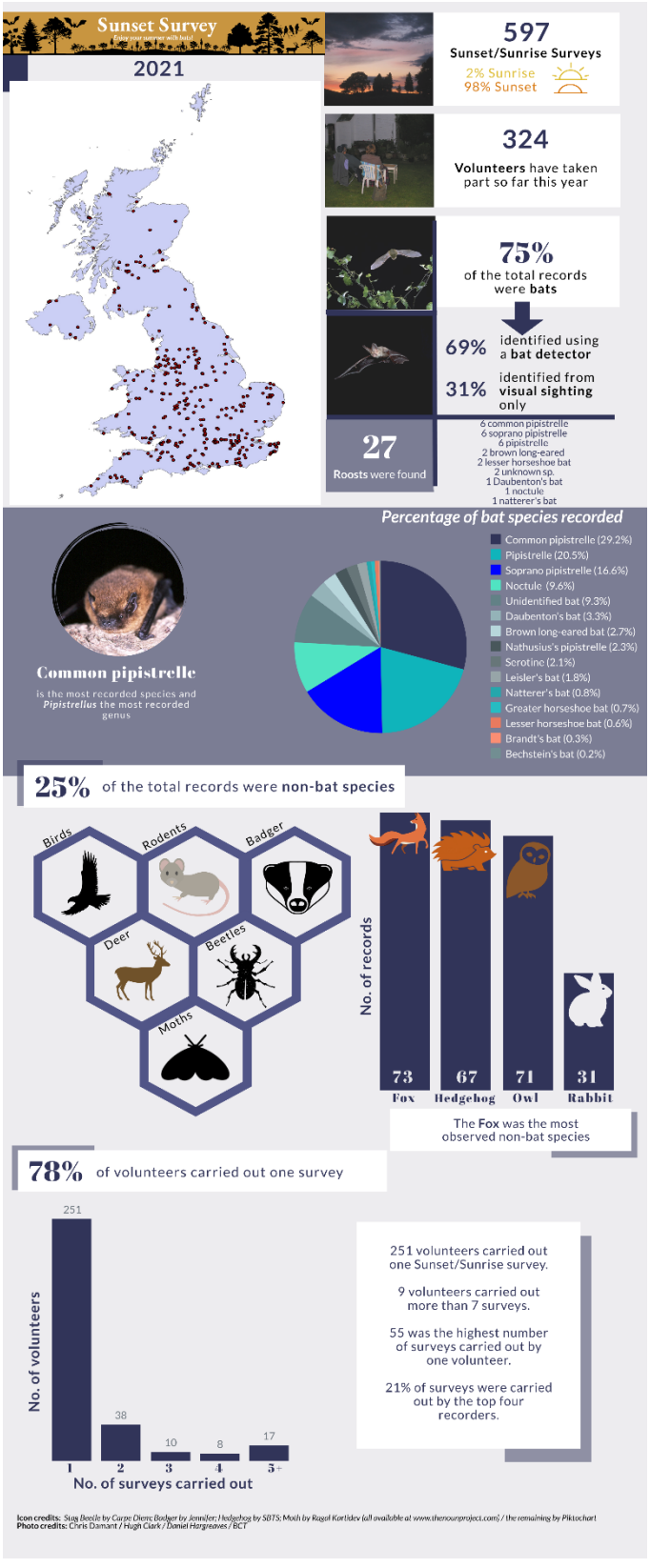
Volunteers are asked to spend the hour after sunset and/or the hour before sunrise in their garden or local open space and look for any bats or other nocturnal animals they can spot. A visual guide is provided to help beginners identify a few of the more common bat species. Results are submitted via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

The survey can be carried out anytime from April to September (extended till end of October in 2021). Between May and August is the best time to see bats swarming as they return to the roost.

In 2021, 597 Sunset/Sunrise Surveys were completed by at least 324 volunteers. 27 bat roosts were reported through spotting dawn swarming.

The infographic on this page was produced after the 2021 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

The National Bat Monitoring Programme contributes data and expertise to a wide variety of research and conservation work. This is a summary of some recent work supported by the NBMP.

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 (Defra, 2019). 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.

All UK bat species are listed in the Habitats Directive. Data from the NBMP contribute to UK reporting on the conservation status of species including range, population status, habitat for the species and future prospects. NBMP data are used for protected site monitoring (Special Areas of Conservation and Sites of Special Scientific Interest).

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. For the first time in 2021 we produced a bat indicator for semi-natural habitat across GB (using data up to and including 2019), designed to contribute to the ONS Semi-natural habitats account. This indicator is a composite of four bat species trends calculated from NBMP Field Survey and Waterway Survey locations that intersect semi-natural habitat. Semi-natural habitat was defined according to the ONS aggregation of the UKCEH Landcover Map 2015. The indicator is one of our downloadable data products and can be accessed here https://www.bats.org.uk/our-work/national-bat-monitoring-programme/reports/nbmp-annual-report. In 2022 we carried out further work for the ONS, producing bat indicators for urban, woodland, enclosed farmland and freshwater habitats. These are due to be published at www.ons.gov.uk in May 2022.

Impacts of bias on detecting bat population change

Over the last year, part of Ella Browning's PhD project that incorporated NBMP data has been published. Ella's PhD study used a Bayesian hierarchical modelling method (integrated nested Laplace approximation) to investigate the impact of spatial and environmental bias on trends estimated using Field Survey data. The nature of the NBMP as a citizen science programme means that there is greater survey coverage in areas of greater population density, and in certain habitats. The over representation of certain regions and habitats in the dataset could be biasing the estimated trends, which has important implications for informing national biodiversity policy and conservation strategies. Using this novel modelling approach this study confirmed that the reported population trends are broadly robust, although some small changes were found. This work can be found in the journal Ecological Indicators (https://www.sciencedirect.com/science/article/pii/S1470160X2200190X).

Bats and Insects

BCT is project partner on a new 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. It will be making the most comprehensive assessment to date of the state of the UK's

insect populations, and seeking to link insect population changes to changes in insect predator populations (bats and birds).

BCT are also co-supervisors 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 SWBio DTP studentship PhD in Sept 2021. She completed her Rotation 1 project with BCT and BTO, as an introduction to the NBMP and bird datasets she will be working with during her PhD. Hannah will complete her Rotation 2 at the University of Bristol and will carry out field work in April-June 2022 to assess whether there are distance dependent effects in how insect abundance and bat activity trends are linked.

Bats in Churches

The Church of England has over 16,000 churches, which can act as valuable roosting sites for bats. This project will enable us to: better understand how bats use churches across England; have a more thorough picture of the perspectives of those living with bats and the issues they may be facing; and provide better information and support for both church communities and bat conservation.

The project is working particularly closely with just over 100 churches, leading engagement activities with local communities to celebrate their bats, sharing expert conservation advice to protect church heritage and working with ecologists and architects in many cases to offer mitigation solutions to help the church while protecting the favourable conservation status of the bats. Included in this work is a trial of the new Natural England Bats in Churches Class Licence.

In April 2021 we held our third Ecologist Best Practice Forum to share learning and updates from the work so far with professional ecological consultants. The Training and Survey Officer has developed a Research Strategy Group to guide the research and the sharing of project learnings.

The citizen science side of the project continued over the summer of 2021, and it was our busiest season to date. In total 335 churches have been surveyed since 2019 and we've recorded at least 12 species of bat. You can explore the summary results on our website: https://batsinchurches.bats.org.uk/Results.aspx. Where we are finding bats in churches, we're often finding multiple species. We found an impressive five species of bats in six churches surveyed in 2021.

The project hosted or was part of 29 engagement events over the year, 13 online events and delivered 28 training sessions. We had articles in nine magazines/newspapers, including *The Biologist* and *Conservation Land Management.*

Other research

Over the last year, NBMP data has contributed to three submitted manuscripts that are in review. The Vincent Wildlife Trust (VWT) used greater and lesser horseshoe bat data from the NBMP in Britain and lesser horseshoe bat data from the Irish Bat Monitoring Programme from 1999 to 2020 to examine the effects of roost improvements at VWT reserve sites. The results from the study indicated that although populations have increased for these species in general in Britain, the increase has been more pronounced at VWT reserves. In Ireland, VWT management has also contributed to a population increase in lesser horseshoe bats. The authors concluded that specialist management actions including improving external and internal structural integrity and conditions, security and bat access points of reserve buildings have contributed to allowing populations to recover at a faster rate.

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 bat, Eptesicus serotinus in Great Britain to create distribution models. Lea's work compared different models that fit more or less to the same data using something called a triangular mesh. Changing the mesh density, to fit more or less to the data can influence the model predictions, which means these useful types of models are often avoided by ecological modellers. In this study, Lea therefore recommends caution when parameterising (setting up the model), to avoid overfitting with a too fine mesh, versus loss of accuracy with increased coarseness. 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.

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 has also been submitted as a manuscript and is currently in review.

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

The British Bat Survey (BBatS) aims to be the first structured national citizen science bat survey in the UK using passive, static bat detectors and a random stratified approach. During 2022-2025 we are trialling a series of pilot and beta surveys to further develop the methodology tested as proof of concept in 2019. So far investigated are the impacts of weatherproofing, deployment height and angle, and the use of amplitude and frequency thresholds on sensor sensitivity. We aim to have the British Bat Survey embedded in the NBMP by 2025. The main proposed outcomes of BBatS are to monitor the trends of a greater number of British bat species and fill in evidence gaps, for example surveying habitats that have received less attention in current established surveys.

Locally-focussed monitoring

NightWatch is a community science/citizen science project launched in 2021. It is run by the Bat Conservation Trust and supported by Esmée Fairbairn Foundation and the JNCC. NightWatch has two main goals:

- Engage people with nature, particularly those from urban and ethnic minority communities
- Produce locally-focused and fine resolution data that can be used at local scale

Ninety-five participants across three cities (London, Birmingham and Manchester) took part in our NightWatch pilot survey in the 2021 summer/autumn. This coming year, we will roll out across a larger area and engage with at least 300 people. We will develop and implement an engagement strategy to liaise with community groups and engage and recruit participants.

NightWatchers are loaned credit-card sized 'AudioMoth' acoustic sensors to place in their window, garden or local green space. In 2022, we will trial an upload app that will allow volunteers to upload sound recordings to our cloud-based classification system.

Woodland monitoring

In 2021 BCT and Forest Research undertook a pilot study to investigate ways to integrate acoustic monitoring of bats into the National Forest Inventory field survey (NFI). In addition, following on from the successful 2019 Forestry England Bat Survey proof-of-concept study, we undertook a second pilot survey with Forestry England in 2021, to further refine the survey protocol for long term woodland monitoring and improve our understanding of the variability of woodland bat monitoring data between years. Statistical analyses of the data from both pilots will inform the survey design of further pilot studies that we will be running in summer 2022 and will feed into our preparations for long term monitoring of Forestry England and NFI sites. We will also continue to support Bat Conservation Ireland with their woodland survey preparations and discuss potential collaborations with the RSPB on their reserves.

Other monitoring partnerships

In summer 2020 we partnered with the Government of Jersey to deliver the Jersey Bat Survey, a passive acoustic bat monitoring survey across Jersey. We have now analysed ten years of acoustic data from Jersey and have recommended a comprehensive monitoring programme for the island that includes a variety of monitoring approaches. We see next steps including, but not limited to, improving the call classifier for Jersey and continuing with Jersey Bat Survey as a structured sample aligning with the British Bat Survey methodology.

We are also supporting the RSPB to pilot bat monitoring across their reserves.

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. The next step will be to soft-launch the website with the collaboration of two or three bat groups.

Equality, Diversity and Inclusion

We are working to increase the diversity of volunteers taking part in the NBMP, with a particular focus on young adults and people from ethnic minority communities. In 2021, we worked with Birdsong Charity Consulting to produce an in-depth volunteer questionnaire which collected anonymised data on volunteer demographics, and also the experience, motivations and highs and lows of participating in the NBMP. Six hundred and fifty-four current and former volunteers completed the survey. The demographic data showed particularly low representation of people identifying themselves as being in one of the ethnic minority categories and the younger age categories (16-20 and 21-25).

We also worked with More Onion, a digital mobilisation agency, to develop a volunteer engagement strategy informed in part by results from the Birdsong questionnaire. The primary objective of this project is to increase the number of active NBMP volunteers, with a specific focus on recruiting more volunteers from ethnic minority communities. As part of this work, More Onion produced a report on improving diversity in the conservation sector which can be found here: https://www.more-onion.com/case-studies/bat-conservation-trust-volunteer-recruitment-and-promoting-diversity/. Work we have carried out towards this so far includes running two of our free introductory online workshops "Discover Your Local Bats" particularly targeted at people from ethnic minority backgrounds, and working with Voyage Youth do engagement sessions with young Black audiences.

In 2021 we worked with our NBMP web host and developer, Exegesis Spatial Data Management, to add an anonymised demographic data collection form to the online NBMP sign-up form. This is enabling us to do ongoing monitoring of the outcomes of our equality, diversity and inclusion strategy. The results so far are encouraging. Comparing the results from the 2021 volunteer questionnaire with latest figures from the online demographic data collection form (covering new sign-ups from May 2021 to April 2022) we've seen volunteers identifying themselves as belonging to one of the ethnic minority categories increase from 2.3% to 3.9%, and belonging to the 16-20 and 21-25 age categories increase from <1% to 2.8% and 2% to 13.8% respectively.

In addition to the above JNCC-funded work we are participating in a project called Race For Nature's Recovery which supports conservation organisations to participate in the government's Kickstart scheme in order to tackle the longstanding lack of racial diversity in the environmental movement. Through this project we recruited two six-month Kickstart placements in succession to fill a new NBMP Volunteer Engagement Officer Role, with the aim of increasing our outreach, particularly to younger and more diverse audiences that are currently under-represented in the NBMP

and the environmental sector as a whole. A similar placement was created for the new Nightwatch project (see *Locally Focussed Monitoring* above). The Kickstart scheme ends in 2022 but we are continuing to have similar paid six-month work placements from 2023 thanks to support from JNCC. This will provide us with the capacity to continue progressing our EDI strategy within the NBMP.

Online training

As in 2020, in 2021 it proved necessary to suspend our usual programme of in-person NBMP training workshops across the UK due to the COVID-19 pandemic. Instead, we took our training online which had the benefit of enabling us to reach a much wider audience, since proximity to a training venue was no longer a factor in being able to attend training. Seventeen bat detector workshops were run online by the NBMP team (plus two by the Scottish Bat Officer), reaching 599 attendees from all countries in the UK (plus a few further afield). Despite the lack of the practical field sessions which normally forms part of the in-person training, 90.5% of attendees stated in the evaluation form that they felt confident in taking part in the NBMP after attending the training (an increase from 79% in 2020). A strategy that is likely to have led directly to this increased figure is running our different workshops as a three-stage training programme: free introductory Discover Your Local Bats workshop, followed by the NBMP Level 1 workshop (focussing on skills needed for the Waterway Survey) and NBMP Level 2 (our long-running Using Your Ears workshop which covers all the skills needed to take part in the Field Survey and the Waterway Survey). The effectiveness of this approach was demonstrated when comparing NBMP participation of workshop attendees between different numbers of workshops attended. Where attendees only attended one workshop 44.3% signed up to the NBMP, increasing to 67.3% when attending two workshops and 82.4% when attending three workshops. The figures for attendees going on to return data for at least one survey were 18.2%, 42.5% and 37.3% for one, two and three workshops attended respectively. The slightly lower figure for data returns where three workshops were attended compared with two workshops can be accounted for by problems that a few of these volunteers had with surveying their sites which were not related to their own confidence levels. In 2022, we are resuming running in-person workshops alongside online events.

Genetics work

We are continuing to develop our genetics projects and have been making progress in the use of novel methods of DNA sampling (air sampling, droppings and other suitable genetic material) to understanding patterns of genetic diversity, population genetics, landscape variability affecting genetic connectivity and historic population change. For example, we continue to facilitate a proof-of concept studies of DNA sampling from air samples in collaboration with NatureMetrics. Depending on outcome of proof-of-concept studies, we will investigate how this technique could be used to monitor the distribution of cryptic bat species in enclosed (e.g. roost, swarming, hibernation, church sites) or open (e.g. woodland) scenarios. We are also piloting a survey involving the non-invasive systematic collection of genetic material (e.g. droppings or other suitable genetic material) to provide information on the distribution and resident status of cryptic UK bat species, and in particular whiskered bat, Brandt's bat, Alcathoe bat and grey long-eared bat. This could involve building inspections, collecting droppings under roosts, and/or trapping. We are also collaborating with the Global Change Genetics group at the University of Exeter, led by Dr Orly Razgour, in their work to estimate historic population change, current population sizes, genetic structure of populations and landscape genetics through novel genetic surveys. Preliminary findings of this technique on barbastelles shows promising results that could be expanded to other species. In 2022 we intend to apply this approach to brown long-eared bats.

Scottish Nathusius' Pipistrelle Project

The focus for BCT's Scottish Bat Project in 2022/23, funded by NatureScot, will be working with Scottish Bat Groups and other partner organisations to fill data gaps regarding distribution of the Nathusius' pipistrelle bat in Scotland. Scottish Bat Groups will take the lead on undertaking field surveys to find Nathusius' pipistrelle 'hot-spots' within

Scotland, using transect and static detector surveys. The collected data will enhance knowledge and conservation opportunities for Nathusius' pipistrelle. Future plans are to survey 'hot-spots' of Nathusius' pipistrelle using advanced survey techniques, such as harp trapping, radiotracking and ringing. A Scottish Nathusius' Pipistrelle Survey Skills Programme is to be run which will include a month of online bat survey skills development events in 2022 and one day of in-person practical bat survey skills training in early 2023.

Increasing sample sizes for country-level species population trends

As highlighted in the summaries for individual species population trends, there is a priority to improve the statistical robustness of reported trends for certain species in Scotland (Daubenton's bat, Natterer's bat and brown long-eared bat from the Hibernation Survey; brown long-eared bat from the Roost Count; and common pipistrelle and soprano pipistrelle from the Field Survey) and Wales (brown long-eared bat from the Roost Count). This is best achieved through getting repeat surveys carried out at additional sites that were originally monitored in the years shortly after the NBMP began in 1997.

We have developed the following actions for engaging volunteers to survey high priority repeat sites:

- Identify locations with clusters of sites where we can focus our engagement and training
- Approach bat groups about taking on sites in their areas, potentially as formal bat group projects or events
- Identify other local wildlife groups in target areas who we can train up to monitor sites
- Identify sites which are within or close to the boundaries of land owned by organisations such as RSPB, National Trust and NatureScot, and engage/train their staff in monitoring the sites
- Contact NBMP volunteers who are already carrying out long-term monitoring in these areas to ask if they can provide support to new volunteers taking on priority sites
- Approach universities in these areas about making monitoring priority NBMP sites an annual field trip activity for students
- Contact bat groups about taking on monitoring of hibernation sites that have not been surveyed for many years
- Contacting Local Environmental Record Centres about staff taking on sites or promoting participation to local recorders

This summer we will be focussing on increasing monitoring of Field Survey sites in Scotland and brown long-eared bat Roost Count sites in Scotland and Wales. We will also begin looking at priority Hibernation Survey sites to look at getting repeated in winter 2022/23.

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