United Kingdom
Butterfly Monitoring Scheme

Annual Report 2021

UKBMS Annual Report 2021

The UKBMS

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

The members of the UKBMS Steering Group in 2021 were Ian Middlebrook, Megan Lowe, Richard Fox and Nigel Bourn (BC), David Roy and Marc Botham (CEH), David Noble and Sarah Harris (BTO), Anna Robinson and Kirsi Peck (JNCC), Jon Curson (NE), Dylan Lloyd (NRW), Simon Foster (NatureScot), Pauline Campbell (DAERA), Colin Edwards (SF) and Jay Doyle (FC).

Team for 2023

Overall project management, conservation uses, biodiversity indicators:
Ian Middlebrook, Butterfly Conservation, Manor Yard, East Lulworth, Wareham, Dorset, BH20 5QP.
Tel: 01929 406032,
email: imiddlebrook@butterfly-conservation.org

UKCEH project management and research uses:
Dr David Roy, UK Centre for Ecology & Hydrology, Maclean Building, Benson Lane, Crowmarsh Gifford, Wallingford, Oxfordshire, OX10 8BB.
Tel 01491 692517, email: ukbms@ceh.ac.uk

General enquiries, support for recorders and co-ordinators:
Rachael Conway, Butterfly Conservation, Manor Yard, East Lulworth, Wareham, Dorset, BH20 5QP.
Tel: 07557 271464, email: transect@butterfly-conservation.org

Data requests and species trends:
Dr Marc Botham, UK Centre for Ecology & Hydrology, Maclean Building, Benson Lane, Crowmarsh Gifford, Wallingford, Oxfordshire, OX10 8BB.
Tel 01491 692517, email: ukbms@ceh.ac.uk

Wider Countryside Butterfly Survey (Butterfly Conservation squares):
Rachael Conway, Butterfly Conservation, Manor Yard, East Lulworth, Wareham, Dorset, BH20 5QP.
Tel: 07557 271464, email: survey@butterfly-conservation.org

Wider Countryside Butterfly Survey (Breeding Bird Survey squares):
James Heywood, British Trust for Ornithology, The Nunnery, Thetford, Norfolk, IP24 2PU.
email: bbs@bto.org

Citation

Middlebrook, I., Botham, M.S., Brice, C., Conway, R., Downey, B., Fox, R., Heywood, J., Lowe, M., Noble, D., Peck, K., Robinson A., & Roy, D.B. 2022. United Kingdom Butterfly Monitoring Scheme report for 2021. Butterfly Conservation, UK Centre for Ecology & Hydrology, British Trust for Ornithology and Joint Nature Conservation Committee.

This report can be downloaded from
https://ukbms.org/publications

UKBMS partners

Butterfly Conservation, Manor Yard, East Lulworth, Wareham, Dorset, BH20 5QP
www.butterfly-conservation.org

UK Centre for Ecology & Hydrology, Maclean Building, Benson Lane, Crowmarsh Gifford, Wallingford, Oxfordshire OX10 8BB
www.ceh.ac.uk

British Trust for Ornithology, The Nunnery, Thetford, Norfolk, IP24 2PU
www.bto.org

Joint Nature Conservation Committee, Monkstone House, City Road, Peterborough, PE1 1JY
www.jncc.gov.uk

Painted Lady. *Photograph by Mark Searle.*

Acknowledgements

We would like to acknowledge the financial contribution by the Joint Nature Conservation Committee, Butterfly Conservation, the British Trust for Ornithology and the UK 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.
Finally we would like to thank Rachel Still at WILDGuides for designing the report, and Mark Searle for allowing his images to be used in this report.

Cover photograph of Glanville Fritillary. In 2021 this butterfly recorded its best year in England since monitoring began. *Photograph by Mark Searle.*

Contents and Online Resources

Brown Argus. *Photograph by Mark Searle.*

Adonis Blue. *Photograph by Mark Searle.*

Online Resources

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

For the Wider Countryside Butterfly Survey go to
https://ukbms.org/wider-countryside-butterfly-survey

For online data entry go to
https://ukbms.org/MyData

For information on Biodiversity Indicators go to
https://jncc.gov.uk/our-work/uk-biodiversity-indicators/

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

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

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

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

Joint Nature Conservation Committee:
https://jncc.gov.uk/

UKBMS News

HIGHLIGHTS IN NUMBERS

46
The number of years of data contributing to the UKBMS

235
The number of days on which UKBMS counts were made in 2021

2,918
The number of UKBMS locations monitored in 2021

6,325
The total number of UKBMS locations monitored across all years

37,820
The number of recording visits made to standard transects and WCBS squares in 2021

1,843,178
The number of butterflies counted on standard transects and WCBS squares in 2021

CHANGES TO THE WCBS SUPPORT TEAM AT BUTTERFLY CONSERVATION AND BTO

After two years of supporting Butterfly Conservation's WCBS volunteers, Megan Lowe has moved on to a different role within the organisation. Megan's responsibilities have now been taken on by Rachael Conway, in addition to the support she was already providing for volunteers and co-ordinators with respect to traditional transects. Having one person as the primary point of contact across all types of transect walking should lead to greater flexibility and easier prioritisation of tasks, as well as some efficiency savings.

Likewise, there have been changes at the BTO, with Sarah Harris moving to a new role in the organisation after over eight years supporting WCBS volunteers through the Breeding Bird Survey. Her responsibilities are now taken on by James Heywood – a welcome addition to the UKBMS team.

We thank both Sarah and Megan for their fantastic contributions to the UKBMS over those years and wish them well in their new roles.

SURVEY OF UKBMS PARTICIPANTS

Butterfly Conservation recently carried out a participant survey in order to document the demographics of its volunteer base, and to understand how volunteers engage with different schemes. UKBMS volunteers were a target group for this survey, and we are very grateful to the 788 of you who responded to the questionnaire. We will use the results of this work to make improvements to the UKBMS, where they are required.

Some of the background information on our volunteers made interesting reading. It's always rewarding to see that people enjoy taking part in the UKBMS enough to hang around, with 20% of our recorders having been with the scheme for over a decade. It should be no great surprise that the things volunteers enjoy most about carrying out their UKBMS surveys are seeing butterflies, being outdoors and supporting wildlife conservation (see Figure 1).

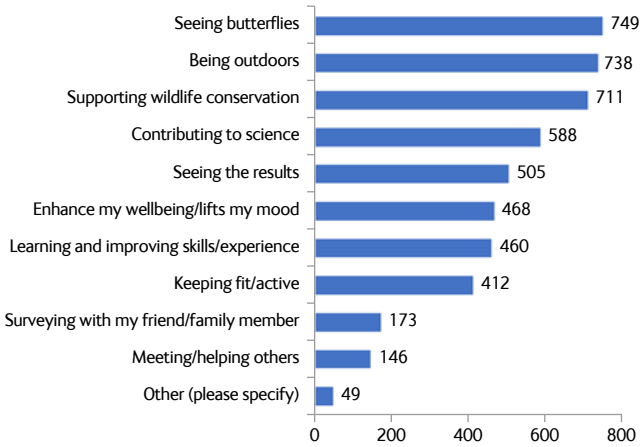


Figure 1. Showing what UKBMS participants enjoy most about their surveys (from 788 respondents – selecting all reasons that apply).

Recruits to the UKBMS come from a wide variety of sources, but it's clear Butterfly Conservation plays a large role in this, with 36% of volunteers saying they found out about the UKBMS directly through their local Butterfly Conservation branch and another 13% through workshops, while 15% of volunteers came to the scheme through family and friends.

When asked about 'challenges' to UKBMS participation, the most frequently cited issue was finding suitable weather conditions for the surveys! 50% of respondents chose this option, while the next most common challenges were competing time pressures – either from other volunteer opportunities, family life or work commitments.

Participants were also asked about the UKBMS Annual Report and again the feedback was extremely positive, with over 95% agreeing that the report is an enjoyable read and well-presented. The most popular articles proved to be the species-by-species review of the butterfly season and the long-term trends.

In terms of rating their experience as part of the UKBMS, over 90% of participants agreed that they enjoyed their surveys, understood the objectives of the UKBMS, found the methods simple to follow and would recommend others to participate. Whilst all feedback

here was overwhelmingly supportive, the statements that drew the least positive responses relate to receiving sufficient training for participation or feedback on results.

In a similar vein, volunteers were asked what would help to improve their experience in the UKBMS. There were some common themes amongst the responses here, such as more training materials, better feedback charts on the website and the option to enter data whilst in the field. We have taken all these comments on board and will progress them as resources allow. In fact, we are already working to develop more training materials in the form of videos, and to improve some visual aspects of the website.

RECRUITING AND INSPIRING UKBMS VOLUNTEERS

Bill Downey has spent the last eight years supporting UKBMS as both Transect Co-ordinator and WCBS Champion for Butterfly Conservation's local branch in Surrey & SW London. Here he details his approach and experiences in recruiting, supporting and inspiring the volunteers in his patch.

"I came to my current role, not via the branch, but through being a conservation volunteer with my local Wildlife Trust – an advantage that gave me a ready-made range of contacts with land managers and conservation bodies.

If you have crawled across a reserve zapping scrub, it is impossible not to develop some feelings for the site, and quite natural to want to see the fruits of your labour rewarded with knowledge of the species you may be benefitting. Thus, conservation volunteering and species monitoring are really two sides of the same coin. This works particularly well for butterflies as the main habitat work takes place October to March (ending when bird nesting intervenes) and monitoring from April to September.

I get most of my new recorders through liaison with conservation bodies and it is immaterial to me whether or not they are Butterfly Conservation members. Often these people are birders or botanists – groups that already have a well-developed culture of recording. There seems to be a perception in the branch that the county is stuffed full of expert entomologists just waiting for the call to walk a transect. If only!

The trick is to find people who are active, enthusiastic, have enough time at their disposal and are willing to learn. Then, based on your assessment of their existing skill sets, provide training in ID and methodology and support their subsequent development.

It is key to build up the confidence of new walkers. Many people coming into the scheme are unsure of their ID skills and are intimidated by the proximity of what they perceive as 'experts'. New recorders will make mistakes and it is necessary to give them a safety net: ensuring their submissions will be checked for anything untoward and that there is no question of their being 'shamed' for making an ID error.

I also think it is necessary to be upfront about the commitment involved. A weekly walk across the season – either for an individual or a group – is a major commitment, and we should not pretend otherwise.

The demands of the methodology also mean that transect walking is not necessarily easy – something I don't think is always conveyed by one-day Zoom courses. Everybody faces the same problem of finding time to walk during suitable weather conditions and fitting this in with whatever else is going on in their lives. You can't just block off your free Tuesday afternoons – it doesn't work like that.

On the other hand, there are real benefits to becoming a transect walker. You go on a steep learning curve but improve very quickly with regular practice. The discipline of a weekly walk soon translates into a deep knowledge of your site and how it changes week by week through the season. Exercising your noticing muscle (not unlike a form of mindfulness) means you progressively see and understand more about the natural world – not just butterflies and day flying moths, but other taxa as well.

I was unsure myself about transect walking when I first started. Then in week three, a Grizzled Skipper (the first I had ever seen) alighted next to me on the bench where I was sitting. It was a great moment and the first of many such through the years. And it is these moments you remember at the end of the season – not the days you set out from home in sunshine and arrive at your site to find it raining.

Recruiting and training new walkers is arguably the easy bit. The real trick to developing and retaining walkers is to match them to a route that is suitable for them and doable by them. Most want to walk something that is close to them. Some do not have the physical capacity to walk more than a few kilometres or up steep slopes. You may not want to put a new walker on a site that has rare species.

It is important to match volunteers with a transect that they feel good about and want to do. It is not easy, and it may take time. Particularly if you are prioritizing the continuation of long-standing transects over the creation of new routes.

It is important as well to create a communication channel with all walkers – not made easier by the advent of GDPR. In my first year of transect walking (before I became Co-ordinator) I soon realised this could be quite a lonely undertaking and that it would be good to chew the cud with others doing the same. So, I have developed a mailing list to send out periodic messages, news, tips etc. Walkers need to know that somebody looks at the data they submit (it doesn't just go into a black hole) and that they can contact me with any sort of query – which they frequently do.

Each participant needs to know that they are contributing to a greater whole. I have shied away from meetings given people's geographic dispersal – although video conferencing now

makes this more feasible. What I have started doing – and the feedback is good – is to produce a monthly report during the season (no more than a series of bullet points) on the progress of the butterfly year. My observations are limited to the four routes which I walk – so I am very happy for others to submit theirs or to disagree with mine.

My efforts don't always work of course. Some people don't take to transect walking or get bored with it. One stopped because he told me it was making him depressed.

However, when you successfully match somebody to a site, they grow into it and find that they love doing it – that is the most rewarding part of my role and what keeps me going. With practice, experience and a bit of support, people improve over time and produce better quality data as a result. As Transect Co-ordinator, I feel I am helping to connect people with nature, provide a reason for them to get outside and contribute to the national data set too. What's not to like?

I always remember and am grateful to that Grizzled Skipper. After my third ever walk I realised that there was nothing else I would rather be doing".

UK POLLINATOR MONITORING SCHEME

Butterfly Conservation are partners in the UK Pollinator Monitoring Scheme (PoMS), which began in 2017 and is the first scheme in the world to generate systematic data on the abundance of bees, hoverflies and other flower-visiting insects at a national scale. Data are collected across two survey methodologies – the Flower-Insect Timed Count (FIT Count) and the 1-km Square Survey.

The FIT Count is a simple 10-minute survey to collect data on pollinator numbers across the UK, recording all flower visitors to group level on a patch of target flowers. FIT Counts work equally well in rural or urban locations, and can be done in warm, dry weather any time from April to September. All the FIT Count materials and video guides are available on the PoMS website. Counts can be done using a printed recording form, and entered online or via the FIT Count app.

The 1-km Square Surveys take a systematic approach, using pan-traps to capture samples of insects from a set of 95 1-km squares across the UK.

More details on the scheme and the different methodologies can be found here: **https://ukpoms.org.uk/**

POMS
UK Pollinator Monitoring Scheme

RESEARCH PUBLICATIONS

With the publication of **The State of the UK's Butterflies 2022**, Butterfly Conservation charts the latest abundance and distribution trends of the UK's 59 species of butterfly, using millions of citizen-science observations derived from long-running, countrywide schemes, including the UKBMS.

Some of the headline results are quite alarming, with 80% of butterfly species having decreased in abundance or distribu tion over the period 1976-2019. These decreases are particularly dramatic amongst habitat specialists, and England's butterflies have fared worse than those in other parts of the UK. Despite this gloomy picture, the report presents numerous examples where targeted species conservation action can turn around the fortunes of threatened butterflies.

The full 28-page report can be viewed or downloaded from the Butterfly Conservation website: **State of UK Butterflies 2022 Report.pdf**

The following new research using UKBMS data has been published since the last UKBMS Annual Report:

Dennis, E.B., Fagard-Jenkin, C. & Morgan, B.J.T. (2022). rGAI: An R package for fitting the generalized abundance index to seasonal count data. *Ecology and Evolution* 12:e9200

Fox, R., Dennis, E.B., Brown, A. & Curson, J. (2022). A revised Red List of British butterflies. *Insect Conservation and Diversity* 15:485-495

Fox R., Dennis E.B., Purdy K.M., Middlebrook I., Roy D.B., Noble D.G., Botham M.S. & Bourn N.A.D. (2023). *The State of the UK's Butterflies 2022*. Butterfly Conservation, Wareham, UK

Hetherington, M., Sterling, P. & Coulthard, E. (2021). Butterfly colonisation of a new chalkland road cutting. *Insect Conservation and Diversity* 15:191-199

Macgregor, C.J., Bunting, M.J., Deutz, P., Bourn, N.A., Roy, D.B. & Mayes, W.M. (2021). Brownfield sites promote biodiversity at a landscape scale. *Science of The Total Environment* 804:150-162

Redhead, J.W., Hinsley, S.A., Botham, M.S., Broughton, R.K., Freeman, S.N., Bellamy, P.E., Siriwardena, G., Randle, Z., Nowakowski, M., Heard, M.S. & Pywell, R.F. (2022). The effects of a decade of agri-environment intervention in a lowland farm landscape on population trends of birds and butterflies. *Journal of Applied Ecology* 59:2486-2496

UKBMS background and methods

DATA COLLECTION

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 original Butterfly Monitoring Scheme (BMS), operated by the Institute of Terrestrial Ecology (ITE), started in 1976. This scheme was rebranded as the UKBMS in 2006 when the Centre for Ecology & Hydrology (now UKCEH – successors to ITE) joined forces with Butterfly Conservation and, supported by JNCC and government agencies, incorporated all the additional butterfly monitoring data that Butterfly Conservation had been collating into the scheme. Trends in butterfly populations are now compiled from a network of 6,325 locations across all years, including 2,918 sample locations in 2021.

The majority of sites are monitored by butterfly transects, also known as 'Pollard walks'. The standard transect method involves weekly butterfly counts along fixed routes through the season made under strict criteria for weather conditions, recording area and time of day (Pollard & Yates 1993). Where possible, counts should be made each week from 1st April through to 29th September. The gaps in transect counts (i.e. weeks without data) due to periods of unsuitable weather or recorders being unavailable, are accounted for within the analysis of trends.

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. These include 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 carried out on single days in suitable weather 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 also been incorporated into the UKBMS.

Most site-based monitoring has historically been biased towards good quality semi-natural habitat relatively rich in butterflies, which does not accurately reflect the UK countryside as a whole, so the Wider Countryside Butterfly Survey (WCBS) was established in 2009 to improve the representativeness of our sampling network. In the WCBS, Butterfly Conservation recorders are allocated randomly selected 1km squares, whilst recorders from the BTO are given the opportunity to survey their existing Breeding Bird Survey squares, which have also been randomly selected. Surveyors are required to walk a standardised route across these squares, following the same methodology and criteria as standard transects. This should be done at least twice over the July and August period, while additional spring visits are also encouraged. 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.

SPECIES INDICES AND TRENDS

Techniques for analysing the UKBMS data have developed rapidly in recent years, with increased computing power allowing more complex statistical models to be applied to the data.

Weekly counts for each species are summed to generate annual site abundance indices. For sites with missing weekly counts, a Generalised Additive Model (GAM) is used to impute the missing values and to calculate a site index (Rothery & Roy 2001).

Since 2017, the compilation of annual species indices has used a Generalised Abundance Index (GAI) method developed by Dennis et al. (2016). There is an additional modification in the final stage of analysis, such that data are weighted relative to the proportion of the species flight period surveyed that year for that site. All butterfly counts collected at both UKBMS sites and WCBS squares are used to estimate the seasonal pattern of butterfly abundance for that year, and this is used to extrapolate from observed data to account for gaps in the recording. This ensures that observed data have a stronger effect upon the final indices than extrapolated data. This new method is used for all species and utilises data from all survey types.

Brown Hairstreak can be monitored by winter egg counts. *Photograph by Mark Searle.*

COMPOSITE MEASURES OF BUTTERFLY ABUNDANCE

Multi-species (composite) indices of butterfly abundance are calculated using a Generalised Linear Model (GLM) 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, sites are further categorised by broad habitat groupings (farmland and woodland) (Brereton *et al.* 2011). Within these measures, each individual species trend is given equal weight, and the annual figure is based on 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.

To identify underlying patterns in composite population trends, assessment of change is based on trends in the underlying smoothed indices. The calculation of smoothed indices, trends and confidence intervals 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 all other years in the series.

Analysis and modelling methods are constantly evolving and alternative methods are being tested, such as those proposed by Freeman *et al.* (2021).

These composite measures are increasingly used by government agencies as one of the indicators of the health of our national biodiversity. The most recently published indicators can be found via these links:

UK Biodiversity Indicators: C6. Insects of the wider countryside (butterflies)
https://jncc.gov.uk/our-work/ukbi-c6-insects-of-the-wider-countryside/

England Biodiversity Indicators: 5. Farmland species
England Biodiversity Indicators: 6. Woodland species
https://www.gov.uk/government/statistics/england-biodiversity-indicators

Scotland's Indicators: Terrestrial Insect Abundance – Butterflies
https://www.nature.scot/doc/scotlands-indicators-terrestrial-insect-abundance-butterflies

Brereton T.M., Roy D.B., Middlebrook, I., Botham, M. & 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., 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.

Freeman, S.N., Isaac, N.J.B., Besbeas, P., Dennis, E.B. & Morgan, B.J.T. (2021). A generic method for estimating and smoothing multispecies biodiversity indicators using intermittent data. *Journal of Agricultural Biological and Environmental Statistics* 26(1)

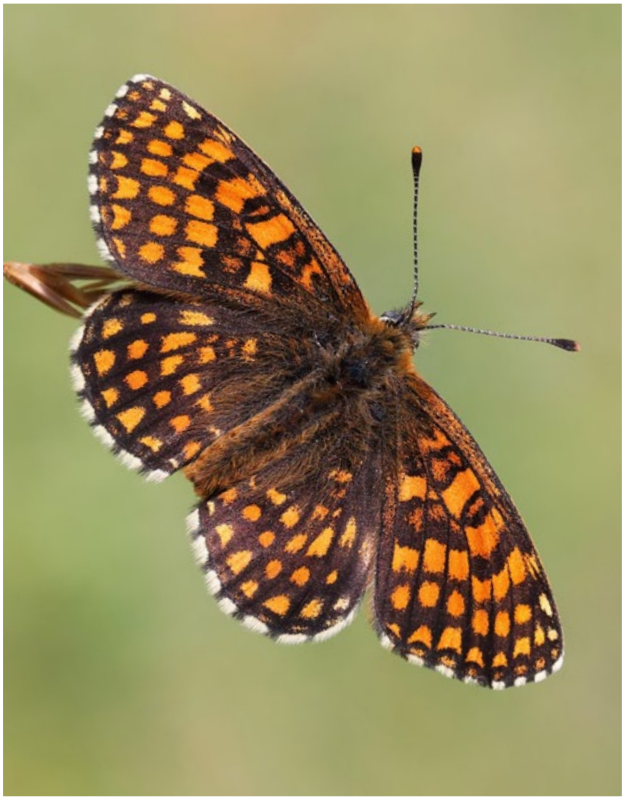
Lewis, O.T. & Hurford, C. (1997). Assessing the status of the Marsh Fritillary (*Eurodryas aurinia* Rott.) – an example from Glamorgan (UK). *Journal of Insect Conservation* 1:159–161.

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.



Heath Fritillary. *Photograph by Mark Searle.*

The 2021 Season

UKBMS SAMPLE COVERAGE IN 2021

Standard transects

The number of standard transect sites in the UKBMS rose to 1,917 in 2021. This represents a new all-time record, and a remarkable bounce back (a rise of 24%) from the COVID affected season of 2020, when only 1,544 transect sites were monitored (a rise of 24%). The number of walks was also very high in 2021 at 36,021, though not quite returning to the record figure of 36,761 from 2019.

At the country level, there were 1,647 standard transect sites in England, 146 in Scotland, 56 in Wales, 30 in Northern Ireland, 37 from the Channel Isles and one on the Isle of Man. Nearly all branches of Butterfly Conservation returned data from more transects in 2021 than the previous year, and the West Midlands branch have now jumped into the top five at the expense of Dorset.

Rank	Butterfly Conservation Branch	No. of transects in 2021 (change from 2020)
1	Hampshire & Isle of Wight	177 (+25)
2	East Midlands	163 (+18)
3	Surrey & SW London	127 (+13)
4	West Midlands	85 (+15)
5	Upper Thames	84 (+12)

There were 195 new transects that contributed to the scheme for the first time in 2021 – comprising 161 in England, 26 in Scotland, six in Wales and two in Northern Ireland. This is great testament to the work that our Branch Co-ordinators are doing to promote the UKBMS in their local area, with Ken Orpe (East Midlands) and Nick Hall (Yorkshire) leading the way.

Rank	Butterfly Conservation Branch	No. of transects new to the scheme in 2021
1	East Midlands	25
2	Yorkshire	18
3	East Scotland	15
4	Kent & SE London	13
5	Cheshire & The Wirral	12

The seasonal pattern of recording was adversely affected by the poor spring weather, with four of the weeks in April and May seeing fewer than 1,000 transect walks (see figure 2), although counts from over 500 walks were returned from each of 19th and 23rd April. The most popular days for transect walking during the year were Weds 23rd June (757 walks) and Tues 10th August (618 walks).

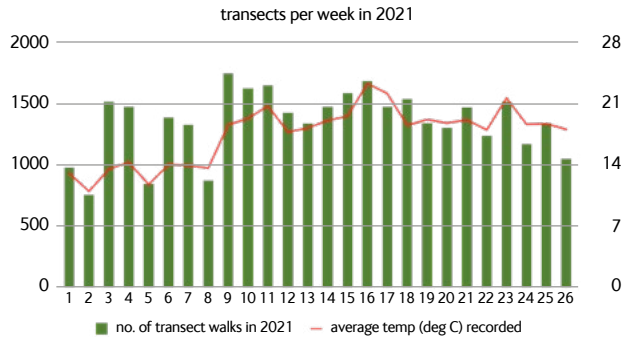


Figure 2. The number of standard transect walks per week in 2021 and the average temperature (°C) recorded (week 1 begins 1st April).

Wider Countryside Butterfly Survey (WCBS) squares

The WCBS ran for a 13th year in 2021, supplying count data that contribute towards our collated indices – chiefly for common and widespread species. The number of squares visited during 2021 increased by more than 70 from the previous year, up to 790 squares which is just above average over the scheme's history. The total number of visits increased by 13.5% to 1,811. This was a welcome bounce back after the previous COVID-hit season.

The number of squares surveyed by BTO/JNCC/RSPB Breeding Bird Survey volunteers rose to 285 (up 34 from 2020), while Butterfly Conservation volunteers surveyed 505 squares (up by 39). At the country level, there were a total of 687 squares surveyed in England (up by 47 compared with 2020), 52 in Scotland (+5), 34 in Wales (+16), 16 in Northern Ireland (+5), and one on the Isle of Man (same as 2020).

Over the core period of July and August, 628 squares (79% of the total) received the required two visits, during which 92,057 butterflies of 44 species were recorded (the same number of species as 2020). There were also 306 spring visits to 199 squares, targeting early flyers, with Orange-tip being recorded in 84 of these squares.

Small Copper was recorded in every week of the transect season in 2021.
Photograph by Mark Searle

Additional monitoring data for key species

Additional (non-transect) monitoring data were received from 216 sites, which was a drop of 8% from the previous year. These included adult timed counts, egg counts and larval web counts. The greatest loss was in the number of egg counts received for both **Brown Hairstreak** and **Large Blue**. The number of **Brown Hairstreak** egg counts fell by 30, but this is partly due to the COVID restrictions in place over the winter of 2020/2021. No **Large Blue** egg counts were received. **Marsh Fritillary** web counts were received from 100 sites (up from 92 in 2020), including all four countries of the UK, while the number of timed counts for **Heath Fritillary**, **High Brown Fritillary** and **Duke of Burgundy** remained on a par with the previous year.

Duke of Burgundy. *Photograph by Mark Searle.*

Overall, the monitoring levels in 2021 represented a great bounce back from the disruption of the previous year. With over 2,900 sites being monitored, it ranked as the third highest figure across the history of the scheme (see figures 3 and 4). It is clear that many of our volunteers kept to their promise, after 80% of those who were unable to take part during 2020 expressed their intention to return to the scheme once it was safe to do so.

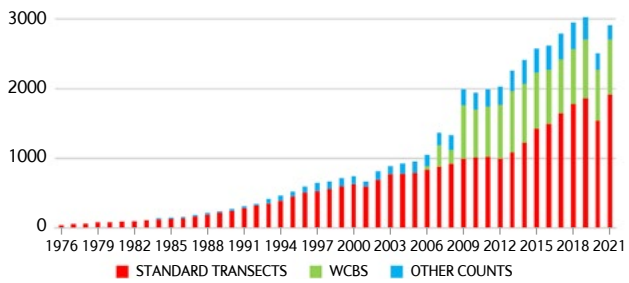


Figure 3. The total number of sites monitored by the UKBMS each year.

THE WEATHER IN 2021

The winter preceding the 2021 butterfly season was unsettled and characterised by cold temperatures and high rainfall. Storm Bella swept in from the Atlantic on Boxing Day with strong winds and heavy rain. Across the UK we had the coldest January since 2010, with a mean temperature of just 2.2 °C. February also brought a very cold spell, with heavy snow in some areas, before becoming much milder. Overall, the winter was very wet, with some areas experiencing twice their average rainfall, especially on the eastern side of Britain.

A warm spell at the end of March, reaching a peak temperature of 24.5 °C at Kew Gardens (London), brought a false start to the 2021 butterfly season. Unfortunately, it soon turned very cold, with the highest number of April air frosts since 1960. The low temperatures made it difficult for recorders to match the UKBMS weather criteria, despite it being the sunniest April since 1919. The cold weather continued into May, which was made worse by being a very wet month (the fourth wettest May since 1862) with strong winds also affecting conditions – a gust of 93mph being recorded at The Needles (Isle of Wight).

The summer months brought some improvements to the weather, although south-east England did not benefit to the same degree as other parts of the UK. While most areas had a relatively dry June, the south-east was very wet, with more than double the usual rainfall in some areas. July brought warm temperatures mixed with numerous thunderstorms, and Northern Ireland reported its highest recorded temperature of 31.3 °C at Castlederg (Co. Tyrone).

August was a rather mixed month, initially fairly wet, but later settling into dry and dull conditions. Several weather stations in central and eastern England recorded the lowest August sunshine figures for 60 years. Temperatures were average for the time of year in most areas, but around 1.5 °C below average in south-east England. September provided a late flourish to the transect season, being the second warmest September since 1884 across the UK. Mean temperatures were 2.1 °C above average, with maximum temperatures nearly 3 °C higher than normal in the East Midlands.

Adapted from the monthly and season summaries published by the Met Office:

https://www.metoffice.gov.uk/research/climate/maps-and-data/summaries/index

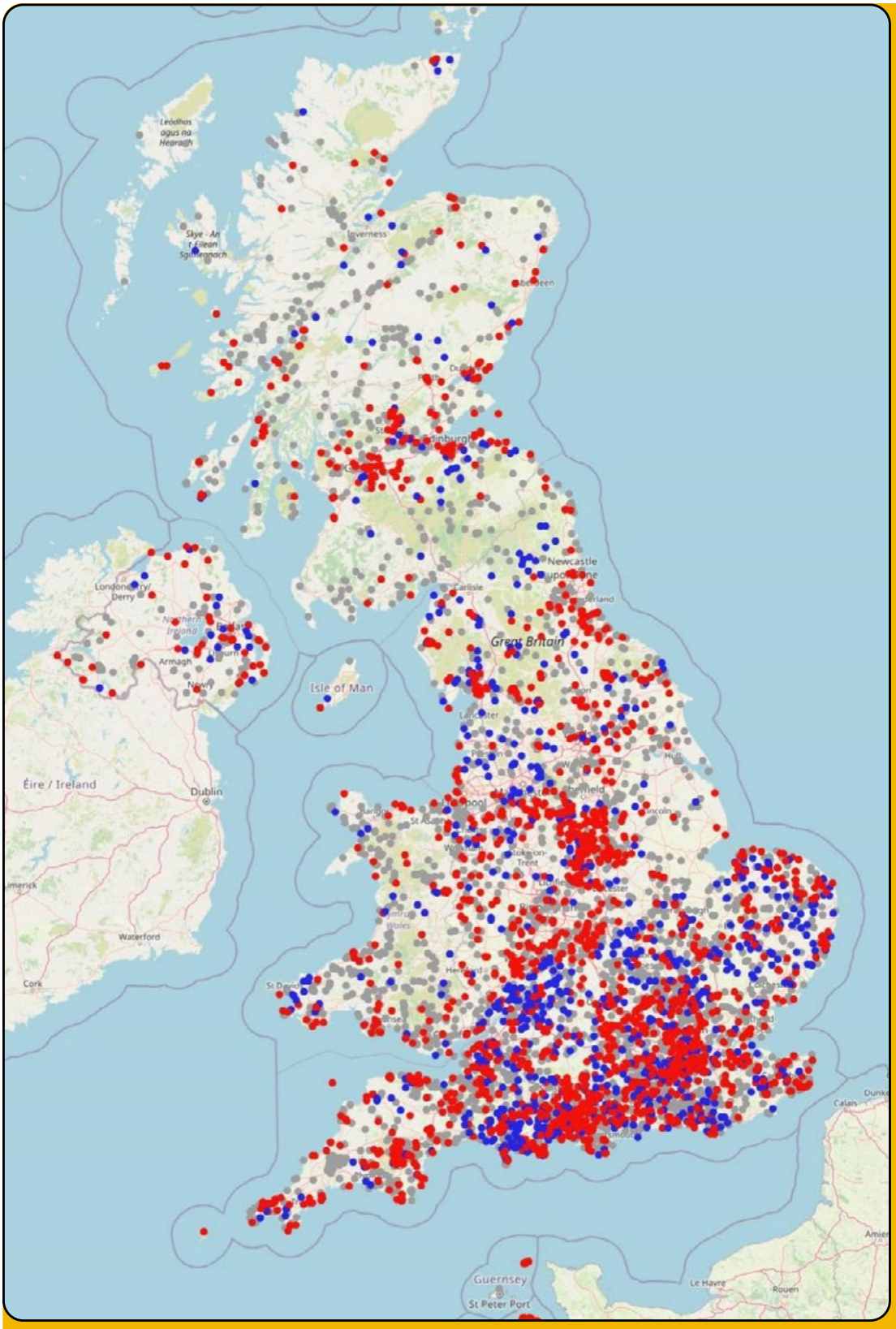
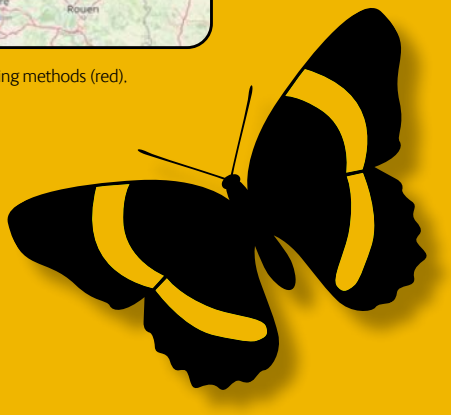


Figure 4. Location of UKBMS monitored sites in 2021. WCBS squares (blue), standard transects and other monitoring methods (red), previously monitored sites and squares (grey).



BUTTERFLY COUNTS IN 2021

Summary

Overall, 2021 was an unremarkable year for butterflies, ranking slightly below average as the 28th best year since 1976. At UK level, 22 species were recorded in above average numbers, while 32 species fared worse than their long–term average. The cold weather in April meant that many species emerged somewhat later than the previous year.

National trends were calculated for 56 of the 59 resident species and regular migrants. At the UK level none of them had either their best or worst year on record, although **Dark Green Fritillary** and **Glanville Fritillary** both recorded their second best year in 2021. Three species had their third best year – **Brown Hairstreak**, **Black Hairstreak** and **Chalk Hill Blue** while **White Admiral** suffered its third worst year.

At the country level, **Dark Green Fritillary** and **Glanville Fritillary** recorded their best years in England, as did **Wall** and **Small Pearl-bordered Fritillary** in Scotland. In Northern Ireland, **Speckled Wood** recorded its joint second best year, though this is over a shorter time period.

It was not possible this year to produce UK trends for **Large Blue** or **Chequered Skipper**, nor for **High Brown Fritillary** in Wales. This was largely down to data not being provided in time for analysis, although work needs to be done to revive monitoring effort for **Chequered Skipper** in Scotland.

The following species summaries for 2021 are based entirely on monitoring data submitted to the UKBMS.

Family: Papilionidae (Swallowtails)

Swallowtail was recorded on eight transect sites in *Norfolk*, the earliest sighting being on 3rd June at *Sutton Fen*, which also recorded the year's highest count of 20 on 23rd June. *Catfield Fen* was just one behind, with 19 recorded on 5th July. The last count in *Norfolk* came at *How Hill* on 2nd August, but there were several counts in *Jersey* after that date, ending on 15th September at *Les Landes*. There was also a confirmed record of either an immigrant or released individual at *Berry Head* (*Devon*) on 22nd July.

Family: Hesperiidae (Skippers)

The first transect counts for **Dingy Skipper** came on 19th April at *Lydden Hill* (*Kent*) and *Hod Hill* (*Dorset*). *Barbury Castle* (*Wilts*) again recorded the highest weekly counts of the year, with 69 seen on 30th May, rising to 91 on 5th June. That date also saw the highest count in the East Midlands, when 47 were recorded at *Hoe Grange Quarry* (*Derbys*). *Ettington Cutting North* (*Warks*), *Boscombe Down* (*Wilts*) and *Buttlers Hanging* (*Bucks*) all saw weekly counts above 50. There was a small second brood at a few sites, most notably in *Dorset*, where the final individuals were recorded on transect at *Bindon Hill* on 12th September.

Grizzled Skipper made its first appearance of the year in Wales, on 15th April at *Merthy Mawr NNR* (*Mid Glamorgan*), followed two days later in England at *Oxted Downs* (*Surrey*). The highest weekly count came from *Giant Hill* (*Dorset*), where 22 were recorded on 30th May. *Ningwood Common* (*Isle of Wight*) and *Dean Hill* (*Wilts*) also saw counts above 20, on 1st June and 12th June respectively. Several sites continued to record this species into July, with the final transect count coming on 19th July at *Cheddar Wood* (*Somerset*).

We only received six counts from five sites for **Chequered Skipper** in time for our analysis (including three transect routes and two timed counts) and were unable to produce a trend for this species. The first of these counts came from *Glenborrodale* (*Highland*) on 26th May, and the last count from *Polldubh* (*Highland*) 18th June. Data subsequently provided by *Glasdrum* (*Argyll & Bute*) revealed a season spanning from 16th May to 28th June, with a peak count of 59 on 31st May.

The earliest transect record for **Essex Skipper** came from *Roding Valley Meadows* (*Essex*) on 2nd June, though it was not seen again on transects until 14th June at *St Ouen's Pond* (*Jersey*). *Gibraltar Point* (*Lincs*) once again recorded the highest single transect count, with 171 seen on 17th July. There were two WCBS squares which also recorded counts of over 100 – both in *Suffolk* – *TM2147* and *TL7673*, whilst *Hurst Meadows* (*Surrey*) recorded two weekly counts above 75. There were a handful of records beyond August, with the final transect count coming on 12th September at *Lullington Heath* (*East Sussex*).

It was a good year in *Cornwall* for **Small Skipper**, with the first transect record of 2021 on 14th May at *Lundy Bay* and the two highest counts at *Little Treleaver* – peaking with 398 on 20th July. Other sites which recorded weekly counts above 200 were *Durlston Country Park East* (*Dorset*), *Ningwood Common* (*Isle of Wight*) and *Aberlady Bay* (*Lothian*). The highest count in Wales came in a WCBS square, when 29 were seen on 18th July at

Essex Skipper counts above 100 were recorded in WCBS squares in Suffolk.
Photograph by Mark Searle

ST0666 (*South Glamorgan*). The last transect record for the year came at *Aqualate Mere* (*Staffs*) on 19th September.

Lulworth Skipper was recorded on 13 transect routes and in four WCBS squares in *Dorset*, in a flight season that started two weeks later than in 2020. *Durlston Country Park East* recorded both the earliest and latest transect counts, on 5th June and 3rd September. The same route provided the highest count, when 53 were seen on 16th July, after *Bindon Hill* had provided a high of 38 two days earlier. The WCBS square *SY8779* recorded two counts in double figures.

The first transect record for **Silver-spotted Skipper** came from *Aston Rowant North* (*Oxon*) on 16th July, followed by a sighting at *Lullington Heath* (*East Sussex*) the following day. The highest count was also recorded at *Aston Rowant*, but on the *South* route, where 63 were seen on 14th August. This was one of three transects to record two weekly counts of 30 or more over the summer – the others being *Box Hill* and *Headley Warren* (both *Surrey*). The final transect record came on 20th September at *Porton Down* (*Wilts*).

The earliest **Large Skipper** transect records came on 26th May at two sites – *Grafton Wood* (*Worcs*) and *Bindon Hill* (*Dorset*) – with the first Welsh sighting at *Mynydd Marian* (*Clwyd*) on 1st June. The highest count of 92 was recorded on a WCBS square at *TM2147* (*Suffolk*) on 18th July, while *Ashclyst Merry Downs* (*Devon*) and *Cockleycley Wood* (*Norfolk*) also recorded weekly counts above 80 in mid-July. The season appeared to be finished following a record from *Luton Rec, Medway* (*Kent*) on 6th September, until a late individual was seen at *Billingshurst* (*West Sussex*) on 29th September.

Family: Pieridae (Whites etc.)

Wood White was recorded on 32 transect routes across 23 different sites in England, where *Haugh Woods North* (*Heref*) saw the earliest count on 28th April, and the sister transect at *Haugh Woods South* provided the final record on 29th August. The first brood peaked with 115 seen across two transect routes at *Chiddingfold Forest* (*Surrey*) on 31st May, and at *Grafton Wood* (*Worcs*) where two weekly counts exceeded 50 in the first half of June. *Bury Ditches* (*Salop*) supplied three weekly counts above 40, and it was the same three sites that also provided the highest counts of the smaller second brood, peaking in early August.

Cryptic Wood White was recorded on six transects in Northern Ireland, with timed counts received from three additional sites. Sightings spanned nine weeks from 8th May at *Craigavon Lakes* (*Co. Armagh*) until 13th July at *Cave Hill* (*Co. Antrim*). It was the worst year for this species across Northern Ireland since 2012 – the highest count was only 25, recorded on 3rd June at *Colin Glen Forest Park* (*Co. Antrim*).

The highest weekly count for **Orange-tip** came from *Lathkill Dale* (*Derbys*), with 47 seen on 23rd April, a day after 42 had been seen at *Rhydymwym Valley Nature Reserve* (*Clwyd*). In Scotland and Northern Ireland the highest counts were at *Hailes* (*Lothian*) on 30th April and *Oxford Island* (*Co. Armagh*) on 19th May, with counts of 27 and 17 respectively. The season was largely over by mid-July, but there was a smattering of records later in the month and a single sighting on 19th August at *Hampton Wood* (*Warks*).

Already on the wing in England, Wales and the Channel Isles at the start of the transect season, **Large White** was first seen in Northern Ireland on 22nd April at *Garry Bog* (*Co. Antrim*) and in Scotland the following day at *Plean Country Park* (*Stirling*). The WCBS square at *TM0553* (*Suffolk*) was the only site where a weekly count above 20 was recorded before the end of May, while another WCBS square at *SZ8693* (*West Sussex*) provided the highest count of the year, when 157 were seen on 4th September. Counts above 100 were seen at *Seaford Head* (*East Sussex*) both in high summer (16th July) and early autumn (4th September). Other sites to exceed 100 for a weekly count included the WCBS square at *NR2943* (*Strathclyde*) on 2nd August and *Grouville Golf Course* (*Jersey*) on 8th September.

The spring emergence of **Small White** did not produce big numbers, with *Ainsdale Sand Dunes* (*Lancs*) being the only site where more than 25 were seen on a weekly count before the end of May. The highest count in summer was at *Breamore* (*Hants*) where 252 were seen on 26th July, and the same site produced two further counts above 100. Three WCBS squares produced weekly counts over 150 – *TM0553* (*Suffolk*), *SZ8693* (*West Sussex*) and *NY1847* (*Cumbria*). The highest count outside of England was 77 seen at *Plemont* (*Jersey*) on 3rd September, with counts above 50 also recorded at *Rhydymwym Valley Nature Reserve* (*Clwyd*) on 13th August and *Grouville Golf Course* (*Jersey*) on 8th September.

Wood White was recorded on transects across 23 sites in England in 2021.
Photograph by Mark Searle

The highest spring counts for **Green-veined White** came outside of England, with 57 recorded at *Slievenacloy* (*Co. Antrim*) on 30th May and 38 at *St Abbs Head* (*Borders*) on 13th June. The highest summer count also came from Northern Ireland, with 116 recorded on 3rd August in the WCBS square at *D2204* (*Co. Antrim*). Scotland also saw good numbers in the summer, with *Mersehead* (*Dumfries & Galloway*) and *Crombie Country Park* (*Angus*) each recording two weekly counts above 80. The highest count in England came at *Bucknell Woods* (*Northants*) on 7th August, when exactly 100 were seen. *Somerton* (*Dyfed*) was the only site in Wales to exceed 30 on a weekly count, when 37 were recorded on 28th July.

Clouded Yellow was recorded at nearly 150 UKBMS sites in 2021, including eight transects on Jersey and 12 WCBS squares in England. The highest weekly count of eight was recorded at *Castle Hill* (*East Sussex*) on 11th August, but the most reliable place to see this migratory species was 10 miles away at *Seaford Head* (*East Sussex*) where 18 in total were seen across seven consecutive weeks at the end of the transect season.

Seven different sites in *Surrey* had already recorded counts of **Brimstone** in double figures before the official UKBMS season had begun, but the early prize goes to *Lords Wood* (*Somerset*), where the count of 42 on 30th March proved to be the highest count for the year on that transect. This figure was just one short of the highest April count, which came at *Danebuy Hill Fort* (*Hants*). *Levin Down* (*West Sussex*) dominated the later spring counts, with four weekly counts exceeding 50 between 26th May and 16th June. The highest count of the year came on 4th August at *Roman Road* (*Cambs*) when 96 were seen – just one more than at *Shipton Bellinger West* (*Hants*) on 22nd August.

Family: Nymphalidae (Browns, Fritillaries, Admirals etc.)

The earliest record of **Wall** came from *La Ville Machon* (*Jersey*) on 7th April, with the first in England coming six days later at *Treluggan Cliffs* (*Cornwall*), and the highest spring count was at *Calstone* (*Wilts*) where 29 were seen on 27th May. This species had its best year in Scotland since 1999, with *Carrick Shore* (*Dumfries & Galloway*) recording the four highest weekly counts of the year across the UK, peaking at 109 on 22nd August. The highest weekly counts in England and Wales both came on 10th August – when 62 were seen at *Pentire* (*Cornwall*), and 13 were seen at *Marloes Mere* (*Dyfed*). A handful of sites continued to record this species beyond September, including a count of 13 at *Blaye* (*Alderney*) on 7th October. Wall has not been recorded on a transect in Northern Ireland since 2013.

The spring counts for **Speckled Wood** were relatively low, particularly in Scotland, where no count reached double figures until 10th July at *Ardersier Common* (*Highland*). The highest counts of the year were generally reserved for late summer. *Wakebarrow* (*Cumbria*) saw five weekly counts in excess of 80, peaking at 201 on 18th September. The transect at *Crom Estate* (*Co. Fermanagh*) recorded exactly 100 on 1st September, while the highest counts in Scotland and Wales were 55 at *Levenhall* (*Lothian*) on 15th September and 54 at *Newport Wetlands* (*Gwent*) on 24th August.

Large Heath was recorded on 12 transect sites across the UK in 2021, along with three WCBS squares and four timed counts in Scotland. The earliest count came on 4th June at *Cors Fochno* (*Dyfed*), with the same site also producing the highest weekly count of 43 two weeks later. The flight period was slightly later in Scotland, with the first count being on 17th June at *Blacklaw Wood* (*South Lanarkshire*). *Mullenakill Peatlands Park* (*Co. Armagh*) was the only site in Northern Ireland to return counts – peaking with 14 on 28th June. The final sighting came on 2nd August at *Lower Killyean* (*Argyll & Bute*).

The earliest **Small Heath** records came on 18th April at *Harewood Common* (*Hants*) and 19th April at *Ryton Pools Country Park* (*Warks*). *Blatchford Down* (*Surrey*) recorded three consecutive weekly counts above 200 – peaking at 279 on 1st July – while the four highest counts in Scotland were all recorded at *Loch Fleet* (*Sutherland*) – peaking at 273 on 16th July. The highest counts in Wales and Northern Ireland came earlier in the year, with 95 recorded at *Mynydd Marian* (*Clwyd*) on 8th June and 41 at *Killard Nature Reserve* (*Co. Down*) on 29th May. For the later brood, both *Prees Heath Common* (*Salop*) and *Cavenham Heath* (*Suffolk*) returned weekly counts above 100 in September.

Mountain Ringlet data were received from two transect sites and a single timed count in 2021. *Hartsop Dodd* (*Cumbria*) provided both the earliest count on 7th June and the highest count of the year on 28th June, when 233 were recorded. The latest count of the year came from *Ben Lawers* (*Perthshire*) on 22nd July.

Scotch Argus was recorded on 10 WCBS squares and 17 standard transect sites in 2021, including four sites in England. The earliest record came from the WCBS square at *NC2234* (*Highland*) on 13th July, while the two highest counts of the year came from *Smardale Gill* (*Cumbria*), falling just short of 200 on both 3rd and 16th August. *Glencoe* (*Argyll & Bute*) provided both the highest count in Scotland, when 173 were seen on 31st July, and the final transect record of the season on 8th September.

The first record of **Ringlet** came on 1st June from *Denemouth South Bank* (*Co. Durham*), but the highest weekly count for the year came at *Ferneydale Harpur Hill* (*Derbys*) on 19th July, when 557 were seen. Three of the four highest counts in Scotland were recorded at *Robroyston Park* (*Glasgow*), peaking at 306 on 6th July, while *Lagan Meadows* (*Co. Down*) saw the highest count in Northern Ireland. This species recorded its worst year in Wales since 2007, although *Roundton Hill* (*Powys*) managed to return a weekly count above 100 on 11th July. The final transect sighting for the year came at *Headley Heath* (*Surrey*) on 18th September.

Early sightings of **Meadow Brown** were recorded in south-west England on 7th May at *Cheddar Wood* (*Somerset*) and *Lincombe & Dunscombe* (*Devon*), though most areas did not see this species before the end of that month. The three highest counts for the year, all above 1000, were seen at *Heath's Meadows* (*Lincs*) where a peak of 1307 was recorded

on 18th July. The highest counts in other parts of the UK were all seen around the same time, with peaks of 638 at *Stackpole Warren* (*Dyfed*), 394 at *Killard* (*Co. Down*), 224 at *St Abbs Head* (*Borders*) and 180 at *Longis* (*Alderney*). There were 15 WCBS squares that recorded counts over 200, with the highest return being 401 at *SU0210* (*Dorset*) on 14th July.

La Ville Machon (*Jersey*) recorded the two earliest records of **Gatekeeper** on 24th May and 2nd June, followed by sightings in most parts of England by mid–June, and finally in Wales on 28th June at *Loggerheads Country Park* (*Clwyd*). The highest weekly count of 420 came on 29th July at *Durlston Country Park East* (*Dorset*), while *Blaye* (*Alderney*) had also recorded in excess of 400 the previous week. The two highest counts in Wales were both recorded on 26th July, with 189 at *Marloes Mere* (*Dyfed*) and 160 at *Mynydd Marian* (*Clwyd*). Many sites in England continued to record this species up to the end of September, though it was not seen in Wales beyond the 7th of that month.

The earliest transect record for **Marbled White** came from the *Isle of Wight*, when one was seen on 28th May at *Walter's Copse*. Another site on the Island, *Ningwood Common*, recorded the second highest weekly count on 8th July, when 428 were seen, but the highest count of the year was reserved for *Tolworth Court Farm* (*Surrey*) three days later, when 524 were recorded. This species was recorded on just four transect routes in Wales, with *Oxwich* (*West Glamorgan*) returning the highest count of 10 on 8th July, while the highest count in a WCBS square came in *Wiltshire*, where 180 were recorded at *SU1142* on 16th July. The final count came from *Prestwood Nature* (*Bucks*) on 8th September.

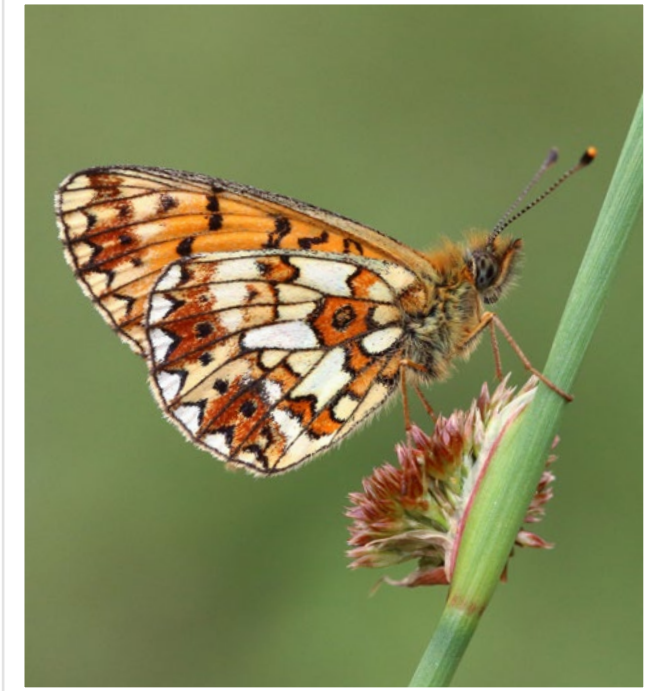
The earliest count for **Grayling** came at *Arnside Knott* (*Cumbria*) on 4th June, but it was not until four weeks later, on 2nd July, that the first sighting in southern England was recorded at *Crook Peak* (*Somerset*). Meanwhile, this species had been first seen in Wales on 12th June at *Great Orme* (*Gwynedd*), in Scotland on 24th June at *Carrick Shore* (*Dumfries & Galloway*), and on 20th June at *Plemont* (*Jersey*). The transect at *Great Orme* also provided the highest weekly count of the year on 22nd July, when 134 were seen, and a partial second brood which returned the only September counts outside southern England or Jersey. *Murlough* (*Co. Down*) was the only transect site in Northern Ireland to record this species, with just three individuals counted between 20th July and 18th August.

The last three years have now been the best three years for **Pearl-bordered Fritillary** in Scotland since 2002, and *Mabie Forest* (*Dumfries & Galloway*) provided four of the five highest transect counts for the year, peaking with 77 on 13th May. The earliest sightings came in *Devon* at *Yarner Wood* on 20th April and *Piddledown Common* three days later, while the highest count in England was recorded at *Frohawk* (*Hants*) on 5th June, when 54 were seen. Other sites to record counts above 30 were *Standing Hat* (*Hants*), *Wakebarrow* (*Cumbria*) and *North Wood* (*Devon*).

Although **Small Pearl-bordered Fritillary** has had a run of poor years in England, 2021 was its best year in Scotland in 43 years of monitoring. *Mabie Forest* (*Dumfries & Galloway*) returned the highest weekly count of the year when 138 were seen on 17th June, along with three other counts above 40. Only two other sites managed to reach this figure – *Wakebarrow*

Ringlet recorded its worst year in Wales since 2007. *Photograph by Mark Searle*

Marbled White was out by the end of May on the Isle of Wight. *Photograph by Mark Searle*



Small Pearl-bordered Fritillary recorded its best year in 43 years of monitoring in Scotland . *Photograph by Mark Searle*

The earliest and highest counts for High Brown Fritillary in 2021 both came from Aish Tor (Devon). *Photograph by Mark Searle*

(*Cumbria*) and *Burn Hill* (*Durham*). The highest count in south-west England came from *East Soar* (*Devon*), when 26 were seen on 13th June, while *Bennar Dunes* (*Gwynedd*) returned the highest count in Wales, with 18 on 26th May. Both these sites saw a second generation in August, as did *Tidna Valley* (*Cornwall*), where the second brood was larger than the first – peaking at 20 on 4th August.

The first **Silver-washed Fritillary** transect records came on 14th June at *Kingley Vale* (*West Sussex*) and *Porton Down* (*Wilts*). The records continued in England up to the end of September, but a shorter season was recorded in Wales, lasting from 2nd July at *Bishopston Valley* (*West Glamorgan*) until 28th August at *Brechfa Forest* (*Dyfed*). *Bishop Wood* (*North Yorks*) recorded the three highest weekly counts of the year, peaking at 85 on 26th July, whilst *Wyre Forest* (*Worcs*) also returned two counts above 60. In Northern Ireland, *Crom Estate* (*Co. Fermanagh*) was the most productive site, with a weekly count of 59 on 30th July.

Dark Green Fritillary had its best year in England since monitoring began in 1976. The earliest record this year came from *Calstone* (*Wilts*) on 27th May, with the final sighting recorded at *Chee Dale* (*Derbys*) on 16th September. The highest count was recorded at *Broughton Down* (*Hants*) on 8th July, when 155 were seen, while two other sites returned weekly counts above 100 – *Mottistone Down* (*Isle of Wight*) and *Fontmell Down* (*Dorset*). In northern England, the transect at *Wakebarrow* (*Cumbria*) recorded four consecutive weekly counts over 75. Outside of England, the first transect sighting was at *Calf of Man* (*Isle of Man*) on 12th June and the highest weekly count came from *Loch Fleet* (*Sutherland*), when 66 were seen on 1st July.

The earliest transect record for **High Brown Fritillary** came on 4th June at *Aish Tor* (*Devon*), though it was not seen in *Cumbria* until two weeks later at *Heathwaite* – the same site also recording the final count of the year on 16th August alongside *Wakebarrow* (*Cumbria*). This species was recorded on 10 transect sites in north-west England, though no weekly counts higher than six were recorded. In south-west England it is mainly monitored by timed counts, and the highest confirmed count also came from *Aish Tor*, with 32 seen on 1st July.

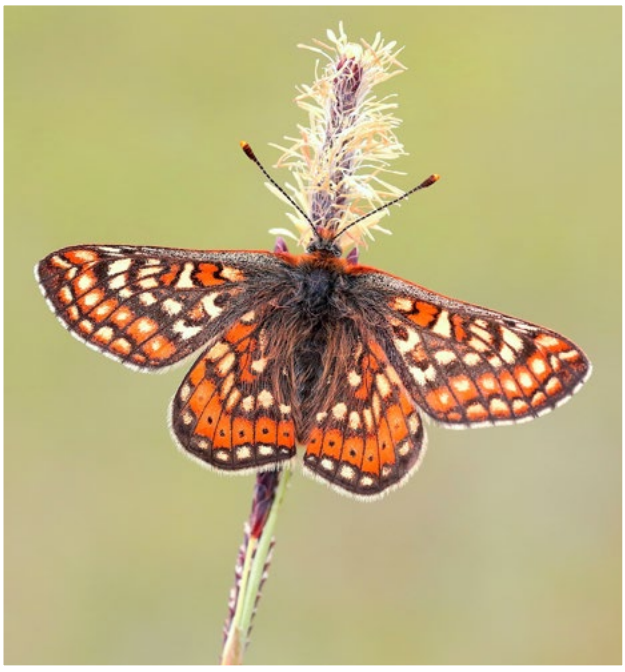
A single early transect sighting of **White Admiral** was recorded on 5th June at *Swinyard Hill* (*Worcs*), but it was not until 22nd June that regular counts were made. The highest weekly count of 18 came early in the season, on 30th June, from *Oaken Wood* (*Surrey*), whereas *Minsmere* (*Suffolk*) did not see their highest count until 11th August, when 15 were recorded. The final count of the main brood came on 27th August at *East Blean Woods* (*Kent*), but there were also signs of a second generation, with *Pamber Forest* (*Hants*) returning two counts in mid-September and the final sighting coming on 24th September at *Epsom Common* (*Surrey*).

Although **Purple Emperor** was recorded on 37 transects and in two WCBS squares during the year, none of the weekly counts recorded more than two individuals. Two sites managed to return four weekly counts – *Bookham Common* (*Surrey*) and *Bentley Wood* (*Wilts*) – although records on the latter site were spread across three separate transect routes. All the sightings came during a five-week period between 9th July and 13th August.

Red Admiral was recorded during every week of the transect season, though Northern Ireland and Scotland only returned one count each during April, at *Garry Bog* (*Co. Antrim*) and *Calton Hill* (*Lothian*). The highest spring count came from *Gibraltar Point* (*Lincs*) on 16th May, when 23 were seen, but the biggest counts of the year were reserved for late summer. *Holkham* (*Norfolk*) was the only site to break 100 for a weekly count, with 104 recorded on 10th August, while *Looe Island* (*Cornwall*) returned the highest count in the south-west when 91 were seen on 22nd September. Another island – *Isle of May* (*Fife*) – provided the highest count in Scotland, with 52 seen on 14th August, while the highest count in a WCBS square came on the same day at *TQ5301* (*East Sussex*) where 82 were seen.

It was a reasonable year for **Painted Lady**, recorded throughout the transect season and in all parts of the UK. The first count to reach double figures came on 9th May at *Blaye* (*Alderney*), followed by *Kemphill Moor Copse* (*Isle of Wight*) six days later. *Cambridgeshire* saw the highest counts in England, with 63 seen at *Roman Road* on 4th August and 53 at *Fleam Dyke* on the same day. *La Ville Machon* (*Jersey*) was the only other site to see a weekly count over 50. *Isle of May* (*Fife*) was the only site across Scotland, Wales or Northern Ireland to reach double figures, with 15 seen on 10th August.

Peacock was out in good numbers even before the transect season started. In fact, the highest spring count came on 30th March at *Bishop Wood* (*North Yorks*) when 54 were seen. The same day also provided counts of 31 at *Monks Wood* (*Cambs*) and 37 at *Rhydymwym Valley* (*Clwyd*). The latter turned out to be the highest count returned from Wales all year. The highest weekly count in the summer came from *Pensthorpe* (*Norfolk*) on 9th August when 156 were seen, just two higher than the count at *Crombie Country Park* (*Angus*) on 22nd August, whilst



Transect counts for Marsh Fritillary were supplemented by larval web counts from 100 sites in 2021. *Photograph by Mark Searle*

the highest count in Northern Ireland came from *Killykeeghan & Crossmurrin Nature Reserve* (*Co. Fermanagh*) on 24th August, with 59 recorded.

The highest spring count for **Small Tortoiseshell** came from *Cotgrave Woods* (*Notts*), where 44 were seen on 13th April. Four other sites returned weekly counts above 25 during April, including two counts each at *Gravel Hill* (*Herts*) and *Murton Fields* (*Northumberland*). The early-summer brood saw the highest count of the year at B*arbury Castle* (*Wilts*), peaking with 166 on 2nd July, while 133 were seen in the WCBS square *TF2105* (*Cambs*) on 8th July. *O'Neills Farm* (*Co. Antrim*) recorded the highest count of 31 in Northern Ireland on 6th July, and the highest count in Wales came on 23rd June at *Central Valley* (*Gwent*), when 22 were seen. Some areas did not record their highest counts until later in the summer. For example, *Ryder Point Hopton* (*Derbys*) recorded 107 on 7th September, while *Isle of May* (*Fife*) returned the highest count from Scotland with 51 seen on 10th August.

Early counts for **Comma** reached double figures before the transect season started – at *Pickett Wood* (*Wilts*) and *Monks Wood* (*Cambs*) on the final two days of March – with the latter site also recording the highest spring count on 4th April, when 18 were seen. The highest summer count came at *Hanningfield Reserve* (*Essex*), where 31 were recorded on 3rd August while *Trittiford* (*Worcs*) and *Priory Country Park* (*Beds*) also saw weekly counts over 20 during July. Late summer counts were similar, with a peak of 30 at *Mockbeggar* (*Hants*) on 17th September. The highest count outside England was on 22nd July at *Newport Wetlands* (*Gwent*) when eight were seen.

Dorset was the first county to record **Marsh Fritillary** on transects this year, with sightings on 11th May at both *Lydlinch Common* and *Giant Hill*. Northern Ireland was just two days behind, with the first sighting at *Murlough* (*Co. Down*). This same transect route provided the final adult record of the year on 28th June, and was one of three sites to record two weekly counts above 100. The others were *Calstone* and *Barbury Castle* (both *Wilts*), with the latter site recording the highest transect count of the year on 5th June with 199. Transect data were supplemented by 100 counts of larval webs from across the four UK countries, including a count of 1137 from *Braithwaite Moss* (*Cumbria*).

Data for **Glanville Fritillary** were received from 12 transects in 2021, including five sites on *Alderney*. On the *Isle of Wight*, the transect season started at *Coombe Bottom* on 7th May and ended at *Shepherd's Chine* on 30th June, though the highest count was recorded at *Mottistone Down* where 60 were seen on 27th May. That same day also marked the first counts of the season on *Alderney*, at *Bonne Terre* and *Trois Vaux*, while the final count came from *Longis* on 10th August.

The earliest sighting of **Heath Fritillary** came on 22nd May at *Greenscombe Wood* (*Cornwall*) with sites in the south-east – *Cole Wood* (*Kent*) and *Hadleigh Great Wood* (*Essex*) – following seven days later. *Blean Woods* (*Kent*) returned the

highest weekly transect count of 170 on 1st July, while a timed count of 224 was received from *Aller Coombe* (*Somerset*) on 15th June. A single late sighting of this species was recorded at *Blean Woods* on 16th September, some seven weeks after the previous record.

Family: Riodinidae (Metalmarks)

Duke of Burgundy was recorded on 29 transects in 12 different English counties during 2021, with the earliest records coming from *Noar Hill* (*Hants*) on 19th April and *Dunstable Downs* (*Beds*) four days later. The highest weekly count of 20 came from *Dean Hill* (*Wilts*) on 27th May, followed by 14 at a site near *Crosthwaite* (*Cumbria*) on 31st May – this latter site also providing the final count of the season on 17th June. Timed count data were also received from the *North Yorkshire* populations, where the highest count of 82 was made at a site near *Arden Hall* on 31st May.

Family: Lycaenidae (Coppers, Hairstreaks and Blues)

Small Copper was recorded in each week of the transect season, with the first sighting coming on 4th April at *St Martins* (*Isles of Scilly*). *Cavenham Heath* (*Suffolk*) provided the joint highest count for the spring brood – 20 on 18th May matched by *Treluggan Cliffs* (*Cornwall*) on 7th May – as well as the highest count of the summer brood (52 on 22nd July) and the highest late summer count in England (77 on 12th September). The latter count was only exceeded at *Sorel* (*Jersey*), where 120 were seen on 21st September. The highest weekly count in Scotland was 51, recorded at *Menstrie* (*Stirling*) on 23rd August.

The **Brown Hairstreak** season was underway on 17th July, with the earliest records from *Ashtead Common* (*Surrey*) and the WCBS square *TQ2042* (*Surrey*). Adult counts were received from 75 transects and five WCBS squares, and these were combined with five egg counts from the previous winter. The highest transect counts, of seven individuals, came from *Shipton Bellinger* (*Hants*) on 22nd August and 3rd September, and *Gatwick Airport* (*Surrey*) on 21st September – no other sites saw weekly counts exceed five adults. The highest egg count of 288 came from *Ryton Wood Meadows* (*Warks*).

The earliest counts for **Purple Hairstreak** came from *Torry Hill* (*Kent*) on 7th June and *Westfield Monument Strip* (*Somerset*) the following day. Three counts of 60 plus were recorded on evening transects at *Ryton Wood* (*Warks*) – peaking with 143 on 23rd July. The highest count during 'regular' transect hours came at *Williamthorpe LNR* (*Derbys*) on 26th July, when 19 were seen, and the same site provided the final count of the year on 21st September. Just eight sites outside England returned counts of this species, with *Bryn Pydew* (*Gwynedd*) providing the highest of those, peaking at seven on 3rd August.

The highest **Green Hairstreak** count came from *Les Landes* (*Jersey*), where 76 were recorded on 9th June, and the same transect saw four other weekly counts above 50. *The Cloud* (*Cheshire*) also recorded a count of 50 on 30th May. This species was active from the first week of the transect season, with *Rodborough Common* (*Glos*) providing a record on 4th April. Several sites, mainly in the south–west, continued to return counts into July, with the final count in England coming on 26th July at *Upton Heath* (*Dorset*). However, records from *Jersey* continued until the final sighting at *Les Landes* on 15th September.

The first transect record for **White-letter Hairstreak** came at *Benfleet Downs* (*Essex*) on 19th June, and this site was also the only one to record double figures on a weekly count, when 12 were seen on 16th July. *Leftwich Woods* (*Cheshire*) and *Crowden Hill Plantation* (*Northumberland*) were the only other sites where more than five individuals were recorded on a single count. The final record came on 5th September at *Nothwood Carr* (*Derbys*).

Black Hairstreak was recorded on six transect routes during 2021, with the season spanning just over a month from 7th June at *Monks Wood* (*Cambs*) to 9th July at *Grendon & Doddershall Woods* (*Bucks*). The two highest counts were seen at the *M40 Compensation Area* (*Bucks*) – peaking at 25 on 25th June.

The earliest transect record of **Small Blue** came on 26th April at *Weymouth Relief Road* (*Dorset*). All the highest counts came during the first brood, peaking on 5th June with 243 at *Durlston Meadows* (*Dorset*). Four other sites returned weekly counts of over 100, including two counts at *Pewsey Downs* (*Wilts*). The summer brood was somewhat smaller – the highest count of 38 being recorded at *Newton Tony* (*Wilts*) on 17th July. Small Blue was recorded on seven transect sites in Scotland and four in Wales, where the highest count was 12 at *Oxwich* (*West Glamorgan*) on 19th May.

The first site to record **Holly Blue** counts in double figures was *Cwm Ivy Tor* (*West Glamorgan*), on 23rd and 25th April, but the

Small Blue was out early along the Weymouth Relief Road (Dorset). *Photograph by Mark Searle*

highest spring counts came from *Kent* where *Montefiore Wood* and *Riverside Country Park* returned figures of 20 and 26 on 10th and 11th June respectively. Counts in England were slightly higher in the summer, peaking with 37 at *Shipton Bellinger* (*Hants*) on 22nd August. The highest count from the Channel Isles was recorded at *Victoria Tower* (*Jersey*) on 31st May, when eight were seen.

Unfortunately no **Large Blue** were recorded on transects in 2021. Egg counts were not submitted in time for our analysis of 2021 data, but have been received subsequently for inclusion in future analyses.

Cornwall was the only county to record **Silver-studded Blue** on transects before June, with the first record coming from *Godrevey Warren* on 14th May. The species appeared in Wales on 1st June at *Mynydd Marian* (*Clwyd*), though the highest transect counts for the year came from another site in Wales, *Great Orme* (*Gwynedd*), where 1549 were counted on 27th June, after 1152 had been seen 10 days earlier. The highest counts in England came from *Upton Towans* (*Cornwall*), where 872 were recorded on 24th June and 862 the following week. *Prees Heath Common* (*Salop*) also returned two counts above 700. Just five sites were still recording this species in September, with the final transect sighting on 12th September at *Sopley Common* (*Dorset*).

Brown Argus was first seen on transects this year on 24th April, at *Mynydd Marian* (*Clwyd*) and *West Yatton Down* (*Wilts*). The highest spring counts were shared between *Fordon Chalk Bank* (*East Riding*) on 9th June and *Wallasea Island* (*Essex*) three days later – each recording 37 individuals. The two highest counts for the year came at *Minsmere* (*Suffolk*) with 78 seen on 11th August and 51 seen four days later. It was recorded on nine transects on *Jersey*, with the highest weekly counts of nine coming on 13th and 15th September at *L'Oeillere Headland* and *St Ouen's Pond* respectively.

The first transect sighting of **Northern Brown Argus** in England came on 30th May at *Jack Scout* (*Lancs*) and in Scotland on 5th June at *St Abbs Head* (*Borders*). *Lea Green Bastow Wood* (*North Yorks*) recorded the highest count of the year on 5th June, when 80 were seen, while the four highest counts in Scotland all came from *Kingcraig* (*Fife*) – peaking at 66 on 8th July. *Kilnsey* (*North Yorks*) and *Thrislington Plantation* (*Co. Durham*) also recorded weekly counts above 50. The final count in Scotland came on 12th August at *Rogart Quarry* (*Highland*), while it survived in England until September, when it was last seen at *Howe Ridding* (*Cumbria*) on the first day of that month.

Common Blue was on the wing in England towards the end of April, with the first transect record coming on 20th April at *Crook Peak* (*Somerset*). They were not seen in Scotland or Northern Ireland until several weeks later, with the earliest counts returned from *Carrick Shore* (*Dumfries & Galloway*) on 27th May and *Craigavon Lakes* (*Co. Armagh*) on 3rd June. The highest weekly count in 2021 came from *Loch Fleet* (*Sutherland*), where a single generation peaked at 196 on 22nd July. The highest count for a spring brood came at *Porton Down* (*Wilts*) on 14th June, when 184 were seen, while the summer brood in England peaked with 155 at *Heath's Meadows* (*Lincs*) on 14th August. The summer brood produced the highest counts in Wales, where 127 were recorded at *Stackpole Warren* (*Dyfed*) on 23rd August. *Longis* (*Alderney*) provided the highest weekly counts for both spring and summer broods in the Channel Isles, where records continued into October at several sites.

The earliest transect records for **Adonis Blue** came on 9th May at *Luton Rec* (*Kent*), followed by *West Hill Corfe* (*Dorset*) six days later. The highest spring count in came on 7th June, when 311 were recorded at *Folkestone Escarpment* (*Kent*), while 218 were seen at *Calstone* (*Wilts*) the following day. The late–summer brood provided higher numbers, with *Anchor Bottom* (*East Sussex*) returning a count of 591 on 30th August, and *Pewsey Downs West* (*Wilts*) recording 583 on 3rd September. Counts in double figures were still possible in the final week of the transect season, including the 16 seen at *Martin Down North* (*Hants*) on 24th September.

Chalk Hill Blue was first recorded on 23rd June at *Stockbridge Hill* (*Hants*), and again three days later at *Malling Down* (*East Sussex*). *Coombe Hill* (*Glos*) recorded the three highest counts of the year, with a peak of 2638 on 9th August, which came during six consecutive weekly counts over 600 at that site. Three other sites that returned at least one weekly count over 1000 were *Devil's Dyke* (*Cambs*), *Castle Hill* (*East Sussex*) and *Denbies Landbarn* (*Surrey*). The highest count in a WCBS square was 296 recorded at *SY6872* (*Dorset*).

Transect counts for Chalk Hill Blue above 1000 were recorded on four sites in 2021.
Photograph by Mark Searle

Long-term trends

Long-term trends, 10-year trends and annual % changes for butterfly species, at UK and country level, are presented in full at the end of this report (Tables 1–5). Further information on each species, including collated index plots, phenology charts and distribution maps of monitored sites, can be found on the UKBMS website at **https://ukbms.org/species**. What follows here is a brief summary of the long-term trends.

UNITED KINGDOM

For the UK we are able to report on long-term and 10-year trends to 2021 for 56 of the 59 regularly occurring species, with the exceptions being **Chequered Skipper**, **Large Blue** and **Mountain Ringlet**.

Since 1976, just over a third (34%) of butterfly species assessed in the UK show a significant long-term decline in abundance, compared to 29% showing a significant long-term increase. However, the situation over the last decade is more positive, with seven species (13%) showing a statistically significant increase and none showing a significant decline. Since the previous years' assessment, the long-term trend class for **Silver-studded Blue** has improved from no significant change to increasing, but that for **Green Hairstreak** has slipped from no significant change to decreasing.

The species showing the greatest population increases since 1976 across the UK are (in order) **Silver-spotted Skipper**, **Clouded Yellow**, **Black Hairstreak**, **Large Heath**, **Ringlet**, **Dark Green Fritillary**, **Red Admiral** and **Silver-washed Fritillary**, which have all increased by 250% or more in that time.

The most severe long-term declines are demonstrated by (in order) **Heath Fritillary**, **Wall**, **Wood White**, **Small Tortoiseshell**, **White-letter Hairstreak**, **Lulworth Skipper**, **Grayling**, **Small Pearl-bordered Fritillary** and **Pearl-bordered Fritillary**, which have all declined by 65% or more.

There have been several, mostly positive, changes in the 10-year UK trends. **Small Blue** and **Small Pearl-bordered Fritillary** have improved their trend class from decreasing to no change, while **Wood White**, **Glanville Fritillary**, **Heath Fritillary**, **White-letter Hairstreak** and **Small Blue** are now classed as increasing. However, the 10-year trends for **Brimstone**, **Marbled White**, **High Brown Fritillary** and **Holly Blue** no longer show a significant increase. These changes should be treated with caution, as 10 years is quite a short time period to assess butterflies and the trends are sensitive to start and end year values.

Combined measures of butterfly abundance, published as biodiversity indicators by the UK Government, show that habitat specialist butterflies (26 species) have declined significantly between 1976 and 2021, whilst butterflies of the wider countryside (24 species) show no significant change over the same period (see figure 5). The unsmoothed indices for these groups have fallen by 60% and 37% respectively, comparing the 2021 value with the starting value in 1976, while the smoothed indices have fallen by 32% and 4%.

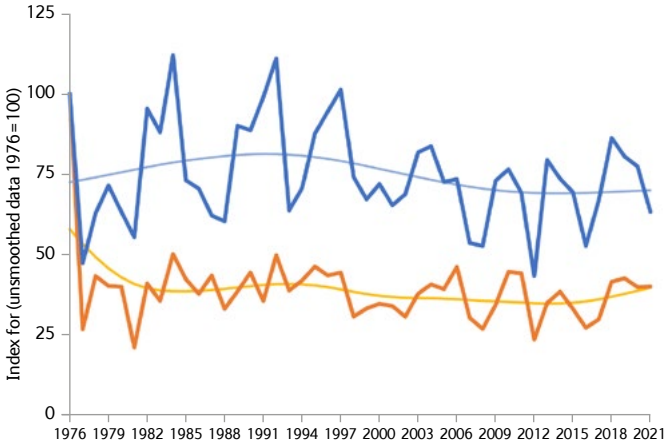


Figure 5. Composite indicators of UK butterfly populations for wider countryside species (blue) and habitat specialists (orange) 1976–2021. Darker lines are unsmoothed values, paler lines are smoothed indicators.

ENGLAND

For England we are able to report on long-term and 10-year trends to 2021 for 54 of the 57 regularly occurring species, with insufficient data this year for **Large Heath**, **Mountain Ringlet** and **Large Blue**.

Since 1976, over a third (37%) of butterfly species assessed in England have decreased significantly in abundance, compared to 22% of species that have shown significant long-term increases. The situation over the last decade is more positive, with eight species (15%) showing a statistically significant increase compared to just one (2%) that has declined significantly (**Small Pearl-bordered Fritillary**). Since the previous years' assessment, the long-term trend class for **Holly Blue** no longer shows a significant increase.

Combined measures of butterfly abundance, published by the UK Government, show that butterflies of the wider countryside

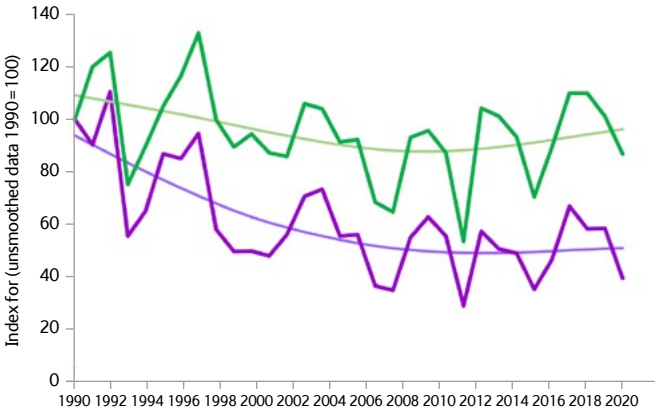


Figure 6. Composite indicators of butterfly populations for wider countryside species on farmland (green) and in woodland (purple) in England 1990–2021. Darker lines are unsmoothed values, paler lines are smoothed indicators.

at woodland sites in England (24 species) have declined significantly between 1990 and 2021, whilst those at farmland sites (22 species) show no significant change (see figure 6). The unsmoothed indices for these groups have fallen by 60% and 13% respectively, comparing the 2021 value with the starting value in 1990, while the smoothed indices have fallen by 46% and 12%.

SCOTLAND

For Scotland we are able to report on long-term and 10-year trends to 2021 for 24 of the 34 regularly occurring species. Since 1979, ten of these species (42%) have shown a significant increase, with just two species (8%) in significant decline (**Grayling** and **Small Tortoiseshell**).

The species showing the greatest long-term population increases in Scotland are (in order) **Red Admiral**, **Wall**, **Orange-tip**, **Ringlet** and **Pearl-bordered Fritillary**, which have all increased by 250% or more. Note that trends for most of these rapidly increasing species only stretch back to the 1990s, as they were not recorded in sufficient numbers in Scotland in the earlier years of the UKBMS.

Combined measures of butterfly abundance, published by NatureScot, show that generalist butterflies in Scotland (14 species) have increased significantly between 1979 and 2021, whilst habitat specialists in Scotland (6 species) show no significant change over the same period (see figure 7). The unsmoothed indices for these groups have changed by +29% and –14% respectively, comparing the 2021 value with the starting value in 1979, while the smoothed indices have changed by +51% and –5%.

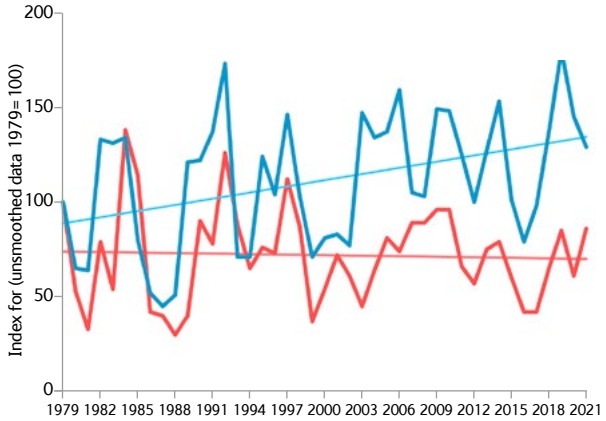


Figure 7. Composite indicators of Scotland butterfly populations for generalist species on (blue) and habitat specialists (red) 1979–2021. Darker lines are unsmoothed values, paler lines are smoothed indicators.

Green Hairstreak shows the greatest long-term increase in Wales. *Photograph by Mark Searle.*

WALES

For Wales we are able to report on long-term and 10-year trends to 2021 for 31 of the 41 regularly occurring species. Since 1976, eight of these species (26%) show a significant increase in abundance, with seven species (23%) in significant decline.

The species showing the greatest population increases in Wales are (in order) **Green Hairstreak**, **Orange-tip**, **Ringlet** and **Comma**, which have all increased by 250% or more. The species in most severe long-term decline are (in order) **Grayling**, **Dark Green Fritillary** and **Small Pearl-bordered Fritillary**, which have all declined by 65% or more.

NORTHERN IRELAND

Trends to 2021 for butterflies in Northern Ireland are available for 14 species, covering time periods ranging from 12 to 18 years. Two of these species (**Large White** and **Small White**) show significant long-term declines. No other species show a significant change over their full time-series, although **Peacock** has increased significantly over the last 10 years.

Drivers of change of butterfly populations

Butterflies are excellent indicators of environmental change due to their rapid and sensitive responses to subtle habitat or climatic changes and there are several factors considered to be driving the changes that we see in butterfly populations.

Weather and climate change

Short-term changes in butterfly populations are often driven by the weather. Being 'cold-blooded', they need the sun's energy to raise their body temperature to a level that enables them to function. The impact of weather on different butterfly species is influenced by factors such as the timing of their flight period, how many generations are produced in a year, and in what life stage they overwinter. Consequently, what could be considered to be good conditions for one species can be less favourable or even detrimental for another. Adverse weather conditions can result in a large drop in butterfly numbers. While butterflies can bounce back from the impacts of unsuitable weather, they can take a long time to recover from a run of adverse weather years.

Longer-term changes in weather patterns as a result of climate change can have an impact on where butterfly species are found, their population sizes, and the timing of their lifecycles. Spring-flying species have been emerging earlier in recent decades as springs have warmed, and a number of single-brooded species are now able to produce a second brood in warm years. However, there may be negative impacts, for example if butterfly species become active before their food sources are available. Any benefits of an earlier season may also be negated if the changing climate results in plants and flowers dying earlier than they used to, bringing a premature end to the flight season.

In recent years we have seen species historically restricted to warmer southern parts of the UK, expanding their range and becoming more abundant in northern areas. However, the scope for northward range expansion may be limited, particularly for habitat specialist species, if networks of suitable habitat are too isolated.

Habitat related drivers

Habitat loss, degradation, and changes in habitat management, continue to be major drivers of change in UK butterfly populations, often resulting in population declines and/or range contractions.

The UK has seen major changes in land use since the UKBMS started in the 1970s, as well as in the preceding decades and centuries. For example, the loss of important semi-natural habitats to conifer plantations, arable land, industrial, commercial or residential development. Wide-scale agricultural intensification has had a big impact on wildlife, with bigger fields and hence less wildlife-friendly margin habitat, and a greater use of herbicides and fertilisers. This has resulted in far fewer wildflowers, meaning reduced nectar sources for butterflies and a decline in some larval food plants.

Many semi-natural habitats in the UK depend on regular management to maintain their distinctive features that their component species rely on. A decline in traditional management activity can impact habitat quality, or even cause loss of that habitat completely due to successional change of the vegetation. Loss of habitat can have a disproportionately negative effect, as it can also increase habitat fragmentation and, therefore, the isolation of remaining butterfly populations. Habitat connectivity is key to a species being able to disperse to new sites and recover from population crashes.

Pesticides and pollution

Alongside the habitat mediated effects of agricultural intensification, the accompanying use of pesticides may have direct toxicity impacts on butterflies. Ongoing and future research into the effects of pesticides is an area of research where monitoring data is likely to help determine the extent to which butterflies are affected by farmland chemicals. Although little research exists on the direct effects of pollution on lepidoptera, nitrogen deposition is considered a major threat to biodiversity and ecosystem functioning. This nutrification, from both airborne pollution and the application of fertilisers, can affect the availability and quality of caterpillar foodplants, as well as the species composition and microclimate conditions within habitats.

Conservation action

Landscape-scale conservation efforts can play a very important role in improving the fortunes of declining butterfly species. As our understanding of butterfly ecology increases, conservationists have been able to restore suitable habitat to help many declining species. This is especially the case for species with specific habitat requirements or poor powers of dispersal, and where the appropriate conditions may often rely on active habitat management. These species can respond well to targeted habitat management, such as woodland coppicing to create more open areas or establishing a sympathetic grazing regime.

A more detailed, fully referenced review of the drivers of change of butterfly populations can be found on the UKBMS website at **https://ukbms.org/official-statistics**.

Notes on Summary Tables 1-5

In the following summary tables, where series trends have been provided, the number of sites monitored is a count of all sites monitored during the current year of analysis where the species was, or has previously been, recorded. This includes sites where the species may have been absent during the current year, but have still contributed to the national index.

Where there are insufficient data to calculate accurate trends for a species at country level (noted as N/A), the number of sites monitored refers only to the number of sites at which the species was recorded in the current year.

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

Table 1. UK Summary of changes 2021. Summary of species abundance changes in the UK from 2020 to 2021 and long-term (over the entire time series; no. yrs max = 46) 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).

Species	Start Year	No. years with Index in 2021	No. sites monitored in 2021	2021 rank	% change 2020-2021	Series trend (%)	10-year trend (%)
Swallowtail	1976	45	25	28	-19	25	41
Dingy Skipper	1976	46	671	16	-13	-6	6
Grizzled Skipper	1976	46	411	31	-17	-46***	0
Chequered Skipper	N/A	N/A	5	N/A	N/A	N/A	N/A
Essex Skipper	1977	45	1112	29	3	-21	17
Small Skipper	1976	46	2010	37	-11	-73***	-13
Lulworth Skipper	1992	30	23	20	-13	-75**	-19
Silver-spotted Skipper	1979	43	74	16	-40	612***	36
Large Skipper	1976	46	2011	42	-29	-25	7
Wood White	1979	43	78	24	-16	-82***	167*
Cryptic Wood White	2009	13	15	11	-47	25	3
Orange-tip	1976	46	1949	11	-9	38**	42
Large White	1976	46	2571	37	-34	-31	47
Small White	1976	46	2585	20	-34	-15	91
Green-veined White	1976	46	2500	43	-27	-18	-11
Clouded Yellow	1979	43	945	23	-64	597*	5
Brimstone	1976	46	1913	10	-5	32*	66
Wall	1976	46	796	36	20	-87***	5
Speckled Wood	1976	46	2406	23	7	100***	8
Large Heath	1990	32	42	5	23	445***	38
Small Heath	1976	46	1831	23	-17	-45**	74
Mountain Ringlet	N/A	N/A	5	N/A	N/A	N/A	N/A
Scotch Argus	1979	43	38	32	-16	55	-50
Ringlet	1976	46	2434	21	-2	335***	-13
Meadow Brown	1976	46	2606	25	-17	1	17
Gatekeeper	1976	46	2246	37	-11	-43**	36
Marbled White	1976	46	1385	7	-7	79**	55
Grayling	1976	46	341	37	0	-71***	-14
Pearl-bordered Fritillary	1976	46	159	36	-13	-66***	8
Small Pearl-bordered Fritillary	1976	46	214	36	17	-68***	-16
Silver-washed Fritillary	1976	46	1044	9	3	268***	38
Dark Green Fritillary	1976	46	788	2	7	279***	52
High Brown Fritillary	1978	44	56	27	-13	-64**	171
White Admiral	1976	46	408	44	-24	-62***	4
Purple Emperor	1979	43	124	9	45	136**	9
Red Admiral	1976	46	2563	5	29	279***	149
Painted Lady	1976	46	2285	17	378	103	509
Peacock	1976	46	2530	21	-30	7	12
Small Tortoiseshell	1976	46	2470	36	-30	-79***	-27
Comma	1976	46	2236	30	-18	185***	4
Marsh Fritillary	1981	41	205	24	24	-1	58
Glanville Fritillary	1989	33	15	2	104	115	1809*
Heath Fritillary	1981	41	42	32	14	-91***	112*
Duke of Burgundy	1979	43	108	30	-34	-35*	38
Small Copper	1976	46	2109	32	-18	-38*	48
Brown Hairstreak	1983	39	171	3	91	-3	31
Purple Hairstreak	1976	46	697	30	-43	-27	142
Green Hairstreak	1976	46	756	40	-39	-31*	128
White-letter Hairstreak	1976	46	337	27	-18	-78***	197*
Black Hairstreak	1995	27	14	3	62	500**	4908**
Small Blue	1978	44	331	17	-15	18	97*
Holly Blue	1976	46	1911	28	-50	124	138
Large Blue	N/A	N/A	4	N/A	N/A	N/A	N/A
Silver-studded Blue	1979	43	130	4	2	70*	176***
Brown Argus	1976	46	1186	27	3	23	118
Northern Brown Argus	1979	43	67	23	-4	-55**	40
Common Blue	1976	46	2253	39	-9	-20	31
Adonis Blue	1979	43	191	18	62	114*	-43
Chalk Hill Blue	1976	46	303	3	48	1	-24

Table 2. ENGLAND Summary of changes 2021. Summary of species abundance changes in England from 2020 to 2021 and long-term (over the entire time series; no. yrs max = 46) 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 of the series in 2021.

Species	Start Year	No. years with Index in 2021	No. sites monitored in 2021	2021 rank	% change 2020-2021	Series trend (%)	10-year trend (%)
Swallowtail	1976	45	16	23	-24	30	45
Dingy Skipper	1976	46	637	13	-11	-1	11
Grizzled Skipper	1976	46	404	31	-17	-47***	1
Essex Skipper	1977	45	1078	29	0	-22	19
Small Skipper	1976	46	1918	39	-16	-74***	-12
Lulworth Skipper	1992	30	23	20	-13	-75**	-19
Silver-spotted Skipper	1979	43	74	16	-40	612***	36
Large Skipper	1976	46	1917	42	-29	-23	8
Wood White	1979	43	78	24	-16	-82***	167*
Orange-tip	1976	46	1736	9	-7	25	42
Large White	1976	46	2265	37	-34	-32	45
Small White	1976	46	2271	19	-32	-12	92
Green-veined White	1976	46	2163	42	-32	-21	-3
Clouded Yellow	1979	43	880	22	-65	676*	12
Brimstone	1976	46	1864	10	-5	28	69
Wall	1976	46	679	38	0	-88***	2
Speckled Wood	1976	46	2183	23	11	100***	9
Large Heath	N/A	N/A	8	N/A	N/A	N/A	N/A
Small Heath	1976	46	1602	27	-19	-50**	72
Mountain Ringlet	N/A	N/A	2	N/A	N/A	N/A	N/A
Scotch Argus	1995	27	12	19	40	-75***	-21
Ringlet	1976	46	2150	23	-4	335***	-11
Meadow Brown	1976	46	2273	26	-17	0	18
Gatekeeper	1976	46	2132	37	-11	-46***	40
Marbled White	1976	46	1365	7	-7	76**	57
Grayling	1976	46	261	37	-5	-58***	-5
Pearl-bordered Fritillary	1978	44	131	38	-18	-73***	2
Small Pearl-bordered Fritillary	1978	44	143	40	20	-62***	-38*
Silver-washed Fritillary	1976	46	1013	9	3	288***	36
Dark Green Fritillary	1976	46	663	1	10	532***	62
High Brown Fritillary	1978	44	49	27	-13	-64**	176
White Admiral	1976	46	405	44	-24	-62***	3
Purple Emperor	1979	43	124	9	45	136**	9
Red Admiral	1976	46	2250	4	38	288***	147
Painted Lady	1976	46	2007	17	408	97	469
Peacock	1976	46	2206	22	-29	4	7
Small Tortoiseshell	1976	46	2132	36	-29	-79***	-24
Comma	1976	46	2082	30	-18	186***	4
Marsh Fritillary	1982	40	148	28	16	-62*	49
Glanville Fritillary	1989	33	10	1	62	145	4808*
Heath Fritillary	1981	41	42	32	14	-91***	112*
Duke of Burgundy	1979	43	108	30	-34	-35*	38
Small Copper	1976	46	1850	32	-24	-34	63
Brown Hairstreak	1983	39	170	3	108	-1	88*
Purple Hairstreak	1976	46	666	30	-43	-29	143
Green Hairstreak	1976	46	686	42	-48	-38*	113
White-letter Hairstreak	1976	46	323	27	-17	-78***	202*
Black Hairstreak	1995	27	14	3	62	500**	4908**
Small Blue	1979	43	304	18	-11	-12	118*
Holly Blue	1976	46	1814	26	-50	134	142
Large Blue	N/A	N/A	4	N/A	N/A	N/A	N/A
Silver-studded Blue	1984	38	122	4	0	6	202***
Brown Argus	1976	46	1144	27	3	25	117
Northern Brown Argus	1979	43	47	28	0	-58**	21
Common Blue	1976	46	2011	38	-9	-17	36
Adonis Blue	1979	43	191	18	62	114*	-43
Chalk Hill Blue	1976	46	302	3	48	1	-24

Table 3. SCOTLAND Summary of changes 2021. Summary of species abundance changes in Scotland from 2020 to 2021 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 of the series in 2021.

Species	Start Year	No. years with Index in 2021	No. sites monitored in 2021	2021 rank	% change 2020-2021	Series trend (%)	10-year trend (%)
Dingy Skipper	N/A	N/A	6	N/A	N/A	N/A	N/A
Chequered Skipper	N/A	N/A	5	N/A	N/A	N/A	N/A
Small Skipper	N/A	N/A	25	N/A	N/A	N/A	N/A
Large Skipper	N/A	N/A	5	N/A	N/A	N/A	N/A
Orange-tip	1999	23	128	7	-17	424***	120
Large White	1979	43	145	14	74	111*	83
Small White	1979	43	155	18	5	71	23
Green-veined White	1979	43	187	32	7	-2	-24
Clouded Yellow	N/A	N/A	6	N/A	N/A	N/A	N/A
Wall	1999	23	26	1	182	795***	693**
Speckled Wood	2001	21	63	3	20	119**	157*
Large Heath	N/A	N/A	27	N/A	N/A	N/A	N/A
Small Heath	1979	43	122	4	-9	164***	87*
Mountain Ringlet	N/A	N/A	3	N/A	N/A	N/A	N/A
Scotch Argus	1990	32	26	21	-6	5	-50*
Ringlet	1996	26	162	3	-2	315***	40
Meadow Brown	1979	43	168	12	25	-3	42
Grayling	1990	32	20	26	91	-91***	-65
Pearl-bordered Fritillary	2002	20	14	2	7	263***	194*
Small Pearl-bordered Fritillary	1979	43	56	1	62	100**	176***
Dark Green Fritillary	1979	43	73	12	17	13	2
Red Admiral	1980	41	157	21	-71	812***	345
Painted Lady	1980	38	136	21	84	122	877
Peacock	1995	27	168	13	-48	240***	139
Small Tortoiseshell	1979	43	179	33	-46	-59**	-40
Comma	2006	16	55	11	-13	183	174
Marsh Fritillary	2006	16	27	8	132	-72	-20
Small Copper	1979	43	128	36	19	-43	-33
Purple Hairstreak	N/A	N/A	8	N/A	N/A	N/A	N/A
Green Hairstreak	1990	32	28	17	-4	21	33
Small Blue	N/A	N/A	13	N/A	N/A	N/A	N/A
Holly Blue	N/A	N/A	5	N/A	N/A	N/A	N/A
Northern Brown Argus	1981	41	20	6	-9	19	184*
Common Blue	1979	43	110	17	-5	50	8

Chequered Skipper mating. *Photograph by Mark Searle.*

Table 4. WALES Summary of changes 2021. Summary of species abundance changes in Wales from 2020 to 2021 and long-term (over the entire time series; no. yrs max = 46) 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 2021.

Species	Start Year	No. years with Index in 2021	No. sites monitored in 2021	2021 rank	% change 2020-2021	Series trend (%)	10-year trend (%)
Dingy Skipper	2004	18	25	18	-64	11	-50
Grizzled Skipper	N/A	N/A	7	N/A	N/A	N/A	N/A
Essex Skipper	N/A	N/A	7	N/A	N/A	N/A	N/A
Small Skipper	1984	38	67	37	-26	-1	-78*
Large Skipper	1977	45	59	39	-19	-61***	-21
Orange-tip	1978	44	50	6	12	376***	28
Large White	1976	46	83	28	-19	-8	15
Small White	1976	46	83	24	-39	-45*	29
Green-veined White	1976	46	72	30	-26	154**	-61
Clouded Yellow	N/A	N/A	24	N/A	N/A	N/A	N/A
Brimstone	1998	24	36	21	-66	77*	62
Wall	1976	46	51	35	117	-58***	-43
Speckled Wood	1978	44	81	16	5	241***	25
Large Heath	N/A	N/A	4	N/A	N/A	N/A	N/A
Small Heath	1976	46	55	14	82	0	-16
Ringlet	1983	39	75	18	-22	271***	-36
Meadow Brown	1976	46	84	31	-19	10	-31
Gatekeeper	1978	44	76	31	-2	31	-37
Marbled White	N/A	N/A	18	N/A	N/A	N/A	N/A
Grayling	1976	46	28	30	142	-95***	-57
Pearl-bordered Fritillary	N/A	N/A	14	N/A	N/A	N/A	N/A
Small Pearl-bordered Fritillary	1992	30	15	12	91	-74**	-30
Silver-washed Fritillary	1995	25	22	15	3	-55	35
Dark Green Fritillary	1979	43	36	22	23	-83***	47
High Brown Fritillary	N/A	N/A	7	N/A	N/A	N/A	N/A
Red Admiral	1976	46	80	15	-42	171*	267*
Painted Lady	1977	44	68	25	46	35	699
Peacock	1976	46	77	34	-57	-24	14
Small Tortoiseshell	1976	46	80	29	-52	-27	-22
Comma	1992	30	67	12	-2	252***	67
Marsh Fritillary	1990	32	16	18	76	-62	15
Small Copper	1976	46	65	28	29	-48*	35
Brown Hairstreak	2004	18	1	4	26	-28	4
Purple Hairstreak	2002	20	16	13	-55	-33	115
Green Hairstreak	1993	29	19	10	-45	417***	159
White-letter Hairstreak	N/A	N/A	9	N/A	N/A	N/A	N/A
Small Blue	N/A	N/A	8	N/A	N/A	N/A	N/A
Silver-studded Blue	N/A	N/A	8	N/A	N/A	N/A	N/A
Holly Blue	1999	23	44	12	-44	36	255*
Brown Argus	1997	25	18	7	118	65	71
Common Blue	1976	46	70	32	62	-28	-24

Table 5. NORTHERN IRELAND Summary of changes 2021. Summary of species abundance changes in Northern Ireland from 2020 to 2021 and long-term (over the entire time series; no. yrs max = 18) 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).

Species	Start Year	No. years with Index in 2021	No. sites monitored in 2021	2021 rank	% change 2020-2021	Series trend (%)	10-year trend (%)
Dingy Skipper	N/A	N/A	2	N/A	N/A	N/A	N/A
Cryptic Wood White	2009	13	15	11	-47	25	3
Orange-tip	2007	15	29	13	-47	-13	74
Large White	2006	16	39	9	144	-56*	-52
Small White	2006	16	37	8	138	-64**	-4
Green-veined White	2005	17	43	10	60	9	-53
Clouded Yellow	N/A	N/A	4	N/A	N/A	N/A	N/A
Wall	N/A	N/A	2	N/A	N/A	N/A	N/A
Speckled Wood	2007	15	40	2	21	62	44
Large Heath	N/A	N/A	3	N/A	N/A	N/A	N/A
Small Heath	2004	18	20	9	29	-38	40
Ringlet	2006	16	43	10	28	54	-45
Meadow Brown	2009	13	43	10	-2	-40	-15
Grayling	N/A	N/A	6	N/A	N/A	N/A	N/A
Silver-washed Fritillary	N/A	N/A	9	N/A	N/A	N/A	N/A
Dark Green Fritillary	N/A	N/A	12	N/A	N/A	N/A	N/A
Red Admiral	N/A	N/A	37	N/A	N/A	N/A	N/A
Painted Lady	N/A	N/A	35	N/A	N/A	N/A	N/A
Peacock	2006	16	40	6	-25	35	869*
Small Tortoiseshell	2010	12	43	3	-57	46	189
Marsh Fritillary	2004	18	14	8	-15	89	234
Small Copper	2005	17	29	9	-26	-33	137
Purple Hairstreak	N/A	N/A	1	N/A	N/A	N/A	N/A
Green Hairstreak	N/A	N/A	3	N/A	N/A	N/A	N/A
Holly Blue	N/A	N/A	12	N/A	N/A	N/A	N/A
Common Blue	2005	17	23	10	-6	-25	-19

Meadow Brown female. *Photograph by Mark Searle.*

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

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

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

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