

4b. Status of priority species: distribution

Type: State Indicator

Prior to the update of the England Biodiversity Indicators in 2021, this indicator used to be presented at a UK-level as England-only level data were not available. However, further work has been undertaken to develop equivalent measures at an England-only level and this is presented here for the first time.

Indicator short description

This indicator measures change in the number of 1 kilometre grid squares across England in which priority species were recorded in any given year. This is referred to as the 'occupancy index' and is effectively equivalent to changes in the distribution of priority species for which data are available. Priority species are defined as those appearing on the priority species list for England (Natural Environment and Rural Communities Act 2006 - Section 41). In England there are 940 species on the priority species list. The priority species were highlighted as being of conservation concern for a variety of reasons, including rapid decline in some of their populations. The indicator will increase when priority species become more widespread on average and decrease when species becomes less widespread on average.

This indicator should be read in conjunction with [4a](#) which provides data on those species for which abundance information is available.

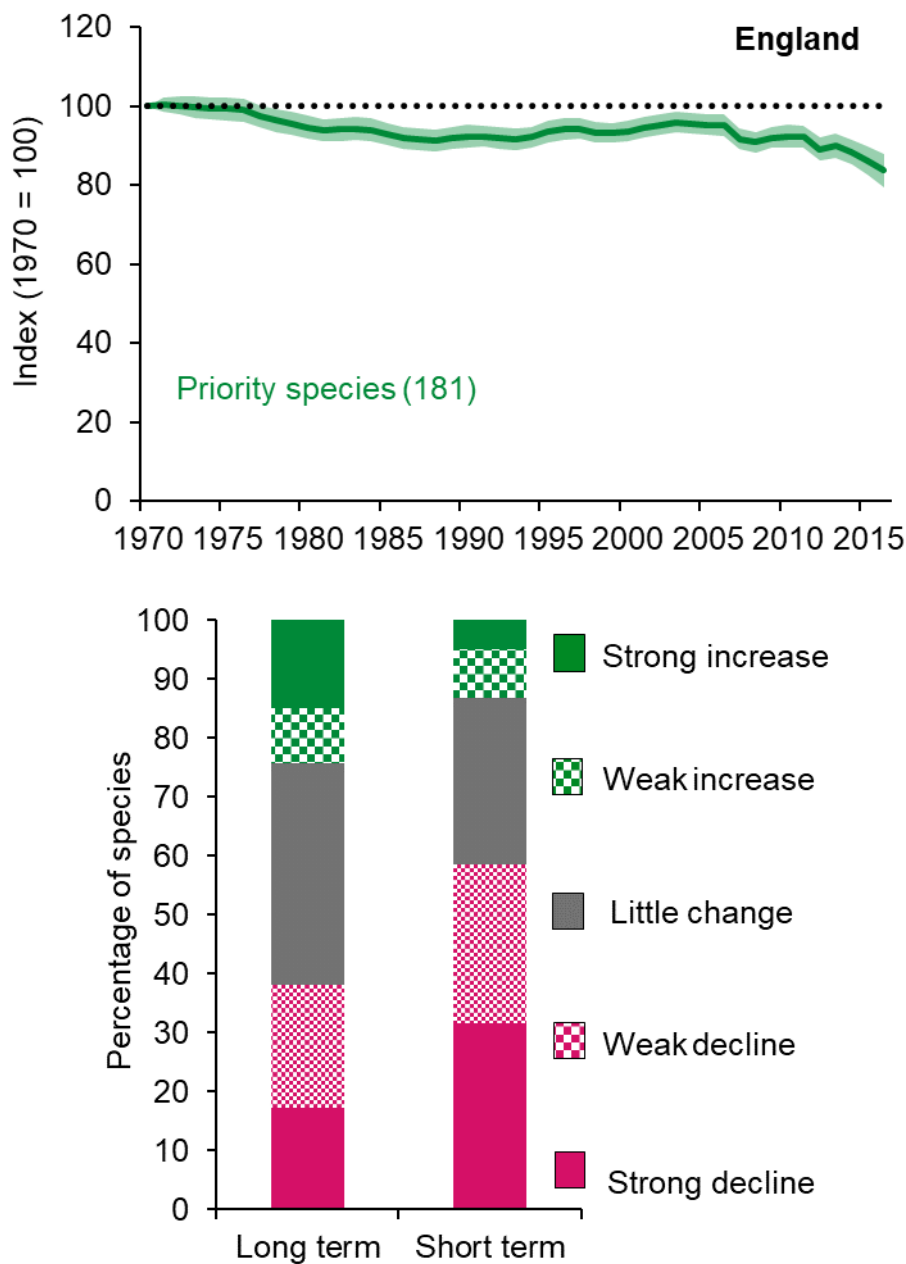
Distribution of priority species in England

Official lists of priority species have been published for each UK country. There are 2,890 species on the combined list, of which in England there are 940 priority species; actions to conserve them are included within the respective countries' biodiversity or environment strategies. This indicator shows the average change in the 181 species for which distribution trends are available in England.

By 2016, the index of distribution of priority species in England decreased to 84, a statistically significant decrease of 16% of the 1970 value (Figure 4a.2). Over this long-term period, 24% of species showed a strong or weak increase and 38% showed a strong or weak decline.

More recently, between 2011 and 2016, the distribution index declined from 92.3 to 83.7, that is, by 9% of the 2011 value – again a statistically significant decrease. Over this short-term period, 13% of species showed a strong or weak increase and 58% showed a strong or weak decline.

Figure 4b.1: Change in distribution of priority species in England, 1970 to 2016



Notes:

1. The line graph shows the smoothed trend (solid line) with its 95% credible interval (shaded area). The width of the credible interval (CI) is in part determined by the proportion of species in the indicator for which data are available.
2. The figure in brackets shows the number of species included in the composite index.
3. The bar chart shows the percentage of species within the indicator that have increased, decreased or shown little change in distribution (measured as the proportion of occupied sites), based on set thresholds of change.
4. All species in the indicator are present on the priority species list for England (Natural Environmental and Rural Communities Act 2006 – Section 41).

5. This indicator is not directly comparable with the previous publication; for the 2021 publication, this indicator has been updated with England-only level data for the first time.

Source: Biological records data collated by a range of national schemes and local data centres.

Indicator assessment

Assessment of change in distribution of priority species in England

Long term (1970 to 2016): Deteriorating; Short term (2011 to 2016): Deteriorating; Latest year (2016): Decreased.

Note: Analysis of the underlying trends is undertaken by the data providers.

Indicator description

Priority species are defined as those appearing on the priority species list for England (Natural Environmental and Rural Communities Act 2006 - Section 41). In England there are 940 species on the priority species list. The priority species were highlighted as being of conservation concern for a variety of reasons, including rapid decline in some of their populations.

Currently, 181 of the 940 species on the priority species list for England have sufficient occupancy data available to be included in this indicator. These 181 species comprise of Bees (13), Bryophytes (9), Lichens (16), Moths (93), Spiders (9), and Wasps (7). Approximately 60 species of moths appear in both the relative abundance (4a) and distribution (4b) indicators. The species have not been selected as a representative sample of priority species and they cover only a limited range of taxonomic groups. The measure is therefore not fully representative of species in the wider countryside. See the [technical background document](#) for more detail.

The relative change in distribution of each of these species is measured by the number of 1 kilometre grid squares across England in which they were recorded – this is referred to as the ‘occupancy index’. Uncertainty in the species-specific annual occupancy estimates are incorporated into the overall indicator; details of how this was done are included in the [technical background document](#).

The occupancy index will increase when a species becomes more widespread; it will decrease when a species becomes less widespread.

Between 1970 and 2016, the index of distribution of priority species in England fell from 100 to 84 (95% credible interval 79, 88). This change was assessed as a statistically significant decline. The long-term assessment is made on the smoothed time series of relative species abundance. It is based on a test of statistical significance that compares the change and the 95% credible intervals between 1970 and 2016. If the credible interval is entirely below 100 (in this case 79 and 88) the time series would be assessed as decreasing, if it was entirely above 100 the indicator would be assessed as increasing, and if the credible interval spanned 100 the indicator would be assessed as no significant change.

To assess the short-term trends, the same approach was applied to the most recent 5-year (2011 to 2016) period. If the credible interval for the most recent year (2016)

is entirely below the value for 5-years previous (2011) the time-series would be assessed as decreasing, if it was entirely above the value for 5-years previous the indicator would be assessed as increasing, and if the credible interval spanned the value for 5-years previous the indicator would be assessed as no significant change. Between 2011 and 2016, the 181 priority species in the distribution measure on average showed a statistically significant decline of 9%.

Relevance

Priority species are defined by the Secretary of State under Section 41 of the Natural Environment and Rural Communities Act 2006 as species which are of principal importance for the purpose of conserving biodiversity in England. The priority species list for England contains a total of 940 species. The indicator therefore includes a substantial number of species that, by definition, are becoming less widespread.

Measures of distribution are less sensitive to change than measures of abundance (see indicator [4a](#)). Nonetheless, if a threatened species that has been declining starts to recover, its distribution should stabilise, and may start to increase. If the proportion of species in the indicator that are stable or increasing grows, the indicator will start to decline less steeply. If the proportion declines, it will fall more steeply. Success can therefore be judged by reference to trends in both indicators 4a and 4b, as well as other information on other priority species for which there are insufficient data for inclusion in the indicator.

The indicator shows progress with commitments to improve the status of our wildlife and habitats. It is relevant to outcomes 1 and 3 in [Biodiversity 2020: A strategy for England's wildlife and ecosystem services](#) (see Annex A). It is also relevant to a number of international targets (see Annex B of the aforementioned publication for further details).

Background

The measure is a composite indicator of 181 species from 30 taxonomic groups, see the [technical background document](#) for a detailed breakdown of the species and groups in the indicator. The priority species identified in the Natural Environment and Rural Communities Act 2006 – Section 41 for England were highlighted as being of conservation concern for a variety of reasons, including their scarcity, their iconic nature or a rapid decline in their population. They are not representative of wider species in general. They do however include a range of taxonomic groups and will respond to the range of environmental pressures that biodiversity policy aims to address, including land use change, climate change, invasive species and pollution. The short-term assessment of change can be used to assess the impact of recent conservation efforts and policy aimed at halting and reversing species declines. However, natural fluctuations (particularly in invertebrate populations) and short-term response to weather may have a strong influence on the short-term assessment.

Regardless of advances in statistical techniques and the increase in the number of biological records collected, there are likely to be species on the priority lists for which little monitoring or occurrence data are available. Reasons for this include rarity, difficulty of detection, or those for which monitoring methods are unreliable or unavailable. In order for the indicator to be representative of priority species, a

method of assessing the changing status of these remaining data poor species would need to be considered.

An occupancy-detection model, following van Strien *et al.* (2013) and Isaac *et al.* (2014), with improvements based on Outhwaite *et al.* (2018), was applied to all species from those taxonomic groups for which data were available. For each site-year combination, the model estimates presence or absence for the species in question given variation in detection probability: from this the proportion of occupied sites, 'occupancy' was estimated for each year. The models are analysed in a Bayesian framework (see the [technical background document](#) for further detail), meaning that, in addition to point estimates of occupancy, credible intervals (a measure of uncertainty) can be generated for each species' time-series based on multiple iterations (here 999) of model fitting. A detailed description of the occupancy model can be found in Outhwaite *et al.* (2018).

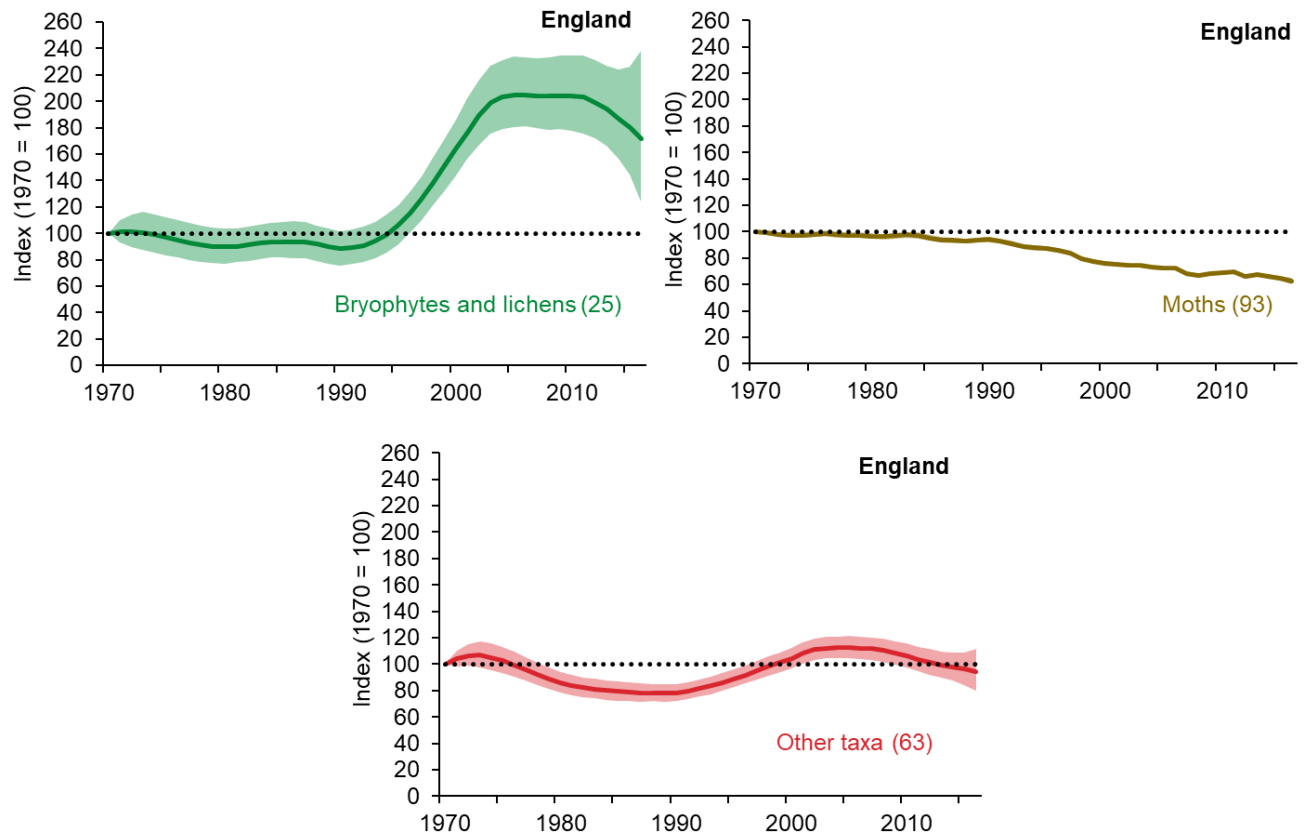
From the occupancy model for each species the proportion of occupied sites are extracted within England. Only those species with at least 10 records in England are used and which passed data availability thresholds (Pocock *et al.* 2019), to ensure reliable inference. Although, due to the size of the dataset for moths, model quality tests were unavailable, so only those moth species with greater than or equal to 10 records in England and greater than or equal to 50 records across all regions (Outhwaite *et al.* 2019) were included. Given these data requirements, 181 species contributed to this indicator.

To create the composite index, a new hierarchical modelling method for calculating multi-species indicators within a state-space formulation was used (Freeman *et al.* 2020), as for indicator 4a. The method produces an estimate of the annual geometric mean occupancy across species. The resulting index is the average of the constituent species' trends, set to a value of 100 in the start year (the baseline). Changes subsequent to this reflect the average change in species abundance; if on average species' trends doubled, the indicator would rise to 200, if they halved it would fall to a value of 50. A smoothing process is used to reduce the impact of between-year fluctuations - such as those caused by variation in weather - making underlying trends easier to detect. The smoothing parameter (number of knots) was set to the number of years divided by 3. See the [technical background document](#) for further detail on production of the indicator.

Species were grouped into one of 5 categories based on both their short-term (over the most recent 5 years of data) and long-term (all years) mean annual change in occupancy. The threshold values for each category were based on those of the wild bird indicator. See the [technical background document](#) for further detail on the calculation of the species-specific trends.

The trends of the taxonomic groups included within a multi-species indicator are often obscured by its composite nature. Indicator lines have been generated for a number of sub groups using the same method so that the trends for these groups can be seen more clearly (see Figure 4b.2). The group for other taxa experienced an overall decline, with an index value in 2016, 95% of that in 1970. These are counterbalanced by increases in bryophytes and lichens, which had an index value of 172 in 2016. The moths have undergone the biggest decline with an index value in the final year 63% of the value in 1970. Similar strong declines in moths were noted in 4a. The underpinning causes of this decrease are not completely understood.

Figure 4b.2: Change in distribution of priority species, by taxonomic group, 1970 to 2016



Notes:

1. The graphs show the smoothed trend (solid line) with its 95% credible interval (shaded area) for each of the taxonomic groups included in the composite indicator. The width of the credible interval is in part determined by the proportion of species in the indicator for which data are available.
2. The figures in brackets show the number of species included in each measure.
3. Other taxa includes a number of insect groups, molluscs and spiders.
4. All species in the indicator are present on the priority species list for England (Natural Environmental and Rural Communities Act 2006 – Section 41).
5. This indicator is not directly comparable with the previous publication; for the 2021 publication, this indicator has been updated with England-only level data for the first time.

Source: Biological records data collated by a range of national schemes and local data centres.

Web links for further information

Aquatic Heteroptera Recording Scheme: [Home page](#)

British Arachnological Society Spider Recording Scheme: [Home page](#)

Bees, Wasps and Ants Recording Society: [Identification guides to download](#)

British Bryological Society: [Home page](#)

British Dragonfly Society: [Recording Dragonflies and Damselflies in the British Isles](#)

British Lichen Society: [Home page](#)

British Myriapod and Isopod Group: [Centipede and Millipede recording schemes](#)

Bruchidae & Chrysomelidae Recording Scheme: [Relevant BRC webpage](#)

Butterfly Conservation: [Butterflies and Moths](#)

Conchological Society of Great Britain and Ireland: [Home page](#)

Diperists Forum: [Cranefly, Empididae & Dolichopodidae, Fungus gnat Recording Schemes](#)

Gelechiid Recording Scheme: [Home page](#)

Ground Beetle Recording Scheme: [Home page](#)

Hoverfly Recording Scheme: [Home page](#)

Hypogean Crustacea Recording Scheme: [Home page](#)

Lacewings and allies: [Recording schemes](#)

National Moth Recording Scheme: [Home page](#)

Natural England: [S41 List of priority species in England](#)

Orthoptera Recording Scheme: [Home page](#)

Riverfly Recording Schemes: Ephemeroptera, Plecoptera and Trichoptera: [Home page](#)

Soldierflies and Allies Recording Scheme: [Home page](#)

Staphylinidae Recording Scheme: [Relevant BRC webpage](#)

Terrestrial Heteroptera Recording Scheme - Shield bugs and allied species: [Home page](#)

UK Biodiversity Partnership: [UK Biodiversity Action Plans](#)

UK Centre for Ecology & Hydrology – Biological Records Centre: [Recording Schemes](#); [Technical Background Document](#); Technical Background Document: [Deriving Indicators from Occupancy Models](#)

UK beetle recording: [Weevil and Bark Beetle Recording Schemes](#)

References

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- Isaac, N. J. B., van Strien, A. J., August, T. A., de Zeeuw, M. P. and Roy, D. B. (2014). Statistics for citizen science: extracting signals of change from noisy ecological data. *Methods in Ecology and Evolution*. <https://doi.org/10.1111/2041-210X.12254>

Van Strien, A. J., van Swaay, C. A. M. and Termaat, T. (2013). Opportunistic citizen science data of animal species produce reliable estimates of distribution trends if analysed with occupancy models. *Journal of Applied Ecology*, **50**(6), 1450 to 1458. <https://doi.org/10.1111/1365-2664.12158>

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Latest data: 2016