United Kingdom
Butterfly Monitoring Scheme

Annual Report 2018

UKBMS Annual Report 2018

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.

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

UKBMS partners

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Large Blue. *Photograph by Tom Brereton.*

Acknowledgements

We would like to acknowledge the financial contribution by the Joint Nature Conservation Committee, Butterfly Conservation, the British Trust for Ornithology and the Centre for Ecology & Hydrology.

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 Black Hairstreak. This butterfly had its best year since the start of monitoring in the series starting in 1976. *Photograph by Iain Leach.*

Contents and online resources

More than two thirds of UK butterfly species were seen in higher numbers than in 2017. *Photograph by Tom Brereton.*

Silver-studded Blue, one of 12 normally single-brooded species to have a partial second brood in the late summer/early autumn. *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
https://jncc.gov.uk/our-work/uk-biodiversity-indicators-2018/

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.gov.uk

News and research

UKBMS HIGHLIGHTS IN NUMBERS

230

The number of days on which UKBMS counts were made in 2018

34,943

The number of transect visits made in 2018

2,868

The record number of UKBMS locations monitored in 2018

92,000

The number of km walked counting butterflies along UKBMS routes over the year

5

The number of major research publications in 2018 using UKBMS data

2,295,260

The number of butterflies counted on transects and WCBS squares in 2018

NEW WCBS 'HOLIDAY SQUARES' WEB PAGES

Thanks to Big Give funding, an area of the UK Butterfly Monitoring Scheme website has finally been developed to encourage recorders to take part in the Wider Countryside Butterfly Survey (WCBS) whilst on holiday. The address is **https://www.ukbms.org/mydata/holiday-squares**

314 squares have been made available for surveying, chiefly in northern and western upland areas of Britain, where coverage is relatively low because of an absence of resident recorders; a problem common to most wildlife surveillance schemes.

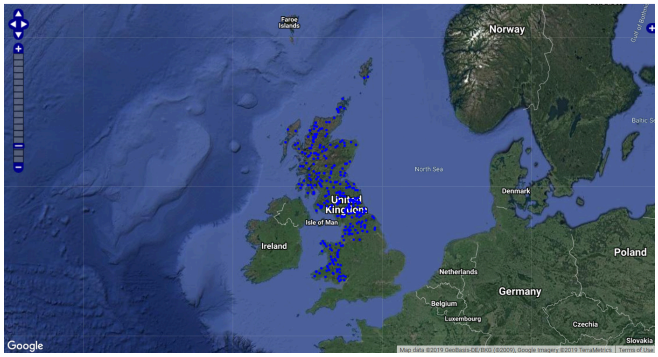
The new web pages enable recorders visiting these regions when on holiday to select squares which have not been recorded and to carry out a WCBS survey near to where they are staying or travelling through.

Surveys take around an hour to complete, plus initial time confirming any access permissions required.

Exciting species which are under-recorded that could be discovered in new localities during these surveys include **Dark Green Fritillary**, **Northern Brown Argus**, **Mountain Ringlet** and **Scotch Argus**.

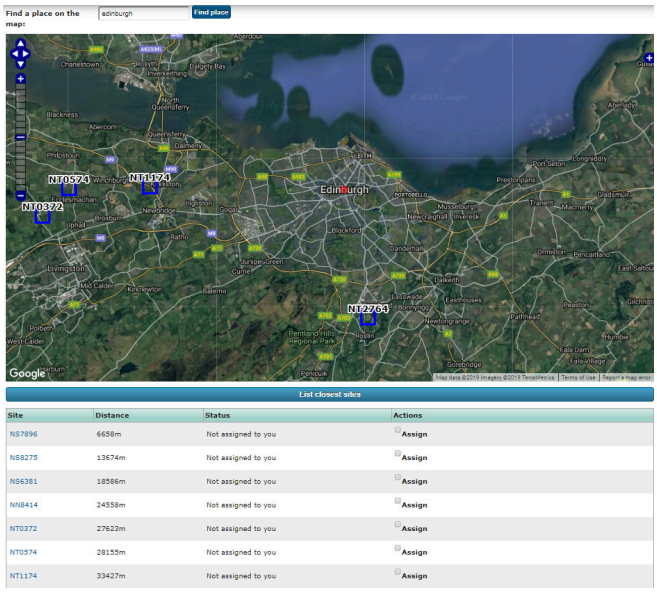
A single visit is acceptable, though ideally two visits are made, spaced at least a week apart during July and August.

The WCBS Holiday Squares web pages are simple to operate. The full list of squares is visible on landing at the page.



Recorders zoom in to an area of interest or type in a place name of where they are staying and click for a list of the 30 closest sites, as in this example for Edinburgh.

A table displays the squares and whether or not they have currently been allocated (blue colour = awaiting allocation). Unallocated squares can be 'bagged' using a check box, which will turn them red in colour, making other recorders aware they do not need to be surveyed.



INTERNATIONAL YEAR OF PLANT HEALTH

The United Nations (UN) has designated 2020 as the **'International Year of Plant Health'** (IYPH). Plants form the backbone of habitats that support our vast array of wildlife, as well as providing essential ecosystem services such food, storage of carbon and regulation of climate. In recent years the occurrence and impact of plant pests and diseases has been increasing, with rising globalisation, trade and movement of plant products. Changes to climate can also result in environmental conditions that are more amenable to pests

and pathogens, facilitating their spread (Macleod *et al* 2010). The IYPH is designed to raise awareness of plant health among the public and policy makers, to stimulate action to promote healthy plants, and contribute to achieving the UN's Sustainable Development Goals.

Plant pests and diseases can spread quickly and cause serious economic and biodiversity impact. For example, the plant pathogen 'Xylella' has spread in mainland Europe damaging a wide variety of host plants, with *HorticultureWeek* reporting in 2019 that damage has reached an estimated €1.2 billion. Sometimes the control measures that are needed to stop the spread of pests and pathogens can be locally damaging to wildlife. In London the invasive Oak Processionary Moth, which has caterpillars that shed hairs that are toxic to humans, has been controlled through spraying trees with insecticide; this may result in collateral damage to other non-target caterpillars that are living on the tree.

So what can you do to help? As always, prevention is better than cure, so stopping pests and diseases reaching the UK in the first place is the 'Plan A'. The UK has strict regulations around plant imports, but the public need to help too, for example by ensuring they don't bring back any plants, flowers, fruit, vegetables, wood or soil to the UK after travelling abroad. Cleaning walking boots after a walking holiday abroad is a useful precaution to reduce the risks of diseases reaching the UK. When gardening, ensure that plants are purchased from reputable suppliers, or grown from seed.

Once a pest or pathogen reaches the UK, their spread can be inadvertently facilitated by people moving around in the countryside. The UKBMS benefits from thousands of volunteers visiting ca2,700 sample sites across the UK, providing important evidence on the state of UK butterflies. We are definitely keen for this to continue, and by taking simple biosecurity measures, you can help reduce the risk of accidentally spreading harmful organisms at the same time. Pests and pathogens can be transported in soil or plant debris on footwear, equipment and wheels of vehicles. Therefore, between visits (particularly in wooded areas, heathland or where livestock are present), please remember to check and clean off mud and debris from footwear and equipment. So next summer, let's make 2020 a year of many productive and biosecure butterfly surveys!

Defra plant health portal:
https://planthealthportal.defra.gov.uk/

Guidance on preventing introduction and spread of tree pests and diseases:
https://www.gov.uk/guidance/prevent-the-introduction-and-spread-of-tree-pests-and-diseases

***HorticultureWeek website, 2019*,**
https://www.hortweek.com/damage-caused-xylella-estimated-€12-billion-report-finds/plant-health/article/1522412

International Year of Plant Health:
https://www.ippc.int/en/iyph/

MacLeod A., **Pautasso M.**, **Jeger M.J.**, and **Haines-Young R.**, 2010, Evolution of the international regulation of plant pests and challenges for future plant health, Food Security. 2:49–70

RHS plant health advice for gardeners:
https://www.rhs.org.uk/science/plant-health-in-gardens/protect-your-garden

TWENTY YEARS OF THE LULWORTH LAKE TRANSECT

Ten years ago, in the 2008 UKBMS Annual Report, Tom Brereton reported on the first ten years of the Lulworth Lake transect – set up near BC's HQ in south Dorset – so we thought it would be a good idea to see how things have changed in the last ten years. The transect had been set up in 1999, at a time when wider-countryside habitats were under-represented in the scheme. So it helped to fill that important gap by taking in intensive farmland mixed with green lanes and the edge of a lake.

Species list

Over those first ten years, Tom reported that 31 butterfly species had been recorded along the transect route, although eight of those were rarities that had only been recorded in one year each (Dark Green Fritillary, Grayling, Lulworth Skipper, Purple Hairstreak, Silver-studded Blue, Small Blue, Small Heath & White Admiral). The bad news is that none of these have reappeared. In fact, along with Clouded Yellow, none of them have been seen since 2006. *Just my luck – I started walking the transect in 2007!*

Some good news is that we have gained one additional species on the transect in that time, with the semi-regular appearance of Brown Argus in more recent years. This was first seen in 2014, and it appeared again in 2017 & 2018 (just single individuals each time). Overall, this means that the last ten years have seen 23 species on the transect. This looks like a big drop from 31, but the average number of species per year has only dropped slightly from 18.6 (in 1999-2008) to 17.7 (in 2009-2018).

Brown Argus – the only new species on the Lulworth transect in the last ten years.
Photograph by the lake on 7th June 2017 by Ian Middlebrook

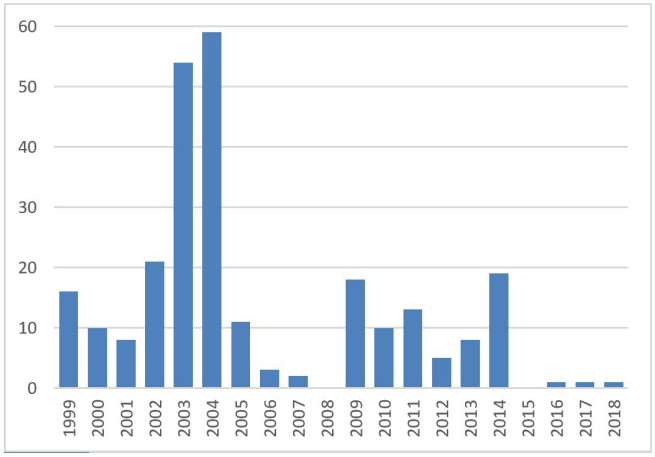
There are eight species that have been seen in every year since 1999 – Comma, Gatekeeper, Green-veined White, Large White, Meadow Brown, Peacock, Small White & Speckled Wood, whilst two species have missed one year (Ringlet in 2007 & Red Admiral in 2013) and two more have gone missing twice (Small Tortoiseshell 2008 & 2015, Large Skipper 2005 & 2012).

Brimstone, Common Blue, Orange-tip, Painted Lady, Silver-washed Fritillary, Small Skipper & Wall Brown have all been seen in most years, whilst the remaining three species (Small Copper, Marbled White & Holly Blue) have been seen less frequently in recent years.

Species trends

The UKBMS provides long-term trends for 21 species on this transect, of which 15 are considered stable and six are in significant decline on the transect (**https://www.ukbms.org/SiteFactsheet?siteId=2231**). These long-term declines include three of the eight 'ever present' species – Comma, Gatekeeper & Peacock. The other three species are also wider-countryside butterflies, but declining here in frequency as well as abundance – Small Copper has only been recorded in one year of the last seven, Holly Blue made a welcome return in 2018 after drawing a blank for the previous seven years and, perhaps the most stark decline, Wall Brown has been absent for the last three years after only missing three of the previous 17 years.

Unfortunately, despite currently being classed as 'stable', the abundance plot for Small Tortoiseshell also indicates a marked recent decline, with only three individuals being seen in the last four years.



Abundance of Small Tortoiseshell on Lulworth Lake transect since 1999

What was 2018 like?

2018 will certainly go down as one of the better years on this transect, at least in terms of overall abundance figures. With 685 butterflies counted, it was the second best year in the 20-year series (after 2006). This was largely due to good years for the most abundant species – Meadow Brown, Speckled Wood and Green-veined White. It was also the best year in the series for Orange-tip, second best year for Silver-washed Fritillary (after 2004) and joint-best year for Holly Blue (making a welcome return).

On the other hand, it was still only an average year in terms of diversity, with 18 species being recorded. Small Skipper was absent for only the fourth time and Peacock surprisingly had its worst year (just 4 recorded).

Across the transect, the most species-rich section in 2018 was section 5, as is often the case. This is a wide, open track between a dense tree-line and lakeside carr with a broad diversity of tall herbs and plenty of bramble. This area catches the sun well and 16 butterfly species were recorded here last year, including the only records of Brimstone, Brown Argus and Painted Lady on the transect.

By contrast, sections 9 and 10 traverse a large open area of improved pasture, which is grazed most of the year round. Whilst these sections did contribute 90 Meadow Browns to the 2018 total, the only other butterflies recorded here were single Small and Large Whites. At least that is better than the next section. Section 11 follows a wide ride between a managed hedgerow and a woodland edge, but it is in heavy shade for much of the day and in 2018 it contributed just a lonely Green-veined White to the transect total.

Section 5 – the most diverse section on the transect. *Photographs by Ian Middlebrook.*

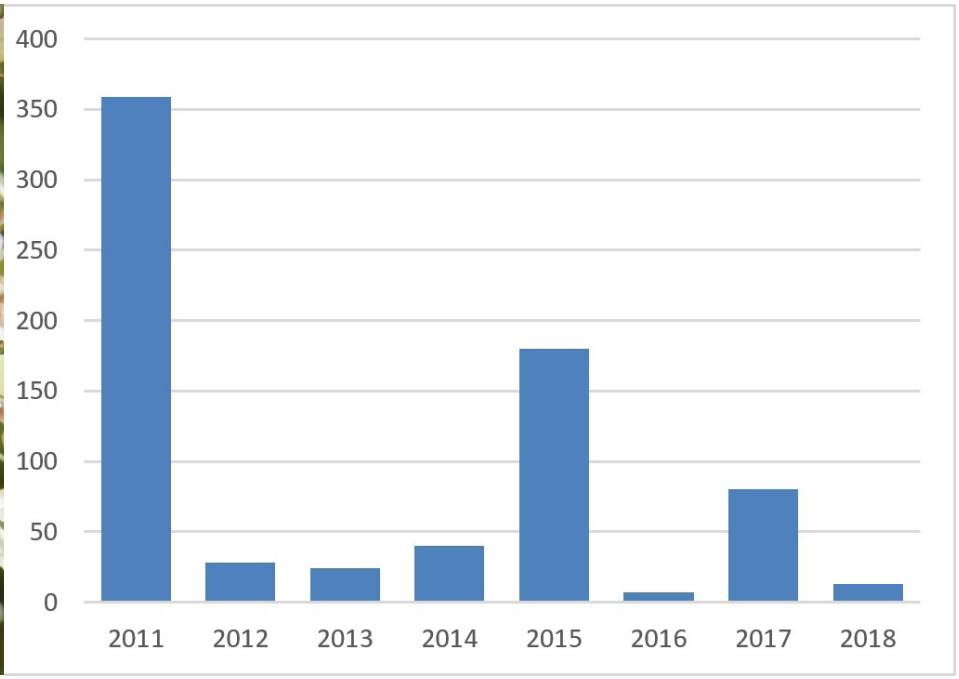
Section 11 – only one Green-veined White recorded in 2018.

Non-butterfly fauna

Beyond butterflies, Tom had previously been recording a number of other fauna, including dragonflies and grasshoppers. Whilst I've continued to record these as best I can, my own special interest lies with beetles. Since 2011 I have been monitoring beetles along the transect, necessarily restricted to those species which make themselves obvious during the day – typically being largish, brightly coloured and/or visiting flowers.

Over those last eight years nearly 40 species of beetle have been recorded including several ladybirds (7 species), soldier beetles (8 species) and leaf beetles (9 species). The most abundant of these is usually the Green Dock Beetle (*Gastrophysa viridula*) which can occur in large numbers in localised patches of Dock around the improved pasture, particularly in the spring when their feeding damage becomes quite obvious. My total count for this beetle in 2017 reached 738.

Two other species which are regularly seen in good numbers are the Thick-legged Flower Beetle (*Oedemera nobilis*), which typically peaks during June, and the Common Red Soldier Beetle (*Rhagonycha fulva*), sometimes known as the Hogweed Bonking Beetle!) which peaks during July and whose numbers can vary wildly from year to year.



Common Red Soldier Beetle *Rhagonycha fulva* and its annual abundance on the Lulworth Lake transect. *Photograph by Ian Middlebrook.*

UPDATE ON THE ASSESSING BUTTERFLIES IN EUROPE (ABLE) PROJECT

Background to the project

Assessing Butterflies in Europe (ABLE) is a major new project that will use butterflies to indicate the future health of Europe's environment. The main aim is to create a representative butterfly monitoring network across as many countries as possible in order to improve the targeting and efficiency of conservation measures within the European Union. To do this, it will develop a suite of indicators that can inform EU biodiversity and land use policies, including the Common Agricultural Policy. The data will also be used to help assess the health of Europe's pollinators as part of the EU Pollinator Initiative.

The project will involve thousands of volunteers across Europe who will contribute data in a standardised way into a central database (the European Butterfly Monitoring Scheme - eBMS). This included data from the UKBMS. It builds on existing Butterfly Monitoring Schemes that are running in twenty countries, but will extend these to other countries that currently do not have schemes. Target countries include Austria, Bulgaria, Croatia, Cyprus, Denmark, Greece, Hungary, Italy, Latvia, Malta, Poland, Portugal and Slovakia.

The ABLE project is a partnership between **Butterfly Conservation Europe**, the **Centre for Ecology and Hydrology (UK)**, the **Helmholtz Centre for Environmental Research (UFZ, Germany)**, **Dutch Butterfly Conservation** and **Butterfly Conservation (UK)**. It is funded by a service contract from the European Union Directorate for the Environment, for an initial period of two years from 2019-20.

Main ABLE outcomes planned

1. New butterfly monitoring schemes, with coordinators and networks of volunteers started in a further 6-8 EU countries where there are no schemes at present;

2. Some further development of fledgling schemes in 5-7 EU countries to increase their sustainability and encourage their contribution of data to the expanding eBMS database;

3. Hold a workshop for existing and new eBMS partners to exchange experiences, share learning and encourage ongoing engagement post 2020;

4. Recruitment and training of more coordinators and volunteers across Europe who are willing to collect butterfly data from the field and report it to the newly developed online database for monitoring data;

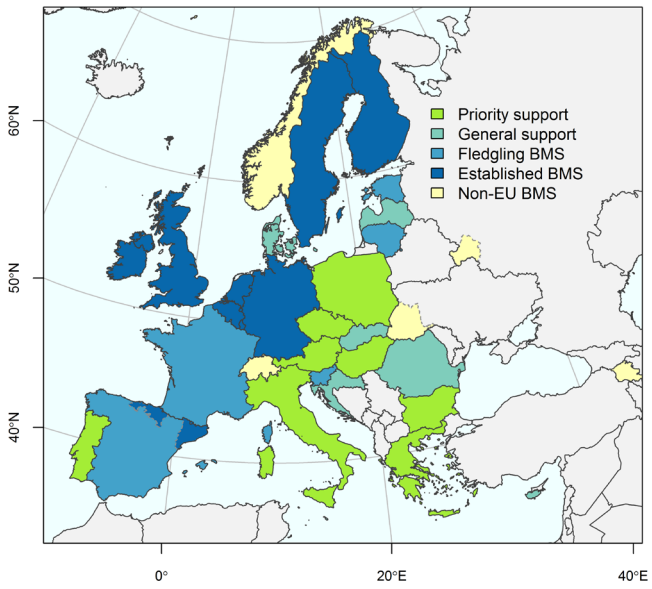
5. Increases in the number of transects walked each year and butterfly records submitted;

6. Regular feedback to volunteers and recorders in EU Member States to foster continuing commitment;

7. An expanded and improved centralised eBMS database with greater functionality, including more butterfly records and providing automated methods for calculating a range of butterfly indicators;

8. Legal data sharing agreements for new eBMS partners, based on those covering existing schemes.

Map: Summary of Butterfly Monitoring Schemes in Europe, and planned activity within the ABLE project.



Relevance of ABLE to the UKBMS and UK butterfly recorders

ABLE is relevant to the UKBMS in the following ways:

1. Both CEH and BC are actively involved in the ABLE project. The UKBMS was the first scheme in Europe and remains by far the largest. Experiences gained from monitoring butterflies in the UK are invaluable when expanding the approach to new areas.

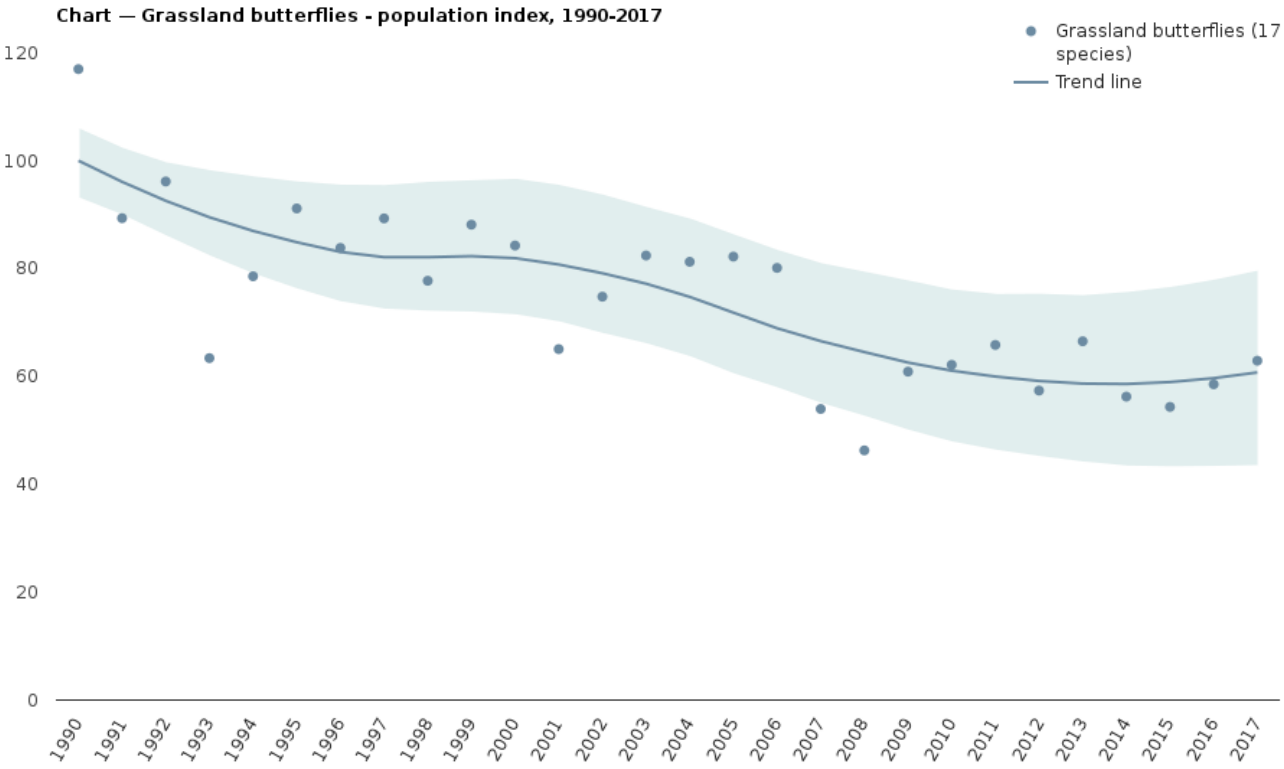
2. The UKBMS data contributes to indicators of the status of butterflies in Europe. For example, an updated indicator of the status of grassland butterflies in Europe was published in the 2019 EU Sustainable Development Goal monitoring **report**, and as one of the biodiversity **indicators** published by the European Environment Agency. The index of grassland butterflies has declined significantly based on data from the 15 EU countries where butterfly monitoring schemes exist. In 2017, the index was 39 % below its 1990 value.

3. UKBMS data will contribute to further biodiversity indicators (e.g. for woodlands, wetlands, urban areas, climate change impacts) that are in development by the ABLE project.

4. The ABLE project (with active involvement from CEH and BC) is developing improved methods and tools for analysing butterfly monitoring scheme data. We aim to adopt some of these methods for future UKBMS reporting – for species trends and indicators

5. A mobile application is being developed to support butterfly monitoring across Europe. The first version of the app is available for use (see details at: **https://www.butterfly-monitoring.net/ebms-app**). The app captures butterfly counts from a fixed time (15 minutes) with accurate information about the area sampled (using the phone GPS to track a route, or by drawing an area on a map). This method can complement UKBMS transects (which remain the 'gold standard'), by providing a way to collect count data at any time in any location. It is particularly suited to monitoring in areas where it is not practical to establish a transect (e.g. remote areas, agricultural areas, urban areas). You can use the app anywhere in the UK but also if travelling elsewhere in Europe - it contains the latest full list of European species.

6. By taking an active role in the project, the UKBMS can support the ABLE aims to influence key policies that aim to improve the conservation of biodiversity.



Ongoing projects

State of Nature project update

The State of Nature partnership was established in 2012 and comprises a grouping of over fifty nature conservation organisations which together have produced two reviews of the status of wildlife in the UK, its Crown Dependencies and Overseas Territories. Technical reports were published in 2013 and 2016, with the purposes of providing a single, unified authoritative statement on the state of nature, to feed into biodiversity conservation. UKBMS data were used to produce the butterfly abundance trends used in the report.

The science behind the State of Nature reports has recently been subject to peer review and published in the journal Ecological Indicators. The paper titled 'An assessment of the state of nature in the United Kingdom: A review of findings, methods and impact', was led by Dr Fiona Burns, a scientist at the RSPB. The paper in particular focuses on the measures of species change that formed the basis of the 2016 report, including assessments of robustness and representativeness.

The study showed that there were biases in the taxonomic representativeness of State of Nature headline metrics, despite including data from a broad range of UK wildlife species and groups. Species trends were calculable for 57% of UK vertebrates, 32% of plants, 6% of invertebrates, but only 1% of fungi; with the bias largely reflecting the preference choices of volunteer recorders for visually appealing and easiest to monitor species. Various statistical 'weighting' procedures have been used to account for these biases in the data. The overall conclusion was that despite the uneven taxonomic representation, the State of Nature measures give a robust account of the overall negative trend in the UK's wildlife.

The partnership will produce a third report in Autumn 2019, shortly in advance of the 2020 deadline for meeting the Aichi global biodiversity targets agreed by the UK Government under the Convention for Biological Diversity.

Read more at:
https://www.rspb.org.uk/our-work/conservation/projects/state-of-nature-reporting/#BT1ZIEYyFuk9Gb0E.99

Lapwing.
Photograph by Tom Brereton.

Peer-reviewed research published in 2018

Burns, F., Eaton, M.A., Hayhow, D.B., Outhwaite, C.L., Al Fulaij, N., August, T.A., Boughey, K.L., Brereton, T., Brown, A., Bullock, D.J., Gent, T., Haysom, K.A., Isaac, N. J.B., Johns, D.G., Macadam, C.R., Mathews, F., Noble, D.G., Powney, G.D., Sims, D.W., Smart, S.M., Stroh, P., Walker, K.J., Webb, J.R., Webb, T.J. & Gregory, R.D. (2018) An assessment of the state of nature in the United Kingdom: A review of findings, methods and impact. *Ecological Indicators* **94**, 226-236.

Franks, S.E., Pearce-Higgins, J.W., Atkinson, S., Bell, J.R., Botham, M.S., Brereton, T.M., Harrington, R. & Leech, D.I. 2018. The sensitivity of breeding songbirds to changes in seasonal timing is linked to population change but cannot be directly attributed to the effects of trophic asynchrony on productivity. *Global Change Biology* **24**, 957-971.

Mason, S.C., Hill, J.K., Thomas, C.D., Powney, G.D., Fox, R., Brereton, T. & Oliver, T.H. 2018. Population variability in species can be deduced from opportunistic citizen science records: a case study using British butterflies. *Insect Conservation and Diversity* **11**, 131-142.

Pearce-Higgins, J.W., Baillie, S.R., Boughey K., Bourn, N.A.D, Foppen, R.P.B., Gillings, S., Gregory, R.D., Hunt, T., Jiguet, F., Lehikoinen, A., Musgrove, A.J., Robinson, R.A., Roy, D.B., Siriwardena, G.M., Walker, K.J. & Wilson, J.D. 2018. Overcoming the challenges of public data archiving for citizen science biodiversity recording and monitoring schemes. *Journal of Applied Ecology* **55**, 2544-2551.

Suggitt, A.J., Wilson, R.J., Isaac, N.J.B., Beale, C.M., Auffret, A.G., August, T., Bennie, J.J., Crick, H.Q.P., Duffield, S., Fox, R., Hopkins, J.J., Macgregor, N.A., Morecroft, M.D., Walker, K.J. & Maclean, I.M.D. 2018. Extinction risk from climate change is reduced by microclimatic buffering. *Nature Climate Change* **8**, 713-717.

Redstart. *Photograph by Photograph by Tom Brereton.*

Background and methods

Trends in butterfly populations were compiled from a network of 2,868 sample locations in 2018 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. Since 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**

The 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.

Egg counts are the chief monitoring method deployed for Large Blue.
Photograph by Peter Eeles

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 ensures that the counts made during the key part of the flight period have a stronger effect upon the final indices. 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 WCBS samples.

White Admiral. *Photograph by Tom Brereton.*

Chalk Hill Blue. *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 are routinely compiled for all resident species, wider countryside species, habitat specialists and the three regular migrants. In addition, UK and England are 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.

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Green-veined White. *Photograph by Tom Brereton.*

Sample coverage

UKBMS sites

At the Country-level there were 1,687 monitored sites in England, 120 in Wales, 191 in Scotland, 37 in Northern Ireland, 41 from the Channel Islands and two from the Isle of Man.

In 2018, 183 new sites were established and monitored for the first time. Twenty-four of these were in Scotland, ten in Wales, six in Northern Ireland and one on the Isle of Man, whilst the rest were in England.

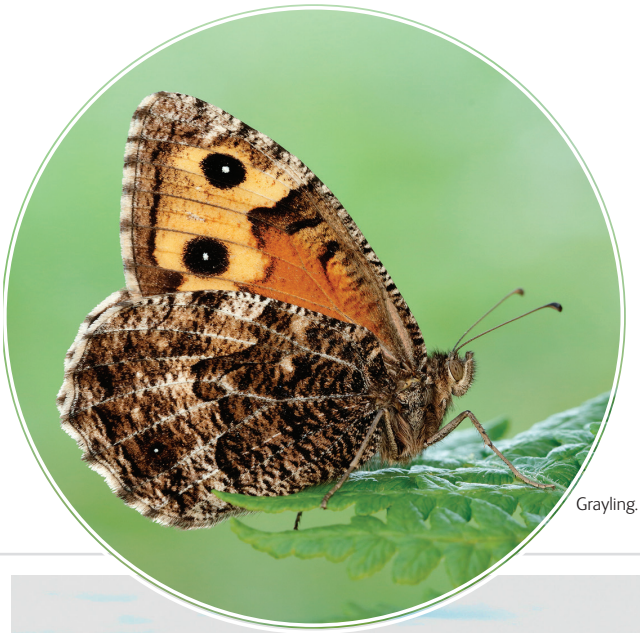
Additionally, 93 sites were either re-established or were brought into the scheme with additional data prior to 2018. Data from Brown Hairstreak egg counts contributed to the scheme for the third year.

Wider Countryside Butterfly Survey (WCBS) squares

The WCBS ran for a tenth year in 2018, supplying count data for compilation of collated indices chiefly for common and widespread species. In total, over 3,600km of survey line was walked by approximately 650 recorders who made 1,804 visits to 790 squares. The number of BC squares surveyed (520) was higher than in any other year in the series, whilst conversely the number of BBS squares surveyed (270) marked a series low. At the Country level there were 677 squares in England (+28 compared with 2017), 57 in Scotland (–1), 35 in Wales (–5), 20 in Northern Ireland (–6) and one on the Isle of Man (the same as in 2017)

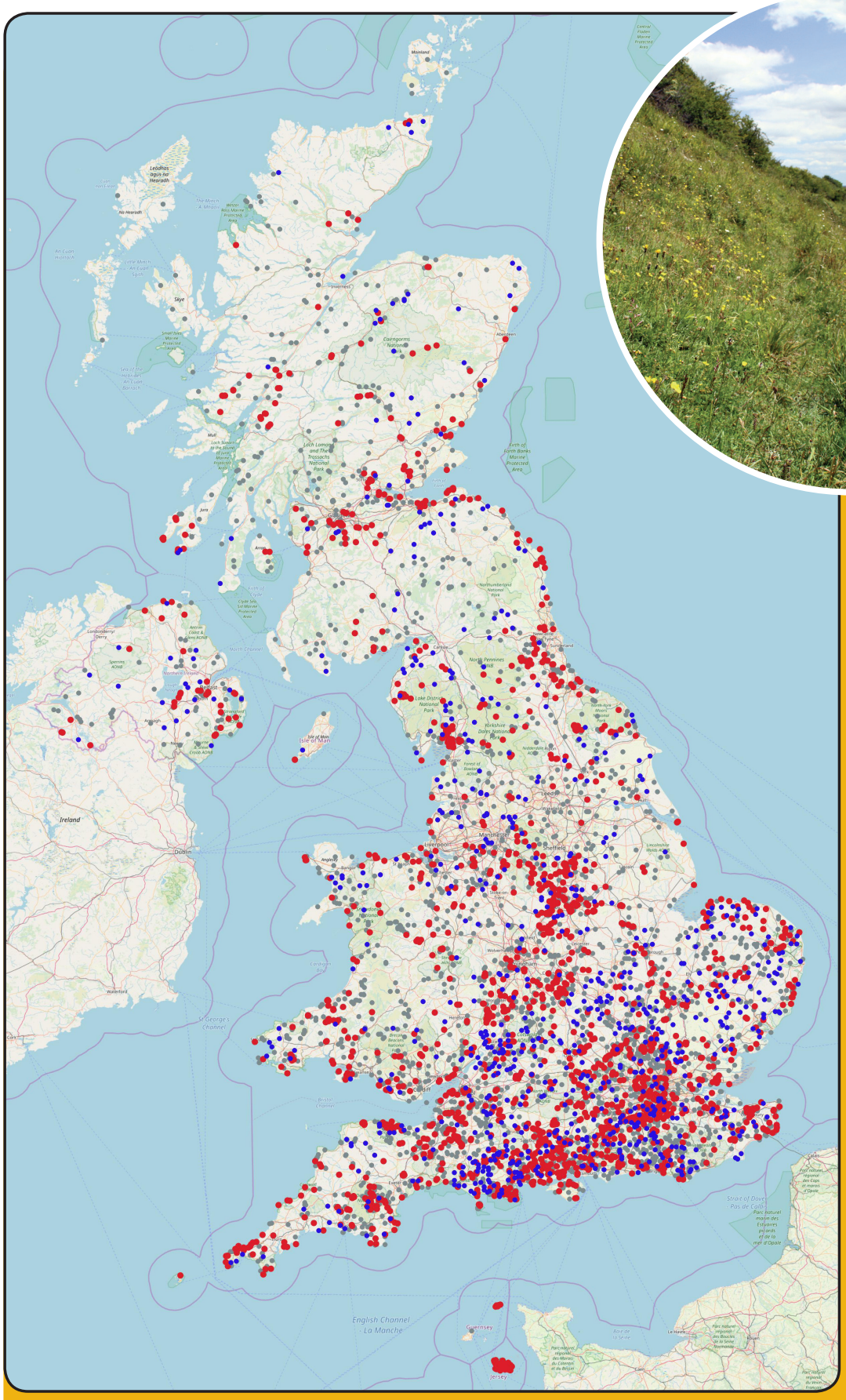
Eighty-nine percent of squares received the required two visits over the core July and August period (up four percentage point from 2017). From April to June, 268 visits were made to target early flyers such as Orange-tip. The value of June visits is becoming increasingly apparent as the flight seasons of UK butterflies gets earlier and earlier in response to climate warming.

When combined with UKBMS sites there was a total of 2,868 sample locations points – marking another record year.



Grayling. *Photograph by Iain Leach.*

Stonebarrow Hill, Dorset. *Photograph by Tom Brereton.*



Green Down, Somerset.
Photograph by Tom Brereton

Figure 1: Location of monitoring in 2018. UKBMS sites (red circles) and WCBS squares (blue circles) walked in 2018, sites and squares not walked in 2018 (grey circles)

The 2018 season

SUMMARY

- 34,943 transect walks (2,920 more visits than in 2017) were completed on 230 days (four more than in 2017) between 4th March and 27th October. The peak day was 14th April when 547 visits were made. Counts were made on every single day of the core recording period from 1st April to the end of September.
- The 'heatwave summer' was the warmest since 2006, the sunniest since 1995 and the driest since 2003. Overall it equalled the warmest in the 1981-2010 series. May, June and July were the standout months for warm, dry and sunny conditions, following a cold and cloudy period in late winter/early spring.
- This 'heatwave summer' helped bring a better year for butterflies, following six poor years in succession. More than two thirds of UK butterfly species (39 of 57) were seen in higher numbers than in 2017.
- Though these results were highly welcome, 2018 ranked only 18th in the 43-year series, as the increases could not fully compensate for the recent series of poor years. Nearly a third of the species showed negative annual population changes despite the fine summer weather, though no species had their worst year in the series.
- The colder than average late winter and early spring delayed the arrival of spring and was thought to be the reason for the later emergence and lower numbers of many spring flying species.
- The long, sustained period of hot and sunny weather encouraged many summer-emerging species to appear earlier. The mean flight date for the vast majority of species was earlier than the series average, with peak dates for many species advanced by two weeks or more. Another pattern was the brevity of the season, with around two thirds of species showing a shorter flight period in 2018 than the average over both the past ten years and the whole series.
- A further feature was the number of normally single-brooded species with partial second broods, including **Dingy Skipper**, **Essex Skipper**, **Gatekeeper**, **Green Hairstreak**, **Grizzled Skipper**, **Heath Fritillary**, **Large Skipper**, **Orange-tip**, **Silver-studded Blue**, **Small Blue**, **Small Pearl-bordered Fritillary** and **Small Skipper**.

How different species fared

- Two species, only found in England, had their best year on record. **Large Blue** increased by 58% over 2017, whilst **Black Hairstreak** annual abundance was up by over 900%.
- No species had their worst year on record.
- At the country-level **Brimstone** had its best year in the series in Wales, as was the case for **Marsh Fritillary** in Northern Ireland.
- **Brown Argus** and **Speckled Wood** thrived, recording their third best year on record.
- **Marsh Fritillary** numbers were up 39% from 2017, whilst the rarer **Heath Fritillary** saw annual abundance up by 161%. **Wood White** had its best year since 2004 with numbers up by 62%. Elsewhere the threatened **Duke of Burgundy** was up 65%, with many of the biggest increases at sites in favourable conservation management.
- Common white butterflies experienced a good year after a recent run of below-average seasons with **Large White** annual abundance up 118%, the **Small White** rising by 155% and the **Green-veined White** increasing by 63%.
- Along with **Black Hairstreak**, other canopy species to fare well included **Purple Hairstreak**, up by nearly 200% making it the fourth best year on record, and **Purple Emperor** up by 70%, (logging the 7th best year).
- Other highlights include a bounce-back for **Grayling**, which having suffered its worst year on record in 2017, increased by over 50%, and for **Wall**, with numbers up by 79% compared with 2017; however, both remain in significant long-term decline.
- Some grassland butterflies struggled though. The **Gatekeeper** dropped by 20% from 2017 levels and the **Small Skipper** and **Essex Skipper** were down by 24% and 32% respectively.
- It was also a surprisingly poor year for some garden favourites. The **Small Tortoiseshell** slumped by 38%, and the **Peacock** was down 25%, whilst the migratory **Red Admiral** crashed by 75% from the good year in 2017.
- Rare species reported on transects included **Large Tortoiseshell**, **Camberwell Beauty** and '**Continental**' **Swallowtail**.

Duke of Burgundy. *Photograph by Iain Leach.*

SEASONAL AND MONTHLY ROUND-UP[1]

Winter

JANUARY was warmer than average across England and Wales, but somewhat colder than average further north. Six species emerged during the month. These were **Peacock** (1st *Norfolk*[2]), **Red Admiral** (1st *Devon* & *Oxfordshire)*, **Brimstone** (5th *Hampshire*), **Comma** (10th *Northants*, *Sussex* & *Wiltshire*) and **Speckled Wood** (25th *London*). FEBRUARY was a cold month, with the mean temperature 1.3 °C below average and no new species reported emerging.

[1] Including in relation to climate summaries published by the **Met Office**

[2] Where only the county names are given, data is from the BNM per Richard Fox, Butterfly Conservation

Spring

MARCH was a cold month, 1.5 to 2 degrees below the 1981-2010 average, with two significant spells of snowfall. Otherwise it was generally wet and cloudy with temperatures peaking at 16.6 °C at *Colwyn Bay*, *Clwyd* on the 10th. Butterflies were counted on 68 UKBMS transect walks made across 19 English counties and one Scottish region. The first transect was walked at *Burnham Beeches* (*New walk*), *Buckinghamshire* and *Cocksburn Reservoir*, *Bridge of Allan*, *Stirlingon* 4th March.

During the month, nine species were recorded, with first sightings for five species, including **Painted Lady** (6th *Sussex*), **Small White** (6th *Kent*), **Small Copper** (14th *Sussex*), **Green-veined White** (21st *Suffolk*) and **Holly Blue** (25th *Derbyshire*).

APRIL saw the return of warmer but wetter weather, though sunshine levels were below average for the second month in a row. The peak temperature of 29.1 °C was recorded at *St James's Park*, *London* on the 19th. The 1st marked the start of the formal transect recording season and over the month a total of 4285 visits were completed, the peak (for the month and indeed year) being 547 on Saturday the 14th. WCBS walks were made too, with a total of seven completed, the first being on the 16th near *Swanage*, *Dorset* and *Sale*, *Greater Manchester*.

Of the 23 species seen during the month, nine were new for the year including **Orange-tip** (2nd *Lanlay*, *South Glamorgan*), **Large White** (5th *Scadbury Park*, *Greater London*), **Clouded Yellow** (7th *Devon*), **Green Hairstreak** (14th *Stinchcombe A*, *Gloucestershire)*, **Grizzled Skipper** (14th *Sussex*), **Wall** (18th *Nare Head*, *Cornwall*), **Dingy Skipper** (19th *Surrey*), **Common Blue** (22nd *Batford Springs*, *Hertfordshire*), **Duke of Burgundy** (22nd *Noar Hill, Hampshire*), **Small Heath** (25th *Sussex*) and **Pearl-bordered Fritillary** (29th *Cornwall*).

Noteworthy records included the peak year counts for **Small Tortoiseshell**, with 56 on the 14th at *Wellingborough*, *Northamptonshire* and **Brimstone**, with 63 on the 22nd at *Pamber Forest*, *Hampshire*. The latter being the highest **Brimstone** count at a UKBMS site since 2014.

Orange-tip. *Photograph by Tim Melling.*

Holly Blue. *Photograph by Iain Leach.*

A **Camberwell Beauty** was reported at *Hothfield Common Extension*, *Kent* on the 18th.

MAY was warm, dry and sunny. It was the sunniest May and the equal second warmest in the series starting in 1910. The maximum temperature of 28.7 °C at *Northolt*, *Greater London* on the 7th, was the highest ever May temperature in this series. The total of 6767 transect surveys was 250 more than the next most intensively surveyed month (June), the highest ever May monthly total for the UKBMS and double the number made in the previous highest, May 2010. An additional 107 WCBS surveys were completed, this being the most ever visits to squares in May.

Of the 48 species recorded during the month, 24 emerged including **Meadow Brown** (3rd *Bradley Manor*, *Devon*), **Large Skipper** (4th *Coulsdon Common*, *Greater London*), **Small Skipper** (4th *Cape Cornwall*, *Cornwall*), **Small Blue** (5th *Pembrokeshire*), **Brown Argus** (6th *Cornwall* & *Sussex*), **Cryptic Wood White** (6th *Marble Arch*, *County Fermanagh*), **Small Pearl-bordered Fritillary** (6th *Tidna Valley*, *Cornwall*), **Wood White** (6th *Sussex*), **Glanville Fritillary** (7th *Whippingham* (*fields*), *Isle of Wight*), **Adonis Blue** (8th *Kent*), **Swallowtail** (10th *Bure Marshes*, *Norfolk*), **Marsh Fritillary** (13th *Wiltshire*), **Ringlet** (14th *Auchtermuchty Common*, *Fife*), **Chequered Skipper** (16th *Highland*), **Dark Green Fritillary** (16th *Crombie Country Park*, *Tayside*), **Lulworth Skipper** (18th *Dorset*), **Heath Fritillary** (19th *Essex*), **Large Blue** (21st *Somerset*) **Northern Brown Argus** (23rd *Witherslack Hall Woods*, *Cumbria)*, **Mountain Ringlet** (26th *Cumbria*), **Marbled White** (28th *Old Park Hill Nature Reserve*, *Kent*), **Silver-studded Blue** (29th *Great Orme*, *Gwynedd*), **Large Heath** (30th *Cumbria*) and **White-letter Hairstreak** (31st *Middlesex*).

Nine species peaked in abundance in May. These were **Brimstone**, **Chequered Skipper**, **Cryptic Wood White**, **Dingy Skipper**, **Duke of Burgundy**, **Green Hairstreak**, **Grizzled Skipper**, **Orange-tip** and **Pearl-bordered Fritillary**. **Duke of Burgundy** annual increases included from 11 to 35 *Dean Hill* (*West*) (*NT*), *Wiltshire*, 28 to 86 at *Heyshott Escarpment*, *West Sussex*, 18 to 62 at *Kithurst The Enclosure*, *West Sussex* and 27 to 57 at *Thorodale Wood*, *North Yorkshire*.

Peak counts for the year made in May included: 65 **Orange-tip** at *Nene Wetlands Nature Reserve*, *Northamptonshire* on the 7th; 46 **Grizzled Skipper** on the 19th at *Twyford Glades*, *Lincolnshire* (this being the highest count in the UKBMS since 2006); 59 **Dingy Skipper** on the 22nd at *Suddern Hill*, *Hampshire* (lowest maximum year count in the UKBMS since 2009); 151 **Small Blue** at *Suddern Hill*, *Hampshire* on the 22nd and 81 **Chequered Skipper** at *Glen Creran – Powerline*, *Strathclyde* on the 26th. There were some impressive first generation **Adonis Blue** counts, the maximum being 453 at *Anchor Bottom*, *East Sussex* on the 27th, which was also the highest UKBMS count for this butterfly since 2013.

Of the rarer species, there were three reports of **Large Tortoiseshell** including at *St Cyrus* (*new*), *Grampian* on the 6th, *Black Heath*, *Suffolk* on the 27th and *Langar Lane*, *Colston Bassett*, *Nottinghamshire* on the 14th.

For the nine species with a mean flight date[3] in May, this date was five days earlier than the series average, including for **Brimstone** which was 15 days earlier.

Summer

JUNE saw a continuation of the good weather, with well above average sunshine and temperatures and below average rainfall levels across the UK. It was the third warmest and driest June since 1910 and the fifth sunniest since 1929. The maximum temperature of 33.0 ˚C was recorded at *Porthmadog*, *Gwynedd* on the 28th. It was another busy month for recording with 6417 transect walks and 158 WCBS surveys completed.

This was the peak month for butterfly diversity with 58 species recorded and 145,175 individuals counted (representing a big increase from the 29,817 individuals counted in May). There were ten new species recorded for the first time in the year, amongst them **Black Hairstreak** (1st *Oxfordshire*); **Essex Skipper** (1st in a WCBS square near *Worksop*, *Nottinghamshire*); **Gatekeeper** (2nd T*he Knapp Community Nature Reserve*, *Devon*); **Purple Hairstreak** (5th *Trench Wood 2*, *Hereford and Worcester*), **Silver-washed Fritillary** (5th *Tudeley Woods - Brakey Bank*, *Kent*), **White Admiral**

Wood White. *Photograph by Tom Brereton.*

Small pearl-bordered Fritillary. *Photograph by Iain Leach.*

(6th *Dorset*), **Grayling** (7th *Arnside Knott NT*, *Cumbria*), **High Brown Fritillary** (13th *Glamorgan*), **Purple Emperor** (13th *Cambridgeshire*) and **Chalk Hill Blue** (21st *Bevendean B*, *East Sussex*).

Fifteen species peaked in abundance in June. These were **Black Hairstreak**, **Glanville Fritillary**, **Heath Fritillary**, **Large Blue**, **Large Heath**, **Large Skipper**, **Marsh Fritillary**, **Mountain Ringlet**, **Northern Brown Argus**, **Silver-studded Blue**, **Small Blue**, **Small Heath**, **Swallowtail**, **White Admiral** and **Small Pearl-bordered Fritillary**.

There were some impressive maximum year counts in June including 105 **Black Hairstreak** on the 13th at *Grendon & Doddershall Woods*, *Buckinghamshire* (more than double the previous maximum UKBMS count made in 2004); 249 **Dark Green Fritillary** on the 28th at *Porton Down*, *Wiltshire* (highest scheme count since 2013); 292 **Heath Fritillary** on the 21st at *Blean Woods*, *Kent* (highest UKBMS count since 2006); 49 **Large Heath** on the 22nd at *Whixall Moss* (*a*), *Shropshire* (best UKBMS count since 2014); 231 **Large Skipper** on the 25th at *Frohawk*, *Hampshire* (highest UKBMS count since 1997); 1461 **Marbled White** on the 25th at *Whippingham* (*fields*), *Isle of Wight* (fifth highest UKBMS count in the series); 3887 **Meadow Brown** also on the 25th at *Whippingham* (*fields*), *Isle of Wight* (3rd highest ever UKBMS count); 246 **Mountain Ringlet** on the 11th at *Hartsop Dodd*, *Cumbria* (biggest ever UKBMS count, with the previous maximum being 101 at the same site in 2013) and 417 **Small Heath** on the 3rd at *Whippingham* (*fields*), *Isle of Wight* (6th highest ever UKBMS count).

Substantial annual increases in index values for species which peaked in June included: for **Black Hairstreak**, rising from 18 to 93 at *Monks Wood*, *Cambridgeshire* and from 2 to 56 at *Whitecross Green Wood*, *Oxfordshire*; for **Marsh Fritillary**, from 61 to 459 at *Ballykillbeg 2*, *County Down*, 284 to 1,668 at *Murlough*, *County Down*, 371 to 1,353 at *Rooksmoor*, *Dorset* and 15 to 293 at *Shapley Farm*, *Devon*; for **Heath Fritillary**,

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

Northern Brown Argus. *Photograph by Iain Leach.*

from 397 to 2,659 at *Grabbist Hill* (*Alcombe*), *Somerset*, from 12 to 108 at *Hadleigh Great Wood*, *Essex*, from 321 to 771 at *Hockley Woods*, *Essex*, from 6 to 473 at *Spangate*, *Somerset* and from 2 to 293 at *Rey Combe*, *Somerset*.

A **Large Tortoiseshell** was reported at *Rowley Hills, Land to south of Bury Hill Park*, *West Midlands* on the 6th.

For the 16 species with a mean flight date in June, this date was 7.5 days earlier than the series average, including for **Small Tortoiseshell** which was 16 days earlier.

JULY saw a further continuation of exceptionally warm and sunny weather, though more changeable conditions came in at the very end of the month. It was the joint second warmest July (with 1983) since at least 1910 and the sixth sunniest July since 1929. The temperature rose to a maximum of 35.3 °C at *Faversham*, *Kent* on the 26th. The combined total of 7074 visits was more than in any month in the series and included 6292 transect walks and 782 WCBS surveys (the highest monthly total since July 2014). There were 56 butterfly species recorded during the month and a staggering 1,129,509 butterflies counted, more than in any other month in the series and only the third occasion that a million have been counted in a month, the previous times being July 2014 and July 2015.

Amongst the 56 species recorded, were the last three to emerge, these being **Silver-spotted Skipper** (4th *Grangelands*, *Buckinghamshire*), **Brown Hairstreak** (5th *Pembrokeshire*) and **Scotch Argus** (12th *Cumbria*).

23 species peaked in abundance in July. These were **Chalk Hill Blue**, **Comma**, **Dark Green Fritillary**, **Essex Skipper**, **Gatekeeper**, **Grayling**, **Green-veined White**, **High Brown Fritillary**, **Large White**, **Lulworth Skipper**, **Marbled White**, **Meadow Brown**, **Peacock**, **Purple Emperor**, **Purple Hairstreak**, **Red Admiral**, **Ringlet**, **Silver-washed Fritillary**, **Small Skipper**, **Small Tortoiseshell**, **Small White**, **White-letter Hairstreak** and **Wood White**.

Peak year counts made in July included 184 **Essex Skipper** on the 7th on a WCBS *square near Peterborough*, *Cambridgeshire* (the highest UKBMS count since 2005); 1,072 **Gatekeeper** on the 15th at *Whippingham* (*fields*), *Isle of Wight* (biggest UKBMS count since 2004); 192 **Grayling** on the 7th on the *Great Orme*, *Gwynedd* (best UKBMS count since 2010); 7 **Purple Emperor** on the 10th at *Weston and Waverley Woods* (*2013 route*), *Warwickshire* (highest UKBMS count since 2013); 373 **Purple Hairstreak** on the 4th at *Ryton Wood & Pool PH Walk*, *Warwickshire* (highest UKBMS count since 1995!); 143 **Silver Washed Fritillary** on the 26th at *Stubhampton Bottom* (*Private*), *Dorset* (best since 2010); 150 **Small Tortoiseshell** on the 7th in a WCBS *square north of Peterborough*, *Cambridgeshire* (best UKBMS count since 2014); 766 **Small White** on the 15th at *Rowthorne Trail*, *Derbyshire* (highest count since 2003) and 165 **Wood White** on the 21st at *Chiddingfold Forest East*, *Surrey* (the biggest ever UKBMS count for this species).

Substantial 2017-2018 increases in index values for July peaking species included: for **Green-veined White** from 257 to 738 at *Highnam Woods* (*new*), *Gloucestershire*, from 94 to 378 at *Melbury Down & Wood*, *Dorset* and from 29 to 313 at *Hunting Hall Farm*, *Northumberland*; for **Grayling**, from 48 to 154 at *Holme Park Fell*, *Cumbria* and from 10 to 54 at *Holyhead Mountain*, *Anglesey*; for **Large White** from 64 to 1041 at *Rowthorne Trail*, *Derbyshire* and from 48 to 565 at *Seal Brook Wood*, *Netherseal*, *Derbyshire*; for **Purple Hairstreak** from 322 to 908 at *Ryton Wood & Pool PH Walk*, *Warwickshire*, from 16 to 478 at *Ryton Wood North PH walk*, *Warwickshire*, from 45 to 296 at *Woodford Golf Course*, *Essex* and from 14 to 155 at *Weeleyhall Wood*, *Essex*; for **Small White** from 166 to 2829 at *Rowthorne Trail*, *Derbyshire*, from 3 to 323 at *Fenny Compton Tunnels*, *Warwickshire* and from 81 to 975 at *Cotgrave Woods*, *Nottinghamshire* and finally, for **Wood White** from 145 to 487 at *Monkwood North*, *Worcestershire* and from 123 to 174 at *Oaken Wood West*, *Surrey*.

Substantial annual decreases for species which peaked in abundance in July included: for **Essex Skipper**, from 67 to 1 at *Malvern Poolbrook Common*, *Hereford & Worcester*, from 62 to 5 at *Dean Hill* (*West*) (*NT*), *West Sussex* and from 201 to 44 at *Alresford*, *Hampshire*; for **Gatekeeper**, from 606 to 242 at *Whipsnade SSSI*, *Bedfordshire*, from 790 to 316 at *West Blean Wood West*, *Kent*, from 504 to 223 at *Belfairs Park Golf Course*, *Essex*, from 787 to 352 at *Frohawk*, *Hampshire* and from 475 to 237 at *Park Downs*, *Surrey*; for **Peacock** from 96 to 59 at *Cavenham Heath*, *Suffolk* and from 145 to 72 at *Covert Wood*, *Kent*; for **Red Admiral** from 474 to 10 at *Grin*

High Brown Fritillary. *Photograph by Iain Leach.*

Low Wood, *Buxton*, *Derbyshire* and from 249 to 37 at *Melbury Down & Wood*, *Dorset*; for **Small Skipper** from 145 to 8 at *Westfield Monument Strip*, *Somerset* and from 239 to 23 at *Sandwich Bay Estate*, *Kent* and finally for **Small Tortoiseshell**, from 204 to 28 at *Carymoor Environmental Centre*, *Somerset*, from 130 to 12 at *Lydlinch Common* (*New*), *Dorset* and from120 to 5 at *Grange Farm* (*North*) *B*, *Cambridgeshire*.

For the 29 species with a mean flight date in July, this date was 10 days earlier than the series average, including for **Lulworth Sipper** and **White-letter Hairstreak** which were both 17 days earlier.

A **Camberwell Beauty** was reported at *Rostherne Mere*, *Cheshire* on the 19th.

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

After a warm and sunny start, AUGUST became unsettled. Over the month temperature and rainfall levels were around average, though sunshine was below average. A maximum temperature of 33.2 °C was recorded at Kew Gardens, Greater London on the 3rd. Monitoring coverage remained high, with 6,137 transect walks and 734 WCBS visits (most ever in August).

In spite of a relatively high number of visits and a good tally of 49 species recorded there was a big drop off in the number of butterflies counted, with the total of 400,443 representing a decrease of 65% from the July total.

There were 11 species which peaked in abundance in August. These were **Adonis Blue**, **Brown Argus**, **Brown Hairstreak**, **Clouded Yellow**, **Common Blue**, **Holly Blue**, **Painted Lady**, **Scotch Argus**, **Silver-spotted Skipper**, **Speckled Wood** and **Wall**.

There were still some noteworthy maximum counts for the year though including 139 **Brown Argus** on the 1st at *Norbury Park grassland*, *Surrey*; 828 **Common Blue** on the 5th at *Whippingham* (*fields*), *Isle of Wight* (biggest ever UKBMS count eclipsing the 705 counted at *Boscombe Down O*

Large Skipper. *Photograph by Tim Melling.*

(*WCC*), *Wiltshire* on 13th August in 1996); 273 **Green-veined White** on the 4th in a WCBS *square near Straws*, *County Antrim* (highest UKBMS count since 2011); 31 **Painted Lady** on the 2nd at *Holkham*, *Norfolk* (best scheme count since 2015); 187 **Peacock** on the 4th at *Mabie Forest*, *Dumfries and Galloway* (highest UKBMS count since 2014) and 55 **Wall** on the 9th at *Blaye*, *Alderney* (highest UKBMS count since 2014).

For species which peaked in abundance in August, substantial increases in annual index values between 2017 and 2018 included: for **Brown Argus**, from 1 to 167 at *Somerford Common*, *Wiltshire*, from 1 to 119 at *Morn Hill* (*Mound & Percy Hobbs Meadows*), *Hampshire* and from 22 to 236 at *Kingley Vale*, *West Sussex*; for **Speckled Wood**, from 209 to 451 at *Blackmoor Copse* (*WWT*), *Wiltshire* and from 133 to 291 at *Beetham Fell*, *Cumbria* and for **Wall**, from 45 to 18 at *Morgan's Hill SSSI*, *Wiltshire*, from 19 to 86 at *Pewsey Down*, *Wiltshire* and from 25 to 78 at *Bratton Castle Earthworks* (*EH*), *Wiltshire*.

Second brood records included **Dingy Skipper** at 12 sites, the last being on the 17th at *Nine Barrow Down*, *Dorset*; **Heath Fritillary** at *East Blean Woods*, *Kent* on the 30th; **Orange-tip** at six sites and in five counties, with the last being in a WCBS *square near Kirkinner*, *Dumfries and Galloway* on the 25th and **Small Pearl-bordered Fritillary** at *Morfa Dyffryn* (*Benar dunes*), *Gwynedd* on the 30th.

Purple Hairsteak. *Photograph by Tim Melling..*

Glanville Fritillary. *Photograph by Tom Brereton.*

Marbled White. *Photograph by Iain Leach.*

A **'Continental' Swallowtail** was reported at *Mill Hill*, *East Sussex* on the 14th.

Across the five species with a mean flight date in August, this date was around the series average, though as expected given the deterioration in weather over the month, the earlier flying species had an earlier mean flight date whilst the reverse was true for later flying species.

Autumn

SEPTEMBER was a little cooler and wetter than average, but generally the month brought typical early autumn weather, with it being rather windy at times. The maximum temperature was 26.5 °C at *Cambridge Botanic Gardens*, *Cambridgeshire* on the 17th. There were 4,603 transect walks and 19 WCBS walks. The last day of the formal transect season on the 29th saw 71 walks completed. There were still reasonable numbers of butterflies around in September with 85,686 counted of 39 species.

Camberwell Beauty. *Photograph by Peter Eeles.*

Small Copper was the only species to peak in abundance in September, with 8,402 individuals counted.

There were not too many noteworthy counts, though the two maximum counts for the year were 55 **Red Admiral** on the 16th at *Waitby Greenriggs*, *Cumbria* and 122 **Small Copper** on the 27th at *Ubley Warren* 2018, *Somerset* (the eighth largest count in the UKBMS series!)

Second brood records included **Essex Skipper** at *Plemont*, *Jersey* on the 2nd; **Gatekeeper** at *Incombe Hole*, *Buckinghamshire* on the 27th; **Green Hairstreak** at *Black Hill*, *Dorset* on the 3rd; **Large Skipper** at *Cluse Hey* (*Lyme Park*), *Cheshire* on the 20th and *Hengistbury Head*, *Dorset* on the 26th; **Heath Fritillary** at five transect sites in *Essex* and *Kent* with the last on the 17th at *RSPB Blean Woods*, *Kent*; **Silver-studded Blue** at *Black Heath*, *Suffolk* on the 25th; **Small Blue** at *Yew Hill*, *Hampshire*, *Bevendean A and B*, *East Sussex* on the 16th and **Small Skipper** at *Bearpark Woods*, *Durham* on the 30th.

Large Tortoiseshells were reported at *Dunstan Heughs*, *Northumberland* on the 12th and *Le Hurel*, *Jersey* on the 30th.

OCTOBER was drier and sunnier than average, though temperatures were around average. A maximum temperature of 26.5 °C was recorded at *Donna Nook*, *Lincolnshire* on the 13th. Though the 26-week season had ended, a further 374 UKBMS transect walks were made, with the last being on the 27th. There were an impressive 20 species recorded on transects, with 2,513 butterflies counted (the most in the series for October). The last butterflies recorded were **Small Copper** and **Common Blue** at two sites in *Nottinghamshire*. A notable second brood record was a **Gatekeeper** at *Seaford Head East 1*, *East Sussex* on the 10th.

Common Blue. *Photograph by Tom Brereton.*

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 on 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, of the 33 species with a significant trend, 12 species (one more than in 2017) show a long-term increase, whilst 21 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**, **Red Admiral**, **Dark Green Fritillary**, **Adonis Blue**, **Comma**, **Silver-washed Fritillary** and **Scotch Argus**.

Of the species showing significant change over the last decade, **Large Blue**, **High Brown Fritillary** and **Marbled White** have increased over the last decade, whilst **Large Heath**, **Grayling**, **Grizzled Skipper**, **Scotch Argus**, **Brown Hairstreak** and **Small Pearl-bordered Fritillary** have decreased.

Looking across all species (including those without significant change) over the long-term, 37% of species show positive trends (down 2 percentage points from the 2016 assessment), whilst 63% show negative trends. Over the last decade, 40% show positive trends with the remaining 60% having negative trends.

Lulworth Skipper. *Photograph by Tom Brereton.*

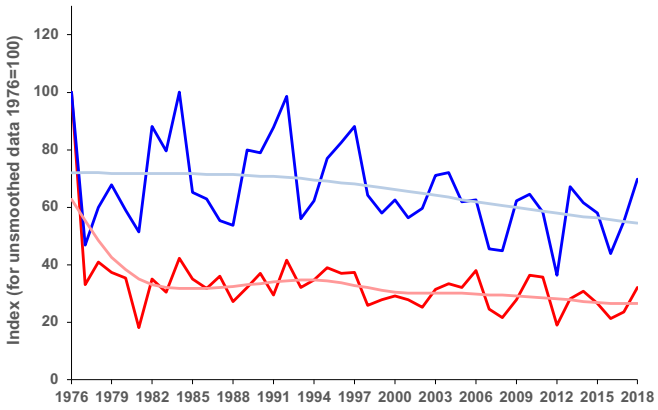


Figure 2. Trends in butterfly populations for habitat specialists (red) and species of the wider countryside (blue) 1976 to 2018. For each species group, darker lines are unsmoothed indices, paler lines are smoothed trends.

Combined measures of butterfly abundance including index data from 26 habitat specialist and 25 wider countryside species (Figure 2) are used as a **biodiversity indicator by the UK Government**.

Since 1976, habitat specialists and wider countryside species show apparent declines of 68% and 30% respectively. Analysis of the underlying smoothed trends shows that both habitat specialists and species of the wider countryside have undergone significant declines since 1976.

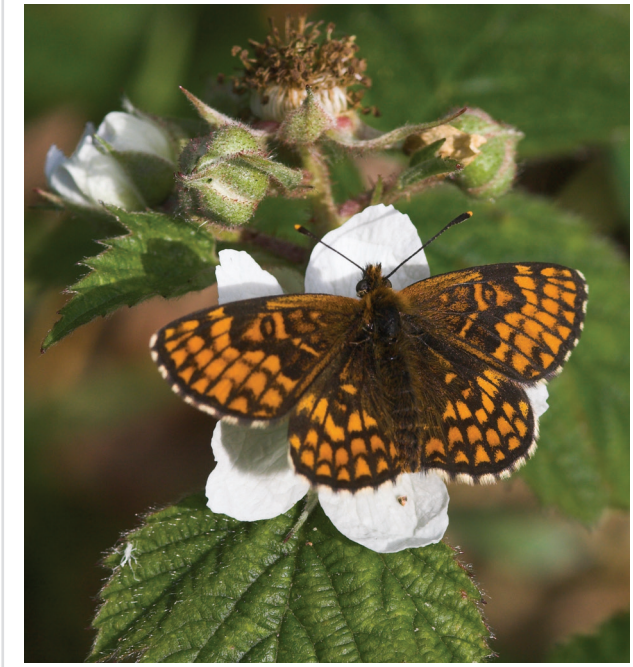
In 2018, the unsmoothed measure of habitat specialist butterfly abundance increased by eight percentage points from the previous year, whilst wider countryside species increased by 14 percentage points.

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, of the 34 species showing significant trends, ten species (same as in 2017) show a long-term increase, whilst 24 are in decline (one fewer than in 2017). 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**, **Small Tortoiseshell**, **Small Skipper**, **Pearl-bordered Fritillary** and **Scotch Argus**. Of the species showing a population increase, the top ten species (greatest first) are **Large Blue**, **Silver-spotted Skipper**, **Dark Green Fritillary**, **Ringlet**, **Red Admiral**, **Silver-washed Fritillary**, **Adonis Blue**, **Comma**, **Speckled Wood** and **Marbled White**.

Species which have increased significantly include **Large Blue**, **High Brown Fritillary** and **Marbled White**, whilst species in significant decline are **Small Pearl-bordered Fritillary**, **Grizzled Skipper** and **Grayling**.

Looking across all species (including those without significant change) over the long-term, 33% of species show positive trends, whilst 67% show negative trends.



Heath Fritillary. *Photograph by Peter Eeles.*

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 62% and 30% respectively. Analysis of the underlying smoothed trends shows that since 1976 both habitat specialist and wider countryside species have declined significantly. In 2018, the unsmoothed composite index for habitat specialist butterflies was up by nine percentage points from the previous year, whilst the wider countryside species index was up by 15 percentage points.

Composite trends have also been calculated for species monitored within woodland and farmland habitats in England. Since 1990, composite measures for 15 habitat specialist and 23 wider countryside butterfly species in woodland habitats in England, show apparent declines of 59% and 40% respectively. Analysis of the underlying smoothed trend shows that since 1990, both habitat specialist and wider countryside species in woodlands have declined significantly. Of the species showing significant trends, three species have increased, whilst 19 including an aggregate measure for **Essex/Small Skipper** 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**, **Pearl-bordered Fritillary**, **Grizzled Skipper**, **Small Tortoiseshell**, **Small Copper**, **White-letter Hairstreak**, **Essex/Small Skipper** aggregate and **Green Hairstreak**.

Species which have increased significantly over the long-term are **Ringlet**, **Purple Emperor** and **Silver-washed Fritillary**. In 2018, the unsmoothed habitat specialist index was up by 11 percentage points from the previous year, whilst the wider countryside measure was up by 15 percentage points.

In English farmland habitats, composite measures of abundance in 2018 for 21 habitat specialist and 21 wider countryside butterflies, were respectively 58% and 90% of the 1990 baseline. The underlying analysis of smoothed trends indicates a significant decline in both measures, though the wider countryside measure has stabilised in recent years. In farmland habitats, 20 species show a significant long-term decline (including the aggregate measure for **Essex/Small Skipper**), whilst four species have increased significantly.

The ten species in most severe long-term decline in farmland habitats (in rank order, largest first) are **Wood White**, **Ringlet**, **Heath Fritillary**, **White-letter Hairstreak**, **Pearl-bordered Fritillary**, **High Brown Fritillary**, **Wall**, **Small Tortoiseshell**, **Brown Hairstreak** and **Northern Brown Argus**. Species which have increased significantly over the long-term are **Speckled Wood**, **Brimstone**, **Dark Green Fritillary** and **Adonis Blue**. In 2018, there was a 12 percentage point annual increase in the unsmoothed habitat specialist index, whilst the wider countryside measure was up by 15 percentage points.

The farmland and woodland measures for wider countryside species are used as a **biodiversity indicator by the English Government**.

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, of the nine species with significant long-term trends, **Small Tortoiseshell** and **Grayling** have declined, whilst **Peacock**, **Pearl-bordered Fritillary**, **Small Pearl-bordered Fritillary**, **Orange-tip**, **Small Heath**, **Red Admiral** and **Ringlet** have increased.

Looking across all species (including those without significant change) over the long-term, 16 species show positive trends, whilst nine have negative trends. Over the last decade, there is an apparently worsening situation with 19 species having negative trends, with only six showing positive trends. However, no species have significantly increased or decreased, so this 10-year result should be treated with caution.

Small White. *Photograph by Tom Brereton.*

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 the three regular migrants (Table 4). Over the long-term, of the 16 species showing significant change, eight species are in decline, whilst eight are increasing. The declining species are (most severely declining first) **Grayling**, **Dark Green Fritillary**, **Silver-washed Fritillary**, **Small Pearl-bordered Fritillary**, **Large Skipper**, **Wall**, **Small White** and **Small Copper**. The increasing species (most rapid first) are **Orange-tip**, **Pearl-bordered Fritillary**, **Speckled Wood**, **Ringlet**, **Green Hairstreak**, **Green-veined White**, **Comma** and **Red Admiral**.

Over the last decade four species show significant change, with **Brimstone** increasing and **Brown Hairstreak**, **Gatekeeper** and **Small Pearl-bordered Fritillary** declining.

Looking across all species (including those without significant change) over the long-term, 16 species have positive trends, whilst 17 species have negative trends. Over the last decade 13 species show positive trends, whilst 20 species show negative trends.

Pearl-bordered Fritillary. *Photograph by Tom Brereton.*

Brown Hairstreak. *Photograph by Peter Eeles.*

NORTHERN IRELAND

In Northern Ireland, temporal trends (9–15 year periods) are calculable for eight species (Table 5). Over the period, **Green-veined White** has increased significantly whilst **Meadow Brown**, **Small White** and **Small Tortoiseshell** have decreased significantly. Looking across all species (including those without significant change) four species have negative trends, whilst four species show positive trends.

Comma. *Photograph by Jim Asher.*

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 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 2017 to 2018 and long-term (over the entire time series: no. yrs max = 43) 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). Blue text has been used to highlight those species that had their best year in the series

Species	Start Year	No. years with Index in 2018	No. sites monitored in 2018	2018 Rank	% change 2017-2018	Series trend (%)	10-year trend (%)	Mean flight date 2018	Series Mean flight date
Swallowtail	1976	42	25	34	-52	37	-49	21-Jun	05-Jul
Dingy Skipper	1976	43	607	28	-10	-22	-18	29-May	31-May
Grizzled Skipper	1976	43	374	36	33	-55***	-52*	25-May	27-May
Chequered Skipper	2003	16	40	9	-29	-32	-35	27-May	03-Jun
Essex Skipper	1977	42	1020	40	-32	-90***	33	09-Jul	24-Jul
Small Skipper	1976	43	1844	39	-24	-76***	23	06-Jul	20-Jul
Lulworth Skipper	1992	27	23	22	15	-77***	125	11-Jul	28-Jul
Silver-spotted Skipper	1979	40	72	8	87	555***	21	07-Aug	15-Aug
Large Skipper	1976	43	1868	32	7	-27	-18	26-Jun	05-Jul
Wood White	1979	40	69	12	62	-86***	29	28-Jun	17-Jun
Cryptic Wood White	N/A	N/A	15	N/A	N/A	N/A	N/A	07-Jun	03-Jun
Orange-tip	1976	43	1783	8	-7	17	1	12-May	16-May
Large White	1976	43	2442	7	118	-33	-20	12-Jul	21-Jul
Small White	1976	43	2447	7	155	-25	-3	14-Jul	21-Jul
Green-veined White	1976	43	2413	7	63	-12	-27	29-Jun	07-Jul
Clouded Yellow	1979	40	968	19	4	274	102	12-Aug	08-Aug
Brimstone	1976	43	1750	7	5	15	69	23-May	07-Jun
Wall	1976	43	775	33	79	-88***	-20	24-Jul	27-Jul
Speckled Wood	1976	43	2301	3	26	67**	-4	20-Jul	26-Jul
Large Heath	1990	29	41	5	162	439***	-81*	30-Jun	05-Jul
Small Heath	1976	43	1659	13	52	-54***	-9	13-Jul	09-Jul
Mountain Ringlet	N/A	N/A	6	N/A	N/A	N/A	N/A	05-Jul	12-Jul
Scotch Argus	1979	40	41	29	26	82	-51*	01-Aug	07-Aug
Ringlet	1976	43	2265	5	-17	307***	18	05-Jul	14-Jul
Meadow Brown	1976	43	2461	22	-16	-3	34	08-Jul	20-Jul
Gatekeeper	1976	43	2116	38	-20	-46**	-6	19-Jul	31-Jul
Marbled White	1976	43	1190	17	-7	51*	111**	04-Jul	14-Jul
Grayling	1976	43	333	39	57	-73***	-67**	27-Jul	04-Aug
Pearl-bordered Fritillary	1976	43	202	40	-17	-78***	-41	30-May	31-May
Small Pearl-bordered Fritillary	1976	43	237	36	3	-70***	-37*	15-Jun	24-Jun
Silver-washed Fritillary	1976	43	936	5	-9	127***	22	14-Jul	26-Jul
Dark Green Fritillary	1976	43	680	13	15	163***	-32	11-Jul	21-Jul
High Brown Fritillary	1978	41	71	20	21	-67**	271*	10-Jul	15-Jul
White Admiral	1976	43	377	26	13	-70***	-39	01-Jul	15-Jul
Purple Emperor	1979	40	107	7	70	68	-31	08-Jul	20-Jul
Red Admiral	1976	43	2371	30	-75	212**	45	20-Jul	05-Aug
Painted Lady	1976	43	1922	26	-16	46	-72	19-Jul	29-Jul
Peacock	1976	43	2335	41	-25	-5	-34	07-Jun	29-Jun
Small Tortoiseshell	1976	43	2309	41	-38	-78***	-22	12-Jun	08-Jul
Comma	1976	43	2106	17	-33	130***	-17	06-Jul	20-Jul
Marsh Fritillary	1981	38	181	16	39	-13	7	31-May	05-Jun
Glanville Fritillary	1989	30	11	9	32	-10	74	09-Jun	08-Jun
Heath Fritillary	1981	38	46	27	161	-91***	-39	23-Jun	01-Jul
Duke of Burgundy	1979	40	121	19	65	-40**	4	25-May	28-May
Small Copper	1976	43	1946	15	77	-42*	-38	08-Aug	31-Jul
Brown Hairstreak	1983	36	177	33	-5	-37	-48*	26-Aug	25-Aug
Purple Hairstreak	1976	43	648	4	184	-56*	43	15-Jul	30-Jul
Green Hairstreak	1976	43	710	24	46	-45**	-30	21-May	27-May
White-letter Hairstreak	1976	43	291	30	47	-92***	-40	07-Jul	24-Jul
Black Hairstreak	1995	24	13	1	926	188	402	14-Jun	27-Jun
Small Blue	1978	41	295	30	-22	-21	-42	23-Jun	30-Jun
Holly Blue	1976	43	1818	9	55	40	127	29-Jun	29-Jun
Large Blue	1983	36	28	1	58	>1000***	294**	21-Jun	26-Jun
Silver-studded Blue	1979	40	117	4	41	47	44	01-Jul	14-Jul
Brown Argus	1976	43	1097	3	152	-15	25	30-Jul	31-Jul
Northern Brown Argus	1979	40	62	33	21	-61**	-13	29-Jun	11-Jul
Common Blue	1976	43	2159	4	104	-16	-3	20-Jul	23-Jul
Adonis Blue	1979	40	161	11	58	136*	-51	25-Jul	26-Jul
Chalk Hill Blue	1976	43	290	35	1	-12	-45	30-Jul	08-Aug

Table 2. England summary of species abundance changes from 2017 to 2018 and long-term (over the entire time series: no. yrs max = 43) 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). Blue text has been used to highlight those species that had their best year in the series.

Species	Start Year	No. years with Index in 2018	No. sites monitored in 2018	2018 Rank	% change 2017-2018	Series trend (%)	10-year trend (%)
Swallowtail	1976	42	16	33	-54	39	-43
Dingy Skipper	1976	43	572	27	12	-18	-21
Grizzled Skipper	1976	43	365	36	33	-55***	-52*
Essex Skipper	1977	42	990	40	-34	-90***	36
Small Skipper	1976	43	1771	39	-24	-76***	23
Lulworth Skipper	1992	27	23	22	15	-79***	125
Silver-spotted Skipper	1979	40	72	8	87	555***	21
Large Skipper	1976	43	1770	32	7	-26	-20
Wood White	1979	40	69	12	62	-86***	29
Orange-tip	1976	43	1556	10	-7	6	1
Large White	1976	43	2144	7	124	-33	-20
Small White	1976	43	2151	7	152	-21	-4
Green-veined White	1976	43	2065	9	74	-16	-28
Clouded Yellow	1979	40	897	18	18	305	120
Brimstone	1976	43	1695	7	5	12	72
Wall	1976	43	659	34	90	-90***	-32
Speckled Wood	1976	43	2081	3	26	66**	-6
Large Heath	N/A	N/A	7	N/A	N/A	N/A	N/A
Small Heath	1976	43	1419	14	48	-59***	-3
Mountain Ringlet	N/A	N/A	2	N/A	N/A	N/A	N/A
Scotch Argus	1995	24	10	7	236	-71***	-40
Ringlet	1976	43	1986	4	-17	325***	19
Meadow Brown	1976	43	2134	20	-17	-5	38
Gatekeeper	1976	43	1998	38	-20	-50***	-4
Marbled White	1976	43	1176	17	-7	50*	113**
Grayling	1976	43	246	39	38	-62***	-69***
Pearl-bordered Fritillary	1978	41	131	41	-21	-75***	-71*
Small Pearl-bordered Fritillary	1978	41	152	36	-2	-58***	-47*
Silver-washed Fritillary	1976	43	909	5	-11	136***	22
Dark Green Fritillary	1976	43	554	15	9	334***	-25
High Brown Fritillary	1978	41	62	20	21	-67**	277*
White Admiral	1976	43	373	28	10	-70***	-40
Purple Emperor	1979	40	107	7	70	68	-31
Red Admiral	1976	43	2063	30	-75	218***	46
Painted Lady	1976	43	1675	27	-22	38	-73
Peacock	1976	43	2027	42	-26	-6	-38
Small Tortoiseshell	1976	43	1994	41	-39	-78***	-17
Comma	1976	43	1963	20	-34	128***	-17
Marsh Fritillary	1982	37	126	21	25	-66*	-6
Glanville Fritillary	1989	30	6	13	128	-18	3
Heath Fritillary	1981	38	46	27	161	-91***	-39
Duke of Burgundy	1979	40	121	19	65	-40**	4
Small Copper	1976	43	1697	13	74	-38*	-35
Brown Hairstreak	1983	36	160	29	8	-49*	-15
Purple Hairstreak	1976	43	618	5	184	-59*	47
Green Hairstreak	1976	43	630	28	40	-49***	-36
White-letter Hairstreak	1976	43	281	27	55	-92***	-38
Black Hairstreak	1995	24	13	1	926	188	402
Small Blue	1979	40	273	27	-22	-34	-33
Holly Blue	1976	43	1715	9	55	43	137
Large Blue	1983	36	28	1	58	1928***	294**
Silver-studded Blue	1984	35	108	5	63	-17	12
Brown Argus	1976	43	1059	3	157	-13	27
Northern Brown Argus	1979	40	46	34	18	-62**	-17
Common Blue	1976	43	1914	3	110	-14	1
Adonis Blue	1979	40	161	11	58	136*	-51
Chalk Hill Blue	1976	43	290	35	1	-12	-45

Table 3. Scotland summary of species abundance changes from 2017 to 2018 and long-term (over the entire time series: no. yrs max = 40) and short-term (last 10-years) changes. Significance of trends: ***P < 0.001 (very highly significant).

Species	Start Year	No. years with Index in 2018	No. sites monitored in 2018	2018 Rank	% change 2017-2018	Series trend (%)	10-year trend (%)
Grayling	1990	29	20	27	100	-89***	-91***
Small Tortoiseshell	1979	40	153	39	0	-63**	-68*
Dark Green Fritillary	1979	40	71	23	47	-20	-68**
Small Copper	1979	40	112	14	193	-44	-56
Painted Lady	1980	35	109	17	-21	68	-56
Large White	1979	40	126	5	278	53	-54
Small Blue	2005	14	7	6	10	37	-53
Small White	1979	40	127	3	325	36	-50
Meadow Brown	1979	40	153	36	50	-13	-45
Green Hairstreak	1990	29	40	17	12	-26	-41
Scotch Argus	1990	29	31	21	-2	18	-37
Chequered Skipper	2003	16	40	7	-28	-32	-34
Common Blue	1979	40	106	21	29	36	-32
Small Heath	1979	40	118	16	35	94*	-32
Ringlet	1996	23	154	10	44	85*	-23
Peacock	1995	24	148	8	5	105*	-21
Orange-tip	1999	20	135	4	12	248***	-12
Green-veined White	1979	40	185	4	22	8	-10
Comma	2006	13	46	5	96	-15	-6
Speckled Wood	2001	18	54	2	26	13	7
Red Admiral	1980	38	142	15	-72	617***	22
Small Pearl-bordered Fritillary	1979	40	67	16	-3	59*	30
Pearl-bordered Fritillary	2002	17	55	3	-11	81*	31
Northern Brown Argus	1981	38	16	17	53	-46	40
Wall	1999	20	17	2	182	10	216
Dingy Skipper	N/A	N/A	5	N/A	N/A	N/A	N/A
Small Skipper	N/A	N/A	8	N/A	N/A	N/A	N/A
Large Skipper	N/A	N/A	6	N/A	N/A	N/A	N/A
Clouded Yellow	N/A	N/A	9	N/A	N/A	N/A	N/A
Large Heath	N/A	N/A	25	N/A	N/A	N/A	N/A
Mountain Ringlet	N/A	N/A	4	N/A	N/A	N/A	N/A
Marsh Fritillary	N/A	N/A	18	N/A	N/A	N/A	N/A
Purple Hairstreak	N/A	N/A	7	N/A	N/A	N/A	N/A
Holly Blue	N/A	N/A	4	N/A	N/A	N/A	N/A

Small Blue. *Photograph by Tim Melling.*

Scotch Argus. *Photograph by Tim Melling.*

Table 4. Wales summary of species abundance changes from 2017 to 2018 and long-term (over the entire time series: no. yrs max = 43) 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). Blue text has been used to highlight those species that had their best year in the series.

Species	Start Year	No. years with Index in 2018	No. sites monitored in 2018	2018 Rank	% change 2017-2018	Series trend (%)	10-year trend (%)
Dingy Skipper	2004	15	26	14	-26	18	16
Grizzled Skipper	N/A	N/A	9	N/A	N/A	N/A	N/A
Essex Skipper	N/A	N/A	5	N/A	N/A	N/A	N/A
Small Skipper	1984	35	65	33	-10	5	-17
Large Skipper	1977	42	63	34	63	-63***	3
Orange-tip	1978	41	55	6	-19	371***	1
Large White	1976	43	90	7	74	-7	-35
Small White	1976	43	89	7	187	-52**	-9
Green-veined White	1976	43	87	8	-4	183**	-60
Clouded Yellow	N/A	N/A	29	N/A	N/A	N/A	N/A
Brimstone	1998	21	41	1	26	30	82*
Wall	1976	43	57	31	59	-55**	-54
Speckled Wood	1978	41	83	2	18	254***	7
Large Heath	N/A	N/A	5	N/A	N/A	N/A	N/A
Small Heath	1976	43	68	12	105	-1	-26
Ringlet	1983	36	80	11	-35	238***	23
Meadow Brown	1976	43	90	30	19	15	-19
Gatekeeper	1978	41	76	34	0	48	-49
Marbled White	N/A	N/A	12	N/A	N/A	N/A	N/A
Grayling	1976	43	36	24	113	-94***	-9
Pearl-bordered Fritillary	1997	22	16	6	15	293**	15
Small Pearl-bordered Fritillary	1992	27	18	17	33	-79**	-48*
Silver-washed Fritillary	1995	22	19	15	-13	-87*	-36
Dark Green Fritillary	1979	40	38	32	11	-87***	-28
High Brown Fritillary	1995	15	9	13	-37	-4	-38
Red Admiral	1976	43	86	21	-65	133*	38
Painted Lady	1977	41	70	14	59	71	-54
Peacock	1976	43	82	38	-27	-37	2
Small Tortoiseshell	1976	43	88	36	27	-39	-50
Comma	1992	27	63	8	-7	151*	-13
Marsh Fritillary	1990	29	27	14	45	-65	200
Small Copper	1976	43	77	9	156	-52*	-20
Brown Hairstreak	2000	19	17	17	-18	4	-54*
Purple Hairstreak	2002	17	15	13	-28	-54	-53
Green Hairstreak	1993	26	18	7	-2	233*	86
White-letter Hairstreak	N/A	N/A	6	N/A	N/A	N/A	N/A
Small Blue	N/A	N/A	9	N/A	N/A	N/A	N/A
Silver-studded Blue	N/A	N/A	9	N/A	N/A	N/A	N/A
Holly Blue	1999	20	48	6	0	-28	115
Brown Argus	1997	22	16	2	216	25	94
Common Blue	1976	43	77	9	94	-13	-42

Table 5. Northern Ireland summary of species abundance changes from 2017 to 2018 and long-term (over the entire time series: no. yrs max = 15) 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). Blue text has been used to highlight those species that had their best year in the series.

Species	Start Year	No. years with Index in 2018	No. sites monitored in 2018	2018 Rank	% change 2017-2018	Series trend (%)	10-year trend (%)
Dingy Skipper	N/A	N/A	3	N/A	N/A	N/A	
Cryptic Wood White	N/A	N/A	15	N/A	N/A	N/A	
Orange-tip	2007	12	29	9	3	-44	
Large White	2006	13	38	7	32	-44	
Small White	2006	13	37	4	103	-65*	
Green-veined White	2005	14	41	3	0	103*	
Clouded Yellow	N/A	N/A	2	N/A	N/A	N/A	
Wall	N/A	N/A	1	N/A	N/A	N/A	
Speckled Wood	2007	12	41	3	-2	32	
Large Heath	N/A	N/A	2	N/A	N/A	N/A	
Small Heath	2004	15	21	7	62	-49	
Ringlet	2006	13	41	6	-11	92	
Meadow Brown	2009	10	41	9	27	-51*	
Grayling	N/A	N/A	6	N/A	N/A	N/A	
Silver-washed Fritillary	N/A	N/A	8	N/A	N/A	N/A	
Dark Green Fritillary	N/A	N/A	14	N/A	N/A	N/A	
Red Admiral	N/A	N/A	38	N/A	N/A	N/A	
Painted Lady	N/A	N/A	27	N/A	N/A	N/A	
Peacock	2006	13	35	3	114	-59	
Small Tortoiseshell	2010	9	40	7	66	-71**	
Marsh Fritillary	2004	15	9	1	288	16	
Small Copper	2005	14	21	4	457	-76	
Purple Hairstreak	N/A	N/A	1	N/A	N/A	N/A	
Green Hairstreak	N/A	N/A	3	N/A	N/A	N/A	
Holly Blue	N/A	N/A	12	N/A	N/A	N/A	
Common Blue	2005	14	19	7	75	-27	

Red Admiral. *Photograph by Mark Gunn.*

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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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