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Red Lists for Invertebrates:
their application at different spatial scales
– practical issues, pragmatic approaches

14th International Colloquium of the European Invertebrate Survey
7th meeting of the Bern Convention Group of Experts on Conservation of Invertebrates
1st meeting of the IUCN European Invertebrates Specialist Group

National Museum & Gallery of Wales
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Contents

Introduction

Invertebrate specialists from across Europe met in Cardiff 5-9 September 2003 to discuss conservation action for marine, freshwater and terrestrial invertebrates under the title of *Red Lists for Invertebrates*. Three consecutive meetings looked at different aspects of this vast topic. The Bern Group of Experts on Conservation of Invertebrates, the European Invertebrate Survey and the IUCN European Invertebrate Specialists Group each held business meetings. Most delegates also attended a one day colloquium on the topic of Red Data Listing at different spatial scales, which provided interesting examples of different approaches that have been proposed for a variety of taxa.

I should like to thank Dr Mary Seddon, Deborah Spiller and all at the National Museum of Wales for setting up the conference venue and for keeping the meetings well organised. My thanks also to Dr Adrian Fowles, David Painter and David Carrington for putting together a stimulating day in the field. I would also like to thank Jean Lambert and colleagues at JNCC for their sanguine approach to conference administration.

Deborah Procter
Convener *IN*Cardiff 2003
December 2004

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Regional Red Data Lists and invertebrates in the Nordic countries

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Abstract

The four Nordic countries; Denmark, Finland, Norway and Sweden, published a new generation of Red Lists between 1997 and 2001. These lists included more native invertebrate species (including insects) than ever before. The national Red Lists and some local lists provide an opportunity to analyse the effects of models using different biogeographic scales on the species composition of Red Listed invertebrates. If the species of Coleoptera on the national Red Lists are compiled on a Nordic level, 2330 of the total of 5000 species that occur in these countries are listed in one or more countries. However, if species that occur in at least one other country, without being Red Listed, are excluded, the Nordic list will include a similar percentage of Red Listed species as any one of the national lists. Using Odonata, a smaller group of species, as an example, this paper shows that assessments made at a local scale will generate additional species on Red Lists for smaller regions. Of the three dimensions in Rabinowitz's analysis of rarity, the factor concerning area of distribution is the most scale dependent factor. It could be argued that the IUCN Red List criteria based on population-size and biogeography should be accompanied by criteria concerning various social values, such as attractiveness, value for tourism or symbolic values, at regional and local levels.

Introduction

This paper examines the value of national Red Lists in invertebrate conservation at regional (supra-national) and local (sub-national) scales. Criteria associated with the perceptions of biodiversity among local communities, and the political aspects of biodiversity conservation, in addition to the purely biological criteria of IUCN, are promoted.

In recent years, new Red Data Lists have been published for all four Nordic countries: Denmark (Stoltze & Pihl, 1998), Finland (Rassie *et al*., 2001), Norway (Direktoratet for naturfovaltning, 1999), Sweden (Gärdenfors, 2000). The Swedish and Finnish lists were adjusted to the new categories of the IUCN, while the Danish and Norwegian lists were based on the more traditional categories applied in earlier generations of Red Lists. A common characteristic of these recent Red Lists is that a large number of invertebrates (including insects) have been included. This ranges from 1,369 in Denmark, to 2,325 in Sweden, and invertebrates constitute between 44% and 56% of the total Red Listed organisms (Table 1). Iceland has not yet published a Red List including invertebrates.

All families of beetles (Coleoptera), a large order with many species, have been assessed in all four countries. Similarly, four less species rich, aquatic insect orders – dragonflies (Odonata), mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) – were fully assessed in all four countries. Three of the countries have included all families of butterflies and moths (Lepidoptera), while Denmark did not include the so-called micro-Lepidoptera. The bugs (Hemiptera) were fully assessed in three countries, but only partly in Denmark. Denmark has also not included the grasshoppers and crickets (Orthoptera) and lacewings (Neuroptera). Only a few families of the very species rich orders of ants, bees and wasps (Hymenoptera) and flies (Diptera) were assessed. Among non-insect invertebrates, the most complete assessment was done by Sweden in their treatment of the slugs and snails (Mollusca) (Table 1).

Table 1. Species on national Red Lists in the Nordic countries.

Taxon	Total number of species in the Nordic countries	Number of species on the Red List in Denmark	Number of species on the Red List in Finland	Number of species on the Red List in Norway	Number of species on the Red List in Sweden
Lepidoptera	3000	182	392	531	438
Coleoptera	5000	964	597	784	1123
Diptera	7500	93	31	61	172
Hymenoptera	9500		159	56	185
Hemiptera	1910	15	103	82	54
Homoptera			31		3
Odonata	59	21	6	21	7
Plecoptera	42	10	3	4	11
Ephemeroptera	69	20	8	9	5
Trichoptera	244	54	22	49	12
Orthoptera	46		6	5	9
Neuroptera	65		5	15	5
Raphidioptera	4				1
Siphonaptera	54		1		
Myriapoda	63		5		8
Arachnida	1973	1	35		71
Crustacea	1650	1	2	6	50
Mollusca	850	7	37	16	143
Echinodermata	135				26
Hirundinea	25	1	1	7	1
Tricladida	1100				1
Porifera	237			2	
Number of invertebrate species	**37000**	**1369**	**1444**	**1646**	**2325**
Percentage share of invertebrates		**43.6%**	**52.5%**	**53.8%**	**56.4%**
Total number of species on national red list		**3142**	**2751**	**3062**	**4120**

The Nordic countries share a common biodiversity, and the boundaries between three biomes (nature regions) run across to the borders between Norway, Sweden and Finland (Figure 1). Denmark, together with the southernmost part of Sweden and small parts of Norway and Finland is within the Nemoral zone, typically with deciduous forests. North of this zone the Boreal, or coniferous taiga zone, covers most of Finland, northern Sweden and lowland Norway. The Artic–alpine, or tundra zone, covers the mountainous area and the northernmost lowland areas of Norway.

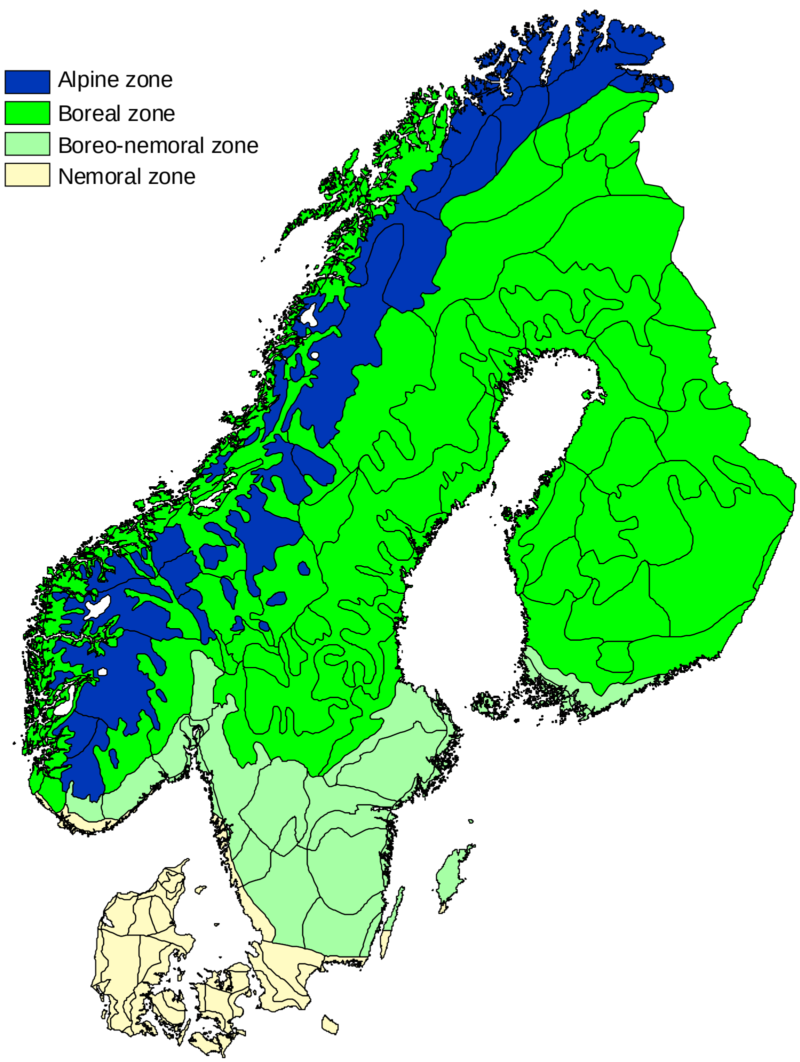

Figure 1. The Physical Geographical regions of the Nordic countries (Nordic Council of Ministers 1984)

This biogeographic structure and the proportion of its elements in each country heavily influence the occurrence of species and the assessment of their national rarity. Comparison of the Norwegian and the Danish Red Lists illustrates this: species with a main distribution in the boreal zone are seldom Red Listed in Norway, but are often listed in Denmark. On the other hand, species that are common in nemoral Denmark are often Red Listed in Norway. The Swedish Red List includes fewer species that are considered nationally rare in Denmark or Norway, because in Sweden there are larger portions of all elements of the Nordic fauna and flora. The Finnish Red List tends to include fewer species with a limited eastern distribution in Scandinavia, compared to the Red Lists of the three other countries.

The Nordic Red List

The most recent book on threatened organisms in the Nordic countries was compiled ten years ago (Höjer 1995). The only invertebrate groups treated in this list were butterflies, some families of beetles, and terrestrial and freshwater Mollusca. The list has not been updated, and it is no longer compatible with the recently published national Red Lists.

The assessment of species on a Nordic scale should involve using distribution and population data from four separate countries, each of which has a different level of faunistic knowledge. Such a project would require a considerable effort, even if all species with a reasonably large or stable population, in some part of the Nordic region, were to be left out. However, using the four national Red Lists as a resource of data, a tentative assessment is possible for groups that have been assessed in all four countries. The four national Red Lists are available from websites and may be downloaded, compared and combined. The work needs to be done by specialists for each taxonomic group, to overcome any differences in the nomenclature applied by the separate national agencies responsible for the lists. Using the four national Red Lists, supra-national assessments for Coleoptera, Odonata and some other freshwater insect groups have been made. Inevitable, the procedure included some subjective assessments because the data sources were not wholly compatible with each other.

The Nordic fauna of Coleoptera comprises about 5,000 species. A total of 2,330 species have been Red Listed in at least one of the countries (Table 2). The number of Coleoptera species listed in each of countries varies from 597 in Finland to 1,123 in Sweden. If we exclude all species which occur in at least one country without being Red Listed there, assuming that a stable, regional occurrence in one of the countries will exclude the species from a Nordic list, the Nordic list would be reduced from the 2,330 species to 835 species. That is nearly 300 species less then the Swedish list, 130 less then the Danish list, and 50 and 240 more than the Norwegian and Finnish lists, respectively. Only 64 of the 835 species occur in and are Red Listed separately in all four countries. On the other hand, 340 species occur in only one of the Nordic countries and are Red Listed there. The 64 species Red Listed in all four countries are mostly ecological specialists living on or in river banks, beaches, dead wood, old oak trees, farm animal excrement, or old farm houses.

Table 2. Number of red listed species of Coleoptera listed and occurring in all four or only three, two or one of the Nordic countries.

No countries Red Listed in	**No countries Coleoptera occur in**			
	4	**3**	**2**	**1**
1	549	239	238	340
2	185	172	278	-
3	112	153	-	-
4	64	-	-	-
SUM	910	564	516	340

The Odonata (dragonflies and damselflies) is a much smaller group with 59 species in the Nordic countries, of which 33 species are Red Listed in at least one country. None of the species are Red Listed in all four countries, and only five species are Red Listed in all the countries in which they occur (Table 3), which would make them candidates for a Nordic Red List according to the criteria applied for the beetles. A thorough assessment of the Odonata species would probably place these five species on the Nordic Red List, in addition to some others, for example six species that are Red Listed in a majority of the countries where they occur.

Table 3 . Odonata species on the national Red Lists in the Nordic countries and on suggested regional list for subnational regions of Norway.

(DK= Denmark, SW =Sweden, SF=Finland, NO=Norway).(+, - = the species occur or do not occur in the area without being listed). Categories as on the respective national lists. Species name in bold = species listed on Bern convention appendix II .

		DK	SW	SF	NO	Trøndelag	Northern Norway
Species listed in all the Nordic countries in which they occur	Nehalennia speciosa	R	RE	EN	-	-	-
	Libellula fulva	E	VU	EN	-	-	-
	Lestes virens	V	NT	-	-	-	-
	Anaciaeshna isosceles	V	NT	-	-	-	-
	Sympecma fusca	-	NT	-	-	-	-
Species listed in most of the Nordic the countries in which they occur	Aeshna viridis	V (EU:I)	+	EN	-	-	
	Coenagrion lunulatum	V	NT	+	R	-	Norwegian list
	Ophiogomphus cecilia	R	EN*	+	-	-	
	Ischnura pumilio	R	EN	+	-	-	
	Orthetrum coerulescens	E	+	VU	R	-	
	Somatochlora sahlbergi	-	NT*	+	E	-	Norwegian list
Species occuring in all four Nordic countries but listed only in two of them	Sympetrum sanguineum	+	+	VU	V	-	-
	Platycnemis pennipes	V	+	+	R	-	-
	Cordulegaster boltoni	V	+	+	R	Norwegian list	-
	Gomphus vulgatissimus	V	+	+	E	-	-

	Leucorrhinia caudalis	Ex (EU:I)	+	+	V	-	-
	Onychogomphus forcipatus	Ex	+	+	V	-	-
	Leucorrhinia albifrons	Ex	+	+	V	-	-
	Epitheca bimaculata	Ex	+	+	R	-	-
	Leucorrhinia pectoralis	E (EU:I)	+	+	R	-	-
	Coenagrion armatum	E	+	+	R	Norwegian list	-
						-	-
Species occuring in most of the Nordic countries but listed only in one of them	Aeshna subarctica	R	+	+	+	local list ?	local list
	Somatochlora arctica	R	+	+	+	local list ?	local list ?
	Lestes barbarus	R	+	-	-	-	-
	Sympetrum vulgatum	+	+	+	R	-	-
	Sympetrum flaveolum	+	+	+	R	Norwegian list	-
	Calopteryx splendens	+	+	+	E	-	-
	Lestes dryas	+	+	+	E	-	-
	Somatochlora flavomaculata	+	+	+	E	-	-
	Orthetrum cancellatum	+	+	+	E	-	-
	Libellula depressa	+	+	+	V	-	-
	Brachytron pratense	+	+	-	R	-	-
	Coenagrion puella	+	+	VU	+	-	-
Species not listed in any of the Nordic Countries	Calopteryx virgo	+	+	+	+	local list ?	local list
	Lestes sponsa	+	+	+	+	local list ?	-
	Pyrrhosoma nymphula	+	+	+	+	local list ?	local list
	Erythromma najas	+	+	+	+	local list	-
	Coenagrion hastulatum	+	+	+	+	+	local list ?
	Coenagrion pulchellum	+	+	+	+	local list	local list
	Coenagrion johanssoni	-	+	+	+	local list	local list
	Enallagma cyathigerum	+	+	+	+	+	+
	Ischnura elegans	+	+	+	+	local list	-
	Aeshna caerula	-	+	+	+	+	+
	Aeshna juncea	+	+	+	+	+	+
	Aeshna grandis	+	+	+	+	+	local list
	Aeshna osiliensis	-	+	+	-	-	-
	Aeshna crenata	-	-	+	-	-	-
	Aeshna cyanea	+	+	+	+	-	-
	Aeshna mixta	+	+	-	-	-	-
	Hemianax ephippiger	+	+	-	(+)	-	-
	Anax imperator	+	-	-	-	-	-
	Cordulia aenea	+	+	+	+	+	local list
	Somatochlora metallica	+	+	+	+	+	+
	Somatochlora alpestris	-	+	+	+	local list ?	local list ?
	Leucorrhinia dubia	+	+	+	+	local list ?	+
	Leucorrhinia rubicunda	+	+	+	+	-	local list ?
	Libellula quadrimaculata	+	+	+	+	+	local list ?
	Sympetrum striolatum	+	+	+	+	local list	
	Sympetrum danae	+	+	+	+	-	local list

The size of sub-national units

A sub-national assessment of several freshwater organisms in Norway (Aagaard *et al.*, 2002) divides the country into five regions, each similar in size to Denmark, composed of several adjacent counties (Figure 2). These five regions cover different parts of the Nordic biomes (Figure 1) and are quite different with respect to their biodiversity. The number of Odonata species decreases from 44 in the south-eastern region to less than 20 in the northernmost region. In the two northernmost regions, only two and three species from the national Red List are found. However, in the central region of Trøndelag, six species in addition to the three nationally listed species would have been good candidates for a regional Red List. About half of the 20 species occurring in the northernmost region would have been listed on a regional list for this large area, which comprises the three northernmost counties (Table 3).

A similar exercise for most other freshwater groups concludes in a similar way. The national Norwegian Red List mainly includes species with limited distribution in the south-eastern region, while locally threatened species in the other regions are given less attention.

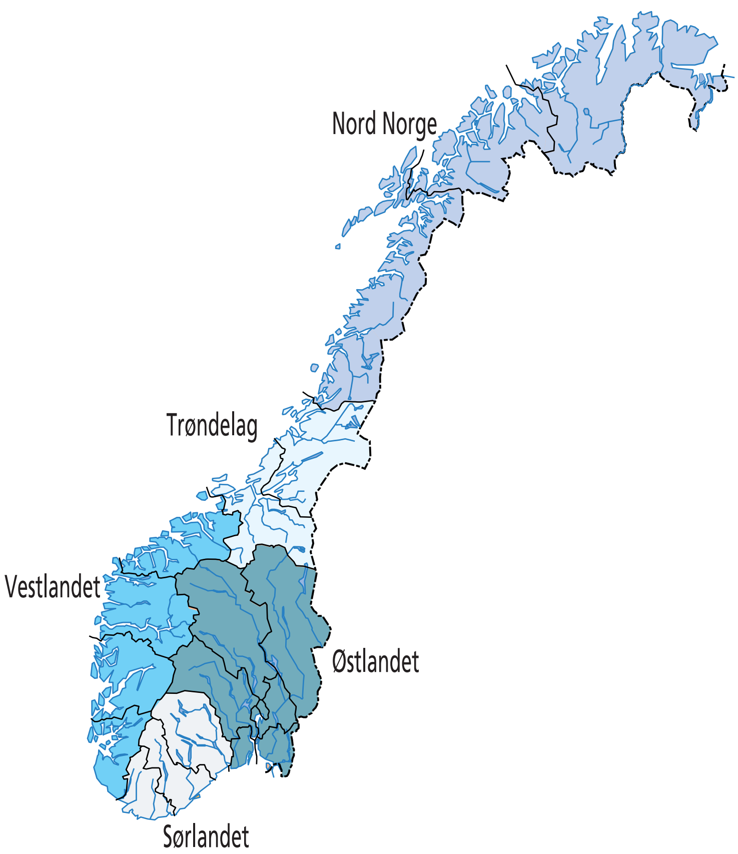

Figure 2. The five regional areas of Norway. (Aagaard *et al.*, 2002).

Conservation biology – a purely scientific sphere?

There have been several analyses of the pattern of rarity among species. Rabinowitz *et al*. (1986) highlighted three dimensions of rarity: limited geographical distribution, specialized ecology, and limited population size. Entomologists seldom have data to perform an analysis of the third dimension, such as small or decreasing populations. The 64 beetles species that were listed in all four Nordic countries may be good examples of second dimension species – ecological specialists.

The first dimension, limited geographical distribution, appears simple and scientifically based provided that the global situation is considered. Gärdenfors (2001) stated that the biologically correct solution would be to not evaluate the extinction risk of anything other than the entire, totally isolated population. When the IUCN criteria are to be applied at a regional level, it is far more difficult to use only scientifically based arguments. However, Gärdenfors (2001) argued that, even if biologists were to refuse to participate in the production of national Red Lists, such lists would be produced by administrators and politicians. A procedure for application of the IUCN criteria at the regional level is described in Gärdenfors *et al.* (2001). The main element is to use the global scale criteria for the region and subsequently "downgrade" or "upgrade" the category level after considering the extent of contact between the local population with populations beyond the region being considered. Biological arguments for including marginal populations in Red Lists, such as those with differences in genetic composition or life history, are summarised by Samways (2003).

One of the founders of conservation biology, Michael Soulé (1986), stressed that this new discipline should be a synthesis where natural science merged with other disciplines. The importance of local species diversity to the local human population is one aspect that should be considered and taken into account when methods for evaluation and assessment are developed. The scale in terms of space and time is intuitively important at the local level. For example, the extinction of a marginal population of a damselfly species might be conceived as an important loss to the local community, even if the species still exists 300 km away and there is a theoretical possibility that the locality may be re-colonised within, 20, 50 or 100 years.

In the case of Red Data Lists at the national and sub-national level, political or administrative borders divide the areas of natural distribution in such a way that it is not reasonable to expect that purely scientific arguments are sufficient when assessing species for Red Lists. An additional criterion to the IUCN vocabulary of population size and geographical range could be the importance of the species in a strictly local context. The introduction of such a criterion would be at odds with the purely scientific logic, which is unlikely ever to be able to fully cater for local Red Lists.

Acknowledgements

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Red Lists in Wallonia (Belgium): existing tools and their limits

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Abstract

The first critical issue in establishing regional Red Lists for invertebrates is the availability of historical and present-day data. Traditionally, for each species we use a comparison of the known area of occurrence, before and after a threshold date, and we compare it to a reference that can be the sum of known area of occurrence for all other species or for a selection of species. The limitations of such an approach – sampling spatial heterogeneity, change in sampling techniques, problems of identification of a set of reference specimens – are identified and described. When biological data are more numerous, trends by time period can be used, but this approach also has problems. A solution can be to agree a monitoring program to obtain data periodically, on a regular or statistical basis, but many threatened species are too rare to be sampled by a stratified monitoring program. In Wallonia, such approaches are now limited to identify a set of species that require specific sampling and monitoring programs to give more precise information about population trends, threats and responses to action plans. The second critical issue is the application or interpretation of a Red List category at the scale of small portion of an overall species area. We need criteria to prioritise action plans for species and these criteria should take into account the role that small countries or regions could play at the European scale.

The challenge of evaluating Red List status for 33,000 invertebrate species in Sweden

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Abstract

There are currently 33,118 known indigenous or naturalized invertebrate species reproducing in Sweden. In the 2000 Red List of Swedish Species, the conservation status of 11,156 invertebrate species was evaluated against the IUCN Red List Criteria. Some experiences from that exercise, as well as the process that will lead to the 2005 Red List of Swedish Species, are presented. We have found that the IUCN Red List Criteria, with some practice, are reasonably applicable to invertebrates. However, for the 20,000 invertebrate species not yet evaluated, taxonomic uncertainties, lack of specialists and absence of suitable data currently make an evaluation very difficult. The Swedish Species Information Centre has been commissioned by the Swedish government to chart and taxonomically describe every multi-cellular species in Sweden within a 20-year period. That work will lead to a considerably enhanced capacity in taxonomy, and to a much better knowledge of the species and their conservation status. Furthermore, this information will be readily available to both professionals and the general public. Consequently, the challenge of evaluating the Red List status for, by then, probably more than 35,000 invertebrate species, may be achievable within a couple of decades.

Introduction

According to a new catalogue of the species in Sweden there are currently 33,118 known indigenous or naturalized invertebrate species reproducing in the country (Gärdenfors *et al*., 2003). To assess the conservation status of all these species according to the IUCN Red List Criteria may appear to be an overwhelming challenge. There are many obstacles to accomplishing a complete evaluation, ranging from taxonomic uncertainties, lack of experts and absence of suitable data, to conceptual difficulties.

The goal of evaluating the Red List status of the entire invertebrate fauna of a country may be achievable. It will involve much work and cost money, but, in particular, the will in the political and scientific community to achieve such a goal is a fundamental prerequisite. Sweden provides a suitable example of the issues, as that country recently has taken important steps towards the eventually reaching such a goal.

The Swedish Taxonomy Initiative

Beginning in 2002, the Swedish Species Information Centre (SSIC) has been commissioned by the Swedish Government to chart and taxonomically describe the entire Swedish fauna and flora, estimated to be more than 50,000 multi-cellular species. It is estimated that the work will be completed within a 20-year period (Ronquist & Gärdenfors, 2003; www.artdata.slu.se). Approximately 30,000 species that can be identified without sophisticated equipment will be described and depicted in a popular science standard work, in Swedish, in digital media and as about 130 published volumes. Experts at all major Swedish universities and natural history museums, as well as from other countries, are or will be involved in the project. Taxonomists can apply for grants for inventories and production of monographs, and a substantial number of positions for doctoral students and senior researchers will be created in order to build a strong taxonomic infrastructure. The project will, over the 20-year period, require some Euro 100 million in direct funds to taxonomic research, inventory work and production of faunas and floras. An additional Euro 60 to100 million will be required to support the infrastructure at the natural history museums. At the present time, high political level discussions are taking place to enlarge the initiative to a Nordic Taxonomy Initiative, which could produce many benefits in co-ordination and synergetic effects. We will rapidly increase knowledge of the identity, biology and distribution of the species stock in Sweden and, hopefully, in the other Nordic countries, providing a sound basis for a complete re-evaluation of the conservation status of species.

For the 2000 Red List there were 14 specialist groups, but for the 2005 Red List process Hymenoptera and Diptera now have separate specialist groups. Eight of the specialist groups are now devoted to the evaluation of invertebrates.

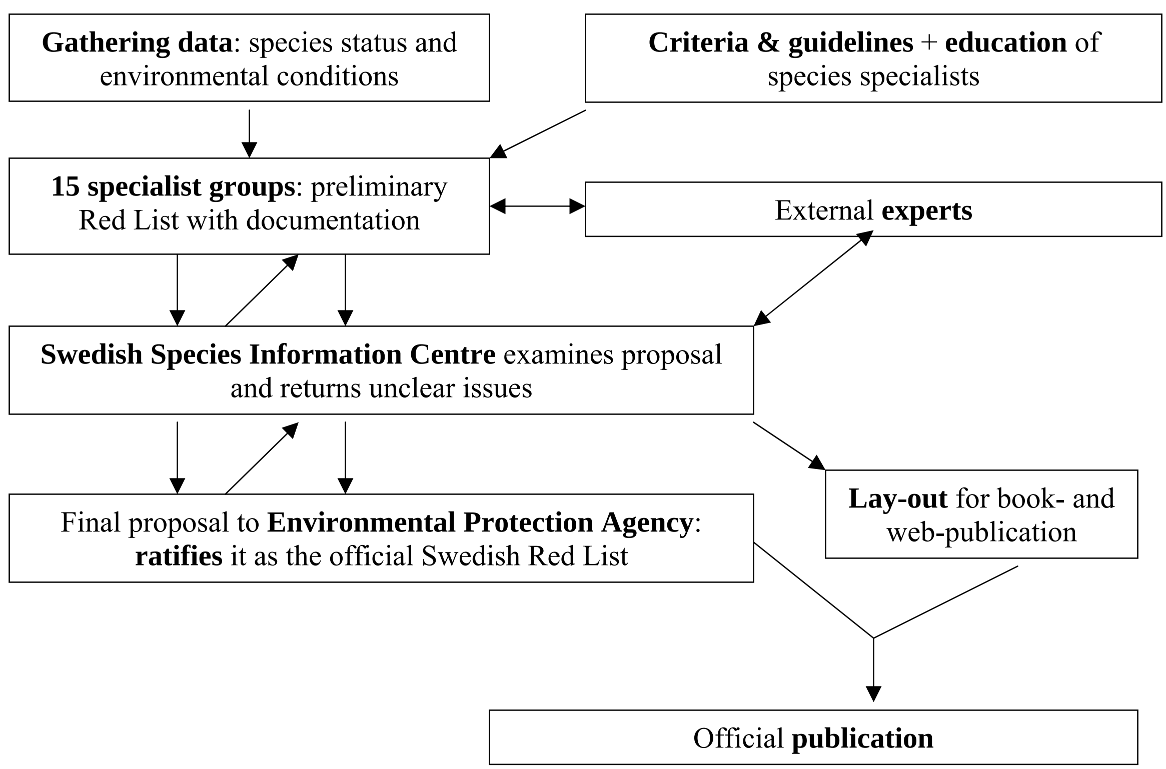

Figure 1. The logistics of the Swedish Red List process.

Using the IUCN Red List Criteria to evaluate species in Sweden

Sweden produced its first Red List of invertebrates in 1986 (Ehnström & Waldén, 1986) followed by another two editions, all based on qualitative criteria. In preparing a new Red List in 2000 (Gärdenfors, 2000b), the new quantitative IUCN Red List Criteria (IUCN, 1994) were adopted (Gärdenfors, 2001). This was a challenge, as we wanted to evaluate all major groups of organisms, including fungi, lichens, bryophytes, vascular plants, vertebrates and invertebrates occurring on land, in fresh water and in the marine environment.

The evaluations were made with the help of 14 specialist groups, involving some 100 experts. The application of the IUCN criteria, including use at the national level, was formulated in guidelines in Swedish (Gärdenfors, 2000a) and communicated to the experts at meetings (Figure 1).

Initially, the experts were concerned about the shortage of data and considered that the system was not suitable for use with invertebrates. Only criterion B (geographic restricted distribution in combination with population decrease, fragmentation or fluctuation) was thought to be applicable, while data to apply criteria A (population decrease) and E (quantitative analysis) was not available, and criteria C and D (restricted number of individuals) was not applicable because the number of individuals – if known –was usually far larger than the threshold numbers for these criteria. With help from the guidelines and from discussions among the experts, they were eventually able to apply the system on their own group of organisms. Methods had to be learned to estimate, infer and project the extinction risk, based on the available data, which were often only the state and changes in environmental quality. With increasing experience it became clear that the IUCN Criteria provide a sound conceptual framework for consistently evaluating the risk of extinction of species. The particular advantage of the IUCN system is that is transparent in that the experts all use the same criteria and that the data and assumptions have to be documented. This standardization and openness may be unfamiliar, but greatly benefits the creditability and long term value of the work.

The 2000 Red List of Swedish Species

A total of 19,756 species was evaluated, including11,156 species of invertebrates. A total 2,337 invertebrate species, 21% of all the invertebrates evaluated, were included on the Swedish Red List (Table 1; Gärdenfors 2000b), of which 1,022 species (9%) met the criteria for being classified as threatened and another 1,315 species (12%) as either Near Threatened (NT) or Data Deficient (DD).

Table 1. Outline of number of evaluated and red-listed invertebrate species according to 1994 IUCN Red List Criteria in Sweden (Gärdenfors 2000b). RE = Regionally Extinct, CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, DD = Data Deficient, LC = Least Concern, NE = Not Evaluated, * signifies species that today, according to IUCN (2003) would be classified as Not Applicable (NA).

	RE	CR	EN	VU	N. of threat-ened species	% threat-ened/ evaluated	NT	DD	Total n. red-listed	% of evaluated	LC	N. of evaluated species	NE	Tot. n. of species
Hymenoptera Wasps	24	4	16	45	65	9	59	37	185	27	507	692	7108	7800
Lepidoptera Butterflies and Moths	15	28	41	103	172	7	216	35	438	17	2162	2600	140*	2740
Diptera Flies and midges	27	5	22	46	73	10	46	26	172	23	578	750	5210	5960
Coleoptera Beetles	98	73	154	316	543	13	403	79	1123	26	3177	4300	140*	4440
Hemiptera Bugs	0	2	19	23	44	4	11	2	57	6	928	985	792	1777
Orthoptera Grasshoppers, katydids and crickets	0	0	2	3	5	14	3	1	9	26	26	35	4*	39
Neuroptera, Raphidioptera, Trichoptera, Plecoptera, Odonata, Ephemeroptera	2	1	4	12	17	4	15	19	53	14	334	387	53	440
Myriapoda	0	0	0	2	2	6		6	8	25	24	32	61	93
Arachnida Spiders et al.	3	2	2	15	19	3	11	38	71	10	670	741	1109	1850
Crustacea	0	0	3	9	12	10	6	32	50	41	72	122	1478	1600
Mollusca	2	8	13	37	58	13	20	63	143	32	298	441	215	656
Echinoderma	0	0	5	7	12	18	2	12	26	40	39	65	7*	72
Hirudinea and *Tricladida* Leaches and planarians	0	0	0	0	0	0	1	1	2	40	4	6	34	40
Remaining invertebrates												0	5611	5611
TOTAL n. invertebrates	171	123	281	618	1022	9	793	351	2337	21	8819	11156	21962	33118

In applying the IUCN criteria, criterion B proved to be the most important for invertebrates, as predicted, but criteria A, C and D were also applied successfully (Table 2). Application of criterion E requires both the availability of quantitative data and a viability analysis, which was not practicable, except for the butterfly *Euphydryas maturna*, for which a quantitative analysis was made. The result, however, met criterion E at a lower level (VU) than did criteria A and B (CR) and consequently the species was not classified according to criterion E.

Table 2. Overview of the applied criteria for threatened invertebrate species in the Swedish Red List

A quantitative analysis was applied to one butterfly species but the result met criterion E at a lower level than did criteria A and B.

	A	B	C	D	E	Total n. Criteria	N. of threatened species	Average n. of met criteria/ species
Hymenoptera Wasps	13	45	1	16	0	75	65	1.2
Lepidoptera Butterflies and Moths	63	136	23	36	0	258	172	1.5
Diptera Flies and midges	1	61	3	14	0	79	73	1.1
Coleoptera Beetles	131	475	170	58	0	834	543	1.5
Hemiptera Bugs	3	29	0	12	0	44	44	1.0
Orthoptera Grasshoppers, katydids and crickets	0	2	1	3	0	6	5	1.2
Neuroptera, Raphidioptera, Trichoptera, Plecoptera, Odonata, Ephemeroptera	2	9	1	7	0	19	17	1.1
Myriapoda	0	0	0	2	0	2	2	1.0
Arachnida Spiders et al.	5	7	1	10	0	23	19	1.2
Crustacea	5	7	0	0	0	12	12	1.0
Mollusca	35	13	1	12	0	61	58	1.1
Echinoderma	7	1	0	4	0	12	12	1.0
TOTAL n. invertebrates	265	785	201	174	0	1425	1022	1.4

Evaluating the Red List status of marine invertebrates proved to be the greatest challenge. The available data was extremely scarce and in many cases it was uncertain whether a particular species is part of the Swedish fauna. Despite these limitations, the marine specialist group successfully evaluated echinoderms, molluscs (except Opisthobranchia) and Malacostraca (Crustacea), although the overall proportion of marine species classified as DD in these groups proved to be substantially higher than those from land and fresh water. The specialist group also tried to evaluated the sponges (Porifera), but found that the vast majority would be classified as DD, so the decision was made to classify the entire group as Not Evaluated (NE). In spite of a limited success in precise Red List classification, just the fact that certain marine invertebrates were included in the Swedish Red List has increased awareness of the problems in the marine environment. The government and their agencies have begun to invest more effort and money on the investigation and restoration of the marine environment. Among other benefits, this will help to generate more information for future Red List evaluations.

The 2005 Red List of Swedish Species

In March 2003 work began towards the next Swedish Red List, to be published in 2005. Over 100 experts in 15 specialist groups (of which eight cover invertebrates) received guidelines in Swedish and the official IUCN documents in English (IUCN, 2001, 2003), and a two-day workshop for initial training and calibration. The specialist groups were also supplied by the SSIC with an Excel file containing all the Swedish taxa in their respective organism groups, including Red List status, distribution summarised by provinces and documentation from the 2000 Red List. The Excel file is to be filled out, were applicable, in over 50 fields reflecting the IUCN Red List Criteria, as well as the fields in Ramas® Red List (Akçakaya & Ferson 2001; www.ramas.com). In the file the specialist must also propose a Red List category for each species, with supporting criteria and brief text to document the data used in the evaluation. The specialists were also provided with a copy of Ramas® Red List if they would prefer to use that. The specialist groups also received distribution maps, printed-out from the SSIC database, showing known occurrences of species in the 2000 Red List, with computer generated calculations of the Extent of Occurrence and Area of Occupancy for use in the evaluation of each species. The data and documentation suggested by the specialist groups will then be examined by specialists at SSIC and any queries or omissions will be returned to and discussed with the specialist groups (Figure 1).

What share of the 33,000 known invertebrate species will we be able to evaluate for the 2005 Swedish Red List? We will definitively increase the number that was evaluated for the 2000 Red List, but the real expansion must await the results of the Swedish or Nordic – or maybe even European – taxonomy initiative. However, I am convinced that an almost complete evaluation of the conservation status of the Swedish species will be possible within a couple of decades.

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Inventory, monitoring, threat assessment and conservation measures for invertebrates in Poland

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Inventory and monitoring

Recent inventories of the fauna of Poland have shown that not less than 40,000 species of Metazoa occur in our country. The insects constitute about 70% of the total and with all the Arthropoda (arachnids and crustaceans) these groups make up 90% of the species (Andrzejewski & Weigle, 1993; Razowski, 1990-1991, 1997). National parks are the best known areas in Poland for their fauna, and these areas are particularly rich in species (Pawłowski 2003). For example, the Białowieża Primeval Forest, which in Poland covers some 27,000 ha hosts more than 10,000 species of Metazoa (Gutowski & Jaroszewicz, 2001), while in the Pieniny National Park, in an area of less than 2,500 ha, more than 7,000 species were collected (Witkowski, in prep.).

These inventories are based on data collated from many sources, including museum and private collections, notes and published materials, that identify the occurrence of a species in an area that has been investigated. Therefore the overall list of species from such an inventory is usually much richer than the fauna actually occurring in the investigated area. It is also richer than may be found from the results of field monitoring, which is carried out regularly in Poland for some group of invertebrates (Buszko, 1997; Kosibowicz & Dobrowolski, 2003; Hilbricht-Ilkowska, 2003).

In Poland and in other countries, the scope of inventory and monitoring work is limited by a lack of biologists specializing in some taxonomic groups. The compilation of the lists of species for these groups is often based on old records and identifications that have not been verified; consequently, the species composition is only an estimate (Razowski ,1990-1991, 1997).

The preparation of an inventory of invertebrate fauna in Poland usually consists of the assessment of the range and number of localities of a particular species in a given area. This may include the identification of points (localities) on the geographical grid of squares (Buszko, 1997), the identification of the occurrence of species in a geographical or administrative unit (Witkowski, in prep), or traditionally, the identification of a town, village or other distinctive place or area, situated nearest to a locality at which a species was found or a survey was made. To assess species distribution and threat on the basis on point localities within the geographical grid, one may use three methods (Głowaciński, 2001): a total of all squares with points, a "contour" range indicated by peripheral localities, or a total of all squares within the range.

Assessment of threat

An analysis of the status of invertebrate species in Poland resulted in the interdisciplinary reports such as the Red Lists (Głowaciński 2002) and a Red Data Book (Głowaciński 2001).

The Red Lists analyze threats to the taxonomic groups as a whole and, on the basis of IUCN criteria (Hilton-Taylor, 2000), indicate species representing particular categories of threat. The Red Data Book deals with species belonging to the higher categories of threat (Extinct (EX), Critically Endangered (CR), Endangered (EN) and Volnerable (VU)), as indicated in the Red Lists.

The Red data Book for invertebrates in Poland is in preparation, but the following groups of invertebrates were described in the Red List of threatened animals (Głowaciński 2002): Bivalvia, terrestrial and aquatic Gastropoda aquatica, Diptera, Hymenoptera (Symphyta, Hymenoptera parasitica, Chrysididae, Pompilidae, Vespoidea, Formicidae, Sphecidae and Apoidea). Also included in the List were the following groups of insects: Trichoptera, Lepidoptera, Coleoptera, Hemiptera, Orthoptera, Plecoptera, Odonata, and Ephemeroptera. Other invertebrate groups covered were Arachnida (Araneae, Opiliones and Pseudoscorpionida), Malacostraca and Hirudinea. A total 2,618 species were regarded to be in a threat category (Table 1).

Table 1. Summary list of threatened species of invertebrates in Poland (Głowaciński 2002).

Animal group	Categories of threat							Sum
	EX in Poland	CR	EN	VU	NT	LC	DD	
Mollusca	1	17	8	36	48	1	18	129
Arthropoda including:	196	135	350	533	240	304	719	2477
Insekta	196	133	258	393	228	304	661	2174
Arachnida	---	---	90	138	---	---	58	286
Crustacea	---	2	2	2	12	---	---	18
Annelida	---	---	---	1	4	1	6	12
Total	197	152	358	570	292	306	743	2618

Conclusions based on the lists were as follows (Głowaciński 2002):

The compilation of Red Lists has shown that in Poland there are significant gaps in knowledge of the species composition of some group of invertebrates, and in knowledge of their status and threats.

The authors preparing the lists were aware of considerable imbalance in the knowledge of groups of invertebrates and among the species within a group. Hence, in spite of the use of unified criteria, the results of threat assessment for particular groups are not strictly comparable.

Assuming that the number of species of Metazoa in Poland is as high as 40,000, some 7% of the species were included on the Red List. Of these, insects are the richest group with 7.7% of the insect fauna of Poland being listed. So the threat status of insects appears to be proportional to the threat status of the other groups, particularly the vertebrate fauna.

In light of the data collected, among the most threatened groups of invertebrate species in Poland are: bivalves, of which as much as 40% of the species are included to the most threatened group (EX, CR, EN and VU), land snails (37%), water snails (28%) orthopterans (28%), ephemeropterans (27%) and wild bees (22%).

Taking into account losses in the fauna, the most threatened groups are caddis-flies (4.8%), wild bees (3.8%) and moths and butterflies (0.4%).
An analysis of the threat status of beetles also included an assessment of threat to particular communities or habitats (Table 2).

Table 2. Analysis of the threat status of beetle communities (or habitats) based on the threat of ecologically defined groups of beetles.

Community or habitat	Number of species							
	EX	CR	EN	VU	NT	LC	DD	Sum
Water	10	11	10	19	9	7	11	77
Bogs and marshes	1	3	13	18	4	1	2	42
Saline	2	4	20	3	---	2	---	31
Xerothermic	36	15	48	28	20	16	65	228
Mesophile meadows	1	---	5	7	---	8	12	33
Segetal and pastures	23	12	5	4	10	8	13	75
Caves and synanthropic	3	2	5	---	1	---	7	18
Primeval forests	62	31	50	44	18	40	152	397
High montane	6	6	4	12	13	20	12	73

Table 2 shows that the most threatened beetle communities are those living in primeval forests and xerothermic habitats. The beetle communities of caves, salines areas and peat bogs also seem to be highly threatened.

Conservation measures

In Poland the basic form of conservation of invertebrates is protection of their habitats in national parks, nature reserves, landscape parks and other protected areas (Głowaciński 2002). In addition, legislation amended in 2001 provides for strict protection of species; the Decree of the Minister of Environment (2001), dated September 26th 2001, provides protection for the invertebrate species listed in (Table 3). The Decree also includes Polish names for most of the taxa listed (not included here).

Table 3. List of the invertebrate taxa living in wild in Poland (including potentially migratory species) which are strictly protected in the country.

HIRUDINEA
Hirudo medicinalis

ARACHNIDA
ARANEIDA
Argiope bruennichi, Atypidae – all species, *Eresus niger, Bathyphantes eumenis, Leptyhyphantes pulcher, Phylaeus chrysops*

INSECTA
ODONATA
Aeschna coerulea, Aeschna viridis, Coenagrion ornatum, Nehalennia speciosa, Somatochlora alpestris, Ophiogomphus cecilia, Stylurus flavipes, Sympecma braueri, Leucorrhinia albifrons, Leucorrhinia caudalis, Leucorrhinia pectoralis

MANTODEA
Mantis religiosa

ORTHOPTERA
Gampsocleis glabra

COLEOPTERA
Buprestis splendens, *Calosoma* – all species, *Carabus*– all species, *Cerambyx cerdo, Cerambyx scopolii, Ergates faber, Gaurotes excellens, Lamia textor, Leioderus kollari, Leptura thoracica, Pseudogaurotina excellens, Purpuricenus kaehleri, Rosalia alpina, Stenocorus meridianus, Tragosoma depsarium, Cucujus cinnaberinus, Cucujus haematodes, Dytiscus latissimus, Graphoderus bilineatus,* Melandryidae, *Phryganophilus ruficollis, Pytho kolwensis, Rhysodes sulcatus, Ceruchus chrysomelinus, Dorcus parallelopipedus, Lucanus cervus, Osmoderma eremita, Trichius fasciatus, Typhoeus typhoeus*

LEPIDOPTERA
Cossidae, *Catopta thrips, Pyrgus armoricanus, Eriogaster catax, Lycaena dispar, Lycaena helle, Maculinea alcon, Maculinea arion, Maculinea nausithous, Maculinea teleius, Polyommatus eroides, Polyommatus ripartii, Pseudophilotes baton, Scolitanides orion, Catocala pacta, Xylomoia strix, Boloria aquilonaris, Boloria eunomia, Euphydryas aurinia. Euphydryas maturna, Neptis rivularis, Iphiclides podalirius, Parnassius apollo, Parnassius mnemosyne, Colias myrmidone, Colias palaeno, Chazara briseis, Coenonympha hero, Coenonympha oedippus, Erebia sudetica, Lopinga achine, Minois dryas, Oenis jutta, Proserpinus proserpina*

HYMENOPTERA
Bombus – all species

GASTROPODA
Chilostoma cingulellum, Chilostoma rossmaessleri, Helicigona lapicida, Helicopsis striata, Helix lutescens, Helix pomatia, Trichia bakowskii, Trichia bielzi, Bythinella austriaca, Bythinella cylindrica, Bythinella metarubra, Bythinella micherdzinskii, Bythinella zyvionteki, Valvata naticina, Falniowskia neglectissima, Acicula parcelineata, Lymnaea glutinosa, Gyraulus laevis, Granaria frumentum, Pagodulina pagodula, Pupilla alpicola, Truncatellina claustralis, Vertigo angustior, Vertigo moulinsiana, Deroceras moldavicum, Tandonia rustica, Oxychilus inopinatus, Balea perversa, Charpentieria ornata, Cochlodina costata, Vestia elata.

BIVALVIA
Margaritifera margaritifera, Anodonta complanata, Anodonta cygnea, Unio crassus, Unio pictorum, Unio tumidus, Spheridae – all species.

In addition, some forms of active protection of invertebrates have been introduced in our country. Species included in recovery programs are indicated in Table 4.

Table 4. Species of invertebrates included in recovery programs in Poland (Witkowski, in prep).

Species name	Known wild localities	Place of recovery	Recovery period	Author of data
Margaritifera margaritifera	Species extinct in Poland	Karkonosze N.P, and Lover Silesia	1965	Dyduch-Falniowska 1992
Parnassius apollo ssp. frankenbergeri	Tatry Mts, Pieniny Mts	Pieniny N.P.	1991-2003	Witkowski et al. 1997
Maculinea alcon	Some localities in Poland, declining	Ojców N.P	since 1991	Klasa & Woyciechowski 1991
Maculinea telejus	Some localities in Poland, declining	Ojców N.P	since 1991	Klasa & Woyciechowski 1991
Maculinea nausithous	Some localities in Poland, declining	Ojców N.P	since 1991	Klasa & Woyciechowski 1991
Minois dryas	One locality near Krakow	Nature reserve ‘Kajasówka”	Since 1973	Dąbrowski 1994, 1999
Zygaena carniolica	Species declining in South Polnd	Ojców N.P.	Since early 70	Dąbrowski 1990, 1994

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Assessing the efficiency of European lists of protected invertebrates: a case study of the Alpine region

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Abstract

The efficiency of lists of species protected by the Bern Convention and the Habitats Directive in the context of the Alpine region was tested against three main criteria: (1) risk of regional extinction, (2) endemicity, and (3) ecological specificity. For many species, no detailed data on their threats were available, because of the paucity of distributional and ecological information. Some species that are threatened in most of their European range have populations in the Alps which are not threatened. Because of the peculiarities of the Alpine region, a Red List of Alpine invertebrate species should be compiled. In spite of the high levels of endemism observed in the Alpine region, the European lists include only two endemic invertebrate species. Recognising areas of endemism may be an important tool in selecting particularly important areas. Species included in European lists do not adequately cover the wide range of habitats in the Alps and, in particular, cave species are omitted completely. Nevertheless, a provisional species-area analysis suggests that the number of threatened species increases with area, as might be expected if they are a sample of the total species richness. Therefore, although these lists may be regarded as basically representative, they require substantial improvement.

Introduction

This study aimed to evaluate the efficiency of lists of invertebrate species protected under the Bern Convention (BC) and the Habitats Directive (HD) in the context of the Alpine region. Information on BC and HD, including full species lists of the Annexes, may be obtained from: www.coe.int/t/e/CulturalCo-operation/Environment/Nature and biological diversity/ and http://europa.eu.int/comm/environment/nature/nature conservation/eu nature legislation/habitats directive/index en.htm respectively. To assess if these lists are representative of the Alpine invertebrate biodiversity in need of protection, they were tested against three main criteria for conservation priorities: (1) risk of regional extinction, (2) endemicity, and (3) ecological specificity.

The research formed part of the project *Data collection about protection and defence level of the Alpine flora and fauna*, carried out in Italy by APAT (Agency for the Environmental Protection and Technical Services) within the activities of SOIA (System for the Observation of and Information on the Alps, www.soia.int). This project was developed in response to the protocol of the Alpine Convention dealing with the Conservation of Nature and the Countryside (cf. www.cipra.org and www.convenzionedellealpi.org).

Materials and methods

The study area was that protected by the Alpine Convention. The regions coded by the Eurostat System of Nomenclature of Territorial Units for Statistics - NUTSs (levels 1 and 2) (cf. http://europa.eu.int/ comm/ eurostat/ ramon/ nuts) were used as geographic units. The presence or absence in the Alps, and specifically in each NUTS 1 & 2 unit, of each invertebrate species on the respective annexes of BC (II, III) and HD (II, IV, V) was scored using data from all relevant literature. In particular, most of the information was taken from van Helsdingen, *et al.* (1996a, 1996b, 1996c), with additions and validation from more recent publications (Delmas & Maechler, 1999; Köhler & Klausnitzer, 1998; Ranius & Nilsson, 1997; Sparacio, 2000; Tolman & Lewington, 1997; Turin *et al*., 2003; D'Antoni, *et al.* 2003).

Differences between the percentages of species included in each list on the total number of protected species recorded for the entire Alpine region and those on the total number of protected species recorded for the Italian Alps were tested by using the following test:

$$Z = \frac{P_1 - P_2}{\sqrt{P(1-P)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

where:
P_1=proportion of species included in a given list on the total number of species included in all lists for the entire Alpine region,
P_2= proportion of species included in a given list on the total number of species included in all lists for the Italian Alpine area,
n_1=total number of species included in all lists for the entire Alpine region,
n_2=total number of species included in all lists for the Italian Alpine area,

$$P = \frac{n_1 P_1 + n_2 P_2}{n_1 + n_2}.$$

The null hypothesis H_0: P_1=P_2 is rejected if $Z < -Z_\alpha$ or $Z > Z\alpha$ For p=0.05, $Z\alpha$= $t_{0.05(2)}$=1.960 (and for p=0.01, $Z\alpha$= 2.576, for p=0.001, $Z\alpha$= 3.291).

As to the ecological specificity, several Alpine habitats were selected (ephemeral ponds, high altitude rivers, screes, nival and subnival belts, and caves) and species lists examined to find species belonging to these habitats.

Based on the acknowledged species-area relationship, species richness should be proportional to areas (Fattorini, 2002, 2003). Thus, the number of threatened species should increases with area of NUTSs 2, both by an area effect (increasing numbers of threatened species with sampling area), and because they are a sample of the total species richness (which increases with area). A preliminary analysis was carried out for the Italian NUTSs using this conceptual framework. The Italian NUTSs were selected because of the availability of detailed distributional information. We correlate the total number of protected invertebrates occurring in the Italian NUTSs 2 with the NUTS area. The entire NUTS2 surfaces (even if exceeding the boundaries of the Alpine Convention) were considered.

Correlations between species numbers and areas were tested by Spearman's rank correlation test. A minimum probability level of $p<0.05$ was accepted.

Results and discussion

Risk of regional extinction

A total of 68 protected species listed under the Bern Convention (BC) and the Habitats Directive (HD) are believed to occur in the Alpine region (Appendix 1). The most extensive list is Annex II of HD (44 species), followed by the Annex II to BC (41 species) (Figure 1). When applied to the Italian Alpine area (with 47 of 68 protected species, see Appendix 2), the same analysis gave very similar results (Figure 2).

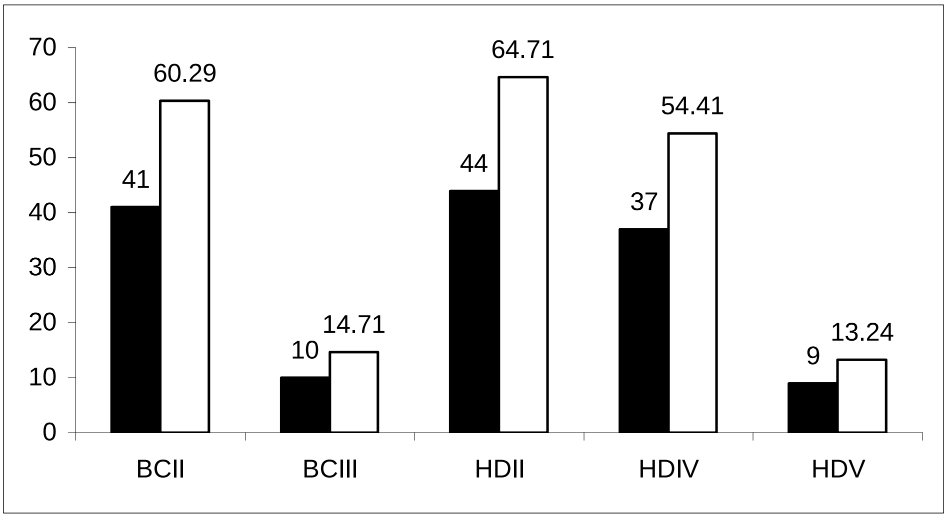

Figure 1. Number of Alpine invertebrate species on the Annexes (indicated by Roman numbers) to the Bern Convention (BC) and Habitat Directive (HD) (solid bars) and their percentage (white bars) of the total number of Alpine species in all Annexes (N=68).

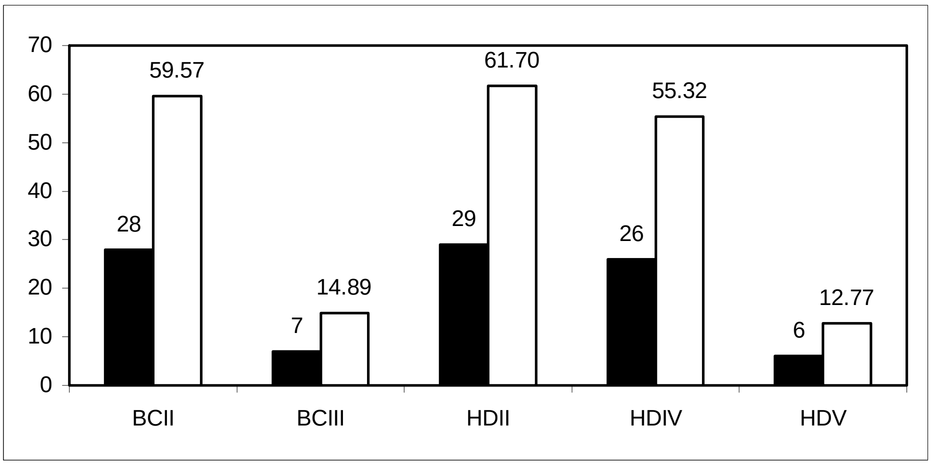

Figure 2. Number of Alpine invertebrate species recorded from Italy and included on the Annexes (indicated by Roman numbers) to the Bern Convention (BC) and Habitat Directive (HD) (solid bars) and their percentage (white bars) of the total number of Alpine species included on all relevant BC and HD Annexes (N=47).

Table 1. Comparisons between the percentage of species included in each list with the total number of protected species recorded for the entire Alpine region (AR) and on the total number of protected species recorded for Italian Alps (IA). Differences were tested using a *Z* test described earlier.

List	AR	IA	Z
BCII	41	28	0.077
BCIII	10	7	-0.028
HDII	44	29	0.329
HDIV	37	26	-0.096
HDV	9	6	0.073

In particular, the percentage of Alpine species reported in each list for Italy was very close to the percentage of Alpine species reported in each list for the entire European data set (Table 1).

Using the sources of data described earlier, the numbers and percentages of species were in similar proportions in the whole data set and in the Italian one. This result shows that for the Alpine invertebrate fauna most of the species, at both the entire European level and at the Italian level, are protected by BC II and HD II. The BC II Annex includes the *strictly protected fauna species* and HD II *the species of community interest whose conservation requires the designation of special areas of conservation*. Also, a high proportion of species is protected by HD IV, which includes *species of community interest in need of strict protection*. Therefore, most of the Alpine species are subject to strict protection, in both the whole list and the list for the Italian Alpine area. However, it is important to note that the BC and HD lists contain much duplication, most of the species being quoted from more then one list. Eighteen species (26%) are recorded from only one list, while 27 (39%) occur in two lists, and well 23 (33%) in three lists. This is mainly because most of the species on the HD annexes were included under the Directive because they were already listed under Annexes to BC. As observed by van Helsdingen (1997), the European Community, after ratifying the Bern Convention, was obliged to introduce EEC legislation to honour its obligations under the Convention, and the Habitats Directive was used for this purpose.

Of the species listed in Appendix 1, only *Heptagenia longicauda* and *Polyommatus humedasae* are included on BC but not on HD Annexes. The actual threat of most species is unknown, because of the paucity of distributional and ecological information. The risk of extinction should be evaluated at international, national and local scales for efficient conservation planning. Therefore, the following four categories for the Alpine invertebrates are proposed.

1. Species that are globally threatened, but which occur only marginally in the Alps and are not threatened here.
These species are of limited importance for Alpine conservation because they are not typical of the Alpine region. Examples include *Lucanus cervus* and *Cerambyx cerdo*. These beetles are typically associated with oak forests and are threatened in most of their range in Europe. In the Alps, where they occur only marginally, they are not considered to be particularly threatened.

2. Species that are both globally, but which occur only marginally the Alps and are locally threatened here.
Although these species are not typical Alpine species, they are of greater importance for the Alpine area, because they are threatened here. Examples include *Osmoderma eremita*, a

scarab beetle associated with oak and beech forests, which is rare and threatened through its range. It occurs in the Alps with scattered populations, which can be considered to be under threat.

3. Species that are globally threatened, which are widely distributed in the Alps and are not threatened here.
These species are of great importance because their Alpine populations may play an important role in species conservation. For species with fragmented populations, source populations must be maintained. Therefore, it is of crucial importance to create 'reservoir' sites from which target species may disperse to areas of suitable habitats in other regions. Examples include *Rosalia alpina*, a longhorn beetle that occurs in the deciduous forests of many European and Asiatic mountain chains, where it is generally threatened. However, in the Alps, where it occurs widely, populations are apparently not threatened.

4. Species that are widely distributed in (or endemic to) the Alps, and which are both globally and regionally threatened.
Examples include the ground beetle *Carabus olympiae*, which is endemic to the Alps, and it is threatened because of excessive collecting and habitat disturbance. Another example, the moth *Graellsia isabelae*, occurs in a few places on the western Alps and the Pyrenees and is vulnerable to the extensive use of insecticides in pine forests.

Endemicity

Two main areas of endemism for the Alpine invertebrates may be recognised: the Western Alps and the Eastern Alps. The Western Alps are characterised by the presence of many endemic species in some taxonomic groups (for example, 24% of ground beetles) (Table 2). Most of these endemic species are of biogeographical importance because they are thought to be relict species, in some cases belonging to ancient European clades (Casale & Vigna Taglianti, 1984, 1992). The Eastern Alps also harbour a number of endemic species (Table 3), especially cave dwelling arthropods in the extensive karst areas of this part of the Alps (Latella & Sbordoni, 2002). However, only two endemic Alpine species*, Carabus olympiae* and *Polyommatus humedasae*, both from the Western Alps, are included in the Red Lists examined.

Table 2. Level of endemism in some invertebrate groups in the Italian Western Alps.

Taxon	Percentage of species endemic to the Western Alps	Reference
Chilopoda	7%	Minelli & Zapparoli, 1984, 1992
Opiliones	14%	Marcellino, 1984
Coleoptera Carabidae	24%	Casale & Vigna Taglianti, 1984, 1992
Lepidoptera Nottuoidea, Bombycoidea and Sphingoidea	3%	Raineri, 1984
Lepidoptera Scythrididae	7%	Passerin D'Entrèves & Zunino, 1992

Table 3. Level of endemism in some invertebrate groups in the Eastern Alps.

Taxon	Percentage of species endemic to the Eastern Alps	Reference
Mollusca (terrestrial)	5%	Boato et al. 1989
Crustacea Isopoda (freshwater)	84%	Stoch, 1989b
Crustacea Cyclopoida	10%	Stoch, 1989a
Opiliones	23%	Marcellino, 1989
Lepidoptera Scythrididae	18%	Passerin D'Entrèves & Zunino, 1992

Ecological specificity

Species that are particularly associated with the following habitats in the Alps are not included on any BC or HD Annexes: ephemeral ponds, high altitude rivers, screes, nival and subnival belts, and caves. Data on the invertebrate communities in these habitats is required to enable more appropriate evaluation to be made of the need to conserve such distinctive habitats.

Species-area relationship

A significant positive correlation was found between the number of invertebrate species protected by BC and HD in Italian NUTSs 2 and the NUTS 2 areas (Table 4). This result suggests that the BC and HD lists are broadly representative of global invertebrate diversity. A significant correlation was also found using only butterflies, which can be therefore considered as representative of other invertebrate groups.

Table 4. Area of Italian Alpine NUTSs 2 and total number of protected invertebrates. The total number of invertebrate species is significantly correlated with area (Spearman Rank correlation test r_s=0.937, p=0.002, N=7).

	Val d'Aosta	Piemonte	Lombardia	Liguria	Trentino-Alto Adige	Veneto	Friuli-Venezia Giulia
Area (km^2)	3264	25399	23859	5418	13607	18365	7844
Protected invertebrates species	15	33	28	17	29	27	25

Conclusions

Incomplete data on distribution, even for well-known insect groups such as dragonflies and butterflies, and the absence of ecological data makes it difficult to use many invertebrates as bioindicators or umbrella species, or to assess their real conservation status. Some species, which are regarded as being threatened in most of their European range, have populations in the Alps that are not threatened. In contrast, the Alps harbour many species that are locally threatened, but which are not included on European lists of protected species because they are threatened in other part of their range in Europe. The Alpine area is recognised as a distinct Biogeographical Region under the Habitats Directive and as a Ecoregion by the Worldwide Fund for Nature. Because of the distinctive composition of the Alpine fauna, and its association with habitats that may be scarce and isolated (but which are often not distinctive botanically), a Red List of Alpine invertebrates should be compiled. In spite of the high levels of endemism among invertebrates observed in the Alpine region, the European lists include only two endemic species, both from the Western Alps. No species endemic to the Eastern Alps is present listed for protection. Recognition of areas of endemism for different groups of invertebrates is a potentially important tool in the selection of areas for conservation. Species included on European lists do not adequately cover the wide range of habitats occurring in the Alps. The complete absence of cave species is particularly notable, because of the extent of caves harbouring endemic species in the karst of the Eastern Alps. Nevertheless, a species-area analysis applied to the Italian Alps suggests that the number of threatened species increases with area. This is to be expected if they are a sample of the total species richness, which is known to generally increase with area. The existing European lists of threatened and protected species are basically representative for conservation purposes, but they need substantial improvement, by including of more species, and removing poorly known species and those that are not truly threatened.

Appendix 1. Invertebrate species included on the Bern Convention (BC) and Habitat Directive (HD) lists and believed to occur in the Alps, within the area covered by the Alpine Convention. Roman numbers refer to BC and HD Annexes.

Order	Family	Species	BCII	BCIII	HDII	HDIV	HDV
STYLOMMATOPHORA	Helicidae	*Helix pomatia*		X			X
STYLOMMATOPHORA	Hygromiidae	*Helicopsis striata*			X		
STYLOMMATOPHORA	Vertiginidae	*Vertigo angustior*			X		
STYLOMMATOPHORA	Vertiginidae	*Vertigo genesii*			X		
STYLOMMATOPHORA	Vertiginidae	*Vertigo geyeri*			X		
STYLOMMATOPHORA	Vertiginidae	*Vertigo moulinsiana*			X		
UNIONOIDA	Margaritiferidae	*Margaritifera margaritifera*		X	X		X
UNIONOIDA	Margaritiferidae	*Margaritifera auricularia*	X			x	
UNIONOIDA	Unionidae	*Microcondylaea compressa*		X			X
UNIONOIDA	Unionidae	*Unio elongatulus*		X			X
UNIONOIDA	Unionidae	*Unio crassus*			X	X	
ARHYNCHOBDELLAE	Hirudinidae	*Hirudo medicinalis*		X			X
EPHEMENOPTERA	Heptageniidae	*Heptagenia longicauda*	X				
ODONATA	Aeshnidae	*Aeshna viridis*	X			X	
ODONATA	Coenagrionidae	*Coenagrion freyi*	X		X		
ODONATA	Coenagrionidae	*Coenagrion mercuriale*	X		X		
ODONATA	Cordulidae	*Oxygastra curtisii*	X		X	X	
ODONATA	Gomphidae	*Lindenia tetraphylla*	X		X	X	
ODONATA	Gomphidae	*Ophiogomphus cecilia*	X		X	X	
ODONATA	Gomphidae	*Stylurus (= Gomphus) flavipes*	X			X	
ODONATA	Lestidae	*Sympecma braueri*	X			X	
ODONATA	Libellulidae	*Leucorrhinia albifrons*	X			X	
ODONATA	Libellulidae	*Leucorrhinia caudalis*	X			X	
ODONATA	Libellulidae	*Leucorrhinia pectoralis*	X		X	X	
ORTHOPTERA	Tettigonidae	*Saga pedo*	X			X	
HEMIPTERA	Aradidae	*Aradus angularis*			X		
COLEOPTERA	Boridae	*Boros schneideri*			X		
COLEOPTERA	Bostrychidae	*Stephanopachys linearis*			X		
COLEOPTERA	Bostrychidae	*Stephanopachys substriatus*			X		
COLEOPTERA	Bupresitidae	*Buprestis splendens*	X		X	X	
COLEOPTERA	Carabidae	*Carabus olympiae*	X		X	X	
COLEOPTERA	Carabidae	*Carabus menetriesi*			X		
COLEOPTERA	Cerambycidae	*Cerambyx cerdo*	X		X	X	
COLEOPTERA	Cerambycidae	*Rosalia alpina*	X		X	X	
COLEOPTERA	Cerambycidae	*Morimus funereus*			X		
COLEOPTERA	Cucujidae	*Cucujus cinnaberinus*	X		X	X	
COLEOPTERA	Dytiscidae	*Dytiscus latissimus*	X		X	X	
COLEOPTERA	Dytiscidae	*Graphoderus bilineatus*	X		X	X	
COLEOPTERA	Elateridae	*Limoniscus violaceus*			X		
COLEOPTERA	Latriitidae	*Corticaria planula*			X		
COLEOPTERA	Leiodidae	*Agathidium pulchellum*			X		
COLEOPTERA	Lucanidae	*Lucanus cervus*		X	X		

COLEOPTERA	Pythidae	*Pytho kolwensis*			X		
COLEOPTERA	Scarabaeidae	*Osmoderma eremita*	X		X	X	
LEPIDOPTERA	Arctiidae	*Callimorpha (=Euplagia, Panaxia) quadripunctata*			X		
LEPIDOPTERA	Lasiocampidae	*Eriogaster catax*	X		X	X	
LEPIDOPTERA	Lycaenidae	*Lycaena dispar*	X		X	X	
LEPIDOPTERA	Lycaenidae	*Maculinea arion*	X			X	
LEPIDOPTERA	Lycaenidae	*Maculinea nausithous*	X		X	X	
LEPIDOPTERA	Lycaenidae	*Maculinea teleius*	X		X	X	
LEPIDOPTERA	Lycaenidae	*Polyommatus humedasae*	X				
LEPIDOPTERA	Nymphalidae	*Erebia calcaria*	X		X	X	
LEPIDOPTERA	Nymphalidae	*Erebia christi*	X		X	X	
LEPIDOPTERA	Nymphalidae	*Erebia sudetica*	X			X	
LEPIDOPTERA	Nymphalidae	*Euphydryas (=Eurodryas) aurinia*	X		X		
LEPIDOPTERA	Nymphalidae	*Hypodryas maturna*	X		X	X	
LEPIDOPTERA	Papilionidae	*Papilio alexanor*	X			X	
LEPIDOPTERA	Papilionidae	*Parnassius apollo*	X			X	
LEPIDOPTERA	Papilionidae	*Parnassius mnemosyne*	X			X	
LEPIDOPTERA	Papilionidae	*Zerynthia polyxena*	X			X	
LEPIDOPTERA	Satyridae	*Coenonympha oedippus*	X		X	X	
LEPIDOPTERA	Satyridae	*Lopinga achine*	X			X	
LEPIDOPTERA	Sphingidae	*Hyles hippophaes*	X			X	
LEPIDOPTERA	Sphingidae	*Proserpinus prosperpina*	X			X	
LEPIDOPTERA	Saturniidae	*Graellsia isabelae*		X	X		X
DECAPODA	Astacidae	*Astacus astacus*		X			X
DECAPODA	Astacidae	*Austropotamobius pallipes*		X	X		X
DECAPODA	Astacidae	*Austropotamobius torrentium*		X			X

Appendix 2. Distribution in Italian Alpine NUTS (level 1 and 2) of protected species included on relevant Annexes to the Bern Convention and Habitat Directive: 1 = definite records ? = doubtful records; 0 = presumed absence; empty cells = insufficient data.

Order	**Family**	**Species**	**NUTS1 North West**	**NUTS2 = Piemonte**	**NUTS2 = Valle d'Aosta**	**NUTS2 = Liguria**	**NUTS1 = Lombardia**	**NUTS2 = Lombardia**	**NUTS1 = North East**	**NUTS2 = Trentino-Alto Adige**	**NUTS2 = Veneto**	**NUTS2 = Friuli-Venzia-Giulia**
STYLOMMATOPHORA	Helicidae	*Helix pomatia*	1	1	1	1	1	1	1	1	1	1
STYLOMMATOPHORA	Vertiginidae	*Vertigo angustior*	1	1	0	0	1	1	1	1	1	1
STYLOMMATOPHORA	Vertiginidae	*Vertigo genesii*	0	0	0	0	0	0	1	1	0	0
STYLOMMATOPHORA	Vertiginidae	*Vertigo geyeri*	0	0	0	0	0	0	1	1	0	0
STYLOMMATOPHORA	Vertiginidae	*Vertigo moulinsiana*	1	1	1	1	1	1	0	1	1	0
UNIONOIDA	Unionidae	*Microcondylaea compressa*	1	1	0	0	1	1	1	1	1	1
UNIONOIDA	Unionidae	*Unio elongatulus*	1	1	0	1	1	1	1	1	1	1
UNIONOIDA	Unionidae	*Margaritifera auricularia*	0	0	0	0	?	?	?	0	?	0
ARHYNCHOBDELLAE	Hirudinidae	*Hirudo medicinalis*	1	1	0	0	0	0	1	1	1	1
ODONATA	Cordulidae	*Oxygastra curtisii*	1	1	0	1	1	1	0	0	0	0
ODONATA	Gomphidae	*Ophiogomphus cecilia*	1	1	0	0	1	1	0	0	0	0
ODONATA	Gomphidae	*Stylurus flavipes*	1	1	0	0	1	1	1	1	1	0
ODONATA	Lestidae	*Sympecma braueri*	1	1	0	0	1	1	1	1	0	0
ODONATA	Libellulidae	*Leucorrhinia pectoralis*	0	0	0	0	1	1	1	0	1	1
ORTHOPTERA	Tettigonidae	*Saga pedo*	1	1	1	1	1	1	1	0	1	1
COLEOPTERA	Bostrychidae	*Stephanopachys linearis*	0	0	0	0	0	0	?	?	0	0
COLEOPTERA	Bostrychidae	*Stephanopachys substriatus*	1	1	1					1		
COLEOPTERA	Carabidae	*Carabus olympiae*	1	1	0	0	0	0	0	0	0	0
COLEOPTERA	Cerambycidae	*Cerambyx cerdo*	1	1	0	1	1	1	1	1	1	1

COLEOPTERA	Cerambycidae	*Rosalia alpina*	1	1	0	0	1	1	1	1	1	1
COLEOPTERA	Cerambycidae	*Morimus funereus*	0	0	0	0	0	0	1	0	0	1
COLEOPTERA	Dytiscidae	*Graphoderus bilineatus*	0	0	0	0	1	1	1	1	0	0
COLEOPTERA	Elateridae	*Limoniscus violaceus*										
COLEOPTERA	Latriitidae	*Corticaria planula*										
COLEOPTERA	Leiodidae	*Agathidium pulchellum*										
COLEOPTERA	Lucanidae	*Lucanus cervus*	1	1	1	1	1	1	1	1	1	1
COLEOPTERA	Pythidae	*Pytho kolwensis*										
COLEOPTERA	Scarabaeidae	*Osmoderma eremita*	1	1	1	0	1	1	1	1	1	1
LEPIDOPTERA	Arctiidae	*Callimorpha quadripunctata*	1	1	1	1	1	1	1	1	1	1
LEPIDOPTERA	Lasiocampidae	*Eriogaster catax*	1	1	0	0	1	1	1	1	1	?
LEPIDOPTERA	Lycaenidae	*Lycaena dispar*	1	1	1	1	1	1	1	1	1	1
LEPIDOPTERA	Lycaenidae	*Maculinea arion*	1	1	1	1	1	1	1	1	1	1
LEPIDOPTERA	Lycaenidae	*Maculinea teleius*	1	1	?	0	0	0	1	0	0	1
LEPIDOPTERA	Lycaenidae	*Polyommatus humedasae*	1	0	1	0	0	0	0	0	0	0
LEPIDOPTERA	Nymphalidae	*Erebia calcaria*	0	0	0	0	0	0	1	0	1	1
LEPIDOPTERA	Nymphalidae	*Erebia christi*	1	1	0	0	0	0	0	0	0	0
LEPIDOPTERA	Nymphalidae	*Euphydryas aurinia*	1	1	1	1	1	1	1	?	1	1
LEPIDOPTERA	Papilionidae	*Papilio alexanor*	1	1	0	1	0	0	0	0	0	0
LEPIDOPTERA	Papilionidae	*Parnassius apollo*	1	1	1	1	1	1	1	1	1	1
LEPIDOPTERA	Papilionidae	*Parnassius mnemosyne*	1	1	1	1	1	1	1	1	1	1
LEPIDOPTERA	Papilionidae	*Zerynthia polyxena*	1	1	0	1	1	1	1	1	1	1
LEPIDOPTERA	Satyridae	*Coenonympha oedippus*	1	1	0	0	1	1	1	1	1	1
LEPIDOPTERA	Satyridae	*Lopinga achine*	1	1	0	0	1	1	1	1	1	1
LEPIDOPTERA	Sphingidae	*Hyles hippophaes*	1	1	1	0	0	0	1	1	0	0
LEPIDOPTERA	Sphingidae	*Proserpinus prosperpina*	1	1	1	1	1	1	1	1	1	1
DECAPODA	Astacidae	*Astacus astacus*	0	0	0	0	0	0	1	1	1	0
DECAPODA	Astacidae	*Austropotamobius pallipes*	1	1	0	1	1	1	1	1	1	1

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German Red Lists for invertebrate taxa at a national level

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Abstract

The current edition of the national Red Lists of threatened animals includes many invertebrate taxa (49 separate lists) and, for the first time, covers the entire territory of Germany including the five new Federal States in the eastern part. The status of more than 15,000 invertebrate species was reviewed for this Red List edition. Almost 40% of these species were classified as threatened (German categories 1, 2, 3, G, and R), and 3% as near-threatened (V). A pilot study on Orthoptera was undertaken to re-assess and evaluate the threat status of species in more detail and to test some new basic principles for threat assessments of invertebrate species in Germany. Work has begun on the process of Red Listing in Germany again, and categories and criteria are being reviewed and reconsidered. The next edition of national Red Lists of animal species is due to be published in 2008, 10 years after the previous lists. This time span is considered adequate to identify and assess new trends and changes affecting all species.

Introduction

The current edition of the national Red Lists of threatened animals was published in 1998 (Binot *et al.* 1998). It covers many invertebrate taxa, with 28 distinct papers, differentiated into 49 separate lists. For the first time all Red Lists in this book cover the entire territory of Germany, including the 5 new Federal States in the eastern part. Some taxonomic groups, such as Pseudoscorpiones, Auchenorrhynchia and three families of Diptera (Syrphidae, aquatic Empididae and Dolichopodidae) had never before been assessed in national Red Lists of Germany.

German Red List categories

The following categories were used for the classification of the species (Table 1). They were adapted from the IUCN categories of 1994 (IUCN 1994), except for categories G (assumed to be endangered, but status unknown) and R (extremely rare or geographically restricted) which are taken from the former IUCN categories Indeterminate (I) and Rare (R) from 1992. The IUCN Red List criteria had been taken into account in developing the criteria to be applied in Germany.

Table 1. Comparison of German Red List categories and IUCN Categories

	German categories (1998)	IUCN categories (1994)		IUCN categories (1992)	
0	Ausgestorben oder verschollen	EX EW	Extinct Extinct in the Wild	EX ?EX	Extinct presumably extinct
1	Vom Aussterben bedroht	CR	Critically endangered	E	Endangered
2	Stark gefährdet	EN	Endangered	V	Vulnerable
3	Gefährdet	VU	Vulnerable	V	Vulnerable
G	Gefährdung anzunehmen, aber Status unbekannt		-	I	Indeterminate
R	extrem selten		-	R	Rare
V	Vorwarnliste	LR:nt	Near Threatened		
D	Daten defizitär	DD	Data Deficient		
		LR:cd	Conservation dependent		

Results

The status of more than 15,000 invertebrate species was reviewed for the current edition of the Red List, including some benthic marine taxa. Almost 40% of these species were classified as threatened according to categories 1, 2, 3, G, and R, and 3% of the species as near-threatened (V). A similar percentage of species were considered to be data deficient (D). Table 2 provides an overview of the threat status of invertebrate taxa. Coleoptera, of which 6537 species were assessed, play a particularly significant role in the overall species figures (Table 2, Figure 1), and account for nearly half of all animals on the Red List. The total number of native vertebrate species, 668, is only 10 % of that for beetles.

The threat levels of the individual invertebrate taxa vary considerably. For example, all the branchiopods (excluding Cladocera) are on the Red List. Most of these species are warm-water animals whose habitats – usually temporary waters – are increasingly disappearing as a result of agriculture and silviculture and activities relating to the management of water resources. The majority of the Thysanoptera (92 %), on the other hand, is not threatened at present, probably because many species of thrips are very adaptable. The figures for the macroLepidoptera approximately correspond to the mean figures for all the animal groups considered and are therefore possibly representative of other animal groups.

Table 2. Threat status of invertebrate taxa in Germany

Species group (scientific name)	**Number of species 1998**	**Red List classification (no. of species)**								**Total [%]**	
		0	**1**	**2**	**3**	**G**	**R**	**V**	**D**	**1-R**	**0-R**
Syrphidae	428	8	16	25	50	58	13	28	14	38	40
Dolichopodidae	325	15	5	22	71	1				30	35
Empididae (aquatic)	c. 50		1	19	23			7		86	86
Ceratopogonidae	(c. 300)	25	26	36	12		6	6			
Psychodidae	c. 160		1	23	15		5	9	5	28	28
Macrolepidoptera	c. 1450	34	99	161	176	15	79	150	8	37	39
Trichoptera	311	11	24	41	56	9	8		2	44	48
Apidae	547	29	21	88	79	49	18	31	35	47	52
Formicidae	108		11	17	31		7	12	3	61	61
Chrysididae	c. 100	1	8	10	9	13			18	40	41
Sphecidae etc. **	449	31	26	39	43	60	8	4	13	39	46
Symphyta	c. 700	14	5	28	66		6		300	15	17
Carabidae/Cicindelidae	553	18	47	74	57		56	65	17	42	46
Coleoptera ***	5984	234	535	838	1084		50	18	11	42	46
Neuropteroidea	111	4	5	7	7	9	5	25	3	30	33
Heteroptera	c. 850	20	118		124	13	15	13		33	36
Auchenorrhyncha	c. 610	3	56	100	88		72	21	29	52	52
Thysanoptera	220		4	5	2	1	6	5	2	8	8
Orthoptera	93	3	14	8	15	3	6	2		49	53
Plecoptera	120	15	7	14	21	8	17			56	68
Odonata	80	2	12	18	12	2	2	5	1	58	60
Ephemeroptera	102	4	11	15	16	6	5		5	52	56
Araneae	956	20	32	99	175	57	131			52	54
Opiliones	45				4		9	1	1	29	29
Pseudoscorpiones	45	1		1	1		14			36	38
Branchiopoda****	12	4	4	4						67	100
Mollusca (excl. marine species)	333	7	36	40	56		26	39		47	50
Marine benthic Evertebrata I	c. 540	4	4	12	29	64	14	2		23	24
Marine benthic Evertebrata II		4	4	4	4	52	18				

Marine benthic Evertebrata I: Porifera, Anthozoa, Polyplacophora, Gastropoda, Bivalvia, Polychaeta, Echinodermata, Echiurioidea
Marine benthic Evertebrata II: Hydrozoa, Oligochaeta, Decapoda, Isopoda, Ascidiacea

** : Pompilidae,Vespidae, "Scolioidea"
*** : not including Carabidae und Cicindelidae
****: not including water flies (Cladocera)

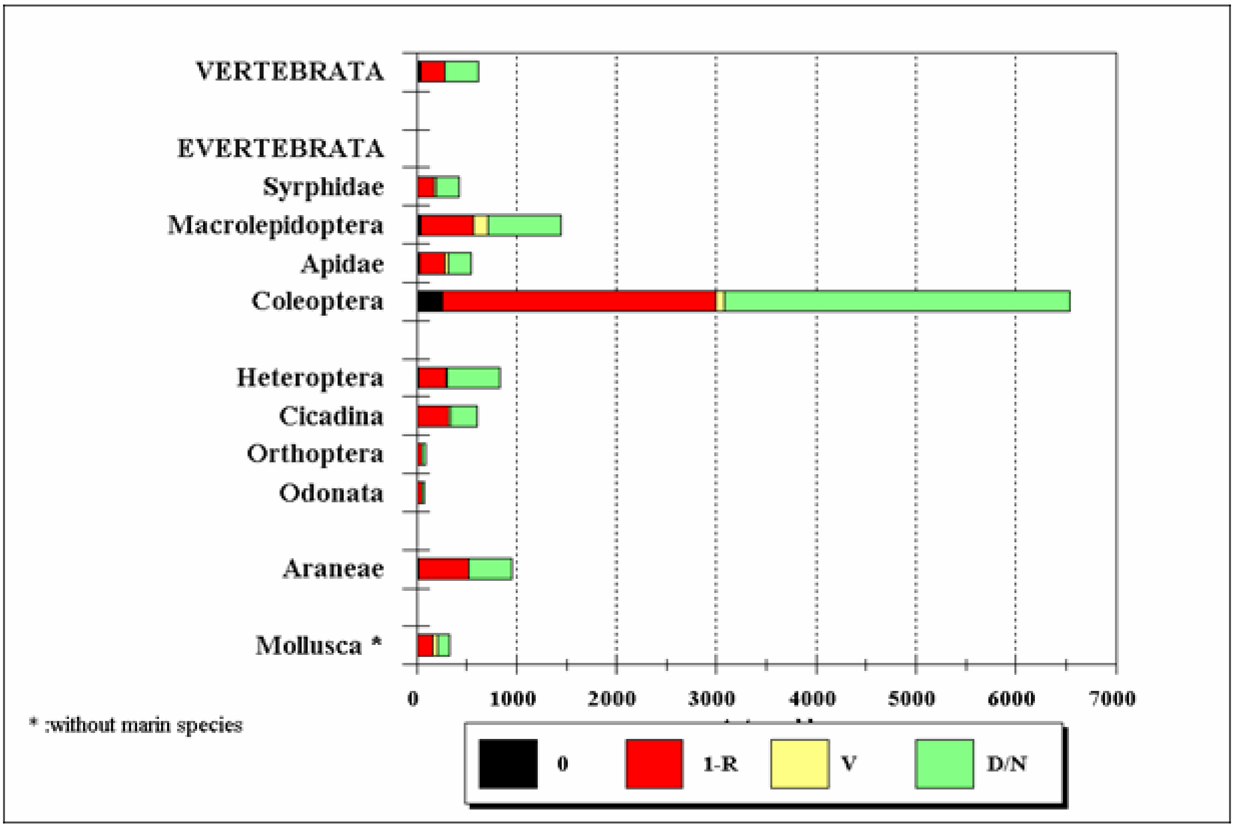

Figure 1. Total numbers of species of selected invertebrate taxa assessed for Red Lists in relation to the respective number of vertebrates (for categories see Table 1; N: not threatened).

Pilot study on Orthoptera

A pilot research and development project on Orthoptera in Germany was launched in 1998 by the Federal Agency for Nature Conservation. In this study, population trends and the current, as well as historical, distribution of all 84 species of grasshoppers, crickets and bush-crickets in Germany was reviewed and analyzed. The aim was to re-assess and evaluate the threat status of these species in more detail and to test some basic principles for threat assessment of invertebrate species in Germany. For assigning species to threat categories a set of criteria was applied, the main criteria being area of occupancy (grid square frequency), degree of isolation and grid square losses (Figure 2). Additional criteria used were: population trend, population size, range of habitats occupied (degree of stenotopy), trend in amount of available habitat, and dispersal activity.

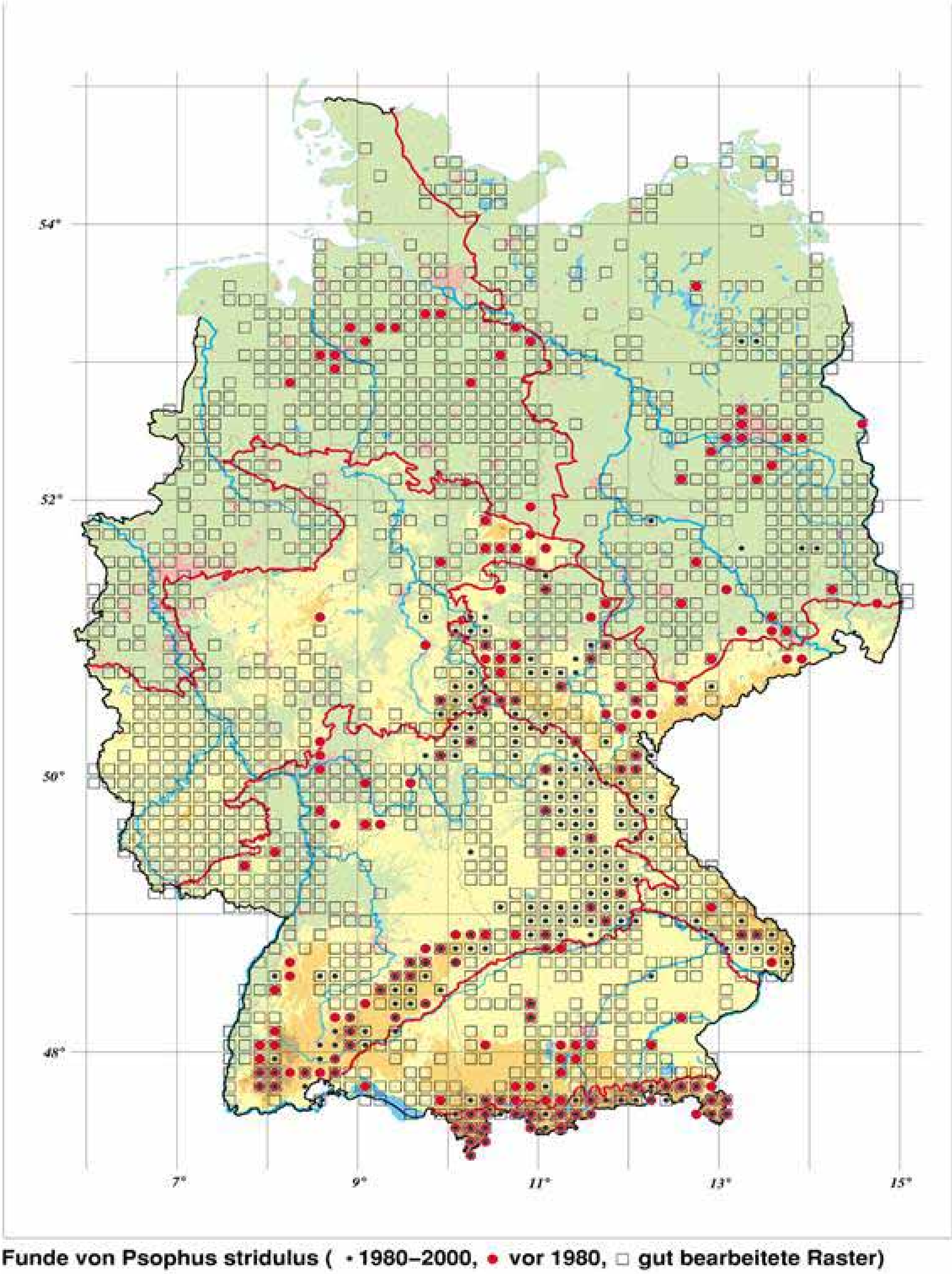

Figure 2. Area of occupancy (in grid squares of approx. 11x11 km, ordnance survey map 1: 25,000) of *Psophus stridulus* in Germany before (red dots) and since 1980 (little black dots). Additionally, well studied grid cells are marked by squares. Grid square losses were calculated only for well studied squares with records before 1980 as difference between occupied squares of both time periods (Figure by courtesy of Dr. S. Maas).

Figure 3 shows the distribution in Germany of *Gryllus campestris*, which is classified as vulnerable (3) in the Red List. This well-known (*Insect of the year 2003* in Germany) and still widespread species suffers from considerable decline in the area and degradation of its habitat, particularly in the northern regions of Germany mainly due to eutrophication and intensive agricultural practices. The project was completed in 2001 and the results, including data sheets and distribution maps of all species, were published by Maas *et al*.(2002).

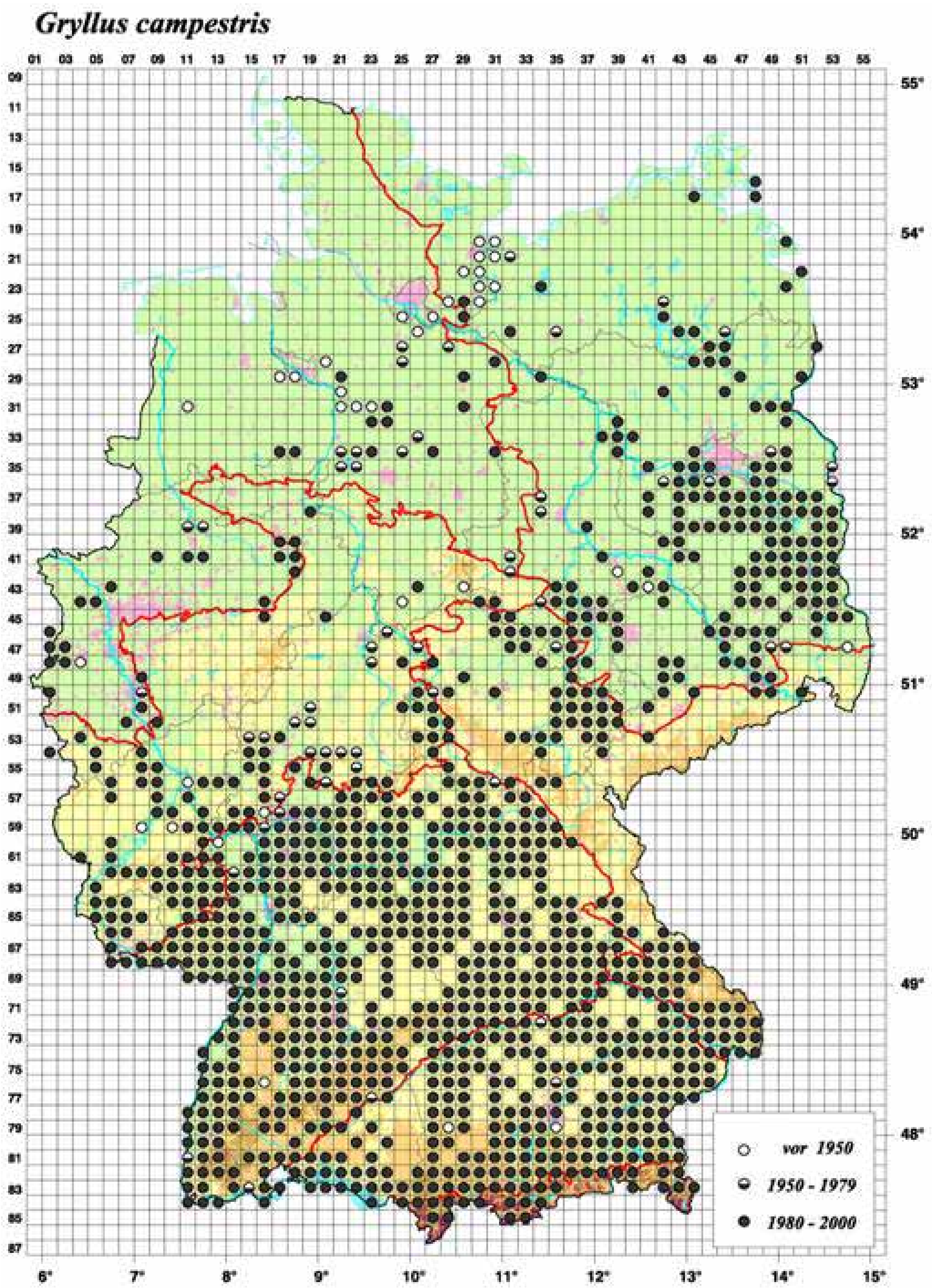

Figure 3: Distribution of *Gryllus campestris* in Germany (grid squares approx. 11x11 km, ordnance survey map 1: 25,000).

Perspectives

The next edition of national Red Lists of animal species is expected to be published in 2008, 10 years after the previous lists. This time span is considered adequate to identify and assess new trends in population development and/or changes in the distribution, range or habitat of all species. The first preparations have been made to begin the process of Red Listing in Germany again and the German Red List categories and criteria are being reviewed and reconsidered. One major aim and advantage of the current German criteria system is its ability to detect species that have undergone moderate declines over long periods, or declines in the past, but are still widespread and/or still quite numerous. The ability to identify this slow but important rate of change is not adequately covered by other red listing systems. This approach also reflects a fundamental provision of the German Federal Nature Conservation Act, which calls for the conservation of species diversity in its historical integrity.

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Trends of invertebrates and Red Lists in the Netherlands

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Abstract

In the Netherlands, Red Lists are an important instrument in governmental nature policy. They are a necessary step towards national species protection plans. The compilation of Red Lists is supported by the government and the lists are published in an official governmental magazine. Official Red Lists have been published covering the following groups of invertebrates: butterflies (Lepidoptera, Rhopalocera), dragonflies (Odonata), grasshoppers and crickets (Orthoptera), bees (Apidae *s.l.*) and terrestrial and fresh water molluscs (Mollusca). A brief summary was given of the Red Lists of invertebrates in the Netherlands, including a comparison between the lists and an explanation of the function of the lists in national nature policy.

The application of invertebrate Red Lists in national and European legislation: the case of Greece

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Abstract

The present study includes an analysis of the invertebrates of Greece that are included in various national and international legislation in comparison with their national threat status. The analysis showed that the European (EU directives and Bern Convention) and national legislation do not cover the invertebrates of Greece adequately because of the high species diversity and levels of endemism, in particular from islands, mountain tops and cave systems. The national threat status has not been assessed comprehensively, but data from both the IUCN world Red List and the existing lists of endemic species indicate that many species, that previously had not been assessed, could be included in the Vulnerable category. This type of gap analysis may assist scientists in countries with high biodiversity, a high level of endemism and a poor knowledge of its fauna, to prioritise their research, and decision makers to create new representative lists that need legal protection.

Introduction

The number of invertebrate species occurring in Greece is unknown today although it is estimated to be between 20,000 and 30,000 (Legakis, 1992). The high diversity of the Greek fauna causes many systematic problems, but it has been studied only sporadically, mainly by foreign researchers, the literature is scattered and in several languages, and collections are similarly dispersed (Legakis, 1983). The number of species of invertebrates in Greece is high in relation to its area (0.22 species/ km^2, when using 30.000 species). This estimate should be compared with markedly lower ratios for other countries: 0.18 species/km^2 for Italy (Minelli *et al*. 1993-1995), 0.09 species/km^2 for the Iberian peninsula (Ramos, 1997) and 0.08 for Sweden (Ronquist, 2002). However, it is unknown how many and which invertebrate species are threatened with extinction in Greece.

Threatened species

Although there is incomplete knowledge, it is probable that at least 10% of the invertebrates of Greece, that is 2-3000 species, are in danger of extinction in the next few years if immediate measures for their protection are not taken (Legakis, 1992). However, a Red List has not been prepared for invertebrates in Greece. The only Red List that exists is one for vertebrates (Karandeinos, 1992). The most recent IUCN Red List (Hilton-Taylor, 2000) includes 41 invertebrate species that occur in Greece, with 20 species classified as vulnerable, 14 as lower risk and seven as data deficient. Table 1 shows the number of IUCN Red List species in groups of invertebrates.

Table 1. Number of invertebrate species that occur in Greece and are listed in the IUCN Red List (Hilton-Taylor, 2000).

	VU	LR	DD
Leeches	-	1	-
Bivalves	-	1	-
Gastropods	1	4	3
Spiders	-	-	1
Crustaceans	3	-	-
Beetles	5	1	-
Ants	10	3	-
Butterflies	1	4	3
Totals	20	14	7

Some of these threatened invertebrates may have a very limited distribution while others may be widely distributed, outside the borders of Greece, but may occur in Greece in small and scattered or isolated populations.Habitats which host threatened species include:

- caves, which host very specialized species with small populations;
- wetlands and fresh waters;
- sand dunes;
- old forests, which are burned or felled for exploitation;
- cultural landscapes – areas where traditional agricultural practices, that were applied for many centuries, have been replaced recently by mechanization and the use of agrochemicals.

Marine habitats with hard substrates are of special interest because they host many invertebrates, such as sponges, cnidozoans, polychaetes, molluscs, crustaceans and echinoderms. The marine phanerogam *Posidonia oceanica* forms a habitat that is host to a specialized invertebrate fauna, but *Posidonia* beds are sensitive to pollution and are seriously threatened, and the fauna is continuously shrinking along with them (Legakis 1992).

Very little is known about the population status of most threatened invertebrates. For some narrow endemic species we know that only a few hundred individuals may exist (Deeleman-Reinhold, 1983). Knowledge of the populations of some other species is restricted to the fact that they are continuously in decline (Mylonas, 1983). No data exist about many species for which we have to suppose that they are declining, based on their ecology and the threats they face. The main threat of the invertebrate populations is the destruction of their habitats. Apart from this, invertebrates suffer from the direct interference of man. There are many invertebrate species that are collected either for consumption or for trade.

National legislation

The protection of the invertebrates in Greece is almost certainly insufficient, although some invertebrate species are protected by Presidential Decree 67/81. The list of species protected by this Decree is unbalanced and incomplete, but for those few that are listed it is prohibited to collect, kill, harm, damage, own, preserve, buy, sell, transport or export them.

International legislation

Under the Bern Convention, 38 invertebrate species that have been recorded from Greece are included on Appendix II and a further 19 are included on Appendix III (see Table 2).Greece has also ratified the CITES convention that restricts trade in threatened species such as the butterfly *Parnassius apollo*, the medicinal leech and several corals. The Habitats Directive of the European Community includes 15 species occurring in Greece on Annex II (3 of which are priority species), 20 species on Annex IV (9 of which are also on Annex II), and 8 species on Annex V (see Table 2).

Table 2. Number of species occurring in Greece that are included on the Bern Convention (BC) and the Habitats Directive (HD).

	BC App. II	BC App.III	HD Ann. II	HD Ann. IV	HD Ann. V
Sponges	3	4	-	-	-
Corals	1	2	-	-	1
Leeches	-	1	-	-	1
Bivalves	3	2	1	3(1)	2
Gastropods	9	1	-	1	
Crustaceans	1	7	-	-	3
Dragonflies	3	-	2	3(2)	-
Butterflies	11	-	4	9(2)	-
Beetles	4	1	6	4(4)	-
Echinoderms	3	1	-	1	-
Totals	38	19	15	20(9)	8

(Numbers in parenthesis indicate species also in HD Annex II)

Assessment of the effectiveness of the legal protection of species

The selection of species for legal protection uses many criteria. One way to estimate the effectiveness of legally protected species is to assess their threat status. In the case of Greece, this was possible only by using the world Red List of IUCN (Hilton-Taylor, 2000). Table 3 shows the degree of overlap between the invertebrates listed on the Bern Convention BC), the Habitats Directive (HD) and the IUCN Red List (IUCN). Although there is a high degree of overlap between the two legal instruments (BC and HD), there is much less overlap between them and the IUCN Red List. O the 41 IUCN species, 14 vulnerable, 12 lower risk and 4 data deficient species do not appear in the strictly protected species annexes of international legislation.

Table 3. Degree of overlap of species listed in legislation (Bern Convention (BC) and Habitats Directive (HD)) and in IUCN Red List (Hilton-Taylor, 2000).

A/B	A	Overlap	B
BC(Ap.II)/HD(An.II+IV)	38	21	25
BC(Ap.II)/IUCN	38	10	41
HD(An.II+IV)/IUCN	26	11	41

Endemic species

Although figures are available for a few taxonomic groups (Table 4), it has been estimated that Greece has more than 5000 endemic species of invertebrates. They are most numerous in Crete, in the Cyclades islands and on the mountains of mainland Greece (Sfenthourakis & Legakis, 2001). Caves are the habitat with the most endemic species. The animal group with most endemic species is the Coleoptera, with Gastropoda Pulmonata, Orthoptera and Isopoda also having many endemics (Figure 1).

Table 4. Number of endemic species of several invertebrate groups (Ministry of Environment, Physical Planning and Public Works, 1998).

TAXA	SPECIES	ENDEMIC SPECIES
Orthoptera	317	113
Trichoptera	255	59
Heteroptera	811	36
Psocoptera	75	6
Siphonaptera	57	1
Gastropoda (fr. water)	~40	12
Bivalvia	293	1
Scorpiones	6	1
Chilopoda	~100	25
Isopoda (Terr.)	195	134
Decapoda	231	1
Cnidaria	91	1
Totals	2471	390 (15.7 %)

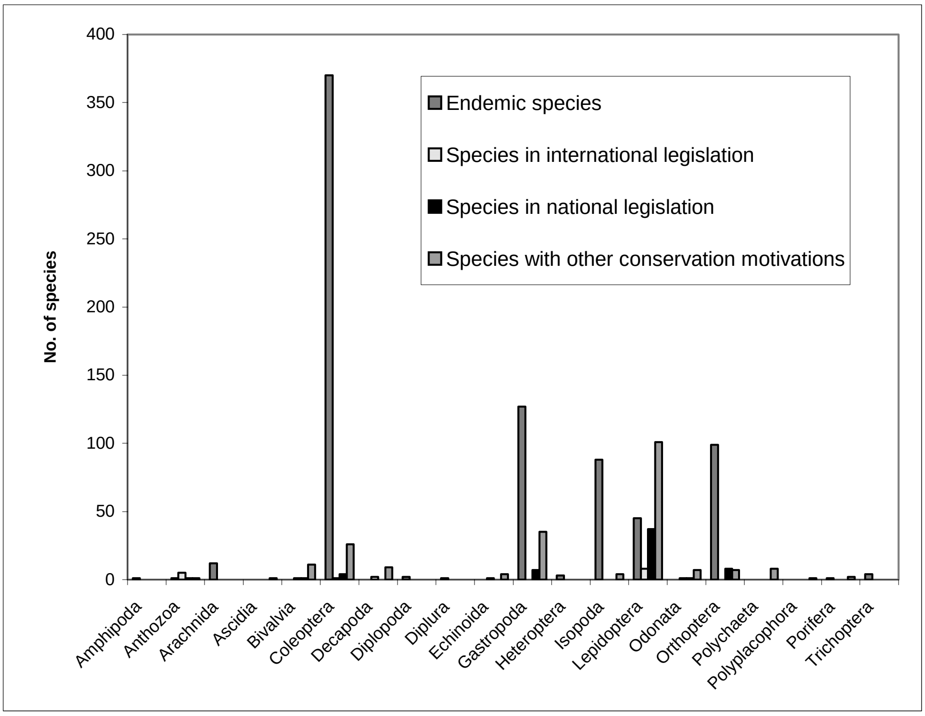

Figure 1. Number of species in each animal group present in proposed Special Areas of Conservation and grouped according to their: a) endemic status, b) presence in international legislation, c) presence in national legislation, and d) other conservation factors, such as being present only in Greece and a small part of an adjacent country, having their northernmost, southernmost, easternmost or westernmost border of distribution in Greece (from Lazaridou-Dimitriadou & Legakis, 1996).

Endemic species may have a very limited distributional range. For example,there are more than 90 islands in Greece with an area between 1 and 20 km^2 and many that are smaller than 1 km^2. Species that are endemic to these islands will automatically fall into the threat category Vulnerable, criterion D2 (IUCN, 2001)). Examples include *Zonites astakidae* (Gastropoda, Zonitidae), *Albinaria janisadana* (Gastropoda, Clausiliidae), *Alpioniscus giourensis* (Isopoda, Trichoniscidae)) and *Paraschizidium falkonerae* (Isopoda, Armadillidiidae).

The case of the Orthoptera

Sixty-two species (20%) of the Orthoptera of Greece are classifieda s Vulnerable because they occupy an area less than 20 km^2 or because they are restricted to less than 5 locations (Willemse, 1984). Some of them, especially cave species, may be Endangered or even Critically Endangered. *Chorthippus lacustris* is a characteristic example because it was, until recently, recorded from only one location, a small wetland near the town of Ioannina in northwestern Greece (La Greca & Messina, 1975). Plans to transform this wetland into a housing complex have met with strong complaints from local and national organizations. More recently the species was recorded from two more locations (Fer Willemse, pers. comm.), but the species still has a Vulnerable status.

Of the 62 endemic species of Orthoptera, 15 are from islands, 24 are from mountains, 19 are cave species and four are found in other habitats (Willemse, 1984). None of these species listed on any international legislation, and only nine species are included in the national legislation.

Conclusions

Greece is a small country with high biodiversity, a high level of endemism and poor knowledge of its fauna. In this it is typical of many nations worldwide. Four important questions arise from the example of Greece outlined above.

Are the narrow endemic species really narrow?

The lack of knowledge suggests that for many cases, species with a narrow distribution may in reality be more widely distributed and may not even be endemic only to Greece. One such example is the gastropod *Zonites casius*. It was first recorded in 1889 (Martens, 1889) from the island of Kasos and for 100 years it was considered as an endemic of the Dodecanese islands. In 1987 it was discovered on the adjacent western part of Asia Minor (Riedel, 1987).

Should we postpone taking actions to protect these species until we have concrete proof of their status?

In this case, the answer should be negative. Even if a species proves later not to be threatened, following the precautionary principle, it is better to act now than to risk losing it.

Will legislation be effective in safeguarding endemic and threatened species?

Legislation will not be effective if it includes long lists of scientific names that enforcement authorities need to be able to identify. This has been the case with Presidential Decree 67/81. The protection of species needs to be coupled with protection of their habitats, which in turn must take into account the special habitat requirements of invertebrates. At the same time, there is need for a widespread campaign to educate and raise awareness of the importance of invertebrates.

Do we protect all their habitats, that is, all caves, all mountain tops, and all small islands?

We need to be able to take effective measures to manage all these areas, which will allow for some kind of human interference, but will be specifically directed towards invertebrates rather than, for example, the flora, birds or reptiles. These areas are normally sparsely populated with either humans or large vertebrates. Therefore, they need management that will almost certainly differ from the traditional forms of management of other types of protected area.

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Protection of invertebrates in Latvia

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Abstract

Currently, Latvia still possesses high invertebrate diversity that is characteristic for the biogeographical region. The conservation of nature has developed dynamically during the last 10 to 15 years in Latvia. Work to compile Red Lists of invertebrates in Latvia started in 1991 based on simplified IUCN categories (Extinct, Endangered, Vulnerable, Rare and Undetermined species). The list includes 131 invertebrate species. The Red Data Book was issued in 1998, but no longer corresponds to the latest knowledge about invertebrates. National legislation Acts in 2000 and 2001, on the protection of animal species, mostly include the same species, with the addition of Bern Convention species (in force in Latvia since 1997) and species on the EU Directive on Conservation of Species and Habitats 92/43/EEC. During 2001 to 2003, as part of the Emerald project, new data were collected about invertebrates, mainly from protected nature areas. This enabled invertebrates to be integrated into the management plans of some protected areas and to start to develop species protection plans. Only one species, pearl mussel *Margaritifera margaritifera*, has a completed species management plan. Current pressures on species and habitats, such as the expansion of intensive farming, a sharp increase in forest logging and a steady increase in building, are motivating scientists to pay more attention to the protection of invertebrates and their habitats. Major activities in nature conservation are linked to the implementation of the Bern Convention and EU directives. Invertebrates are included in the National Biodiversity Monitoring Programme in Latvia.

Habitats, distribution and conservation status of the Habitats Directive Lepidoptera in Hungary

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Abstract

UTM grid maps of 26 Lepidoptera species were presented and analysed. The Habitat Directive species (Annex II-IV), European and Hungarian Red List species were compared. The main types of distribution, biogeographical significance for the Pannonian region, trends and possible factors of changes were discussed. Data on habitats, life cycles, larval food-plants, imago nectar sources and symbiotic interactions were presented. The connections between Annex I and II were discussed. The use of Lepidoptera as an “umbrella” group, with “flagship species” to characterise the Habitats of Annex I was discussed. Threat factors and conservation measures will be considered.

Fauna Europaea and Species 2000 Europa – major taxonomic resources for management of invertebrates

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Abstract

Two projects, both funded under the European Union's fifth framework programme, will provide taxonomic information for a broad range of users. Fauna Europaea will provide taxonomic, including synonymic information on an estimated 130,000 species of European non-marine animals, as well as distributional information mostly at the national level. Species 2000 Europa, via its predecessor Species 2000, is a core member of the "Catalogue of Life" consortium which aims at providing a complete list of names, including synonyms, of all known living organisms on earth, thereby fulfilling one of the priorities of the Global Biodiversity Information Facility. Correct names, and – not the least – information on synonymy, is of paramount importance in obtaining high quality Red Lists and other instruments for the protection and preservation of invertebrates, as well as other living species.

Linking faunistic databases together - a road to European grid maps?

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Abstract

Ever since the European Invertebrate Survey (EIS) was set up, computing technology has steadily increased. Many computerised databases of faunistic records have now been established. Using the internet, we are now used to linking information together, both at work and at home. Therefore, it should be easy to link faunistic databases together to create European grid maps for species. The EISnet group has a simple goal: to link together some example databases that hold records of a small number of species, to produce grid maps of all or parts of Europe. Although this is difficult enough, the difficulties increase quickly if you try to link more species and more databases for a larger range. The hardware and software are not the limiting factors. The main problems are caused by the apparent incompatibility of geographical and nomenclatural data, the heterogenous data density and data quality, and especially the problems of getting organisation to work together. All these problems were explained by some examples, and proposals for their solution were made.

Invertebrate Red Lists, legislative tools and management effectiveness for biodiversity conservation at local to pan European scales

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Abstract

The use of Red Lists to highlight species that are particularly worthy of protection is an important instrument of legislative conservation biology. However, the difficulties surrounding the creation and use of Red Lists for most invertebrate groups mean that attention is often focussed upon other groups of organisms, such as flowering plants, birds or mammals. This approach ignores the significance of invertebrates as a major driving force behind most ecosystems; to neglect their conservation is to neglect the maintenance of a key component in ecosystem function. This imbalance could be overcome by what is essentially a marketing approach to promoting the importance and relevance of invertebrates in biodiversity conservation. Existing international conservation institutions and organisations (for example, European Invertebrate Survey, Planta Europa, IUCN, Council of Europe) could promote better integration of information on invertebrate Red Lists with other types of nature protection, and with efforts to protect other groups of organisms. As well as enabling invertebrate Red Lists to gain a higher level of credibility, and with this general acceptance, the strategy would have the potential to greatly increase the effectiveness of management for nature protection as a whole. Invertebrate Red Lists would thus be able to play a much stronger role in issues of, for example, site design of protected areas, appropriateness of management systems and processes, and delivery of specific objectives at a particular site, nationally and across Europe.

Observations on the implementation of the Bern Convention, the Habitats Directive and the European Water Framework Directive

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Abstract

Examples of the practical application of Red Lists and legislation in environmental impact assessments are discussed and recommendations are made to improve the standards of such assessments.

Introduction

Considerable time and effort has been spent on drawing up Red Data Lists, at international, national and regional levels, but few of those that have prepared these Lists have experienced how the information contain in the Lists is subsequently used. During the past ten years I have been involved with national and local governmental public inquiries into planning applications in south west Scotland. From this experience, I have been concerned by the lack of reference to the Bern Convention, the Habitats Directive and the European Water Framework Directive.

Three Environmental Impact Assessments (EIA)

Scottish-Irish Electrical Inter-connector

The Scottish-Irish Electrical Inter-connector project was proposed to pass electricity cables from Drongan to Ballantrae in Ayrshire and then continue on the sea-floor to Ireland. The EIA prepared in 1994 for the applicant stated that the route (some 50 km long in Ayrshire) was *devoid of any fauna or flora of any consequence*. The EIA appeared to disregard the fact that the route would cross the River Doon near Patna. This river has been renowned for its 'Doon Pearls' for over 200 years and still had a population of the freshwater pearl mussel, *Margaritifera margaritifera*. This omission in the EIA was unfortunate and surprising at a time when the importance of this species was well publicised in the Scottish local and national press, and on television. This publicity was due to increased legislation for its protection being proposed by the Bern Convention and Council of Europe; it was already granted limited protection in Great Britain though the 1991 Variation to the Wildlife and Countryside Act, 1981. My involvement in public enquiry came about quite by chance but, as a consequence, I was able to submit observations to the Public Inquiry. As a direct result, the route of the pylons adjacent to the River Doon was modified, so that the effects on the river of their construction were kept to a minimum. This same EIA highlighted another problem with basic standards. Authors' names were omitted from lists of the fauna and flora, and the list of marine fauna included a species of *Patella* that was unknown to me and apparently new to science.

Flood prevention barrier

In 1999, I was shown an EIA for a flood prevention barrier in south west Scotland. Again, the EIA was without reference to species listed on the Bern Convention or the Habitats Directive although the river in question contains a breeding population of Atlantic salmon, *Salmo salar*, and a relatively rare damselfly. A nearby wetland is frequented in winter by marsh harriers *Circus aeruginosus* and wildfowl. The number of visits to the area in order to produce the assessment of its fauna and flora was not stated.

Loudoun Hill quarry

In the summer of 2001 I became involved with the EIA for Loudoun Hill, regarding an application to extend sand and gravel quarries. Loudoun Hill forms the boundary between East Ayrshire and South Lanarkshire and, due to its strategic position, has played a significant role in Scotland's historic past being site of battles in 1297 and 1307 during Scotland's war of independence. I have known the site for more than 20 years. In 1980 the quarry was at most 20 hectares with the old quarry face supporting a colony of more than 2,000 sand-martins, *Riparia riparia*. Since 1980, mechanised extraction methods have greatly extended the area and depth of the quarry, and removal of peat deposits has led to the destruction of several archaeological sites. The topography of this historic locality has totally changed. Loudoun Hill is also the source for two river catchments, the River Irvine, which flows in a westerly direction, and the easterly flowing River Avon.

The extraction of sand and gravel, both past and present, has lowered the water table in the area. This is demonstrated by major changes in the water flow of the two rivers and by many domestic wells in the vicinity of Loudoun Hill that have become dry. The EIA on the fauna and flora was based solely on ten site visits in June 2001, of which only four actually took place on the site, two of these being undertaken during heavy rain, and no lists of fauna or flora were produced. Due to our objections, a hasty survey for badgers, *Meles meles*, was undertaken, which proved negative – hardly surprising when the site is heavily illuminated for 24 hours per day

Conclusions

The current use of Environmental Impact Assessments in landscape scale planning is not satisfactory. There is no basic standard or quality control, with individual assessments apparently depending upon chance, especially in regard to fauna and flora.

Recommendations

1. It is recommended that standards should be set to include the following in all Environmental Impact Assessments and to ensure that these standards are followed.

Verification of the presence or absence at the site in question, of all species listed on:
Bern Convention and Habitats Directive,
National Red Data Lists of the country concerned,
Local Biodiversity Action Plans for the region concerned.

A full list of fauna and flora should be included in the EIA, based, as far as practicable, on recording at the site throughout the year and consultation with relevant international, national, regional and local biological data centres. A copy of the list should be lodged for public access with an appropriate data centres.

Determine whether the site formerly held any species protected by legislation or Red Data species, which might provide opportunities for their future natural expansion or re-introduction.

Determine whether the proposed area is a type locality or one of special significance for the distribution of any particular species.

Full consultation must take place with other interested parties including the local community, historical monuments and archaeology trusts, Forestry Commission, farmers, angling associations, and any others with a legitimate interest in the area in question.

2. National and local governmental organisations, as well as all societies and action groups concerned with the natural sciences, should consider the establishment of Environmental Conservation Officers in order to ensure that all interested parties play an active part in decision making relating to all types of planning.

Red Data Book of European Butterflies – a pragmatic approach to target conservation action

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Abstract

The *Red Data Book of European Butterflies* was published in 1999 using data collected through a network of over 50 expert national compilers. Its aims were to provide an objective overview of the present distribution and trend of all 576 butterfly species and identify priorities for conservation action using the new IUCN Red List criteria. As the quality of data varied considerably between the 45 countries that make up the Council of Europe, it was necessary to make pragmatic decisions over data quality, whilst taking advantage of the vast amount of information available from recording schemes and local entomologists. The analysis showed that 71 species are threatened in Europe (12% of the total) because of either their extreme rarity or rapid decline. Of these 19 species are threatened globally and 52 are threatened at a European level. A further 43 species are classified as Lower Risk (near threatened). A follow-up project has identified *Prime Butterfly Areas in Europe* where conservation should be targeted as a priority. Due to constraints of time and resources, this review was not comprehensive and concentrated on identifying the most important (prime) areas for 34 target species, again using the network of national compilers. The book gives details of 431 areas covering 1.8% of the land surface of Europe. It shows that target species are declining in one quarter of these prime areas, indicating that breeding habitats are continuing to deteriorate even though many are protected by national designation. The main threats are from agricultural intensification, afforestation, abandonment of traditional practices, and isolation. The results of these two projects provide useful models of what can be achieved at a European scale and demonstrate the effective collaboration of experts in many countries to achieve shared conservation objectives.

Introduction

The decline of Europe's butterflies has been recognised for many years (e.g. Heath, 1981; Pavlicek-Van Beek *et al*., 1992; Pullin, 1995), but the full scale of the problem was not known until the publication of the *Red Data Book of European Butterflies* (Van Swaay & Warren, 1999). The report was produced at the request of the Council of Europe by De Vlinderstichting (Dutch Butterfly Conservation) and Butterfly Conservation (UK), with additional funding from English Nature.

The main aims of the Red Data Book were to provide an objective overview of the present distribution and trend of all butterfly species within each European country, and identify priorities for conservation action using the new IUCN Criteria for Red Lists. The report also aimed to identify the main problems facing threatened species and summarise these in species fact sheets.

Europe is a large and diverse region and the quality of data varies considerably between the 45 countries that make up the Council of Europe. It was therefore necessary to make pragmatic decisions over data quality, whilst taking advantage of the vast amount of information available from country recording schemes and the expert knowledge of local entomologists. We viewed the Red Data Book not as an end in itself, but rather as a means to an end, namely the better conservation of butterflies in Europe using the best available data. We were conscious that data on butterflies are probably better than for nearly every other invertebrate group, making them a useful group to test the applicability of the IUCN criteria as applied to invertebrates. In this paper we present a summary of the method and main results of the *Red Data Book of European Butterflies* and of a follow up project to identify *Prime Butterfly Areas in Europe*, where conservation efforts should be focused.

Red Data Book of European Butterflies

Methods

Information was gathered from all European countries belonging to the Council of Europe, including Madeira, the Azores, the Canary Islands, Cyprus, the whole of Turkey and Russia east to the Urals. Distribution and trend data were collected for each country through a network of over 50 expert national compilers who each completed a questionnaire in 1997. For each native species the questionnaire had to be completed with information on:

- The quality of the data;
- The present distribution in five classes;
- The trend in species distribution over the last 25 years;
- The habitat by CORINE code.

Data were obtained for all countries except Iceland and the republics of the Caucasus.

The resulting database allowed an objective, quantitative assessment of the threat and conservation status of each species. A provisional report was sent to compilers and other experts for checking and revision. Finally, datasheets were compiled on threatened species by sending a further questionnaire to compilers in 1998, with detailed questions on habitat requirements, threats, conservation measurements and references.

Threat status was assessed by following the new criteria of the World Conservation Union (IUCN) as closely as possible, adapting them for use with the distributional data available for butterflies. For species restricted to Europe (189 endemic species, 33% of the total) the new criteria (IUCN, 1994) were applied directly, while for species that also occur outside Europe the criteria were adapted for use at the continental level.

The new IUCN criteria are based on estimates of rates of decline and extinction risk as well as rarity. One result is the inclusion of widespread but rapidly declining species, highlighting large-scale changes that might otherwise have been ignored until species reached critical levels. The new criteria are felt to be the best available method for assessing conservation priorities and identifying species requiring conservation action.

Criteria were developed to identify Species of European Conservation Concern (SPECs) according to their global and European status, and to the proportion of their total distribution that occurs in Europe. The aim of this assessment is to identify species that are of conservation concern at a European scale, following the concept of Tucker & Heath (1994). SPECs are divided into four categories depending on their threat status and the part of their world range in Europe:

SPEC 1: Species of global conservation concern because they are restricted to Europe and are considered to be globally threatened.
SPEC 2: Species whose global distribution is concentrated in Europe and are considered to be threatened in Europe.
SPEC 3: Species whose global distribution is not concentrated in Europe, but are considered to be threatened in Europe.
SPEC 4: Species whose global distribution is restricted (SPEC 4a), or concentrated (SPEC 4b) in Europe, but are not considered to be threatened.

Results

The analysis showed that a total of 71 European species are threatened (12% of the total), comprising 19 threatened at a global level and 52 threatened at a European level. Amongst the species that are endemic to Europe and are globally threatened:

- 1 species is *Critically Endangered;*
- 4 species are *Endangered;*
- 14 species are *Vulnerable.*

The European threat status for species that are also found outside Europe is:

- 1 species is *Extinct*;
- 6 species are *Critically Endangered*;
- 14 species are *Endangered*;
- 31 species are *Vulnerable*.
- A further 43 species are classed as *Lower Risk* (near threatened).

The number of species per SPEC category is shown in Figure 1. All European countries (except Malta) contain one or more threatened species, but the highest concentrations are in the east, notably the European part of Russia, Ukraine and the Asian part of Turkey (Figure 2). Although low numbers of threatened species occur on the Azores and Madeira, these islands are of considerable importance for several endemic and globally threatened species (SPEC 1).

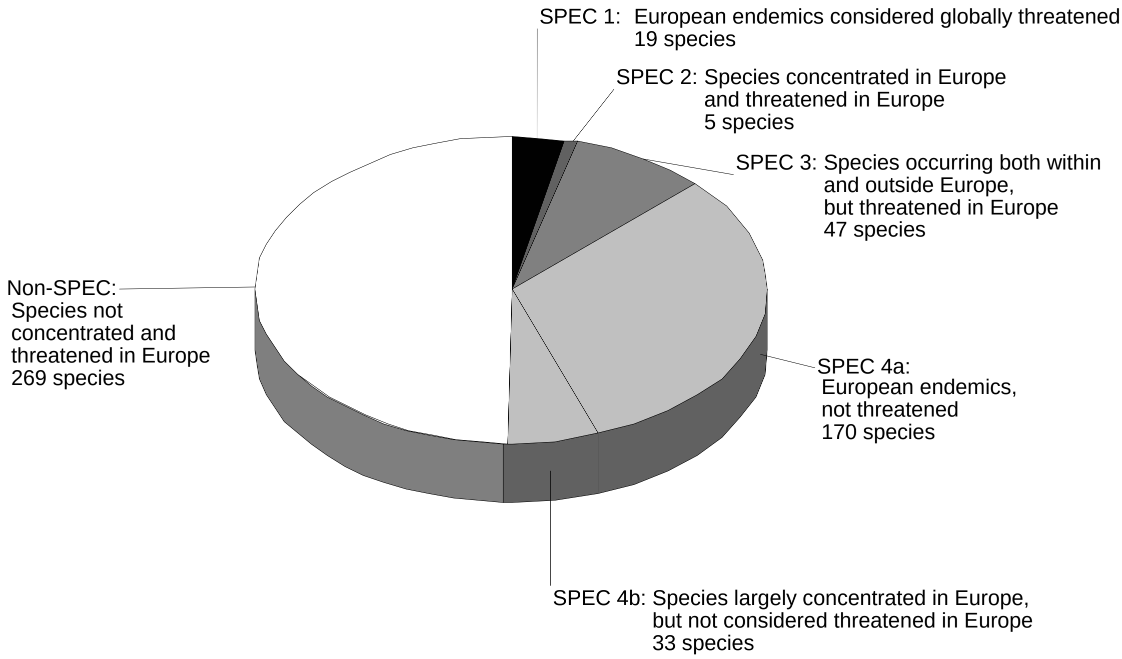

Figure 1. Proportion of European butterflies within each SPEC-category.

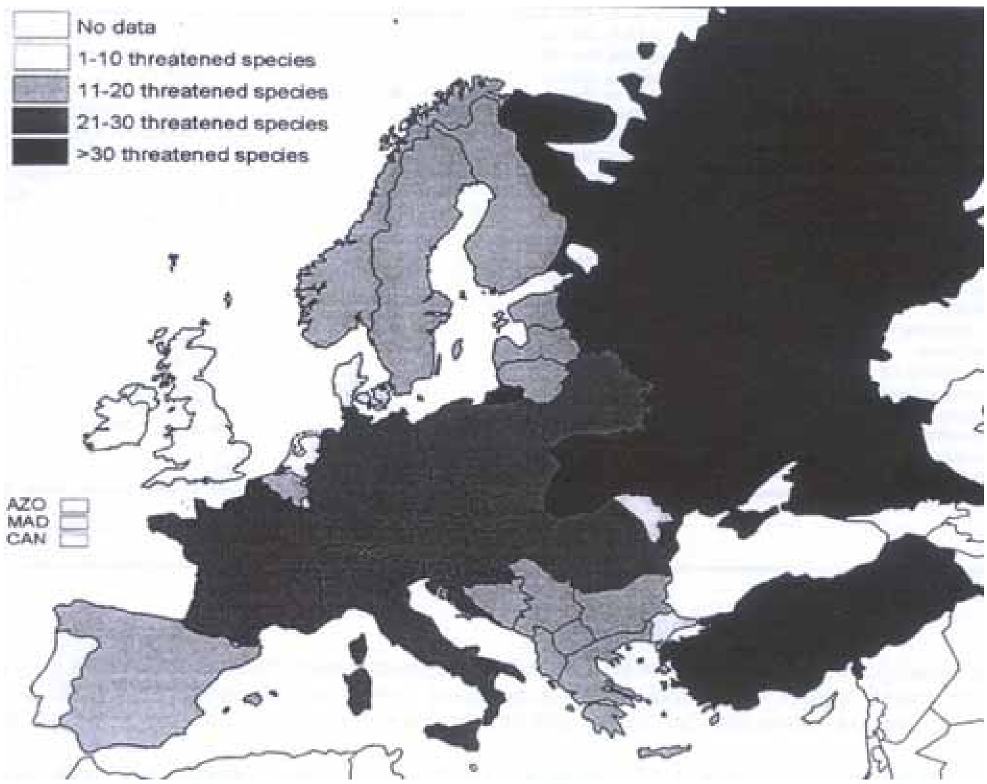

Figure 2. Number of threatened butterfly species (SPEC 1-3) per country.

The main threats reported for threatened butterfly species are:

- Agricultural improvements, affecting 90% of the threatened species (for example, conversion of unfertilised grasslands to arable crops and application of artificial fertilisers);
- Built developments and urbanisation, affecting 83%;
- Increasing use of herbicides and pesticides, affecting 80%;
- Abandonment of agricultural land and changing habitat management, affecting 65%.

The widespread loss and reduction in size of breeding habitats is also a growing threat due to habitat isolation and fragmentation which is now affecting 83% of threatened species. However, the precise nature of these threats varies considerably between countries, reflecting the range of habitats used by species within their range across Europe, and the many different political and cultural systems and land-use practices.

Discussion

The results confirm what has long been suspected, namely that many butterfly species are declining through substantial parts of their range and some are now seriously threatened. Moreover it is likely that the situation may be even worse than has been shown as data are sparse for many countries and species declines may consequently have been underestimated or not reported due to lack of good evidence.

The decline of butterflies is of course just one facet of the loss of wildlife in general and most European countries have taken measures to conserve their biodiversity and wild habitats, for example by the declaration of national parks and nature reserves. Many countries have also taken specific measures to conserve certain butterfly species, for example by listing them in protective legislation or creating particular reserves. Butterflies have also been protected under various pan-European measures, notably the Bern Convention, CITES, and the EC Habitats and Species Directive.

Prime Butterfly Areas in Europe

Background

For the most threatened species, immediate action is needed to avoid extinction and to maintain existing populations. The main way to achieve this is to ensure the protection and good management of important habitats. In order to support national and European nature conservation organisations to protect these locations, we have followed the Red Data Book with an overview of the most important (Prime) Butterfly Areas in Europe. The results are intended to support other initiatives, such as Natura 2000, the Pan-European Ecological Network (PEEN), the Pan-European Biological and Landscape Diversity Strategy and the Bern Convention. Protection and proper management of these areas will not only help to conserve these species, but also many other characteristic butterflies and other invertebrates occurring in the same habitats.

The principal aims of the project were to:

- Identify an initial selection of the most important areas for the conservation of priority butterflies in Europe;
- Promote awareness of threatened butterflies in Europe, their special refuges and the main issues affecting them;
- Present information on each area in a standardised way;
- Help focus conservation and management measures on these areas.

Methods

The selection of Prime Butterfly Areas (PBAs) is targeted by butterfly species fulfilling at least two of the following three criteria (grey-shaded in Figure 3):

1. Zoo-geography: the world range of the species is restricted to Europe (Range Affinity 4 in Van Swaay & Warren, 1999) (189 species).
2. Conservation: the species is threatened according to the *Red Data Book of European Butterflies* (Van Swaay & Warren, 1999) or the IUCN Red List of threatened animals (71 species).
3. Legislation: the species is listed in Appendix II of the Bern Convention and/or the Habitats Directive (23 species).

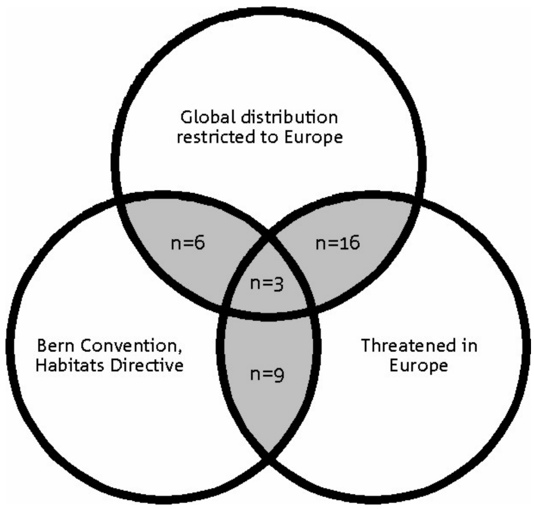

Figure 3. Selection of target-species used for the selection of Prime Butterfly Areas. Target-species fulfil at least two of three criteria (grey-shaded).

The 34 target-species select by these criteria for inclusion in the Prime Butterfly Areas in Europe are listed in Table 1. A site is identified as a Prime Butterfly Area (PBA) if it contains a substantial resident population of at least one of these target species. We included two types of areas: 1) discrete sites that support one or more rare or threatened species; or 2) wider areas (such as mountain ranges or valley systems) where a target species occurs as scattered populations that may well be connected as a single metapopulation.

Table 1. List of target-species for Prime Butterfly Areas project, each of which fulfilled at least two of three criteria (grey-shaded in Figure 3). For more details on the global distribution see Van Swaay & Warren (1999). Threatened species are listed as such by in the Red Data Book of European Butterflies or on the IUCN Red List of threatened animals.

Species	Global distribution restricted to Europe	Threatened	Bern Convention Habitat Directive
Pyrgus cirsii	X	X	
Zerynthia caucasica	X	X	
Parnassius apollo		X	X
Papilio hospiton	X		X
Pieris wollastoni	X	X	
Pieris cheiranthi	X	X	
Gonepteryx maderensis	X	X	
Lycaena ottomanus	X	X	
Maculinea arion		X	X
Maculinea teleius		X	X
Maculinea nausithous		X	X
Maculinea rebeli	X	X	
Plebeius trappi	X	X	
Plebeius hesperica	X	X	
Polyommatus golgus	X		X
Polyommatus humedasae	X	X	X
Polyommatus galloi	X		X
Polyommatus dama	X	X	
Argynnis elisa	X		X
Euphydryas maturna		X	X
Euphydryas aurinia		X	X
Lopinga achine		X	X
Coenonympha oedippus		X	X
Coenonympha hero		X	X
Erebia christi	X	X	X
Erebia sudetica	X	X	X
Erebia epistygne	X	X	
Erebia calcaria	X		X
Melanargia arge	X		X
Hipparchia maderensis	X	X	
Hipparchia azorina	X	X	
Hipparchia occidentalis	X	X	
Hipparchia miguelensis	X	X	
Pseudochazara euxina	X	X	

Within the short time and limited funding available for this project, it was possible to identify only a first selection of the most important areas for target species in Europe, combined with a wide geographic coverage that includes both marginal and core populations. We aimed to include the three best populations of each target species within each country. As with the Red Data Book, the data were provided by national compilers who were asked to select the Prime Butterfly Areas for their country and complete a questionnaire giving details on location, key butterfly species, habitats and land uses, threats, protection, and conservation issues (following the classification of Tucker and Heath, 1994). Details of the methods can be found on the project-website www.vlinderstichting.nl/en/randc/pba.htm. The results were published in a lengthy book (Van Swaay and Warren, 2003).

Results

A total of 433 Prime Butterfly Areas were identified from 37 countries and three island archipelagos (Figure 4). They cover more than 21 million ha, equivalent to 1.8 % of the land area of Europe. The exact number of PBAs identified in each country depends on many different factors, such as the size of the country, the number of target species present, the extent of relevant habitats remaining in the country, and the capacity to gather the data.

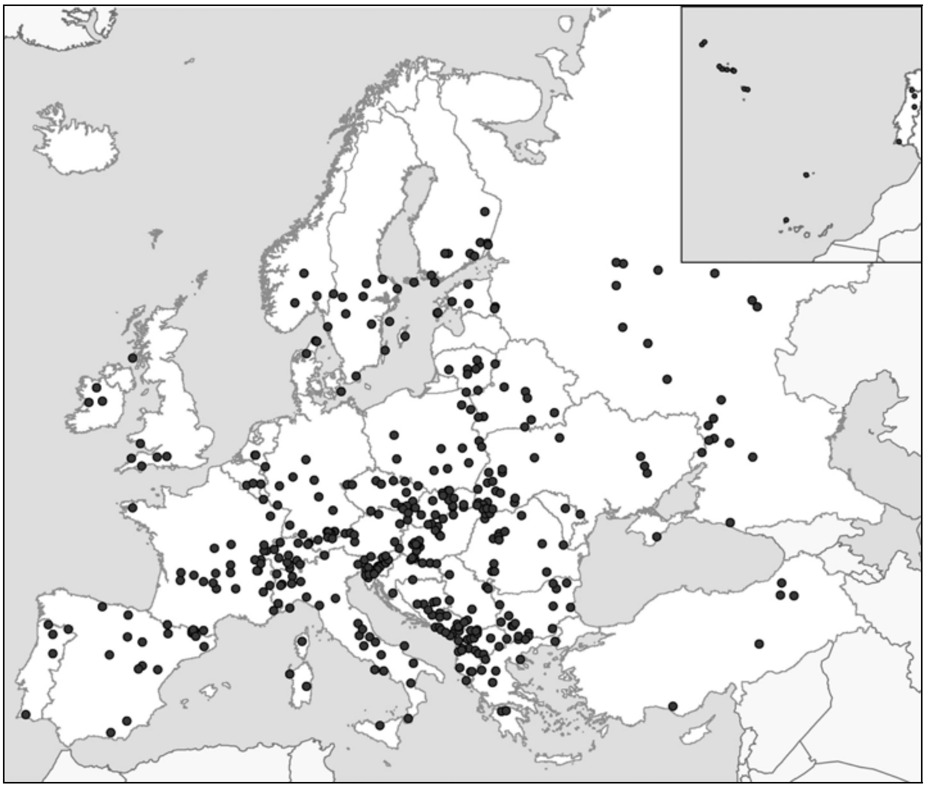

Figure 4. The location of the 431 Prime Butterfly Areas of Europe, identified for the 34 target species.

The most frequently occurring species within PBAs are *Maculinea arion* and *Euphydryas aurinia*, and *Parnassius apollo*, which are found in over 100 PBAs. Together with *Maculinea teleius*, these three species also have the largest number of discrete breeding areas, with at least 1000 estimated populations within the PBAs. In contrast, many target species have a very restricted range and the sites selected are of the utmost importance for the conservation of rare and highly threatened species. They include several endemic species that are restricted to just one or two sites in the entire world: for example, *Gonepteryx maderensis*, *Hipparchia maderensis*, *Hipparchia azorina ssp.*, *Polyommatus dama* and *P. humedasae.*

Information on trends shows that many target species are declining within PBAs, even within protected areas. This is extremely alarming and indicates that breeding habitats are deteriorating rapidly on most PBAs and that conservation measures are needed urgently. Very few species have undergone a recent increase on PBAs, the maximum being increases of *Euphydryas aurinia* at five sites. However trends of target species are not known on many PBAs, indicating the general need for increased monitoring of populations.

The habitat types present on PBAs reflect those of the target species present and mainly comprise woodland, alpine/sub-alpine grassland, dry grassland, and humid grassland. A great variety and intensity of land-uses are recorded within the Prime Butterfly Areas, reflecting the long history of human settlement and management of most habitats throughout Europe. The conservation of habitats and butterflies therefore frequently depends on the continuation of traditional land-use practices, and suitable policies and programmes that can support them, or where necessary replace them. The main types of land-use recorded within PBAs are agriculture (62% of PBAs), forestry (60%), nature conservation (60%), tourism and recreation (50%).

The threats facing PBAs are diverse, ranging from adverse management activities, land-use, urban or industrial developments, and impacts of land-uses from neighbouring areas (for example, pollution, drainage). The main types of threats affecting PBAs are intensification of agriculture (43% of the PBAs), afforestation of former open land (40%), isolation and habitat fragmentation (35%), abandonment of traditional land use (33%, mainly in eastern and southern Europe). Other important threats include: adverse management, the negative effects of tourism and recreation (especially within Alpine and Mediterranean habitats), the felling of woodland, land drainage, urbanization and burning of vegetation. Collecting is not considered to be an important threat to the target species within the PBAs.

A total of 192 PBAs in Europe (44% of the total) have at least some protection under national law. In the countries of the European Union, 53% of the PBAs were also classified as Natura 2000 sites. Though this large overlap of PBAs with sites protected under the Natura 2000 program is positive, a lot of PBAs still have no international protection in spite of having major populations of butterflies for which Europe has a high responsibility.

Discussion

The Prime Butterfly Areas report documents, for the first time, the most important butterfly sites across Europe and we urge national conservation agencies to use the list to target protection measures within their own country and to tackle the many problems that have been identified on individual PBAs. The following specific actions are recommended in the report:

- Produce detailed descriptions of the PBAs within each country and designate all PBAs as protected areas under national law (56 % of PBAs are not protected);
- Protect PBAs under relevant international law such as Natura 2000 designation; and outside the EU, designation as part of the Emerald Network. (47% of PBAs in the EU are not protected under international laws);
- Provide adequate protection of PBAs in accession countries and consider PBAs identified in this review as Natura 2000 equivalent sites (for example in Czech Republic, Estonia, Hungary, Poland, Slovenia and Cyprus);
- Ensure sound habitat management within PBAs and sympathetic management in surrounding areas (for example, continuation of traditional agriculture and forestry practices and support through EC Agri-environment Regulation (EC Reg. 2078/92)).
- Take measures to conserve the wider environment and whole landscapes within and surrounding PBAs in order to sustain viable metapopulations;
- Monitor populations of target species and conduct research to identify appropriate habitat management techniques;

- Revise pan-European legislation as a matter of urgency, to take account of the new information provided in the Red Data Book of European butterflies (eg Bern Convention and the EU Habitats and Species Directive);
- Conduct a more comprehensive review of Important Butterfly Areas in Europe as soon as possible (the review has shown that this is feasible and that there is great willingness among key entomologists across Europe to support such an initiative).
- Keep the list of Prime Butterfly Areas up-to-date (for example, via the internet).

Overall conclusions

These two projects demonstrate the effective collaboration of country experts to achieve shared conservation objectives over a short time scale. They have brought together unique datasets that help plan conservation at a pan-European level and which are already being used to initiate and guide action within many countries. However, new information on butterflies is coming available constantly and our knowledge of the status and threats to European butterflies will undoubtedly improve in coming years. We must therefore recognise that no review is ever perfect, but merely represents a snapshot of the best data available at the time. The results also provide a good platform to build improved information systems and better conservation strategies in the future. We hope that the two projects provide useful models of what can be achieved at a European scale because similar information is needed urgently on other invertebrate taxa in order to stem their widespread decline.

Acknowledgements

The *Red Data Book of European Butterflies* was funded by the Council of Europe, English Nature and The Dutch Ministry of Agriculture, Nature Conservation and Fisheries. The *Prime Butterfly Areas in Europe* project was funded by the Expertise Centre of the Dutch Ministry of Agriculture, Nature Conservation and Fisheries (EC-LNV). We are deeply grateful to the national compilers for their time and invaluable expertise that enabled the completion of both projects.

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Biodiversity and conservation of Hydrobiids in the Iberian Peninsula

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Abstract

The prosobranch mollusc family Hydrobiidae has a cosmopolitan distribution and is made up of minute or small species that inhabit permanent aquatic ecosystems. The evolutionary relationships between members of this family and their taxonomic status are still unclear because:

1) There is insufficient information on the morphological characters of many of the described taxa;

2) Uncertainty exists about which morphological characters are of greatest taxonomic and phylogenetic importance;

3) Molecular characters are rarely used to study evolutionary relationships.

Twelve genera and 38 species have been described and accepted to date for the Ibero-balearic region, but there are still many taxa to be described in this poorly studied taxonomic group. The Iberian Peninsula is one of the areas of greatest hydrobiid diversity in Europe, with a large number of endemic genera and species in addition to those that are distributed throughout the Mediterranean region. Many species and populations are threatened, and in some cases, are in danger of extinction. The majority of hydrobiids have restricted ranges and live in habitats that are rich in biodiversity but which are fragile in terms of conservation. Although the available information is far from complete, most of the systematic studies published in scientific papers since the 1950s have not been taken into account when developing conservation and management policies. For this reason, there is an urgent need to compile all this scientific knowledge and establish the criteria for protecting species and their habitats. This applies particularly to the Bern Convention and the EU Habitats Directive. Because of the high endemicity among Hydrobiids in the Iberian Peninsula, initiatives such as national or regional Red Lists and regional plans to protect and manage important microhabitats could play an important role in conserving these species. The conservation of species and sites requires public funds and collaboration between scientists, local authorities and the general public.

Craynet and the European crayfish atlas

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Abstract

Monitoring European native crayfish populations as indicators of biodiversity is an important tool in environmental management. *Craynet* (http://labo.univ-poitiers.fr/craynet) is a core group of scientists from 11 European countries. *Craynet* will emphasize knowledge-based management strategies and a common European approach to management techniques; it will also develop the links between researchers, managers and sustainable policies for development, through rural agencies and regional programmes. To conserve Europe's five indigenous crayfish species and control the spread and impact of non-indigenous species and crayfish plague, it is essential to know the detailed distribution of the various crayfish species and the outbreaks of crayfish plague in every country. As part of the *Craynet* programme, the Natural History Museum in Paris is compiling an atlas and database of European crayfish, based on authenticated records, in collaboration with national and regional experts and data centres.

Going from Regional to Global: the need for documentation

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Abstract

One of the key elements of Red Data Listing is to make sure that all decisions are clearly documented. This necessary process serves two main purposes:
it encourages the assessors to be very clear about the information they are using and the use they are putting it to and; it allows others to follow the process.

Remarks on the distribution and use of a provisional red list of the ants of Flanders (Formicidae, Hymenoptera)

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Abstract

In the beginning of 2001 all available data of ants in Flanders (northern part of Belgium) were brought together and several inventory works were started. Some general conclusions on the distribution and diversity of the ants of Flanders and their habitat width are discussed and a provisional Red List is presented and its possible use is evaluated. Further we assess for which habitat-types ants could be indicators. In Flanders heathlands have the most stenotopic and threatened ant fauna. We provide a list of species which should be monitored in those sites and can be used to evaluate sites together with red list of other invertebrate groups.

Introduction

Red Lists of particular taxonomic groups have become increasingly indispensable tools in nature conservation research and practice. At a local scale (for example Flanders, the northern part of Belgium) those lists are used in the development of a modern nature conservation policy and in site assessment studies and monitoring (Maelfait, 1993; Maes et al., 1995; Hoogeveen, 1998; Maelfait *et al*., 1998). The use of less well known taxonomic groups, such as several orders of insects and other invertebrates, in assessments of the effects of management measures, is a recent development. However, a critical approach should be maintained in using groups of insects to evaluate sites (Samways, 1993; Barendregt *et al*., 1998; Heijerman & Turin, 1998; Ellis, 1998). Because of their small size, they are often considered as difficult to identify, hard to study and it is time-consuming to prepare inventories. Moreover, they generally lack sympathy from the public. Sometimes populations can persist in very small areas, which could not support larger animals. One cannot compare macrobiota (birds, plants, mammals) with insects and other invertebrate groups and treat them as equal in evaluating different sites (Ellis, 1998). Sometimes butterflies, grasshoppers and dragonflies are used as representatives for all insect groups, or all invertebrates, and the evaluation and protection of sites is based on the occurrence of species of only these very mobile groups, which are often poor in species and with low abundances. These groups, however, represent a small part of the invertebrate and insect fauna. Sometimes their responses to management and changes in the environment differ greatly. An approach which uses many species, with representatives from several taxonomic groups, could give more complete and representative information. A drawback of this approach may be that long lists of species will have to be followed up and that this may lead to conflicting recommendations. For example, monitoring dragonflies and water bugs would accentuate the importance of the water quality and quantity, but would neglect the very different needs of bees, wasps and ants or soil macro-invertebrates.

In Belgium and especially Flanders, Red Lists of several insect and macro-invertebrate groups are available and have proved useful:

- Coleoptera, Carabidae – Desender *et al*., 1995;
- Odonata – De Knijf & Anselin, 1996;
- Spiders – Maelfait *et al*. 1998;
- Butterflies – Maes & Van Dyck, 1999;
- Orthoptera – Decleer et al., 2000;
- Diptera, Dolichopodidae – Pollet, 2000;
- Diptera, Empididae – Grootaert *et al*., 2001.

Until now, there was no Red List case for ants. How could ants fit in this multi-species approach using insects and other invertebrates? To be able to use ants in nature conservation, management and evaluation, reliable information was needed on the distribution, habitat width and rarity of all ant species occurring in our region. The distribution of ants was poorly documented in Flanders, but recent studies (Dekoninck & Vankerhoven, 2001a, 2001b; Schoeters & Vankerkhoven, 2001a, 2001b) have raised the need for a coherent survey of all known Flemish records. There was also an increasing need to include ants in several conservation management and evaluation initiatives in Flanders. A recent report on the ecology and distribution of ants in Flanders was published, including distribution maps, the habitat preferences, and status of each ant species, together with other information (Dekoninck *et al*., 2003).

In this paper we present some general conclusions on the distribution and diversity of the ants of Flanders (Figure 1), their habitat width is discussed and a provisional Red List is proposed. We also evaluate habitat types for which ants can be used as indicators and provide a list of species that should be monitored in these habitats and which can be used to evaluate sites when used with species from other invertebrate groups.

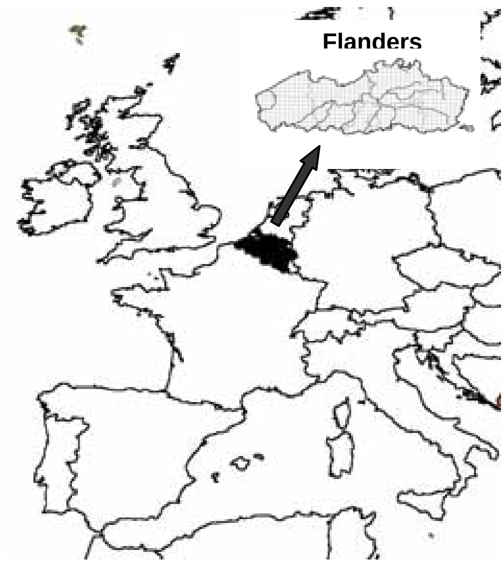

Figure 1. Location of Flanders, the northern part of Belgium

Materials and methods

Data collection

In the beginning of 2001 all available data of ants in Flanders (northern part of Belgium) were brought together and several surveys were started. Several sampling methods were used: pitfall trap, coloured water-traps, ecclectors-traps, malaise traps, nest collections and hand collecting. Each method has its advantages and disadvantages (Dekoninck *et al*., 2003). If still available, specimens in museum collections were checked. More than 20,000 records (mostly dating from after 1990) were gathered in the database FORMIDABEL (FORMIcidaeDAtaBELgium). The presence of each species was checked in as many as possible of the UTM 5x5km squares covering Flanders. Identifications, using an Olympus SZH10 binocular microscope (magnification 150x), relied on Seifert (1996) and Schoeters & Vankerkhoven (2001b) as key works.

Habitat types and ecological preferences

Nine types of habitat and landscape were defined to collect accurate information on the habitat preference of all ant species (Table 1). The nine types were based on the EIS-code and the Flemish nature types (see Vandenbussche, 2002; Zwaenepoel *et al*. 2002). A habitat types was included with each record, but when no habitat description was available for a record (for example, with some older records) the habitat was coded as 'Not known or not observed'.

Table 1. Nine landscape and habitat types defined for use with the species records.

Description landscape type	Landscape Code
Antropogenic habitats	AN
Woodlands	WO
Shrubs	SH
Heathland	HE
Fens and highland bogs	BO
Dry grasslands	DG
Moist grassland	MG
Chalk grasslands, stony slopes and other rocky xerothermic habitats	RO
Coastal and inland dunes	DU
Not known or not observed	X

Habitat width of each ant species

To identify whether a species is restricted to one or more habitat types in its distribution area, counts were made of the number of habitats in which each species was recorded in Flanders. From these counts, four categories of stenotopy were defined:

- Stenotopic species (ST): a species found in only one habitat type;
- Almost stenotopic species (AST): species present in only two or three habitat types;
- Moderate stenotopic (MST): species present in four or five different habitat types, with no discernable preference for any one;
- Eurytopic species (EU): species found in six or more habitat types.

Results

General results: Flanders is a moderately ant-rich region

A total of 79 species of ants have been recorded in the whole of Belgium. In Flanders 52 species, plus one hybrid (*Formica rufa* x *polyctena*) and one microgyne (*Myrmica ruginodis*), can be found in natural habitats. In addition, two exotic species (*Monomorium pharaonis, Hypoponera bondroiti*) are frequently discovered in buildings, bringing the Flemish total on 56 distinct taxa. There has been at least one record of each of these taxa since 1986, and no species have been lost during the last 20 years. Compared with some neighbouring countries and regions Flanders is a moderately ant-rich region (Table 2).

Table 2. Comparison of the ratio of number of species of ants to the surface area in Flanders and four other areas.

Species	Stenotopicity	Habitat and % of records
Anergates atratulus	ST	HE 100%
Formicoxenus nitidulus	ST	HE 100%
Myrmica sulcinodis	ST	HE 100%
Polyergus rufescens	ST	HE 100%
Tapinoma ambiguum	ST	HE 100%
Tapinoma erraticum	ST	HE 100%
Lasius jensi	ST	RO 100%
Lasius myops	ST	RO 100%
Camponotus vagus	ST	AN 100%
Hypoponera bondroiti	ST	AN 100%
Solenopsis fugax	ST	AN 100%
Lasius neglectus	ST	AN 100%
Tetramorium impurum	AST	AN 99%; DG 1%
Lasius emarginatus	AST	AN 97%; MG 3%
Myrmica lonae	AST	HE 95%; WO 5%
Leptothorax muscorum	AST	HE 92%; WO 8%.
Formica lusatica	AST	HE 83%; DG 17%
Hypoponera punctatissima	AST	AN 56%; MG 33%; X 11%
Leptothorax affinis	AST	AN 57%; WO 29%; SH 14%
Stenamma westwoodi	AST	WO 50%; DG 25%;X 25%
Strongylognathus testaceus	AST	HE 69%; DG 9%; X 22%

Flemish hot-spots for ants

In Figure 2 the number of ant species per 5x5 km square of the UTM grid are shown. Many ant species were recorded in some squares and those with more than 25 species were classified as hot-spots. All the hot-spot squares in the province of Limburg and, although it is the smallest province of Flanders, 49 different taxa (87.5% of the total Flemish ant fauna) were found there. There are extensive heathland areas in Limburg, with many potentially suitable habitat types for ants. Almost all the Flemish hot-spots for ants are situated in large heathlands and their surroundings.

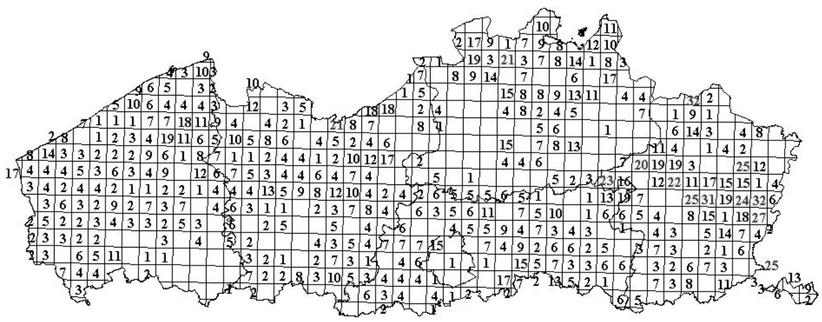

Figure 2. Number of ant species recorded in each 5x5 km square of the UTM grid.

Diversity in different habitat types

Figure 3 shows the number of ant species in each of none habitat types. Heathlands are the richest habitat type for ants in Flanders. In this habitat type 42 different species (75% of the Flemish ant fauna) were found. Perhaps surprisingly, anthropogenic habitats contained 66% of the Flemish ant fauna. In bog and peat habitats only 25% of the ant fauna was collected.

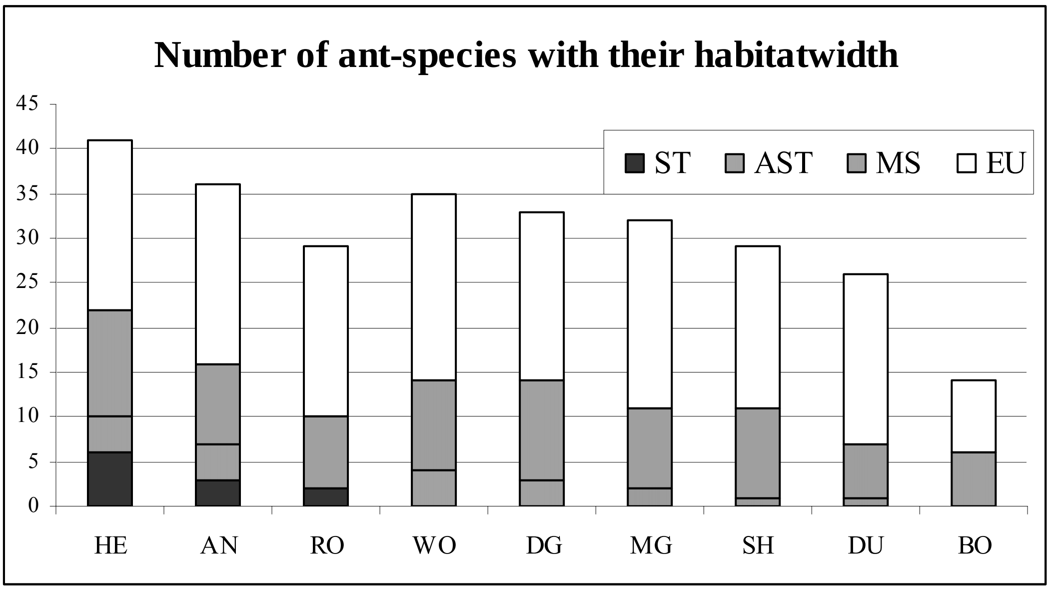

Figure 3. Number of ant-species in each of the nine habitat types with their habitat width found in each type.

(ST= Stenotopic, AST= Almost Stenotopic, MS= Moderately Stenotopic, EU= Eurytopic; HE: heathland; RO: rocky xerothermic habitats; AN: Antropogenic habitats; WO: forests; MG: moist grassland; DG: dry grassland; SH: shrubs, DU: dunes; BO Fens and bogs).

A search for Flemish stenotopic ant species

Twelve species can be considered as Stenotopic (ST). *Anergates atratulus*, *Formicoxenus nitidulus*, *Myrmica sulcinodis*, *Polyergus rufescens*, *Tapinoma ambiguum* and *Tapinoma erraticum* were only found in heathland in Flanders. However, in the southern part of Belgium *T. erraticum* is a common species on rocky soils and chalky grasslands. In Flanders *Lasius jensi* and *Lasius myops* are stenotopically bound to rocky soils and *Camponotus vagus*, *Hypoponera bondroiti*, *Solenopsis fugax* and *Lasius neglectus* were only found in anthropogenic habitats. The nine species considered as Almost Stenotopic (AST) were found in only two or three habitat types (Table 3). Their habitat width is also rather restricted and they can be considered as an important part of the characteristic ant-auna in those habitats.

Table 3. Stenotopy and % of records for each habitat type for Stenotopic (ST) and Almost Stenotopic (AST) ant species in Flanders.

HE: heathland; RO: rocky xerothermic habitats; AN: Antropogenic habitats; WO: forests; MG: moist grassland; DG: dry grassland; SH: shrubs; X not known or not observed.

Habitat type	% of not Eurytopic ant-species found in each habitat type
AN	44,4 %
WO	40 %
DG	42,42 %
DU	26,92 %
HE	53,66 %
MG	34,38 %
RO	34,48 %
SH	37,93 %
BO	42,86 %

The habitat type heathland is the only type that has more than half of the non-eurytopic ant-species (22 species, 54 %). Although fens and bogs have only six ant species that are non-eurytopic, the relative amount of stenotopic (ST, AST and MS) species is comparable with all other habitat types (between 34% and 44%) except that for the habitat type dunes (7 species, 26 %):

A provisional Red List of Flemish ants

Based on the distribution patterns, the habitat choice and the number of records, a provisional Red List has been prepared by assigning each species to one of the following categories (see also Binot *et al*., 1998; Maelfait *et al*., 1998).

- Extinct in the wild (EW): species not recorded in the wild during the last fifty years.
- Critical (CR): species with few recent observations, that became very rare due to a drastic reduction of their preferred habitat or living in highly threatened habitats, which are stenotopic and were found in less than five UTM 5x5 km squares and less than 10 records.
- Endangered (EN): species that became rare because of the extensive deterioration and destruction of their habitat, which are at least moderately stenotopic (ST, AST or MST), which were found in 5-10 UTM5x5 squares and for which we have less than 15 records.

- Vulnerable (VU): species which became quite uncommon or with a restricted distribution in Flanders, which are at least moderately stenotopic (ST, AST or MST) and which were found in 10 to 40 UTM 5x5 km squares;
- Indeterminate (IN): species assumed to be threatened, but for which there is not enough information (e.g. recently discovered species) to decide which of the preceding categories is appropriate;
- Restricted Geographically (RG): rare, geographically restricted species in Flanders;
- Introductions and living in buildings (IB): Species introduced by human activities or which can only survive in Flanders in heated buildings;
- Not Threatened (NT): common and widespread, eurytopic (EU) species that are not currently threatened.

All Flemish ant species are listed in Table 4, with their provisional Red List status. About half of the Flemish ant species (29 species, 48%) are threatened in one or another way (CR, EN, VU, IN or RG). Most of them are or became very rare because they depend upon one or more other species of ant to complete their life cycle. In many cases their hosts have also greatly declined or they are very sensitive to disturbance and destruction of their habitat. The Critical, Endangered and Vulnerable species are especially associated with heathlands. Some also occur on rocky soils (chalk grasslands) and anthropogenic habitats.

Introductions and species living in buildings – Invasive species in Flanders?

Five species (*Camponotus vagus*, *Hypoponera bondroiti*, *Hypoponera punctatissima*, *Lasius neglectus* and *Monomorium pharaonis*) are rare in Flanders because they do not occur here naturally or they can survive here only in (heated) buildings. Most of them are introduced by human activities. If they can survive here during several, consecutive mild winters it is possible that they could spread locally and even cause a threat to the native ant fauna. At a local scale species such as *Lasius neglectus* can become a noticeable part of the ant fauna (Dekoninck *et al*., 2002). Such species are not consider as being threatened.

Table 4. List of all Flemish ant species, their habitat width, provisional Red List status, number of UTM 5x5km squares where the species was recorded and number of Flemish records.

Species	Provisional Red list status	Habitat width	number of UTM 5x5km squares after 1986	number of records in Flanders
Myrmica sulcinodis	CR	ST	1	1
Anergates atratulus	CR	ST	4	6
Formicoxenus nitidulus	CR	ST	1	1
Polyergus rufescens	CR	ST	1	1
Solenopsis fugax	CR	ST	2	2
Tapinoma erraticum	CR	ST	2	2
Formica transkaucasica	EN	MS	10	12
Leptothorax muscorum	EN	AST	6	7
Myrmica lonae	EN	AST	8	8
Ponera coarctata	EN	MS	5	5
Strongylognathus testaceus	EN	AST	8	10
Tapinoma ambiguum	EN	ST	7	7
Formica polyctena	VU	MS	25	25

Formica pratensis	VU	MS	28	28
Formica rufa	VU	MS	20	20
Formica rufibarbis	VU	MS	24	24
Formica sanguinea	VU	MS	37	40
Lasius meridionalis	VU	MS	20	40
Lasius psammophilus	VU	MS	22	40
Myrmecina graminicola	VU	MS	11	11
Myrmica schencki	VU	MS	40	40
Myrmica specioides	VU	MS	31	40
Formica lusatica	IN	AST	6	6
Lasius myops	IN	ST	1	1
Formica rufa x polyctena	IN	MS	5	5
microgyne of *Myrmica ruginodis*	IN	EU	9	17
Stenamma westwoodi	IN	AST	2	3
Lasius jensi	RG	ST	2	2
Leptothorax affinis	RG	AST	6	8
Camponotus vagus	IB	ST	1	1
Hypoponera punctatissima	IB	AST	4	5
Hypoponera bondroiti	IB	ST	2	2
Lasius neglectus	IB	ST	1	50
Monomorium pharaonis	IB	NG	?	?
Formica cunicularia	NT	EU	> 50	> 50
Formica fusca	NT	EU	> 50	> 50
Lasius brunneus	NT	EU	> 50	> 50
Lasius emarginatus	NT	AST	> 50	> 50
Lasius flavus	NT	EU	> 50	> 50
Lasius fuliginosus	NT	EU	> 50	> 50
Lasius mixtus	NT	EU	18	18
Lasius niger	NT	EU	> 50	> 50
Lasius platythorax	NT	EU	> 50	> 50
Lasius sabularum	NT	EU	15	15
Lasius umbratus	NT	EU	> 50	> 50
Leptothorax acervorum	NT	EU	34	40
Leptothorax nylanderi	NT	EU	> 50	> 50
Myrmica microrubra	NT	EU	15	18
Myrmica rubra	NT	EU	> 50	> 50
Myrmica ruginodis	NT	EU	> 50	> 50
Myrmica rugulosa	NT	EU	> 50	> 50
Myrmica sabuleti	NT	EU	> 50	> 50
Myrmica scabrinodis	NT	EU	> 50	> 50
Stenamma debile	NT	EU	> 50	> 50
Tetramorium caespitum	NT	EU	> 50	> 50
Tetramorium impurum	NT	AST	> 50	> 50

Discussion

Flanders can be considered to be a moderately ant-rich region where their distribution is well known and properly documented (Dekoninck *et al*., 2003). It is possible that a few, previously undiscovered species could be added to the fauna. If so, any additional species would be likely to be rare in Flanders because the recent, intensive study covered all major habitats and species that are not stenotopic are known common and widespread over the region. Only exceptionally would naturally immigrant species or imported species became abundant, for example due to climatic or other major environmental changes.

Only two species that are widespread in Flanders, *L. emarginatus* and *T. impurum*, are almost stenotopic in their association with anthropogenic habitats. The apparent stenotopicity of some species (*C. vagus*, *S. fugax* and *L. neglectus*) should be interpreted with caution because there are few records of these species. Two stenotopic species are known to have been introduced to Flanders (*C. vagus* (Dekoninck & Pauly, 2002) and *L. neglectus* (Dekoninck *et al*., 2002)) so that they could not be allocated a meaningful stenotopicity status. Some habitat types lack stenotopic species, for example dry grasslands, humid grasslands, dunes, bogs and peatlands, woodlands and scrub. Only two stenotopic species occur on rocky soils in Flanders because this habitat type is very rare in the northern Belgium, although it is widespread in Wallonia (southern Belgium). For these reasons the scale of the use of the Red List needs to considered carefully. The possible number of habitats and locations in Flanders is different from that in Wallonia, where there are more rocky soils and fewer heathlands.

Heathlands are well represented in Flanders and it is significant that it was in this habitat type that most of the stenotopic, almost stenotopic and moderately stenotopic species of ants were found, with many fewer eurytopic species. Heaths contain the highest number of species of ants and of threatened ant species in Flanders. Ants are one of the invertebrate groups that should be used to develop and test habitat and landscape scale procedures for the conservation of heathlands on sandy soils. They could also be used in heathland habitats, together with other groups such as robberflies and bees, to monitor site management.

A provisional red list of the Flemish ants: sense or nonsense?

Ants and ant nests usually persist for several years in the same habitat, which makes them good indicators for the present state and the past history of a site and therefore Red Lists of ants are important instruments (Bauschmann & Buschinger, 1992; Agosti & Cherix, 1994; Seifert, 1996; 1998; Bauschmann *et al*., 1996; Steiner & Schlick-Steiner, 2002). The short life cycles of other most other invertebrate groups can result in rapid fluctuations in population densities (Ellis, 1998), but these are less likely in colonial insects such as ants. Therefore ant populations can be monitored more easily than most other invertebrate groups, and they are easy to detect and sample (Bauschmann *et al*., 1996; Siefert, 1996; Mabelis, 2002; Steiner & Schlick-Steiner, 2002).

Several criteria were used to give each species a provisional Red List status. Rarity (number of UTM 5x5 km squares and number of records) and stenotopicity of the species (only ST, AST and MST are threatened) were used to evaluate the present status of each ant species. Four species (*Lasius sabularum*, *Lasius mixtus*, *Myrmica microrubra* and *Leptothorax acervorum*) are eurytopic and were classified as Not Threatened, but were found in less than 40 UTM 5x5 squares. The first two are *Chthonolasius*-species, which are only found after intensive search underground and presumably their number of records is much higher as here present. The Red List of the ants of Flanders does not include the trends of the species, because old observations are scarce. Also, because of recent taxonomic revisions in European myrmecology, the old records need to be checked and updated because some probably refer to recently described, new species, particularly in the genus *Lasius*. The list is dynamic and we hope to have the opportunity to update it after 10 years, including surveying all previous localities, plus additional ones, to compile a more complete and up-to-date view of the ant fauna of Flanders.

The diversity and the number of Red List ant species in heathlands can be an indication of the ecological importance of the site. The total number of Red List species (CR, EN, VU, IN and RG) in heathlands should be taken into account when evaluating sites and managing and restoring heathlands for nature conservation. The presence or absence of ant nests or workers of most of the species on this list can be easily checked and evaluated. The typical ant fauna of undisturbed heaths in Flanders was not found at restored sites after 25 years, even where source populations were very close to the restored heaths (Dekoninck *et al*. 2001).

In Flanders, some ant species are found only in areas with great ant diversity, at locations that have been undisturbed for a long time. With the exception of *T. eraticum* and *M. sulcinodis*, all endangered Flemish ants depend, in one way or another, on other species of ants. *Formicoxenus nitidulus* and *Anergates atratulus* need sufficient host nests, *Polyergus rufescens* cannot exist without enough potential slavery nests and *Solenopsis fugax* nests need other, larger, ant species from which they obtain their food. The local extinction of these endangered species is almost certainly caused by the loss of healthy, complete and species rich ant populations.

We favour a multi-species approach to the conservation of threatened Flemish biotopes and we suggest that for each habitat type an adequate species list, with typical species, should be compiled for conservation monitoring. When considering heathlands in Flanders, the number of nests of all the threatened ant species (Critical, Endangered, Vulnerable) should be monitored, as indicators of a rich ant fauna. Current threats to most species are related to the deterioration or destruction of their favoured habitats.

This Red List should be considered as a stepping-stone. Only by continuing the work, by adding new records and revising existing collections, will it be possible to compile a reliable Red List of our ants for use in evaluating the biodiversity of Flanders. Ants have a distinctive and important role to play as possible indicators of site history, habitat quality and sustainable management for nature conservation, and in helping to inform policies for nature conservation.

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European Invertebrate Survey - Council and Committee meetings

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Summary

The EIS Council and Committee met formally on 5 September 2003I. The meetings were concerned mainly with the usual business of such meetings, including:

- Minutes of previous meetings and matters arising;
- Revision of the EIS Statutes (constitution);
- Election of a new EIS international Committee, under the terms of the revised Statutes, with Dr Anastasios Legakis (Greece) as Chairman;
- Publication of EIS Newsletter No 13;
- Publication of the Proceedings of 13th EIS International Colloquium held in Leiden in 2001;
- Publication by Pensoft Publications of 2nd volume of occasional EIS series *Fauna Evertebrata Europapaeae*, covering the genus *Carabus* in Europe;
- Report on the EIS Luxembourg workshop (November 2002) highlighting the need to make sure EIS work is compatible with GBIF and with Fauna Europaea nomenclature;
- The role of the EIS Bureau was defined to include maintenance of the website and 'publication' of the newsletter series, colloquia proceedings and field survey reports, members addresses;
- Possible options for the EIS Colloquium in 2005 were discussed;
- EIS involvement in the proposed Virtual Biodiversity Laboratory project is led by Legakis.

On 7 September the EIS Council and a few other members met informally to brainstorm the form and content of the proposed 'Conservation Strategy for Invertebrates' proposed by the Council of Europe. John Haslett agreed to prepare a first draft outline proposal to CoE for further debate by a small sub-group of EIS Council.

EISinfo.net project - Workshop

Slide show with report on the workshop in Luxembourg, from Nov. 29 to Dec. 1, 2002 and on the ongoing pilot project, presented by M. Meyer.

Draft online mapping situated on the website of the ZOBODAT database Centre in Linz (A), designed by M. Malicky and presented here by E. Geise.

Free discussion on the following subjects:

Need and usefulness of a separate information network run by EIS
The audience found good arguments to continue the project as agreed at the previous EIS Committee meeting in Leiden in 2001. The fact that big international projects with similar aims are being developed does not interfere directly with the EIS project where a separate structure owned by our organisation can much better be adapted to specific requirements.

Relations to other international projects

Projects like Fauna Europaea and Species2000 Europe will produce taxonomic dictionaries to be used by EISnet. The geographic tools of these projects are far from being sufficient for our purpose.

On the other hand contacts to more record orientated projects like GBIF and BioCASE, but also to NBN-Gateway could provide technical standards to be adopted by EISnet, mainly in the network structure system and the developed software modules.

> Action Point 1: Y. Gonseth will contact GBIF to find out whether collaboration is possible and report to the project members by 31st Dec 2003,
> Action Point 2: M. Meyer will contact BioCASE to find out whether collaboration is possible and report to the project members by 31st Dec 2003, and ;
> Action Point 3: D. Procter will contact NBN to find out whether collaboration is possible, and report to the project members by 31st Dec 2003,

Logistic support

The pilot project is situated on the server from ZOBODAT in Linz (A). The development plan of the future main project should consider the need of logistic support to be offered by an institution or an organisation, i.e. we need to know where the server for EISnet can be situated. Y. Gonseth proposed to contact the European Topic Centre on Nature Protection & Biodiversity in Paris, but a better solution could be a support from ESRI-Europe in Krantzberg (D) if we use their GIS software.

> Action Point 4: P.Noël will find out if the Topic Centre can host EISNet
> Action Point 5: M. Meyer will find out if software developed by ESRI-Europe can be used by EISNet.

Data model and structure

The data model proposed by M. Malicky for the pilot project is approved but for the main project some more information on records and sites may be useful.

Action Point 6: All to propose fields needed within EISNet.

It is decided to ask location accuracies as fine as possible to allow detailed analyses but the representation on the project maps will not be narrower than 10x10 km, or 50x50 km for sensitive species defined by data providers.
The project zooming will not include national distributions, but switch to a link to national database centres.

How to apply the IUCN criteria to invertebrates - workshop

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This well attended workshop went through the practical steps needed to apply the IUCN criteria to invertebrate species with examples drawn from the mollusca. The use of direct and proxy data were discussed as was the difficult issue of how to deal with uncertain data. Uncertainty comes from several quarters including natural variation i.e. changes in time and space; semantic uncertainty i.e. vagueness in the terms and definitions used and; measurement error. The need for sound documentation at each stage of the process was emphasised as it provides a data trail for others to follow either to verify elements of the data or to repeat the analysis.

Bern Group of Experts meeting

Key topics covered at the meeting were:

- invertebrates in the Emerald Network – an update;
- distribution mapping of European invertebrates: EIS initiatives and other work;
- European Strategy for Invasive Alien Species;
- conservation Strategy for Invertebrates in Europe and future of the Group of Experts.

A full report of the meeting is available from the Bern Secretariat and can be downloaded from the Bern web site:

www.coe.int/t/e/Cultural Co-operation/Environment/Nature and biological diversity/Nature protection/sc23 tpvs17e.pdf?L=E

European Invertebrate Specialist Group - A specialist group of the IUCN Species Survival Commission

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The first meeting of the EISG was introduced by a short presentation summarised below. The meeting then discussed the way the EISG might operate and in what areas.

Introductory presentation

The Species Survival Commission vision for invertebrates is:

"A world that researches, documents, monitors, values and conserves invertebrate biodiversity for the maintenance of ecosystem health and integrity into the future."

The EISG seeks to build on existing different initiatives in Europe to provide a bridge between the various types of specialists in Europe, so that we can work together to develop a better understanding of the nature of the threats facing invertebrates and how we better manage our resources to minimise our effects on the species and their habitats.

The EISG aims to work with existing, well established groups to build a stronger network of invertebrate conservation activity in Europe. The group will cover all European taxa: terrestrial, fresh-water and marine.

Initial work areas:

- The collation of information needed to assess the conservation status of threatened species. To act as a Red List Authority, contributing to the IUCN global Red List;
- To build awareness and understanding of threats posed by introduced non-native species, their current ranges and rates of movement;
- To work with other groups on specific topics such as reintroduction, sustainable use and conservation breeding.

Discussion

The principle of strong collaborative working was generally welcomed and recommended as the most practical way for the EISG to develop. The IUCN 'brand' was recognised for it's high profile amongst national and international bodies built as it is on sound science from dedicated contributors in many countries.

Discussion of how to set up the practical work of the EISG resulted in a proposal to form EISG working groups by inviting existing alliances to work within the EISG, IUCN framework. Three such groups, based on functional guilds were discussed and will be followed up:

1. Saproxylic invertebrates (Adrian Fowles, UK)
2. Alpine invertebrates (John Haslett, Austria)
3. Cave dwelling invertebrates (Anastasios Legakis, Greece)

The European Invertebrate Survey lead in producing a European Invertebrate Conservation Strategy was welcomed; the EISG is keen contribute to the development of this important document.

Red listing at the global, European and national scale was discussed briefly at the meeting and in much greater depth at a workshop the following day.

www.iucn.org/themes/ssc/sgs/EISG

JOINT NATURE CONSERVATION COMMITTEE
REPORT DISTRIBUTION

Report number	367
Report title	Proceedings of *IN*Cardiff 2003: Red Lists for invertebrates: their application At different spatial scales – practical issues, pragmatic approaches
Comments	Invertebrate specialists from across Europe met in Cardiff 5-9 September 2003 to discuss conservation Action for marine, freshwater and terrestrial Invertebrates under the title of *Red Lists for* *Invertebrates*

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