



United Kingdom
Butterfly Monitoring Scheme

Annual Report 2013

UKBMS Annual Report 2013

The UKBMS

The UK Butterfly Monitoring Scheme (UKBMS) is run by Butterfly Conservation (BC) the Centre for Ecology & Hydrology (CEH), and the British Trust for Ornithology (BTO) and is co-funded by a multi-agency consortium led by Joint Nature Conservation Committee (JNCC) and including the Department for Environment, Food, and Rural Affairs (DEFRA), Natural Resources Wales (NRW), the Forestry Commission (FC), Natural England (NE) and Scottish Natural Heritage (SNH).

The members of the UKBMS SG in 2013 were David Roy (CEH), Tom Brereton (BC), David Noble (BTO), Deborah Proctor and Anna Robinson (JNCC), Natasha Chick (Defra), Keith Porter (NE), David Allen (NRW), Simon Foster (SNH) and Sallie Bailey (FC).

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This report can be downloaded from
<http://www.ukbms.org/reportsAndPublications.aspx>

Cover photograph of Chalkhill Blue *Polyommatus coridon*.
This downland specialist had its best ever year in 2013.
Photograph by Iain Leach

UKBMS partners



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www.naturalengland.org.uk



Scottish Natural Heritage, Great Glen House, Leachkin Road, Inverness, IV3 8NW
www.snh.gov.uk

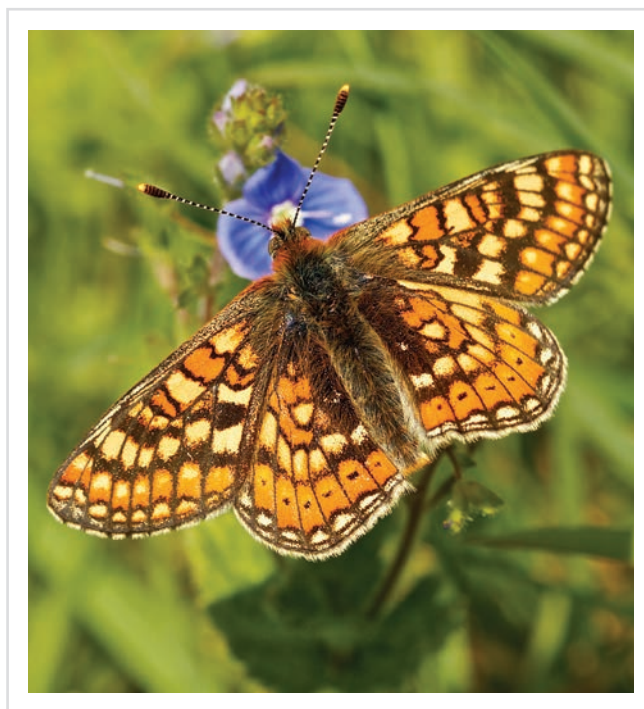
Acknowledgements

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Finally we would like to thank the JRS Document Solutions - part of the support services to the UK Research Councils - for designing and printing the report.

Contents and online resources

News and research	4
UKBMS online	4
UKBMS joins Twitter	4
Cutting down on paper copies of the report	4
Priority Species indicator	4
Butterfly Conservation International Symposium	5
UKBMS future funding 2014-2017	5
Research	6
Ongoing projects	6
Publications	6
Background and methods	7
Sample coverage	8
The 2013 season	10
Summary	10
Monthly round up	10
Summary tables of species trends	13 - 14
Comparison of trends in wider countryside species using new and old analysis methods	15
Long-term trends	15
United Kingdom	15
England	16
Scotland	17
Northern Ireland	17
Wales	17
Appendices	18 - 19



Marsh Fritillary had a poor year – the 10th worst in the 33 year series. *Photograph by Tony Cox*

Online resources

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

<http://www.ukbms.org>

For the Wider Countryside Butterfly Survey go to

<http://www.ukbms.org/wcbs.aspx>

For online data entry go to

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

For information on taking part in the WCBS on your BBS route email:

bbs@bto.org

For information on Biodiversity Indicators go to

<http://jncc.defra.gov.uk/page-1824>

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

Centre for Ecology & Hydrology:

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

Butterfly Conservation:

<http://butterfly-conservation.org>

British Trust for Ornithology:

<http://www.bto.org>



A substantial Long-tailed Blue immigration occurred in south east England during the summer. *Photograph by Leigh Prevost*

News and research

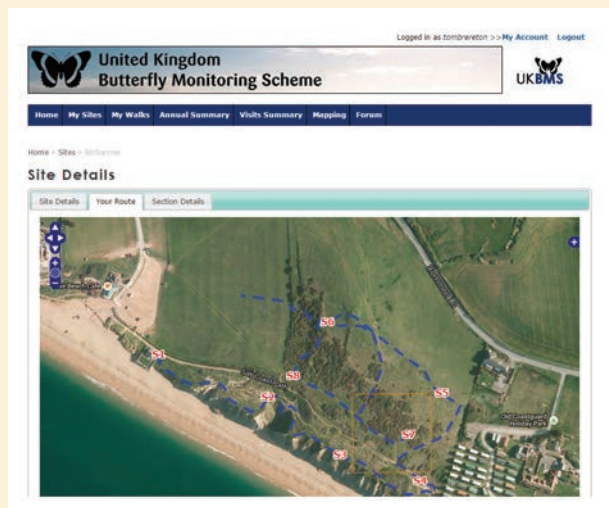
UKBMS ONLINE

The new online data entry system for the UKBMS at www.ukbms.org/mydata became fully operational for the 2013 season, after going live on 9th April. The response to this from volunteers and co-ordinators was fantastic. By the end of the year we received 70% of our transect data directly through the online system – that's 760 sites. There are now around 900 registered users of the site, with more and more new transects being registered directly online.

The main development at the end of the 2013 season was to set up additional facilities for branch co-ordinators so that they could more easily review, edit and download all the data from their area as necessary. This has been a success, and the facilities have been extended to allow similar access to some conservation organisations, such as county Wildlife Trusts.

Feedback on the new system has generally been very positive, but we are aware that some aspects of the site are in need of improvement. All suggestions made by volunteers are given consideration, so please do not feel inhibited in putting ideas forward. However, we must also make it clear that the budget for such work is limited, so not all your ideas can be put into action straight away.

The main priorities for further development of the site currently include: fully incorporating the data entry system for the Wider Countryside Butterfly Survey (allowing WCBS volunteers the same access to review and edit their data), online data entry for Timed Counts and other non-transect methods, uploading historic transect data and providing a wider range of feedback charts and graphs as were available in Transect Walker.



Online Transect Walker is now the main system for collating butterfly transect data each year

CUTTING DOWN ON PAPER COPIES OF THE REPORT

The UKBMS partner organisations are continuing to look to reduce the use of paper where possible. Whilst a printed report will remain as the main format for this year, the report for the 2014 season will chiefly be distributed in electronic format (as a pdf file). Should you wish to continue to receive a printed copy of the report, please contact Ian Middlebrook by the end of March 2015 via transect@butterfly-conservation.org.

UKBMS JOINS TWITTER

With the advent of the internet, new forms of communication are developing providing exciting possibilities to enhance interaction with recorders and engage new people. In 2013, two new Twitter accounts were set up for the UKBMS and for the Wider Countryside Butterfly Survey (WCBS) for this purpose. To date these new Twitter feeds have attracted more than 400 followers, enjoying over 300 butterfly monitoring related tweets on current emergence times, noteworthy counts, migration events, news of recent research publications, conservation stories and many other snippets. In addition, UKBMS news features at times in the main Twitter accounts set up by CEH and BC and from personal pages of the UKBMS core and wider team including by David Roy, Tom Brereton, Martin Warren, Nick Isaac, Tom Oliver and Marc Botham. Feel free to follow any of these accounts to get the latest UKBMS news daily to your computer, tablet or smartphone.

Core accounts:

UKBMs Transect News

<https://twitter.com/UKBMSLive>

Wider Countryside Butterfly Survey News

<https://twitter.com/WCBSLive>

BC

<https://twitter.com/savebutterflies>

CEH Science News

<https://twitter.com/CEHScienceNews>

Personal accounts:

David Roy

<https://twitter.com/DavidRoyBRC>

Tom Brereton

https://twitter.com/tom_m_brereton

Marc Botham

<https://twitter.com/MarcBotham>

Tom Oliver

https://twitter.com/Dr_Dolittle_81

Nick Isaac

<https://twitter.com/drnickisaac>

Martin Warren

<https://twitter.com/martinswarren>

PRIORITY SPECIES INDICATOR

A new official Biodiversity Indicator on the Status of Priority Species which utilises UKBMS data was published in October 2013. The indicator documents changes in the relative abundance of priority species in the UK, from 1970 to 2010 using surveillance data on bird, butterfly, moth and mammal species from structured monitoring schemes. The indicator shows that the composite measure of abundance for priority species for conservation in the UK declined by 58% between 1970 and 2010. The decline is perhaps not surprising as by definition the list includes species which are threatened and in long-term decline, though it is important to track whether

there are signs of improvement in response to conservation efforts. In this respect, the short term trend (2005-2010) is not encouraging, with a significant 7% decline over the last five years and 60% of species showing a negative trend over this period. The indicator will be updated annually, and the long-term aim is to increase representivity by adding trend data from other wildlife groups. Further details, including breakdowns for species groups, are available at <http://jncc.defra.gov.uk/page-4238>

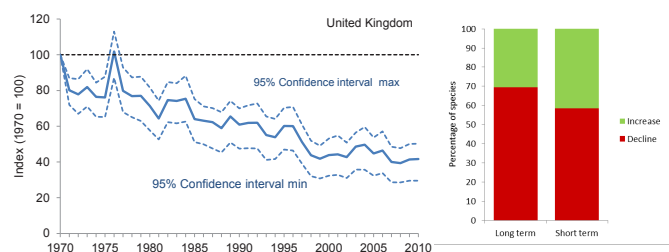


Figure 1. Changes in the relative abundance of Priority Species in the UK, 1970 to 2010. Data source: JNCC

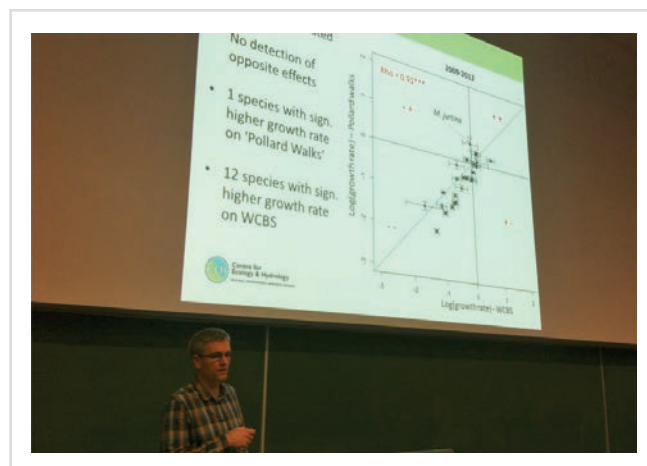
BUTTERFLY CONSERVATION INTERNATIONAL SYMPOSIUM

Uses of UKBMS data featured heavily at Butterfly Conservation's International Symposium held in March 2014, with the results included in 10 talks and two posters. Tom Brereton kicked off events with a keynote presentation reviewing the UKBMS over the past 40 years. Tom highlighted the wealth of conservation and research uses of UKBMS data, with more than 120 scientific papers published on various aspects of ecology. The UKBMS continues to evolve and this aspect was covered by both Zoë Randle, describing the first five years of the Wider Countryside Butterfly Survey (WCBS) and David Roy, who assessed whether trends in butterfly species were comparable between the WCBS and traditional transects. Furthermore, Tom Prescott from BC Scotland showcased the fantastic efforts being made by BC in partnership with Forestry Commission Scotland to improve Scottish monitoring coverage of two flagship Priority Species - Pearl-bordered Fritillary and Chequered Skipper.

Marc Botham described a CEH led study looking at how habitat and landscape factors affect the variety and abundance of butterflies in agricultural landscapes in southern England, highlighting the need to retain habitat diversity especially in areas of semi-natural grassland. Kate Risely presented the results from a BTO study that used WCBS data to investigate patterns and causes of corresponding variation in butterfly and bird communities. The research demonstrated that in general terms, areas supporting a relatively high variety of widespread birds were also rich in common butterflies. However, the more specialised and rarer bird species were distributed differently in the landscape to rare and specialised butterflies indicating that these groups have different needs at a local level and therefore require bespoke targeted conservation effort. Mark Eaton of the RSPB reviewed butterfly monitoring along 50 transects on 38 RSPB Reserves since 1976. The analysis confirmed that broadly, trends across RSPB reserves are similar but slightly more positive than those for the country as a whole, with 10 of the 14 species showing more positive trends and one, the White Admiral, showing a rapidly increasing trend.

In a macro ecology study, Robin Curtis from the Institute of Zoology/CEH conducted a community level analysis using data on 1,250 butterfly populations in England, spanning 30 species on 54 sites. The work highlighted the importance of food resources (hostplant abundance and a measure of nectar availability) in determining population density. Louise Mair of the University of York, used both UKBMS transect and BNM distribution data to demonstrate that favourable population trends and high habitat availability at range edge sites are vital to facilitate range expansion.

Beyond the UK, Belgian butterfly transect data was used in a study by Nicolas Schtickzelle and colleagues at the Université catholique de Louvain, to show that reduced effort (3-5 visits) mark-release-recapture (MRR) surveys can be used as an alternative to transects and conventional MRR surveys in generating accurate measures of population size. On a wider scale Reto Schmucki led an analysis, facilitated through the LOLA-BMS project¹, of transect data from national monitoring schemes that have established in recent decades across Europe, focussing on better understanding the consistency of patterns and drivers of change in butterfly populations and their distribution at a continental scale. The results from a number of these studies will be published in a special issue of the Journal of Insect Conservation due later in 2014.



David Roy of CEH presenting UKBMS results at BC's International Symposium. Photograph by Martin Warren

UKBMS FUTURE FUNDING 2014-2017

The current contract to maintain and develop the UKBMS ended in March 2014. Negotiations are at an advanced stage for a new three-year contract that will seek to maintain the UKBMS at its current level, whilst looking for efficiency savings (given continued level funding) and developing policy and research uses of the data. We are pleased to announce that all current partner Agencies will continue to provide financial support to the scheme. However, funding will be slightly reduced which will impact on how much network development work we can do nationally. This is essentially a continuation project, though there will be some changes in how the scheme is managed. Further details will be available in due course in the News section of the UKBMS website.

¹ Lola BMS - Local-scale processes build up the LArge-scale response of Butterflies to global changes: Integrative analysis across Monitoring Schemes



RESEARCH

Ongoing projects

The UKBMS data continues to be used for a wide range of research projects. Each year we receive a high number of data requests and the data has been used as a model example of long-term ecological data by lecturers to teach students, particularly with regard to the effects of climate change on insect populations. The following is a brief description of some of the larger projects using UKBMS data in 2013.

The impacts of extreme weather events on butterfly populations

Research led by Dr Tom Oliver at CEH will identify which butterfly species are sensitive to drought (prime candidates are Ringlet, Speckled Wood, Large Skipper, and all three common white pierids), and attempt to investigate how their responses to drought, in terms of population crashes and recovery, are affected by the structure and composition of the surrounding landscape. Further to this, the research will use IPCC5 climate projections on the expected frequency of extreme droughts up to 2100 to project forwards and determine what impact this might have on drought sensitive species.

Concurrent with this, studies at the University of East Anglia by Osgur McDermott Long are focusing on the impacts of extreme weather events on short-term changes in the population abundance and distribution of UK butterflies. Part of this work will determine common life history traits of those species that are most sensitive to extreme weather and will be used to improve the accuracy of Species Distribution Models.

As the climate is warming butterfly communities are changing as a result of changes in species' ranges and abundances. However, high intensity land use such as agriculture and urban development affects the extent to which species are able to move throughout the landscape and utilise available habitats. Current research led by Dr Tom Oliver at CEH aims to determine the effects of high intensity land use on responses of butterfly communities to climate change.



Research led by Tom Oliver of CEH shows that Ringlet recovery from drought depends on how the surrounding countryside is managed. Photograph by Heath McDonald

Measuring the variability of rates in range shifts over time

As part of a collaborative project between CEH, BC, Rothamsted Research and the University of York, PhD student Suzanna Mason is investigating how the rate of range shift varies over time for different butterfly species to determine whether they are speeding up or slowing down in their response to climate change.

LOLA-BMS project

The LOLA-BMS research project is funded by the Centre for Synthesis and Analysis of Biodiversity, a programme of the FRB research organisation (funded by the French government). LOLA-BMS brings together researchers involved in Butterfly Monitoring Schemes across Europe and North America. The UKBMS is closely involved in the project and the UK scheme is seen as leading the way in developing methods for analysing butterfly monitoring data and addressing a range of research questions. LOLA-BMS is focusing on three projects: 1) to quantify rates of colonisation and extinction in different parts of Europe, and how these relate to recent changes in temperature within these regions; 2) to analyse relationships between temperature and butterfly numbers, and to assess whether this relationship is different across European countries and states of America; and 3) to quantify trends in butterflies within different regions of Europe and the USA and relate declines and increases to the ecological traits of species (e.g. life cycles, over-wintering stage, temperature requirements of species). The LOLA-BMS project is due to finish in 2015 and more detailed reports on the outputs from the project will be presented in future UKBMS reports.

Publications

Bennie, J., Hodgson, J.A., Lawson, C.R., Holloway, C.T.R., Roy, D.B., Brereton, T., Thomas, C.D., & Wilson, R.J. (2013). Range expansion through fragmented landscapes under a variable climate. *Ecology Letters*, **16**: 921-929.

Bishop, T.R., Botham, M.S., Fox, R., Leather, S.R., Chapman, D.S. & Oliver, T.H. (2013). The utility of distribution data in predicting phenology. *Methods in Ecology and Evolution* **4**: 1024-1032. doi: 10.1111/2041-210X.12112.

Burns, F., Eaton M.A., Gregory R.D., et al. (2013) State of Nature report. The State of Nature partnership. Available at www.rspb.org.uk/stateofnature

van Swaay et al. (2013). The European Grassland Butterfly Indicator: 1990-2011.

Dapporto, L. & Dennis, R.L.H. (2013). The generalist-specialist continuum: testing predictions for distribution and trends in British butterflies. *Biological Conservation* **157**: 229-236.

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

Dooley, C.A., Bonsall, M.B., Brereton, T. & Oliver, T. (2013). Spatial variation in the magnitude and functional form of density-dependent processes on the large skipper butterfly *Ochlodes sylvanus*. *Ecological Entomology* **38**: 608-616.

Oliver, T.H., Brereton, T. & Roy, D.B. (2013). Population resilience to an extreme drought is influenced by habitat area and fragmentation in the local landscape. *Ecography* **36**: 579-586.

Stefanescu, C. et al. (2013). Multi-generational long-distance migration of insects: studying the painted lady butterfly in the Western Palearctic. *Ecography* **36**: 474-486.

Taylor, D.L., Ramsey, A., Convery, I., Lawrence, A. & Weatherall, A. (2013). The impacts of commercial woodland management on woodland butterfly biodiversity in Morecambe Bay, UK. *Conservation Evidence* **10**: 10-15.

Zmihorski, M., Dziarska-Palac, J., Sparks, T. & Tryjanowski, P. (2013). Ecological correlates of the popularity of birds and butterflies in Internet information resources. *Oikos* **122**: 183-190.

Background and methods

Trends in butterfly populations were compiled from a network of around 2,000 sample locations in 2013 and over 4,000 locations across all years.

Species indices and trends

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

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

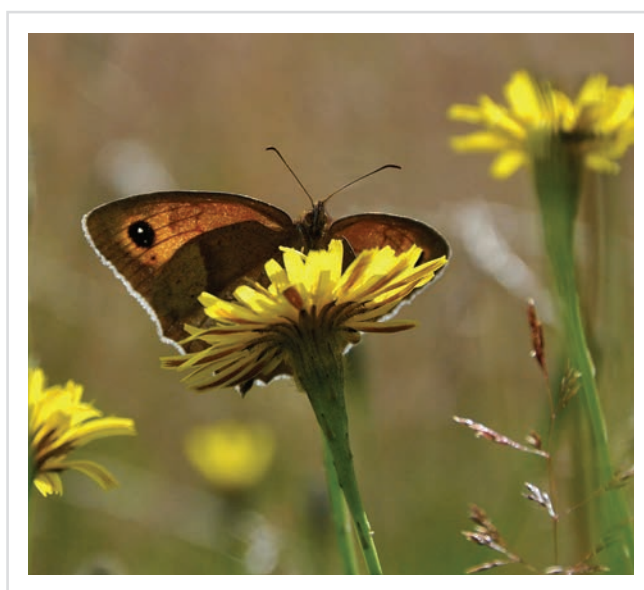
For a number of habitat-specialist species (especially the fritillaries) two 'reduced effort' methods are also used to monitor annual abundance at the site level, especially in more remote parts of the UK; adult timed counts for fritillaries (Warren *et al.* 1981) and larval web counts for Marsh Fritillary (Lewis & Hurford 1997). For both methods, systematic recording is made on single days in suitable weather (when UKBMS recording criteria are met), with the counts converted to a site index that accounts for both the size of the colony and the time in the season when the count was made. In addition, standardised egg counts are undertaken to monitor Large Blue populations (Thomas *et al.* 2009).

The Wider Countryside Butterfly Survey (WCBS) was established in 2009 to improve data on the national population status of butterflies across the countryside as a whole. This is important given that most site-based monitoring is biased towards good quality semi-natural habitat relatively rich in butterflies. In the WCBS, BC recorders are allocated randomly selected squares within the county in which they live, whilst BTO recorders are given the opportunity to survey their existing randomly allocated Breeding Bird Survey (BBS) squares.

Both sets of surveyors are asked to survey these squares at least twice over the July and August period with visits spaced at least ten days apart. Optional visits are encouraged, especially in the spring to sample Orange-tip and for the first generation of bivoltine species. On each visit, recorders survey two parallel 1km survey lines spaced approximately 300m apart. Along the survey lines, recorders count butterflies, day-flying moths and dragonflies using the same time of day, recording width and weather condition criteria used in transect monitoring. Due to the low level of sampling effort WCBS data is not used to derive local measures of butterfly abundance (site indices).

In the 2012 report we described planned changes to analysis methods, by making better use of available transect data and incorporating WCBS data, to compile more representative national and UK indices. These were implemented for the 25 wider countryside species (see Appendix 1 for list of species) and the three regular migrants in 2013. Briefly, the new method (Dennis *et al.* 2012) uses a two-stage model. Firstly, all butterfly counts in a season from both traditional BMS transects and wider countryside squares are used to estimate the seasonal pattern of butterfly counts for that year. A second stage of the model is then applied to the full set of annual counts, accounting for where the counts occur within the flight season, to then calculate annual population indices and trends that account for the seasonal pattern.

Work to apply this method to habitat specialist species (see Appendix 1 for list of species) has not yet been completed, because not all of the required raw data (weekly counts) is available from earlier in the time series. Hence, for habitat specialist, the old method is used. In this, site index data from all past and present transects and timed counts/larval webs at monitored sites is combined each year to derive national and UK 'Collated' Indices (CI) and to estimate trends over time. Because not all sites are monitored each year, a statistical model (using log-linear regression) is needed to estimate missing values and to produce national indices and trends. The model takes into account the fact that for a particular butterfly species, some years are better than others (a year effect), typically due to the weather, and some sites support larger populations than others (a site effect). The precision of indices and trends is estimated by a further statistical technique called 'bootstrapping'.



Meadow Brown. Photograph by Tim Melling



Butterfly indicators

Multi-species (composite) indices of butterfly abundance were calculated following methods developed for UK birds and as used for stock markets to monitor changes in the value of the top 100 companies (e.g. the FTSE 100). Multi-species indices were derived by calculating the geometric mean index across each species assemblage. In this, for each year separately, the log of each species index value was taken, then averaged across selected species and the exponential of the result calculated. Grouped measures have been compiled for species of the wider countryside and habitat specialists and categorised by broad habitat groupings (farmland and woodland) in England (Brereton *et al.* 2011).

To identify underlying patterns in population trends in butterfly indicators, the assessment of change is based on smoothed indices. Trends and confidence intervals in smoothed indices were assessed by structural time-series analysis and the Kalman Filter using the program TrendSpotter (Soldaat *et al.* 2007).

A statistical test is performed using the software TrendSpotter to compare the difference in the smoothed index in the latest year versus other years in the series. Within the measures, each individual species trend is given equal weight, and the

annual figure is the geometric mean of the component species indices for that year. Populations of individual species within each measure may be increasing or decreasing, irrespective of the overall trends.

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

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 Roome, 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.

Thomas, J.A., Simcox, D.J. & Clarke, R.T. (2009). Successful Conservation of a Threatened *Maculinea* Butterfly. *Science* 325, 80-83.

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.

Sample coverage

UKBMS sites

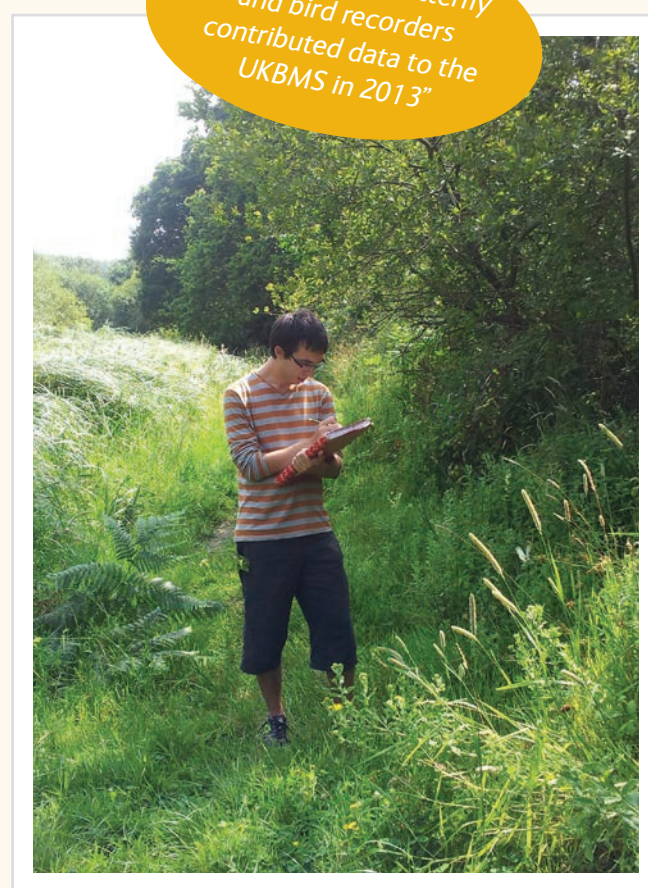
In 2013 1,212 sites were monitored, a rise of 8% on the previous best ever total in 2012. This included 1,041 sites in England, 65 in Wales, 92 in Scotland and 13 in Northern Ireland. No data was received from the Channel Islands.

1,082 of these sites were monitored using standard transects, whilst 130 were monitored using reduced effort methods. Of these, 1,147 sites (95%) produced indices for at least one species.

Since 1976, an overall total of 2,302 sites have been monitored. There is approximately a 7% turnover of sites each year. In 2013, a further 149 new sites were established and monitored for the first time. 27 of these were in Scotland and 15 in Wales whilst the rest were in England. Within England, East Midlands had the greatest number of new sites with 21, whilst close behind was Hampshire & the Isle of Wight with 19.

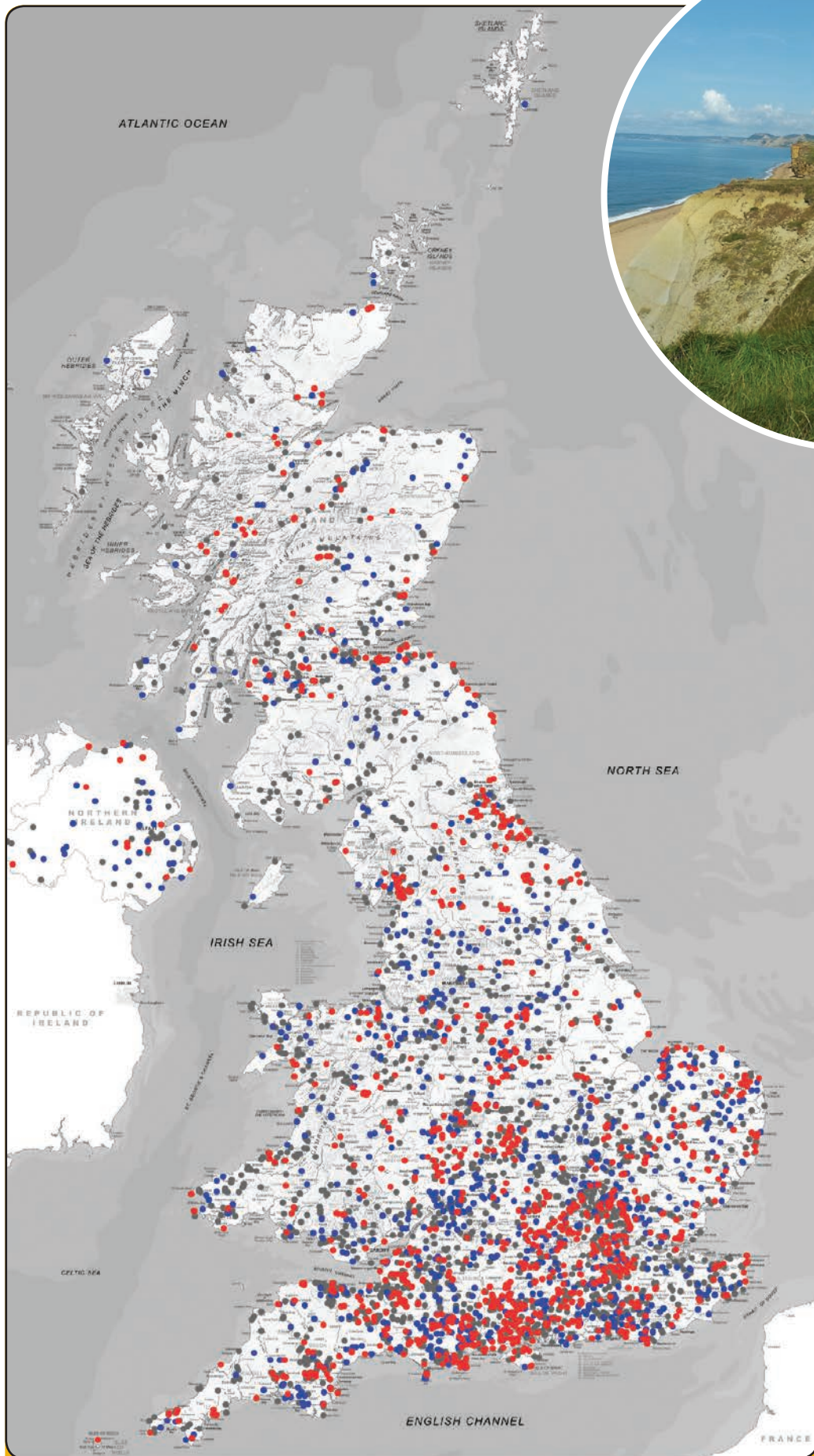
Wider Countryside Butterfly Survey (WCBS)

The WCBS ran for a fifth year in 2013. The survey continues to grow year on year, with 857 squares sampled in 2013, representing 11% more than 2012. The greatest overall increase in square coverage occurred in Northern Ireland, with 15 more squares than in 2012. For the first time, more than 700 recorders took part in the scheme, walking over 3,500 km of survey line on 1,815 visits and counting 142,217 butterflies of 45 species. BBS volunteers covered 374 squares (44% of the total) whilst BC volunteers covered the remaining 483



Volunteers sampled butterflies at around 2000 UKBMS locations in 2014. Photograph by Tom Brereton

squares (56%). Good coverage (species present in more than 30 squares) was achieved for 23 wider countryside species, with 19 of these being present in more than 100 squares.



Bindbarrow, Dorset – the most westerly outpost for Lulworth Skipper in the UK and monitored by a single species transect since 2010
 Photograph by Tom Brereton

Figure 2. Location of monitored sites in 2013. UKBMS sites producing a site index (red circles), WCBS squares walked (blue circles), sites and squares not walked in 2013 (grey circles)





The 2013 season

“Butterflies rallied following their worst year on record, but numbers were still below average”

SUMMARY

Following a disastrous year in 2012, the majority of butterflies rallied in 2013, benefiting from the best summer weather since 2006, whilst some Priority Species (for list see Appendix 2) benefited from ongoing conservation efforts. Headline results from the survey included:

- 46 of the 56 species assessed recorded an annual increase from 2012
- Almost 630,000 more butterflies were counted than in 2012 on UKBMS sites, with each recorder seeing on average approximately 500 more butterflies per monitored site
- Some of the largest improvements in fortunes were for summer species whose main/second broods coincided with the July heatwave. Chalkhill Blue had its best year on record.
- In spite of some positives, the year was still well below average, ranking only 25th in the 38 year series
- It was a poor year for single-brooded, spring flying species, with eight of the nine species having below average years and the ninth barely above average. Grizzled Skipper had its worst year in the series.
- It was a late season, with 47 of 55 resident species peaking later in abundance than the series average.
- The mean emergence date for species was seven days later than the long-term average, whilst the mean flight date was five days later.

Good summer weather was a key factor in the recovery, with long periods of warm sunny weather boosting emergence and facilitating greater activity. Immigration from overseas may well have played a part in the recovery too, with coastal movements of ‘cabbage whites’, Small Tortoiseshells and Peacocks noted in parts of eastern and southern England and offshore across the North Sea. The cold weather in spring was equally important in shaping how the season unfolded, and largely explained why the year was below average. Firstly, cold weather slowed growth rates, leading to longer development times and delaying the emergence of many species. Secondly, cold conditions reduced emergence rates and activity levels for many species flying early in the year, leading to a number of spring species faring badly.

MONTHLY ROUND-UP

The year began with notably mild weather in early **JANUARY**, with a maximum temperature of 14.5°C recorded in *North Wales* on the 2nd. This was warm enough for butterflies to help bring in the New Year, with January 1st sightings of **Red Admiral** in seven counties, both **Painted Lady** and **Peacock** in five, **Brimstone** in *Bedfordshire* and *Oxfordshire*, **Small Tortoiseshell** in *Dorset* and *Sussex* and **Speckled Wood** in *Cornwall*. A **Comma** was recorded in *Kent* on the 8th, but from mid-January onwards there was a return to more typically wintry weather and there were no further new



Red Admirals were recorded in seven counties on New Years Day. Photograph by Allan Drewitt

emergences. January and **FEBRUARY** could be summarised as being ‘cold but not particularly so’. Mild weather and a burst of sunshine towards the end of February, tempted out the only new emergence in the month, a very early **Orange-tip** in *Oxfordshire* on the 27th.

MARCH was one of the coldest in the historical series, being 3.3°C below the 1981-2010 average and the coldest since 1962. There were odd warm days, though, especially in the early part of the month, with a maximum temperature of 17.5°C at *Trawsgoed (Ceredigion)* on the 5th, yielding a **Small White** on the 2nd in *Lincolnshire*, a very early **Small Copper** on the 5th in *Norfolk*, and **Large White** in *Warwickshire* on the 7th. With snow and gales from the north-east, there was precious little butterfly activity for the remainder of the month, though a **Green-veined White** was seen in *Bedfordshire* on the 24th.

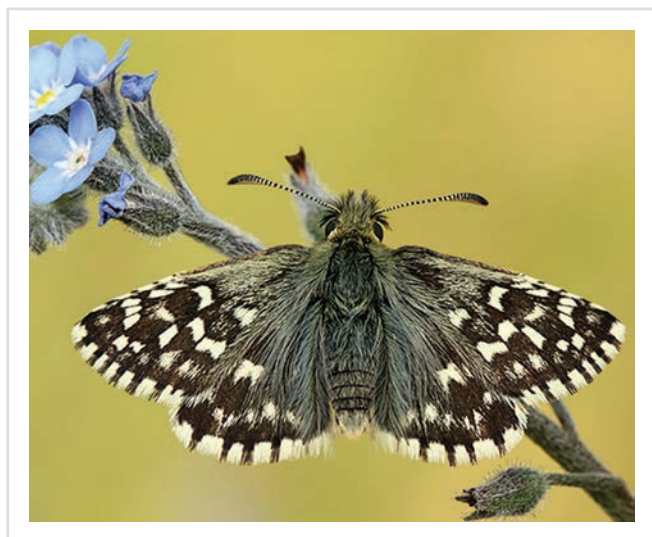
There was no great improvement in the weather in **APRIL**, with temperatures below the seasonal average making it the coldest April in the UK since 1989. Despite this, a further eight species emerged, these being **Holly Blue** (1st *Dorset*), **Green Hairstreak** (11th *Hampshire*), **Grizzled Skipper** (23rd *Somerset*), **Clouded Yellow** (24th *Sussex*), **Dingy Skipper** and **Small Heath** (25th *Surrey*), **Pearl-bordered Fritillary** (27th *Devon*) and finally **Duke of Burgundy** (30th *Hampshire*).

Cool conditions continued into **MAY**, with temperatures below the long-term average everywhere. Rainfall was above average and sunshine below average, though in between periods of generally unsettled and often windy weather there were some fine sunny days, with temperatures peaking at 23.8 °C in

Cumbria on the 7th. Seventeen species newly emerged including **Common Blue** (1st Hertfordshire), **Wall Brown** (1st Dorset and Pembrokeshire), **Wood White** (2nd Surrey), an early **Meadow Brown** (2nd Warwickshire), **Small Blue** (6th Glamorgan), **Cryptic Wood White** (7th Fermanagh), **Brown Argus** (11th Cornwall), **Small Pearl-bordered Fritillary** (11th Cornwall), **Marsh Fritillary** (16th Dorset), **Ringlet** (17th Norfolk) **Swallowtail** (19th Norfolk), **Chequered Skipper** (21st Argyll), **Adonis Blue** (22nd Sussex), **Dark Green Fritillary** (22nd Cumbria), **Large Skipper** (23rd Warwickshire), **Glanville Fritillary** (25th Isle of Wight) and **Small Skipper** (25th West Midlands).

Like the preceding two months, **JUNE** overall continued to be cooler than average over most parts of the UK, though on the plus side rainfall was mostly below normal, except in Northern Ireland, and sunshine levels were average. There were some fine spells of weather in western parts of Britain, especially in Scotland benefiting our increased efforts to improve survey and monitoring coverage of **Chequered Skipper**. First sightings were made for 17 species including **Heath Fritillary** (1st in Devon), **Large Blue** (3rd Somerset), **Marbled White** (3rd Somerset), **Silver-studded Blue** (3rd Denbighshire), **Northern Brown Argus** (4th Lancashire), **Essex Skipper** (5th Kent), **Silver-washed Fritillary** (7th West Sussex), **Purple Hairstreak** (8th Midlothian), **High Brown Fritillary** (10th Devon), **Mountain Ringlet** (10th Cumbria), **Large Heath** (14th Lancashire), **Grayling** (16th Devon), **White Admiral** (17th Hampshire), **Gatekeeper** (19th East Sussex), **Black Hairstreak** (21st Buckinghamshire and Oxfordshire), **Chalkhill Blue** (26th Dorset) and **White-letter Hairstreak** (27th Hampshire).

Inevitably the poor spring weather took its toll, with seven of the nine species which chiefly fly in spring having below average years. These included **Grizzled Skipper** (worst year in the 38 year series), **Green Hairstreak** (35th best out of 38), **Duke of Burgundy** (25th of 34), **Glanville Fritillary** (19th of 22), **Marsh Fritillary** (24th of 33), **Orange-tip** (27th of 38) and **Pearl-bordered Fritillary** (30th of 38).



2013 was the worst year on record for the Grizzled Skipper. Photograph by Nigel Kiteley



Chalkhill Blue. Photograph by Iain Leach

Dingy Skipper fared only slightly better, with the year being just above average (16th of 38). The greatest annual declines amongst these species were for **Glanville Fritillary** (down by 82% from 2012 levels) and **Grizzled Skipper** (by 42%).

The cool spring weather no doubt slowed growth rates for both spring and summer flying species, with emergence times later than average in all of the spring and summer months (May by an average of 6 days across all species, June by 6 days, July 8 days, August 5 days). For example, the average emergence date of Large Heath on UKBMS sites in 2013 was 19 days later than the series average (21st July compared with 2nd July) and 24 days later than in 2012. Other summer species emerging much later than the series average included **High Brown Fritillary** (later by 18 days), **Lulworth Skipper** (by 15 days), **Pearl-bordered Fritillary** (by 13 days), **Glanville Fritillary** and **Heath Fritillary** (both by 12 days).

JULY finally delivered some better weather, with high pressure settled over most of the UK bringing plenty of warm, dry, sunny weather. Daytime temperatures exceeded 28°C on 19 consecutive days from 6th to 24th peaking at 33.5°C in south-east England, resulting in the UK's most notable summer heat wave since 2006. The mean temperature was approximately 2°C above the long-term average, placing it as the third warmest summer since 1910 (exceeded only in 1983 and 2006). The month saw the last five UK butterflies to emerge including **Lulworth Skipper** (1st in Sussex), **Purple Emperor** (1st Buckinghamshire), **Scotch Argus** (11th Highland), **Silver-spotted Skipper** (20th Sussex) and finally **Brown Hairstreak** (24th Dorset).

Following an unsettled spell at the start of the **AUGUST**, there was plenty more nice summer weather over the remainder of the month, with sunshine levels around average, temperature levels slightly above average, and rainfall levels below average, making it the driest August in more than a decade. There were some very hot days, with a maximum temperature of 34.1°C recorded in south-east England on the 1st, this being the highest UK temperature since July 2006.



The glorious weather in July and continued good spells in August brought a big turnaround in the fortunes of many summer flying species. Familiar garden species whose main second broods coincided with the July heat wave were among those species to benefit most. Winners included **Small White** (numbers up by 388% from 2012), **Large White** (+356%), **Small Tortoiseshell** (+232%), **Peacock** (+196%) and **Green-veined White** (+171%). **Small Tortoiseshell** had its best year for more than a decade and, for example, was recorded in 80% of WCBS squares, whilst **Peacock**, **Small White** and **Large White** all had 'top five' years out of the 38-year series. **Peacock** was present in over two-thirds of WCBS squares compared to less than half in 2012. There was a welcome increase in **Common Blue** numbers following an appalling year in 2012, with an average five-fold increase in abundance per WCBS square and an almost 200% increase across transects and WCBS squares combined. Even **Wall Brown** had a better year, being seen in twice the number of squares as in 2012 (8% of squares versus 4%) and showing an annual increase of more than 100%. There were some spectacular local increases in these species including for **Large White** at *Waterford Heath South (Hertfordshire)* where abundance increased from one in 2012 to 201 in 2013.

Chalkhill Blue recorded its best year since the start of monitoring in 1976, whilst several other summer flying species similarly associated with short to medium turf herb-rich grasslands had excellent years including **Adonis Blue** (6th best year), **Silver-spotted Skipper** and **Dark Green Fritillary** (both having their 2nd best years). All four species have positive long-term trends, and have benefitted from targeted conservation management on grassland sites, especially those notified as protected areas and entered into agri-environment schemes. Numbers of some of our rarest species were boosted too. Following eight below average years in succession, **Lulworth Skipper** made a much awaited recovery, with abundance up by 162%, whilst numbers of the critically endangered **High Brown Fritillary** were up by 133% and **Swallowtail** numbers were up by 11%, the latter species having its 9th best year. There was good evidence for a substantial immigration occurring over the summer period too, bolstering numbers of some common species in eastern areas. **Small Tortoiseshells** and **Peacocks** were seen from a fisheries research vessel working in the middle of the North Sea migrating in quantity in a south-westerly direction in August, whilst there were reports of thousands of whites congregating in some localities along the East coast of England over the same period.

Of the regular migrants, **Clouded Yellow** had an excellent year, the 7th best in the 37-year series and the best since 2006. The butterfly was recorded at 386 UKBMS sites compared with just 18 sites in 2012 and abundance was substantially up. Similarly, it was seen in 85 WCBS squares in 2013 compared to only five in the previous year. Following a flurry of sightings between 19th and 26th June, numbers began to really build up from the 1st August peaking on the 26th, when 8% of the total was counted. Far fewer were seen after the second week

in September, with the last record on a traditional transect being on the 23rd October in *Somerset*. It was a poor year for the other regular migrants though: **Red Admiral** declined by 65% from 2012 levels, with the year ranked as the 8th worst in the series, whilst **Painted Lady** had its 11th worst year, even though more were counted than in 2012.

In migration terms, the year will be remembered for the influxes of the Continental race of the **Swallowtail**, with a wide scattering of sightings across southern England and especially for **Long-tailed Blues**. For the latter species, this was the biggest immigration for almost 60 years, with sightings in at least eight counties in southern England between July and October and breeding confirmed in *Kent* and *East Sussex*. Sadly, there were no records of either Continental **Swallowtails** or **Long-tailed Blues** on UKBMS sites or in WCBS squares.

Good weather continued into the first half of **SEPTEMBER**, with temperatures reaching 30.2°C in *Essex* and *Kent* on the 5th, though just a day later in *Sutherland* a frosty -2.4°C was recorded! The latter half of the month was more typically autumnal and butterfly diversity rapidly tailed off, coinciding with the end of the formal 26-week transect walking season on the 30th.

OCTOBER was unsettled, with moderately milder, wetter and duller conditions than average. There were still some nice days though with temperature peaking at 23.0°C in *Skegness, Lincolnshire* on the 8th. Optional visits to transects produced 17 species on 170 visits, bringing the recording season to an end.



Small Tortoiseshell had its best year for more than a decade, with numbers boosted in Eastern areas by a mid-summer immigration. Photograph by Tim Melling

Table 1. Summary of species abundance changes in the UK from 2012 to 2013 and long-term (over the entire time series: no. yrs max = 38) and short-term (last 10-years) changes. The mean flight date is calculated as the weighted mean date of counts and is highly correlated to both first appearance and the peak flight date (Botham et al. 2008). Significance of trends: *P < 0.05 (significant), **P < 0.01 (highly significant), *P < 0.001 (very highly significant). Red text has been used to highlight those species that had their worst year of the series in 2013 and blue text best year in the series.**

Species	Start Year	No. Sites with Index (as of 2013)	No. Years with Index in 2013	2013 Rank	% change 2012-2013	Series trend (%)	10-year trend (%)	Mean flight date 2013	Series Mean flight date
Small Skipper	1976	651	38	30	106	-73***	-31	23-Jul	21-Jul
Essex Skipper	1977	573	37	33	58	-90***	-81**	26-Jul	25-Jul
Lulworth Skipper	1992	14	22	11	162	-82***	-53	03-Aug	28-Jul
Silver-spotted Skipper	1979	37	35	2	140	903***	-23	14-Aug	15-Aug
Large Skipper	1976	1237	38	34	44	-21	-16	15-Jul	06-Jul
Dingy Skipper	1976	259	38	16	-3	-25*	57	09-Jun	01-Jun
Grizzled Skipper	1976	183	38	38	-45	-35*	12	03-Jun	29-May
Swallowtail	1980	12	34	9	115	90*	-13	04-Jul	21-Jun
Wood White	1979	44	35	29	26	-86***	-56	28-Jun	17-Jun
Clouded Yellow	1979	703	35	7	4373	5017	-88	19-Aug	09-Aug
Brimstone	1976	1103	38	8	103	-16	-30	19-Jun	09-Jun
Large White	1976	1794	38	4	356	-28	-1	28-Jul	21-Jul
Small White	1976	1805	37	3	388	-20	10	01-Aug	23-Jul
Green-veined White	1976	1759	38	6	171	-11	26	17-Jul	09-Jul
Orange-tip	1976	1118	38	27	-17	0	32	23-May	17-May
Green Hairstreak	1976	265	38	35	68	-44**	-40	02-Jun	29-May
Brown Hairstreak	1983	41	31	29	29	-18	-75***	24-Aug	25-Aug
Purple Hairstreak	1976	409	37	20	102	-59*	-25	04-Aug	30-Jul
White-letter Hairstreak	1976	162	38	36	80	-96***	-74*	29-Jul	25-Jul
Black Hairstreak	1996	10	18	16	600	-52	-89	29-Jun	29-Jun
Small Copper	1976	1320	38	28	20	-34	-19	10-Aug	03-Aug
Small Blue	1978	138	36	25	8	18	-25	10-Jul	30-Jun
Silver-studded Blue	1979	56	35	11	130	13	2	19-Jul	18-Jul
Brown Argus	1976	641	38	23	221	-35	-34	11-Aug	01-Aug
Northern Brown Argus	1979	40	35	31	19	-50*	-9	17-Jul	12-Jul
Common Blue	1976	1448	38	16	191	-25	-27	05-Aug	25-Jul
Chalkhill Blue	1976	171	38	1	78	26	77	10-Aug	09-Aug
Adonis Blue	1979	73	35	6	70	194**	-23	11-Aug	26-Jul
Holly Blue	1976	1125	38	29	-32	17	-60	03-Jul	29-Jun
Large Blue	1983	28	31	10	-42	1704***	-11	27-Jun	27-Jun
Duke of Burgundy	1980	79	34	25	3	-43**	24	04-Jun	30-May
White Admiral	1976	186	38	28	64	-58***	-50	24-Jul	18-Jul
Purple Emperor	1979	63	35	8	45	57	-19	24-Jul	22-Jul
Red Admiral	1976	1629	37	30	-65	173**	-14	01-Aug	07-Aug
Painted Lady	1976	1317	37	27	157	43	-89	30-Jul	31-Jul
Small Tortoiseshell	1976	1755	38	23	232	-78***	-28	17-Jul	10-Jul
Peacock	1976	1747	38	5	196	5	-6	08-Jul	02-Jul
Comma	1976	1489	38	10	66	144***	-25	21-Jul	21-Jul
Small Pearl-bordered Fritillary	1976	92	38	25	3	-56***	6	01-Jul	25-Jun
Pearl-bordered Fritillary	1976	88	38	30	-22	-71***	23	09-Jun	02-Jun
High Brown Fritillary	1978	65	36	30	133	-63*	-74*	23-Jul	16-Jul
Dark Green Fritillary	1976	308	38	2	82	176***	30	23-Jul	22-Jul
Silver-washed Fritillary	1976	373	38	3	105	128***	-3	02-Aug	26-Jul
Marsh Fritillary	1981	75	33	24	133	-10	-66	11-Jun	06-Jun
Glanville Fritillary	1992	7	22	19	-82	-50	1076	15-Jun	09-Jun
Heath Fritillary	1981	27	33	32	10	-85***	-82***	14-Jul	04-Jul
Speckled Wood	1976	1627	38	7	69	90***	-9	05-Aug	27-Jul
Wall Brown	1976	555	38	32	108	-86***	-56	05-Aug	28-Jul
Scotch Argus	1979	47	35	10	-21	176***	40	03-Aug	10-Aug
Marbled White	1976	788	37	13	48	25	-16	20-Jul	16-Jul
Grayling	1976	143	38	25	47	-59***	25	04-Aug	05-Aug
Gatekeeper	1976	1544	36	32	30	-43**	-67***	02-Aug	02-Aug
Meadow Brown	1976	1831	38	18	2	2	-25	25-Jul	21-Jul
Small Heath	1976	1100	37	23	22	-55***	0	17-Jul	09-Jul
Large Heath	1990	9	24	22	-37	186**	-60	23-Jul	09-Jul
Ringlet	1976	1614	37	2	56	352***	38	18-Jul	15-Jul



Table 2. Country-level summary of species abundance changes from 2012 to 2013 and long-term (over the entire time series: no. yrs max = 38) 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). Note: some country-level changes are based on relatively small sample sizes and thus should be interpreted with caution.**

Species	No. sites producing an index in 2013			% change in Collated index 2012-2013			SERIES TREND			10-YEAR TREND		
	Eng	Scot	Wales	Eng	Scot	Wales	Eng	Scot	Wales	Eng	Scot	Wales
Small Skipper	635	-	15	103	-	55	-74***	-	-14	-36	-	125
Essex Skipper	571	-	1	53	-	N/A	-90**	-	N/A	-82**	-	N/A
Lulworth Skipper	14	-	-	162	-	-	-82***	-	-	-53	-	-
Silver-spotted Skipper	37	-	-	140	-	-	903***	-	-	-23	-	-
Large Skipper	1196	-	35	44	-	21	-19	-	-84***	-16	-	-51*
Dingy Skipper	251	2	5	-5	N/A	N/A	-21	N/A	N/A	57	N/A	N/A
Grizzled Skipper	183	-	-	-45	-	-	-36*	-	-	13	-	-
Swallowtail	12	-	-	115	-	-	90*	-	-	-16	-	-
Wood White	44	-	-	26	-	-	-86***	-	-	-56	-	-
Clouded Yellow	684	-	6	3881	-	N/A	5017	-	N/A	-87	-	N/A
Brimstone	1084	-	5	107	-	N/A	-19	-	N/A	-30	-	N/A
Large White	1586	93	85	367	176	133	-27	-4	-53**	4	-56	-32
Small White	1596	96	85	388	86	347	-17	10	-77***	12	-36	53
Green-veined White	1483	159	77	181	124	190	-15	16	75	17	77	176
Orange-tip	986	86	29	-19	-2	45	-10	177**	291***	31	82	27
Green Hairstreak	255	5	4	64	194	N/A	-48***	66	N/A	-44	-9	N/A
Brown Hairstreak	40	-	1	56	-	N/A	-19	-	N/A	-76**	-	N/A
Purple Hairstreak	394	-	8	107	-	N/A	-59*	-	N/A	-21	-	N/A
White-letter Hairstreak	160	-	2	80	-	N/A	-96***	-	N/A	-76*	-	N/A
Black Hairstreak	10	-	-	600	-	-	-52	-	-	-89	-	-
Small Copper	1175	72	58	35	-43	90	-30	-22	-54*	-20	6	-22
Small Blue	129	6	2	12	-7	N/A	-30	171*	N/A	-35	171*	N/A
Silver-studded Blue	55	-	1	134	-	N/A	-26	-	N/A	-10	-	N/A
Brown Argus	638	-	2	221	-	N/A	-34	-	N/A	-34	-	N/A
Northern Brown Argus	32	8	-	35	-51	-	-66***	-79	-	-13	-98	-
Common Blue	1309	72	58	219	70	81	-24	29	-7	-28	-35	-18
Chalkhill Blue	171	-	-	78	-	-	26	-	-	77	-	-
Adonis Blue	73	-	-	70	-	-	194**	-	-	-23	-	-
Holly Blue	1080	1	32	-32	N/A	-78	18	N/A	-52	-60	N/A	-77*
Large Blue	28	-	-	-42	-	-	1704***	-	-	-11	-	-
Duke of Burgundy	79	-	-	3	-	-	-43**	-	-	24	-	-
White Admiral	186	-	-	64	-	-	-58***	-	-	-50	-	-
Purple Emperor	63	-	-	45	-	-	57	-	-	-19	-	-
Red Admiral	1442	99	67	-64	-79	31	183**	>1000*	128	-12	-73	-19
Painted Lady	1185	73	49	167	-47	80	45	-76	-48	-88	-96	-87*
Small Tortoiseshell	1499	138	81	277	55	106	-78***	-44	-40	-30	41	44
Peacock	1531	117	74	196	104	182	5	142*	-51*	1	-55*	-18
Comma	1405	29	54	66	108	140	139***	-51	15	-26	-51	5
Small Pearl-bordered Fritillary	75	10	7	-4	5	-9	-33	-38	-24	25	-66*	89
Pearl-bordered Fritillary	73	3	12	-55	N/A	74	-54**	N/A	171*	-2	N/A	72
High Brown Fritillary	56	-	9	129	-	990	-64*	-	-8	-75*	-	-33
Dark Green Fritillary	271	21	12	73	120	147	401***	-28	-84***	16	111*	29
Silver-washed Fritillary	365	-	7	105	-	151	142***	-	-86**	-1	-	149
Marsh Fritillary	55	-	20	95	-	272	-71*	-	-79**	-76	-	-44
Glanville Fritillary	7	-	-	-85	-	-	-48	-	-	1150	-	-
Heath Fritillary	27	-	-	10	-	-	-85***	-	-	-82***	-	-
Speckled Wood	1491	31	72	74	48	90	90***	24	120***	-10	44	-31
Wall Brown	510	5	36	104	118	476	-88***	-31	-38	-59	-67*	39
Scotch Argus	9	38	-	71	-28	-	-61**	34	-	-29	49	-
Marbled White	786	-	2	45	-	N/A	28	-	N/A	-17	-	N/A
Grayling	128	6	7	40	45	447	-38**	-69***	-84***	48	-50	257*
Gatekeeper	1474	-	69	30	-	31	-48**	-	36	-61**	-	-47*
Meadow Brown	1584	125	18	4	47	-46	-2	-11	46	-24	-70**	7
Small Heath	944	89	48	22	9	44	-63***	149**	15	6	-48*	14
Large Heath	3	6	-	N/A	N/A	-	N/A	N/A	-	N/A	N/A	-
Ringlet	1393	119	64	51	45	164	383***	73*	77**	52	-6	84

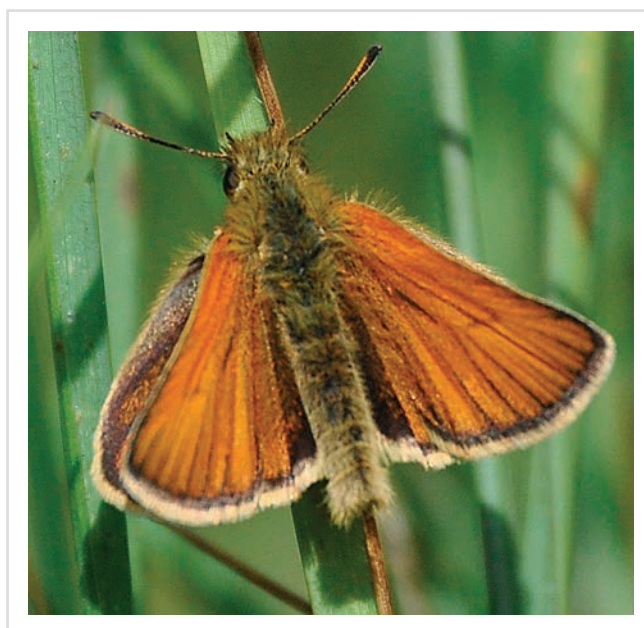
Comparison of trends in wider countryside species using new and old analysis methods

On average, the new analysis method more than doubled the sample size for wider countryside species and migrants (mean increase of 120% for the 28 species). The biggest increase in sample coverage was for Scotch Argus, where the number of sites used in the analysis increased by 292% (47 versus 12 sites). For the majority of species the long-term trend estimated by the new method was similar to the old method. For 15 of the 28 species, the trend was in the same direction and the difference in % change over the series change was small (within 20%). For five species Comma, Speckled Wood, Holly Blue, Painted Lady and Red Admiral the trend was in the same direction, but less substantial with the new analysis method. For Clouded Yellow and Ringlet the trend was in the same direction, but showing a more substantial change with the new analysis method. For Brimstone and Brown Argus, the long-term trend was negative with the new method and positive with the old method, though none of the trends were substantial in magnitude or statistically significant.

Three species differed in trend classification according to the analysis method. The new analysis method estimated a significant 59% long-term decline for Purple Hairstreak based on an additional 133 sites, compared with an apparent 1% decline using the old method. The new long-term trend for Marbled White is classed as an apparent 25% increase from 788 sites, compared with a significant 52% increase using the old method from 466 sites. With the new method, the Essex Skipper is estimated to have undergone a very highly significant 90% decline at 573 sample locations, compared with a 69% highly significant decline from 346 sites under the old method.

Because the new method uses additional data from the transect network (counts from sites where indices were not calculable with the old method) and WCBS data, we can't say at this stage whether the differences in trends reflect differences in the habitats sampled by the schemes.

As previously mentioned, a paper comparing trends in butterfly species between the WCBS and traditional transects has been compiled and submitted to the *Journal of Insect Conservation*.



The Essex Skipper is in severe decline at monitored sites. Photograph by Tim Melling

“Across the UK 60% of species show a negative long-term trend”

Long-term trends

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

UNITED KINGDOM

For the UK we are able to report on long-term and ten year trends for 56 of the 59 regularly occurring species, including 28 habitat specialist species, 25 wider countryside species and the three regular migrants (Table 1). Since 1976, 39% of species show a positive trend, 60% show a negative trend and Orange-tip shows no overall change. Of the species with a significant trend, 12 species (44% of the total) show a long-term increase, whilst 15 (56%) are in significant decline. The top 10 species in most acute long-term decline (in descending rank order, with 2012 rank in parentheses) are **White-letter**

Hairstreak (2), **Essex Skipper** (12), **Wood White** (4), **Wall Brown** (3), **Heath Fritillary** (5), **Lulworth Skipper** (1), **Small Tortoiseshell** (6), **Small Skipper** (7), **Pearl-bordered Fritillary** (8) and **High Brown Fritillary** (13). The top 10 species showing the largest population increase (in descending rank order, with 2012 rank in parentheses) are **Large Blue** (1), **Silver-spotted Skipper** (2), **Ringlet** (4), **Adonis Blue** (8), **Large Heath** (5), **Scotch Argus** (7), **Dark Green Fritillary** (9), **Red Admiral** (3), **Comma** (6) and **Silver-washed Fritillary** (11).

Over the last decade, 40 species (71%) show negative trends, including all three regular migrants, and 15 species (27%) show positive trends, whilst **Small Heath** shows no change. There are no species with a significant 10 year increase, whilst 11 species are in significant decline over the period. In descending

rank order, declining species (most rapid first) include **Heath Fritillary**, **Essex Skipper**, **Brown Hairstreak**, **White-letter Hairstreak**, **High Brown Fritillary** and **Gatekeeper**.

The UK butterfly indicator includes data from 26 habitat specialist and 24 wider countryside species. Since 1976, habitat specialists and wider countryside species show declines of 73% and 36% respectively. Analysis of the underlying smoothed trends shows that since 1976 both habitat specialists and species of the wider countryside have declined significantly. Over the last five years (since 2008), habitat specialist butterflies have shown an apparent increase from 21% to 27% of the 1976 level, whilst species of the wider countryside show an apparent increase from 44% to 64% of the 1976 level. However, the underlying analysis shows that neither of these recent increases is statistically significant. In 2013, habitat specialist butterflies increased by 9% from the previous year, whilst wider countryside species increased by 29%. For both wider countryside and habitat specialist species the smoothed and unsmoothed indices in 2012 were the lowest in the series.

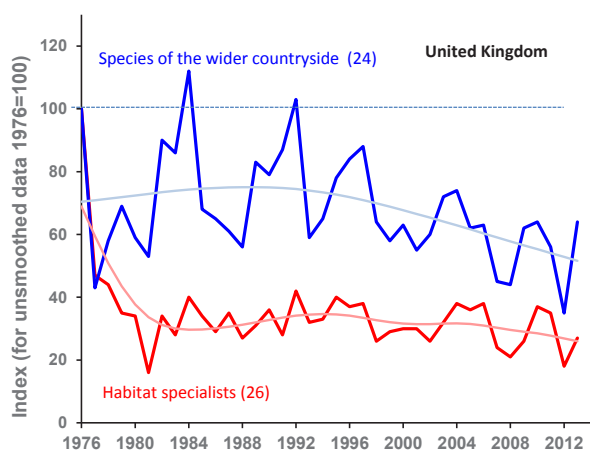


Figure 3. Trends in butterfly populations for habitat specialists and species of the wider countryside, 1976 to 2013.

ENGLAND

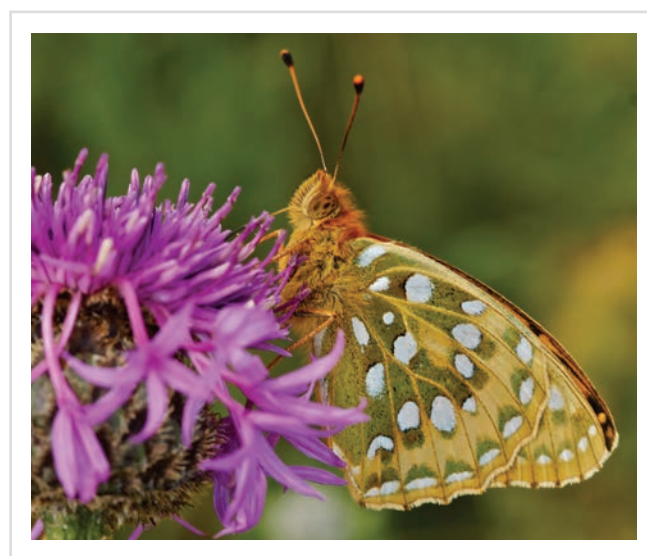
For England, we are able to report on long-term and 10 year trends for 55 of the 57 regularly occurring species, including 28 habitat specialist species, 24 wider countryside species and three regular migrants (Table 2). Since 1976, 30% of species show positive trends, whilst 70% have a negative trend. Of the species showing significant trends, nine species (30%) show a long-term increase, whilst 21 (70%) are in decline.

The 10 species in most severe long-term decline (in descending rank order, with 2012 rank in parentheses) are **White-letter Hairstreak** (4), **Essex Skipper** (not listed in 2012), **Wall Brown** (3), **Wood White** (1), **Heath Fritillary** (5), **Lulworth Skipper** (2), **Small Tortoiseshell** (6=), **Small Skipper** (6=), **Marsh Fritillary** (8) and **Northern Brown Argus** (9). The 10 species showing a significant population increase (in descending rank order, with 2012 rank in parentheses) are **Large Blue** (not listed in 2012), **Silver-spotted Skipper** (1), **Dark Green Fritillary** (2), **Ringlet** (4), **Adonis Blue** (6), **Red Admiral** (3), **Silver-washed Fritillary** (not listed in 2012), **Comma** (5), **Swallowtail** (8) and **Speckled Wood** (7).

Over the last decade, 40 species (73%) show negative trends, including all three regular migrants, whilst 15 species (27%) show positive trends. No species shows a significant 10 year increase, whilst six species are in significant decline. In rank order (most rapid first, with 2012 rank in parentheses) these include **Essex Skipper** (not listed in 2012) and **Heath Fritillary** (6), **White-letter Hairstreak** (5) and **Brown Hairstreak** (3), **High Brown Fritillary** (not listed in 2012) and **Gatekeeper** (not listed in 2012).

Composite indices of butterfly abundance can be calculated for 23 wider countryside and 26 habitat specialist species. Since 1976, habitat specialists and wider countryside species show apparent declines of 71% and 37% respectively. Analysis of the underlying smoothed trends shows that since 1976 both specialists and species of the wider countryside have declined significantly. Over the last five years (since 2008), habitat specialist butterflies have shown an apparent increase from 23% to 29% of the 1976 level, whilst species of the wider countryside show an apparent increase, from 42% to 63% of the 1976 level. However, the underlying analysis shows that neither of these recent increases is statistically significant. In 2013, habitat specialist butterflies increased by 53% from the previous year, whilst wider countryside species increased by 90%. The large increases reflect that for both wider countryside and habitat specialist species the smoothed and unsmoothed indices in 2012 were the lowest in the series.

The English Government uses population trends of wider countryside butterflies in farmland and woodland habitats as biodiversity indicators. Since 1990, the composite measure for 21 butterfly species on farmland has fallen by 14%, reaching a historical low point in 2012 and making a substantial recovery in 2013. Whilst these figures demonstrate annual fluctuations in numbers, the overall change since 2008 is assessed as deteriorating. Species in severe decline on farmland include **Gatekeeper**, **Large Skipper**, **Small Copper**, **Small Tortoiseshell** and **Wall Brown**.



Dark Green Fritillary. Photograph by Tony Cox

Butterfly numbers in woodland have fallen by 48% since 1990. As with farmland butterflies, the combined index for woodland species dropped to an historical low point in 2012 but made a substantial recovery in 2013. Since 2008 there has been little or no overall change in the woodland butterfly indicator. Species in severe decline in woodland include **Brown Argus**, **Common Blue**, **Gatekeeper**, **Marbled White**, **Peacock**, **Small Heath**, **Small Copper**, **Small Tortoiseshell** and **Wall Brown**.

NORTHERN IRELAND

In Northern Ireland, data is too sparse to calculate long-term trends. Over the short term (last five years) **Large White**, **Marsh Fritillary**, and **Small Tortoiseshell** have negative linear trends, whilst **Ringlet**, **Meadow Brown**, **Orange-tip** and **Speckled Wood** show positive trends.

SCOTLAND

For Scotland we are able to report on long-term and 10 year trends for 24 of the 34 regularly occurring species, including seven habitat specialist species, 15 wider countryside species and two regular migrants Red Admiral and Painted Lady (Table 2). Since 1979, half of all species show positive trends, whilst the other half show negative trends. Of the seven species showing significant long-term trends, all but one showed an increase, with just **Grayling** showing a decline. Those species showing significant increases (in rank order, largest first) are **Red Admiral**, **Orange-tip**, **Small Blue**, **Small Heath**, **Peacock** and **Ringlet**.

Over the last decade, 16 species (67%) show negative trends, including the two regular migrants, whilst eight species (33%) show positive trends. Of the significant trends over this period, **Dark Green Fritillary** and **Small Blue** increased, whilst **Meadow Brown**, **Small Heath**, **Small Pearl-bordered Fritillary** and **Wall Brown** all decreased.



Green-veined White. Photograph by Tony Cox



Painted Lady. Photograph by Nick Edge

WALES

In Wales, we are able to report on trends for 27 of the 43 regularly occurring butterfly species in the country including seven habitat specialists, two regular migrants and 18 species of the wider countryside (Table 2).

Over the long-term, 37% of species show a positive trend, whilst 63% have a negative trend. Of the 13 species showing significant long-term change, nine species are in decline (69%), whilst four are increasing. The declining species are (most severe decline first) **Silver-washed Fritillary**, **Large Skipper**, **Dark Green Fritillary**, **Grayling**, **Marsh Fritillary**, **Small White**, **Small Copper**, **Large White** and **Peacock**. The increasing species (most rapid first) are **Orange-tip**, **Pearl-bordered Fritillary**, **Speckled Wood** and **Ringlet**.

Over the last 10 years 56% of species show positive trends including **Grayling** which has increased significantly, whilst 44% show negative trends including **Painted Lady**, **Holly Blue**, **Large Skipper** and **Gatekeeper** which are in significant decline.



Appendix 1

List of habitat specialist, wider countryside and regular migrant species.

Wider Countryside species

Brimstone	(<i>Gonepteryx rhamni</i>)
Brown Argus	(<i>Aricia agestis</i>)
Comma	(<i>Polygonia c-album</i>)
Common Blue	(<i>Polyommatus icarus</i>)
Essex Skipper	(<i>Thymelicus lineola</i>)
Gatekeeper	(<i>Pyronia tithonus</i>)
Green-veined White	(<i>Pieris napi</i>)
Holly Blue	(<i>Celastrina argiolus</i>)
Large Skipper	(<i>Ochlodes sylvanus</i>)
Large White	(<i>Pieris brassicae</i>)
Marbled White	(<i>Melanargia galathea</i>)
Meadow Brown	(<i>Maniola jurtina</i>)
Orange-tip	(<i>Anthocharis cardamines</i>)
Peacock	(<i>Aglais io</i>)
Purple Hairstreak	(<i>Favonius quercus</i>)
Ringlet	(<i>Aphantopus hyperantus</i>)
Scotch Argus	(<i>Erebia aethiops</i>)
Small Copper	(<i>Lycaena phlaeas</i>)
Small Heath	(<i>Coenonympha pamphilus</i>)
Small Skipper	(<i>Thymelicus sylvestris</i>)
Small Tortoiseshell	(<i>Aglais urticae</i>)
Small White	(<i>Pieris rapae</i>)
Speckled Wood	(<i>Pararge aegeria</i>)
Wall Brown	(<i>Lasiommata megera</i>)
White-letter Hairstreak	(<i>Satyrium w-album</i>)

Regular migrants

Clouded Yellow	(<i>Colias croceus</i>)
Red Admiral	(<i>Vanessa atalanta</i>)
Painted Lady	(<i>Vanessa cardui</i>)

Habitat specialist's

Adonis Blue	(<i>Polyommatus bellargus</i>)
Black Hairstreak	(<i>Satyrium pruni</i>)
Brown Hairstreak	(<i>Thecla betulae</i>)
Chalkhill Blue	(<i>Polyommatus coridon</i>)
Chequered Skipper	(<i>Carterocephalus palaemon</i>)
Cryptic Wood White	(<i>Leptidea juvernica</i>)
Dark Green Fritillary	(<i>Argynnis aglaja</i>)
Dingy Skipper	(<i>Erynnis tages</i>)
Duke of burgundy	(<i>Hamearis lucina</i>)
Glanville Fritillary	(<i>Melitaea cinxia</i>)
Grayling	(<i>Hipparchia semele</i>)
Green Hairstreak	(<i>Callophrys rubi</i>)
Grizzled Skipper	(<i>Pyrgus malvae</i>)
Heath Fritillary	(<i>Melitaea athalia</i>)
High Brown Fritillary	(<i>Argynnis adippe</i>)
Large Blue	(<i>Maculinea arion</i>)
Large Heath	(<i>Coenonympha tullia</i>)
Lulworth Skipper	(<i>Thymelicus acteon</i>)
Marsh Fritillary	(<i>Euphydryas aurinia</i>)
Mountain Ringlet	(<i>Erebia epiphron</i>)
Northern Brown Argus	(<i>Aricia artaxerxes</i>)
Pearl-bordered Fritillary	(<i>Boloria euphrosyne</i>)
Purple Emperor	(<i>Apatura iris</i>)
Silver-spotted Skipper	(<i>Hesperia comma</i>)
Silver-studded Blue	(<i>Plebejus argus</i>)
Silver-washed Fritillary	(<i>Argynnis paphia</i>)
Small Blue	(<i>Cupido minimus</i>)
Small Pearl-bordered Fritillary	(<i>Boloria selene</i>)
Swallowtail	(<i>Papilio machaon</i>)
White Admiral	(<i>Limenitis camilla</i>)
Wood White	(<i>Leptidea sinapis</i>)

Appendix 2

List of country-level Priority Species

Common name	Scientific name	England	Northern Ireland	Scotland	Wales
Chequered Skipper	<i>Carterocephalus palaemon</i>			✓	
Small Skipper	<i>Thymelicus sylvestris</i>				
Lulworth Skipper	<i>Thymelicus acteon</i>	✓			
Silver-spotted Skipper	<i>Hesperia comma</i>				
Large Skipper	<i>Ochlodes sylvanus</i>				
Dingy Skipper	<i>Erynnis tages</i>	✓	✓	✓	✓
Grizzled Skipper	<i>Pyrgus malvae</i>	✓			✓
Swallowtail	<i>Papilio machaon</i>				
Wood White	<i>Leptidea sinapis</i>	✓			✓
Cryptic Wood White	<i>Leptidea juvernica</i>		✓		
Clouded Yellow	<i>Colias croceus</i>				
Brimstone	<i>Gonepteryx rhamni</i>				
Large White	<i>Pieris brassicae</i>				
Small White	<i>Pieris rapae</i>				
Green-veined White	<i>Pieris napi</i>				
Orange-tip	<i>Anthocharis cardamines</i>				
Green Hairstreak	<i>Callophrys rubi</i>				
Brown Hairstreak	<i>Thecla betulae</i>	✓			✓
Purple Hairstreak	<i>Favonius (Neozephyrus) quercus</i>				
White-letter Hairstreak	<i>Satyrium w-album</i>	✓			✓
Black Hairstreak	<i>Satyrium pruni</i>				
Small Copper	<i>Lycaena phlaeas</i>				
Small Blue	<i>Cupido minimus</i>	✓	✓	✓	✓
Silver-studded Blue	<i>Plebejus argus</i>	✓			✓
Brown Argus	<i>Aricia agestis</i>				
Northern Brown Argus	<i>Aricia artaxerxes</i>	✓		✓	
Common Blue	<i>Polyommatus icarus</i>				
Chalkhill Blue	<i>Polyommatus (Lysandra) coridon</i>				
Adonis Blue	<i>Polyommatus (Lysandra) bellargus</i>				
Holly Blue	<i>Celastrina argiolus</i>				
Large Blue	<i>Phengaris (Maculinea) arion</i>	✓			
Duke of Burgundy	<i>Hamearis lucina</i>	✓			
White Admiral	<i>Limenitis camilla</i>	✓			✓
Purple Emperor	<i>Apatura iris</i>				
Red Admiral	<i>Vanessa atalanta</i>				
Painted Lady	<i>Vanessa (Cynthia) cardui</i>				
Small Tortoiseshell	<i>Aglais urticae</i>				
Peacock	<i>Aglais (Inachis) io</i>				
Comma	<i>Polygonia c-album</i>				
Small Pearl-bordered Fritillary	<i>Boloria selene</i>	✓		✓	✓
Pearl-bordered Fritillary	<i>Boloria euphrosyne</i>	✓		✓	✓
High Brown Fritillary	<i>Argynnis adippe</i>	✓			✓
Dark Green Fritillary	<i>Argynnis aglaja</i>				
Silver-washed Fritillary	<i>Argynnis paphia</i>				
Marsh Fritillary	<i>Euphydryas (Eurodryas) aurinia</i>	✓	✓	✓	✓
Glanville Fritillary	<i>Melitaea cinxia</i>	✓			
Heath Fritillary	<i>Melitaea (Mellicta) athalia</i>	✓			
Speckled Wood	<i>Pararge aegeria</i>				
Wall Brown	<i>Lasiommata megera</i>	✓	✓	✓	✓
Mountain Ringlet	<i>Erebia epiphron</i>	✓		✓	
Scotch Argus	<i>Erebia aethiops</i>				
Marbled White	<i>Melanargia galathea</i>				
Grayling	<i>Hipparchia semele</i>	✓	✓	✓	✓
Gatekeeper	<i>Pyronia tithonus</i>				
Meadow Brown	<i>Maniola jurtina</i>				
Small Heath	<i>Coenonympha pamphilus</i>	✓	✓	✓	✓
Large Heath	<i>Coenonympha tullia</i>	✓	✓	✓	✓
Ringlet	<i>Aphantopus hyperantus</i>				



The 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 Government on UK and international nature conservation. Its work contributes to maintaining and enriching biological diversity, conserving geological features and sustaining natural systems. JNCC delivers the UK and international responsibilities of the four country nature conservation agencies - Council for Nature Conservation and the Countryside, Natural Resources Wales, Natural England and Scottish Natural Heritage.



The Department for Environment Food and Rural Affairs (Defra) is the UK government department responsible for policy and regulations on the environment, food and rural affairs. The overarching challenge for Defra is to secure a healthy environment in which we and future generations can prosper. As we build a low carbon, resource efficient economy, Defra helps people to adapt to changes, deals with environmental risks and makes the most of the opportunity we have to secure a sustainable society and a healthy environment.



Natural Resources Wales (NRW) is the principle adviser to the Welsh Government on the environment, enabling the sustainable development of Wales' natural resources for the benefit of people, the economy and wildlife.



The Forestry Commission (FC) is the government department for forestry in Great Britain. It works to improve people's lives through the many benefits provided by sustainably managed woods and forests, including timber production, public recreation, nature conservation, and rural and community development. It does this by supporting woodland managers with grants, tree felling licences, regulation and advice, and advising Ministers in the UK, Scottish and Welsh Assembly Governments on forestry policy. It manages more than 1 million hectares (2.5 million acres) of public forest land owned or leased by Ministers to provide the above benefits, and through its Forest Research agency, it conducts world-class scientific research and technical development relevant to forestry.



Natural England (NE) is an independent public body whose purpose is to protect and improve England's natural environment, for its intrinsic value, the wellbeing and enjoyment of people and the economic prosperity that it brings.



Scottish Natural Heritage (SNH) is the government body that looks after all of Scotland's nature and landscapes, across all of Scotland, for everyone.

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