5. Species in the wider countryside: farmland

Type: State indicator

5a. Populations of farmland species

Indicator Description

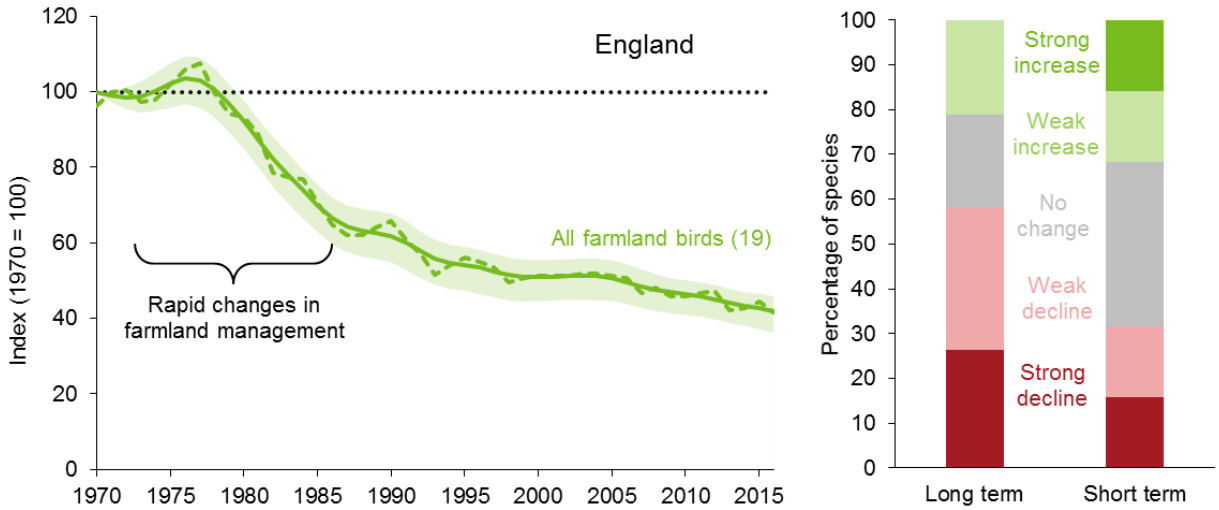
The first part of this indicator shows relative changes in abundance of species in the farmed landscape. Farmland refers to the large proportion of England which is devoted to agriculture and consists of crops or grasslands for grazing. Farmland also provides semi-natural habitats such as hedgerows and field margins that provide food and shelter.

In 2016, the England farmland bird index was less than half its 1970 value having fallen by 57% (Figure 5.1). The majority of this decline occurred between the late 1970s and early 1980s; it was largely due to the impact of rapid changes in many farmland management practices during this period. More recently, the smoothed index decreased by 8% between 2010 and 2015.

Since 1990, the farmland butterflies index has fallen by 27% (Figure 5.2). It reached an all-time low in 2012 and although the index has shown some recovery in the last 5 years, both the long and short-term smoothed trends show a statistically significant decline. 2017 was a relatively bad year for butterflies; this was likely due to periods of unfavourable weather during both the spring and summer months and the preceding winter.

Between 1999 and 2016, populations of the bats in the indicator have increased by 28% (Figure 5.3). In the short term, between 2011 and 2016, the indicator shows no significant change. The bat species vary in their habitat requirements, but all occur in farmland and woodland landscapes. For convenience they are only presented in the farmland indicator.

Figure 5.1: Breeding birds on farmland in England, 1970 to 2016

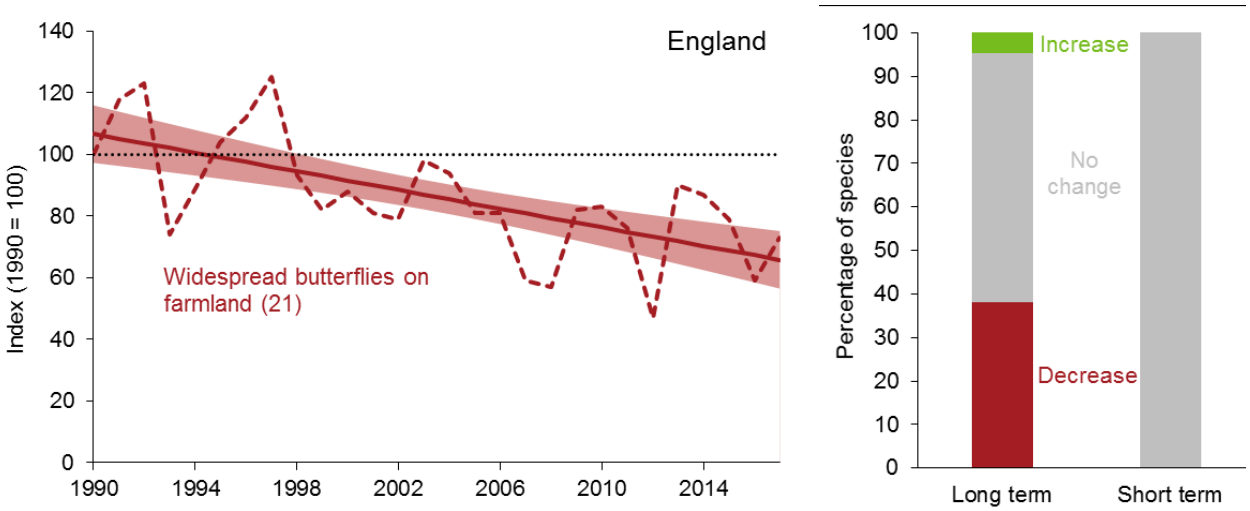


Notes:

1. The figure in brackets shows the number of species in the index.
2. The graph shows the unsmoothed trend (dashed line) and the smoothed trend (solid line) together with its 95% confidence interval (shaded).
3. The bar chart shows the percentage of species within the indicator that have increased, decreased or shown no change, based on set thresholds of annual change.

Sources: British Trust for Ornithology, Department for Environment Food and Rural Affairs, Joint Nature Conservation Committee and the Royal Society for the Protections of Birds.

Figure 5.2: Widespread butterflies on farmland in England, 1990 to 2017

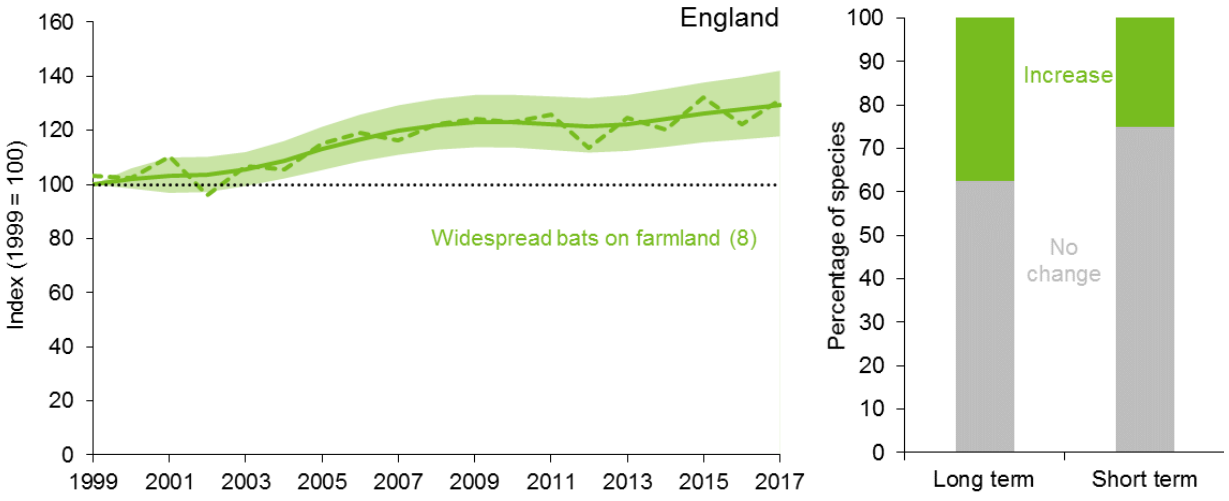


Notes:

1. The figure in brackets shows the number of species in the index.
2. The graph shows the unsmoothed trend (dashed line) and the smoothed trend (solid line) together with its 95% confidence interval (shaded).
3. The bar chart shows the percentage of species within the indicator that have shown a statistically significant increase, a statistically significant decrease or shown no significant change.
4. In 2018 an improved analysis method has been used to derive the species indices (see 'Background' section for further information).
5. The graph is not directly comparable to previous versions of this publication. Improvements in the modelling technique have allowed the inclusion of more data, resulting in slight alternations to the individual species trends.

Sources: Butterfly Conservation, Centre for Ecology & Hydrology, Defra, Joint Nature Conservation Committee.

Figure 5.3: Widespread bats on farmland in England, 1999 to 2017



Notes:

1. The index is a composite of 8 species: serotine; Daubenton's bat; Natterer's bat; noctule; common pipistrelle; soprano pipistrelle; brown long-eared bat; and lesser horseshoe bat.
2. The graph shows the unsmoothed trend (dashed line) and the smoothed trend (solid line) together with its 95% confidence interval (shaded).
3. The bar chart shows the percentage of species within the indicator that have increased, decreased or shown no change.

Source: Bat Conservation Trust.

The farmland bird index is comprised of trends for 19 species. The long-term decline of farmland birds in England has been driven mainly by the decline of those species that are restricted to, or highly dependent on, farmland habitats (the 'specialists'). Between 1970 and 2016, the farmland specialists index declined by 73% while farmland generalists declined by only 4%. Whilst generalist species have fared better than specialists, the rates of decline have been closer in the last decade. Smoothed trends showed declines of 73% and 6% respectively (Figure 5.4).

Since 1990, the farmland butterflies index has fallen by 27%. These figures demonstrate how numbers fluctuate from year to year, but overall, based on the underlying smoothed trend, the indicator has continued to show a significant long-term and short-term decline. Species fare differently within this overall long-term trend; those in significant decline include gatekeeper, large skipper, small copper, small tortoiseshell, small white, wall and white-letter hairstreak. All of these, however, were assessed as showing no significant short-term change since 2012. One species, the ringlet, increased over the long term but also showed no significant change in the short-term.

Between 1999 and 2016, populations of bats in the indicator have increased by 28%; an assessment of the underlying smoothed trend shows that this is a statistically significant increase. In the short term, between 2011 and 2016, the indicator shows no significant change and is therefore considered to be stable. An increase in both the lesser horseshoe bat and common pipistrelle trends have been sustained throughout the period of the indicator and have been attributed to conservation measures including legislation and for lesser horseshoe bat, a series of mild winters that have enhanced its winter survival. Assessments are run to the penultimate year of the trend as the most recent smoothed data point (2017) is likely to change as future years of data are added. There was an increase in the unsmoothed index between 2016 and 2017, however this result should be treated as provisional for the reason outlined above. These trends reflect relatively recent changes to bat populations. Prior to this, there were significant historical declines in bat populations dating back to at least the beginning of the 20th century.

Indicator assessment

Assessment of change in abundance and diversity of species in the wider countryside (farmland)			
	Long term	**Short term**	**Latest year**
Breeding farmland birds	⊗ 1970-2015	⊗ 2010-2015	No Change (2016)
Butterflies of the wider countryside on farmland	⊗ 1990-2017	⊗ 2012-2017	Increased (2017)

Bat populations	1999-2016	2011-2016	Increased (2017)

Note: To better capture patterns in the data, where possible, long-term and short-term assessments are made on the basis of smoothed data. Due to differences in the methods used to produce smooth trends for birds, butterflies and bats, long-term and short-term assessments made on smoothed bird trends are made to 2015 and to 2016 for bats, while assessments made on smoothed butterfly data are made to 2017. All latest year assessments are based on unsmoothed data to the latest year available.

5b Farmland plant species richness

An indicator of plant species richness has been published previously within the biodiversity indicators set, based on analysis of changes in land cover recorded in the Countryside Survey – a detailed periodic audit of a statistically representative sample of land across Great Britain. As the latest Countryside Survey data are from 2007, the data previously presented for this indicator is considered too out of date to be fit-for-purpose and retained within the indicator set as a headline measure: the UK Biodiversity Indicators Steering Group therefore took the decision to move this data and analysis to the background section of this fiche.

During 2015 and 2016, the Centre for Ecology & Hydrology (CEH), Joint Nature Conservation Committee (JNCC) and Defra have investigated the possibility of using Bayesian occupancy models – see indicators 4 and 10 for details – to identify trends in plant species. Trials have focussed on species that will be monitored with the National Plant Monitoring Scheme (NPMS; see below). Although initial testing using Botanical Society of Britain & Ireland (BSBI) atlas distribution data is encouraging, the measures under development (for woodlands and for lowland heathland) require further work before they will be fit for publication as experimental statistics. Unfortunately, further development was not possible in 2016-2017; however it is hoped that a new experimental statistic can be developed in the next year or two.

In the slightly longer term it is anticipated that the National Plant Monitoring Scheme designed by the BSBI, CEH, Plantlife and JNCC will provide relative abundance data for around 400 indicator species – which will be more equivalent to the data underpinning the birds, bats and butterfly indicators – allowing a more comparable indicator of plants and habitat trends to be developed. It will not be possible to produce a trend before 2020, as the NPMS was only launched in 2015 and further time is needed to collect enough data to be able to calculate the size and direction of the trend. Initial consideration of possible options for an indicator focussed on plant diversity in the survey plots; a more detailed evaluation of the data is being undertaken to see if trends for individual species within habitats can be derived from the data.

Relevance

Species groups such as bats, birds and butterflies are considered to provide a good indication of the broad state of the environment because they occupy a wide range of habitats and there are long-term data on changes in populations which help in the interpretation of shorter term fluctuations. Butterflies also play a complementary role to birds and bats as an indicator, because they use the landscape at a far finer scale.

These indicators show progress towards commitments to improve the status of our wildlife and habitats. They are relevant to outcomes 1 and 3 in *Biodiversity 2020, A strategy for England's wildlife and ecosystem services* (see Annex A). The indicators are also relevant to international goals and targets (see Annex B of the aforementioned publication).

Background

Farmland birds

The farmland bird measure has been supplied by the British Trust for Ornithology (BTO), the Royal Society for the Protection of Birds (RSPB) and the Joint Nature Conservation Committee (JNCC) and is compiled using data from the Common Bird Census (CBC) and Breeding Bird Survey (BBS). Within the farmland bird measure there are trends for 19 species (Table 5.1). Each species is given equal weighting and the index is the geometric mean of the individual species indices. The assessment of change is based on a statistical test of the underlying trend, using smoothed species trends derived from general additive models, with bootstrapping to generate confidence limits. Further details about species and methods can be found on the British Trust for Ornithology website (see web-links).

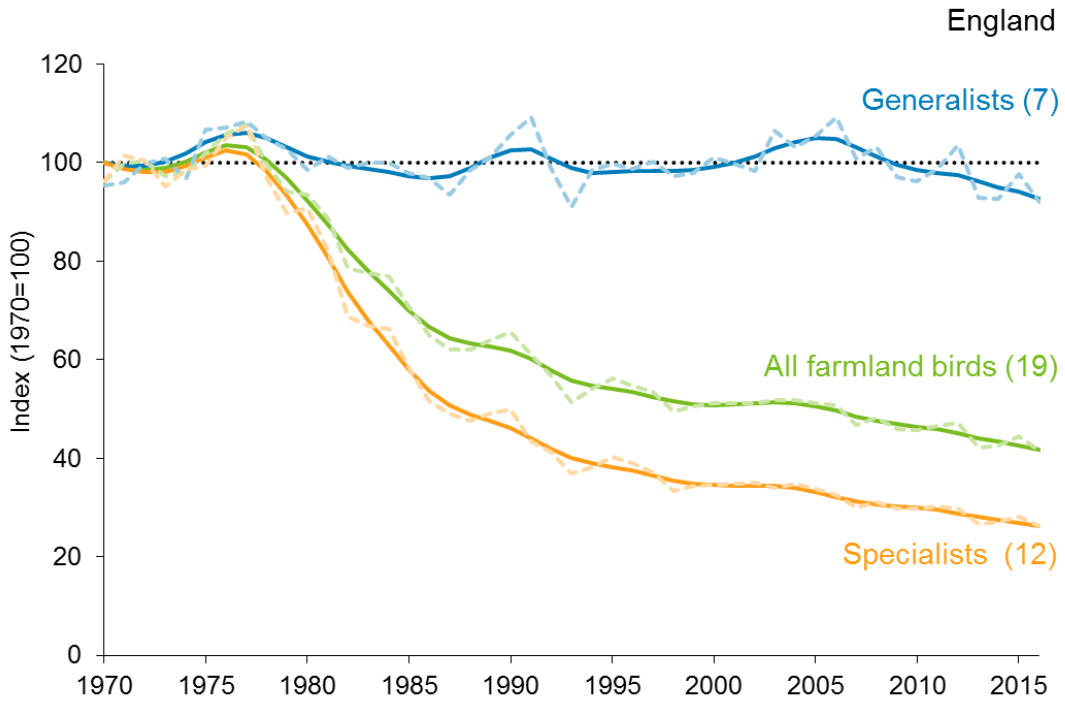
Within the farmland bird measure, the decline is generally steeper for specialist bird species – those that are restricted to or very strongly associated with farmland habitats, as opposed to generalists, which are found in a wider range of habitats (Figure 5.4). Changes in farming practices, such as the loss of mixed farming systems, the move from spring to autumn sowing, and increased pesticide use, have been demonstrated to have had adverse impacts on farmland birds such as skylark and grey partridge. Three farmland specialists (grey partridge, turtle dove and tree sparrow) have declined by 90% or more relative to 1970 levels. By contrast, two other farmland specialists (stock dove and goldfinch) have more than doubled over the same period, illustrating how pressures and responses to pressures varies between species.

The bar chart provided alongside the headline chart shows the percentage of species within the indicator that have increased, decreased or shown no change. Whether an individual bird species is defined as increasing or decreasing has been decided by its rate of annual change over the time period (long or short) of interest. If the rate of annual change would lead to a population decrease of 50% (halving), or a population increase of 100% (doubling) or more over 25 years, the species is said to have shown a ‘strong decline’ or a ‘strong increase’ respectively. Rates of change less than these but above +33% (increase) or below -25% (decrease) are labelled 'weak'. Asymmetric thresholds are used for declines and increases to represent symmetrical proportional change in an index. These thresholds for decline are based on the rates used in the Birds of Conservation Concern status assessment for birds in the UK. Note that for most species, particularly over the longer period, the change is statistically significant.

Table 5.1 Species included in the farmland bird indicator

Generalist birds (7)	Specialist birds (12)
Greenfinch (*Carduelis chloris*)	Corn bunting (*Emberiza calandra*)
Jackdaw (*Corvus monedula*)	Goldfinch (*Carduelis carduelis*)
Kestrel (*Falco tinnunculus*)	Grey partridge (*Perdix perdix*)
Reed bunting (*Emberiza schoeniclus*)	Lapwing (*Vanellus vanellus*)
Rook (*Corvus frugilegus*)	Linnet (*Carduelis cannabina*)
Woodpigeon (*Columba palumbus*)	Starling (*Sturnus vulgaris*)
Yellow wagtail (*Motacilla flava*)	Stock dove (*Columba oenas*)
	Skylark (*Alauda arvensis*)
	Tree sparrow (*Passer montanus*)
	Turtle dove (*Streptopelia turtur*)
	Whitethroat (*Sylvia communis*)
	Yellowhammer (*Emberiza citronella*)

Figure 5.4: Populations of specialist and generalist farmland birds in England, 1970 to 2016



Notes:

1. The figures in brackets show the number of species in each index.
2. The graph shows the unsmoothed trends (dashed lines) and the smoothed trends (solid lines).

Source: British Trust for Ornithology, Royal Society for the Protection of Birds, Defra and the Joint Nature Conservation Committee.

Butterflies on farmland

The measure for butterflies on farmland is a multi-species index compiled by Butterfly Conservation (BC) and the Centre for Ecology & Hydrology (CEH) from data collated through the UK Butterfly Monitoring Scheme (UKBMS) including the Wider Countryside Butterfly Survey (WCBS), the latter in collaboration with BTO. The indicator includes individual trends for 21 species of butterflies associated with farmland. Populations of individual species within the measure may be increasing or decreasing irrespective of the overall trends.The bar chart provided alongside the headline trend chart shows the percentage of species within the indicator that have shown a statistically significant increase, a statistically significant decrease or shown no significant change. A list of the species included in the indicator can be found below. A more detailed table summarising the estimated long-term and short-term changes for each species together with an assessment of whether the individual species trends are increasing or decreasing can be found in the statistical dataset 'trends in populations of selected butterfly species, 1990 to 2017'.

The year-to-year fluctuations of butterflies are often linked to natural environmental variation, especially weather conditions; therefore, to identify underlying patterns in population trends, the assessment of change is based on smoothed indices. The smoothed trend in this multi-species indicator is assessed by structural time-series analysis. A statistical test is performed using the software 'TrendSpotter' to compare the difference in the smoothed index in the latest year versus other years in the series. Within the measure, each species is given equal weight, and the annual figure is the geometric mean of the component species indices for that year.

The method for compiling species annual indices was improved in 2018. Indices are calculated for species using the Generalised Abundance Index (GAI) method developed in 2016 (Dennis *et al.*) with an additional modification that the data from each site in each year is weighted in the final stage relative to the proportion of the species flight period surveyed that year for that site. This weighting is necessary as the GAI extrapolates from observed data to estimate the total count across the season, accounting for gaps in the recording, and ensures that the observed data have a stronger effect upon the final indices than the extrapolated data.

The new method uses data from butterfly transect sites on farmland from UKBMS sites and randomly selected farmland plots from the WCBS. The method uses all butterfly counts in a season to estimate the seasonal pattern of butterfly counts for that year, using a concentrated likelihood method; the resulting indices and species trends are similar to those generated through previous analysis methods.

Since 2015, the site index only data has been incorporated into the models; these data are most prevalent in earlier years and thus the graphs are slightly different to those previously presented. As there are delays in data submission, data for previous years are also updated retrospectively; in 2017 extra data were added for 2015 and 2016, for example. This means that the species index for individual years may vary from previous publications. Further details of the methods used can be found on the UKBMS website; in the Technical background document for this indicator; and in the UKBMS data capture, processing, validation and reporting summary document.

Table 5.2 Species included in the England farmland butterfly indicator

Species (21)	
Brimstone (*Gonepteryx rhamni*)	Peacock (*Aglais io*)
Brown argus (*Aricia agestis*)	Ringlet (*Aphantopus hyperantus*)
Common blue (*Polyommatus icarus*)	Small copper (*Lycaena phlaeas*)
Gatekeeper (*Pyronia tithonus*)	Small heath (*Coenonympha pamphilus*)
Green-veined white (*Pieris napi*)	Small tortoiseshell (*Aglais urticae*)
Holly blue (*Celastrina argiolus*)	Small/Essex skipper (*Thymelicus sylvestris/lineola*)
Large skipper (*Ochlodes venata*)	
Large white (*Pieris brassicae*)	Small white (*Pieris rapae*)
Marbled white (*Melannargia galathea*)	Speckled wood (*Pararge aegeria*)
Meadow brown (*Maniola jurtina*)	Wall (*Lasiommata megera*)
Orange-tip (*Anthocharis cardamines*)	White-letter hairstreak (*Satyrium w-album*)

Bats

The bats measure has been compiled by the Bat Conservation Trust (BCT) using data collected annually from the UK-wide National Bat Monitoring Programme (NBMP). This delivers trends for 11 of the UK's 17 resident bat species, and has deployed a network of over 4,000 volunteers (over 3,000 in England) to record observations at 6,484 sites (4,530 in England).

The indicator is a composite index which combines population trend data for 8 species. To generate the overall composite bat indicator, each of these species has been given equal weighting, and the annual index figure is the geometric mean in that year. Populations of individual species within the measure may be increasing or decreasing irrespective of the overall trends. The bar chart provided alongside the headline chart shows the percentage of species within the indicator that have increased, decreased or shown no change.

Surveys for the bat species in the indicator include summer roost counts, counts at hibernation sites and visual and/or acoustic observations made along predetermined transects within randomly selected 1km survey grids or along 1km sections of waterway. Most species are surveyed by 2 different survey methods, both of which are included in the index apart from summer roost count data for common and soprano pipistrelle. Pipistrelle species' frequent 'roost switching' can cause a negative bias in trends calculated from summer roost counts, so these data are omitted. The predominant habitat types represented in the combined dataset are woodland (broadleaf and conifer), farmland (arable and grassland), urban and waterway (rivers, streams and canals). They are currently presented within the farmland indicator.

For each species, Generalised Additive Modelling (GAM) is used to calculate the trends in numbers over time. The models include terms for factors that can influence the apparent population means (e.g. bat acoustic detector model, temperature), so their effect can be taken into account. The GAM models produce smoothed trends with confidence intervals which are the basis of the indicator assessment. The survey methods and statistical analysis used by the NBMP to produce individual species trends are described in Barlow *et al.* (2015). The species indices are revised when new data become available or when improved modelling methods are developed and applied retrospectively to earlier years. This year the covariates used in analysis of one of the bat detector surveys have been updated to better account for the number of different types of detectors used by volunteers. This means trends for four species, common pipistrelle, noctule, serotine and soprano pipistrelle, are not directly comparable to those previously published.

Bats experienced major declines throughout Western Europe during the latter half of the 20th century, which have been attributed to agricultural intensification, habitat and roost loss, deliberate killing, remedial timber treatment and insecticide poisoning, and declines of their insect prey. However bats were relatively understudied in the UK during the period of greatest population loss, and the supporting evidence, synthesised in Haysom *et al*. (2010), is fragmented. Evidence includes:

- reports of the loss of large colonies of several species from traditional roosting sites;
- a questionnaire survey documenting roost loss, declines in abundance at roosts, and deliberate killing (Racey and Stebbings, 1972);
- range contractions of lesser horseshoe bat (*Rhinolophus hipposideros*); and
- a small number of published population trends (e.g. Ransome, 1989, Guest *et al*., 2002).

In response to these declines, large-scale national monitoring was put in place so that future changes could be detected. Bats have benefited from strict legal protection, direct conservation action and public education (Mitchell-Jones, 1993, Haysom *et al.*, 2010), but remain vulnerable to pressures such as landscape change, climate change, development and emerging threats such as new building practices, wind turbines, and light pollution (Haysom *et al*., 2010, Kunz *et al.*, 2007, Rebelo *et al.*, 2010, Stone *et al.*, 2009, 2012).

Table 5.3: Species included in the bat indicator

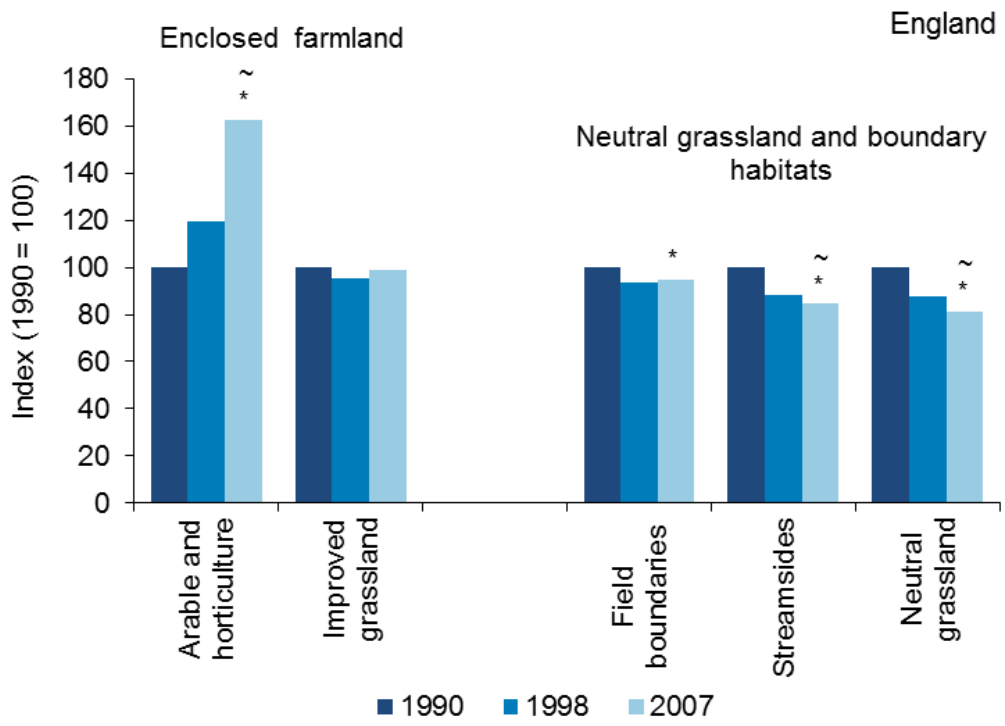
Species (8)	
Daubenton's bat (*Myotis daubentonii*)	Serotine (*Eptesicus serotinus*)
Natterer's bat (*Myotis nattereri*)	Common pipistrelle (*Pipistrellus pipistrellus*)
Lesser horseshoe bat (*Rhinolophus hipposideros*)	Soprano pipistrelle (*Pipistrellus pygmaeus*)
Noctule (*Nyctalus noctula*)	Brown long-eared bat (*Plecotus auritus*)

Plants in the wider countryside

Until 2013, this indicator was based on an analysis of the change in plant species richness in the wider countryside. The start point of the data series was 1990, but it has not been possible to update the indicator since 2007. As the data has not been updated for a number of years and future opportunities to update the data in a consistent way are unlikely, the decision was taken by UK Biodiversity Indicators Steering Group to reclassify this indicator as 'under development'. The group decided to look at new options for a headline measure, whilst retaining the previous data and analysis as background information. Key messages from the previous indicator update are presented here.

Within enclosed farmland, there was a significant increase in plant species richness in *arable and horticultural land* in both the longer term (1990–2007) and shorter term (1998–2007). There was little or no overall change in species richness in *improved grassland* between 1990 and 2007. Within neutral grassland and boundary habitats, there was a significant decrease in plant species richness in all 3 habitats in the longer term, as well as a significant decrease in species richness in *stream sides* and *neutral grassland* in the shorter term.

Figure 5.6: Plant species richness in the wider countryside 1990 to 2007: enclosed farmland, neutral grassland and boundary habitats



Notes:

1. * A statistically signicant change between 1990 and 2007.
2. ~ A statistically significant change between 1998 and 2007.

Source: Countryside Survey, Centre for Ecology & Hydrology.

Data for plants in the wider countryside are taken from the Countryside Survey. This takes a random sample of vegetation plots located in arable and horticultural fields, agricultural grasslands, woodlands and associated boundary habitats in Great Britain.

The indicator compares species richness per plot for plots surveyed in 1990, 1998 and 2007. For each broad habitat type, the data are converted to an index (1990 values are set at 100) to compensate for the difference in plot size and species richness between habitats. As a result of agricultural intensification over many years (e.g. the use of herbicides and artificial fertilizers and the implementation of new cropping and land management practices), arable fields and improved grassland already had low plant diversity in 1990. There is some evidence that arable set-aside schemes in England contributed to a slight increase in diversity by 2007.

Web links for further information

Organisation	Subject
Bat Conservation Trust	The National Bat Monitoring Programme
British Trust for Ornithology (BTO)	Methods | BTO - British Trust for Ornithology
British Trust for Ornithology (BTO)	Volunteer-led surveys
British Trust for Ornithology (BTO), Royal Society for the Protection of Birds (RSPB) and Defra	Technical background document - birds
Butterfly Conservation	The state of Britain's butterflies
Butterfly Conservation and Centre for Ecology & Hydrology	Technical background document - butterflies
Centre for Ecology & Hydrology	Countryside survey
Centre for Ecology & Hydrology	Summary of UK BMS
Defra	Butterflies in the wider countryside: England
Defra	Wild bird populations in England
Joint Nature Conservation Committee	Tracking Mammals Partnership
UK Butterfly Monitoring Scheme	Butterflies as indicators

References

Barlow, K.E., Briggs, P.A., Haysom, K.A., Hutson, A.M., Lechiara, N.L., Racey, P.A., Walsh, A.L. & Langton, S.D. (2015) Citizen science reveals trends in bat populations: the National Bat Monitoring Programme in Great Britain. *Biological Conservation*, **182**, 14–26.

Dennis, E.B., Morgan, B.J.T., Freeman, S.N., Brereton, T. & Roy, D.B. 2016. A generalized abundance index for seasonal invertebrates. *Biometrics*, **72**(4), 1305–1314, https://doi.org/10.1111/biom.12506.

Guest, P., Jones, K.E. and Tovey, J. (2002). Bats in Greater London: unique evidence of a decline over 15 years. British Wildlife, 13, 1 - 5

Harris, S., Morris, P., Wray, S. and Yalden, D. (1995). A review of British mammals: population estimates and conservation status of British mammals other than cetaceans. Peterborough, JNCC.

Haysom, K. A., Jones, G., Merrett, D. and Racey, P.A. (2010). Bats. Pp 259 – 280 in: Maclean N (ed.) Silent Summer: The State of Wildlife in Britain and Ireland. Cambridge University Press.

Kunz, T.H., Arnett, E.B., Erickson, W.P., Hoar, A.R., Johnson, G.D., Larkin, R.P., Strickland, M.D., Thresher, R.W. & Tuttle, M.D. (2007). Ecological impacts of wind energy development on bats: questions, research needs, and hypotheses. Frontiers in Ecology and the Environment, 5, 315-324.

Mitchell-Jones, A.J. (1993). The growth and development of bat conservation in Britain. Mammal Review, 23, 139-148.

Racey, P.A. and Stebbings, R.E. (1972). Bats in Britain – a status report. Oryx, 11, 319 – 327.

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

Rebelo, H., Tarroso, P. & Jones, G. (2010). Predicted impact of climate change on European bats in relation to their biogeographic patterns. Global Change Biology, 16(2), 561–576.

Stone, E.L., Jones, G., Harris, S. (2009). Street lighting disturbs commuting bats. Current Biology, 19, 1123-1127.

Stone, E.L., Jones, G., Harris, S. (2012). Conserving energy at a cost to biodiversity? Impacts of LED lighting on bats. Global Change Biology, 18, 2458-2465.

Last updated: July 2018

Latest data available:

5a Populations of farmland species: birds – 2016, bats and butterflies – 2017

5b Farmland plant species richness – no update (2007)