10. Biodiversity and ecosystem services: pollination

Type: State / Benefit indicator

Indicator Description

This indicator indicates changes in pollinator distribution (bees and hoverflies) in the UK. The indicator is based on 377 species (148 species of bee and 229 species of hoverfly), and measures change in the number of 1km grid squares across the UK in which they were recorded in any given year: this is referred to as the 'occupancy index'. Many insect species are involved in pollination but bees and hoverflies are known to be important and are presented here as an indicator of overall pollinator trend.

Distribution of pollinators in the UK

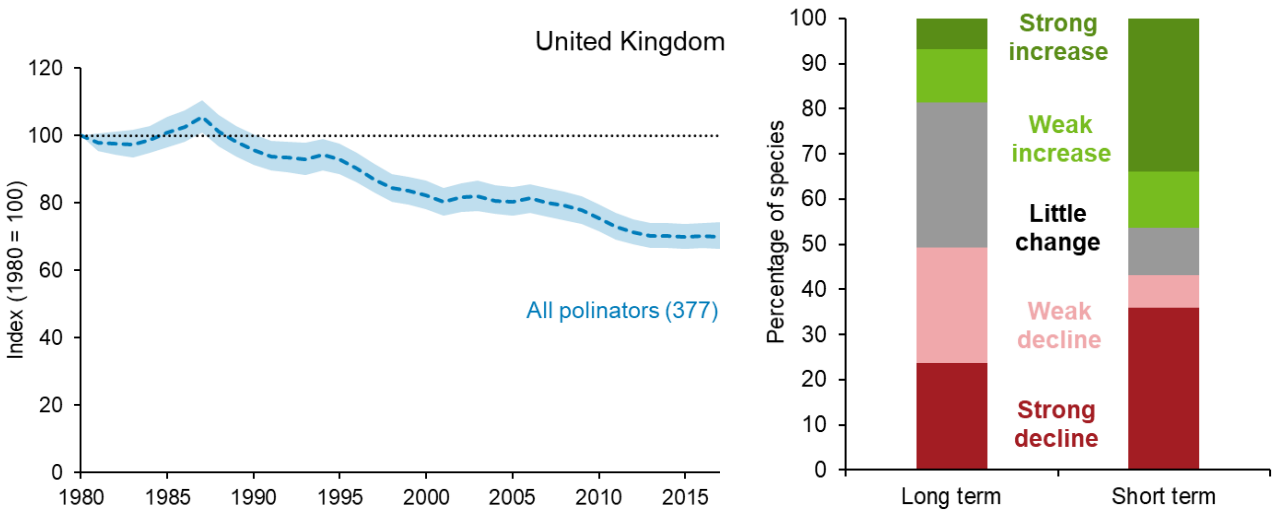
This indicator has been updated since the 2019 publication by the inclusion of additional data to 2017 for hoverflies and to 2018 for bees.

There was an overall decrease in the pollinator indicator from 1987 onwards. In 2017, the indicator had declined by 30% compared to its value in 1980. The long-term trend was assessed as declining (Figure 10.1).

Between 2012 and 2017, the indicator showed a decrease of 2%; as a result, the short-term trend was assessed as little change.

Over the long term, 19% of pollinator species became more widespread (7% showed a strong increase), and 49% became less widespread (24% showed a strong decrease). By contrast, over the short term, a greater proportion of species were increasing (46%; with 34% exhibiting a strong increase) than decreasing (43%; with 36% exhibiting a strong decrease).

Figure 10.1: Change in the distribution of UK pollinators, 1980 to 2017



Notes:

1. The line graph shows the unsmoothed composite indicator trend with variation around the line (shaded) within which we can be 90% confident that the true value lies (credible interval).
2. The figure in brackets shows the total number of species included in the index (the number of species can vary between years) - 148 wild bee and 229 hoverfly species; note this varies for each year.

3. The bar chart shows the percentage of species within the indicator that have increased, decreased or shown little change in occupancy, based on set thresholds of change (see supporting technical document).
4. This indicator is not directly comparable with the previous publication. An additional 12 species of bee and 6 species of hoverfly now meet the criteria for inclusion, whereas 6 species have been removed due to taxonomic issues, resulting in a net increase of 11 species of bee and 1 species of hoverfly.

Source: Bees, Wasps & Ants Recording Society; Biological Records Centre (supported by Joint Nature Conservation Committee and UK Centre for Ecology & Hydrology); Hoverfly Recording Scheme.

Indicator assessment

Assessment of change in the distribution of pollinators in the UK

Long term (1980 to 2017): Deteriorating; Short term (2012 to 2017): Little change; Latest year (2017): No change.

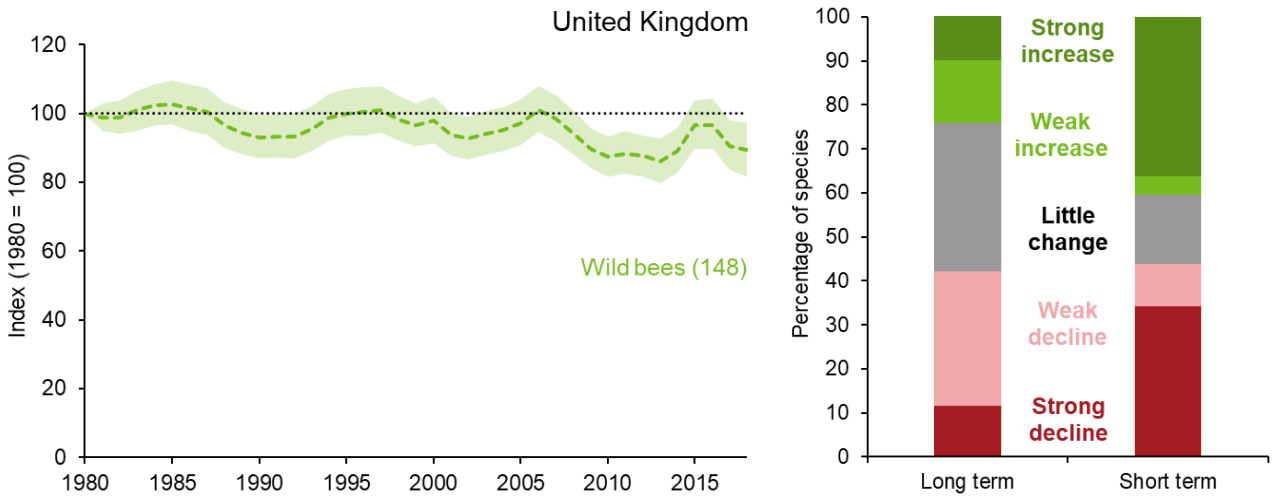
Note: Analysis of the underlying trends is carried out by the data providers – see Assessing Indicators.

Indicator description

As individual pollinator species become more or less widespread, the communities in any given area become more or less diverse, and this may have implications for pollination as more diverse communities are, in broad terms, more effective in pollinating a wider range of crops and wild flowers. Despite the inter-annual variation, the overall trend for pollinators remains downward.

The indicator occupancy index was also produced for bee (Figure 10.2) and hoverfly (Figure 10.3) species separately. The bee index was relatively stable up to 2006, before undergoing several years of decline. From 2014 onwards, there was evidence of a recovery, however, the bee index in 2018 was estimated to be 11% lower than in 1980. A larger proportion of bee species have decreased than increased over the long term (42% decreased and 24% increased). Over the short term, 44% decreased and 40% increased.

Figure 10.2: Change in the distribution of wild bee species in the UK, 1980 to 2018



Notes:

1. The line graph shows the unsmoothed composite indicator trend with variation around the line (shaded) within which we can be 90% confident that the true value lies (credible interval).
2. The figure in brackets shows the number of species included in the index.
3. The bar chart shows the percentage of species within the indicator that have increased, decreased or shown little change in occupancy, based on set thresholds of change.

4. This indicator is not directly comparable with the previous publication because the composition of species has changed. New data permitted inclusion of an additional 12 species, whilst 1 was removed due to taxonomic issues.

Source: Bees, Wasps & Ants Recording Society; Biological Records Centre (supported by Joint Nature Conservation Committee and UK Centre for Ecology & Hydrology).

There was a noticeable decline in the bee index from 2007 to 2014. Loss of foraging habitat is understood to be a major driver of change in bee distribution (Vanbergen *et al*., 2014) and pesticide use has been shown to have an effect on bee behaviour and survival (Stanley *et al*., 2015). Weather effects, particularly wet periods in the spring and summer, are also likely to have had an impact. Further research would help to better understand the relative importance of these potential drivers of change.

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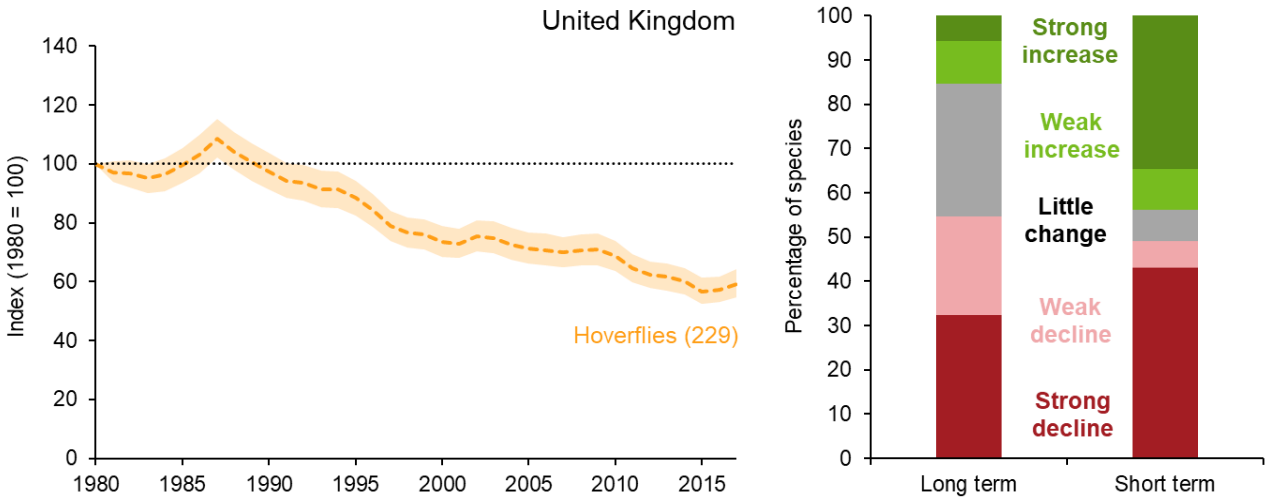
With regard to hoverflies (Fig. 10.3), the index shows a gradual decline between 1987 and 2000. In 2000, the composite index was approximately 74% of the value in 1980. The trend was relatively stable up to 2009, before declining again, ending 41% lower than the value in 1980.

A greater proportion of hoverflies have declined than increased in occupancy over both the long and short term (1980 to 2017: 55% decreased and 15% increased; 2012 to 2017: 49% decreased and 44% increased). It is not clear why hoverflies show a different trend to bees, although differences in the life cycle will mean they respond differently to weather events and habitat change.

Figure 10.3: Change in the distribution of hoverfly species in the UK, 1980 to 2017



Notes:

1. The line graph shows the unsmoothed composite indicator trend with variation around the line (shaded) within which we can be 90% confident that the true value lies (credible interval).
2. The figure in brackets shows the number of species in the index.
3. The bar chart shows the percentage of species within the indicator that have increased, decreased or shown little change in occupancy, based on set thresholds of change.
4. This indicator is not directly comparable with the previous publication because the composition of species has changed. New data permitted inclusion of an additional 6 species, but another 5 were removed due to taxonomic issues.

Source: Biological Records Centre (supported by Joint Nature Conservation Committee and UK Centre for Ecology & Hydrology), Hoverfly Recording Scheme.

Relevance

Nature is essential for human health and well-being. Pollination is an important ecosystem service that benefits agricultural and horticultural production, and is essential for sustaining wild flowers. Bees and hoverflies are also popular insects and people enjoy seeing them in towns, cities and the wider countryside. Insect pollination depends on the abundance, distribution and diversity of pollinators. Knowledge of the population dynamics and distribution of those species that provide the service, the pollinators, helps us assess the risk to these values. Many wild bees and other insect pollinators have become less widespread, particularly those species associated with semi-natural habitats. At the same time, a smaller number of pollinating insects have become more widespread. This may have implications for the pollination service they provide to crops and wild flowers and is an area of active research (Potts *et al*., 2010; Garratt *et al*., 2014).

This indicator shows progress towards 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

Occupancy of pollinators refers to the overall area where each species is found and does not refer directly to their abundance. The reduction in the index shows that overall pollinators are becoming more restricted in their distributions so that on average, in any one place the diversity of pollinator species found is reduced.

The indicator is the average trend across all 377 species included in the analysis. Individual species within the indicator will have different time-series trends (i.e. some may be increasing while others may show strong declines). The shaded region on Figures D1ci, D1cii and D1ciii is the 90% credible interval of the annual occupancy estimates and represents the statistical uncertainty surrounding the annual occupancy estimates. Credible intervals are similar to the confidence intervals used in parametric statistics, but are the appropriate metric to use with Bayesian statistics. Estimates will be revised as new data become available.

The Bayesian occupancy approach is an established analytical method that enables an estimation of species occurrence even though the data utilised in this indicator were collected without a standardised survey design (van Strien *et al.*, 2013; Isaac *et al.*, 2014). For each species, records were extracted at the 1km grid cell scale with day precision, and an annual time-series of the proportion of sites occupied was calculated. Each species-specific time-series was scaled so the first value in 1980 was set to 100. The annual index (the pollinator occupancy indicator) was estimated as the arithmetic mean of the scaled species-specific occupancy estimates. Each species was given equal weighting within the indicator. Uncertainty in the species-specific annual occupancy estimates is represented by the 90% credible intervals. See the technical background document and the Bayesian technical report for further detail on the production of this indicator.

As species become more or less widespread, individual grid squares will have richer (more species) or poorer (fewer species) pollinator communities; pollination services are generally likely to be higher where the pollinator community is richer (Vanbergen *et al.*, 2013). The area occupied does not necessarily relate to pollinator abundance, as a species with one individual in each of 10 grid squares would receive the same occupancy score as a species with 100 individuals in each of the same grid squares, although generally, species with greater occupancy are likely to be more abundant. National level data on changes in abundance of pollinators is not currently available.

The short-term trends tend to have fewer species falling into the 'stable' category than the long-term trends. This is likely to be a result of the high level of short-term variation in invertebrate populations. The species-specific trends were calculated as the mean percentage change in occupancy per year, therefore across a 37-year period, the influence of short-term variation on the trend is reduced compared to its influence on a shorter 5-year period.

Web links for further information

Bees, Wasps & Ants Recording Society (BWARS homepage): http://www.bwars.com/

Biological Records Centre and UK Centre for Ecology & Hydrology (Technical background document; Deriving Indicators from Occupancy Models): https://www.gov.uk/government/statistics/england-biodiversity-indicators

Department for Food, Environment & Rural Affairs (The National Pollinator Strategy: for bees and other pollinators in England): https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/370199/pb14221-national-pollinator-strategy.pdf

Hoverfly Recording Scheme (HRS homepage): http://hoverfly.org.uk/portal.php

UK Centre for Ecology & Hydrology (Biological Records Centre homepage): http://www.brc.ac.uk/

References

Garratt, M. P. D., Truslove, C. L., Coston, D. J., Evans, R. L., Moss, E. D., Dodson, C., Jenner, N., Biesmeijer, J. C. and Potts, S. G. (2014). Pollination deficits in UK apple orchards. *Journal of Pollination Ecology*, **12**, 9–14.

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*, **5**, 1052–1060.

Potts, S. G., Biesmeijer, J. C., Kremen, C., Neumann, P., Schweiger, O. and Kunin, W. E. (2010). Global pollinator declines: trends, impacts and drivers. *Trends in Ecology & Evolution*, **25**, 345–53.

Stanley, D. A. Garratt, M. P. D., Wickens, J. B., Wickens, V. J., Potts, S. G. and Raine, N. E. (2015). Neonicotinoid pesticide exposure impairs crop pollination services provided by bumblebees. *Nature*, online.

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**, 1450–1458.

Vanbergen, A., Heard, M., Breeze, T., Potts, S. and Hanley, N. (2013). Status and Value of Pollinators and Pollination Services. Report to DEFRA.

Last updated: October 2020

Latest data: Bees: 2018; hoverflies: 2017