6. Species in the wider countryside: woodland

Type: State indicator

Methodological note relating to the England woodland butterfly index:

Improvements were made to the analytical techniques in 2020 to better account for the colonisation of sites. The change has been to add pre-colonisation zero abundance counts for species at sites they have colonised, where the site was being monitored prior to colonisation. In general, the effect of these changes has been most notable for expanding species whereby there has been a slight reduction in their population indices for the earlier years, relative to the latter years. This analysis improvement has coincided with relatively favourable recent years for butterflies. The combination of the relative reductions in the indices of earlier years for colonising species with the relatively high indices in recent years have resulted in the current indicator assessment differing from previous assessments to a greater extent than in previous updates. Further details can be found in the Technical background document.

Indicator Description

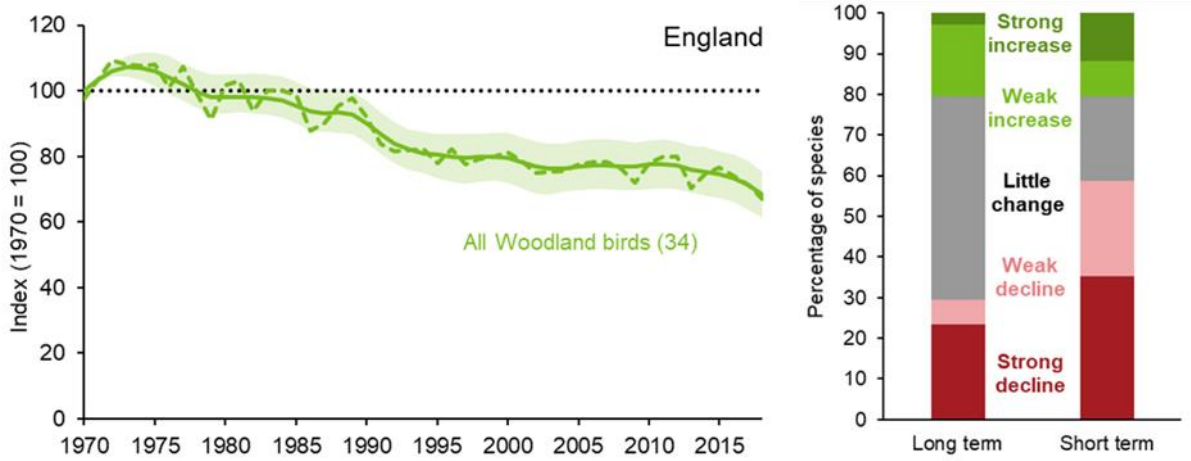
The first part of this indicator shows changes in relative abundance of species in woodland, namely birds and butterflies. Woodland provides habitat from canopy to ground level, important food resources for birds and butterflies, as well as nesting opportunities for birds and cover from predators.

6a. Populations of woodland species

Birds (National Statistics)

In 2018 the breeding woodland bird indicator for England was 31% lower than in 1970 (Figure 6.1). The greatest decline occurred between the early 1980s and the early 1990s, since 1996 the index has been relatively stable although more recently the smoothed index decreased significantly by 8% between 2012 and 2017.

Figure 6.1: Breeding birds in woodland in England, 1970 to 2018



Notes:

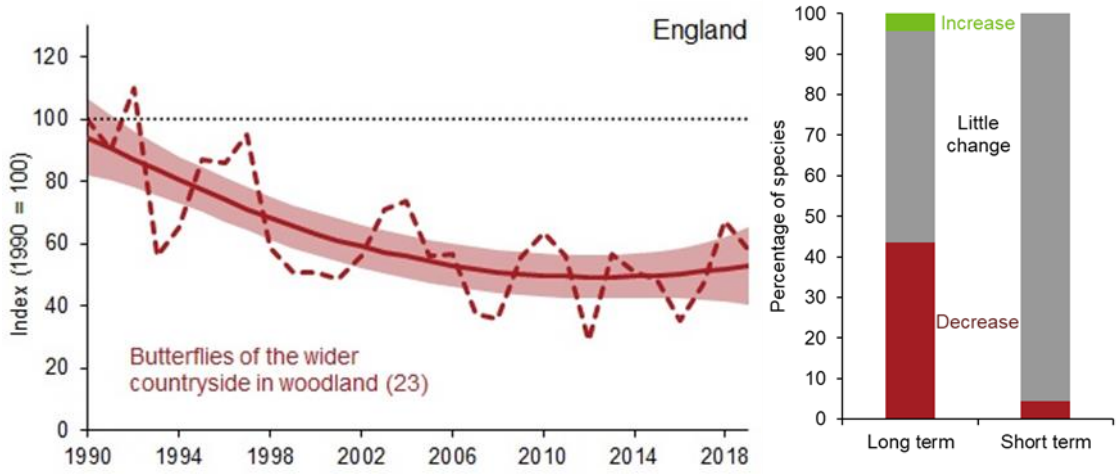
1. This indicator is taken from the Defra National Statistics publication 'Wild bird populations in England'.
2. The line graph shows the unsmoothed trend (dashed line) and the smoothed trend (solid line) together with its 95% confidence interval (shaded).
3. The figure in brackets shows the number of species in the index.
4. The bar chart shows the percentage of species within the indicator that have increased, decreased or shown little change, based on set thresholds of annual change.

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

Butterflies

Since 1990, the woodland butterfly index for England has fallen by 42% (Figure 6.2). Although the index has shown some recovery since it reached an all-time low in 2012, the short-term assessment of the smoothed trend shows no significant change. With warmer than average spring and summer temperatures, 2019 was a good year for butterflies across England.

Figure 6.2: Butterflies of the wider countryside in woodland in England, 1990 to 2019



Notes:

1. The line graph shows the unsmoothed trend (dashed line) and the smoothed trend (solid line) together with its 95% confidence interval (shaded).
2. The figure in brackets shows the number of species in the index.
3. This indicator includes individual measures for 24 species of butterflies, the woodland index, however, only includes 23 trends. This is because an aggregate trend is used for small skipper and Essex skipper; these 2 species have been combined due to historical difficulties with distinguishing between them in the field.
4. 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 (little change).
5. Since 2017, an improved analysis method has been used to derive the species indices (see 'Background' section for further information).
6. Further improvements were made to the analytical techniques in 2020 to better account for the colonisation of sites. The change has been to add pre-colonisation zero abundance counts for species at sites they have colonised, where the site was monitoring prior to colonisation. In general, the effect of these changes has been most notable for expanding species whereby there has been a slight reduction in their population indices for the earlier years, relative to the latter years. This analysis improvement has coincided with relatively favourable recent years for butterflies. The combination of the relative reductions in the indices of earlier years for colonising species with the relatively high indices in recent years have resulted in the current indicator assessment differing from previous assessments to a greater extent than in previous updates. Further details can be found in the Technical background document (see 'Background' section for further information).

Source: Butterfly Conservation, British Trust for Ornithology, Defra, Joint Nature Conservation Committee, UK Centre for Ecology & Hydrology.

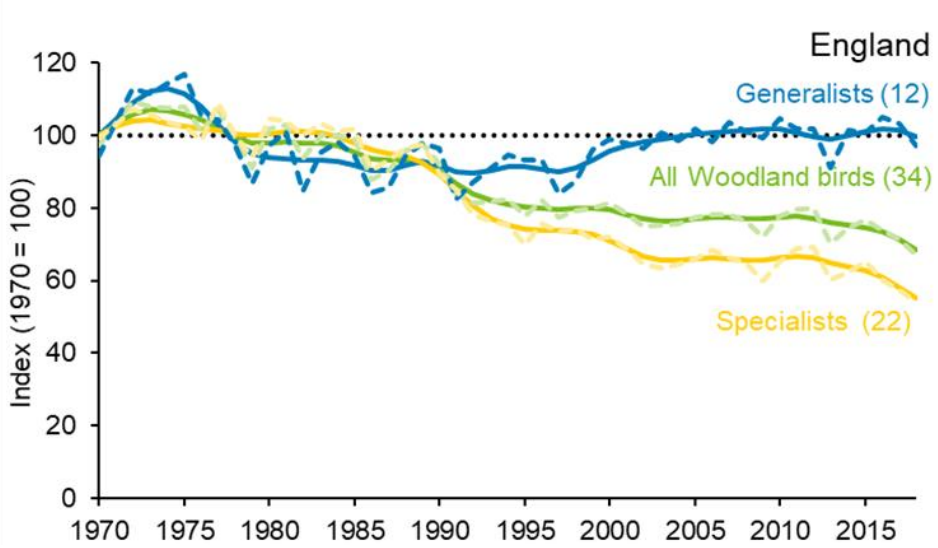
Birds

The long-term decline of the woodland bird indicator in England has been mostly driven by the decline of specialist woodland birds such as willow tit, spotted flycatcher and lesser redpoll (species restricted to or highly dependent on particular woodland habitats). Between 1970 and 2018, the index for woodland specialists declined by 45% while the index for woodland generalist species increased by 3% (Figure 6.3).

The declines in woodland birds have been attributed to a number of pressures. Changes in woodland management including the cessation of traditional practices such as coppicing, and increased deer browsing pressure result in a reduced diversity of woodland structure. This reduces the availability of suitable nesting and foraging habitats. Over the past 50 years, changes in

farmland management, such as the removal of hedgerows, have adversely affected many of the species in the indicator which have substantial populations outside of woodland e.g. in farmland and gardens. Woodland specialists have also been affected where hedgerows and copses helped improve connectivity between isolated woodland patches. Moreover, many declining woodland birds are long-distance migrants, and loss and degradation of habitats used outside of the UK in the non-breeding season may also be affecting these species. Factors likely to be having a beneficial impact include the increasing area of woodland cover and milder winters.

Figure 6.3: Specialist and generalist woodland birds in England, 1970 to 2018



Notes:

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

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

Butterflies

Since 1990, the woodland butterflies index has fallen by 42%. This long-term decline is thought to be chiefly due to a lack of woodland management and loss of open spaces in woods. These figures demonstrate how numbers fluctuate from year-to-year. Species fare differently within this overall trend. Species of the wider countryside showing the largest long-term decline in woodland include: wall; small tortoiseshell; small copper; Essex/small skipper; gatekeeper and white-letter hairstreak. Of these, the small tortoiseshell has undergone a significant short-term decline, mirroring their performance on farmland. Ringlet also displayed the same trends in woodland as on farmland, increasing significantly over the long term, but showing no significant change since 2014.

Indicator assessment

Assessment of change in abundance of species in the wider countryside (woodland)

Breeding birds in woodland (National Statistics): Long term (1970 to 2017): Deteriorating; Short term (2012 to 2017): Deteriorating; Latest year (2018): Decreased.

Butterflies of the wider countryside in woodland: Long term (1990 to 2019): Deteriorating; Short term (2014 to 2019): Little change; Latest year (2019): Decreased.

Note: To better capture patterns in the data, long-term and short-term assessments are made on the basis of smoothed data, with analysis of the underlying trends being undertaken by the data providers. Due to differences in the methods used to produce smooth trends for woodland birds and butterflies, the long-term and short-term assessments are made to 2017 for the bird index and 2018 for the butterfly index. All latest year assessments are based on unsmoothed data.

6b. Abundance of woodland plant species

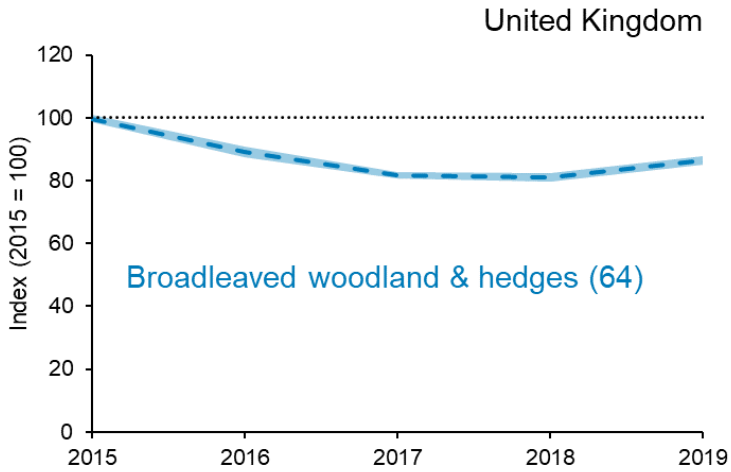
Experimental statistic: The UK biodiversity indicators project team would welcome feedback on the novel methods used in the development of this indicator.

Indicator Description

The second part of this indicator measures, in small plots, change in the abundance of plant species considered indicative of good habitat condition in UK woodland, using modelled abundance data from the National Plant Monitoring Scheme. Plant populations form the environment in which most other species exist, as well as providing numerous ecosystem services. Drivers of change are well-understood for many UK habitats.

Between 2015 and 2019, average indicator plant abundance for the broadleaved woodland and hedges habitat type included within this UK indicator shows a decline of 18% before levelling off (Figure 6.4).

Figure 6.4: Abundance of plant species in one broad UK woodland habitat, 2015 to 2019



Notes:

1. The line graph shows the unsmoothed trends (dashed line); the variation around the lines shown (the shaded area) is the standard deviation of 1,000 simulated trend indices calculated according to the method of Soldaat *et al*. (2017).
2. Abundance is measured by the percentage area covered by a species within a plot.
3. The figures in brackets indicate the number of species or species aggregates included in the composite index for that particular habitat type.

Source: Botanical Society of Britain and Ireland, Joint Nature Conservation Committee, National Plant Monitoring Scheme, Plantlife, UK Centre for Ecology & Hydrology.

The National Plant Monitoring Scheme (NPMS) was designed to monitor UK habitats of conservation importance. This is achieved through the establishment of small plots in areas of habitats targeted by the scheme. The abundances of plant species, measured as the percentage area covered by a species within a plot, are recorded each year. Surveyors record from different lists of indicator species depending on their level of experience and the habitat within which a plot is located. Both the placement of plots, and the selection of one-kilometre national grid squares within which the plots are located, are subject to statistical methodologies designed to minimise bias (Pescott *et al.*, 2019a).

The design of the NPMS included the definition of a set of 11 broad habitat types, within which 28 finer habitat types are nested. These fine-scale habitats are linked to existing classifications such as the British National Vegetation Classification. Surveyors can choose, based on their knowledge of a habitat, whether to record a plot at the broader or finer level. The current indicator summarises species' percentage cover (abundance) data at the broad habitat level. This is done using a model that is able to account for both the range of percentage covers that a species may exhibit in a

habitat when present, and the fact that species may often be absent from any given plot (Pescott *et al.*, 2019b). Such data are often described as "zero-inflated". This model is applied across years for each species/habitat combination, and the indicators presented here for each broad habitat are the result of combining the resulting species/habitat time trends across the relevant set of NPMS habitat indicator species. The broad UK woodland habitat measure presented in this indicator is a subset of those for which the largest numbers of NPMS plots currently exist. See the technical background document for more detail.

As this is an experimental statistic it has not been assessed.

Relevance

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

Plants are a large part of the fundamental fabric of which habitats are made and directly indicate changes to environmental conditions and habitat management. Plants provide essential habitats and food for wildlife, and essential ecosystem services for humans, such as reduced erosion, nutrient cycling, oxygen production, and climate regulation.

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

Woodland birds

The woodland bird measure has been supplied by the British Trust for Ornithology (BTO), the Royal Society for the Protection of Birds (RSPB), and JNCC and is compiled using data from the Common Bird Census (CBC) and the Breeding Bird Survey (BBS). Within the woodland bird measure there are 34 species (Table 6.1). Each species is given equal weighting and the index is the geometric mean of the individual species indices. Bird count data from more than 3,000 sites surveyed annually by volunteers are analysed using log linear models to calculate population trends for each species. The longer-term changes in the indicator are assessed using the version of the indicator generated from the smoothed species trends, with bootstrapping used to generate confidence limits. Further details about species and methods can be found on the BTO website (see web-links).

Table 6.1: Species included in the woodland bird indicator

Generalist birds (12 species)

Blackbird (*Turdus merula*); Blue tit (*Cyanistes caeruleus*); Bullfinch (*Pyrrhula pyrrhula*); Chaffinch (*Fringilla coelebs*); Dunnock (*Prunella modularis*); Great tit (*Parus major*); Lesser whitethroat (*Sylvia curruca*); Long-tailed tit (*Aegithalos caudatus*); Robin (*Erithacus rubecula*); Song thrush (*Turdus philomelos*); Tawny owl (*Strix aluco*); Wren (*Troglodytes troglodytes*)

Specialist birds (22 species)

Blackcap (*Sylvia atricapilla*); Chiffchaff (*Phylloscopus collybita*); Coal tit (*Periparus ater*); Garden warbler (*Sylvia borin*); Goldcrest (*Regulus regulus*); Great spotted woodpecker (*Dendrocopos major*); Green woodpecker (*Picus viridis*); Jay (*Garrulus glandarius*); Lesser redpoll (*Carduelis cabaret*); Lesser spotted woodpecker (*Dendrocopos minor*); Marsh tit (*Poecile palustris*); Nightingale (*Luscinia megarhynchos*); Nuthatch (*Sitta europaea*); Redstart (*Phoenicurus phoenicurus*); Siskin (*Carduelis spinus*); Sparrowhawk (*Accipiter nisus*); Spotted flycatcher (*Muscicapa striata*); Treecreeper (*Certhia familiaris*); Tree pipit (*Anthus trivialis*); Willow tit (*Poecile montanus*); Willow warbler (*Phylloscopus trochilus*); Wood warbler (*Phylloscopus sibilatrix*).

Composite indicators can mask a lot of variation among the species within them. The bar chart provided alongside the headline chart above (Figure 6.1), shows the percentage of species within the indicator that have increased, decreased or shown little 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 an equivalent 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.

Butterflies in woodland

The woodland butterflies indicator is a multi-species index compiled by Butterfly Conservation (BC) and the UK Centre for Ecology & Hydrology (UKCEH) from data collated through the UK Butterfly Monitoring Scheme (UKBMS) including the Wider Countryside Butterfly Survey (WCBS). The indicator includes 24 species of butterflies associated with woodland, however the woodland measure only includes trends for 23 species because an aggregate trend is used for small skipper and Essex skipper. These 2 species have been combined due to historical difficulties with distinguishing between them in the field (Table 6.2).

Table 6.2: Species included in the England woodland butterfly indicator

Butterflies (23 species)

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

The year-to-year fluctuations in butterfly numbers are often linked to natural environmental variation, especially weather conditions. Therefore, in order to identify underlying patterns in population trends, the assessment of change is based on smoothed indices. The smoothed trend in the 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 measures, each species is given equal weight, and the annual figure is the geometric mean of the component species indices for 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 trend chart (Figure 6.2), shows the percentage of species within the indicator that have shown a statistically significant increase, a statistically significant decrease or shown no statistically significant change (little change). A table summarising the estimated long-term and short-term changes for each species together with an assessment of the individual species trends can be found in the statistical dataset 'trends in populations of selected butterfly species, 1990 to 2019'.

The method for compiling species annual indices was improved in 2017 and used again here. Indices are calculated for species using the Generalised Abundance Index (GAI) method developed by Dennis *et al.* (2016) with an additional modification that the data from each site in each year are 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 and in woodland from UKBMS sites and additionally 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 (see Dennis *et al*. (2016)); the resulting indices and species trends are similar to those generated through previous analysis methods. In 2020, further improvements were made to better model trends for species that have expanded in range and colonised new UKBMS sites, changing the trend for a small number of species including Essex Skipper and Purple Hairstreak.

Since 2015, the site index data have 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 2019, for example, extra data were added for 2016 and 2017. 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 and in the Technical background document for this indicator.

Woodland plants

The creation of the NPMS allowed for the creation of annual trends in the abundance of plants in habitats of conservation importance. Following 5 years of development, the scheme was launched by a partnership consisting of the Botanical Society of Britain and Ireland (BSBI), JNCC, Plantlife, and UKCEH in 2015. This indicator uses a subset of the species selected by the NPMS as indicative of good condition in those habitat types considered to be of most importance for the conservation of UK biodiversity – see the technical background document for a full list of species included. These species are monitored in small sample plots (between 25 and 100 m^2 in area) according to a methodology that was designed to minimise biases in data collection. Results for the UK broadleaved woodland and hedges habitats are presented here in the woodland plant species richness indicator.

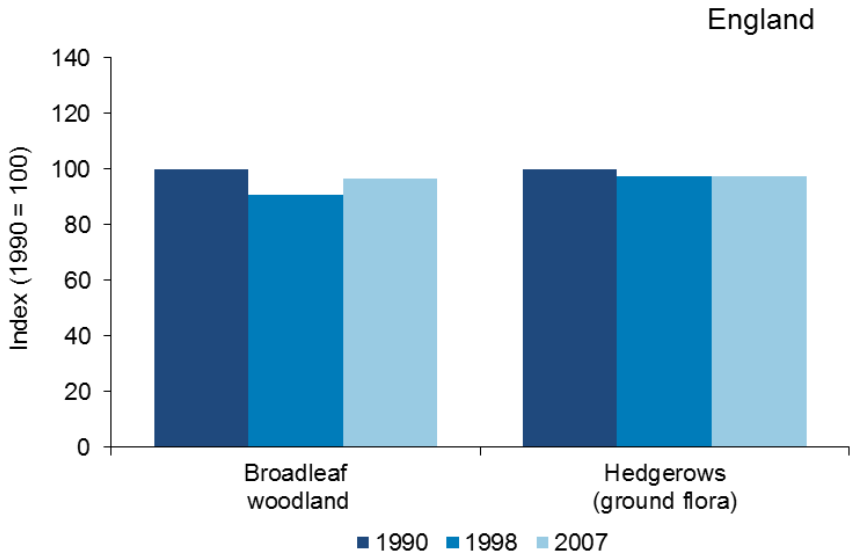
Since 2018, UKCEH, with input from all partners, have been developing a method of using NPMS data to indicate annual changes in habitat condition. The method is based on a hierarchical model, formulated in a Bayesian framework, that integrates information on a species' abundance and occupancy; the occupancy estimates also take advantage of the fact that most plots are surveyed twice a year, allowing adjustments for false negatives (i.e. species that are overlooked during surveys). Simulation tests and applications to real data indicate that the method is robust and produces ecologically sensible metrics.

The one-kilometre squares of the NPMS were selected according to a weighted-random algorithm designed to introduce a known bias towards semi-natural habitats. However, within this design, a sampling bias exists in that, in common with other UK structured monitoring schemes based on volunteer participation, squares located within lowland areas are more likely to be sampled. Further work will focus on additional adjustment for bias (Pescott *et al.*, 2019b).

Until 2013, this indicator was based on analysis of the change in plant species richness in the wider countryside. Data were taken from the UK Countryside Survey. This survey provides a random sample of vegetation plots located in arable and horticultural fields, agricultural grasslands, woodlands and associated boundary habitats in Great Britain. Key messages from the previous indicator are presented here; although now archived, the indicator can be viewed in full by following this link.

The indicator shows the number of different plant species per standard unit area (species richness) in broadleaf woodland habitats and in hedgerow bases (ground flora only). Within woodlands and hedgerows, there was no significant change in plant species richness over the period 1990 to 2007 (Figure 6.5).

Figure 6.5: Plant species richness in the wider countryside of England, 1990 to 2007: woodland



Source: Countryside Survey, UK Centre for Ecology & Hydrology.

Web links for further information

Botanical Society of Britain & Ireland**:** Home page

British Trust for Ornithology: Methods | BTO - British Trust for Ornithology

British Trust for Ornithology: Potential volunteering for surveys

British Trust for Ornithology: BTO - Bird Trends

British Trust for Ornithology, Defra and Royal Society for the Protection of Birds: Technical background - birds

Butterfly Conservation: The state of Britain's butterflies

Butterfly Conservation and UK Centre for Ecology & Hydrology: Technical background - butterflies

Countryside Survey: Home page

Defra: Butterflies in England: species of the wider countryside on farmland and in woodland

Defra: Wild bird populations in England

Defra and UK Centre for Ecology & Hydrology: Technical background document - plants

Joint Nature Conservation Committee: Home page

National Plant Monitoring Scheme: Home page

Plantlife: Home page

UK Butterfly Monitoring Scheme: Butterflies as indicators

UK Centre for Ecology & Hydrology: Home page

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based plant monitoring scheme for the United Kingdom. *PLoS ONE* 14(4): e0215891. https://doi.org/10.1371/journal.pone.0215891

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Last updated: October 2020

Latest data available:

6a Populations of woodland species: birds – 2018; butterflies – 2019

6b Abundance of woodland plant species – 2019