United Kingdom
Butterfly Monitoring Scheme

ANNUAL REPORT 2008

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Tracking changes in the abundance of UK butterflies

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Cover photograph of a Common Blue, *Polyommatus icarus*, sheltering from the almost continuous rains that characterised 2008. Despite such poor weather, the Common Blue showed some recovery from 2007 on UKBMS transects. Photograph by Alex Winser.

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Butterfly Conservation
Saving butterflies, moths and their habitats

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About the UKBMS

Welcome to the fourth report of the United Kingdom Butterfly Monitoring Scheme (UKBMS).

Changes in the abundance of butterflies throughout the United Kingdom have been monitored using transects since 1976. Over the past 33 years, there have been over 4,000 recorders who have collectively made nearly 200,000 weekly visits to over 1,650 different sites, walking an impressive 474,441 km and counting over 14 million butterflies.

The UKBMS is based on a well-established and enjoyable recording method and has produced important insights into almost all aspects of butterfly ecology.

Butterflies are well placed amongst British terrestrial insects and other invertebrate groups to act as indicators of the state of the environment, allowing us to assess the impacts of habitat change, climate change and the progress of government policy initiatives such as the UK Biodiversity Action Plan, agri-environment schemes and the condition of Sites of Special Scientific Interest (SSSIs). Not only are butterflies biologically suitable as indicator species, having rapid lifecycles and, in many cases, high sensitivity to environmental conditions, but the recording and monitoring volunteer networks and datasets built up by Butterfly Conservation (BC) and the Centre for Ecology & Hydrology (CEH) enable accurate assessment of their trends.

The UKBMS is run as a partnership between BC and CEH. The scheme also benefits from the active involvement of the National Trust (NT), the Royal Society for the Protection of Birds (RSPB), the Forestry Commission.(FC) and several wildlife trusts and local authorities.

Since 2005 the UKBMS project has been funded by a multi-agency consortium led by the Department of the Environment, Food and Rural Affairs (Defra), currently including the Countryside Council for Wales (CCW), Forestry Commission (FC), Joint Nature Conservation Committee (JNCC), Natural England (NE), Northern Ireland Environment Agency (NIEA) and Scottish Natural Heritage (SNH). Current funding runs through to 2011.

UKBMS Objectives

- To maintain and develop a network of transect and other monitored sites in order to assess and interpret changes in the abundance and status of UK butterflies.
- To encourage participation in scientific butterfly monitoring by supporting volunteer recording networks.
- To ensure a high level of quality assurance for butterfly monitoring data by development and promotion of standards, and by applying rigorous data validation and verification procedures.
- To secure and manage butterfly monitoring data and provide access to academia, governments, industry and the public.
- To advance knowledge in butterfly ecology through interpretation of butterfly monitoring data.
- To provide scientific underpinning for solutions to butterfly conservation issues arising from habitat and climate change.
- To provide a knowledge base, including indicators of change, for government policies addressing environmental issues.
- To promote public awareness and understanding of butterflies through communication of the results of the scheme.

Further information on the UKBMS can be found at www.ukbms.org

Contacts

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Meet the team

David Roy has worked for CEH since 1994. He took over as manager of the BMS in 2003 and is an ecologist who specialises in data analysis. He manages the UKBMS for CEH and his research focuses on the impacts of climate change.

Tom Brereton has worked for BC since 1997 after completing a PhD on the ecology of the Grizzled Skipper. At BC he is Head of Monitoring, and project manages the UKBMS for BC. Tom is particularly involved in developing butterfly indicators and farmland research, management and policy.

Ian Middlebrook joined BC in January 2007 as their Butterfly Monitoring Co-ordinator. He had already been based with BC at Manor Yard for 6 years, leading conservation work on a suite of rare (non-lepidopteran) invertebrates through the 'Action for Invertebrates' partnership project. Ian is the first point of contact for UKBMS recorders and local transect co-ordinators.

Marc Botham joined CEH in 2007 as a Post-doctoral Research Assistant following a PhD in behavioural ecology at the University of Leeds. In May 2008 he took the position of Butterfly Ecologist. His role with the UKBMS is to conduct data analysis and lead research applications. He will also oversee the collation of the dataset and take a leading role in the production of UKBMS reports.

Jim Bacon joined CEH in 2007 as a website designer. His role has included updating and extending the UKBMS site, including the development of online recording for the wider countryside monitoring scheme.

Katie Cruickshanks joined BC in April 2006 after completing a PhD in ecology at Southampton University. In her role as wider countryside coordinator, Katie is responsible for planning and co-ordinating the roll out of the Wider Countryside Butterfly Survey.

Stephen Freeman joined CEH in 2008. Before this he studied models for population dynamics and demography at the Universities of Kent, Oxford and London, and spent ten years modelling the widespread declines in British bird species for the British Trust for Ornithology. Stephen's role at CEH is as a modeller specializing in the application of statistical methods and mathematical models in ecology. He collaborates on the analysis of UKBMS data.

Colin Harrower joined CEH in December 2008 where he worked on the UKBMS project until June 2009. During this period he provided invaluable database and statistical knowledge helping to automate the data collation, analysis and standard reporting of UKBMS results.

Björn Beckmann started work with CEH in September 2007. His main contribution to the UKBMS was to collate the electronic data for 2007-8. Following his employment on the UKBMS project Björn acquired the position of Recording and Outreach Officer for the Biological Records Centre at CEH Wallingford. He is also in his first year of a PhD looking at the effects of climate change on the distribution of Orthoptera in the UK.

Survey methods

In the UKBMS, data on the population status of UK butterflies is derived from a wide-scale program of site-based monitoring. The majority of sites are monitored by butterfly transects (Pollard & Yates 1993). The transect method, which was established in 1976, involves weekly butterfly counts along fixed routes through the season made under strict weather, recording area and time of day criteria. Weekly counts for each species are summed to generate 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 the index (Rothery & Roy 2001).

For a number of specialist species (especially the fritillaries) two 'reduced effort' scientific methods; adult timed counts (Warren et al. 1981) and larval web counts (Lewis & Hurford 1997), are also used to monitor annual abundance, especially in remoter parts of the UK. In both methods, systematic recording is made on single days in suitable weather (when UKBMS recording criteria are met), with the counts converted to a robust index that accounts for both the size of the colony and the time in the season when the count was made.

Data from all past and present transects and timed counts/larval webs monitored sites is combined each year to derive regional and national '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 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'.

This is now the fourth year that data from a combined UKBMS dataset have been used to calculate trends in butterfly populations. In 2008, 803 transects and 105 timed/larval web counts were used in the analysis (Figure 1). This enabled Collated Indices to be calculated for 50 of the 59 regular species of butterfly in the UK. As in previous years, trends were assessed for four canopy species; Purple, White-letter and Brown Hairstreaks and the Purple Emperor, even though transects are generally not considered the best monitoring method for them. However, they are included because 'extreme' high or low years in the abundance of these species can be determined from transect monitoring.

Graphs showing the updated Collated Indices are presented in Appendix I. The Collated Index for each species is updated each year with the inclusion of additional monitoring data and therefore indices may differ to those presented in earlier reports. Similarly, the rank order used to show those years in which butterflies fared better or worse compared to other years, may be modified by these additional data (see Table 1). As in the 2007 report, we have produced a combined single index for all sites for each species rather than separate indices for double-brooded species. In the future we aim to split our analyses for those species with more than one brood in a year.

Summary

HIGHLIGHTS

- Wet and windy weather with low sunshine levels caused problems for most butterfly species
- The year ranked as the second worst in the 33-year series and the worst since 1981
- 12 species had their worst year, with continued declines for Small Tortoiseshells and some of our most threatened species, including several of the fritillaries
- There was a noticeable absence of migrants after several good years
- On the positive side it was a good year for some of the Browns including Ringlet and Speckled Wood

The weather during the final two months of 2007 was characterised by above average temperatures and rainfall. Temperatures remained warm into the New Year, with January 2008 being the fourth warmest since 1914. Although rainfall was above average and sunshine levels were low in January, the relative warmth allowed four species to emerge - Red Admiral (on New Year's Day), Brimstone, Painted Lady and Comma.

February was cool, sunny and dry, and a further three species emerged – Holly Blue, Large White and Small White. Wet weather returned in March (wettest for 15 years). There was also heavy snow and sleet in England (especially in the East) during March and April and many areas became flooded for prolonged periods. Although May was the warmest since 1914, there was no repeat of the early appearance of spring butterflies that featured in 2007. Only two new species emerged in March – Green-veined White and Orange-tip, whilst most species emerged one or two weeks later than 2007, exceptions included Small White (two weeks earlier) and Holly Blue (a month earlier).

Wet weather was to remain the striking feature of 2008 (e.g. wettest October for 50 years). With such high levels of rainfall it was not surprising that sunshine levels were not as high as in previous years and were

close to or below average. Similarly, whilst the temperature was generally lower than in the last decade, the temperature rarely went below the average recorded 1961-1990 and was generally a couple of degrees above it. June proved the coldest since 2001.

The bad weather in 2008 gave rise to the second poor year in succession for butterflies with numbers reaching their lowest level since 1981. 2008 ranked as the second worst year in the 33 years series (Table 1), with 12 species producing their lowest ever Collated Index. 27 species (52%) were in lower numbers than in 2007. In terms of long-term trend since 1976, eight species have increased significantly, whilst sixteen have decreased (see Table 2 and plots in Appendix I).

Table 1. UKBMS years ranked according to how good each year was relative to the others (1=best, 33 = worst).

Year	Rank	Year	Rank
1976	6	**1993**	25
1977	31	**1994**	16
1978	21	**1995**	7
1979	19	**1996**	4
1980	24	**1997**	3
1981	33	**1998**	23
1982	5	**1999**	28
1983	14	**2000**	18
1984	2	**2001**	29
1985	17	**2002**	27
1986	20	**2003**	9
1987	22	**2004**	10
1988	26	**2005**	12
1989	13	**2006**	15
1990	8	**2007**	30
1991	11	**2008**	32
1992	1		

Note: Ranks are calculated by taking the average of the ranks of all species for which a Collated Index was calculated in each year for the period 1976-2008 (33 years).

Collated Indices were calculated for 19 UK Biodiversity Action Plan (BAP) Priority species. Ten of these decreased in abundance compared to the previous year, whilst eight species showed an increase. One species, the Small Blue, showed no year-to-year change (Appendix II).

Multi-species indices of butterfly abundance also declined from 2007; by 16% for habitat specialists (n=24 species), 6% for wider countryside species (n=24) and 78% for migrants (n=3) (Figure 2).

The Skippers did particularly badly, with six of the seven species monitored showing a decrease since 2007, and four (Dingy, Large, Small and Lulworth Skippers) producing their lowest ever Collated Index. A number of species showed increases from 2007, notably several Browns such as Speckled Wood and Ringlet. However, 2007 itself was a very poor year (the fourth worst on record), and thus the Collated Indices of many of those species that showed an increase still remained low compared to earlier years despite this recovery.

In terms of phenology, most species (> 90%) emerged later than in 2007 - by about a week on average. Four-fifths of species also peaked later, although flight period lengths were similar to 2007. Spring species, particularly those with more than one generation in a year, such as Small Copper, Green-veined White and Pearl-bordered Fritillary, showed the greatest phenological differences between 2007 and 2008 (see feature article on butterfly phenology).

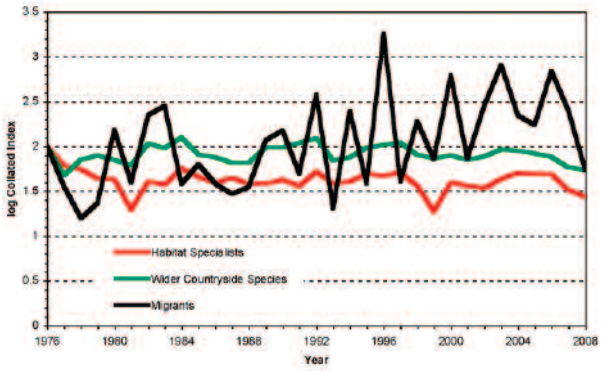


Figure 2. The Annual Collated Index for Habitat Specialists, Wider Countryside Species and Regular Migrants

There was a return to dry and cold weather at the year-end, with December being the coldest in England and Wales since 1996. It is thought that cold dry winters benefit those species that overwinter in pre-adult stages of their lifecycle, bringing hope for a recovery in butterfly numbers in 2009.

Further details of the weather in 2008 can be found at **http://www.metoffice.gov.uk/climate/uk/2008.** Weather summaries are based on a series of years dating back to 1914, with averages being taken from the period 1961-1990.

Figure 1: Sites monitored in 2008 (denoted in green symbols) throughout the UK and sites that have been monitored in the past (denoted in smaller red symbols)

Table 2. Summary of species abundance changes. Significance of long-term changes: *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.

SPECIES	no sites with index	no years with index	2008 Rank	% Change in Collated Index 2007-8				Long-term trend (%)			
				UK	England	Wales	Scotland	UK	England	Wales	Scotland
Small Skipper	390	33	32	0	2	-11		-58**	-59**	192*	
Essex Skipper	104	33		7	7			-2	-2		
Lulworth Skipper	10	17	17	-22	-22			-69*	-69*		
Silver-spotted Skipper	34	30	17	-34	-34			1321***	1321***		
Large Skipper	458	33	33	-29	-29	-22		-19	-17	-78***	
Dingy Skipper	213	33	33	-24	-22			-41**	-37**		
Grizzled Skipper	172	33	32	-28	-28			-44**	-44**		
Wood White	172	33	32	-28	-28			-44**	-44**		
Clouded Yellow	157	30	20	-90	-91			1118	1128		
Brimstone	342	33	28	-32	-32			15	14		
Large White	472	33	17	41	48	-5	-40	-34	-33	-24	-7
Small White	464	33	30	7	5	45	78	-21	-17	-62***	29
Green-veined White	465	33	26	10	12	7	-19	-17	-17	-5	1
Orange Tip	434	33	33	-26	-28	-21	-31	9	2	230***	95
Green Hairstreak	237	33	33	-54	-55	-44		-37*	-40*		62*
Brown Hairstreak	30	26	18	15	17			117	115		
Purple Hairstreak	189	33	15	20	26			-3	-5		
White-letter Hairstreak	95	33	33	-40	-38			-82**	-81**		
Small Copper	408	33	29	-29	-29	-38	-19	-25	-18	-51	5
Small Blue	109	31	24	0	-15			-22	-55*		
Silver-studded Blue	37	30	27	29	32			-13	-11		
Brown Argus	261	33	28	-19	-21			6	8		
Northern Brown Argus	23	30	27	91	70			-55*	-55*		
Common Blue	455	33	30	51	51	86	35	-16	-12	-36	13
Chalk-hill Blue	114	33	30	5	5			21	21		
Adonis Blue	67	30	15	17	17			105	105		
Holly Blue	368	33	15	-29	-29	-17		201	210	-21	
Duke of Burgundy Fritillary	74	30	27	2	2			-35*	-35*		
White Admiral	131	33	28	-26	-26			-59**	-59**		
Purple Emperor	37	30	26	15	20			-6	-6		
Red Admiral	423	33	18	-44	-46	10	41	382***	389***	208*	1758***
Painted Lady	273	33	27	-81	-79	-77		368	382	-21	
Small Tortoiseshell	368	33	33	-45	-41	-62	-42	-61*	-61*	-32	-28
Peacock	420	33	28	-35	-34	-48	-29	45	46	-15	9
Comma	433	33	10	32	35	5		267***	267***	17	
Small Pearl-bordered Fritillary	91	33	31	-9	7	-2	-13	-66***	-75**	-74*	37
Pearl-bordered Fritillary	89	33	33	-56	-49		-67	-71***	-69**		105
High Brown Fritillary	57	31	31	-49	-50			-33	-34		
Dark Green Fritillary	204	33	12	-32	-38	26	-7	94*	290***	-93***	-54*
Silver-washed Fritillary	198	33	12	-15	-15			73*	83**		
Marsh Fritillary	70	26	16	-45	-26			51	-59		
Heath Fritillary	32	25	18	23	23			-70**	-70**		
Speckled Wood	431	33	4	51	55	0	0	122***	122***	114*	20
Wall Brown	223	33	32	15	29	-41		-80***	-82***	-48*	
Scotch Argus	11	30	25	0			20	83			-39*
Marbled White	317	33	23	-24	-22			86**	83**		
Grayling	96	33	32	45	48	58	29	-60***	-32*	-83***	-4
Gatekeeper / Hedge Brown	431	33	29	15	17	2		-22	-27	74*	
Meadow Brown	502	33	16	12	10	23	17	19	17	37	35
Small Heath	384	33	33	-15	-17	2	-17	-60***	-65***	-19	87
Large Heath	9	19	1	70			114	366***			-17
Ringlet	457	33	2	35	32	29	62	312**	323***	42*	115*

Species accounts

The skippers

2008 proved to be a poor year for the skippers. Six of the seven species assessed decreased over the previous year (including all of the 'golden skippers') whilst four species had their worst ever year (see Table 2).

The **Chequered Skipper** declined at all three monitored sites, including at Allt Mhuic, Loch Arkaig where numbers halved compared with 2007.

Of the 'golden skippers', the, **Silver-spotted Skipper** fared best, but even for this species the index dropped below average for the first time in over 20 years. The **Silver-spotted Skipper** is a short-turf species that has increased substantially since 1976, attributable to increases in rabbit grazing, conservation grazing and climate warming (Davies et al. 2005) and numbers are expected to bounce back in future favourable years.

However, the future for three long-turf grassland species **Lulworth Skipper**, **Small Skipper** and **Large Skipper** is less certain. Each of these species produced their worst Collated Index, with **Lulworth Skipper** and **Small Skipper** having declined significantly in abundance since 1976.

The **Lulworth Skipper**, has declined sharply since 1999 with numbers below average for the last four years. 2008 was the worst in the 17-year series and there has been a significant long-term decline of 69%. At Durlston Country Park West, Dorset numbers have dropped from 1,957 at the start of monitoring in 1992 to 201 in 2008.

The Lulworth skipper is being negatively impacted by conservation grazing on some sites. Photograph by *Charlotte Barwick*

For the last five years in succession, the **Small Skipper** has produced its worst Collated Indices of the series, with a significant long-term decline of 59%. Conservation grazing to create uniform short swards is thought to be having a negative impact on this and other long-turf skipper species on some sites.

This is the first year that a separate trend has been calculated for the **Essex Skipper**. This preliminary analysis suggests that the **Essex Skipper** fared better than the **Small Skipper** on monitored sites, both compared with 2007 and over the longer term. We aim to report more fully on the **Essex Skipper** in the 2009 report and would encourage recorders to identify 'smaller' skippers to species level where possible to allow more comprehensive analyses in the future.

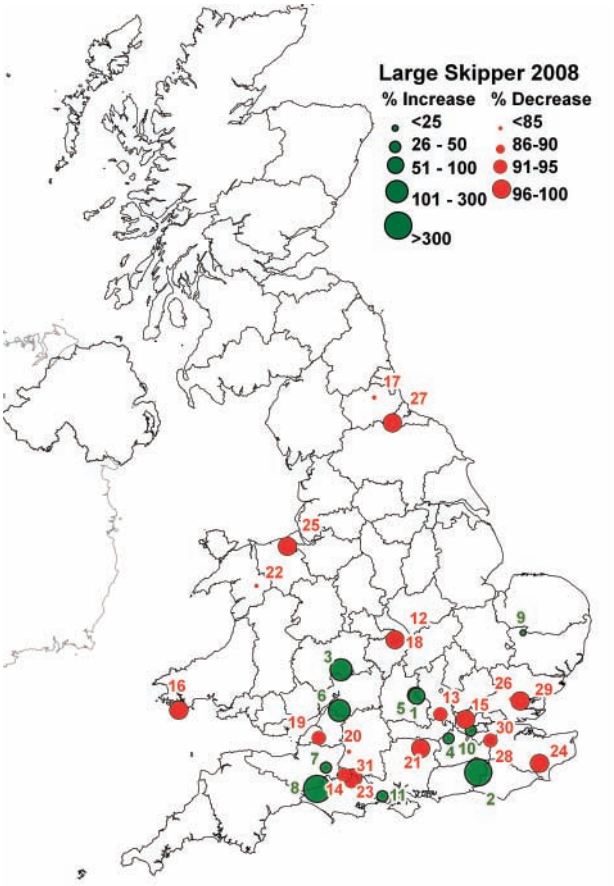
The **Large Skipper** decreased by nearly a third in 2008 and since the late 1990s Collated Indices have been below average. Whilst there were some increases on sites in southwest and south central England, there were far more sites showing decreases across all parts of the UK (see Figure 3). Some formerly large populations have dwindled to small numbers including at Barbury Castle in Wiltshire, where the index has dropped from 202 in 2005 to 141 in 2007 and just 31 in 2008.

Large Skipper numbers reached a new low in 2008. Photograph by *Matteo Di Nicola*

Dingy Skipper numbers dropped by 24% from 2007 to produce a series low and it was the tenth year in a row that the Collated Index was below average. At a local level, there was a curious result at Durlston Country Park, Dorset where numbers dropped by 40% on the West transect but doubled on the East transect! The result shows how sites can buck the trend, presumably due to habitat and management changes. The **Dingy Skipper** has declined significantly by 41% since 1976.

Grizzled Skipper numbers fell by almost a third to produce the second worst Collated Index of the series. As in 2007 there were no three-figure indices and only two sites registered an index greater than 50, the largest being 81 at Levin Down, West Sussex. The **Grizzled Skipper** has declined significantly by 44% since 1976.

Figure 3. Sites where Large Skipper abundance changed substantially between 2007 and 2008



Sites: *1 Shabbington Wood (new); 2 Beech Farm, Whiteman's Green, Cuckfield; 3 Coombe Hill, Wotton-u-Edge; 4 Chobham Common; 5 Oakley Woods; 6 Castlemorton Common; 7 Carymoor Environmental Centre; 8 Bracketts Coppice (DTNC); 9 Elveden Center Parcs; 10 Wimbledon Common; 11 Wootton Coppice; 12 Ryton Wood & Pool; 13 Carrinton's New Farm; 14 Duncliffe Wood (WT); 15 Horsenden Hill – East; 16 Stackpole Warren, Stackpole NNR; 17 Hedleyhope Fell; 18 Ryton Wood East; 19 Redding Pit Quarry; 20 Upton Cow Down (MOD); 21 Crabtree; 22 Trawscoed; 23 Stubhampton Bottom (Private); 24 Orlestone Forest; 25 Greenfield Valley Nature Reserve; 26 Writtle College (West); 27 The Whinnies; 28 Downe Bank; 29 Danbury Country Park; 30 Down House Estate; 31 Melbury Down & Wood*

The whites

The six whites had mixed fortunes, with an equal number increasing and decreasing compared with 2007.

The **Wood White** is the only white listed as a UK BAP priority. 2008 proved to be the worst ever year for the species, with numbers dropping by two-thirds between years and by a shocking 90% since the start of monitoring. Of the 15 sites monitored in 2008, the largest decreases were detected at Whitecross Green Wood, Oxfordshire and Oaken Wood, Surrey.

Another of the *Pieridae* that fared badly in 2008 was the **Brimstone**. Whilst this species has been expanding its range throughout the UK and is showing a steady increase over the 33 years of transect recording, numbers were down by almost a third compared with 2007. At Bentley Wood (excluding the North transect) numbers fell sharply from 616 in 2007 to 221 in 2008. **Large Whites** showed a recovery in numbers following a very poor year in 2007 with a 41% increase. The butterfly did particularly well at Biss Wood, Wiltshire increasing nearly four-fold to a series high of 288.

There was a minor recovery in **Small White** numbers in 2008 with a 7% annual increase. A noteworthy increase in Small White numbers occurred at Snakeholme Pit, Lincolnshire where the Site Index rose from 38 in 2007 to 231 in 2008.

Following a poor year in 2007 the Small White showed a recovery in 2008. Photograph by *Ben Woodward*

There was a modest improvement in **Green-veined White** for the second year in succession with a 10% increase from 2007 - although across the UK results were highly mixed. There was again good news at Snakeholme Pit, Lincolnshire which logged nearly a four-fold annual increase and a highest ever index in the 19-year series totalling 300. There were some large annual decreases in Scotland with Taynish down from 230 to 97, Culvie Wood from 468 to 240 and Dunnet 211 to 78.

The **Orange-tip**, which had increased in 2007, dropped in numbers by almost a quarter to produce its lowest ever Collated Index. However, there are no immediate conservation concerns for this species, as the long-term abundance trend is stable and there is a continuing northward spread.

The Orange Tip showed a large decline in numbers in 2008, producing its lowest Collated Index of the series. Photograph by *Dean Morley*

Green Hairstreak was another species that had its worst ever year in 2008. Photograph by *Nigel Kendall*

The blues, coppers and hairstreaks (Lycaenids)

There were improved fortunes for many of the Lycaenids following a particularly bad year in 2007, though two of the hairstreaks had their worst year.

The **Green Hairstreak** decreased by 54%, producing its lowest Collated Index of the series. Apart from at Meathop Moss, Cumbria where there was a massive index of 717, no other site recorded an index greater than 40. Of concern is the significant long-term decline in this species, by nearly 40% since 1976; the causes of which are unknown.

2008 was a mixed year for the canopy hairstreaks. The **White-letter Hairstreak** had another poor year producing its lowest Collated Index of the series with a 40% decrease from 2007. Only two sites had indices in double figures (maximum 16 at Worley Hill, Somerset) and the butterfly was absent from ~80% of sites with previous records. This hairstreak has shown a rather alarming 82% significant decline across the UK since 1976 and is reportedly in sharp decline in a number of other European countries.

2008 brought improvements for the **Brown Hairstreak** which had an annual increase of 15%, though it was still only an average year. No site indices reached double figures.

There were also improvements for the **Purple Hairstreak** which increased by 20% over 2007, though again it was no more than an average year for this butterfly. As with other canopy-dwelling species it is possible that the windy weather over much of the flight season made these species less detectable than in warm weather years, thus suppressing counts.

Small Copper abundance dropped by almost a third compared with 2007 and it was the fifth worst year in the series. Most of the site indices were small, with for example, 90% being less than 20. Ten sites recorded an index in excess of 100, three of these being in Suffolk including Cavenham Heath National Nature Reserve, where the index of 807 was more than double that of any other site. Numbers dropped only slightly in 2008 and there has been a significant increase at this site since the start of monitoring in 2003.

The **Small Blue** fared as badly as in 2007, with 2008 being the tenth worst since 1976. There was some evidence to suggest the butterfly did better in Wales with substantial increases at Kenfig and Oxwich – both sand dune habitats. There were some gloomy results in England, including at Banstead Downs, a former Surrey stronghold (e.g. 110 counted in 1992) where for the first time in 23 years there were no records on the transect.

The elusive Brown Hairstreak showed an annual increase of 15% in 2008. Photograph by *Charlotte Barwick*

There were improvements for the **Silver-studded Blue** in 2008 (by 29%), though it was still a well below average year – the 7th worst in the 33-year series. Sites on which it recovered well included Bramshott Common, Hampshire where the index rocketed from 347 in 2007 to 1,197 in 2008.

The **Brown Argus** declined by 19% to produce its sixth worst Collated Index of the series. This species undergoes extreme fluctuations at some sites, for example at Potton Wood, Bedfordshire where following an absence of records 1976-1994, there was a colonisation in 1995 with 227 counted. Numbers collapsed to zero in 2000, went back up to 141 in 2006 and down to zero again in 2008! An index of 50 or more was only achieved at 16 sites, with just three sites recording three figures, the maximum being 169 at Magdalen Hill Down, Hampshire.

The **Northern Brown Argus** increased in abundance by 91% from 2007, but it was still a relatively poor year - the third worst in the series. The butterfly has declined significantly by 55% since the 1979 baseline. The largest Site Index was recorded at Thrislington Plantation, County Durham where numbers have increased from 185 in 2006 to 238 in 2008.

The **Common Blue** increased by more than 50% in 2008, but again this was still a relatively poor year – the fourth worst in the series. The species did particularly well in parts of Wales and northern England, including at Stackpole Warren National Nature Reserve, Pembrokeshire where the index more than doubled from 335 to 771 and at Bishop Middleham Quarry, County Durham where the index of 352 was the highest since 1998.

Small Copper numbers dropped by nearly a third in 2008. Photograph by *Tony Morris*

The **Chalkhill Blue** increased by 5% from 2007, but as for many other species 2008 was still a relatively poor year – the fourth worst since 1976. There was considerable variation in the species' fortunes across sites. For example, at Giant Hill (Cerne Abbas), Dorset the index of 25 was the lowest in the 15-year series, yet at Coombe Hill in the Cotswolds there was a substantial increase from 1348 in 2007 to 2396 in 2008.

The **Adonis Blue** Collated Index increased by 17% from 2007. In spite of this modest recovery it was a relatively poor year - the fourth worst in the series. The butterfly fared much better in coastal and eastern localities compared with inland (see Figure 4). For example, at Malling Down, East Sussex there was a ten-fold increase between 2007 and 2008, with the site index reaching its highest level since 1997.

The **Holly Blue** decreased in annual abundance by about a third in 2008. Large annual fluctuations in this species are frequent (see Collated Index plot for this species in Appendix 1) with no significant long-term change.

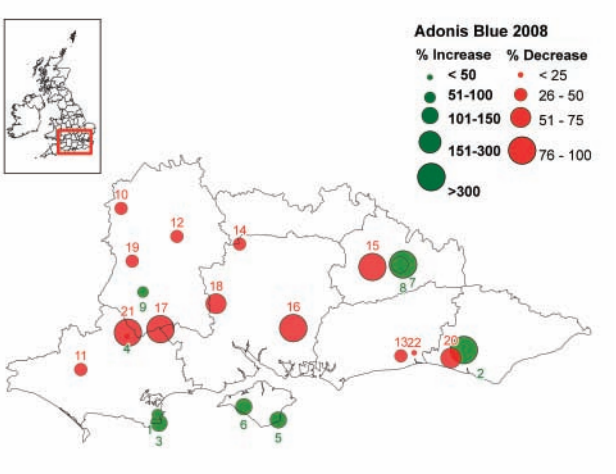
In terms of phenology, peak counts for all Lycaenids except the **Small Blue** were later than in 2007. Multi-voltine species seemed most affected by the weather. In particular, individuals from the first generation of **Small Coppers**, **Common Blues** and **Brown Argus**' were recorded up to four weeks later in 2008 than in 2007. Peak counts for these species were later in 2008 by a similar amount of time (see Figure 5). This contrasts sharply with the long-term trend of advancement in these species (see featured article on Butterfly Phenology).

Adonis Blues recovered in 2007, especially in coastal and eastern areas. Photograph by *John Vallender*

The metalmarks

The Duke of Burgundy had another worryingly poor year, the 7th worst in the series and only marginally better (by 2%) than 2007.

Figure 4. Sites where Adonis Blue abundance changed substantially between 2007 and 2008



Sites: *1 Swanage; 2 Malling Down; 3 Durlston Country Park West; 4 Fontmell Down (new); 5 Bonchurch Down; 6 Mottistone Down; 7 Denbies Landbarn B; 8 Denbies Hillside; 9 Park Bottom; 10 West Yatton Down; 11 Cerne Abbas Giant; 12 Pewsey Down; 13 Cissbury Ring; 14 Pilot Hill; 15 Pewley Down; 16 Old Winchester Hill; 17 Martin Down Kitts Grave; 18 Broughton Down 2; 19 Bratton Castle Earthworks (EH); 20 Castle Hill; 21 Clubmens Down (NT); 22 Anchor Bottom*

The butterfly has declined significantly by 35% since 1976. Only 18 sites produced validated indices, with just one site doing moderately well - Township Plantation, with the index approximately doubling from 14 to 29. Only two sites (both in Hampshire) had indices in excess of 30, these being the Mountain, Meon Valley (index of 107) and Noar Hill (89).

The nymphalids – (Vanessids excluding regular migrants)

Three of the five resident Vanessids had a worse year than 2007, including the Small Tortoiseshell which reached a new low.

The **White Admiral** showed a decrease of 26% from 2007, with the 2008 Collated Index the sixth worst in the series. This is a species in trouble with a significant long-term decline of 59% since 1976. Most of the declines are occurring at sites in Southern England with the greatest declines detected at Shabbington Wood, Buckinghamshire and Cole Wood, Kent. Thankfully, there were improvements at some sites including at Wick Wood in Hampshire, where the index of 35 was ten-fold higher than in 2007 and the best in the 14-year series.

Another woodland species, the **Purple Emperor**, fared better, with a moderate 15% annual increase in 2008. However, it was still a below average year – the eighth worst since 1976. These data need to be treated with particular caution, as only ten sites registered a validated

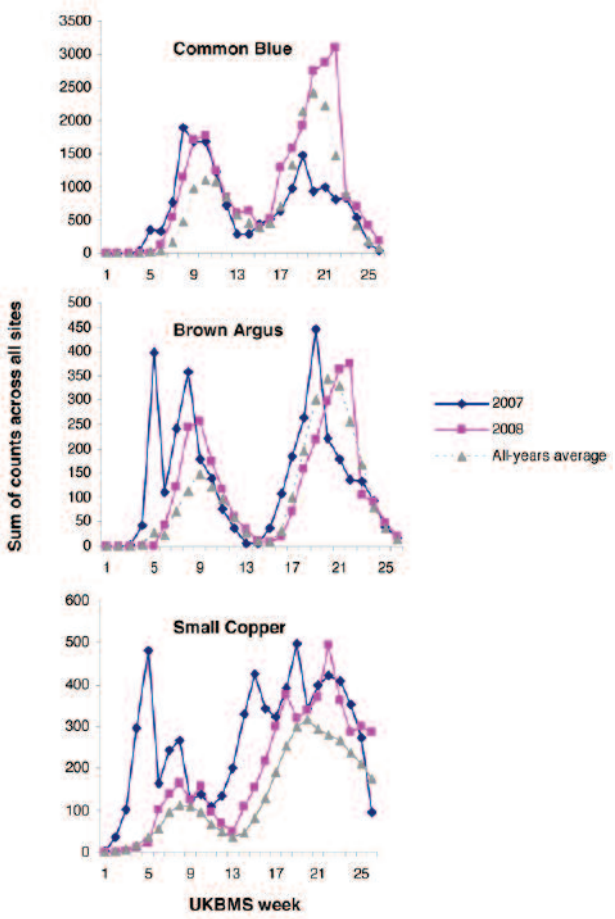


Figure 5. Flight times of Common Blue, Brown Argus and Small Copper counted on UKBMS transects. Note week 1= 1-7 April, week 26 = 23-29 September

index and the maximum site index was three! Unlike the other nymphalids, which were all recorded on transects at later dates than in 2007, the **Purple Emperor** emerged more than a week earlier in 2008. Peak **Purple Emperor** counts were almost two weeks later than in 2007 but the length of their flight period was no different between the two years.

The demise of the **Small Tortoiseshell** continued. For the fourth year in a row the Collated Index was the worst in the series. The butterfly is now in significant long-term decline, with a 61% reduction since 1976. Annual abundance dropped by 45% in 2008, and the butterfly was absent from 15% of sites with former records. The largest decreases occurred at sites in west/central England, Wales and Northern Ireland. There was a glimmer of hope in southern and eastern areas where a good number of sites recorded increases (Figure 6). These increases are likely to have resulted from the influx of individuals migrating from the continent in late summer, since numbers on transects were greatest in the last few weeks of the monitoring season. For example, hundreds were observed along the coast of Norfolk in late August and early September. Large numbers were

then seen inland across southern counties during the first half of September. In Dorset, there was a spectacular surge in sightings in the second week of September when large numbers were reported in gardens across the county. Of note, only three UK sites recorded an index of more than 100 and all of these were in Somerset; with 113 at Carrymoor, 157 at Hucker's Bow, Sand Point and 236 at West Sedgemoor.

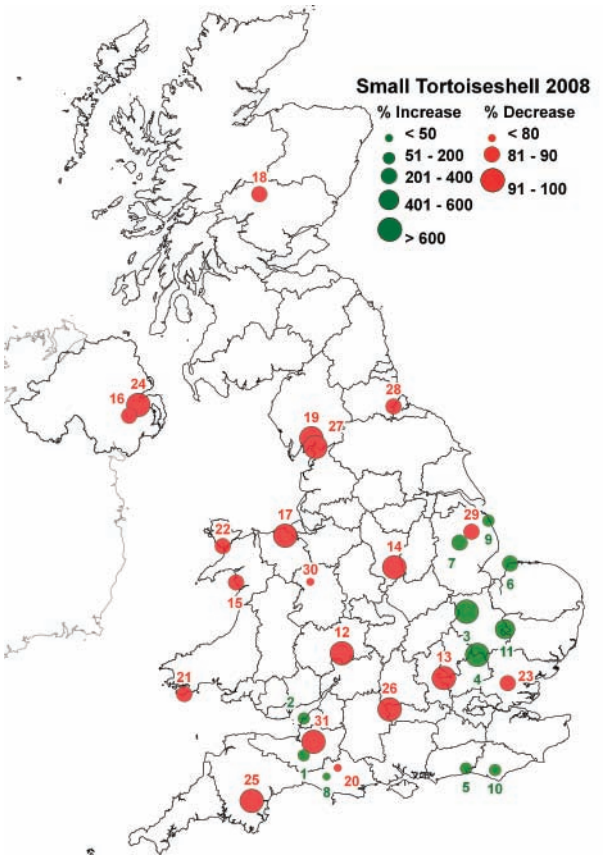
Research to understand the causes of decline in this species is underway. Further work by Owen Lewis at Oxford University on the potential effects of *Sturmia bella*, a parasitic tachinid fly that predominantly uses nettle feeding Nymphalids as a host, has not yet reached a definite conclusion. Whilst **Small Tortoiseshell's** do seem to carry higher loads of this parasite than the Peacock, it seems unlikely to be the sole explanation for their decline. Other factors which may be important include (1) the effects of drought and nitrogen enrichment on foodplant quality, (2) changes in the quantity and availability of larval foodplants (3) native parasitoids and other predators and (4) the contribution of migrant influxes from the continent. More details on the Small Tortoiseshell research, and how people can help, can be found at
http://users.ox.ac.uk/~zool0376/small-tortoiseshell.htm

Peacock annual abundance also declined, by more than a third, with the 2008 index being the seventh worst year in the series. There were some noteworthy collapses over the previous year, including from 133 to 30 at Warton Crag Lancashire Wildlife Trust Reserve and 133 to 33 at Tadnoll National Nature Reserve, Dorset.

Comma numbers were up by a third in 2008. Photograph by *Gerard Roest*

It was however, a good year for the **Comma** with numbers up by a third from 2007, making it the tenth best in the series. The butterfly has increased significantly since 1976, by nearly 270%. The **Comma** was widespread in 2008, being seen at more than 98% of sites with previous records. The largest site index of 239 was recorded at Orlestone Forest in Kent, where there was more than a five-fold increase over the previous year, to reach the highest level since the start of monitoring in 1994.

Figure 6. Sites where Small Tortoiseshell abundance changed substantially between 2007 and 2008



Sites: *1 West Sedgemoor; 2 Hucker's Bow, Sand Point; 3 Holme Fen; 4 Therfield Heath, Church Hill (3); 5 Anchor Bottom; 6 Holme Dunes; 7 Southrey Wood; 8 Lankham Bottom; 9 Saltfleetby; 10 Arlington Reservoir; 11 Chippenham Fen; 12 St Wulstans LNR; 13 Aldbury Nowers; 14 Breadsall Cutting; 15 Morfa Dyffryn (Benar dunes); 16 Hillsborough; 17 Pen-y-Gelli; 18 Baluain; 19 Whitbarrow - Howe Ridding NNR; 20 Alners Gorse; 21 Stackpole Warren, Stackpole NNR; 22 Newborough Warren; 23 Writtle College (East); 24 Lagan Meadows; 25 Waterleat 2006; 26 Watts Bank; 27 Gait Barrows NNR (Warden's); 28 Stillington Forest Park; 29 Red Hill Nature Reserve; 30 Tedsmere; 31 Ham Wall*

The nymphalids - fritillaries

2008 was another poor year for fritillaries, with six of the seven species doing worse than 2007, whilst two species recorded their lowest collated indices since the start of monitoring.

The **Small Pearl-bordered Fritillary** decreased by 9% in 2008, but the long-term trend for this species is also

alarming, with a significant decline of 66% since 1976 (see Table 3). The highest **Small Pearl-bordered Fritillary** index in the UK was 154 recorded at West Down (Dartmoor), Devon. This site is bucking the trend, with the 2008 index being the largest in the eight-year series.

Numbers of the **Pearl-bordered Fritillary** were reduced by more than 50% over the previous year, to reach their lowest ever level. Since 1976, there has been a significant decline of 71%. The butterfly collapsed in a former stronghold, the Morecambe Bay area of north-west England, with almost every site doing badly. Numbers were low in all areas of the UK. The highest index of 110 was recorded at Warton Crag RSPB Reserve and only one other transect produced an index over 50. There is some evidence to suggest that both **Small Pearl-bordered** and **Pearl-bordered Fritillaries** are faring better in Scotland than other parts of the UK, though the improvements are not significant.
It was more bad news for another threatened species, the **High Brown Fritillary**, which had an annual decrease of 50% to reach a series low. The butterfly held its own at the majority of sites in north-west England, but there were some big declines on Dartmoor, where some of the most important populations were reduced in size by up to 90%. The **High Brown Fritillary** remains threatened with extinction in Wales and the West Midlands and vulnerable on Exmoor with no encouraging news from any of these areas. The **Dark Green Fritillary** also decreased from 2007, by 32%, but 2008 was still an above average year – the 12th best in the series. Sites which bucked the trend included Whitbarrow - Township Plantation, where the index increased from 99 in 2007 to 180. There was a sharp drop at Melbury Down and Wood, Dorset from an exceptional 445 in 2007 to 88 in 2008.

The **Silver-washed Fritillary** decreased by 15% in 2007, but 2008 was still a relatively good year – the 12th best in the series. This butterfly has increased significantly by 73% since 1976. It was a particularly poor year at Deadmoor Common, Dorset where the index of 55 was the lowest in the 15-year series. The largest site index was recorded at Pamber Forest, Hampshire where there was a 15% decrease to 440. A number of sites bucked the trend including Biss Wood, Wiltshire where the index of 232 was the highest since 1987.

It was a below average year for the **Marsh Fritillary** with numbers down by nearly 50% from 2007. At Rhos Llawr Cwrt, Ceredigion numbers reached a new low, with a site index of just 46, down from a high of 1,957 in 2000. Although this index was the worst in the 15-year series, the index has been at a low ebb before e.g. 46 in 1996 following on from 1,375 in 1994. There was also a dramatic decline at Cerne Abbas Giant from 725 in 2007 to 31, but this was not the lowest in the series, again highlighting the large annual fluctuations that can occur in this species.

The **Heath Fritillary** was up by 23% from 2007, although numbers were still below average. The butterfly was present at all sites on Exmoor where it was recorded in 2007 and encouragingly a new population was found. With all of the sites being positively managed for **Heath Fritillaries**, the future prospects in this region look more favourable than they have done for perhaps 20 years. At the Blean Wood complex in Kent, poor weather frustrated monitoring efforts, though the general impression was that numbers were reduced. The species has recovered in this woodland complex from a low in the mid-1990s and is now well spread throughout the whole area, although there are concerns that the total amount of suitable habitat being created annually is insufficient to meet conservation targets (see feature article).

2008 was a terrible year for the High Brown Fritillary in all areas. Photograph by *Jim Asher*

The browns

Seven of the ten brown species increased in abundance compared to 2007, although six species had below average years across the 33-year series.

The upward trend for the **Speckled Wood** continued with a 51% annual increase, making 2008 the fourth best year since 1976. The largest index was recorded at North Warren, Suffolk where the index doubled to 577 - the highest in the 18-year series. There has been a dramatic long-term increase at this site from indices of 2-5 in the first three years of monitoring. Wytham, Oxfordshire also recorded its highest index of the series with the 257 in 2008 representing nearly a six-fold annual increase.

There was a modest increase in the **Wall Brown** by 15%, but it was still a relatively poor year – the second worst in the series. The significant decline in the **Wall Brown** by 80% since 1976 is one of the most extreme of

any British butterfly. This species was absent from 55% of monitored sites with former records. There were no large site indices, the highest being 82 at Havannah Local Nature Reserve, Northumberland. Former strongholds where the butterfly is now extinct as a regular breeding species include Rostherne Mere, Cheshire (previous maximum index of 488 in 1983) and Woodwalton Fen (416 in 1983).

The Collated Index for the Scotch Argus was the same as in 2007, with 2008 the tenth worst year in the 30-year series. Only ten sites produced indices, including Taynish National Nature Reserve where there was a welcome improvement from 35 in 2007 to 151 in 2008.

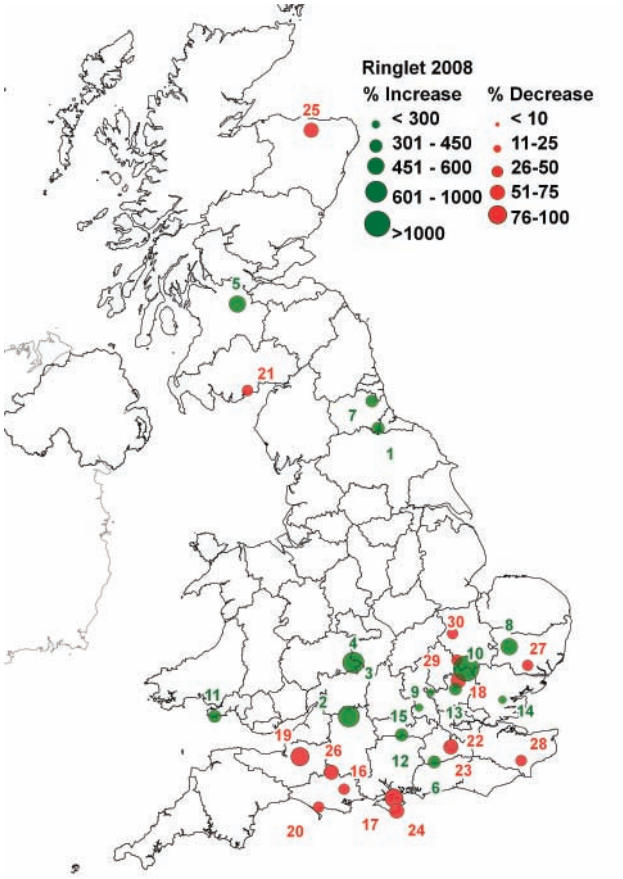
It was a below average year for the **Marbled White**, with abundance decreasing by nearly a quarter since 2007. At Cheriton Hill, Kent numbers dropped by two thirds over the previous year, with the site index dropping below 100 for the first time ever and comparing particularly unfavourably with the previous peak of 1,574 in 1997. Some of the annual declines need to be put into perspective. For example at the M40 Compensation Area, Buckinghamshire the index dropped from 425 in 2007 to 334 in 2008, but this compares with only single butterflies recorded in the first three years of monitoring starting in 1991. The long-term trend for this species is positive with a significant increase across the UK of 86% since 1976.

The **Grayling** showed an annual increase of 45% in 2008, but this positive change belies the fact that it was a very poor year – the second worst since 1976. Concern for this species is evidenced by absences in 2008 from 55% of monitored sites with former records. There has been a significant decline of 60% since 1976. The butterfly is now predominantly restricted to coastal areas and southern heathlands. By far and away the largest index of 1,051 was recorded at West Moors, Dorset (see feature article on Grayling habitat requirements analysing data from this and other Dorset sites). Only four other sites generated three figure indices, the maximum being 302 at the new Winterton Dunes transect in Norfolk.

Gatekeeper showed a modest annual increase of 15%, with 54% of sites showing improvements over 2007. In spite of these improvements, 2008 was a well below average year - the fifth worst in the series. The highest index in the UK of 1,804 was recorded at North Warren, Suffolk.

Meadow Brown numbers were up by 12% over the previous year, but it was a fairly average year for the species. There was a big drop at Whippingham Fields, Isle of Wight from 11,159 in 2007 to 5,687 in 2008, though (as in 2007) this site supported the largest index for this species. At Badbury Rings, Dorset numbers doubled over the previous year to their highest level since 1999.

Figure 7. Sites where Ringlet abundance changed substantially between 2007 and 2008



Sites: *1 The Whinnies; 2 Somerford Common; 3 Aldbury Nowers; 4 Windmill Hill; 5 RSPB Scotland Baron's Haugh reserve; 6 Oaken Wood; 7 Newton Hall Junction; 8 Spring Lane; 9 Butler's Hangings; 10 Therfield Heath, Lancaster Hill (5); 11 Oxwich; 12 Crabtree; 13 Danesbury Park; 14 Danbury Country Park; 15 Padworth Common; 16 Badbury Rings (NT); 17 Whippingham (Woodhouse); 18 Pryors Wood; 19 Ham Wall; 20 Lorton Meadows; 21 Dalbeattie Forest - 'Lovers Loup'; 22 Box Hill, Viewpoint; 23 Headley Warren; 24 Coombe Bottom & St Boniface Down (Ventnor); 25 Culvie Wood; 26 Duncliffe Wood (WT); 27 Wolves Wood; 28 Orlestone Forest; 29 Potton Wood; 30 Monks Wood*

Overall, the **Ringlet** had an excellent year, the second best in the series, with an annual increase of 35%. This butterfly has increased significantly in abundance by more than 300% since 1976. There has also been range expansion with a number of transect sites colonised. Sites which had their best year included Tedsmere, Shropshire (established 2001), Rodney Stoke, Somerset (1989) and Biss Wood, Wiltshire (1987). The majority of substantial increases were recorded in the Home Counties of 'Middle England', whilst in southern England the reverse was true (see Figure 7). Four sites achieved indices over 1,000, including Trimdon Railway Walk (Raisby Way), County Durham; Bradfield Woods, Suffolk; Blean Woods RSPB Reserve, Kent and the new transect at Long Wood, Somerset where the index of 1,242 was the largest in the UK.

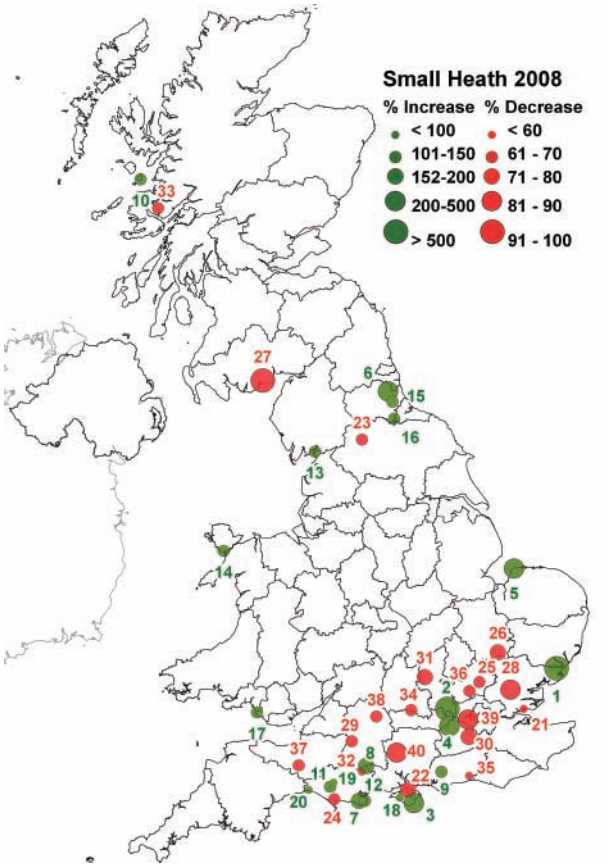
2008 was the second best year for the Ringlet in the 33-year series. Photograph by *Marc Botham*

The **Small Heath**, showed an annual decline of 15% in 2008, to produce its lowest Collated Index of the series. In 2008, there was no obvious pattern as to where the species was faring well or badly, although there were more substantial decreases than increases in south east/central England (Figure 8). The butterfly bucked the trend at Arnside Knott, Cumbria where the index of 149 was the highest since the start of monitoring in 1991. In contrast, the index of 36 at Aston Upthorpe Downs, Berkshire was the lowest in the 16-year series.

Small Heath numbers plunged to a new low in 2008. Photograph by *Marc Botham*

The modelled trend suggests that the **Large Heath** had a good year, although very few sites contributed data in 2008, so this result should be treated with caution. It was certainly a good year at Knowetop Lochs, Dumfries and Galloway, where the index increased from 45 in 2007 to 129 in 2008 (the best in the five-year series).

Figure 8. Sites where Small Heath abundance changed substantially between 2007 and 2008



Sites: *1 Stour Wood; 2 Burnham Beeches (New walk); 3 Bonchurch Down; 4 Chobhan Common North-east; 5 Holme Dunes; 6 Newton Hall Junction; 7 Corfe Common; 8 Martin Down Kitts Grave; 9 Levin Down; 10 Isle of Eigg; 11 Southfield Hog Cliff; 12 Swanage; 13 Arnside Knott NT; 14 Newborough Warren; 15 Bishop Middleham Quarry; 16 The Whinnies; 17 Kenfig; 18 Mottistone Down; 19 Cerne Abbas Giant; 20 Stonebarrow Hill; 21 Leigh Marshes; 22 Leckford-J; 23 Ballowfield LNR; 24 Lorton Meadows; 25 Waterford Heath North; 26 Granta Park; 27 Dalbeattie Forest - 'Lovers Loup'; 28 Writtle College (West); 29 Upton Cow Down (MOD); 30 Headley Heath; 31 Grendon & Doddershall Woods; 32 Cashmoor New Route; 33 Arienas Wood; 34 Aston Upthorpe Downs; 35 Anchor Bottom; 36 The Warren; 37 Thurlbear Quarrylands'; 38 Barbury Castle; 39 Richmond Park; 40 Whippingham (fields)*

Migrants

2008 was the second successive year of low numbers of migrant butterflies (and moths).

Following a general trend of increased numbers over the last decade and a very good year in 2006, in which all three common migrants had one of their best years of the series, the three migrant butterfly species all arrived in very low numbers in 2008, lower still than 2007. All three species showed decreases in 2008 compared with 2007. The **Clouded Yellow** showed the largest decrease (-90%) with the **Painted Lady** close behind (-81%). **Red Admiral** numbers were not so drastically affected, but were still 44% lower than in 2007. A **Camberwell Beauty** was recorded on Oxted Downs, Surrey in April and there were two records of **Large Tortoiseshell** on UKBMS transects. One of these was recorded at Brading Quarries on the Isle of Wight in April whilst the other was recorded later in the year in July on the Durlston Country Park East transect in Dorset.

Despite two poor years however, numbers of migrant butterflies have increased significantly since 1976. The influx of migrants is very variable from year to year and good years are often followed by relatively poor years (see Figure 2). Migration is very dependent on the weather (both home and away) and with a general long-term trend of climate warming in the UK it is likely that we will continue to see increasing numbers of migrant species periodically in the coming years.

For the second year in a row it was a poor year for migrants with numbers of our three regular species down again Despite this there were two transect records of the Large Tortoiseshell. Photograph by *John Vallender*

Butterfly monitoring strategy

To set out a roadmap of how the UKBMS should develop over the next decade, BC and CEH are currently producing a development plan for the future of butterfly surveillance and monitoring. The plan will review the current structure and main functions of butterfly monitoring in the UK by assessing the UKBMS and its relationship to other butterfly monitoring activity. The plan will identify the strengths and weaknesses of the main field methods for assessing butterfly abundance, identify the current and potential policy uses of butterfly monitoring data and provide a critical assessment of the current level of butterfly sampling. The plan will conclude with recommendations for future development of the UKBMS, including a costed set of proposals for the transect network, targeted surveys and a Wider Countryside Butterfly Survey. A draft plan is currently being considered by Defra and other funding bodies, with further details to follow in the 2009 report.

Butterfly monitoring health and safety update

The UKBMS relies on volunteers to carry out fieldwork and it is our duty to promote safe practice amongst our volunteers whilst carrying out any butterfly monitoring activities in the field. The launch of the Wider Countryside Butterfly Survey in 2009 has prompted a review of our health and safety guidance. Below is a summary of the new guidance note and the butterfly monitoring risk assessment which are both available on the UKBMS website (**www.ukbms.org**).

General guidance

Volunteers are responsible for their own health and safety, and should not put themselves in a position that could place them, or others, in danger. As a volunteer, you are under no obligation to participate or continue with a survey or scheme. If you have any concerns, you should stop the work and raise these with BC or your local coordinator. Before undertaking any activities, every fieldworker should consider the particular health and safety hazards associated with their individual sites and whether their individual circumstances and medical conditions expose them to particular hazards. You should think about what practical precautions should be taken to reduce the level of any risks which could be associated with fieldwork activities. Fieldworkers should pass on health and safety information provided by BC to other people helping them with BC-related activities. All serious accidents and incidents must be reported to BC.

Insurance

Any volunteer who is undertaking butterfly monitoring on behalf of BC and whose name and address is held either by Head Office or a co-ordinator will be covered by BC's Employer's Liability and Public Liability Insurances. In addition the volunteer will have Personal Accident cover.

Risk assessment summary

Whenever undertaking fieldwork you should inform a buddy of your whereabouts and what time you will be home and who to contact if you do not return by a certain time. Before commencing fieldwork always obtain permission from the relevant landowners or tenant to enter private land not subject to open access legislation. Do not continue fieldwork if access permission is later revoked. A letter confirming your participation in fieldwork can be provided by BC on request. Avoid confrontation with landowners, land workers or members of the public. If you have any concerns about your personal safety, cease fieldwork immediately.

Butterfly monitoring can involve long walks and prolonged periods spent in the sun possibly leading to tiredness, dehydration and accidents. This risk can be minimised by taking regular breaks in the shade, wearing a sun hat, applying sunscreen and drinking plenty of water. If you suffer from asthma, hay fever or any allergies ensure that you carry the appropriate medication and avoid situations which may trigger symptoms. Some sites can involve crossing uneven terrain, wet boggy areas or passing by open water and steep slopes. Appropriate footwear should be worn and extra care taken in these areas to avoid slipping. Surveys may involve crossing stiles, fences and passing through vegetation, therefore care should be taken especially if surfaces are wet. If possible, barbed wire fences should not be crossed. Appropriate clothing should be worn (as required) including full length trousers and long sleeved shirts.

Particular attention should be paid to prevention of Lyme disease including use of insect repellent, wearing light coloured clothing to identify ticks, regularly checking skin and hair for ticks, being aware of the symptoms (advice leaflet available from BC) and removing any ticks as soon as possible. Adders may be encountered in the countryside and they should be left alone. If you are bitten by an adder you should seek medical attention immediately. Take special care when entering areas with livestock, especially cattle, rams and horses. Do not enter fields containing bulls and be especially cautious in the vicinity of farm dogs.

Latest developments in butterfly indicators

Biodiversity indicators seek to measure progress in implementing biodiversity strategies and meeting national and international targets to slow/halt biodiversity declines. The UKBMS continues to play a crucial role in the development of butterfly indicators by providing data to compile the indicators. Butterfly indicators show measures for both species associated strongly with semi-natural habitats (specialists) and for those found in the wider countryside (generalists). Long-term trends in the butterfly indicators are assessed by a statistical smoothing procedure that separates the underlying pattern from annual variability.

Over the reporting period, established butterfly indicators for England, Scotland and the UK were updated, whilst new indicators were under development for Wales, south-west England (Figure 9) and in relation to measuring climate change impacts in the UK and across Europe.

Note that in annual updates, butterfly indicators lag a year behind species assessments, so here we describe changes between 2006 and 2007. In view of the poor weather over the season, rather predictably most of the butterfly indicators showed further decreases in 2007. The composite measure for habitat specialists dropped in abundance by a third across England, Wales and the UK as a whole, but increased by 8% in Scotland. The biggest annual decrease for specialists (37%) was at farmland sites in England. Wider countryside species decreased by ~25-33%, except in Wales where there was a more modest drop of 12%.

The Scottish butterfly indicator was assessed by smoothing for the first time, producing some changes to the previous assessment. The smoothing indicates that habitat specialists are doing worse in Scotland than previously suspected, with a significant decline in abundance of almost 50% since 1979. In comparison, wider countryside species have increased to a smaller degree than previously documented, with the 16% change not significant.

A new indicator was drafted for a Welsh Assembly Government-funded project investigating options for biodiversity indicators in Wales. The indicator confirms the acute long-term problems for Welsh habitat specialist butterflies, with an 83% decrease between 1976 and 2007. In contrast, there was a non-significant increase of 7% for wider countryside species.

A new regional indicator was developed for butterflies in south west England, as part of an assessment of the State of the Environment co-ordinated by the South West

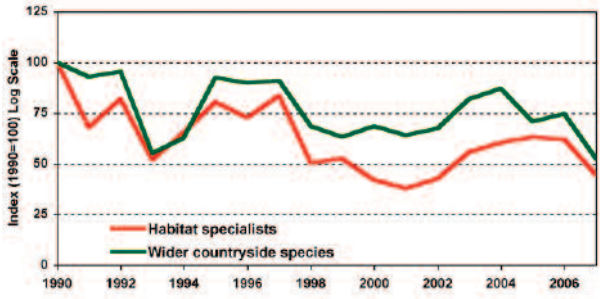


Figure 9. Populations of butterflies in south west England: 1990-2007

Observatory **www.swo.org.uk/**. The indicator highlights more bad news for butterflies in what is a key region for survival of threatened species such as Heath and High Brown Fritillaries. Between 1990 and 2007 there were significant and worrying declines of 53% for habitat specialist species and 41% for wider countryside species.

In Europe, a Grassland Butterfly Indicator has now been formally adopted by the European Union as a headline indicator (alongside birds) to assess progress towards the European target of halting biodiversity loss by 2010. The indicator was produced by Dutch Butterfly Conservation, Butterfly Conservation Europe and Statistics Netherlands under an EU contract using collated transect data from twelve different countries (Van Swaay & Van Strien 2008). Further details of the methodology used can be found at **www.bc-europe.eu**. The indicator shows that grassland butterflies are declining severely in the 12 sampled countries, with populations having fallen significantly by 60% since 1990 (Figure 10). Both habitat specialist and wider countryside species are in significant decline. The indicator is included in the European Environment Agency (EEA) report "Progress towards the European 2010 biodiversity target" and can be downloaded at:
http://www.eea.europa.eu/publications/progress-towards-the-european-2010-biodiversity-target-indicator-fact-sheets

A draft European Climate Change Butterfly Indicator has been developed and submitted via the EEA. The indicator measures annual change of the Community Temperature Index (CTI). An increase in CTI would reflect butterfly communities becoming increasingly composed of species associated with warmer temperatures. The results show a clear upward trend over the 18 years from 1990 to 2007, with the shift corresponding to 206 (± 148) km north in the United Kingdom - a rate thought to be faster than for birds.

2010 is an important year for biodiversity indicators, as UK and other European Governments make conclusions

on whether ambitious targets to halt biodiversity loss have been met. Given that targets are unlikely to have been met, it will be interesting to see what comes next in terms of a policy response. A real concern in these times of global recession and concerns over food security is that biodiversity conservation becomes a lower political priority.

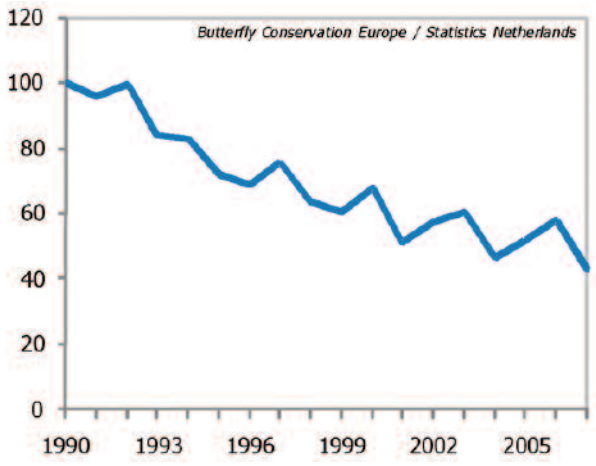


Figure 10. The European Grassland Butterfly Indicator (population index on the y axis and year on the x axis) shows a strong decline. Source: Van Swaay & Van Strien (2008)

Recorder achievements – an update

The UKBMS can only operate as successfully as it does through the fantastic efforts of its army of volunteers, who readily give up their time to count butterflies on a regular basis.

In the last two reports we have detailed some of the amazing achievements of our long-standing transect walkers, and in this report we have also taken the opportunity to list every single recorder who has contributed data to the scheme. We also aim to publish this list on the UKBMS website, where we can keep it updated, and it will serve as a lasting tribute to all your hard work.

The aim of this article is to briefly mention the recorders who can be added to the tables of major achievers (see 2006 Report) – either as a result of their efforts in 2008 or corrections to our database.

Firstly, in terms of the number of transects walked, **Jess Pain**, **Glynne Evans** (both Hampshire) and **Rebecca Woodell** (Bucks) have all moved into the top 10 having each walked over 1,000 transects, covering 1,000+ miles in the process. Glynne and Rebecca have also counted more than 50,000 butterflies each.

Other walkers to have cleared 1,000 miles are **Simon King** (Hampshire), **Andrew Scott** (Surrey), **Ron Harold** (Norfolk) and **David Thurlow** (Somerset). David has also counted over 50,000 butterflies, along with **Bill Shreeves** (Dorset), **Philip Green** (Kent) and **Rob Macklin** (Suffolk).

Additional milestones reached in 2008 include **Ken Orpe** having now walked over 2,000 miles and **Ian Woiwod** having counted over 100,000 butterflies.

Finally our thanks and congratulations go to the following additional recorders who have been walking transects for 20 years or more: **Alan Bowley** (Holme & Woodwalton Fens), **Ron Harold** (Holkham Dunes), **Mark Holloway** (Hengistbury Head), **Mike Enfield** (Corporation of London & Kent Wildlife Trust), **Gary Hibberd** (Holme Dunes), **Martin Allison** (Tudeley Woods), **Raymond Wheeler** (Melbury Down & Woods), **Keith Miller** (Powerstock & Kingcombe), **John Chester** (Isle of Eigg), **Norman Heywood** (Duncliffe Wood), **Helen Read** (Burnham Beeches), **Caroline Steel** (Upper Thames) and **John Halliday** (Taynish & Glasdrum).

Wider countryside butterfly survey update

Katie Cruickshanks and Tom Brereton (BC)

Introduction

Since 2006, BC and CEH in partnership with the British Trust for Ornithology (BTO) have been developing a new method to more effectively monitor butterflies and other common insects in the wider countryside. This is important because many wider countryside species are thought to be in long-term population decline due to intensification of land use, whilst others have increased regionally due to climate change. A new scheme is required to provide unbiased abundance estimates of widespread butterflies across the whole countryside to assess future changes and to inform future land use policies that impact upon biodiversity.

The new method

Based on the BTO Breeding Bird Survey (BBS), the Wider Countryside Butterfly Survey (WCBS) method involves a minimum of just two visits over July and August to randomly selected 1-km squares with optional extra visits in May and June. On each visit, butterflies and other insects (for example day-flying moths and dragonflies) are counted along two parallel, evenly spaced 1-km survey lines, each divided into five 200m continuous sections. The survey lines are placed in the same general location in every square (i.e. running north-south or east-west). Counts are made in similar conditions to transects – in a 5m 'box' and under set weather conditions suitable for butterfly activity.

Common Blue - more accurate trends are needed through the WCBS. Photograph by *Dean Morley*

Field testing in 2008

As in 2007, recorders from four BC Branches (Highlands and Islands, Norfolk, Somerset and Bristol and South Wales) and a quarter of the BTO BBS regions were invited to take part in the field testing. 192 squares were surveyed in 2008 - 62% of last year's total (310 squares). 60% were surveyed by BTO BBS recorders and the remainder were completed by BC recorders. The 38% drop in participation was disappointing but most likely due to very unsettled weather and uncertainty over the future of the scheme, given that there were no guarantees of a scheme launch in 2009. 82% of recorders entered their data online, representing an encouraging increase of 14% compared with 2007.

On average, 11 species and 104 individuals were seen per square based on two summer visits, which is very similar to 2007 (10 species and 95 individuals). In total 40 species were recorded in 2008 compared with 42 in 2007. Five species were 'lost' since 2007 and three species gained, all of which were habitat specialists recorded in low numbers. Meadow Brown, Large White and Small White were the most widespread species, being found in more than 80% of squares (Table 3). Meadow Brown was the most widespread and abundant species in both years.

Species ranks in terms of both abundance and occupancy were generally very similar across years, although the migrants moved 'down the table'. Small between-year changes in occupancy were particularly evident in the ten most frequently seen and lower mobility wider countryside species - Meadow Brown, Speckled Wood, Gatekeeper, Green-veined White, Ringlet, Common Blue, Small Skipper, Small Heath, Large Skipper, Marbled White and Small Copper. These species had a mean annual change in occupancy of only 2.3%. Low annual changes in occupancy provide evidence that species distributions are being sampled consistently and that the method is scientifically robust.

Peacock was down 22% from 2007 on wider countryside squares. Photograph by *Dean Morley*

The Small Heath, a target species of the survey, had an excellent year on WCBS squares - increasing in abundance by 126% from 2007, although there was no corresponding change in occupancy. Other species which increased substantially in abundance included

Table 3. Species occupancy and abundance in comparison with 2007 - using data from 104 squares visited twice between July and August in both years. Note: occupancy = % squares recorded in; abundance = total count. For ranks, most widespread/abundant = 1.

Species	2008 rank occupancy (2007)	2008 % occupancy (2007)	Occupancy change 2007 to 2008	2008 rank abundance (2007)	2008 abundance (2007)	Abundance % change 2007 to 2008
Meadow Brown	1 (1)	91 (96)	-5	1 (1)	3179 (2594)	+23
Large White	2 (2)	83 (85)	-2	4 (4)	1089 (968)	+13
Small White	2 (7)	83 (70)	+13	3 (3)	1629 (1546)	+5
Speckled Wood	4 (5)	73 (71)	+2	6 (8)	735 (480)	+53
Gatekeeper	5 (3)	71 (78)	-7	2 (2)	1822 (1559)	+17
Green-veined White	6 (8)	68 (58)	+11	7 (6)	687 (521)	+32
Peacock	7 (4)	51 (73)	-22	8 (7)	302 (491)	-38
Ringlet	7 (10)	51 (45)	+6	5 (5)	891 (610)	+46
Red Admiral	9 (5)	48 (71)	-23	14 (9)	138 (349)	-60
Comma	10 (11)	36 (43)	-8	15 (14)	100 (118)	-15
Small Tortoiseshell	10 (9)	36 (52)	-16	9 (10)	242 (263)	-8
Holly Blue	12 (12)	21 (36)	-14	21 (13)	43 (121)	-64
Common Blue	13 (17)	20 (13)	+7	18 (22)	70 (33)	+112
Small Skipper	14 (13)	18 (26)	-8	12 (11)	166 (244)	166 (244)
Small Heath	16 (14)	17 (17)	+1	13 (16)	146 (64)	+128
Brimstone	17 (17)	14 (13)	+1	19 (23)	52 (26)	+100
Large Skipper	18 (17)	13 (13)	0	20 (18)	46 (58)	-21
Marbled White	19 (22)	10 (9)	+1	22 (24)	36 (20)	+80
Small Copper	19 (21)	10 (10)	0	23 (25)	24 (19)	+26
Painted Lady	21 (16)	8 (15)	-8	26 (19)	11 (49)	-78
Silver-washed Fritillary	21 (23)	8 (8)	0	17 (21)	73 (38)	+92
Wall Brown	21 (23)	8 (8)	0	25 (25)	18 (19)	-5
Essex Skipper	24 (20)	7 (13)	-6	16 (15)	99 (98)	+1
Dark Green Fritillary	25 (25)	3 (5)	-2	24 (20)	20 (39)	-49
Scotch Argus	25 (26)	3 (3)	0	11 (12)	181 (167)	+8
Brown Argus	27 (26)	2 (3)	-1	30 (29)	3 (6)	-50
Grayling	27 (28)	2 (2)	0	27 (27)	7 (9)	-22
Small Pearl-bordered Fritillary	27 (28)	2 (2)	0	30 (30)	3 (3)	0
Green Hairstreak	30 (32)	1 (1)	0	32 (33)	1 (1)	0
Purple Hairstreak	30 (28)	1 (2)	-1	27 (31)	7 (2)	+250
Silver-studded Blue	30 (39)	1 (0)	+1	32 (39)	1 (0)	+100
White Admiral	30 (28)	1 (2)	-1	32 (31)	1 (2)	-50
White-letter Hairstreak	30 (39)	1 (0)	+1	32 (39)	1 (0)	+100
Brown Hairstreak	36 (32)	0 (1)	-1	36 (33)	0 (1)	-100
Chalk-hill Blue	36 (32)	0 (1)	-1	36 (28)	0 (7)	-100
Clouded Yellow	36 (32)	0 (1)	-1	36 (33)	0 (1)	-100
Grizzled Skipper	36 (32)	0 (1)	-1	36 (33)	0 (1)	-100
Large Heath	36 (32)	0 (1)	-1	36 (33)	0 (1)	-100

Speckled Wood (up by 53%), Common Blue (112%) and Ringlet (46%). The Nymphalids showed the greatest decline in annual occurrence, with Peacocks in 22% fewer squares compared with 2007, Red Admirals down by 23% and Small Tortoiseshells by 16%. It was a poor year for Holly Blue, being lost from 14% of squares and declining in abundance by 64%.

Note that Table 3 only includes data from squares which were visited twice in July-August in both years (N=104) therefore occupancy figures are quite low for some wider countryside species (e.g. Wall Brown and Brown Argus). With a greater sample size which more fully samples the flight periods and habitats range, we expect the occupancy figures to increase and the changes between years to be more representative.

Comparing WCBS and transect counts

Wider countryside species population trends are currently obtained from UKBMS butterfly transect data. WCBS data can be used to test whether trends in these species obtained from transects are representative of the countryside as a whole i.e. similar to those found across randomly selected WCBS squares. A preliminary analysis was carried out to compare annual changes in the abundance of wider countryside species on transects and WCBS squares between 2007 and 2008. Data from 104 WCBS squares and all transect sites, both visited at least twice from July to August in 2007 and 2008, were used in this analysis.

For approximately one third of wider countryside species, the annual change on WCBS squares and transects sites was similar (change difference was less than 10%). For nearly 50% of wider countryside species, the difference in annual change was substantial (>30%). These results, although highly provisional, indicate that trends of wider countryside generated from butterfly transect data may not be representative of the countryside as a whole. Further analysis in this area is in development.

Monitoring other insects

The WCBS provides an opportunity to collect simultaneous data on a wider variety of insects including day-flying moths and dragonflies. Recording of other insect groups was tested during the pilot surveys. Day-flying moths were recorded on 22% of squares in total (30% of BC squares and 17% of BBS squares). Dragonflies were recorded on 46% of squares, including over half of BBS squares and nearly 40% of BC squares.
In addition, an optional visual search method to monitor common, easily identifiable and indicative insects including bumblebee, hoverfly and beetle species has been developed over the last three years. The method involves separate 10 minute foliage and nectar searches.

In 2008, volunteer recorders helped test the visual search methods for a list of 20 species. To validate the method, the results were compared with those from more intensive and standardised methods - sweep nets for foliage searches and pan traps for nectar searches. On average, a 10 minute flower head search picked up 1.3 target species and 9 individuals, whereas a foliage search of similar duration picked up less than one individual per survey. The sweep net picked up twice as many individuals and nearly three times more species than the visual foliage search. For species on flower heads, insect abundance in pan traps was 11 times higher than the visual searches, and yielded three times more species. Despite the effectiveness of the pan traps and sweep nets, it is likely that more people will take part and the survey will achieve greater coverage by using visual search methods which does not require either or an ability to identify many individuals to species level.

A workshop was held with expert entomologists to refine the method in November 2008. From this it was decided to drop the unproductive foliage search and test an 'Insect Flower Search' method in 2009. The primary aim of the pilot study in 2009 will be to assess popularity of such a survey amongst volunteers and to determine the likelihood of encountering these species in WCBS squares. The method involves walking back from the last surveyed section for 10 minutes searching flower heads in a 1m wide strip on one side of the survey line. Twelve species were selected (5 beetles, 5 hoverflies, 2 bumblebees), with an option to record three other species most frequently seen during the search. Flower cover and distance walked are recorded as relative measures of habitat quality.

Black and Yellow Longhorn Beetle (*Rutpela maculata*) - a target species of the Insect Flower Search. Photograph by *Les Binns*

Habitat recording pilot study

A draft method for recording butterfly resource quality was developed for lowland, intensive farmland. The method involved sampling the last section of the survey route for butterfly resources and habitat attributes at three levels: 1) the whole 200m section (e.g. aspect, shelter,

grazing intensity), 2) for key habitat features (e.g. crop type, flower cover, hedge condition) and 3) in quadrats within the key habitats (recording variable such as turf height, key nectar species, grass species diversity). 21 surveys were completed by 16 recorders and a high number of the selected features were recorded. A questionnaire to recorders showed that 92% enjoyed the survey, 85% would be happy to repeat annually but that more guidance was needed for plant identification.

WCBS to be launched in 2009

The project has gained momentum over the last three years attracting substantial support from BC and BTO volunteers. With three years of data already collected and an excellent partnership established with the BTO, the opportunity to roll out the WCBS was too good to miss. In December 2008 BC, BTO and CEH took the decision to roll out the scheme across the UK, setting a coverage target of ~1000 squares (500 each for BC and BTO recorders).

Stop press: By the start of the 2009 season, BC and BTO recorders had committed to surveying 1000 squares, indicating that (weather permitting) we may possibly reach our ambitious coverage target (Figure 11). A big thank you to everyone who will be taking part and it will be fascinating to describe the results of this unique survey in next years report.

Figure 11. Distribution of the 1000 squares allocated to volunteers for the WCBS roll out in 2009. Green circles are squares to be covered by BC recorders, blue circles are squares to be covered by BTO and BBS recorders

For more information please contact Katie Cruickshanks by email kcruickshanks@butterfly-conservation.org, telephone 01929 406036 or visit **www.ukbms.org/wcbs.htm**

Research article: Habitat requirements of the Grayling butterfly *Hipparchia semele* on lowland heathland

Anna Robinson (JNCC) and Tom Brereton (BC)

Introduction

UKBMS data indicate that the Grayling butterfly has decreased significantly in abundance by 69% between 1976 and 2007. The species was listed as a Biodiversity Action Plan (BAP) priority species in the 2007 BAP review due to this marked decline (BRIG, 2007). The Grayling has one of its UK strongholds on the heathland sites of Dorset which have declined in extent by 85% since the 18th Century and now mostly exist in small isolated fragments (Thomas and Webb 1984). Lack of, or inappropriate, heathland management may have contributed to declines in the Grayling population by leading to decreases in essential habitat resources.

The Grayling butterfly requires different resources at different stages of its life cycle (Thomas and Lewington 1991; Shreeve 1990). Three key habitat requirements include the larval host plants (fine-leaved grasses), nectar-bearing plants for adults to feed on (particularly heathers), and bare ground. Bare ground is thought to be important for several reasons, including camouflage, mineral provision, and as an area for Grayling to bask to regulate their temperature.

This study aimed to determine if variation in specific habitat characteristics at lowland heathland sites in Dorset and Devon could explain differences in the size of Grayling populations as recorded through the UKBMS.

Grayling pictured basking on bare ground. Photograph by *Anna Robinson*

Methods

Seven UKBMS heathland transect sites were chosen with differing Grayling abundances - West Moors (RAOC), Bovey Heath, Upton Heath North, Upton

Heath South, Stoborough Heath, Hethfelton Wood, and Avon Heath. As part of the UKBMS methodology, transects are divided into sections, with adult butterfly numbers being recorded in each (Pollard and Yates 1993). A total of 34 sections from seven sites were included in this study.

Grayling abundance for each section was obtained from UKBMS data, averaged over the three years prior to this study (i.e. 2005-2007). Abundance indices for individual sections were converted to a density index by dividing the section abundances by the length of each respective transect section. For one site, butterfly numbers had been recorded at the whole transect level, but estimates of the proportions of Grayling found in the different sections were provided by the transect walker.

In 2008, fieldwork was carried out to record specific habitat characteristics thought to be important for the Grayling within each of the sections studied. This included the percentage cover of different types of vegetation and bare ground, vegetation height, slope of ground and topological unevenness (see Results section for details). Typically, between thirty and forty 1m^2 quadrats were used to sample the habitat along each section, the exact number depending on section length, variability and time constraints. Quadrats were positioned up to 10m either side of the central transect line, with twice the sampling intensity in the central 10m band.

Habitat characteristics for each section were analysed in relation to Grayling density. Multiple regression analysis was used to test for the effects of habitat type on Grayling density.

Results

Vegetation cover and bare ground

76% of variation in Grayling density was explained by the percentage cover of the following types of vegetation and bare ground: fine-leaved grass, broad-leaved grass, Bell Heather (*Erica cinerea*), Cross-leaved Heath (*E. tetralix*), Heather (*Calluna vulgaris*), scrub, Bracken, (*Pteridium aquilinum*), sedges/rushes, herbs, bare earth, leaf litter, and rocky substrate (P=<0.001, n=34). However, of these variables, hierarchical partitioning analysis showed that only four variables had significant effects: fine-leaved grass, rocky substrate, leaf litter and Bracken. Fine-leaved grass and rocky substrate had a positive effect, whilst Bracken and leaf litter had a negative effect on Grayling density. Amongst these variables, the percentage cover of fine-leaved grass was most strongly related to Grayling density, with linear regression analysis revealing that 51% of the variation in density was accounted for by this variable alone (Figure 12).

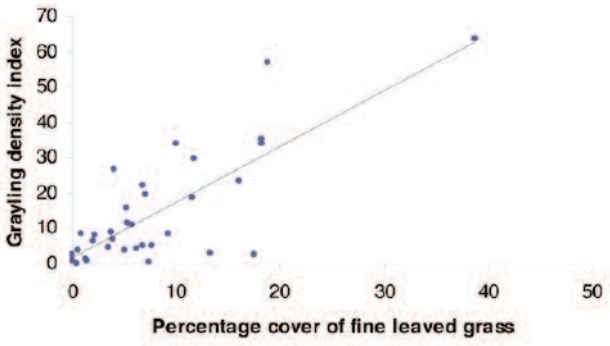


Figure 12. The relationship between fine-leaved grass and Grayling density

Structural habitat characteristics

Grayling density tended to be lower in areas of tall vegetation. Structural habitat characteristics explained 40% of the variation in Grayling density: grass height, heather height, scrub height, maximum vegetation height, average vegetation height, slope, and topological unevenness. Of these variables, hierarchical partitioning analysis showed that only scrub height had a significant effect. Scrub height had a negative effect on Grayling density.

Discussion

This study showed that high percentage cover of fine-leaved grass and, to a lesser extent, rocky substrate characterised sites with high Grayling density. This is in agreement with previous habitat descriptions (Thomas and Lewington 1991; Asher *et al*. 2001; Loram e*t al*. 2003). The percentage cover of heathers (Ling, Bell Heather and Cross-leaved Heath) did not have a significant effect on Grayling density, despite the value of these plants in providing nectar for adult butterflies. Nectar-bearing plants were not rare at any of the sites studied and may not be a limiting factor to Grayling survival.

The percentage cover of fine-leaved grasses was shown to explain over half of the variation in Grayling density (Figure 12). Grayling larvae have been reported to feed on a variety of fine-leaved grasses, including Bristle Bent (*Agrostis curtisii*), Sheep's Fescue (*Festuca ovina*), Red Fescue (*F. rubra*), and Early Hair-grass (*Aira praecox*) (Emmet & Heath 1989). At the heathland sites surveyed, the vast majority of fine-leaved grass consisted of Bristle Bent, growing in tussocks. However, it was observed that in a few sections studied the dominant fine-leaved grasses were of other species, for example Red Fescue, growing in a more evenly spreading manner. Interestingly, these areas had lower Grayling densities than would be expected for the percentage cover of fine-leaved grass they contained. This suggests that the Grayling may particularly benefit from a high cover of tussocky fine-leaved grass species.

Although Bristle Bent often functions in this way on dry heathlands in south west Britain (Stace 1997), the butterfly actually has a much wider distribution.

Rocky substrate (including bare rock, loose aggregates, sand and man-made substrate) also had a significant positive effect on Grayling density. Bare ground is thought to have an important role in butterfly temperature regulation (Dreisig 1995). An adult Grayling butterfly needs to keep its body temperature at around 32°C to remain active (Thomas and Lewington 1991). Numerous studies have shown that during the day, bare ground heats up more quickly and reaches higher temperatures than vegetation, for example, Loram *et al*. (2003). The site with the highest Grayling densities (West Moors (RAOC)) had a lot of rocky substrate, consisting of a concrete road and an old cinder rail track. The transect walker for this site reported Grayling often basking on the road and track.

Leaf litter had a significantly negative effect on Grayling density. It tended to be found in areas containing scrub or under tree cover, which is likely to shade the ground and minimise its value for basking. Bracken cover had a significantly negative effect on Grayling density. Areas with a high percentage cover of scrub (for example Gorse, *Ulex europeaus*, and Bramble, *Rubus fruticosus*) were also associated with lower Grayling densities, although this effect was not significant. Bracken and scrub tend to shade bare ground and reduce the cover of low grassy vegetation. The height of scrub had a significant negative effect on Grayling density. One site, West Moors (RAOC), had a substantial amount of gorse in the grassy areas, but still managed to maintain very high Grayling densities. This site was mown on a regular basis, so the gorse was very stunted and not able to shade out the grass. Interestingly, despite the negative effect of scrub height, it should be noted that not all good Grayling sites were entirely devoid of tall scrub. For example, Bovey Heath, the site with the second highest Grayling density, had a mix of areas of fine-leaved grass and areas of tall scrub. In fact, Graylings have been reported to benefit from some scrub by using its shade to stop overheating during very warm conditions (Dreisig 1995).

The availability of essential habitat resources for the Grayling is likely to have been affected by the decline in traditional heathland management. Heathland sites were historically managed by stock grazing, controlled burns, and cutting and collection of gorse and bracken (Thomas and Webb 1984). These once widespread practices have now largely died out and current management, where this exists, tends to be limited to sites managed for conservation purposes. In this study it was seen that some areas of heathland were becoming encroached with scrub and mature stands of heather, leaving fewer open patches of fine-leaved grass and bare ground. The current lack of stock grazing, in particular, is likely to have decreased the cover of fine-leaved grass at sites.

High numbers of Grayling were more associated with tussocks of the fine-leaved grass Bristle Bent growing amongst bare ground. Photograph by *Anna Robinson*

Sites that were dominated by Bracken and broad-leaved Purple Moor Grass were poor for Grayling. Photograph by *Anna Robinson*

Conservation Implications

Maintenance of heathland vegetation requires regular management to control succession. Open heathland can be maintained by cutting, controlled burning and grazing by various livestock. Ideally, management should aim to create a mosaic of habitat types to benefit many different species. Maintaining areas of scrub and mature heather, for example, can benefit birds such as Dartford Warbler (Moore 1962).

In order to conserve Grayling populations our analyses suggest that the most important management prescription is to maintain stock grazing at levels that (1) encourage the formation of heather/grass mosaics

with frequent to locally abundant tussocks of fine-leaved grasses and (2) disturb the vegetation to create frequent patches of bare ground. If grazing levels are insufficient, Bracken, scrub and extensive stands of heathers are likely to be over dominant (Moore 1962), whilst on sites that are overgrazed, grassy areas will become too short and the required medium height grass tussocks will be lost. Even with appropriate grazing levels, periodic cutting or burning will be required (successional management) to selectively control patches of scrub, tall tussocky grasses such as Purple Moor Grass (*Molinia caerulea*) and Bracken (Todd *et al*., 2002).

If grazing does not create sufficient quantities of bare ground, other forms of management should be considered e.g. scraping shallow pits or even bulldozing the vegetation away and creating mounds or banks with the material removed. These should be targeted to hot areas (e.g. south facing) and where natural processes (e.g. erosion) are likely to maintain such conditions over a longer time period than elsewhere.

Management for Grayling is likely to benefit many other invertebrates (especially those requiring bare ground) and given that it is a widespread species, it should perhaps be more widely valued as an indicator of the condition of heathland habitat. A positive step would be to revise the current guidance on conservation objectives for monitoring and managing lowland heathland SSSIs **http://www.jncc.gov.uk/pdf/CSM_lowland_heathland.pdf**, placing greater emphasis on the need to retain fine-leaved grasses growing in tussocks and allowing a higher cover of bare ground (than the current 10% threshold) at the site, if it is in a region where Grayling occurs

We feel these measures could be useful because the sad fact is that Grayling is continuing to decline even on sites in active conservation management. This suggests that sufficient structural variety is not being maintained on heathland sites and that many other insect species less well monitored than the Grayling are also likely to be in trouble.

Acknowledgements
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Monitoring and management for the Heath Fritillary in Blean Woods - counting down to 2010.

Tom Brereton and Amber Rosenthal (BC)

Status of the Heath Fritillary
During the twentieth century, the Heath Fritillary declined severely in range, disappearing from an estimated 90% of 10km squares. It remains one of Britain's rarest butterflies, and is listed as vulnerable in the UK Red Data Book (van Swaay and Warren 1999). The Heath Fritillary is protected under schedule 5 of the 1981 Wildlife and Countryside Act and is a priority species for conservation action in the UK Government's Biodiversity Action Plan (UK BAP).

The first national survey of Heath Fritillary was completed in 1980 and located 31 colonies in the UK, chiefly in two localised areas of south-west and south-east England; Exmoor and Blean Woods, Kent. Further surveys in subsequent years have discovered new sites across the UK, especially on Exmoor though the total number has never exceeded 50. In 1980, 80% of the colonies were in Blean Woods highlighting the crucial importance of this 3000 hectare woodland complex to the survival of the Heath Fritillary in the UK.

Heath Fritillary woodland habitat – a coppice coup cut two years ago with abundant Common Cow-wheat. Photograph by *Tom Brereton*

Species ecology in the Blean woodlands
Much of what is known about the ecology and habitat requirements of the Heath Fritillary in the Blean Woods complex was determined by the research of Martin Warren in the early 1980s. In Blean Woods the Heath

Fritillary occupies woodland clearings (e.g. coppiced or recently clear-felled woodland), glades, rides and pylon lines which support frequent to abundant patches of its larval food-plant, Common Cow-wheat (*Melanpyrum pratense*), growing in sunny, sparse vegetation. In woodland clearings, colonies tend to reach a maximum size in the first two or three years after clearance and then decline rapidly as the habitat quality changes through succession. In order to maintain a stable population, regular management in the form of cutting is therefore essential to create and maintain fresh habitat for the butterfly to move into as existing areas become unsuitable.

Experience has shown that only one in three cleared areas can be expected to provide suitable breeding habitat. Sustained active management over a suitably large area is therefore required to conserve this butterfly. Coppice plots should ideally be 0.4-2 hectares in size and cut on a rotation of 10-20 years. Martin Warren's studies confirmed that the butterfly had low mobility in woodland and formed discrete colonies in suitable clearings, with adjacent mature coppice and trees forming barriers to dispersal. As a result, newly created clearings with suitable habitat are unlikely to be colonised if they are more than 600m from an existing population, and so wide sunny rides are also needed to allow the species to move between cleared areas. The research also identified the importance of close monitoring, (1) as the species status can rapidly decline and (2) to determine the effects of the recommended management prescriptions, which had only been trialled for a few years at the time.

Conservation

Since 1980 there have been considerable efforts to conserve the Heath Fritillary in Blean Woods with a variety of organisations involved in coppice, ride and other forms of proactive management work. The organisations involved include: Natural England, The RSPB, Kent Wildlife Trust (KWT), The Woodland Trust, Forestry Commission and Tilhill Forestry on behalf of private landowners. Currently, most of Blean Woods is owned and managed by nature conservation bodies. Kent Wildlife Trust owns over 1000 hectares for example.

Monitoring Heath Fritillary in the Blean

The Heath Fritillary has been intensively monitored in Blean Woods since the early 1980s by a variety of conservation bodies. The varied functions of monitoring have included: (1) to inform site management, (2) to assess site status and (3) to assess regional status for progress in BAP delivery (see Table 4).

BC acts as the *Lead Partner* for this species under the UK BAP – coordinating monitoring efforts, promoting suitable habitat management and monitoring progress in UK BAP delivery. The UK BAP gives two clear performance indicators and monitoring targets to measure progress in conserving the Heath Fritillary in the Blean Woods Complex by 2010.

1. To maintain a minimum of 25 interconnected colonies
2. To restore the area of suitable interconnected habitat (active coppice & open areas) to 1980 levels by 2010 and then maintain 30 hectares per year.

Table 4. Monitoring of the Heath Fritillary in the Blean woodland complex

Site	Monitoring	Recorders	Purpose
East Blean Wood	Transect since 1989 & annual sweep count around peak flight since the mid-1990s	Kent Wildlife Trust staff & volunteers	Inform site management and assess site status
Thornden & West Blean Woods (including Cole Wood)	Annual Timed Count of all colonies around peak flight since 1996	BC staff	Inform site management and assess site status
Blean Woods NNR (including Church Wood RSPB reserve)	2 transects (RSPB since 1982 and NNR since 1991) & regular recording of all colonies to obtain peak numbers	RSPB/Natural England staff	Inform site management and assess site status
All sites	Timed count of all colonies around peak flight period every 5-8 years since 1980	Lead by BC staff	Assess regional status and progress in BAP delivery

Two principal monitoring methods have been employed across the complex, with both data types collated through the UKBMS: (1) *butterfly transects* to monitor impacts of nature reserve management and (2) *timed counts* to enable a rapid assessment of the population size and area occupied of individual colonies.

For timed counts, individual colonies are defined as aggregations of adults within clear habitat boundaries (e.g. a recently cut coppice clearing and adjacent section of ride) separated by unsuitable habitat (e.g. mature closed canopy woodland). In continuous open habitats (e.g. clearfell or long rides) two or more colonies may be present if discrete aggregations of adults are separated by more than 300m of unsuitable habitat (e.g. no foodplant present).

The timed count method, which was developed in Blean Woods and other Heath Fritillary sites, involves undertaking a zig-zag walk through the whole colony area, sampling evenly and counting the number of

butterflies seen per minutes of search effort. Absolute abundance is estimated by calibration with mark-release recapture data, once the count has been corrected for stage in the flight season. Due to a degree of imprecision, colony abundance estimates at the peak flight period tend to be converted to these colony size categories (1) Large - >250 adults (2) Medium - 100-250 (3) Small - 10-100 (4) Very small - <10.

Monitoring conservation progress - regional status and BAP delivery

Six (inventory) surveys of the total number of colonies in Blean Woods have been undertaken by BC since 1980 at four to eight year intervals. The results from this work show mixed fortunes for the species. On the positive side, the BAP target for the Blean Woods complex to hold 25 colonies has been exceeded (37 in 2008), but on the negative side, the target to maintain 30 hectares of suitable occupied habitat has not been met (16.5 hectares in 2008). Of concern is a recent decrease in the amount of breeding habitat, to its lowest ever level in 2008 (Figure 13). A further concern is that the apparent increase in colony numbers is at least partly explained by the fragmentation of several colonies in East Blean and Thornden and West Blean Woods.

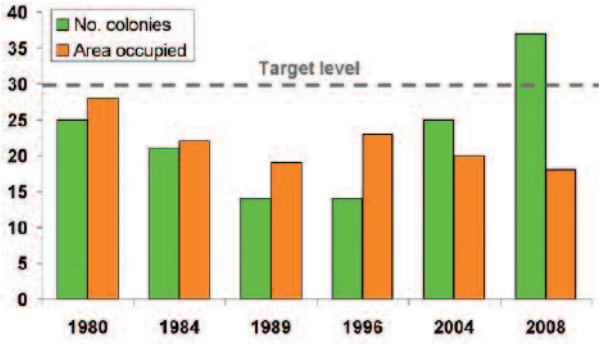

Figure 13. Overall number of colonies and colony flight areas for the Blean Woods, years with data for all sites only

A comparison between 2004 and 2008 highlights some particular successes including (1) the recovery of the Heath Fritillary to Clowes Wood due to targeted management work by the Forestry Commission and (2) substantial improvements in status at Blean Wood NNR due to ongoing management work led by the RSPB. Ride management (in addition to coppice) is playing an increasingly important role in supporting Heath Fritillary colonies in improvement areas.

Monitoring conservation progress at the site level - Thornden and West Blean Woods

BC has had particular involvement in monitoring the changing fortunes of the Heath Fritillary in Thornden and West Blean Woods. This was due to the site being in private rather than conservation ownership over much of the period (until purchase by KWT in 2003), and because in the baseline survey in 1980 it was the most important site for the species in the Blean Woods complex supporting four-fifths of colonies. The central position of the woodland further enhances its importance to the overall survival of the Heath Fritillary in the Blean Woods complex. During the 1980s and early 1990s, the Heath Fritillary progressively declined in abundance across the site, due to a combination of a reduction in coppicing activity and shading over of clearfell habitats. By 1992 the species was on the brink of extinction, with just two colonies remaining. This was all in spite of SSSI notification, production of a detailed management plan aimed specifically at helping to conserve the butterfly and the continuation of small-scale coppicing over parts of the wood.

Renewed efforts by Natural England's (then English Nature) Kent Team and BC to conserve the butterfly at the site were launched in the mid-1990s. An extensive programme of conservation management work was carried out targeted at Heath Fritillary, enhanced through grant-funding made available through two mechanisms - English Nature Management Agreements and the Forestry Commissions *Coppice for Butterflies Challenge* Scheme. Although the level of coppicing remained similar to levels in the late 1980s and early 1990s, the key difference during the mid and late-1990s was that the coppicing was targeted adjacent to existing Heath Fritillary colonies and there was an associated extensive programme of wide ride management and thinning of High Forest areas rich in Common Cow-wheat.

In 1996, a programme of annual monitoring at the site was launched by BC to determine the effects of positive management and crucially to aid future targeting of annual management. In each year, all known colonies, rides and woodland clearings that had been cut over the previous seven years were visited and their suitability for Heath Fritillaries assessed, with condition indicators including size of clearing and extent of Cow-wheat growing amongst bare ground/short vegetation in an unshaded position. Information on the location of cut compartments was obtained from site managers. If Heath Fritillaries were present in the habitat patch, a timed count was completed to determine colony population size and spatial area occupied. The results of monitoring, including the location of colonies, was sent annually to site managers in the autumn to aid targeting of management adjacent to existing colonies over the coming winter.

Monitoring data highlights that in the early years the project was a huge success. From just two colonies in two 1-km squares in 1993, there were 14 colonies present located in ten 1-km squares by 2000 with a total

flight area of 7.4 hectares. The increase in Heath Fritillaries in the late 1990s coincided with improved targeting of coppicing close to existing colonies, which significantly increased the level of occupancy of coppice coups. Between 1990 and 1992, 18% (2 of 11) of cut coppice coups were colonised by Heath Fritillaries, compared with 75% (9 of 12) between 1998 and 2000. In 1996 and 1997 (prior to targeting), there were no Heath Fritillary colonies located in commercially managed coppice coups, even though there were 18 scattered through the wood which had been cut over the previous 4 years.

Heath Fritillary. Photograph by *Jim Higham*

During the mid and late-2000s the fortunes of the Heath Fritillary in the Blean have again taken a turn for the worse. By 2004, the condition of the population was little better than it had been at the start of monitoring eight years previously, despite a huge amount of good work in the interim. In the latest assessment in 2008, there was a further deterioration to six colonies (two fewer than in 2004 and the same as 1996) occupying 1.17 hectares of woodland (representing 75% and 50% reductions compared with 2004 and 1996). The cause of the recent decline is simple to explain and due to a corresponding decline in the amount of targeted ride management/thinning and coppicing. It is recommended that 10-11 hectares of targeted management are required to maintain the Heath Fritillary population in favourable condition in Thornden and West Blean Woods. In 2008, only 2 hectares were created highlighting the substantial shortfall (see Table 5). A further concern is the trend towards smaller coppice coupes which at best support generally only small Heath Fritillary populations that persist for shorter periods of time due to greater shading effects.

Part of the (short-term) problem has been a change in ownership of the wood, which inevitably leads to disruption of management activity. On the positive side, the new owners, Kent Wildlife Trust, have a proven track record of managing successfully for Heath Fritillaries (at East Blean Woods) and have now started a programme of extensive habitat management in Thornden and West Blean Woods which should benefit a range of species including the Heath Fritillary. Management to be undertaken over the next four years includes an increased level of traditional rotational coppicing in suitable plots, ride work and removal or thinning of further sections of conifer plantation to create scrubby heathland habitat.

With much of the Blean Wood complex in conservation ownership and positive management for the Heath Fritillary an agreed high priority, future prospects ought to be good. However, a wider problem is the long-term sustainability of coppice management given the increasing costs, the lack of suitably skilled labour to undertake the work, and of any market for coppice products to offset management costs. The lack of market for wood also leads to the retention of large quantities of cut material within the coupe system reducing both the potential area of suitable breeding habitat and the future economic potential of the coupe. Prospects for the long term sustainability of the Heath Fritillary in the Blean could be much improved if suitable habitat management can be linked to an economically viable coppicing system driven by the wood-fuel market.

Table 5. Annual monitoring results 1996-2008 at Thornden and West Blean Woods and overall condition assessments (red font shows target not met)

Condition indicators	Site specific target	1996	1997	1998	1999	2000	2001	2002	2003	2004	2008
No. colonies	13	6	7	10	14	14	13	14	11	8	6
No. 1-km squares occupied	8	6	7	9	10	9	9	9	8	6	4
Total extent of breeding habitat occupied (ha)	10	2.07	3.62	5.6	7.2	7.4	7.74	6.22	3.93	4.4	1.17
Relative Abundance Index	400	33	420	436	1223	1250	996	223	334	274	552
Total Population (emergence)	1200	99	1260	1308	3669	3750	2988	669	1002	822	1141
No. new colonies	2	?	1	3	5	4	4	3	1	1	0
No. large colonies	1	0	2	2	2	4	3	0	0	1	1

Climate change poses a further threat, as it may increase the vigour of coppice re-growth and thus reduce the number of years in which individual coppice coupes remain suitable necessitating a need for increased management effort. There is already some evidence for this from Thornden and West Blean Woods, where colony longevity in the early 2000s was 2-6 years, compared to 3-9 years described by Warren in the 1980s.

Conclusions

Monitoring data has shown that the Heath Fritillary responds well to positive conservation management work. Thanks to the efforts of a considerable number of organisations and individuals, the number of Heath Fritillary colonies in Blean Woods has increased since the 1980 baseline, although the total area occupied has shrunk by almost 50%. Although this is a mixed result, it can still be considered a success in the context that in the early 1980s there was a real fear the butterfly would become extinct due to proposed management changes across the complex. The butterfly has fared much worse in other parts of the UK and Blean Woods now supports approximately 60% of all UK colonies.

This case study has demonstrated the key role that monitoring data can play in helping to successfully target habitat management work, with clear efficiency gains. At Thornden and West Blean Woods, the change in occupancy of coppice from 18% in the early 1990s (without targeting) to 75% by the late 1990s (by targeting with monitoring data) is testimony to this.

Finally, this case study has highlighted the importance of annual monitoring to help keep managers focussed on the conservation priority, and to avoid complacency as the condition status can soon change. Changes at Thornden and West Blean Woods show how a management success can quickly be reversed.

Further reading

Martin Warren, BC's Chief Executive, published many papers on the ecology and conservation of the Heath Fritillary in the 1980s and early 1990s. Much of this work is summarised in BC's Species Action Plan published in 1995. The Millennium Atlas, and The State of Butterflies in Britain and Ireland give up to date trends for Heath Fritillary in the UK, and further detail of current status in the Blean can be found in BC's 2008 report.

Site focus: Lulworth Lake transect - ten years of butterfly monitoring (1999-2008)

Tom Brereton (BC)

Geography and habitat

Lulworth Lake transect is located in south Dorset, 3.5km from the sea and just a one minute walk from BC Head Office. The surrounding land chiefly comprises mixed intensive farmland, plantation woodland and a eutrophic pond, though other habitats nearby include heathland (0.2 km), parkland (1km), chalk grassland (2.5km) and river valley meadows (2.6km). The transect extends over 1.8km, with the twelve sections sampling a range of 'wider countryside' habitats including improved grassland, arable fields, arable field margins, fallow land/set-aside, hedgerows, green lanes, woodland edge, marshy grassland, willow scrub, Bracken stands and lake margins with fen vegetation. The transect was established in 1999 to increase the coverage of 'ordinary countryside' sampled by the scheme before the development of the Wider Countryside Butterfly Survey.

Butterflies have benefited from field management change along Section 6

Recorders

Since 1999 around 30 BC staff have walked the Lulworth Lake transect, with core personnel being Tom Brereton (1999-2004), Tom Wigglesworth (2005-2006) and Ian Middlebrook (2007 onwards).

Tim Warburton along Section 7 in 2005

Species list and status

Thirty one butterfly species have been recorded over the ten years, the majority of which do not breed along the transect route. Regular breeding species include Comma, Gatekeeper, Green-veined White, Meadow Brown, Ringlet, Small Skipper and Speckled Wood. Regular visitors/occasional breeding species include Common Blue, Large Skipper, Large White, Marbled White, Orange-tip, Peacock, Red Admiral, Silver-washed Fritillary and Small White. Irregular visitors include Brimstone, Clouded Yellow, Holly Blue, Painted Lady and Small Tortoiseshell. A number of stray habitat specialist species have been recorded, presumably dispersing from nearby semi-natural habitats, including Dark Green Fritillary, Grayling, Lulworth Skipper, Silver-studded Blue, Small Blue and White Admiral, whilst a Monarch was seen tantalisingly nearby at BC HQ in autumn 2001 (see Table 6). The virtual lack of Small Heath records is intriguing and indicates this species may be less mobile than would be expected for a wider countryside species.

Table 6. 'Rarities' recorded along the Lulworth Lake transect

Species	Number/Year	Distance to nearest known colony (km)
Dark Green Fritillary	3 in 2001	2.75
Grayling	1 in 1999	0.5
Lulworth Skipper	1 in 2006	2.75
Purple Hairstreak	1 in 2003	0.13
Silver-studded Blue	1 in 1999	0.25
Small Blue	2 in 2003	4.75
Small Heath	1 in 2005	0.23
White Admiral	3 in 2001	1.75

Small Heath – a rare visitor despite numerous colonies nearby! Photograph by *Dean Morley*

Best and worst years

In terms of overall butterfly abundance, 2006 was the best year in the 10-year series with 841 butterflies counted. The worst year was 2002, with only 198 individuals counted (a figure less than the Foot and Mouth year of 2001, when only July was walked!).

Species trends

Two species, Wall Brown and Gatekeeper (see Figure 14) have declined significantly in abundance over the last decade, the reasons for which are unknown. Small Tortoiseshell has undergone a major decline since 2003. Common Blue is an irregular breeder, and its presence is dependent on how herb-rich grassland in Section 5 is managed. Disturbance on this section (compaction by heavy vehicle use) is beneficial, stimulating growth in leguminous foodplants the following year. As with many other sites, the number of migrants visiting the site fluctuates greatly from year to year. There have been no Clouded Yellows since 2006, whilst 60% of all Painted Ladies were recorded in 2003.

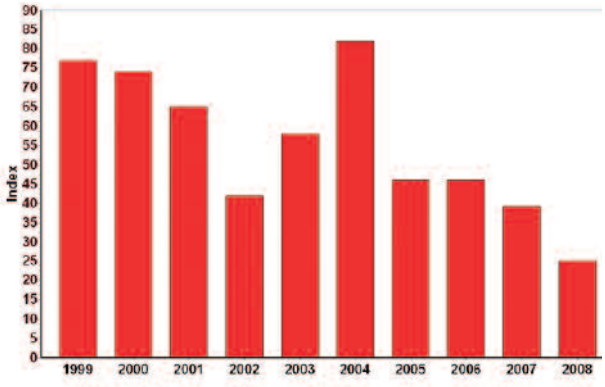

Figure 14. Plot showing the decline in the Gatekeeper since 1999

Gatekeeper. Photograph by *Rachel Scopes*

Trends along different sections

There has been a decline in butterfly abundance along Sections 2 and 3 (a green lane), whilst numbers have increased along Section 6, following conversion from improved pasture to arable land with a 2m weedy margin containing frequent nectar sources. Sections 9

and 10 (uniformly short, species poor improved pasture) support very few butterflies in most years, other than when patches of Creeping Thistle, Cirsium arvense, escape spot spraying and prove attractive to nectaring Nympahlids.

How was 2008 for butterflies?
Average, rather than poor. It was a good year for Green-veined White (habitat quality along Section 1 has improved, with a greater growth of crucifers along the ditch) with a six-fold increase over 2007, whilst Large White, Comma and Speckled Wood did reasonably well. In contrast, it was a poor year for Small White, the worst in the series with only four counted. Notable absentees included Small Copper (last record 2004), Holly Blue and Small Tortoiseshell. It was a poor year for migrants.

Monitoring other insects
Day-flying moths, dragonflies, grasshoppers and crickets are also monitored weekly along the transect and many species have bell-shaped flight periods like butterflies. About 20 dragonfly species have been recorded, chiefly eutrophic species around the lake and oligotrophic species on the feeder stream. Rarities recorded have included Small Red-eyed Damselfly, Scarce Chaser and Red-veined Darter. With increased algal pollution several species have declined in abundance, including Emerald Damselfly (waterfowl have also declined substantially). Influxes of Silver Y moths occur from time to time, whilst other day-flying species recorded have included Bordered Straw, Scarlet Tiger and Hummingbird Hawkmoth.

Conclusions
Though not the most exciting of transects, Lulworth Lake has served its purpose well. It has provided insights into how land management and weather impact on butterfly abundance, whilst providing valuable training opportunities for new staff joining BC HQ. Importantly, for established staff, it provides an opportunity to escape from the computer and remind them of how fabulous butterflies are!

Butterfly phenology

Marc Botham and David Roy (CEH)

Backgound
Phenology is the study of periodic events such as bud burst and leaf fall. In butterflies we can measure when each species is first on the wing (first appearance), what time of year each species reaches its peak, when a species is last seen on the wing (last appearance) and for how long (flight period). Many of these measurements can be calculated from the UKBMS data. Butterfly phenology is a good indicator of the impact of climate change since butterflies are poikilothermic and as such their development is strongly dependent on temperature. Studies from the UK and north-west Spain have shown the effects of climate on the timing of flight periods tends to be remarkably consistent, with most species showing advanced timing of first appearance and peak abundance with warmer temperatures (Sparks and Yates 1997; Roy and Sparks 2000; Stefanescu et al. 2003). It has been suggested that such marked changes in butterfly phenology will have pronounced effects on a species' ecology although published evidence is still lacking. Effects may be both beneficial and detrimental.

Analysing phenology data
There are certain limitations in what measurements we can calculate accurately from the UKBMS data. First and last appearance data, from which we could make simple calculations of length of flight period (Roy and Sparks 2001), are not likely to be accurate since transects are not walked until the first week of April and finish at the end of September. In addition, because weeks within this period are often missed because of poor weather etc., the date on which the peak abundance of a species is recorded is also likely to be inaccurate. For this reason, we use alternative measurements of phenology which are highly correlated to these and less sensitive to the UKBMS methodology. A measurement which is highly correlated to both date of first appearance and the date on which the peak abundance is recorded is the mean flight date, calculated as the weighted mean date of the counts (Stefanescu et al. 2003). This can be used to measure the timing of flight periods and is less sensitive to variation in recording intensity. The standard deviation (SD) around this mean is a measure of the degree of synchronization (length) of the flight period. In this article we report on these two measurements. Many UK butterflies have more than one generation per year. However, for some of these species the generations overlap (e.g. speckled wood, *Pararge aegeria*) and it is not possible to separate flight period data accurately. For these species we report on phenology measures derived for the whole flight period. For ten multivoltine species it is possible to split the data

for two distinct generations (we are unable to split third and fourth generations accurately as there is considerable overlap in associated flight periods), and for these species we report on phenological trends for their first and second broods separately. It is important to consider that the ability to provide phenology measures for separate generations are limited by constraints to the data in separating out flight periods rather then actual biological splits.

Climate

We briefly describe patterns in weather over the last thirty three years in which UKBMS transects have been walked, using data provided by the Meteorological Office of the United Kingdom (**http://www.metoffice.gov.uk/**). In summary, summers have become drier over this period (with the exception of Scotland) whilst autumn and winter have become wetter. Spring has also become drier in southern England, but wetter in Scotland and northern England.

Whilst rainfall has a strong effect on butterflies (see summary of UKBMS results earlier in this report) it is the effects of temperature on butterfly phenology that we focus on here. Over the last thirty-three years, average annual temperatures across the UK have increased by 1.3°C. This increase has not been proportional throughout the year however (see Figure 15), with greater increases occurring in the months of January and February; winter has become milder. Spring temperatures have also increased greatly, whereas summer temperatures have increased less over this period. The hottest month of the year on average, July, has experienced the second lowest increase in temperature over the last thirty-three years. The overall effect therefore, is of a more homogenous temperature throughout the year resulting in warmer, wetter winters, hotter springs and slightly warmer and drier summers. There are of course exceptions to this trend such as the last two years (2007/8) which were extremely wet throughout the summer and colder than recent years.

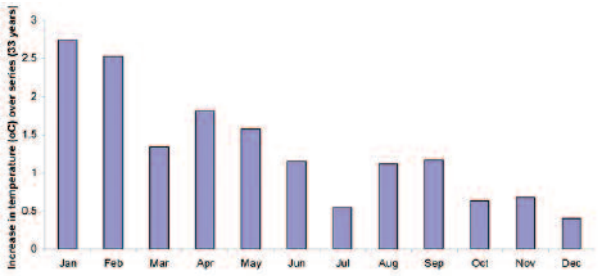

Figure 15. Average increase in temperature across the UK for each month of the year over the last thirty-three years

Trends in phenology: individual species results

A total of fifty-seven species were analysed. Forty-seven of these were analysed as species with one distinct flight period whilst ten species showed two distinct flight periods and were thus analysed separately for each brood. Table 7a shows the change in mean flight date and flight period for those species with one distinct flight period. Of the forty-seven species with one distinct flight period, 91% showed advances in the mean flight date since 1976. The greatest advance of over three weeks (twenty three days) was shown by the Black Hairstreak, whilst the average advance over all species was close to two weeks (eleven days). In over half the cases, advances were statistically significant. Only 9% of species showed a delay in mean flight date over the last thirty-three years, of which none were statistically significant. The greatest delay was shown by the Mountain Ringlet which has shown a delay of a week in its date of mean abundance. On average, trends in flight period length have remained largely unchanged since 1976 with an average trend close to zero. There is great variation between species however with similar numbers showing small increases to those showing small decreases in their flight period length. Less than 50% of these changes are statistically significant (Table 7a). Regular migrant species such as the Clouded Yellow and Red Admiral as well as species currently expanding their range in the UK such as the Speckled Wood and Comma showed the greatest increases in the length of their flight period (up to two weeks: see Table 7a). Reductions in flight period were generally lower, but less variable than the increases with the greatest reduction in flight period being by one week for Brown Hairstreak. Nine species have shown no change in the length of their flight period.

Table 7b shows the same analysis for those species with two distinct flight periods with both broods (flight periods) analysed separately. All ten species showed a significant advance in mean flight date in their first flight period. The greatest advance was shown by the Small White (almost three weeks). Only the Small Blue showed a delay in mean flight date in its second generation and the advances shown by the other nine species were much smaller in the second compared to the first flight period, with only four species showing significant advances and the greatest advance being two weeks in the Wall Brown. The length of flight periods, as for univoltine species, has changed remarkably little since 1976 and is variable between species (Table 7b). However, all but one species (the Wall Brown) showed an increase in the length of their second flight period.

Table 7a. Trends in mean flight date and length of flight period for those species with one distinct flight period. Levels of statistical significance are also given: * P < 0.05, ** P < 0.01, *** P < 0.001.

Species	Change in date of mean abundance (days)	Change in Flight Period length (days)	No. Years of transect monitoring	Mean flight date	Mean flight period (days)
Skippers					
Chequered Skipper	-9	-3	19	16-May	46
Small Skipper	-8*	-2**	33	19-Jun	38
Essex Skipper	-12**	-1**	33	18-Jun	31
Lulworth Skipper	-11	-2	31	2-Jul	68
Silver-spotted Skipper	-6	2	33	6-Jul	28
Large Skipper	-6	0	33	6-Jun	32
Dingy Skipper	-12**	1	33	11-May	32
Grizzled Skipper	-14***	-2	33	8-May	32
Swallowtails					
Swallowtail	-3	2	32	31-May	34
Whites					
Wood White	-7	-3	33	27-May	43
Clouded Yellow	-8	10*	32	3-Jul	53
Brimstone	-12*	2*	33	30-Jun	35
Orange Tip	-21***	0	33	29-Apr	29
Lycaenids					
Green Hairstreak	-12***	0	33	8-May	32
Brown Hairstreak	-3	-7*	27	8-Jul	30
Purple Hairstreak	-10*	-1	33	21-Jun	32
White-letter Hairstreak	-16***	-6**	33	16-Jun	28
Black Hairstreak	-23***	0	28	30-May	22
Silver-studded Blue	-15**	-2	33	28-Jun	57
Northern Brown Argus	-11*	-2	31	7-Jun	36
Chalk-hill Blue	-8*	0	33	11-Jul	56
Metalmarks					
Duke of Burgundy	-18***	-2*	33	7-May	26
Nymhalids (excluding Fritillaries)					
White Admiral	-12**	-1	33	11-Jun	28
Purple Emperor	-14**	0	31	10-Jun	26
Red Admiral	-20***	12***	33	25-Jun	69
Painted Lady	-12*	7	33	22-Jun	69
Small Tortoiseshell	-19**	-8**	33	8-Jun	85
Peacock	-13**	0	33	30-Jun	34
Comma	-12*	15***	33	13-Jun	83
Fritillaries					
Small Pearl-bordered Fritillary	-3	-3*	33	28-May	30
Pearl-bordered Fritillary	-12**	-3**	33	11-May	31
High-brown Fritillary	-7*	-2	33	15-Jun	30
Dark-green Fritillary	-6	-2*	33	15-Jun	35
Silver-washed Fritillary	-6	2**	33	20-Jun	31
Marsh Fritillary	-11**	1	30	19-May	33
Glanville Fritillary	5	-4*	16	15-May	34
Heath Fritillary	-13**	-1	29	3-Jun	47
Browns					
Speckled Wood	-10*	9***	33	21-Jun	57
Mountain Ringlet	7	-2	29	15-Jun	50
Scotch Argus	0	0	32	16-Jul	59
Marbled White	-13***	1*	33	16-Jun	35
Grayling	-6*	-4***	33	27-Jun	35
Gatekeeper	-9**	0	33	3-Jul	42
Meadow Brown	-2	1*	33	3-Jul	52
Small Heath	4	-1	33	13-Jun	55
Large Heath	5	-5*	32	4-Jun	29
Ringlet	-13***	2***	33	18-Jun	35

Table 7b. Trends in mean flight date and the length of flight period for those species with two distinct flight periods for both flight periods (FP1 and FP2) separately. Levels of statistical significance are also given: * P < 0.05, ** P < 0.01, *** P < 0.001.

	Change in date of mean abundance (days)		Change in Flight Period (days)		Mean Flight Date		Mean Flight Period (days)		No. Years of transect monitoring	
Species	FP 1	FP 2	FP 1	FP 2	FP 1	FP 2	FP 1	FP 2	FP 1	FP 2
Large White	-14***	-10**	-3**	4***	9-May	28-Jun	35	35	33	33
Small White	-19***	-6	-4***	3**	6-May	2-Jul	38	37	33	33
Green-veined White	-18***	-6	0	5***	5-May	29-Jun	32	35	33	33
Small Copper	-15***	-3	-1	1	9-May	6-Jul	34	39	33	33
Small Blue	-11**	8	-1	1	19-May	24-Jun	27	32	33	31
Brown Argus	-14**	-10**	-1	1	15-May	4-Jul	32	29	33	33
Common Blue	-14***	-11**	-1	1	21-May	5-Jul	32	35	33	33
Adonis Blue	-14**	-7	1	1	20-May	19-Jul	43	48	33	33
Holly Blue	-10**	-8	2	1	29-Apr	25-Jun	31	28	33	33
Wall Brown	-16***	-14***	-3***	-2	11-May	4-Jul	31	30	33	33

Below, we will describe some of the most interesting trends in individual species within each butterfly family.

Species with one distinct flight period

Skippers: It is the skipper that flies earliest in the year, the Grizzled Skipper, which has shown the greatest advance in mean flight date, advancing by two weeks since 1976 (see Figure 16). There has been no significant change in the length of flight period for the Grizzled Skipper suggesting that the whole flight period has advanced over time. The other spring-flying skipper, the Dingy Skipper, has also shown a significant advance in date of mean abundance, of almost two weeks

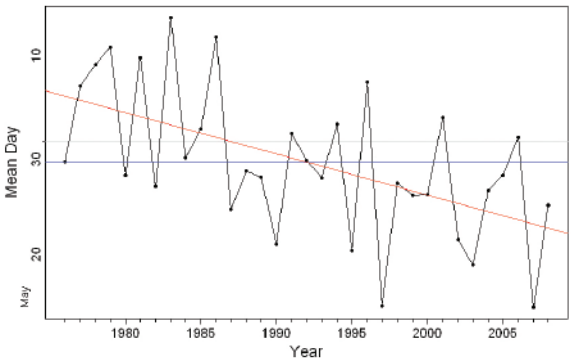

Figure 16. The change in mean flight date for the Grizzled Skipper since 1976

The mean flight date of the Grizzled Skipper has advanced by two weeks since 1976. Photograph by *Charlotte Barwick*

Swallowtails: Both the timing and duration of the flight period for our single UK species of this family, the Swallowtail, have changed very little since 1976. There has been a non-significant advance in the mean flight date of just three days and a non-significant increase of two days in the length of flight period.

Neither the timing or duration of flight period in the Swallowtail have changed significantly since 1976. Photograph by *Matthew Berry*

Whites: The Orange Tip has shown the most significant advance of three weeks (Figure 17) whilst the length of its flight period has not changed since 1976, suggesting that the entire flight period from start to finish has become earlier.

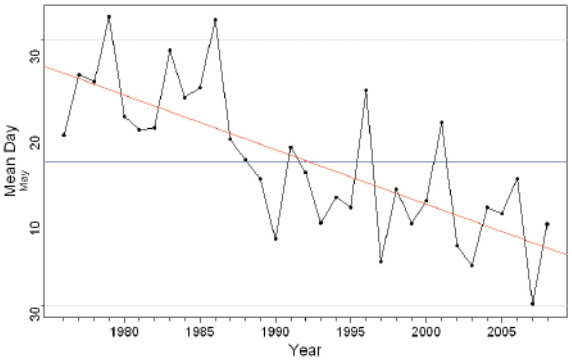

Figure 17. The change in mean flight date for the Orange Tip since 1976

Lycaenids: All Lycaenids with only one distinct flight period have shown an advance in mean flight date (Table 7a). Of particular note, the Black Hairstreak has shown a significant advance of over three weeks in the last thirty-three years (Figure 18) although it has shown no change in the length of its flight period (Table 7a).

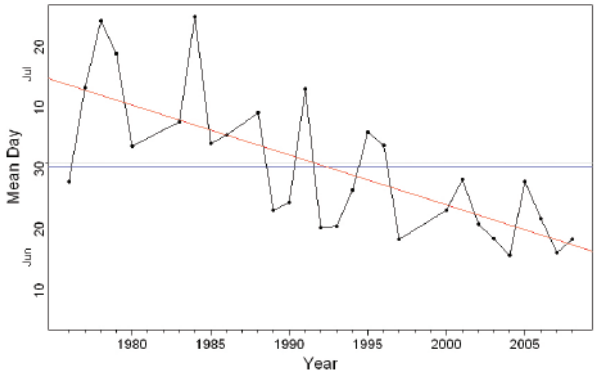

Figure 18. The change in mean flight date for the Black Hairstreak since 1976

Black Hairstreaks have only a brief flight period of three to four weeks maximum (Thomas, 2007) which means the current flight period has shifted greatly from that of thirty-three years ago. If this trend continues the flight period of this small and inconspicuous butterfly will have shifted completely, e.g. the current flight period will no longer overlap with the flight period of three decades ago. This species is only recorded in small numbers on standard UKBMS transects and therefore, as with the Collated Index for this species, these results should be interpreted with caution.

The flight period of the Black Hairstreak has advanced by over three weeks in less than thirty years. Photograph by *Marc Botham*

Metalmarks: The single British member of this butterfly family, the Duke of Burgundy, has shown a significant advance of almost three weeks mean flight date since 1976, in addition to a significant reduction of two days in the length of its flight period.

Nympalids (excluding fritillaries): On the whole, the nymphalids have shown the greatest advance in mean flight dates of single brooded butterflies with an average advance of almost two weeks (Table 7a). Changes in length of flight period have been much more variable. The Small Tortoiseshell has shown a significant reduction of over a week in the length of its flight period since 1976 (Figure 19). Evidence suggests that the abundance of the Small Tortoiseshell is strongly affected by climate in the UK and a large decline in its Collated Index of abundance has occurred in parallel to these significant phenological changes. Drought has been proposed as one factor causing the decline in Small Tortoiseshells (Pollard et al. 1997) as it reduces the quality of its host plants (common nettle, *Urtica dioica*) for larval development. The climate has generally warmed since monitoring began, possibly leading to poorer host-plant quality in summer, reduced larval survivorship and fewer adults emerging late in the year and subsequently reducing the overall length of the flight period.

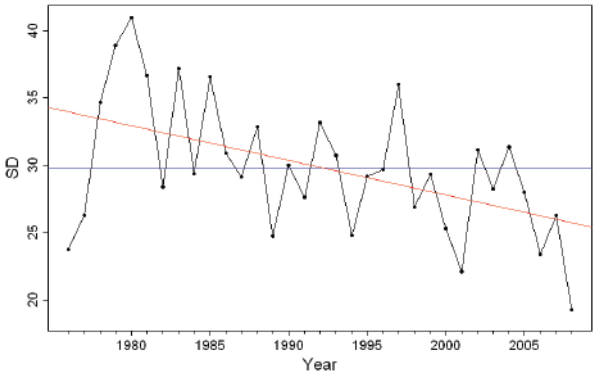

Figure 19. Length of flight period (standard deviation around the mean flight date) each year since 1976 for the Small Tortoiseshell. The blue line represents the average over the thirty-three year period, whilst the red line represents the trend (change in flight period over time) calculated from a linear regression

Unlike for most UK butterflies, the date on which the mean abundance of the Glanville Fritillary is recorded has become later over time. Photograph by *Steve Covey*

Fritillaries: Apart from the Glanville Fritillary, all of the other fritillaries have shown an advance in their mean flight date. For three species (Pearl-bordered, Marsh and

Heath Fritillaries) this was a significant advance of almost two weeks. The Glanville Fritillary is one of the few species to have shown a later mean flight date over time, although not significantly so. It is also the fritillary that has shown the greatest change in length of flight period with a reduction of four days over sixteen years. This species has not been recorded for as long as most other species (16 years) and thus these results should be interpreted with caution as the degree of climate warming in this shorter period is likely to differ.

Browns: Based on the average for the family, the browns, or Satyrids, have shown the least advance in mean flight date of all butterfly families in the UK (Table 7a). Of note, the two species showing significant increases are both expanding in range in the UK and are becoming more abundant (Speckled Wood and Ringlet) whilst the species showing a significant reduction is the Grayling which is a species declining in range, going extinct from many of its inland colonies (Figure 20). Length of flight period is calculated as the SD around the mean flight date so a relationship between abundance and length of flight period may be expected. As a species colonises new sites with different microclimates etc, there is likely to be more variability in its flight period.

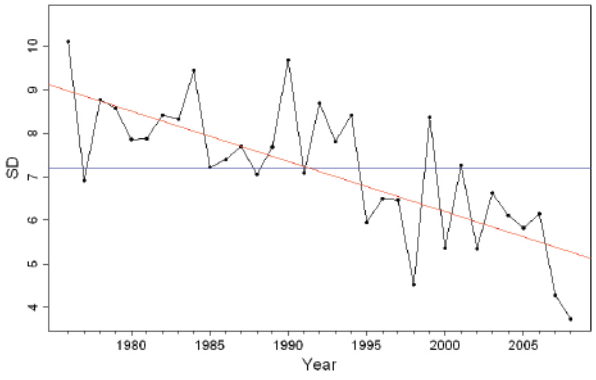

Figure 20. Length of flight period (standard deviation around the mean flight date) each year since 1976 for the Grayling. The blue line represents the average over the thirty-three year period, whilst the red line represents the trend (change in mean flight date over time) calculated from a linear regression

Species with two distinct flight periods

Table 7b shows the trend in mean flight date and length of both flight periods for the ten multivoltine species for which we are able to separate the data for two distinct flight periods. For both phenological measurements there is a very clear difference between the two flight periods taken across all species. Although not statistically significant, there is a much greater advance in the mean flight date in the first than there is in the second flight period. All ten species showed significant advances in the timing of the first flight, but only four species showed a significant advance in the mean flight date of their second flight period (Table 7b). The length of the first flight period has become shorter whilst it has become longer in the second flight brood.

Proportionally hotter springs are likely to help explain why there has been a greater advance in the timing of the first flight period which occurs in this spring period. However, warmer temperatures have been associated with an increase in the length of the flight period for butterflies (Stefanescu et al. 2003; Roy and Sparks 2000). Like many of the single brooded species, the first flight period of the double brooded species have shown a reduction in the length of their flight period in conjunction with an advance in the timing of their flight period suggesting these butterflies are showing a tendency towards a more synchronised emergence. This seems sensible since increases in temperature might mean that optimal/threshold temperatures are more regularly attained for larval and pupal development reducing the variation in development times between individuals within a species.

The species showing the greatest and most significant advances in timing of their first flight period were the Small White, Green-veined White and Wall Brown, all three showed advances of almost three weeks. The Wall Brown has also shown a significant advance of two weeks in the date of mean flight date of its second generation (Figure 21).

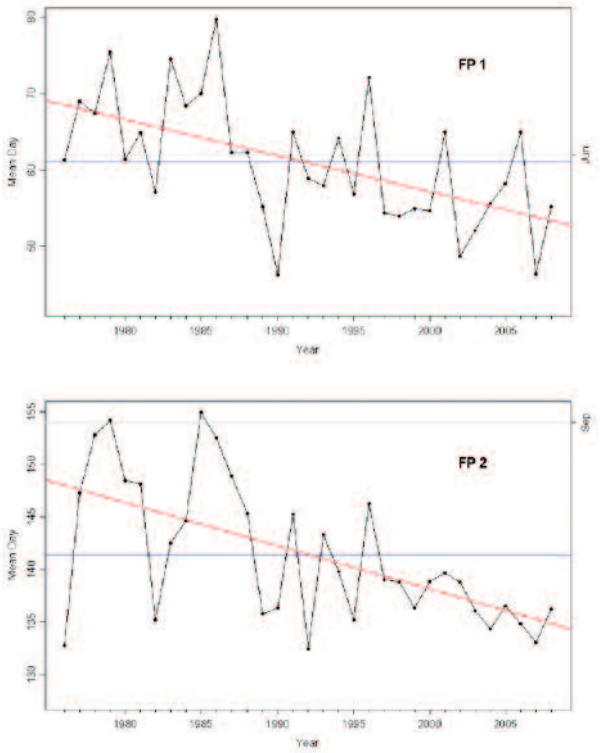

Figure 21. The date at which the mean flight date was recorded for the first flight period (FP1) and second flight period (FP2) of the Wall Brown since 1976. The blue line represents the average over the thirty-three year period, whilst the red line represents the trend (change in mean flight date over time) calculated from a linear regression

All three white species (Large, Small and Green-veined) have shown significant increases in the length of their second flight period. This is likely to be a clear example of polyvoltinism, where species such as these are completing (or partially completing) more generations in warmer years and thus the second flight period appears extended. An alternative explanation is that these species may actually be becoming more asynchronous in emergence. In continental Europe, these species can complete up to five generations in a year (Tolman & Lewington 2008), so it seems most likely that as the climate warms and the UK becomes more similar in climate to continental Europe, the number of generations per year will increase for multivoltine species.

The Large White has shown a significant advance in the timing of its flight period for both its first and second broods. Whilst the first brood is showing a decrease in the length of its flight period, the second brood is showing an increase. This is most likely a result of increased polyvoltinism. Photograph by *John Jeffery*

Finally, there is a difference between species depending on what time of year they fly. This is evident between the different flight periods of the polyvoltine species as discussed above, but is also evident in the univoltine species. By splitting the species into those that fly in the spring (April through to early June), those that fly in early summer (late May through to early July) and those that fly in late summer (July through to September) we can see that the advances in mean flight date are greatest for the spring species and lowest for the late summer species (Figure 22). The reasons for this have been discussed throughout this article with respect to proportionately greater increases in spring temperatures compared to summer temperatures (refer to Figure 14). The length of flight periods does not differ between spring, early summer or late summer species and seems to be much more variable and species-specific.

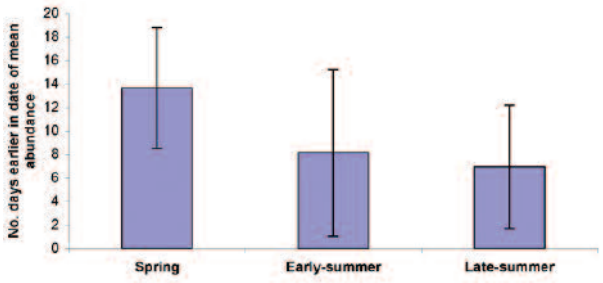

Figure 22. Mean (+/- 1 s.d.) advance in mean flight date for species grouped by the time of year they fly

Spotlight on a local co-ordinator – Catherine Bertrand

Experiences of the Northern Ireland transect and Wider Countryside Butterfly Survey co-ordinator – Catherine Bertrand, a personal perspective.

Catherine Bertrand – Northern Ireland transect and Wider Countryside Butterfly Survey co-ordinator

I currently work full time as natural heritage outreach officer for the Mourne Heritage Trust, a charity which looks after the 570 km^2 Mourne Area of Outstanding Natural Beauty in County Down, Northern Ireland. My remit is huge, covering every habitat from coast to mountain top and all the creatures and plants that live there, and unfortunately I can no longer justify very much time spent in the field. I was delighted when Maurice Hughes, our BC staff representative in NI, approached me to take on voluntarily co-ordinating the NI transects.

I have been volunteering as Northern Ireland transect co-ordinator since the beginning of 2009. Since 2004 I had set up, walked, and recruited volunteers for three separate transects both on mainland UK at Hatfield Forest on the Essex/Hertfordshire border, and at Slievenacloy, one of the Ulster Wildlife Trust's sites in the Belfast Hills where I had been the warden.

However, looking after a number of transects, even if it's only just into the teens, is a challenge. I have realised

how different it is managing a number of remote sites, to simply setting up a single route and then making sure you have cheerful, curious and committed people to walk it! There appears to have been a lot of confusion in the past about the 'who, when, where and how' of butterfly recording in Northern Ireland which I am still digging to the bottom of!

All transects in Northern Ireland are on nature reserves, The National Trust, Ulster Wildlife Trust, and Northern Ireland Environment Agency being responsible for the ownership and management of land. Thankfully these organisations have active volunteers and staff who are able to gather data. However, these organisations also have a lot of other conservation commitments as well. Therefore in the coming months I will be ensuring that there is enough knowledge amongst volunteers to walk the transect routes with confidence by finding time to train up volunteers and raising awareness amongst organisation staff of how crucial the data are.

I have been able to run several butterfly recording training courses this year in Northern Ireland, including two focusing on the Wider Countryside Butterfly Survey. All these training days have been attended by a wide range of people, some with years of experience, many with none. For me it is the total beginners that we need to focus on, encourage and inspire as we are simply not going to find active, interested recorders wandering about that we haven't bumped into yet, Northern Ireland simply isn't big enough!

It seems there is often a perception that the general public should not be allowed to get involved in survey work, but this huge body of people is where the butterfly and moth recorders of the future can be found, and we have to go out and actively look for them. No one can complain there is too much to learn, there are less than 30 butterfly species present in Northern Ireland! We are all people with an interest and time we would like to spend looking at butterflies, some of us have just spent a bit more time on it than others.

We will hopefully get our transect recorders together soon to talk about their transects and highlight the gaps in our knowledge that we need to focus on through support and training next year. Most of all I want transect recording to be a fun and rewarding experience for those involved, so that they can take pride in the work that they are doing and get the feedback they deserve.

The threatened Marsh Fritillary is found at a number of sites in Northern Ireland. Picture by *Marc Botham*

Contact details for local co-ordinators

RECORDING AREAS	NAME & ADDRESS OF MONITORING OFFICER	TELEPHONE	EMAIL
UK	Ian Middlebrook Butterfly Conservation, Manor Yard, East Lulworth, Wareham, Dorset, BH20 5QP.	01929 400209	transect@butterfly-conservation.org
SCOTLAND (all)	Vacant		
NORTHERN IRELAND	Catherine Bertrand Mourne Heritage Trust, 74 Head Road, Kilkeel, Co. Down, BT34 4PU	028 4176 5489	butterfly.transects.ni@googlemail.com
WALES (all)	Clare Williams Butterfly Conservation (Wales), 10 Calvert Terrace, Swansea, SA1 6AR	01792 642972	cwilliams@butterfly-conservation.org
ENGLAND			
NORTHERN ENGLAND	Dave Wainwright Butterfly Conservation, Low Barns Visitor Centre, Witton-le-Wear, Bishop Aukland, DL14 0AG	01388 488428	dwainwright@butterfly-conservation.org
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Bedfordshire & Northamptonshire	Data co-ordinator Keith Balmer 6 Salcombe Close, Bedford, Bedfordshire MK40 3BA	01234 355435	keith@balmer.co.uk
Cambridgeshire & Essex	Paul Parmenter 15 King`s Road, Great Totham, Essex, CM9 8DJ	Not available	Paul.parmenter@sky.com
Cheshire & Peak District	Stu Burnet 17 Alderdale Road, Cheadle Hulme, Cheadle, Cheshire, SK8 5PP	0161 485 5107	stuburnet@ntlworld.com
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Devon	John Randall 112 Peters Park Lane, St Budeaux, Plymouth, Devon PL5 1PT	01752 309857	jmrandall@blueyonder.co.uk
Dorset	Bill Shreeves Little Garth, 5 Butt's Mead, Shaftesbury Dorset. SP7 8NS	01747 852587	w.shreeves@btinternet.com
East Midlands	Ken Orpe 34 Derwent Avenue, Allestree, DERBY, DE22 2DQ	01332 730524	ken@malaga.plus.com
Gloucestershire	Chris Wiltshire The Brambles, Stinchcombe Hill, Dursley, Gloucestershire GL11 6AQ	01453 545509	chriswiltshire164@o2.co.uk
Hampshire & I.O.W.	Andy Barker 13 Ashdown Close, Chandlers Ford, Eastleigh, Hants. SO53 5QF	02380 270042	aj3barker@btinternet.com
Herts & Middlesex	Dr John Murray Field End, Marshalls heath, Wheathampstead, Herts. AL4 8HS. Andrew Wood 93 Bengeo Street, Hertford, SG14 3EZ	01582 833544 01992 503571	j.b.murray@open.ac.uk zoothorn@ntlworld.com
Isle of Man	Vacant		
Kent	Mike Brown 29 Eynswood Drive, Sidcup, Kent. DA14 6JQ	0208 3001875	mikeh.brown@ntlworld.com
Lancashire	Laura Sivell 1, Burrow Heights Farm Cottages, Scotforth, Lancaster. LA2 OPG	01524 752247	laura.sivell@mypostoffice.co.uk
Lincolnshire	Allan Binding 6 Willow Court, Washingborough, Lincs, LN4 1AS	01522 879002	allan.binding@ntlworld.com

RECORDING AREAS	NAME & ADDRESS OF MONITORING OFFICER	TELEPHONE	EMAIL
Norfolk	Dr Chris Dawson 395 Unthank Road, Norwich, Norfolk. NR4 7QG	01603 454092	aandcdawson@talktalk.net
North West England	Vacant		
North East England	Brian Denham 1 Swaledale Avenue, Darlington, DL3 9AJ	01325 263449	brian.denham@ntlworld.com
Suffolk	Rob Parker 66 Cornfield Road, Bury St Edmunds, Suffolk. IP33 3BN	01284 705476	robparker@waitrose.com
Surrey	Richard Donovan 65 Stoughton Avenue, Cheam, Surrey SM3 8PH	0208 6441563	Richard.Donovan@Reichhold.com
Sussex	Peter Atkinson 55 Furze Road, Worthing, W. Sussex, BN13 3BH	01903 690943	patkinson55@tiscali.co.uk
Upper Thames (Berks, Bucks & Oxon)	Mike Wilkins 65, The Causeway, Steventon, Abingdon, Oxfordshire. OX13 6SE	01235 831300	mikeawilkins@googlemail.com
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WALES			
Ceredigion	TBA		
Denbigh, Flintshire & Wrexham	TBA		
Glamorgan	TBA		
Gwynedd & Anglesey	Andrew Graham 'Trawscoed', Llanuwchllyn, Bala, Gwynedd. LL23 7TD	01678 540370	angrhm@globalnet.co.uk
Monmouthshire	TBA		
Montgomeryshire	TBA		
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Powys & Brecon Beacons National Park	Julian Jones Radnorshire Wildlife Trust, Warwick House, High Street, Llandrindod Wells, Powys, LD1 6AG	01597 823298	jonesj@radnorshirewildlifetrust.org.uk

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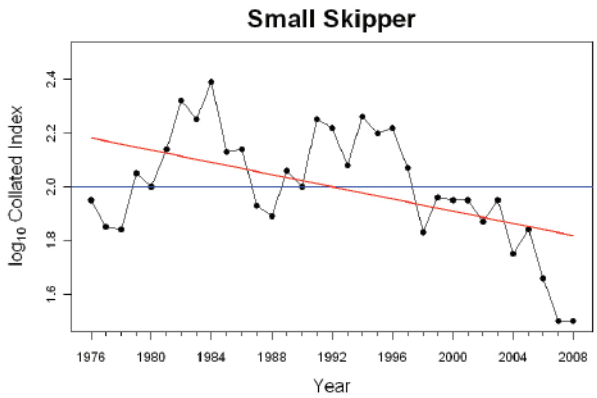
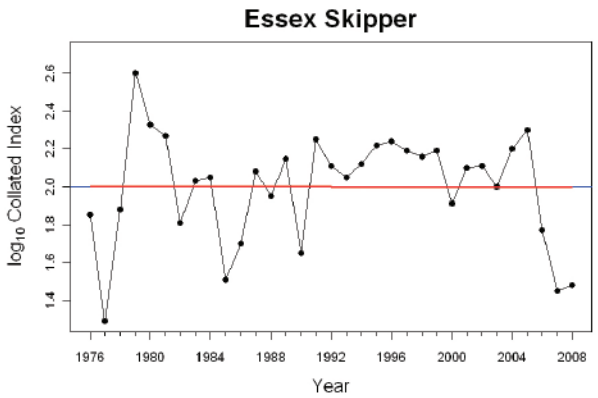
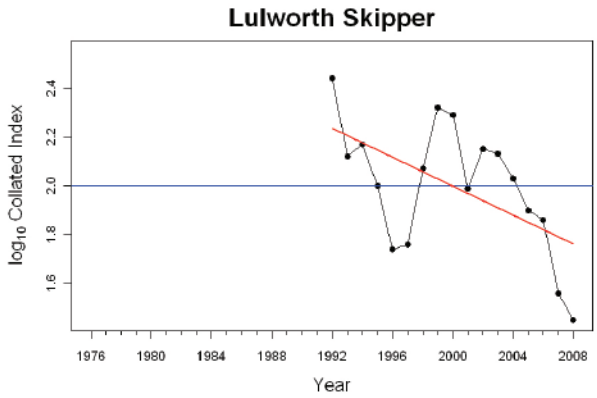
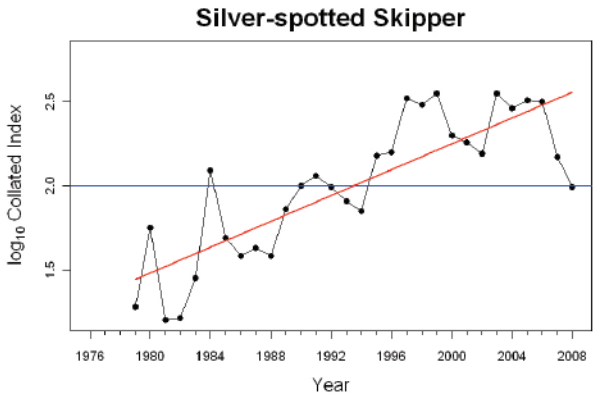
Appendix I

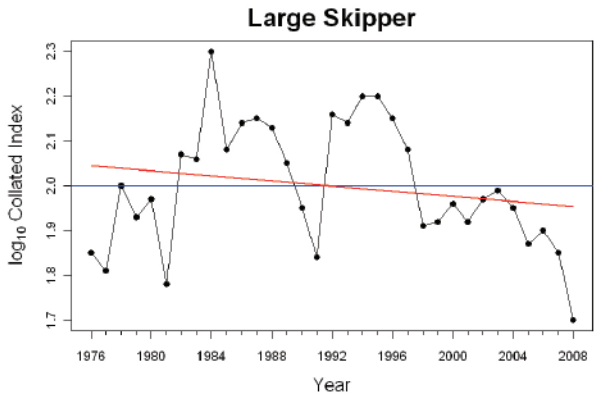
Appendix I. Figures showing the Collated Index (log_{10}) by year for each species for which an index was calculable in 2008. The horizontal blue line shows the average index value for the series. The red line shows the linear trend over the series. The scale on the y-axis varies with species to highlight annual trends for each individual species. Thus, care must be taken when comparing the magnitude of annual differences in the Collated Index for different species.

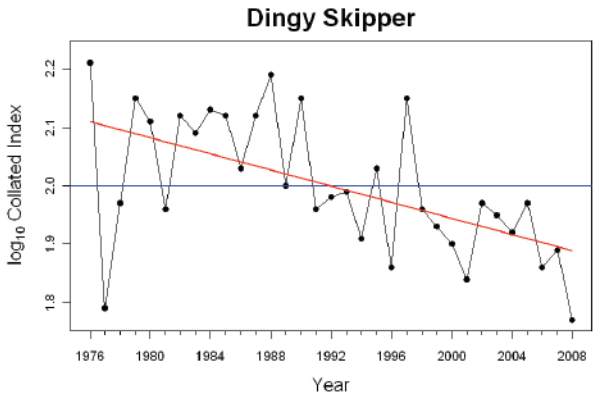


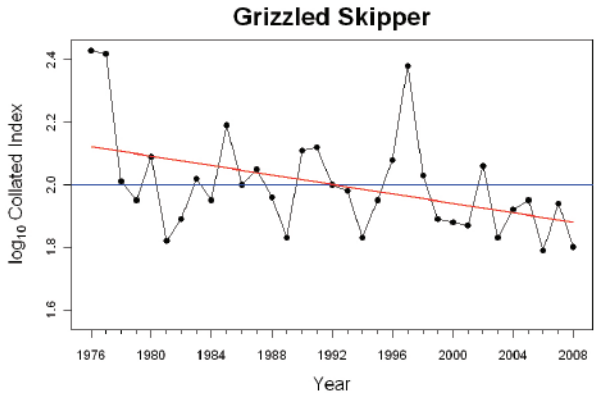


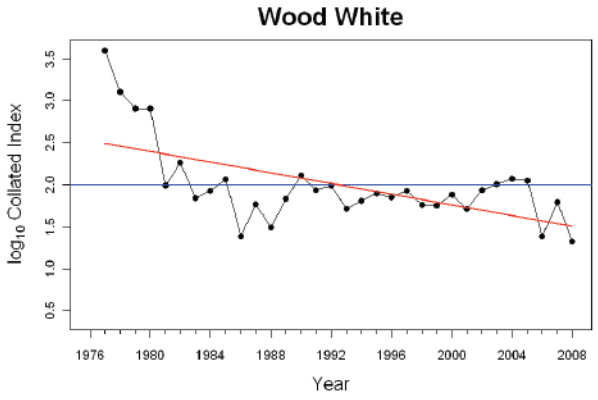


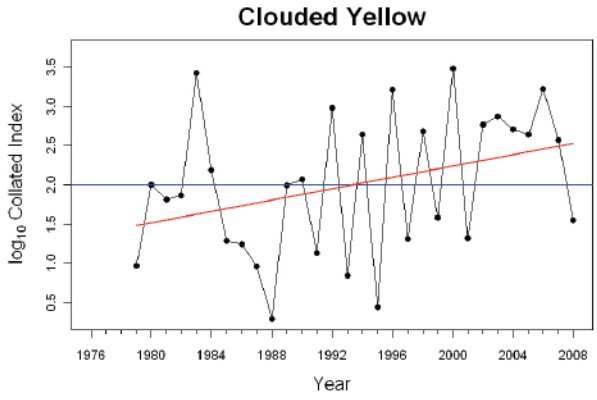







Grizzled Skipper
log10 Collated Index
Year


Wood White
log10 Collated Index
Year


Clouded Yellow
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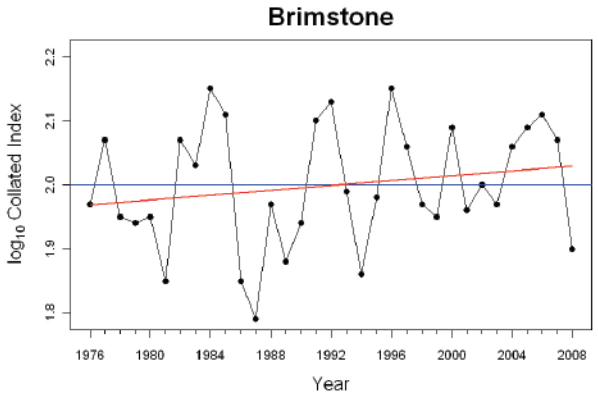
Brimstone
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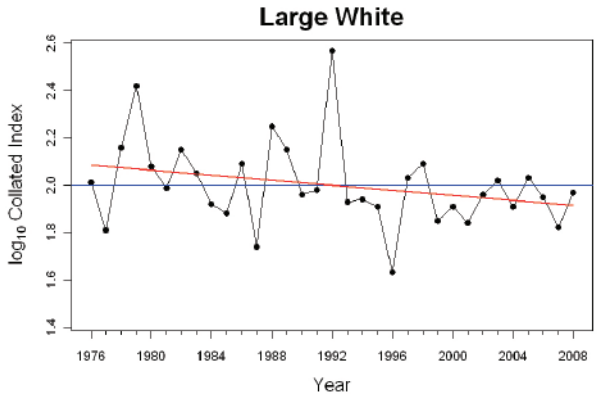
Large White
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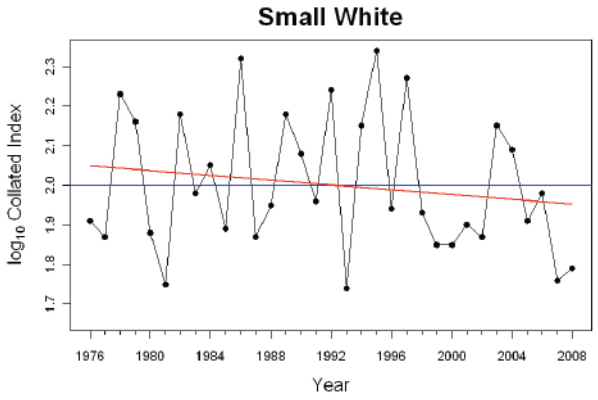
Small White
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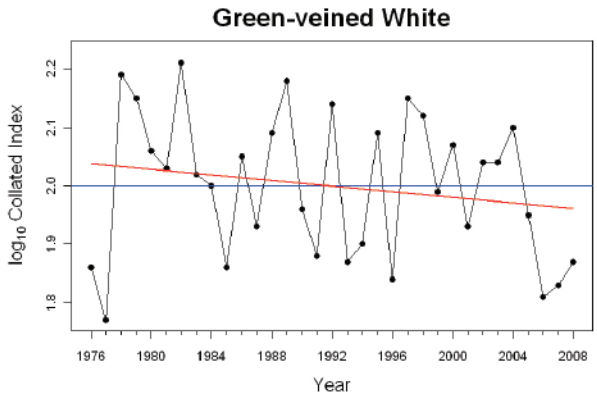
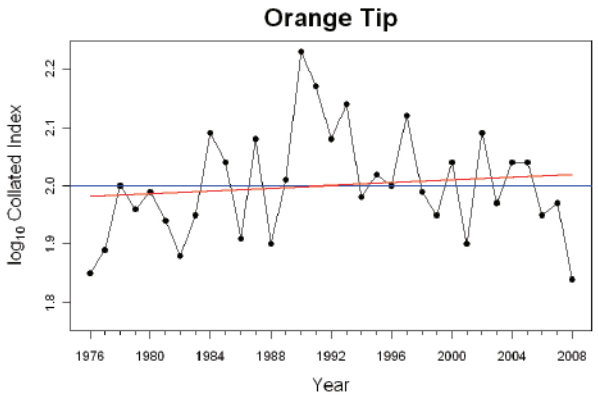
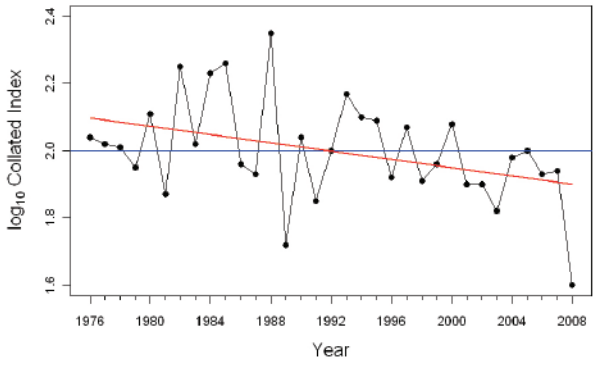
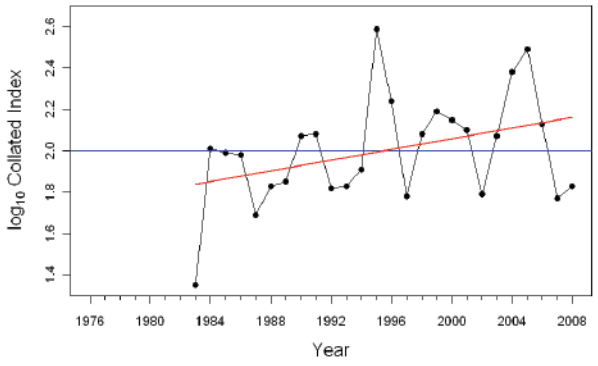

Green-veined White
log10 Collated Index
Year


Orange Tip
log10 Collated Index
Year

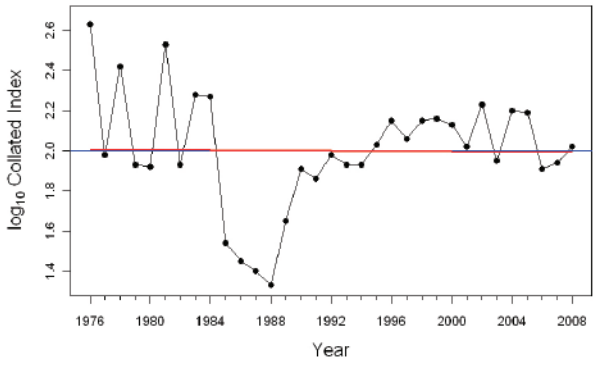
Green Hairstreak



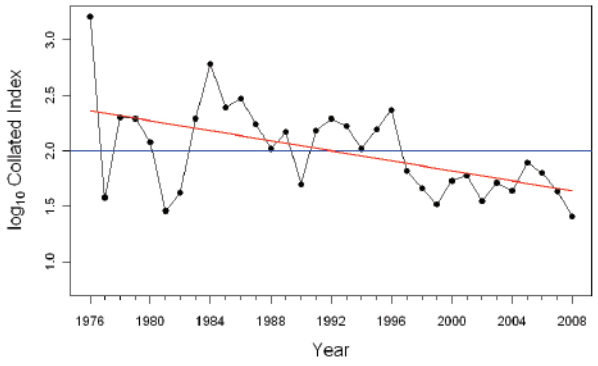
Brown Hairstreak



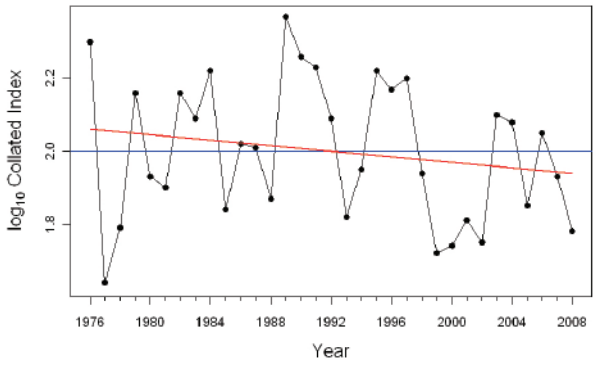
Purple Hairstreak



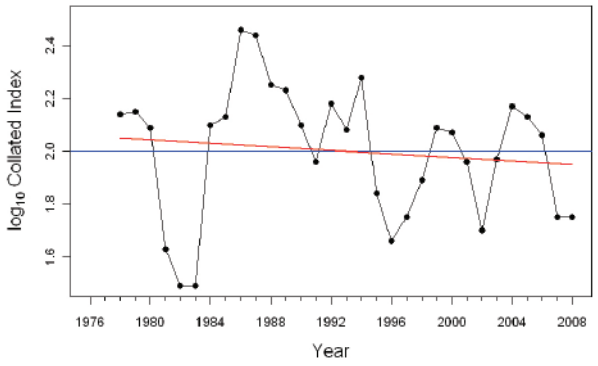
White-letter Hairstreak



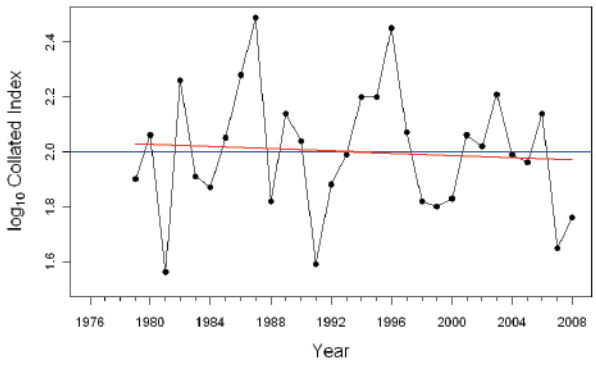
Small Copper



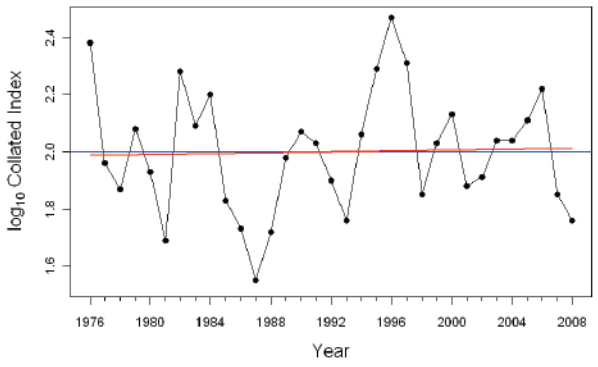
Small Blue



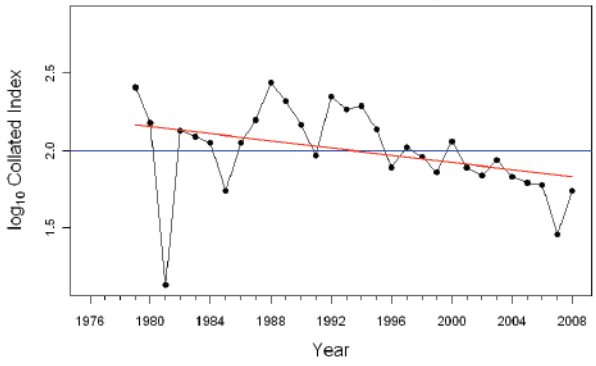
Silver-studded Blue



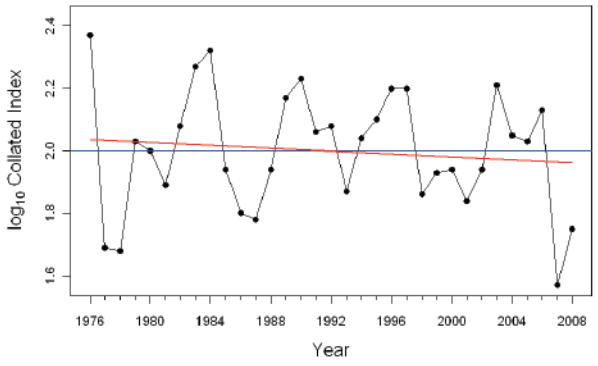
Brown Argus



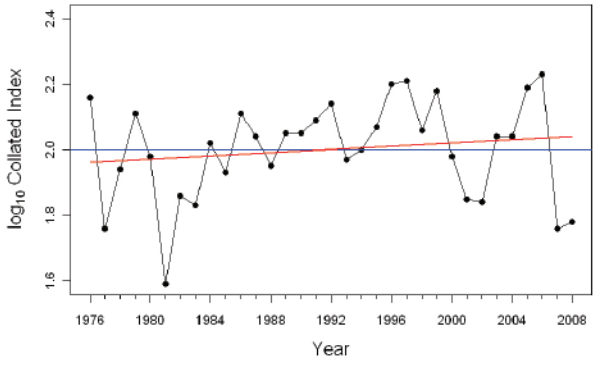
Northern Brown Argus



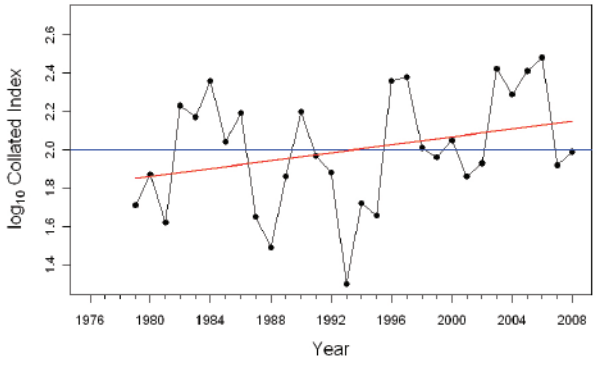
Common Blue



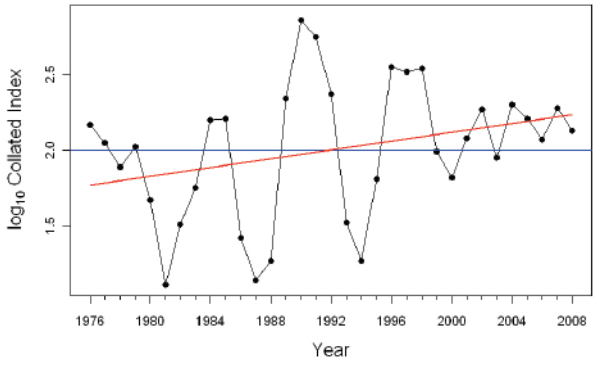
Chalk-hill Blue



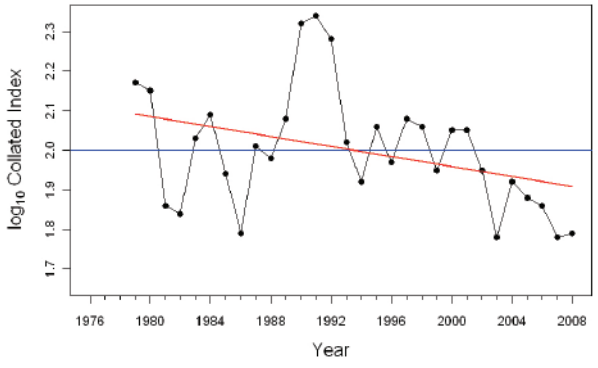
Adonis Blue



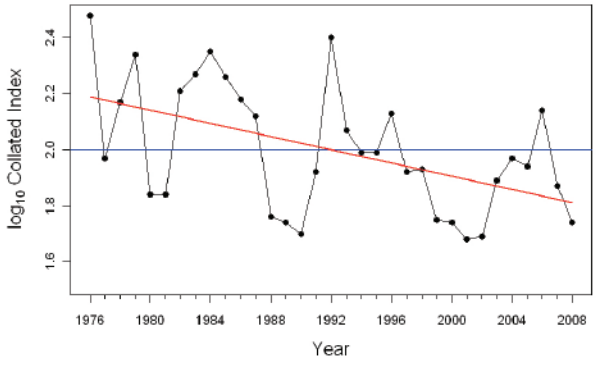
Holly Blue



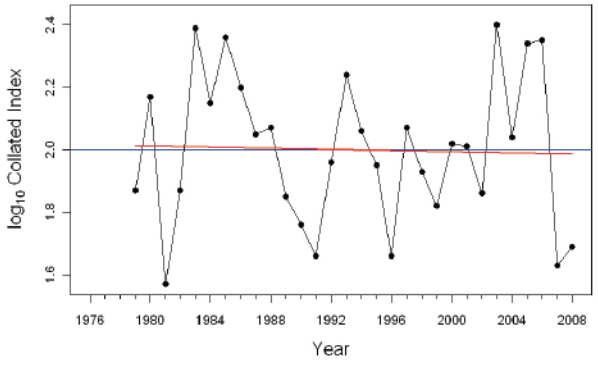
Duke of Burgundy Fritillary

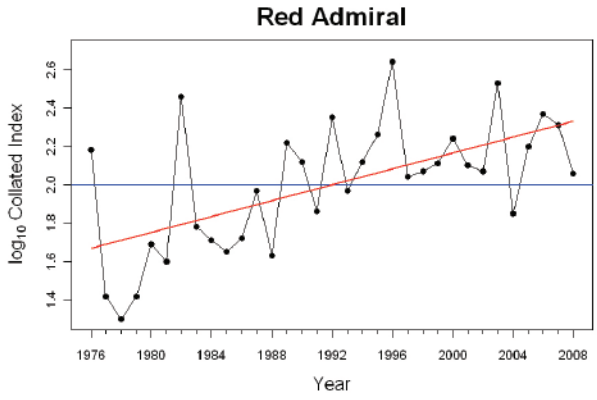


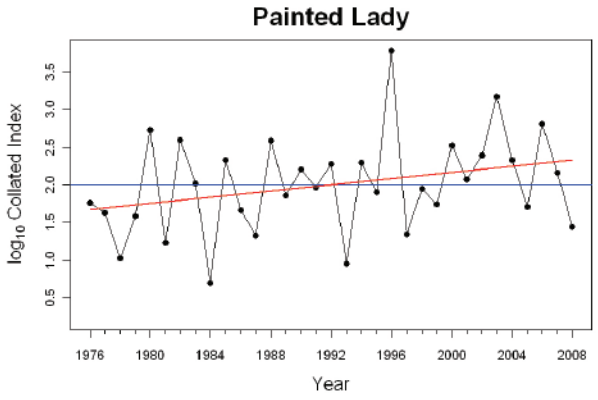
White Admiral

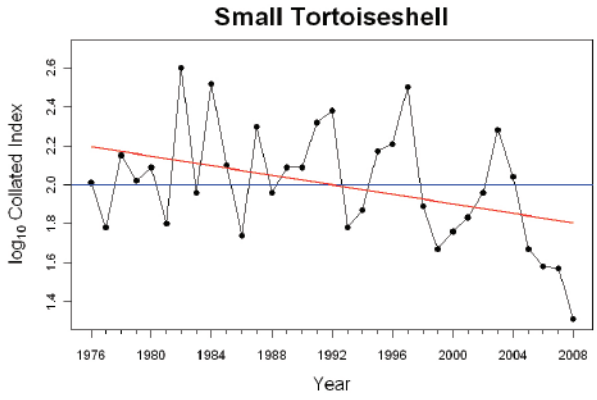


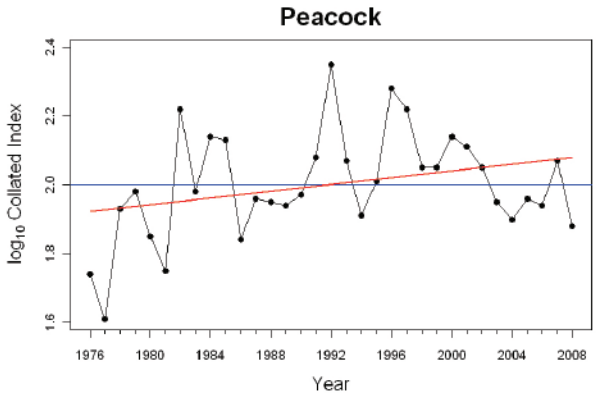
Purple Emperor

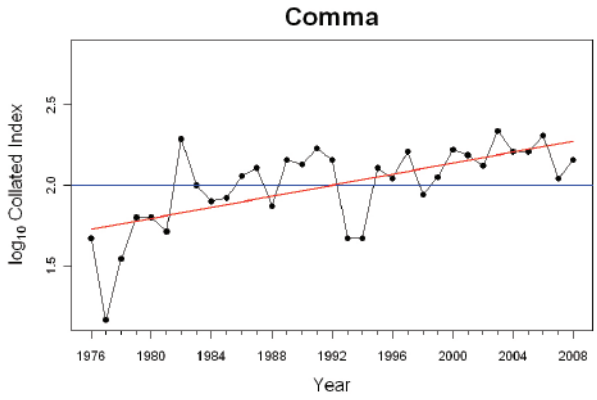


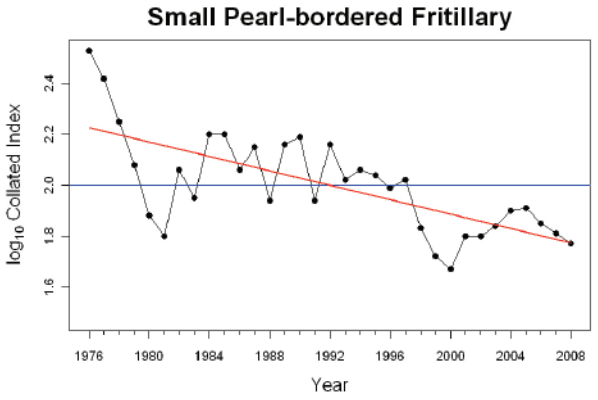

Red Admiral
log10 Collated Index
Year

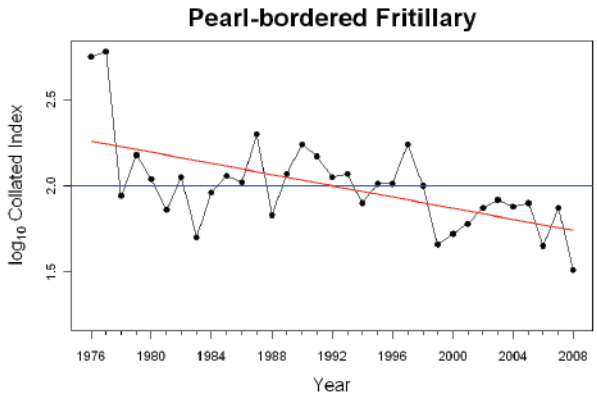

Painted Lady
log10 Collated Index
Year

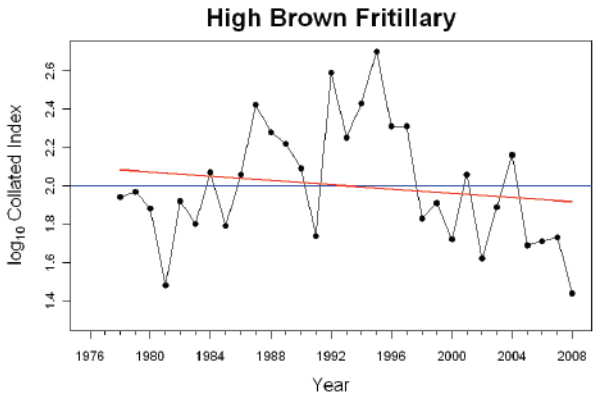

Small Tortoiseshell
log10 Collated Index
Year


Peacock
log10 Collated Index
Year

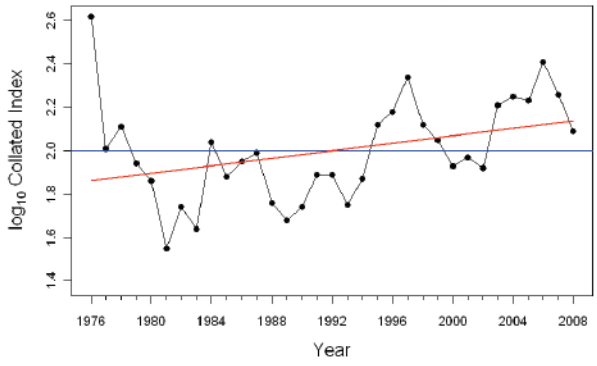

Comma
log10 Collated Index
Year


Small Pearl-bordered Fritillary
log10 Collated Index
Year

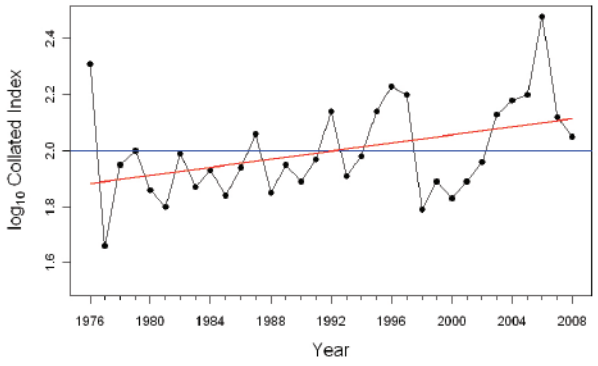

Pearl-bordered Fritillary
log10 Collated Index
Year


High Brown Fritillary
log10 Collated Index
Year

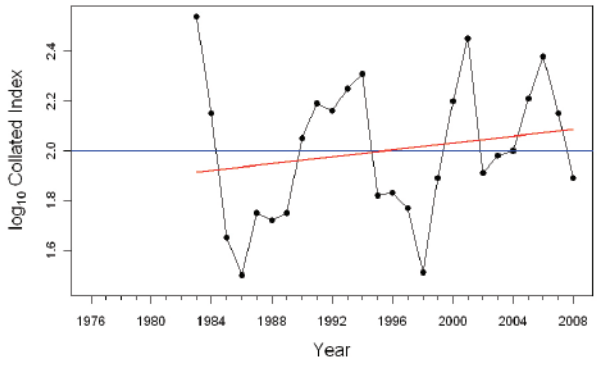
Dark Green Fritillary



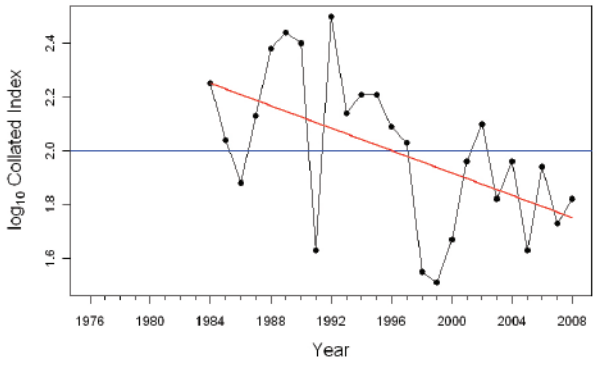
Silver-washed Fritillary



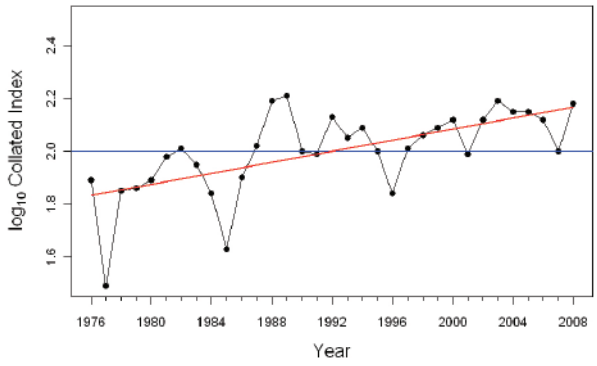
Marsh Fritillary



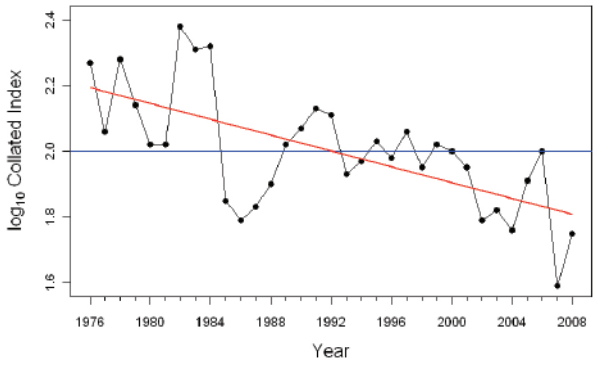
Heath Fritillary



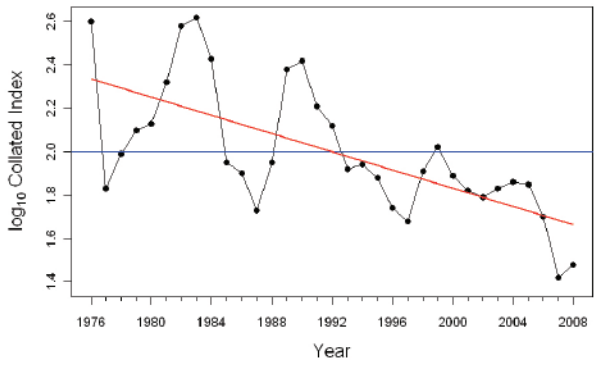
Speckled Wood



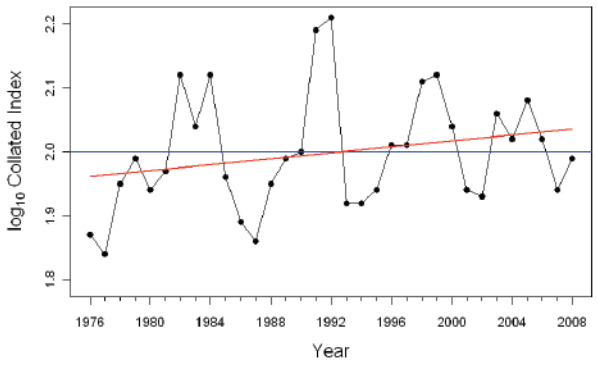
Grayling

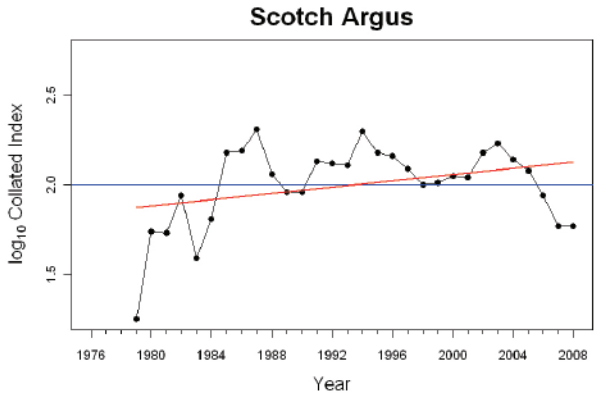


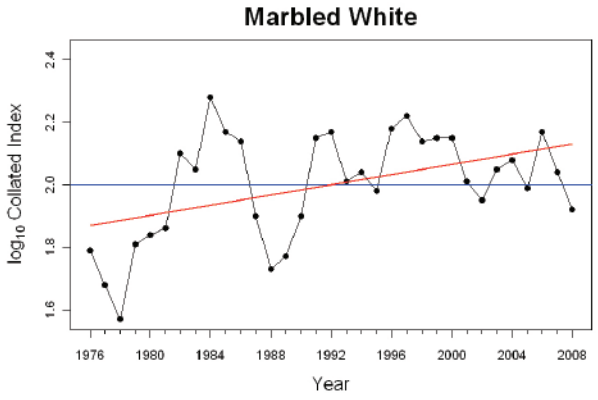
Wall Brown

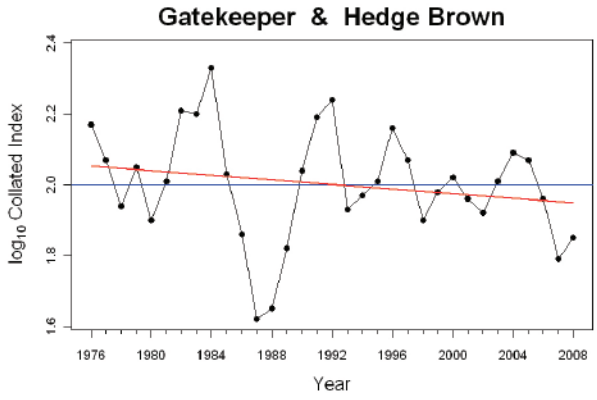


Meadow Brown




Scotch Argus
log10 Collated Index
Year


Marbled White
log10 Collated Index
Year


Gatekeeper & Hedge Brown
log10 Collated Index
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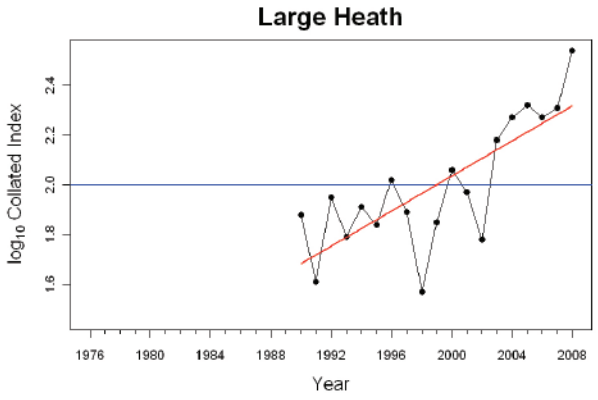
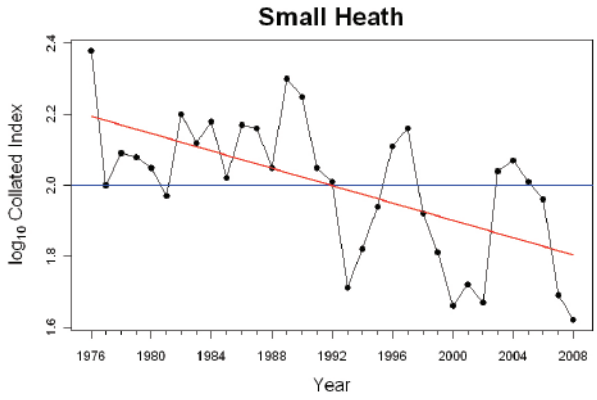
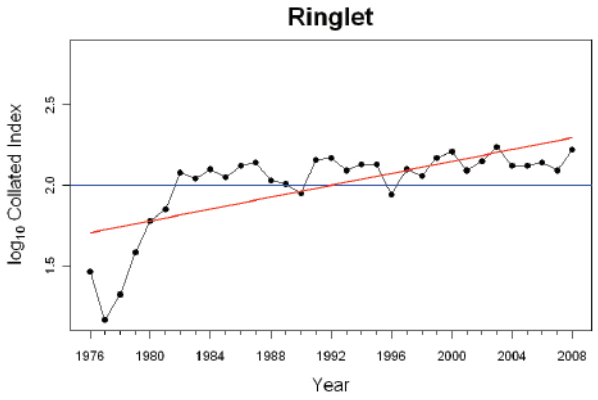

Large Heath
log10 Collated Index
Year


Small Heath
log10 Collated Index
Year


Ringlet
log10 Collated Index
Year

Appendix II

Appendix II. Trends in the list of UK Biodiversity Action Plan Priority species (this list contains some species that are to be removed from the BAP list and some that will be added). Given are the number of transects on which each species is increasing and declining since transect recording began. In addition, the number of sites deemed to have stable populations of each species is also presented. Only those transects that have operated for >10 years and have at least one index in the last 5 years are included in this analysis. Included is the change in the Collated Index between 2007 and 2008 to show how these species fared in 2008.

BAP priority species	No. sites where increasing	No. sites where declining	No. sites where stable	Total sites recorded on	Change in Collated Index 2007-8
Adonis Blue	9	1	42	64	17
Brown Hairstreak	4	1	11	26	15
Dingy Skipper	14	44	114	248	2
Duke of Burgundy Fritillary	3	22	25	84	-24
Grayling	4	23	56	135	45
Grizzled Skipper	16	29	92	208	-28
Heath Fritillary	0	11	19	30	23
High Brown Fritillary	3	16	36	71	-49
Large Heath	2	1	5	12	66
Marsh Fritillary	3	16	46	87	-45
Northern Brown Argus	0	7	16	30	91
Pearl-bordered Fritillary	3	28	43	121	-56
Silver-spotted Skipper	12	4	16	44	-34
Silver-studded Blue	2	4	16	34	29
Small Blue	10	14	41	113	0
Small Pearl-bordered Fritillary	9	26	46	124	-9
White Admiral	12	15	79	152	-26
White-letter Hairstreak	3	5	20	104	-40
Wood White	1	4	16	42	-66

Appendix III

Apendix III - Vernacular & scientific names of species referred to in this report

Butterflies
(order and nomenclature follows Fox et al. 2006).

Chequered Skipper	*Carterocephalus palaemon*
Small Skipper	*Thymelicus sylvestris*
Essex Skipper	*Thymelicus lineola*
Lulworth Skipper	*Thymelicus acteon*
Silver-spotted Skipper	*Hesperia comma*
Large Skipper	*Ochlodes sylvanus*
Dingy Skipper	*Erynnis tages*
Grizzled Skipper	*Pyrgus malvae*
Swallowtail	*Papilio machaon*
Wood White	*Leptidea sinapis*
Clouded Yellow	*Coleus croceus*
Brimstone	*Gonepteryx rhamni*
Large White	*Pieris brassicae*
Small White	*Pieris rapae*
Green-veined White	*Pieris napi*
Orange-tip	*Anthocharis cardamines*
Green Hairstreak	*Callophrys rubi*
Brown Hairstreak	*Thecla betulae*
Purple Hairstreak	*Neozephyrus quercus*
White-letter Hairstreak	*Satyrium w-album*
Small Copper	*Lycaena phlaeas*
Large Copper	*Lycaena dispar*
Small Blue	*Cupido minimus*
Silver-studded Blue	*Plebeius argus*
Brown Argus	*Plebeius agestis*
Northern Brown Argus	*Plebeius artaxerxes*
Common Blue	*Polyommatus icarus*
Chalkhill Blue	*Polyommatus coridon*
Adonis Blue	*Polyommatus bellargus*
Holly Blue	*Celastrina argiolus*
Duke of Burgundy	*Hamearis lucina*
Purple Emperor	*Apatrua iris*
Red Admiral	*Vanessa atalanta*
Painted Lady	*Vanessa cardui*
Small Tortoiseshell	*Aglais urticae*
Large Tortoiseshell	*Nymphalis polychloros*
Camberwell Beauty	*Nymphalis antiopa*
Peacock	*Inachis io*
Comma	*Polygonia c-album*
Small Pearl-bordered Frit.	*Boloria selene*
Pearl-bordered Fritillary	*Boloria euphrosyne*
High Brown Fritillary	*Argynnis adippe*
Dark Green Fritillary	*Argynnis aglaja*
Silver-washed Fritillary	*Argynnis paphia*
Marsh Fritillary	*Euphydryas aurinia*
Glanville Fritillary	*Melitaea cinxia*
Heath Fritillary	*Melitaea athalia*
Speckled Wood	*Parage aegeria*
Wall Brown	*Lasiommata megera*
Mountain Ringlet	*Erebia epiphron*
Scotch Argus	*Erebia aethiops*
Marbled White	*Melanargia galathea*
Grayling	*Hipparchia semele*
Gatekeeper	*Pyronia tithonus*
Meadow Brown	*Maniola jurtina*
Ringlet	*Aphantopus hyperantus*
Small Heath	*Coenonympha pamphilus*
Large Heath	*Coenonympha tullia*
Monarch	*Danaus plexippus*

Other Insects
(Alphabetical order).

Bordered Straw	*Heliothis peltigera*
Emerald Damselfly	*Lestes sponsa*
Hummingbird Hawkmoth	*Macroglossum stellatarum*
Red-veined Darter	*Sympetrum fonscolombii*
Scarce Chaser	*Libellula fulva*
Scarlet Tiger	*Callimorpha dominula*
Silver Y	*Autographa gamma*
Small Red-eyed Damselfly	*Erythromma viridulum*

Plants
(Alphabetical order, nomenclatrure follows Stace 1997).

Bell Heather	*Erica cinerea*
Bracken	*Pteridium aquilinum*
Bramble	*Rubus fruticosus*
Bristle Bent	*Agrotis curtisii*
Common Cow-wheat	*Melanpyrum pratense*
Common nettle	*Urtica dioica*
Creeping Thistle	*Cirsium arvense*
Cross-leaved Heath	*Erica tetralix*
Early Hair-grass	*Aira praecox*
Gorse	*Ulex europeaus*
Ling	*Calluna vulgaris*
Red Fescue	*Festuca rubra*
Sheep's Fescue	*Festuca ovina*

Appendix IV

Appendix IV - list of recorders walking UKBMS transects (1976-present)

The following list is an acknowledgement to all those recorders who have walked butterfly transects as part of the United Kingdom Butterfly Monitoring Scheme since it began in 1976. Over 3,400 people have walked transects since the scheme began, an incredible achievement which has enabled the status of butterflies in the UK to be assessed and monitored to an extent to which butterflies are now used as government biodiversity indicators. This list will also appear on the UKBMS website where it will be updated annually.

A Addleton, A Amphlett, A Baldry (*Herefordshire*), A Bantick, A Barnes (*Anglesey*), A Barnes (*Tayside*), A Brooker, A Brooks, A Brown, A Brunstrom, A Buckham, A Burrows, A Cheadle, A Cheeseman, A Coles, A Cooke, A Drysdale, A Duncan, A Frost, A Hargreaves (*Clwyd*), A Hargreaves (*Dorset*), A Hold, A Horder, A Hughes, A Hyatt Williams, A Innes, A J Greenland, A J Reid, A Jessel, A King, A L Grogan, A Leftwich, A Lesiuk, A Maguire, A Mason, A Mayled, A McGuire, A McKeeman, A Moore, A Moralee, A Morrison, A Polkey, A Pollard, A R Baker, A Robinson, A Scott (*Derbyshire*), A Scott (*Lincolnshire*), A Selbie, A Shearer, A Smithies, A Spalding, A Surtees, A Thompson, A Tytler, A Warren, A Wells, A Wheatcroft, A Wilby (*Cambridgeshire*), A Wilby (*Dorset*), A Williams, A. Faehrmann, AB Booth, AB Woodhall, Abbie Patterson, Abi Boyd, Abigail Shaw, AC Aldridge, AC Sutcliffe, AC Warwick, AD Fox, Adam Hick, Adam Lindsay, Adam Maskill, Adam Samson, Adam Teuber, Adrian ED Hickman, Adrian Fowles, Adrian H Thomas, Adrian M Riley, Adrian Neil, Adrian Simmons, Adrian Skeates, Adrian Tucker, Adrian Turner, Adrian Woodhall, AE Holden, AE Pope, AG Payne, AI Bloomfield, Ailsa Malcolm, Ailsa Mckee, AJ Banks, AJ Claxton, AJ Elliot, AJ Farrant, AJ Holman, AJ Panter, AJ Patterson, AJ Prichard, AJ Pritchard, AJ Pulley, AJ.Sharman, AK Beat, Alan Alper, Alan Bardsley, Alan Beale, Alan Brampton, Alan Coles, Alan Collison, Alan Cooper, Alan Downie, Alan E Holden, Alan Ferguson, Alan Green, Alan Gudge, Alan Hold, Alan Horsewell, Alan Johnson (*Gloucestershire*), Alan Johnson (*Kent*), Alan L Bowley (*Cambridgeshire*), Alan L Bowley (*East Sussex*), Alan Long, Alan Loweth, Alan Maddison (*Herefordshire*), Alan McBride, Alan McVittie, Alan Mills, Alan Osborn, Alan Parfitt, Alan Parker, Alan Preece, Alan R Holder, Alan Reid (*Shropshire*), Alan Reid (*Surrey*), Alan Rix, Alan Roscoe, Alan Shelley, Alan Steel, Alan Wild, Alastair Cummings, Alastair Moralee, Alastair Ross, Alastair Wemyss, Alastair Wilken, Albert Knott, Albert Stanley, Alec G Mackonochie, Alec Jackson, Alex Clothier, Alex G Scott, Alex Hill, Alex Till, Alex Turner, Alexandra Cochrane, Alf Farrant, Ali Tuckey, Alice Barker, Alice Clifford, Alice Fenton, Alison Alwright, Alison Bolt, Alison Brooks, Alison Couch, Alison Etherington, Alison Gorley, Alison Harper, Alison Lee, Alison Looser, Alison Matheson, Alison Ruyter, Alison Shipley, Alison Smithies, Alison Turner, Alison Turnock, Alison Wright, Alistair Murdoch, Alistair Whyte, Allan Binding, Allan Weedman, Allison Cushley, Amanda Borrows, Amanda Collins, Amanda McCormick, Amanda Robb, Amber Rosenthal, Amie Angell, Amy Green, Amy King, Amy Oliver, Andre Gardner, Andrew Anderson, Andrew Bailey, Andrew Bolton, Andrew Brown, Andrew Bullock, Andrew Carey, Andrew Clarke, Andrew Culshaw, Andrew D McBridge, Andrew Daw, Andrew Evans, Andrew Ferguson, Andrew George, Andrew Graham, Andrew Guy, Andrew Halcro-Johnston, Andrew J Barrie, Andrew King, Andrew McBride, Andrew Parris, Andrew S Ferguson, Andrew S Gardiner, Andrew Scott, Andrew Shaw, Andrew Whitehouse, Andrew Wood, Andrew Wright, Andy Abbott, Andy Bailey, Andy Baker, Andy Brown (*Greater London*), Andy Brown (*Hertfordshire*), Andy Ellard, Andy Fairbairn, Andy Fale, Andy Fitchett, Andy Holtham, Andy J Barker, Andy MacGregor, Andy Nicholls, Andy Phillips, Andy Rae, Andy Schofield, Andy Turner, Anette Watt, Angela Blackburn, Angela De Muynck, Angela Nisbet, Angela Peters, Angie Forman, Angie Roberton, Angus Davies (*Somerset*), Angus Davies (*Surrey*), Ankie Mosker, Ann Bowker, Ann Dale, Ann Elton, Ann Gipps, Ann Layfield, Ann Piper, Ann Poulsen, Ann Rix, Anna Barwick, Anna Brunton (*East Sussex*), Anna Brunton (*Kent*), Anna Georgiou, Anna Griffith, Anna Griffiths, Anna Humphries, Anna Ilston, Anna Mullarkey, Annabel Drysdale, Anna-Marie Ford, Anne Abbott, Anne Anderson, Anne Barr, Anne Booth, Anne Deacon, Anne Dean, Anne Dyer, Anne Hand, Anne Imm, Anne Kelly, Anne Kiggins, Anne Litherland, Anne Millar, Anne Riley, Anne Williamson, Anne-Marie McDevitt, Anne-Marie Smout, Annemleke Visch, Annette Composite, Annette Hutchinson, Annette Kilworth, Annie Cree, Anthony Ashwell, Anthony Blunden, Anthony Cherry, Anthony Croft, Anthony J Horner, Anthony R Mainwood, Anthony R Mead, Anthony Robinson, Arthur Bowes, Arthur Bryant, Arthur Cleverly, Arthur Greenwood, Arthur McCulloch, AS Barnes, Ashley Bradshaw, Ashley Murray, Ashley White, Ashley Whitlock, Audrey Brown, Audrey Moss, Austen Dobbs, AW Evans, Azure Wilson, B Benat, B Bewsher, B Bigden, B Burdock, B D Batty, B Dimmock, B Edwards, B Gillam, B Heath, B Hillier, B Hoffmann, B Nolan, B Redman, B Reed, B Ridley, B Savage, B Simpson, B Spencer, B Whitehall (*Devon*), B Whitehall (*Kent*), B Yates Smith, BA Shotter, Barbara Bruce, Barbara Frost, Barbara Steadman, Barbara Taylor, Barbara Walton, Barry Allan, Barry Collett, Barry Embling, Barry Fox, Barry Frampton, Barry Gutteridge, Barry Poole, Barry Proctor, Barry Shaw, Barry Sutton, Barry Western, Barry Weston, Basil Yates-Smith, BC Riahy, BE Dicker, Beatrice Rose, Becky Sapsford, Becky Thorpe, Belinda Cook, Belinda Lloyd, Belinda Wheeler, Ben Andrew, Ben Carpenter, Ben Jones, Ben le Bas, Ben McCallum, Ben Mitchell, Ben Wallbridge, Bernard Franklin, Bernard Watts, Bernice Cassels, Beryl M Hulbert, Beryl Petters, Bethan Foulkes, Betsy Vulliamy, Bettina Vettori, Betty Legg, Betty Reinold, Bev Dodd, Bev Nichols (*Dyfed*), Bev Nichols (*Norfolk*), Beverley Dodd, BG Hogarth, Bill Canning, Bill Deakins, Bill G Shreeves, Bill Jordan, Bill Morris, Bill shaw, BJW Heath, Bob Clift, Bob Fisher, Bob Gillam, Bob Hall (*Herefordshire*), Bob Lord, Bob Lugg, Bob Schmedlin, Bob Steadman, Bob Watts, Bob Woodroof, BP Fletcher, BR Foxall, BR Scampion, Brenda Clapperton, Brenda Hague, Brenda Hudson, Brenda Innes, Brian Anderson, Brian Bewsher, Brian Buffery, Brian Bull, Brian C Eversham, Brian C Manning, Brian D Fensome, Brian Denham, Brian Dicker, Brian Eardley, Brian Fletcher, Brian Greenough, Brian Hancock (*Lancashire*), Brian Hancock (*West Sussex*), Brian Heaton, Brian Jessop, Brian Lightfoot, Brian Neath, Brian Pollinger, Brian Roberts, Brian Robinson, Brian Scurr, Brian Thomas, Brian Weeks, Brian Williamson, Bridget de Whalley, Bridget Self, Bridgit Young, Briony Canning, Bron Towner, Brownie Turtle, Bruce Maxfield, Bryan Barnacle, Bryan G Nelson, Bryan Michie, Bryan Parnell, Bryan Pinchen, Bryan Roberts, Bryan Thorne, Bryony Carnie, BS Hatto, C Allison, C Aspinwall, C Banks, C Belshaw, C Bird, C Bowell, C Britt, C Clarke, C Crick, C Deeson, C Doarks, C F Liggett, C F Tweedale, C Gibson, C Golden-Hann, C Hobbs, C Howells, C Hurst, C Johnson, C Lawler, C McCorty, C Mooney, C Morris (*Gloucestershire*), C Morris (*Kent*), C Newberry, C Peacock, C Piatkiewicz, C Reid, C Sertorio, C Slack (*East Sussex*), C Slack (*Kent*), C Slack (*Outer London*), C Steer, C Studman, C T Smith, C Taylor, C Titcombe, C Tomlinson, C Upton, C Wheelwright, C Wright, C. Roche, CA Malpass, CA Rawlings, CA Walls, Cal Sherratt, Cameron Moyes, Cari Wooldridge, Carlos Abrahams, Carly Fretwell, Carol Drake, Carol Goulden, Carol Huston, Carol Wood, Carole Bennett, Carole Bottomley, Carole Drake, Carole Dyer, Carole Parker, Carole Tresilian, Caroline Bailey, Caroline Bateson, Caroline Clift, Caroline Daguet, Caroline deCarle, Caroline Drake, Caroline FitzGerald, Caroline Graham, Caroline Phillips, Caroline Searle, Caroline Steel, Caroline Tetley, Caroline Vulliamy, Caroline Wilson, Carolyn Bloor, Carolyn Smith, Cat Butcher, Cath Sproston, Catherine Batten, Catherine Blakey, Catherine Kemp, Catherine Price, Cathy Race, Catriona Reid, Catrona Burns, CB Collins, CD Thomas, CE Ollivant, Celia Cox, Celia Tanner, Ceri Adams, Ch Garrett Jones, Charles Aitcheson, Charles Baker, Charles Dale, Charles Hendry, Charles Smith, Charles Trimmer, Charlie Dyson, Charlie Howe, Charlotte Atkin, Charlotte Rose, Chas Morgan, Cherry Greenway, CHJ Hill, Chris Allen, Chris Bailey, Chris Banks, Chris Bartlett, Chris Bottrell, Chris Britton, Chris Buckle, Chris Burbanks, Chris Cockburn, Chris Coppock, Chris D Thomas, Chris Dodd, Chris Gardiner, Chris Gibbard, Chris Goddard, Chris Gregory, Chris Hall, Chris HJ Hill, Chris Howes, Chris Huggins, Chris Iles, Chris Johnson, Chris Marrable, Chris Matthews, Chris McCarty, Chris Puddifoot, Chris RC Paul, Chris S Waller, Chris Slack, Chris Smout, Chris Sullivan, Chris Sutton, Chris Tracy, Chris Tyler, Chris Wiltshire, Christina Drebitz, Christine Allison, Christine Barton, Christine Blanco, Christine Booth, Christine Cooper, Christine Hoskins, Christine Reynolds, Christine Tilbury, Christopher A Rawlings, Christopher D

Johnson, Christopher J Price, Christopher Shaw, Christopher Stock, Christopher Weeks, Cindy Cogan, Cinzia, CJ Beale, CJ Blease, CJ Davies, CJ Neil, CJ Robinson, CL Johnson, CL Robbins, Claire Belshaw, Claire Beresford, Claire Farmer, Claire Stevens, Claire Studman (*Cleveland*), Claire Studman (*Suffolk*), Claire Travis, Claire Wells, Clare Bishop, Clare Bury, Clare Collier, Clare Sawyer, Cliff Williams, Clive Bealey, Clive Carter, Clive Dunmow, Clive Lloyd, Clive Osborne, CM Brownsward, Colin Baker, Colin Brett, Colin Conroy, Colin Dawson, Colin Dolding, Colin Everett, Colin Lawrance, Colin Marsden, Colin Mcfarlane, Colin Nunn, Colin Ormston, Colin Peacock, Colin R Burningham, Colin Ritchie, Colin Ward, Colin Williams, Colleen Milligan, Coralie Dickinson, Corinna Gregory, Corinne Hambly, Corinne Hamdy, CP. Cuthbert, CR Cuthbert, Craig Stenson, Crispin Holloway, CRV Holt, Cyril Johnson, D Allan, D Bateson, D Bennett, D Bines, D Birkett, D Bonnett, D Boyle, D Bridge, D Bromwich, D Brooks, D Carstairs, D Cowan, D Dunn, D Elias, D Evans, D Feast, D Frost, D Furley, D Gale, D Gilbert, D Groom, D Haigh, D Harmer, D Hatch, D Hoblyn, D Ireland, D King, D L Butchart, D Lonsdale, D M Elliot, D MacArthur, D Marsdonokh, D McCutcheon, D Milbarrow, D Miller (*East Sussex*), D Miller (*Tayside*), D Muir, D Nightingale, D Northcote-Wright, D O'Connor, D Orr, D Painter, D Pearson, D Phillips (*Derbyshire*), D Phillips (*Hampshire*), D Rayner, D Rees, D Roe, D Savil, D Scott, D Thelwell, D Thomas, D Treacher, D Trevor, D Walters, D Warner (*Clwyd*), D Warner (*Somerset*), D Weaver, D Wheeler (*Dorset*), D Wheeler (*Dyfed*), D Widgington, D Wright (*Dorset*), D Wright (Hereford and Worcester), D Wynn, DA Coleman, DA Henshilwood, Dafydd Parry, Damon Bridge, Dan Hoare, Dan Jackson, Dan Tomes, Dan Watson, Daniel Fellman, Daniel Piec, Danny Cavanagh (*Gloucestershire*), Danny Cavanagh (*Highland*), Daphne Aplin, Daphne Macfarlane Smith, Darien Pugh, Darrel Watts, Daryl Short, Dave A Rogers, Dave Bateson, Dave Chase, Dave Fairhurst, Dave Fawcett, Dave Gibbon, Dave Hopkins, Dave Hutton, Dave J Hewitt, Dave Jones, Dave L Thomas, Dave M Jones, Dave MA Rogers, Dave Mitchell, Dave Munson, Dave Page, Dave Payne, Dave Scott, Dave Thomas, Dave Thurlow, Dave Wainwright, Dave Warburton, Dave White (*Hampshire*), Dave White (*Hereford and Worcester*), Dave Williams, Dave Wilton, David Attwell, David Ayling, David B Roy, David Badham, David Ball, David Barwick, David Bevan, David Bowman, David Brown, David Burgess, David Burrows, David Burton, David Byrne, David Carstairs, David Carter, David Chandler, David Cooling, David Cooper, David Cox, David D Massen (*Cambridgeshire*), David D Massen (*Oxfordshire*), David D Massen (*Wiltshire*), David Dennis, David Dewsbury, David Dunbar, David Eastlick, David Elliott, David Evans, David Feltham, David G Carrington, David G Thurlow, David Gittins, David Glover, David Gradidge, David Graham, David H Gantzel, David Hackett, David Hall, David Hamilton, David Harding, David Harries, David Hatch, David Hatfield, David Havenhand, David Hill, David Howdon, David Howse, David Howson, David Hughes (*Cambridgeshire*), David Hughes (*Dorset*), David Hutton, David J Brown, David J Henderson, David Jewsbury, David Jode, David King, David Kirk, David Laing, David Lambert, David Land, David Lee, David Lester, David Liddle, David Livingstone, David Lockyer, David Luckhurst, David M Bath, David Mercer, David Mower, David Newton, David Northcote-Wright, David Nye, David O Elias, David Olliver, David P Maylam, David Page, David Painter, David Parker, David Phillips, David Player, David Poole, David Porter, David Preston, David Pyle, David Rear, David Redhead, David Shears, David Shepherd, David Slade, David Smart, David Smith, David Stebbings, David W McAllister, David W Perkins, David Warren, David Webb, David Whitaker, David White (*Hereford and Worcester*), David White (*West Midlands*), David Wickens, David Wild, David Woolley, David Wraith, David Wrigley, Dayne West, DE Hardy, Debbie Lewis, Debbie Worland, Deborah Butterworth, Deborah Stevens, Debra Stickley, Dee Raper, Denise J Palmer, Denise Molyneux, Denise Neely, Dennis Abbott, Dennis Bell, Dennis Carter, Dennis Dell, Dennis Dey, Dennis Whittaker, Derek Abbott, Derek Allen, Derek Arthurs, Derek Bryant, Derek Fox, Derek J Remington, Derek Lord, Derek McManus, Derek Mills, Dermot Barton, Des Sussex, DF Calnon, DG Notton, DG Thurlaw, DI Hill, Diana Barnham, Diana Holt, Diana Kingston, Diana Le V. Long, Dick Best, Dick Sheppard, Digby Wood, Dilys Farrant, DJ Ashworth, DJ Brown, DJ Dean, DJ Gilbert, DJ Nisbet, DJ Radford, DK Mardon, DL Arthurs, DL Woodfall, DM Lenain, Dom Graves, DominicAsh, Dominic Coath, Dominic Harmer (*Dyfed*), Dominic Harmer (*Oxfordshire*), Dominic North, Dominic Sheldon, Dominique Langlois, Don Downes, Don Hunford, Don Wilkinson, Donald Kennedy, Donna Dawson, Dora Marshall, Doris Allen, Dot Ruston, Doug Cullen, Doug Taylor, Dougie Mayner, Douglas Gilbert, Dr Michael Barry, Dudley Cheesman, Dudley Hull, Duncan Forbes, Duncan Greig, Duncan Priddle, Duncan S Cooper, Duncan Smith, Duncan Stevenson, DW MacAllister, DW Sweet, Dyanna Innes, Dylan Everett, E Dunford, E Ford, E Gillings, E Hughes, E J Cameron, E Jarvie, E M Makdon, E Matthews, E Ogilvie, E Pedley (*Clwyd*), E Pedley (*Shropshire*), E Taylor, E Titcombe, E Underwood, E W Baigent, E Wilberforce, EC Britnell, Ed Partridge, Ed Rispin, Edmond Mackrill, Edward Andrews, Edward J Ambrose, Edward Knowles, Edward Stubbings, Edwin Third, Edwina Clements, EE Roderick, EJ Bennett, EJ Pain, Elaine Aldridge, Elaine Shimmin, Eleanor Stafford, Eleanor Stamp, Elisa Pflug, Elizabeth Bamford (*Cumbria*), Elizabeth Bamford (*Northumberland*), Elizabeth Kendall, Elizabeth Martin Fisher, Elizabeth Sykes, Elizabeth Tunnah, Ellie Rotheray, Elsie Ashworth, Elspeth Christie, Emilie Mitchell, Emily Chambers, Emily Griffiths, Emily Wilkins, Emily Woodfield, Emma Beck, Emma Birnie, Emma Broad, Emma Daniel, Emma Newman, Emma Robbins, Emma Stewart (*Central*), Emma Stewart (*Norfolk*), Emma Webb, Emma Williams, Enid Turnbull, EP Morris, Eric Allan, Eric Marsh (*Clwyd*), Eric Marsh (*Shropshire*), Eric Rose, Eric Steer, Erica Godman, Erica Murray, Erin Pettifer, Ernie Pollard, Errol Newman, Estella Roberts, Estelle Hughes, Esther Collis, Evelyn Carter, EW Baigent, F Coster, F Evans, F Harrison, F Lilley, F Renard, F Stuart, F Wase, FA Booth, FA Edmondson, FE Harvey, Felicity Cox, Felicity Davies, Fergus Cook, Fiona Annals, Fiona Aungier, Fiona Barker, Fiona Brown, Fiona Hall, Fiona Haynes, Fiona Proffitt, Fiona Shipp, FJ Hulbert, FR Batchelor, Fran Thompson, Frances Barker, Frances Bee (*Oxfordshire*), Frances Bee (*Suffolk*), Frances Mudd, Frances Thetford, Francis Ratmeks, Francois Chazel, Frank Bowen, Frank Lancaster, Frank Train, Fraser Abernethy, Fraser Alexander, Fraser Symonds, Fred Vanstone, Freda Draper, G Baldrey, G Banwell, G Bebbington, G Brown, G Carrier, G Checkley, G Christie, G Fernell, G Gynn, G Hamer, G Hersey, G Hersey-Green, G Kendall, G Kyle, G Lohoar, G Porseti, G Pozseti, G Roberts, G Shearer, G Stockton, G Stonehill, G Stredwick, G Thompson, G Voller, G Williamson, G.Marshall, Gabor Pozsgai, Gail Cisman, Gail Jeffcoate, Galena Gardner, Gareth Blockley, Gareth Cunningham, Gareth Luscombe, Gareth Shelley, Gareth Trezise, Garth Lowe, Gary Aldridge, Gary Atkins, Gary F Hibberd, Gary Linstead, Gary Richardson, Gary Tanner, Gavin Hageman, Gavin Vicary, Gaye Pickard, GB Hall, GC Bellamy, GE Clarks, Ged Connell, Ged Keele, Gemma Harfield, Gemma Taylor, Geof Grafton, Geoff Bichard, Geoff Harris, Geoff Hewlett, Geoff Hiscocks, Geoff Hobson, Geoff Rapley, Geoff Stevens, Geoff White, Geoff Wilkinson, Geoffrey Sell, George Cox, George Guther, George Lewis, George Osmond, George Rogers, Geraint Evans, Gerald Light, Geraldine Broughton, Geraldine Fewster, Gerry Callaghan, GG Ushaw, Giles Alder, Giles Strother, Gill Blackband, Gill Coles, Gill Peachey, Gill Seddon, Gill Smith, Gillian Cleeve, Gillian J Fyfe, Gillian M Barker, Gillian Mordant, Gillian Newcombe, Gillian Oldfield, Ginny Herring, GJ White, GL Watson, Glad Brown, Glen Sharman, Glenn Tutton, Glenys Proctor, Gloey Finnsdottir, Glyn Clarke, Glynne C Evans, Glynne Evans, GN Megson, Gordon Allison, Gordon Brown, Gordon Flower, Gordon French, Gordon Hopkins, Gordon Mackie, Gordon Whiting, GP Radley, GR Watson, Grace Edwards, Grace Hall, Gracie Barrett, Gracie Edwards, Graeme Clayton, Graeme Guy, Graeme Platman, Graeme Skelcher, Graham Bailey, Graham Bugg, Graham Checkley, Graham Dennis, Graham Fulford, Graham Hamer, Graham P Weaver, Graham Parris, Graham Poynter, Graham Revill, Graham Smith, Graham Watkins, Graham Wellfare, Graham West, Graham Wilkins, Graham Williams (*Anglesey*), Graham Williams (*Strathclyde*), Graham Windsor, Grahame Hawker, Greg Herbert, Greg Morgan, Greig Stewart, Grizel M Lindsay-Watson, GT Pierce, Guenter Petters, Guy Manning, Gwilym Jones, GWS Tonhill, Gwyneth Pearman-Jenkins, H Avery, H Cavilla, H Ivimey-Cook, H MacLeod, H McMillan, H Pena, H S James, HA Ferguson, HA Williams, Hamish Cole, Hamish Dickson, Hannah Cooper, Hannah Levene, Harriet Carty, Harry Turner, Harvey Skelcher, Haydn Cockram, Hazel White, HE Maggs, HeatherR Winship, Heather Fisher, Heather Harley, Hebe Carus, Hebe L Carns, Helen Bantock, Helen Bentley, Helen Bentley-Fox, Helen Carlton, Helen Cole, Helen Fenby, Helen Henderson, Helen Lanchbery, Helen Lilley, Helen Porter, Helen Read, Helen Senior, Helen Wilkinson, Helena Carter, Heli Gittins, Hendryk Jurk, Henry Kemm, Henry Mannall, Hilary Cotter, Hilary Morton, Hilary Quick, Holly Harries, Holly Lagdon, Holly Niner, Howard Croft, Howard Snell, Howard Street, Howard Whiting, HT Mainwood, Hugh Brown, Hugh Dixon, Hugh Glennie, Hugh Thurgate, Hugh Todd, Hugh Welford, Hugo Brooke, HV Jones, Hywel Maggs, I Barton, I Bonner, I Carr, I Cheeseborough, I Clowes, I Cross, I Davenport, I Findlay, I Fuller, I K Langford, I Keirle, I MacGowan, I Pritchard, I Shepherd, I Spalding, I Stone, I W Duncan, Iain D Webb, Iain Yoxall, Ian Boyd, Ian Bradwell, Ian Cade, Ian Chadwick, Ian Cunningham, Ian D Bullock, Ian Dillon, Ian Duncan, Ian Greenwood, Ian H Findlay, Ian Henderson, Ian Hesketh, Ian Hodgson, Ian Hounsell, Ian J Tillotson, Ian Jenkins, Ian Kelloway, Ian Kille, Ian M Nicol, Ian Mann, Ian McLean, Ian Medgett, Ian Middlebrook, Ian R Wynne, Ian Rickards, Ian S Thomson, Ian Stevenson, Ian Taylor, Ian Waller, Ian Woiwod, Ian Wright, IC Macleod, ID Bullock, ID Meredith, IG Black, IL Clowes (*Dorset*), IL Clowes (*Dyfed*), IL Emerson, IM Elphick,

IM Nicol, IM Strachan, Innes Muir, Iola Veal, Irene Downing, Irene Wade, Isabel Moy, Isobel Francis, IT Rowlands, Ivan Arnold, Ivan J Proctor, Ivan Kruys, J A Norton, J Armstrong, J Athill, J Baird, J Bancroft, J Barrett, J Bills, J Bingham, J Bowker, J Brown, J Burgon, J Butlin, J C Robinson, J Castledine, J Chester, J Crewe, J Crisp, J Dowell, J Elliott, J Ellis, J England, J Evans, J Fowler, J Fraser, J Freeborn, J French, J Gibson, J Halls, J Hardwick, J Havard, J Hunt, J Jones, J K Campbell, J Kahl, J King, J Kinsley, J Kirkman, J Leece, J Leven, J Lyons, J M Cameron, J MacAllister, J Malcolm, J Mander, J Mee, J Meldrum, J Miles, J Mitchell, J Moulin, J Newton, J Osborne (*Essex*), J Osborne (*Kent*), J Osborne (*Northumberland*), J Pain, J Pike, J Plunkett, J Porter, J Rae, J Rankin, J Rees Cox, J Robinson, J Rogers, J Roswan, J Scott (*Essex*), J Scott (*Lincolnshire*), J Searle, J Shackles, J Soal, J Sorensen, J Stevenson, J Sykes, J Taverner, J Taylor, J Trevor, J Upton, J Wateridge, J Webb, J Wyat, J Young (*Fife*), J Young (*Outer London*), J.Oldland, JA Bishop, JA Wood, Jack Peeters, Jack Seymour, Jack Stratfold, Jackie Newcombe, Jacky Hart, Jacquie Grocott, James Baye, James Bloss, James Campbell, James Coombes, James Darke, James Fleetwood, James Hayward, James Hitchcock, James May, James Nevitt, James Pitman, James Power, James Roadnight, James Seymour, Jan Bollington, Jan Breckenridge, Jan Galley, Jan Hall, Jan Haseler, Jan Heaney, Jan Hodgson, Jan Hughes, Jan L Plunkett, Jan Miller, Jan Tapson, Jan Wilson, Jane Bisby, Jane Carpenter, Jane Chance, Jane Craven, Jane Gibbons, Jane Hill, Jane Mercer, Jane Newdick, Jane Petley-Jones, Jane Smith, Jane Wise (*Herefordshire*), Jane Worroll, Janet Dicks, Janet Frost, Janet Holmes (*Hampshire*), Janet Holmes (*Hertfordshire*), Janet Kyriakides, Janet Main, Janet Owen, Janette Easton, Janis Bald, Jarrod E Sneyd, Jason Clay, Jason Dyer, Jason Hann, Jason Mitchell, Jason Moss, Jason P Ball, JB Kelsall, JC Maylam, JD Lobb, JD Porter, Jean Cooper, Jean Keddie, Jeff Andrews, Jeff Hayes, Jeff Hazell, Jenna Dewhurst, Jenna Fox-Wheddon, Jenni Hignett, Jennie Garrod, Jennie Norman, Jennifer Bower, Jennifer Davidson, Jennifer Heatley, Jennifer Newton, Jenny Chapman, Jenny Columbi, Jenny Edwards, Jenny Higgins, Jenny Hyde, Jenny Joy, Jenny Mallet, Jenny Mallett, Jenny Plackett, Jenny Rees, Jeremy A Thomas, Jeremy Adams, Jeremy Bishop, Jeremy Woodward, Jess Daish- Miller, Jess Hill, Jess Pain, Jess Tyler, Jessica Clunas, Jessica Morgado, Jessica Poole, Jessie Mackay, JG Hitchcock, JG Stewart, JH Duffield, JH Swan, JH Theaker, JH Wilson, Jill Gillott, Jill Hall, Jill Philips, Jill Shrearer, Jillian McVean, Jim Alexander, Jim Asher, Jim Barker, Jim Braven, Jim Cropper, Jim Ferguson, Jim Flight, Jim Frith, Jim G Potter, Jim Giles, Jim Graham, Jim McIntosh, Jim Morrison, Jim Parkin, Jim Pitman, Jim Powell, Jim Rouquette, Jim Sayner, Jim Searle, Jim Steedman, Jim Timms, Jim Vale, Jim Wallwork, Jim Wells, Jim Whitehouse, Jimmy Maxwell, Jinny Jehu, JJ Canovan, JJ Edwards, JJ Hicks, JK Adamson, JK Dryden, JK McNaught, JL Small, JL Tillotson, JM Glasscock, JM Hatts, JM Hicks, JM Lancaster, JM Lawman, JM Lester, JM Maxwell, JM Noakes, JM Pocock, JM Skenning, Jo Bowry, Jo Darlington, Jo Heading, Jo Mercer, Jo Saunders, Jo Scott, Jo Shipton, Jo Smith, Jo Stafford, Jo Trotter, Jo Wilson (*Hampshire*), Jo Wilson (*Outer London*), Joan Daniels (*Hampshire*), Joan Daniels (*Shropshire*), Joan Daniels3, Joan Durran, Joan Fisher, Joan Green, Joan Ingram, Joan Lowe (*Dorset*), Joan Lowe (*Surrey*), Joanna Brown, Joanna Ciudiskis, Joanna Clark, Joanna Lawrence, Joanne Gore, Joanne Osmond, Joanne Swales, Jodie Crane, Joe Murphy, Joe Smith, Joe Soap, John A Blackburn, John Allen, John Argent, John B Halliday, John Ball, John Barker, John Barkham, John Barnard, John Barry, John Batchelder, John Bell, John Bellamy, John Buckley, John Burrell, John C Bacon, John Chater, John Chester, John Coates, John Collier (*Buckinghamshire*), John Collier (*Dyfed*), John Collier (*Oxfordshire*), John Cranham, John Crowther, John D Russell, John Davis, John Dellow, John Dillow, John Dowling, John Down, John E Bater, John Elliott, John F Holloway, John Fawcett, John Foster, John Foulsham, John Gilbert, John Glazebrook, John Gorst, John Gowenlock, John Grayley, John Gregory, John Gulliver, John Hankin, John Harvey, John Heathcote, John Hoare, John Holder, John Holland, John Hollis, John Hope, John Iles, John Jenking, John Kennedy, John Kerby, John Lawson, John Leigh-Pemberton, John Leonhardt, John Lerpiniere, John Liggins, John Lobb, John Lucas, John Luck, John M Elliott, John M Mackenzie, John Madden, John McAllister, John McKenzie, John Messer, John Moss, John Murray, John Neal, John Nundy, John O'Keefe, John O'Reilly, John Orr, John Petts, John Phillips, John Plaxton, John Powell, John Rae, John Randall, John Rea, John Rowan, John Standeven, John Stow, John Strutt, John Thorpe, John Tilt, 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Butterfly Conservation 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 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.

The Countryside Council for Wales champions the environment and landscapes of Wales and its coastal waters as sources of natural and cultural riches, as a foundation for economic and social activity, and as a place for leisure and learning opportunities. We aim to make the environment a valued part of everyone's life in Wales.

The Department for Environment Food and Rural Affairs 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.

The Forestry Commission 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.

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, the Countryside Council for Wales, Natural England and Scottish Natural Heritage.

Natural England 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

The Northern Ireland Environment Agency takes the lead in advising on, and in implementing, the Government's environmental policy and strategy in Northern Ireland. It aims to protect and conserve Northern Ireland's natural heritage and built environment, control pollution, and promote the wider appreciation of the environment and best environmental practices.

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

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