Biodiversity and Conservation **10**: 1283–1296, 2001.

Setting priorities for the conservation of terrestrial vertebrates in Hungary

ANDRÁS BÁLDI[1,*], GÁBOR CSORBA[2] and ZOLTÁN KORSÓS[2]
[1]*Animal Ecology Research Group of the Hungarian Academy of Sciences, c/o Hungarian Natural History Museum, Ludovika tér 2, H-1083 Budapest, Hungary;* [2]*Deparment of Zoology, Hungarian Natural History Museum, Baross u. 13, H-1088 Budapest, Hungary; *Author for correspondence (fax: 36-1-317-1669; e-mail: baldi@ludovika.nhmus.hu)*

Received 28 August 2000; accepted in revised form 18 September 2000

Abstract. The first step towards the preservation of endangered species is to establish an appropriate ranking system, which assigns different nature conservation priority scores to different taxa. The system developed by Millsap et al. (Wildlife Monograph 1990, 111: 1–57) has been modified and applied to the mammal, bird, reptile, and amphibian species of Hungary. Three variable groups have been compiled, including eight (measuring biological characteristics), three (features of the Hungarian population) and five (evaluation of research and conservation actions) variables, respectively. In cooperation with several experts, we gave scores to all 379 taxa considered. The most endangered taxon proved to be the Hungarian Meadow Viper (*Vipera ursinii rakosiensis*), which occurs only in Hungary with just a few hundred individuals. The species rank depends on the availability and quality of data, so it is urgent to devote more effort to survey and monitoring projects. We present a possible application of the species list, where the taxa are grouped according to their legal status in Hungary (strictly protected, protected, partly protected and not protected), and the validity of this categorisation was tested by applying multivariate discriminant analysis. Only 58.36% of the species were correctly classified. The reasons for stronger than expected protection include popularity, attractiveness, and local rarity, while reasons for lower protection include preference for hunting and control of predators and pests.

Key words: amphibians, birds, mammals, nature conservation, prioritisation, reptiles

Introduction

Following the political changes in the former Eastern bloc, which included Hungary, nature conservation policy has recently been reconsidered. However, owing to rigorous economic constraints, nature conservation has been subordinated to other goals. In order to allocate rather limited financial resources to those species most in need of active conservation, establishing an objective ranking system and identifying the most endangered species are urgent tasks (Mace 1995). There are already numerous nature conservation ranking systems in the USA (Millsap et al. 1990, and references therein), and there are some in Hungary as well (see in Báldi et al. 1995). Nevertheless, these systems are usually used only locally, on a limited number of taxa, or need quantitative data (Millsap et al. 1990). Besides, publication, translation, disseminations and application of these ranking systems are almost totally absent.

An exception seems to be the system of Millsap et al. (1990), which is valid for all vertebrate taxa and was widely distributed after publication in Wildlife Monographs. Therefore its rapid application in Korea (Won 1991), Australia (Cogger et al. 1993) and Hungary (Báldi et al. 1992, 1994, 1995) is not surprising. More recently, the revision of IUCN Red List Categories provided a good possibility to identify endangered taxa (IUCN Species Survival Commission 1994; Pinchera et al. 1997).

In this paper: (1) some modifications applied to the system developed by Millsap et al. (1990) will be described; these may improve its efficiency in Hungary; (2) the reactions of amateur and professional conservationists will be analysed based on the comments we received, partly on a dispute over the ranking system organised by the Environmental and Nature Conservation Section of the Hungarian Biological Society; (3) we will re-evaluate the scores for some important taxa where our knowledge has recently increased and (4) we will demonstrate a way to apply the ranking system in conservation action.

Methods

Description of the ranking system

Amphibians (18 taxa), reptiles (15 taxa), birds (269 taxa) and mammals (77 taxa) occurring in Hungary were all included in the evaluation process. (The Great Crested Newt (*Triturus cristatus*) has recently been divided into three separate species (vs. Báldi et al. 1995).) At least one of the following criteria for inclusion were required: (1) permanent population or regular occurrence (more than one individual per year) in Hungary; or (2) without permanent population, but occasional (non-regular) reproduction in Hungary; or (3) only earlier observations of a former permanent population are known, however, present regular occurrence can be presumed.

The variables contributing to the priority scores were divided into three groups. The first group consists of eight biological variables (cf. Millsap et al. 1990) that measure different aspects of the systematics, abundance, distribution, and life history of the species. In this case, global status of the taxon in question was considered. The values of variables within each group were summed. The higher the biological score, the greater the vulnerability. The second variable group consists of three variables that measure the status of the species in Hungary. The third group contains five action variables that reflect our knowledge, scientific research and conservation efforts on the taxon in Hungary. High action scores indicate poorly known and endangered taxa. All species were scored by the authors according to the variables; then the result was sent to several highly qualified experts (see 'Acknowledgements'). The final scores are the result of consensus among experts on the given taxa. Objectivity was achieved by not summing the variables and making species ranking before the final scores were given. Therefore, no personal opinions on the position of taxa influenced the estimations for individual variables.

Biological variables
In this variable group, all questions refer to the entire geographical distribution of the taxon (Table 1).

1. '*Systematic status of the taxon*' (scores from 0 to 10). A genetically unique taxon has a greater value in wildlife diversity than a species with many closely related subspecies. In addition to the genetic value, this variable also shows the exact taxonomic status of the taxon.
2. '*Population size*' (0–10). The number of reproducing adults estimated for the total (world-wide) population under consideration.
3. '*Population trend*' (0–10). Changes in the number of reproducing individuals. The time scale concerned is usually restricted to the 20th century, owing to the availability of (written or reliable) records.
4. '*Size of the taxon's area*' (0–10). Species with small geographic ranges are more vulnerable, because local effects can be fatal for the whole population.
5. '*Distribution trend*' (0–10). Habitat loss and fragmentation are among the most important factors causing decline in a species' population and area.
6. '*Population concentration*' (0–10). There is a higher environmental risk for a species having relatively compact habitat or aggregating during any period of its life cycle.
7. '*Reproductive potential for recovery*'. (A) The number of offspring produced per breeding female per year (0–5 scores); (B) Minimum age at which females first reproduce (0–5). These variables provide important information on the reproductive capacity of the species. How fast can the population recover after a catastrophe?
8. '*Ecological specialisation*'. (A) Dietary specialisation (0–3); (B) Reproductive specialisation (0–3); (C) Other specialisations (0–3). It is important for a species to be able to shift its ecological niche along the different axes together with environmental changes. 'Specialisation' means narrow ecological tolerance, reduced adaptability, and hence reduced chance of survival in a changing environment.

Features of the Hungarian population
These variables measures the status of the species in Hungary (Table 2).

1. '*Population size in Hungary*' (0–10). The size of the Hungarian population of the species is taken as the percentage of the world-wide population.
2. '*Trend of the taxon in Hungary*' (0–10). Changes in the number of reproducing individuals in Hungary. The time scale concerned is usually restricted to the 20th century, owing to the availability of (written or reliable) records.
3. '*Occurrence in Hungary*' (1–5). If a species occurs permanently only in Hungary, our responsibility for its 'world-wide' protection is high. If a threatened species has its migration route through Hungary, its protection requires only temporary activities, e.g. guarding the resting sites.

Table 1. Biological variables, categories within variables, and scores used in ranking taxa. The higher the sum of scores, the greater the vulnerability.

(1) Systematic significance of the taxon	
Monotypic family	10
Monotypic genus	8
Monotypic species	6
Isolated subspecies	3
One of several integrading subspecies	0
(2) Population size – the estimated number of adults throughout the range of taxon	
1–500	10
501–1000	8
1001–3000	6
3001–10 000	4
10 001–50 000	2
50 000<	0
(3) Population trend – overall trend in number of individuals throughout the taxon's range	
Known to be decreasing	10
Suspected to be decreasing	8
Stable or increasing after the collapse of the population	6
Stable or suspected to be increasing	2
Known to be increasing	0
(4) Range size – the area over which the taxon is distributed during the season when distribution is most restricted (e.g. breeding, migration)	
<100 km^2	10
101–1000 km^2	9
1001–50 000 km^2	7
50 001–100 000 km^2	4
100 000<	0
(5) Distribution trend – high score if the range fragmented and/or decreased	
Area declined by 90–99%	10
Area declined by 75–89%	8
Area declined by 25–74%	5
Area declined by 1–24%	2
Area is stable or has increased	0
(6) Population concentration – degree to which individuals within populations congregate or aggregate seasonally or daily (migration focal points, hibernacula, resting sites, breeding sites, roosting sites)	
Majority concentrates at single location	10
Concentrates at 2–25 locations	6
Colonial breeding, roosting or wintering (>25 locations)	2
Does not concentrate (living solitary or in family units)	0
(7) Reproductive potential for recovery	
(A) Number of eggs or youngs/adult female/year	
≤1	5
2–9	3
10–100	1
100<	0
(B) Minimum age at which females first reproduce	
>8	5
4–8	3
2–3	1
<2	0

Table 1. Continued.

(8) Ecological specialisation	
(A) Dietary specialisation	
Number of individuals declines if preferred food decreased	3
Substantial shift in diet if preferred food decreased	0
(B) Reproductive specialisation	
Number of individuals declines if the availability of preferred breeding sites deceased	3
Substantial shift to alternate breeding sites	0
(C) Other specialisations – ecological or behavioural specialisation not covered in variables 8A and 8B (e.g. strict requirements for water quality, soil structure)	
There is a special requirement	3
There is no special requirement	0

Action variables

These variables measure our conservation knowledge and management efforts concerning the taxon in Hungary (Table 3). Effective conservation activity in Hungary requires knowledge of several characteristics of the local population. Scientific research and conservation planning are essential parts of an endangered species' recovery plan.

1. '*Knowledge of distribution in Hungary: survey*' (0–10). Mapping projects and population size estimation should be carried out to establish an initial conservation data bank.

Table 2. Variables ranking the status of the Hungarian population, categories within variables, and scores used in ranking taxa. The higher the sum of scores, the greater is the vulnerability.

(1) Percentage of the total population living in Hungary	
81–100%	10
61–80%	8
31–60%	6
11–30%	3
1–10%	0
(2) Trend in the Hungarian population of the taxon	
Known to be decreasing	10
Suspected to be decreasing	8
Stable or increasing after the collapse of the population	6
Stable or suspected to be increasing	2
Known to be increasing	0
(3) Period of occurrence in Hungary	
Resident	5
Resident during breeding	3
Resident in winter or summer	2
Transient	1

Table 3. Action variables, categories within variables, and scores used in ranking taxa. These variables evaluate our knowledge and actions.

(1) Knowledge of distribution in Hungary (survey)	
There are only a few known locations, or large scale distribution maps	10
Broad range limits are known	5
There is a detailed distribution map of the taxon (e.g. 10 × 10 km UTM)	0
(2) Knowledge of population trend in Hungary (monitoring)	
Not currently monitored	10
Monitored locally	5
Country wide monitoring	0
(3) Knowledge of Hungarian population limitations (research)	
Factors are unknown	10
Some factors are known	5
Major factors are known	0
(4) Ongoing management activities (management)	
None	10
Occasional or limited management program	5
Program that guarantees the survival of Hungarian population	0
(5) Protection and harvest of the taxon in Hungary (protection)	
Harvested with no legal protection	5
Harvested, but harvest regulated	3
No harvest, no protection	2
Harvest prohibited by law	0

2. ‘*Knowledge of population trend in Hungary: monitoring*’ (0–10). Without continuous observation of the population in question, it is impossible to distinguish between natural variation and harmful environmental influences.
3. ‘*Knowledge of population limitations in Hungary: research*’ (0–10). Conservation actions should be based on the biological characteristics of the species.
4. ‘*Ongoing management activities in Hungary: conservation management*’ (0–10). If a species is already the focus of conservation projects, it receives lower scores.
5. ‘*Harvest and protection in Hungary: protection*’ (0–5). This category reflects the present state of the species: its protection status according to the nature conservation act (Anon 1993, 1996), or regulation of its harvesting (hunting, pest-control, etc.).

Modifications compared to the system by Millsap et al. (1990)

The ranking system developed by Millsap et al. (1990) was modified in some ways, to improve the system’s applicability in the Central European situation. The differences partly resulted from the different biogeographical positions of Hungary and Florida.

The third variable group (‘Supplemental variables’ of Millsap et al. 1990) was reduced to three variables, which all measure Hungary’s significance in the preservation of the taxa. The ‘Systematic significance of the taxon’ variable clustered with the biological variables; it is meant to measure the genetic uniqueness of a taxon. Although it also estimates a biological feature, it differs from the other variables, because they measure ecological characters.

The ‘Harvesting of taxon’ variable was added to the ‘Action variables’, because it belongs to conservation activities.

The scores of some variables were also modified. The maximum score value of the variable ‘Systematic significance of the taxon’ was changed to 10, because all other variables among biological variables were scored out of a maximum of ten. Lesser modifications were also made in the ‘Range size’, ‘Other specialisation’, ‘Period of occurrence’, ‘Monitoring’, and ‘Harvesting’ variables. These changes consisted of the exclusion or inclusion of one more score and resulted in only minor changes.

The second variable group measured Hungary’s significance in the preservation of a taxon, in contrast to the system of Millsap et al. (1990), where it was the third, mixed group of different variables. Hence, our second group became as important as the other two groups. Consequently, the 9th and 10th variables were scored out of 10.

The variable ‘Percent of taxon’s total range that occurs in Florida’ was modified to ‘Percent of taxon’s population that occurs in Hungary’. The difference lies in Hungary’s area, which is small (93 000 km^2) but harbours significant populations of several threatened species. For example, 10% of the European population of Spoonbill (*Platalea leucorodia*), 10% of the Imperial Eagle (*Aquila heliaca*), 5% of the Great Bustard’s (*Otis tarda*) and 15% of the Saker’s (*Falco cherrug*) European populations are confined to Hungary (Tucker and Heath 1994). The ranges of these species are large, so the relation of the taxon’s Hungarian range to the world distribution is well below 1%. Consequently, the relative population size better indicated Hungary’s significance in the preservation of the taxon.

Results and discussion

Our knowledge of the ecology of vertebrates is still incomplete; therefore any ranking system will be imperfect. However, experts help to evaluate the list we produced according to our present knowledge.

The response to the ranking system and the re-scoring of bats and the Root Vole

We paid much attention to the dissemination of our work. The system was introduced at three national conferences (Annual Meeting of the Hungarian Biological Society 1992; Eastern Hungarian Conference on Fishery, Forestry, Agriculture and Nature Conservation 1994; Fourth Scientific Meeting of the Hungarian Ornithological and Nature Conservation Society 1995) and was published in several scientific and popular periodicals. Therefore, the publication of the ranking system in a separate booklet in January 1995 has had a favourable reception. However, there were two clearly different criticisms of the system. On theoretical grounds, several experts argued that the comparison of taxa in different taxonomic classes is biologically incorrect. In addition, they said, it is not possible to estimate the variables accurately, e.g. for total population size. Although these criticisms are scientifically true, our aim was to produce a single priority list for conservation; thus, we had to evaluate different taxa in one system. For some variables we were able to produce only a rough estimation, but this was sufficient, because a categorisation rather than an exact value was required.

On practical grounds, the critics argued that the system is too complicated, and a more simple ranking system would be more useful. In addition, there was strong criticism of the position of several species in the list of threatened taxa. Another source of concern emerged from the time gap between the compilation of scores (1990–1993) and the publication (1995), which resulted in the loss of new information. In any event, our work was incorporated into several conservation biological projects, like the Hungarian National Biodiversity Monitoring System (Horváth et al. 1997), or into the handbook on grassland management (Kelemen 1997), and to university courses (Kovács and Kiss 1995; Margóczi 1998).

The two latter problems were investigated for bats. Bats had high scores in our former list (accepted in 1993), as compared to other highly threatened species (Báldi et al. 1995), partly because of our very poor knowledge of this order. Fortunately, in the last 5 years, bats have became one of the most popular animal groups in Hungary. The Hungarian Bat Research Society has co-ordinated and organised numerous inventories and monitoring projects, e.g. monitoring of building-dwelling bats, monitoring of Schreiber's Long-fingered Bat (*Miniopterus schreibersii*) in Central-Europe, and the inventory of bat faunas of protected areas. Approximately 60% of the country is systematically surveyed by volunteers. Therefore, we now have much more detailed information on the distribution and status of bats in Hungary, which allowed us to re-evaluate the scores after 5 years in 1998. Since our better understanding of bats' distribution and population trends were limited mainly to Hungary, the scores of the whole population (Table 1), and the Hungarian population (Table 2) decreased differently. The average sum of scores for the biological variables of bats decreased by 11%, and the scores for the Hungarian population by 23%. The status of bats generally became less vulnerable than before, owing to our much better knowledge and protection efforts. The sum of scores slightly increased for only two species, Schreiber's Long-fingered Bat and the Giant Noctule (*Nyctalus lasiopterus*). The Northern Bat (*Eptesicus nilssoni*) was excluded from the analysis, because recent surveys suggest that the species is a rare vagrant in Hungary and thus did not fit the criteria for inclusion (see 'Methods'). The problem of time lag between the preparation and publication of a priority list will always exist, owing to the fortunately high activity level of volunteers. However, quick publication, and especially, re-evaluation of the ranking system, e.g. every 5 years, is necessary.

There was another important change in species rank. We also re-evaluated the status of the Root Vole (*Microtus oeconomus*). Because the subspecific distinctness of the Central European population (*M. o. méhelyi*) is widely accepted among mammalogists, and the recent distribution of the subspecies (Final draft of the European Mammals Atlas, Societas Eurpaea Mammalogica 1997) is restricted to the small isolated area encompassing Western-Hungary, Burgenland (Austria), and Csallóköz (Slovakia), we evaluated and scored the Root Vole as a subspecies, and not as full species; a similar case is that of the Hungarian Meadow Viper (*Vipera ursinii rakosiensis*).

Another potential taxon for re-evaluation is the Short-toed Lark (*Calandrella brachydactyla*), which has a distinct breeding population in Hungary. This was originally described as an endemic subspecies (*C. b. hungarica* Horváth, 1956). Recent opinions, however, suggest that the subspecific status of the only Hungarian population in the Hortobágy region is doubtful (Magyar et al. 1998). Therefore, we did not include the taxon in the list as a subspecies, but as a species. A taxonomic revision of the species is needed and may result in a change in its nature conservation priority status.

Evaluation of the most threatened taxa

The threat to a species was evaluated by the sum of scores in the biological and 'Features of the Hungarian population' variables. Globally endangered species that are threatened in Hungary also got the highest scores. A total of 71 highly endangered terrestrial vertebrate species were selected from the entire sample of 379 taxa, based on the sum of the scores (>28) (Table 4). The score level was chosen because it resulted in the best list of threatened species, where the best list is one that contains almost all species of international lists and matches our expectations. Our list, however, used a different evaluation procedure than other lists, and instead of rough categories, it provides a priority list.

Atop the list is the Hungarian Meadow Viper, a venomous snake on the brink of extinction, having probably less than 2000 individuals surviving in two main distribution areas of Hungary (Korsós 1991; Újvári et al. 2000). There are a number of bat species in the highly endangered category, possibly because they are often specialists, having strict requirements for breeding and wintering places, etc. Several bird species are also among the most endangered species, including the Great Bustard, Slender-billed Curlew (*Numenius tenuirostris*), Imperial Eagle, etc. No class was disproportionately over- or under-represented on the list, e.g. there were six mammals, six birds and three reptiles among the 15 most threatened species and subspecies, which correlates roughly with the numbers of species in the classes.

The decline of several species may be the consequence of habitat loss (mainly for wetland and grassland species). Hunting and persecution may also be an important factor, e.g. in the case of the Otter (*Lutra lutra)* and European Lynx (*Lynx lynx*).

Table 4. The 71 most threatened terrestrial vertebrates in Hungary. Those taxa were listed for which the sum of the biological variables (BIOL) and the 'Features of the Hungarian population' (HUNG) is greater than 28. This table was based on the re-evaluated data for bats and Root Vole, therefore, there are differences compared to our former species rank (Báldi et al. 1995).

		BIOL	HUNG	SUM
Meadow Viper	*Vipera ursinii rakosiensis*	57	25	82
Slender-billed Curlew	*Numenius tenuirostris*	44	11	55
Root Vole	*Microtus oeconomus méhelyi*	26	25	51
Great Bustard	*Otis tarda*	33	18	51
Caspian Whip Snake	*Coluber caspius*	33	18	51
Mediterranean Horseshoe Bat	*Rhinolophus euryale*	28	15	43
Common Adder	*Vipera berus*	28	15	43
Imperial Eagle	*Aquila heliaca*	33	10	43
Schreiber's Long-fingered Bat	*Miniopterus schreibersii*	26	15	41
Western Barbastelle	*Barbastella barbastellus*	30	11	41
Lesser White-fronted Goose	*Anser erythropus*	30	11	41
Giant Noctule	*Nyctalus lasiopterus*	30	11	41
Bechstein's Bat	*Myotis bechsteini*	30	11	41
White-tailed Eagle	*Haliaetus albicilla*	34	7	41
Pygmy Cormorant	*Phalacrocorax pygmaeus*	29	11	40
Lesser Horseshoe Bat	*Rhinolophus hipposideros*	23	15	38
Greater Horseshoe Bat	*Rhinolophus ferrumequinum*	23	15	38
Pond Bat	*Myotis dasycneme*	25	13	38
Aesculapian Snake	*Elaphe longissima*	25	13	38
Brandt's Bat	*Myotis brandti*	27	11	38
Spoonbill	*Platalea leucorodia*	26	11	37
Blind Mole-rat sp.	*Nannospalax leucodon*	21	15	36
Southern Birch Mouse	*Sicista subtilis*	21	15	36
Squacco Heron	*Ardeola ralloides*	23	13	36
Red-footed Falcon	*Falco vespertinus*	23	13	36
European Pond Turtle	*Emys orbicularis*	23	13	36
Booted Eagle	*Hieraetus pennatus*	25	11	36
Saker	*Falco cherrug*	28	8	36
Lesser Spotted Eagle	*A. pomarina*	31	5	36
Short-toed Eagle	*Circaetus gallicus*	31	5	36
Eagle Owl	*Bubo bubo*	20	15	35
Pannonian Snake-eyed Skink	*Ablepharus kitaibelii*	20	15	35
Pratincole	*Glareola pratincola*	22	13	35
Rock Thrush	*Monticola saxatilis*	22	13	35
Ferruginous Duck	*Aythya nyroca*	24	11	35
Corncrake	*Crex crex*	24	11	35
Natterer's Bat	*Myotis nattereri*	24	11	35
Roller	*Coracias garrulus*	21	13	34
Lesser Grey Shrike	*Lanius minor*	21	13	34
Dipper	*Cinclus cinclus*	17	15	32
Black-tailed Godwit	*Limosa limosa*	19	13	32
Red Kite	*Milvus milvus*	19	13	32
Alpine Newt	*Triturus alpestris*	19	13	32
Whiskered Bat	*Myotis mystacinus*	21	11	32
Lesser Mouse-eared Bat	*Myotis blythi*	21	11	32
Large Mouse-eared Bat	*Myotis myotis*	21	11	32
Geoffroy's Bat	*Myotis emarginatus*	21	11	32
Grey Long-eared Bat	*Plecotus austriacus*	21	11	32

Table 4. Continued.

		BIOL	HUNG	SUM
Brown Long-eared Bat	*Plecotus auritus*	21	11	32
White Stork	*Ciconia ciconia*	21	11	32
Nathusius' Pipistrelle	*Pipistrellus nathusii*	25	7	32
Bee-eater	*Merops apiaster*	27	5	32
Black Stork	*Ciconia nigra*	27	5	32
Caspian Tern	*Hydroprogne tschegrava*	29	3	32
Kentish Plover	*Charadrius alexandrinus*	18	13	31
Aquatic Warbler	*Acrocephalus paludicola*	23	8	31
Particoloured Bat	*Vespertilio murinus*	24	7	31
Golden Eagle	*Aquila chrysaetos*	24	7	31
European Souslik	*Spermophilus citellus*	15	15	30
Lesser Noctule	*Nyctalus leisleri*	19	11	30
Eurasian Lynx	*Lynx lynx*	19	11	30
Green Treefrog	*Hyla arborea*	23	7	30
Barn Owl	*Tyto alba*	14	15	29
Redshank	*Tringa totanus*	16	13	29
Eurasian Water Shrew	*Neomys fodiens*	16	13	29
Southern Water Shrew	*Neomys anomalus*	16	13	29
Forest Dormouse	*Dryomys nitedula*	16	13	29
Hazel Dormouse	*Muscardinus avellanarius*	16	13	29
Otter	*Lutra lutra*	18	11	29
Wild Cat	*Felis silvestris*	18	11	29
Black Kite	*Milvus migrans*	20	9	29
Crane	*Grus grus*	26	3	29

Comparison with other nature conservation lists

Validity of the most threatened species (with biological scores higher than 28) in our ranking system was tested by comparing the results with the Hungarian Red Book (Rakonczay 1990), the IUCN Red Lists (IUCN 1990; Groombridge 1993), and the Berne Convention Appendices II and III. A total of 70 taxa from our 71 were found on these lists, indicating that our results are in good agreement with the international applications. The only species missing from the Appendices of the Berne Convention is a Blind Mole-rat species (*Nannospalax leucodon*) that does not occur in Western Europe, the former focus area of the Berne Convention. There are a lot of species included in the Appendix II of the Berne Convention, but owing to the stable populations in Hungary, they are missing from our list. There are a variety of reasons for the differences: the species has a basically Eastern European and/or Asian range and in Western Europe only isolated populations exist (e.g. Common Hamster, *Cricetus cricetus*); owing to the Hungarian conservation efforts the population of given taxa increased (e.g. Great White Egret, *Egretta alba*); the relatively large proportion of seminatural habitats in Hungary (e.g. Bittern, *Botaurus stellaris*; Green Lizard, *Lacerta viridis*). These show the necessary changes in the focus of international nature conservation bodies as well.

An application of the ranking system as an argument in conservation actions

The aim of preparing such a ranking system was to give guidelines for nature conservation and indicate which species need urgent action. One of the possible actions is to modify the legal status of several species, based on their biological characters compiled in this database and list. Báldi and Csorba (1997) carried out a multivariate discriminant analysis on the biological variables and on the variables 'Features of the Hungarian population'. A similar multivariate analysis was published by Given and Norton (1993) on New Zealand plants. The grouping variable was the legal status of the species, according to the Hungarian Nature Conservation Act (Anon. 1993, 1996), a special Hungarian law that prescribes protection of wildlife on four different levels: not protected, partly protected, protected and strictly protected species. The 'partial protection' means that the species is protected, but it can be hunted or otherwise disturbed in a specified time (hunting season) and place (fisheries, hatcheries, etc.). 'Protected' means that the killing of species is a minor offense, while that of 'strictly protected' species is a felony. In addition, for strictly protected species not only the species, but its actual habitat also became protected, e.g. the near vicinity of an Imperial Eagle's nest. We showed that only 58.36% of species were protected in accordance with our ranking system. Many species (107 spp.) got stronger legal protection, however, for reasons other then biological. For example, they were locally or regionally rare, attractive species, thus became symbolic species (Great White Egret *Egretta alba*), or popular species (many small passerines, like warblers and tits), or economically valuable species (e.g. insectivores as potential agents of biological pest control). But 50 species (1 amphibian, 4 reptilian, 30 bird and 15 mammal species) had lower protection than expected based on their biological status (see Báldi and Csorba 1997). Several unprotected or partly protected species do not need stronger protection, however, because they are abundant, or can even be pest species in some instances. In these cases the biological reasons should be subordinate, and the preservation of other species should gain priority. For example, the Wild Boar (*Sus scrofa*), Fox (*Vulpes vulpes*), Magpie (*Pica pica*) and Hooded Crow (*Corvus corone cornix*) are in this group. Other species, like some popular game species (e.g. the Bean Goose (*Anser fabalis*), Teal (*Anas crecca*), and Garganey (*A. querquedula*)) should have their status modified from 'partly protected' to 'protected' in order to prevent their being hunted. Most of the suggested modifications are to upgrade the legal status of terrestrial vertebrates from 'protected' to 'strictly protected' species.

Conclusions

Our results revealed that any species prioritisation depends highly on the availability and quality of data. Insufficient data can result in misleading species ranks. Thus, it is absolutely urgent to survey as many taxa as possible and to conduct long-term research and monitoring projects both on protected and unprotected areas (Moskát et al. 1993; Fekete et al. 1994; Horváth et al. 1997; Margóczi et al. 1997).

Management programs have already been initiated for some of the most endangered species, e.g. the Hungarian Meadow Viper, the Great Bustard, the Saker. However, these taxa and many others are still in need of effective conservation actions. Both the number and activity of the different non-governmental nature conservation organisations and societies show rapid increase in Hungary. The largest of all is BirdLife Hungary (the Hungarian Ornithological and Nature Conservation Society), which has ca. 5000 active members. Its activity concerns not only birds but more and more emphasises general nature conservation, including the protection of every living organism and of wildlife habitat. There are other societies as well. Some of them are more scientific, others are rather practical, e.g. the Hungarian Bat Research Society, the Hungarian Mammalogical Society, and hundreds of green NGOs. Many of these bodies provide an appropriate and essential basis for widening and strengthening nature conservation activities in Hungary. It is hoped that the priority ranking system presented here will help them and the responsible decision makers to find the right way to fulfill our common goal, to save wildlife for the future.

Acknowledgements

Development of the ranking system was based on the knowledge of many experts: A. Bankovics (Hungarian Natural History Museum), Z. Bihari (Department of Zoology, Agricultural University, Debrecen), E. Boros (BirdLife Hungary), D. Csanádi (Hungarian Bat Research Society), A. Demeter (Hungarian Academy of Sciences), A. Gubányi (Hungarian Natural History Museum), Zs. Kalotás (Institute of Ornithology), I. Kiss (Department of Zoology and Ecology, Gödöllő Agricultural University), V. Molnár (University of Veterinary Sciences, Budapest), Z. Molnár (Zoological and Botanical Garden of the City of Budapest), E. Schmidt (BirdLife Hungary), L. Szemethy (Department of Wildlife Biology, Gödöllő Agricultural University) and Z. Waliczky (BirdLife International). We greatly appreciate their kind effort to score the taxa. We are indebted to T. Fuisz and two anonymous referees for comments.

References

Anon. (1993) 12/1993 Departmental Order of the Minister of Environmental Conservation and Regional Policy. Magyar Közlöng 36: 2002–2044 [in Hungarian]

Anon. (1996) 15/1996 Departmental Order of the Minister of Environmental Conservation and Regional Policy. Magyar Közlöng 64: 4073–4075 [in Hungarian]

Báldi A and Csorba G (1997) Ecological validation to the legal status of terrestrial vertebrates in Hungary. Természetvédelmi Közlemények 5–6: 79–86 [in Hungarian with English summary]

Báldi A, Csorba G and Korsós Z (1994) Setting priorities for the conservation of wildlife species in Hungary, a preliminary report. In: Bissonette JA and Krausman PR (eds) Integrating People and Wildlife for a Sustainable Future. Proceedings of the First International Wildlife Management Congress, pp 633–636. The Wildlife Society, Bethesda, Maryland

Báldi A, Csorba G, Korsós Z and Waliczky Z (1992) Setting priorities for the conservation of terrestrial vertebrates in Hungary. 20th Congress of the Hungarian Biological Society, p 17 [in Hungarian]

Báldi A, Csorba G and Korsós Z (1995) Setting Priorities for the Conservation of Terrestrial Vertebrates in Hungary. Hungarian Natural History Museum, Budapest, Hungary [in Hungarian with English summary]

Cogger HG, et al. (1993) Action Plan for Australian Reptiles. Australian Nature Protection Agency, ESP Project No. 124

Fekete G, et al. (1994) Foundations for developing a national strategy of biodiversity conservation. Acta Zoologica Hungarica 40: 289–327

Given DR and Norton DA (1993) A multivariate approach to assessing threat and for priority setting in threatened species conservation. Biological Conservation 64: 57–66

Groombridge B (ed) (1993) 1994 IUCN Red List of Threatened Animals. IUCN, Gland, Switzerland/Cambridge, UK

Horváth F, Korsós Z, Kovácsné-Láng E and Matskási I (eds) (1997) Hungarian National Biodiversity Monitoring System. I–X. Hungarian Natural History Museum, Budapest, Hungary

IUCN (1990) 1990 IUCN Red List of Threatened Animals. IUCN, Gland, Switzerland/Cambridge, UK

IUCN Species Survival Commission (1994) IUCN Red List Categories. IUCN, Gland, Switzerland

Kelemen J (1997) Guidelines for the Nature Conservation Management of Grasslands. Természetbúvár Alapítvány, Budapest, Hungary [in Hungarian]

Korsós Z (1991) The most threatened venomous snake of Europe, the *Vipera ursinii rakosiensis*. Természetvédelmi Közlemények 1: 83–88

Kovács M and Kiss I (1995) Nature and Land Conservation. Gödöllő University of Agricultural Sciences, Gödöllő, Hungary [in Hungarian]

Mace GM (1995) Classification of threatened species and its role in conservation planning. In: Lawton JH and May RM (eds) Extinction Rates, pp 198–213. Oxford University Press, Oxford

Magyar G, Hadarics T, Waliczky Z, Schmidt A, Nagy T and Bankovics A (1998) Nomenclator Avium Hungariae. An Annotated List of the Birds of Hungary. Madártani Intézet, MME, Winter Fair, Budapest, Szeged, Hungary

Margóczi K (1998) Conservation Biology. JATE Press, Szeged, Hungary [in Hungarian]

Margóczi K, Báldi A, Dévai Gy and Horváth F (1997) Ecological research priorities for nature conservation. Természetvédelmi Közlemények 5–6: 5–16 [in Hungarian with English summary]

Millsap BA, Gore JA, Runde DE and Cerulean SI (1990) Setting priorities for the conservation of fish and wildlife species in Florida. Wildlife Monograph 111: 1–57

Moskát C, Báldi A and Mahunka S (1993) Conservation of biodiversity in Hungary: history, strategy and examples. Manuscript Collection of International Symposium on Biodiversity and Conservation, pp 36–92. Korean Entomological Institute, Seoul

Pinchera F, Boitani L and Corsi F (1997) Application to the terrestrial vertebrates of Italy of a system proposed by IUCN for a new classification of national Red List categories. Biodiversity Conservation 6: 959–978

Rakonczay Z (ed) (1990) Red Data Book. Extinct and Threatened Plant and Animal Species of Hungary. Akadémiai Kiadó, Budapest [in Hungarian with English summary]

Tucker GM and Heath MF (1994) Birds in Europe. Their Conservation Status. BirdLife International, Cambridge, UK

Újvári B, Korsós Z and Péchy T (2000) Life history, population characteristics and conservation of the Hungarian meadow viper (*Vipera ursinii rakosiensis*). Amphibia–Reptilia 21: 267–278

Won P-O (1991) Setting priorities for the conservation of avian species in Korea. Nature Conservation 74: 35–48 [in Korean with English summary]