



Butterfly
Conservation

Saving butterflies, moths and our environment

The State of the UK's Butterflies 2011



The Duke of Burgundy is one of the most rapidly declining butterflies in the UK

Photograph Neil Hulme



Small Tortoiseshell numbers fell to unprecedented lows in the last few years. The recently arrived parasitoid *Sturmia bella* may be part of the problem but is not the sole factor driving the decline of this familiar and much-loved butterfly.

Photograph Rachel Scopes

Summary

This report summarises the findings of two world-leading citizen science projects: the UK Butterfly Monitoring Scheme, which involves weekly butterfly counts at over 1,000 sites, and Butterflies for the New Millennium, which has collated over six million butterfly sightings across the UK from thousands of members of the public.

- The results show that the 2010 European Union target to halt the loss of biodiversity has not been met for the UK's butterflies. Ten-year trends show that 72% of species declined in abundance at monitored sites and that the UK distributions of 54% of butterflies also declined. Three-quarters of species showed a 10-year decrease in either their distribution or population levels.
- Habitat specialist species have continued to decline and, for the first time, a significant decrease in overall numbers of wider countryside butterflies has also been recorded. Butterflies fared better in Scotland than in England, where there have been large population decreases in farmland and woodland habitats.
- UK butterflies are thus still in serious decline and remain one of our most threatened wildlife groups in spite of increased conservation expenditure. Our results suggest that simple ecosystem-led approaches will not be effective in halting the decline of many specialist butterflies. A more targeted strategy is needed.
- The ongoing deterioration of habitats is the main cause of these declines, resulting from inappropriate management (e.g. continued intensification or abandonment), insufficient quantity, quality or targeting of suitable conservation management and the effects of small habitat area and isolation. Highly variable summer weather may also be contributing, counteracting the mainly beneficial effects of climate warming.
- There were positive signs too. Thirty-one species showed some evidence of increase in either their distribution or population trend. A minority of species, mostly wider countryside butterflies, extended their ranges substantially, spreading northwards in response to climate warming. In addition, there are promising signs that the long-term declines of some threatened butterflies have been slowed or reversed by conservation initiatives. This demonstrates that addressing the declines of UK butterflies, for example through the species-focussed UK Biodiversity Action Plan (BAP) or targeted 'higher level' agri-environment schemes, can work given sufficient time and resources.
- Butterflies provide a focal point for citizen science and community engagement, and have been adopted by Government as official indicators of biodiversity and the environment. The UK butterfly indicators show 10-year population declines of 18% for habitat specialists and 24% for wider countryside butterflies.
- The UK is committed to a new European Union target to halt the loss of biodiversity and degradation of ecosystem services by 2020. Achieving the 2020 target will require ongoing focussed grants for sustainable agricultural and woodland management, as well as targeted efforts to conserve threatened species at site-specific and landscape scales, involving partnerships between government, NGOs and local communities.

Introduction

The past decade has seen unprecedented attempts to understand and conserve the UK's butterflies. With the help of thousands of volunteers, recording and monitoring schemes have generated a massive resource of high quality data to assess the changing fortunes of these flagship insects and to provide the foundations for conservation initiatives at both site and landscape scales.

The value of butterflies as indicators has been recognised scientifically and politically, with UK and devolved governments adopting butterfly population trends as a key measure of biodiversity and environmental health. Butterflies provide not only a sensitive measure of subtle climatic and habitat changes, but also shed light on the fortunes of thousands of other insect species that form the core of the UK's biodiversity and perform vital roles in the ecosystem services that underpin human welfare and prosperity.

Political and public focus, as well as Government spending, on biodiversity conservation has been unparalleled over this period, driven by international obligations and public service agreements. In particular, the UK Government was party to an ambitious European Union commitment to halt the loss of biodiversity by 2010.

The comprehensive data gathered by the Butterflies for the New Millennium (BNM) recording scheme and UK Butterfly Monitoring Scheme (UKBMS) provide a rare opportunity to assess directly the progress made towards the 2010 biodiversity target, as well as to update our knowledge of the status of this popular group of insects.

This report builds upon two previous State of Britain's Butterflies reports (in 2001 and 2007), as well as atlases and scientific studies, but is the first time that a 10-year assessment of both species distribution and population changes has been possible.

Recording and monitoring the UK's butterflies

UK butterflies are one of the best-studied wildlife groups on the planet thanks to an enormous workforce of highly skilled and committed volunteer recorders who contribute to world-leading citizen science projects run by Butterfly Conservation, the Centre for Ecology & Hydrology and other partner organisations.

Butterfly distributions

Traditionally, the main way to assess the changing status and extinction risk of species has been to map their occurrence or 'distribution' across the UK. The Butterflies for the New Millennium (BNM) recording scheme has undertaken successive five-year surveys to map the entire UK distribution of each butterfly species since 1995. Over that period, an estimated 10,000 members of the public have participated, generating over 6.1 million sightings of butterflies covering 99.9% of the 10km x 10km grid squares in the UK.

Survey work is targeted at achieving wide coverage, but participants are free to record butterflies at any location and date. This inclusive approach enables widespread engagement of members of the public, who can make a real contribution to conservation and scientific knowledge even if only recording butterflies in their garden. A thorough system of quality assurance exists at both local and national levels to ensure that the data are reliable. BNM data are made publicly available via the National Biodiversity Network (www.nbn.org.uk).

Although this survey approach leads to uneven sampling for the purposes of producing national trends, its strengths come from the inclusion of many citizens and from generating a large volume of highly detailed information on where butterflies occur - the foundation of almost all conservation initiatives.

Here we assess 10-year trends for the 59 butterfly species that breed regularly in the UK, by comparing their distribution (measured as the number of occupied 10km grid squares) in the 1995-99 BNM survey with that in the 2005-09 survey. Almost all 10km grid squares of the UK were visited by recorders in both survey periods, but squares that were visited in only one survey were excluded from the assessment.

Assessing distribution change at this geographical resolution is normal for national trends in the UK, but also greatly reduces bias due to people recording in different places in different survey periods. Recording coverage at the 10km grid square resolution is very similar between the two surveys (see table below) and, therefore, complex statistical corrections were not applied.

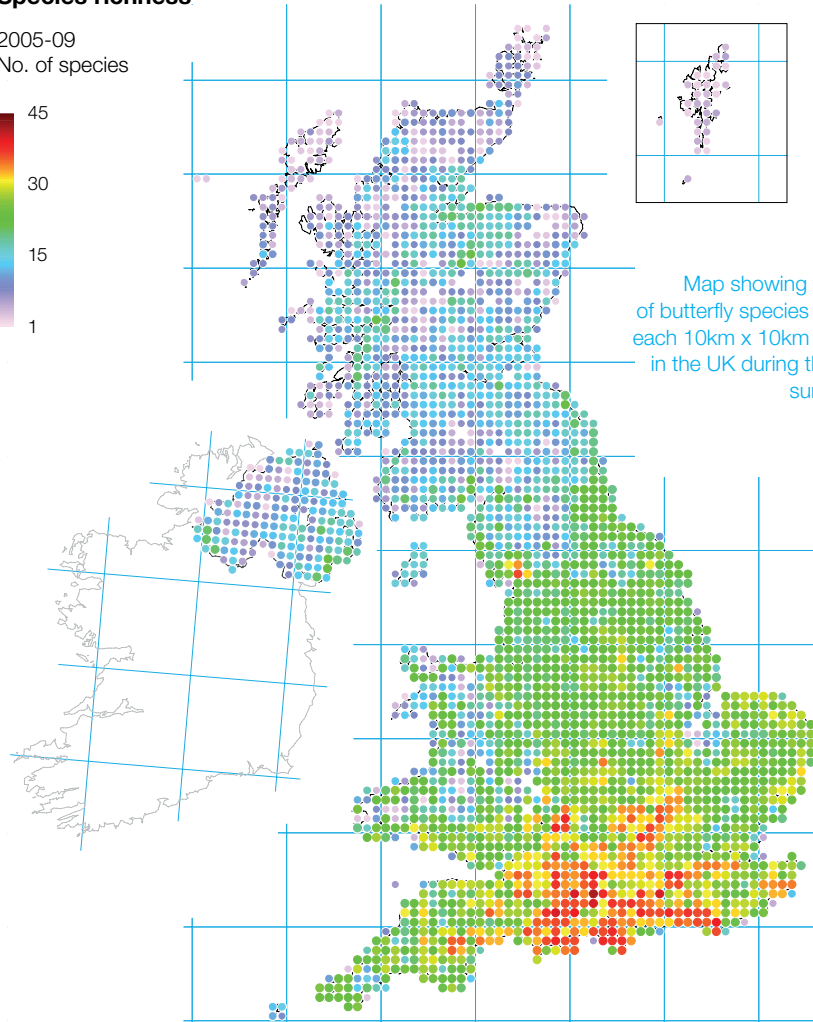
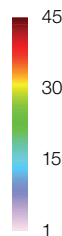
Change in a species' distribution at the 10km grid square level correlates with population-level change, but may underestimate the latter, for example because species can undergo large decreases in abundance before becoming extinct in a 10km square.

Overall statistics on number of records and coverage for the 1995-99 and 2005-09 BNM surveys.

| | Number of UK records | % coverage of 10km grid squares | % of 10km grid squares not recorded in the other survey |
|----------------|----------------------|---------------------------------|---|
| 1995-99 | 1,882,798 | 98.2% | 2.8% |
| 2005-09 | 2,307,862 | 96.6% | 1.2% |

Species richness

2005-09
No. of species



Map showing the number of butterfly species recorded in each 10km x 10km grid square in the UK during the 2005-09 survey period.

Butterfly populations

The UK is fortunate to have a long-running scheme for monitoring butterfly population levels at specific sites. The UK Butterfly Monitoring Scheme (UKBMS) has operated since 1976 and currently samples over 1,000 sites per year.

At the majority (c. 90%) of these sites a fixed route (butterfly transect) is walked every week from the beginning of April until the end of September, under weather conditions that are suitable for butterfly activity. The recorder identifies and counts all of the individual butterflies seen along the transect and these weekly counts are compiled to create an annual total for each species at each site, which reflects the relative abundance of the butterflies present.

For a number of specialist species, two 'reduced effort' scientific methods (adult timed counts and larval web counts) are also used to monitor annual abundance as part of the UKBMS. Site totals from all UKBMS methods are collated into national annual indices of abundance for each species and used to assess population trends over time. Data are also compiled into multi-species indicators to assess changes among different species groups (e.g. habitat specialists and wider countryside species), in different UK countries and in different habitats (e.g. farmland and woodland).

Since the UKBMS began, volunteers have walked over 563,000km of butterfly transects - equivalent to over 14 times around the Equator. The transect method has been adopted in many other countries and can now be used to generate butterfly trends at a European scale.

Butterfly populations are highly sensitive to environmental change and respond very rapidly. Thus, annual population trends derived from the UKBMS give early warnings of change, while trends over time highlight species' reactions to conservation management or policy initiatives.

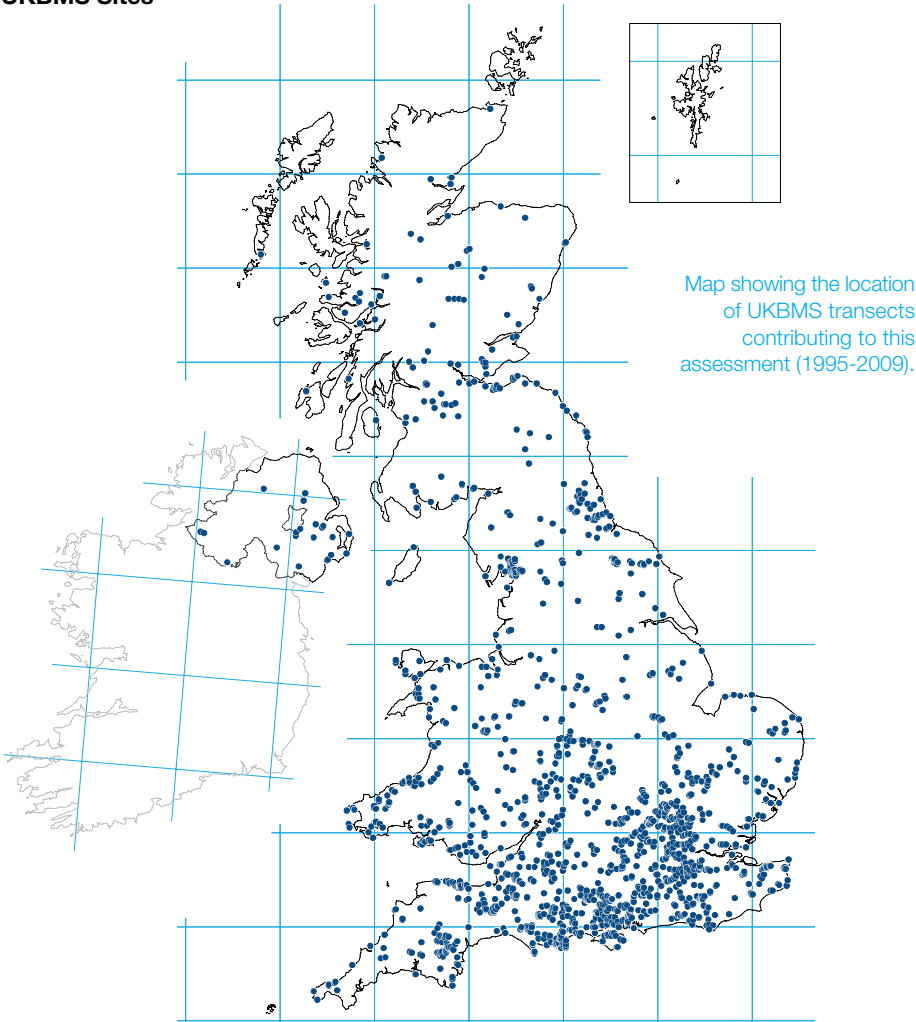
In common with most insects, butterfly populations fluctuate greatly from year to year, largely in response to variations in weather. As a result, long time-series of data, such as the UKBMS provides, are needed to spot underlying population trends within the 'noise' of annual fluctuations.

UKBMS sites are not chosen at random - most monitoring is undertaken in semi-natural habitats and in protected areas. The strength of this is that population trends can be generated for almost all threatened species. The approach also helps to maintain the high levels of commitment needed by transect recorders. However, another implication is that the UKBMS trends may not be fully representative of more widespread species in highly-modified habitats such as intensive farmland, gardens and parks.

To address this concern, a new national monitoring scheme (the Wider Countryside Butterfly Survey) based upon randomly selected grid squares has operated since 2009. It is too early to include the findings in this assessment.

We have used UKBMS data to calculate annual rates of population change for 53 species over the period 1995-2009 (data were not sufficient for the other six species), the same time period as used to calculate distribution trends. This annual rate of change was then used to calculate the percentage change over a 10-year period for each species. Thus the 10-year UKBMS trends presented in this report are not for the 10-year period 2000-09 but are derived from changes measured over the 15 years 1995-2009. In addition, UKBMS data were used to provide overall indicators of butterfly populations in different UK countries and habitats. As for individual species, the trends of these indicators were calculated as 10-year trends but using data from the period 1995-2009.

UKBMS Sites



UK 10-year distribution and population trends

UK Biodiversity Action Plan Priority Species are shown with vernacular and scientific names in bold.

| Species | Scientific name | 1995-99 occupied squares | 2005-09 occupied squares | 10-year distribution trend | No. of UKBMS sites 1995-2009 | 10-year population trend | Statistical significance † |
|--|--|--------------------------------|--------------------------------|----------------------------------|---------------------------------------|--------------------------------|-------------------------------|
| Chequered Skipper | <i>Carterocephalus palaemon</i> | 28 | 26 | -7% | - | - | |
| Small Skipper | <i>Thymelicus sylvestris</i> | 1459 | 1422 | -3% | 993 | -62% | *** |
| Essex Skipper | <i>Thymelicus lineola</i> | 639 | 687 | 8% | 492 | -67% | *** |
| Lulworth Skipper | <i>Thymelicus acteon</i> | 12 | 12 | 0% | 14 | -52% | * |
| Silver-spotted Skipper | <i>Hesperia comma</i> | 31 | 42 | 35% | 64 | -19% | |
| Large Skipper | <i>Ochlodes sylvanus</i> | 1565 | 1442 | -8% | 1074 | -35% | *** |
| Dingy Skipper | <i>Erynnis tages</i> | 578 | 547 | -5% | 450 | -19% | * |
| Grizzled Skipper | <i>Pyrgus malvae</i> | 385 | 320 | -17% | 357 | -29% | + |
| Swallowtail (resident) | <i>Papilio machaon britannicus</i> | 5 | 5 | 0% | - | - | |
| Swallowtail (migrants) | <i>Papilio machaon gorganus</i> | 38 | 44 | 16% | - | - | |
| Wood White | <i>Leptidea sinapis</i> | 82 | 63 | -23% | 65 | -49% | * |
| Cryptic Wood White | <i>Leptidea juvernica</i> | 48 | 53 | 10% | - | - | |
| Clouded Yellow | <i>Colias croceus</i> | 1151 | 1143 | -1% | 696 | 235% | |
| Brimstone | <i>Gonepteryx rhamni</i> | 1240 | 1232 | -1% | 996 | 0% | |
| Large White | <i>Pieris brassicae</i> | 2299 | 2126 | -8% | 1223 | 34% | |
| Small White | <i>Pieris rapae</i> | 2157 | 2060 | -4% | 1213 | -26% | |
| Green-veined White | <i>Pieris napi</i> | 2594 | 2594 | -3% | 1203 | -9% | |
| Orange-tip | <i>Anthocharis cardamines</i> | 2195 | 2192 | 0% | 1111 | -8% | |
| Green Hairstreak | <i>Callophrys rubi</i> | 948 | 1002 | 6% | 512 | -27% | * |
| Brown Hairstreak | <i>Thecla betulae</i> | 134 | 136 | 1% | 61 | -40% | + |
| Purple Hairstreak | <i>Favonius quercus</i> | 1006 | 847 | -16% | 451 | -9% | |
| White-letter Hairstreak | <i>Satyrium w-album</i> | 571 | 756 | 32% | 205 | -55% | ** |
| Black Hairstreak | <i>Satyrium pruni</i> | 24 | 29 | 21% | 11 | - | |
| Small Copper | <i>Lycaena phlaeas</i> | 2050 | 1927 | -6% | 1123 | -24% | |
| Small Blue | <i>Cupido minimus</i> | 247 | 238 | -4% | 209 | 31% | |
| Silver-studded Blue | <i>Plebejus argus</i> | 94 | 91 | -3% | 75 | -29% | |
| Brown Argus | <i>Aricia agestis</i> | 720 | 795 | 10% | 593 | -38% | * |
| Northern Brown Argus | <i>Aricia artaxerxes</i> | 120 | 132 | 5% | 54 | -44% | *** |
| Common Blue | <i>Polyommatus icarus</i> | 2273 | 2147 | -6% | 1186 | -30% | |
| Chalkhill Blue | <i>Polyommatus coridon</i> | 211 | 208 | -1% | 263 | -26% | |
| Adonis Blue | <i>Polyommatus bellargus</i> | 96 | 125 | 30% | 122 | 33% | |
| Holly Blue | <i>Celastrina argiolus</i> | 1460 | 1409 | -3% | 956 | -29% | |
| Large Blue | <i>Phengaris arion</i> | 3 | 6 | 100% | 21 | 271% | ** |
| Duke of Burgundy | <i>Hamearis lucina</i> | 108 | 76 | -30% | 123 | -46% | ** |
| White Admiral | <i>Limenitis camilla</i> | 374 | 428 | 14% | 267 | -9% | |
| Purple Emperor | <i>Apatura iris</i> | 91 | 131 | 44% | 61 | 31% | |
| Red Admiral | <i>Vanessa atalanta</i> | 2451 | 2402 | -2% | 1228 | -21% | |
| Painted Lady | <i>Vanessa cardui</i> | 2209 | 2419 | 10% | 1185 | 52% | |
| Small Tortoiseshell | <i>Aglais urticae</i> | 2554 | 2470 | -3% | 1214 | -64% | ** |
| Peacock | <i>Aglais io</i> | 2134 | 2492 | 17% | 1234 | -24% | * |
| Comma | <i>Polygonia c-album</i> | 1487 | 1599 | 8% | 1103 | 34% | + |
| Small Pearl-bordered Fritillary | <i>Boloria selene</i> | 763 | 671 | -12% | 230 | -19% | |
| Pearl-bordered Fritillary | <i>Boloria euphrosyne</i> | 260 | 149 | -43% | 187 | -42% | * |
| High Brown Fritillary | <i>Argynnis adippe</i> | 55 | 28 | -49% | 110 | -69% | *** |
| Dark Green Fritillary | <i>Argynnis aglaja</i> | 938 | 931 | -1% | 452 | 18% | |
| Silver-washed Fritillary | <i>Argynnis paphia</i> | 525 | 586 | 12% | 443 | 38% | |
| Marsh Fritillary | <i>Euphydryas aurinia</i> | 246 | 225 | -9% | 199 | 71% | + |
| Glanville Fritillary | <i>Melitaea cinxia</i> | 9 | 11 | 22% | 9 | - | |
| Heath Fritillary | <i>Melitaea athalia</i> | 13 | 14 | 8% | 47 | -34% | |
| Speckled Wood | <i>Pararge aegeria</i> | 1614 | 1932 | 20% | 1133 | 42% | ** |
| Wall | <i>Lasiommata megera</i> | 1381 | 1093 | -21% | 596 | -37% | * |
| Mountain Ringlet | <i>Erebia epiphron</i> | 38 | 47 | 24% | 6 | - | |
| Scotch Argus | <i>Erebia aethiops</i> | 320 | 329 | 3% | 36 | -33% | ** |
| Marbled White | <i>Melanargia galathea</i> | 657 | 668 | 2% | 728 | -21% | * |
| Grayling | <i>Hipparchia semele</i> | 598 | 489 | -18% | 238 | -33% | * |
| Gatekeeper | <i>Pyronia tithonus</i> | 1400 | 1372 | -2% | 1074 | -23% | * |
| Meadow Brown | <i>Maniola jurtina</i> | 2496 | 2441 | -2% | 1276 | -8% | |
| Ringlet | <i>Aphantopus hyperantus</i> | 1824 | 1970 | 8% | 1077 | 25% | * |
| Small Heath | <i>Coenonympha pamphilus</i> | 2133 | 1934 | -9% | 955 | -28% | |
| Large Heath | <i>Coenonympha tullia</i> | 359 | 295 | -18% | 26 | 189% | *** |

† Statistical significance of 10-year population trends + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

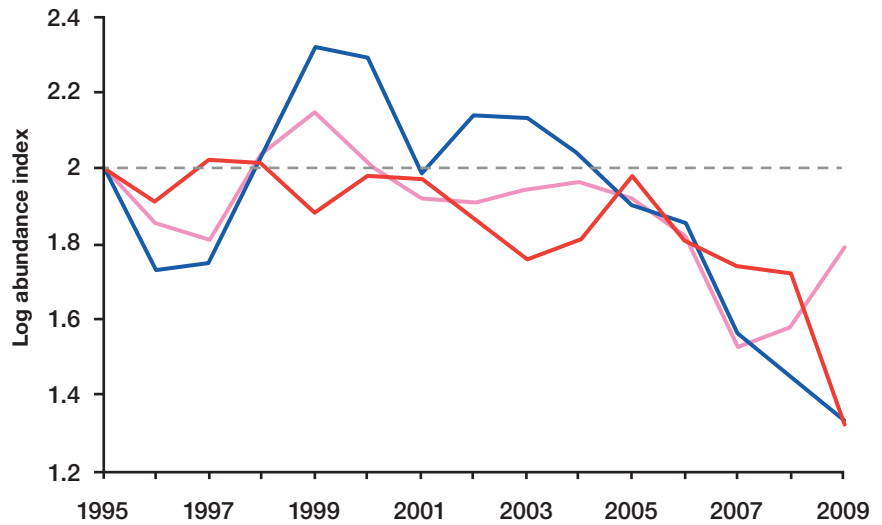
Trends of UK butterflies

Butterflies in decline

The results of the analysis of 10-year distribution and population trends for butterflies in the UK are shown opposite (left).

The results show that over three-quarters of UK species have declined over the 10-year period, either in distribution or population, or both. Examples include the Lulworth Skipper, Duke of Burgundy and Wall (see below and right). Many of these butterflies have also suffered long-term declines, going back 50-150 years.

UKBMS population indices for the Lulworth Skipper (blue line), Duke of Burgundy (red line) and Wall (pink line), all showing decreasing abundance.



Duke of Burgundy



10-year population change -46%
10-year distribution change -30%

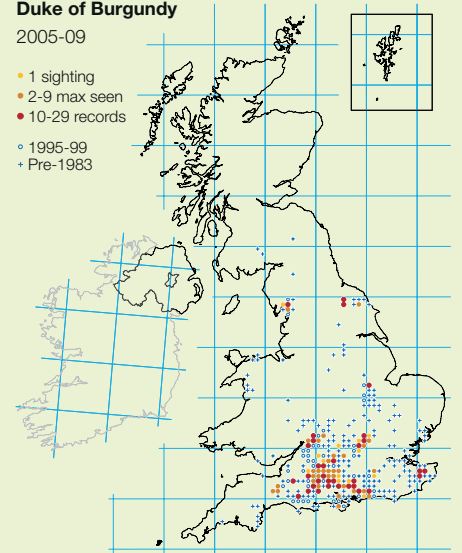
The Duke of Burgundy is one of the UK's most rapidly declining butterflies. In both grassland and woodland, the butterfly relies upon a mosaic of tall grassland sheltered by scrub. Colonies have declined due to either too little or too much management, which have replaced the mature grassland sward with scrub or short turf respectively. Many colonies are now small and isolated, and thus prone to extinction.

Targeted, landscape-scale conservation can turn the situation around as has been demonstrated by Butterfly Conservation's programme of scrub management at a network of remaining sites in the North York Moors.

Duke of Burgundy

2005-09

- 1 sighting
- 2-9 max seen
- 10-29 records
- 1995-99
- Pre-1983



Wall



10-year population change -37%
10-year distribution change -21%

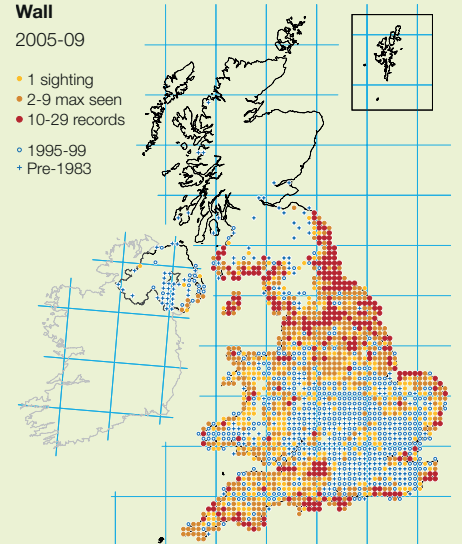
Although still a commonplace butterfly of the wider countryside in the north and west of its range, populations of the Wall have collapsed across a huge swathe of England. The decline began in the 1990s but has continued more recently.

The dramatic loss of colonies, the causes of which are not understood, has spread northwards; the initial declines were seen in southern counties such as Surrey and Oxfordshire in the late 1990s but the same pattern is now being repeated in Derbyshire, Leicestershire and Staffordshire.

Wall

2005-09

- 1 sighting
- 2-9 max seen
- 10-29 records
- 1995-99
- Pre-1983



Butterflies in decline *continued*

Other butterflies that have declined substantially over the past decade include threatened species such as the Lulworth Skipper (image below), Wood White, High Brown Fritillary, Pearl-bordered Fritillary and Grayling. With the exception of the Lulworth Skipper, all of these species have suffered long-term declines highlighted in previous reports. Thus, the 10-year trends presented here represent further substantial losses to species whose range and abundance have already been reduced.

Perhaps the most surprising recent decline is that of the Small Tortoiseshell, one of the most familiar and best loved garden butterflies. Its populations are naturally prone to 'boom and bust' cycles, but the butterfly has undergone an unprecedented decrease over the period reported here.

After a modest peak in 2003, population levels fell to record lowest levels (since monitoring began in 1976) in each of four successive years from 2005 to 2008, before a small recovery in 2009.

Suggestions that this decline was caused solely by a parasitic fly *Sturmia bella*, which has recently colonised the UK, have not been substantiated by recent research; other unknown (possibly climatic) factors are probably also involved.

Other surprising population decreases were those of the Small Skipper and Essex Skipper, both species that are expanding their UK distributions. Poor summer weather may be responsible, but further research is needed to see whether there are other drivers of change.

Turning the corner

Several species, shown in previous reports to have undergone severe long-term declines, appear to have fared better recently. Examples include the Large Blue, Heath Fritillary, White Admiral and Silver-washed Fritillary, whose national distributions have increased slightly over this period, and the Dingy Skipper, Small Blue, Silver-studded Blue and Dark Green Fritillary, which have remained almost stable.

The population levels of the Small Blue, Dark Green Fritillary and Silver-washed Fritillary (as well as the Marsh Fritillary) have also increased, while that of the White Admiral has only declined by a small amount. However, the population trends for the Dingy Skipper, Silver-studded Blue and Heath Fritillary at monitored sites are negative and, therefore, remain a cause for concern.

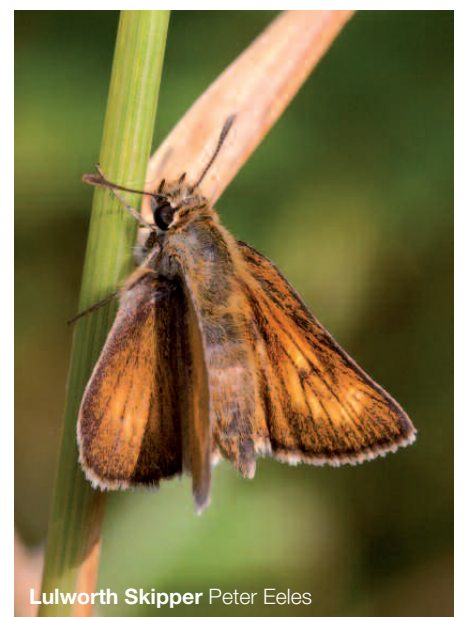
Nevertheless, the reversal or stabilization of national distribution trends and, in some cases, population trends, is a cause for celebration and a vindication of intense efforts by Butterfly Conservation and its partners at countless sites across the UK.

The substantial increases in recorded distribution shown by the BNM data for the White-letter Hairstreak, Purple Emperor and Mountain Ringlet can be attributed, in large part, to increased recording effort resulting from specific projects to target these traditionally under-recorded species.



Heath Fritillary Michael Walter

A decade of intensive conservation management in Kent and Essex woodlands, as well as on Exmoor, has brought the Heath Fritillary back from the brink of extinction in the UK. On Exmoor, the number of colonies was the same in 2009 as in 1999 (15 colonies), while in the Blean Woods stronghold in Kent, the number of colonies has more than doubled from 14 in 1996 to 30 in 2009. Nevertheless, the 10-year population trend for the Heath Fritillary is strongly negative and indicates an ongoing challenge to conserve this species.



Lulworth Skipper Peter Eeles

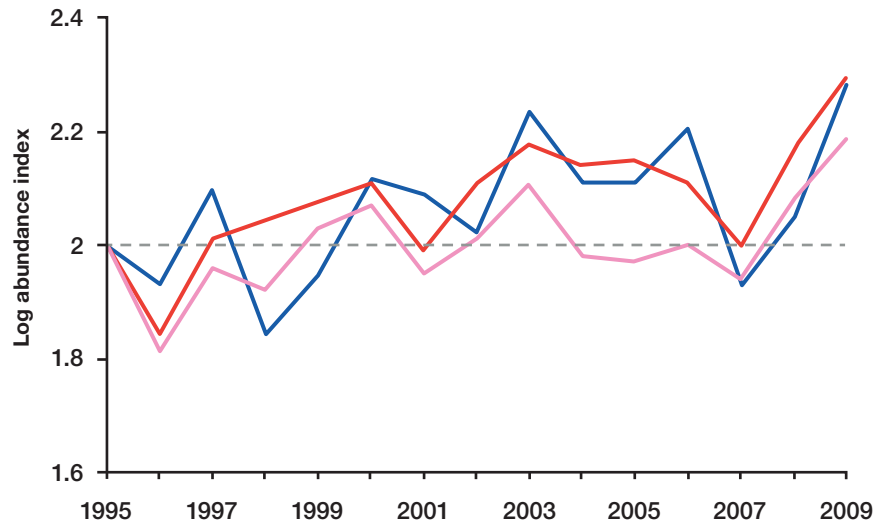
The Lulworth Skipper has suffered a 52% population decline over 10 years.

Flying high

A small number of UK butterflies have continued to thrive over the past decade. Most of these are mobile, generalist species which are able to find suitable breeding habitat even in highly-modified landscapes such as intensive farmland and urban areas.

Species such as the Peacock, Comma, Speckled Wood and Ringlet have continued to spread rapidly northwards in mainland Britain, and the Comma may also have started to colonise Northern Ireland. There is convincing scientific evidence that the increases in distribution and population levels of these species have been caused by climate change.

UKBMS population indices for the Comma (blue line), Speckled Wood (red line) and Ringlet (pink line), all showing increasing abundance.



Peacock Robert Thompson

The Peacock has undergone a major recent expansion of its range in northern Scotland.



Adonis Blue Peter Eeles

The Adonis Blue, a previously-threatened, habitat specialist butterfly that is now recovering thanks to conservation management and climate warming.

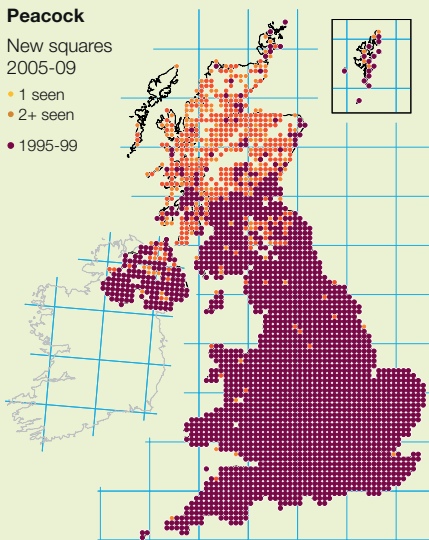
Another apparent impact of climate change has been the Red Admiral's recent colonisation of the UK. Previously regarded purely as an immigrant species that bred in the UK during the summer, Red Admirals are now staying here throughout the winter. The species is now the most commonly recorded UK butterfly during the winter, with courtship behaviour and mating having been observed during January and larval development continuing all year round in a number of recent years.

In addition, some formerly-declining butterflies that had shown signs of recovery in the last status report have continued to improve. The Large Blue, which was reintroduced to the UK after its extinction here in 1979, has made good progress, particularly in the Polden Hills, Somerset. Here, introduced colonies of the Large Blue have spread naturally leading to the establishment of around 20 new colonies. Overall, numbers have increased enormously (271% increase in 10-year population trend) and the best sites now contain the greatest densities of Large Blue butterflies ever recorded worldwide.

The Silver-spotted Skipper and Adonis Blue, both of which were downgraded from UK BAP Priority Species status after the previous report, have continued to recover lost ground increasing by 35% and 30% in distribution respectively. Population trends are more variable for these species, but show an increase for the Adonis Blue and an apparent decline for the Silver-spotted Skipper. The positive progress made by these three species can be attributed to successful conservation of their unimproved grassland habitats, with climate warming also having a beneficial effect.

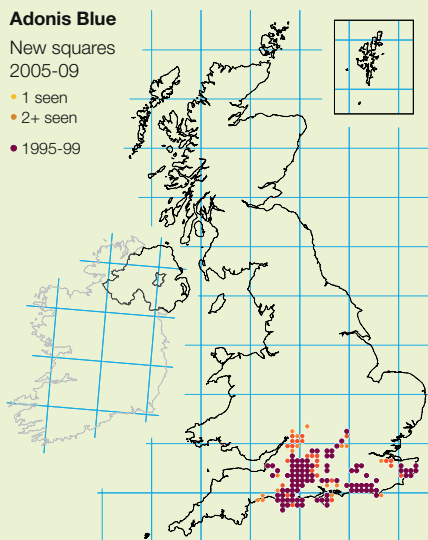
Peacock

New squares 2005-09
 • 1 seen
 • 2+ seen
 • 1995-99



Adonis Blue

New squares 2005-09
 • 1 seen
 • 2+ seen
 • 1995-99



Butterfly indicators

The past decade has seen the development of a range of ‘butterfly indicators’ – multi-species population measures based upon UKBMS data. Several of these indicators have been adopted by Government as policy-relevant measures of the broad state of biodiversity and the environment.

In addition to calculating butterfly indicators for separate countries and habitat types, an informative distinction is to compare trends for habitat specialist species (i.e. those restricted to semi-natural habitats such as heathland, bog, unimproved grassland and native woodland) with those of wider countryside species (i.e. those that can breed in landscapes that have been highly modified by humans such as intensive farmland, parks and gardens). Previous reports have shown that habitat specialists have fared much worse since the 1970s than wider countryside species.

It is not yet possible to construct all combinations of butterfly indicator because there are insufficient data for some countries, habitats and species groups. This will improve in the future as more sites are monitored and we are actively seeking new volunteers to help fill the gaps, for example in the uplands.

A selection of indicators are shown on this page. These demonstrate an ongoing decline in the UK population of butterflies as a whole over the 10-year period, with both habitat specialists and wider countryside species in decline (although the former trend is not statistically significant). Butterfly populations appear to be faring much better in Scotland, at present, than in England.

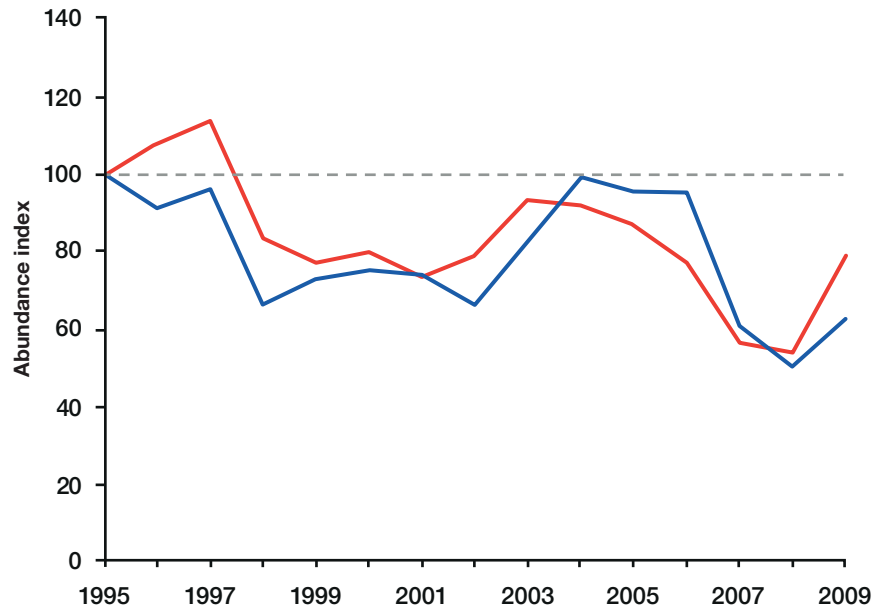
The habitat indicators for England show steep declines of butterfly populations (habitat specialists and wider countryside species) at both farmland (which includes all land managed agriculturally by livestock grazing or cultivation) and woodland sites.

The major decline of woodland butterflies (51% decrease) is thought to be due to a lack of woodland management and loss of open spaces in woods (see box opposite).

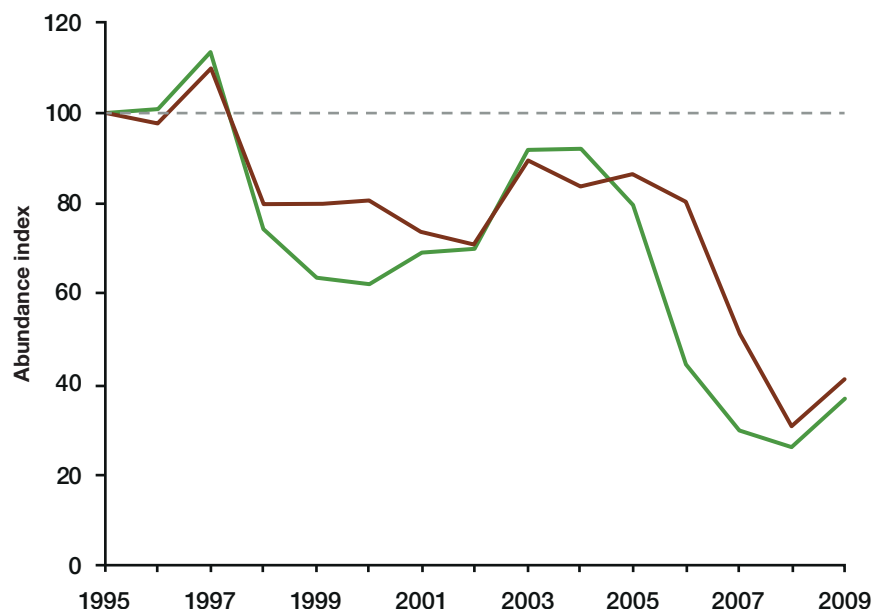
Ten-year trends in butterfly indicators.

| Indicator | 10-year trend | Statistical significance (+ p<0.1, * p<0.05, ** p<0.01, *** p<0.001) |
|-------------------------------------|---------------|--|
| UK habitat specialists | -18% | |
| UK wider countryside species | -24% | * |
| England habitat specialists | -22% | |
| England wider countryside species | -25% | ** |
| England all butterflies in woodland | -51% | ** |
| England all butterflies on farmland | -41% | ** |
| Scotland habitat specialists | 0% | |
| Scotland wider countryside species | 11% | |

UK butterfly indicators for habitat specialists (blue line) and wider countryside species (red line).



Butterfly indicators for different habitats in England: woodland (green) and farmland (brown)



The state of the UK's butterflies

The millions of records collated from thousands of members of the public over recent years allow a comprehensive assessment to be made of the state of butterflies in the UK.

Three clear themes emerge.

1 Ongoing butterfly declines

Although not every species is affected in every part of the UK it is clear that **UK butterflies are still in serious decline and continue to be one of our most threatened wildlife groups.**

The UKBMS 10-year population trends show that significantly more species declined than increased: 38 species (72% of the 53 species for which trends were calculated) declined in numbers compared to only 14 species (26%) that increased and a single species that showed no change (2%). In addition, the UK distributions of 32 species (54% of the 59 species assessed) decreased during the decade, while 24 species (41%) increased their distribution and three remained stable (5%).

Thus, three-quarters of butterfly species declined in either distribution or population over the period reported here, following on from the severe long-term declines, documented in previous reports. However, half of species showed an increase in either distribution or population trend.

The composite population indicators provide further evidence of decline. The total number of wider countryside butterflies in the UK decreased significantly (by 24%) and habitat specialists also showed an apparent decline. This picture is repeated for trends in England, but butterfly populations seem to be faring better in Scotland over recent years with no decline in habitat specialists and an apparent increase in the abundance of wider countryside species. At woodland and farmland sites in England (which include nature reserves managed by grazing livestock for example) the total number of butterflies (all species) decreased sharply.

2 Ongoing range expansions of some common butterflies

A minority of species have continued their long-term range expansions in response to climate change. Around a dozen wider countryside species have spread substantially, mainly in Scotland and northern England, although some of these have simultaneously undergone decreases in their national population levels.

3 Recovery of some threatened species through conservation effort

For the first time, analysis of butterfly trends provides evidence across a range of species that **targeted conservation effort is having a beneficial impact on threatened butterflies.** Previously, indications of recovery had only been seen in the Silver-spotted Skipper, Adonis Blue and Large Blue. These have been joined by other butterflies whose distributions and/or populations show signs of stabilizing (albeit at low levels) or increasing. At present, only half a dozen or so threatened species show signs of recovery but it is hoped that more successes will be revealed in years to come, provided that conservation effort continues.

Causes of change

Weather is the principal factor that causes butterfly populations to fluctuate from year to year. However, through the long time-series of data gathered by the UKBMS and BNM, underlying trends can be distinguished from short-term weather effects.

The ongoing deterioration of butterfly habitats is the primary reason for continued declines. As a result of the cessation of traditional management systems in both agriculture and forestry, land management

has become increasingly polarised with some areas being managed ever more intensively while others are completely abandoned. Butterflies and other wildlife are squeezed out of the landscape in both instances. Furthermore, butterfly habitats continue to be destroyed for development. The isolation and often small size of the remaining habitats further increase risks of extinction, for example due to bad weather, fire or disease.

The past decade or so has also seen considerable effort and expenditure to improve land management for biodiversity, especially on protected areas and through agri-environment and woodland grant schemes. However, with some exceptions, this positive management appears not to have yielded the desired benefits for butterflies. The quantity, quality and targeting of such management appears to have been insufficient to stem the general decline of butterflies.

In contrast, the outlook for some threatened species has improved substantially in response to sustained conservation management. The warming climate may also have aided the recovery of some of these species.

Climate warming has undoubtedly improved conditions for most of the UK's butterflies. However, because of habitat destruction, only around one-fifth of butterflies have been able to benefit from climate warming by expanding their ranges. In addition, the recent run of years with unsettled summer weather may have counteracted the benefits of general warming (and conservation management) and might have contributed to the decline of butterflies reported here.

Crisis in the woods

Woodlands provide breeding habitats for two-thirds of the UK's butterfly species. The amount of broadleaved woodland in the UK increased over the past century, but woodland butterflies have declined drastically. The 10-year indicator trends show that the number of butterflies in English woodlands fell by 51%, and both habitat specialists (49% decrease) and wider countryside butterflies (52% decrease) declined markedly at woodland sites.

Changing woodland management appears to be the cause. Traditional management has ceased in most woodlands and, as a result, our woods are darker, shadier places than they have been for hundreds of years. While this favours a few butterflies, such as the Speckled Wood, White Admiral, Silver-washed Fritillary and Purple Hairstreak, it is highly damaging for most threatened species such as the Wood White, Pearl-bordered Fritillary and Duke of Burgundy, which require open sunny habitats within woods.



Pearl-bordered Fritillary Neil Hulme

The 2010 target and beyond

The UK Government has accepted that the target to halt the loss of biodiversity by 2010 has not been met. Despite some successes, many butterflies, including UK BAP Priority Species, continue to decline severely, from levels already much reduced during the preceding decades.

This is a deeply disappointing conclusion. The UK's butterflies continue to show an overall decline and efforts must be redoubled to address this ongoing and enormous challenge. Nevertheless, the 2010 target provided many benefits. In addition to increased levels of funding for conservation, the initiatives adopted over the past decade to conserve butterflies are starting to bear fruit.

Landscape-scale projects (partnerships between communities, conservation groups and statutory bodies) integrated with the species-focussed aspects of the UK BAP process have benefited butterflies and other wildlife. These positive outcomes can be seen time and time again at the local level (see examples below) and are becoming clear in the national trends for species such as the Heath Fritillary.

This approach needs to be built upon and allocated more resources in order to tackle the continued declines of the UK's butterflies in the coming decade.

Case studies in landscape-scale species conservation

Bringing the woods back to life



Volunteer work party Steve Teale

Butterfly Conservation's *South East Woodlands* project aimed to reverse the decline of threatened butterflies by co-ordinating management at the landscape-scale across heavily-wooded landscapes from Kent to Wiltshire.

By training thousands of members of the public to monitor butterflies, giving advice on over 200 sites and by targeting over £400,000 of grants for woodland improvement to create butterfly habitats,

species such as the Duke of Burgundy, Wood White, Grizzled Skipper and Pearl-bordered Fritillary have increased and spread to form new colonies.

Many once-abandoned woods are now being managed, improving conditions for local wildlife and local people, and landowners are benefiting from emerging markets for timber such as charcoal and woodfuel.

Saving the High Brown Fritillary



High Brown Fritillary Tim Melling

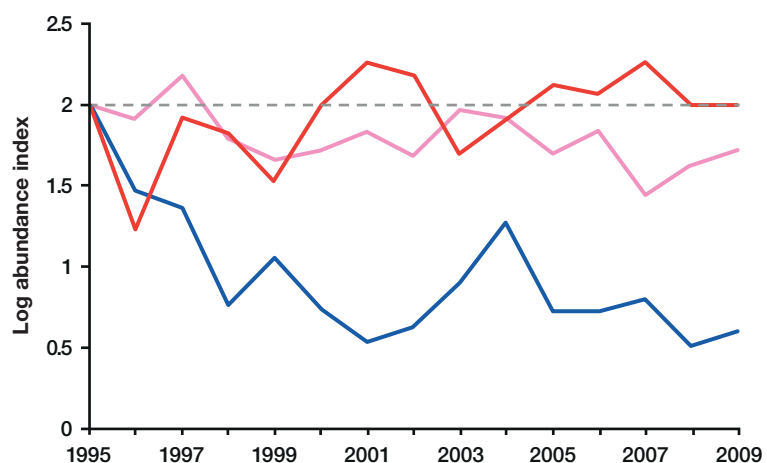
Britain's most endangered butterfly, the High Brown Fritillary, is on the verge of extinction in Wales and has only two remaining strongholds in England.

Working in partnership with local people, local authorities and other organisations, Butterfly Conservation volunteers and staff have reinstated habitat management, such as scrub clearance and livestock grazing, at the last Welsh site, in the Alun Valley, and on over 30 sites in the Morecambe Bay area of North West England.

Regular butterfly monitoring by volunteers has shown the immediate benefits of this work: the number of High Brown Fritillaries in the last Welsh colony has increased tenfold since 1999, while in the Morecambe Bay area the butterfly's populations, although in decline, have fared far better than elsewhere (see plot below).

A focus on the specific needs of this threatened butterfly has been key in both projects, benefiting not only the High Brown Fritillary, but much other wildlife besides.

UKBMS population indices for the High Brown Fritillary at monitored sites in the Morecambe Bay area (pink line), Alun Valley in South Wales (red line) and rest of UK sites (blue line).



Turning the tide: halting butterfly declines by 2020

After the acknowledged failure of the 2010 target, European Union governments including the UK have agreed a new and equally ambitious goal: to halt the loss of biodiversity and degradation of ecosystem services by 2020.

Butterflies provide an excellent opportunity not only to monitor progress towards this target, but also an important focus for the development of efficient and cost-effective policies and initiatives to achieve the objective. We believe that the following approaches are essential:

Landscape-scale conservation

Landscape-scale conservation, often pioneered with butterfly-focussed projects, has provided a paradigm shift in UK biodiversity conservation during the past decade. The approach recognises the importance of targeted habitat management and restoration across networks of sites in the local landscape. This sustains butterflies and other wildlife in the long term, by increasing the net amount of high quality habitat that is available to species and by allowing the natural processes of colonisation and extinction to occur at individual sites. The approach requires good information on actual and potential habitat, as well as suitable management techniques, local site knowledge and partnership working with landowners.

In addition to improving the long-term survival of threatened species, landscape-scale conservation brings other benefits including economies of scale in the costs of habitat management, employment opportunities, maintenance of the distinctive landscape character of areas, partnership working between organisations from statutory, private and non-governmental sectors and far greater involvement of local people, volunteers and communities.

During the past decade, Butterfly Conservation has been involved in over 70 landscape-scale conservation projects. Thousands of members of the public and hundreds of organisations have worked with us to benefit species such as the Marsh Fritillary in Argyll, Fermanagh and South Tyrone, and on the moors of Devon and Cornwall, the Duke of Burgundy in the North York Moors and the Small Blue and Grizzled Skipper on the brownfields sites of the English Midlands. Such projects have yielded many local successes, but the ongoing decreases of most butterfly species underline the need for wider application and greater resourcing of landscape-scale action to reverse decades of decline.

Agri-environment schemes

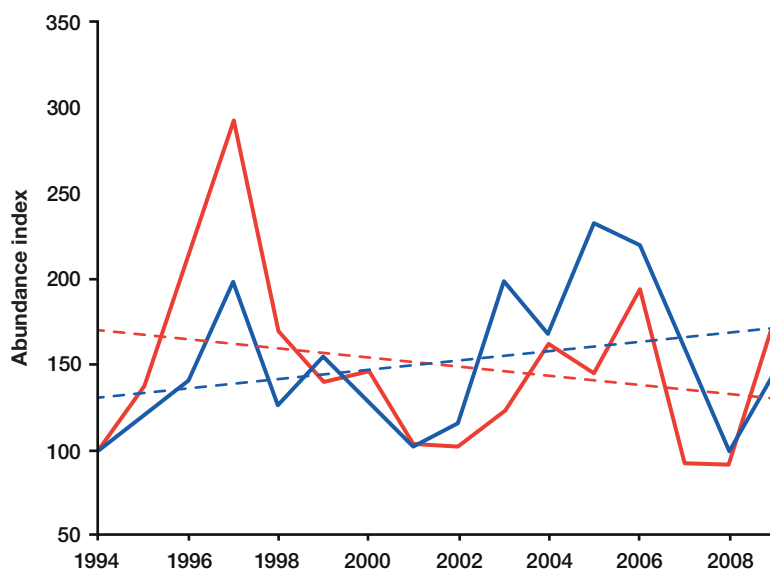
Targeted agri-environment schemes (e.g. Higher Level Stewardship) that are focussed on high nature value farmland have proved their worth over the past decade. BNM data have been used to enable effective targeting of scheme agreements and butterfly monitoring has provided clear evidence of the benefits of such payments. Studies of individual species (e.g. Silver-spotted Skipper, Chalkhill Blue) and composite indices of habitat specialists (see plot below) show that populations have fared better at sites entered into agri-environment schemes. Thus, especially in times of severe constraints on government expenditure, such highly-focussed schemes provide an effective means of delivery across a range of policy areas.

The benefits of 'entry-level' agri-environment schemes are unproven at present for butterflies and, as currently implemented, are unlikely to bring major benefits. However, the ongoing decline of common butterflies and other insects, such as bees and moths, necessitates the restoration of biodiversity across the whole landscape in order to preserve ecosystem services. Properly resourced mass-participation entry-level schemes should thus play a key role in the efforts to meet the 2020 target. Refined options, enhanced advice and targeting will be necessary to deliver measurable benefits for wildlife.

Woodland management

Woodland butterflies and other wildlife have suffered major declines in recent decades due to the lack of appropriate management. The abandonment of traditional silvicultural systems such as coppicing and wood pasture has led to dense, shady woods. The management needed to reverse the declines of butterflies is well-understood and aims to create structurally complex woodlands, with a diversity of habitats and vegetation, and long-term continuity of management as part of the wider landscape. Specific techniques include promoting a diverse age structure of trees by selective felling, widening rides, thinning the canopy, restoring active coppice, reducing browsing by deer, developing grassland or scrub buffer strips around the woodland edge, and reducing isolation through new planting and hedgerow management.

The sustainable management of woodlands for biodiversity and recreation relies heavily on grants from public sector and charitable organisations and on the development of new economic models and markets for timber (e.g. woodfuel in the form of logs, woodchip, pellets or charcoal). The targeting of woodland grants according to the existing biodiversity value of sites would promote efficient use of limited funds and maximise the benefits for threatened butterflies and other wildlife.



Comparison of UKBMS composite population indices 1994-2009 for 12 habitat specialist butterflies on sites entered into higher level agri-environment schemes (blue line; 239 sites) and those not entered into schemes (red line; 233 sites) in England. Linear trends are marked as dotted lines and show increasing population levels at scheme sites (blue) and decreasing ones at non-scheme sites (red).

Climate change adaptation

Climate continues to play a major role, in conjunction with habitat availability, in determining the status of UK butterflies. Butterfly data remain at the forefront of research into the impact of climate change on biodiversity and ecosystem services. The influence of climate change in the observed northward spread of butterflies at UK and European scales is firmly established, and predictive models are being refined further to incorporate measures of habitat and species mobility. The arrival of new butterfly species in gardens can be persuasive evidence of climate change for the public.

Evidence is accumulating for significant negative impacts of current and future climate change on butterflies at the lower altitudinal or latitudinal limits of their ranges. The recent *Climatic Risk Atlas of European Butterflies* suggested that three-quarters of European butterflies would lose more than half of their present suitable climatic range by 2080 under high climate change scenarios. Even under the most optimistic climate change predictions for Europe, half to two-thirds of European species would lose more than 50% of their current range.

In general, UK butterflies are predicted to benefit from climate change in the medium term, although conditions may deteriorate for certain species such as the Northern Brown Argus and Large Heath. Nevertheless, it is clear that many butterflies face substantial barriers to their movement in the UK countryside: only a minority of species, typically highly mobile, generalist butterflies, have been able to respond to climate change to date and even these have not moved as far or as fast as expected. Thus, the potential benefits of climate change will not be realised without radical improvements to the quality of our landscape through the re-creation of wildlife habitats. For the most specialised and isolated of species, movement to newly suitable sites may only be possible with direct human involvement (assisted translocation).



Brown Hairstreak and observers
Martin Warren

Butterflies and people

For many people, butterflies provide a focal point for engagement with the beauty and wonder of the natural world, which brings emotional, psychological and cultural benefits, as well as environmental and scientific ones. Citizen science butterfly recording and monitoring schemes, such as the BNM, UKBMS, Wider Countryside Butterfly Survey and the Big Butterfly Count, provide an opportunity for tens of thousands of people to contribute directly to biodiversity research and conservation while enjoying wildlife and the natural environment. UK butterflies are probably the best studied insects in the world and much of the knowledge that underpins conservation initiatives and policy has come from committed amateur naturalists.

Through such schemes, as well as involvement in site management and educational activities, members of the public contributed over 150,000 volunteer days to Butterfly Conservation in 2010. This in turn leads to improved community engagement in decision making at site and local landscape levels, ensuring that resources invested in management or infrastructure are of wider benefit to the public.

Resources for conservation

It is vital to underpin all the above measures with proper resources. Funding for agri-environment schemes should be enhanced in the 2013 Common Agricultural Policy reforms and Woodland Grant Schemes should continue to target management that benefits butterflies and other wildlife. Mechanisms for landscape-scale conservation need to be maintained and increased, including the Landfill Communities Fund, Heritage Lottery Fund and grants from the statutory conservation agencies. Novel forms of halting and reversing biodiversity declines also need to be explored including conservation credits and biodiversity offset schemes.

Such measures not only help conserve threatened butterflies and enrich our lives, but they also support the fabric of nature that is essential for human life. The Economics of Ecosystems and Biodiversity (www.teebweb.org) reports clearly show the economic importance of conserving wildlife and habitats because of the critical services provided by ecosystems, such as pollination, flood mitigation, nutrient cycling and soil formation, water purification, and climate regulation. Although butterflies alone do not provide these vital services, they are important indicators of biodiversity and the quality of the environment.

Conclusions and recommendations

- Butterflies provide an important insight into the changing fortunes of the UK's biodiversity, which underpins ecosystem services essential for human welfare and economic prosperity. They also enrich our quality of life and act as flagship species to engage the public, local communities and the media in biodiversity conservation.
- A decade ago, the UK Government and its counterparts across the European Union pledged to halt the decline of biodiversity by 2010. Butterflies are one of the few wildlife groups for which sufficient data exist to assess progress towards this highly ambitious goal.
- Millions of sightings gathered over recent years show conclusively that the 2010 target was not met for UK butterflies, despite an increase in resources for conservation. Our results show that a simple habitat or ecosystem-led approach is unlikely to be effective for many threatened butterflies without careful targeting and specialist input.
- Overall, three-quarters of butterfly species have declined: 10-year trends show that 54% of species decreased in distribution and 72% decreased in abundance. The total abundance of habitat specialist and wider countryside species decreased at the UK level (although not in Scotland) and, in England, the abundance of all butterflies decreased significantly at woodland and farmland sites.
- Despite this, there are clear signs that some threatened species are beginning to respond favourably to conservation efforts, suggesting that the new 2020 target could be achieved given sufficient political will and resources.
- Butterflies provide a focus for the development of policies and conservation initiatives that will benefit wider biodiversity and ecosystem services.
- Having adopted butterflies as indicators we urge the UK Government and the devolved administrations to use all necessary means to halt the loss of biodiversity by 2020. In particular, we call on them to:
 1. Maintain and restore high-quality habitats through landscape-scale projects delivered by partnerships of conservation organisations and local communities.
 2. Retain and resource the species-focussed approach of the UK Biodiversity Action Plan, which has proved effective at local levels and is starting to turn around the long-term national declines of threatened butterflies.
 3. Enhance funding of 'higher level' agri-environment schemes and woodland grants targeted effectively at threatened UK BAP species and habitats. We urge the Government to resist pressures to further divide the landscape into ever-more intensive agriculture and land 'put aside' for public benefits such as biodiversity and recreation, as this will further damage ecosystem services and move us away from the 2020 target.
 4. Recreate a wider landscape, in both rural and urban areas, that is hospitable to biodiversity through the mass uptake of appropriate design and management options via, for example, revised and refined 'entry level' agri-environment schemes. This will start to restore degraded ecosystem services, benefiting the economy and improving human welfare, and enable species and habitats to respond to climate change.
 5. Encourage public engagement in biodiversity issues, including ecosystem services and climate change, through participation in citizen science projects to monitor butterflies. Such schemes, including the BNM and UKBMS projects, require sustained funding to maintain long-term data collation, but are highly cost-effective as a result of huge inputs of skilled volunteer effort.
 6. Maintain and expand funding schemes for targeted species conservation and landscape-scale initiatives, while exploring new mechanisms such as conservation credits and biodiversity offsets.



Wood White Tim Melling

The Wood White has undergone a 49% population decline and 23% distribution decline over 10 years.

Butterfly Conservation is the UK charity working towards a world where butterflies and moths can thrive for future generations to enjoy. Through conservation programmes on threatened species, management of nature reserves, survey and monitoring, education, training, raising awareness and carrying out research, Butterfly Conservation's work contributes not only to the conservation of biodiversity but also to the creation of a healthier world in which we all can live.

www.butterfly-conservation.org

The Centre for Ecology & Hydrology (CEH) is the UK's Centre of Excellence for integrated research in the land and freshwater ecosystems and their interaction with the atmosphere. CEH is part of the Natural Environment Research Council, employs more than 450 people at four major sites in England, Scotland and Wales, hosts over 150 PhD students, and has an overall budget of about £35m. CEH tackles complex environmental challenges to deliver practicable solutions so that future generations can benefit from a rich and healthy environment.

www.ceh.ac.uk

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The reintroduction and subsequent natural spread of the Large Blue is one of the greatest conservation successes of recent times.

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