



United Kingdom
Butterfly Monitoring Scheme

Annual Report 2019

UKBMS Annual Report 2019

The UKBMS

The UKBMS is organised and funded by Butterfly Conservation (BC), the UK Centre for Ecology and Hydrology (UKCEH), British Trust for Ornithology (BTO), and the Joint Nature Conservation Committee (JNCC). The UKBMS is indebted to all volunteers who contribute data to the scheme.

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This report can be downloaded from
<https://www.ukbms.org/reportsandpublications>

UKBMS partners



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Essex Skipper. Photograph by Tom Brereton.

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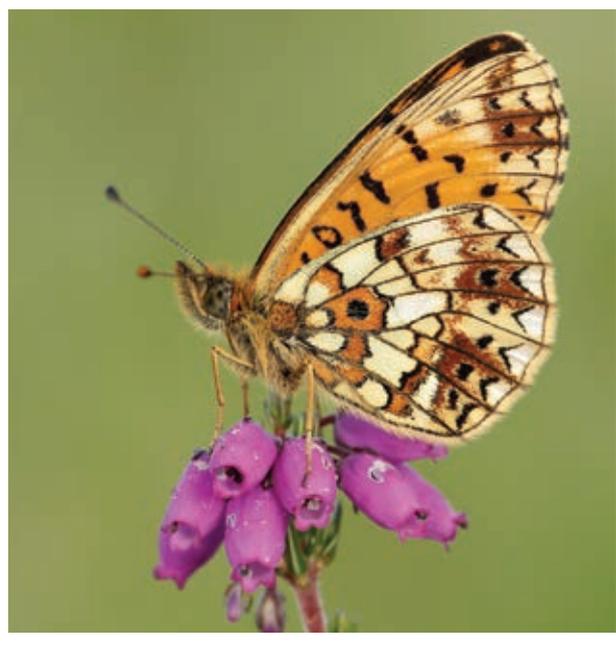
We are indebted to all the volunteers who co-ordinate and contribute data to the scheme throughout the United Kingdom, as well as to those who allow access to their land and in some cases actively promote butterfly monitoring thereon. We would like to thank the photographers for allowing their images to be used in this report.

Finally, we would like to thank JRS Creative Services - part of UK Research and Innovation (UKRI) - for designing and printing the report.

Cover photograph of Brimstone. This butterfly had its best year since the start of monitoring in 1976.
Photograph by Iain Leach.

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Small Pearl-bordered Fritillary, one of a dozen or so species to have late/additional brood records in the late summer/early autumn period. *Photograph by Iain Leach.*

Online resources

Further information on the UK Butterfly Monitoring Scheme, including individual species and site trends, and how to take part in butterfly monitoring can be found at:

<https://www.ukbms.org/>

For the Wider Countryside Butterfly Survey go to

<https://www.ukbms.org/wcbs>

For online data entry go to

<https://www.ukbms.org/mydata/>

For information on Biodiversity Indicators go to

<https://jncc.gov.uk/our-work/uk-biodiversity-indicators/>

The following links provide more information on the UKBMS delivery partner organisations:

Butterfly Conservation:

<https://butterfly-conservation.org/>

UK Centre for Ecology & Hydrology:

<https://www.ceh.ac.uk/>

British Trust for Ornithology:

<https://www.bto.org/>

Joint Nature Conservation Committee:

<https://jncc.gov.uk/>



More than half of UK butterfly species were seen in higher numbers than in 2018. *Photograph by Tom Brereton.*

News and research

UKBMS HIGHLIGHTS IN NUMBERS

44



The number of years the UKBMS has been in operation.

232



The number of days on which UKBMS counts were made in 2019

38,768



The record number of transect visits made in 2019

3,003



The record number of UKBMS locations monitored in 2019

7



The number of major research publications in 2019 using UKBMS data

2,673,607



The number of butterflies counted on transects and WCBS squares in 2019.

CHANGES TO THE TEAM AT BC FOR 2020

Zoë Randle has left her role as Wider Countryside Butterfly Survey (WCBS) co-ordinator, which she has held since 2010, moving within Butterfly Conservation (BC) to become Senior Surveys Officer to co-ordinate butterfly and moth recording. Zoë is being replaced by Megan Lowe, who has been at BC since 2017 and brings a wealth of experience in working with volunteers. It is also time to say goodbye to Tom Brereton, who has overseen butterfly monitoring for BC since 1998, resigning from BC to pursue other interests. We thank both Tom and Zoë for their hugely important contributions to the UKBMS.

Moving forward the scheme will now be managed for BC by Ian Middlebrook, who has vast experience of the UKBMS having been the point of contact for transect recorders since 2007, whilst a watching eye will be made by Richard Fox and Nigel Bourn will lead on research uses of UKBMS data.

Though it is always sad to see people move on, rest assured the scheme remains in very good hands and we look forward to a new energy brought to the scheme by these changes.

IMPACT OF CORONAVIRUS (COVID-19) ON MONITORING IN 2020

As we write this report for 2019, we sit in the knowledge that 2020 has become a very difficult year for many of our volunteers and for biological recording in general. The Coronavirus pandemic has caused massive disruption to all our lives, and we hope that you are all managing to stay safe and healthy during this very difficult time.

The UKBMS partners consider the welfare of staff, volunteers and partners of utmost importance and have taken the threat of COVID-19 very seriously. We acted to suspend butterfly monitoring activities before the start of the 2020 season, in line with the restrictions on outdoor activities and social interactions that were laid down by the Government at that time. We have subsequently tracked the easing of restrictions at different times across different parts of the UK, and updated our guidance to re-instate monitoring wherever and whenever possible. We have also updated our Health & Safety note to include guidance on minimising the risk of contracting or spreading this disease. All this guidance can be found on the UKBMS website: <https://www.ukbms.org/resources>.

Clearly this situation will mean that we have limited data available for the early part of the 2020 season and for a longer period in more remote areas where travel restrictions remained in place for longer. This is likely to cause some problems with our ability to calculate country-level trends and annual changes when we come to analyse the data. The full impact of this situation will not be known until all the 2020 data have been submitted, but it will receive full attention in next year's Annual Report.

NEW VERSION OF THE UKBMS WEBSITE

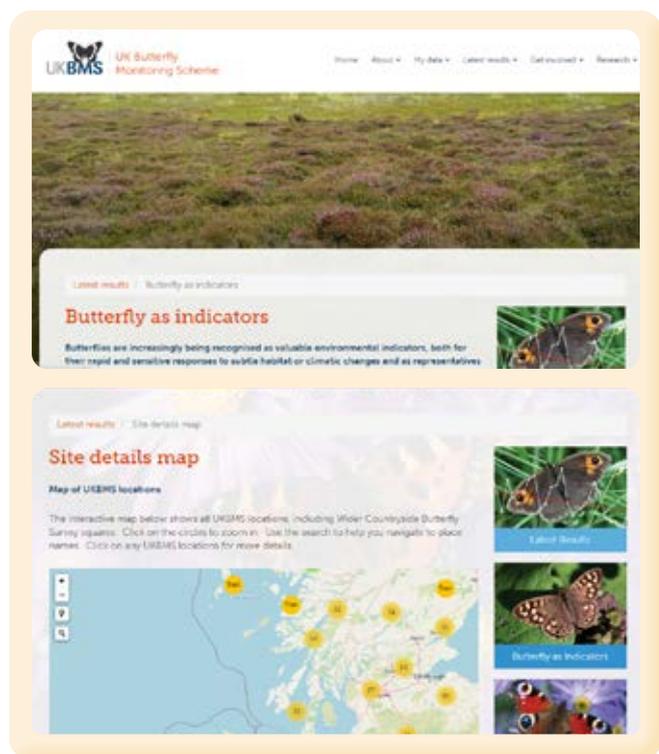
We have been working hard on a new version of the UKBMS website, to replace the current site which was first developed almost two decades ago – a very long time in the lifetime of a website. The new website will retain most of the content and functionality of the existing website but will be better suited to the way that many of us now access information online – through our phones or tablets. The site will also be easier for the whole UKBMS team to update the content on the site, enabling us to communicate new information rapidly. We have also taken the opportunity to make some other improvements, notably:

- simplification of some of the UKBMS guidance material
- improved online data entry input forms and reports
- greater access to locations of traditional UKBMS transects (Pollard walks) and Wider Countryside Butterfly Survey (WCBS) 1km grid squares
- access to view all historic transect data, for all sites and all years



We aim to launch the new website by the end of 2020. This is to avoid disruption during the transect season when you will be accessing the website to enter your transect/WCBS data. We would welcome all 2020 data to be entered soon after the end of the UKBMS season in October so we can make the new website available as soon as possible.

In the meantime, here are some example screenshots of the new website.

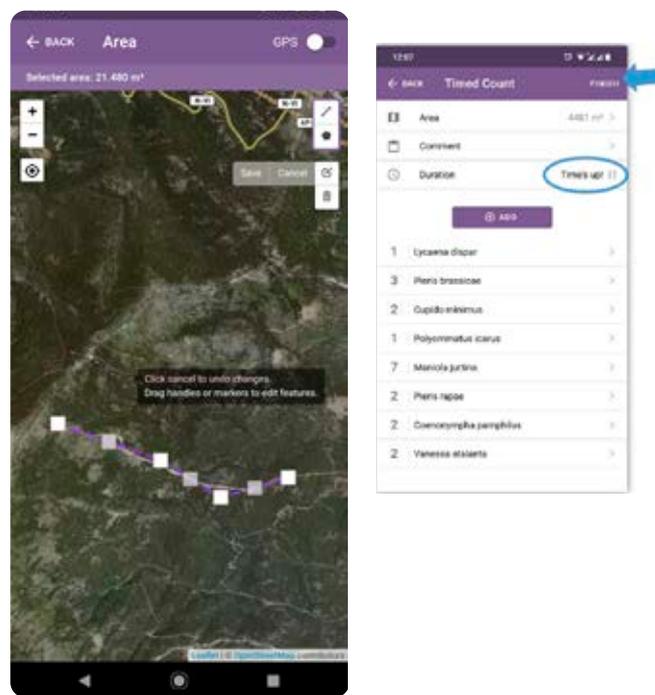


NEW MOBILE APPLICATION FOR TIMED AREA COUNTS OF BUTTERFLIES

As part of the Assessing Butterflies in Europe (ABLE) project, a new ButterflyCount mobile application has been developed to support butterfly monitoring across Europe. As partners in the ABLE project, Butterfly Conservation (BC) and the UK Centre for Ecology & Hydrology (UKCEH) have helped develop the app. It has been designed to easily add a butterfly list and count during a 15-minute time period, together with accurate location information via phone GPS route information or drawing an area on a map. Data from such 'timed area counts' can complement standard UKBMS transects and, in time, will improve our ability to assess trends in butterflies. We particularly encourage its use in areas that lack transects due to being remote (e.g. mountainous areas) or in areas that you visit regularly but are not suited to transects (e.g. urban parks, farmland). You could, for example, add on a few 15-minute counts when travelling to or from your regular UKBMS transects or when visiting your favourite sites for walking or recording wildlife.

The ButterflyCount app can also be used anywhere in Europe, is multi-lingual and includes a guide to species. For those able to travel to Europe, butterfly counts can add greatly to support conservation efforts and we have established data flows to our

national partners who co-ordinate butterfly monitoring. Within the UK, the data collected through the app is automatically available to BC Branches by using the same underlying software and database as the iRecord Butterflies App, the Butterflies for the New Millennium input system, the UKBMS online transect walker and iRecord. More information about the ButterflyCount app and the ABLE project can be found at: <https://butterfly-monitoring.net/ebms-app>



BIRD SURVEYORS CONTRIBUTE TO BUTTERFLY MONITORING

Since 2009, volunteers surveying BTO/JNCC/RSPB Breeding Bird Survey (BBS) squares have been revisiting their survey sites in order to contribute towards the Wider Countryside Butterfly Survey (WCBS) - data from which feeds to the wider UKBMS. Participation in the WCBS by BBS volunteers has been relatively steady, but in 2019, the number of BBS squares visited to monitor butterflies increased by 15% when compared to 2018. This was a fantastic contribution from BBS volunteers and resulted in a total of 829 sites being surveyed for the WCBS in 2019, 311 of which by BBS volunteers. A big thank you is due to all the BBS volunteers who go that extra mile to revisit their squares during the summer to help track population changes in butterflies, moths and Odonata. Thank you.

The BTO/JNCC/RSPB Breeding Bird Survey is a partnership jointly funded by the BTO, RSPB and JNCC, with fieldwork conducted by volunteers.



Small Heath. Photograph by Tom Brereton.



Billberry Bumblebee. Photograph by Tim Melling.

THE UK POLLINATOR MONITORING SCHEME (POMS)

As a partner in the UK Pollinator Monitoring Scheme (PoMS), BC have been encouraging recorders to get involved with 'Flower-Insect Timed Counts' in their WCBS squares or gardens over the summer months. The FIT Count is a simple 10-minute survey to collect data on pollinator numbers, recording all flower visitors to group level. It works equally well in rural or urban locations. Participation in the PoMS surveys continues to grow with 809 public FIT Counts submitted in 2019 (584 in 2018). A total of 10,651 insects were counted, at an average of 13.2 insects per 10-minute count (compared with an average of 9.3 per count in 2018).

You can read the Progress Report in full here:

https://www.ceh.ac.uk/sites/default/files/Pollinator%20Monitoring%20and%20Research%20Partnership_Progress%20report_January%202020_final.pdf

FIT Counts take place between April and September. The latest reports, FIT Count Survey Guidance, Flower Guide, Insect Guide, Videos, and Recording Form are all available on the PoMS website: <https://www.ceh.ac.uk/pollinator-monitoring>

BEYOND BUTTERFLIES: THE BIGGER PICTURE OF MONITORING WILDLIFE

Butterflies are rightly a popular and relatively well recorded species group in the UK. These attractive insects can be particularly useful in telling us about the environment, as well as being a good indicator of how other wildlife is faring. Butterflies are sensitive to environmental change, being strongly affected by changes in the extent, condition and fragmentation of habitats caused by the intensification of farming, forestry practices, urban development, pollution and climate change (see https://www.ukbms.org/official_statistics). But to get a more complete picture of the environment it is useful to monitor other wildlife too.

The UKBMS is one of a series of monitoring schemes keeping track on different species groups in the UK. There are structured monitoring schemes across the UK available for groups as diverse as birds, plants, and bats, as well as many more schemes and societies encouraging people to submit

ad hoc records of the species they come across. The **monitoring schemes work together** to share ideas and discuss common issues, for example the UKBMS has recently introduced 'Holiday Squares' for the Wider Countryside Butterfly Survey, following the example of the similar 'Upland Rovers' scheme introduced in the BTO/JNCC/RSPB Breeding Birds Survey.

JNCC – one of the partners in the UKBMS, as well as several other monitoring schemes - are keen to ensure that data from the different monitoring schemes are used together to provide a more comprehensive understanding of the environment. Species trends based on monitoring data from a wide range of species groups feed into the National Statistic compendium – 'the UK Biodiversity Indicators', to provide that bigger picture. The UKBMS data contributes to indicator 'C6 Insects of the countryside (butterflies)', and focusses on both habitat specialist butterflies and species of the wider countryside. Other indicators within the compendium include birds and bats, and an indicator using data from the new National Plant Monitoring Scheme is being developed. The UK Biodiversity Indicators report informs policy-makers as they decide on how best to action to help the environment in the UK. The latest version of the report can be found here: <https://jncc.gov.uk/our-work/uk-biodiversity-indicators-2019/>.

Of course, in the UKBMS's humble opinion, butterfly recording is very high up the interest and enjoyment rankings, but if you would like to find out more about other national monitoring schemes too, then do take a look at the JNCC webpage on the monitoring schemes within their Terrestrial Evidence programme: <https://jncc.gov.uk/our-work/surveillance-schemes/>. Whether or not you pick up a new interest, it's always good to see how your contribution fits in with wider recording activity. Approximately 18,000 volunteers contribute to UK structured recording schemes, so if you take part in the UKBMS, you really are contributing to something even bigger that can make a real difference.



Bluebell woodland. Photograph by Tom Brereton.

BUTTERFLY RECORDING FOR HEALTH AND WELLBEING

Covid-19 continues to impact us in many ways – from our personal lives, to society, the economy and the environment. But perhaps the situation has encouraged us to reassess what we value in life. Sadly, we often take things for granted and only really appreciate them when they are limited or taken away. At the same time, the lack of opportunity to get further afield and engage in usual recreational activities has increased many people’s focus on the wildlife where they live.

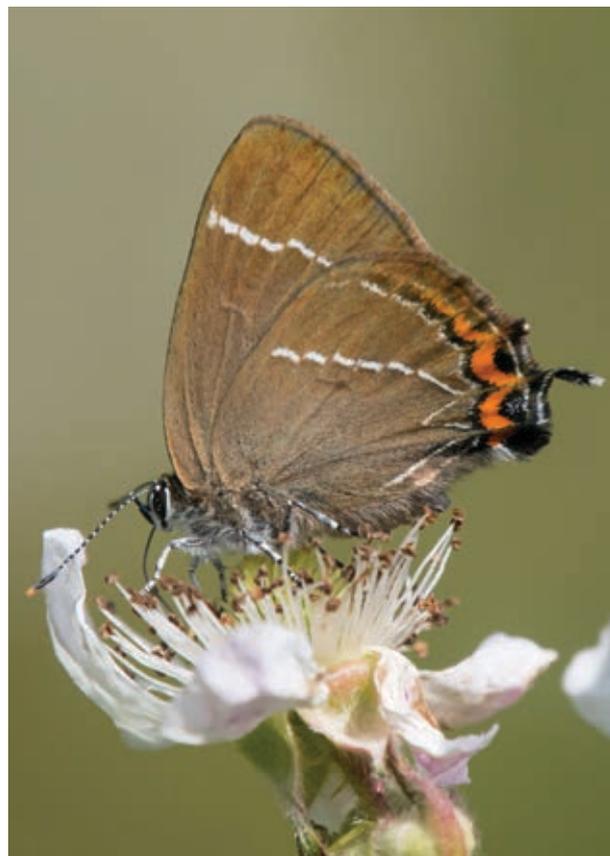
A recent YouGov poll commissioned by the National Trust showed that over two thirds of adults (68%) either agreed or strongly agreed that spending time noticing the nature around them has made them feel happy during lockdown. A similar poll commissioned by RSPB in May 2020 found that 77% agreed that visiting nature has been important for their general health and happiness, and 81% agreed they had felt happier whilst/after spending time visiting nature.

As we move forwards through this crisis, it’s important to remember the value of engaging with nature. Walking butterfly transects provides the benefits of physical exercise, as well as the benefits of appreciating fresh air and the wonder and beauty of wildlife and landscapes. A recent study has shown that just 20 to 30 minutes of exposure to nature significantly reduces levels of the stress hormone, cortisol (Hunter et al 2019). The potential cost savings to the NHS if everyone had good access to greenspace are huge (Defra 2017). In July, Environment Secretary George Eustice set out his **vision for a green recovery** from the coronavirus pandemic. In it he recognised the health and social benefits of engaging with nature, and announced a £4m two-year pilot to bring green prescribing to four urban and rural areas that have been hit the hardest by coronavirus.

Within the UKBMS, total participation rates have been continuing to grow year on year, albeit we are expecting a blip in this trend with the situation and restrictions in place this season. It’s good to know that success of the UKBMS is not only something to celebrate from a scientific and conservation point of view, but it also provides health and wellbeing benefits to participants.



A transect walker. Photograph by Tom Brereton.



White-letter Hairstreak. Photograph by Tim Melling.

References

Defra, 2017, Evidence Statement on the links between natural environments and human health.

http://randd.defra.gov.uk/Document.aspx?Document=14042_EvidenceStatementonnaturalenvironmentsandhealth.pdf

Hunter MR, Gillespie BW and Chen SY-P (2019) Urban Nature Experiences Reduce Stress in the Context of Daily Life Based on Salivary Biomarkers. *Front. Psychol.* 10:722 doi: 10.3389/fpsyg.2019.00722

Polls on lockdown views:

<https://www.nationaltrust.org.uk/press-release/uk-values-nature-more-as-a-result-of-lockdown-according-to-summer-solstice-poll->

https://www.rspb.org.uk/globalassets/downloads/recovering-together-report/recovering-together-report_nature-and-green-recovery_rspbyougov_june-2020.pdf

Ongoing projects
Effects of climate change on butterfly, moth, bird and aphid phenology

A fifty-year study led by Dr James Bell at Rothamsted Research used UKBMS data along with other long-term monitoring datasets to investigate the effects of climate change on the timing of biological events in butterflies, aphids, moths and birds. Climate change has advanced the breeding season of many species in the UK, but just how much varies markedly across the country and with habitat. While corroborating previous studies showing that, particularly in spring, the timing of many biological events is advancing earlier and earlier over time, consistent with rising temperatures, the study also revealed that this rate of advancement does not seem to be buffered by habitat type as predicted. Populations of butterflies and other taxa in open habitats such as calcareous grasslands were shown to have advanced their flight periods at the same rate as those in more shaded habitats such as woodlands. The study was published in *Global Change Biology*.



Scarlet Tiger moth.
Photograph by Tom Brereton.

Peer-reviewed research published in 2019

Bell, J.R., Botham, M.S., Henrys, P.A., Leech, D.I., Pearce-Higgins, J.W., Shortall, C.R., Brereton, T.M., Pickup, J. & Thackeray, S.J. (2019). Spatial and habitat variation in aphid, butterfly, moth and bird phenologies over the last half century. *Global Change Biology* **25**: 1982-1994.

Dennis, E.B., Morgan, B.J.T., Fox, R., Roy, D.B. & Brereton, T.M. (2019). Functional data analysis of multi-species abundance and occupancy data sets. *Ecological Indicators* **104**, 156-165.

Ellis, S., Wainwright, D., Dennis, E.B., Bourn, N.A.D., Bulman, C.R., Hobson, R., Jones, R., Middlebrook, I., Plackett, J., Smith, R.G., Wain, M. & Warren, M.S. (2019). Are habitat changes driving the decline of the UK's most threatened butterfly: the High Brown Fritillary *Argynnis adippe* (Lepidoptera: Nymphalidae)? *Journal of Insect Conservation* **23**, 351-367.



Chequered Skipper. Photograph by Tom Brereton.

Fox, R., Harrower C.A., Bell, J.R., Shortall, C.R., Middlebrook, I. & Wilson, R.J. (2019). Insect population trends and the IUCN Red List process. *Journal of Insect Conservation* **23**, 269-278.

Greenwell, M.P., Brereton, T., Day, J.C., Roy, D.B. & Oliver, T.H. (2019). Predicting resilience of ecosystem functioning from co-varying species' responses to environmental change. *Ecology and Evolution* **9**, 11775-11790.

Macgregor, C.J., Thomas, C.D., Roy, D.B., Beaumont, M.A., Bell, J.R., Brereton, T., Bridle, J.R., Dytham, C., Fox, R., Gotthard, K., Hoffmann, A.A., Martin, G., Middlebrook, I., Nylin, S., Platts, P.J., Rasteiro, R., Saccheri, I.J., Villoutreix, R., Wheat, C.W. & Hill, J.K. (2019). Climate-induced phenology shifts linked to range expansions in species with multiple reproductive cycles per year. *Nature Communications* **10**, 4455.

Middlebrook, I., Hardy, P.B., Botham, M.S. & Dennis R.L.H. (2019). The importance of unique populations for conservation: the case of the Great Orme's Head grayling butterfly *Hipparchia semele* (Linnaeus, 1758) (Lepidoptera: Satyriinae). *Journal of Insect Conservation* **23**, 381-391.

Sánchez-Bayo, F. & Wyckhuys, K.A.G. (2019). Worldwide decline of the entomofauna: A review of its drivers. *Biological Conservation* **232**, 8-27.

Van Swaay, C.A.M., Dennis, E.B., Schmucki, R., Sevilleja, C.1,2, Balalaikins, M., Botham, M., Bourn, N., Brereton, T., Cancela, J.P., Carlisle, B., Chambers, P., Collins, S., Dopagne, C., Escobés, R., Feldmann, R., Fernández-García, J. M., Fontaine, B., Gracianteparaluceta, A., Harrower, C., Harpke, A., Heliölä, J., Komac, B., Kühn, E.11, Lang, A., Maes, D., Mestdagh, X., Middlebrook, I., Monasterio, Y., Munguira, M.L.,1, Murray, T., Musche, M.1, Öunap, E., Paramo, F., Petterson, L., Piqueray, J., Settele, J., Stefanescu, C., Švitra, G., Tiitsaar, A., Verovnik, R., Warren, M.S., Wynhoff, I & Roy, D. (2019). The EU Butterfly Indicator for Grassland species: 1990-2017: Technical Report. Butterfly Conservation Europe.

Background and methods

Trends in butterfly populations were compiled from a network of 3,003 sample locations in 2019 and 5,816 locations across all years

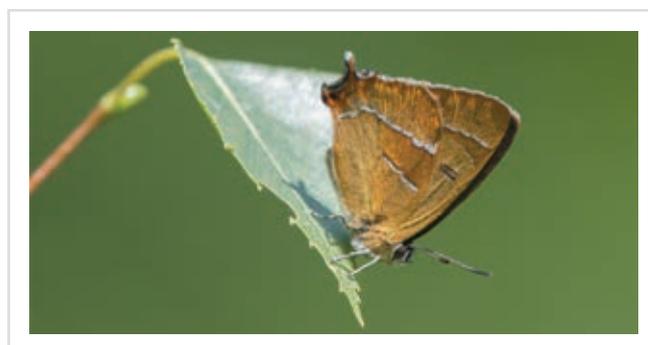
Species indices and trends

In the UKBMS, data on the population status of UK butterflies are derived from a wide-scale program of site-based monitoring and sampling in randomly selected 1km squares.

The majority of sites are monitored by butterfly transects. The 'traditional' transect method, which was developed from 1973-75 and launched in 1976, involves weekly butterfly counts along fixed routes through the season made under strict weather, recording area and time of day criteria (Pollard & Yates 1993). Weekly counts for each species are summed to generate site annual abundance indices. For sites with missing weekly counts, a statistical model (a Generalised Additive Model, 'GAM') is used to impute the missing values and to calculate a site index (Rothery & Roy 2001).

For a number of habitat-specialist species (especially the fritillaries) 'reduced effort' methods are also used to monitor annual abundance at the site level, especially in more remote parts of the UK, for example; adult timed counts for fritillaries (Warren *et al.* 1981), larval web counts for **Marsh Fritillary** (Lewis & Hurford 1997) and egg counts for **Large Blue** (Thomas *et al.* 2009). For timed count and larval search methods, systematic recording is made on single days in suitable weather (when UKBMS recording criteria are met), with the counts converted to a site index that accounts for both the size of the colony and the time in the season when the count was made. From 2015, winter egg counts for **Brown Hairstreak** have been incorporated into the UKBMS, see https://www.ukbms.org/Downloads/NG3_Brown%20Hairstreak%20Egg%20Count%20Guidance.pdf

Wider Countryside Butterfly Survey (WCBS) was established in 2009 to improve the representativeness of assessments of the population status of butterflies across the countryside as a whole. This is important given that most site-based monitoring is biased towards good quality semi-natural habitat relatively rich in butterflies. In the WCBS, BC recorders are allocated randomly selected 1km squares within the BC branch in which they live, whilst BTO recorders are given the opportunity to survey their existing Breeding Bird Survey squares. Both sets of surveyors are asked to survey these squares at least twice over the July and August period with visits spaced at least 10 days apart. Optional visits are encouraged, especially in the spring to sample **Orange-tip** and for the first generation of bivoltine species. On each visit, recorders survey two parallel 1km survey lines evenly spaced ca300m apart. Along the survey lines, recorders count butterflies, (and optionally day-flying moths and dragonflies) using the same time of day, recording width and weather condition criteria used in transect monitoring. Due to the low



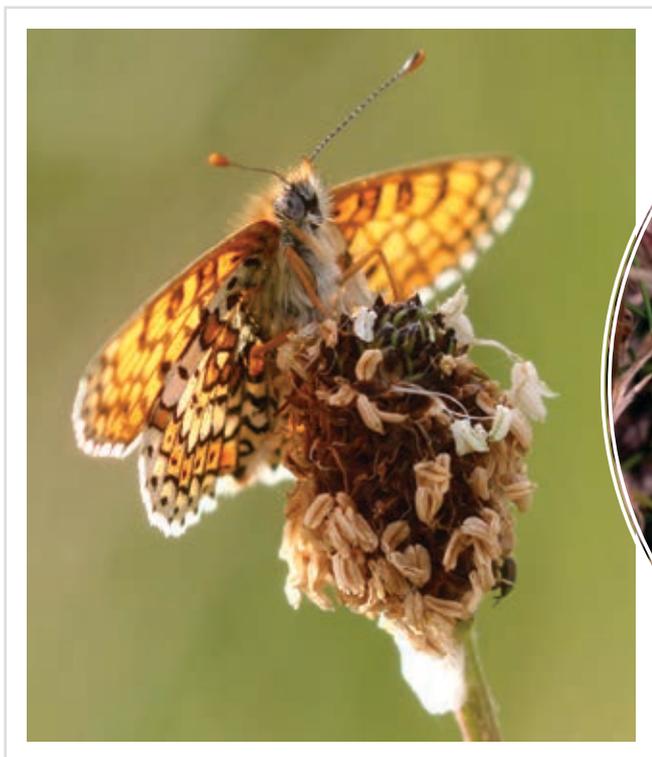
Brown Hairstreak. Photograph by Tim Melling.

level of sampling effort (and unlike conventional transects), WCBS data are not routinely used to derive local measures of butterfly abundance.

Originally the WCBS results were analysed separately from the traditional transects and reduced effort methods. However, in 2013 we implemented a new 'two stage Generalised Additive Model (GAM)' analysis method for 25 wider countryside species, to make better use of available transect data, and to incorporate WCBS data into the population analyses, in order to compile more representative national and UK indices (Dennis *et al.* 2013).

The method for compiling species annual indices was again improved in 2017. Indices are now calculated for all species (across WCBS squares and traditional UKBMS sites) using the Generalised Abundance Index (GAI) method developed in 2016 (Dennis *et al.* (2016) BIOMETRICS: DOI: 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. The method uses all butterfly counts in a season collected at both UKBMS sites (3,164 compared with 2,383 in 2014) and randomly selected 1km squares of the Wider Countryside Butterfly Survey (1,940) to estimate the seasonal pattern of butterfly counts for that year, and this is used to extrapolate from observed data to account for gaps in the recording. The weighting is necessary as it ensures that the observed data have a stronger effect upon the final indices than the extrapolated data. The resulting indices and species trends are similar to those generated through previous analysis methods, but are a bit more robust and the method can be used for all species, not just those that are well covered by WBCS samples.

In 2019, further improvements were made to better model trends for species that have expanded in range and colonised new UKBMS sites.



Glanville Fritillary. Photograph by Tom Brereton.



Marbled White. Photograph by Tom Brereton.

Composite measures of butterfly abundance

Multi-species (composite) indices of butterfly abundance are calculated using a generalised linear model accounting for species and year. Grouped measures have been compiled for all resident species, wider countryside species, habitat specialists and the three regular migrants. In addition, England is further categorised by broad habitat groupings (farmland and woodland) (Brereton *et al.* 2011).

To identify underlying patterns in population trends in these grouped measures, assessment of change is based on trends in the underlying smoothed indices. Calculation of smoothed indices and trends and confidence intervals in them are assessed by structural time-series analysis and the Kalman Filter as implemented in the program TrendSpotter (Soldaat *et al.* 2007). 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.

Brereton T.M., Roy D.B., Middlebrook, I., Botham, M. and Warren, M. (2011). The development of butterfly indicators in the United Kingdom and assessments in 2010. *Journal of Insect Conservation* 15: 139-151.

Dennis E.B., Freeman, S.N., Brereton, T. & Roy, D.B. (2013). Indexing butterfly abundance whilst accounting for missing counts and variability in seasonal pattern. *Methods in Ecology and Evolution* 4:637-645.

Dennis, E.B., Morgan, B.J.T., Freeman, S.N., Brereton, T.M. & Roy, D.B. (2016). A generalized abundance index for seasonal invertebrates. *Biometrics* 72: 1305-1314.

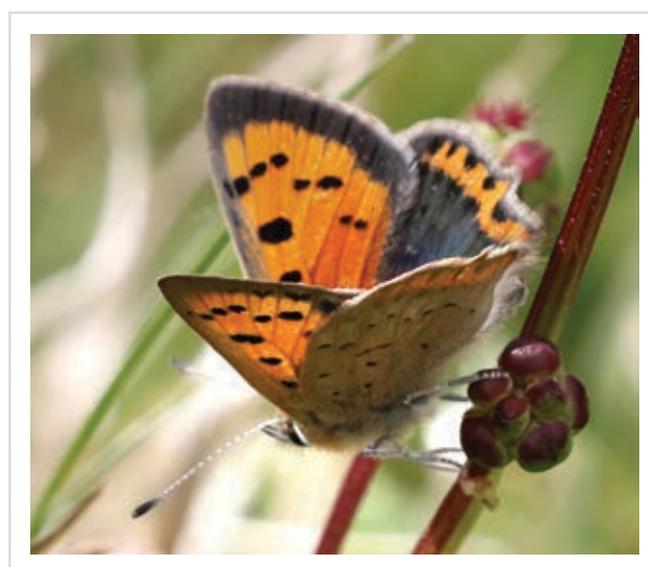
Lewis, O.T. & Hurford, C. (1997). Assessing the status of the Marsh Fritillary (*Eurodryas aurinia* Rott.) – an example from Glamorgan (UK). *Journal of Insect Conservation* 1:159-161.

Pollard, E. & Yates, T.J. (1993). *Monitoring Butterflies for Ecology and Conservation*. Chapman and Hall, London 2.

Rothery, P. & Roy, D.B. (2001). Application of generalized additive models to butterfly transect count data. *Journal of Applied Statistics* 28:897-909.

Soldaat, L.L., Visser, P., van Roomen, M. & van Strien, A. (2007). Smoothing and trend detection in waterbird monitoring data using structural time-series analysis and the Kalman filter. *Journal of Ornithology* Vol. 148 suppl. 2: Dec. 2007.

Warren, M., Thomas, C.D. & Thomas, J.A. (1981). *The Heath Fritillary. Survey and conservation report*. Unpublished report to the Joint Committee for the Conservation of British Insects. Butterfly Conservation, Wareham.



Small Copper. Photograph by Tom Brereton.

Sample coverage

UKBMS sites

At the country level there were 1,812 monitored sites in England, 120 in Wales, 154 in Scotland, 39 in Northern Ireland, 37 from the Channel Islands and one from the Isle of Man.

In 2019, 270 new sites were established and monitored for the first time. Fifteen of these were in Scotland, nine in Wales and six in Northern Ireland, whilst the rest were in England.

Additionally, 168 sites were either re-established or were brought into the scheme with additional data prior to 2019. Data from Brown Hairstreak egg counts contributed to the scheme for the fourth year.



Orange-tip. Photograph by Tim Melling.

Wider Countryside Butterfly Survey (WCBS) squares

The WCBS ran for an eleventh year in 2019, supplying count data for compilation of collated indices chiefly for common and widespread species. The survey had a welcome surge of coverage in 2019 with 5% more squares being visited than in 2018. Almost 4,000km of survey line was walked by approximately 650 recorders who made 1,957 visits to 829 squares. Survey effort by BTO/JNCC/RSPB Breeding Bird Survey (BBS) volunteers increased by 15% to cover a total of 311 squares, which is a great turnaround from 2018 when BBS participation was at a series low. In contrast the number of BC squares covered in 2019 was down by two to 518 (-0.4%). At the country level there were 737 squares surveyed in England (+60 compared to 2018), 50 in Scotland (-7 compared to 2018), 32 in Wales (-3), 20 in Northern Ireland (same as in 2018) and one on the Isle of Man (same as in 2018).

706 squares (85%) received the required two visits over the core July and August period. From April-June, 315 visits were made to 206 squares to target early flyers such as Orange-tip. The value of June visits is becoming increasingly apparent as the flight seasons of UK butterflies gets earlier and earlier in response to climate warming.

When combined with UKBMS sites there was a total of 3,003 sample locations points – marking another record year.



Ashclyst Forest, Devon. Photograph by Tom Brereton.



Marsh Fritillary.
Photograph by Tom Brereton.

Figure 1: Location of monitored sites in 2019. UKBMS sites (red circles), WCBS squares walked (blue circles), previously monitored sites and squares not walked in 2019 (grey circles).



The 2019 season¹

ANNUAL SUMMARY

- 38,768 surveys (2021 more visits than in 2018) were completed on 232 days (two more than in 2018) between 4th March and 27th October, including 36,765 transects and 2,003 WCBS surveys. The peak days were 21st May and 23rd July with 650 counts on each day. Counts were made on every single day of the core recording period from 1st April to the end of September.
- 60 species were recorded, including one rare migratory species, the **Large Tortoiseshell**.
- Butterflies experienced a strong recovery in 2019. In terms of average abundance for the 58 of 59 UK species assessed, it was the 8th best year in the 44 year series and the best year since 1997, with just over half of species (53%) showing higher population levels compared to the previous year.
- Weather conditions were likely the main factor boosting annual numbers. Spring was slightly warmer, wetter and sunnier than average, whilst the summer was very warm (12th warmest in the 110 year series) and wet (7th wettest in the series). The warm conditions were favourable to the emergence of adult butterflies, whilst the wet spring and summer conditions aided development of the immature stages.
- The peak flight season and the highest level of survey effort occurred in July, where on conventional transects 55% of all butterflies within the standard 26 week season were counted and 57 species were logged, whilst 25 species had peak counts in the month.

How different species fared

- Summer flying species which benefitted (showing % annual abundance where it increased and year rank in parentheses) included **Marbled White** up by 66% (1), **Ringlet** +23% (2), **Black Hairstreak** (2), **Large Blue** (2), **Dark Green Fritillary** +51% (3), **Large Heath** +5% (4) and **Meadow Brown** +38% (4).
- Other winners included the **Chequered Skipper** (annual abundance up by 175%), **Orange-tip** (+63%) and **Brimstone** (+32%), all of which had their best year on record.

- It was a good year for migrants too with **Painted Lady** and **Red Admiral** having their third and fifth best years respectively.
- There was also a welcome boost for two species which have been hard hit in recent years, the rare **Lulworth Skipper** (annual abundance up by 138%) and iconic **Small Tortoiseshell** (+33%), though both remain in long-term decline.
- Species that fared particularly badly in 2019 included **Common Blue** -54% (29), **Green-veined White** -43% (33), **Large White** -40% (25), **Heath Fritillary** -34% (33) and **White Admiral** -26% (33).
- At the country level **Marbled White**, **Orange-tip** and **Brimstone** had their best year in the series in England, whilst the same was the case for **Brimstone** and **Orange-tip** in Wales. In Scotland **Chequered Skipper**, **Orange-tip**, **Speckled Wood**, **Pearl-bordered Fritillary**, **Painted Lady** and **Peacock** all had their best year in the series. The situation was more mixed in Northern Ireland with **Peacock**, **Orange-tip** and **Marsh Fritillary** having their best year in the series and **Green-veined White** and **Large White** having their worst year in the series. No species had their worst year in England, Wales or Scotland (though the Northern Ireland ranks cover a shorter time period).
- The warm weather over much of the season and preceding winter meant that many species had an advanced flight season, with the mean flight date on average five days earlier than the series average.
- A further feature was the number of normally single-brooded species with very late first or partial second broods, including **Dingy Skipper**, **Essex Skipper**, **Gatekeeper**, **Glanville Fritillary**, **Grizzled Skipper**, **Heath Fritillary**, **Large Skipper**, **Orange-tip**, **Silver-studded Blue**, **Small Blue**, **Small Pearl-bordered Fritillary** and **Small Skipper**.

¹ Weather statistics have been obtained from annual climate summaries published by the **Met Office**. Where only the county names are given, data is from the BNM per Richard Fox, Butterfly Conservation



Silver-studded Blue. Photograph by Ian Middlebrook.



Peacock. Photograph by Tom Brereton.



SEASONAL AND MONTHLY ROUND-UP

Late Winter Period

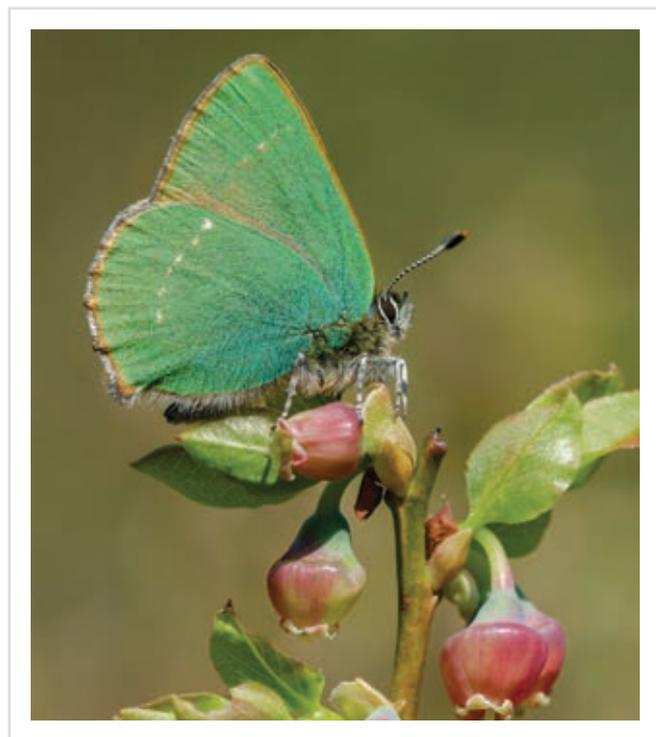
JANUARY was drier and a little cooler than average, though sunshine levels varied at the country-level. The maximum temperature was 14.2°C at *Slapton, Devon* on the 25th. Eight species emerged during the month. These were **Brimstone** (1st *Hampshire*), **Painted Lady** (1st *Devon*), **Peacock** (1st *Derbyshire, Devon, Dorset, Nottinghamshire, Somerset, Sussex & Yorkshire*), **Red Admiral** (1st *Berkshire, Devon, Hampshire, Kent & Sussex*), **Small Tortoiseshell** (1st *Derbyshire*), **Speckled Wood** (8th *Derbyshire*), **Holly Blue** (12th *Essex*) and **Comma** (28th *Glamorgan & Middlesex*).

Overall **FEBRUARY** was dry, and both very sunny (second sunniest February in the series from 1929, just behind 2008) and warm (the warmest in the series from 1910). Four species had first sightings in the month, these being **Large White** (22nd *Norfolk*), **Small White** (23rd *London, Oxfordshire & Sussex*), **Clouded Yellow** (24th *Dorset*) and **Green-veined White** (24th *Derbyshire*).

Spring

MARCH was blustery, very warm (10th warmest since 1910) and wet (5th wettest in the same series) with sunshine levels above average too. The highest temperature of 19.8°C was recorded at *Kew Gardens (Greater London)* on the 26th.

351 surveys were completed covering all BC Branches except *Cumbria* and *Surrey*, with 2,857 butterflies counted on transects and 123 in the WCBS. The first five transects were walked on 5th March in the widely scattered counties of *Londonderry, Stirling, Worcester* and *Devon*. The first WCBS walks were made too, with a total of six completed, the first being on the 18th near *Chippenham, Wiltshire*.



Green Hairstreak. Photograph by Tim Melling.



Clouded Yellow. Photograph by Tom Brereton.

During the month, 16 species were recorded, with first sightings for six species, including **Small Copper** (5th *Norfolk*), **Orange-tip** (18th *Coombeswood Wedge, West Midlands*), **Green Hairstreak** (24th *Kent*), **Wall** (27th *Cornwall*), **Small Heath** (29th *Ham Street Wood, Kent*) and **Grizzled Skipper** (30th *Sussex*).

Following a cool and wet start to the month, **APRIL** turned out to be relatively warm, dry and sunny. The maximum temperature of 25.8°C was recorded at *Treknow, Cornwall* on the 19th.

The 1st marked the start of the formal transect recording season and over the month a total of 5,829 visits were completed, the peak (for the month) being 649 on Tuesday the 30th. A further 40 WCBS surveys were also undertaken. Of the 28 species seen during the month, 10 were new for the year including **Duke of Burgundy** (1st *Noar Hill, Hampshire*), **Dingy Skipper** (11th *Sussex*), **Pearl-bordered Fritillary** (11th *Cornwall*), **Small Blue** (14th *Kent*), **Wood White** (17th *Meeth Quarry, Devon*), **Brown Argus** (18th *Glamorgan*), **Common Blue** (20th *Somerset*), **Glanville Fritillary** (22nd *Hutchinson's Bank, Greater London*), **Adonis Blue** (30th *Dorset*) and **Small Pearl-bordered Fritillary** (30th *Aish Tor, Devon*).

There were 88,748 butterflies counted on transects and 45 through the WCBS. Noteworthy records included the peak year counts for three species: **Brimstone**, with 54 on the 23rd at *Levin Down, West Sussex*; **Green Hairstreak** with 23 on the 24th at *Meathop Moss 2, Cumbria*; and **Orange-tip** with 89 in the *Derbyshire Dales, Derbyshire* on the 30th (the highest count in the series).



Meadow Brown. Photograph by Tom Brereton.

Orange-tip showed some notable abundance index increases from the previous year, including from 63 to 192 at *Marshall's Arm LNR, Cheshire*, 39 to 126 at *Bucknell Woods, Northamptonshire* and 22 to 79 at *Beeston Sidings, Nottinghamshire*.

The weather during **MAY** was rather variable leading to monthly temperature, rainfall and sunshine values around the long-term UK average, though with considerable further variation between countries. The maximum temperature was 25.8 °C at *Kinlochewe, Ross & Cromarty* on the 15th.

The total of 5,569 transect surveys was around a hundred fewer than in April and more than a thousand less than in 2018. Over the month 103 WCBS surveys were completed. In total there were 116,911 butterflies counted on transects and 1,765 on WCBS surveys.

Of the 44 species recorded during the month, 18 had their first emergence including **Cryptic Wood White** (1st *Cos Antrim, Armagh & Fermanagh*), **Lulworth Skipper** (6th *Dorset*), **Marsh Fritillary** (6th *Wiltshire*), **Chequered Skipper** (11th *Arienas Wood, Highland* and 11th *Glasdrum, Strathclyde*), **Swallowtail** (12th *Norfolk*), **Heath Fritillary** (13th *Lydford, Devon*), **Large Skipper** (15th *Derbyshire & Isle of Wight*), **Meadow Brown** (19th *WCBS SD7233, Lancashire*), **Black Hairstreak** (21st *Sussex*), **Northern Brown Argus** (21st *Whitbarrow NNR - Wakebarrow, Cumbria*), **Ringlet** (21st *Sarah's Wood, Leicestershire*), **Dark Green Fritillary** (22nd *Devon*), **Large Heath** (22nd *Lancashire*), **Silver-studded Blue** (23rd *Cornwall*), **White Admiral** (28th *St Catherines Wood Site 3, Jersey*), **Marbled White** (30th *Somerset*), **Mountain Ringlet** (30th *Cumbria*) and **Large Blue** (31st *Painswick Beacon South, Gloucestershire*).

Seven species had peak counts in May, including 35 **Duke of Burgundy** on the 15th at *Hawnby Hill, North Yorkshire*; 134 **Pearl-bordered Fritillary** on the 16th at *Mabie Forest, Dumfries and Galloway*; 131 **Chequered Skipper** 21th *Glen Creran - Powerline, Strathclyde* (the highest count in the series); 199 **Common Blue** 24th *Whippingham (fields), Isle of Wight*; 25 **Grizzled Skipper** 25th *Twyford Glades, Lincolnshire*; 232 **Dingy Skipper** 27th *Rhydymwym Valley Nature Reserve, Clwyd*; and 702 **Adonis Blue** 28th *Calstone 2, Wiltshire* on the 28th.

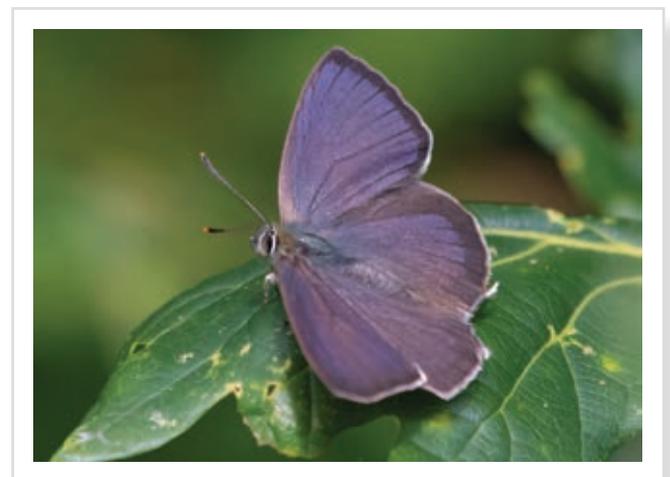
For the nine species with a mean flight date² in May, the 2019 date was between five days and 18 days earlier than the series average, the latter number being for **Brimstone**.

Summer

Unsettled and variable conditions continued through **JUNE**, with temperature, rainfall and sunshine values around the long-term average. During a hot spell at the month end the maximum temperature of 34 °C was recorded at both Heathrow and Northolt, Greater London on the 29th.

It was another busy month for recording with 6,365 transect walks and 168 WCBS surveys completed.

On transects there were 343,073 butterflies counted of 57 species (one fewer than in 2018), plus 7,549 counted on the WCBS and a respectable 37 species. There were eleven new species recorded for the first time in the year, amongst them **Essex Skipper** (1st *Ladies Walk Down, Hampshire*); **Grayling** (1st *Lancashire*); **Purple Hairstreak** (1st *Hertfordshire*); **Small Skipper** (1st *WCBS SK2442, East Midlands*); **Gatekeeper** (5th *WCBS TM2975, Suffolk*); **Silver-washed Fritillary** (5th *Sussex*); **White-letter Hairstreak** (8th *Middlesex & Sussex*); **High Brown Fritillary** (10th *Devon*); **Purple Emperor** (11th *Hampshire*); **Brown Hairstreak** (21st *Finemere Wood, Buckinghamshire*); and **Chalk Hill Blue** (27th *Hatch Hill, Somerset*).



Purple Hairstreak. Photograph by Tim Melling.

² Defined as the weighted date of counts see Brakefield 1987 https://openaccess.leidenuniv.nl/bitstream/handle/1887/11022/029_017.pdf?sequence=1

Peak year counts were made in June for thirteen species, with 75 **Cryptic Wood White** on the 3rd at *Colin Glen Forest Park, County Antrim*; 413 **Small Blue** 3rd *Hutchinson's Bank, Greater London* (second highest count in the series); 32 **Glanville Fritillary** 6th *Trois Vaux, Alderney*; 85 **Wood White** 6th *Wigmore Rolls, Hereford and Worcester*; 320 **Marsh Fritillary** 11th *Murlough (single-species), County Down*; 41 **Black Hairstreak** 16th *M40 Compensation Area, Buckinghamshire*; 15 **White-letter Hairstreak** 24th *Benfleet Downs, Essex*; 248 **Mountain Ringlet** 27th *Hartsop Dodd, Cumbria* (second highest count in the series); 95 **Small Pearl-bordered Fritillary** 27th *Burn Hill, Durham*; 1,643 **Marbled White** 28th *Whippingham (fields), Isle of Wight*; 5,583 **Meadow Brown** 28th *Whippingham (fields), Isle of Wight* (highest count in the series); 82 **Northern Brown Argus** 29th *Low Ox Pasture, Kilnsey, Yorkshire*; and 14 **Swallowtail** 29th *Sutton Fen, Norfolk*.

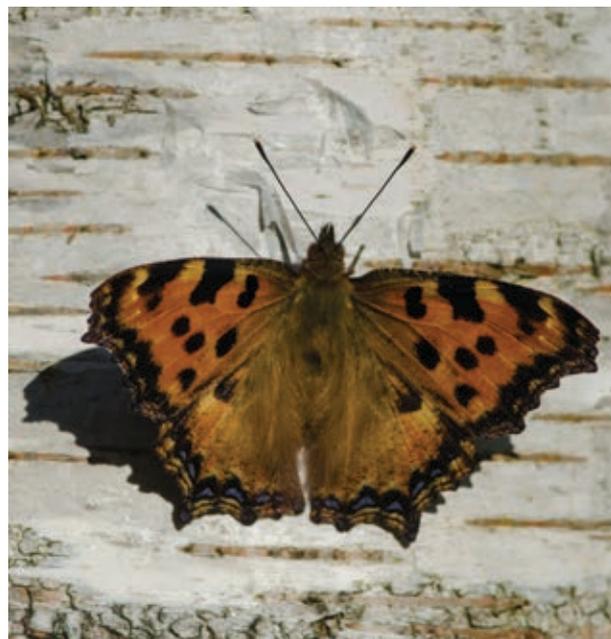
Substantial annual abundance index increases for June-peaking species which had a good year included for **Meadow Brown** (rising from 1,968 to 4,802 at *Bramshott Common, Hampshire*; from 1,159 to 2,723 at *Pilot Hill, Hampshire*; and from 646 to 2,201 at *Wytham, Oxfordshire*) and for **Small Blue** (from 879 to 3,090 at *Hutchinson's Bank, Surrey*; and from 157 to 1,197 at *Newton Tony, RSPB, Wiltshire*).

Of the 10 species with a mean flight date in June, this date was on average 7 days earlier than the series average, with it being 18 days earlier for **Holly Blue**.

JULY was a month of two halves characterised by mostly dry and settled weather in the first half, with much wetter conditions in the second. It reached 38.7°C at *Cambridge Botanic Garden* on the 25th, this being a new UK temperature



Gatekeeper. Photograph by Ian Middlebrook.



Large Tortoiseshell. Photograph by Tim Melling.

record. The average monthly temperature was just over a degree warmer than the 1981-2010 average, though sunshine and rainfall averages were nearer normal.

This was the busiest month of the year both in terms of survey effort and numbers of butterflies to be counted. The combined total of 7,917 visits was more than in any month in the series and included 7,092 transect walks (the highest ever monthly total) and 825 WCBS surveys (the highest number since July 2013). There were 57 butterfly species recorded during the month and a staggering 1,393,566 butterflies counted on transects, more than in any other month in the series and only the fourth occasion that a million have been counted in a month, the previous times being July 2014, 2015 and 2018. There were 87,115 butterflies counted on WCBS visits, more than double the number in August.

Amongst the species recorded, were the last two to emerge, these being **Scotch Argus** (7th *WCBS NX4438, Dumfries & Galloway*) and **Silver-spotted Skipper** (13th *Sussex*).

Peak year counts were made in July for 25 species, with these being 456 **Heath Fritillary** on the 1st at *Blean Woods, Kent*; 223 **Large Skipper** and 100 **Silver-washed Fritillary** on the 1st at *Frohawk, Hampshire*; 250 **Dark Green Fritillary** 3rd *Whitbarrow NNR - Hervey CWT, Cumbria*; 29 **Holly Blue** 3rd *Chafford Gorges Nature Park Grays Gorge, Essex*; 51 **Large Heath** 3rd *Whixall Moss (a), Shropshire*; 1084 **Silver-studded Blue** 4th *Great Orme, Gwynedd*; 31 **White Admiral** 5th *Bucknell Woods, Northamptonshire*; 115 **Lulworth Skipper** 6th *Durlston Country Park West, Dorset*; 750 **Ringlet** 8th *Basing Wood, Hampshire*; 3 **Purple Emperor** 10th *Bucknell Woods, Northamptonshire*; 110 **Essex Skipper** 11th *Westfield Farm (Countryside Restoration Trust), Cambridgeshire*; 786 **Gatekeeper** 12th *Whippingham*



Green-veined White. Photograph by Tim Melling.

(fields), Isle of Wight; 240 **Small Skipper** 12th Priddy Mineries, Somerset; 118 **Grayling** 15th Whitbarrow NNR - Hervey CWT, Cumbria; 143 **Purple Hairstreak** 15th Ryton Wood & Pool PH Walk, Warwickshire; 160 **Large White** 17th Cley Marshes, Norfolk; 131 **Brown Argus** 23rd Minsmere, Suffolk; 17 **High Brown Fritillary** 23rd Whitbarrow NNR - Wakebarrow, Cumbria; 412 **Peacock** 23rd Minsmere, Suffolk (highest UKBMS count since 2001); 95 **Small Tortoiseshell** 23rd Hardwick Park, Durham; 731 **Small White** 23rd Rowthorne Trail, Derbyshire; 1,763 **Chalk Hill Blue** 24th Devil's Dyke, near Newmarket, Cambridgeshire; 78 **Wall** 25th Pentire, Cornwall & Isles of Scilly; and 1,465 **Painted Lady** 30th Newton Point, Northumberland (highest count in series, previous maximum was 1,044 in 1996).

Substantial 2018-2019 increases in annual abundance index values for July peaking species, which had good years, included: for **Marbled White** from 44 to 646 (1368% annual increase!) at Oxted Downs, Whistlers Steep (2018 route), Surrey, from 198 to 791 at M40 Compensation Area, Oxfordshire, from 386 to 1,430 at Rough Bank, Gloucestershire and from 173 to 606 at Grendon & Doddershall Woods, Oxfordshire; for **Dark Green Fritillary** from 35 to 164 at Swanage, Dorset, from 35 to 161 at Mottistone Down, Isle of Wight, from 32 to 147 at Dean Hill (West) (NT), Wiltshire from 244 to 617 at Porton Dn.2 (Tower Hill Wood), Wiltshire.

Substantial annual decreases in abundance indices, for species which had poor years and peaked in abundance in July, included for **Wall** from 591 to 63 at Blaye, Jersey, from 539 to 154 at Trois Vaux, Jersey, from 156 to 58 at Bratton Castle Earthworks (EH), Wiltshire and from 173 to 66 at Pewsey Down, Wiltshire; and for **White Admiral** from 117

to 54 at Kemphill Moor Copse, Isle of Wight, from 79 to 38 at Briddlesford Woods Nature Reserve 1, Isle of Wight and from 94 to 34 at Covert Wood.

For the 35 species with a mean flight date in July, on average this date was 5 days earlier than the series average. The **Small Copper** had the most advanced mean flight date of 18 days earlier than the series average.

The years only rare migrant was a **Large Tortoiseshell**, reported at Blaye, Alderney on 21st July.

A presumed second brood **Grizzled Skipper** was recorded at White Sheet Hill Quarry (NT), Wiltshire on the 23rd July.

AUGUST was warm and wet (rainfall was 153% of the 1981-2010 average) with sunshine levels near normal. The August Bank Holiday weekend was the hottest ever, with temperatures of 33.3°C and 33.2°C on 25th and 26th respectively – both recorded at Heathrow airport.

Monitoring coverage remained high, with 7,237 transect walks and 823 WCBS visits (both record totals for August).

In spite of a relatively high number of visits only 36 species were recorded (13 fewer than in 2018). There was a big drop off in the number of butterflies counted, with the total of 481,949 on transects representing a decrease of 65% from the July total, whilst on the WCBS the drop was 59%.



Heath Fritillary. Photograph by Iain Leach.



Six species had peak year counts in August, including 111 **Green-veined White** on the 1st at *Liddell's Wood, Northumberland*; 268 **Scotch Argus** on the 7th at *Smardale Gill, Cumbria*; 129 **Silver-spotted Skipper** on the 8th at *Malling Down, East Sussex*; eight **Brown Hairstreak** on the 11th at *Shipton Bellinger (West), Hampshire*; 985 **Red Admiral** on the 24th *Inner Farne, Northumberland* (easily the highest series count far surpassing the 331 made in 1996); and 460 **Small Heath** 27th *Whippingham (fields), Isle of Wight* (second highest count in the series).

Second/very late first brood records included **Dingy Skipper** at six sites, the last being on the 28th at *Prestwood Nature, Buckinghamshire*; **Heath Fritillary** at *West Blean Woods East, Kent* on the 30th; **Orange-tip** at two sites, **Glanville Fritillary** over much of August at *Hutchinson's Bank, Greater London*, **Small Blue** at 58 sites and **Small Pearl-bordered Fritillary** at a remarkable 17 sites compared with just one in 2018).

Across the five species with a mean flight date in August, this date was around the series average, reflecting, as in 2018, the slightly cooler conditions compared with previous months.

Autumn

SEPTEMBER continued relatively warm and wet, but also sunnier than average. The peak temperature logged was 22.7°C at *Weybourne, Norfolk* on the 22nd.



Silver-washed Fritillary. Photograph by Ian Middlebrook.

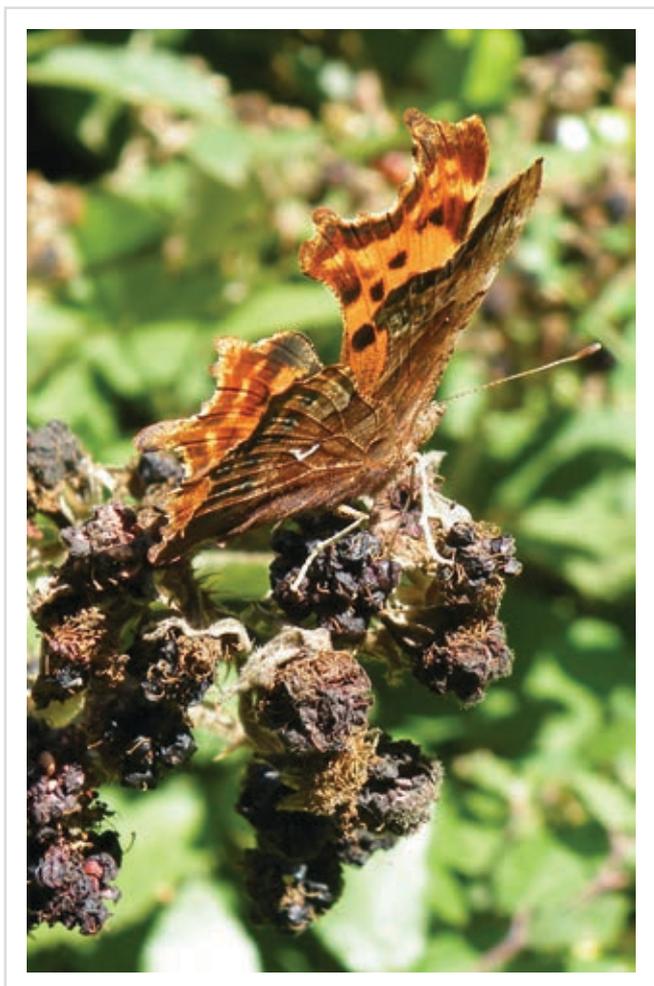
There were 4959 transect walks and 33 WCBS walks. The last day of month 30th saw 36 walks completed. There were still reasonable numbers of butterflies around in September with 111,345 counted of 36 species on transects, though only 713 in the WCBS of 19 species.

Peak year counts were made in September for four species, with these being 106 **Speckled Wood** on the 7th at *Heald Brow NT, Lancashire*; 55 **Comma** 13th *Trench Wood2, Hereford and Worcester*; 112 **Small Copper** 13th *Cavenham Heath, Suffolk*; and 14 **Clouded Yellow** 17th *Hutchinson's Bank, Greater London*.

Second/very late first brood records included **Dingy Skipper** on the 2nd at *Mottistone Down, Isle of Wight*; **Essex Skipper** 7th at *Les Mielles Site 11, Jersey*; **Glanville Fritillary** 15th at *Hutchinson's Bank, London*; **Heath Fritillary** 10th and 17th at *West Blean Wood West, Kent*; **Large Skipper** at six sites the last being on the 20th at *Lower Portmellon Valley, Cornwall*; **Small Blue** at nine sites; and **Small Skipper** at 10 sites.

OCTOBER was unsettled and rather cool, with temperature 0.5°C below the 1981-2010 average. Sunshine was a little below average, whilst the reverse was true for rainfall. The peak temperature was 21.3°C recorded at *Trawsgoed, Dyfed* on the 1st.

Though the 26-week recording season had ended, a further 230 transect walks were made and 1,611 butterflies counted. The last walks were made at eight sites on the 27th, with **Green-veined White**, **Peacock** and **Red Admiral** recorded.



Comma. Photograph by Ian Middlebrook.

Long-term trends

UK-wide and country level trends are described below, whilst further information on each species, including individual collated index plots, are available at the UKBMS website www.ukbms.org.

UNITED KINGDOM

For the UK we are able to report on long-term and 10-year trends for 58 of the 59 regularly occurring species, including 30 habitat specialist species, 25 wider countryside species and the three regular migrants (Table 1). A long-term trend is calculable for **Cryptic Wood White** for the first time, leaving **Mountain Ringlet** as the only species with insufficient data for a series trend.

Since 1976, just under a third of butterfly species assessed in the UK are showing a significant long-term decline in abundance (31%), compared to 26% showing a significant long-term increase. The remainder show no significant change. There continue to be more species declining than increasing in the long term, but the situation is more positive than reported last year following another relatively good year for butterflies in 2019. The change may also partly be attributed to changes in analysis methods, with better accounting for species colonisations in range expanding species.

Since the previous years' assessment three species now have more favourable long-term trend categories, with **Black Hairstreak**, **Orange-tip** and **Purple Emperor** classed as increasing rather than showing no significant change. In contrast, no species had a less favourable long-term trend category reported.

The 10 species showing the greatest population increase since 1976 (in rank order, largest first) are **Large Blue**, **Silver-spotted Skipper**, **Clouded Yellow**, **Large Heath**, **Black Hairstreak**, **Ringlet**, **Silver-washed Fritillary**, **Red Admiral**, **Dark Green Fritillary** and **Comma**.

The eleven species showing the most acute long-term decline (in rank order, most rapidly declining first) are **Heath Fritillary**, **Wall**, **Wood White**, **Small Tortoiseshell**, **White-letter Hairstreak**, **Lulworth Skipper**, **Grayling**, **Small Skipper**, **Small Pearl-bordered Fritillary**, **High Brown Fritillary** and **Pearl-bordered Fritillary**.

The situation is more positive over the last decade, with six species (10%) showing a statistically significant increase over this time period compared to five species (9%) showing a significant decline. The remaining 81% of species show no significant change. This is a notable improvement from last year when there were twice as many species showing significant declines compared to increases. However, note that 10 years is quite a short time to assess butterflies and the trend is sensitive to start and end year values.

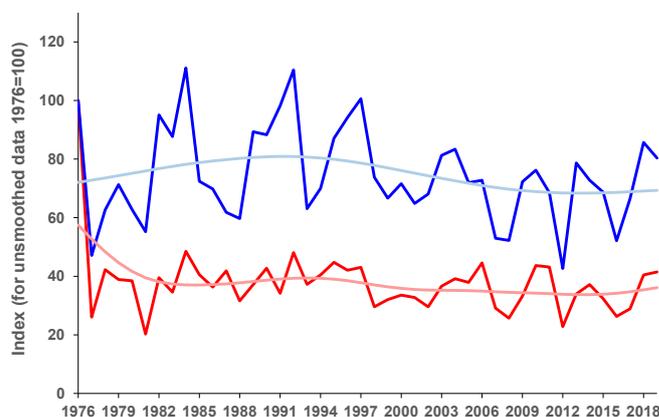


Figure 2. Trends in butterfly populations for habitat specialists (red) and species of the wider countryside (blue) 1976 to 2019. For each species group, darker lines are unsmoothed indices, paler lines are smoothed trends.

Brimstone, **Large Blue**, **High Brown Fritillary**, **Painted Lady**, **Meadow Brown** and **Marbled White** have increased significantly over the last decade, whilst **Grayling**, **Grizzled Skipper**, **Scotch Argus**, **Chalk Hill Blue** and **Small Pearl-bordered Fritillary** have significantly decreased.

Combined measures of butterfly abundance including index data from 26 habitat specialist and 25 wider countryside species are used as a **biodiversity indicator by the UK Government**.

Since 1976, habitat specialists and wider countryside species show apparent declines of 59% and 20% respectively. Analysis of the underlying smoothed trends shows that habitat specialists have decreased significantly since 1976, whilst species of the wider countryside show no significant change.

In 2019, the unsmoothed measure of habitat specialist butterfly abundance increased by one percentage point from the previous year, whilst wider countryside species decreased by five percentage points.

Whilst there is still concern that some species are declining, the results show that overall butterfly populations seem to have stabilised, and in some cases negative trends are starting to be reversed. Reasons for this include positive conservation work such as targeted agri-environment schemes and field margin restoration, increased woodland cover, the positive aspects of climate warming, natural changes (e.g. grazing herbivore levels) and a slowing in the rate of agricultural intensification.

Encouragingly a number of Conservation Priority Species such as **Adonis Blue**, **Brown Hairstreak**, **Dingy Skipper**, **Large Heath**, **Marsh Fritillary**, **Silver-studded Blue**, **Small Blue** and **Silver-spotted Skipper** that have been the focus of conservation efforts in recent decades are no longer in long-term population decline.



Adonis Blue. Photograph by Tom Brereton.

ENGLAND

For England, we are able to report on long-term and 10-year trends for 55 of the 57 regularly occurring species, including 27 habitat specialist species, 25 wider countryside species and three regular migrants (Table 2). Since 1976, 24% of species show a significant increase, whilst 36% have declined significantly, with the remaining 40% of species showing no significant change.

The 10 species in most severe long-term decline (in rank order, largest first) are **Heath Fritillary, Wall, Wood White, Small Tortoiseshell, White-letter Hairstreak, Lulworth Skipper, Pearl-bordered Fritillary, Scotch Argus, Small Skipper** and **High Brown Fritillary**. Of the species showing a population increase, the top 10 species (greatest first) are **Large Blue, Clouded Yellow, Silver-spotted Skipper, Dark Green Fritillary, Black Hairstreak, Ringlet, Silver-washed Fritillary, Red Admiral, Comma** and **Purple Emperor**.

Over the last decade, butterfly population changes for England have improved with 13% of species significantly increasing, 9% decreasing and the remaining 78% showing no significant change. Species which have increased significantly include **Painted Lady, Large Blue, High Brown Fritillary, Marbled White, Brimstone, Brown Hairstreak** and **Meadow Brown**, whilst species in significant decline are **Grizzled Skipper, Small Pearl-bordered Fritillary, Grayling** and **Chalk Hill Blue**.

Composite indices of butterfly abundance have been calculated for 23 wider countryside and 26 habitat specialist species.

Since 1976, habitat specialists and wider countryside species show apparent declines of 49% and 19% respectively. Analysis of the underlying smoothed trends shows that habitat specialists have declined significantly, whilst wider countryside species show no significant change. In 2019, the unsmoothed composite index for habitat specialist butterflies was up by two percentage points from the previous year, whilst the wider countryside species index was down by six percentage points.

Since 1990, composite measures for 15 habitat specialist and 23 wider countryside butterfly species in woodland habitats in England, show apparent declines of 50% and 42% respectively. Analysis of the underlying smoothed trend shows statistically significant declines.

Of the species showing significant trends in woodland habitats, three species have increased, whilst 18 (47% of the total) including an aggregate measure for **Essex/Small Skipper** are in decline. The 10 species in most severe long-term decline (in rank order, largest first) are **Wall, High Brown Fritillary, Duke of Burgundy, Pearl-bordered Fritillary, Grizzled Skipper, Small Tortoiseshell, Small Copper, Essex/Small Skipper, Gatekeeper** and **White-letter Hairstreak**. Species which have increased significantly over the long-term are **Ringlet, Purple Emperor** and **Silver-washed Fritillary**, representing eight percent of the total, whilst the remaining 45% of species show no significant change.

In 2019, the unsmoothed habitat specialist index showed no change on the previous year, whilst the wider countryside measure was down by nine percentage points.

In English farmland habitats, composite measures of abundance in 2019 for 22 habitat specialist and 21 wider countryside butterflies (including **Essex/Small Skipper**), were respectively 79% and 110% of the 1990 baseline. The underlying analysis of smoothed trends indicates a decline in the specialist measure, but no significant change in the wider countryside measure.

In farmland habitats 16 species (37% of the total) show a significant long-term decline (four fewer than in 2018) including the aggregate measure for **Essex/Small Skipper**, whilst four species (nine percent) have increased significantly. The remaining 53% of species show no significant change.



Grizzled Skipper. Photograph by Tom Brereton.

The 10 species in most severe long-term decline in farmland habitats (in rank order, largest first) are **Wood White**, **Heath Fritillary**, **Pearl-bordered Fritillary**, **High Brown Fritillary**, **Small Tortoiseshell**, **Wall**, **Lulworth Skipper**, **Northern Brown Argus**, **Grayling** and **Small Pearl-bordered Fritillary**. Species which have increased significantly over the long-term are **Speckled Wood**, **Brimstone**, **Dark Green Fritillary** and **Ringlet**. In 2019, there was a 12 percentage point annual increase in the unsmoothed habitat specialist index, whilst the wider countryside measure was down by one percentage point.

The farmland and woodland measures for wider countryside species are used as biodiversity indicators for England by the UK Government.

SCOTLAND

For Scotland we are able to report on long-term and 10-year trends for 25 of the 34 regularly occurring species, including eight habitat specialist species, 15 wider countryside species and two regular migrants, **Red Admiral** and **Painted Lady** (Table 3). Since 1979, nine species have increased (36% of the total), two have decreased (8%), whilst the remaining 56% show no significant change.

Over the last decade, there is twice the number of increasing versus decreasing species (four versus two), though three quarters of species (76%) show no significant change.



Large Skipper. Photograph by Ian Middlebrook.



Red Admiral. Photograph by Iain Leach.

WALES

In Wales, long-term trends can be assessed for 33 of the 43 regularly occurring butterfly species in the country including nine habitat specialists, 21 wider countryside species and three regular migrants (Table 4). Over the long-term, nine species (27% of the total) have increased, seven have decreased (21%), whilst 17 (52%) show no significant change.

The declining species are (most severely declining first) **Grayling**, **Dark Green Fritillary**, **Small Pearl-bordered Fritillary**, **Large Skipper**, **Wall**, **Small White** and **Small Copper**. The increasing species (most rapid first) are **Orange-tip**, **Green Hairstreak**, **Pearl-bordered Fritillary**, **Ringlet**, **Comma**, **Speckled Wood**, **Green-veined White**, **Red Admiral** and **Brimstone**.

Over the last decade **Painted Lady**, **Brimstone** and **Green Hairstreak** have increased, whilst no species have declined significantly leading to 91% of species showing no significant change.

NORTHERN IRELAND

In Northern Ireland, temporal trends (11–16 year periods) are calculable for 14 species (Table 5). Over the period, **Small White** has declined whilst the remainder show no significant change.

Notes on Summary Tables 1-5

In the following summary tables the number of sites monitored is a count of all sites on which a species has been monitored in the current analysis year, including those sites on which a species was absent but has been formerly recorded, and thus contribute to the calculation of the national index.

For species where at country level there is insufficient data to calculate accurate trends, the number of sites refers to the total number of sites at which the species was recorded in the current analysis year.

Note: some country-level changes are based on relatively small sample sizes and thus should be interpreted with caution.



Table 1. Summary of species abundance changes in the UK from 2018 to 2019 and long-term (over the entire time series: no. yrs max = 44) and short-term (last 10-years) changes. The mean flight date is calculated as the weighted mean date of counts and is highly correlated to both first appearance and the peak flight date (Botham et al. 2008). Significance of trends: *P < 0.05 (significant), **P < 0.01 (highly significant), *P < 0.001 (very highly significant). Red text has been used to highlight those species that had their worst year of the series in 2019 and blue text best year in the series**

Species	Start Year	No. years with Index in 2019	No. sites monitored in 2019	2019 Rank	% change 2018-2019	Series trend (%)	10-year trend (%)	Mean flight date 2019	Series Mean flight date
Swallowtail	1976	43	24	31	11	38	-47	08-Jul	05-Jul
Dingy Skipper	1976	44	637	15	23	-14	-22	24-May	31-May
Grizzled Skipper	1976	44	398	30	9	-48***	-50*	22-May	27-May
Chequered Skipper	2003	17	14	1	175	10	34	28-May	03-Jun
Essex Skipper	1977	43	1094	25	52	-19	114	17-Jul	24-Jul
Small Skipper	1976	44	2001	31	39	-71***	41	15-Jul	20-Jul
Lulworth Skipper	1992	28	23	15	138	-77**	100	14-Jul	27-Jul
Silver-spotted Skipper	1979	41	71	10	-5	633***	11	13-Aug	15-Aug
Large Skipper	1976	44	2024	25	7	-23	-12	05-Jul	05-Jul
Wood White	1979	41	70	17	-22	-84***	36	17-Jun	17-Jun
Cryptic Wood White	2009	11	15	4	26	57	53	06-Jun	03-Jun
Orange-tip	1976	44	1893	1	63	33*	23	03-May	15-May
Large White	1976	44	2584	25	-40	-32	37	24-Jul	21-Jul
Small White	1976	44	2579	16	-30	-21	41	27-Jul	22-Jul
Green-veined White	1976	44	2509	33	-43	-14	-16	08-Jul	08-Jul
Clouded Yellow	1979	41	996	19	-11	586*	301	13-Aug	09-Aug
Brimstone	1976	44	1868	1	32	25	108*	20-May	07-Jun
Wall	1976	44	820	37	-24	-87***	3	11-Jul	26-Jul
Speckled Wood	1976	44	2437	17	-26	114***	20	11-Jul	26-Jul
Large Heath	1990	30	39	4	5	458***	-70	11-Jul	06-Jul
Small Heath	1976	44	1772	10	5	-50***	2	11-Jul	10-Jul
Mountain Ringlet	N/A	N/A	5	N/A	N/A	N/A	N/A	06-Jul	11-Jul
Scotch Argus	1979	41	38	31	-11	73	-59*	07-Aug	07-Aug
Ringlet	1976	44	2419	2	23	376***	44	11-Jul	14-Jul
Meadow Brown	1976	44	2610	4	38	1	58*	15-Jul	20-Jul
Gatekeeper	1976	44	2263	25	51	-43**	22	28-Jul	31-Jul
Marbled White	1976	44	1329	1	66	71**	144**	09-Jul	14-Jul
Grayling	1976	44	359	38	5	-72***	-58*	31-Jul	04-Aug
Pearl-bordered Fritillary	1976	44	205	25	29	-66***	-30	25-May	31-May
Small Pearl-bordered Fritillary	1976	44	219	34	0	-67***	-39*	21-Jun	24-Jun
Silver-washed Fritillary	1976	44	1000	6	-17	258***	29	23-Jul	26-Jul
Dark Green Fritillary	1976	44	729	3	51	220***	-20	17-Jul	21-Jul
High Brown Fritillary	1978	42	63	26	-20	-66**	287*	19-Jul	15-Jul
White Admiral	1976	44	398	33	-26	-61***	-29	11-Jul	15-Jul
Purple Emperor	1979	41	114	11	-55	152**	29	16-Jul	20-Jul
Red Admiral	1976	44	2560	5	195	247***	69	29-Jul	05-Aug
Painted Lady	1976	44	2480	3	1993	152	>1000*	29-Jul	29-Jul
Peacock	1976	44	2518	16	113	0	-3	16-Jun	29-Jun
Small Tortoiseshell	1976	44	2422	41	33	-79***	-35	28-Jun	08-Jul
Comma	1976	44	2251	18	-2	208***	13	18-Jul	20-Jul
Marsh Fritillary	1981	39	203	14	15	-4	28	29-May	05-Jun
Glanville Fritillary	1989	31	10	10	-18	1	158	06-Jun	08-Jun
Heath Fritillary	1981	39	39	33	-34	-91***	-17	02-Jul	01-Jul
Duke of Burgundy	1979	41	108	8	24	-35*	11	21-May	28-May
Small Copper	1976	44	2077	20	-20	-38*	-15	14-Jul	01-Aug
Brown Hairstreak	1983	37	188	18	62	-5	-40	26-Aug	26-Aug
Purple Hairstreak	1976	44	678	15	-57	-30	82	21-Jul	29-Jul
Green Hairstreak	1976	44	766	9	38	-30	4	18-May	27-May
White-letter Hairstreak	1976	44	317	22	-39	-79***	25	16-Jul	24-Jul
Black Hairstreak	1995	25	13	2	-49	422*	>1000	18-Jun	27-Jun
Small Blue	1978	42	320	7	82	9	1	22-Jun	30-Jun
Holly Blue	1976	44	1932	10	-24	124	99	11-Jun	29-Jun
Large Blue	1983	37	28	2	-28	>1000***	301**	16-Jun	24-Jun
Silver-studded Blue	1979	41	132	12	-22	47	58	09-Jul	13-Jul
Brown Argus	1976	44	1178	8	-40	25	53	23-Jul	31-Jul
Northern Brown Argus	1979	41	62	22	44	-57**	4	08-Jul	11-Jul
Common Blue	1976	44	2272	29	-54	-17	-8	15-Jul	24-Jul
Adonis Blue	1979	41	184	22	-43	136*	-58	20-Jul	27-Jul
Chalk Hill Blue	1976	44	304	31	21	-8	-59*	07-Aug	08-Aug



Table 2. England summary of species abundance changes from 2018 to 2019 and long-term (over the entire time series: no. yrs max = 44) and short-term (last 10-years) changes. Significance of trends: *P < 0.05 (significant), **P < 0.01 (highly significant), *P < 0.001 (very highly significant). Red text has been used to highlight those species that had their worst year of the series in 2019 and blue text best year in the series.**

Species	Start Year	No. years with Index in 2019	No. sites monitored in 2019	2019 Rank	% change 2018-2019	Series trend (%)	10-year trend (%)
Swallowtail	1976	43	16	28	17	43	-42
Dingy Skipper	1976	44	601	16	18	-9	-25
Grizzled Skipper	1976	44	389	30	9	-48***	-50*
Essex Skipper	1977	43	1062	25	48	-20	125
Small Skipper	1976	44	1915	32	35	-72***	44
Lulworth Skipper	1992	28	23	15	138	-77**	100
Silver-spotted Skipper	1979	41	71	10	-5	633***	11
Large Skipper	1976	44	1925	22	9	-21	-11
Wood White	1979	41	70	17	-22	-84***	36
Orange-tip	1976	44	1680	1	56	20	22
Large White	1976	44	2286	27	-40	-32	36
Small White	1976	44	2290	16	-31	-18	41
Green-veined White	1976	44	2182	35	-44	-18	-16
Clouded Yellow	1979	41	926	19	-3	663*	330
Brimstone	1976	44	1816	1	29	22	109*
Wall	1976	44	703	37	-20	-89***	-4
Speckled Wood	1976	44	2211	18	-28	114**	18
Large Heath	N/A	N/A	8	N/A	N/A	N/A	N/A
Small Heath	1976	44	1559	12	5	-54***	6
Mountain Ringlet	N/A	N/A	2	N/A	N/A	N/A	N/A
Scotch Argus	1995	25	13	21	-68	-73***	-31
Ringlet	1976	44	2147	2	23	380***	46
Meadow Brown	1976	44	2288	3	38	-1	61*
Gatekeeper	1976	44	2148	23	51	-47**	27
Marbled White	1976	44	1310	1	66	69**	142**
Grayling	1976	44	272	36	24	-60***	-57*
Pearl-bordered Fritillary	1978	42	126	30	116	-74***	-65
Small Pearl-bordered Fritillary	1978	42	149	38	-7	-57***	-52**
Silver-washed Fritillary	1976	44	973	5	-15	282***	30
Dark Green Fritillary	1976	44	608	2	55	443***	-14
High Brown Fritillary	1978	42	54	27	-20	-67**	298*
White Admiral	1976	44	395	32	-26	-61***	-29
Purple Emperor	1979	41	114	11	-55	152**	29
Red Admiral	1976	44	2246	5	211	252***	65
Painted Lady	1976	44	2173	4	>1000	143	>1000*
Peacock	1976	44	2203	19	120	-1	-8
Small Tortoiseshell	1976	44	2112	39	30	-80***	-30
Comma	1976	44	2107	18	-2	208***	15
Marsh Fritillary	1982	38	125	20	5	-61*	3
Glanville Fritillary	1989	31	5	2	17	-11	132
Heath Fritillary	1981	39	39	33	-34	-91***	-17
Duke of Burgundy	1979	41	108	8	24	-35*	11
Small Copper	1976	44	1831	19	-24	-34	-13
Brown Hairstreak	1983	37	168	7	34	-3	63*
Purple Hairstreak	1976	44	653	15	-57	-33	85
Green Hairstreak	1976	44	691	13	42	-35*	0
White-letter Hairstreak	1976	44	307	22	-40	-79***	31
Black Hairstreak	1995	25	13	2	-49	422*	1411
Small Blue	1979	41	297	7	91	-23	19
Holly Blue	1976	44	1838	10	-24	133	103
Large Blue	1983	37	28	2	-28	>1000***	301**
Silver-studded Blue	1984	36	120	11	-17	-11	52
Brown Argus	1976	44	1141	8	-40	28	51
Northern Brown Argus	1979	41	45	24	34	-59**	-3
Common Blue	1976	44	2036	27	-57	-14	-6
Adonis Blue	1979	41	184	22	-43	136*	-58
Chalk Hill Blue	1976	44	304	31	21	-8	-59*



Table 3. Scotland summary of species abundance changes from 2018 to 2019 and long-term (over the entire time series: no. yrs max = 41) and short-term (last 10-years) changes. Significance of trends: *P < 0.001 (very highly significant). Red text has been used to highlight those species that had their worst year of the series in 2019 and blue text best year in the series.**

Species	Start Year	No. years with Index in 2019	No. sites monitored in 2019	2019 Rank	% change 2018-2019	Series trend (%)	10-year trend (%)
Dingy Skipper	N/A	N/A	6	N/A	N/A	N/A	N/A
Chequered Skipper	2003	17	14	1	175	10	37
Small Skipper	N/A	N/A	16	N/A	N/A	N/A	N/A
Large Skipper	N/A	N/A	6	N/A	N/A	N/A	N/A
Orange-tip	1999	21	118	1	119	436***	38
Large White	1979	41	130	10	-31	105	17
Small White	1979	41	126	16	-49	71	-11
Green-veined White	1979	41	163	11	-20	10	14
Clouded Yellow	N/A	N/A	8	N/A	N/A	N/A	N/A
Wall	1999	21	19	2	-9	523***	455*
Speckled Wood	2001	19	57	1	26	107**	134*
Large Heath	N/A	N/A	23	N/A	N/A	N/A	N/A
Small Heath	1979	41	100	7	32	126**	-11
Mountain Ringlet	N/A	N/A	3	N/A	N/A	N/A	N/A
Scotch Argus	1990	30	25	23	-2	14	-51*
Ringlet	1996	24	140	2	32	285***	6
Meadow Brown	1979	41	147	19	96	-10	-15
Grayling	1990	30	21	27	10	-90***	-88**
Pearl-bordered Fritillary	2002	18	33	1	82	185**	117
Small Pearl-bordered Fritillary	1979	41	48	6	41	75*	79
Dark Green Fritillary	1979	41	66	14	39	-1	-51
Red Admiral	1980	39	145	4	183	818***	258
Painted Lady	1980	36	142	1	>1000	209	>1000*
Peacock	1995	25	147	1	91	216**	54
Small Tortoiseshell	1979	41	150	26	131	-61**	-65
Comma	2006	14	48	7	-45	263	54
Marsh Fritillary	N/A	N/A	16	N/A	N/A	N/A	N/A
Small Copper	1979	41	111	11	5	-38	-35
Purple Hairstreak	N/A	N/A	4	N/A	N/A	N/A	N/A
Green Hairstreak	1990	30	32	4	35	19	27
Small Blue	2005	15	8	14	-66	19	-66
Holly Blue	N/A	N/A	3	N/A	N/A	N/A	N/A
Northern Brown Argus	1981	39	17	5	78	8	139*
Common Blue	1979	41	96	15	23	43	-15



Wall. Photograph by Tim Melling.



Small Blue. Photograph by Tim Melling.

Table 4. Wales summary of species abundance changes from 2018 to 2019 and long-term (over the entire time series: no. yrs max = 44) and short-term (last 10-years) changes. Significance of trends: *P < 0.05 (significant), **P < 0.01 (highly significant), *P < 0.001 (very highly significant). Red text has been used to highlight those species that had their worst year of the series in 2019 and blue text best year in the series.**

Species	Start Year	No. years with Index in 2019	No. sites monitored in 2019	2019 Rank	% change 2018-2019	Series trend (%)	10-year trend (%)
Dingy Skipper	2004	16	27	5	143	48	20
Grizzled Skipper	N/A	N/A	9	N/A	N/A	N/A	N/A
Essex Skipper	N/A	N/A	6	N/A	N/A	N/A	N/A
Small Skipper	1984	36	70	20	47	22	-40
Large Skipper	1977	43	66	34	-3	-62***	7
Orange-tip	1978	42	56	1	74	385***	28
Large White	1976	44	85	36	-61	-10	-20
Small White	1976	44	85	28	-61	-51**	0
Green-veined White	1976	44	83	23	-44	176*	-59
Clouded Yellow	N/A	N/A	29	N/A	N/A	N/A	N/A
Brimstone	1998	22	39	1	82	86*	231***
Wall	1976	44	59	29	-4	-53**	-37
Speckled Wood	1978	42	84	5	-15	265***	42
Large Heath	N/A	N/A	4	N/A	N/A	N/A	N/A
Small Heath	1976	44	62	17	-9	3	-25
Ringlet	1983	37	81	5	38	308***	12
Meadow Brown	1976	44	89	12	52	16	-4
Gatekeeper	1978	42	78	25	52	46	-41
Marbled White	N/A	N/A	15	N/A	N/A	N/A	N/A
Grayling	1976	44	37	31	-44	-94***	-45
Pearl-bordered Fritillary	1997	23	11	2	99	360***	8
Small Pearl-bordered Fritillary	1992	28	22	16	9	-77**	-43
Silver-washed Fritillary	1995	23	20	13	5	-63	15
Dark Green Fritillary	1979	41	38	18	54	-84***	1
High Brown Fritillary	1995	16	9	9	134	-3	-31
Red Admiral	1976	44	89	8	113	152*	159
Painted Lady	1977	42	83	2	>1000	69	>1000*
Peacock	1976	44	86	11	130	-29	34
Small Tortoiseshell	1976	44	85	26	60	-36	-61
Comma	1992	28	65	10	-19	275***	14
Marsh Fritillary	1990	30	28	16	-5	-61	91
Small Copper	1976	44	75	20	-35	-47*	-5
Brown Hairstreak	2004	16	17	9	104	-41	-49
Purple Hairstreak	2002	18	16	12	-47	-31	30
Green Hairstreak	1993	27	20	2	66	374***	345*
White-letter Hairstreak	N/A	N/A	7	N/A	N/A	N/A	N/A
Small Blue	N/A	N/A	10	N/A	N/A	N/A	N/A
Silver-studded Blue	N/A	N/A	12	N/A	N/A	N/A	N/A
Holly Blue	1999	21	43	8	-19	2	144
Brown Argus	1997	23	16	5	-42	75	149
Common Blue	1976	44	79	33	-51	-18	-41



Table 5. Northern Ireland summary of species abundance changes from 2018 to 2019 and long-term (over the entire time series: no. yrs max = 16) and short-term (last 10-years) changes. Significance of trends: *P < 0.05 (significant), **P < 0.01 (highly significant), *P < 0.001 (very highly significant). Red text has been used to highlight those species that had their worst year of the series in 2019 and blue text best year in the series**

Species	Start Year	No. years with Index in 2019	No. sites monitored in 2019	2019 Rank	% change 2018-2019	Series trend (%)	10-year trend (%)
Dingy Skipper	N/A	N/A	2	N/A	N/A	N/A	N/A
Cryptic Wood White	2009	11	15	5	26	55	51
Orange-tip	2007	13	33	1	130	-15	10
Large White	2006	14	44	14	-59	-47	-40
Small White	2006	14	39	11	-47	-62*	-42
Green-veined White	2005	15	48	15	-68	46	-26
Clouded Yellow	N/A	N/A	4	N/A	N/A	N/A	N/A
Wall	N/A	N/A	1	N/A	N/A	N/A	N/A
Speckled Wood	2007	13	47	2	23	57	60
Large Heath	N/A	N/A	2	N/A	N/A	N/A	N/A
Small Heath	2004	16	22	7	0	-44	-54
Ringlet	2006	14	48	4	26	110	-5
Meadow Brown	2009	11	48	4	102	-45	-38
Grayling	N/A	N/A	7	N/A	N/A	N/A	N/A
Silver-washed Fritillary	N/A	N/A	7	N/A	N/A	N/A	N/A
Dark Green Fritillary	N/A	N/A	13	N/A	N/A	N/A	N/A
Red Admiral	N/A	N/A	41	N/A	N/A	N/A	N/A
Painted Lady	N/A	N/A	43	N/A	N/A	N/A	N/A
Peacock	2006	14	43	1	175	-10	601*
Small Tortoiseshell	2010	10	45	2	42	-46	-46
Marsh Fritillary	2004	16	9	1	51	87	184
Small Copper	2005	15	24	7	-23	-58	-59
Purple Hairstreak	N/A	N/A	1	N/A	N/A	N/A	N/A
Green Hairstreak	N/A	N/A	3	N/A	N/A	N/A	N/A
Holly Blue	N/A	N/A	14	N/A	N/A	N/A	N/A
Common Blue	2005	15	22	7	29	-22	36



Painted Lady. Photograph by Tom Brereton.



Large White. Photograph by Tim Melling.





UK Centre for Ecology & Hydrology (CEH) is the UK's Centre of Excellence for integrated research in terrestrial and freshwater ecosystems and their interaction with the atmosphere. As part of the Natural Environment Research Council (NERC) CEH works in partnership with the research community, policymakers, industry and society, to deliver world-class solutions to the most complex environmental challenges facing humankind.



Butterfly Conservation (BC) is the charity aimed at securing a lasting future for butterflies, moths and their habitats. It works in partnership with thousands of volunteers and a wide range of organisations in the UK and Europe to secure a healthy environment where we all can live.



The British Trust for Ornithology (BTO) is an independent charitable research institute combining professional and citizen science aimed at using evidence of change in wildlife populations, particularly birds, to inform the public, opinion-formers and environmental policy- and decision-makers.



The Joint Nature Conservation Committee (JNCC) is the statutory adviser to the UK Government and devolved administrations on UK and international nature conservation. Its work contributes to maintaining and enriching biological diversity and sustaining natural systems.

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