



BUTTERFLY MONITORING SCHEME

Report to recorders 2004





**Centre for
Ecology & Hydrology**

NATURAL ENVIRONMENT RESEARCH COUNCIL



The Butterfly Monitoring Scheme
Report to Recorders
2004

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April 2005

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SUMMARY

1. This report reviews the national Butterfly Monitoring Scheme (BMS) for the 2004 season and marks the twenty-ninth year of monitoring since the scheme started in 1976.
2. The year 2004 was an above average year for butterflies in general, ranking **12th highest of the series** (1976-2004) only slightly poorer than 2003 which ranked 10th highest in the series and was the best year since 1997. Of the 50 species and generations for which overall indices of abundance were calculated, 23 increased from 2003 to 2004, 26 showed a decrease and one no change.
3. No species produced their **highest index** though the **Silver-washed Fritillary** and the first generation of the **Adonis blue** produced their second highest index of the series. No species produced their **lowest index**.
4. There was an improvement in the indices of most species flying in the spring, probably largely due to the good summer of 2003. The **Brimstone** and **Holly Blue** did particularly well.
5. Most violet feeding fritillaries improved especially **Silver-washed Fritillary** and **Dark Green Fritillary** which both produced high indices. Satyrids showed small changes with many species retaining a high index and the **Small Heath**, which increased dramatically in 2003, showed a further increase. Conversely the **Wall Brown** remains very low declining further in 2004. After a big increase in 2003 the **Small Tortoiseshell**, which has shown large fluctuations in recent years, dropped by nearly 40% to produce an average index.
6. Migrant species did rather less well than in the good migrant year of 2003, particularly the **Red Admiral**, whose index dropped by 75% from 2003. It was the poorest year for this species since 1991.
7. The day-to-day operation of the scheme is 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.
8. Data were received from 134 transects (including 14 Environmental Change Network (ECN) transects) for the 2004 season. For 8 of these transects data too few for any annual indices to be calculated. Data from 2 transects were collected but were not submitted in time to be included in the analysis for this report. Five transects joined the scheme in 2004 and three rejoined. Two sites were lost from the scheme.
9. Data were received electronically from Transect Walker software from 47 transects; this is a slight drop from 54 in 2003. The new version of the Transect Walker software is undergoing final tests before being released later this year.
10. A three-year contract with Defra which commenced in January will enable the joining together of the two schemes run by Butterfly Conservation (BC) and CEH. It will also enable the development of an extension to the scheme to monitor butterflies in the wider countryside.
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 from 1976-2004

INTRODUCTION

The purpose of this report is to review the Butterfly Monitoring Scheme (BMS), to summarise the results of the scheme for the year 2004 and to provide updates on recent developments in transect recording. The main aim is to give feedback to the many transect recorders, site managers and site owners involved with the scheme.

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 BMS continues to be run by Mr Nick Greatorex-Davies and Mr David Roy has overall responsibility for the management of the scheme. Dr Ernie Pollard retired from active involvement in the scheme in 1998 (apart from walking a transect as part of the scheme) but still provides advice when required.

The BMS has benefited greatly from close collaboration with Butterfly Conservation (BC) for several years. We are now entering a formal partnership, funded by a multi-agency consortium led by Defra, to integrate the BMS and BC transect schemes with the aim of launching a combined scheme in spring 2006. See the 'Updates' section of the report for the full details.

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 gained

Five new transects were brought into the BMS in 2004. Three of these were in Scotland and two in England. These are **Aberarder** and **Scamodale** in Highland, and **Cragbank** near Hawick in the Borders. Two transects are in England, these are **Torrington Commons** in Devon, and **Wootton Coppice** in Hampshire.

Aberarder is a high altitude single species transect that was set up in 1995 on the high slopes of Creag Meagaidh to monitor the **Mountain Ringlet**. **Small Pearl-bordered Fritillary**, **Dark Green Fritillary**, and **Scotch Argus** are also recorded on the transect. A second transect (called Creag Meagaidh) on the lower slopes of the mountain is already part of the BMS.

Scamodale is on the west shore of Loch Sheil, west of Fort William. It is a single species transect that was set up in 2003 to cover the habitat and flight period of the Chequered Skipper. The recording period also covers the flight period of several other scarce species which occur at the site, these are **Pearl** and **Small Pearl-bordered Fritillaries** and **Green Hairstreak**. It is primarily a wet heathland site where tussocks of Purple Moor Grass abound bordered by actively managed plantation coniferous woodland. Data for both 2003 and 2004 have been added to the BMS database.

Cragbank is a National Nature Reserve in the Scottish Borders a few miles SE of Hawick near the Northumberland border. The transect was set up in 2004 mainly to monitor the population of **Northern Brown Argus** that occurs on the site. It was hoped that coverage could be maintained throughout the season but this may not be feasible. The site is mostly a small (8.8.ha) ancient ash-elm-hazel woodland but in addition has some moderately herb-rich grassland on the upper edge of the woodland where the Northern Brown Argus occurs.

Torrington Commons is at Great Torrington, a few miles south of Bideford in Devon. The transect began in 2003. The site is particularly good for the violet feeding fritillaries. Good numbers of **Pearl** and **Small Pearl-bordered Fritillaries** are recorded on the transect and smaller numbers of **Dark Green** and **Silver-washed Fritillaries**. The last confirmed sighting of **High Brown Fritillary** at the site was in 2001. **Green Hairstreak**, **Wall Brown** and **Marbled White** also occur in reasonable numbers.

The transect at **Wootton Coppice** in the New Forest in Hampshire is monitored by staff of the Forestry Commission and was established in 2004. The site is mature mixed woodland with some open glades. The entire wood was thinned in 2003 and many rides have been opened up. **Silver-washed Fritillary** is recorded on the transect.

Lost sites regained

Two long-standing transects that were lost to the BMS in 1996 were restarted in 2004 and brought back into the BMS. These are **Tentsmuir Point** and **Morton Lochs** in Fife, on the east coast of Scotland.

Excellent data were provided for both these sites for 19 and 18 years respectively. When the recorder was no longer able to continue the transects after the 1996 season, no replacement could be found at the time despite a concerted effort. However, as the result of an appeal made at the Butterfly Recorders Gathering held in Stirling in February 2004 several people came forward to offer to help record one or both of these transects again.

A team of recorders now covers both the transects and is co-ordinated by staff at the local Scottish Natural Heritage office. However, due to its length (4.2 km) the Tentsmuir transect has been split into two (Tentsmuir north and Tentsmuir south), so results will not be directly comparable with the earlier transect as there are additional sections (to make a circular route) and the route has had to change in parts. The Morton Lochs transect has also changed in that one section has been omitted. The remainder of the route remains the same.

Tentsmuir Point hosted populations of **Green Hairstreak**, **Small Pearl-bordered Fritillary**, **Dark Green Fritillary** and **Grayling** and at Morton Lochs there were populations of **Small Pearl-bordered Fritillary**, **Dark Green Fritillary** and **Grayling**.

Loch fleet on the north-east coast of Scotland north of Inverness was reported as lost to the BMS in the 2003 Report to Recorders, and in this remote part of Britain it seemed unlikely that a new recorder would be easily found. Against the odds someone contacted us in July,

having already started the transect, to say that he had taken it on. We are delighted that this, one of our two most northern UK sites, is continuing. The site hosts strong populations of **Grayling** and **Dark Green Fritillary**, and a large (but fluctuating) population of **univoltine Common Blue**.

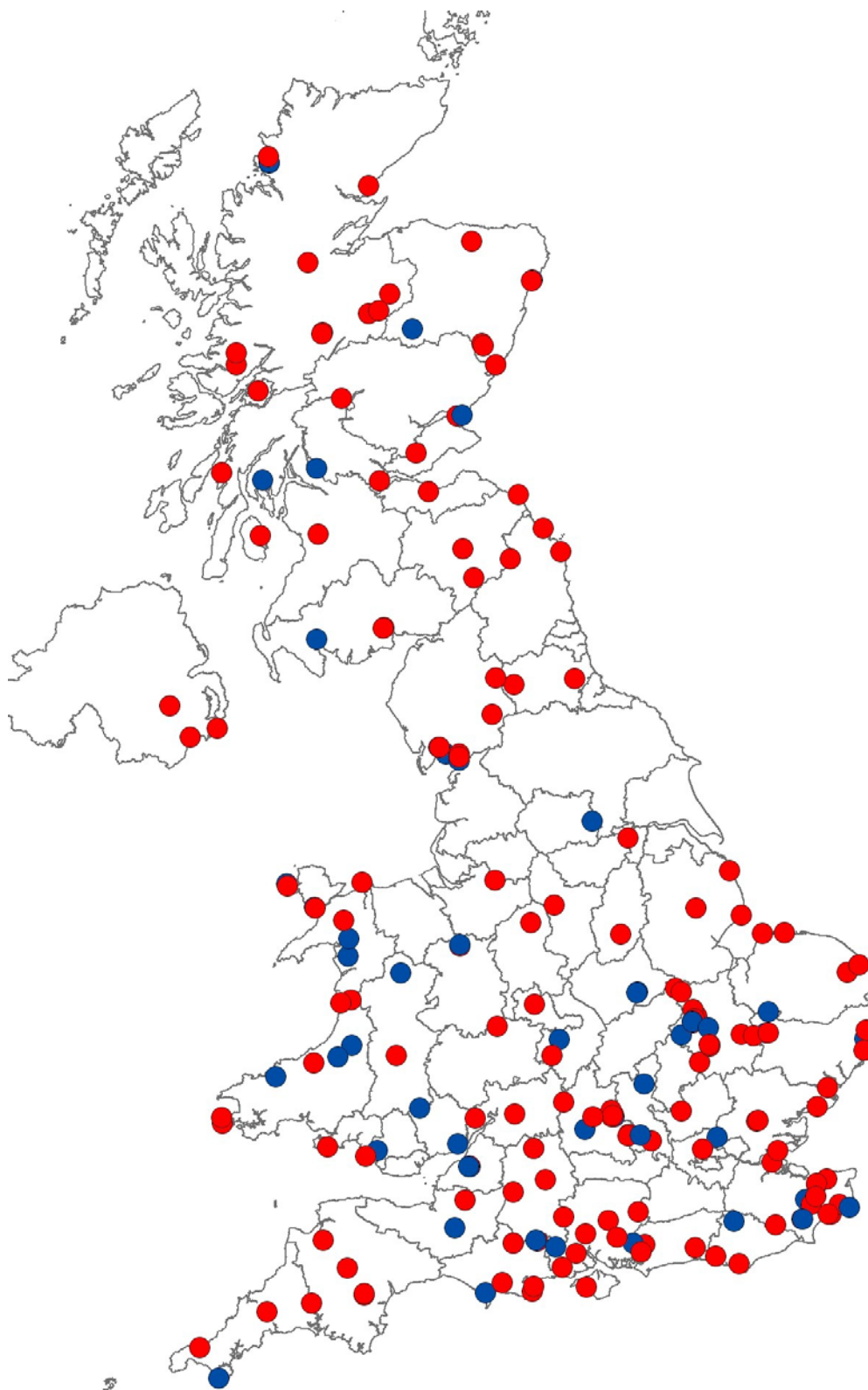
Sites lost

The **Gunthorpe** transect was on the site of disused gravel pits just east of Nottingham. The transect ran for just six years, from 1998 to 2003. In late 2002 we heard that there were plans to reopen the site for gravel extraction. The site was closed to public access in 2004 and so it is no longer possible to continue the transect. A good range of widespread butterfly species were resident at the site including **Brown Argus** and **Wall Brown**.

Whitlaw Mosses in the Scottish Borders joined the BMS in 1992. The recorder has moved away and at present no-one has been found to take over the transect. It is a small wetland site with some drier areas with herb-rich grassland. Sixteen species have been recorded on the transect (including two migrants). The site hosts populations of **Dark Green Fritillary** and **Scotch Argus**. Interestingly a single **Speckled Wood** was recorded in 2002, outside its current range.

Distribution of sites

Map 1. The distribution of BMS (including ECN sites) sites in 2004. Active sites = red; non-current sites = light blue.



UPDATES ON THE CONTINUED DEVELOPMENT OF THE BMS AND TRANSECT RECORDING

Development of transect recording

CEH, Butterfly Conservation (BC) and the Joint Nature Conservation Committee (JNCC) have been striving to attract additional resources to expand butterfly transect recording the United Kingdom. We are therefore pleased to report that the research and development of an expanded UK Butterfly Monitoring Scheme (UKBMS) has been funded from January 2005 until March 2008 by a multi-agency consortium led by Defra, and including the Countryside Council for Wales (CCW), English Nature (EN), Environment and Heritage Service (EHS), Forestry Commission (FC), Scottish Executive Environment and Rural Affairs Department (SEERAD), and Scottish Natural Heritage (SNH).

The overall project aim is to develop an integrated UK-wide scheme to monitor butterfly abundance with the objective of producing composite and individual species abundance indices at the UK level and by country, region, habitat and land use type (e.g. agri-environment schemes, protected areas). This will be achieved by two separate projects: the first focussed on integrating and expanding the existing network of butterfly transects (the BMS and transects co-ordinated by BC), which effectively sample habitat specialist butterflies on semi-natural sites, and the second to develop a new monitoring scheme for common species in the wider countryside, which would be based upon random sampling and therefore representative of the UK landscape as a whole.

Some of the objectives and main activities of the project are:

Project 1. Integrating and expanding the existing network of butterfly transects.

Maintain, support and extend BC monitoring scheme

- Maintain BC transect scheme in England from June 2005 – April 2008
- Extend transect development to rest of UK from 2005 until 2008
- Hold dedicated workshop/training courses in each country in each year

Integrate CEH and BC monitoring schemes

- Combine the BMS and BC transect schemes
- Development of a joint CEH-BC-JNCC UK BMS web site
- Launch combined scheme in Spring 2006
- Merge data into a single database of butterfly abundance data (transect and timed count data)
- Data collated annually from 2005-2007 and fed into the single database, to produce national trends from all the available data

Develop a long-term plan for continuation of a combined Transect Scheme

- Develop a costed proposal for the long-term running of a single transect-based butterfly monitoring scheme (UKBMS)

Develop and test a range of butterfly biodiversity indicators using the following approaches:

- Measure the coverage of the combined transect schemes for UK butterfly populations
- Assess the statistical power of the combined transect scheme for detecting trends
- Derive indices of abundance and report trends by:
 - The UK-wide trend for individual species, including all BAP species that can be monitored by transects
 - The trends in individual species within countries and regions
 - Trends in individual species for performance on sites with different habitats

- o Performance of species on protected land (SSSIs etc) vs non-protected land
 - o Performance on sites under agri-environment schemes vs sites not entered into such schemes
- Develop *composite* abundance indices based on groups of species such as Biodiversity Action Plan species, habitat specialist species etc.

Developing butterfly indicator(s)

- Develop a UK Populations of Habitat Specialist Butterflies Headline Indicator
- Develop indicators by country where data are sufficient and in some cases by Defra Governmental Region
- Develop additional indicators such as a Populations of BAP Priority Butterflies Index and by BAP habitat type

Project 2. Develop and test a method for assessing the abundance of butterflies in the wider countryside.

Scheme design

- Model when and how often to sample, through analysis of existing transect data
- Design a sampling method, e.g. where and how to sample butterflies in the wider countryside
- Run a workshop to identify methods to be tested during field trials

Field testing

- Identify the most efficient and robust method for monitoring wider countryside butterflies
- Field test a range of potential recording methods in 2006 using a researcher
- Development of a web-based data entry system for use by volunteers
- Expand field test using volunteers (BC and BTO) to two pilot areas in 2007 (southern England and an Upland area)

Assessment of volunteer potential

- In 2005/6, assess the potential of volunteer surveyors to take part in a wider countryside scheme
- In 2007/8 obtain feedback on proposals for wider countryside scheme from butterfly (BC/CEH) and bird recorders (BTO) as well as potential recorders in partner organisations (RSPB, NT, WT, Agencies etc.)
- Assess likely take-up of scheme and retention of volunteer recorders

New BMS website

Over the past year we have been developing a completely new BMS website. It contains far more information than the old website, which it will soon replace on url <http://www.bms.ceh.uk>. The site includes the following features:

For sites:

- Basic information on the location, transect and habitat of all sites that have ever provided transect data to the BMS
- Site maps for most transects, showing transect routes and sections
- Weekly summary tables for all sites for all years

For species:

- All-sites trend graphs, with explanatory text
- Phenology graphs
- Interactive abundance and trend maps

Other information:

- Details of methodology
- Downloadable and customisable transect Field Recording Forms
- Downloadable reports to recorders (pdf files) from 1997
- Lists of publications produced relating to the BMS and its work

We welcome suggestions for further additions and improvements to the site.

A new version of Transect Walker

A new version of Transect Walker (TW) (version 2) has been developed and tested over the winter months and is now almost ready to be made available to recorders. The current version of TW (version 1.3) is still available as a free download from BC's website. When the new version is ready it will replace version 1.3 on BC's website.

A range of bugs have been fixed and the new version has several new features and improvements. These include the following:

- A data converter for converting old TW files (i.e. those created in version 1) to the new format)
- Facility to include more than one transect count in a week
- Facility to record three weeks earlier in March and another week later in October
- Facility to add extra species
- Two separate indices are calculated – now includes a simple index which disregards the BMS rules
- Index can be calculated for upland northern sites where temperature allowed for walking a transect may be as low as 11⁰c
- Custom species list once created is now linked to the site as the default
- Improvements to the weekly count data entry screen

SUMMARY OF THE 2004 SEASON

Weather summary for 2003 and 2004

Although it may not have seemed like it at times, 2004 was the fifth warmest year for England (overall assessment unavailable for rest of UK) since records began in 1659. With the exception of July (which had average temperatures), temperatures were well above average throughout the recording season (April – October). These warm temperatures were recorded despite only average or below average sunshine levels during most of the recording season. Only May and September had above average levels of sunshine. Particularly wet periods during the recording season occurred in April and August, with August being the wettest since 1912. Parts of England and Wales also had relatively high rainfall in July. May was dry and sunny, but the second half of June was cool and cloudy. There were a few spells of hot sunny weather, including a week in mid June and the first week of August.

The mixed weather in 2004 was in contrast to the generally dry, warm and sunny weather in 2003 which was the warmest and second sunniest year since 1961 (the Met Office use 1961-1990 data to measure deviations from the mean of this period, see: <http://www.metoffice.com/index.html>), and the fifth warmest for Britain since records began in 1659. England and Scotland had the sunniest year of the period, the previous sunniest being 1995. The good weather translated into a good butterfly year in 2003 with increases in the Collated Indices of many species and the best year for butterflies overall since 1997 (see 2003 report and **Figure 1**).

Review of trends in 2004

Overall changes in abundance: another good year for butterflies

As a result of the generally poor summer weather in 2004, numbers of many species of butterfly might be expected to have been rather depressed, but this was not generally the case and 2004 proved to be an above average year for butterflies and almost as good as 2003 (**Figure 1**). The warm dry May may have benefitted the young stages of some species reducing the effect of the poor weather later in the season.

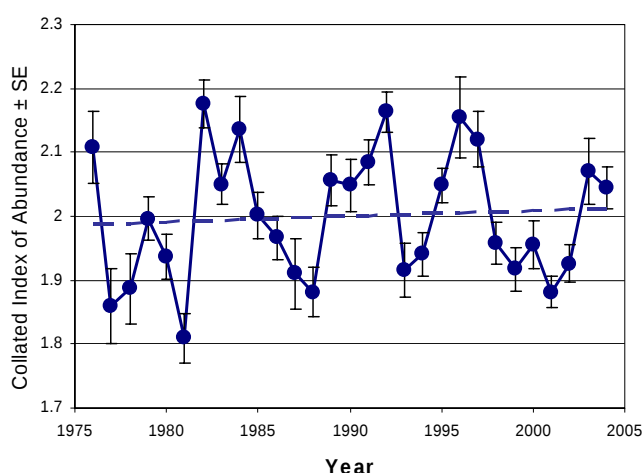


Figure 1. Fluctuations in the mean index of abundance. Values are means ($\pm$ SE) of collated index values for 33 species.

Collated indices were calculated for 50 species and generations. Of these, 23 showed an increase between 2003 and 2004, 26 a decline and one no change at all. Some of the changes were very small. For 33 species (second generation/flight only of bivoltine / Spring/Autumn species) for which collated indices are most reliable, 15 showed an increase, 17 a decrease and one no change.

Since the inception of the BMS in 1976, a general pattern in species trends has been the increase in the abundance (and distribution) of generalist species as they have benefited from warmer temperatures. In contrast, habitat specialist species have suffered badly over the same time period. Declines in the abundance of these species have occurred in parallel with severe contractions in range (Warren *et al.* 2001). In 2004 however, habitat specialist species fared relatively well, continuing an upward trend that has been apparent since 2000 (**Figure 2**).

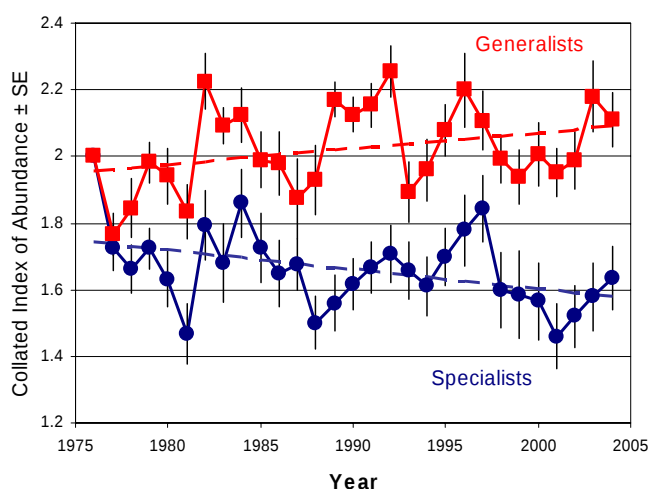
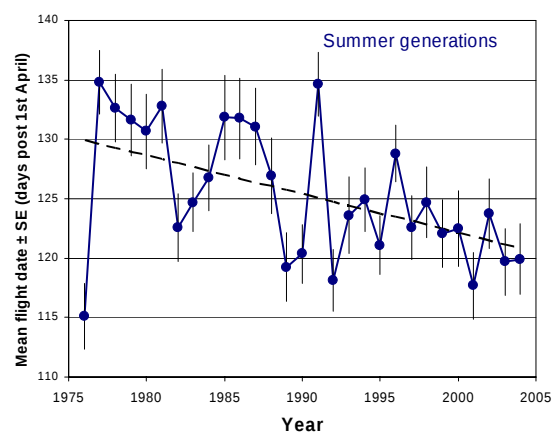
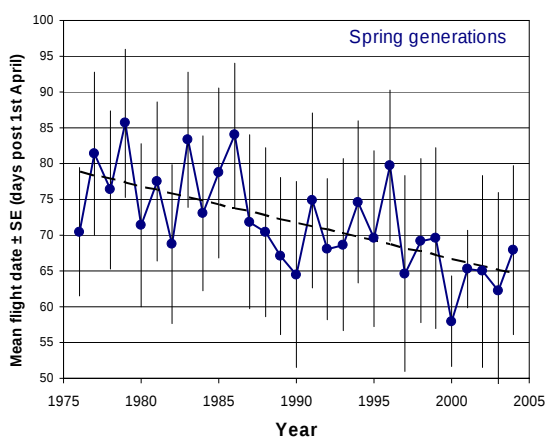


Figure 2. Variation in trends of generalist (red line, square symbols) and specialist species (blue line, circle symbols) measured from over 29 years (1976-2004).

Overall changes in phenology

As well as changes in the abundance of butterflies, transect data is invaluable for assessing changes in the timing of appearance. Measures of phenology have become important indicators of the effects of climate change, and we have calculated the mean date of almost 47,000 flight periods recorded by the BMS. Since 1976, there has been a significant trend towards earlier appearance of butterflies in both spring (including 1st generations of bi- or multi-voltine species) and summer (including 2nd generations)(**Figure 3**).

Figure 3. Trends towards earlier appearance in both spring and summer generations of bi- and multivoltine butterfly species.



The rate of change is more marked for spring species than those flying later in the season with the mean date of flight periods being 5 days and 3¼ days per decade earlier, respectively. The effects of temperature on rates of development of immature stages of butterflies and the resulting timing of adult emergence are well established. These trends in the phenology of British butterflies are consistent with trends found in a range of taxonomic groups (birds, flowers, trees) from many regions in the northern temperature zone that suggest that climate warming is having a profound effect on the timing of naturally recurring events.

Changes in individual species: no highest or lowest indices

No species produced a highest or lowest index of the series (1976-2004) though 1st generation **Adonis Blue** produced its second highest of the series, 1984 being the highest. The **Silver-washed Fritillary** also produced its second highest index, the highest index being in 1976.



Silver-washed fritillary (female)
Church Place, Hants

Spring species improved

Of the fifteen species which either fly in the Spring or have their first generation in the Spring all but two (**Dingy Skipper** and **Brown Argus**) showed an increase, although the increases for first generation **Large White**, **Common Blue** and **Wall Brown** were extremely small. These increases are in contrast to 2003 when most of these species declined, and probably reflects the good summer weather of 2003 which would have resulted in improved breeding success of many of these species.

Whites remain unchanged but Brimstone does well

Both **Small** and **Green-veined Whites** showed substantial increases in their first brood but all three whites showed virtually no change from 2003 in their second brood. However numbers of all three species produced a well above average second brood index. **Brimstone** showed a substantial increase in both the Spring and Summer/Autumn flights taking the indices from fairly low levels in 2003 to relatively high indices especially in the Spring.



Brimstone – Bevill's Wood, Cambs

Good year for Holly Blue but most other blues declined

Judging by the patterns of ups and down of the strongly cyclical **Holly Blue** it seemed likely that this butterfly would experience a further drop in 2004. In the event it showed substantial increases in both broods with a 49% increase in the first brood and a large 260% increase in the second generation giving a well above average index in both cases. Other blues generally showed declines. There was virtually no change in the first brood of the **Common Blue**, but the second brood



Holly Blue - Folkestone Escarpment, Kent

dropped by 43% from the high index of 2003 to well below average. **Brown Argus** was down in both generations but still remains fairly high after its big increase in 2003. The **Chalkhill Blue** remains low, and after two years of increases, dropped again in 2004. This butterfly has showed a general decline since its best years of 1995-7, though at Barnack Hills and Holes in north Cambridgeshire, where the species was introduced in 1987 (now it's most northern site in Britain), numbers are still generally increasing. The **Adonis Blue** showed mixed fortunes with a big increase in the first generation (76%) but a substantial decline in its second generation (60%) from its all-time high of 2003. However the second generation index remains relatively high ranking 6th highest of the 29 years of the series. It must be remembered that the Collated Index for this species is derived from relatively few comparisons (8 for 2003-4).

A good year for fritillaries

Four of the five violet-feeding fritillaries showed increases in 2004. The biggest increases were for the **Dark Green** and **Silver-washed Fritillaries** with 40% and 64% increases respectively. As already pointed out, this gave the **Silver-washed Fritillary** its second highest index of the series. For the **Dark Green Fritillary** it was its third highest of the series. The **Pearl** and **Small Pearl Bordered Fritillaries** showed smaller increases. Note that data is only available for a small number of sites for the **Pearl-bordered Fritillary**.



Small Tortoiseshell – Monks Wood, Cambs

Small tortoiseshell fluctuations

The **Small Tortoiseshell** has shown large fluctuations in recent years. Numbers were high in 1997, but plummeted the following two years to produce the lowest index of the series in 1999. Low numbers caused concern amongst butterfly enthusiasts and there was fear that a parasite, *Sturmia bella* (Meigen) (Diptera: Tachinidae), discovered new to Britain from specimens reared from **Peacock** pupae in 1998 (Ford *et al*, 2000), may be having a serious effect on this species in Britain. However since the low of 1999 numbers of **Small Tortoiseshell** increased gradually and in

2003 a high index was produced again (6th highest in the series). In 2004 the index dropped by 39% to produce an average index. The parasite is now well established in southern England (Baumgart *et al*, 2003) and was recorded new to Wales in 2003 (John, 2004). This Tachinid fly is a widespread and common parasite of Nymphalidae in continental Europe.

A poorer year for migrants

2003 was an excellent year for migrant species and the **Painted Lady** produced the second highest index of the series, the highest being in 1996, the year of the huge immigration of this species to the UK. In early to mid-February 2004 an influx of **Painted Ladies** was reported all across southern England and also in Wales (see: <http://www.migrantmoth.com/>).

Smaller numbers were reported in March. This might have been expected to herald another good year for this species but although the index remained relatively high (7th in the series) the numbers expected did not generally materialise. In general counts were highest at western and northern sites. Smardale Gill in Cumbria again produced the highest count with 142 recorded on transect counts (558 in 2003).

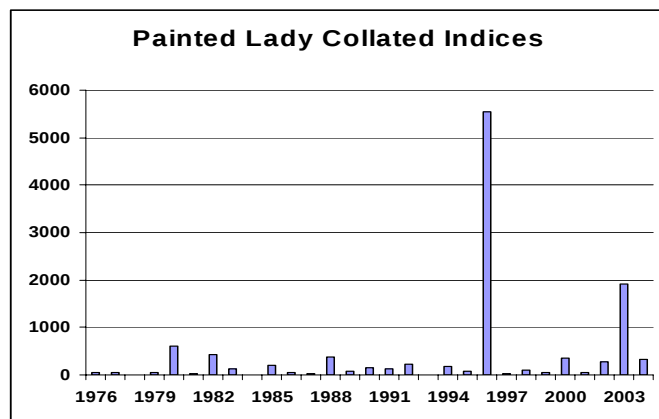
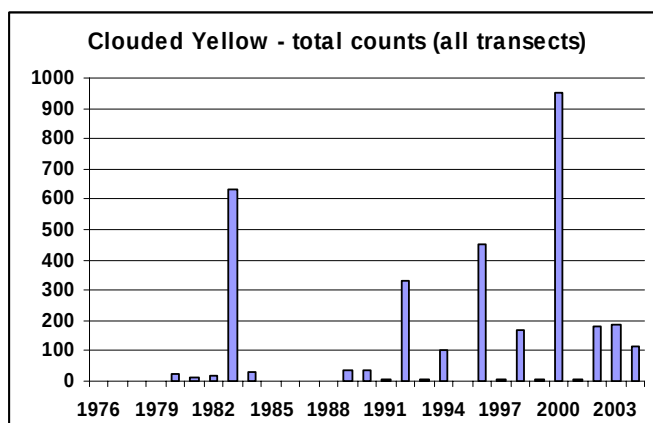


Figure 4. Painted Lady collated indices 1976-2004.



After its all-series high in 2003 the **Red Admiral** index dropped dramatically by 75% producing its lowest index since 1991. **Clouded Yellow** numbers were also lower but it is interesting to note that high counts have been recorded every other year since 1992 but in each of the last three years.

Figure 5. Clouded Yellow collated indices 1976-2004.

Relatively small changes amongst the Satyrids

Relatively small changes occurred amongst the browns and other satyrids. The **Gatekeeper** showed the biggest increase (20%) giving a fairly high index (ranking 8th). The **Small Heath** has retained its recovery of 2003 and increased by a further 10% to produce a well above average index. The biggest declines were shown by the **Wall Brown** (2nd brood) (23%) and **Ringlet** (24%). This was 3rd lowest for **Wall Brown** and the lowest since 1997. The **Ringlet**, however, remains high.



Tabular summary of changes 2003 TO 2004

Details of the changes outlined on the preceding pages are summarised in **Table 1** on page 15.

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.

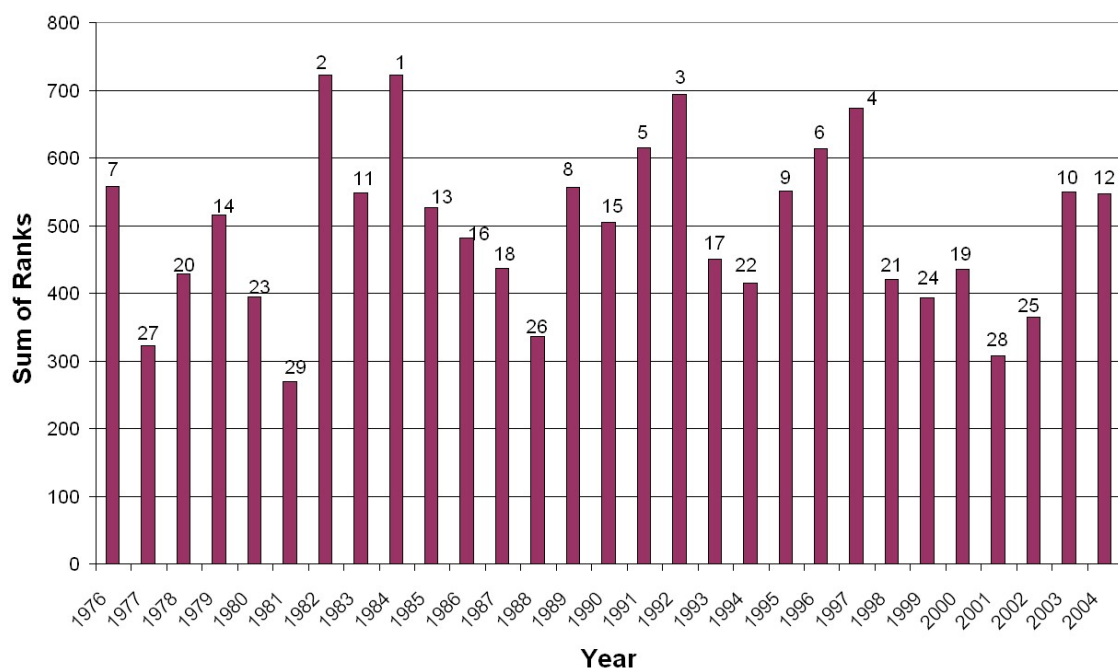
Table 1. Summary of changes 2003/4.

SPECIES	2003 all-sites index	2004 all-sites index	% change down	% change up	Rank order of 28 years 2003	Rank order of 29 years 2004	Lowest / highest all-sites index	Comments	Trend in all-sites index
Small / Essex Skipper	93	112		20	17	13	Average		0.001
Large Skipper	92	90	2		15	17	Average		0.001
Dingy Skipper	79	77	3		23	24	Low		-0.009 **
Grizzled Skipper	64	71		11	24	20	Below average		-0.012 *
Brimstone 1 (Spring)	90	143		59	19	5	High	Substantial increase	0.003
Brimstone 2 (Summer/Autumn)	77	110		43	24	10	Above average	Substantial increase	-0.005
Large White 1 (1st generation)	58	54	8		22	24	Low		-0.021 **
Large White 2 (2nd generation)	107	108		1	10	10	Above average		-0.004
Small White 1	57	86		51	25	22	Low	Substantial increase	-0.014 **
Small White 2	152	141	8		7	10	Above average		0.002
Green-veined White 1	83	101		122	22	14	Average		-0.004
Green-veined White 2	120	120	-	-	9	9	Above average		0.002
Orange Tip	102	121		19	12	6	High		0.003
Green Hairstreak	55	89		62	26	20	Below average	Substantial increase	-0.005
Small Copper 1	77	131		70	21	11	Above average	Substantial increase	-0.001
Small Copper 2	151	126	17		7	12	Above average		0.001
Common Blue 1	126	125	1		9	10	Above average		-0.004
Common Blue 2	164	76	43		5	21	Below average	Substantial decrease	0.004
Brown Argus 1	74	61	18		21	25	Low		-0.008
Brown Argus 2	152	127	16		10	11	Above average		0.009
Chalkhill Blue	78	64	18		21	24	Low		-0.002
Holly Blue 1	166	247		49	11	9	Above average		0.022
Holly Blue 2	72	259		260			Above average	Big increase	0.012
White Admiral	71	87		23	18	16	Average		-0.017 ***
Red Admiral	369	94	75		1	18	Below average	Big drop to below average after last years highest ever index	0.023 ***
Painted Lady	1912	318	83		2	7	High	Big drop but still well above average	0.027
Small Tortoiseshell	168	103	39		6	14	Average	Substantial decrease	-0.002
Peacock 1	110	140		27	15	6	High		0.015 ***
Peacock 2	101	99	2		13	17	Average		0.007
Comma	263	205	22		1	3	3rd highest		0.021 ***
Small Pearl-bordered Fritillary	49	63		29	26	23	Low		-0.02 ***
Pearl-bordered Fritillary	52	63		21	26	22	Low		-0.019 ***
Dark Green Fritillary	161	225		40	4	3	3rd highest	Substantial increase	0.003
Silver-washed Fritillary	127	209		65	6	2	2nd highest	Substantial increase	0.003
Wall Brown 1	83	81	2		17	18	Below average		-0.009
Wall Brown 2	62	48	23		23	27	3rd lowest		-0.02 **
Speckled Wood	169	150	11		2	4	High		0.016 ***
Marbled White	123	105	15		13	15	Average		0.012 **
Grayling	71	72		1	21	20	Below average		-0.015 ***
Gatekeeper	104	125		20	11	8	High		-0.005
Meadow Brown	111	105	5		10	11	Above average		0.004
Small Heath	107	118		10	13	11	Above average	A further increase to above average	-0.011 **
Ringlet	198	151	24		1	5	High		0.024 ***

COMPARISON OF THE 29 YEARS OF THE BMS

The following method has been used to assess the overall relative abundance of butterflies in each of the 29 years of the BMS (1976-2004). For the 33 species (plus the northern univoltine Common Blue) for which all-sites collated indices have been calculated over the period 1976-2004, the years have been ranked 1 to 29 according to the collated index value for the species. The score 29 was given to the year with the highest value (best year), and 1 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 6** shows these sums of ranks. 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.

Figure 6. Histogram showing the sum of the ranks of 33 species for the period 1976-2004.



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ACKNOWLEDGEMENTS

The Butterfly Monitoring Scheme is jointly funded by the Centre for Ecology and Hydrology and by the Joint Nature Conservation Committee acting on behalf of English Nature, Scottish Natural Heritage, the Countryside Council for Wales and the Environment and Heritage Service for Northern Ireland.

We are particularly wish to express our gratitude to all the recorders and site managers who make the BMS possible through their enthusiasm and commitment to recording their transects as part of the scheme. We would especially like to thank Val Burton for all her willing hard work during the autumn months processing the incoming data and inputting it onto computer and also Juliet Francis who from time to time helps with mail-outs and other administrative work. The map showing the distribution of monitored sites was constructed using Alan Morton's DMAP programme. We thank Ernie Pollard for his advice on occasions when it has been requested. We would especially like to thank Dr Ian McLean of the Joint Nature Conservation Committee and Drs Tom Brereton and Martin Warren of Butterfly conservation for their co-operation in seeking to develop the butterfly monitoring partnership. Butterfly photographs are by Nick Greateorex-Davies except the Silver-washed Fritillary on the front cover which was taken by Eddie John and is used by kind permission. Finally we would like to thank Carl Thompson and his team at the Joint Reprographic Services Unit at the Natural Environment Research Council's headquarters in Swindon who do an excellent job in producing this report for us each year.

APPENDIX I

Collated indices graphs for 41 species, 1976-2004

The graphs on the following pages (**Figure 7**) show fluctuations in the all-sites collated indices. These include all species for which sufficient site annual indices can be calculated. 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) both broods/flight are given although the second brood/flight is generally the most abundant and used to assess change. 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 and broods which produce, or have produced, collated indices with large associated standard errors. In these cases, indices are based on relatively few sites and include Silver-spotted Skipper, Scotch Argus, Small Blue, Silver-studded Blue, Northern Brown Argus, High Brown Fritillary and Adonis Blue. All figures are of logged values and, where practical, are shown to the same scale so that visual comparisons between graphs can be made. However note the extended scale for the species listed above which have large standard error bars or species with large annual variations in numbers, e.g. Holly Blue and Painted Lady.

Figure 7. Log collated indices, 1976-2004

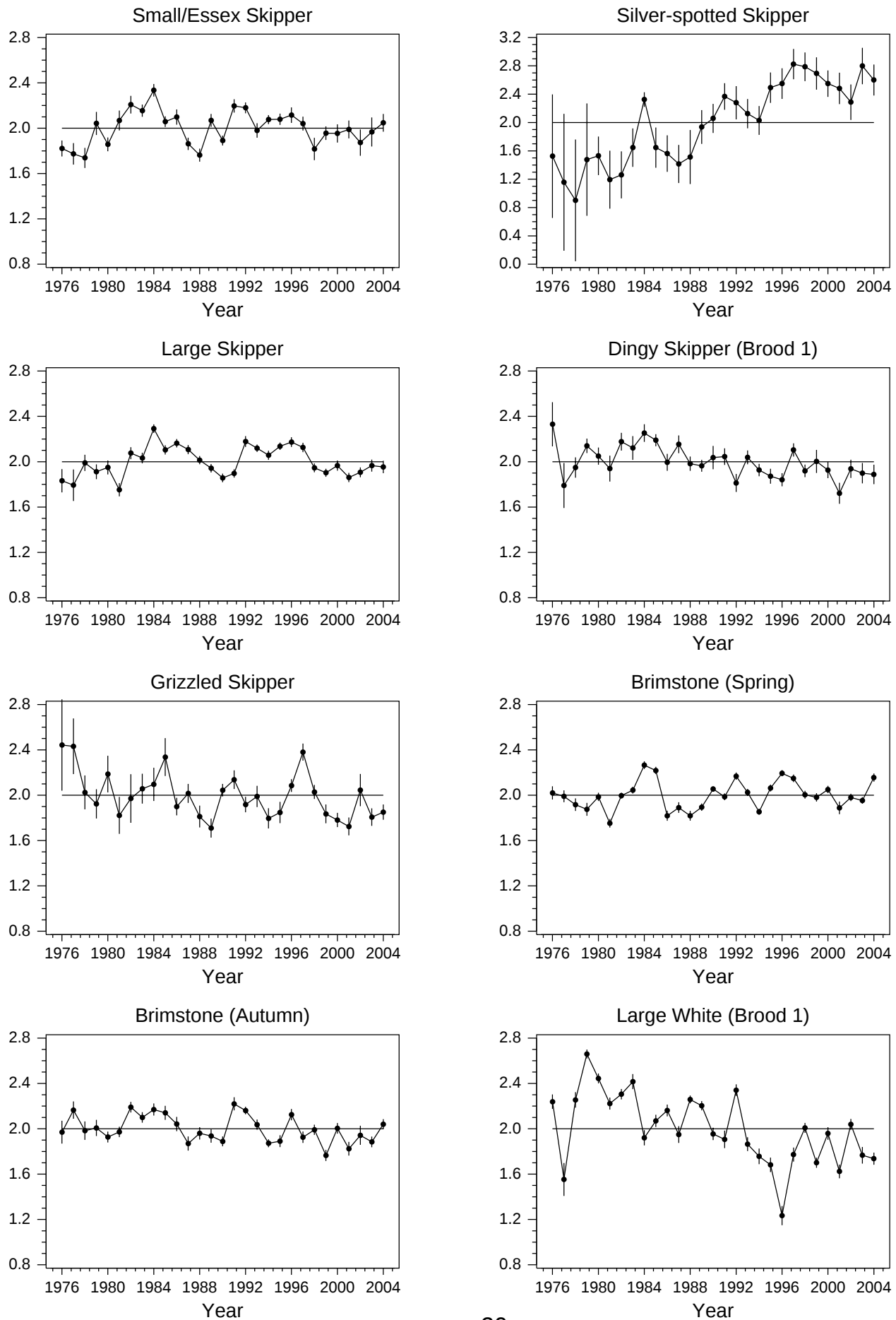


Figure 7. Log collated indices, 1976-2004

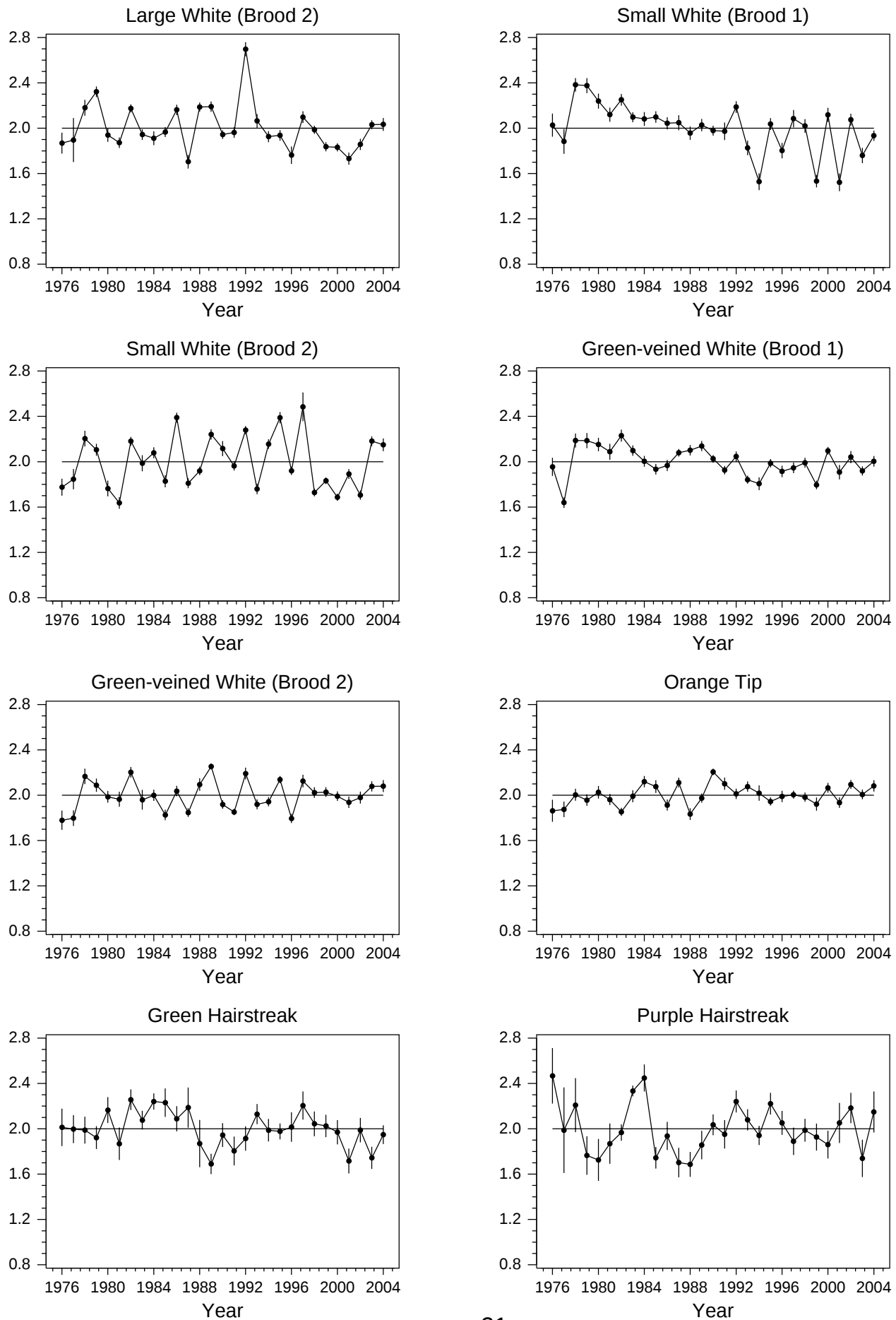


Figure 7. Log collated indices, 1976-2004

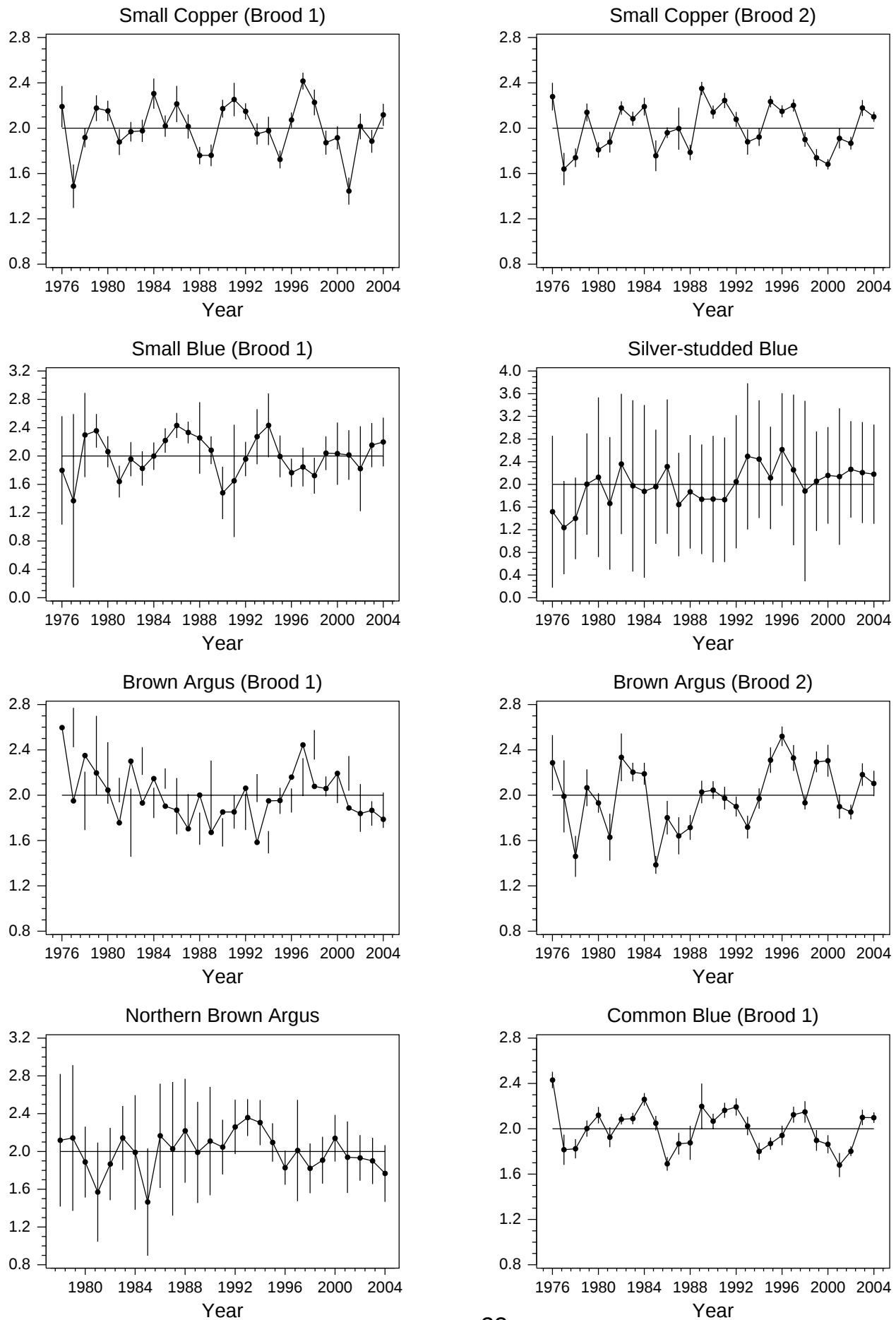


Figure 7. Log collated indices, 1976-2004

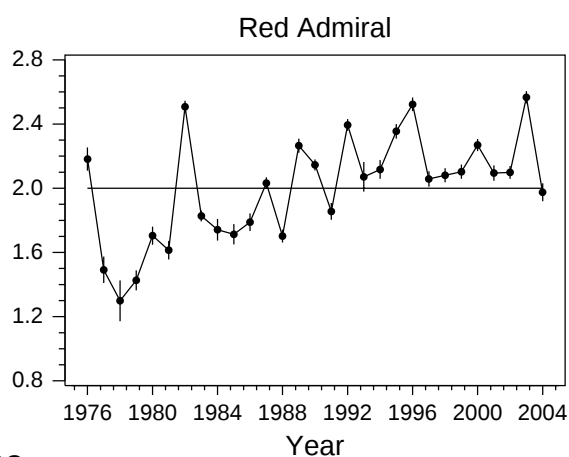
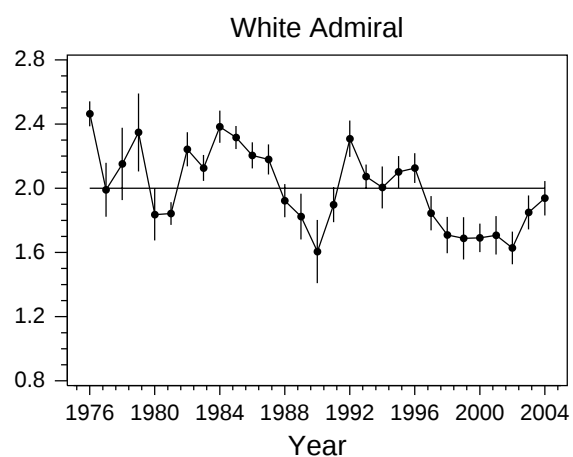
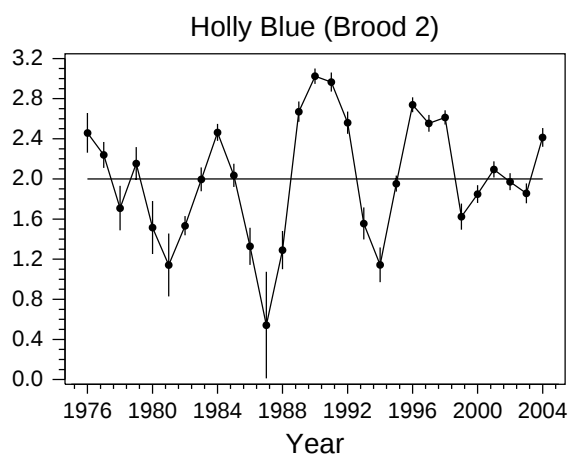
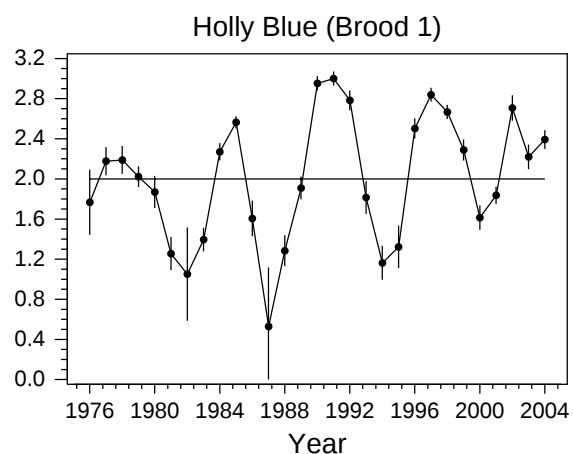
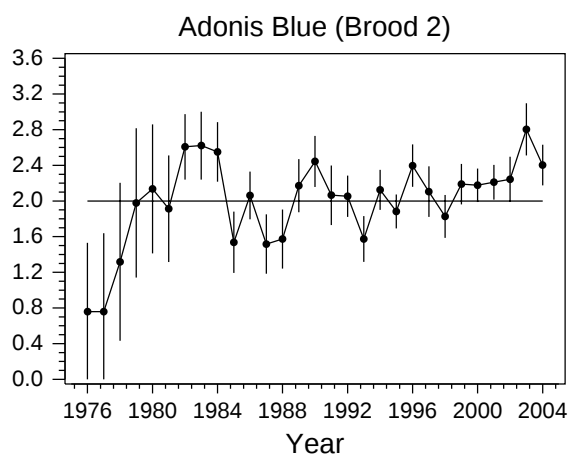
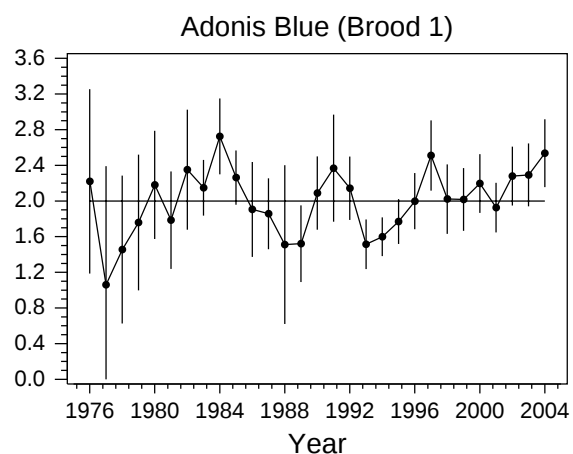
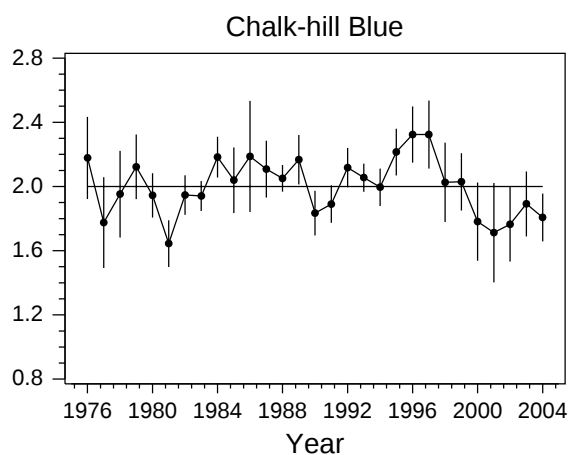
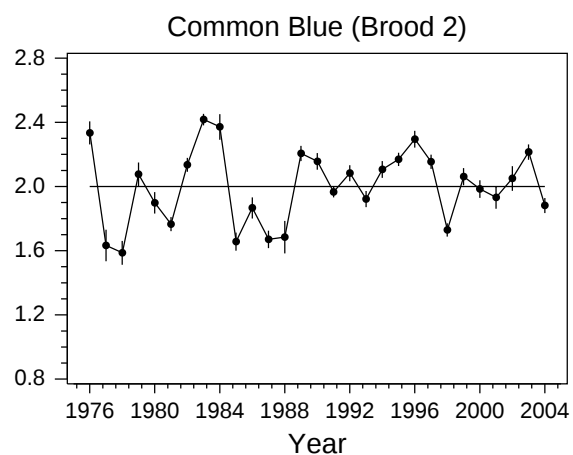


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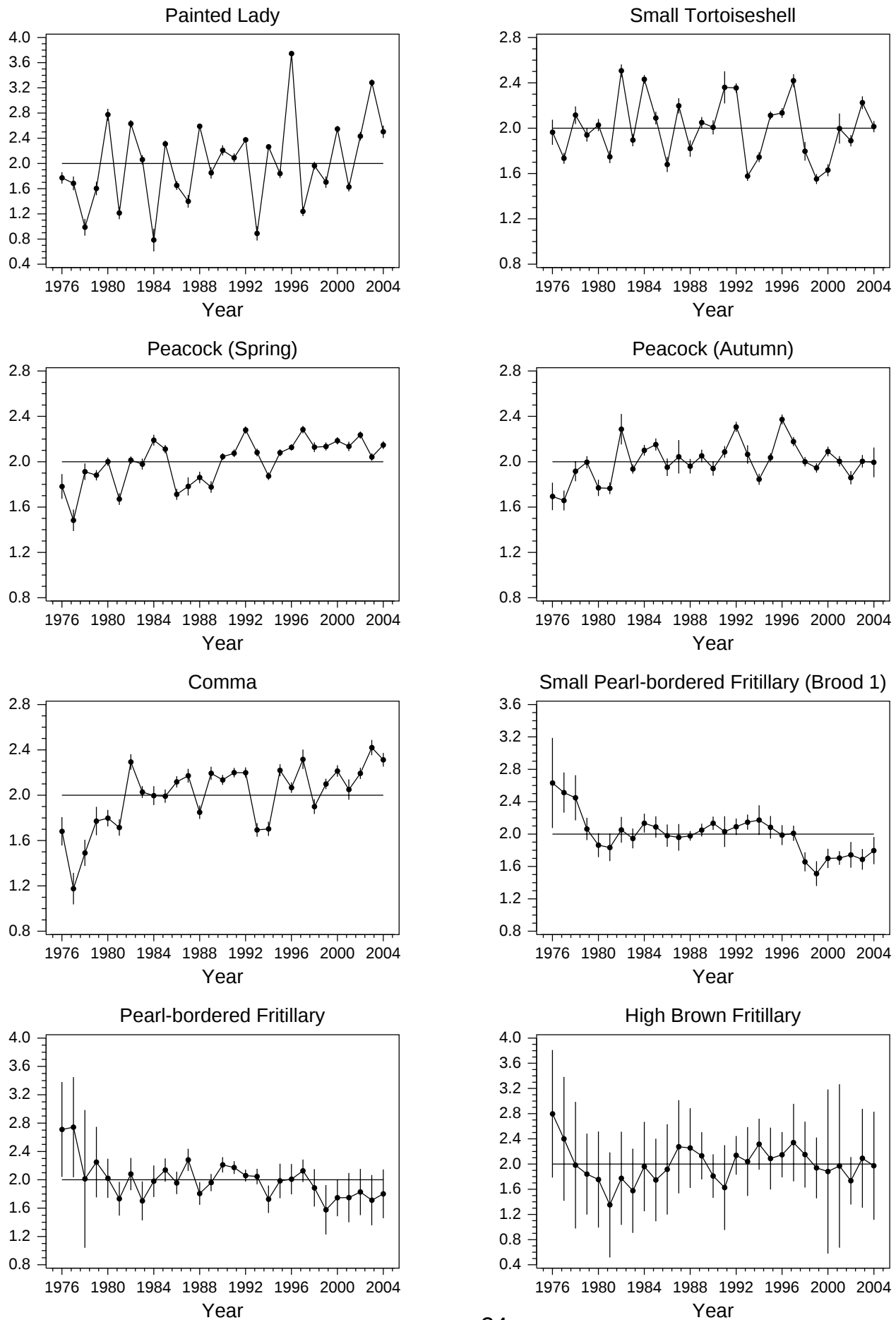


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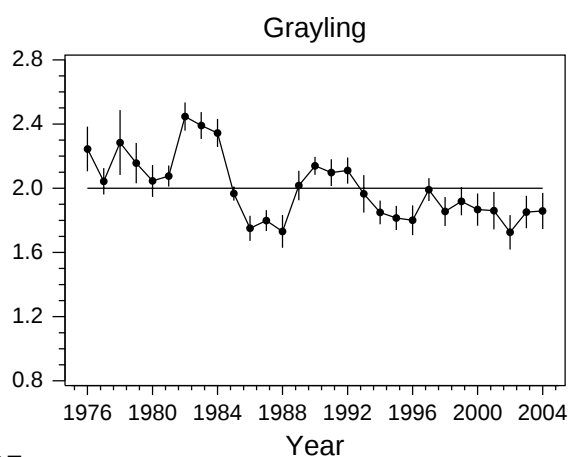
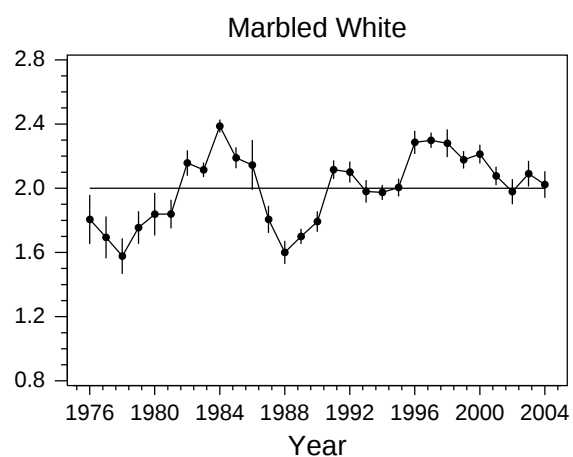
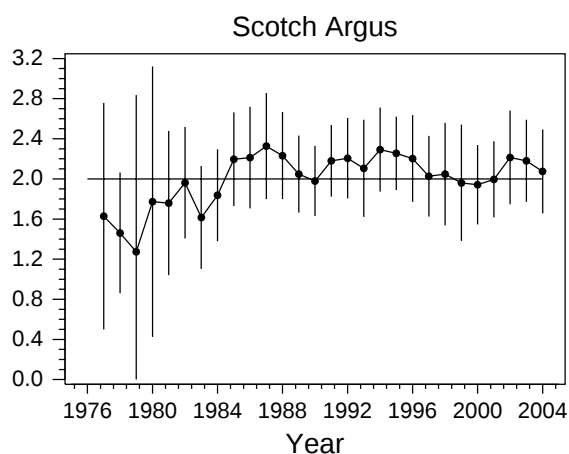
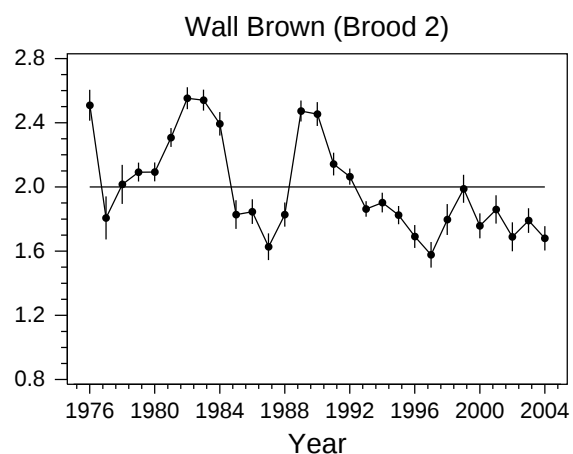
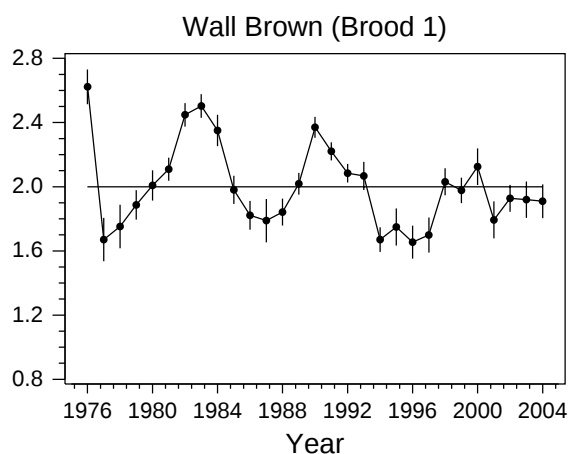
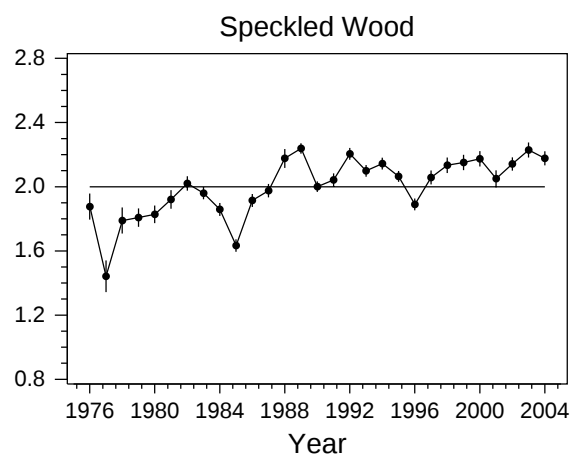
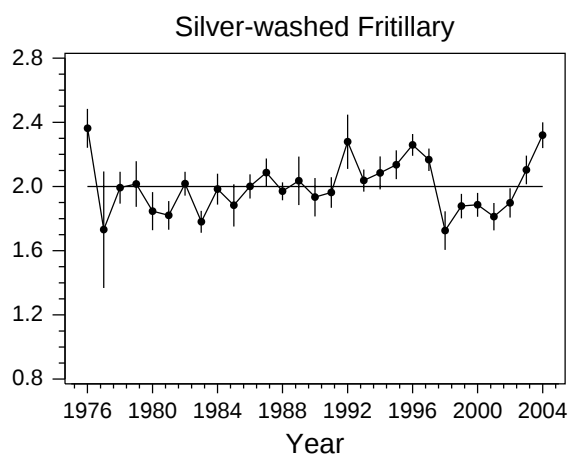
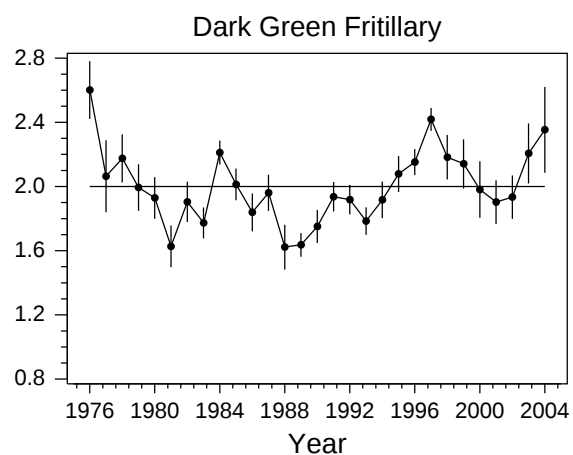


Figure 7. Log collated indices, 1976-2004

