Journal of Insect Conservation (2006) 10:189–209
DOI 10.1007/s10841-006-6293-4


# Biotope use and trends of European butterflies

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Received 17 May 2005; accepted in revised form 5 October 2005

*Key words:* Biodiversity, Biotope, Butterflies, Conservation, Europe, Generalists, Indicator, Specialists, Threats

**Abstract**

Europe has undergone substantial biotope loss and change over the last century and data are needed urgently on the rate of decline in different wildlife groups in order to identify and target conservation measures. However, pan-European data are available for very few taxonomic groups, notably birds. We present here the first overview of trends for an insect group within different biotopes across Europe, based on data from the Red Data Book of European Butterflies. The most important biotopes for Europe's 576 butterfly species, including threatened species, are man-made or man-influenced, notably types of grassland or heath/scrub communities. Our results show that butterflies are declining substantially across Europe, with a decline in distribution of −11% over the last 25 years. The distributions of the 25 most "generalist" species are declining only slowly (−1%) compared to specialist butterflies of grassland (−19%), wetlands (−15%), and forests (−14%). On average, grassland butterflies have declined somewhat slower than farmland birds (annual decrease −0.8% compared to −1.5%), but woodland butterflies have decreased more rapidly (−0.01% to −0.6%) than woodland birds, which are more or less stable. The sensitivity of butterflies to environmental changes and the availability of data across Europe suggest that they are very good candidates to build biodiversity indicators and, along with other major groups such as birds, suitable to monitor progress towards the EU target of halting biodiversity loss by 2010.

## Introduction

Europe has undergone a period of substantial change and development over the last hundred years, which has led to major declines of wildlife and their biotopes in many countries (Delbaere 1998; Horlyck and Lois 2005). However, pan-European data on the rate of decline of species are available for very few taxonomic groups, notably birds (Tucker and Heath 1994; EEA 2004; European Communities 2004; Gregory et al. 2005). Such data are important to properly assess the threats in different biotopes and to identify priorities for conservation action.

Here, we present the first overview of trends for an insect group within different biotopes across Europe, and compare these with bird trends calculated by Birdlife International (Gregory et al. 2005). The analysis is based on data from the first comprehensive review of the status and trends of butterflies across Europe, commissioned by the Council of

Europe (Van Swaay and Warren 1999). This showed that butterflies are declining seriously in almost every country and that 71 out of Europe's 576 species are threatened according to the 1994 IUCN criteria.

In addition to providing trend data for the Red Data Book, country compilers were asked to provide information on the biotope type used by each species, and the main threats, according to a simple classification system. These results have been used to identify the most important biotopes for European butterflies and to generate trends of species by biotope and identify the importance of biotopes that should be targeted for urgent action. As butterflies have been identified as valuable indicators for many other insects (Thomas 2005), which comprise a large proportion of terrestrial species, we believe the results highlight issues of great importance for the conservation of Europe's biodiversity as well as for assessing European environmental policy. They also demonstrate that butterflies can be used to monitor trends in European biotopes and would provide a valuable and complementary indicator to birds.

## Materials and methods

### *Red data book*

Data for the Red Data Book were gathered on all 576 butterfly species known to occur in Europe and were collated primarily by distributing questionnaires to over 50 expert national compilers in all 45 European countries covered by the Council of Europe (Van Swaay and Warren 1999). These data were usually based on the field work carried out by hundreds or even thousands of amateur lepidopterists over many years, often drawing on detailed distribution data.

Using these questionnaires, data were collected on all native species within each country covering:

- Present distribution
- Trend over the last 25 years
- Main biotope used by the species

Species whose ranges just extend within European boundaries, are considered marginal to Europe and were excluded from the review. For all remaining species the European distribution class and trend over the whole continent were calculated, and weighted by country size. Compilers were asked to rank the quality of the trend data from very good, good, moderate, or poor depending on the amount of quantitative data available. These data were used to produce a list of threatened butterflies in Europe, using the 1994 IUCN criteria as closely as possible (IUCN 1994; Van Swaay and Warren 1999).

Each national expert classified the main biotopes for each species in their country according to the main Corine biotope classes, as described in Moss et al. (1991). Their classification was the first attempt to describe European biotopes in a standardized way (Table 1).

The nomenclature used follows Karsholt and Razowski (1996) with the exceptions of *Pontia daplidice* and *P. edusa* (summarized as *Pontia daplidice complex*), and *Leptidea sinapis* and *L. reali* (*Leptidea sinapis complex*), since at the time of compilation of the Red Data Book the exact status and distribution and distinction between these species was still unclear.

### *Biotope profile*

A biotope profile was calculated for each species by counting the number of biotope-mentions (= biotope mentioned in a country), and then calculating the percentage of biotope-mentions for each biotope (the biotope profile). Since species with a wide distribution have a long list of biotopes mentioned only once or twice, the biotopes referred to in less than 5% of the biotope-mentions were considered to be of minor importance to the species and were omitted from further analysis. Table 2 demonstrates this with the example of *Glaucopsyche alexis*. Biotope data for this Lycaenid butterfly were received from 38 countries. From the 17 listed biotopes, 11 were mentioned only once or twice (less than 5% of the biotope mentions) and were therefore omitted. Consequently the final biotope profile for this butterfly contained only the first six biotope descriptions.

### *Threats*

Data on suspected threats were collected only for the 71 European threatened species (Van Swaay

*Table 1.* Classification of the biotopes by Corine biotope descriptions (based on Moss et al. 1991) and grouping to the Main biotope groups.

| Corine code | Corine biotope description | Main biotope group |
|---|---|---|
| 16 | coastal sand-dunes and sand beaches | Coastal |
| 18 | cliffs and rocky shores | Coastal |
| 31 | heath and scrub | Heath and scrub |
| 32 | sclerophyllous scrub | Heath and scrub |
| 33 | phrygana | Heath and scrub |
| 34 | dry calcareous grasslands and steppes | Grassland |
| 35 | dry siliceous grasslands | Grassland |
| 36 | alpine and subalpine grasslands | Grassland |
| 37 | humid grasslands and tall herb communities | Grassland |
| 38 | mesophile grasslands | Grassland |
| 41 | broad-leaved deciduous forests | Forest |
| 42 | coniferous woodland | Forest |
| 43 | mixed woodland | Forest |
| 44 | alluvial and very wet forests and brush | Forest |
| 45 | broad-leaved evergreen woodland | Forest |
| 51 | raised bogs | Wetland |
| 52 | blanket bogs | Wetland |
| 53 | water-fringe vegetation | Wetland |
| 54 | fens, transition mires and springs | Wetland |
| 61 | screes | Unvegetated |
| 62 | inland cliffs and exposed rocks | Unvegetated |
| 64 | inland sand-dunes | Unvegetated |
| 66 | volcanic features | Unvegetated |
| 81 | improved grasslands | Agriculture |
| 83 | orchards, groves and tree plantations | Agriculture |
| 84 | tree lines, hedges, small woods, bocage, parkland dehesa | Agriculture |
| 85 | urban parks and large gardens | Urban |
| 86 | towns, villages, industrial sites | Urban |
| 87 | fallow land, waste places | Urban |

*Table 2.* Classification of the biotopes of the Lycaenid butterfly *Glaucopsyche alexis*.

| Biotope description | N of mentions | % | Class |
|---|---|---|---|
| dry calcareous grasslands and steppes | 11 | 18.3 | 2 |
| mesophile grasslands | 11 | 18.3 | 2 |
| broad-leaved deciduous forests | 8 | 13.3 | 2 |
| dry siliceous grasslands | 8 | 13.3 | 2 |
| fallow land, waste places | 3 | 5.0 | 1 |
| sclerophyllous scrub | 3 | 5.0 | 1 |
| alpine and subalpine grasslands | 2 | 3.3 | Not used |
| heath and scrub | 2 | 3.3 | Not used |
| mixed woodland | 2 | 3.3 | Not used |
| orchards, groves and tree plantations | 2 | 3.3 | Not used |
| phrygana | 2 | 3.3 | Not used |
| coniferous woodland | 1 | 1.7 | Not used |
| humid grasslands and tall herb communities | 1 | 1.7 | Not used |
| inland rocks, screes and sands | 1 | 1.7 | Not used |
| inland sand-dunes | 1 | 1.7 | Not used |
| tree lines, hedges, small woods, bocage, parkland dehesa | 1 | 1.7 | Not used |
| urban parks and large gardens | 1 | 1.7 | Not used |

and Warren 1999). Fourteen types of threat have been distinguished. National experts have indicated the degree of threat for each threatened butterfly in their country (1 = low, 2 = medium, 3 = high). To calculate the average degree of threat per main biotope type, each threatened species is assigned to

the biotope type where it has been mentioned most frequently. This was only possible for forests, grasslands and wetlands. Threats mentioned less than three times have been omitted. Of course, there is a strong risk that biotopes where no endangered species occur are also threatened. Here, the lack of data makes such an assessment unfeasible.

*Biotope specialist butterflies*

A biotope specialist species was defined as being mentioned more often in one biotope than in the sum of all the others. The following procedure was used to determine the number of biotope specialist species per biotope type per country:

- In order to remove any bias in biotope assessment amongst country compilers, we only included species for which we had biotope data from at least three separate sources, usually from three countries.
- For each species the number of Corine biotopes mentioned per country per species is counted.
- Then, the number of each Corine biotope-mentions per country per species per biotope type is counted.
- These numbers are then evaluated using broad biotope classes (see Table 1).
- The percentage of broad biotope classes mentions per biotope type available in the country is calculated for each species.
- Species for which one biotope gets a percentage as high as 50% were considered specialists of that biotope (Appendix 2).

*Generalist butterflies*

To define generalists, each butterfly species was ranked according to the average number of biotopes that it was reported to use compared to the maximum number of biotopes mentioned per country. This allowed the full list of species to be sorted from generalists to specialists. Then, to determine the group of generalists, the top 25 were selected. A control was made on species distribution to avoid narrowly distributed species that would not be representative at the continental scale. The number of countries in which each species occurred was extracted. The method above favours widespread species, and the species selected occurred in a minimum of 18 countries. Nevertheless, this means that especially south European countries were excluded from analysis since in many of these countries the availability of good trend data is poor.

Table 3 shows that some of the species selected as generalists at a pan-European level are specialists in some parts of their range, especially at the edge of their distribution (e.g., *Pyrgus malvae* and *Papilio machaon*). In this analysis, the definition of 'generalist' species thus focuses on the most widespread species that occur in a wide range of biotope types. *Vanessa atalanta* was excluded as it is a migrant species in most of Central and Northern Europe and trends were not available in every country.

*Calculating European trends for specialists and generalists*

As the quality and accuracy of trend data available from the Red Data Book varied considerably among countries and species, we calculated trends only from those countries that fulfilled the following arbitrary requirements considered to ensure good data quality:

- at least 80% of the species were given a trend, since this shows that sufficient expertise is available and
- not more than 75% of the trends given were "stable" or "fluctuating" as such a high proportion of these categories, often given by default, might be related to a lack of knowledge of national populations especially over such a long time.

This left 20 countries representing more than 50% of Continental Europe area (See Table 4, note that Russia and Turkey are excluded here).

*Table 3.* List of butterflies considered to be generalist species at a European level.

| |
|---|
| *Aglais urticae*, *Maniola jurtina*, *Anthocharis cardamines*, *Melanargia galathea*, *Aphantopus hyperantus*, *Ochlodes venata*, *Callophrys rubi*, *Papilio machaon*, *Coenonympha pamphilus*, *Pieris brassicae*, *Erebia medusa*, *Pieris napi*, *Gonepteryx rhamni*, *Pieris rapae*, *Inachis io*, *Polygonia c-album*, *Iphiclides podalirius*, *Polyommatus icarus*, *Issoria lathonia*, *Pontia daplidice complex*, *Leptidea sinapis complex*, *Pyrgus malvae*, *Lycaena phlaeas*, *Thymelicus lineola*, *Thymelicus sylvestris*. |

*Table 4.* Countries selected for the calculation of trends of specialist and generalist butterflies.

| |
|---|
| Austria, Belgium, Canary islands, Czech Republic, Denmark, Finland, Germany, Hungary, Latvia, Lithuania, Luxembourg, Moldova, Netherlands, Poland, Romania, Slovakia, Slovenia, Sweden, Switzerland, United Kingdom. |

Overall European trends per biotope were obtained as follows:

- Trend classes were converted into trends using the geometric mean of the class extremes. ''Extinct'' was converted arbitrary to a 99.9% decrease.
- For each species, we estimated the weighted geometric mean and variance, weighted by country area in relation to the mid values of the distribution area occupied within each country (each country compiler classified species along 4 classes of country occupation : <1%, 1–5%, 5–15%, >15%).
- We estimated geometric mean and variance (and thus standard errors) of species according to their attributed biotope group. As a reference group, we also provide the average trend of all the species together to allow a general overview of the situation.

## Results

### *Biotope use*

The main biotopes for 436 European butterfly species, based on data collected for the Red Data Book of European Butterflies, are shown in Appendix 1 and a summary of the importance of each biotope is shown in Table 5.

*Table 5.* Total number of species, number of threatened species and the percentage of threatened species per CORINE-biotope. $N$ = total number of species, $T$ = total number of threatened species, $\%T$= percentage threatened.

| CORINE-biotope | $N$ | $T$ | $\%T$ |
|---|---|---|---|
| blanket bogs | 45 | 14 | 31.1 |
| raised bogs | 48 | 13 | 27.1 |
| fens, transition mires and springs | 59 | 15 | 25.4 |
| water-fringe vegetation | 75 | 15 | 20 |
| mesophile grasslands | 223 | 39 | 17.5 |
| humid grasslands and tall herb communities | 171 | 27 | 15.8 |
| mixed woodland | 187 | 29 | 15.5 |
| alluvial and very wet forests and brush | 100 | 15 | 15 |
| coniferous woodland | 156 | 23 | 14.7 |
| dry calcareous grasslands and steppes | 274 | 37 | 13.5 |
| broad-leaved deciduous forests | 186 | 25 | 13.4 |
| heath and scrub | 189 | 25 | 13.2 |
| alpine and subalpine grasslands | 261 | 34 | 13 |
| dry siliceous grasslands | 220 | 27 | 12.3 |
| inland sand-dunes | 43 | 5 | 11.6 |
| broad-leaved evergreen woodland | 67 | 6 | 9 |
| inland cliffs and exposed rocks | 70 | 6 | 8.6 |
| tree lines, hedges, small woods, bocage, parkland dehesa | 128 | 11 | 8.6 |
| Phrygana | 137 | 11 | 8 |
| Screes | 88 | 7 | 8 |
| fallow land, waste places | 104 | 8 | 7.7 |
| orchards, groves and tree plantations | 95 | 6 | 6.3 |
| cliffs and rocky shores | 17 | 1 | 5.9 |
| sclerophyllous scrub | 202 | 12 | 5.9 |
| urban parks and large gardens | 96 | 5 | 5.2 |
| coastal sand-dunes and sand beaches | 40 | 2 | 5 |
| scrub and grassland | 28 | 1 | 3.6 |
| towns, villages, industrial sites | 66 | 2 | 3 |
| improved grasslands | 74 | 1 | 1.4 |

* three SPEC1-3 species on the Azores (*Hipparchia miguelensis*, *H. occidentalis* and *H. azorina*) are mentioned for agricultural land and artificial landscapes but are not given in the table.

The results show that the most species-rich biotopes in Europe are dry grassland: notably dry calcareous grasslands and steppes (274 species), alpine and subalpine grasslands (261), mesophile grasslands (223) and dry siliceous grasslands (220 species). These are followed by sclerophyllous scrub, and heath (202 and 189 species respectively) and different types of woodlands including mixed woodland (187 species), broad-leaved deciduous forests (186 species), coniferous woodland (156 species). Humid grasslands and tall herb communities comprise 171 species (Table 5).

The biotopes with the largest absolute numbers of species threatened across Europe are also mainly grasslands: mesophile grasslands (39 threatened species), dry calcareous grasslands and steppes (37), alpine and subalpine grasslands (34) and humid grasslands and tall herb communities and dry siliceous grasslands (27). Different types of woodlands generally hold lower numbers of threatened butterflies: mixed woodland (29 threatened species), broad-leaved deciduous forests (25) and coniferous woodland (23) while heath and scrub have 25 species considered threatened.

In contrast, the biotopes supporting the greatest proportion of threatened species are dominated by bogs and marshes (including blanket bogs, raised bogs, fens, transition mires and springs, waterfringe vegetation), humid grasslands and tall herb communities. These are followed in importance by mesophile grasslands and different types of woodlands (mixed woodland, coniferous woodland, broad-leaved deciduous forests), and different types of dry grasslands (dry calcareous grasslands and steppes, alpine and subalpine grasslands, dry siliceous grasslands). Note that specific biotopes such as volcanic features, islets and rock stacks or inland rocks, screes and sands are not discussed owing to their low total number of species mentioned, although they can be of great importance locally (e.g. volcanic features with *Hipparchia maderensis* on Madeira and *Scolitantides orion* in Eastern-Europe, islets and rock stacks with *Parnassius apollo* or inland rocks, screes and sands with *Glaucopsyche alexis*).

### *European trends for specialists and generalists*

Our overall results show that butterflies are declining substantially across Europe, with a decline in distribution of −11% over the last 25 years (Figure 1). The results also show that the 25 most generalist species, according to our ranking (see above), did not significantly decline (−1%, NS) compared to specialist butterflies. The biggest declines in distribution are among grassland specialists (−19%), followed by wetland species (−15%), and forest species (−14%).

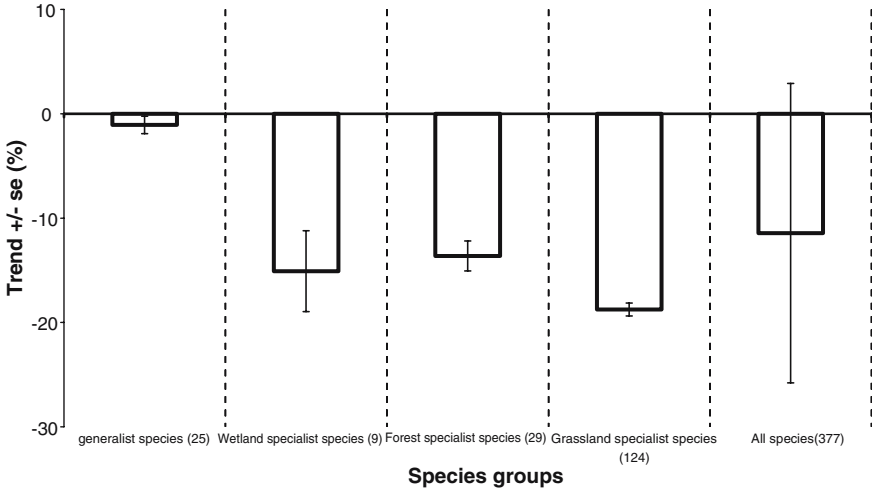


*Figure 1.* European trends of selected species groups according to broad biotope classes and specialism.

*Table 6.* Average grade of threat for threatened butterflies in Europe as well as per main biotope group.

| Threat | All biotopes | Forest | Grassland | Wetland | *N* |
|---|---|---|---|---|---|
| Land drainage | **2.2** | 1.7 | **2.2** | **2.4** | 33 |
| Agricultural improvements | 2.1 | 1.9 | **2.2** | 2.0 | **63** |
| Land claims /coastal development | 2.1 | 2.0 | 2.1 | * | 41 |
| Agricultural abandonment | 2.1 | 1.9 | **2.2** | 1.9 | 46 |
| Felling/destruction of woodland | 2.1 | **2.2** | 2.0 | 1.7 | 45 |
| Isolation and fragmentation of habitat | 2.1 | 2.1 | 2.0 | 2.0 | 62 |
| Afforestation on non-woodland habitats | 1.9 | 1.8 | 1.9 | 2.0 | 53 |
| Abandonment and change of woodland management | 1.9 | **2.2** | 1.8 | 1.7 | 45 |
| Recreational pressure and disturbance | 1.8 | 1.9 | 1.8 | 2.0 | 48 |
| Natural ecological change | 1.8 | 2.0 | 1.7 | * | 37 |
| Built development (inc. roads, housing, etc.) | 1.8 | 1.8 | 1.8 | 1.7 | 58 |
| Chemical pollution (inc. herbicides and pesticides) | 1.8 | 1.6 | 1.8 | 1.6 | 55 |
| Climatic change | 1.7 | 2.1 | 1.6 | 1.6 | 45 |
| Collecting (killing or taking) | 1.4 | 1.5 | 1.4 | 1.5 | 46 |

*N* = total number of species. Average grade of threat: 1 = low, 2 = medium, 3 = high. * = mentioned for less than three species.

*Threats*

Data on suspected threats were gathered only for the 71 species classed as threatened at the European level and are shown in Table 6. The majority of species ($n = 63$, almost 90%) are affected by agricultural improvement, which includes a wide range of activities from conversion of unimproved grasslands to arable crops, through to fertilisation of pastures. Although affecting only 33 species, land drainage is the major threat for wet grassland and wetland butterflies. Drainage immediately destroys the biotope of these butterflies, and is mostly followed by agricultural improvements. Characteristic species that suffer heavily from drainage are *Coenonympha oedippus* and *C. tullia*.

Other important threats are from the abandonment of agricultural land and changing biotope management. This is thought to affect 65% of the threatened species and is symptomatic of the widespread cessation of traditional farming systems that is known to have a negative impact on a variety of other wildlife groups (Tucker and Heath 1994; Poole et al. 1998). Examples of changing management include the cessation of cutting of damp hay meadows (affecting species like *Maculinea nausithous*, *M. teleius*, and *Lycaena helle*) and abandonment of pasture land (affecting species such as *Euphydryas aurinia* and *Maculinea alcon*).

The increasing use of herbicides and pesticides on farmland is also reported to be a serious problem for butterflies (affecting 80% of threatened species), especially in some eastern countries where economic pressures are more severe and regulations are less strict. Building developments such as roads, quarries and housing are also important (affecting 80% of threatened species). As a result of this massive direct loss of breeding areas, a growing threat arises from the subsequent isolation and fragmentation of biotopes which now affects 87% of threatened species.

Similar problems of abandonment and changing management were also reported in woodland biotopes, affecting 63% of threatened species. The main problem in woodlands seems to be loss of open woodland habitats following a shift from traditional management, such as short-rotation coppice systems, to high forest systems. This has been recognised as a major problem in western countries for many years (e.g., Warren and Key 1991) but there is growing evidence that this is a widespread and serious problem across Europe (e.g., Benes et al. 2002). The shift from traditional short-rotation standing crop to intensive high forests has a very negative impact on characteristic woodland butterflies as *Lopinga achine* (Bergman 2001). Afforestation of non-woodland biotopes is also a major threat to many species, especially those occurring in small breeding areas such as *Parnassius apollo*.

Contrary to many people's views of threats to butterflies, collecting was reported to be only of very minor or local importance. However, there were some important exceptions of species which are possibly quite seriously threatened by collecting, notably *Parnassius apollo, Polyommatus humedasae, Polyommatus poseidon, Polyommatus damone, Euphydryas maturna* and *Coenonympha oedippus*. Nevertheless, all these species are suffering far more seriously from problems such as biotope loss or changing biotope management.

Climatic change is also mentioned as a potential threat to several species, notably highly restricted montane endemics which are closely adapted to specific vulnerable biotopes and which have a very limited possibility of adapting to global warming (Dennis 1993; Wilson et al. 2005).

## Discussion

### *Biotopes and their threats*

This paper presents the first objective overview on the biotope requirements of almost all European butterflies as well as the main threats to threatened species. Unlike preceding descriptions, the material has been collected in a standardized way over the whole of Europe, giving a unique insight into the threats for this insect group.

The results show that butterflies are highly dependent on man-made biotopes such as dry grassland and meadows, which are typically maintained by traditional forms of farming management such as livestock grazing and haymaking. A wide range of factors associated with the rapid intensification of agriculture across the region threatens such biotopes. Although dry grasslands are the richest in butterfly species, the most important biotopes for threatened butterflies are wet biotopes such as bogs and marshes. These are under particular threat from drainage to create fertile agricultural land, and in some cases to control disease-bearing insects such as mosquitoes.

When considering threats, it is worth stressing that Europe is a large and diverse region, and it is therefore clear that the types of threat vary considerably among countries. This partly reflects the fact that the types of biotope used by each species vary naturally across different climatic zones, but also reflects the wide variation of economic and political situations. Threats vary from site to site and have been examined further in the Prime Butterfly Areas of Europe report (van Swaay and Warren 2003). It is likely that most major threats identified for butterflies will continue to operate in the foreseeable future, and may even become more serious in some countries. For example, eastern European countries have already started to suffer from serious agricultural intensification (e.g., Donald et al. 2001; Konvicka et al. 2006) and the problem may be exacerbated further now that their markets are becoming more open. The speed of change in some countries may also increase rapidly now they have joined the European Union and have access to extra subsidies for increased production. This poses a particularly serious potential threat as these countries hold a disproportionate large number of threatened butterflies.

On the plus side, there is a growing move to reform EU agricultural and forestry policies to encourage more environmentally sustainable systems, for example within mechanisms such as the Agri-environment Regulation (EU Reg. 2078/92). Although schemes currently being funded under such regulations comprise a very small proportion of the agricultural budget, they have the potential to slow down some of the trends reported. However, much wider reforms of agricultural policies are also urgently needed (e.g., see Baldock et al. 1994; Tucker and Heath 1994; Poole et al. 1998). Policies such as the EU Habitats and Species Directive may also help to slow declining trends but many countries have been slow to implement this Directive (e.g., Flanders – Maes and Van Dyck 2001) and its likely impact on butterflies remains uncertain.

Recent studies have shown that many montane species are shifting their distributions to higher altitudes, presumably as a result of climatic warming, and montane and boreal species may be threatened in future (Wilson et al. 2005).

### *Trends and comparison with other groups*

The overall decline of butterflies at a European level confirms many previous observations (e.g.,

Heath 1980) and reflects the widespread loss of biodiversity reported in many other taxa (e.g., Delbeare 1998). However, for the first time we show that declines have been far more rapid in specialist species of grasslands, wetlands and forests. Our results show that butterflies seem to be reacting differently compared to a recent study describing biotope related trends in breeding birds (Gregory et al. 2005). Whereas our paper measured trends amongst specialists, the bird trends focused on communities (e.g., farmland birds and woodland birds). Although the methods of the two studies were different, the results make an interesting comparison.

While farmland birds (which occur in arable biotopes as well as managed grasslands), show an annual population decrease of −1.5% (from 1980 to 2002), grassland butterflies showed an annual distribution decrease of −0.8% (for the 25 year period pre 1997). However, the rates of change cannot be compared directly because the butterfly trends are calculated from distribution data that substantially underestimates population decline (e.g., Thomas and Abery 1995; Warren et al. 1997).

In contrast, trends in woodland birds show little change compared to forest specialist butterflies, which showed an annual distribution decrease over this period of −0.01 to −0.6%. The comparatively rapid decline of forest butterflies suggests that they are more sensitive than birds to changes in this biotope. In woodlands, the decline of butterflies is probably linked with the loss of open woodland or forest clearings, whereas many of the birds studied are associated with closed forests where change has been less dramatic. It should also be noted that the butterflies studied have been pre-selected as specialists as opposed to woodland birds, which may occur in a range of other biotopes. Nevertheless the study supports the findings of Thomas et al. (2004) that butterflies are declining at least as fast as birds and possibly faster in many biotopes.

Butterflies are likely to respond to different factors than birds and, because of their annual life cycles, are likely to react more quickly (Thomas 1994). Butterflies tend to breed in smaller habitat patches and are more likely to reflect changes occurring at a finer scale. Thus, they provide additional and complementary information to birds, which tend to range more widely and have populations that operate over larger areas. Contrary to woodland birds, that can occur in dark forests, woodland butterflies are only found in open places, paths and glades where sun reaches the ground and nectaring flowers are found.

## Conclusions

Our study demonstrates that data currently available for butterflies can be successfully used to produce generic trends at a continental scale as well as trends within different broad biotope types. The sensitivity of butterflies to environmental change and the availability of suitable data from many countries across Europe suggest that butterflies are very good candidates to build biodiversity indicators. Along with other major groups such as birds, they are therefore ideal candidates to monitor performance regarding the EU target to halt biodiversity loss by 2010. No equivalent data are available for other invertebrate taxa, making butterflies unique in enabling an assessment of trends in this exceptionally diverse and ecologically important group.

There is a growing network of specialist Lepidoptera groups in countries across Europe, many of them using volunteers to compile extensive datasets on butterflies and their trends. Datasets for butterflies include traditional mapping schemes to identify trends such as those used in the Red Data Book (Van Swaay and Warren 1999) but also detailed monitoring schemes based on weekly transect counts using networks of sites. A summary of the schemes currently in operation is given in the country summaries of the Prime Butterfly Areas of Europe (Van Swaay and Warren 2003). New monitoring schemes are being started or planned in other countries and the monitoring network is being developed each year. A new organization, called Butterfly Conservation Europe, has been started to co-ordinate and collate such data and to provide the support for volunteers and organizations who contribute (see www.europeanbutterflies.net). The infrastructure needed to obtain butterfly data at a European level is thus already well developed and, given sufficient resources, could produce an even more scientifically robust method of monitoring change in the future.

*Appendix 1.* Habitat profiles of European butterflies (listed in alphabetical order with taxonomy according to Karsholt and Razowski 1996).

| Species | No of Countries | Coastal | | Heath and Scrub | | | Grassland | | | | | | Forest | | | | | Wetland | | | | Unvegetated | | | | Agriculture | | | Urban | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | coastal sand-dunes and sand beaches | cliffs and rocky shores | heath and scrub | sclerophyllous scrub | phrygana | dry calcareous grasslands and steppes | dry siliceous grasslands | alpine and subalpine grasslands | humid grasslands and tall herb communities | mesophile grasslands | broad-leaved deciduous forests | coniferous woodland | mixed woodland | alluvial and very wet forests and brush | broad-leaved evergreen woodland | raised bogs | blanket bogs | water-fringe vegetation | fens, transition mires and springs | screes | inland cliffs and exposed rocks | inland sand-dunes | volcanic features | improved grasslands | crops | orchards, groves and tree plantations | tree lines, hedges, small woods, bocage, parkland dehesa | urban parks and large gardens | towns, villages, industrial sites | fallow land, waste places |
| *Aglais urticae* | 42 | | | | | | | | | 1 | 1 | 1 | | 1 | | | | | | | | | | | | 1 | 1 | 2 | 2 | 1 |
| *Anthocharis cardamines* | 43 | | | | | | | | | 2 | 2 | 2 | | 2 | | | | | | | | | | | | | 1 | | | |
| *Anthocharis damone* | 4 | | | 4 | 4 | | 4 | | | | | | | | | | | | | | | | | | | | | | | |
| *Anthocharis euphenoides* | 4 | | | | 3 | 1 | 2 | 2 | 1 | | | 1 | | | | 1 | | | | | | | 1 | | | | | | | |
| *Anthocharis gruneri* | 5 | | | | 3 | 3 | 3 | | | | | | | | | | | | | | 3 | | | | | | | | | |
| *Apatura ilia* | 33 | | | | | | | | | | | 4 | | 3 | 3 | | | | 1 | | | | | | | | | | | |
| *Apatura iris* | 35 | | | | | | | | | | | 4 | | 3 | 2 | | | | | | | | | | | | | 1 | | |
| *Apatura metis* | 13 | | | | | | | | | | | 3 | | 3 | 3 | | | | 2 | | | | | | | | | | | |
| *Aphantopus hyperantus* | 38 | | | | | | | 1 | | 2 | 2 | 2 | | 1 | | | | | | | | | | | | | 1 | | | |
| *Aporia crataegi* | 39 | | | 1 | | | 1 | | | | 1 | 2 | | 2 | | | | | | | | | | | | 1 | 2 | | 1 | |
| *Araschnia levana* | 33 | | | | | | | | | 1 | 1 | 2 | | 2 | 1 | | | | | | | | | | | 1 | 1 | 2 | | 1 |
| *Archon apollinus* | 3 | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Arethusana arethusa* | 22 | | | | | | 4 | 3 | | | 1 | 1 | | | | | | | | | | 1 | | | | | | | | |
| *Argynnis adippe* | 39 | | | | | | 1 | 1 | | 1 | 2 | 2 | 1 | 2 | | | | | | | | | | | | | | | | |
| *Argynnis aglaja* | 41 | | | | | | 1 | 1 | 1 | 1 | 2 | 2 | | 2 | | | | | | | | | | | | | | | | |
| *Argynnis elisa* | 2 | | | | | | 5 | | | | | 5 | | | | | | | | | | | | | | | | | | |
| *Argynnis laodice* | 15 | | | | | | | | | 3 | 1 | 2 | 1 | 2 | 1 | | | 1 | 1 | 1 | | | | | | | 1 | | | |
| *Argynnis niobe* | 39 | | | 1 | | | 1 | 2 | 1 | 1 | 2 | 2 | | 2 | | | | | | | | | | | | | | | | |
| *Argynnis pandora* | 23 | | | | 1 | | 2 | 1 | 1 | | 1 | 3 | | 1 | | 1 | | | | | | | | | | | 1 | | | |
| *Argynnis paphia* | 42 | | | | | | | | | | 1 | 3 | 2 | 3 | | | | | | | | | | | | | 1 | | | |
| *Aricia agestis* | 36 | | | | | | 2 | 2 | | | 2 | 1 | | | | | | | | | | | | | | | | | | 1 |
| *Aricia anteros* | 10 | | | | | | 4 | | 4 | | 2 | | | | | | | | | | 2 | | | | | | | | | |
| *Aricia artaxerxes* | 31 | | | 1 | | | 2 | 1 | 2 | 1 | 2 | 1 | | 1 | | | | | | | | | | | | | | | | |
| *Aricia cramera* | 4 | | | 2 | 2 | | | | 2 | | | | | | | 2 | | | | | | | | | | | 2 | | | 2 |
| *Aricia eumedon* | 31 | | | | | | 2 | | 1 | 3 | 2 | 1 | | | | | | | 1 | 1 | | | | | | | | | | |
| *Aricia morronensis* | 1 | | | | | | | 3 | 3 | | | | | | | | | | | | 3 | 3 | | | | | | | | |
| *Aricia nicias* | 9 | | | | | | | 1 | 2 | 3 | 2 | 1 | 2 | 2 | | | | | | | | | | | | | | | | |
| *Aricia teberdinus* | 2 | | | | | | | | 9 | | | | | | | | | | | | | | | | | | | | | |
| *Boloria alaskensis* | 3 | | | | | | | | 4 | 4 | 4 | | | | | | | | | | | | | | | | | | | |
| *Boloria angarensis* | 3 | | | | | | | | 3 | 3 | | | 3 | | | | 3 | | | | | | | | | | | | | |
| *Boloria aquilonaris* | 23 | | | | | | | | | 2 | | | 1 | | | | 4 | 2 | 1 | 2 | | | | | | | | | | |
| *Boloria chariclea* | 6 | | | 2 | 2 | | | | 2 | 2 | 2 | | | | | | | | | | | | | | | | | | | |
| *Boloria dia* | 34 | | | | | | 2 | 1 | | 1 | 2 | 1 | | 1 | 1 | | | | | | | | | | | | | | | |
| *Boloria distincta* | 2 | | | | | | | | | | | | | | | | | | | | | 9 | | | | | | | | |
| *Boloria eunomia* | 23 | | | | | | | | 1 | 3 | | | | | | | 3 | 1 | | 2 | | | | | | | | | | |
| *Boloria euphrosyne* | 40 | | | | | | | 1 | | 2 | 2 | 2 | 2 | 2 | | | 1 | | | | | | | | | | | | | |
| *Boloria freija* | 10 | | | 1 | | | | | 2 | 1 | 1 | | 1 | | | | 5 | | | 1 | | | | | | | | | | |
| *Boloria frigga* | 10 | | | | | | | | 1 | 1 | 1 | | | | | | 7 | | | 1 | | | | | | | | | | |
| *Boloria graeca* | 10 | | | | | | | | 5 | | | | 4 | 3 | | | | | | | | | | | | | | | | |

*Appendix 1.* (Continued).

| Species | No of Countries | Coastal | | Heath and Scrub | | | Grassland | | | | | | Forest | | | | | | Wetland | | | | Unvegetated | | | Agriculture | | | Urban | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | coastal sand-dunes and sand beaches | cliffs and rocky shores | heath and scrub | sclerophyllous scrub | phrygana | dry calcareous grasslands and steppes | dry siliceous grasslands | alpine and subalpine grasslands | humid grasslands and tall herb communities | mesophile grasslands | broad-leaved deciduous forests | coniferous woodland | mixed woodland | alluvial and very wet forests and brush | broad-leaved evergreen woodland | raised bogs | blanket bogs | water-fringe vegetation | fens, transition mires and springs | screes | inland cliffs and exposed rocks | inland sand-dunes | volcanic features | improved grasslands | crops | orchards, groves and tree plantations | tree lines, hedges, small woods, bocage, parkland dehesa | urban parks and large gardens | towns, villages, industrial sites | fallow land, waste places |
| *Boloria improba* | 6 | | | 2 | 2 | | | | 2 | 2 | 2 | | | | | | | | | | | | | | | | | | | | |
| *Boloria napaea* | 10 | | | 2 | 2 | | | | 7 | | | | | | | | | 2 | | | | | | | | | | | | | |
| *Boloria pales* | 17 | | | 2 | | | | | 8 | | | | | | | | | 1 | | | | | | | | | | | | | |
| *Boloria polaris* | 6 | | | 2 | | | | | 2 | 2 | 2 | | | | | | | | | | | 2 | | | | | | | | | |
| *Boloria selene* | 34 | | | | | | | 1 | | 2 | 2 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | |
| *Boloria selenis* | 5 | | | | | | | | 2 | 2 | 5 | | | 2 | | | | | | | | | | | | | | | | | |
| *Boloria thore* | 14 | | | | | | | | 3 | 2 | | | 1 | 1 | | | | | | 2 | | | | | | | | | | | |
| *Boloria titania* | 21 | | | | | | | | 2 | 2 | 2 | 1 | 1 | 2 | | | | | | | | | | | | | | | | | |
| *Borbo borbonica* | 1 | | | | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Brenthis daphne* | 27 | | | 1 | | | 1 | 1 | | 1 | 2 | 2 | | 2 | | | | | | | | | | | | | 1 | | | | |
| *Brenthis hecate* | 21 | | | | | | 2 | 2 | 1 | | 3 | 2 | | 1 | | | | | | | | | | | | | | | | | |
| *Brenthis ino* | 36 | | | | | | | | | 4 | 2 | 1 | | 1 | | | | | 1 | | | | | | | | | | | | |
| *Brintesia circe* | 26 | | | | 1 | | 2 | | | | 1 | 3 | 1 | 2 | | | | | | | | 1 | | | | | | | | | |
| *Cacyreus marshalli* | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | 5 | 5 | |
| *Callophrys avis* | 3 | | | 3 | 5 | | | | | | | | | | | 3 | | | | | | | | | | | | | | | |
| *Callophrys butleri* | 2 | | | 3 | | | 3 | 3 | | | | | | | | | | | | | | 3 | | | | | | | | | |
| *Callophrys rubi* | 41 | | | 2 | | | 1 | | | | | 2 | 1 | 2 | | | 1 | | | | | | | | | | 1 | | 1 | | |
| *Carcharodus alceae* | 31 | | | | | | 3 | 2 | | | 2 | 1 | | | | | | | | | | | | | | 1 | 1 | | | | 2 |
| *Carcharodus baeticus* | 5 | 4 | | | | | | 4 | | | | | | | | | | | | | 4 | | | | | | | | | | |
| *Carcharodus floccifera* | 29 | | | | | | 2 | 1 | | 1 | 3 | 2 | | 1 | | | | | | | | | | | | | | | | | |
| *Carcharodus flocciferi* | 1 | | | | | | | | | | 5 | 5 | | | | | | | | | | | | | | | | | | | |
| *Carcharodus lavatherae* | 23 | | | | 1 | | 4 | 2 | | | | 2 | | | | | | | | | | | | | | | | | | | |
| *Carcharodus orientalis* | 10 | | | | 1 | 2 | 5 | 1 | 1 | | 2 | | | | | | | | | | | | | | | | | | | | |
| *Carcharodus stauderi* | 2 | | 5 | | | 5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Carterocephalus palaemon* | 34 | | | | | | | | | 2 | 2 | 3 | 1 | 2 | | | | | | | | | | | | | | | | | |
| *Carterocephalus silvicola* | 15 | | | | | | | | | | | 3 | 2 | 4 | 2 | | | | | | | | | | | | | | | | |
| *Celastrina argiolus* | 42 | | | 1 | | | | | | | | 3 | | 2 | 1 | | | | | | | | | | | | 2 | 1 | 1 | | |
| *Charaxes jasius* | 10 | 1 | | | 4 | 3 | 3 | 1 | | | | | | | | 1 | | | | | | | | | | | | | | | |
| *Chazara briseis* | 27 | | | | | | 4 | 2 | | | | 2 | | | | | | | | | | 2 | | | | | | | | | |
| *Chazara persephone* | 4 | | | | | | 2 | 4 | 2 | | | | | 2 | | | | | | | | | | | | | | | | | |
| *Chazara prieuri* | 2 | | | | 5 | | 5 | | | | | | | | | | | | | | | | | | | | | | | | |
| *Chilades trochylus* | 4 | | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Coenonympha amaryllis* | 2 | | | | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | |
| *Coenonympha arcania* | 37 | | | 1 | | | 2 | 1 | | | 2 | 2 | | 2 | | | | | | | | | | | | | 1 | | | | |
| *Coenonympha corinna* | 1 | | | | 5 | | 5 | | | | | | | | | | | | | | | | | | | | | | | | |
| *Coenonympha darwiniana* | 2 | | | | | | | | 9 | | | | | | | | | | | | | | | | | | | | | | |
| *Coenonympha dorus* | 4 | | | 2 | 2 | | 5 | 2 | | | | | | | | | | | | | | | | | | | | | | | |
| *Coenonympha gardetta* | 9 | | | | | | | | 6 | | 3 | 3 | | | | | | | | | | | | | | | | | | | |
| *Coenonympha glycerion* | 31 | | | | | | 2 | 1 | | 2 | 3 | 1 | | 2 | | | | | | | | | | | | | 1 | | | | |
| *Coenonympha hero* | 21 | | | | | | | | | 3 | 2 | 2 | | 2 | | | | | | 1 | | | | | | | | | | | |
| *Coenonympha leander* | 9 | | | | | | 1 | 3 | 1 | | 3 | 3 | | 3 | | | | | | | | | | | | | | | | | |
| *Coenonympha oedippus* | 14 | | | | | | | | | 3 | 1 | 1 | | 1 | | | 2 | 2 | 1 | 1 | | | | | | | | | | | |
| *Coenonympha pamphilus* | 42 | | | | | | 2 | 2 | | 1 | 2 | | | | | | | | | | | | | | 1 | | | 1 | | | 1 |
| *Coenonympha rhodopensis* | 6 | | | | | | 3 | | 5 | | 4 | | | | | | | | | | | | | | | | | | | | |

*Appendix 1.* (Continued).

| Species | No of Countries | Coastal | Heath and Scrub | | Grassland | | | | Forest | | | | | Wetland | | | Unvegetated | | | Agriculture | | | Urban | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | coastal sand-dunes and sand beaches<br>cliffs and rocky shores | heath and scrub | sclerophyllous scrub<br>phrygana | dry calcareous grasslands and steppes | dry siliceous grasslands | alpine and subalpine grasslands | humid grasslands and tall herb communities | mesophile grasslands | broad-leaved deciduous forests | coniferous woodland | mixed woodland | alluvial and very wet forests and brush | broad-leaved evergreen woodland | raised bogs | blanket bogs | water-fringe vegetation<br>fens, transition mires and springs | screes | inland cliffs and exposed rocks | inland sand-dunes<br>volcanic features | improved grasslands | crops | orchards, groves and tree plantations<br>tree lines, hedges, small woods, bocage, parkland dehesa | urban parks and large gardens | towns, villages, industrial sites<br>fallow land, waste places |
| *Coenonympha thyrsis* | 1 | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | |
| *Coenonympha tullia* | 30 | | | | | | 1 | 2 | 1 | | | | | | 3 | 3 | 2 | | | | | | | | |
| *Colias alfacariensis* | 25 | | 1 | | 3 | 2 | | | 1 | | | | | | | | | | | | 1 | 1 | | | 1 |
| *Colias aurorina* | 4 | | | 2 | 2 | 2 | 2 | | | | 2 | | | | | | | | | | | | | | |
| *Colias caucasica* | 6 | | 2 | | | | 4 | | | | 4 | | | | | | | | | | | | | | |
| *Colias chrysotheme* | 10 | | | 1 | 5 | 4 | | | 1 | | | | | | | | | | | | | | | | 1 |
| *Colias croceus* | 26 | | | | 1 | | | | 1 | | | | | | | | | | | | 1 | 1 | 1 | | 1 |
| *Colias erate* | 15 | | | 1 | 3 | 1 | | | 1 | | | | | | | | | | | | 1 | 2 | | | 1 |
| *Colias hecla* | 5 | 2 | 2 | | | | 5 | 2 | 2 | | | | | | | | | | | | | | | | |
| *Colias hyale* | 27 | | | | 2 | 1 | | | 2 | | | | | | | | | | | | 2 | 1 | | | 2 |
| *Colias myrmidone* | 17 | | | | 3 | 3 | | | 3 | | 1 | 1 | | | | | | | | | | | | | |
| *Colias nastes* | 5 | | 2 | | 2 | | 4 | 2 | 2 | | | | | | | | | | | | | | | | |
| *Colias palaeno* | 21 | | | | | | 2 | 1 | | | 2 | 1 | | | 4 | 2 | 1 | | | | | | | | |
| *Colias phicomone* | 8 | | | | | | 9 | 2 | | | | | | | | | | | | | | | | | |
| *Colotis evagore* | 1 | | | | 5 | | | | | | | | | | | | | | | | | | | | 5 |
| *Cupido alcetas* | 21 | | 1 | | 2 | 1 | 1 | 2 | 2 | 2 | 1 | 2 | 1 | | | | | | | | | | | | |
| *Cupido argiades* | 33 | | | | 1 | 1 | | 2 | 2 | 1 | | | 1 | | | | | | | | 1 | | | | 1 |
| *Cupido decolorata* | 16 | | | 1 | 2 | 2 | | | 2 | 2 | | | 2 | | | | | | | | | | | | |
| *Cupido lorquinii* | 2 | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | |
| *Cupido minimus* | 41 | | | | 2 | 2 | 1 | 1 | 2 | 1 | | 1 | | | | | | | | | | | | | |
| *Cupido osiris* | 20 | | | | 3 | 1 | 2 | 1 | 2 | | 1 | 1 | | | | | | | | | | | | | |
| *Danaus chrysippus* | 3 | | | 2 | 2 | | | | | | | | | | | | | | | | 2 | | | | |
| *Danaus plexippus* | 3 | | | | | | | | | | | | | | | | | | | | | | 2 | | 2 |
| *Erebia aethiopella* | 1 | | | | | | 4 | | | 4 | | | | 4 | | | | | | | | | | | |
| *Erebia aethiops* | 29 | | | | 1 | | 1 | | 2 | 2 | 3 | 3 | | | | | | | | | | | | | |
| *Erebia alberganus* | 6 | | | | | | 4 | | 4 | 4 | | | | | | | | | | | | | | | |
| *Erebia calcaria* | 3 | | | | | | 5 | | | | | | | | | | | 3 | 3 | | | | | | |
| *Erebia cassioides* | 12 | | | | | | 6 | | | | | | | | | | | 3 | 2 | | | | | | |
| *Erebia claudina* | 1 | | | | | | 9 | | | | | | | | | | | | | | | | | | |
| *Erebia cyclopius* | 4 | | | | | | | 3 | | | 5 | 3 | | | | | | | | | | | | | |
| *Erebia dabanensis* | 2 | | | | | | | | | | | | | | | | | | 9 | | | | | | |
| *Erebia disa* | 6 | | | | | | 3 | 2 | | | | 2 | | | 4 | | 2 | | | | | | | | |
| *Erebia discoidalis* | 3 | | | | | | 4 | 4 | | | | | | | 4 | | | | | | | | | | |
| *Erebia embla* | 9 | | | | | | | 1 | | | 3 | 1 | | | 5 | | 1 | | | | | | | | |
| *Erebia epiphron* | 20 | | 2 | | | 1 | 7 | | | | | | | | | | | | | | | | | | |
| *Erebia epistygne* | 2 | | | | 5 | | 5 | | | | | | | | | | | | | | | | | | |
| *Erebia eriphyle* | 4 | | | | | | 9 | | | | | | | | | | | | | | | | | | |
| *Erebia euryale* | 23 | | 1 | | | | 4 | | | 1 | 3 | 2 | | | | | | | | | | | | | |
| *Erebia fasciata* | 4 | | | | | | 4 | 4 | | | | 4 | | | | | | | | | | | | | |
| *Erebia flavofasciata* | 2 | | | | | | 9 | | | | | | | | | | | | | | | | | | |
| *Erebia gorge* | 17 | | | | | | 5 | | | | | | | | | | | 4 | 1 | | | | | | |
| *Erebia gorgone* | 3 | | | | | | 7 | | | | | | | | | | | 4 | | | | | | | |
| *Erebia graucasica* | 2 | | | | | 5 | 5 | | | | | | | | | | | | | | | | | | |
| *Erebia hispania* | 3 | | | | | | 7 | | | | | | | | | | | 4 | | | | | | | |

*Appendix 1.* (Continued).

| Species | No of Countries | Coastal | | Heath and Scrub | | | Grassland | | | | | | Forest | | | | | | Wetland | | | | Unvegetated | | | | Agriculture | | | | Urban | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | coastal sand-dunes and sand beaches | cliffs and rocky shores | heath and scrub | sclerophyllous scrub | phrygana | dry calcareous grasslands and steppes | dry siliceous grasslands | alpine and subalpine grasslands | humid grasslands and tall herb communities | mesophile grasslands | broad-leaved deciduous forests | coniferous woodland | mixed woodland | alluvial and very wet forests and brush | broad-leaved evergreen woodland | raised bogs | blanket bogs | water-fringe vegetation | fens, transition mires and springs | screes | inland cliffs and exposed rocks | inland sand-dunes | volcanic features | improved grasslands | crops | orchards, groves and tree plantations | tree lines, hedges, small woods, bocage, parkland dehesa | urban parks and large gardens | towns, villages, industrial sites | fallow land, waste places |
| *Euphydryas desfontainii* | 3 | | | 3 | 3 | | 3 | | | | | | | | | 3 | | | | | | | | | | | | | | | | |
| *Euphydryas iduna* | 6 | | | 2 | 2 | | | | 3 | 2 | | | | | | | 3 | | | | | | | | | | | | | | | |
| *Euphydryas intermedia* | 8 | | | 1 | | | | | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | |
| *Euphydryas maturna* | 27 | | | | | | | | | 2 | 2 | 4 | | 2 | 1 | | | | | | | | | | | | | | | | | |
| *Gegenes nostrodamus* | 11 | | | | 4 | 4 | 3 | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Gegenes pumilio* | 9 | | | | 3 | 3 | 3 | | | | | | | | | | | | | | | 2 | | | | | | | | | | |
| *Glaucopsyche alexis* | 38 | | | | 1 | | 2 | 2 | | | 2 | 2 | | | | | | | | | | | | | | | | | | | | 1 |
| *Glaucopsyche melanops* | 3 | | | 4 | 4 | | | | | | | 2 | | | | | | | | | | | | | | | | | | | | |
| *Gonepteryx cleopatra* | 14 | | | 1 | 3 | 1 | | | | | | | | | | 2 | | | | | | | | | | | | | | | | |
| *Gonepteryx farinosa* | 7 | | | | 3 | | | | | | | 5 | | | | | | | | | 3 | | | | | | | | | | | |
| *Gonepteryx maderensis* | 1 | | | | | | | | | | 5 | | | | | 5 | | | | | | | | | | | | | | | | |
| *Gonepteryx rhamni* | 41 | | | 1 | | | | | | | | 2 | 1 | 2 | | | | | | | | | | | | | | 1 | 1 | | | |
| *Hamearis lucina* | 34 | | | 1 | | | 2 | | | 2 | 2 | 3 | | 2 | | | | | | | | | | | | | | | | | | |
| *Hesperia comma* | 40 | | | 1 | | | 2 | 2 | 1 | | 2 | | | | | | | | | | | | | | | | | | | | | 1 |
| *Heteropterus morpheus* | 28 | | | 1 | | | | | | 3 | 2 | 1 | | 1 | 1 | | | | 1 | | | | | | | | | | | | | |
| *Hipparchia alcyone* | 20 | | | 1 | 1 | | 2 | 2 | | | | 2 | 4 | 1 | | | | | | | | | 1 | | | | | | | | | |
| *Hipparchia aristaeus* | 4 | | | | 2 | 2 | 2 | | | | | | | 2 | | | | | | | 2 | | | | | | | | | | | |
| *Hipparchia autonoe* | 2 | | | | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | | |
| *Hipparchia azorina* | 1 | | | 4 | | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | |
| *Hipparchia christenseni* | 1 | | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Hipparchia cretica* | 1 | | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Hipparchia fagi* | 22 | | | 1 | | | 1 | 2 | | | | 3 | 1 | 1 | | | | | | | | 1 | | | | | | | | | | |
| *Hipparchia fatua* | 7 | | | | 2 | | 5 | | | | | | 2 | 2 | | | | | | | 2 | | | | | | | | | | | |
| *Hipparchia fidia* | 3 | | | 4 | 4 | | 2 | | | | | | | | | 2 | | | | | | | | | | | | | | | | |
| *Hipparchia maderensis* | 1 | | | | | | | 2 | | | | | 2 | 2 | | 2 | | | | | | | | 2 | | | | | | | | |
| *Hipparchia mersina* | 2 | | | | | | | | | | | | 9 | | | | | | | | | | | | | | | | | | | |
| *Hipparchia miguelensis* | 1 | | | 4 | | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | |
| *Hipparchia neomiris* | 1 | | | 5 | | | 5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Hipparchia occidentalis* | 1 | | | 4 | | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | |
| *Hipparchia pellucida* | 5 | | | | 1 | 2 | 1 | 1 | 2 | | | | 1 | 1 | | | | | | | 1 | | | | | | | | | | | |
| *Hipparchia semele* | 33 | 2 | | 2 | | | 2 | 2 | | | | 1 | 2 | 1 | | | | | | | | 1 | 1 | | | | | | | | | |
| *Hipparchia statilinus* | 28 | | | 1 | | | 2 | 3 | | | | 1 | 1 | | | | | | | | | 1 | 1 | | | | | | | | | |
| *Hipparchia syriaca* | 10 | | | | | | 5 | | | | | 2 | 2 | 2 | | 2 | | | | | | | | | | | | | | | | |
| *Hipparchia volgensis* | 7 | | | | 1 | 1 | | 3 | 1 | | | 2 | | 2 | | | | | | | | 2 | | | | | | | | | | |
| *Hyponephele huebneri* | 1 | | | | | | | 9 | | | | | | | | | | | | | | | | | | | | | | | | |
| *Hyponephele lupinus* | 20 | | | | 1 | 1 | 2 | 2 | | | | 2 | | 1 | | | | | | | | | | | | | | | | | | |
| *Hyponephele lycaon* | 32 | | | 1 | | | 3 | 3 | | | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | |
| *Inachis io* | 42 | | | | | | | | | 1 | 1 | 1 | | 1 | | | | | | | | | | | | | | 1 | 2 | 2 | 1 | |
| *Iolana iolas* | 15 | | | | 2 | 1 | 2 | 1 | | 2 | 2 | | | | | | | | | | | | | | | | | | | | | |
| *Iphiclides podalirius* | 31 | | | 1 | 1 | | 1 | | | | 1 | 2 | | 1 | | | | | | | | | | | | 2 | 1 | 1 | | | | |
| *Issoria eugenia* | 2 | | | | | | | | 7 | | | | 4 | | | | | | | | | | | | | | | | | | | |
| *Issoria lathonia* | 37 | | | 1 | | | 2 | 2 | | | 2 | 1 | | | | | | | | | | | | | 1 | 1 | | 1 | | | | 2 |
| *Kirinia roxelana* | 11 | | | | 3 | | | | | | | 6 | | | | 2 | | | | | | | | | | | | | | | | |
| *Laeosopis roboris* | 4 | | | | | | | | | | | 2 | | | 4 | | | | 2 | | | | | | | | 4 | | | | | |

*Appendix 1.* (Continued).

| Species | No of Countries | Coastal | Heath and Scrub | | Grassland | | | | Forest | | | | | Wetland | | | | Unvegetated | | | | Agriculture | | | | Urban | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | coastal sand-dunes and sand beaches | heath and scrub | sclerophyllous scrub | dry calcareous grasslands and steppes | dry siliceous grasslands | alpine and subalpine grasslands | humid grasslands and tall herb communities | broad-leaved deciduous forests | coniferous woodland | mixed woodland | alluvial and very wet forests and brush | broad-leaved evergreen woodland | raised bogs | blanket bogs | water-fringe vegetation | fens, transition mires and springs | screes | inland cliffs and exposed rocks | inland sand-dunes | volcanic features | improved grasslands | crops | orchards, groves and tree plantations | tree lines, hedges, small woods, bocage, parkland dehesa | urban parks and large gardens | towns, villages, industrial sites | fallow land, waste places |
| | | cliffs and rocky shores | | phrygana | | | | mesophile grasslands | | | | | | | | | | | | | | | | | | | | |
| *Euphydryas desfontainii* | 3 | | 3 | 3 | 3 | | | | | | | | 3 | | | | | | | | | | | | | | | |
| *Euphydryas iduna* | 6 | | 2 | 2 | | | 3 | 2 | | | | | | 3 | | | | | | | | | | | | | | |
| *Euphydryas intermedia* | 8 | | 1 | | | | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | |
| *Euphydryas maturna* | 27 | | | | | | | 2 | 2 | 4 | | 2 | 1 | | | | | | | | | | | | | | | |
| *Gegenes nostrodamus* | 11 | | | 4 | 4 | 3 | | | | | | | | | | | | | | | | | | | | | | |
| *Gegenes pumilio* | 9 | | | 3 | 3 | 3 | | | | | | | | | | | | | 2 | | | | | | | | | |
| *Glaucopsyche alexis* | 38 | | | 1 | | 2 | 2 | | 2 | 2 | | | | | | | | | | | | | | | | | | 1 |
| *Glaucopsyche melanops* | 3 | | 4 | 4 | | | | | | 2 | | | | | | | | | | | | | | | | | | |
| *Gonepteryx cleopatra* | 14 | | 1 | 3 | 1 | | | | | | | | 2 | | | | | | | | | | | | | | | |
| *Gonepteryx farinosa* | 7 | | | 3 | | | | | | 5 | | | | | | | | 3 | | | | | | | | | | |
| *Gonepteryx maderensis* | 1 | | | | | | | | 5 | | | | 5 | | | | | | | | | | | | | | | |
| *Gonepteryx rhamni* | 41 | | 1 | | | | | | | 2 | 1 | 2 | | | | | | | | | | | | | 1 | 1 | | |
| *Hamearis lucina* | 34 | | 1 | | 2 | | | 2 | 2 | 3 | | 2 | | | | | | | | | | | | | | | | |
| *Hesperia comma* | 40 | | 1 | | 2 | 2 | 1 | | 2 | | | | | | | | | | | | | | | | | | | 1 |
| *Heteropterus morpheus* | 28 | | 1 | | | | | 3 | 2 | 1 | | 1 | 1 | | | 1 | | | | | | | | | | | | |
| *Hipparchia alcyone* | 20 | | 1 | 1 | 2 | 2 | | | | 2 | 4 | 1 | | | | | | | | 1 | | | | | | | | |
| *Hipparchia aristaeus* | 4 | | | 2 | 2 | 2 | | | | | | 2 | | | | | | 2 | | | | | | | | | | |
| *Hipparchia autonoe* | 2 | | | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | |
| *Hipparchia azorina* | 1 | | 4 | | | | | | 4 | | | | | | | | | | | | | | | | | | | |
| *Hipparchia christenseni* | 1 | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | |
| *Hipparchia cretica* | 1 | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | |
| *Hipparchia fagi* | 22 | | 1 | | | 1 | 2 | | | 3 | 1 | 1 | | | | | | | 1 | | | | | | | | | |
| *Hipparchia fatua* | 7 | | | 2 | | 5 | | | | | 2 | 2 | | | | | | 2 | | | | | | | | | | |
| *Hipparchia fidia* | 3 | | 4 | 4 | | 2 | | | | | | | 2 | | | | | | | | | | | | | | | |
| *Hipparchia maderensis* | 1 | | | | | | 2 | | | | 2 | 2 | 2 | | | | | | | | 2 | | | | | | | |
| *Hipparchia mersina* | 2 | | | | | | | | | | 9 | | | | | | | | | | | | | | | | | |
| *Hipparchia miguelensis* | 1 | | 4 | | | | | | 4 | | | | | | | | | | | | | | | | | | | |
| *Hipparchia neomiris* | 1 | | 5 | | | 5 | | | | | | | | | | | | | | | | | | | | | | |
| *Hipparchia occidentalis* | 1 | | 4 | | | | | | 4 | | | | | | | | | | | | | | | | | | | |
| *Hipparchia pellucida* | 5 | | | 1 | 2 | 1 | 1 | 2 | | | 1 | 1 | | | | | | 1 | | | | | | | | | | |
| *Hipparchia semele* | 33 | 2 | 2 | | | 2 | 2 | | | 1 | 2 | 1 | | | | | | | 1 | 1 | | | | | | | | |
| *Hipparchia statilinus* | 28 | | 1 | | | 2 | 3 | | | 1 | 1 | | | | | | | | 1 | 1 | | | | | | | | |
| *Hipparchia syriaca* | 10 | | | | | 5 | | | | 2 | 2 | 2 | 2 | | | | | | | | | | | | | | | |
| *Hipparchia volgensis* | 7 | | | 1 | 1 | | 3 | 1 | | 2 | | 2 | | | | | | | 2 | | | | | | | | | |
| *Hyponephele huebneri* | 1 | | | | | | 9 | | | | | | | | | | | | | | | | | | | | | |
| *Hyponephele lupinus* | 20 | | | 1 | 1 | 2 | 2 | | | 2 | | 1 | | | | | | | | | | | | | | | | |
| *Hyponephele lycaon* | 32 | | 1 | | | 3 | 3 | | 1 | 1 | 1 | | | | | | | | | | | | | | | | | |
| *Inachis io* | 42 | | | | | | | 1 | 1 | 1 | | 1 | | | | | | | | | | | | | 1 | 2 | 2 | 1 |
| *Iolana iolas* | 15 | | | 2 | 1 | 2 | 1 | 2 | 2 | | | | | | | | | | | | | | | | | | | |
| *Iphiclides podalirius* | 31 | | 1 | 1 | | 1 | | | 1 | 2 | | 1 | | | | | | | | | | | | 2 | 1 | 1 | | |
| *Issoria eugenia* | 2 | | | | | | 7 | | | | 4 | | | | | | | | | | | | | | | | | |
| *Issoria lathonia* | 37 | | 1 | | | 2 | 2 | | 2 | 1 | | | | | | | | | | | | 1 | 1 | | 1 | | | 2 |
| *Kirinia roxelana* | 11 | | | 3 | | | | | | 6 | | | 2 | | | | | | | | | | | | | | | |
| *Laeosopis roboris* | 4 | | | | | | | | | 2 | | 4 | | | | 2 | | | | | | | | | 4 | | | |

*Appendix 1.* (Continued).

| Species | No of Countries | Coastal | | Heath and Scrub | | | Grassland | | | | | | Forest | | | | | | Wetland | | | | Unvegetated | | | Agriculture | | | Urban | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | coastal sand-dunes and sand beaches | cliffs and rocky shores | heath and scrub | sclerophyllous scrub | phrygana | dry calcareous grasslands and steppes | dry siliceous grasslands | alpine and subalpine grasslands | humid grasslands and tall herb communities | mesophile grasslands | broad-leaved deciduous forests | coniferous woodland | mixed woodland | alluvial and very wet forests and brush | broad-leaved evergreen woodland | raised bogs | blanket bogs | water-fringe vegetation | fens, transition mires and springs | screes | inland cliffs and exposed rocks | inland sand-dunes | volcanic features | improved grasslands | crops | orchards, groves and tree plantations | tree lines, hedges, small woods, bocage, parkland dehesa | urban parks and large gardens | towns, villages, industrial sites | fallow land, waste places |
| *Lampides boeticus* | 23 | | | 1 | 2 | 2 | 1 | 1 | | | | 1 | | | | | | | | | | | | | 1 | 1 | 1 | | | 1 |
| *Lasiomata megera* | 1 | | | 3 | | | 3 | | | | | | | | | | | | | | | | | | | 3 | 3 | | | |
| *Lasiommata deidamia* | 3 | | | | | | | | | 4 | | | 4 | 2 | | | | | | | | 2 | | | | | | | | |
| *Lasiommata maera* | 37 | | | 1 | | | 1 | | | | 2 | 2 | 1 | 2 | | | | | | | | | | | | | | | | |
| *Lasiommata megera* | 39 | | | 1 | | | 2 | 2 | | | 1 | 1 | | | | | | | | | | 1 | | | | | 1 | | | 1 |
| *Lasiommata paramegaera* | 1 | | | | 5 | | | 5 | | | | | | | | | | | | | | | | | | | | | | |
| *Lasiommata petropolitana* | 29 | | | 1 | | | | | 2 | | 1 | 1 | 3 | 3 | | | | | | | | | | | | | | | | |
| *Leptidea duponcheli* | 10 | | 1 | 1 | 1 | 1 | 3 | 3 | | 1 | | | | 1 | | | | | | | | | | | | | 1 | | | |
| *Leptidea morsei* | 15 | | | | | | | | | 2 | 2 | 4 | 2 | 2 | | | | | | | | | | | | | | | | |
| *Leptidea sinapis complex* | 41 | | | | | | 1 | 1 | | 1 | 2 | 2 | 1 | 1 | | | | | | | | | | | | | 1 | | | |
| *Leptotes pirithous* | 19 | | | | 2 | 2 | 2 | 2 | | | | | | | | | | | | | | | | | | | 1 | 1 | | |
| *Libythea celtis* | 19 | | | | | | 2 | | | | | 2 | | 2 | | | | | | | | | | | | | 1 | 2 | | |
| *Limenitis camilla* | 37 | | | | | | | | | | | 6 | | 3 | | | | | | | | | | | | | | | | |
| *Limenitis populi* | 31 | | | | | | 1 | 1 | | | | 4 | | 3 | | | | | | | | | | | | | | 1 | | |
| *Limenitis reducta* | 25 | | | | 1 | | 1 | | | | | 5 | 1 | 2 | | | | | | | | | | | | | | | | |
| *Lopinga achine* | 28 | | | | | | | | | | | 4 | 2 | 4 | 1 | | | | | | | | | | | | | | | |
| *Lycaena alciphron* | 31 | | | 1 | | | 2 | 2 | 1 | 2 | 2 | 1 | | | | | | | | | | | | | | | | | | |
| *Lycaena candens* | 7 | | | | | | | | 5 | | 5 | | | | | | | | | | | | | | | | | | | |
| *Lycaena dispar* | 34 | | | | | | 1 | | | 3 | 2 | 1 | | | | | | 1 | 2 | 1 | | | | | | | 1 | | | |
| *Lycaena helle* | 23 | | | | | | | | 1 | 4 | 1 | | | | | | | | 1 | 1 | | | | | | | | | | |
| *Lycaena hippothoe* | 33 | | | | | | | | 2 | 4 | 3 | | | | | | | | | 1 | | | | | | | | | | |
| *Lycaena ottomanus* | 8 | | | | 3 | 3 | 3 | | | | 2 | | | 1 | | | | | | | | | | | | | | | | |
| *Lycaena phlaeas* | 44 | | | 1 | | | 2 | 2 | 1 | | 2 | 1 | | | | | | | | | | | | | | | | | | |
| *Lycaena thersamon* | 20 | | | | | | 3 | 2 | | | 1 | 1 | | | | | | | | | | | | | | | | 1 | | 1 |
| *Lycaena thetis* | 3 | | | | | 4 | 4 | | | | | 4 | | | | | | | | | | | | | | | | | | |
| *Lycaena tityrus* | 34 | | | 1 | | | 1 | 2 | 1 | 1 | 2 | 1 | | | | | | | | | | | | | 1 | | | | | |
| *Lycaena virgaureae* | 35 | | | | | | 1 | 1 | 1 | 2 | 3 | 1 | 1 | 2 | | | | | | | | | | | | | | | | |
| *Maculinea alcon* | 28 | | | 1 | | | 1 | | | 3 | 2 | 1 | | | | | | | | 1 | | | | | | | | | | |
| *Maculinea arion* | 39 | | | 1 | | | 2 | 2 | 1 | 1 | 2 | 1 | 1 | | | | | | | | | | | | | | | | | |
| *Maculinea nausithous* | 21 | | | | | | | 1 | | 4 | 2 | | | | | | | 2 | 2 | 1 | | | | | | | | | | |
| *Maculinea rebeli* | 15 | | | | | | 5 | 2 | 4 | | 1 | | | | | | | | | | | | | | | | | | | |
| *Maculinea teleius* | 21 | | | | | | | | | 4 | 3 | | | | | | | 2 | 1 | 1 | | | | | | | | | | |
| *Maniola chia* | 1 | | | | 9 | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Maniola halicarnassus* | 2 | | | | 5 | | 5 | | | | | | | | | | | | | | | | | | | | | | | |
| *Maniola jurtina* | 42 | | | | | | 1 | 1 | | 1 | 2 | 1 | | 1 | | | | | | | | | | | | | 1 | 1 | | 1 |
| *Maniola megala* | 2 | | | | | | | | | | | | | | | | | | 5 | 5 | | | | | | | | | | |
| *Maniola telmessia* | 2 | | | | 5 | | 5 | | | | | | | | | | | | | | | | | | | | | | | |
| *Melanargia galathea* | 29 | | | | | | 2 | 2 | | 1 | 3 | 1 | | 1 | | | | | | | | | | | | | 1 | | | |
| *Melanargia ines* | 2 | | | | 5 | | 5 | | | | | | | | | | | | | | | | | | | | | | | |
| *Melanargia lachesis* | 6 | | | | 3 | | 3 | | | | 2 | | | | | 2 | | | | | 2 | | | | | | 2 | | | |
| *Melanargia larissa* | 8 | | | | 2 | 2 | 4 | | | | | | | | | | | | | | | 4 | | | | | | | | |
| *Melanargia occitanica* | 3 | | | | 4 | | 4 | | | | 2 | | | | | | | | | | | | | | | | | | | |
| *Melanargia russiae* | 13 | | | | 1 | 1 | 3 | 3 | 1 | 1 | 2 | | 1 | 1 | | | | | | | | | | | | | | | | 1 |
| *Melitaea aetherie* | 2 | | | | | | | | | | | | | | | 9 | | | | | | | | | | | | | | |

*Appendix 1.* (Continued).

| Species | No of Countries | Coastal | Heath and Scrub | | | Grassland | | | | | Forest | | | | | Wetland | | | | Unvegetated | | | | Agriculture | | | | Urban | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | coastal sand-dunes and sand beaches cliffs and rocky shores | heath and scrub | sclerophyllous scrub | phrygana | dry calcareous grasslands and steppes | dry siliceous grasslands | alpine and subalpine grasslands | humid grasslands and tall herb communities | mesophile grasslands | broad-leaved deciduous forests | coniferous woodland | mixed woodland | alluvial and very wet forests and brush | broad-leaved evergreen woodland | raised bogs | blanket bogs | water-fringe vegetation | fens, transition mires and springs | screes | inland cliffs and exposed rocks | inland sand-dunes | volcanic features | improved grasslands | crops | orchards, groves and tree plantations | tree lines, hedges, small woods, bocage, parkland dehesa | urban parks and large gardens | towns, villages, industrial sites | fallow land, waste places |
| *Melitaea arduinna* | 8 | | | | | 2 | 2 | 1 | | 2 | 2 | | 1 | | | | | | | | | | | | | | | | | |
| *Melitaea asteria* | 2 | | | | | | | 9 | | | | | | | | | | | | | | | | | | | | | | |
| *Melitaea athalia* | 41 | | 1 | | | 1 | 2 | | 1 | 2 | 2 | 1 | 1 | | | | | | | | | | | | | | | | | |
| *Melitaea aurelia* | 27 | | 1 | | | 3 | 2 | 1 | 2 | 3 | | | | | | | | | | | | | | | | | | | | |
| *Melitaea britomartis* | 16 | | | | | 3 | 2 | | 1 | 3 | 1 | | | | | | | | | | | | | | | | | | | |
| *Melitaea cinxia* | 40 | | | | | 2 | 2 | | 1 | 3 | | | | | | | | | | | | | | | | | | | | |
| *Melitaea deione* | 5 | | | | | 3 | 3 | 2 | | 3 | | | | | | | | | | | | | | | | | | | | |
| *Melitaea diamina* | 36 | | | | | 1 | 1 | | 4 | 2 | | | | | | | | | 1 | | | | | | | | | | | |
| *Melitaea didyma* | 32 | | | | | 3 | 3 | | | 1 | 1 | | | | | | | | | | | | | | | | | | | |
| *Melitaea parthenoides* | 7 | | | | | 2 | 2 | 3 | | 3 | | | | 1 | | | | | 1 | | | | | | | | | | | |
| *Melitaea phoebe* | 34 | | | | | 2 | 2 | | 1 | 3 | 1 | | | | | | | | | | | | | | | | | | | |
| *Melitaea trivia* | 20 | | | | | 3 | 2 | | 2 | 4 | 2 | | | | | | | | | | | | | | | | | | | |
| *Melitaea varia* | 3 | | | | | | | 9 | | | | | | | | | | | | | | | | | | | | | | |
| *Minois dryas* | 28 | | | | | 2 | 1 | | 1 | 2 | 2 | | | 1 | | | | | | | | | | | | | | | | |
| *Muschampia cribrellum* | 5 | | | | 2 | 4 | 3 | | | | | | | | | | | | | | | | | | | | | | | 1 |
| *Muschampia proto* | 11 | | 2 | 3 | 3 | 3 | 1 | 2 | | | | | | | | | | | | | | | | | | | | | | |
| *Muschampia tessellum* | 10 | | 1 | | 1 | 3 | 2 | | | 2 | | | | | | | | | | | | | | | | | | | | |
| *Neolycaena rhymnus* | 3 | | 2 | | | 2 | 5 | | | | | | | | | | | | | 2 | | | | | | | | | | |
| *Neozephyrus quercus* | 42 | | | | | | | | | | 6 | | 2 | | 1 | | | | | | | | | | | | 1 | 1 | | |
| *Neptis rivularis* | 20 | | | | | | | | | 1 | 4 | 1 | 2 | 2 | | | | | | | | | | | | | 1 | | | |
| *Neptis sappho* | 19 | | | | | | | | | | 5 | | 3 | 2 | | | | | | | | | | | | | | | | |
| *Nymphalis antiopa* | 39 | | | | | | | | | | 3 | 2 | 2 | 1 | | | | | | | | | | | | | 1 | 1 | | |
| *Nymphalis polychloros* | 39 | | | | | | | | | | 2 | | 2 | | | | | | | | | | | | | 1 | 2 | 2 | | |
| *Nymphalis vaualbum* | 17 | | | | | | | | | | 4 | 1 | 2 | 1 | | | | | | | | | | | | | 1 | 1 | 1 | |
| *Nymphalis xanthomelas* | 24 | | | | | | | | | | 3 | 1 | 3 | 2 | | | | | | | | | | | | 1 | 1 | 1 | 1 | |
| *Ochlodes venata* | 39 | | | | | | 1 | | 2 | 2 | 1 | | 1 | | | | | | | | | | | | | | 1 | | | |
| *Oeneis bore* | 5 | | 2 | | | | | 2 | 2 | | | | | | | | | | | 2 | 2 | | | | | | | | | |
| *Oeneis glacialis* | 4 | | | | | | | 5 | | | | | | | | | | 2 | | 2 | 2 | | | | | | | | | |
| *Oeneis jutta* | 11 | | | | | | | 1 | 1 | | | 3 | | | | 7 | | | | | | | | | | | | | | |
| *Oeneis melissa* | 2 | | | | | | | 4 | 4 | | | | | | | | | | | | 4 | | | | | | | | | |
| *Oeneis norna* | 5 | | 2 | | | | | 2 | 2 | 2 | | | | | | 4 | | | | | | | | | | | | | | |
| *Oeneis patrushevae* | 2 | | | | | | | | 5 | | | | | | | 5 | | | | | | | | | | | | | | |
| *Oeneis polixenes* | 1 | | | | | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | |
| *Oeneis tarpeia* | 3 | | | | | 4 | 4 | 2 | | | | | | | | | | | | | | | | | | | | | | |
| *Papilio alexanor* | 8 | | 2 | 2 | 4 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | |
| *Papilio hospiton* | 1 | | 2 | 2 | 2 | 2 | 2 | 2 | | | | | | | | | | | | | | | | | | | | | | |
| *Papilio machaon* | 43 | | | | | 1 | 1 | | 1 | 2 | 1 | | | | | | | | | | | | | | | 1 | | 1 | 1 | 1 |
| *Pararge aegeria* | 45 | | | | | | | | | | 3 | 2 | 2 | 1 | | | | | | | | | | | | | 1 | 1 | | |
| *Pararge xiphia* | 1 | | | | | | | | | | | | | | 9 | | | | | | | | | | | | | | | |
| *Parnassius apollo* | 30 | | | | | 2 | | 3 | | 1 | 1 | 1 | | | | | | | | 1 | 2 | | | | | | | | | |
| *Parnassius mnemosyne* | 34 | | | | | 1 | | 2 | 2 | 2 | 3 | | 1 | | | | | | | | | | | | | | | | | |
| *Parnassius phoebus* | 7 | | | | | | | 5 | 2 | 2 | | | | | | | | 2 | 2 | | 2 | | | | | | | | | |
| *Pieris balcana* | 6 | | | | | | | | | | 7 | 2 | 2 | | | | | | | | | | | | | | | | | |
| *Pieris brassicae* | 44 | | | | | | | | 1 | 1 | | | | | | | | | | | | | | 1 | 2 | 1 | 1 | 2 | 2 | 1 |

*Appendix 1.* (Continued).

| Species | No of Countries | Coastal | | Heath and Scrub | | | Grassland | | | | | | Forest | | | | | | Wetland | | | | Unvegetated | | | | Agriculture | | | | Urban | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | coastal sand-dunes and sand beaches | cliffs and rocky shores | heath and scrub | sclerophyllous scrub | phrygana | dry calcareous grasslands and steppes | dry siliceous grasslands | alpine and subalpine grasslands | humid grasslands and tall herb communities | mesophile grasslands | broad-leaved deciduous forests | coniferous woodland | mixed woodland | alluvial and very wet forests and brush | broad-leaved evergreen woodland | raised bogs | blanket bogs | water-fringe vegetation | fens, transition mires and springs | screes | inland cliffs and exposed rocks | inland sand-dunes | volcanic features | improved grasslands | crops | orchards, groves and tree plantations | tree lines, hedges, small woods, bocage, parkland dehesa | urban parks and large gardens | towns, villages, industrial sites | fallow land, waste places | |
| *Pieris bryoniae* | 15 | | | 1 | | | | | 3 | 1 | | 1 | 2 | 1 | | | | | | | | | | | | | | | | | | | |
| *Pieris ergane* | 14 | | | | 1 | | 3 | 1 | | | | 2 | | 1 | | | | | | | 2 | 2 | | | 1 | | | | | | | | |
| *Pieris krueperi* | 5 | | | | | | 3 | | | | | | | | | | | | | | 3 | 3 | | | 3 | | | | | | | | |
| *Pieris mannii* | 18 | | | | 1 | | 2 | 2 | | | | 2 | | 1 | | | | | | | | 1 | | | | | | | | | | | |
| *Pieris napi* | 42 | | | | | | | | | 1 | 1 | 1 | | 1 | | | | | | | | | | | 1 | 1 | 1 | | | 1 | | | |
| *Pieris rapae* | 44 | | | | | | | | | | 1 | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 2 | 1 | 1 | | |
| *Plebeius argus* | 41 | | | 2 | | | 2 | 2 | | | 2 | | 1 | 1 | | | | | | | | | | | | | | | | | | | |
| *Plebeius argyrognomon* | 30 | | | | | | 3 | 2 | | 1 | 2 | 1 | | | | | | | | | | | | | 1 | 1 | | | | | | | |
| *Plebeius eurypilus* | 2 | | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Plebeius glandon* | 12 | | | 1 | | | 1 | 1 | 7 | | | | | | | | | | | | 2 | | | | | | | | | | | | |
| *Plebeius hesperica* | 1 | | | | | | 5 | | | | | | | | | | | | | | | | | | | | | | | | | 5 | |
| *Plebeius idas* | 37 | | | 2 | | | 1 | 2 | 1 | | 2 | 1 | | 2 | | | | | | | | | | | | | | | | | | | |
| *Plebeius loewii* | 2 | | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Plebeius optilete* | 24 | | | 1 | | | | | 1 | | | | 3 | | | | 4 | | | | | | | | | | | | | | | | |
| *Plebeius orbitulus* | 9 | | | | | | | | 8 | | | | | | | | | | | | 2 | 2 | | | | | | | | | | | |
| *Plebeius psylorita* | 1 | | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Plebeius pylaon* | 11 | | | | 1 | 1 | 5 | 2 | | | 1 | | | | | | | | | | | 2 | | | | | | | | | | | |
| *Plebeius pyrenaica* | 8 | | | | | | | | 4 | 2 | 3 | | | | | | | | | | 2 | | | | | | | | | | | | |
| *Plebeius sephirus* | 1 | | | | | | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Polygonia c-album* | 41 | | | | | | | | | | | 2 | | 2 | | | | | | | | | | | | | 1 | 2 | 2 | 1 | | | |
| *Polygonia egea* | 12 | | | | 3 | 3 | 3 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus admetus* | 13 | | | | | | 5 | | 1 | | 2 | 4 | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus albicans* | 1 | | | | 5 | | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus amandus* | 34 | | | | | | 2 | 2 | | 1 | 3 | 1 | | | | | | | | | | | | | 1 | | | | | | | | |
| *Polyommatus andronicus* | 1 | | | | | | | | 5 | | 5 | | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus aroaniensis* | 2 | | | | 4 | | 4 | | | | | | | | | | | | | | 4 | | | | | | | | | | | | |
| *Polyommatus bellargus* | 32 | | | | | | 4 | 2 | 1 | | 2 | 1 | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus caucasica* | 1 | | | | | | 3 | | 3 | 3 | 3 | | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus coelestina* | 5 | | | | | | 8 | | | | 3 | | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus coridon* | 31 | | | 1 | | | 4 | 2 | | | 2 | 1 | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus cyane* | 2 | | | | | | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus damocles* | 2 | | | | | | 5 | 3 | | | | | | | | | | | | | | 3 | | | | | | | | | | | |
| *Polyommatus damon* | 23 | | | | | | 4 | 2 | 2 | | 1 | 2 | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus damone* | 3 | | | | | | 5 | 3 | | | 3 | | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus daphnis* | 27 | | | | | | 4 | 2 | | | 2 | 1 | | 1 | | | | | | | | | | | | | | | | | | | |
| *Polyommatus dolus* | 1 | | | | 4 | | 4 | 4 | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus dolus (ainse)* | 1 | | | | 5 | | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus dorylas* | 29 | | | | | | 4 | 2 | 2 | | 2 | 2 | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus eroides* | 14 | | | | | | 2 | 3 | 2 | 1 | 2 | | 1 | 1 | | | | | | | | | 1 | | | | | | | | | | |
| *Polyommatus eros* | 10 | | | | | | 4 | | 6 | | | | | | | | | | | | 2 | | | | | | | | | | | | |
| *Polyommatus escheri* | 13 | | | | 1 | 2 | 4 | 1 | 1 | 2 | 1 | | | | | | | | | | 1 | 1 | | | | | | | | | | | |
| *Polyommatus fabressei* | 1 | | | | 5 | | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus fulgens* | 1 | | | | | | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus golgus* | 1 | | | | | | | | 5 | | | | | | | | | | | | 5 | | | | | | | | | | | | |

*Appendix 1.* (Continued).

| Species | No of Countries | Coastal | | Heath and Scrub | | | Grassland | | | | | Forest | | | | | Wetland | | | | Unvegetated | | | | Agriculture | | | | Urban | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | coastal sand-dunes and sand beaches | cliffs and rocky shores | heath and scrub | sclerophyllous scrub | phrygana | dry calcareous grasslands and steppes | dry siliceous grasslands | alpine and subalpine grasslands | humid grasslands and tall herb communities | mesophile grasslands | broad-leaved deciduous forests | coniferous woodland | mixed woodland | alluvial and very wet forests and brush | broad-leaved evergreen woodland | raised bogs | blanket bogs | water-fringe vegetation | fens, transition mires and springs | screes | inland cliffs and exposed rocks | inland sand-dunes | volcanic features | improved grasslands | crops | orchards, groves and tree plantations | tree lines, hedges, small woods, bocage, parkland dehesa | urban parks and large gardens | towns, villages, industrial sites | fallow land, waste places |
| *Polyommatus hispana* | 2 | | | 2 | 2 | | 4 | | 2 | | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus icarus* | 44 | | | | | | 2 | 2 | | 1 | 2 | | | | | | | | | | | | | | | | | | 1 | | 1 |
| *Polyommatus iphigenia* | 2 | | | | 5 | | 5 | | | | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus kamtschadalus* | 1 | | | | | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus menelaos* | 1 | | | | | | 5 | | | | 5 | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus nephohiptameno* | 2 | | | | | | 4 | | | | 4 | | | | | | | | | | 4 | | | | | | | | | | |
| *Polyommatus nivescens* | 1 | | | | 4 | | 4 | | | | | | | | | | | | | | | 4 | | | | | | | | | |
| *Polyommatus philippi* | 1 | | | | | | 5 | | | | 5 | | | | | | | | | | | | | | | | | | | | |
| *Polyommatus poseidon* | 2 | | | | | | 4 | | 4 | | | | | | | | | | | | | 4 | | | | | | | | | |
| *Polyommatus ripartii* | 13 | | | | 2 | | 6 | 2 | 1 | | 1 | | | 1 | | | | | | | | | | | | | | | | | |
| *Polyommatus semiargus* | 41 | | | | | | 1 | 1 | 1 | 2 | 3 | 1 | | 1 | | | | | | | | | | | | | | | | | 1 |
| *Polyommatus thersites* | 25 | | | 1 | 1 | | 3 | 2 | 1 | | 2 | 1 | | | | | | | | | | | | | | | | | | | 1 |
| *Pontia callidice* | 12 | | | | | | | | 7 | 1 | | | | 1 | | | | | | | 1 | | 1 | | 1 | | | | | | 1 |
| *Pontia chloridice* | 12 | | | | | | 3 | 2 | 1 | | 2 | | | | | | | | | | 2 | 2 | | | | | | | | | 2 |
| *Pontia daplidice* | 31 | | | | | | 1 | 1 | | | 1 | 1 | | | | | | | | | | | | | 1 | 1 | | 1 | 1 | | 2 |
| *Proterebia afra* | 6 | | | 2 | 2 | 3 | 2 | 3 | 2 | | | | | 2 | | | | | | | | | | | | | | | | | |
| *Proterebia afra krymea* | 1 | | | | | | | | 9 | | | | | | | | | | | | | | | | | | | | | | |
| *Pseudochazara alpina* | 1 | | | | | | | 9 | | | | | | | | | | | | | | | | | | | | | | | |
| *Pseudochazara amymone* | 1 | | | | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Pseudochazara anthelea* | 7 | | | | 2 | 2 | 4 | | | | | | | | | | | | | | 2 | | | | | | | | | | |
| *Pseudochazara cingovskii* | 2 | | | | | | 9 | | | | | | | | | | | | | | | | | | | | | | | | |
| *Pseudochazara euxina* | 2 | | | | | | | | 5 | | | | | | | | | | | | | 5 | | | | | | | | | |
| *Pseudochazara geyeri* | 5 | | | | | | 7 | 4 | | | | | | | | | | | | | | | | | | | | | | | |
| *Pseudochazara graeca* | 2 | | | | | | 7 | | | | | | | | | | | | | | | 4 | | | | | | | | | |
| *Pseudochazara hippolyte* | 3 | | | 2 | | | 4 | 4 | | | | | | | | | | | | | 2 | | | | | | | | | | |
| *Pseudochazara mniszechii* | 2 | | | | 5 | | | | | | | | 5 | | | | | | | | | | | | | | | | | | |
| *Pseudochazara orestes* | 2 | | | | 4 | 4 | | | | | | | | | | | | | | | 4 | | | | | | | | | | |
| *Pseudochazara quirensis* | 1 | | | | | | | 9 | | | | | | | | | | | | | | | | | | | | | | | |
| *Pseudophilotes abencerragu* | 2 | | | | | | 5 | | | | | | | | | | | | | | | | | | | | | | | | 5 |
| *Pseudophilotes baton* | 13 | | | 2 | 2 | 1 | 4 | 3 | 1 | | 1 | | | | | | | | | | | | | | | | | | | | |
| *Pseudophilotes bavius* | 9 | | | | 1 | 2 | 5 | 2 | | | | | | | | | | | | | 1 | | | | | | | | | | |
| *Pseudophilotes vicrama* | 23 | | | 1 | 1 | 1 | 3 | 3 | | | | | 1 | | | | | | | | | | | | | | | | | | |
| *Pyrgus alveus* | 33 | | | 1 | | | 2 | 2 | 2 | | 3 | | | | | | | | | | | | | | | | | | | | |
| *Pyrgus andromedae* | 16 | | | | | | | | 6 | | | | | | | | | | | | | 1 | | | | | | | | | |
| *Pyrgus armoricanus* | 26 | | | 1 | | | 4 | 2 | 1 | 1 | 2 | | | | | | | | | | | | | | | | | | | | |
| *Pyrgus bellieri* | 3 | | | | | | | | 4 | 4 | 4 | | | | | | | | | | | | | | | | | | | | |
| *Pyrgus cacaliae* | 10 | | | | | | 1 | | 8 | 1 | | | | 1 | | | | | | | | | | | | | | | | | |
| *Pyrgus carlinae* | 2 | | | | | | 2 | 2 | 2 | 2 | 2 | | | | | | | | | | | | 2 | | | | | | | | |
| *Pyrgus carthami* | 29 | | | | | | 3 | 2 | 1 | 1 | 2 | 1 | | | | | | | | | 1 | | | | | | | | | | |
| *Pyrgus centaureae* | 5 | | | | | | | | 2 | | | | 2 | | | | 6 | 2 | | | | | | | | | | | | | |
| *Pyrgus cinarae* | 9 | | 1 | 1 | | | 3 | 2 | | 1 | | | | | | | | | | | 1 | 1 | | | | | | | | | |
| *Pyrgus cirsii* | 9 | | | | | | 2 | 2 | 2 | | 2 | | | | | | | | | | | | 1 | | | | | | | | 1 |
| *Pyrgus malvae* | 40 | | | 1 | | | 2 | 1 | | 2 | 2 | 1 | | 1 | | | | | | | | | | | | | | | | | |
| *Pyrgus malvoides* | 7 | | | 1 | 1 | 1 | 3 | 2 | 1 | 1 | 2 | | | | | | | | | | | | | | 1 | | | | | | |

*Appendix 1.* (Continued).

| Species | No of Countries | Coastal | | Heath and Scrub | | | Grassland | | | | | | Forest | | | | | | Wetland | | | | Unvegetated | | | | Agriculture | | | | Urban | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | coastal sand-dunes and sand beaches | cliffs and rocky shores | heath and scrub | sclerophyllous scrub | phrygana | dry calcareous grasslands and steppes | dry siliceous grasslands | alpine and subalpine grasslands | humid grasslands and tall herb communities | mesophile grasslands | broad-leaved deciduous forests | coniferous woodland | mixed woodland | alluvial and very wet forests and brush | broad-leaved evergreen woodland | raised bogs | blanket bogs | water-fringe vegetation | fens, transition mires and springs | screes | inland cliffs and exposed rocks | inland sand-dunes | volcanic features | improved grasslands | crops | orchards, groves and tree plantations | tree lines, hedges, small woods, bocage, parkland dehesa | urban parks and large gardens | towns, villages, industrial sites | fallow land, waste places |
| *Pyrgus onopordi* | 6 | | | | 2 | | 4 | 2 | 2 | 2 | 2 | | | | | | | | | | | | | | 2 | | | | | | | |
| *Pyrgus serratulae* | 32 | | | | | | 3 | 3 | 2 | | 2 | | | | | | | | | | | | | | | | | | | | | |
| *Pyrgus sidae* | 18 | | | | 1 | 1 | 3 | 1 | | | 1 | | 1 | | | | | | | | 1 | | | | | | | | | | | |
| *Pyrgus warrenensis* | 4 | | | | | | | | 9 | | | | | | | | | | | | | | | | | | | | | | | |
| *Pyronia bathseba* | 3 | | | | 2 | 2 | 2 | 2 | | | | | | | | | | | | | | | | | | | | | | | | |
| *Pyronia cecilia* | 8 | | | | 4 | 2 | 3 | 2 | | | | | | | | 2 | | | | | | | | | | | | | | | | |
| *Pyronia tithonus* | 26 | | | 1 | | | 2 | 1 | | 1 | 2 | 2 | | | 1 | | | | | | | | | | | | | 2 | | | | |
| *Satyrium acaciae* | 26 | | | 3 | | | 2 | | | | 1 | 4 | | 2 | | | | | | | | | | | | | | | | | | |
| *Satyrium esculi* | 4 | | | | 1 | | | | | | | 1 | | | | 2 | | | | | | | | | | | 1 | 2 | 1 | 1 | 1 | |
| *Satyrium ilicis* | 36 | | | 2 | | | | | | | | 5 | | 2 | | | | | | | | | | | | | | | | | | |
| *Satyrium ledereri* | 2 | | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Satyrium pruni* | 34 | | | 1 | | | | | | | | 3 | | 2 | | | | | | | | | | | | | 1 | 2 | 1 | | | |
| *Satyrium spini* | 31 | | | 2 | | | 2 | 1 | | | | 3 | | 2 | | | | | | | | | | | | | | 2 | | | | |
| *Satyrium w-album* | 39 | | | | | | | | | | | 4 | | 3 | | | | | | | | | | | | | | 2 | 2 | | | |
| *Satyrus actaea* | 6 | | | 2 | | | 5 | 2 | 2 | | 2 | | | | | | | | | | | | | | | | | | | | | |
| *Satyrus ferula* | 16 | | | | | 1 | 2 | 2 | 2 | | | 2 | | | 2 | | | | | | 2 | | | | | | | | | | | |
| *Scolitantides orion* | 29 | | | | | | 3 | 2 | 1 | | | 1 | | | | | | | | | 1 | 2 | | | | | | | | | | |
| *Spialia orbifer* | 15 | | | | | | 3 | 2 | | | 3 | | | | 2 | | | | | | | | | | | | | | | | | |
| *Spialia phlomidis* | 7 | | | | 3 | 1 | 3 | 2 | | | | | | | | | | | | | 1 | | | | | | | | | | | |
| *Spialia sertorius* | 20 | | | 1 | | | 4 | 2 | | 1 | 1 | | | | | | | | | | | | | | | | | | | | | |
| *Spialia therapne* | 1 | | | | 4 | 4 | 4 | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Tarucus balkanica* | 10 | | | | 6 | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Tarucus theophrastus* | 1 | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Thecla betulae* | 41 | | | 1 | | | | | | | | 3 | | 2 | | | | | | | | | | | | | 1 | 2 | 2 | | | |
| *Thymelicus acteon* | 29 | | | | 1 | | 4 | 2 | | | 2 | 2 | | | | | | | | | | | | | | | | | | | | |
| *Thymelicus hyrax* | 2 | | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Thymelicus lineola* | 40 | | | | | | 1 | 2 | | 1 | 2 | 1 | | | | | | | | | | | | | | | | 1 | | | 2 | |
| *Thymelicus sylvestris* | 37 | | | | | | 2 | 2 | | 1 | 3 | 2 | | 1 | | | | | | | | | | | | | | 1 | | | | |
| *Tomares ballus* | 3 | | | | 2 | | 4 | 4 | | | | | | | | | | | | | | | | | | | | | | | 2 | |
| *Tomares callimachus* | 4 | | | | | | 3 | 3 | | | | 2 | | 2 | | | | | | | 2 | | | | | | | | | | | |
| *Tomares nogelii* | 5 | | | | | 2 | 7 | | | | | 2 | | | | | | | | | | | | | | | | | | | | |
| *Tongeia fischeri* | 1 | | | | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | | |
| *Triphysa phryne* | 4 | | | 2 | | | 4 | 4 | | | | | | 2 | | | | | | | | | | | | | | | | | | |
| *Turanana endymion* | 2 | | | | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Vanessa atalanta* | 22 | | | | | | | | | 1 | 1 | 1 | | 1 | | | | | | | | | | | | | | 1 | 1 | 1 | | |
| *Vanessa cardui* | 15 | | | | 1 | | | | 1 | 1 | 2 | | | | | | | | | | | | | | | 1 | | | 1 | | 1 | |
| *Vanessa indica* | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Vanessa virginiensis* | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Ypthima asterope* | 3 | | | | | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Zegris eupheme* | 5 | | | | | | 4 | 2 | | | | | | | | | | | 1 | | | | | | 1 | | | | | | 3 | |
| *Zegris pyrothoe* | 2 | | | | | | 7 | 4 | | | | | | | | | | | | | | | | | | | | | | | | |
| *Zerynthia cerisy* | 11 | | | 1 | 2 | 1 | 4 | | | | 1 | | | 1 | | | | | | | | | | | | | | | | | | |
| *Zerynthia cretica* | 1 | | | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Zerynthia polyxena* | 22 | | | 1 | 1 | | 2 | 1 | | 2 | 2 | 1 | | 1 | 1 | | | | | | | | | | | | | | | | | |
| *Zerynthia rumina* | 4 | 1 | | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | | | | | | | | | | | 1 | | | | | 1 | | | | |
| *Zizeeria knysna* | 3 | | | | | | 3 | 3 | | | | | | | | | | | | | | | | | | | | | 3 | | 3 | |

## Appendix 2

List of specialist butterflies per biotope.

*Forests*

*Apatura ilia*, *Apatura iris*, *Apatura metis*, *Argynnis paphia*, *Carterocephalus silvicola*, *Erebia aethiops*, *Erebia ligea*, *Esperarge climene*, *Euphydryas maturna*, *Gonepteryx farinosa*, *Hipparchia alcyone*, *Kirinia roxelana*, *Lasiommata petropolitana*, *Leptidea morsei*, *Limenitis camilla*, *Limenitis populi*, *Limenitis reducta*, *Lopinga achine*, *Neozephyrus quercus*, *Neptis rivularis*, *Neptis sappho*, *Nymphalis antiopa*, *Nymphalis vaualbum*, *Nymphalis xanthomelas*, *Pararge aegeria*, *Pieris balcana*, *Satyrium ilicis*, *Satyrium pruni*, *Satyrium w-album*.

*Grasslands*

*Arethusana arethusa*, *Aricia anteros*, *Aricia artaxerxes*, *Aricia nicias*, *Boloria graeca*, *Boloria napaea*, *Boloria pales*, *Boloria polaris*, *Boloria titania*, *Brenthis hecate*, *Brenthis ino*, *Carcharodus lavatherae*, *Carcharodus orientalis*, *Coenonympha dorus*, *Coenonympha gardetta*, *Coenonympha glycerion*, *Coenonympha leander*, *Coenonympha rhodopensis*, *Colias alfacariensis*, *Colias aurorina*, *Colias chrysotheme*, *Colias erate*, *Colias hecla*, *Colias myrmidone*, *Colias nastes*, *Colias phicomone*, *Cupido minimus*, *Cupido osiris*, *Erebia alberganus*, *Erebia cassioides*, *Erebia epiphron*, *Erebia eriphyle*, *Erebia gorge*, *Erebia manto*, *Erebia medusa*, *Erebia melampus*, *Erebia meolans*, *Erebia oeme*, *Erebia orientalis*, *Erebia pandrose*, *Erebia pharte*, *Erebia pronoe*, *Erebia sudetica*, *Erebia triaria*, *Erebia tyndarus*, *Erynnis marloyi*, *Erynnis tages*, *Euchloe ausonia*, *Euphydryas aurinia*, *Euphydryas cynthia*, *Glaucopsyche alexis*, *Hipparchia syriaca*, *Leptidea duponcheli*, *Lycaena alciphron*, *Lycaena candens*, *Lycaena helle*, *Lycaena hippothoe*, *Lycaena ottomanus*, *Maculinea arion*, *Maculinea nausithous*, *Maculinea rebeli*, *Maculinea teleius*, *Melanargia galathea*, *Melanargia russiae*, *Melitaea arduinna*, *Melitaea aurelia*, *Melitaea britomartis*, *Melitaea cinxia*, *Melitaea deione*, *Melitaea diamina*, *Melitaea didyma*, *Melitaea parthenoides*, *Melitaea phoebe*, *Melitaea trivia*, *Muschampia cribrellum*, *Neolycaena rhymnus*, *Oeneis glacialis*, *Parnassius mnemosyne*, *Parnassius phoebus*, *Plebeius argyrognomon*, *Plebeius glandon*, *Plebeius orbitulus*, *Plebeius pylaon*, *Plebeius pyrenaica*, *Polyommatus admetus*, *Polyommatus amandus*, *Polyommatus bellargus*, *Polyommatus coelestina*, *Polyommatus coridon*, *Polyommatus damon*, *Polyommatus damone*, *Polyommatus daphnis*, *Polyommatus dorylas*, *Polyommatus eroides*, *Polyommatus eros*, *Polyommatus escheri*, *Polyommatus ripartii*, *Polyommatus semiargus*, *Polyommatus thersites*, *Pontia callidice*, *Pontia chloridice*, *Pseudochazara anthelea*, *Pseudochazara geyeri*, *Pseudophilotes baton*, *Pseudophilotes bavius*, *Pseudophilotes vicrama*, *Pyrgus alveus*, *Pyrgus andromedae*, *Pyrgus armoricanus*, *Pyrgus cacaliae*, *Pyrgus carthami*, *Pyrgus cinarae*, *Pyrgus cirsii*, *Pyrgus malvoides*, *Pyrgus onopordi*, *Pyrgus serratulae*, *Satyrus actaea*, *Spialia orbifer*, *Spialia sertorius*, *Thymelicus acteon*, *Tomares callimachus*, *Tomares nogelii*, *Triphysa phryne*, *Zerynthia cerisy*.

*Wetlands*

*Boloria aquilonaris*, *Boloria freija*, *Boloria frigga*, *Coenonympha tullia*, *Colias palaeno*, *Erebia disa*, *Erebia embla*, *Oeneis jutta*, *Pyrgus centaureae*

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