Trends for butterfly species in Europe

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Chris van Swaay

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De Vlinderstichting
Postbus 506
NL-6700 AM Wageningen
The Netherlands
tel: 0317-467346
fax: 0317-420296
e-mail: info@vlinderstichting.nl
www.vlinderstichting.nl

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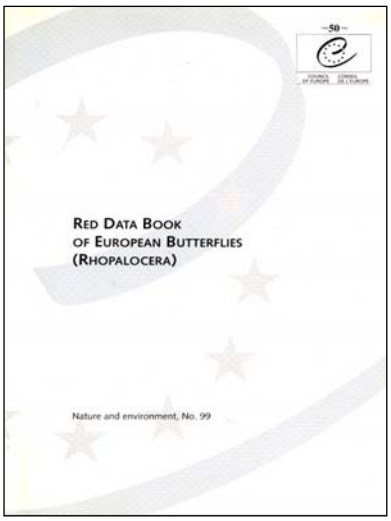
Chapter 1 / Introduction

The project 'Biodiversity Trends & Threats in Europe' (by UNEP-WCMC and RIVM) aims to develop biodiversity trend indicators for policy support. A species index will be tested by mobilising existing data.

The rapid economic development of the twentieth century has brought about profound changes in the European environment. Agricultural intensification has been a major cause of the loss of remaining natural habitats and bio-diverse semi-natural habitats. Similarly, forestry expansion and intensification, urbanization, industrialization and increasing recreational demands have caused widespread damage through habitat loss, degradation and pollution (Van Swaay & Warren, 1999).

In this report an overview is given of the present knowledge on the trends of butterfly species in twenty-one combinations of bio-geographic region and habitat in the last thirty years. This information was not only gathered in states belonging to the European Union or accession states, but also in other European non-EU countries. This information will be used to develop trend indicators for policy support. Butterflies belong to the best studied groups of animals. Furthermore they are appealing and many of them are threatened, which makes them very suitable indicator species.



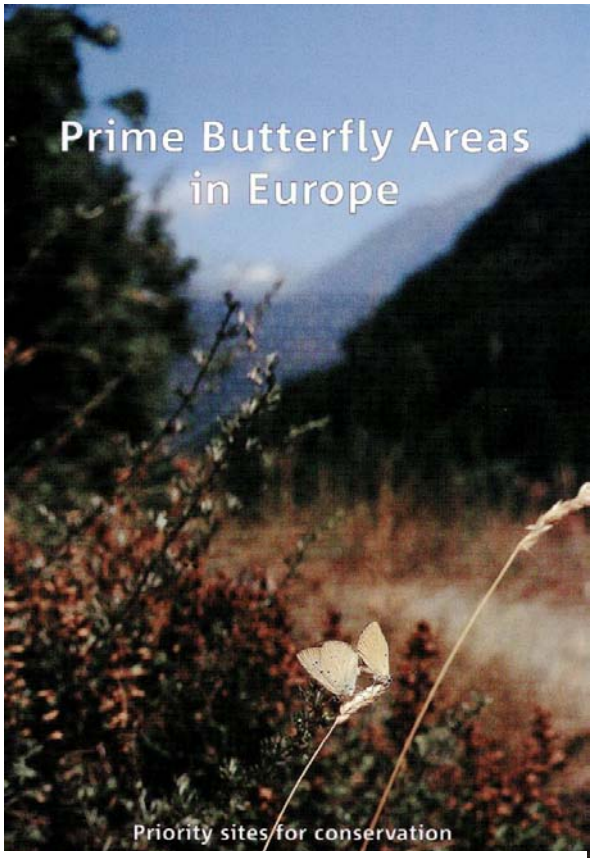
The* Red Data Book *provides information on distribution and trend on a country level for all 576 European butterfly species.

Dutch Butterfly Conservation (De Vlinderstichting) has built up a large network of national butterfly experts in all European countries. As a first result of this co-operation the *Red Data Book of European Butterflies* (Van Swaay & Warren, 1999) has been produced together with British Butterfly Conservation. As a follow-up to this report a book on *Prime Butterfly Areas in Europe* has been published in 2003. The network of national experts has also been consulted to produce this report, in which detailed information on trends of butterflies in Europe are collated.

In many European countries distribution data on butterflies is available which can be used to estimate population decline. Nevertheless corrections for research intensity haven been hardly made up to now. For this report many countries have made an attempt to make a first rough correction. It is possible to extend this and do these improved calculations in other countries as well in the near future.

Well designed monitoring schemes are the best way to follow changes in butterfly populations. At present there are monitoring schemes in five countries. It would be possible to extend these to other countries as well, especially if counts are restricted to Habitats Directive or threatened species and only have to be made a few times a year. This offers a promising chance for the future to monitor changes in the populations of these species closely.

Acknowledgements
This report never would have been possible without the help and support of Mireille de Heer (WCMC-UNEP/RIVM), Helmut Höttinger (Austria), Eddie John (UK), J. Kullberg (Finland), Zsolt Balint (Hungary), of Laszlo Rakosy (Romania), Rudi Verovnik (Slovenia), Nils Ryrholm (Sweden), Gilles Carron and Yves Gonseth (Switzerland) and Sergey Popov (Ukraine).



In* Prime Butterfly Areas in Europe *information on the 431 most important sites for butterflies in Europe are collated.

Chapter 2 / Method

Characteristic species for 21 combinations of bio-geographic region and habitat type are selected. Using available information on trends for these species, extended with knowledge of national or regional experts, trends for these areas will be determined.

Bio-geographic regions

The bio-geographic regions (figure 1) used are the official delineations used in the Habitats Directive (92/43/EEC) and for the EMERALD Network set up under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention).

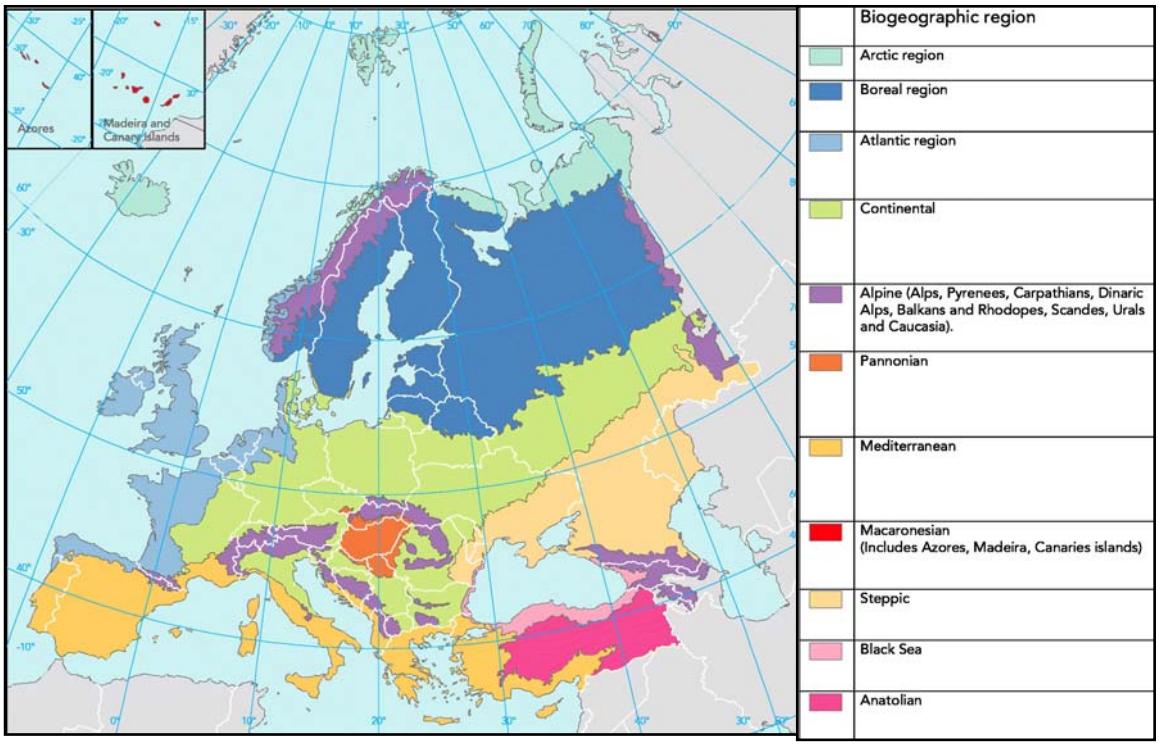


Figure 1: *Bio-geographic regions in Europe (source: EEA).*

Geographical definition

The geographical area covered in this report includes the whole of Europe, but excluding the Canary Islands, Madeira, the Azores, the Asian part of Turkey and the Caucasian Republics.

Habitat types

The following top level habitat types of the EUNIS Habitat classification are distinguished for the combinations (Davies & Moss, 2002):

Woodland and forest habitats and other wooded land
Habitats where the dominant vegetation is, or was until very recently, trees, typically single-stemmed, and with a canopy cover of at least 10%. Includes lines of trees, coppices, and very recently clear-felled areas with pre-existing ground cover, not yet re-stocked and with no succession to weedy vegetation. Trees are normally able to reach a height of 5m at maturity but this height may be lower at high latitudes or altitudes. Tall shrubs such as hazel (*Corylus*)and some willows (*Salix*) with a woodland-type structure are treated as woodland. Includes regularly tilled tree nurseries and tree-crop plantations. Excludes dwarf trees and scrub (under 50cm)such as occur in extreme alpine conditions and sparsely wooded grassland areas with canopy cover 5 -10%, including parkland.

Heathland, scrub and tundra habitats
Non-coastal habitats which are dry or only seasonally wet (with the water table at or above ground level for less than half of the year)with greater than 30%vegetation cover. The dominant vegetation is shrubs or dwarf shrubs. Includes regularly tilled shrub orchards, hedges (which may have occasional tall trees)and habitats characterised by the presence of permafrost. Also includes dwarf trees and scrub (under 50cm, such as occur in extreme alpine conditions).

Grassland and tall forb habitats
Non-coastal habitats which are dry or only seasonally wet (with the water table at or above ground level for less than half of the year) with greater than 30 %vegetation cover. The dominant vegetation is grasses and other non-woody vegetation (including moss-, lichen-, fern-and sedge-dominated communities). Includes sparsely wooded grassland areas with canopy cover of 5 -10%. Includes successional weedy communities and managed grasslands such as recreation fields and lawns. Does not include regularly tilled habitats dominated by cultivated herbaceous vegetation such as arable fields, but does include agricultural grasslands.

Inland unvegetated and sparsely vegetated habitats
Non-coastal habitats with less than 30% vegetation cover (other than where the vegetation is chasmophytic or on scree and or cliff) which are dry or only seasonally wet (with the water table at or above ground level for less than half of the year). Subterranean non-marine caves and passages including underground waters. Habitats characterised by the presence of permanent snow and surface ice other than marine ice bodies.

Mire, bog and fen habitats
Habitats which are saturated, with the water table at or above ground level for at least half of the year, dominated by herbaceous or ericoïd vegetation e. g. bogs, marshes. Includes waterlogged habitats where the groundwater is frozen. Excludes waterlogged habitats dominated by trees or large shrubs.
Note that habitats which intimately combine waterlogged habitats with pools of open water are considered as complexes.

Coastal habitats
Coastal habitats are those above spring high tide limit (or above mean water level in non-tidal waters)occupying coastal features and characterised by their proximity to the sea, including coastal dunes and wooded coastal dunes, beaches and cliffs. Includes free-draining supralittoral habitats adjacent to marine habitats which are normally only affected by spray or splash, strandlines characterised by terrestrial invertebrates and moist and wet coastal dune slacks. Excludes dune slack pools and rockpools.

Regularly or recently cultivated agricultural, horticultural and domestic habitats
Habitats maintained solely by frequent tilling or arising from recent abandonment of previously tilled ground such as arable land and gardens. Includes tilled ground subject to inundation. Excludes shrub orchards, tree nurseries and tree-crop plantations.

Combinations of bio-geographic region and habitat type

Sets of characteristic butterflies are selected for 21 bio-geographic regions*habitat types in Pan-Europe. The combinations are indicated in table 1 with a 1. Combinations indicated by a 0 were requested as well, but data availability was estimated to be too low.

Table 1: Combinations of bio-geographic region and habitat for which characteristic species will be selected (indicated with a 1).

Habitat	ALPINE	ARCTIC	ATLANTIC	BOREAL	CONTINENTAL	MEDITERRAENAN	PANNONIAN	STEPPIC	BLACK SEA	ANATOLIAN	MACARONESIAN
woodland and forest habitat and other wooded land	1		1	1	1	1					
heathland, scrub and tundra habitats		0	1			1					
grassland and tall forb habitats	1		1		1	1					
inland unvegetated or sparsely vegetated habitats	1	0									
mire, bog and fen habitats			1								
inland surface water habitats			0		0						
coastal habitats			1			1					
regularly or recently cultivated agricultural, horticultural and domestic habitats	1		1	1	1	1	1	0			
constructed, industrial and other artificial habitats											
marine habitats											

Species selection

Criteria for species selection are given in table 2. Also the estimated data availability was a selection criterion. Given the limited time available for this project we aimed for ten species per combination.

For each species ecological characteristics are determined on the position in the food chain, main food source, dispersion capacity, minimum viable population area, causes of changes and political relevance. This is done by expert judgement of the author, except for the causes of change and political relevance (Van Swaay & Warren, 1999).

Table 2: Criteria for species selection.

1.	CORE CRITERIUM: the set of species should be representative for the ecosystem as a whole. This means that the set should represent the variation in (e.g.) taxa, sub-habitats, abiotic conditions, trophic levels and guilds, spatial requirements (mobility, area requirements, dispersion), sensitivities to the major human pressures, common and rare species, threatened and non-threatened and endemism.
2.	The individual species should be indigenous to the ecosystem, i.e. alien invasive species should be avoided.
3.	Given the criteria above, the set should also contain a representative share of policy-relevant species (e.g. Red List species and species mentioned in EU Directives) and species which are appealing to the general public.

Data quality

For each record the data quality in 1970 and present was assigned according to table 3.

Table 3: Description and explanation of the data quality categories.

category	description	explanation
1	Reliable quantitative data	e.g. indices from well-designed monitoring schemes; total population counts
2	Limited quantitative data, some corrections and interpretations applied	e.g. indices from incomplete or biassed counts, adapted with some expert judgement; atlas data, corrected for research intensity
3	Limited quantitative data, no corrections and interpretations applied	as category 2, but without corrections and interpretations
4	Extensive expert judgement	general agreement on the estimated figures
5	Limited expert judgement	no general agreement (no effort made, or no concensus)
6	Combination of quantitative data and expert judgement	This class can be applied when no explicit data for 1970 and present are given, but rather a trend estimate at once, based on a mix of quantitative data and expert judgement

Collecting trend data

For each country data on the trend of the selected species was collected per combination of bio-geographic region and habitat. The data available in the European countries shows great differences from country to country. Nevertheless a few groups of data-sources can be distinguished:

- Distribution atlases: most of them show maps with the distribution per species on a grid square basis. In some cases separate tables or maps for two or more periods are available.
- Butterfly Monitoring Schemes: in a few countries Butterfly Monitoring Schemes are operational, but only in the United Kingdom it goes back long enough (to 1976) to be used in this project.
- Experts using a database with distribution data, local volunteers or other means to give an up-to-date estimate on the distribution around 1970 and at present.
- Data collected for the *Red Data Book of European Butterflies* (Van Swaay & Warren, 1999). In this book data is gathered per country on the present distribution and the trend in the last 25 years. If the results had to be assigned to several bio-geographic regions in the country, this could only be done for species whose distribution is more or less restricted to one of those regions. The trend data are used in an index form in which the 1970 situation is set to 100.

In many cases combinations of these data sources are used. The data source per country per bio-geographic region and per habitat are given in detail in table 5.

For species for which no data on combinations of region and habitat are available in a country, the national trend from Van Swaay & Warren (1999) is given in a separate column.

Table 5: For each combination of bio-geographic region and habitat per country the data source and the way it has been used is described in detail.

Country	Region	Data source	Data
Albania	Mediterranean Alpine	Van Swaay& Warren (1999)	Estimates of present distribution and trend in the last 25 years. Only for species more or less restricted to one of the regions an indication for the trend is given as an index in which the 1970 situation is put to 100.
Andorra		Van Swaay& Warren (1999)	An estimate of the present distribution is given, but there is no information about the trend in the last 25 years. As a consequence it is not possible to calculate back the 1970 situation.
Austria	Continental	Höttinger & Pennerstorfer (1999)	For threatened species maps of Niederösterreich are presented on a 35 km^2 grid squares. The Alpine region is excluded from this analysis.
Austria	Continental Alpine	Austrian Red Data Book (in prep.); database of Josef Pennerstorfer and Helmut Hoettinger.	Occupied squares (6x10-minutes) between 1960-1980 (repr. 1970) and 1981-2003 (repr. present)
Belarus		Van Swaay& Warren (1999)	One half of the county is in the Continental region, one half in the Boreal region. It is not possible to distinguish between the two region with the material available.
Belgium	Atlantic	Maes & Van Swaay (1997); Maes & Van Dyck (1999)	Appendix 1 of Maes & Van Swaay (1997) gives the relative presence in two periods for Flanders (which coincides with the Atlantic part of Belgium): 1901-1980, representing the situation around 1970, and 1981-1995, representing the present situation. For the coastal habitat the number of 5 km grid squares in the coastal areas was counted in the periods before and after 1990 (representing resp. 1970 and the present) in Maes & Van Dyck (1999).
Belgium	Continental	Goffart et al. (1992)	For five parts of Wallonie Goffart et al. (1992) present a semi-quantative indication of the abundance, ranging from 1 (=very localized) to 4 (=very common). This is done for two periods:

Country	Region	Data source	Data
			before 1980 (representing the 1970 situation) and after 1980 (representing the present situation). Four of the regions belong to the Continental Region. For those regions the abundance indications are summed.
Bosnia and Herzegovina		Van Swaay& Warren (1999)	An estimate of the present distribution is given, but information about the trend in the last 25 years is only available for a few species. Next to that the country is in three bio-geographic regions, whereas the information is only available at country level. As a consequence it is not possible to calculate back the 1970 situation.
Bulgaria	Continental	Abadjiev (2001) and Van Swaay & Warren (1999)	Abadjiev (2001) gives distribution maps on a 10 km square basis. Excluding the Alpine region this indicates the historical presence (around 1970). With trend data from Van Swaay & Warren (1999) the present number of squares is estimated.
Bulgaria	Alpine	Abadjiev (2001) and Van Swaay & Warren (1999)	Abadjiev (2001) gives distribution maps on a 10 km square basis. Using the Alpine region this indicates the historical presence (around 1970). With trend data from Van Swaay & Warren (1999) the present number of squares is estimated.
Croatia		Van Swaay& Warren (1999)	An estimate of the present distribution is given, but information about the trend in the last 25 years is only available for a few species. Next to that the country is in three bio-geographic regions, whereas the information is only available at country level. As a consequence it is not possible to calculate back the 1970 situation.
Cyprus	Mediterranean	Makris (2003)	The book on butterflies of Cyprus presents maps with a resolution of 10 km squares. Next to that Eddie John, who has produced the maps and database, used his best professional judgement to estimate past and present distribution of all species to modify numbers.
Czech Republic	Continental	Beneš (2002)	The Czech Butterfly distribution atlas uses a grid cells that are 10 minutes of eastern longitude by 6 minutes of northern latitude, corresponding to an approximate area of 11. 1 x 12. 0 km. The number of grid cells in the period 1950-1980 represent the 1970 situation, the number of grid cells between 1995 and 2001 the present.
Denmark	Atlantic Continental	Stoltze (1996)	Maps in which the area of distribution before and after 1990 (representing resp. 1970 en the present) is indicated with a colour. For common species the percentage of the part of the country occupied in both periods is estimated. For rare species the number of meta-population areas can be distinguished and is used for the comparison. For the coastal habitat the percentage of the coastal area occupied by the species in both periods is estimated.
Estonia	Boreal	Van Swaay& Warren (1999)	Estimates of present distribution and trend in the last 25 years. Using this information the 1970 situation is calculated back using table 4.
Former Yugoslav Republic of Yugoslavia		Van Swaay& Warren (1999)	An estimate of the present distribution is given, but information about the trend in the last 25 years is only available for a few species. Next to that the country is in three bio-geographic regions, whereas the information is only available at country level. As a consequence it is not possible to calculate back the 1970 situation.
Finland		J. Kullberg	Personal best knowledge of J. Kullberg and the data for the Atlas of Finnish Macrolepidoptera were used to estimate the occurrence percentage of 10 km grid squares for each species.
France	Mediterranean Alpine	Van Swaay& Warren (1999) and Lafranchis (2000)	Estimates of present distribution and trend in the last 25 years. Only for species more or less restricted to one of the regions according to Lafranchis (2000) an indication for the trend is given as an index in which the 1970 situation is put to 100.
France	Atlantic Continental	Van Swaay& Warren (1999)	The data cannot be used since almost all species occur both or even all French regions, with the exception of *Maculinea alcon*.
Germany	Atlantic	Kolligs (2003)	Maps with distribution data of several periods on 10 km squares in Schleswig-Holstein. The areas ('Naturraum') Marsch, Niedere Geest and Hohe Geest are considered to be in the Atlantic Region, the Östliches Hügelland in the Continental Region. The period 1951-1984 represents the situation around 1970, the period 1985-2001 the present situation.
Germany	Atlantic	Niedersächsisches	'Minutenfelder' (squares of 1' latitude and 1' longitude) in

Country	Region	Data source	Data
		Landesamt für Ökologie - Tierartenschutz (2001)	Niedersachsen (1946-1980 repr. 1970 and 1996-2000 repr. present)
Germany	Continental	Ebert (1991)	Baden-Württemberg: estimated number of grid squares of appr 135 km2 before vs after 1970.
Germany	Continental	Anthes et al. (2003)	Only for Euphydryas aurinia a detailed analysis of the distribution is made, among them for the periods 1950-1980 (representing the situation around 1970) and after 1996 (representing the present).
Greece	Mediterranean	Pamperis (1997) & Van Swaay & Warren (1999)	For each species Pamperis (1997) gives the number of localities. Using the trend from the Red Data Book the number of localities around 1970 is calculated back.
Hungary	Pannonian	Zsolt Balint	Zsolt Balint used his personal experience, together with information from the database of the Hungarian Natural History Museum.
Iceland			Iceland has no native butterflies.
Ireland	Atlantic	Asher et al. (2001)	The number of 10 km grid squares in the periods 1970-1982 (representing the situation around 1970) and 1995-1999 (representing the present) is given. No form of correction for differences in recording efforts is made.
Italy	Alpine Continental Mediterranean	Van Swaay& Warren (1999)	Estimates of present distribution and trend in the last 25 years. Only for species more or less restricted to one of the regions an indication for the trend is given as an index in which the 1970 situation is put to 100.
Latvia	Boreal	Van Swaay& Warren (1999)	Estimates of trend in the last 25 years.
Lithuania	Boreal Continental		Half of Lithuania lies in the boreal region, half in the continental region. This makes it impossible to distinguish the results from the Red Data Book between the two regions
Liechtenstein	Alpine		No data on trend available.
Luxembourg	Continental	Van Swaay& Warren (1999)	Estimates of present distribution and trend in the last 25 years. Using this information the 1970 situation is calculated back using table 4.
Malta	Mediterranean	Van Swaay& Warren (1999)	Estimates of present distribution and trend in the last 25 years. Using this information the 1970 situation is calculated back using table 4.
Moldova	Continental	Van Swaay& Warren (1999)	Estimates of present distribution and trend in the last 25 years. Using this information the 1970 situation is calculated back using table 4.
Netherlands	Atlantic	New data, adjusted method of Maes & Van Swaay (1997)	For the period 1950-2000 the relative presence is calculated for each year using Maes & Van Swaay (1997). A trendline is calculated through the data, and using this trendline the 1970 and 2000 situation is calculated. If the average relative presence from 1995-2000 differed strongly from the trend, then this average is used.
Norway	Alpine Atlantic Boreal Continental	Van Swaay& Warren (1999)	An estimate of the present distribution is given, but information about the trend in the last 25 years is only available for a few species. Next to that the country is in four bio-geographic regions, whereas the information is only available at country level. As a consequence it is not possible to calculate back the 1970 situation.
Poland	Continental	Buszko (1997) and Van Swaay& Warren (1999)	For some species the number of occupied 10 km UTM grid squares can be counted from Buszko (1997). If not, data from the Red Data Book is used. Using the trend from the Red Data Book an estimation of the number of UTM squares around 1970 is calculated back.
Portugal	Mediterranean Atlantic	Van Swaay& Warren (1999)	An estimate of the present distribution is given, but information about the trend in the last 25 years is not available. As a consequence it is not possible to calculate back the 1970 situation.
Romania		Database of L. Rakosy	For each species the percentage of investigated 10 km squares per combination is calculated. For the 1970 situation all data until 1970 is used, for the present situation the data for the period 1970-present.
Russia		Van Swaay&	An estimate of the present distribution is given, but information

Country	Region	Data source	Data
		Warren (1999)	about the trend in the last 25 years is only available for a few species. Next to that the country is in many bio-geographic regions, whereas the information is only available at country level. As a consequence it is not possible to calculate back the 1970 situation.
Slovakia		Kulfan & Kulfan (1990)	Estimates of present distribution and trend in the last 25 years. Only for species more or less restricted to one of the regions according to Kulfan & Kulfan (1990) an indication for the trend is given as an index in which the 1970 situation is put to 100.
Slovenia		Slovenian Rhopalocera database and expert judgement of Rudi Verovnik	For both periods an estimation of the number of UTM squares (100 km2) is made, based on the database and expert judgement of Rudi Verovnik.
Spain	Mediterranean Alpine Atlantic	Van Swaay& Warren (1999)	Estimates of present distribution and trend in the last 25 years. Only for species more or less restricted to one of the regions an indication for the trend is given as an index in which the 1970 situation is put to 100.
Sweden	Boreal Alpine	N. Ryrholm	An estimation of the number of squares in both periods is given, based on the database of Swedish butterflies, managed by N. Ryrholm.
Switzerland	Alpine	Swiss Centre for Faunal Cartography, Neuchâtel; interpretation by Gilles Carron and Yves Gonseth	The Swiss Centre for Faunal Cartography in Neuchâtel has a database with butterfly records. For each species they calculated the occurrence at investigated 5 km squares (with at least one butterfly observation) pre 1971 (representing the 1970 situation) and post 1989 (representing the present situation)
Ukraine	Continental	S. Popov	From the database of SW Ukrainian butterflies from S. Popov, the percentage of investigated 1 km squares before 1990 (representing 1970) and after 1990 (representing the present) is given.
United Kingdom	Atlantic	Asher et al. (2001)	The number of 10 km grid squares in the periods 1970-1982 (representing the situation around 1970) and 1995-1999 (representing the present) is given. No form of correction for differences in recording efforts is made.
United Kingdom	Atlantic	Greatorex-Davies & Roy (2002)	The Butterfly Monitoring Scheme in the UK produces indexes. The index for 1976 is put to 100 (representing the situation around 1970), the index for 2000 is presented. The indexes are based on transect counts and therefore present a more reliable view on changes than the one base on 10 km grid squares.
Yugoslavia	Continental	Jakšić (2003)	For a selected group of species 10 km grid squares with the distribution in the Serbian part of Yugoslavia are presented, together with a trend indication.
Yugoslavia	Pannonian	Jakšić (2003)	For a selected group of species 10 km grid squares with the distribution in the Serbian part of Yugoslavia are presented, together with a trend indication.

Chapter 3 / Results

Species selection

After feeding on* Gentiana pneumonanthe *for a few weeks, the caterpillars of* Maculinea alcon *leave the plant and are taken to an ants nest, where they live on as carnivores.
Photo: Inge van Halder, De Vlinderstichting.

The species selection is given in appendix 1. In total 192 species were selected. The main ecological characteristics of the species are summarized in the following pages.

Position in the food chain

All butterflies are herbivore consumers. The only exceptions are the species of the genus *Maculinea*. These butterflies of the family *Lycaenidae* (Blues) spend their first weeks as herbivores in a food plant, but after this they leave the plant and are adopted by workers of a specific ant nest. After this they live a carnivorous life in the ant nest.

Table 6: Summary of dispersion capacity of the selected species per bio-geographic region and habitat. For each combination the number of species is given.

Region	Habitat	0-3 km	3-15 km	>15 km	unknown
Alpine		**2**	**3**	**9**	**21**
	grassland	1	1		10
	tillage			8	
	unvegetated		1		6
	woodland	1	1	1	5
Atlantic		**14**	**12**	**17**	**8**
	bog		1		4
	coastal	3	2	4	1
	grassland	3	6	1	
	heathland	3	1	1	2
	tillage			8	
	woodland	5	2	3	1
Boreal		**2**	**2**	**8**	**5**
	tillage	1		6	
	woodland	1	2	2	5
Continental		**12**	**4**	**10**	**9**
	grassland	7	4		2
	tillage			8	1
	woodland	5		2	6
Mediterranean		**4**	**1**	**15**	**26**
	coastal			5	3
	grassland	3	1		6
	heathland	1			8
	tillage			7	3
	woodland			3	6
Pannonian				**8**	
	tillage			8	
Total		**34**	**22**	**67**	**69**

Vanessa atalanta ***is a very mobile butterfly, colonizing Europe each year from its Mediterranean winter strongholds.***
Photo: H. Joziasse.

Dispersion

Table 6 gives a summary of the dispersion capacity of the selected butterfly species. For many species there is no reliable information available (indicated in the table as unknown). Nevertheless it is likely that most of these species will show a low dispersion capacity. Butterflies characteristic of tillage are very mobile. This high mobility is essential for them, since their habitat is only temporary. Every year new patches have to be colonized.

Movements

Table 7 shows that most selected butterflies are sedentary. Only few species, most of them with tillage as most important habitat, show only migratory behaviour.

Table7: Summary of movements of the selected species per bio-geographic region and habitat. For each combination the number of species is given.

Region	Habitat	sedentary	migratory	variable
Alpine		**26**	**2**	**7**
	grassland	12		
	tillage		2	6
	unvegetated	7		
	woodland	7		1
Atlantic		**39**	**1**	**11**
	bog	5		
	coastal	9		1
	grassland	10		
	heathland	7		
	tillage		1	7
	woodland	8		3
Boreal		**9**	**1**	**7**
	tillage	1	1	5
	woodland	8		2
Continental		**25**	**1**	**9**
	grassland	13		
	tillage	1	1	7
	woodland	11		2
Mediterranean		**32**	**3**	**11**
	coastal	3	1	4
	grassland	10		
	heathland	9		
	tillage	3	2	5
	woodland	7		2
Pannonian			**1**	**7**
	tillage		1	7
Total		**131**	**9**	**52**

Cupido minimus ***can survive for a long time in small populations. Photo: H. Kievit, De Vlinderstichting.***

Minimum Viable Population Area

For a viable population size each species needs a minimum area of suitable habitat. For species in Northwestern Europe Bink (1992) gives an indication of this area. For other species the authors best professional judgement is used wherever possible.

Table 8 shows a summary of the results. Most butterflies only need a small area to maintain a viable population size.

Table 8: Summary of the minimal viable population area of the selected species per bio-geographic region and habitat. For each combination the number of species is given.

Region	Habitat	0-100 ha	100-500 ha	500-2000 ha	> 2000 ha	unknown
Alpine		**25**	**4**	**2**	**3**	**1**
	grassland	12				
	tillage		3	2	3	
	unvegetated	6				1
	woodland	7	1			
Atlantic		**38**	**6**	**2**	**5**	
	bog	4	1			
	coastal	9	1			
	grassland	10				
	heathland	7				
	tillage		3	1	4	
	woodland	8	1	1	1	
Boreal		**8**	**3**	**2**	**4**	
	tillage	1	2	1	3	
	woodland	7	1	1	1	
Continental		**24**	**7**	**2**	**2**	
	grassland	13				
	tillage	1	4	2	2	
	woodland	10	3			
Mediterranean		**29**	**6**	**2**	**6**	**3**
	coastal	1	2	1	2	2
	grassland	10				
	heathland	8				1
	tillage	3	3		4	
	woodland	7	1	1		
Pannonian			**4**	**2**	**2**	
	tillage		4	2	2	
Total		**124**	**30**	**12**	**22**	**4**

Causes of change

For each species up to five of the most important causes of changes are marked. For species threatened in Europe the results of the Red Data Book could be used (Van Swaay & Warren, 1999).

Some of the causes are hard to separate, e.g. the lack of or wrong nature management and Natural succession: lack of management leads to natural succession (e.g. heathlands and grasslands transform to woodland without management)

Table 9 shows a summary of the results.

Table 9: Summary of the causes of change of the selected species per bio-geographic region and habitat. For each combination the number of species is given.

Region	Habitat	habitat loss	land use change	climate change	fragmentation	eutrofication	acidification	toxification	lowering groundwater	invasive species	disturbance	exploitation	Lack of or wrong nature management	natural succession	factors abroad	no cause/not relevant	unknown3
Alpine		**7**	**5**	**2**	**4**			**1**	**1**					**1**		**11**	**17**
	grassland	2	2		1											3	7
	tillage															7	1
	unvegetated	2	1	1	1			1									5
	woodland	3	2	1	2				1					1		1	4
Atlantic		**19**	**6**	**2**	**15**	**15**	**2**		**10**				**21**	**11**		**19**	**1**
	bog	5		1	4	3			4				3				
	coastal	1	1		1	4							5	4		2	1
	grassland	3	2		4	4	1		2				3	1		5	
	heathland	4			3	4	1		2				4	2		2	
	tillage			1												7	
	woodland	6	3		3				2				6	4		3	
Boreal		**1**	**1**	**3**	**1**			**1**								**7**	**7**
	tillage			1												6	
	woodland	1	1	2	1			1								1	7
Continental		**9**	**4**	**1**	**8**	**1**		**5**	**7**				**6**	**4**		**17**	**6**
	grassland	5	2		5	1		3	3				3	2		5	2
	tillage															9	
	woodland	4	2	1	3			2	4				3	2		3	4
Mediterranean		**5**	**2**	**2**	**4**			**4**					**1**	**2**		**22**	**17**
	coastal															5	3
	grassland	3	2		2			2					1	1		4	2
	heathland	1		2	2			2						1		2	5
	tillage															7	3
	woodland	1														4	4
Pannonian																**8**	
	tillage															8	
Total		**41**	**18**	**10**	**32**	**16**	**2**	**11**	**18**				**28**	**18**		**84**	**48**

Parnassius apollo ***is listed in the Habitats Directive and considered threatened in the Red Data Book of European butterflies and the IUCN Red List.***
Photo: K. Veling, De Vlinderstichting.

Political relevance

For each species the following items are marked (table 10):

- Habitat Directive: the species is listed on appendix 2 and/or 4 of the Habitats Directive
- IUCN Red List: the species is listed.
- Red Data Book: the threat status of the species in the whole of Europe is given
- Red Data Book: the SPEC (Species of European Conservation Concern) status is given (Van Swaay & Warren, 1999)
- Endemic species: marked if the species is restricted to Europe.

Table 10: Summary of the political relevance of the selected species per bio-geographic region and habitat. For each combination the number of species is given.

Region	Habitat	Habitat Directive (n=23)	IUCN Red List (n=22)	Red Data Book (threat status) (n=71)	Red Data Book (SPEC status) (n=274)	endemic species (n=189)
Alpine		**4**	**6**	**8**	**16**	**9**
	grassland	1	3	4	8	4
	tillage					
	unvegetated	3	1	1	6	5
	woodland		2	3	2	
Atlantic		**2**	**3**	**3**	**7**	**2**
	bog	1	1	1	1	
	coastal				1	1
	grassland	1	1	1	3	
	heathland		1	1	2	1
	tillage					
	woodland					
Boreal		**2**	**2**	**2**	**2**	
	tillage					
	woodland	2	2	2	2	
Continental		**5**	**7**	**8**	**9**	
	grassland	2	4	5	6	
	tillage					
	woodland	3	3	3	3	
Mediterranean		**4**	**5**	**8**	**12**	**2**
	coastal			1		
	grassland	1	3	3	3	
	heathland	2	2	3	6	1
	tillage	1		1		
	woodland				3	1
Pannonian						
	tillage					
Total		**17**	**23**	**29**	**46**	**13**

Population trend data

All population trend data is gathered in a database containing 2733 records. 1172 records contain the trend of a species in the combination of region and habitat in a country. In another 318 cases the species was not present in that combination. This is because not all butterflies occur in all countries in which the combination of region and habitat occurs. Although the species selection contains common and widespread species, also species with a restricted range or with highly specialized habitat requirements are included (e.g. some characteristic butterflies of the Alps are not found in the Pyrenees).
For species for which no data on combinations of region and habitat are available in a country, the national trend from Van Swaay & Warren (1999) is given in a separate column (1243 records). Table 12 shows the number of species for each combination of bio-geographic region and habitat per country of which trend data were gathered.

Data from EU / non-EU countries

Within the scope of this project data could be obtained for 30 countries: twenty-two of them belonging to the European Union or accession states and eight non-European Union countries: Albania, Bulgaria, Moldova, Romania, Slovakia, Switzerland, Ukraine (SW part) and Yugoslavia.

Quality of the data

Table 11 gives an overview of the quality of the data according to table 3. For each data quality class the number of countries per combination of bio-geographic region and habitat is presented. In some cases a country can have different quality classes for different species (e.g. the distribution of rare species can be known in detail, whereas information on common species can be bad). For most countries trend data is available from distribution atlases (data quality 3), from a combination of quantitative data and expert judgement (data quality 6) or from atlas data, corrected for research intensity (data quality 2). Data quality 1 (data from well-designed monitoring schemes) is only available on a large scale in the United Kingdom since 1976. In other countries butterfly monitoring schemes started later, so they could not be used in this assessment.

The trends of butterflies on Atlantic heathlands are well known. Photo: Kars Veling, De Vlinderstichting.

Table 11: For each combination of bio-geographic region and habitat the number of countries with the specified data quality (table 3) at present is given.

		Data quality						
Region	**Habitat**	**1**	**2**	**3**	**4**	**5**	**6**	**Total**
Alpine	grassland		3	4			5	**12**
Alpine	tillage		3	4			5	**12**
Alpine	unvegetated		3	4			5	**12**
Alpine	woodland		3	4			5	**12**
Atlantic	bog		2	5			3	**10**
Atlantic	coastal	1	2	6			3	**12**
Atlantic	grassland	1	2	5			3	**11**
Atlantic	heathland	2	2	5	1		3	**13**
Atlantic	tillage	1	2	6			3	**12**
Atlantic	woodland	1	2	5			3	**11**
Boreal	tillage		1	1			2	**4**
Boreal	woodland		1	1			2	**4**
Continental	grassland	1	2	12			5	**20**
Continental	tillage		1	10			4	**15**
Continental	woodland		1	12			4	**17**
Mediterranean	coastal			1		1	5	**7**
Mediterranean	grassland			1		1	5	**7**
Mediterranean	heathland			1		1	5	**7**
Mediterranean	tillage			1		1	5	**7**
Mediterranean	woodland			1		1	5	**7**
Pannonian	tillage		2	1			2	**5**
Total		**7**	**32**	**90**	**1**	**5**	**82**	**217**

Example of tillaged land in Hungary (Pannonian region): most butterflies are restricted to road verges.
Photo: Kars Veling, De Vlinderstichting.

Table 12: Number of species per combination of bio-geographic region, habitat and country. Species which are 'not present', or for whom the trend is unknown, are excluded.

Region	Alpine				Atlantic						Boreal		Continental			Mediterranean					Pan.
Habitat	grassland	tillage	unvegetated	woodland	bog	coastal	grassland	heathland	tillage	woodland	tillage	woodland	grassland	tillage	woodland	coastal	grassland	heathland	tillage	woodland	tillage
Albania	3	1	2	2												3	5	2	2	7	
Austria	12	8	6	8									13	9	13						
Austria - Niederösterreich													4		2						
Belgium					1	7	10	6	8	11			10	7	12						
Bulgaria	4	7	2	6									10	8	10						
Cyprus																6	3		7	5	
Czech Republic													13	9	13						
Denmark					4	10	9	6	7	6			7	8	7						
Estonia											7	10									
Finland											7	10									
France	6		5	1				1								1	1	3	3	5	
Germany													3		2						
Germany - Baden-Württemberg													12	9	12						
Germany - Niedersachsen					4	7	10	6	8	11											
Germany - Schleswig-Holstein					3	6	10	6	8	10			8	5	8						
Greece																8	9	4	7	8	
Hungary																					8
Ireland					1	2	6	3	5	5											
Italy				1											3				1		
Latvia											7	10									
Luxemburg													11	7	11						
Malta																5	2		5	2	
Moldova													5	8	7						
Netherlands					4	9	9	6	8	9											
Poland													13	9	13						
Portugal								1													
Romania	5	8	1	6									13	8	12						8
Slovakia	1	1	1																		3
Slovenia	7	7	4	7									13	9	12						
Spain	5	6	2	1												1	8	6	5	8	
Sweden	4	3		2							7	10									
Switzerland	12	7	7	8																	
Ukraine	3	2		5																	7
United Kingdom					1	3	10	3	7	11											
Yugoslavia													2	1	5						1

Chapter 4 / Discussion

Species selection

Euphydryas aurinia ***is mentioned on appendix 2 of the Habitats Directive, and is considered to be threatened in Europe according to the Red Data Book. Photo: H. Kievit.***

The species selection criteria (table 2) resulted in a representative selection of butterflies:

- with a high and low dispersal capacity;
- being sedentary and migratory;
- with a small and large minimum viable population area;
- of political relevance (Habitats Directive, IUCN Red List, threatened according to the Red Data Book of European butterflies; endemicity) and common, widely distributed species.

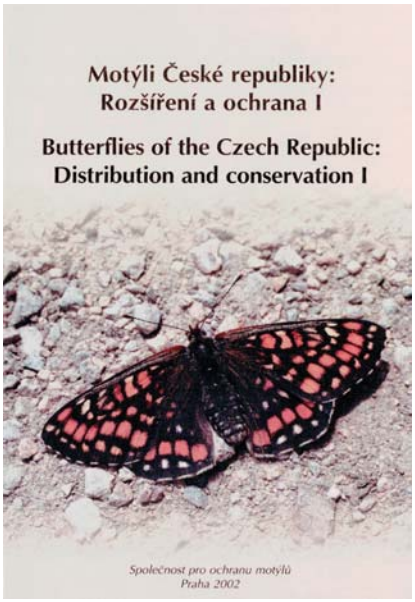
Almost all species are characteristic of a habitat or even combination of region and habitat. The only exceptions are a few common species occurring at more than one habitat type.

In some cases it was difficult to find representative species for large parts of the region, since many species are restricted to only a part of the region. This was especially the case in the Mediterranean region (many species are either Western-Mediterranean or Eastern-Mediterranean) and the Alpine region (many are restricted to either the Alps or the Pyrenees). For a more representative overview the number of species in the selection should be enlarged, especially for the Mediterranean and Alpine region (both also the species-richest parts of Europe).

Population trend data

EU / Non-EU countries

From eight non EU / non-accession states data could be used (from the Red Data Book) or were collected: Albania, Bulgaria, Moldova, Romania, Slovakia, Switzerland, Ukraine (SW part) and Yugoslavia.



In some countries good quality distribution data has been published in an atlas (e.g. Czech Republic).

Quality of the data

Data from butterfly monitoring schemes (data quality 1 in table 3) is available from five countries, but only in the United Kingdom the BMS exists long enough to be used for this analysis.

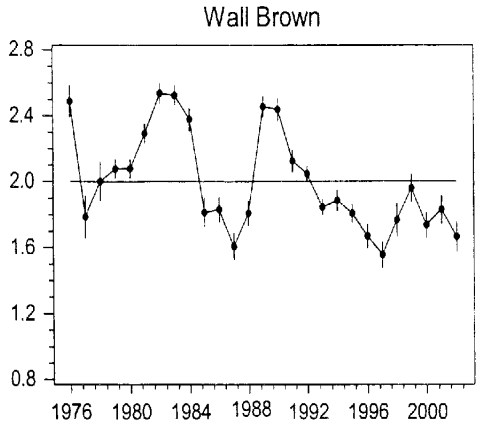
For the other countries only distribution data were available. In most cases these data were not corrected for differences in research intensity (data quality 3 in table 3). Mostly a relatively long, poorly investigated period around 1970 is compared with a relatively short, much better investigated period for the present.

In a part of the cases a correction could be made for these differences, for example by using the method described by Maes & Van Swaay (1997) or with a much simpler correction by using the number of investigated squares.

In some countries only data from the Red Data Book of European Butterflies is available, in which information on distribution and trend is available in classes (data quality 6 in table 3).

Quality of population change estimates

Main objective of this report is to give an overview of the present knowledge on the trends of butterfly species in twenty-one combinations of bio-geographical region and habitat in the last thirty years. The data available differs enormously from country to country, from habitat to habitat and from region to region.



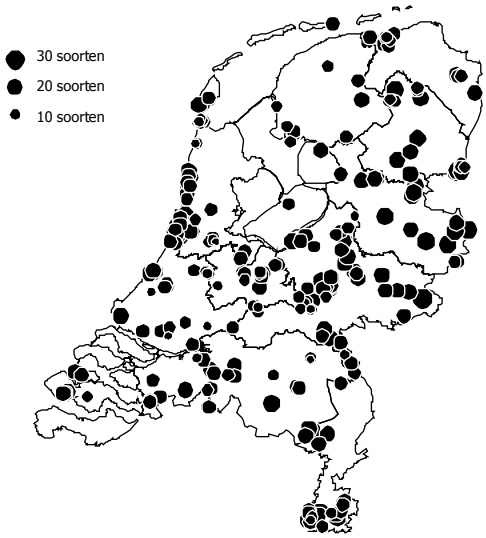
The results of Butterfly Monitoring Schemes provide the best estimation of changes in population size. Here as an example the log collated indices of* Lasiommata megera *in the UK(Greatorex-Davies & Roy, 2003). In the Atlantic region this is a typical species of grasslands.

- Results from butterfly monitoring schemes are based on line transects. Thus they give information on changes in the size of the population, both in actual numbers and in distribution. In an ideal monitoring scheme all transects are randomly selected (stratified) from the species distribution areas and all observers participate from the beginning, count every week, are equally experienced and none quit before the end. The Dutch Butterfly Monitoring Scheme is the only one that tries to correct for the bias from unequal sampling. This correction is based on separate trends for each species per combination of physical geographical region and habitat (Van Swaay *et al.*, 2002). The British Butterfly Monitoring Scheme, which is used in this report, does not perform such a correction. Nevertheless these results give the best estimation of changes in population size possible at this moment.
- Changes in distribution area is used for most of the other countries. It is generally assumed that a considerable change in distribution area will be caused by and is correlated with a change in population size (e.g. Maes & Van Swaay, 1997). There are, however, a few possible biases in comparing the distribution area from two periods:
    - The two periods can be of a different length. In many Red Lists a relatively long period (e.g. 'until 1990') is compared with a relatively short recent period (e.g. 'after 1990'). ***In this report we have tried to make both periods of equal length.*** This was not always possible. In that case the length of the periods is indicated in table 5.
    - In most cases distribution data is collected on a grid square basis. These data must be interpreted with caution, and they generally give very conservative estimates of decline. Declines may be taking place within grid squares, but not be detected. Greater declines are detected with a 2 km grid than with a 10 km grid, and even the 2 km grid must hide steep declines (Thomas & Abery, 1995). ***For this report this means that the declines in populations size will be larger than indicated by the changes in the number of grid squares.***
    - The number of records and the number of investigated squares show large differences in both periods. In all cases there are much less records/investigated squares for the period around 1970 than for the present situation. A species that has remained stable will show an increase in the number of records/investigated squares. This can lead to a major bias if no correction is made. These records are marked with quality 3 (see table 3). This means that the true change in population size is far more negative than indicated by these results: a small decrease in the number of records/investigated squares will mean a major decline in real population size, and a small increase in number of records/investigated squares might be a decrease in actual population size. ***For this report this means that the declines in populations size will be larger than indicated by the changes in the number of grid squares.*** More reliable is a correction for investigations intensity. This can be done in several

ways (e.g. Maes & Van Swaay, 1997). ***In this report these corrected data are used whenever possible.*** They are marked with quality 2 (see table 3).

- On the other hand expansion in range (usually indicating increasing total population size) is detected rapidly by distribution data. New observations outside a species' range have a high chance of getting reported to national distribution databases.

Summarizing: the use of distribution data on a grid square basis generally leads to an underestimation of decline in population size. Expansion is quickly detected.



In the Netherlands 300 transects in the Dutch Butterfly Monitoring Scheme are scattered over the country and provide exact data on the trend of almost all butterflies (Van Swaay* et al.*, 2003).

Possible future improvements

Monitoring data

At present five butterfly monitoring schemes, all using more or less the same method based on line-transects (Pollard & Yates, 1993), are active:

- United Kingdom: more than 120 transects in the Butterfly Monitoring Scheme (running since 1976) (Graetorex-Davies & Roy, 2003). At present data from more than 550 other sites is gathered by Butterfly Conservation (Brereton & Stewart, 2003).
- The Netherlands: about 300 transects a year for all species since 1990; for rare and threatened species there are 50-100 'single-species transects', where only one species is counted (Van Swaay *et al.*, 2003).
- Flanders (N-Belgium): 10-20 transects since 1991.
- Finland: since 1999, 37 transects at present, most of them in southern Finland (Kuussaari, 2002).
- Catalonia (NE Spain): since 1994, more than 40 transects at present (Stefanescu, 2002).

Next to these butterflies are monitored in a slightly different way in SW Ukraine (Popov, 2003).

The coming years these butterfly monitoring schemes will provide more and more detailed information on the trends of butterflies in these countries. Combining these data will result in a detailed knowledge of the trends of these species, especially in Western Europe.

Distribution atlases

In many countries the production of a distribution atlas is the first step in combining the knowledge on butterflies. Atlases have been produced for many countries, and they have been used for this study. It is expected that more atlases will be published in the near future.

The only more or less complete atlas on the distribution of butterflies in Europe (Kudrna, 2002), has the disadvantage of being based on reference localities rather than on exact locations. Also the presentation of the maps (not on the more commonly used UTM grid, but on a 30' x 60' grid) makes it hard to use these maps for other purposes.

Databases with distribution data

As a result of the production of a national or regional distribution atlas, often a database with historical and recent distribution data is created. Apart from 'simple' maps, such a database offers the possibility to do a more detailed trend analysis and to correct for changes in research intensity. In spite of good results of such an analysis in The Netherlands and Flanders (Maes & Van Swaay, 1997), the method is not currently used in many countries, mostly because of lack of time or facilities. ***A project in which these databases would be analyzed in a similar way, could generate detailed and high quality results in many European countries in a relatively short amount of time and to low costs.***

Monitoring butterflies in Europe

Butterfly Monitoring Schemes

As mentioned above Butterfly Monitoring Schemes are active in five countries, all bases on line transects. These transects offer a way of measuring the number and variety of butterflies present at a site from year to year, and require a weekly recording, throughout the main period in which butterflies fly. Most of the field work in these transects is done by volunteers and the wardens or managers of nature reserves.
These monitoring schemes have the advantage of being a highly cost effective way of collecting detailed data of high quality.
A disadvantage is that a random designed, stratified sampling is often not possible, since volunteers want to chose their own site for monitoring. In The Netherlands the bias caused by stratification problems is corrected for (Van Swaay *et al.,* 2002).

Monitoring of butterflies as part of biodiversity monitoring

In some countries counting butterflies is part of a larger biodiversity monitoring scheme, like in Hungary or Switzerland. Although this method does give information on the occurrence of the species and the diversity, it does not give useful information on the trend of the species. Main reason for this is the short flight period of most butterflies (three to five weeks). For a correct estimation of the number of butterflies, at least three counts are needed. Most biodiversity monitoring schemes have a lower frequency of counts.

Monitoring threatened or policy relevant species

Even in densely populated countries with many volunteers, like The Netherlands and the United Kingdom, there are sometimes not enough transect to make reliable index and trend calculations for some rare and threatened species. Often these species occur in remote, well protected nature reserves, far away from towns and villages with volunteers.
To be able to collect good data on these species, it is possible to count single-species transects during the flight period only. With only three to five visits, enough data is collected to be used for index and trend calculation.
This method could easily be extended to other countries in Europe, making it possible for example to get exact counts, indexes and trends for all species on the appendices of the Habitats Directive (30 taxa, see appendix 2) for a price of only 1.5 – 2 million Euro a year.

Coenonympha hero ***is a highly threatened, declining species in Europe, listed on appendix 4 of the Habitats Directive. The trend of this species could be monitored Europe wide. Photo: M. Maier.***

Potential natural baseline

This report presents the efforts of coming to an estimate of the trend of butterflies in Europe since 1970. However there might be large differences between the situation of 1970 and the potential natural baseline. In some southern and eastern European countries the 1970 situation will not show large differences with the potential natural baseline, but in Western Europe the differences will be large. An attempt to make population estimates for The Netherlands has been made. Making such an attempt in other countries will be difficult for a number of reasons:

- A database with old records and literature is needed to get a good view on the past situation.
- If a country is in more than one bio-geographic region, the analysis has to be done for all regions.
- Good habitat descriptions of the period around the potential natural baseline should be available.
- Inevitably the assumptions that are made in estimating the population estimate for the potential natural baseline will be based partly on the 'best professional judgement' of an expert. In some countries there is a strong opposition against such methods, which makes it difficult to find experts that are willing to take such a risk.

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Appendix 1 / Selected species per combination of region and habitat

Region	Habitat	Species
Alpine	grassland	*Boloria napaea*
Alpine	grassland	*Boloria pales*
Alpine	grassland	*Boloria titania*
Alpine	grassland	*Coenonympha gardetta*
Alpine	grassland	*Colias phicomone*
Alpine	grassland	*Erebia medusa*
Alpine	grassland	*Maculinea arion*
Alpine	grassland	*Melitaea varia*
Alpine	grassland	*Plebeius glandon*
Alpine	grassland	*Plebeius orbitulus*
Alpine	grassland	*Polyommatus eros*
Alpine	grassland	*Polyommatus icarus*
Alpine	tillage	*Aglais urticae*
Alpine	tillage	*Colias hyale*
Alpine	tillage	*Inachis io*
Alpine	tillage	*Issoria lathonia*
Alpine	tillage	*Papilio machaon*
Alpine	tillage	*Pieris brassicae*
Alpine	tillage	*Pieris rapae*
Alpine	tillage	*Vanessa atalanta*
Alpine	unvegetated	*Erebia calcaria*
Alpine	unvegetated	*Erebia christi*
Alpine	unvegetated	*Erebia meolans*
Alpine	unvegetated	*Erebia pluto*
Alpine	unvegetated	*Lasiommata petropolitana*
Alpine	unvegetated	*Oeneis glacialis*
Alpine	unvegetated	*Parnassius apollo*
Alpine	woodland	*Argynnis paphia*
Alpine	woodland	*Boloria euphrosyne*
Alpine	woodland	*Boloria thore*
Alpine	woodland	*Erebia aethiops*
Alpine	woodland	*Erebia ligea*
Alpine	woodland	*Euphydryas intermedia*
Alpine	woodland	*Limenitis camilla*
Alpine	woodland	*Pararge aegeria*
Atlantic	bog	*Boloria aquilonaris*
Atlantic	bog	*Callophrys rubi*
Atlantic	bog	*Coenonympha tullia*
Atlantic	bog	*Lycaena dispar*
Atlantic	bog	*Plebeius optilete*
Atlantic	coastal	*Argynnis niobe*
Atlantic	coastal	*Aricia agestis*
Atlantic	coastal	*Coenonympha pamphilus*
Atlantic	coastal	*Cupido minimus*
Atlantic	coastal	*Hipparchia semele*
Atlantic	coastal	*Issoria lathonia*
Atlantic	coastal	*Lasiommata megera*

Region	Habitat	Species
Atlantic	coastal	*Polyommatus icarus*
Atlantic	coastal	*Pyrgus malvae*
Atlantic	coastal	*Thymelicus lineola*
Atlantic	grassland	*Anthocharis cardamines*
Atlantic	grassland	*Boloria selene*
Atlantic	grassland	*Erynnis tages*
Atlantic	grassland	*Euphydryas aurinia*
Atlantic	grassland	*Lasiommata megera*
Atlantic	grassland	*Maniola jurtina*
Atlantic	grassland	*Melanargia galathea*
Atlantic	grassland	*Melitaea cinxia*
Atlantic	grassland	*Polyommatus icarus*
Atlantic	grassland	*Thymelicus lineola*
Atlantic	heathland	*Callophrys rubi*
Atlantic	heathland	*Coenonympha pamphilus*
Atlantic	heathland	*Hesperia comma*
Atlantic	heathland	*Hipparchia semele*
Atlantic	heathland	*Lycaena phlaeas*
Atlantic	heathland	*Maculinea alcon*
Atlantic	heathland	*Plebeius argus*
Atlantic	tillage	*Aglais urticae*
Atlantic	tillage	*Celastrina argiolus*
Atlantic	tillage	*Inachis io*
Atlantic	tillage	*Papilio machaon*
Atlantic	tillage	*Pieris brassicae*
Atlantic	tillage	*Pieris rapae*
Atlantic	tillage	*Polygonia c-album*
Atlantic	tillage	*Vanessa atalanta*
Atlantic	woodland	*Apatura iris*
Atlantic	woodland	*Argynnis adippe*
Atlantic	woodland	*Argynnis paphia*
Atlantic	woodland	*Boloria euphrosyne*
Atlantic	woodland	*Carterocephalus palaemon*
Atlantic	woodland	*Gonepteryx rhamni*
Atlantic	woodland	*Limenitis camilla*
Atlantic	woodland	*Melitaea athalia*
Atlantic	woodland	*Neozephyrus quercus*
Atlantic	woodland	*Pararge aegeria*
Atlantic	woodland	*Polygonia c-album*
Boreal	tillage	*Aglais urticae*
Boreal	tillage	*Inachis io*
Boreal	tillage	*Lycaena phlaeas*
Boreal	tillage	*Papilio machaon*
Boreal	tillage	*Pieris brassicae*
Boreal	tillage	*Pieris rapae*
Boreal	tillage	*Vanessa atalanta*
Boreal	woodland	*Carterocephalus silvicola*
Boreal	woodland	*Erebia ligea*
Boreal	woodland	*Euphydryas maturna*
Boreal	woodland	*Gonepteryx rhamni*
Boreal	woodland	*Leptidea sinapis complex*
Boreal	woodland	*Limenitis populi*
Boreal	woodland	*Lopinga achine*

Region	Habitat	Species
Boreal	woodland	*Melitaea athalia*
Boreal	woodland	*Nymphalis antiopa*
Boreal	woodland	*Pararge aegeria*
Continental	grassland	*Aphantopus hyperantus*
Continental	grassland	*Coenonympha pamphilus*
Continental	grassland	*Colias alfacariensis*
Continental	grassland	*Colias myrmidone*
Continental	grassland	*Euphydryas aurinia*
Continental	grassland	*Lycaena hippothoe*
Continental	grassland	*Maculinea teleius*
Continental	grassland	*Maniola jurtina*
Continental	grassland	*Melanargia galathea*
Continental	grassland	*Minois dryas*
Continental	grassland	*Polyommatus icarus*
Continental	grassland	*Polyommatus semiargus*
Continental	grassland	*Thymelicus acteon*
Continental	tillage	*Carcharodus alceae*
Continental	tillage	*Coenonympha pamphilus*
Continental	tillage	*Colias hyale*
Continental	tillage	*Issoria lathonia*
Continental	tillage	*Papilio machaon*
Continental	tillage	*Pieris brassicae*
Continental	tillage	*Pieris rapae*
Continental	tillage	*Pontia daplidice complex*
Continental	tillage	*Vanessa atalanta*
Continental	woodland	*Apatura ilia*
Continental	woodland	*Apatura iris*
Continental	woodland	*Araschnia levana*
Continental	woodland	*Argynnis paphia*
Continental	woodland	*Carterocephalus palaemon*
Continental	woodland	*Coenonympha hero*
Continental	woodland	*Erebia ligea*
Continental	woodland	*Euphydryas maturna*
Continental	woodland	*Limenitis camilla*
Continental	woodland	*Lopinga achine*
Continental	woodland	*Melitaea diamina*
Continental	woodland	*Neptis rivularis*
Continental	woodland	*Satyrium ilicis*
Mediterranean	coastal	*Carcharodus alceae*
Mediterranean	coastal	*Carcharodus stauderi*
Mediterranean	coastal	*Colias croceus*
Mediterranean	coastal	*Gegenes nostrodamus*
Mediterranean	coastal	*Gegenes pumilio*
Mediterranean	coastal	*Papilio machaon*
Mediterranean	coastal	*Pontia daplidice complex*
Mediterranean	coastal	*Vanessa atalanta*
Mediterranean	grassland	*Arethusana arethusa*
Mediterranean	grassland	*Chazara briseis*
Mediterranean	grassland	*Coenonympha pamphilus*
Mediterranean	grassland	*Glaucopsyche alexis*
Mediterranean	grassland	*Maculinea arion*
Mediterranean	grassland	*Melanargia occitanica*
Mediterranean	grassland	*Polyommatus icarus*

Region	Habitat	Species
Mediterranean	grassland	*Polyommatus thersites*
Mediterranean	grassland	*Pyronia tithonus*
Mediterranean	grassland	*Thymelicus acteon*
Mediterranean	heathland	*Anthocharis damone*
Mediterranean	heathland	*Euphydryas aurinia*
Mediterranean	heathland	*Glaucopsyche melanops*
Mediterranean	heathland	*Hipparchia fidia*
Mediterranean	heathland	*Lycaena ottomanus*
Mediterranean	heathland	*Papilio alexanor*
Mediterranean	heathland	*Pyronia bathseba*
Mediterranean	heathland	*Satyrium esculi*
Mediterranean	heathland	*Zerynthia rumina*
Mediterranean	tillage	*Cacyreus marshalli*
Mediterranean	tillage	*Carcharodus alceae*
Mediterranean	tillage	*Colias croceus*
Mediterranean	tillage	*Leptotes pirithous*
Mediterranean	tillage	*Papilio machaon*
Mediterranean	tillage	*Pieris brassicae*
Mediterranean	tillage	*Vanessa atalanta*
Mediterranean	tillage	*Zerynthia polyxena*
Mediterranean	tillage	*Zerynthia rumina*
Mediterranean	tillage	*Zizeeria knysna*
Mediterranean	woodland	*Brenthis daphne*
Mediterranean	woodland	*Brintesia circe*
Mediterranean	woodland	*Charaxes jasius*
Mediterranean	woodland	*Gonepteryx cleopatra*
Mediterranean	woodland	*Hipparchia fagi*
Mediterranean	woodland	*Laeosopis roboris*
Mediterranean	woodland	*Libythea celtis*
Mediterranean	woodland	*Limenitis reducta*
Mediterranean	woodland	*Pararge aegeria*
Pannonian	tillage	*Carcharodus alceae*
Pannonian	tillage	*Colias hyale*
Pannonian	tillage	*Issoria lathonia*
Pannonian	tillage	*Papilio machaon*
Pannonian	tillage	*Pieris brassicae*
Pannonian	tillage	*Pieris rapae*
Pannonian	tillage	*Pontia daplidice complex*
Pannonian	tillage	*Vanessa atalanta*

Appendix 2 / Butterflies of the Habitats Directive

From 1 May 2004 thirty butterfly taxa are listed at the Habitats Directive: 27 species and three subspecies.

Species	Appendix of the Habitats Directive (1 May 2004)
Apatura metis	4
Argynnis elisa	4
Boloria improba	2
Coenonympha hero	4
Coenonympha oedippus	2 4
Colias myrmidone	2 4
Erebia calcaria	2 4
Erebia christi	2 4
Erebia medusa polaris	2
Erebia sudetica	4
Euphydryas aurinia	2
Euphydryas maturna	2 4
Hesperia comma catena	2
Leptidea morsei	2 4
Lopinga achine	4
Lycaena dispar	2 4
Lycaena helle	2 4
Maculinea arion	4
Maculinea nausithous	2 4
Maculinea teleius	2 4
Melanargia arge	2 4
Nymphalis vaualbum	2 4*
Papilio alexanor	2 4
Papilio hospiton	4
Parnassius apollo	4
Parnassius mnemosyne	4
Plebeius glandon aquilo	2
Polyommatus eroides	2 4
Polyommatus golgus	2 4
Zerynthia polyxena	4