



Department
for Environment
Food & Rural Affairs

Butterflies in the United Kingdom: habitat specialists and species of the wider countryside, 1976 to 2020

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In this release

This release covers 2 measures of annual butterfly population abundance: the first for habitat specialist butterflies (species strongly associated with semi-natural habitats such as chalk downland) and the second for more widespread butterflies found in both semi-natural habitats and the wider countryside in the UK. These statistics contribute to a suite of indicators due to be updated in October this year (UK Biodiversity Indicators, 2021); earlier data availability is allowing their release ahead of that publication.

- Since 1976, the unsmoothed habitat specialist butterfly index has fallen by 61%.
- Over the same period, the unsmoothed index for species of the wider countryside has fallen by 22%.
- Large fluctuations in numbers between years are a typical feature of butterfly populations, principally in response to weather conditions. Despite the sunniest spring on record, 2020 was only an average year for butterflies in the UK with more than half of all species (32 from 58, or 55%) decreasing in annual abundance, after a summer which was duller and wetter than average.
- The statistical assessment of change is made on an analysis of the underlying smoothed trends. Since 1976, populations of habitat specialists have declined significantly though species of the wider countryside show no significant change. Assessments of the short-term trends (2015 to 2020) show no significant change for either habitat specialists or species of the wider countryside.

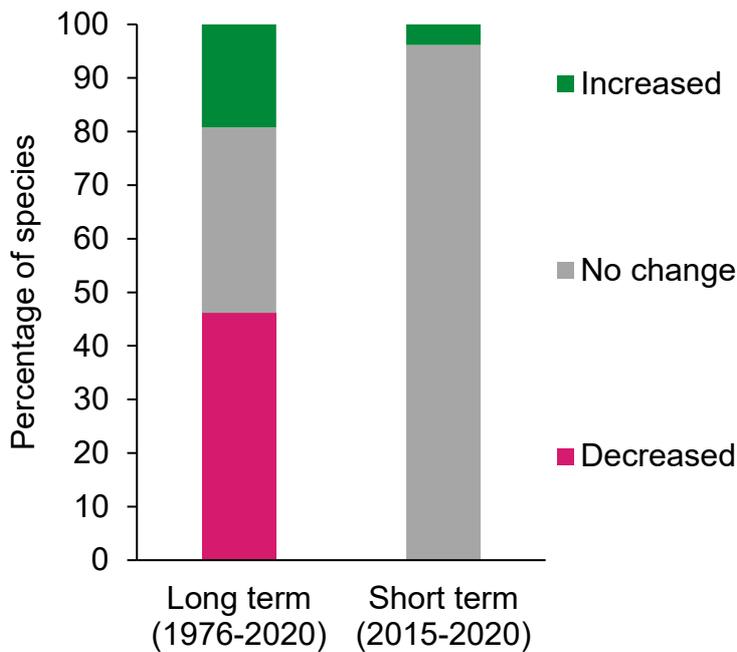
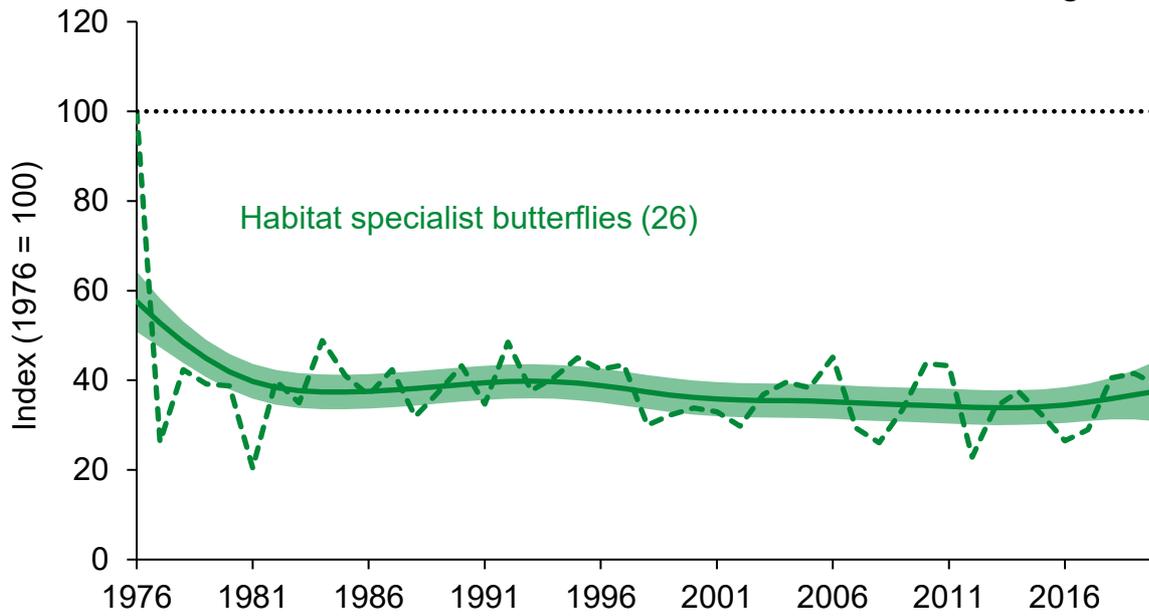
Habitat specialists

Habitat specialist species, which are vulnerable to semi-natural habitat loss and fragmentation, have not recovered from declines experienced in the late 1970s. These declines were mainly attributed to the knock-on effects of the drought conditions experienced in 1976. Overall, the habitat specialist index declined by 61% between 1976 and 2020 (Figure 1). Analysis of the smoothed trend shows a statistically significant reduction in relative abundance over the period 1976 to 1979. The index showed an increase over the period 2015 to 2020 from 32% to 39% of the 1976 level, however, analysis of the smoothed trend showed no statistically significant short-term change.

Individual butterfly species fare differently within the overall trend. Habitat specialists showing the greatest long-term decline since 1976 include heath fritillary; wood white; Lulworth skipper; grayling; and small pearl-bordered fritillary. No species show a significant short-term decline since 2015. Silver-spotted skipper; large heath; black hairstreak; silver-washed fritillary; and dark green fritillary show the largest significant increases over the long term, whilst silver-studded blue is the only species of habitat specialist butterfly to show a statistically significant increase since 2015.

Figure 1: Trends for habitat specialist butterflies in the UK, 1976 to 2020

United Kingdom



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 included in the index.
3. The bar chart shows the percentage of species within the indicator that have shown a statistically significant increase, a statistically significant decrease or no statistically significant change (little change).
4. and in 2020, improvements were made to better account for the colonisation of sites

(see 'Background' section for further information); therefore, the charts presented here are not directly comparable to those presented in releases prior to 2020.

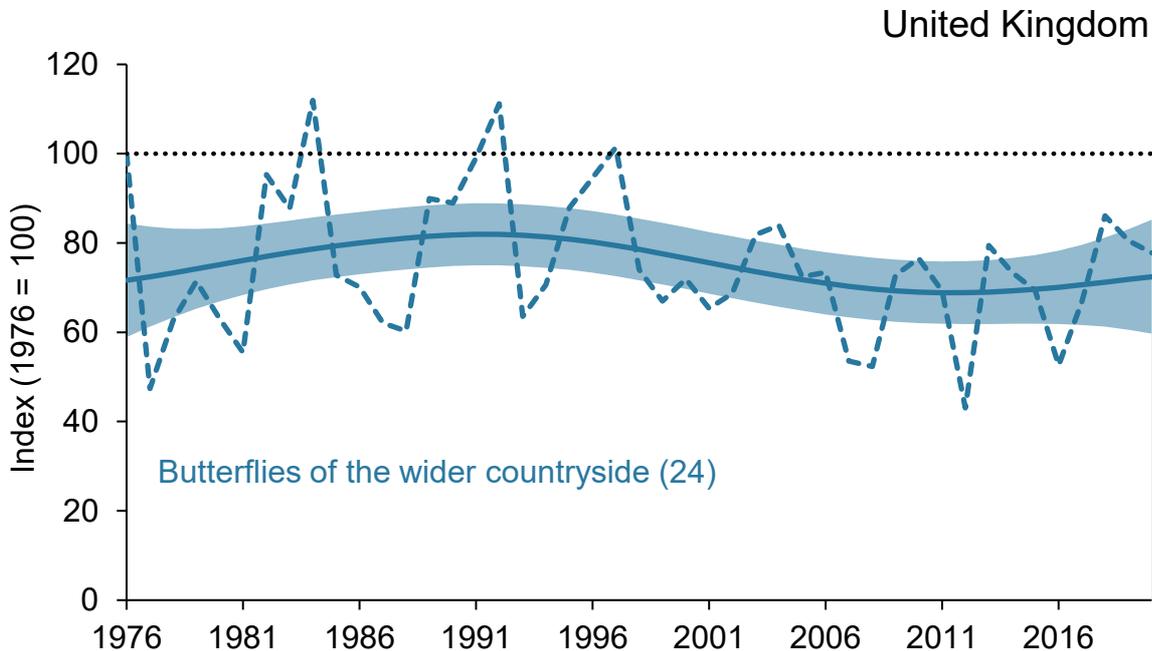
Source: Butterfly Conservation, UK Centre for Ecology & Hydrology, Defra, British Trust for Ornithology, Joint Nature Conservation Committee.

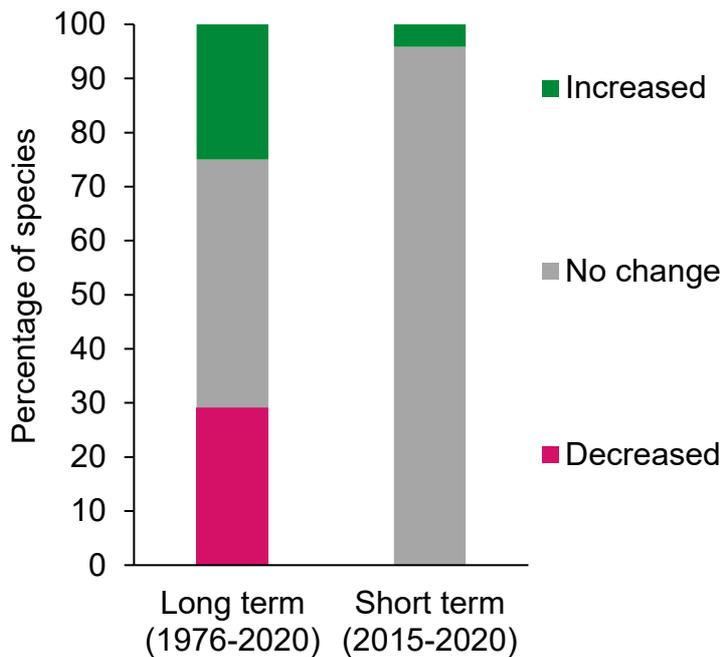
Species of the wider countryside

The species of the wider countryside index showed a decrease of 22% between 1976 and 2020 (Figure 2); however, analysis of the smoothed trend shows the change was not statistically significant. The index showed an increase over the period 2015 to 2020, from 69% to 78% of the 1976 level, however, analysis of the smoothed trend also showed this short-term change is not statistically significant.

Individual butterfly species again fare differently within the overall trend. Species of the wider countryside showing the greatest long-term declines include wall; small tortoiseshell; white-letter hairstreak; small heath; and gatekeeper. No wider countryside butterfly species show a significant short-term decline since 2015. Ringlet; comma; speckled wood; and marbled white show the largest significant increases over the long term. Small Heath shows a significant short-term increase since 2015.

Figure 2: Trends for butterflies of the wider countryside in the UK, 1976 to 2020





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 trends included in the index.
3. This indicator includes individual measures for 25 species of butterflies; the UK wider countryside butterfly index, however, only includes 24 trends. This is because an aggregate trend is used for small skipper (*Thymelicus lineola*) and Essex skipper (*Thymelicus sylvestris*); 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 no statistically significant change (little change).
5. Since 2017, an improved analysis method has been used to derive the species indices and in 2020, improvements were made to better account for the colonisation of sites (see 'Background' section for further information); therefore, the charts presented here are not directly comparable to those presented in releases prior to 2020.

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

Assessment

Long and short-term assessments of the statistical significance of changes over time (that is, since the time series began in 1976 and over the latest 5 years) are based on smoothed data, with the analysis of the underlying trend performed by the data providers. Latest-year changes are based on unsmoothed data. While this final period is too short to

make any meaningful assessment, when the change exceeds a 1% threshold, the direction is given simply as an acknowledgement of very recent trends and as a possible early indication of emerging trends.

Habitat specialist butterflies:

- Long term (1976 to 2020) – deteriorating,
- Short term (2015 to 2020) – little or no overall change, and
- Latest year (2020) – decreased

Butterflies of the wider countryside:

- Long term (1976 to 2020) – little or no overall change,
- Short term (2015 to 2020) – little or no overall change, and
- Latest year (2020) – decreased

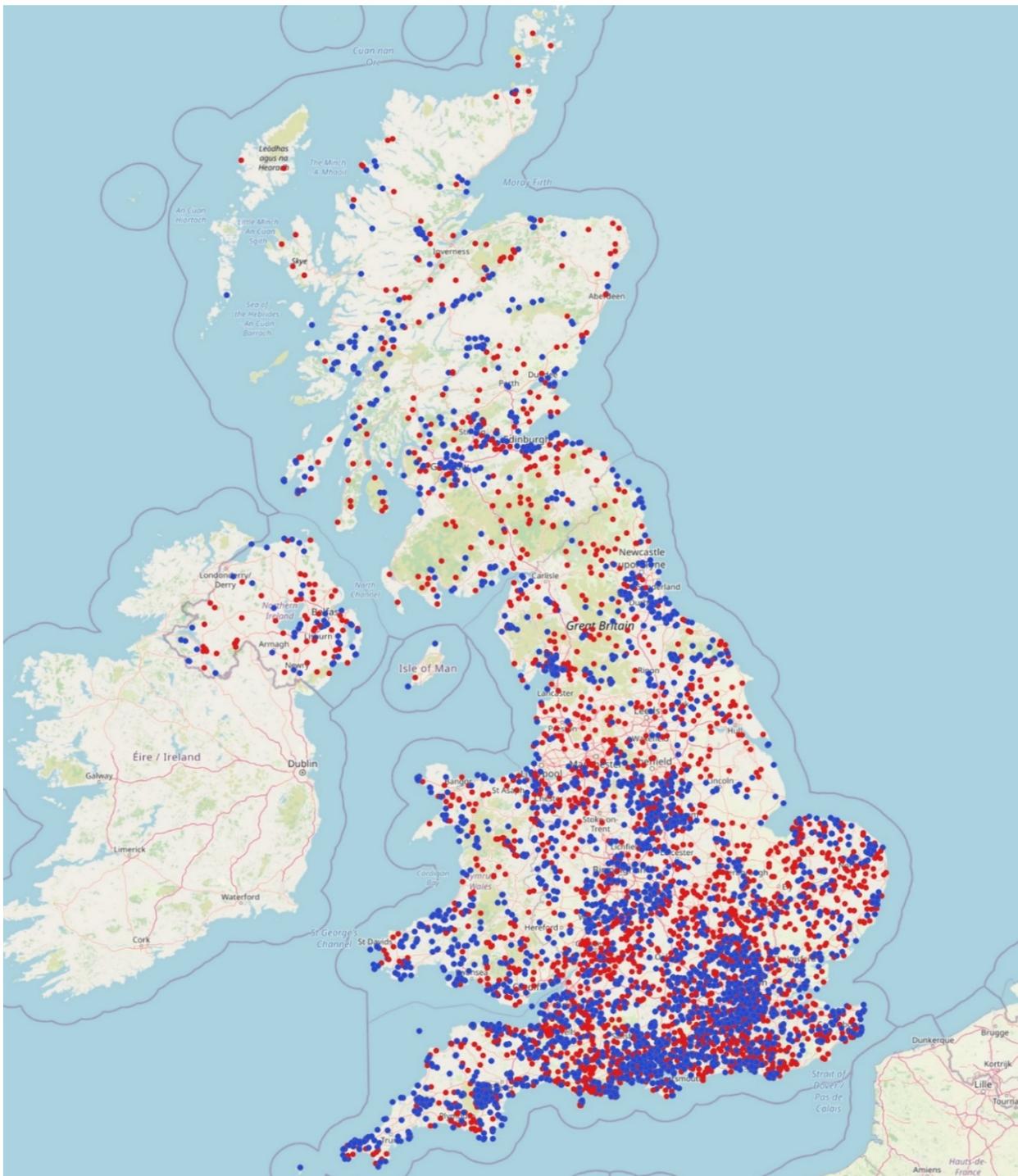
Relevance

Butterflies are considered to provide a good indication of the broad state of the environment because they respond rapidly to changes in environmental conditions and habitat management, occur in a wide range of habitats, and are representative of many other insects, in that they utilise areas with abundant plant food resources. Butterflies are complementary to birds and bats as indicator species, especially the habitat specialists, because they use resources in the landscape at a much finer spatial scale than either birds or bats. There are also long-term data available on changes in populations of butterflies which help in the interpretation of shorter-term fluctuations.

Background

This indicator is comprised of 2 multi-species indices compiled by Butterfly Conservation (BC) and the UK Centre for Ecology & Hydrology (UKCEH) from data collated through the UK Butterfly Monitoring Scheme (UKBMS) including from the Wider Countryside Butterfly Survey (WCBS). The indicator includes individual measures for 26 habitat specialist butterflies (low mobility species restricted to semi-natural habitats) and 25 more widespread butterflies (which use both semi-natural and general countryside habitats) using data collected at 5,917 sample locations (see Figure 3). The UK wider countryside butterfly measure, however, only includes 24 trends because an aggregate trend is used for small skipper (*Thymelicus lineola*) and Essex skipper (*Thymelicus sylvestris*). These 2 species have been combined due to historical difficulties with distinguishing between them in the field.

Figure 3: Locations of the 3,768 UK Butterfly Monitoring Scheme sites (blue) and the 2,149 Wider Countryside Butterfly Survey squares (red) as of 25 August 2021.



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 individual species trend 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 each measure may be increasing or decreasing, irrespective of the overall trends. The bar chart provided alongside each trend graph above shows the percentage of species within that indicator that have shown a statistically significant increase, a statistically significant decrease or no statistically significant change (little change). A list of species included within each index, together with a summary of the estimated long-term and short-term changes for each species and an assessment of the individual species trends can be found in the accompanying [data set](#).

In 2017, the method for compiling species annual indices was improved. Indices are now calculated for all species using the Generalised Abundance Index (GAI) method developed in 2016 (Dennis *et al.* (2016) BIOMETRICS: [DOI: 10.1111/biom.12506](https://doi.org/10.1111/biom.12506)) 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 improved method uses butterfly count data collected at both UKBMS butterfly transect and reduced effort sites (3,768) and randomly selected 1 km squares of the WCBS (2,149) (see Figure 3 for the locations of these sites). All butterfly counts in a season are used 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 analysis methods used prior to 2017.

In 2020, further methodological improvements were made to better model trends for species that have expanded in range and colonised new sites (UKBMS transects and WCBS squares) by adding pre-colonisation zero abundance counts for species at sites they have colonised, where the site was being monitored prior to colonisation. At the time, the effect of these changes was most notable for species such as Essex/small skipper and purple hairstreak, where there was a slight reduction in their population indices for the earlier years relative to the latter years.

As there are delays in data submission, data for previous years are also updated retrospectively. This means that the species indices 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.

Since 2019, 2 additional multi-species indices have also been compiled for butterflies in the UK: the first for butterflies of the wider countryside on farmland, the second for butterflies of the wider countryside in woodland. Although these habitat-specific measures are not included within the formal assessment for 'Butterflies in the United Kingdom: habitat specialists and species of the wider countryside', they are presented here in order to give a more complete picture of the trends for UK butterfly populations.

These habitat indices include 23 species of wider countryside butterflies surveyed on farmland and 25 species surveyed in woodland; the farmland and woodland indices, however, only include 22 and 24 trends respectively. This is because an aggregate trend is used for small skipper (*Thymelicus lineola*) and Essex skipper (*Thymelicus sylvestris*); these 2 species have been combined due to historical difficulties with distinguishing between them in the field. The indices use data collected at 4,143 locations with farmland habitat and 2,871 locations with woodland habitat (these farmland and woodland locations are subsets of the 5,917 locations shown in Figure 3). A list of species included within each index, together with a summary of the estimated long-term and short-term changes for each species and an assessment of the individual species trends can be found in the accompanying [data set](#).

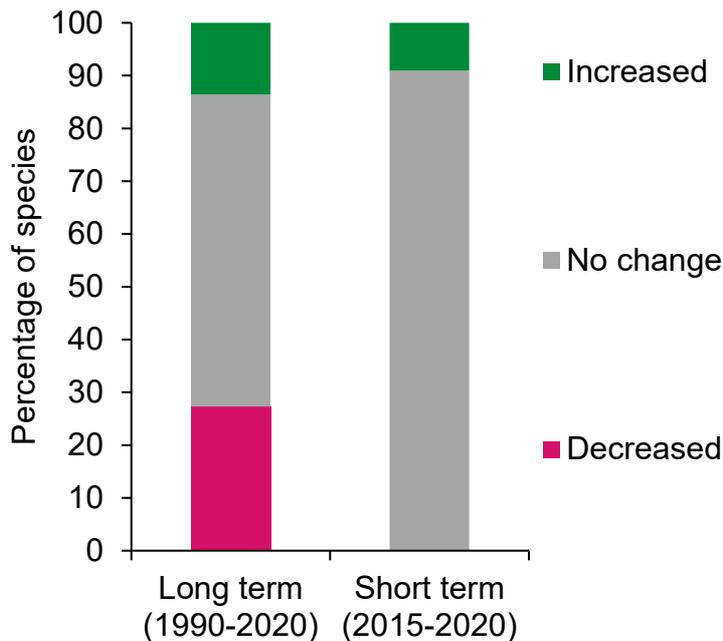
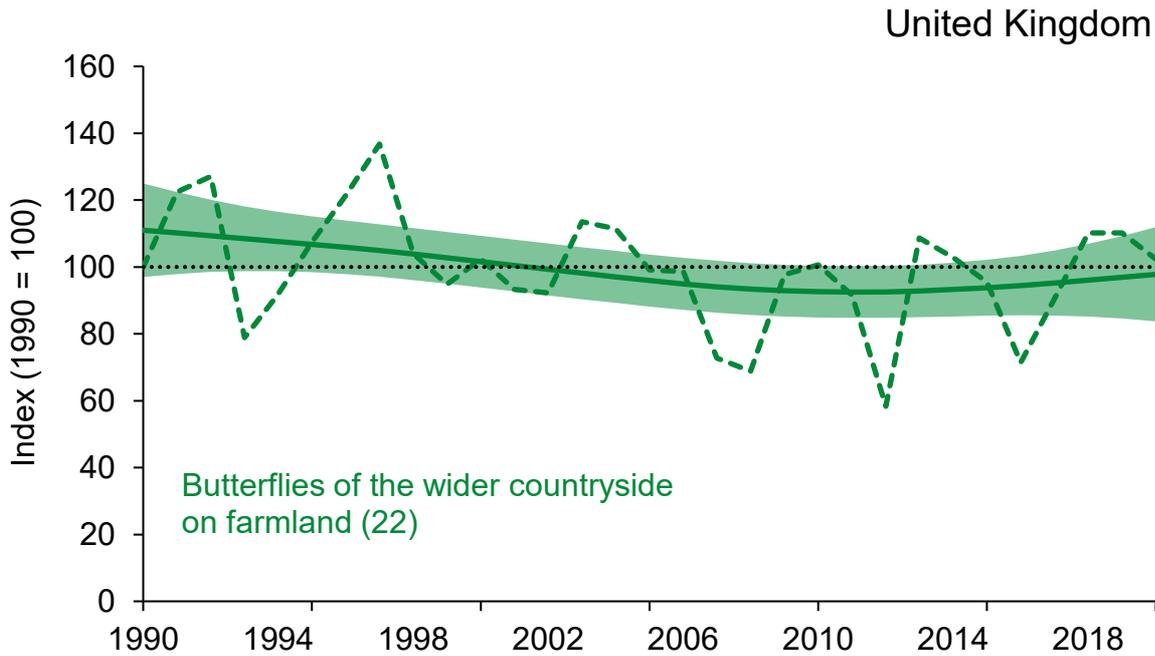
The assessment of change for these habitat measures is made on an analysis of the underlying smoothed trends, however, the base year for the long-term trends is 1990 rather than 1976. This is because prior to this date, there are insufficient data for a number of species included within the 2 indices. Since 1990, UK populations of wider countryside butterflies on farmland show no significant long-term change, whilst in woodland, butterflies have declined significantly. Since 2015, the short-term trends for both farmland and woodland butterflies show no statistically significant change.

Butterflies of the wider countryside on farmland

The wider countryside farmland butterflies index for the UK increased by 2% between 1990 and 2020. The index also increased in the 5 years to 2020, from 4% below its 1990 level in 2015 to 2% above this level in 2020 (Figure 4). Analysis of the smoothed trends shows that neither increase is statistically significant.

Individual butterfly species fare differently within the overall stable long-term trend. Species in significant long-term decline on farmland include small tortoiseshell; wall; Scotch Argus; gatekeeper; and Essex/small skipper. No species decreased on farmland over the short term (since 2015). Three species, the ringlet; speckled wood; and brimstone, increased significantly on farmland over the long term, whilst small heath and small copper have increased significantly over the short term.

Figure 4: Trends for butterflies of the wider countryside on UK farmland, 1990 to 2020



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 trends included in the index.
3. This indicator includes individual measures for 23 species of butterflies; the UK farmland butterflies index, however, only includes 22 trends. This is because an aggregate trend is used for small skipper (*Thymelicus lineola*) and Essex skipper (*Thymelicus sylvestris*); 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 no statistically significant change (little change).
5. In 2020, improvements were made to the analytical techniques to better account for the colonisation of sites (see 'Background' section for further information); therefore, the charts presented here are not directly comparable to those presented in releases prior to 2020.

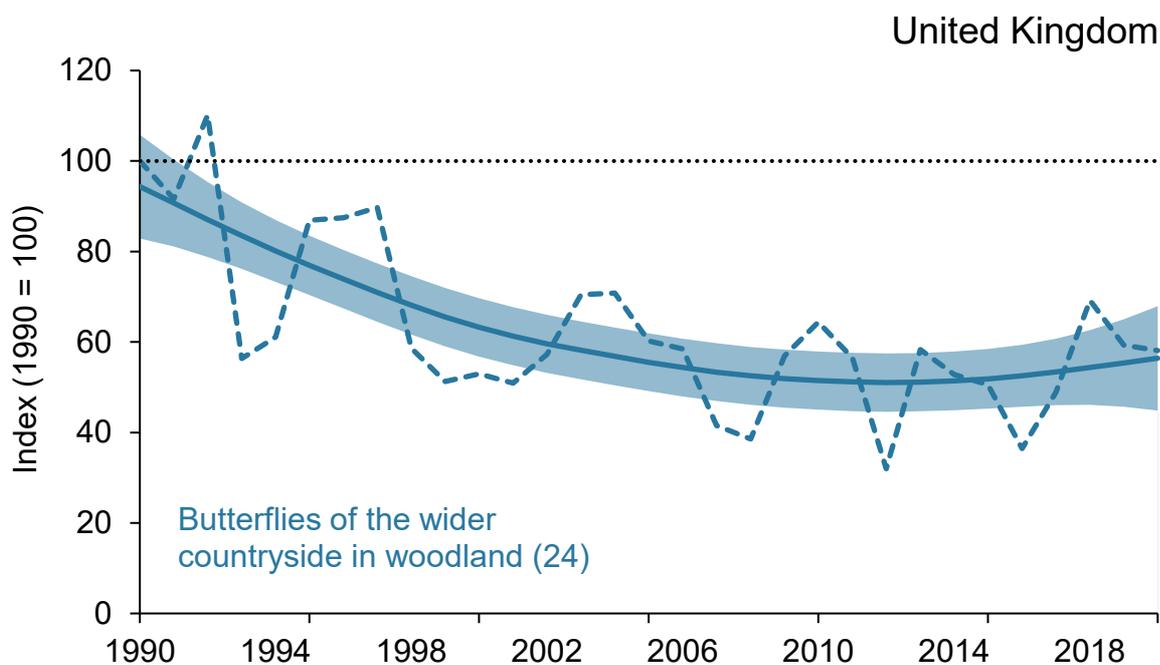
Source: Butterfly Conservation, UK Centre for Ecology & Hydrology, British Trust for Ornithology, Defra, Joint Nature Conservation Committee.

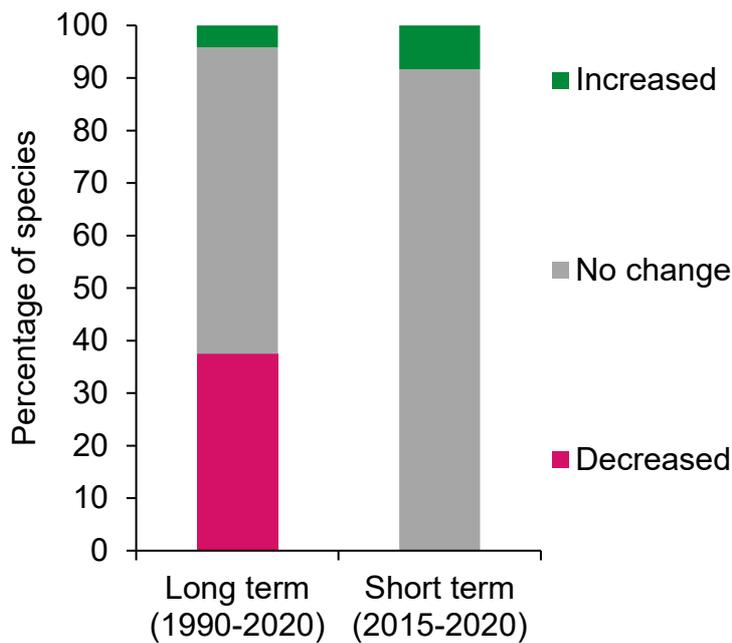
Butterflies of the wider countryside in woodland

The wider countryside woodland butterfly index for the UK decreased by 42% between 1990 and 2020 but increased in the 5 years to 2020, from 51% of its 1990 level in 2015 to 58% of its 1990 level in 2020 (Figure 5). Analysis of the smoothed trends shows a statistically significant decline since 1990 but no significant change in the short term.

The long-term decline of woodland butterflies is thought to be due to a lack of woodland management and loss of open spaces in woods. Species showing the greatest long-term significant declines in woodland include wall; small tortoiseshell; small copper; Essex/small skipper; and gatekeeper. No species show a significant decline in the short term. Ringlet displayed the same trends in woodland as on farmland, increasing significantly over the long term, but showing no significant change since 2015. Small heath and white-letter hairstreak show a significant short-term increase.

Figure 5: Trends for butterflies of the wider countryside in UK woodland, 1990 to 2020





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 trends included in the index.
3. This indicator includes individual measures for 25 species of butterflies; the UK woodland butterfly index, however, only includes 24 trends. This is because an aggregate trend is used for small skipper (*Thymelicus lineola*) and Essex skipper (*Thymelicus sylvestris*); 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 no statistically significant change (little change).
5. In 2020, improvements were made to the analytical techniques to better account for the colonisation of sites (see 'Background' section for further information); therefore, the charts presented here are not directly comparable to those presented in releases prior to 2020.

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

Web links

Butterfly Conservation: [The state of Britain's butterflies](#)

Joint Nature Conservation Committee: [UK Biodiversity Indicators](#)

UK Butterfly Monitoring Scheme: [Butterflies as indicators](#)

Next publication date

Summer 2022