United Kingdom
Butterfly Monitoring Scheme

Annual Report 2017

UKBMS Annual Report 2017

The UKBMS

The UKBMS is organised and funded by Butterfly Conservation (BC), the Centre for Ecology and Hydrology (CEH), 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.

The members of the UKBMS SG in 2017 were Tom Brereton (BC), David Roy (CEH), David Noble (BTO), Kirsi Peck and Anna Robinson (JNCC), Jon Curson (NE), Dylan Lloyd (NRW), Simon Foster (SNH), Stewart Snape (FC) and Melina Quinn (DOENI).

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This report can be downloaded from
http://www.ukbms.org/reportsandpublications.aspx

UKBMS partners

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www.jncc.defra.gov.uk

The Comma had its 4th best year in the 42-year series. *Photograph by Tm Melling*

Acknowledgements

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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 the Joint Reprographic Services (JRS) Unit - part of the support services to UK Research and Innovation (UKRI) - for designing and printing the report.

Cover photograph of Grayling. This butterfly had its worst year since the start of monitoring in 1976 for the second year in a row.
Photograph by Ilija Vukomanovic

Contents and online resources

The Swallowtail bounced back in 2017 after two poor years in a row.
Photograph by Tim Melling.

It was the worst year in the 42-year series or the Grizzled Skipper.
Photograph by Tom Brereton

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:
http://www.ukbms.org/

For the Wider Countryside Butterfly Survey go to
http://www.ukbms.org/wcbs.aspx

For online data entry go to
http://www.ukbms.org/mydata/

For information on Biodiversity Indicators go to
http://www.jncc.defra.gov.uk/page-1824

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

Butterfly Conservation:
http://butterfly-conservation.org/

Centre for Ecology & Hydrology:
http://www.ceh.ac.uk/

British Trust for Ornithology:
http://www.bto.org/

Joint Nature Conservation Committee:
www.jncc.defra.gov.uk

News and research

UKBMS HIGHLIGHTS IN NUMBERS

226

The number of days in 2017 when transect counts were made, including on every day from 1st April to the end of September

32,020

The number of transect visits made in 2017

1,723,016

The number of butterflies counted on transects in 2017

2,696

The record number of UKBMS locations monitored in 2017

2,720

The number of registered users of the UKBMS online system.

11

The number of major research publications in 2017 using UKBMS data.

25,561,089

The number of butterflies counted on transects since 1976

More people than ever are walking butterfly transects. *Photograph by Tom Brereton*

DATA PROTECTION AND THE UKBMS

You have doubtless all heard about the new 'General Data Protection Regulation' (GDPR) by now, and probably went through a period in early summer where every time you logged on to your emails you became aware of yet another company you weren't aware of, telling you how much they value your privacy! The new regulation has caused us to make a few minor changes related to running the UKBMS, but nothing too drastic... as we have always valued your privacy. You may have noticed on the UKBMS website that we have published a 'privacy notice' explaining what personal data we collect to run the scheme (e.g. your email address), how we use it and keep it secure, and what your rights are. We have also been updating the terms and conditions for setting up an online monitoring account, for example, due to the extra data protection rules involved, you have to be 13 or over to have an online account. We would still encourage children to get involved in butterfly recording, but up to this age would request they assist a teenager or adult and that any records are entered under the teenager/adult's name.

As a butterfly surveyor, you may well need to get in touch with a landowner to ask permission to enter their land. If you collect any personal details from them (i.e. their name or contact details), then please draw their attention to the new privacy notice on the website, as this has a small section for them. We have updated the letter for you to provide to landowners/occupiers with the relevant information on it. These changes have been made to reassure you that you are doing the right thing, and to reassure landowners that their details are secure. Where you already hold their details, please let them know about the privacy notice next time you get in touch.

The other task for you as surveyors is to be responsible for keeping their information safe and only using it for the purposes of the scheme as set out in the privacy notice. To help keep their information safe, and ensure that landowner contact details can be passed on to any future surveyors who may take over your site, please make sure you write their details on the survey site description forms which are stored and accessible via the online database. As well as keeping landowner information secure, this also ensures that you can find their contact details easily when it is time for your next survey.

If you are a 'transect coordinator', 'wider countryside champion', or 'regional organiser' you should have received some slightly more detailed information on dealing with personal data. Largely it involves carrying on applying common sense, but do have a read, take note, and get in touch if you have any questions.

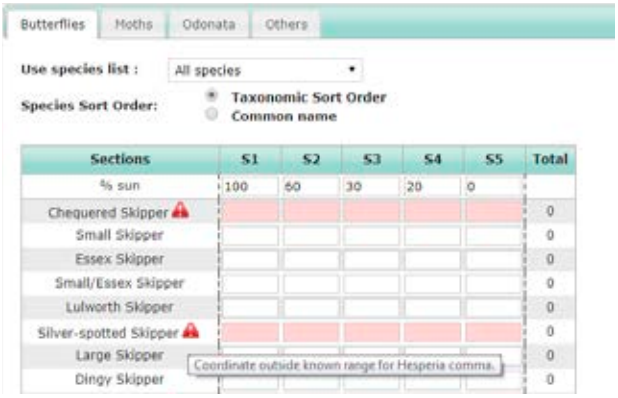
The UKBMS contacts for GDPR issues are Ian Middlebrook for BC and Sarah Harris for the BTO.

Finally, if anyone involved in the scheme experiences a 'data breach' (e.g. you leave a form with contact details on a train), don't panic (we're not dealing with highly sensitive data here) but do let them know as soon as you can. Thanks!

UKBMS ONLINE DATA ENTRY: AUTOMATED DATA VALIDATION

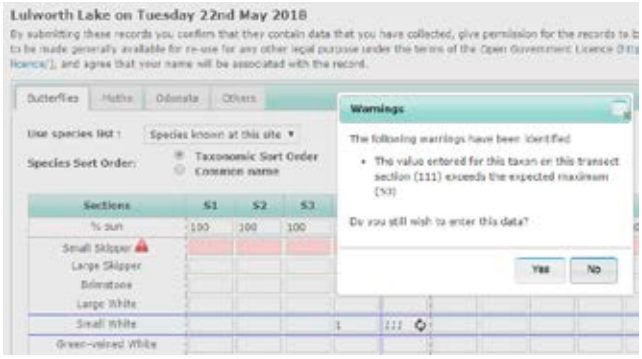
For those recorders using our **online data entry system**, a major development during 2018 has been the introduction of some automated validation checks when entering data. This will help reduce the number of unintentional errors that are made during data entry due to a simple slip of the finger. The majority of these checks mirror the checks used in the old Transect Walker software, but there are additional checks for species outside their known range, based on your site location and the known distribution of species (based on the NBN cleaner). The latter checks have also been applied to some non-butterfly species groups.

Any species that is either outside its known range or expected flight period, is now highlighted in pink on the data entry form. If you want to know why a species is highlighted, then hover your mouse over the red warning triangle next to the species name. These checks are not intended to stop you from entering exactly what you saw. They are just an aid against entering counts on the wrong line by mistake.



New flight period validation checks in the UKBMS online system

There are also checks against entering large individual counts for some species. Again, this does not stop you entering exactly what you saw, but is just an aid against clumsy fingers from hitting extra digits. In this case a warning message will appear with a query, which you just need to answer before you can continue.



New count validation checks in the UKBMS online system

BUTTERFLY GENETICS MONITORING SCHEME (BGEMS)

UKBMS data are now being used to assist with a pilot study for setting up a long-term monitoring scheme for butterfly genetics. The plan is to sample and archive individual butterflies from populations at sites with long-term population abundance monitoring data. These samples will then be analysed for genetic diversity to allow the development of indicators of the change in genetic diversity at site, regional and national levels.

The pilot study, organised by Reading University, is concentrating on Meadow Browns across areas of southern England, where they will be able to link genetic diversity with long-term abundance data from the UKBMS. As well as successful sampling at 16 sites in the UK, the core team have sampled 12 sites in northern France, and a number of collaborators across Europe have been able to collect specimens from sites across the continent. These samples will form part of a three-year study into Meadow Brown genetics across Europe.

For more details see **http://www.butterfly-monitoring.net/project/butterfly-genetics-monitoring-scheme-bgems-2020-pilot-study**.

Meadow Brown. *Photograph by Tim Melling*

EUROPEAN BUTTERFLY MONITORING SCHEME (eBMS) UPDATE

Under the auspices of Butterfly Conservation Europe, the eBMS partnership has grown in the last year to help co-ordination of Butterfly Monitoring Schemes across Europe. In April 2016, the first partnership agreement for eBMS was established and formed of seven partner organisations (Butterfly Conservation Europe, CEH, and BMS partners in Catalonia, Finland, Germany, Netherlands and the UK). In 2017, the partnership was extended to 14 partners (BMS schemes joining for Flanders, France, Ireland, Sweden, Luxembourg, Spain – *Zerynthia* monitoring). The eBMS partnership aims to support and promote butterfly monitoring schemes across the continent, whilst also providing a platform to collate data from the various schemes and support its provision for research. Combining data from all these countries into a single database with standardised formatting has been completed by CEH. To date, 10 countries (12 schemes) have contributed data from over 6000 monitoring sites (Figure 1) covering a gradient of ca. 6,800 km south-west to north-east across Europe, comprising 3.88 million observations from over 640k transect walks. The dataset is being used to facilitate research projects to understand the status of butterflies at large scales and support conservation. Further schemes are likely to join the partnership in 2018.

An important part of the eBMS is a website (**http://www.butterfly-monitoring.net/**) to enable the submission of butterfly monitoring data for recorders in areas of Europe (or elsewhere) which are not covered by existing national or regional schemes. The data entry process is largely based on the data entry site used by the UKBMS.

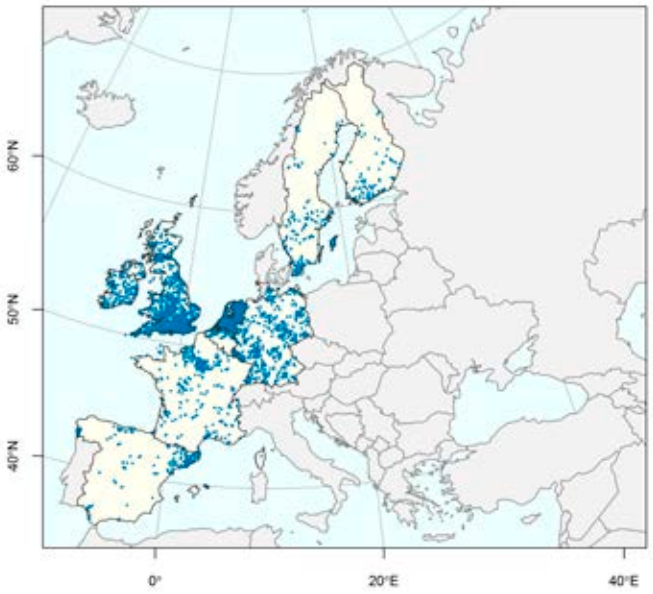


Figure 1: Location of monitored sites in the eBMS

THE IMPORTANCE OF BUTTERFLIES AND OTHER INSECTS TO BIRDS

One of the benefits of the Wider Countryside Butterfly Survey (WCBS) is that trends for butterflies can be linked to information on birds as well as to finer details of habitat at the same site. Since 2009, BBS volunteers have been given the option to carry out the WCBS on their BBS square, which allows the trends and abundance of different taxonomic groups to be compared locally or in the same geographical area; for example, are there correlations between butterfly and insectivorous bird trends?

Whinchat. *Photograph by Tom Brereton*

Information collected through the Breeding Bird Survey (BBS) has shown that the Whinchat population in the UK has declined by 51% since the mid-1990s. Over recent decades, the species has been lost from lowlands and continues to decline in the uplands. Many factors, including suitability of breeding and wintering habitat, food supply, climate and threats along migration routes, may be at play. Over the last three years, the RSPB has been undertaking research on whether the Whinchat decline is linked to changes in breeding habitat. Studies are now underway within upland BBS squares with differing Whinchat trends, the aim being to determine whether Whinchats are being retained in areas that have a greater abundance of invertebrates. As a contribution to this, we are contacting BBS volunteers in the uplands who monitor our 90 Whinchat study grid squares to encourage them to help out even more in 2019 by taking part in the WCBS. Further details on WCBS for BBS participants are available at **www.bto.org/butterflies**

YOU'RE NEVER TOO YOUNG TO START BUTTERFLY RECORDING...

Congratulations to Joseph Harris (10) who recently received a Blue Peter badge for surveying butterflies! Joseph first helped his mum to survey a WCBS square transect aged 4. After many years of returning to the same site he enjoys seeing which butterflies will be around each year, and is keen to share the word on the importance of monitoring wildlife. Here Joseph answers some questions on his experience.

What is the most memorable experience you have from butterfly surveying?

I have lots of great memories for doing the survey each year. I really enjoy spotting and identifying the different butterfly species. This summer I identified a Painted Lady that everyone thought was a Small Tortoiseshell, but it wasn't.

What is your favourite species of butterfly?

My favourite species is the Purple Emperor butterfly- it is stunning.

Why do you think it's important to monitor wildlife?

It is really important to monitor wildlife to get sufficient data for different species. If we don't have that data and a species starts to die out, we will have no warning of what is happening, so possibly the species will become endangered or extinct.

What would you say to someone else thinking of getting involved?

I would definitely recommend getting involved, it is very important and lots of fun.

Addendum: children are encouraged to take part in the UKBMS when supervised by an adult. Non relatives who accompany children alone need to be CRB checked, which BC can pay for. Children under 13 should not walk transects alone, whilst it is not recommended for 13-16 year olds.

CITIZEN SCIENCE SURVEY TO MONITORING POLLINATORS CONTINUES

The UK Pollinator Monitoring Scheme (PoMS) has been set up to gather additional evidence to inform research and conservation of the insects that provide such an important service.

In 2017, UKBMS recorders were invited take part in a simple but important survey to help monitor pollinating insects. The 'FIT' counts involve a 10-minute timed count of pollinator groups on particular plants in flower. We are further encouraging UKBMS recorders to take part in this survey in 2019. For further details and to download the FIT Count guides and forms go to the PoMS website, whilst a video guide can be found here:
https://www.youtube.com/watch?v=FZo8sZcZfvM

Ongoing projects

The UKBMS data continues to be used for a wide range of research projects with, for example, 11 peer-reviewed articles published in 2017. Developing improved methods to analyse UKBMS data and the impacts of climate change were prominent research uses in 2017 amongst a range of other topics. Here, by example, lead author Emily Dennis of Butterfly Conservation describes the findings of a paper published in June 2017 on the state of butterfly populations in urban areas.

Butterflies are declining faster in urban areas than rural areas. *Photograph by Tom Brereton*

Small Copper. Photograph by Tom Brereton

The state of urban butterfly populations

The study compared trends for 28 species in urban and countryside environments, and showed that over a 20-year period, urban butterfly abundance fell by 69% compared to a 45% decline for butterflies in rural areas. The Small Copper and Small Heath declined much more dramatically in towns and cities than in the countryside. From 1995 to 2014 Small Copper abundance fell by 75% in urban areas compared to a 23% decline in rural areas. The Small Heath declined in abundance by 78% in urban areas, compared with a 17% decline in rural areas. The causes of these changes require further research but it is likely to be due to the combined effects of habitat loss, habitat modification and climate change. The study found that butterflies in urban areas emerged on average two days earlier than their countryside counterparts with urban Brimstones emerging five days earlier than those found in rural locations. Flight periods for many of the species studied were also found to be slightly longer for urban butterflies than their rural counterparts. The probable cause behind the earlier emergence and longer flight periods of urban butterflies is the 'urban heat island' effect - in which towns and cities are slightly warmer than the surrounding countryside due to human activities.

For more detailed information you can read the paper, E B Dennis *et al*., (2016) Urban indicators for UK butterflies. *Ecological Indicators* **http://dx.doi.org/10.1016/j.ecolind.2017.01.009**

Peer-reviewed research published in 2017

Peer-reviewed research published in 2017

De Palma, A., Dennis, R.L.H., Brereton, T., Leather, S.R. & Oliver, T.H. (2017) Large reorganizations in butterfly communities during an extreme weather event. Ecography 40, 577-585.

Dennis, E.B., Morgan, B.J.T., Brereton, T.M., Roy, D.B. & Fox, R. (2017) Using citizen science butterfly counts to predict species population trends. Conservation Biology 31, 1350-1361.

Dennis, E.B., Morgan, B.J.T., Freeman, S.N., Ridout, M.S., Brereton, T.M., Fox, R., Powney, G.D. & Roy, D.B. (2017) Efficient occupancy model-fitting for extensive citizen-science data. PLoS ONE 12, e0174433.

Dennis, E.B., Morgan, B.J.T., Roy, D.B. & Brereton, T.M. (2017), Urban indicators for UK butterflies. Ecological Indicators 76, 184-193. News story

Elston, D.A., Brewer, MJ Martay, B Johnston, A Henrys, PA Bell, JR Harrington, R Monteith, D Brereton, TM Boughey, KL Pearce-Higgins JW. 2017/12/1. A new approach to modelling the relationship between annual population abundance indices and weather data. Journal of Agricultural, Biological and Environmental Statistics 22 (4), 427-445.

Martay, B., Brewer, M.J., Elston, D.A., Bell, J.R., Harrington, R., Brereton, T.M., Barlow, K.E., Botham, M.S. & Pearce-Higgins, J.W. 2017. Impacts of climate change on national biodiversity population trends. Ecography 40, 1139-1151.

McDermott Long, O., Warren, R., Price, J., Brereton, T.M., Botham, M.S. & Franco, A.M.A. 2017. Sensitivity of UK butterflies to local climatic extremes: which life stages are most at risk? Journal of Animal Ecology 86, 108-116. News story

Mills, S.C., Oliver, T.H., Bradbury, R.B., Gregory, R.D., Brereton, T., Kühn, E., Kuussaari, M., Musche, M., Roy, D.B., Schmucki, R., Stefanescu, C., van Swaay, C. & Evans, K.L. 2017. European butterfly populations vary in sensitivity to weather across their geographical ranges. Global Ecology and Biogeography 26, 1374-1385.

Oliver, T.H., Gillings, S., Pearce-Higgins, J.W., Brereton, T., Crick, H.Q.P., Duffield, S.J., Morecroft, M.D. & Roy, D.B. 2017. Large extents of intensive land use limit community reorganization during climate warming. Global Change Biology 23, 2272-2283. News story

Palmer, G., Platts, P.J., Brereton, T., Chapman, J.W., Dytham, C., Fox, R., Pearce-Higgins, J.W., Roy, D.B., Hill, J.K. & Thomas, C.D. 2017. Climate change, climatic variation and extreme biological responses. Philosophical Transactions of the Royal Society B 372, 20160144.

Sullivan, M.J.P., Pearce-Higgins, J.W., Newson, S.E., Scholefield, P., Brereton, T. & Oliver, T.H. 2017. A national-scale model of linear features improves predictions of farmland biodiversity. Journal of Applied Ecology 54, 1776-1784.

Brown Argus – one of 18 species which lingered into October on transects. *Photograph by Tim Melling*

Background and methods

Trends in butterfly populations were compiled from a network of 2,696 sample locations in 2017 and 5,078 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).

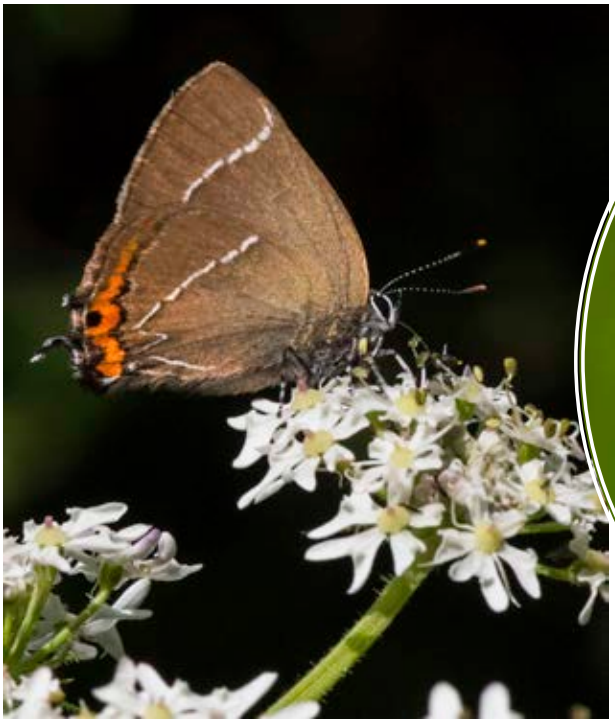
For a number of habitat-specialist species (especially the fritillaries) 'reduced effort' methods are also used to monitor annual abundance at the site level, especially in more remote parts of the UK, for example; adult timed counts for fritillaries (Warren et al. 1981), larval web counts for Marsh 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 **http://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 ten 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 level of sampling effort (and unlike conventional transects), WCBS data are not routinely used to derive local measures of butterfly abundance.

A group of recorders counting Purple Hairstreaks in the canopy, with an adapted transect method. *Photograph by Tom Brereton*

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.



White-letter Hairstreak. *Photograph by Tim Melling*

Small Heath. *Photograph by Tim Melling*

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.

Adonis Blue. *Photograph by Iain Leach*

Sample coverage

UKBMS sites

At the Country-level there were 1,587 monitored sites in England, 159 in Wales, 157 in Scotland, 31 in Northern Ireland, 30 from the Channel Islands and a single site from the Isle of Man.

In 2017, 196 new sites were established and monitored for the first time. Sixteen of these were in Scotland, seven in Wales, eight in Northern Ireland and one in the Channel Islands, whilst the rest were in England.

Additionally, 148 sites were either re-established or were brought into the scheme with additional data prior to 2017. Data from Brown Hairstreak egg counts contributed to the scheme for the second year.

Wider Countryside Butterfly Survey (WCBS) squares

The WCBS ran for a ninth year in 2017, supplying count data for compilation of collated indices chiefly for common and widespread species. In total, over 3,000km of survey line was walked by approximately 650 recorders who made 1,733 visits to 774 squares (63% by BC, 37% by BTO BBS recorders). Eighty-five percent of squares received the required two visits over the core July and August period (up one percentage point from 2016. From April-June, 220 visits were made to 149 squares to target early flyers such as Orange-tip.

Overall, there was a net gain of three squares from 2016. Coverage by BC recorders was up by two percentage points, whilst BBS recorder effort dropped by two percentage points. A total of 96 new squares were established, whilst monitoring was re-instated in a number of squares with at least five years of data. When combined with UKBMS sites there was a total of 2,720 sample points – again a record high.

Powerstock disused railway line, Dorset. *Photograph by Tom Brereton*

Gatekeeper.
Photograph by Tim Melling

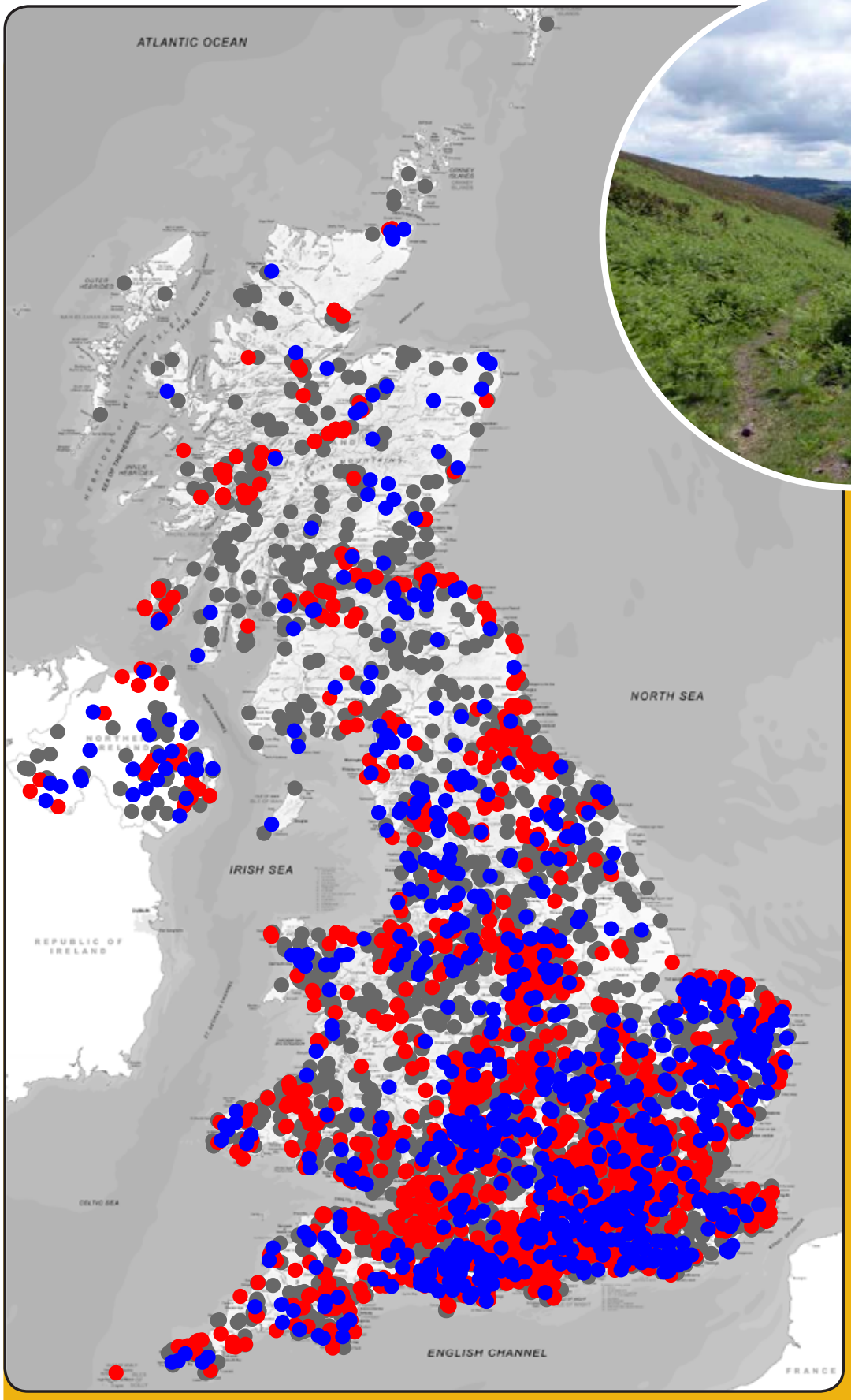


Figure 2: Location of monitored sites in 2017. UKBMS sites producing a site index (red circles), WCBS squares walked (blue circles), sites and squares not walked or not producing a site index in 2017 (grey circles)

Trendlebere Combe, a fritillary timed count site on Dartmoor, Devon. *Photograph by Tom Brereton*

The 2017 season

SUMMARY

- The year as a whole was rather warmer than average for the UK, the 5th warmest since records began in 1910. It was the equal-warmest spring on record (with 2011), with the highest June temperatures since 1976. Rainfall was around average, though April was notably dry, whilst June to September were all rather wet. It was a slightly sunnier than average year, especially during the spring.
- Transect walks were completed on 226 days from 7th March to 27th October including on every day of the formal recording season (April to September). The peak day was the 17th July when 335 walks were made.
- 2017 was a better year for butterflies than 2016. 38 of the 57 species assessed (two thirds of the total) showed an increase compared to 2016, eighteen showed a decline and one showed no change.
- Despite this, 2017 still ranked well below average being the seventh worst in the 42-year series. The observed annual increases were largely expected given that 2016 was one of the worst years on record (4th worst).
- 2017 started fairly warm, and as a result most species (88%) were out earlier than in 2016 and the series average (1976-2017). However, over the shorter-term, most species appeared later than the recent 10-year average (2007-2016).
- Over the summer, sunshine levels were slightly below average and rainfall levels considerably above average which is likely to have had a negative impact on the index figures. The knock-on effects of last season (which was the 4th worst on record) are also likely to have contributed to lower butterfly numbers than would otherwise have been the case.
- Mean butterfly abundance on transects peaked in week 13 (end of June), four weeks earlier than the long-term average (end of July).

How different species fared

- Two species had their worst index on record in 2017 (**Grizzled Skipper** and **Grayling**).
- At the country-level **Grizzled Skipper** had its worst year in the series in England, while this was the case for **Grayling** in England and Scotland. **Small Tortoiseshell** faired worst in Scotland and Northern Ireland. In Wales, **Large Skipper** and **Purple Hairstreak** had their worst year in the series. On the positive side, **Small Copper** had its best year in Northern Ireland, and **Red Admiral** in Scotland.
- It was a good year for the **Swallowtail** with numbers above average (+57% over 2016) after two poor years.
- Skippers fared much better in 2017 than in 2016, with five out of the eight species showing increases on 2016 levels. **Chequered Skipper** did particularly well with a 141% increase on 2016.
- 'Browns' had a better year than in 2016, with seven of the 10 species increasing in abundance. While **Grayling** continues to decline (national long-term trend -72%), **Wall** numbers increased slightly, although the long-term decline is still 89%.
- The 'whites' had a poor year across the UK with annual decreases in all three of the common species. – **Large**, **Small** and **Green-veined**.
- Most fritillaries had a better year than 2016, with increases in all species except **Marsh** and **Glanville**. **Silver-washed Fritillary** showed an annual increase of 141 %. Amongst the other Nymphalids, **Comma** annual abundance was up 91%, whilst **White Admiral** increased by 157%.
- The **Duke of Burgundy**, was down by 45%, which was the biggest annual decline by any species.
- The 'blues' fared better than in 2016, with a number of the species that showed large declines in 2016 recovering. In particular, **Common Blue** and **White-letter Hairstreak** were up by 90% and 55% respectively.
- Of the regular migrants, there was a notable increase in the **Red Admiral**, which, after a good end to the season in 2016 recorded a 78% annual increase, making it the third best year on record in the UK, and its best year in Scotland. The **Clouded Yellow** showed an annual decline of 40%, whilst the **Painted Lady** was down by 26%.

Silver-washed Fritillary annul abundance was up by 145% in 2017. *Photograph by Tom Brereton*

MONTHLY ROUND-UP

Spring

The weather was changeable at the start of the month and a cold snap occurred at the end of the third week, but otherwise MARCH was characterized by some fine spells of sunny weather, with above average temperatures. The UK mean temperature was 7.3 °C, which is 1.8 °C above the 1981-2010 long-term average, leading to the equal-fifth warmest March since 1910. The temperature peaked at 22°C in Gravesend, Kent on the 30th.

Transect recording was made on 18 dates between the 7th and the 31st, with 11 butterfly species recorded. These were **Brimstone**, **Holly Blue**, **Orange-tip** and **Peacock** (7th *Hatch Hill, Somerset*), **Comma** (9th *Cambridgeshire, Greater London*, *Warwickshire*, *Hampshire*, *Surrey* and *Worcestershire*), **Red Admiral** (9th *Gravesend Marling Cross*, *Kent*), **Small Tortoiseshell** (9th Dorset, *Kent* and *Surrey*), **Small White** (25th *KAC towpath*, *Bradford-on-Avon*), **Speckled Wood** (15th *Cornwall*, *Dorset* and *Wiltshire*), **Green-veined White** (26th *Whippingham* (*fields*), *Isle of Wight*) and **Painted Lady** (26th *Castor Hanglands*, *Cambridgeshire*).

Brimstone. *Photograph by Tim Melling*

APRIL started warm and sunny, with temperatures peaking at 25.5°C in Cambridge on the 9th. Across the month, temperature and sunshine levels were above average, whilst it was the 9th driest April since 1910. Transect walks were completed on every day of the month, producing sightings of 25 species. Of these, 13 had their first sightings for the year on transects including **Green Hairstreak** (2nd *Cumbria*, *East Sussex* and *Hampshire*), **Small Copper** (4th *Sustrans NCN77*, *Dunkeld* and *Birnam*), **Common Blue** (6th *Hampshire*, *Norfolk* and *Suffolk*), **Wall** (6th *Trois Vaux*, *Alderney*), **Dingy Skipper** (7th *Prestwood Nature*, *Buckinghamshire*), **Grizzled Skipper** (8th *East Sussex*, *Greater London*, *Hampshire* and *Surrey*), **Duke of Burgundy** (9th *The Mountain* (*Meon Valley 3*) and *Noar Hill*, *Hampshire*), **Small Heath** (9th *Anton Lakes Local Nature Reserve*, *Hampshire*), **Wood White** (11th *Bury Ditches*, *Shropshire*), **Small Pearl-bordered Fritillary** (20th *Hudder Down to Hells Mouth*, *Cornwall*), **Clouded Yellow** (21st *Trois Vaux*, *Alderney*), **Pearl-bordered Fritillary** (23rd *Yarner Wood*, *Devon*), **Adonis Blue** (27th *Folkestone Escarpment*, *Kent*). Species which had their peak day counts in April included **Green Hairstreak** (49 on 22nd *Meathop Moss*, *Cumbria*) and **Orange-tip** (88 on 22nd *Rhydymwym Valley Nature Reserve*, *Flintshire*).

This warm start may have contributed to the annual increases in a number of spring flying species, for example **Pearl-bordered Fritillary** (which was up by 57% over 2016), and **Orange-tip** (up by 23% over the 2016 index), although other spring flying species did not fare so well, potentially influenced by the cold snap at the end of April. The **Grizzled Skipper** had its worst year in the 42-year data series in the UK, and now has a significant long term decrease of 54%. This is a spring flying species emerging in April, so the cold snap could have had an impact.

Good weather continued into MAY, which was sunnier, drier and especially warmer than average, being the second warmest since 1910 (behind 2008). Northern and western areas experienced some excellent weather, with temperatures peaking at 29.4 °C in Lossiemouth (*Morayshire*) during a hot spell at the month end. During May, transect walks were made on every day with 48 species seen and first sightings for 23 species. These were: **Brown Argus** (2nd *Hampshire*, *Kent*, *Somerset* and *Wiltshire*), **Cryptic Wood White** (2nd *Craigavon Lakes*, *Armagh*), **Small Blue** (2nd

Speckled Wood. *Photograph by Tom Brereton*

Boscombe Down O (WCC), *Wiltshire*), **Small Skipper** (5th *Knettishall Heath*, *Suffolk*), **Large Skipper** (7th *Bubbenhall Meadow*, *Warwickshire*), **Meadow Brown** (7th *Lancashire*, *Northumberland* and *West Midlands*), **Ringlet** (7th *Wigmore Rolls*, *West Midlands*), **Chequered Skipper** (8th *Glasdrum*, *Strathclyde*), **Marsh Fritillary** (8th *Martin Down North*, *Hampshire*), **Northern Brown Argus** (18th *Bishop Middleham Quarry*, *County Durham*), **Glanville Fritillary** (21st *Trois Vaux*, *Alderney*), **Heath Fritillary** (22nd ***Hockley Woods***, *Essex*), **Silver-studded Blue** (22nd *Beaulieu Heath North*, *Hampshire*), reports of a very early **Gatekeeper** (24th *Bedfordshire* and *Suffolk*), **Swallowtail** (24th *Bure Marshes*, *Norfolk*), **Grayling** (27th *Great Orme*, *Gwynedd*), **White Admiral** (29th *Fore Wood*, *East Sussex*), **Black Hairstreak** (30th *Finemere Wod*, *Buckinghamshire*), **Marbled White** (30th *Portsdown SSSI East 7 – 10*, *Hampshire*), **Dark Green Fritillary** (31st *Upper Dunsforth Carrs*, *North Yorkshire*), **Essex Skipper** (31st *Levin Down*, *West Sussex*), **Large Heath** (31st *Cors Fochno*, *Ceredigion*) and **Lulworth Skipper** (31st *Bindon Hill*, *Dorset*).

Maximum day counts for spring-flying species in May included 130 **Chequered Skipper** (31st *Glen Creran – Powerline*, *Argyll* and *Bute*), a rather lowly peak of 18 **Grizzled Skipper** (13th *Clubmens Down* (*NT*), *Dorset*), 80 **Cryptic Wood White** (17th *Craigavon Lakes*, *Armagh*), 134 **Dingy Skipper** (21st *Rhydymwym Valley Nature Reserve*, *Flintshire*), 19 **Duke of Burgundy** (2nd May *Noar Hill*, *Hampshire*), 42 **Marsh Fritillary** (31st *Lydlinch Common* (*New*), *Dorset*) and 40 **Pearl-bordered Fritillary** (25th *Mabie Forest*, *Dumfries* and *Galloway*).

Orange-tip. *Photograph by Tim Melling*

130 Chequered Skippers were seen at site in Argyll on the 31st May. *Photograph by Tim Melling*

Though annual abundance was only down by 9%, it was a poor year for the **Grizzled Skipper**, the worst in the series for the second year in a row. The butterfly peaked in mid-May. The highest number of individuals seen at one site was 90 at *Bossington, Somerset*. The largest annual drop in abundance was at *Hod Hill, Dorset* (38 to 12). **Duke of Burgundy**, which peaked in the second week of May had a poor year. Annual abundance was reduced by 45%, making 2017 the 6th worst in the 39-year series. The most severe site decline was at *Harting Down Site HMP1, West Sussex* (45 to 34).

Summer

The weather deteriorated somewhat in JUNE, with below average sunshine levels (especially in Scotland and Northern Ireland) and rainfall well above average, making it the 8th wettest since 1910. It was another warm month though, the 5th equal warmest since 1910, with a maximum temperature of 34.5 °C, at Heathrow Airport on the 21st being the highest in June since 1976. Transect walks were completed every day, with 55 species seen, including the only **Large Tortoiseshell** of the year on the 1st at *Les Mielles Site 11, Jersey*. There were first sightings for seven resident species, including **Large Blue** (3rd *Green Down, Somerset*), **Mountain Ringlet** (3rd, *Hartsop Dodd, Cumbria*), **Purple Hairstreak** (3rd *Warren Bank, Torry Hill, Kent*), **Silver-washed Fritillary** (3rd *Holme Fen, Cambridgeshire*), **White-letter Hairstreak** (4th *Benfleet Downs, Essex*), **Purple Emperor** (16th *Maidenhead Thicket, Berkshire*) and **High Brown Fritillary** (17th *Whitbarrow - Township Plantation, Cumbria*).

During the month, 28 species recorded their maximum counts on transects. These counts were: 143 **Small Pearl-bordered Fritillary** (1st *Glasdrum, Strathclyde*), 68 **Northern Brown Argus** (14th *Low Ox Pasture, Kilnsey, North Yorkshire*), 50 **Mountain Ringlet** (17th *Hartsop Dodd, Cumbria*), 101 **Essex Skipper** (27th *Little Wittenham, Hill Farm, Oxfordshire*), 676 **Gatekeeper** (15th *Whippingham (fields), Isle of Wight*), 41 **Lulworth Skipper** (19th June, *Bindon Hill, Dorset*), 38 **Glanville Fritillary** (18th *Trois Vaux, Alderney*), 11 **Clouded Yellow** (18th *Colepit Lane, Torry Hill, Kent*), 183 **Dark Green Fritillary** (19th *Porton Dn.2 (Tower Hill Wood), Wiltshire*), 115 **Heath Fritillary** (17th *Blean Woods, Kent*), 11 **Black Hairstreak** (3rd *Monks Wood, Cambridgeshire*), 77 **Brown Argus** (6th *Magdalen Hill Down, Hampshire*), 19 **High Brown**

Ringlet. *Photograph by Tim Melling*

Purple Hairstreak. *Photograph by Tim Melling*

Fritillary (19th *Aish Tor, Devon*), 2452 **Silver-studded Blue** (21st *Great Orme Gwynedd*), 2786 **Meadow Brown** (17th *Whippingham (fields), Isle of Wight*), 44 **Holly Blue** (10th *Benfleet Downs, Essex*), 28 **Large Heath** (19th *Cors Fochno, Ceredigion*), 8 **Purple Emperor** (26th *Grendon & Doddershall Woods, Buckinghamshire*), 174 **Small Blue** (3rd *Newton Tony RSPB, Wiltshire*), 125 **Speckled Wood** (26th *Wadswick Common, Wiltshire*), 34 **Swallowtail** (21st *Sutton Fen, Norfolk*), 26 **White Admiral** (26th *Oaken Wood, Surrey*) and 13 **White-letter Hairstreak** (10th and 17th *Benfleet Downs, Essex*).

It was poor year for the **Northern Brown Argus**, which peaked in mid-June. Annual abundance was down by 31% with 2017 the 4th worst in the 39-year series. Only one double figure index was logged (at sites monitored in both 2016 and 2017), this being a lowly 16 at *Arnside Knott, Lancashire*.

For species with mean flight dates in May and June, these dates were mostly one to three weeks earlier than the series average. These included the **Holly Blue** (by 26 days), **Peacock** (20 days) and the **Black Hairstreak** (19 days).

JULY saw a continuation of unsettled weather. Temperatures and rainfall levels were a little above the long-term average, whilst sunshine was below average. Over the month, 53 species were observed on transects (two fewer than June), including the final four making their first appearance of the year: **Chalk Hill Blue** (1st *Bedfordshire, Gloucestershire, Hertfordshire* and *Surrey*), **Scotch Argus** (12th *Arnside Knott NT, Cumbria*), **Silver-spotted Skipper** (12th *Hackhusrt Down, Surrey*) and **Brown Hairstreak** (18th *Blindley Heath, Surrey*).

Thirteen species had their peak day counts on transects, these being; 158 **Large Skipper** (1st *Standing Hat, Hampshire*), 83 **Small Copper** (15th *Whippingham (fields), Isle of Wight*), 86 **Brimstone** (25th *Shipton Bellinger (West), Hampshire*), 1195 **Small Skipper** (8th July *Gibralter Point, Lincolnshire*), 272 **Green-veined White** (25th *Mersehead RSPB, Dumfries and Galloway*), 61 **Grayling** (6th *Great Orme, Gwynedd*), 1024 **Marbled White** (8th July, *Whippingham (fields), Isle of Wight*), 843 **Ringlet** (1st July *Rhydymwym Valley Nature Reserve, Flintshire*), 393 **Chalk Hill Blue** (30th *Sharpenhoe Clappers, Bedfordshire*), 116 **Purple Hairstreak** (10th *Ryton Wood & Pool PH Walk, Warwickshire*), 135 **Silver-washed**

Silver-studded Blue. *Photograph by Tim Melling*

Fritillary (25th *Pamber Forest*, *Hampshire*), 107 **Red Admiral** (25th *Holkham*, *Norfolk*), 172 **Small White** (16th *Bingham Linear Park*, *Nottinghamshire*) and 84 **Wood White** (25th *Wigmore Rolls*, *West Midlands*).

Of the species which peaked in abundance in July, it was a good year for the **Comma**; the fourth best in the series with annual abundance up by 91%. Abundance peaked early in the month, with noteworthy annual increases in index values including from 18 to 64 at *Bossington*, *Somerset* and from 2 to 36 at *Melbury Down and Wood, Dorset*. **Ringlet**, which peaked in late June/early July had its second best year in the series, with annual abundance up by 32%. Substantial annual increases included at *Nyman's*, *West Sussex* (35 to 278) and *Shute Shelve Hill* (*new*), *Somerset* (262 to 630). There were improved fortunes for the **High Brown Fritillary** which recorded its second best year in the 40-year series, with abundance up 17% from 2016. Abundance of this butterfly peaked in mid-July and annual increases included from 14 to 33 *Arnside Knott*, *Lancashire*. The **Silver-washed Fritillary**, which peaked in mid-July, had its third best year, with the most substantial site increase being at *Ashclyst Caddihoe*, *Devon* (from 40 to 255). The **Small Copper**, which peaked at the end of July, increased in annual abundance by 28%, though it was still a below average year (15th worst in the series). Substantial site increases included from 25 to 69 at *Nare Head*, *Cornwall* and from 18 to 52 at *Aldbury Nowers*, *Hertfordshire*. Of the regular migrants, it was a very good year for the **Red Admiral** (ranked 3rd best in the series), with annual abundance up by 78%. Abundance peaked at the end of July and marked annual site increases including at *Ailwood Down*, *Dorset* (49 to 152) and *Bossington*, *Somerset* (25 to 104).

Other species which peaked in July fared less well. **Large White** was particularly low in numbers early in the year and a 19% decrease in numbers over 2016 means the overall long-term trend for this species at UK level is now a significant decline of 38%. Furthermore, 2017 was the 8th worst in the series for this butterfly. Site declines (between 2016 and 2017) included at *Ashclyst Merry Downs*, *Devon* (113 to 65) and *Melbury Down & Wood, Dorset* (103 to 36). **Lulworth Skipper**, which peaked in mid-July, had its 3rd worst year in the 25-year series, with annual abundance down by 43%. The sharpest drop was at *Binbarrow*, *Dorset* (64 to 26).

The unsettled weather continued over much of AUGUST. Though the monthly temperature was around the long-term average, sunshine was below average and rainfall above average. Transect walks were completed on every day, with 45 species recorded. Maximum counts were achieved for 10 species, with 94 **Small Tortoiseshell** (10th *West Sedgemoor* (*North*), *Somerset*), 315 **Adonis Blue** (27th *Swanage*, *Dorset*), 9 **Brown Hairstreak** (10th *Shipton Bellinger* (*West*), *Hampshire*), 329 **Common Blue** (5th *Whippingham* (*fields*), *Isle of Wight*), 85 **Large White** (26th *Le Hurel*, *Jersey*), 119 **Peacock** (6th *Southrey Wood*, *Lincolnshire*), 162 **Scotch Argus** (4th *Smardale Gill*, *Cumbria*), 61 **Silver-spotted Skipper** (13th *Malling Down*, *East Sussex*), 276 **Small Heath** (26th *Whippingham* (*fields*), *Isle of Wight*) and 32 **Wall** (25th *Dunstan Heughs*, *Northumberland*).

With poorer summer weather, it was interesting to note that the **Scotch Argus**, which peaks in August, was one of the very few species to have a later mean flight date in 2017 (by three days) than the series average.

Summer flying species peaking in August which had poor years included **Grayling** and **Wall**. For the second year in succession, it was the worst year in the series for Grayling, with annual abundance down by 6%. At *Scolt Head Island*, *Norfolk*, **Grayling** abundance dropped sharply from 70 in 2016 to 24 in 2017. The largest site index in 2017 was 204 at *Lea Green Bastow Wood*, *North Yorkshire*. In comparison, in 2010, the last above average year for **Grayling**, the largest site index was 2115 at *West Moors*, *Dorset*. **Wall** abundance was up by 40%. Though encouraging, 2017 was actually the 3rd worst year in the series, highlighting how low an ebb the UK **Wall** population is at. Sites where **Wall** bounced back included *Swanage*, *Ballard Down*, *Dorset* (11 to 22) and *Scolt Head Island*, *Norfolk* (52 to 89).

Following a fine spell at the start of the month, SEPTEMBER was unsettled with temperatures around the long-term average, along with below average sunshine and above average rainfall. Transect counts were made daily, with 39 species recorded. Two species had maximum site counts during the month, with 75 **Comma** (16th *Mockbeggar, Hampshire & Isle of Wight*) and 35 **Painted Lady** (1st *Mabie Forest*, *Dumfries* and *Galloway*).

For the 10th month in a row OCTOBER was a warmer month than the 1961-1990 average, this time by around 2 °C. The weather was rather changeable over the month, with drier and cloudier conditions than average. For Northern Ireland it was the equal dullest October in a series starting in 1910. Over the month 18 species were recorded (last dates in parentheses): **Adonis Blue** (3rd), **Brimstone** (22nd), **Brown Argus** (12th), **Clouded Yellow** (15th), **Comma** (27th), **Common Blue** (18th), **Green-veined White** (27th), **Holly Blue** (14th), **Large White** (23th), **Meadow Brown** (25th), **Painted Lady** (15th), **Peacock** (25th), **Red Admiral** (27th), **Small Copper** (27th), **Small Heath** (12th), **Small Tortoiseshell** (27th), **Small White** (27th) and **Wall** (14th).

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 ten-year trends for 57 of the 59 regularly occurring species, including 29 habitat specialist species, 25 wider countryside species and the three regular migrants (Table 1). Long-term trends are not calculable for **Cryptic Wood White** and **Mountain Ringlet**. Since 1976, 39% of species show positive trends (down 3 percentage points from the 2016 assessment), whilst 61% show negative trends. Of the species with a significant trend, 11 species (three fewer than in 2016) show a long- term increase, whilst 22 are in significant decline.

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

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

Over the last decade the overall picture is a little better than the long-term, with 56% of species showing negative trends, whilst 44% show positive trends. However, this is a worsening picture to the previous 10-year assessments in 2015 and 2016. **Marbled White**, **Large Blue** and **High Brown Fritillary** have increased significantly over the last decade, whilst **Large Heath**, **Heath Fritillary**, **Grayling** and **Purple Emperor** have significantly decreased.

A combined measure of butterfly abundance including index data from 26 habitat specialist and 25 wider countryside species is used as a Governmental butterfly biodiversity

Large Blue – the UKs most rapidly increasing species. *Photograph by Pete Withers*

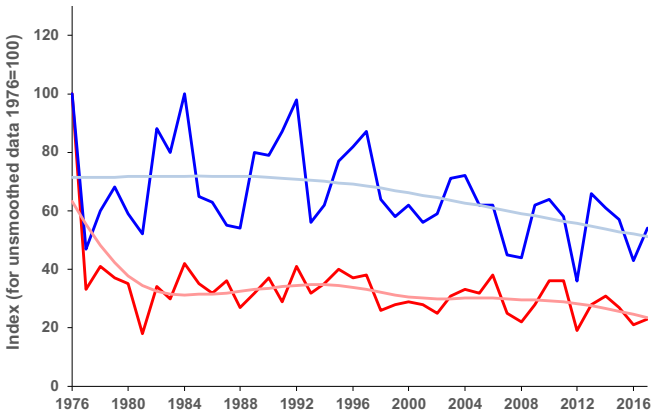


Figure 3. Trends in butterfly populations for habitat specialists (red) and species of the wider countryside (blue) 1976 to 2017. For each species group, darker lines are unsmoothed indices, paler lines are smoothed trends.

indicator **http://jncc.defra.gov.uk/page-4236**. Since 1976, habitat specialists and wider countryside species show apparent declines of 77% and 46% respectively. Analysis of the underlying smoothed trends shows that both habitat specialists and species of the wider countryside have undergone significant 'moderate' declines since 1976.

In 2017, the unsmoothed measure of habitat specialist butterfly abundance increased by two percentage points from the previous year, whilst wider countryside species increased by 11 percentage points.

ENGLAND

For England, we are able to report on long-term and ten-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, 35% of species show positive trends, whilst 65% have a negative trend. Of the species showing significant trends, ten species (two fewer than in 2016) show a long-term increase, whilst 25 are in decline (two more than in 2016). The ten species in most severe long-term decline (in rank order, largest first) are **White-letter Hairstreak**, **Heath Fritillary**, **Essex Skipper**, **Wall**, **Wood White**, **Lulworth Skipper**, **Scotch Argus**, **Small Skipper**, **Small Tortoiseshell** and **Pearl-bordered Fritillary**. Of the species showing a population increase, the top ten species (greatest first) are **Large Blue**, **Silver-spotted Skipper**, **Dark Green Fritillary**, **Ringlet**, **Clouded Yellow**, **Red Admiral**, **Adonis Blue**, **Comma**, **Silver-washed Fritillary**, **Speckled Wood** and **Swallowtail**.

Over the last decade, butterfly population changes for England have improved with 45% of species showing positive trends, whilst 51% show negative trends and 4% show no change. Species which have increased significantly include **Large Blue**, **High Brown Fritillary** and **Marbled White**, whilst species in significant decline are **Grayling**, **Purple Emperor** and **Heath Fritillary**.

Composite indices of butterfly abundance have been calculated for 23 wider countryside and 26 habitat specialist species. Since 1976, habitat specialists and wider countryside

Small Blue. *Photograph by Tim Melling*

species show apparent declines of 74% and 46% respectively. Analysis of the underlying smoothed trends shows that since 1976 both habitat specialist and wider countryside species have declined significantly. In 2017, the unsmoothed composite index for habitat specialist butterflies was up by 2 percentage points from the previous year, whilst the wider countryside species index was up by 9 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 70% and 58% respectively. Analysis of the underlying smoothed trend shows these declines to be statistically significant. Of the species showing significant trends, two species have increased, whilst 22 are in decline. The ten species in most severe long-term decline (in rank order, largest first) are **Wall**, **Duke of Burgundy**, **High Brown Fritillary**, **Grizzled Skipper**, **Pearl-bordered Fritillary**, **White-letter Hairstreak**, **Small Copper**, **Small Tortoiseshell**, **Small Heath** and **Green Hairstreak**. Species which have increased significantly over the long-term are **Ringlet** and **Silver-washed Fritillary**. In 2017, the habitat specialist index was down by 1 percentage point, whilst the wider countryside measure was up by 10 percentage points.

In English farmland habitats, composite measures of abundance in 2017 for 21 habitat specialist and 21 wider countryside butterflies, were respectively 47% and 73% of the 1990 baseline. The underlying analysis of smoothed trends indicates a progressive 'moderate' decline in both measures. In farmland habitats, 18 species show a significant long-term decline, whilst three species have increased significantly. The ten species in most severe long-term decline (in rank order, largest first) are **Wood White**, **Heath Fritillary**, **White-letter Hairstreak**, **High Brown Fritillary**, **Wall**, **Pearl-bordered Fritillary**, **Brown Hairstreak**, **Small Tortoiseshell**, **Northern Brown Argus** and **Lulworth Skipper**. Species which have increased significantly over the long-term are **Ringlet**, **Adonis Blue** and **Dark Green Fritillary**. In 2017, there was a 5 percentage point annual increase in the habitat specialist index, whilst the wider countryside measure was up by 14 percentage points.

SCOTLAND

For Scotland we are able to report on long-term and ten-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, 10 species show positive trends, whilst 15 species have negative trends. Of the eight species with significant long-term trends, **Small Copper**, **Small Tortoiseshell** and **Grayling** have declined, whilst **Small Pearl-bordered Fritillary**, **Orange-tip**, **Small Heath**, **Red Admiral** and **Ringlet** have increased.

Over the last decade 76% of monitored species have negative trends, whilst 24% show positive trends. **Grayling**, **Small Copper** and **Dark Green Fritillary** have declined significantly over the period, whilst no species have significantly increased.

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, 45% of species have positive trends, whilst three percent show no change and 52% have negative trends. Of the 17 species showing significant long-term change, 9 species are in decline (53%), whilst eight (47%) are increasing. The declining species are (most severely declining first) **Grayling**, **Dark Green Fritillary**, **Silver-washed Fritillary**, **Small Pearl-bordered Fritillary**, **Marsh Fritillary**, **Large Skipper**, **Small White**,

Pearl-bordered Fritillary. *Photograph by Gareth Knass*

Small Copper and **Wall**. The increasing species (most rapid first) are **Orange-tip**, **Pearl-bordered Fritillary**, **Ringlet**, **Speckled Wood**, **Green-veined White**, **Red Admiral**, **Comma** and **Gatekeeper**.

Over the last decade 39% of species show positive trends (six percentage points fewer than in 2016), including **Brimstone**, **Ringlet** and **Marsh Fritillary** which have increased significantly, whilst 61% of species show negative trends, though no species have declined significantly.

NORTHERN IRELAND

In Northern Ireland, temporal trends (8–14 year periods) are calculable for 13 species (Table 5). Over the period, four species have increased, whilst nine species have decreased. Species which show significant changes (all declines) are **Small Tortoiseshell**, **Small White**, **Large White** and **Meadow Brown**.

Large Heath. *Photograph by Tim Melling*

Purple Emperor. *Photograph by Tim Melling*

Small Copper. *Photograph by Tim Melling*

Notes on Summary Tables 1–4

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 are 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 2016 to 2017 and long-term (over the entire time series: no. yrs max = 42) 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 2017 and blue text best year in the series

Species	Start Year	No. years with Index in 2017	No. sites monitored in 2017	2017 Rank	% change 2016-2017	Series trend (%)	10-year trend (%)	Mean flight date 2017	Series Mean flight date
Swallowtail	1976	41	20	7	202	57	-52	27-Jun	01-Jul
Dingy Skipper	1976	42	562	35	-22	-23	22	24-May	31-May
Grizzled Skipper	1976	42	352	42	-9	-54***	-43	19-May	28-May
Chequered Skipper	2003	15	32	4	141	-38	-33	29-May	04-Jun
Essex Skipper	1977	41	943	33	16	-90***	57	10-Jul	24-Jul
Small Skipper	1976	42	1718	34	22	-75***	68	09-Jul	20-Jul
Lulworth Skipper	1992	26	21	23	-43	-77**	216	20-Jul	28-Jul
Silver-spotted Skipper	1979	39	63	17	5	566***	38	15-Aug	15-Aug
Large Skipper	1976	42	1737	34	9	-26	14	28-Jun	05-Jul
Wood White	1979	39	76	27	50	-88***	26	22-Jun	17-Jun
Cryptic Wood White	N/A	N/A	8	N/A	N/A	N/A	N/A	15-Jun	04-Jun
Orange-tip	1976	42	1649	5	23	15	43	02-May	16-May
Large White	1976	42	2259	35	-19	-38*	-42	19-Jul	21-Jul
Small White	1976	42	2275	37	-16	-31	-21	17-Jul	21-Jul
Green-veined White	1976	42	2231	28	-2	-17	-25	04-Jul	08-Jul
Clouded Yellow	1979	39	909	20	-40	284	419	03-Aug	09-Aug
Brimstone	1976	42	1635	8	10	11	88	31-May	08-Jun
Wall	1976	42	695	40	48	-89***	-42	11-Jul	27-Jul
Speckled Wood	1976	42	2155	9	15	62**	-23	14-Jul	26-Jul
Large Heath	1990	28	34	17	-18	408***	-80*	30-Jun	07-Jul
Small Heath	1976	42	1472	29	65	-58***	-5	09-Jul	09-Jul
Mountain Ringlet	N/A	N/A	2	N/A	N/A	N/A	N/A	09-Jul	15-Jul
Scotch Argus	1979	39	39	35	-3	90	-38	11-Aug	08-Aug
Ringlet	1976	42	2095	2	32	299***	29	04-Jul	14-Jul
Meadow Brown	1976	42	2305	8	58	-3	26	12-Jul	20-Jul
Gatekeeper	1976	42	1987	30	59	-44**	-2	24-Jul	01-Aug
Marbled White	1976	42	1091	9	7	50*	147**	03-Jul	14-Jul
Grayling	1976	42	306	42	-6	-72***	-63*	29-Jul	04-Aug
Pearl-bordered Fritillary	1976	42	186	35	57	-77***	-6	24-May	01-Jun
Small Pearl-bordered Fritillary	1976	42	223	32	22	-68***	-22	17-Jun	24-Jun
Silver-washed Fritillary	1976	42	835	3	141	115***	37	17-Jul	26-Jul
Dark Green Fritillary	1976	42	642	16	20	160***	-12	12-Jul	21-Jul
High Brown Fritillary	1978	40	67	23	17	-67**	225*	09-Jul	15-Jul
White Admiral	1976	42	354	29	157	-71***	-46	04-Jul	16-Jul
Purple Emperor	1979	39	102	23	2	42	-61*	13-Jul	21-Jul
Red Admiral	1976	42	2271	3	78	242***	106	22-Jul	05-Aug
Painted Lady	1976	42	1800	23	-26	56	-33	10-Jul	29-Jul
Peacock	1976	42	2182	36	8	4	-7	10-Jun	29-Jun
Small Tortoiseshell	1976	42	2179	36	18	-75***	84	20-Jun	08-Jul
Comma	1976	42	1962	4	91	129***	-14	12-Jul	20-Jul
Marsh Fritillary	1981	37	166	24	-12	-11	47	28-May	05-Jun
Glanville Fritillary	1989	29	12	13	-31	-28	157	11-Jun	08-Jun
Heath Fritillary	1981	37	40	35	28	-91***	-78***	30-Jun	02-Jul
Duke of Burgundy	1979	39	116	34	-45	-40**	11	20-May	29-May
Small Copper	1976	42	1736	32	28	-46**	-44	20-Jul	01-Aug
Brown Hairstreak	1983	35	163	31	-35	-32	-15	18-Aug	25-Aug
Purple Hairstreak	1976	42	538	27	31	-63*	-21	17-Jul	30-Jul
Green Hairstreak	1976	42	636	38	15	-48**	-34	20-May	27-May
White-letter Hairstreak	1976	42	254	38	55	-93***	-59	09-Jul	24-Jul
Black Hairstreak	1995	23	12	7	2	23	5	09-Jun	27-Jun
Small Blue	1978	40	266	23	-15	-18	-18	23-Jun	30-Jun
Holly Blue	1976	42	1603	18	23	29	30	03-Jun	29-Jun
Large Blue	1983	35	26	3	-5	>1000***	162*	17-Jun	24-Jun
Silver-studded Blue	1979	39	101	10	0	50	44	02-Jul	14-Jul
Brown Argus	1976	42	927	26	35	-27	10	27-Jul	31-Jul
Northern Brown Argus	1979	39	63	36	-31	-60**	-3	01-Jul	10-Jul
Common Blue	1976	42	1947	25	90	-24	-17	16-Jul	23-Jul
Adonis Blue	1979	39	138	17	51	134*	-47	27-Jul	26-Jul
Chalk Hill Blue	1976	42	266	35	17	-7	-9	01-Aug	08-Aug

Table 2. England summary of species abundance changes from 2016 to 2017 and long-term (over the entire time series: no. yrs max = 42) 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 2017 and blue text best year in the series.

Species	Start Year	No. years with Index in 2017	No. sites monitored in 2017	2017 Rank	% change 2016-2017	Series trend (%)	10-year trend (%)
Swallowtail	1976	41	13	5	202	58	-22
Dingy Skipper	1976	42	530	33	-17	-17	18
Grizzled Skipper	1976	42	344	42	-9	-54***	-43
Essex Skipper	1977	41	926	33	13	-90***	57
Small Skipper	1976	42	1651	34	24	-75***	66
Lulworth Skipper	1992	26	21	23	-43	-77**	216
Silver-spotted Skipper	1979	39	63	17	5	566***	38
Large Skipper	1976	42	1656	33	12	-24	12
Wood White	1979	39	76	27	50	-88***	26
Orange-tip	1976	42	1459	6	20	5	47
Large White	1976	42	2001	35	-20	-38*	-43
Small White	1976	42	2019	36	-18	-29	-21
Green-veined White	1976	42	1923	33	-11	-21	-29
Clouded Yellow	1979	39	851	19	-40	309	432
Brimstone	1976	42	1593	8	10	8	85
Wall	1976	42	600	41	35	-90***	-46
Speckled Wood	1976	42	1949	9	15	60**	-23
Large Heath	N/A	N/A	2	N/A	N/A	N/A	N/A
Small Heath	1976	42	1276	29	77	-63***	0
Mountain Ringlet	N/A	N/A	1	N/A	N/A	N/A	N/A
Scotch Argus	1995	23	11	21	-12	-77***	-59
Ringlet	1976	42	1850	2	32	319***	29
Meadow Brown	1976	42	2018	7	62	-5	28
Gatekeeper	1976	42	1885	29	65	-49***	-1
Marbled White	1976	42	1080	9	7	48*	147**
Grayling	1976	42	234	42	-8	-60***	-62*
Pearl-bordered Fritillary	1978	40	121	39	6	-72***	-48
Small Pearl-bordered Fritillary	1978	40	143	26	44	-56***	-17
Silver-washed Fritillary	1976	42	814	2	146	128***	38
Dark Green Fritillary	1976	42	524	16	21	340***	0
High Brown Fritillary	1978	40	58	23	14	-68**	225*
White Admiral	1976	42	351	29	157	-71***	-46
Purple Emperor	1979	39	102	23	2	42	-61*
Red Admiral	1976	42	1993	2	74	249***	122
Painted Lady	1976	42	1594	22	-22	49	-36
Peacock	1976	42	1918	36	2	5	-6
Small Tortoiseshell	1976	42	1900	35	20	-75***	100
Comma	1976	42	1836	4	91	130***	-14
Marsh Fritillary	1982	36	114	26	-24	-65*	48
Glanville Fritillary	1989	29	7	20	-74	-36	64
Heath Fritillary	1981	37	40	35	28	-91***	-78***
Duke of Burgundy	1979	39	116	34	-45	-40**	11
Small Copper	1976	42	1535	28	46	-42*	-42
Brown Hairstreak	1983	35	142	32	-14	-48*	-28
Purple Hairstreak	1976	42	517	28	27	-65*	-22
Green Hairstreak	1976	42	571	38	16	-51***	-35
White-letter Hairstreak	1976	42	243	37	60	-93***	-56
Black Hairstreak	1995	23	12	7	2	23	5
Small Blue	1979	39	248	22	-15	-33	-4
Holly Blue	1976	42	1515	16	23	29	35
Large Blue	1983	35	26	3	-5	1649***	162*
Silver-studded Blue	1984	34	93	19	2	-23	9
Brown Argus	1976	42	898	26	35	-25	10
Northern Brown Argus	1979	39	49	36	-31	-60**	-4
Common Blue	1976	42	1743	23	94	-23	-11
Adonis Blue	1979	39	138	17	51	134*	-47
Chalk Hill Blue	1976	42	266	35	17	-7	-9

Table 3. Scotland summary of species abundance changes from 2016 to 2017 and long-term (over the entire time series: no. yrs max = 39) 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 2017 and blue text best year in the series.

Species	Start Year	No. years with Index in 2017	No. sites monitored in 2017	2017 Rank	% change 2016-2017	Series trend (%)	10-year trend (%)
Dingy Skipper	N/A	N/A	1	N/A	N/A	N/A	N/A
Chequered Skipper	2003	15	32	4	141	-39	-34
Small Skipper	N/A	N/A	5	N/A	N/A	N/A	N/A
Large Skipper	N/A	N/A	3	N/A	N/A	N/A	N/A
Orange-tip	1999	19	113	4	38	218***	5
Large White	1979	39	98	33	44	17	-76
Small White	1979	39	101	33	2	21	-68
Green-veined White	1979	39	159	8	59	4	11
Clouded Yellow	N/A	N/A	2	N/A	N/A	N/A	N/A
Wall	1999	19	13	13	3	-70	231
Speckled Wood	2001	17	53	2	29	1	-7
Large Heath	N/A	N/A	5	N/A	N/A	N/A	N/A
Small Heath	1979	39	97	26	5	89*	-35
Mountain Ringlet	N/A	N/A	1	N/A	N/A	N/A	N/A
Scotch Argus	1990	28	28	19	29	24	-14
Ringlet	1996	22	123	16	-8	90*	-30
Meadow Brown	1979	39	128	38	-42	-8	-49
Grayling	1990	28	16	28	-36	-87***	-89***
Pearl-bordered Fritillary	2002	16	49	2	139	68	41
Small Pearl-bordered Fritillary	1979	39	61	14	-17	73*	-7
Dark Green Fritillary	1979	39	64	35	-26	-20	-67**
Red Admiral	1980	37	124	1	664	615**	2
Painted Lady	1980	34	90	15	-47	42	-26
Peacock	1995	23	124	10	83	108	-33
Small Tortoiseshell	1979	39	131	39	-15	-54*	-37
Comma	2006	12	38	11	-35	-22	-37
Marsh Fritillary	N/A	N/A	15	N/A	N/A	N/A	N/A
Small Copper	1979	39	87	37	-52	-52*	-64*
Green Hairstreak	1990	28	31	22	131	-53	-47
Small Blue	2005	13	5	7	44	30	-44
Holly Blue	N/A	N/A	1	N/A	N/A	N/A	N/A
Northern Brown Argus	1981	37	14	24	-37	-52	10
Common Blue	1979	39	85	24	0	35	-18

Table 4. Wales summary of species abundance changes from 2016 to 2017 and long-term (over the entire time series: no. yrs max = 42) 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 2017 and blue text best year in the series.

Species	Start Year	No. years with Index in 2017	No. sites monitored in 2017	2017 Rank	% change 2016-2017	Series trend (%)	10-year trend (%)
Dingy Skipper	2004	14	26	11	-54	55	78
Grizzled Skipper	N/A	N/A	4	N/A	N/A	N/A	N/A
Essex Skipper	N/A	N/A	1	N/A	N/A	N/A	N/A
Small Skipper	1984	34	63	32	-41	14	94
Large Skipper	1977	41	56	41	-59	-68***	46
Orange-tip	1978	40	49	3	35	375***	28
Large White	1976	42	90	24	7	-15	-60
Small White	1976	42	87	30	31	-58***	-33
Green-veined White	1976	42	83	7	59	173**	-51
Clouded Yellow	N/A	N/A	3	N/A	N/A	N/A	N/A
Brimstone	1998	20	33	11	-15	0	89*
Wall	1976	42	52	40	72	-55**	-40
Speckled Wood	1978	40	82	4	23	240***	-5
Large Heath	N/A	N/A	1	N/A	N/A	N/A	N/A
Small Heath	1976	42	59	41	3	-1	-23
Ringlet	1983	35	75	4	12	246***	90*
Meadow Brown	1976	42	87	37	13	20	-17
Gatekeeper	1978	40	74	32	-29	64*	-38
Marbled White	N/A	N/A	7	N/A	N/A	N/A	N/A
Grayling	1976	42	33	32	7	-95***	-8
Pearl-bordered Fritillary	1997	21	16	10	9	293**	103
Small Pearl-bordered Fritillary	1993	25	19	21	4	-72*	-37
Silver-washed Fritillary	1995	21	17	13	31	-87*	-17
Dark Green Fritillary	1979	39	39	32	-12	-88***	5
High Brown Fritillary	1995	14	9	10	-38	9	7
Red Admiral	1976	42	89	4	145	137*	51
Painted Lady	1977	40	68	19	-34	88	-26
Peacock	1976	42	77	27	29	-30	23
Small Tortoiseshell	1976	42	82	37	-18	-36	-5
Comma	1992	26	65	5	119	133*	-16
Marsh Fritillary	1990	28	26	18	31	-71*	607*
Small Copper	1976	42	66	34	54	-56*	-30
Brown Hairstreak	2004	14	21	14	-41	-33	-15
Purple Hairstreak	2002	16	12	10	279	-59	-63
Green Hairstreak	1993	25	16	7	8	143	46
White-letter Hairstreak	N/A	N/A	4	N/A	N/A	N/A	N/A
Small Blue	N/A	N/A	6	N/A	N/A	N/A	N/A
Silver-studded Blue	N/A	N/A	7	N/A	N/A	N/A	N/A
Holly Blue	1999	19	49	7	129	-42	-9
Brown Argus	1997	21	15	10	47	27	14
Common Blue	1976	42	74	31	87	-14	-55

Table 5. Northern Ireland summary of species abundance changes from 2016 to 2017 and long-term (over the entire time series: no. yrs max = 14) 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 2017 and blue text best year in the series.

Species	Start Year	No. years with Index in 2017	No. sites monitored in 2017	2017 Rank	% change 2016-2017	Series trend (%)	10-year trend (%)
Dingy Skipper	N/A	N/A	2	N/A	N/A	N/A	N/A
Cryptic Wood White	N/A	N/A	8	N/A	N/A	N/A	N/A
Orange-tip	2007	11	24	9	-8	-46	-37
Large White	2006	12	40	10	57	-52	-62*
Small White	2006	12	38	10	2	-75**	-71*
Green-veined White	2005	13	43	3	82	106	22
Speckled Wood	2007	11	42	2	59	20	19
Small Heath	2009	9	18	8	-1	-68	-68
Ringlet	2006	12	44	5	24	101	96
Meadow Brown	2009	9	43	9	-35	-52**	-52**
Grayling	N/A	N/A	1	N/A	N/A	N/A	N/A
Silver-washed Fritillary	N/A	N/A	2	N/A	N/A	N/A	N/A
Dark Green Fritillary	N/A	N/A	9	N/A	N/A	N/A	N/A
Red Admiral	N/A	N/A	30	N/A	N/A	N/A	N/A
Painted Lady	N/A	N/A	8	N/A	N/A	N/A	N/A
Peacock	2006	12	34	6	100	-74	-18
Small Tortoiseshell	2010	8	41	8	-15	-79**	-79**
Marsh Fritillary	2004	14	9	10	62	-30	-39
Small Copper	2005	13	20	1	1700	-46	-56
Green Hairstreak	N/A	N/A	1	N/A	N/A	N/A	N/A
Holly Blue	N/A	N/A	3	N/A	N/A	N/A	N/A
Common Blue	2005	13	15	11	-29	-20	14

Red Admiral had a very good year in 2017, with abundance up by 78%. *Photograph by Iain Leach*

The Large White is now in significant long-term decline. *Photograph by Tim Melling*

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