BUTTERFLY MONITORING

SCHEME

Report to recorders 2002

Centre for Ecology & Hydrology

NATURAL ENVIRONMENT RESEARCH COUNCIL

JOINT NATURE CONSERVATION COMMITTEE

The Butterfly Monitoring Scheme

Report to Recorders

2002

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SUMMARY

1. This report reviews the national Butterfly Monitoring Scheme (BMS) for the 2002 season and marks the twenty-seventh year of monitoring since the scheme started in 1976.

2. The day-to-day operation of the scheme continues to be run by Mr Nick Greatorex-Davies at the Centre for Ecology and Hydrology (CEH, formerly ITE), Monks Wood. Mr David Roy (CEH Monks Wood) has overall responsibility for management of the BMS. He is also responsible for the technical aspects of the scheme, and co-ordination of research using the BMS. The BMS is jointly funded by the Joint Nature Conservation Committee (JNCC) and by CEH.

3. The method of calculating site indices has been further improved allowing an extra 10% of indices to be calculated compared with the previous method. A smoothed curve using General Additive Models is fitted to counts using the actual date of the count and estimates are produced for unrecorded weeks.

4. The partnership agreement between CEH, JNCC and BC has been finalised and will be signed shortly.

5. Data were received from 125 transects (including 13 Environmental Change Network (ECN) transects) for the 2002 season, though for 24 transects data were too few for any annual indices to be calculated. Data from 5 transects were collected but have yet to be submitted! Ten transects produced no data, but 5 of these are expected to produce data again in 2003 and the other 5 remain part of the BMS with the hope that new recorders can be found. The total number of transects in the BMS in 2002, including those that produced no data, was 137.

6. Data were received electronically from Transect Walker software from 32 transects, an increase of 8 from 2001.

7. The year 2002 was another poor year for butterflies but was slightly better than 2001. It ranked fifth lowest of the 27 years of the scheme. Of 34 species for which collated indices (all-season or summer) were calculated, 18 species showed an increase and 16 a decline on the 2001 figures. In general the **skippers**, **whites** and **fritillaries** did better than 2001 but the **browns** (Satyrinae) did worse or remained more or less unchanged.

8. Three species produced their ***lowest collated index*** of the series. These were **White Admiral**, **Grayling** and, for the third year running, the **Small Heath**. The **Wall Brown** produced another low index with the index dropping from 2001. The **Chalkhill Blue** remained low after the declines of recent years. Of the whites only the **Small White** did badly, and then only in the second generation, producing its third lowest index of the series, continuing a run of five poor seasons for its second generation.

9. No species produced its ***highest collated index***. The **Orange Tip** increased producing it's 5th highest index of the series as did the **Speckled Wood**. The **Grizzled Skipper** showed a substantial increase producing its 9th highest index, and the **Dingy Skipper** showed some signs of recovery after it lowest index in 2001. The **Holly Blue** showed another big increase in the first generation but, unexpectedly, a drop in the second generation. Of the migrant species the **Painted Lady** had a good year producing it's sixth highest index of the series.

10. This report includes a section provided for us by Butterfly Conservation. Using the Adonis Blue as an example it illustrates the value of combining BMS transect data and the large amount of transect data collated by BC. Approximately 40% of 10km squares currently occupied by the Adonis Blue have monitoring coverage, with a good spatial spread through its range, providing more than adequate data for robust collated indices since 1990. Data are also sufficient for regional analysis.

11. Recent and forthcoming publications using data from the BMS are listed.

12. Appendix I contains graphs showing annual fluctuations in the all-sites collated indices of 33 species from 1976-2002.

INTRODUCTION

The purpose of this report is to review the Butterfly Monitoring Scheme (BMS) and to summarise the results of the scheme for the year 2002, with the particular aim of providing feedback to the many transect recorders, site managers and site owners involved with the scheme, on long and short term changes and trends in butterfly abundance and other features of interest.

Origins, organisation and aims of the BMS

The BMS was launched in 1976 by Dr Ernie Pollard based at the Institute of Terrestrial Ecology (ITE) at Monks Wood. The scheme was initially financed jointly by the Nature Conservancy Council (NCC) and ITE. Since 1991 it has been jointly financed by the Joint Nature Conservation Committee (JNCC) (acting on behalf of the statutory conservation agencies (successors to NCC): English Nature, Countryside Council for Wales, Scottish Natural Heritage and the Environment and Heritage Service Northern Ireland), and ITE (now the Centre for Ecology and Hydrology (CEH)).

The day-to-day operation of the scheme continues to be run by Mr Nick Greatorex-Davies. Mr David Roy has taken overall responsibility for the management of the BMS from Dr Dorian Moss, who retires at the end of July 2003. Mr David Roy also provides technical assistance with database management and programming, and co-ordinates research activities using the BMS. Dr Ernie Pollard retired from active involvement in the scheme in 1998 (apart from walking a transect as part of the scheme) but is still available for advice when required.

The primary aims of the scheme are to provide information at regional and national levels on changes in the abundance of butterfly species, to detect trends which may indicate changes in their status and to provide a reliable long-term reference against which population changes in species studied elsewhere on individual sites, or in other countries, can be monitored. It also aims to monitor changes at individual sites and, by comparison with results elsewhere, to assess the impact of local factors such as habitat change caused by management. The scheme also provides information on aspects of the population ecology and phenology of individual species, both in relation to the effect of environmental changes (including climate change) and as a contribution to butterfly ecology.

Sites from which the BMS receives data

The year 2002 was the 27th year of the BMS. Currently 137 transects at sites throughout the United Kingdom contribute to, or are part of, the BMS. At least some data were received from 125 transects (including 13 Environmental Change Network (ECN) transects[1]). Of these, 101 transects provided sufficient data to produce annual site index values for at least some species. 33 transects produced sufficient data for annual indices to be calculated for all the species recorded compared with 20 in 2001 when transect recording was affected by Foot and Mouth Disease.

[1] The ECN was set up in 1993 with funding from the Department of the Environment (now Department for Environment, Food and Rural Affairs) in conjunction with a number of research organisations (including CEH) to monitor changes in the environment, particularly in relation to climate change. Butterfly monitoring is just one part of this programme. ECN transects are not managed as part of the BMS, but data from most of the ECN sites are now used together with the BMS data to calculate the annual all-sites collated indices. Two of the BMS transects are now also ECN transects, making a total of 13 ECN transects. Within the rest of this report BMS and ECN transects will simply be referred to as BMS transects because all potentially contribute to the scheme in providing data for the calculation of the collated annual indices.

Site gained and lost

Three transects were added to the BMS in 2002. These were **Bodmin Mount** in Cornwall and **Dean Castle Country Park** and **Glasdrum NNR** both in Strathclyde, west Scotland. Butterfly monitoring at **Bodmin Mount** local nature reserve has been carried out for several years by the North Cornwall District Council on land that is being managed by the council for nature conservation and amenity. The transect samples areas of heathland, scrub, semi-improved grassland, young broad-leaved woodland and hedge-lined country lanes. **Dean Castle Country Park** is owned by the East Ayreshire Council who manage the site for recreation, education and conservation. The main habitats are mixed woodland and unimproved grassland. The **Glasdrum** transect adds a second Chequered Skipper transect to the national scheme. Apart from Chequered Skipper, the site also has populations of several other scarce butterfly species including Pearl-bordered Fritillary, Small Pearl-bordered Fritillary, Dark Green Fritillary and Scotch Argus. The main habitats on the site are oak and birch woodland with open areas of bracken and mire with abundant Purple Moor Grass (*Molinia caerulea*).

UPDATES ON THE CONTINUED DEVELOPMENT OF VARIOUS FEATURES OF THE BMS

Method of calculating annual indices

As part of our ongoing efforts to improve the efficiency of the BMS, the method of calculating site annual indices has been improved again this year. Indices have been calculated using the actual date the transect was walked, rather than the week number. A smoothed curve is fitted to the daily counts using a Generalized Additive Models (GAMS) and estimates produced for unrecorded weeks. Full details of the method can be found in Rothery & Roy (2001).

The main advantage of the new method is that approximately 10% more indices have been calculated than would have been possible by the previous method. The '30% rule' has still been applied to highlight those indices where the estimated value (for missing counts) is greater than 30% of the total. Plots of these were produced showing the data points and fitted curve to assess whether the site annual index was acceptable. An assessment was carried out separately by NG-D and DBR and there was a high level of agreement in the results of the assessment. As a result of the improved method, we no longer provide estimates for missing weeks on summary tables as estimates relate to a point on the fitted curve rather than an interpolated value.

Partnership agreement & collaboration with Butterfly Conservation

Partnership agreement

The partnership agreement between CEH, Butterfly Conservation and Joint Nature Conservation Committee has almost been completed and finalised. It should be signed by all participating organisations shortly.

Aims of a joint scheme

The three organisations have been working together on butterfly monitoring for several years, notably by sharing data, information, expertise, software (Butterfly Conservation's Transect Walker) and other technical developments for the handling and analysis of data. We aim to secure extra funding for an enlarged joint butterfly monitoring scheme to produce improved **national**, **regional** and major habitats **collated indices**. We aim to cover the majority of the UKs butterfly species for which the BMS method is a suitable monitoring method, including species for which it has not been possible to provide collated indices in the past. In addition, improved data will be provided for more in depth scientific research into butterfly ecology and for investigating the impacts of climate change.

Butterfly Conservation transect co-ordination

Since 1999, Butterfly Conservation has conducted projects for Defra (former Ministry of Agriculture, Fisheries and Food component) to assess the impacts of agri-environment schemes (Countryside Stewardship and Environmentally Sensitive Areas) on butterflies. Through these contracts, BC (Tom Brereton and colleagues) have developed a network of volunteer local transect co-ordinators for each of BCs 31 UK branches, and collated a large quantity of transect data not currently within the BMS. Of this data, about 350 transects walked outside the BMS produce annual indices; a huge potential resource for helping to assess the status of UK butterfly populations. An example of this resource for the Adonis Blue is given on page 30.

Ongoing developments

In collaboration with BC and JNCC, we are investigating a number of areas that may improve the use of BMS data, thereby increasing the value of the scheme.

Alert limits

Firstly, we aim to investigate the feasibility of using smoothed population trends derived from Generalised Additive Models to look at short-, medium- and long-term changes in the status of butterflies. This method is used for assessing the status of breeding birds by the British Trust for Ornithology (BTO) whereby a system of 'Alerts' highlights declines of greater than 25% or greater than 50% that have occurred over the past 5 years, 10 years, 25 years and 31 years (period of monitoring so far). A 25% decline over a given period is recorded as 'amber alert', whereas a 50% decline over the same period as a 'red alert'. See http://www.bto.org/birdtrends/ for further details.

Butterflies as indicators

We are also currently seeking to promote the use of butterflies as indicators to monitor changes in the environment. Two measures derived from BMS are currently used as indicators of climate change for Defra (http://www.nbu.ac.uk/iccuk/): the population index for Common blue (second generation of bivoltine populations) and the mean peak flight date of Orange tip. As many butterfly species are relatively sedentary and form more or less closed populations, they have the potential to act as extremely sensitive indicators of habitat change. As such they would provide an excellent complimentary group to birds that are already used as Headline Indicators by Defra.

Analysis of transect data

Developments in the analysis of transect data are also planned. Building on the use of Generalized Additive Models (GAM) to produce annual site indices (as described in the section above), we plan to extend the technique to further increase the use of data from sparsely monitored transects, i.e. where too few weeks are walked for it to be possible to calculate annual indices by current methods. A proposal, led by BC, has been submitted to Defra to fund a PhD study, jointly supervised by Tom Brereton (BC), David Roy (CEH) and Professor Steve Buckland (Centre for Research into Ecological and Environmental Modelling, University of St. Andrews). The studentship will investigate the use of models to combine data from neighbouring transects and environmental data to estimate missing values. This may prove to be particularly useful in northern areas where it is often very difficult to get a full season's data.

Butterfly monitoring in Scotland

In December BC Scotland held a one-day workshop in Perth on butterfly monitoring. The number of BC staff in Scotland last year increased dramatically from one to four, and they have been able to turn their attention to the issue of how best to monitor butterflies in Scotland. Seventy people attended from all over Scotland and speakers included representatives from CEH BMS and BCs HQ in Dorset. The day highlighted the difficulties of monitoring butterflies in Scotland, particularly those due to the relatively poor weather, the greater distances recorders often need to travel to monitor sites and the relatively small pool of available recorders to draw upon. In addition, many recorders are no longer able to drop everything and go and walk a transect when the weather is suitable. It is clear from BMS data, that for Scotland as a whole, the number of weeks recorders have been able to walk has declined in recent years. In many cases, there has been insufficient data to calculate annual indices. In the early years of the scheme, coverage was much better. The seminar provided

further impetus to finding solutions to using data where fewer weeks have been recorded and for looking at alternative ways for monitoring butterflies in Scotland.

Despite the rather negative message of results presented at the seminar, the day seems to have inspired a greater commitment to, and participation in, monitoring in Scotland. This has been shown by the large response to (nearly half), and positive results of, a questionnaire that was sent out to participants in the wake of the conference. Subsequent contact with recorders of some Scottish transects has also confirmed this. The questionnaire confirmed that the main constraint was lack of resources, both financial and staff/volunteer time. Butterfly monitoring was seen by their organisation (or funding partners) as a low priority.

There are currently 24 transects operating in Scotland that are contributing to the BMS. Since the conference, the Scottish office of Butterfly Conservation have been carrying out an audit of butterfly transects in Scotland that are not part of the BMS. Already another 28 existing transects have been identified, although not all of these are currently being walked and may only have a few, often incomplete, years of data. However the enthusiasm generated by the seminar and the process of the audit is likely to result in some of these transects being better monitored in the future. In addition to these 28 a further 15 transects are due to have started this season.

Butterfly Conservation are planning, in consultation with the BMS to produce a Butterfly Monitoring Strategy for Scotland this autumn once the audit has been completed.

Recording habitat – Site Data Forms

Butterflies tend to be associated with particular types of 'habitat', or more correctly biotope (see definition at the bottom of the page[2]). For convenience the word habitat will be used here. It would be very helpful if habitat could be recorded on butterfly transects so we can gain a greater understanding of how butterflies are faring in different habitats and in different parts of the country.

In the year 2000, together with Butterfly Conservation, we introduced a 40 category classification to enable recorders to record habitats present on their transects section by section, and we have been asking recorders for this information on the now familiar Site Data Form (SDF). In 2001, the SDF was revised so that habitat could be recorded in slightly greater detail (example in Appendix II). The response to this has been encouraging, though there are still many sites for which we do not have SDFs. To date, we have received SDFs on the 2000 forms from 56 transects, and on the revised 2001 form from 50 transects. Some filled in the 2000 form and the 2001 form and in total we have at least one of the SDFs from 81 transects. We would like to encourage all those responsible for BMS transects to complete one of the revised (2001) forms, as this information will be vital when we are in the position to produce separate indices for different major habitats (biotope indices).

[2] The terms biotope and habitat are often used interchangeably as there is confusion and disagreement over exactly what each term means. This is because of the overlap in meaning between the two terms and because of the difficulty in defining the conceptual difference between them. This is made more difficult when considering organisms that occupy habitats at different scales, e.g a Grey Squirrel (temperate broadleaved woodland) versus a springtail (leaf litter). Biotope tends to be a broader term and describes an area as characterised by its environmental conditions and by the biota that are characteristic of it. Habitat considers a species and describes the living and breeding conditions that are required by that particular organism. Temperate broadleaved woodland can be considered as a biotope or a habitat depending on how it is being considered. It is a biotope characterised by certain environmental conditions and is populated by a characteristic flora and fauna. Within the woodland will be many habitats, more precisely defined areas that are suitable living and breeding areas for particular species (e.g mature Blackthorn scrub in sunshine for Black Hairstreak. However for some species the whole area may be described as habitat (e.g. White Admiral).

Developing a system for recording habitat structure & management on butterfly transects

Apart from the presence of adequate supplies of foodplant, it is well known that habitat structure is vitally important for butterflies. Foodplants need to be growing in the right environmental conditions, and these requirements are different for each butterfly species. Clearly how a habitat is managed, including the method, intensity and frequency of management will greatly influence habitat structure. In order to gain a greater understanding of the factors affecting changes in the abundance of butterflies it is important that these things can be measured on a regular basis.

With this aim in mind, an undergraduate student from Bath University (Daria Dadam from Italy) worked with us for six months last summer on this problem. Together we produced a classification for recording habitat structure and management which was then tested in the field on butterfly transects at several woodland sites in eastern England. Results were inconclusive but did serve to highlight particular features of habitat structure and management that would provide valuable information and could be recorded fairly easily on butterfly transects. Further review and development of the work is needed before volunteers among BMS recorders are asked for to try recording some more detailed habitat structure and management information. However Butterfly Conservation have already separately initiated a pilot project to measure turf heights on open habitats on butterfly transects and some BMS recorders are among those who have volunteered to take part.

Transect Walker

In 2002 we received data electronically from Transect Walker (TW) from 32 transects, an increase of eight from 2001. The take up by BMS recorders has been a little disappointing in the light of the numbers of those using TW for the transects monitored outside the BMS and co-ordinated by local BC branches. In this case the majority of recorders are now using TW.

TW can be downloaded free of charge from BCs web site at www.butterfly-conservation.org/. It is very easy to use and it does not take long to enter data. At the end of the 2002 season one of us (NG-D) entered the whole season's data for the three transects local to Monks Wood in less than three hours!

BMS web site

Those of you who have visited the BMS web site recently will see that few updates have occurred over the last year. We aim to address this inactivity by improving the ease with which the content of the site can be more easily updated without the need for input from technical staff (web developers). As a first step we intend to make past BMS reports available as well as selected research highlights.

SUMMARY OF THE 2002 SEASON

The method of calculating collated indices

Up until this year we have reported on changes to butterflies as indicated by collated indices produced by a method known as the chaining method (Moss & Pollard 1993). Last year we carried out a comparison between collated indices produced by the chaining method and those produced by log linear models used by statistical packages such as TRIM (see Appendices I and II in the 2001 report pages 33-46) (ter Braak *et al*. 1993, Pannekoek & van Strien 2001). This is the standard method for analysing monitoring data, and has been adopted by Butterfly Conservation, the Dutch Butterfly Monitoring Scheme, the British Trust for Ornithology and others. For each species there is a very high degree of correspondence between the results produced by the two methods and the general pattern of ups and downs is very much the same. This year, we have decided to change over to using the TRIM method in order to be consistent with other similar schemes. This will inevitably mean there will be some inconsistencies when comparing results presented here with those presented in previous reports, but the general picture should remain unchanged.

First and second generation indices

It should be remembered that first and second generation indices are independent of one another. The indices relate only to those of previous years of that generation. So for example, because there is an increase in the first generation index and a drop in the second generation index, it does not mean that the numbers on the wing in the second generation will be smaller than those in the first. In fact they may be much higher as for many species the second generation is usually the largest.

Fuller details of the results summarised here can be found in Table 1 on page 13, Table 7 on pages 27-28. Graphs showing the collated indices (includes only second generation indices for species which are given separate brood/flight indices) are in Appendix 1 on pages 36-41.

Review of changes in indices

Another poor year for butterflies

The year 2002 was a poor year for butterflies overall for the series (1976-2002) but appeared to be slightly better than 2001, ranking the 5th lowest of the 27 years (Figure 7, page 29). Of the 33 species (plus univoltine Common Blue) for which all-sites collated indices have been produced, and taking into account second generation indices only for double-brooded/two flight species for which separate brood/flight indices are calculated, there were 18 increases in the collated index and 16 decreases from 2001 to 2002, though most of the declines were not large (five species <10%). Twenty-six species produced a below average index and three species (see below) had their worst year of the series. No species had its best year. Some first generation indices are also compared in this section.

Higher spring indices for some species

Spring weather in 2002 was warm and sunny, with February-April weather being 1.6°C warmer and 8% sunnier when compared to the same period between 1951 and 1980 (Table 2). Butterflies with flight periods in April and May apparently benefited from these favourable conditions. **Dingy** and **Grizzled Skippers** and **Orange tip** showed marked increases in their collated index. First generation counts for **Small white, Small Copper** and **Holly blue** also increased substantially, but without increases being apparent in the subsequent generation. Species overwintering as adults, **Peacock** and **Brimstone**, also appeared in good numbers in the spring.

Lowest collated index of the series for three species

Three species produces their lowest collated index of the series, these were the **White Admiral** (23% drop from the 2001 figure) the **Grayling** (28% drop) and the **Small Heath** with a further, but small, drop of 1%. Both the **Grayling** and **Small Heath** have shown a statistically significant decline in their collated index over the monitoring period.

Grayling at St Cyrus NNR, Grampian

Most Skippers improved

There was a general increase in skippers with three of the 'four' species showing increases. There were substantial increases in the collated index for both the **Dingy** and **Grizzled Skippers**. The later species showed the largest increase with the collated index increasing by over 102% and ranking 9th highest of the series indicating a better than average year for this species. Conversely the **Small/Essex Skipper** had a poor year with a 27% drop producing a low index (ranked 21).

Grizzled Skipper at Monks Wood NNR, Cambs

A better year for whites

In nearly all cases the whites showed increases in both generations. The **Orange Tip** did particularly well, the collated index increasing by over 100% providing the *5th best* year of the series according to these figures. Only the **Small White** bucked the trend, although it showed a big increase of nearly 250% in the first generation, there was a drop of more than 30% in the second generation.

Orange Tip, Cambridgeshire

Big increase and then decline for the Holly Blue and Small Copper

There was a big increase in the collated index for the spring generation of the **Holly Blue** but perhaps surprisingly a drop in the second generation from last years index. This decline has occurred sooner than would be expected judging by most previous cycles (see Figure 11, page 41). The **Small Copper** also increased substantially in the first generation but there was a small drop in the second generation index.

Mixed fortunes for Common Blue and Brown Argus

There were increases in the collated indices for both generations of the southern **bivoltine Common Blue**, but in comparison with values throughout the duration of the scheme, this was an average year for this species. The **Brown Argus** declined in both generations with indices ranking low in the series indicating a poor year for this species.

Fritillaries increased

There was an increase of at least 20% in the collated index of all four fritillaries considered. However in the case of the **Pearl-bordered Fritillary** the index is based on the data from very few transects, with only five (of 11 in the BMS where the species still occurs) producing sufficient data for an index in both 2001 and 2002. The biggest increase was of 29% was for the **Silver-washed Fritillary**.

Silver-washed Fritillary, Alice Holt, Hants

The browns mostly declined or remained unchanged

The collated index for several of the 'browns' (Satyrinae) remained more or less unchanged, though the **Wall Brown**, **Marbled White** and **Grayling** (see above) showed a clear drop in numbers. Only the **Speckled Wood** increased appreciably with a 26% increase from 2001 and ranking *5th highest* of the series.

Migrants

It was a relatively good year for the **Painted Lady** with a more than 500% increase in the index from last year providing the sixth highest index of the series. It was an about average year for the **Red Admiral** with virtually no change in the index from 2001.

Explanation of changes in the Small Tortoiseshell collated index

Small Tortoiseshell at Monks Wood, Cambs

In 2002 the collated index for the Small Tortoiseshell dropped by 24% and ranked 17th in the series. Over the preceding two years we have reported a small annual improvement in the fortunes of the **Small Tortoiseshell** since the all-series low of 1999 (following its all-series high in 1997), based on the indices calculated by the chaining method. The increase in the 2001 index produced by the log-linear model method indicates a much more favourable increase than was shown by that produced by the chaining method, last years index ranking 13th, instead of 23rd by the chaining method. Differences in the indices calculated by the two methods for this species can be seen clearly on the graph presented on page 44 in Appendix II of last years report. The general pattern of ups and downs overall is the same for the two methods, but the ranked order has changed appreciably in this case. By the TRIM method, 1999 remains the lowest index of the series for the **Small Tortoiseshell**, but 1997 is only the 3rd highest, with 1982 and 1984 ranking first and second (previously ranking 2nd and 3rd respectively). Anecdotal reports from the British Wildlife Journal and from the egroup UK-Leps indicate that Small Tortoiseshell numbers have remained very low since 1999 and would suggest that numbers have not increased as much as the TRIM index would indicate.

Tabular summary of changes 2001 to 2002

Details of the changes outlined on the preceding pages are summarised in Table 1 on page 13, with further details in Table 7 on pages 27 and 28.

In the last column of Table 1 (Trend in all-sites [collated] index), significant trends are identified using simple regressions of $\log_{10}$ all-sites collated index on years (for method see Pollard *et al* 1995). The figure gives the degree of slope (trend) of the regression line, positive or negative. Asterisks indicate the degree of statistical significance of trend: * $P < 0.05$, ** $P < 0.01$; *** $P < 0.001$. It should be noted that simple regression results may give rather too many significant results with population data (Diggle, 1990), so these figures should be treated with caution. Nevertheless they do give an indication as to how the different species are faring on monitored sites. Particular caution needs to be exercised in looking at the results for species for which relatively few sites are used for the calculation of all-sites collated indices such as Common Blue (northern univoltine), Chalkhill Blue, Small Pearl-bordered and Pearl-bordered Fritillaries. The very big fluctuations in the index for the Holly Blue may make testing for a trend of relatively little value.

Table 1. Summary of changes 2001/2002

	2001	2002	% change	% change	Rank order	Rank order	Lowest / highest	Comments	Trend in
	all-sites	all-sites	Down	Up	of 26 years	of 27 years	all-sites		all-sites
SPECIES	index	index			2001	2002	index		index
Small Skipper	98	72	27		16	21			0.007
Large Skipper	71	79		11	24	20			0.022
Dingy Skipper	51	84		65	27	19			-0.091 **
Grizzled Skipper	54	109		102	26	9			-0.101 *
Brimstone 1 (Spring)	78	97		25	22	18			0.026
Brimstone 2 (Summer/Autumn)	65	87		34	26	18			-0.055
Large White 1 (1st generation)	39	103		163	25	13			-0.223 **
Large White 2 (2nd generation)	53	71		35	26	22			-0.059
Small White 1	33	115		248	26	12			-0.147 **
Small White 2	78	51	34		16	25			-0.013
Green-veined White 1	81	110		37	23	12			-0.042
Green-veined White 2	85	96		13	19	15			0.012
Orange Tip	84	123		47	22	5	Highest since 1989		0.027
Green Hairstreak	49	95		94	26	16			-0.042
Small Copper 1	29	109		269	27	12			-0.012
Small Copper 2	83	75	9		16	20			-0.01
Common Blue 1	61	68		12	17	14			-0.056
Common Blue 2	86	112		30	17	14			0.038
Common Blue (univoltine)	40	7	82		25 of 25	22 of 26			0.015
Brown Argus 1	76	67	11		19	23	Lowest since 1993		-0.063
Brown Argus 2	83	69	16		18	20	Lowest since 1993		0.081
Chalkhill Blue	47	54		14	26	25			-0.018
Holly Blue 1	70	524		643	12	16			0.214
Holly Blue 2	125	92	26		12	16		Unexpected drop in 2nd gen.	0.115
White Admiral	52	40	23		22	27	**Lowest ever**		-0.199 ***
Red Admiral	129	127	1		11	12			0.236 ***
Painted Lady	55	336		509	19	6			0.202
Small Tortoiseshell	107	82	24		13	17			-0.043
Peacock 1	137	174		27	7	3			0.167 ***
Peacock 2	99	74	26		14	22	Lowest since 1994		0.087 *
Comma	119	162		36	14	8			0.19 **
Small Pearl-bordered Fritillary	54	66		22	24	22		Collated index from 5 transects only	-0.196 ***
Pearl-bordered Fritillary	51	62		22	23	20			-0.212 **
Dark Green Fritillary	67	80		20	22	19			-0.06
Silver-washed Fritillary	67	86		29	24	18			-0.007
Wall Brown 1	62	82		33	20	16			-0.101
Wall Brown 2	68	46	32		17	25			-0.203 **
Speckled Wood	117	147		26	11	5			0.16 ***
Marbled White	121	93	23		13	17	Lowest since 1990		0.14 **
Grayling	71	51	28		20	27	**Lowest ever**		-0.163 ***
Hedge Brown	89	84	6		16	18			-0.071
Meadow Brown	91	86	5		15	19	Lowest since 1995		0.043
Small Heath	48	48	1		26	27	**Lowest ever**	For third year running	-0.144 ***
Ringlet	143	149		4	10	8			0.254 ***

Summary of the weather in 2001 / 2002 and some apparent effects on butterflies

Table 2 shows a summary of UK weather in 2001/2002. Figures for 2001 are taken from a weather summary provided by Dr M. Hulme of the University of East Anglia on the internet at website: http://www.cru.uea.ac.uk/~mikeh. The information is also published in *The Guardian* newspaper. From 2002 the weather summaries have been taken over by a University of East Anglia weather company called Weatherquest and can now be found at: http://www.uea.ac.uk/~e870/guardian.htm. The summary is for the UK as a whole and so will not necessarily describe weather in particular regions precisely. [Anomalies are with respect to the 1951-80 average].

In last year's report it was suggested that the declines in butterfly numbers in 2001 may have been due to the exceptionally wet autumn, winter and early spring of 2000/2001. The autumn and winter months of 2001/2002 were not so wet as the previous year and may explain why butterfly numbers did not decline further. However the wet May, June and July of 2002 may have kept numbers suppressed.

Table 2. Summary of UK weather in 2001/2002

2001	**Daytime temp**	**Rainfall (%)**	**Sunshine(%)**	**Brief description**
January	-0.2	+1	+54	Very sunny, wet in the south
February	+0.4	+50	+25	Wet and mild in the south; sunny elsewhere
March	-0.9	+63	-1	Cloudy and wet in the south; cool
April	-0.4	+56	+3	Cool and wet, but dry in Scotland
May	+1.5	-38	+19	Rather warm, sunny and dry
June	-0.3	-31	-7	Dry; warm and sunny in south
July	+0.4	+9	-5	A rather average month; cool in north
August	+0.7	+12	+4	Rather warm; on the wet side
September	-0.5	-11	-10	Cool; wet in the east
October	+1.9	+47	+1	Wet and very mild
November	+0.6	-31	-1	Rather mild and dry; sunny in the south
December	-0.9	-34	+64	Very sunny and dry; rather cold
Annual	**+0.1**	**+7**	**+4**	**An average year; slightly wet**
2002	**Daytime temp**	**Rainfall (%)**	**Sunshine(%)**	**Brief description**
January	+1.6	0	-12	Cloudy and mild
February	+2.0	+98	+8	Mild and very wet
March	+1.6	-13	+3	Mild
April	+1.3	-8	+13	Mild and quite sunny
May	+0.6	+51	-7	Rather wet
June	0	+17	-14	Quite wet
July	-0.3	+25	-10	Quite cool and wet
August	+1.1	-26	-8	Warm and dry
September	+1.0	-51	+13	Warm, dry and sunny
October	-0.9	+80	+4	Cool and very wet
November	+1.4	+52	-5	Wet and very mild
December	-0.3	+2	-21	Cloudy
Annual	**+0.7**	**+14**	**-2**	**Warmer and wetter than average**

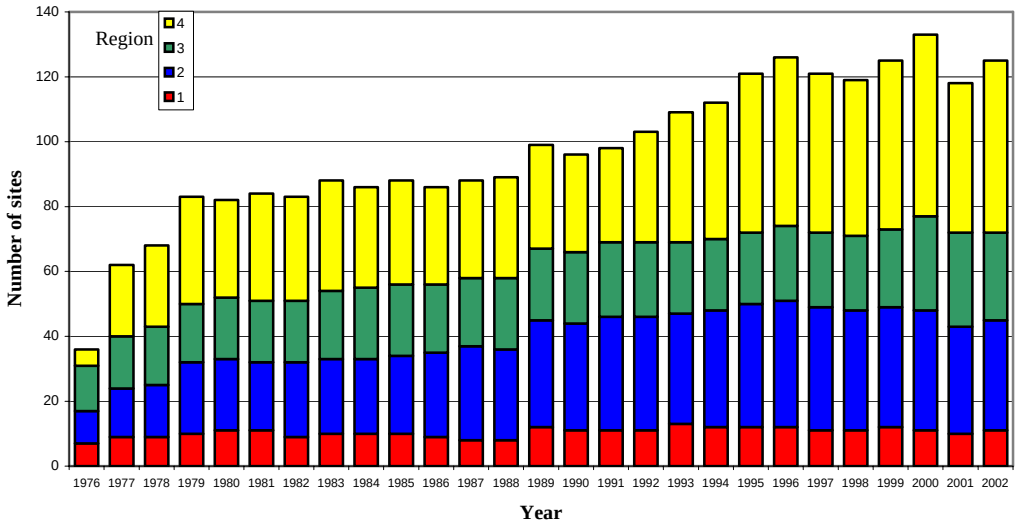
SITES CONTRIBUTING DATA TO THE BMS IN 2002

The number of sites contributing data to the BMS in 2002

The BMS was officially launched in 1976 with just 36 sites contributing to the scheme. However three years of trials preceded this when data were being gathered to test the methodology. Seven sites still in the BMS, which were monitored during this period as part of this process, have data going back to 1974. The number of sites contributing to the BMS (Figure 2) has gradually increased over the years with at least one site being added to the scheme in most years. Three new sites were brought into the BMS in 2002.

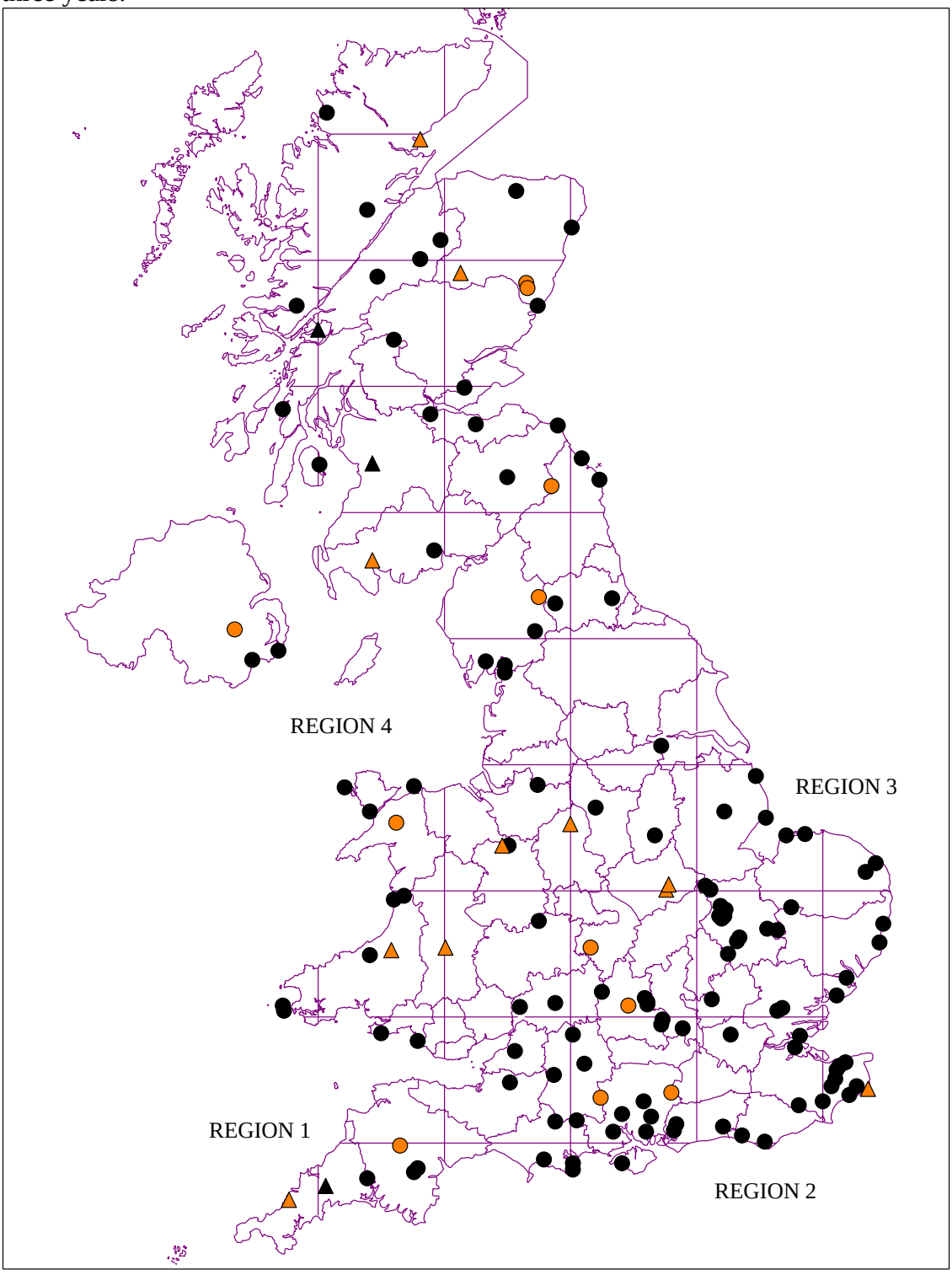
In 2002, 122 of the 136 transects part of the BMS submitted at least some data to the scheme. Ten transects produced no data at all in 2002. Data for five transects were collected but have yet to be submitted! The distribution of the transects currently part of, or contributing to, the BMS is shown on Map 1 on page 16.

Figure 1. The number of sites contributing data to the scheme



THE CURRENT UK DISTRIBUTION OF BMS SITES

Map 1. BMS and ECN sites in 2002, (BMS = black circles, ECN = orange circles), showing county boundaries (*not* Vice-counties) and the four BMS regions. Black triangles indicate sites new to the scheme in 2002. Orange triangles indicate sites that have not produced data in 2002 or have been lost from the scheme during the past three years.



ANALYSIS OF THE AMOUNT OF DATA RECEIVED

Percentage of counts completed

The overall percentage of counts completed in 2002 was 74%, a comparable level to recent years (Table 3). The percentage of counts completed in 2001 was low (68%) due to disruption to transect recording at many sites affected by Foot and Mouth Disease. All sites submitting at least some data have been included in the analysis.

From Table 3 it can be seen that the percentage of weeks completed has been fairly consistent over the years with the higher percentages of counts being completed in the sunniest summers (e.g. 1982, 1984, 1990, 1992, 1995 and 1997).

Table 3. Percentage of counts completed 1974-2002

YEAR	% of weeks completed	Number of sites	Number of weekly counts
1976	68%	36	639
1977	62%	62	996
1978	69%	68	1219
1979	74%	83	1587
1980	76%	82	1610
1981	74%	84	1607
1982	79%	83	1714
1983	72%	88	1649
1984	79%	86	1761
1985	73%	88	1659
1986	72%	86	1621
1987	73%	88	1680
1988	75%	89	1732
1989	78%	99	2012
1990	80%	96	2002
1991	75%	98	1920
1992	78%	103	2098
1993	73%	109	2076
1994	72%	112	2089
1995	75%	121	2370
1996	73%	126	2388
1997	76%	121	2380
1998	68%	119	2109
1999	74%	125	2406
2000	74%	133	2552
2001	68%	118	2090
2002	74%	125	2413

With good spring weather, the early weeks were well recorded in 2002. In contrast, weeks early in 2001 were badly recorded due to a combination of poor weather and the Foot and Mouth Disease epidemic. For details of regions see Map 1 on page 16.

Figure 2. The number of sites with completed transects in each week in 2001

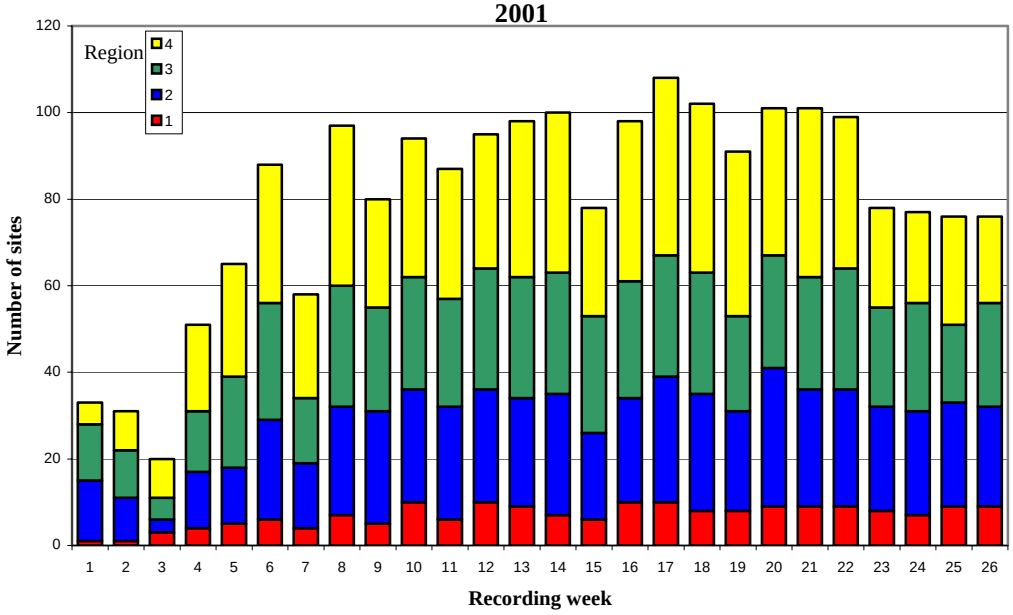
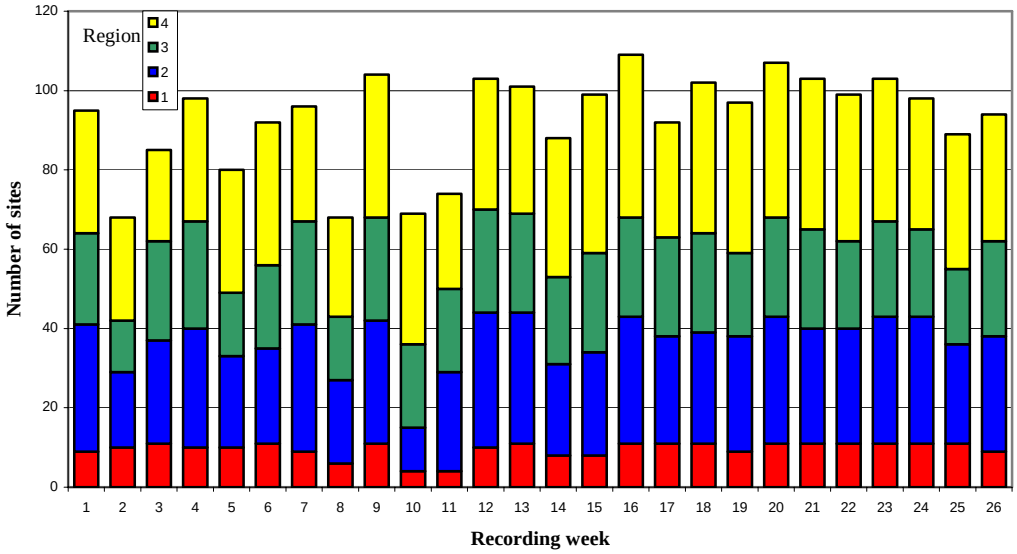


Figure 3. The number of sites with completed transects in each week in 2002



The number of weeks recorded for each transect

The number of weeks recorded for each transect in 2001 and 2002 are shown in Figures 5 and 6 respectively. The area covered by each region is shown on Map 1 on page 16.

Figure 4. Number of weeks recorded for each transect in 2001

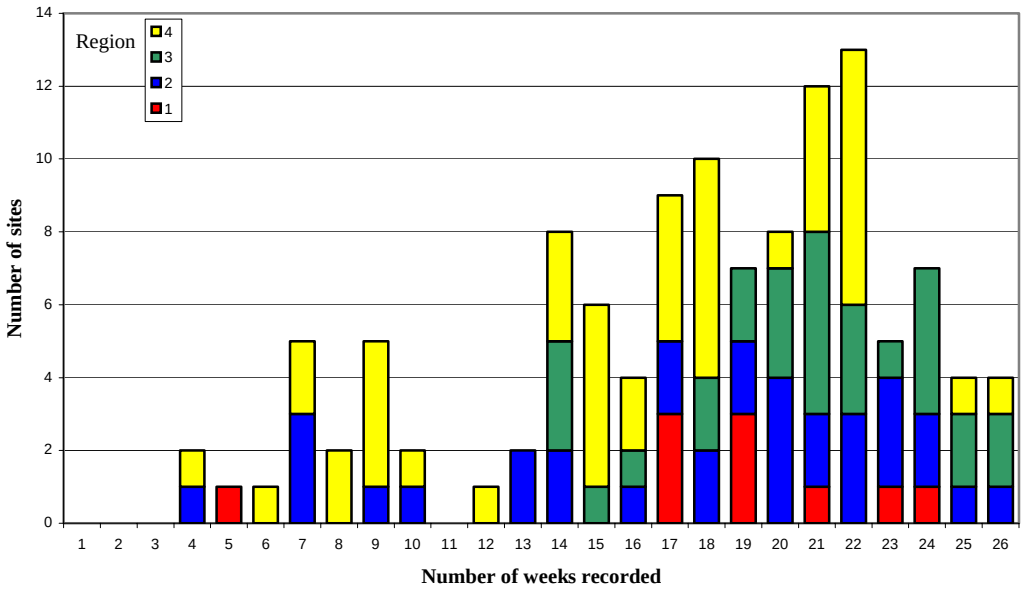
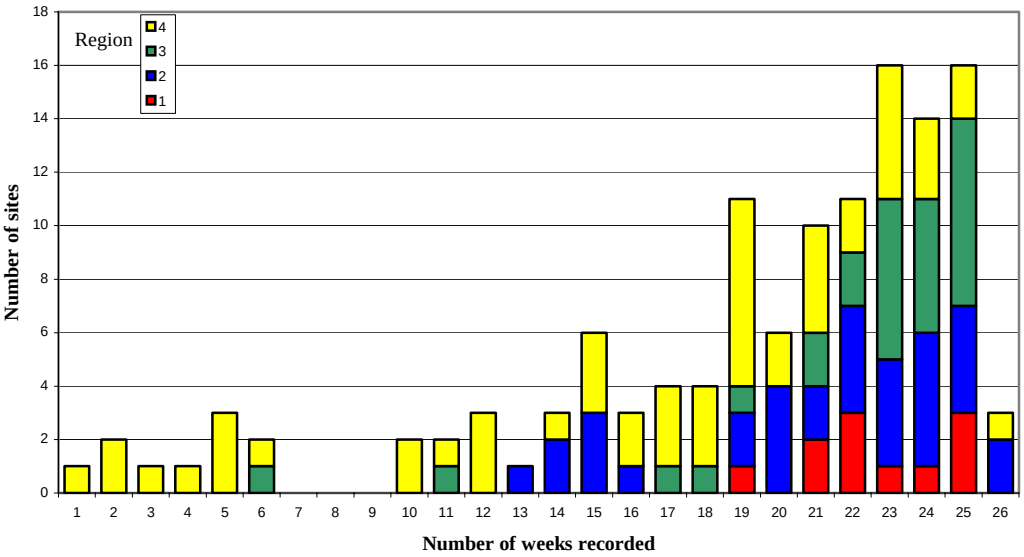


Figure 5. Number of weeks recorded for each transect in 2002



Annual indices and the proportion that could be calculated

Annual indices

Site annual indices are calculated for each species for each transect where the species occurs and where data are sufficient. An annual index for a species is simply the total mean weekly count on a transect for the year including estimates (see section on estimates below). Where a species is double-brooded or, in the case of the hibernating species Peacock and Brimstone where there is a separate spring and summer flight, two separate indices are calculated. Where species produce a third brood (notably Small Copper and Wall Brown) third brood figures are combined with those of the second brood. In some cases the divisions between the broods are indistinct and a single index is given for the year. These species are Red Admiral, Painted Lady, Small Tortoiseshell, Comma, Speckled Wood and Small Heath.

Table 4. The number of transects for which different proportions of annual indices could be calculated for all years (1976 – 2002) for all transects recorded in each year.

YEAR	0%	>0-20%	20-40%	40-60%	60-80%	80-<100%	100%	Total no. transects contributing data
1976	2	0	1	1	2	22	8	36
1977	11	1	1	2	3	15	29	62
1978	9	2	2	4	5	17	29	68
1979	5	2	2	2	5	12	55	83
1980	3	0	2	2	9	14	52	82
1981	4	1	2	1	2	13	61	84
1982	4	1	0	1	5	18	54	83
1983	2	0	1	1	6	20	58	88
1984	2	0	1	3	11	12	57	86
1985	5	3	2	3	7	16	52	88
1986	2	3	3	5	13	7	53	86
1987	6	2	2	2	18	22	36	88
1988	6	1	5	8	9	10	50	89
1989	6	2	2	4	10	16	59	99
1990	3	2	2	3	8	16	62	96
1991	5	4	2	5	17	25	40	98
1992	5	5	2	7	3	20	61	103
1993	17	6	2	1	6	20	57	109
1994	13	2	3	5	18	19	52	112
1995	9	3	8	11	17	23	50	121
1996	20	2	7	10	9	32	46	126
1997	16	9	7	10	11	26	42	121
1998	20	5	7	12	20	40	15	119
1999	17	5	12	12	20	32	27	125
2000	13	10	9	12	20	34	35	133
2001	17	7	11	19	15	30	19	118
2002	24	5	6	7	14	36	33	125

Estimates

Estimates are calculated for weeks where the counts have been missed (e.g. due to unsuitable weather, holidays etc.) and where they are considered appropriate.

Annual indices are produced by the process described on page 5 of this report. In the past, as a general rule, when estimates for a species on a transect comprised 30% or more of the total for the annual index, the annual index was usually rejected. However, the new method fits a smoothed curve to the available data. In all cases where the estimates came to 30% or more of the total a graph of the data with the curve was produced. This allowed for rapid visual assessment of these data. Annual indices were then accepted or rejected on a case by case basis. This resulted in an additional 10% of annual indices being produced. Although the decisions were subjective, the close agreement between the assessments carried out separately by NG-D and DBR gave us confidence to accept these additional annual indices.

Table 5. The proportion of annual indices which could be calculated from all transects recorded in each year (1976 – 2002) expressed as a percentage (another way of looking at the data in Table 4).

YEAR	0%	>0-20%	20-40	40-60	60-80%	80-<100%	100%	Total number of transects contributing data
1976	6%	0%	3%	3%	6%	61%	22%	36
1977	18%	2%	2%	3%	5%	24%	47%	62
1978	13%	3%	3%	6%	7%	25%	43%	68
1979	6%	2%	2%	2%	6%	14%	66%	83
1980	4%	0%	2%	2%	11%	17%	63%	82
1981	5%	1%	2%	1%	2%	15%	73%	84
1982	5%	1%	0%	1%	6%	22%	65%	83
1983	2%	0%	1%	1%	7%	23%	66%	88
1984	2%	0%	1%	3%	13%	14%	66%	86
1985	6%	3%	2%	3%	8%	18%	59%	88
1986	2%	3%	3%	6%	15%	8%	62%	86
1987	7%	2%	2%	2%	20%	25%	41%	88
1988	7%	1%	6%	9%	10%	11%	56%	89
1989	6%	2%	2%	4%	10%	16%	60%	99
1990	3%	2%	2%	3%	8%	17%	65%	96
1991	5%	4%	2%	5%	17%	26%	41%	98
1992	5%	5%	2%	7%	3%	19%	59%	103
1993	16%	6%	2%	1%	6%	18%	52%	109
1994	12%	2%	3%	4%	16%	17%	46%	112
1995	7%	2%	7%	9%	14%	19%	41%	121
1996	16%	2%	6%	8%	7%	25%	37%	126
1997	13%	7%	6%	8%	9%	21%	35%	121
1998	17%	4%	6%	10%	17%	34%	13%	119
1999	14%	4%	10%	10%	16%	26%	22%	125
2000	10%	8%	7%	9%	15%	26%	26%	133
2001	14%	6%	9%	16%	13%	25%	16%	118
2002	19%	4%	5%	6%	11%	29%	26%	125

Proportion calculated

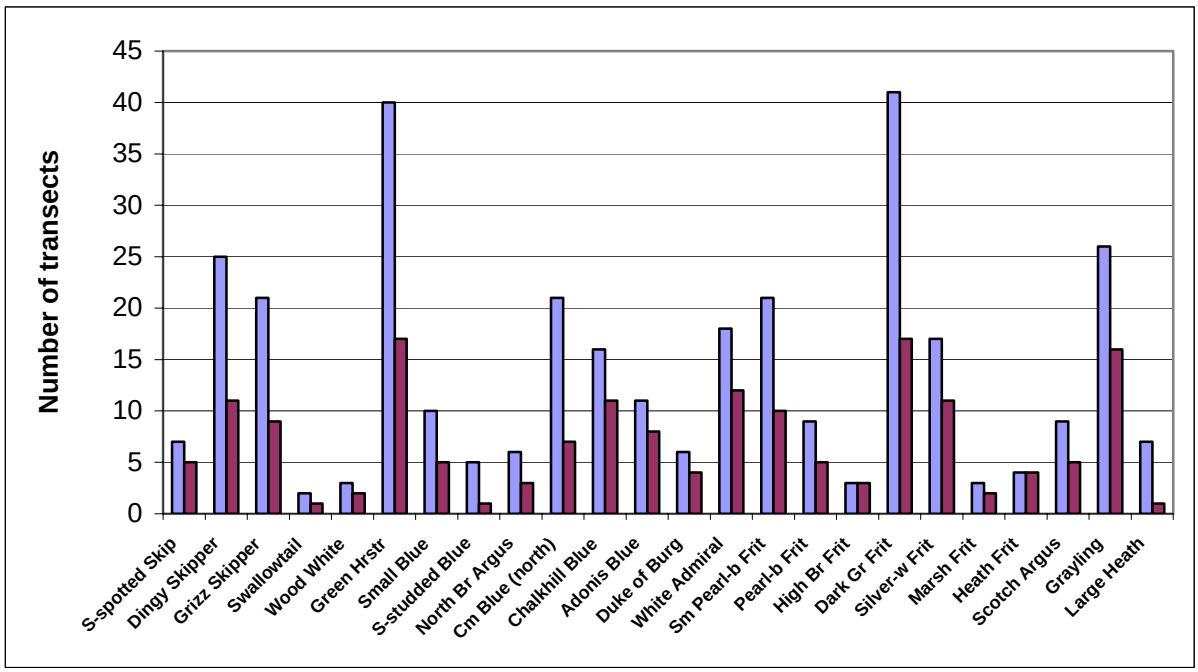
There was an overall improvement in the percentage of annual indices that could be calculated in 2002 as compared to 2001 as would be expected following the restrictions on access imposed by the Foot and Mouth Disease epidemic in 2001. Fourteen transects provided too few data for any annual indices to be calculated (Table 4).

Number of annual indices for the scarcer species

In general, all-sites collated indices are only calculated if data from seven or more sites are available in every year since the start of the BMS in 1976, (data from sites where a zero index was produced in both of any pair of years are excluded). This limit was set based on a subjective assessment on the number of sites needed to produce a meaningful index at the start of the scheme in 1976. Usually the number of sites is much larger than this, and for the majority of species the number of sites for which data are available has increased greatly since the start of the scheme as the number of sites in the scheme has increased. However the fewer the number of sites then the less reliable are any trends in the data likely to be. The species whose collated indices need to be treated with the greatest caution are Common Blue (northern, univoltine), Chalkhill Blue, White Admiral (though the number of sites providing data for this species has increased markedly over the years), Small Pearl-bordered Fritillary and Pearl-bordered Fritillary. Consequently for these and other species represented on a relatively low number of sites, it is important to make sure that recording fully covers the flight periods so that site annual indices can be calculated which in turn will enable more reliable all-sites collated indices to be produced.

Figure 6 shows for many of the scarcer species the number of transects on which each was recorded in 2001 or 2002, including where an annual index could not be calculated (first column), and the number of transects for which data were sufficient to calculate an annual index in both years (second column), but excluding transects where the annual index was zero in both years. The second column therefore represents the number of transects which could contribute to an all-sites collated index for 2002 (or which did, in the case of those species for which one is calculated), and the first column those which potentially could have.

Figure 6. The number of annual indices calculated for the scarcer species compared with the number of sites where the species was actually recorded in 2001 and/or 2002. [*Some species have been excluded, these are the 'canopy' hairstreaks, the Purple Emperor, and species that occur on a single BMS transect only (Chequered Skipper, Lulworth Skipper and Glanville Fritillary*)].



Only a proportion of these species have been sufficiently represented on BMS transects over the years for an all-sites collated index to be produced. In the future collated indices will be possible for more species as data from the existing BMS and the many other transects operated by Butterfly Conservation volunteers and others are combined.

As in 2001, for nearly all of the scarcer species where an all-sites collated index is produced, a relatively high number of sites (in many cases >50%) did not produce enough data for annual indices to be produced in both years and therefore these sites could not be used in the calculation of the all-sites indices. This was probably largely due to the knock-on effect from 2001, the year of the Foot and Mouth Disease epidemic, when many transects could only be recorded for part of the season.

ANALYSIS OF CHANGES IN BUTTERFLY NUMBERS

Numbers of butterflies recorded

The number of sightings of butterfly species recorded on BMS transects in 2002 are listed in Table 6. Numbers included in this analysis are only those where sufficient data were provided in either 2001 or 2002 for site annual indices to be calculated.

Table 6. Sum of site indices and order of abundance for 2001and 2002

Species	2001	2002	2001 order	2002 order
Meadow Brown	31682	39120	1	1
Gatekeeper	12939	13280	2	2
Ringlet	10318	12324	3	3
Green-veined White	7076	10475	4	4
Speckled Wood	3902	7765	8	5
Common Blue	4093	6413	7	6
Peacock	3663	5538	9	7
Small Skipper	5914	5174	5	8
Silver-studded Blue	87	4304	41	9
Small Heath	3590	3968	10	10
Small Tortoiseshell	1178	3628	17	11
Small White	4112	3475	6	12
Marbled White	2409	3158	11	13
Large White	1649	2934	14	14
Scotch Argus	707	2861	24	15
Chalk-hill Blue	2277	2757	12	16
Brimstone	904	2516	20	17
Large Skipper	1628	2469	15	18
Adonis Blue	1303	2065	16	19
Orange Tip	750	1637	23	20
Red Admiral	1001	1471	19	21
Small Copper	1131	1397	18	22
Comma	274	1197	32	23
Painted Lady	80	779	43	24
Wall Brown	877	778	21	25
Grayling	768	737	22	26
Dark Green Fritillary	534	678	26	27
Common Blue (northern)	547	60	25	28
Dingy Skipper	233	597	33	29
Brown Argus	415	491	28	30
Holly Blue	161	450	37	31
Heath Fritillary	481	439	27	32
Silver-washed Fritillary	281	331	31	33
Grizzled Skipper	87	280	40	34
Northern Brown Argus	291	278	30	35
Small Pearl-bordered Fritillary	179	270	35	36
Pearl-bordered Fritillary	163	269	36	37

Species	2001	2002	2001 order	2002 order
Green Hairstreak	142	249	38	38
Marsh Fritillary	1848	214	13	39
Silver-spotted Skipper	183	197	34	40
Clouded Yellow	1	187	54	41
Purple Hairstreak	73	138	45	42
Small Blue	295	120	29	43
Large Heath	65	118	46	44
Wood White	80	95	44	45
White Admiral	44	85	47	46
High Brown Fritillary	142	81	39	47
Duke of Burgundy Fritillary	81	54	42	48
Mountain Ringlet	0	34	57	49
Lulworth Skipper	19	30	49	50
Swallowtail	30	23	48	51
Chequered Skipper	0	19	58	52
Black Hairstreak	8	13	51	53
Brown Hairstreak	14	12	50	54
White-letter Hairstreak	4	4	53	55
Purple Emperor	4	3	52	56
Glanville Fritillary	0	0	55	57
Pale Clouded Yellow	0	0	56	58

Summary of changes at site level 2001/2002

Table 7 summarises the changes in the site indices for all species from 2001 to 2002 (number of sites for which site annual indices could be calculated, increases, decreases, no change). The all-sites collated indices for 2001 and 2002 are shown where these are calculated and the species names shown in bold type (second generation / flight where two separate collated indices are calculated). Many of the rarer species do not have collated indices because they are recorded on too few BMS transects for a meaningful index to be calculated. Where collated indices have been calculated for species recorded on relatively few transects these figures should be treated with caution. These include Chalkhill Blue, Small Pearl-bordered and Pearl-bordered Fritillaries and Silver-washed Fritillary. For species with two distinct flight periods the second is used here.

Table 7. Summary of changes at site level 2001/2002. (*Column headed ' No. of sites with index in 2001 or 2002', includes transects where the index was zero in both years)*

Species	Brood	No. of site with index in 2001 or 2002	No. of site with index in 2001 and 2002	Increase	Decrease	No change	Zero index in 2001 and 2002	2001 only	2002 only	National collated index 2001	National collated index 2002
Chequered Skipper	1	1	0						1		
Small Skipper/Essex	1	88	56	16	37	1	2	10	22	98	72
Lulworth Skipper	1	1	1	1							
Silver-spotted Skipper	1	8	5	1	4			1	2		
Large Skipper	1	90	62	28	27	3	4	9	19	71	79
Dingy Skipper	1	35	17	8	3		6	4	14	51	84
Dingy Skipper	2	1	1				1				
Grizzled Skipper	1	34	17	4	5		8	3	14	54	109
Swallowtail	1	1	1		1						
Wood White	1	9	5	1			4		4		
Wood White	2	1	1		1						
Pale Clouded Yellow	1	7	7				7				
Clouded Yellow	1	76	38	19			19	14	24		
Brimstone	1	76	24	12	12			4	48	78	97
Brimstone	2	80	55	22	24	3	6	8	17	65	87
Large White	1	103	57	38	7	4	8	9	37	39	103
Large White	2	104	64	34	22	7	1	11	29	53	71
Small White	1	100	60	41	5	3	11	10	30	33	115
Small White	2	104	63	20	40	1	2	12	29	78	51
Green-veined White	1	105	61	44	13	2	2	14	30	81	110
Green-veined White	2	109	67	38	24	1	4	11	31	85	96
Orange Tip	1	88	48	32	13	1	2	10	30	84	123
Green Hairstreak	1	42	21	11	6		4	7	14	49	95
Brown Hairstreak	1	9	6	1	3		2		3		
Purple Hairstreak	1	47	32	13	8		11	2	13		
White-letter Hairstreak	1	22	14	1	2		11	2	6		
Black Hairstreak	1	4	3	2			1		1		
Small Copper	1	97	51	15	6		30	17	29	29	109

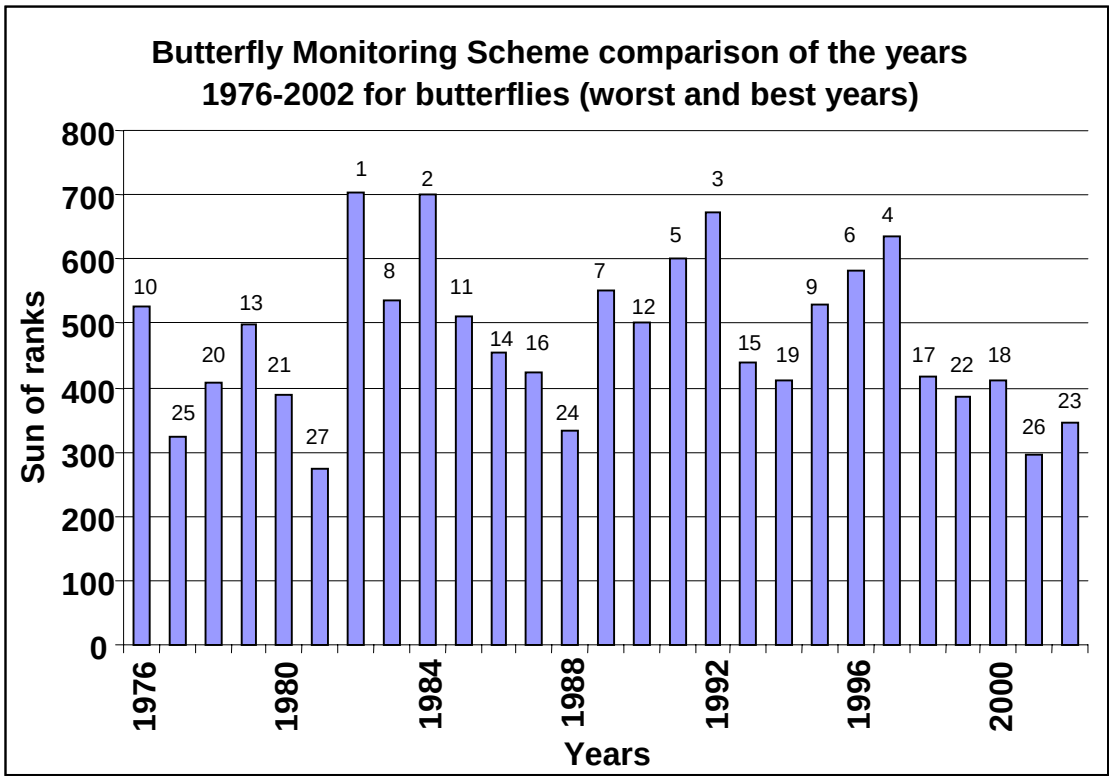
Species	Brood	No. of site with index in 2001 or 2002	No. of site with index in 2001 and 2002	Increase	Decrease	No change	Zero index in 2001 and 2002	2001 only	2002 only	National collated index 2001	National collated index 2002
Small Copper	2	96	57	25	21	1	10	12	27	83	75
Large Copper	1	1	1				1				
Small Blue	1	15	8	1	3	1	3	2	5		
Small Blue	2	10	6	2	2		2	2	2		
Silver-studded Blue	1	6	3	1			2	1	2		
Brown Argus	1	54	33	6	6	1	20	7	14	76	67
Brown Argus	2	53	35	11	13	1	10	6	12	83	69
Northern Brown Argus	1	6	3	2	1			1	2		
Common Blue	1	83	54	27	7	3	17	12	17	86	112
Common Blue	2	84	58	24	22	3	9	6	20	86	112
Common Blue (northern)	1	20	9	1	8			6	5	40	73
Chalk-hill Blue	1	22	18	4	7		7	1	3	47	54
Adonis Blue	1	11	6	4	1		1	1	4		
Adonis Blue	2	13	9	3	5		1	1	3		
Holly Blue	1	76	40	28	3	4	5	5	31	125	92
Holly Blue	2	77	55	11	17	4	23	7	15	125	92
Duke of Burgundy	1	14	7	2	2		3	1	6		
White Admiral	1	30	19	7	3	2	7	2	9	52	40
Purple Emperor	1	8	5		1		4		3		
Red Admiral	1	106	55	29	24	2		7	44	129	127
Painted Lady	1	98	49	38	5	2	4	9	40	55	336
Small Tortoiseshell	1	100	26	13	11	2		3	71	107	82
Camberwell Beauty	1	2	2				2				
Camberwell Beauty	2	2	2				2				
Peacock	1	93	28	17	8	2	1	3	62	137	174
Peacock	2	101	60	12	43	4	1	10	31	99	74
Comma	1	83	22	13	8	1		2	59	119	162
Small Pearl-bordered	1	28	15	5	5		5	8	5	54	66
Pearl-bordered Fritillary	1	23	13	4	1		8	4	6	51	62
High Brown Fritillary	1	6	5	2	1		2	1			
Dark Green Fritillary	1	50	30	10	6	2	12	7	13	67	80
Silver-washed Fritillary	1	34	22	6	3	2	11	3	9	67	86
Marsh Fritillary	1	12	6		2		4	4	2		
Heath Fritillary	1	4	4	2	2						
Speckled Wood	1	91	51	32	18		1	5	35	117	147
Wall Brown	1	82	44	13	5	1	25	15	23	62	82
Wall Brown	2	82	51	14	14	3	20	12	19	68	46
Mountain Ringlet	1	1	0						1		
Scotch Argus	1	9	6	2	3		1	1	2		
Marbled White	1	51	35	8	16	2	9	3	13	121	93
Grayling	1	36	24	2	13	1	8	4	8	71	51
Gatekeeper	1	91	62	26	34		2	9	20	89	84
Meadow Brown	1	111	71	22	49			12	28	91	86
Small Heath	1	89	49	16	20		13	15	25	48	48
Large Heath	1	7	1		1			4	2		
Ringlet	1	89	53	28	24		1	12	24	143	149

Comparison of the 27 years of the BMS

The following method has been used to assess the overall relative abundance of butterflies in each of the 27 years of the BMS (1976-2002). For the 33 species (plus the northern univoltine Common Blue) for which all-sites collated indices are calculated, the years have been ranked 1 to 27 according to the collated index value for the species. The score 1 was given to the year with the highest value (best year), and 27 to the year with the lowest value. For each year, the 34 ranks were summed, to give an overall indication of the year's quality for butterflies compared with the other years in the series. Figure 7 shows these sums of ranks, which theoretically could have ranged from 34 (if there had been a year in which every species was at its lowest collated index) to 918 (34 x 27). The overall ranking of years is shown above the columns in the histogram. 1981 emerges as the worst butterfly year of the series overall, and 1982 as the best. 2002 comes out as one of the poorest years ranking only 23 out of 27 (fifth worst).

Because we are now using TRIM instead of the chaining method to calculate collated indices there are slight changes in the order of ranks from lat year, though the overall pattern is essentially the same (for comparison see Figure 8 on page 27 of last years report). So, whereas 2001 was ranked 22 out of 26, i.e the fifth worst year for butterflies of the series, it now comes out as 26 of 27, i.e. the second worst year.

Figure 7. Histogram showing the sum of the ranks of each species for which a collated index is calculated for each year of the BMS, 1976-2002.



WORKING IN PARTNERSHIP: THE VALUE OF ADDING DATA SUPPLIED BY BUTTERFLY CONSERVATION TO AN EXPANDED BUTTERFLY MONITORING SCHEME, WITH SPECIAL REFERENCE TO THE ADONIS BLUE

Tom Brereton, Katherine Stewart & Martin Warren, Butterfly Conservation

Butterfly Conservation's role in collating transect data

Over the past five years Butterfly Conservation has put a large amount of effort and resources into collating centrally butterfly transect data from a wide range of sites recorded independently of the BMS (sadly, sufficient resources have never been available for CEH to collate all this data through the BMS). The data gathering job has been aided by the provision of Transect Walker software and the strengthening of an already locally well-established network of Butterfly Conservation volunteer co-ordinators who validate, collate, transfer and report on local data (for software download and contact lists go to www.butterfly-conservation.org).

A massive new database of butterfly transect data has been collated from over 700 sites, including over 350 recorded each year outside of the BMS. Much of this data has been successfully used by Butterfly Conservation in a Defra research contract to assess the impacts of agri-environment schemes on butterflies in England (Brereton, Stewart & Warren, 2002). The results of the study have gained widespread media coverage and have played a valuable role in helping to promote butterfly monitoring at a government level as a tool to inform conservation management and land management policy making. At a time when many recorders are finding it increasingly difficult to find time to walk their transects, demonstrates that the data they collect is more highly valued and is being used for nature conservation more than ever before.

Opportunities for the BMS

Clearly, the recent project conducted by Butterfly Conservation has changed the face of butterfly monitoring in the UK, with exciting implications for the existing BMS. In particular the vast new data source of butterfly transect data now available could make an important contribution to an expanded BMS, enabling assessment of more representative UK trends and trends for additional species that are poorly covered by the current BMS. For some species there is also the possibility to compare trends by region, habitat and according to type of ownership, conservation management and level of statutory protection. Here, by example we show the potential of this additional data to the BMS for the assessment of Adonis Blue trends.

Case study: the Adonis Blue

The Adonis Blue is a stunningly attractive butterfly restricted to short/sparse south-facing calcareous grassland in Southern England, where substantial quantities of its larval foodplant Horseshoe Vetch grow in sheltered situations. It is a BAP Priority Species that is the focus of considerable conservation attention. Data from the BMS has played an important role in helping our understanding of the conservation requirements of

this rare species. Dr Jeremy Thomas of CEH used results from BMS counts at Ballard Down, Dorset as an important part of his early work into the population structure and dynamics of the butterfly (Thomas, 1983). More recent research by BMS Manager David Roy has utilised BMS data to identify average differences between population sizes of the first and second broods, with important implications for practical habitat management at northern range margins and for future climate change research (Roy & Thomas, 2002).

The Adonis Blue has been identified as a Priority Species in the UK Biodiversity Action Plan, owing to a historical 90% decline in range, although there has been some recovery since the1980s (Bourn & Warren, 1998). The butterfly is the subject of a Governmental Species Action Plan (SAP), which outlines priority actions for future conservation and monitoring of the butterfly, including to "collate population monitoring data and management data from all monitored sites annually, and calculate an annual index to compare trends on individual sites. Review and extend the network if necessary" (UK Biodiversity Group Tranche 2 Action Plans - Volume IV: Invertebrates, 1999).

Monitoring the Adonis Blue

Despite the BAP target, in recent years the Adonis Blue has been monitored at only about a dozen BMS sites, with usually less than ten sites in any one year, giving insufficient data to generate an all sites collated index. Consequently our knowledge of the annual status and short-term population trends of this butterfly at a regional and UK level through the BMS is incomplete, and therefore delivery of some of the actions in the UK SAP unclear.

Inspection of transect data collated by Butterfly Conservation reveals that since 1990, more than 60 transects which monitor this butterfly have been established outside of the BMS – representing a remarkable coverage of nearly 40% of all known colonies. Of these, 40 currently support and monitor Adonis Blue populations (Brereton *et al*., 2003).

By plotting BMS and BC data together we can see that the level of coverage is impressive – approximately 40% of all currently occupied 10-km squares have monitoring coverage with a good spatial spread through its range (Figure 8).

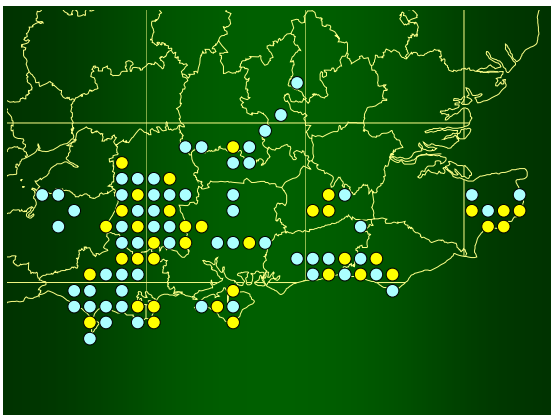


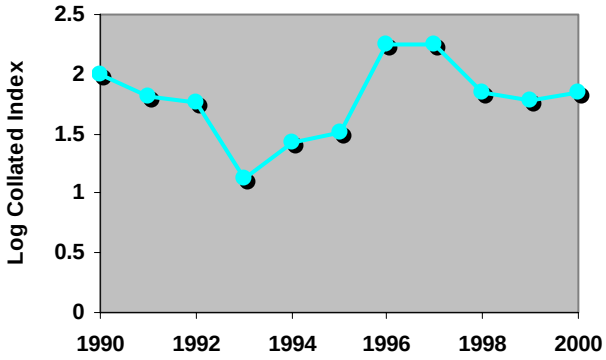
Figure 8. Annual monitoring coverage of the Adonis Blue in relation to its overall distribution in GB and Ireland. Map key: blue circles = 10-km squares where species was recorded in 1995-99 BNM survey, but no annual monitoring coverage in 1999-00, yellow circles = 10-km squares where species was monitored at one or more transects 1999-00. Map produced with DMAP software supplied by Alan Morton.

One recurring criticism of the BMS from some quarters is that the majority of monitored sites are nature reserves, and therefore not representative of the countryside as a whole. This issue is less of a problem for the Adonis Blue, as the majority of remaining colonies are located on semi-natural land managed for conservation. However, it is encouraging to note that nearly a third of the current non-BMS Adonis Blue transects are located away from nature reserves or land under the ownership of sympathetic land management bodies such as the National Trust.

Changing status of the Adonis Blue over the last decade

By combining BMS and BC transect data it is now possible to generate a collated index and have some confidence (given the large number of sites, and the good geographical and ownership spread) that this population index reflects the overall UK situation. We plotted annual indices from more than 70 BMS and BC sites during the 1990s (Figure 9). **This is the first time that an Adonis Blue collated index has been illustrated in a BMS report**. The butterfly had a run of relatively poor years in the early 1990s, but subsequently recovered strongly towards the end of the decade. Over the period, the insect colonised three transects and did not become extinct at any natural sites, although it become extinct at one site where there was an introduction in the late 1980s.

Figure 9. Adonis Blue log collated indices during the 1990s assessed from 71 butterfly transects collated by CEH and BC



The trend analysis provides evidence to support results from distribution surveys (e.g. Asher et al, 2002, Whitfield, 1999, Bourn et al., 1999) and anecdotal observations that the UK Adonis Blue population has been increasing steadily since 1993 in both range and abundance. It is pleasing to report that the two main SAP targets to "Maintain existing populations" and "Restore populations to the 1970/82 distribution by 2010" are probably on-course.

Regional trends

The large sample size available by combining BC and CEH data transect data also enables regional analysis, to assess whether this increase is occurring across the board or is particularly strong in certain areas. We carried out a broad-scale regional analysis by Defra Governmental Region, which indicated that the increase was broad-scale as there was no statistically significant difference in trends between South West England (Dorset, Gloucestershire, Somerset and Wiltshire, n=37 sites) and the South East (Hampshire and the Isle of Wight, Kent, Oxfordhire, Surrey and Sussex, n=35 sites) (Wald-Test=0.01, P=0.92).

However, looking at a more local level and by plotting linear trendlines fitted to the collated indices (Figure 10), there is a suggestion that the butterfly may be doing slightly better in some areas than others (although the overall differences were not Statistically Significant). In particular, the butterfly was doing well in Wiltshire, which is a core area for the butterfly, and least well in an amalgamation of counties characterised by having generally both fewer populations and monitored sites (Gloucestershire, Kent, Oxfordshire, Somerset and Surrey).

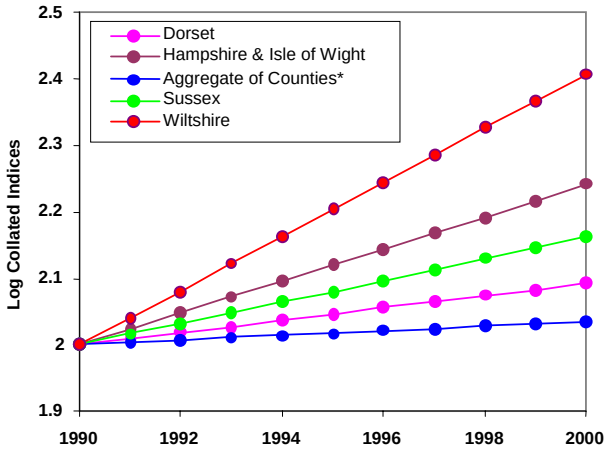


Figure 10. Modelled Adonis Blue linear population trends in five different regions during the 1990s.

*Aggregate of Counties (Gloucestershire, Kent, Oxfordshire, Somerset and Surrey)

Conclusions

We hope that these brief analyses have shown some of the potential value in bringing both BC and CEH butterfly transect datasets together to enhance the vital role that the BMS plays in documenting the changing fate of butterflies in the UK countryside. It is hoped that resources are made available soon, to ensure that these powerful datasets can be combined in a new unified scheme to maximise their potential to inform the conservation of biodiversity in the UK.

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PUBLICATIONS USING BMS DATA

Publications in 2002/3

Morecroft, M. D., Bealey, C. E., Howells, O., Rennie, S. & Woiwod, I. P. 2002 Effects of drought on contrasting insect and plant species in the UK in the mid-1990s. *Global Ecology and Biogeography* **11**, 7-22.

Roy, D. B. & Thomas, J. A. 2003 Seasonal variation in the niche, habitat availability and population fluctuations of a bivoltine thermophilous insect near its range margin. *Oecologia* **134**, 439-444.

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APPENDIX I

Collated indices graphs for 34 species, 1976-2002

Figures 11. The graphs on the following pages show fluctuations in the all-sites collated indices for 33 species and are produced using the statistical package TRIM (see page 9). These include all species for which sufficient site annual indices can be calculated for a collated index to be considered valid (see page 23). Two separate indices are shown for the Common Blue, one for the southern bivoltine (two generations per year) populations and one for the northern univoltine (single generation per year) populations, making 34 collated indices in all. In addition a collated index graph for the Adonis Blue from 1990 can be found in Figure 9 on page 32. Where species are bi- or multivoltine (two or more generations per year) or have a separate spring and summer-autumn flight (i.e. Brimstone and Peacock) only the second brood/flight figures are normally used to identify and quantify changes. In the case of species which have a partial third brood, such as the Small Copper and Wall Brown, third brood figures are included with the second brood figures. For some bivoltine species it is difficult to separate the generations due to significant overlap in the broods. These are Painted Lady, Red Admiral, Comma, Small Tortoiseshell, Speckled Wood and Small Heath. In these cases a single all-season index is calculated.

Graphs should be interpreted with caution for species which produce, or have produced, collated indices from relatively few sites, notably, Dingy Skipper, Common Blue (northern, univoltine), Chalkhill Blue, White Admiral, Small Pearl-bordered Fritillary, Pearl-bordered Fritillary and Silver-washed Fritillary. The Brown Argus is now recorded on many transects and despite possible identification problems (especially confusion with brown Common Blue females), we consider that the collated index for this species has become more reliable in recent years.. All figures are of logged values and, where practical, are shown to the same scale so that visual comparisons between graphs can be made.

In the cases of the Holly Blue and Painted Lady, the fluctuations in the all-sites indices are somewhat greater than for other species. These are shown separately on page 41 of Figure 11 to draw attention to the fact that the scales are drawn differently to accommodate the particularly large fluctuations.

Standard error bars are shown on the graphs. These are used to assess the significance of changes in the index value for a particular year relative to a base-line year. A difference of more than two standard errors is significant at the 5% level. How the standard errors are calculated is explained in Appendix II of last years report.

The graphs do not start at 2 (log 100) in 1976 as in previous reports. This is because we have decided to scale the plots by setting the mean for the whole series at 2. The years above or below the mean for the whole series can more readily be seen.

Figure 11. Log collated indices, 1976-2002

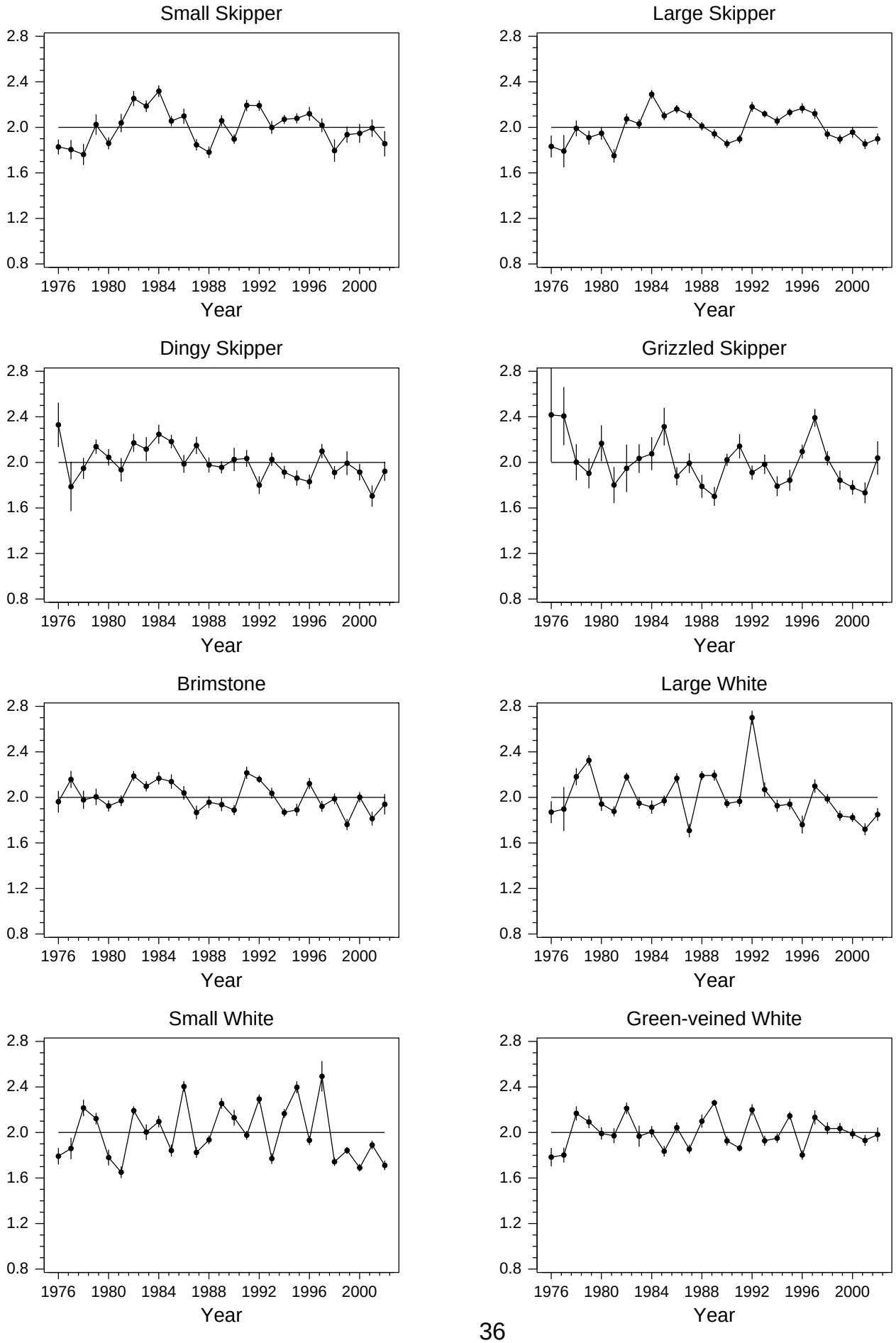
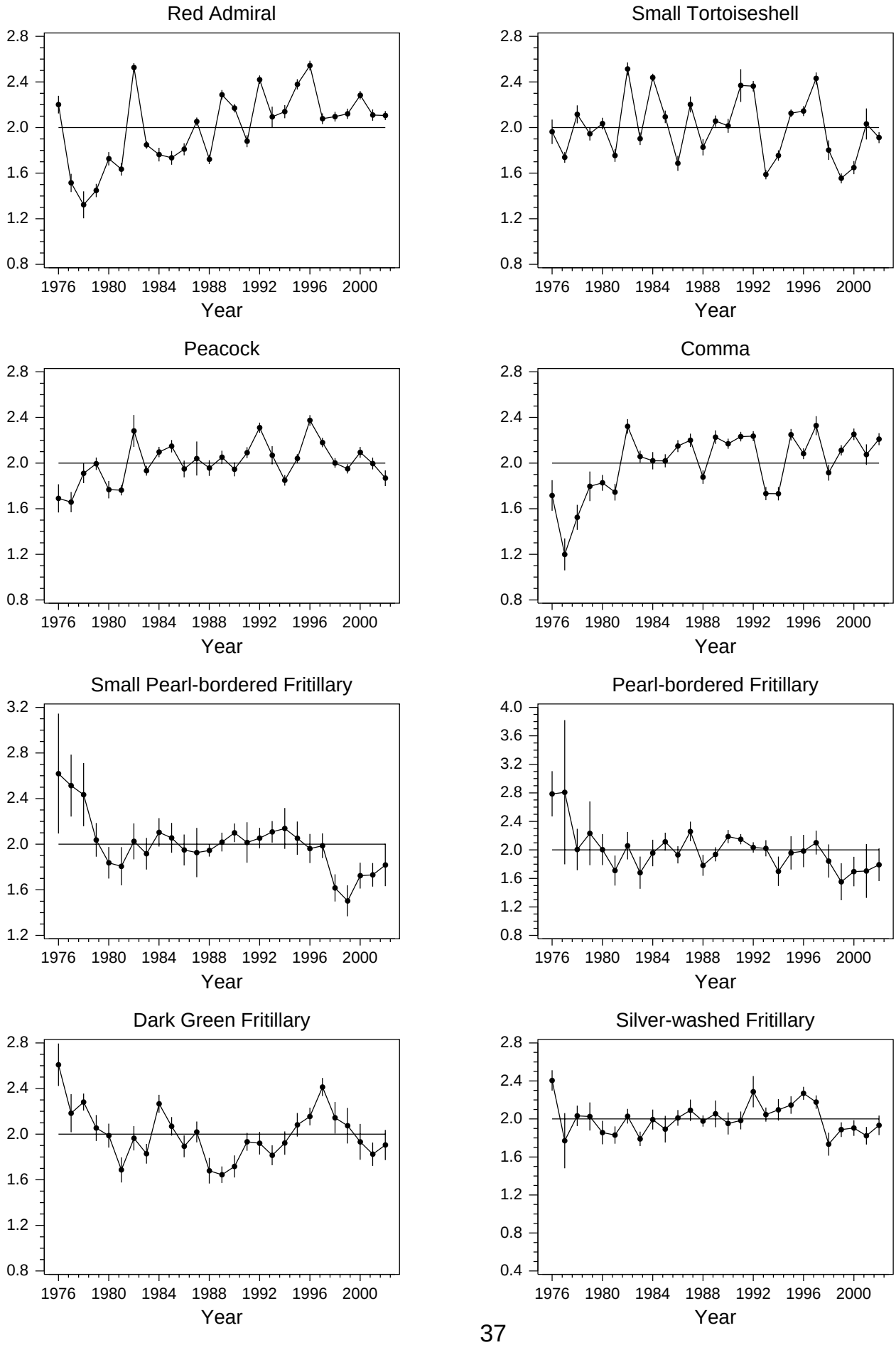


Figure 11. Log collated indices, 1976-2002



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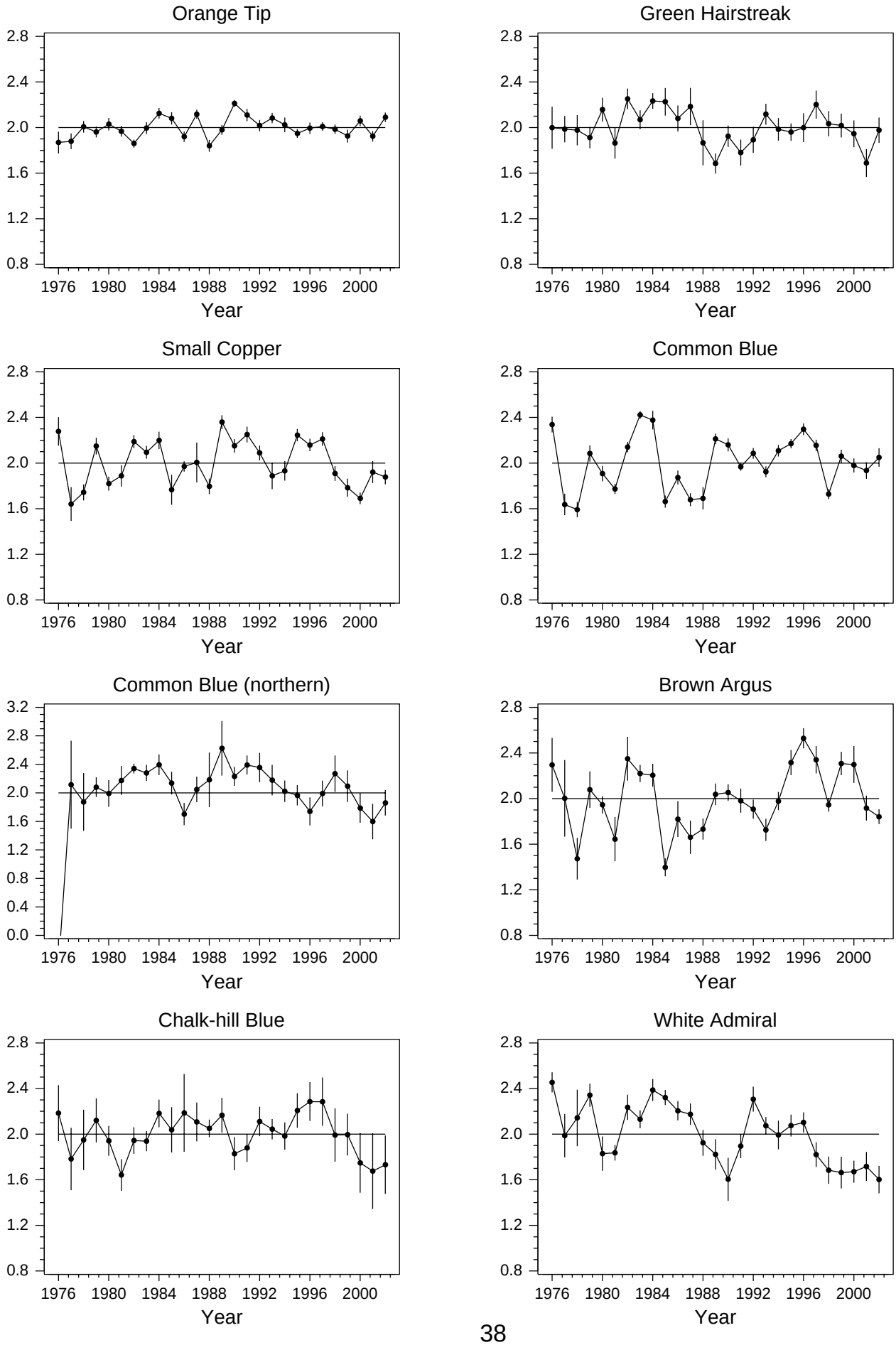

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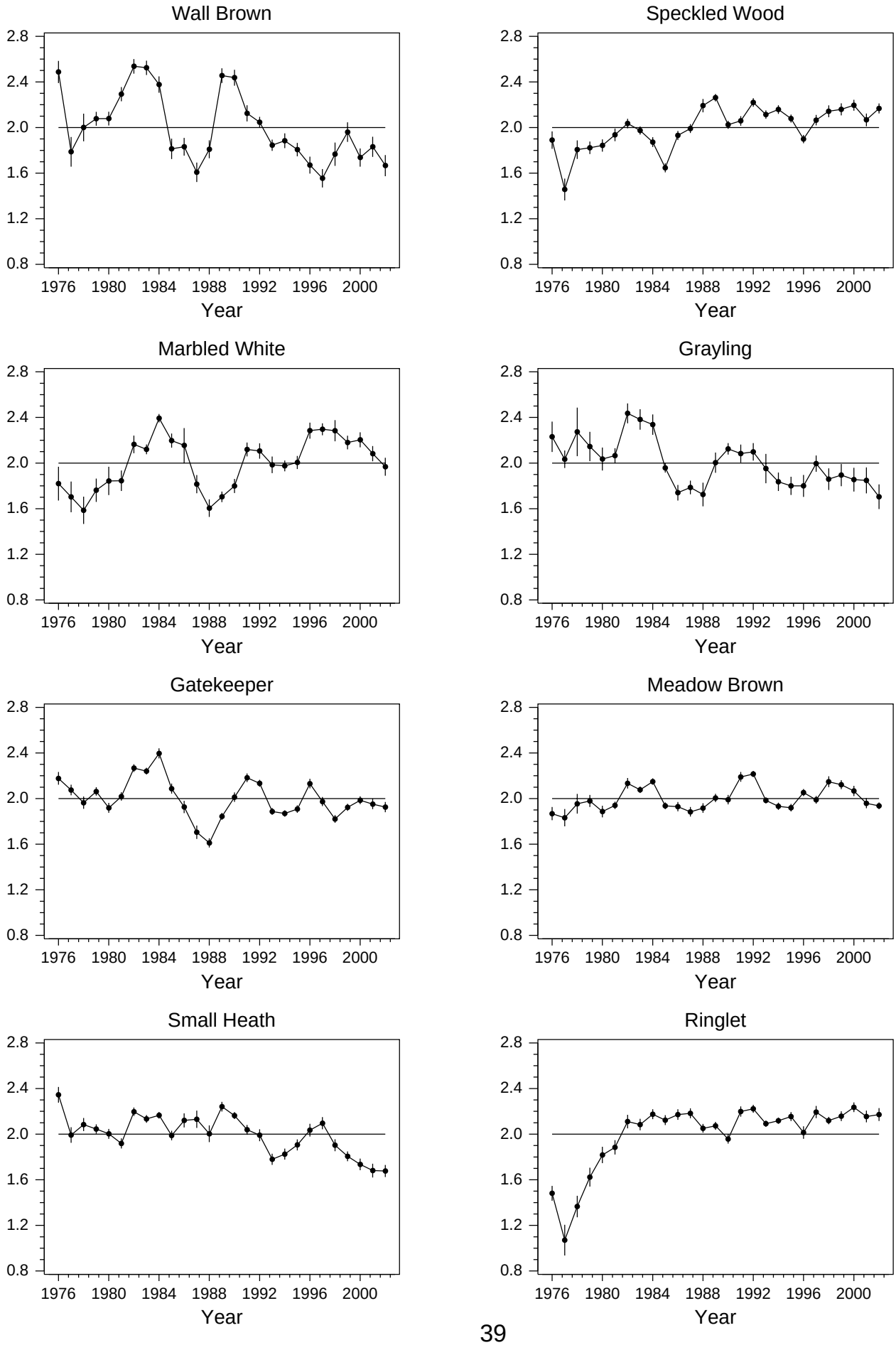

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