



Carpathian List of Endangered Species



CARPATHIAN ECOREGION INITIATIVE



Contributors

This Red List is the result of the work of a group of scientists from countries located in the area of the Carpathian Mountains in Central Europe. It has been technically edited by Zbigniew J. Witkowski (chief editor), Wiesław Król and Wojciech Solarz.

The editors would like to thank the following people for their excellent contributions to the following chapters of this publication: Vascular Plant Species (Lydia Tassenkevich); Vertebrates — small mammals and large herbivores (Kajetan Perzanowski), large carnivores (Henryk Okarma); Birds (Tomas Ruzicka); Reptiles and Amphibians (Mojmir Vlasin); Fishes and Lampreys (Krzysztof Kukuła, Judit Sandor); Invertebrates (Jerzy Pawłowski); Plant Alliances (Viera Stanova).

Digital maps of the Carpathians were prepared by Jan Seffer and Rastislav Lasak. Databases for data gathering were designed by Wiesław Król, Paweł Adamski and Zbigniew J. Witkowski.

This Red List would not have been completed without the commitment and support of the Carpathian Ecoregion Initiative (CEI), facilitated by the WWF International Danube–Carpathian Programme (DCP), within the framework of which biodiversity in the Carpathians has been assessed. Special thanks goes to Philip Weller, Sissi Samec and Suzie Holt — all former staff at the WWF International Danube–Carpathian Programme Office in Vienna.

Text editing and design advice was provided by Paul Csagoly, Communications Manager for the WWF International Danube–Carpathian Programme. Illustrations were drawn by Marek Keppert. Cover page design was made by Edward Bobeł, Wiesław Król. Layout and typesetting of the whole publication was provided by Edward Bobeł.

This List was completed using databases and other sources of information as well as technical equipment and support from the Institute of Nature Conservation, Polish Academy of Sciences, Krakow, Poland.

Carpathian List of Endangered Species

Edited by

Zbigniew J. Witkowski — chief editor

Wiesław Król

Wojciech Solarz

Authors

Krzysztof Kukuła

Henryk Okarma

Jerzy Pawłowski

Kajetan Perzanowski

Tomas Ruzicka

Judit Sandor

Viera Stanova

Lydia Tassenkevich

Mojmir Vlasin

Vienna, Austria and Krakow, Poland

April 2003



This edition published 2003
by the Carpathian Ecoregion Initiative

About the Carpathian Ecoregion Initiative

The Carpathian Ecoregion Initiative is a unique international partnership achieving conservation of nature in the globally important Carpathian Mountains and, at the same time, supporting local economy and culture for the lasting benefit of people living in the heart of Europe. Facilitated by WWF, more than 50 organizations from seven countries are working together to make this vision a reality.

Copyright © 2003 WWF

Reproduction of this publication for sale, resale or other commercial purposes is prohibited without prior written permission of the copyright holder.

Citation:

Witkowski Z.J., Król W., Solarz W. (eds.). 2003.
Carpathian List Of Endangered Species.
WWF and Institute of Nature Conservation, Polish Academy of Sciences,
Vienna-Krakow

ISBN 83-918914-0-2

Published by:
WWF International Danube-Carpathian Programme,
Vienna, Austria; and
Institute of Nature Conservation, Polish Academy of Sciences,
Krakow, Poland

Printed by EUROPRESS, Kraków, Poland

Contents

| | |
|---------------------------|----|
| About this book | iv |
|---------------------------|----|

Part I INTRODUCTION

| | |
|---|------|
| Species Conservation, Mountains and the Carpathians. | v |
| Why a Carpathian List Of Endangered Species?. . . | vii |
| Methodology Used | viii |
| How to Use This Book | x |
| References. | xii |

Part II CONCLUSIONS AND SPECIES GROUPS ANALYSES

| | |
|-----------------------------------|----|
| Conclusions | 1 |
| Vascular Plants | 6 |
| Mammals | 20 |
| Birds | 27 |
| Reptiles and Amphibians | 32 |
| Fishes and Lampreys | 35 |
| Invertebrates | 39 |
| Plant Alliances | 47 |

| | |
|--|----|
| WWF International Danube–Carpathian Programme and the Carpathian Ecoregion Initiative | 62 |
|--|----|

About this Book

While the importance of the conservation of species is globally recognized, the rate of man-made extinctions and the development of new threats to species are catastrophic. In response, WWF created its list of Global 200 ecoregions which represent the world's most outstanding areas requiring targeted conservation efforts. The Carpathian Mountains, perhaps Europe's richest mountains in terms of overall biodiversity, is one such Global 200 ecoregion.

The Carpathian Ecoregion Initiative, facilitated by the WWF International Danube Carpathian Programme, has been responsible for mapping overall biodiversity in the Carpathian ecoregion, as a first step in its targeted conservation efforts. Following initial analyses, the editors of this publication concluded that existing red lists and red books do cover parts of the Carpathians, but that no red list or book covers the entire Carpathian ecoregion as a whole. This publication is therefore an initial response to filling in that gap and constitutes the second step in the data analysis process of the Carpathian Ecoregion Initiative (CEI), following its earlier work on sectoral syntheses (Witkowski et al. 2000, Turnock 2001) and the report on "The Status of the Carpathians" (Webster et al. 2001).

The ultimate goal of this document is not only the presentation of a list of threatened plants, animals and plant alliances in the Carpathians, but also the popularisation of general knowledge about this region throughout Europe.

Part I of the publication begins with an introduction about the importance of species conservation, especially in mountain systems. It then defines red lists and red books, their origins and the need for a new comprehensive Carpathian List Of Endangered Species. The methodology used in compiling this Carpathian List Of Endangered Species is then explained, as are guidelines on how to understand the data presented.

Part II opens with a set of conclusions that summarize the overall results taken from the six separate chapters on species groups that follow.

The publication ends with additional information about the objectives and work of both the Carpathian Ecoregion Initiative and WWF.

PART I

Introduction

Species Conservation, Mountains and the Carpathians

The conservation of species, particularly those in danger of extinction, forms one of the basic elements of biodiversity conservation. As early as the 1980s, this principle of the preservation of genetic diversity was established as the foundation for the practice of conservation through the World Conservation Strategy, prepared jointly by IUCN, WWF and UNEP.

The lifespan of a species is not unlimited. Over a period of millions of years, species either become extinct in the ever-changing environment or develop into new distinctive forms. It is assumed that in natural conditions at least one species per year becomes extinct for purely natural reasons (Shaffer 1990). This situation has rapidly changed today, with people altering the biosphere and pushing an uncountable number of species to the verge of extinction.

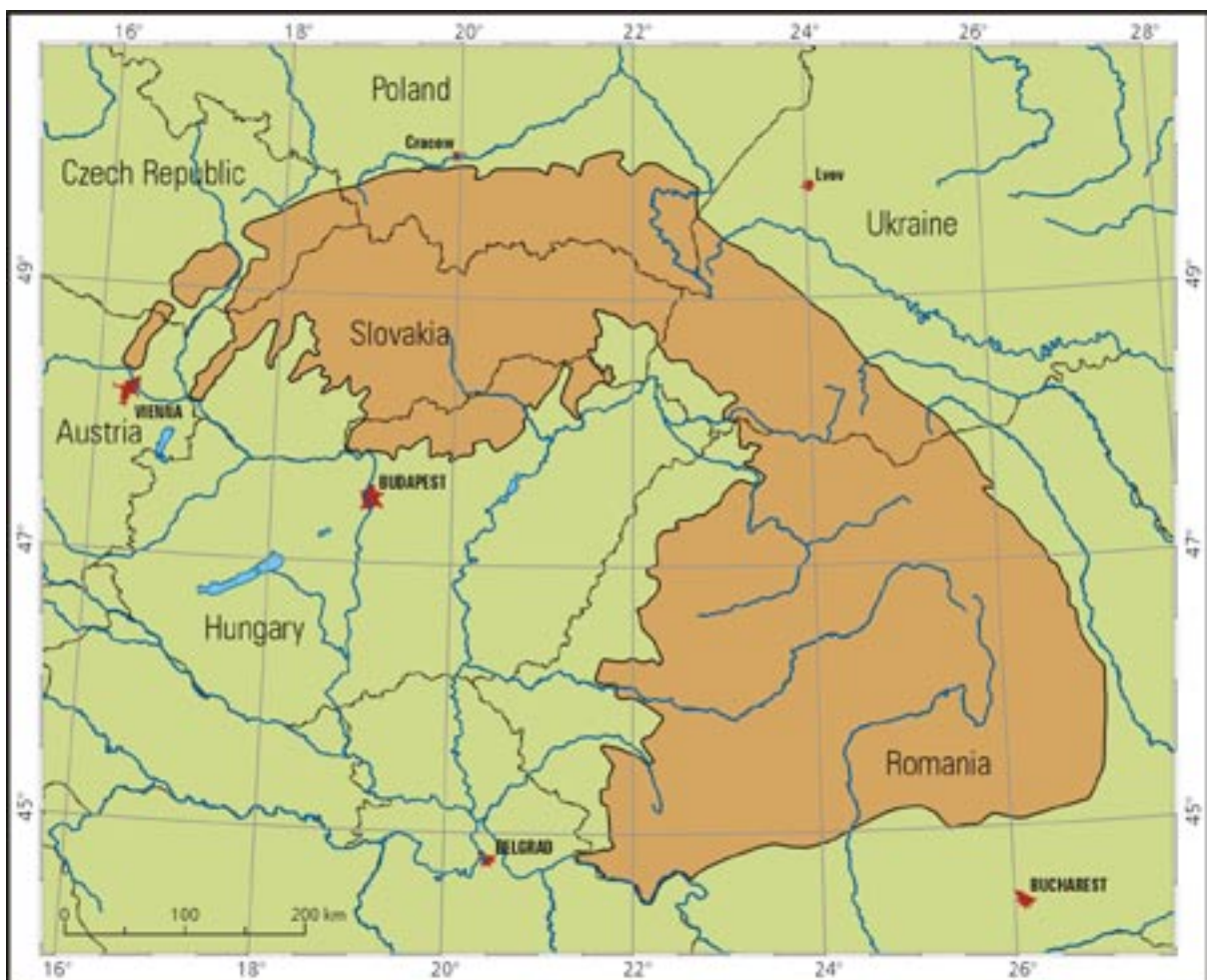
The rate of man-made extinctions is high enough to be called catastrophic. Every year, tens of thousands of species are disappearing from our planet (May 1999) and the intensity of the extinction process is as high as the mass extinctions known from paleobiological records (Sepkoski 1992). Bearing in mind that we have so far described less than 2 million species globally — only a 10% to 15% fraction of total world species diversity — the majority of extinct forms are not known and never will be known to science.

Progress in ecology and related sciences, including conservation biology, has proven that mountain areas are of particular value for human beings. These ecosystems are key sources and reservoirs of freshwater. The specific micro- and meso-climates of mountain areas play an important role in diminishing the global greenhouse effect (Cernuska et al. 1999). Vast complexes of mountain forests are vital for the timber production industry. Moreover, in the past several decades, mountains have become the main areas for the rapid development of tourism and recreation. First and foremost, however, mountains host a unique variety of species, many of which are rare, vulnerable or threatened. All over the world, mountains are the sites of continental or regional species diversity hot spots.

These were among the main reasons why WWF (World Wide Fund for Nature) identified montane forests and grasslands as ecosystems with global biodiversity importance in its Global 200 initiative (Dinerstein et al. 2000). The Carpathians are included in this list of global biodiversity hot spots as one of the world's key Palaeartic montane ecoregions (Webster et al. 2001).

Covering an area of approximately 206,000 square km, the Carpathians are one of Europe's largest mountain ranges (fig. 1). Owing to its relatively intact habitats and particularly extensive forest complexes, the Carpathians are one of Europe's most valuable refuges of primeval forest fauna. This is possibly the last place in Europe where all "big game" species can be found. Moreover, Carpathian populations of brown bear, wolf and lynx, numbered in the thousands, are the largest montane populations of these species in Europe (Witkowski 1998).

Fig. 1. General location of the Carpathians.



At the same time, Carpathian elevations are rather moderate, with less than 1% of the area exceeding 2,000 metres above sea level. Small, scattered areas of alpine landscape and vast areas of primeval forests distinguish the Carpathians from other mountain ranges in Europe. One consequence of these specific bio-geographical characteristics is

that the alpine flora and fauna of the Carpathians are restricted to small, patchy, and to a large extent, isolated areas scattered throughout the whole massif (Mirek, Piękoś–Mirkowa 1992, Tasenkevich 1997, Witkowski 1998). As a result, despite a considerable number of endemic species that only occur here, the diversity of high-mountain flora and fauna in the Carpathians is rather poor in comparison with other large European mountains.

Why a Carpathian List of Endangered Species?

This Carpathian List of Endangered Species is based upon the concept of a Red book of species which was forged in the early 1960s as a reaction to the urgent need of gathering, assessing and popularising information about the most threatened plant and animal species on Earth. The leading role was taken by the Survival Service Commission (currently the Species Survival Commission — SSC) of the International Union for Conservation of Nature and Natural Resources/World Conservation Union (IUCN). Early efforts resulted in the preparation and publication of red books on globally threatened mammals (Simon 1966) and birds (Vincent 1966).

In the following decades, a considerable number of red books and red lists were published. While red books contain in-depth analyses of species status, distribution, factors of decline and conservation measures, data published in red lists are usually restricted to a concise presentation of species distribution and status. At the same time, because red lists cover whole taxa, they include more species than do red books.

More recently, red lists and red books have been drawn up for geographic areas at different spatial scales: worldwide, continental, regional, country and local. For example, the Species Survival Commission of IUCN at Cambridge prepares red data books for species that are threatened globally or at the continental scale. At the other end of the spectrum are red lists and red books focusing on specific areas within one nation, defined either according to political or ecoregional (biome) divisions (e.g. Czylok et al. 1996, Kricfalusy et al. 1999, Parusel et al. 1996).

National and regional approaches operate on an intermediate scale, covering areas of one or more countries. The nation-based approach is far more widespread than the region-based approach: while country red lists and books have been developed in a considerable number of nations, regional initiatives covering many countries, such as this List of Endangered Species, are few and far between (e.g. Ingellog et al. 1993, Voloscuk 1996).

In the Carpathian countries, several red lists and red books of plants and animals have been developed. However, in these lists which cover separate countries (Austria, Czech Republic, Romania, Poland, Slovakia, Ukraine and Hungary), the Carpathians were included either as a part of a country's territory (Čeřovský et al. 1999, Dihoru, Dihoru 1994, Głowaciński 1992, Głowaciński 1993, Maglocký, Feráková 1993, Niklfeld 1999, Oltean et al. 1994, Rakonczay 1989, Shelag–Sosonko 1996, Sytnyk 1980, Zarzycki, Kaźmierczakowa 1993, Zarzycki, Szeląg 1992), or only a part of the range was covered (e.g. Kricsfalusy et al. 1999).

The only list where the Carpathians are considered as a whole, irrespective of political borders, is the *Red data book, Lists of threatened plants and animals of the Carpathian*

National Parks and reserves (Voloscuk ed. 1996). This list (in fact lists) includes the vascular plants and vertebrates of 17 national parks in the Carpathians. Along with threatened and rare species, the list also includes relatively common ones.

In conclusion, as a result of the analysis of the existing data, it was determined that there is a gap in knowledge about the pan-Carpathian status of threatened plant and animal species. This publication is an attempt to fill this gap.

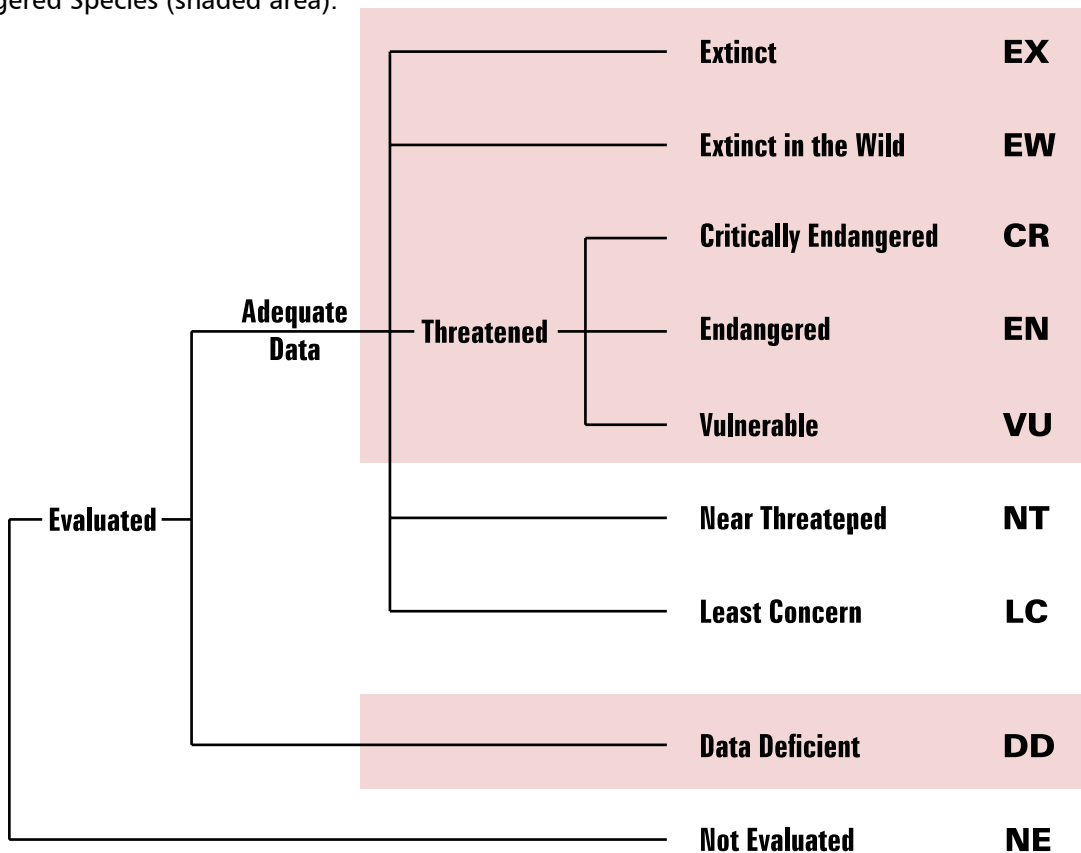
Methodology Used

Several authors participated in the data gathering process for the plant and animal species in this Carpathian List of Endangered Species. In order to make the data more consistent, a database was designed and species were selected according to unified criteria. The key criteria for choosing species for the Carpathian List of Endangered Species was based on the IUCN classification scheme for threatened species (IUCN 1994, 2001).

Categories of Threat and Protection Status

The authors assessed the status of species for the whole of the Carpathians using “categories of threats” in countries available from existing country red lists and red books. As a result, this Carpathian List of Endangered Species comprises species for which the category of threat in the whole region (see fig. 2) was estimated to be one of the following: Extinct (EX); Extinct in the Wild (EW); Critically Endangered (CR); Endangered (EN); or Vulnerable (VU).

Fig. 2. Categories of threat according to IUCN (IUCN 1994, 2001) used in this Carpathian List of Endangered Species (shaded area).



Additional criteria applied when choosing species categories included whether the species was: Arctic/Alpine; Listed in the Bern Convention; Listed in the European Union's Bird Directive or Habitat Directive; A large proportion of the European population of a species situated in the Carpathians; Endemic to the Carpathians; High mountain; or Relic species.

On the basis of lists of protected and hunted species in the Carpathian countries, data on the protection status of species was also collected. Although land protection can be regarded as an additional form of species conservation, it is not covered in this List.

Species and Physiographic Units

The presentation of species distribution is a vital part of any list or book of endangered species. In order to present the distribution of Carpathian endangered species, it was necessary to use a consistent method for dividing the extensive mountain range into units.

The only available division that covered the whole region was elaborated by Kondracki (1978). The division is hierarchical and each unit is given a unique digital code. There are eight large units (sub-provinces): Outer Western Carpathians, Central Western Carpathians, Inner Western Carpathians, Outer Eastern Carpathians, Inner Eastern Carpathians, Southern Carpathians, Bihoru Mountains, and Transsilvanian Upland. These are delineated on the grounds of general geological, relief, hydro-graphical and bio-geographical characteristics. Sub-provinces are in turn divided into small units (mesoregions). Altogether, there are 186 mesoregions in the Carpathians. In addition to the criteria applied for the delineation of sub-provinces, mesoregions were delineated on the basis of geographic location, details of the relief, lithology, and in some cases, anthropogenic alternations as well.

Carpathian Region = 8 Sub-provinces = 186 Mesoregions

In order to present a map of the division units, the original 1:2,000,000 map of the Carpathians (Kamiński 1993) was wrapped to the Gauss-Kruger zone 34 projection system. Afterwards, on the basis of regional maps of orographical units, correction was carried out for Romania, Slovak Republic, Czech Republic and Hungary (Mazúr and Lukniš 1980, Posea and Badea 1984, Demek et al. 1987, Pécsi et al. 1989).

Limitations of the Methodology

Despite the efforts made to unify the work, some differences in interpretation between the authors became apparent as the work progressed. Discrepancies in the state of knowledge between separate taxa partly account for this fact. For instance, it was impossible to present species distribution consistently, invertebrates being a good example. There were also some differences in the selection of criteria of species between vertebrates, invertebrates and vascular plants. In the case of Arctic/Alpine and high mountain species, some authors used a broader approach, at times including boreal-montane species.

Regarding categories of "protection" status, these turned out to be too simplified, since potentially exploited species can at the same time be protected. For example, local or state authorities can decide to suspend or restrict exploitation of some threatened spe-

cies under hunting law. This in practice may lead to the protection of all or part of a population of species, temporarily or permanently.

The list covering vegetation taxa (plant alliances) is relatively more consistent than other lists in this publication because it was elaborated by only one author. It must be emphasized that the development of a complete Carpathian List of Endangered Species, for plant communities was not a goal of this project. The philosophy here was to have an overview about communities occurring within the Carpathians and to select the top 20 communities. The plant alliances section of this book differs thoroughly from the plant and animal species chapters. For example, the evaluation of plant alliances was done on the grounds of the occurrence of endemic vascular plant species. The selection was based on the endemism of communities and the high proportion of endemic vascular plants within communities.

How to Use This book

The Carpathian List of Endangered Species is divided into the following chapters:

1. Vascular Plants
2. Mammals
3. Birds
4. Reptiles and Amphibians
5. Fishes and Lampreys
6. Invertebrates
7. Plant Alliances

Each chapter begins with a textual explanation, followed by two sets of data tables:

1. Species Category of Threat and Protection Status
2. Species and Physiographic Units

To facilitate the use of this Carpathian List of Endangered Species, species of vascular plants within one class and vertebrates within one phylum are listed in alphabetical order (according to scientific name), irrespective of their exact systematic position.

The presentation of the data for plant and vertebrate species (chapters 1 to 5) differs considerably from that for invertebrates and plant alliances (chapters 6 and 7). Invertebrate distribution can be attributed only to countries, not to mesoregions (as with vascular plants and vertebrates). Furthermore, plant alliances are not strictly related to species lists; specific differences are explained below in descriptions to the tables.

Tables on Species Category of Threat and Protection Status

Tables for vascular plants and vertebrates include the following information (see Sample Table 1 below):

1. Category of Threat for Entire Carpathians and for Separate Carpathian Countries
 - EX – Extinct
 - EW – Extinct in the Wild
 - CR – Critically Endangered
-

Sample Table 2: Table on Species and Physiographic Units

| Species | Physiographic Units |
|--|--|
| Large Carnivores | |
| <i>Canis lupus</i> Linnaeus, 1758 | 513.412, 513.43-45, 513.48-49, 513.51-52, 513.54-57, 513.65, 513.71-72, 514.9, 514.11-12, 514.14, 514.33-34, 514.43, 514.51-53, 514.62-64, 514.71-74, 514.84-85, 515.11-14, 515.23-29, 516.2, 516.4a, 517.1, 522, 523.1-2, 523.31, 523.41-42, 523.44-47, 523.51-54, 523.56, 523.61-66, 523.71-73, 524.1-2, 524.4-6, 525, 526, 531.4, 531.11-17, 531.21-25, 531.31-33, 531.35-37, 532.1-2, 533, 541.1, 541.3-4, 542.1, 542.21-22, 542.31-34, 542.41, 542.43 |
| <i>Felis sylvestris</i> Schreber, 1777 | 513.412, 513.55-57, 513.64-65, 513.72, 514.9, 514.14, 514.33-34, 514.42-43, 514.51-53, 514.62-64, 514.71-74, 514.81-85, 515, 516, 517, 522, 523, 524, 525, 526, 531, 532, 533, 541, 542 |
| <i>Lutra lutra</i> (Linnaeus, 1758) | 513.31, 513.34, 513.411-412, 513.45-49, 513.51-57, 513.61-65, 513.67-69, 513.71-72, 514, 515, 516, 517, 522, 523, 524, 525, 526, 531, 532, 533, 541, 542 |

As with plants and vertebrates, the exact systematic order of invertebrates was not followed in the tables. Invertebrates within one phylum are listed in alphabetical order according to scientific name.

Due to a scarcity of data on invertebrates, it was impossible to avoid the following inconsistencies between data on invertebrates and data on plant and vertebrate sections:

1. There is no data on “Category of Threat” in Austria.
2. Data on the “Protection” of species is presented only for Poland, Slovakia and the Czech Republic.
3. Presentation of species distribution in physiographic units was not possible. A rough estimation of species distribution can be done on the basis of “Categories of Threat” in the countries.

Data on plant alliances is restricted to distribution in the countries. Additionally, the list of endemic plant species and the list of the 20 most precious alliances are presented.

References

- Cernusca A., Bahn M., Bayfield N., Catizzone M. 1999. Land-use changes in mountain areas. In (A. Farina ed.). Perspectives in Ecology: a glance from the VIIth International Congress of Ecology. Backhuys Publ., Leiden.
- Czylok A., Parusel J.B., Kuliński W. 1996. Red List of Upper Silesian Vertebrates. In: (J.B. Parusel ed.) Upper Silesian Nature Heritage Centre, Raports Opinions vol. I: 43-58.
- Čerňovský J., Feráková V., Holub J., Maglocký S., Proháčka F., Zezula A., Gregor F. (eds.) 1999. Červená kniha ohrozených a vzácných druhov rastlin a živočíchov SR a ČR. Vyššie rastliny. Príroda, Bratislava.
- Demek J. et al. (eds.). 1987: Zeměpisný lexikon ČSR. Hory a nížiny. Academia Praha, 584 pg.
- Dihoru G., Dihoru A. 1994. Plante rare. P periclitare și endemice in flora Romaniei – Lista Roșie. Acta Botanica Horti Bucurestiensis: 173–197.
- Dinerstein E., Powell G., Olson D., Wikramanayake E., Abell R., Louks C., Underwood E., Allnutt T., Wettengel W., Ricketts T., Strand H., O'Connor S., Burgess N. 2000. A workbook for conducting biological assessments and developing biodiversity visions for ecoregion-based conservation. Msc, WWF.
- Głowaciński Z. (ed.) 1992. Polish Red Data Book of Animals. PWRiL, Warszawa.
- Głowaciński Z. 1993. Czerwona Lista zwierząt ginących i zagrożonych w Polsce. Zakład Ochrony Przyrody i Zasobów naturalnych PAN, Kraków.
- Ingelog T., Andersson R., Tjernberg M. (eds) 1993. Red Data Book of the Baltic Region, Part I List of threatened vascular plants and vertebrates. Swedish Threatened Species Unit, Uppsala and Institute of Biology, Riga. Uppsala & Riga.
- IUCN 1994. IUCN Red List Categories. Prepared by IUCN Species Survival Commission, Gland, Switzerland.
- IUCN. 2001. IUCN Red List Categories and Criteria: Version 3.1. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK. ii + 30 pp.
- Kamiński P. 1993. Biblioteka Almanachu Karpackiego „Plaj”. PTR Kartografia Warszawa.
- Kondracki J. 1978. Karpaty. Wydawnictwa szkolne i pedagogiczne, Warszawa.
- Kricsfalussy V.V., Budnikov. G.B., Mihaly A.V. 1999. Red List of Transcarpathia. Threatened plant species and plant alliances. Ministry of Education of Ukraine and Uzhgorod State University, Uzhgorod.
- Maglocký S., Feráková V. (eds.) 1993. Red list of ferns and flowering plants (Pteridophyta and Spermatophyta) of the flora of Slovakia (second draft). Biológia 48: 361–368.
- Mazúr E., Lukniš M. 1980. Slovak Republic – Geomorphological units, scale 1:500 000, Slovak Academy of Sciences.
- May R.H. 1999. What we do and do not know about the diversity of life on Earth. In (A. Farina ed.). Perspectives in Ecology: a

- glance from the VIIth International Congress of Ecology. Backhuys Publ., Leiden.
- Mirek Z., Piękoś-Mirkowa H. 1992. Plant cover of the Western Carpathians. *Veröff. Geobot. Inst. ETH*, 107: 11–150.
- Niklfeld H. (ed.) 1999. Rote Listen gefährdeter Pflanzen Oesterreichs (zweite Auflage). *Gruene Reiche des Bundesministeriums fuer Umwelt, Jugend und Familie. B. 10*, Graz.
- Oltean M., Negrean G., Popescu A., Roman N., Dihoru G., Sanda V., Mihăilescu S. (eds.) 1994. Lista roşie a plantelor superioare din România. Institutul de Biologie Bucuresti, Studii, Sinteze, Documentatii de Ecologie 1: 6–10.
- Parusel J.B. 1996. Red List of Upper Silesian Vascular Plants. In: (J.B. Parusel ed.) *Upper Silesian Nature Heritage Centre, Reports Opinions vol. 1*: 8-42.
- Pécsi, M. et al. ed. 1989: National Atlas of Hungary. *Cartographia*, Budapest. pp. 30–31.
- Posea G., Badea L. 1984. Romania – Unitatile de Relief (Regionarea Geomorfologica) scale 1:815 000. *Interprindera*, Brasov.
- Rakoczay Z. (ed.) 1989. *Vörös Könyv. A Magyarországon kipusztult és veszélyeztetett növény-és állatfajok*, Akadémiai Kiadó, Budapest.
- Sepkoski J. J. 1992. Phylogenetic and ecologic patterns in the Phanerozoic history of marine biodiversity. In: (N. Eldredge ed.) *Systematics, Ecology and Biodiversity Crisis*. Columbia Univ. Press. New York.
- Shaffer M. 1990. Minimum viable populations: coping with uncertainty. In: (M.E. Soule ed.) *Viable populations for conservation*. Cambridge Univ. Press. Cambridge.
- Shelag-Sosonko Y. (ed.) 1996. Red Data Book of Ukraine. *Plant Kingdom*. [Chervona knyha Ukrainy. Roslynniy svit]. *Ukrains'ka encyklopedia*, Kyiv.
- Simon N. 1966. Red Data Book, vol. 1 Mammalia. IUCN, Arts graphiques Heliographia S.A., Lausanne.
- Sytnyk K.M. (ed.) 1980. Red Data Book of the Ukrainian SSR (in Ukrainian). *Nauk. Dumka*, Kiev.
- Tasenevich L. 1997. Protected areas and plant cover diversity in the Ukrainian Carpathians: an assessment of representativeness. In: (J. R. Nelson & R. Serafin, eds.) *National parks and protected areas, keystones to conservation and sustainable development*. NATO ASI Ser., vol. G 40. Springer Verl., Berlin – Heidelberg.
- Turnock, D. 2001. The Carpathian Ecoregion Initiative: Socio-economic Perspectives. Unpublished Report.
- Vincent J. 1996. Red Data Book, vol. 2 Aves. IUCN, Arts graphiques Heliographia S.A., Lausanne.
- Voloscuk, I. (ed.) 1996. Red data book, Lists of threatened plants and animals of the Carpathian National Parks and reserves. ACNAP, Tatranska Lomnica, Slovak Republic.
- Webster R., Holt S., Avis C., 2001. The Status of the Carpathians. A report developed as a part of the Carpathian Ecoregion Initiative. *WWF*, Vienna.
- Witkowski Z. 1998. The Carpathian Mountain Range as an ecological system within the Pan-European Ecological Network. In: (P. Nowicki, ed.) *The green backbone of Central and Eastern Europe*. ECNC publ. ser. *Man and Nature* 3: 161–173.
- Witkowski Z., Adamski P., Solarz W. 2000. The Carpathian Biodiversity Assessment – Reconnaissance phase. Unpubl. report for the WWF Danube-Carpathian Programme, Vienna.
- World Conservation Strategy: Living resource conservation for sustainable development. 1980. IUCN, UNEP, WWF, Gland.
- Zarzycki K., Kaźmierczakowa R. (eds.) 1993. *Polska czerwona księga roślin*. Instytut Botaniki PAN, Kraków.
- Zarzycki K., Szelağ Z. 1992. Czerwona lista roślin naczyniowych zagrożonych w Polsce. In: (K. Zarzycki, W. Wojewoda and Z. Heinrich eds.) *Lista roślin zagrożonych w Polsce* (wyd. 2) Instytut Botaniki PAN, Kraków.

PART II

Conclusions and Species Groups Analyses

Overall assessment of threat

A number of conclusions can be reached in assessing the data that has been compiled in this Carpathian List of Endangered Species. Table 1 below presents the number of species in each taxon classified according to categories of threat, according to data from the database. It can be seen that the majority of species fall into three categories: vulnerable, endangered or critically endangered.

Table 1. Numbers of species in each category of threat. EX — extinct; EW — extinct in the wild; CR — critically endangered; EN — endangered; VU — vulnerable; DD — data deficient.

| Systematic group | EX | EW | CR | EN | VU | DD |
|-------------------------|-----------|----------|------------|------------|------------|----------|
| Vascular plants* | 13 | 1 | 39 | 135 | 155 | 1 |
| Mammals | 2 | — | 2 | 12 | 44 | — |
| Birds | — | — | 7 | 11 | 11 | — |
| Reptiles and Amphibians | — | — | 1 | 6 | 7 | 3 |
| Fishes and Lampreys | 2 | — | 3 | 14 | 11 | — |
| Invertebrates ** | — | — | 74 | 125 | 141 | — |
| Total | 17 | 1 | 126 | 303 | 369 | 4 |

*including species and subspecies

**CR/EN Pan-Carpathian status of invertebrates was classified as CR; and EN/VU status as EN

While this table shows that extinct species are far less frequently represented than in existing Carpathian country red lists and books, one should not conclude that extinction processes do not occur in the Carpathians. Extinctions certainly do take place, as

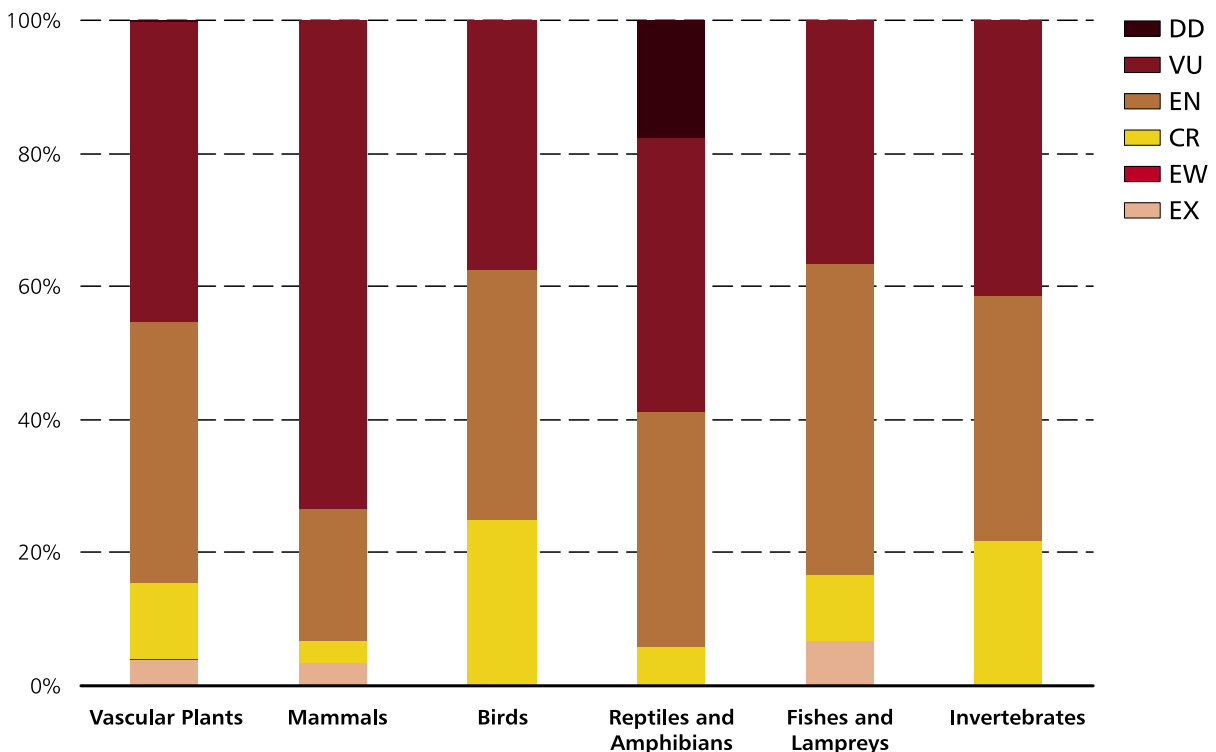
they do in other areas, but in the Carpathians only a small fraction may be detected due to the fact that no monitoring system has been developed for the whole ecoregion, except for vascular plants (Tasenkevych 1998) and bats (Wołoszyn, Bahsta 2001). It may be assumed, therefore, that in the case of groups for which data was relatively scarce in the Carpathians (e.g. invertebrates), actual numbers of extinct, and extinct in the wild, species are higher than those in the table.

Extinction processes in the past have been poorly monitored across the planet. This Carpathian List of Endangered Species could only use local data related to changes to the flora and fauna of some regions. Therefore, the final extirpation of populations can only be estimated based on red data books for particular Carpathian countries or from the repeated monitoring of species. The process of data collection on extinctions used here was not standardized, as such data was very limited in space and time.

Overall assessments of threat

Fig. 3 presents the percentage of species in taxonomic groups in different categories of threat. Generally, vulnerable (VU) species account for 45% of all species; endangered species (EN), for approximately 37%; and critically endangered (CR) — for more than 15% of species. The fraction of critically endangered species in the Carpathians is particularly high among invertebrates (21.8%). Vertebrates as a whole are the least threatened group, while birds are the most threatened among vertebrates. Mammals are the least threatened group of vertebrates, with as many as 73.3% of species classified as vulnerable.

Fig 3. Percentage of species in taxonomic groups in different categories of threat; explanations as in Table 1.



Comparisons with other lists

These results are concordant with results obtained in other national and regional lists, pointing to the fact that, in the Carpathian ecoregion, flora and fauna are threatened as in other areas in Europe.

Out of approximately 3,988 native and archaeophyte vascular plants recorded in the Carpathians (Tasenkévych 1998), 344 — or 9% of Carpathian flora — were classified as endangered, on the verge of extinction, or extinct. In comparison, a total of 40% of European flora species is estimated to be threatened (Lucas and Walters 1976, Kornaś 1982). This European evaluation, however, also included species classified as of rare or lower risk, and these groups were not covered in this Carpathian List of Endangered Species. At the same time, one can observe that, in the Carpathians, the process of flora degradation is less intensive than in the majority of the European biomes.

More informative is a comparison of the results in this Carpathian List of Endangered Species with results obtained in the two red lists of the Carpathian countries of Poland and Slovakia (Zarzycki and Wojewoda 1986). Here, if only the species which fall into the five categories of threat included in this Carpathian List of Endangered Species are considered, then the threat to Carpathian flora appears to be similar or even higher than that in these two countries. However, one has to bear in mind that any general conclusions drawn on the basis of simple comparisons of the Carpathian List of Endangered Species, Polish and Slovakian red lists may be misleading because the lists differ in terms of methodology of data gathering and analysis, as well as in different spatial coverage.

While threat status of the Carpathian mammals and reptiles in this Carpathian List of Endangered Species are concordant with results obtained in the red lists of different European countries (Głowaciński 1992, Nowak et al. 1994, Rassi, Vaisanen 1987), birds and fishes in the Carpathians appear to be less threatened compared to their status in each Carpathian country even though these two groups are the most threatened among the Carpathian vertebrates (Fig. 3).

In the case of birds, the result can easily be explained by the fact that waterfowl and waders, which are among the most threatened groups of birds throughout Europe, do not find favourable breeding habitats in the Carpathians. Fishes of the region have been better preserved than in rivers outside of the region due to the fact that Carpathian rivers still constitute one of the major reservoirs of clean waters in central Europe.

A regional approach, similar to the one followed here, was also applied in the Red Data Book of the Baltic Region (Ingelög et al. 1993). Among the Carpathian countries, only Poland is included in this book, and as it focuses on marine and lowland vascular plants and vertebrates, any comparison with the Carpathian List of Endangered Species is irrelevant.

Comparison with the only other Carpathian list

As noted in the Introduction, this Carpathian List of Endangered Species is the second attempt ever to cover the whole Carpathian ecoregion. The first list, however, dealt exclusively with vascular plants and vertebrates recorded in 17 national parks of the

Carpathians (Voloscuk ed. 1996). Moreover, species in the list are selected according to seven categories of threat (IUCN 1994); apart from Extinct (Ex), Endangered (En) and Vulnerable (Vu) species, Rare (R), Care demanding (Cd), Indeterminate (I) and Present (Pr) species are also listed. Therefore non-threatened species constitute a substantial part of that list. As a result, the number of vascular species and vertebrates in the Voloscuk list significantly exceeds that included in this list. Altogether, the Voloscuk list comprises 1,163 species and subspecies of vascular plants, 85 species of mammals, 236 species of birds, 15 species of reptiles, 17 species of amphibians and 59 species of fishes and lampreys (see Table 2 below).

Table 2. Numbers of vascular plants and vertebrates in the “Red Data Book” (Voloscuk ed. 1996) compared with those in this Carpathian List of Endangered Species. I — total number of species in Voloscuk’s list; II — number of species in Voloscuk’s lists, classified at least in 1 national park as EX, E(EN); or V; III — number of species in the present list (only EX, EW, CR, EN, and VU species are included in the list).

| | I | II | III |
|-------------------------------|-------------|------------|------------|
| Vascular Plants (taxa) | 1163 | 500 | 344 |
| Vertebrates | 412 | 206 | 136 |
| Mammals | 85 | 59 | 60 |
| Birds | 236 | 100 | 29 |
| Reptiles and Amphibians | 32 | 26 | 17 |
| Fishes and Lampreys | 59 | 21 | 30 |

A comparison of the two lists allows for a solid conclusion if threatened species alone from the Voloscuk list are considered (table 2, column II), whereupon a significant concordance of the results becomes apparent. Differences, however, stem from two reasons. One is that the Voloscuk list of vascular plants includes subspecies, while this List is restricted almost exclusively to species; the result is that there are more vascular plant taxa in the Voloscuk list (compare columns II and III in table 2).

The other source of difference is that the Voloscuk list and this List were based on different methodologies. The Voloscuk list is restricted to flora and fauna in national parks, and does not try to determine the Pan–Carpathian status of species made in this Carpathian List of Endangered Species. Therefore, column II in Table 2 represents a total number of species which, at least in one national park (out of 17 analysed by Voloscuk), were classified as extinct, endangered or vulnerable, while column III lists only species threatened on the Pan–Carpathian level. Some of the species in the Voloscuk list were by no means threatened on the Pan–Carpathian level, and they were not included into our List. The result of differences in methodology applied in the Voloscuk list and this List is a statistical artifact implying that, generally, there are more threatened species in the Voloscuk list than in this List (see columns II and III in table 2).

Overall, our results show that there are 480 plant and animal taxa and 129 plant alliances presented in this Carpathian List of Endangered Species. Carpathian biodiversity, however, is certainly far richer. It must be remembered that fungi and lower plants are

not covered in this Carpathian List of Endangered Species. Furthermore, invertebrates — a major part of biological diversity — are undoubtedly underrepresented here.

Invertebrates

While data on vascular plants and vertebrates in this Carpathian List of Endangered Species were based upon red lists and red books published in the Carpathian countries and scientific monitoring, information on invertebrates included here should be referred to as a rough assessment rather than a comprehensive source of information.

In other red lists and red books, estimates for invertebrates vary between different taxa, ranging from less than 10% to over 40% species threatened (Głowaciński ed. 1992, Rassi, Vaisanen 1987).

Available data on other organisms in the Carpathians, such as fungi, are even more incomplete, and including them into this List would be of very little use.

The future

As the body of knowledge on biodiversity in the Carpathians is relatively large, this will almost certainly result in updated red lists to be published in some countries in the near future. This is true at least for vascular plants, vertebrates and plant communities. Such lists will contribute to filling in some of the inconsistencies evident in this Carpathian List of Endangered Species.

One possible future step to continue work on biological diversity in the Carpathians is an analysis of the list of several tens of focal species, such as large carnivores or the most valuable endemic plants and invertebrates which were selected through the biodiversity assessment of the region (Witkowski et al. 2000). Another opportunity is the development of an assessment, following the concept of a Red Book of Carpathian biodiversity which would include an in-depth analysis of population status, threats and conservation measures for focal species.

References

- Głowaciński Z. (ed.) 1992. Polish Red Data Book of Animals. PWRiL, Warszawa.
- Ingelög T., Andersson R., Tjernberg M. (eds) 1993. Red Data Book of the Baltic Region, Part 1 List of threatened vascular plants and vertebrates. Swedish Threatened Species Unit, Uppsala and Institute of Biology, Riga. Uppsala & Riga.
- IUCN 1994. IUCN Red List Categories. Prepared by IUCN Species Survival Commission, Gland, Switzerland.
- Kornaś J. 1982. Man's impact upon the flora: processes and effects. *Memorabilia Zoologica* 37: 11-30.
- Lucas G.L., Walters S.M. 1976 List of rare, threatened and endemic plants for the countries of Europe. IUCN, Royal Botanic gardens, Kew. London, 290 pp.
- Novak E., Blab J., Bless R. (eds.). 1994. Rote Liste der gefährdeten Wirbeltiere in Deutschland. Kilda-Verlag, Bonn – Bad Godesberg.
- Rassi P., Vaisanen R. (eds.). 1987. Threatened animals and plants in Finland. Helsinki.
- Tasenkevich L. 1998. Flora of the Carpathians. Checklist of the native vascular plant species. State Museum of Natural History NASU, Lviv.
- Volocuk. I. (ed.) 1996. Red data book, Lists of threatened plants and animals of the Carpathian National Parks and reserves. ACNAP, Tatranska Lomnica, Slovak Republic.
- Witkowski Z., Adamski P., Solarz W. 2000. The Carpathian Biodiversity Assessment – Reconnaissance phase. Unpubl. report for the WWF Danube-Carpathian Programme, Vienna.
- Wołoszyn B.W., Bashta A.-T. V. 2001. Nietoperze Karpat, Polowy klucz do oznaczania nietoperzy. Chiropterological Information Center, Poland Bat Research and Protection Group & Institute of Ecology of the Carpathians UAN, Ukraine, Kraków, Lviv.
- Zarzycki K., Wojewoda W. (eds.) 1986. Lista roślin wymierających i zagrożonych w Polsce. Państwowe, Wydawnictwo Naukowe, Warszawa.

Vascular Plants

by Lydia Tassenkevich



State of knowledge

The flora of the Carpathians have been studied by generations of Austrian, Czech, Hungarian, Polish, Romanian, Russian, Slovakian and Ukrainian botanists. These studies are summarized in a number of documents including Checklists and Keys, some of which are complete, and some of which are still in preparation (*see list below*).

List 1: Documents on the Flora of the Carpathians

- Exkursionsflora von Österreich (Adler, Oswald, Fischer 1993)
- Checklist of Non-Vascular and Vascular Plants of Slovakia (Marhold, Hindák eds. 1998)
- Flora of Romania, Vols. 1–2 (Beldie 1977–1979)
- Flora Polska (Flora Polski), Vols. 1–14 (1919–1992)
- Flora Republicae Popularis Romanicae [Flora RP (RS) Romîne], Vols. 1–13 (1952–1976)
- Flora Slovenska, Vols. 1–5 (1966–1997)
- Flora of the Ukrainian SSR [Flora Ukrain's'koyi RSR], Vols. 3–12 (1950–1965)
- Key for Determination of Vascular Plants in the Ukrainian Carpathians (1977) [“Vyznachnyck roslyn Ukrain's'kykh Karpat”]
- Květena České Republiky [Flora of the Czech Republic], Vols. 1–4 (1988–1995)
- Nová Květena ÈSSR, Vols. 1–2 (Dostál 1989)
- Synopsis Systematico-Geobotanica Florae Vegetationis Hungaricae, Vols. 1–5 (Soó 1964–1973) Vascular Plants of Poland. A Checklist (Mirek et al. 1995)

These publications, however, have been mainly concerned with the entire flora of individual countries of the Carpathian region. No data was available on the composition and quantitative structure of Carpathian flora itself, until a checklist of native vascular plant species of the Carpathians (Tassenkevich 1998) was published.

It can now be asserted that the native flora of the Carpathians is among the richest on the European continent. It is composed of 3,988 species and subspecies belonging to 131 families and 710 genera. Even if the group of inbreeding, hybrid and apomictic taxa¹ (for which their claim to the rank of species seems doubtful) are to be excluded from the count, the remaining 3,698 species and subspecies of the Carpathian native flora still make up approximately 30% of the 12,500 total for all European flora. At the same time, the ratio of the area between the Carpathians and Europe is 1:46.

The 383 species and subspecies of unquestionable taxonomic rank and 99 micro-species of genera *Alchemilla*, *Rubus*, *Sorbus* and *Hieracium* are endemic to Carpathian flora. The diversity and richness of native flora is also due to Atlantic, Central, Northern and Eastern European, Mediterranean and Asian floristic elements which meet in the Carpathians.

Red lists and red data books have been compiled in nearly all European countries with the aim of revealing the number of species in need of protection and their conservation status. In the Carpathian countries, red lists (Dihoru, Dihoru 1993, Maglocký 1983, Maglocký, Feráková 1993, Niklfeld 1999, Oltean et al. 1994, Zarzycki 1986, Zarzycki, Szeląg 1992) and Red Books (Čeřovský et al. 1999, Rakonczay 1989, Shelag–Sosonko 1996, Zarzycki, Kaźmierczakowa 1993) have also been published.

The data presented in existing red lists and red books (*see Introduction*) are concerned with the entire territories of individual countries, as are the documents listed above in List 1. An estimation of the specific threat to the flora of a specifically Carpathian area of a country has only been made in Poland (Mirek, Piękoś–Mirkowa 1992) and Ukraine (Stojko 1977, Komendar 1988).

Methods

To estimate the threat to the entire vascular flora of the Carpathians, data on the conservation status of plant species from national red lists and red books cited above and several other sources (Convention 1973, Council Directive 1992, Convention 1973) have been used in this work.

As noted in the Introduction, and according to IUCN criteria (IUCN 1994), “threatened” taxa are listed as: extinct (EX); extinct in the wild (EW); critically endangered (CR); endangered (EN); and vulnerable (VU). It should be noted that, only in the *Checklist of Slovakian Flora* (Marhold, Hindak, 1998) and in the joint *Slovak and Czech Red Book of Threatened and Rare Vascular Plants* (Čeřovský et al., 1999), were the threatened plant species evaluated according to the 1994 criteria adopted by the IUCN. In the rest of the national listings, the status category of every taxon was defined on the basis of IUCN categories introduced over 20 years ago (Lucas, Synge 1977). From those lists, only taxa listed in the extinct (EX), endangered (E) and vulnerable (V) categories have been taken into consideration in this Carpathian List of Endangered Species.

¹ This includes: 84 species of genus *Alchemilla* in the Carpathians (for which the total number of species in the Carpathians is 121); 117 species of *Rubus* from a total of 192; 22 species of *Sorbus* from a total of 33 species and subspecies; 203 species of *Hieracium* from a total of 289 species and subspecies; and 86 species of genus *Taraxacum* Weber from a total of 114 species.

It must be noted that the category of threat for a particular taxon may not be the same in different countries. In the case that a particular taxon was given a lower risk (LR), rare (R), out of danger (O) or data deficient (DD) category in a certain country's list, or even was not listed (NE) in certain countries, but was classified as EX, E (EN) or V (VU) in others, this taxon has been taken into account for inclusion in this Carpathian List of Endangered Species.

Conclusions

Of approximately 1,500 pteridophytes and flowering plants listed in national threatened and rare plant species inventories cited above, a total of 307 species and 37 subspecies have been chosen and are to be considered as threatened on the pan-Carpathian scale.

A total of 13 species have become extinct in the whole Carpathian area, and one is extinct in the wild. Among these, three taxa were Glacial relics, seven occurred only on the edge of their range in the Carpathians, two are weeds suffering in their whole range, and a further two mountain species had only one location each in the Carpathians.

The number of critically endangered (CE) taxa is very high. The 41 species and subspecies belonging to the CE category are on the verge of extinction from Carpathian flora and need particular care and urgent implementation of active protection measures in a number of cases. Most of the plants of this group have only one or a few relic sites in the Carpathians. Seven species are endemic, two are sub-endemic, 12 taxa are Glacial relics and four are older settlers in the Carpathian flora of Tertiary age. A total of 10 taxa are on the very edge of their geographical ranges, two weed species are declining archeophytes, another two are declining species of threatened wet habitats and the rest occur in xerothermic grasslands and broad-leaved forests.

A total of 135 taxa are classified as endangered (EN) and 155 species and subspecies are considered as vulnerable (VU). These alarmingly numerous groups of endangered and vulnerable species comprise, among others, 65 endemic species and subspecies, 71 relics (mainly of the Glacial period) and 76 species on the edge of their geographical range. For one species, there is insufficient data to assess their status on the regional level, so it is listed as data deficient (DD).

Altogether, amongst 344 threatened taxa of the flora of the Carpathian Mountains, 62 species and subspecies are endemic, 12 are sub-endemic, 91 are relics and 95 taxa are on the edges of their geographical range in the Carpathians (Table 3). Their eventual extinction in the Carpathians would be a great loss not only to regional Carpathian flora but also to world flora. Overall, 9.9% of native vascular plant taxa in the Carpathians are highly threatened.

This list of threatened vascular plants in the Carpathian Mountains is the first attempt to assess the conservation status of the flora of this natural geographic unit regardless of state borders. There can be no doubt that further field investigations on the populations of threatened Carpathian plants would provide new data on which to base a more specific estimation of the conservation status of threatened plant species and verify the *Carpathian Ecoregion Initiative* database.

Table 3. Groups of threatened vascular plant taxa in the Carpathians, according to criteria of their rarity and protection.

| Criteria | Number of taxa |
|-------------------------------------|----------------|
| Endemics | 62 |
| Pan-Carpathian | 4 |
| West-Carpathian | 28 |
| East-Carpathian | 11 |
| South-Carpathian | 6 |
| Transsilvanian | 1 |
| Bihorian | 1 |
| West-East Carpathian | 1 |
| West-South Carpathian | 2 |
| East-Carpathian-Bihorian | 1 |
| East-South Carpathian | 6 |
| West-Carpathian-Transsilvanian | 1 |
| Sub-endemics | 12 |
| Pannonian-Carpathian | 6 |
| Alpine-Carpathian | 3 |
| Carpathian-Balcanic | 3 |
| Relics | 90 |
| Tertial | 7 |
| Glacial | 71 |
| Postglacial | 12 |
| Species on the edge of distribution | 95 |
| Bern Convention | 43 |
| Habitat Directive | 13 |
| CITES | 13 |
| Archeophytes | 8 |
| Herbal plants | 2 |
| High-montane plants | 22 |
| Hydrophytes | 15 |
| Hygrophytes | 18 |
| Xerophytes | 2 |
| Halophytes | 2 |

Acknowledgements

I am most grateful to Ms. Robin Webster for taking the trouble to revise the English text. I greatly appreciate the work of Ms. Viera Stanova and Ms. Judit Sandor in checking the Slovakian and the Hungarian threatened plant species distribution data respectively.

References

- Adler W., Oswald K., Fischer R. 1993. Exkursionsflora von Österreich, Ulmer.
 Beldie A. 1977–1979. The Flora of Romania. Illustrated determinant of vascular plants. Vols.1–2. Editura Academiei Republicii Socialiste România, Bucuresti.
 Bertova L., Futák J., Goliašová K (eds.) 1966–1997. Flora Slovenska. Vols. 1–5. Veda Press, Bratislava.

- Čerňovský J., Feráková V., Holub J., Maglocký S., Proháčka F., Zezula A., Gregor F. 1999. Červená kniha ohrozených a vzácných druhov rastlín a živočíchov SR a ČR. Vyššie rastliny. Bratislava: Príroda.
- Chopyk V. (ed.). 1977. Key for determination of vascular plants in the Ukrainian Carpathians. [Vyznachnyck roslin Ukrain's'kykh Karpat]. Naukova Dumka, Kyiv.
- Convention on international trade in endangered species of wild fauna and flora. Washington, 1973, 6 p.
- Convention on the conservation of European wildlife and natural habitats. Appendix 1 of 28 May 1999: Strictly protected flora species. Bern, 18 p.
- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Annex II (b). Plants: 32-50 p.
- Dihoru Gh., Dihoru A. 1994. Plante rare, periclitatę și endemice în flora României – Lista Roșie // Acta Botanica Horti Bucurestiensis 1993–1994.
- Dobrochaeva D.M., Kotov M.N., Prokudin J.N., Zaverukha V.B., Chopyk V. I., Protopopova V.V., Krytskaya L.I. (eds.) 1987. Key for determination of vascular plant species of Ukraine [Opredelitel' vyshih rasteniy Ukrainy]. Naukova Dumka, Kyiv.
- Dostál J. 1989. New Flora of the CSSR [Nová Květena CSSR]. Vols. 1–2. Academia Press, Praha.
- Hejný S., Slavík B. (eds.). 1988–1995. Květena České Republiky. 1995 [Flora of the Czech Republic]. Vols. 1–4. Academia Press, Praha.
- IUCN Red List Categories. 1994. IUCN, Gland.
- Jasiewicz A. 1981. Wykaz gatunków rzadkich i zagrożonych flory polskiej. *Fragm. Flor. Geobot.* 27 (3): 401–414.
- Komendar V.I. 1988. Problems of Protection of the Carpathian Phytogenepool [Проблеми охорони фітогеноефонду Карпат]. *Ukr. Botan. Journ.*, 45: 1–6.
- Kondracki J. 1978. Karpaty. Wydawnictwa Szkolne i Pedagogiczne. Warszawa.
- Kricsfalusy V. V., Budnikov. G.B., Mihaly A. V. 1999. Red List of Transcarpathia. Threatened plant species and plant alliances. Ministry of Education of Ukraine and Uzhgorod State University, Uzhgorod.
- Lucas G.L., Syngé A.M.H. 1977. The IUCN Plants Committee and Its Work Throughout the World. *Environmental Conservation*, 4: 179–187.
- Maglocký S. 1983. Zoznam vyhynutých, endemických a ochrozených taxónov vyšších rastlín flóry Slovenska. *Biológia (Bratislava)*, 38: 825–852.
- Maglocký S., Feráková V. 1993. Red List of ferns and flowering plants (Pteridophyta and Spermatophyta) of the flora of Slovakia (the second draft). *Biológia*, 48: 361–384.
- Marhold K., Hindak F. (eds.) 1998. Checklist of Non-Vascular and Vascular Plants of Slovakia. Veda, Bratislava.
- Mirek Z., Piękoś-Mirkowa H. 1992. Contemporary threat to the vascular flora of the Polish Carpathians (S.Poland). *Veröff. Geobot. Inst. ETH*, 107: 151–162.
- Mirek Z., Piękoś-Mirkowa H., Zajac A., Zajac M.. 1995. Vascular plants of Poland. A Checklist. Polish Botanical Studies. Guidebook series, 15. Kraków.
- Niklfeld H. (ed.) 1999. Rote Listen gefährdeter Pflanzen Österreichs (zweite Auflage). Grüne Reihe des Bundesministeriums für Umwelt, Jugend und Familie, Band 10, Graz.
- Oltean M., Negrean G., Popescu A., Roman N., Dihoru G., Sanda V., Mihăilescu S. 1994. Lista roșie a plantelor superioare din România. Institutul de Biologie București, Studii, sinteze, documentatii de ecologie 1: 6–10.
- Raciborski M., Szafer W., Pawłowski B., Jasiewicz A. (eds.) 1919–1992. Flora Polski. Vols. 1–14. Warszawa – Kraków.
- Rakonczay Z. (ed.) 1989. Vörös Könyv. A Magyarországon kipusztult és veszélyeztetett növény-és állatfajok, Akadémiai Kiadó, Budapest.
- Savulescu T., Nyárády E.I. (eds.) 1952–1976. Flora Republicii Populare Române Vols. 1–13. Editio Academiae Popularis Romanicae, Bucuresti.
- Shelag-Sosonko Y. (ed.) 1996. Red Data Book of Ukraine. Plant Kingdom. [Chervona knyha Ukrainy. Roslynni svit]. Ukrain's'ka encyklopedia, Kyiv.
- Soó R. 1964–1973. Synopsis systematico-geobotanica florum vegetansium Hungariae. Vols. 1–5. Akadémiai Kiadó, Budapest.
- Stojko S.M. 1977. Ever Green Carpathians. [Карпатам зелєніти вічно]. Karpaty, Uzhgorod.
- Tasenkevich L. 1998. Flora of the Carpathians. Checklist of the native vascular plant species. State Museum of Natural History NASU, L'viv.
- Zarzycki K. 1986. Lista wymierających i zagrożonych roślin naczyniowych Polski. In: (K. Zarzycki, W. Wojewoda eds.) Lista roślin wymierających i zagrożonych w Polsce. Państwowe Wydawnictwo Naukowe, Warszawa.
- Zarzycki K., Kaźmierczakowa R. (eds.) 1993. Polska czerwona księga roślin. Instytut Botaniki PAN, Kraków.
- Zarzycki K., Szélag Z. 1992. Czerwona lista roślin naczyniowych zagrożonych w Polsce. In: (K. Zarzycki, W. Wojewoda and Z. Heinrich eds.) Lista roślin zagrożonych w Polsce (wyd. 2) Instytut Botaniki PAN, Kraków.
- Zerov. K., (ed.) 1950–1965. Flora of the Ukrainian SSR. Flora Ukrain's'koi RSR]. Vols. 3–12. Academy of Sciences of the Ukrainian SSR Press, Kyiv.

16 | Carpathian List Of Endangered Species

Vascular Plants

| Species | Physiographic Units |
|--|--|
| <i>Asplenium adnigrum</i> Milde | 513.1, 514.9, 515.28, 531.34, 533.2 |
| <i>Asplenium ceterach</i> L. ssp. <i>bivalens</i> (D.E.Mey.) Greuter et Burdet | 514.2, 517.2 |
| <i>Asplenium ceterach</i> L. ssp. <i>ceterach</i> | 514.85, 531.17, 542.1 |
| <i>Asplenium cuneifolium</i> Viv. | 513.44, 514.53, 516.4, 516.4a, 523.51, 531.4, 531.15, 531.37, 541.2 |
| <i>Asplenium fontanum</i> (L.) Bernh. | 517.1 |
| <i>Asplenium lepidum</i> C.Presl | 513.1, 531.37, 533.3, 541.2, 542.1 |
| <i>Astragalus alpinus</i> L. | 514.43, 514.52-53, 514.85, 523.31, 523.43, 531.11, 531.15 |
| <i>Astragalus australis</i> (L.) Lam. ssp. <i>krajiniae</i> Domin | 522.24 |
| <i>Astragalus dasycanthus</i> Pallas | 516.3, 517.1, 523.63, 531.26, 541.2, 542.22 |
| <i>Astragalus excapus</i> L. | 517.1, 517.4, 531.4, 541.2 |
| <i>Astragalus frigidus</i> (L.) A.Gray | 514.43, 514.52-53, 523.31, 531.11, 531.15 |
| <i>Astragalus norvegicus</i> Weber | 514.43, 514.52-53, 523.31 |
| <i>Astragalus penduliflorus</i> Lam. | 514.52-53, 514.85, 523.31, 531.11 |
| <i>Astragalus peterfii</i> Jáv. | 541.2 |
| <i>Astragalus pseudopurpureus</i> Guşuleac | 523.45 |
| <i>Astragalus roemerii</i> Simonk. | 523.46, 523.63, 524.3, 542.1 |
| <i>Astragalus vesicarius</i> L. | 513.1, 516.2, 517.4, 526.2, 541.2, 542.1 |
| <i>Aubrieta intermedia</i> Heldr. et Orph. ex Boiss. ssp. <i>falcata</i> Ciocirlan | 531.13 |
| <i>Avenula pubescens</i> (Hudson) Dumort. ssp. <i>laevigata</i> (Schur) Holub | 523.1, 523.31, 523.46, 531.11, 531.33 |
| <i>Barbarea lepuznica</i> Nyár. | 531.32 |
| <i>Betula humilis</i> Schrank | 523.63, 526.1 |
| <i>Betula nana</i> L. | 523.42, 523.63 |
| <i>Botrychium lanceolatum</i> (S.G.Gmelin) Angstr. | 513.52 |
| <i>Botrychium matricariifolium</i> (Retz.) A.Braun ex W.D.J. Koch | 513.411, 513.51, 514.12-13, 514.51-53, 517.1, 522.25, 523.1, 531.25, 541.2 |
| <i>Botrychium multifidum</i> (S.G.Gmel.) Rupr. | 513.411, 513.44, 514.9, 514.43, 514.52-53, 514.72-73, 515.23, 515.25-26, 517.1-2, 523.1, 523.31, 523.51, 523.63, 531.4, 531.15 |
| <i>Botrychium virginianum</i> (L.) Swartz | 526.1, 531.4, 533.3 |
| <i>Bromus pannonicus</i> Kummer et Sendtner | 513.1, 517.2, 523.2 |
| <i>Bulbocodium versicolor</i> (Ker Gawl.) Sprengel | 517.4, 541.2 |
| <i>Bupleurum praealtum</i> L. | 514.2, 517.2-3, 517.5, 523.31, 531.37, 533.2, 541.2, 542.1 |
| <i>Bupleurum rotundifolium</i> L. | 513.1, 513.411, 513.43, 514.2, 514.82, 516.2 |
| <i>Calamagrostis stricta</i> (Timm) Koeler | 523.31, 523.63, 523.73 |
| <i>Callianthemum coriandriifolium</i> Rchb. | 514.9, 514.52-53, 522.25, 523.31, 531.13, 531.15 |
| <i>Callitriche hamulata</i> Kütz. ex W.D.J. Koch | 513.33, 513.53 |
| <i>Camelina alyssum</i> (Mill.) Thell. | 523.31, 523.42, 524.3, 532.3, 541.2, 542.1 |
| <i>Campanula macrostachya</i> Waldst. et Kit. | 514.83, 517.2-3, 517.5, 523.73, 531.37, 532.3, 541.2, 542.1, 542.21 |
| <i>Campanula transilvanica</i> Schur | 523.31, 524.5, 531.11, 531.15, 531.32-33 |
| <i>Campanula xylocarpa</i> Kovanda | 514.2, 514.41, 514.73, 515.11, 515.26, 515.28, 516.2, 517.1 |
| <i>Carex atrofusca</i> Schkuhr | 514.53, 523.31 |
| <i>Carex bicolor</i> All. | 522.25, 523.31 |
| <i>Carex bohemica</i> Schreber | 513.1, 514.62, 514.81, 523.65, 525.1, 541.2 |
| <i>Carex brevicollis</i> DC. | 516.2, 517.2-5, 523.31, 531.4, 532.3, 541.2, 542.21, 542.41 |
| <i>Carex buxbaumii</i> Wahlenb. | 513.1, 514.2, 522.25-26, 523.1-2, 523.46, 523.62-63, 523.65, 525.1, 531.15, 531.32, 541.2, 542.1 |
| <i>Carex chordorrhiza</i> Ehrh. | 513.51, 514.53, 514.72, 522.25, 523.31, 523.62-63, 531.11 |
| <i>Carex davalliana</i> Sm. | 513.2, 513.411, 513.43, 513.55-57, 513.71, 514.2, 514.9, 514.12-13, 514.42-43, 514.51, 514.53, 514.63-64, 514.71-72, 514.85, 515.11, 515.26-27, 517.4, 522.12-14, 522.25, 523.1, 523.46, 523.63, 523.65, 526, 531.15, 541.2 |
| <i>Carex diandra</i> Schrank | 513.51, 514.13, 514.72, 516.3-4, 517.1, 517.4-5, 522.25, 523.1-2, 523.31, 523.73, 526.1, 531.4, 541.2 |
| <i>Carex dioica</i> L. | 513.51, 513.57, 514.64, 514.72, 514.83, 514.85, 515.11, 523.31, 523.46, 523.63, 531.15, 541.2 |
| <i>Carex hallerana</i> Asso | 514.41, 517.4-5, 531.11, 531.37 |
| <i>Carex limosa</i> L. | 513.57, 514.11, 514.53, 514.72, 516.4, 522.15, 522.25-26, 523.1, 523.31, 523.55, 523.62-63, 524.6, 531.11, 531.32, 533.5, 541.2, 542.1, 542.41 |
| <i>Carex liparocarpos</i> Gaudin | 513.1, 514.2, 517.2, 526.2, 541.2 |
| <i>Carex parviflora</i> Host | 514.52, 531.11, 531.15, 531.22 |
| <i>Carex pediformis</i> C.A. Mey. ssp. <i>rhizodes</i> (Blytt.) H.Lindb. | 513.1, 514.71, 514.73, 515.27, 515.29, 516.2, 516.4, 523.1 |
| <i>Carex praecox</i> Schreber ssp. <i>curvata</i> (Knaf.) Kük. | 513.2, 513.411, 514.53, 523.2, 542.32 |
| <i>Carex pulicaris</i> L. | 513.1-2 |
| <i>Carex rupestris</i> All. | 514.43, 514.52-53, 514.85, 522.22, 522.25, 523.1, 523.31, 523.45, 531.11, 531.33, 542.1 |
| <i>Carex secalina</i> Willd. ex Wahlenb. | 513.1, 514.64, 517.1, 523.73, 526.1, 532.3, 542.21 |
| <i>Carex stenophylla</i> Wahlenb. | 513.1, 514.2, 514.31, 514.81, 516.2-4, 516.12, 516.14, 517, 523.62-63, 531.4, 541.2, 542.1 |
| <i>Carex strigosa</i> Huds. | 513.2, 513.33, 513.63, 513.71-72, 514.2, 517.1, 517.3, 522.12, 523.51, 531.15, 541.2, 542.1 |
| <i>Carex supina</i> Willd. ex Wahlenb. | 513.1, 517.1, 517.4, 523.51, 541.2 |
| <i>Centaurea badensis</i> Tratt. | 513.1, 514.2, 514.83, 516.2, 523.51 |
| <i>Centaurium littorale</i> (D. Turner) Gilmour | 514.71-73, 514.85, 517.2, 517.4, 533.6, 541.2, 542.1 |
| <i>Cerastium uniflorum</i> Clairv. | 514.53 |
| <i>Chimaphila umbellata</i> (L.) W.P.C. Barton | 513.411, 513.42-43, 513.55, 513.72, 514.9, 514.85, 515.29, 516.3, 517.1-3, 522.14, 523.51, 523.63, 523.73, 526.1 |
| <i>Cicuta virosa</i> L. | 513.411, 514.9, 514.13, 515.28, 516.2, 517.1-2, 517.4, 523.63, 526.1, 541.2, 542.1 |
| <i>Cimicifuga europaea</i> Schipcz. | 513.1, 513.55, 514.9, 514.12, 514.51-53, 514.71-73, 515.26-28, 516.2, 517.2, 522.23, 523.1, 523.31, 523.42, 542.23 |
| <i>Cirsium brachycephalum</i> Jur. | 513.1, 517.1, 523.31, 531.15, 541.2, 542.1, 542.21 |
| <i>Cochlearia tatrae</i> Borbás | 514.52-53 |
| <i>Colchicum arenarium</i> Waldst. et Kit. | 517.4, 532.3 |
| <i>Conioselinum tataricum</i> Hoffm. | 513.51, 514.9, 514.12-13, 514.52-53, 514.72, 514.85, 515.23, 515.26-27, 522.12, 522.23, 523.1, 523.31, 523.45-46, 531.11, 531.13, 531.15 |
| <i>Corispermum canescens</i> Kit. | 517.4, 531.37 |
| <i>Corispermum nitidum</i> Kit. ex Schult. | 513.1, 517.4, 541.2 |
| <i>Coronilla emerus</i> L. | 514.2, 531.4, 533.2, 541.2 |
| <i>Corydalis capnoides</i> (L.) Pers. | 513.54, 514.9, 514.12-13, 514.51, 514.53, 514.71, 514.73-74, 515.23, 515.26-29, 516.2, 522.26, 523.2, 523.42, 523.56, 524.5, 541.2, 542.1 |
| <i>Crambe tatarica</i> Sebeök | 517.1, 517.4, 526.1, 541.2 |
| <i>Crassula aquatica</i> (L.) Schönbl. | 514.11 |
| <i>Crepis alpestris</i> (Jacq.) Tausch | 513.57, 514.9, 514.12, 514.42, 514.51-53, 514.71, 514.85, 515.26-27, 515.29, 522.12, 523.45 |
| <i>Crepis sibirica</i> L. | 514.9, 514.42-43, 514.74, 514.82, 514.85, 523.31, 523.44, 523.63, 531.11, 531.15, 541.2 |
| <i>Crocus albiflorus</i> Kit. ex Schult. | 513.411-412, 523.53 |
| <i>Crocus banaticus</i> Gay | 523.54, 523.63, 523.73, 531.4, 531.37, 533.2, 541.1-2, 542.1, 542.42 |
| <i>Crocus flavus</i> Weston | 531.37, 532.3, 533.2 |
| <i>Cryptogramma crispa</i> (L.) R.Br. | 514.9, 523.31, 531.15 |
| <i>Cyclamen fatrense</i> Halda et Soják | 514.9, 514.85 |
| <i>Cyperus flavescens</i> L. | 522.12, 523.2, 523.31, 523.65, 526.1, 531.4, 531.15, 532.3, 542.1 |
| <i>Cypripedium calceolus</i> L. | 513.411-412, 513.43, 514.9, 514.42, 514.51, 514.53, 514.73, 514.85, 515.14, 515.24, 515.26-27, 516.2, 517.2, 517.4, 522.16, 522.24, 523.1-2, 523.43, 523.63, 523.65, 523.73, 525.1, 526.1, 531.11, 531.15, 531.25, 531.33, 531.37, 542.1, 542.23 |
| <i>Daphne arbuscula</i> Čelak. | 515.25-26 |

| Species | Physiographic Units |
|---|---|
| <i>Daphne cneorum</i> L. | 513.2, 513.412, 513.56, 514.9, 514.12-13, 514.41-43, 514.51, 514.53, 514.71, 514.81-82, 514.85, 515.26-27, 516.2, 517.2, 523.43, 526.1, 531.15, 541.2, 542.1 |
| <i>Daphne laureola</i> L. | 517.5, 533.3 |
| <i>Dendranthema zawadzkii</i> (Herb.) Tzvelev | 514.12 |
| <i>Dianthus diutinus</i> Kit. | 517.4 |
| <i>Dianthus nitidus</i> Waldst. et Kit. | 514.9, 514.42-43, 514.51-52, 514.85 |
| <i>Dianthus serotinus</i> Waldst. et Kit. | 513.1, 515.22, 517.4, 541.2 |
| <i>Dictamnus albus</i> L. | 513.1, 513.411, 514.2, 514.41-42, 514.81, 515.28, 516.2-3, 516.11, 517.2, 517.5, 522.16, 526, 532.3, 541.2 |
| <i>Digitalis ferruginea</i> L. | 526, 532.3, 541.2 |
| <i>Diphysastrum issleri</i> (Rouy) Holub | 513.51, 514.13, 514.52, 515.28, 517.2 |
| <i>Doronicum orientale</i> Hoffm. | 522.24-25, 523.1, 523.31, 523.42, 523.45, 523.57, 531.11, 531.13, 531.15, 531.22, 531.32, 531.34, 542.1 |
| <i>Draba aizoides</i> L. | 513.411, 514.2, 514.9, 514.42-43, 514.51-53, 514.85, 515.26, 522.24-25, 523.1, 523.31 |
| <i>Draba dorneri</i> Heuff. | 531.32 |
| <i>Draba dubia</i> Suter | 513.57, 514.52-53, 531.34 |
| <i>Draba fladnizensis</i> Wulfen | 514.53, 523.31, 531.11 |
| <i>Draba haynaldii</i> Stur | 523.45, 531.11, 531.13 |
| <i>Draba stellata</i> Jacq. ssp. <i>simonkaiana</i> (Jáv.) Beldie | 531.22, 531.32 |
| <i>Dracocephalum austriacum</i> L. | 513.1, 514.13, 514.73, 516.2, 517.2, 517.4, 523.73, 531.11, 541.2, 542.23 |
| <i>Dracocephalum ruyschiana</i> L. | 517.2, 523.45, 523.63, 524.3, 541.2 |
| <i>Drosera anglica</i> Huds. | 513.57, 514.64, 523.73 |
| <i>Echinops ritro</i> L. ssp. <i>ruthenicus</i> (M.Bieb.) Nyman | 513.1, 516.2, 516.12, 517.4, 531.4, 541.2, 542.1 |
| <i>Elatine hypodipiper</i> L. | 513.65, 523.51, 523.65, 525.1 |
| <i>Eleocharis austriaca</i> Hayek | 513.411-412, 513.57, 514.14, 514.71, 515.21, 522.12, 523.1 |
| <i>Eleocharis carniolica</i> Koch | 515.15, 516.2-4, 516.13, 517.1, 517.5, 523.1-2, 523.51, 523.63, 523.65, 531.4, 541.2, 542.1, 542.21, 542.42 |
| <i>Epipactis albensis</i> Nováková et Rydlo | 513.2, 513.411, 514.2, 516.2, 516.12 |
| <i>Epipogium aphyllum</i> Swartz | 513.2, 513.42-43, 513.65, 514.9, 514.42-43, 514.52-53, 514.85, 515.11, 515.26-28, 522.23, 523.44, 523.46, 523.66, 526.2, 531.11, 533.6, 541.2 |
| <i>Erysimum hungaricum</i> Zapal. | 514.9, 514.12, 514.51, 514.53, 514.85, 523.1, 523.31, 523.42 |
| <i>Erysimum wittmannii</i> Zaw. ssp. <i>pallidiflorum</i> (Jáv.) Jáv. | 515.27, 516.2, 517.2, 517.5, 523.51 |
| <i>Erythronium dens-canis</i> L. | 516.2, 517.2, 517.5, 522.23, 523.1 |
| <i>Euonymus nanus</i> M. Bieb. | 523.63, 524.2, 525.1, 526.1 |
| <i>Euphorbia carpatica</i> Wot. | 522.12, 522.15, 522.24-25, 523.1 |
| <i>Euphrasia exaristata</i> Smejkal | 514.52 |
| <i>Ferula sadlerana</i> Ledeb. | 516.2, 517.2, 517.5, 541.2 |
| <i>Fritillaria meleagris</i> L. | 515.15, 516.2-3, 516.13, 517.2-3, 522.12, 523.51, 523.73, 526.1, 531.4, 541.2, 542.1 |
| <i>Fritillaria orientalis</i> Adams | 523.73, 531.4, 532.3, 533.2, 541.1-2 |
| <i>Fumaria jankae</i> Hausskn. | 542.1 |
| <i>Gagea bohémica</i> (Zauschner) Schult. et Schult. fil. | 514.2, 514.81, 517.5, 531.37 |
| <i>Gagea fistulosa</i> (Ram. ex DC.) Ker Gawl. | 523.1, 531.11, 531.25 |
| <i>Galium parisiense</i> L. | 514.81, 531.37, 533.3, 542.1 |
| <i>Galium transcarpaticum</i> Stojko et Tasenk. | 522.23, 523.1 |
| <i>Gentiana lutea</i> L. | 522.24-25, 523.1, 523.31, 523.46, 523.55, 524.5, 531.11, 531.13, 531.15, 531.24, 531.32, 542.1 |
| <i>Geranium bohemicum</i> L. | 514.13, 514.72, 515.27-28, 517.5, 533.2, 541.2, 542.1 |
| <i>Gladiolus felicitis</i> Mirek | 513.51 |
| <i>Gladiolus palustris</i> Gaudin | 513.411, 517.3, 523.53, 523.73, 542.1, 542.21 |
| <i>Glax maritima</i> L. | 514.73, 523.63, 541.2 |
| <i>Groenlandia densa</i> (L.) Fourr. | 523.65, 541.2 |
| <i>Hammarbya paludosa</i> (L.) Kuntze | 522.13, 522.15, 522.24, 523.1, 531.36, 542.1 |
| <i>Hedysarum hedysaroides</i> (L.) Schinz et Thell. | 514.9, 514.43, 514.52-53, 514.85, 522.24-25, 523.31, 531.15, 531.32 |
| <i>Helianthemum grandiflorum</i> (Scop.) DC. | 522.23 |
| ssp. <i>glaucescens</i> Holub | |
| <i>Heracleum carpaticum</i> Porcius | 522.25, 523.1, 523.31, 523.44 |
| <i>Hermidium monorchis</i> (L.) R.Br. | 514.43, 515.27 |
| <i>Hesperis vrbelyiana</i> (Schur) Borbás | 517.2 |
| <i>Himantoglossum hircinum</i> (L.) Sprengel | |
| ssp. <i>caprinum</i> (M.Bieb.) Sunderm. | 517.2, 517.4, 526.2, 531.4, 531.36-37, 532.3, 533.2, 533.5, 541.2, 542.1 |
| <i>Hottonia palustris</i> L. | 513.2, 516.12, 517.2-3, 517.5, 523.52, 526.1, 541.2 |
| <i>Inula salicina</i> L. ssp. <i>aspera</i> (Poirot) Hayek | 514.41, 515.21, 516.2-4, 516.11-12, 516.14, 517 |
| <i>Iris aphylla</i> L. ssp. <i>hungarica</i> (Waldst. et Kit.) Hegi | 514.73, 515.27-28, 516.2-4, 516.4a, 516.14, 517.1, 517.5, 523.45, 523.65, 523.73, 526, 531.17, 532.3, 541.2, 542.21, 542.23 |
| <i>Iris graminea</i> L. ssp. <i>pseudocyperus</i> (Schur) Soó | 513.2, 513.411, 515.21, 516.2, 517.1-3, 517.5, 522.12, 522.23, 523.1, 523.51-53, 526, 531.4, 532.3, 541.2 |
| <i>Iris humilis</i> Georgi | 517.4, 541.2 |
| <i>Iris sibirica</i> L. | 513.411, 513.71, 515.21-23, 515.29, 516.2-3, 516.12, 517, 522.12, 523.1-2, 523.51, 526.1, 541.2 |
| <i>Iris spuria</i> L. | 516.3, 517.1-2, 517.4, 526.1, 541.2, 542.1, 542.23 |
| <i>Juncus bulbosus</i> L. | 513.51, 523.51, 541.2 |
| <i>Juncus castaneus</i> Sm. | 514.52-53, 522.15, 522.24-25, 523.31 |
| <i>Juncus sphaerocarpus</i> Nees | 513.411, 514.2 |
| <i>Juncus triglumis</i> L. | 514.52-53, 522.25, 523.31, 531.11, 531.15, 531.22 |
| <i>Juniperus sabina</i> L. | 514.12, 522.23, 523.46, 525.1, 531.17, 531.21-22, 531.37, 542.23 |
| <i>Jurinea mollis</i> (L.) Rchb. | 516.3, 541.2 |
| ssp. <i>transsilvanica</i> (Sprengel) Hayek | |
| <i>Kobresia myosuroides</i> (Vill.) Fiori | 514.53, 531.11, 531.15, 531.33 |
| <i>Kobresia simpliciuscula</i> (Wahlenb.) Mackenzie | 514.53, 523.31, 531.11 |
| <i>Laserpitium siler</i> L. | 531.21 |
| <i>Lathyrus pannonicus</i> (Jacq.) Garcke | 513.1, 513.411, 516.2, 517, 541.2 |
| <i>Lathyrus pisiformis</i> L. | 516.2, 517.1 |
| <i>Lathyrus transsilvanicus</i> (Spreng.) Fritsch | 515.22, 515.26, 516.13, 517.2, 523.52, 541.2 |
| <i>Ledum palustre</i> L. | 513.51, 514.11, 514.14, 514.53, 514.85, 522.25, 523.1, 523.52 |
| <i>Leontopodium alpinum</i> Cass. | 514.9, 514.12, 514.51-53, 514.85, 515.27, 522.24, 523.1, 523.31, 523.42-43, 523.45-46, 524.5, 525.1, 531.11, 531.15, 531.17, 531.21, 531.32-34, 542.1, 542.23 |
| <i>Leucojum aestivum</i> L. | 516.3, 517.1, 517.4, 523.54, 531.4, 532.3 |
| <i>Leucojum vernum</i> L. | 522.12-16, 522.21, 522.23-26, 523.51-54, 523.63, 523.65, 531.4, 541.2 |
| ssp. <i>carpaticum</i> (Spring.) O.Schwarz | |
| <i>Ligularia glauca</i> (L.) J.Hoffm. | 515.26, 523.1, 523.31, 523.46, 526.1, 531.11, 531.15, 531.21, 542.23 |
| <i>Ligularia sibirica</i> (L.) Cass. | 514.9, 514.53, 515.27, 515.29, 523.1, 531.11, 531.21, 541.2 |
| <i>Lilium bulbiferum</i> L. | 513.411, 513.44, 513.56, 514.9, 514.43, 514.51, 514.74, 514.85, 515.21, 515.26-27, 523.31, 523.45, 523.73, 541.2 |
| <i>Limodorum abortivum</i> (L.) Swartz | 513.1-2, 513.411, 514.2, 514.33, 514.41-42, 514.81, 515.14, 515.21, 515.28, 516.2, 517, 523.73, 531.36, 532.3, 533.2, 541.2 |
| <i>Linaria alpina</i> (L.) Mill. | 514.52, 531.11, 531.13 |
| <i>Linaria arvensis</i> (L.) Desv. | 513.411, 514.2, 514.81, 541.2 |
| <i>Lindernia procumbens</i> (Krocker) Borbás | 513.65, 514.2, 516.3, 516.12, 517.1, 517.5, 523.51, 523.56, 523.73, 531.15, 541.2, 542.1 |
| <i>Linnaea borealis</i> L. | 514.9, 514.52-53, 522.25, 523.62 |
| <i>Linum trigynum</i> L. | 515.21, 517.3, 522.12, 523.51, 531.37 |
| <i>Liparis loeselii</i> (L.) Rich. | 513.411, 522.25, 523.1, 523.31, 523.45, 523.63, 523.73, 531.4, 531.15, 541.2 |
| <i>Loiselouria procumbens</i> (L.) Desv. | 514.9, 514.53, 522.25, 523.31, 523.46, 523.62, 531.11, 531.13-15, 531.22, 531.25, 531.32-34 |
| <i>Lomatogonium carinthiacum</i> (Wulfen) Rchb. | 531.11 |
| <i>Lonicera alpigena</i> L. | 515.26, 523.43, 523.73, 524.2, 524.6 |
| <i>Lonicera coerulea</i> L. | 522.25, 531.11, 531.25, 531.33-34 |

18 | Carpathian List Of Endangered Species

Vascular Plants

| Species | Physiographic Units |
|--|---|
| <i>Lotus borbasii</i> Ujhelyi | 513.1, 514.2, 517.5 |
| <i>Ludwigia palustris</i> (L.) Elliott | 522.22, 523.51, 531.4, 541.2, 542.1, 542.21 |
| <i>Lychnis nivalis</i> Kit. | 523.31 |
| <i>Lycopodiella inundata</i> (L.) Holub | 513.1, 513.31, 513.44, 513.51, 522.15, 523.45, 523.51, 523.55-56, 525.2 |
| <i>Lysimachia thysiflora</i> (L.) Rchb. | 513.51, 513.56, 514.34, 523.42, 523.63, 531.15, 541.2 |
| <i>Marsilea quadrifolia</i> L. | 523.52, 542.1 |
| <i>Micromeria thymifolia</i> (Scop.) Fritsch | 517.2 |
| <i>Microstylis monophyllos</i> (L.) Lindley | 513.411, 513.51, 513.54, 513.57, 514.9, 514.12, 514.52-53, 514.71-72, 515.11, 515.26-27, 522.12, 522.15, 522.24-25, 523.31, 523.45-46, 523.51, 523.53, 523.63, 531.14, 531.37 |
| <i>Minuartia hirsuta</i> (M.Bieb.) Hand.-Mazz. ssp. <i>frutescens</i> (Kit.) Hand.-Mazz. | 516.3, 517.1-3, 531.4, 531.15, 531.17, 531.37, 533.2, 542.1 |
| <i>Montia fontana</i> L. | 513.1, 513.44, 531.37, 541.2, 542.1 |
| <i>Narcissus angustifolius</i> Curt. | 522.24, 523.1, 523.31, 523.54, 526.2, 531.4, 531.15, 531.32, 532.3, 541.2 |
| <i>Nigritella carpatica</i> (Zapal.) Teppner, Klein et Zagulski | 523.1 |
| <i>Nigritella nigra</i> (L.) Rchb. ssp. <i>nigra</i> | 523.1, 525.2, 531.11, 531.33, 531.37 |
| <i>Nigritella nigra</i> (L.) Rchb. ssp. <i>rubra</i> (Wettst.) Beauverd | 523.31, 523.43, 523.45, 524.5, 531.11, 542.1, 542.23 |
| <i>Onobrychis montana</i> DC. | 514.52-53, 523.43, 531.11, 531.15, 531.32 |
| <i>Ononis repens</i> L. | 541.2 |
| <i>Onosma arenarium</i> Waldst. et Kit. | 517.4, 541.2, 542.1 |
| <i>Onosma pseudoarenaria</i> Schur ssp. <i>tuberculata</i> (Kit.) Rauschert | 516.2, 516.11-12, 517.1-3, 517.5, 523.51, 541.2, 542.23 |
| <i>Onosma tornensis</i> Jáv. | 516.2 |
| <i>Ophrys apifera</i> Huds. | 513.411, 514.2, 514.31, 514.41-42, 514.51, 514.81, 517.4, 526.2, 531.25, 533.2, 542.22 |
| <i>Ophrys fuciflora</i> (F.W.Schmidt) Moench | 513.411-412, 514.2, 514.31, 514.41-42, 514.81, 531.25, 533.6 |
| <i>Ophrys sphegodes</i> Mill. | 514.2, 517.2, 523.73, 531.4, 542.1, 542.22 |
| <i>Orchis pallens</i> L. | 513.2, 513.31-32, 513.411-412, 513.43-44, 513.51, 513.54, 514.2, 514.42, 515.14, 515.24, 515.27-28, 517.1-2, 517.5, 523.1, 523.63, 523.73, 533.6, 541.2 |
| <i>Orchis spitzelii</i> Sauter ex Koch | 514.43 |
| <i>Ornithogalum sphaerocarpon</i> A.Kern. | 513.411, 513.43, 514.2, 515.14, 515.21, 515.26, 516.2, 516.13-14, 533.6 |
| <i>Orobanche picridis</i> F.W.Schultz | 513.72, 514.41-42, 516.2, 516.4, 516.11, 517.2-3, 526.2, 532.3, 541.2, 542.1 |
| <i>Oxytropis carpatica</i> Uechtr. | 514.53, 522.24, 523.31, 523.46, 531.11 |
| <i>Paonia mascula</i> (L.) Mill. ssp. <i>triternata</i> (Pallas ex DC.) Stearn et P.H.Davis | 526.2, 532.3 |
| <i>Paonia tenuifolia</i> L. | 532.3, 541.2 |
| <i>Papaver alpinum</i> L. ssp. <i>tatricum</i> Nyár. | 514.52-53, 514.85 |
| <i>Pedicularis sceptrum-carolinum</i> L. | 514.52-53, 514.71-72, 522.13-14, 523.62-63, 523.73, 526.1 |
| <i>Petrocallis pyrenaica</i> (L.) R.Br. | 514.53 |
| <i>Pinguicula vulgaris</i> L. | 513.412, 513.44, 513.51-52, 513.54-57, 514.9, 514.12-13, 514.41-43, 514.51-53, 514.63-64, 514.71-72, 514.85, 515.26-28, 522.24-25, 523.1, 523.31, 523.43, 523.45, 523.63, 524.3, 531.11, 531.15 |
| <i>Poa margilicola</i> Bernátová et Májovský | 514.85 |
| <i>Poa nobilis</i> Skalińska | 514.53 |
| <i>Poa pannonica</i> A.Kern. ssp. <i>scabra</i> (Asch. et Graebn.) Soó | 514.72, 514.83-84, 515.15, 515.21-23, 515.28, 516.2, 516.11, 517, 523.73, 531.15, 541.2, 542.21, 542.32 |
| <i>Polycarpon tetraphyllum</i> (L.) L. f. | 514.2, 533.2 |
| <i>Polypodium interjectum</i> Shivas | 513.2, 516.2, 517.2, 517.4, 533.3 |
| <i>Potamogeton alpinus</i> Balbis | 522.25, 523.44, 523.63 |
| <i>Potamogeton compressus</i> L. | 513.65, 541.2 |
| <i>Potamogeton trichoides</i> Cham. et Schlecht. | 516.2, 517.4, 523.63 |
| <i>Potentilla haynaldiana</i> Janka | 531.22, 531.37 |
| <i>Potentilla palustris</i> (L.) Scop. | 513.51, 513.57, 514.9, 514.11, 514.13, 514.43, 514.53, 514.64, 514.71-72, 515.27, 522.25, 523.43, 523.63, 524.5, 531.15, 541.2 |
| <i>Potentilla sterilis</i> L. | 514.31 |
| <i>Primula farinosa</i> L. | 514.9, 514.12, 514.43, 514.51-53, 514.72, 514.85, 515.11, 515.26-27, 515.29, 516.2, 531.33, 531.36-37 |
| <i>Primula halleri</i> J.F.Gmel. | 514.53, 522.24-25, 523.1, 523.31, 523.42, 523.46, 531.11, 531.13, 531.15, 531.34 |
| <i>Primula wulfeniana</i> Schott ssp. <i>baumgarteniana</i> (Degen et Moesz) Ludi | 531.13, 531.15 |
| <i>Pulmonaria angustifolia</i> L. | 513.411, 514.2, 514.74, 515.26, 516.2-3, 516.13 |
| <i>Pulsatilla halleri</i> (All.) Willd. ssp. <i>slavica</i> (G.Reuss) Zamels | 513.412, 513.56, 514.2, 514.9, 514.31-32, 514.41, 514.43, 514.51-53, 514.62-63, 514.85, 515.14, 515.24-29, 516.2 |
| <i>Pulsatilla patens</i> (L.) Mill. | 514.72, 516.2, 517.1, 541.2 |
| <i>Pulsatilla vernalis</i> (L.) Mill. | 514.52-53 |
| <i>Pulsatilla vulgaris</i> Mill. ssp. <i>grandis</i> (Wenderoth) Zamels | 513.1, 513.411, 513.55, 513.72, 514.2, 514.41-42, 514.81, 515.21, 515.26, 516.2-3, 516.11, 516.14, 517, 522.12, 523.51 |
| <i>Pyrola media</i> Swartz | 513.51, 514.9, 514.13, 514.41, 514.51, 514.53, 514.71, 514.85, 515.26-29, 517.4-5, 522.12, 523.31, 523.45, 523.63, 523.73, 533.5, 541.2 |
| <i>Pyrus nivalis</i> Jacq. | 514.41-42, 514.81, 515.26, 516.11, 517.1, 517.3-4 |
| <i>Ranunculus altitatisensis</i> Paclová et Murín | 514.53 |
| <i>Ranunculus glacialis</i> L. | 514.52-53 |
| <i>Ranunculus malinowskii</i> Jelen. et Derv.-Sok. | 522.25 |
| <i>Ranunculus millefoliatus</i> Vahl | 531.37 |
| <i>Ranunculus pygmaeus</i> Wahlenb. | 514.53 |
| <i>Ranunculus reptans</i> L. | 514.53 |
| <i>Ranunculus thora</i> L. | 514.52-53, 522.24-25, 523.1, 523.31, 531.11, 531.15, 531.25, 531.33 |
| <i>Rosa glauca</i> Pourret | 514.9, 514.43, 514.51, 515.21, 515.25, 515.27, 517.1, 522.15, 531.15 |
| <i>Rubus bertramii</i> G.Braun | 513.31 |
| <i>Rubus senticosus</i> Köhler ex Weihe | 513.44, 517.3 |
| <i>Ruppia maritima</i> L. | 523.62, 523.66, 541.2 |
| <i>Salix bicolor</i> L. | 514.9, 514.52-53, 523.1, 523.31, 523.44, 523.46, 531.11, 531.22, 531.26 |
| <i>Salix helvetica</i> Vill. | 514.9, 514.52-53 |
| <i>Salix herbacea</i> L. | 513.51, 514.9, 514.43, 514.52-53, 522.25, 523.1, 523.31, 531.11, 531.15, 531.22, 531.32-34 |
| <i>Salix myrtilloides</i> L. | 513.51, 514.11, 531.11 |
| <i>Salix retusa</i> L. | 514.43, 514.52-53, 522.24-25 |
| <i>Salix starkeana</i> Willd. | 514.74, 515.29, 517.1, 523.63, 541.2 |
| <i>Saussurea discolor</i> (Willd.) DC. | 514.43, 514.53, 514.85, 522.26, 523.1, 523.44-45, 531.11, 531.15, 531.32-34 |
| <i>Saussurea porcii</i> Degen | 522.25, 523.1 |
| <i>Saussurea pygmaea</i> (Jacq.) Sprengel | 514.52-53 |
| <i>Saxifraga cernua</i> L. | 514.52-53, 523.31, 531.11 |
| <i>Saxifraga hirculus</i> L. | 514.52, 523.63, 524.5 |
| <i>Saxifraga mutata</i> L. ssp. <i>demissa</i> (Schott et Kotschy) D.A.Webb | 525.2, 531.11 |
| <i>Saxifraga mutata</i> L. ssp. <i>mutata</i> | 514.9, 523.73 |
| <i>Saxifraga pedemontana</i> All. ssp. <i>cymosa</i> Engler | 522.24, 523.31, 524.5, 531.15, 531.22, 531.24, 531.32-34, 531.37 |
| <i>Saxifraga retusa</i> Gouan | 514.52-53, 523.31, 523.43, 531.11, 531.15, 531.21 |
| <i>Scheuchzeria palustris</i> L. | 513.44, 514.53, 522.15, 523.2, 523.42, 523.51, 523.63, 525.2, 531.15, 542.1 |
| <i>Schoenoplectus mucronatus</i> (L.) Palla | 513.32, 523.65, 524.5, 531.15, 532.3, 542.21 |
| <i>Schoenus ferrugineus</i> L. | 514.34, 514.72, 514.85, 523.53, 523.63, 526.1 |
| <i>Scirpus hudsonianus</i> (Michx) Fernald | 513.51, 514.53 |

| Species | Physiographic Units |
|--|--|
| <i>Scorzonera humilis</i> L. | 513.411, 513.44, 513.54, 522.12-13, 522.15, 523.42, 523.46, 523.51, 523.63, 523.73, 524.2, 541.2 |
| <i>Scorzonera lanata</i> (L.) Hoffm. | 531.37 |
| <i>Scorzonera parviflora</i> Jacq. | 513.1, 514.73, 516.13, 517.4, 523.1, 523.57, 523.63, 525.1, 541.2 |
| <i>Sedum villosum</i> L. | 513.44, 514.53, 523.63 |
| <i>Selaginella helvetica</i> (L.) Spring | 514.51, 515.21, 515.26-28, 516.2, 516.14, 523.52 |
| <i>Senecio congestus</i> (R.Br.) DC. | 514.12, 541.2 |
| <i>Senecio doria</i> L. ssp. <i>umbrosus</i> (Waldst. et Kit.) Soó | 513.411, 513.57, 514.9, 514.13, 514.42, 514.51, 514.53, 514.71, 516.3, 517.2, 522.16 |
| <i>Serratula lycopifolia</i> (Vill.) A.Kern. | 513.1, 513.411, 517.1, 541.2 |
| <i>Sesleria caerulea</i> (L.) Ard. | 514.31, 514.43, 514.63, 514.85, 523.73 |
| <i>Sesleria heuflerana</i> Schur ssp. <i>hungarica</i> (Ujhelyi) Soó | 516.2, 517.2 |
| <i>Sibbaldia procumbens</i> L. | 514.52 |
| <i>Silene zawadzkyi</i> Herlich | 523.1, 523.44, 523.46 |
| <i>Sisymbrium austriacum</i> Jacq. | 514.85 |
| <i>Sorbus austriaca</i> (Beck) Hedl. | 515.26-28, 516.2, 517.2 |
| ssp. <i>hazslinszkyana</i> (Soó) Kárpáti | |
| <i>Sorbus chamaemespilus</i> (L.) Crantz | 513.55, 514.9, 514.43, 514.51, 514.53, 514.85, 515.26, 522.12, 531.15, 531.32-33 |
| <i>Sorbus pekarovae</i> Májovský et Bernátová | 514.85 |
| <i>Sparganium angustifolium</i> F. Michx | 514.52, 522.24 |
| <i>Spiranthes spiralis</i> (L.) Chevall. | 513.44, 513.72, 517.2, 517.4, 523.2, 523.31, 523.45, 525.1, 526.2, 531.4, 531.11, 531.15, 532.3, 533.2, 533.6, 541.2, 542.1, 542.22 |
| <i>Stellaria hebecalyx</i> Fenzl | 523.1 |
| <i>Sternbergia colchiciflora</i> Waldst. et Kit. | 517.4-5, 526.1, 531.37, 533.2-3 |
| <i>Stipa danubialis</i> Dihoru et Roman | 531.37 |
| <i>Stipa dasphylla</i> (Lindem.) Trautv. | 516.2-4, 516.12, 516.14, 517, 531.4 |
| <i>Stipa pulcherrima</i> K. Koch | 514.41-42, 514.51, 514.81, 516.2-4, 516.12, 516.14, 517, 523.51, 523.73, 531.4, 531.37, 541.2, 542.21 |
| <i>Succisella inflexa</i> (Kluk) Beck | 516.2, 517.2, 522.12, 523.2, 523.51-52, 541.2, 542.1, 542.21 |
| <i>Syringa josikaea</i> J. Jacq. ex Rchb. | 522.12-13, 522.21, 542.1 |
| <i>Taraxacum arachnoideum</i> Kirscher et Štěpánek | 513.411 |
| <i>Taraxacum erythrocarpum</i> Kirschner et Štěpánek | 513.411-412, 514.2, 514.42, 514.85 |
| <i>Taraxacum obliquum</i> (Fries) Dahlst. | 542.42 |
| <i>Taraxacum pienicum</i> Pawl. | 514.12 |
| <i>Tesdalea nudicaulis</i> (L.) R.Br. | 516.3, 517.2-4, 524.5, 531.11, 531.15 |
| <i>Tephrosia longifolia</i> (Jacq.) Griseb. et Schenk ssp. <i>moravica</i> Holub | 513.411, 514.81-83 |
| <i>Teucrium scorodonia</i> L. | 513.44, 514.81 |
| <i>Thesium ebracteatum</i> Hayne | 513.1, 541.2 |
| <i>Thlaspi jankae</i> A.Kern. | 514.81, 516.2-3, 517.2-5 |
| <i>Tofieldia pusilla</i> (Michx) Pers. | 514.53 |
| <i>Trapa natans</i> L. | 516.13, 523.73, 531.4, 541.2 |
| <i>Trifolium lupinaster</i> L. | 514.52, 523.1, 523.62, 524.6 |
| <i>Utricularia australis</i> R.Br. | 513.56, 514.11, 514.73, 516.14, 517.4, 523.55, 523.62, 523.65 |
| <i>Utricularia bremii</i> Heer | 516.3, 523.2, 523.63, 523.65, 531.15, 541.2 |
| <i>Utricularia minor</i> L. | 514.34, 514.52, 514.64, 514.71-72, 514.85, 517.3-4, 523.44, 523.64, 541.2 |
| <i>Utricularia vulgaris</i> L. | 513.52, 514.52, 516.12-14, 523.2, 523.44, 523.63, 523.73, 526.1, 531.4, 532.3, 542.1 |
| <i>Vaccinium microcarpum</i> (Turcz. ex Rupr.) Schmalh. | 514.11, 514.52-53, 522.12, 522.15, 522.24-25, 523.1-2, 523.42, 523.55, 523.63, 526.1, 542.1 |
| <i>Vaccinium oxycoccus</i> L. | 513.44, 517.3, 522.12, 522.15, 522.24-25, 523.1, 523.42, 523.55, 523.63, 524.5, 541.2 |
| <i>Vicia sparsiflora</i> Ten. | 514.81, 515.21, 517.2-5, 531.37 |
| <i>Viola epipsila</i> Ledeb. | 514.53, 515.12, 523.1, 523.43, 523.63 |
| <i>Vulpia bromoides</i> (L.) S.F.Gray | 514.82, 531.26, 532.1, 542.1 |
| <i>Waldsteinia teppneri</i> Májovský | 515.21 |
| <i>Waldsteinia ternata</i> (Stephan) Fritsch | 515.15, 515.22-23, 515.25-26, 515.28 |
| <i>Woodsia alpina</i> (Bolton) S.F.Gray | 514.52-53, 517.3, 522.15, 523.1, 523.53 |
| <i>Woodsia ilvensis</i> (L.) R.Br. | 513.52, 514.9, 514.43, 514.52-53, 514.82, 514.84, 515.15, 515.21, 515.23, 515.25, 515.28, 516.2, 517.1-3, 517.5, 522.12, 523.1, 523.31, 523.42, 523.51, 523.62, 531.25, 541.2, 542.1 |



Mammals

Large Carnivores

by Henryk Okarma

Carnivores are the top consumers in a trophic web and have considerable influence on populations of large herbivores. Except for bears, which consume considerable amounts of plant food, carnivores are meat eaters. Altogether, 10 carnivore species were selected for this Carpathian List of Endangered Species including four flagship species: Brown bear *Ursus arctos*, Wolf *Canis lupus*, European lynx *Lynx lynx* and Wildcat *Felis silvestris*.

The Brown bear is present in all Carpathian countries, although in considerably variable numbers. Official statistics for the whole Carpathian population indicate a population of about 7,000 individuals. However, many consider this figure to be slightly overestimated. The species is most numerous in Romania and Slovakia, while in Hungary and Czech Republic it has been recorded only sporadically. The general population trend in the region is either stable or slightly increasing. The conservation status of the Brown bear varies between the Carpathian countries: it is strictly protected, partially protected or hunted. However, in those countries where hunting is prohibited, it is done so on the basis of relatively accurate estimates of population numbers and can be considered as a sustainable harvest.

The Wolf is the second most numerous large carnivore in the Carpathians. Official statistics estimate the whole Carpathian population to be about 5,500 individuals. However, this number is probably considerably overestimated and scientists put the number at fewer than 4,000. The general population trend in the region is increasing or stable, with a slight decrease reported from Slovakia. The conservation status of the Wolf in the Carpathians is not satisfactory. The species is only strictly protected in countries where small or medium populations occur. In countries where the species is more numerous (Romania, Slovakia), it is intensively hunted with long hunting seasons (e.g. more than 5 months in Romania). In Ukraine, despite a relatively small population, wolves are hunted throughout the year.

Officially, statistics show the total Carpathian Lynx population to be about 3,400 individuals. However, it is probable that this is a considerable overestimate and the lat-

est scientific research indicates there to be only about 2,400 Lynx. The general population trend in the Carpathians is decreasing or stable, with an increase reported from Romania. The conservation status of the Lynx in the region generally appears to be relatively satisfactory: the species is strictly protected in four countries. Hunting is permitted only in Romania and Slovakia, however with a very long hunting season (5–6 months). Scientific assessments clearly demonstrate that the Lynx should be considered the most vulnerable large carnivore species in the region.

Knowledge about the Wildcat is very limited in the Carpathians. According to official data, the species is common in Romania and Hungary. In Slovakia and Poland it is strictly protected and its population size is estimated to be 1,200 and less than 200 individuals, respectively. There is no reliable data from Ukraine. Major threats to the wildcat include unfavourable changes in forestry (e.g. even–age monocultures), hybridisation with the domestic cat, poaching and killing by hunters (who often mistake this species for feral cats).

Recommendations for Conservation and Management

The distribution of large carnivores in the Carpathians is divided between administrations, so a national management policy would need to be coordinated at a regional level and between neighbouring countries. National management plans for carnivores should be developed according to guidelines worked out by the *Large Carnivore Initiative for Europe* and adopted by the *Bern Convention*. Monitoring of the population dynamics of large carnivores is also required. In order to achieve this, there is a need to elaborate and apply more accurate methods of estimating carnivore numbers. Essential is the development of compensation systems and their application to mitigate conflicts with local human populations. Education programmes for gaining public acceptance of various target groups (e.g. livestock owners, hunters, game managers) are also necessary.

Large Herbivores

by Kajetan Perzanowski

The three flagship species selected to represent large herbivores are the strictly herbivorous, hoofed animals which ruminant their food, including European bison *Bison bonasus*, Chamois *Rupicapra rupicapra* and Moose *Alces alces*. They occupy a range of ecological niches from concentrate selectors (i.e. species being highly selective towards the quality of their diet), through intermediate feeders to true grazers.

All of these large herbivore species are important components of a trophic web, having a pronounced influence on the composition and structure of local flora. Their foraging activity considerably affects the processes of plant succession and is therefore a potentially important modifying factor for the landscape.

The European bison has been reintroduced to the Carpathians after having been extirpated there about 200 years ago. Population numbers are estimated to be about 160

in the Bieszczady Mountains in Poland and about 220 in the Ukrainian Carpathians. Separate, isolated herds are threatened by inbreeding and further loss of genetic variability. Due to its habitat and spatial requirements, the European bison may serve as an umbrella species for other endangered animals. Its present numbers do not guarantee the survival of a self-sustainable population.

The Chamois is the only ungulate species occurring in the alpine zone of the highest part of the Carpathians — the High Tatras. Its presence in the ecoregion is limited to the Tatras, Fatra and Slovensky Raj. It is very sensitive to human-related disturbance and the loss of natural refuges. Therefore due to the absence of contact with other populations of the species, the Carpathian Chamois are highly threatened by inbreeding. Total numbers are currently estimated at about 300 individuals. The joint Polish–Slovak population has been on the decline for a number of years.

The Moose is present only sporadically on the northern slopes of the Carpathian range. Total numbers in the ecoregion probably do not exceed 100. The species is unable to form a stable breeding population due to the lack of suitable habitats. Its continued presence in the Carpathians depends on accessibility and continuity of migration routes from the core population in north-eastern Poland and Byelorussia.

Two large herbivore species, namely Aurochs *Bos primigenius* and Wild horse *Equus caballus gmelini*, became extirpated from the region several centuries ago.

Currently, the main threats for the large herbivore group include:

- habitat loss, resulting from infrastructure development encroaching up mountain valleys as well as improper practices in forestry, including clear cuts and artificial rejuvenation of forests with spruce mono-cultures;
- habitat fragmentation due to the increasing density and development of the road and railway network;
- poaching (locally intensive); and
- population fragmentation and inbreeding.

Recommendations for Conservation and Management

The most important and urgent needs regarding the protection and sustainable management of these ungulate species are improved information exchange and the development of a monitoring system common to all countries of the region. This could provide the basis for a joint conservation action plan, which among other aspects, would unify the legal status of particular species and impose the same approach to their protection and management over the whole home range of a population, regardless of administrative borders.

Small Mammals

by Kajetan Perzanowski

For this Carpathian List of Endangered Species, insectivores, bats and rodents were combined together under the single category of *Small Mammals*. This group is fairly well

studied in the Carpathians. So far, several lists of threatened species (Głowaciński 2001, Okołów 1998, Voloscuk ed. 1996) and monographs of Carpathian fauna have been published (Wołoszyn, Bashta 2001). The respective categories of threat for particular species applied in this Carpathian List of Endangered Species follow earlier red lists.

The majority of species named in this Carpathian List of Endangered Species occur in small isolated populations, seriously threatened by habitat loss or alterations. Other threats include probable high inbreeding in local populations which is further increased by low reproduction rates and, in the case of marmot and beaver, poaching.

Due to their requirements for highly specific environmental conditions, including their sensitivity to human pressure, small mammals serve as important indicators of environment quality.

Recommendations for Conservation and Management

The status of the species belonging to this group is in general not sufficiently assessed. Therefore, it is necessary to introduce the monitoring of their population parameters (numbers, trends and distribution) on an eco-regional scale. Effective conservation depends on the ability to protect their crucial habitats as well as on the introduction of a consistent legal status of the species in the region.

Acknowledgements

The authors would like to thank Dr Tadeusz Buchalczyk for providing base data on rodents and other small mammals of the Polish Carpathians, and to Drs Yaroslav Dovhanych, Ovidiu Ionescu, Ivan Voloscuk and Mojmir Vlasin for comments at various stages of the report.

References

- Anděra M., Hanzal V. 1996. Atlas of the mammals of the Czech Republic. A Provisional Version. II. Carnivores (Carnivora). Národní muzeum, Praha: 1–85.
- Bieniek M., Wolsan M., Okarma H. 1998. Historical biogeography of the lynx in Poland. *Acta zoologica cracoviensis* 41: 143–167.
- Brzuski P., Malawski J., Uhl T. 1995. Liczebne i przestrzenne granice występowania w ocenie polskich służb leśnych. *Fund. Ratowania Fauny i Flory Karpat i Podkarpacia*, Kraków.
- Faragó, S. 1993. Large carnivores re-settling in the Hungarian fauna: Will there be room for them? *Proceedings of the XXI IUGB Congress*, Halifax, Canada: 257–264.
- Findo S. 1995. Present situation and perspectives on conservation of the Grey wolf (*Canis lupus*) in Slovakia. *Vyskum a ochrana cicavcov na Slovensku II*: 37–47.
- Frąckowiak W., Gula R., Perzanowski K. 1999. Bears – status survey and conservation action plan, Poland. In: (C. Servheen, S. Herrero and B. Peyton comp.) *IUCN/SSC Bear and Polar Bear Specialist Groups*. Information Press, Oxford: 89–93.
- Głowaciński Z. (ed.) 2001. *Polska czerwona księga zwierząt*. PWRiL, Warszawa.
- Hell P. 1992. Current situation and perspectives of the wolf in Czechoslovakia. *Proceedings of the workshop „Wolves in Europe – current status and prospects”*. Oberammergau, Germany: 36–42.
- Hell P., Findo S. 1999. Slovakia. In: (C. Servheen, S. Herrero, B. Peyton eds.) *Bears: Status, survey and conservation plan*. IUCN/SSC Bear Specialist Group and Polar Bear Specialist Group, Gland, Switzerland and Cambridge UK: 1–309.
- Hunchak M. 1999. Buryi vedmid' v Karpatakh. *Lisovyi i Myslyvs'kyi Zhurnal*, 5: 25.
- Ionescu O. 1996. The wolf in Romania, past, present and future. In: (W. Schroeder and C. Promberger eds.) *Wolves of Europe*: 23–29.
- Ionescu O., Isuf C. 1999. Bear-human conflicts in Romania. XII International Bear Association Conference on bear research and management. Brasov, Romania.
- Jakubiec Z. 1993. *Ursus arctos* Linnaeus, 1758 – Braunbär. In: (M. Stubbe, F. Krapp eds.) *Handbuch der Säugetiere Europas*. 5/1 Raubsäuger. Aula Verlag, Wiesbaden: 254–300.
- Koubek P., Červený J. (eds.) 1996. Lynx in the Czech and Slovak Republics. *Acta Sc. Nat.*, Brno 30: 1–78.
- Koubek P., Červený J. 1996. Lynx in the Czech and Slovak Republics. *Acta Sc. Nat.* Brno 30 (3): 1–78.
- Krupka J. (ed.) 1989. *Łowicтво*. PWRiL, Warszawa.
- Okarma H. 1993. Status and management of the wolf in Poland. *Biological Conservation* 66:153–158.
- Okarma H. 2001. *Canis lupus* Linne, 1758. Wilk. W: (Z. Głowaciński ed.). *Polska czerwona księga zwierząt*, Kręgowce. PWRiL, Warszawa.

24 | Carpathian List Of Endangered Species

Mammals

Okarma H., Dovchanych Y., Findo S., Ionescu O., Koubek P., Szemethy L. Status of carnivores on the Carpathian Ecoregion. Carpathian Ecoregion Initiative, WWF Danube-Carpathian Programme, Unpublished Report: 1–37.

Okolów C. (ed.) 1998. Chronione gatunki roślin i zwierząt w polskich Parkach Narodowych. Białowiecki Park Narodowy, Białowieża.

Perzanowski K., Augustyn M. (eds). 1997. Selected ecological problems of Polish-Ukrainian Carpathians, Proc.2nd Annual Meeting of ICE–PAS, Bieszczady, Ustrzyki Dolne.

Perzanowski K., Kozak I. 2000. The Carpathian bison: its past and future perspectives. Biosphere Conservancy 2,2:75–8.

Perzanowski K., Paszkiewicz R. 2000. Restytucja i współczesny stan populacji żubrów w Bieszczadach. W: W: Monografie bieszczadzkie: Kręgowce Bieszczadów Zachodnich (Z. Głowaciński ed.) Vol. 7: 217–229.

Promberger C., Ionescu O. 1996. The Carpathian Wolf – Romania at its Wildest, International Wolf Magazine, 6: 16–17.

Promberger F., Promberger C., Ionescu O. 1998. Large carnivores in the Romanian Carpathian. Carpathian Large Carnivore Project, annual Report 1998: 4–23.

Sabadoš K., Šimiak M. 1981. Distribution and management of the brown bear (*Ursus arctos* L.) in Slovakia. Folia Venatoria 10–11: 15–35.

Slobodyan A. A. 1993. Ukraine. Bears (distribution, ecology, use and protection). Izdatelstvo “Nauka”, Moscow: 67–91.

Śmietana W., Okarma H., Śnieżko S. 2000. Bieszczadzka populacja rysia. Monografie Bieszczadzkie 9: 147–155.

Śmietana W., Wajda J. 1997. Wolf number changes in Bieszczady National Park, Poland. Acta Theriologica 42: 241–252.

Volosuk I. (ed.) 1996. Red data book – list of threatened plant and animals of the Carpathian National Parks and Reserves. ACANAP, 86pp.

Wolsan M., Okarma H. 2001. *Felis silvestris* Schreber, 1775. Żbik.. In: (Z. Głowaciński ed.). Polska Czerwona Księga Zwierząt, Kręgowce. PWRiL, Warszawa..

Wolsan M., Okarma H. 2001. *Lynx (Felis) lynx* (Linne, 1758). Ryś. In: (Z. Głowaciński ed.). Polska Czerwona Księga Zwierząt, Kręgowce. PWRiL, Warszawa.

Wołoszyn B.W., Bashta A.–T. V. 2001. Nietoperze Karpat, Połowy klucz do oznaczania nietoperzy. Chiropterological Information Center, Poland Bat Research and Protection Group & Institute of Ecology of the Carpathians UAN, Ukraine, Kraków, Lviv.

Carpathian List of Endangered Species – mammals (for explanations, see chapter on How to Use This Book)

| Species | Category of Threat | | | | | | | | | | | | | | Aretic/Alpine | Bern Convention | Carpathian hold large pro-portion of world population | Endemic | Habitat Directive | High Mountain Species | Relic | |
|---|---|--|----|----|----|----|----|----|------------------------------------|----|----|----|----|----|---------------|-----------------|---|---------|-------------------|-----------------------|-------|----|
| | Category of Threat for Entire Carpathians | Category of Threat in Carpathian Countries | | | | | | | Protection in Carpathian Countries | | | | | | | | | | | | | |
| | | A | CZ | H | PL | RO | SK | UA | A | CZ | H | PL | RO | SK | | | | | | | | UA |
| Large Carnivores | | | | | | | | | | | | | | | | | | | | | | |
| <i>Canis lupus</i> Linnaeus, 1758 | VU | EX | CR | CR | VU | VU | VU | VU | | SP | SP | SP | PP | PP | E | + | + | + | | | | |
| <i>Felis sylvestris</i> Schreber, 1777 | EN | | CR | VU | CR | VU | VU | VU | | | PP | SP | SP | SP | | + | + | + | | | | |
| <i>Lutra lutra</i> (Linnaeus, 1758) | VU | | CR | EN | VU | VU | VU | VU | | SP | SP | SP | SP | SP | SP | + | + | | | | | |
| <i>Lynx lynx</i> Linnaeus, 1758 | EN | EX | CR | CR | EN | VU | VU | EN | NP | SP | SP | SP | PP | SP | SP | + | + | + | | | | |
| <i>Ursus arctos</i> Linnaeus, 1758 | EN | | CR | + | EN | + | + | VU | | PP | SP | SP | PP | PP | PP | + | + | + | | | | |
| Large Herbivores | | | | | | | | | | | | | | | | | | | | | | |
| <i>Alces alces</i> (Linnaeus, 1758) | VU | | | | VU | | + | + | | NP | E | | | E | + | | | | | | | |
| <i>Bison bonasus</i> (Linnaeus, 1758) | EN | EW | EW | EW | VU | EW | EW | EN | | NP | SP | | | PP | + | + | | | | | | |
| <i>Bos primigenius</i> Bojanus, 1827 | EX | | | | | | | | | | | | | | | | | | | | | |
| <i>Equus caballus gmelini</i> Antonius, 1912 | EX | | | | | | | | | | | | | | | | | | | | | |
| <i>Rupicapra rupicapra</i> (Linnaeus, 1758) | EN | | | | EN | | EN | EW | | PP | SP | E | | PP | | + | + | + | | | | |
| Small Mammals | | | | | | | | | | | | | | | | | | | | | | |
| <i>Barbastella barbastellus</i> (Schreber, 1774) | VU | | VU | CR | VU | VU | VU | VU | | SP | SP | | | | | + | | + | | | | |
| <i>Castor fiber</i> Linnaeus, 1758 | VU | | | EX | VU | | + | + | | PP | SP | | | | | + | | + | | | | |
| <i>Crocidura leucodon</i> (Hermann, 1780) | VU | | | | + | | VU | VU | | PP | SP | | | | | + | | | | | | |
| <i>Crocidura sauveolens</i> (Pallas, 1811) | VU | | | | + | | EN | VU | | PP | SP | | | | | + | | | | | | |
| <i>Dryomys nitedula</i> Pallas, 1778) | VU | | | | EN | VU | | VU | | PP | SP | | | | | + | | + | | | | |
| <i>Eliomys quercinus</i> (Linnaeus, 1766) | VU | | | | VU | | EN | | | PP | SP | | | | | + | | | | | | |
| <i>Eptesicus nilssonii</i> (Keyserling & Blasius, 1839) | EN | EN | EN | VU | VU | | VU | VU | | PP | SP | | | | | + | | + | | | | |
| <i>Eptesicus serotinus</i> (Schreber, 1774) | VU | | VU | VU | VU | VU | VU | VU | | PP | SP | | | | | + | | + | | | | |
| <i>Erinaceus concolor</i> Martin, 1838 | VU | | | | VU | | VU | | | PP | SP | | | | | + | | + | | | | |
| <i>Erinaceus europaeus</i> Linnaeus, 1758 | VU | + | + | + | VU | VU | + | + | | NP | SP | | | | | + | | | | | | |
| <i>Glis glis</i> (Linnaeus, 1766) | VU | | | | EN | VU | | VU | + | PP | SP | | | | | + | | | | | | |
| <i>Marmota marmota</i> (Linnaeus, 1758) | EN | | | | CR | + | EN | EW | | NP | SP | | | | | + | | | | | | |
| <i>Microtus nivalis</i> (Martins, 1842) | VU | | | | VU | | VU | VU | | NP | SP | | | | | + | | + | | | | |
| <i>Miniopterus schreibersi</i> (Kuhl, 1817) | EN | | EN | EN | EN | VU | VU | + | | SP | SP | | | | | + | | | | | | |
| <i>Muscardinus avellanarius</i> (Linnaeus, 1758) | VU | + | + | EN | VU | + | + | + | | PP | SP | | | | | + | | + | | | | |
| <i>Mustela eversmanni</i> Lesson, 1827 | VU | | | | VU | | | | | PP | SP | | | | | + | | | | | | |

26 | Carpathian List Of Endangered Species

Mammals

| Species | Physiographic Units |
|---|--|
| <i>Eptesicus serotinus</i> (Schreber, 1774) | 514.12, 514.52-53, 522.12 |
| <i>Erinaceus concolor</i> Martin, 1838 | 514.9, 514.12, 514.43, 514.52-53, 515.27 |
| <i>Erinaceus europaeus</i> Linnaeus, 1758 | 513, 514, 515, 516, 517, 522, 523, 524, 525, 526, 531, 532, 533, 541, 542 |
| <i>Glis glis</i> (Linnaeus, 1766) | 513.45, 513.51-52, 513.65, 514.9, 514.12, 514.43, 514.52-53, 515.27, 522.12 |
| <i>Marmota marmota</i> (Linnaeus, 1758) | 514.9, 514.52-53, 531.32 |
| <i>Microtus nivalis</i> (Martins, 1842) | 514.9, 514.53, 522.15, 522.25 |
| <i>Miniopterus schreibersi</i> (Kuhl, 1817) | 514.12, 517.2, 522.15, 522.25 |
| <i>Muscardinus avellanarius</i> (Linnaeus, 1758) | 513, 514, 515, 516, 517, 522, 523, 524, 525, 526, 531.4, 531.11-17, 531.21-26, 531.31, 531.33-37, 532, 533, 541, 542 |
| <i>Mustela lutreola</i> (Linnaeus, 1758) | 522.15, 522.25 |
| <i>Mustela nivalis</i> Linnaeus, 1766 | 513, 514, 515, 516, 517, 522, 523, 524, 525, 526, 531.4, 531.11-17, 531.21-26, 531.31, 531.33-37, 532, 533, 541, 542 |
| <i>Myotis bechsteini</i> (Kuhl, 1818) | 514.9, 514.12, 514.43, 514.52-53, 516.2, 517.2 |
| <i>Myotis blythi</i> (Tomes, 1857) | 514.9, 514.12, 514.52-53, 515.27, 516.2 |
| <i>Myotis brandtii</i> (Eversmann, 1845) | 513.52, 514.52-53, 515.27, 517.2 |
| <i>Myotis capaccinii</i> (Bonaparte, 1837) | 531.4, 531.32, 533, 542.1, 542.21-23 |
| <i>Myotis dasycneme</i> (Boie, 1825) | 514.12, 514.43, 515.27, 517.2, 522.15, 522.25 |
| <i>Myotis daubentonii</i> (Kuhl, 1817) | 513.52, 514.9, 514.12, 514.43, 516.2 |
| <i>Myotis emarginatus</i> (Geoffroy, 1806) | 513.51, 514.12, 516.2, 517.2, 522.12, 522.15, 522.25 |
| <i>Myotis myotis</i> (Borkhausen, 1797) | 513.52, 514.12, 514.52-53, 515.27, 516.2 |
| <i>Myotis mystacinus</i> (Kuhl, 1817) | 513.51-52, 514.9, 514.12, 514.43, 514.52-53, 515.27, 516.2, 517.2, 522.12 |
| <i>Myotis nattereri</i> (Kuhl, 1817) | 513.51, 514.9, 514.12, 514.43, 514.52-53, 515.27, 516.2, 517.2 |
| <i>Nannospalax leucodon</i> Nordmann, 1840 | 522.15, 522.25 |
| <i>Neomys anomalus</i> Cabrera, 1907 | 513, 514, 515, 516, 517, 522, 523, 524, 525, 526, 531, 532, 533, 541, 542 |
| <i>Neomys fodiens</i> (Pennant, 1771) | 513, 514, 515, 516, 517, 522, 523, 524, 525, 526, 531, 532, 533, 541, 542 |
| <i>Nyctalus lasiopterus</i> (Schreber, 1780) | 516.2, 517.2 |
| <i>Nyctalus leisleri</i> (Kuhl, 1817) | 514.52-53, 516.2, 517.2 |
| <i>Nyctalus noctula</i> (Schreber, 1774) | 514.9, 514.12, 514.43, 516.2, 522.12 |
| <i>Pipistrellus kuhlii</i> (Kuhl, 1817) | 513.1, 531.4, 531.32, 533, 542.1 |
| <i>Pipistrellus nathusii</i> (Keyserling & Blasius, 1839) | 513.52 |
| <i>Pipistrellus pipistrellus</i> (Schreber, 1774) | 514.9, 514.12, 516.2, 522.12, 531.32 |
| <i>Pitymys tatricus</i> Kratochvil, 1952 | 513.51, 514.9, 514.43, 514.52-53, 514.71, 514.84, 522.15, 522.25, 531.32 |
| <i>Plecotus auritus</i> (Linnaeus, 1758) | 513.51-52, 514.12, 514.43, 514.52-53, 515.27, 516.2 |
| <i>Plecotus austriacus</i> (Fischer, 1829) | 514.9, 514.12, 516.2 |
| <i>Rhinolophus blasii</i> (Peters, 1866) | 533 |
| <i>Rhinolophus euryale</i> Blasius, 1853 | 516.2, 517.2 |
| <i>Rhinolophus ferrumequinum</i> (Schreber, 1774) | 516.2, 522.25, 523.1 |
| <i>Rhinolophus hipposideros</i> (Bechstein, 1800) | 513.45, 513.51-52, 514.9, 514.12, 514.52-53, 516.2, 522.15, 522.25 |
| <i>Rhinolophus mehelyi</i> (Matschie, 1901) | 513.34, 526, 531.4, 531.32, 532, 533.3, 533.5, 542.1 |
| <i>Sciurus vulgaris</i> Linnaeus, 1758 | 513, 514, 515, 516, 517, 522, 523, 524, 525, 526, 531, 532, 533, 541, 542 |
| <i>Sicista betulina</i> (Pallas, 1778) | 514.9, 514.12, 514.43, 514.52-53, 515.27, 522.12, 522.15, 522.25 |
| <i>Sorex alpinus</i> Schinz, 1837 | 513.51, 514.9, 514.12, 514.43, 514.52-53, 515.27, 522.12, 522.15, 522.25 |
| <i>Spermophilus citellus</i> (Linnaeus, 1766) | 514.9, 515.27, 516.2, 517.2 |
| <i>Vespertilio murinus</i> Linnaeus, 1758 | 513.52, 513.54, 513.71, 514.9, 514.12, 514.52-53, 522.12 |



Birds

by Tomas Ruzicka

A total of 29 birds were selected for this Carpathian List of Endangered Species. Altogether, 7 species are considered critically endangered, 11 endangered and 11 vulnerable. Characteristic species were defined as those species where a significant area of their range falls into the Carpathians, or those for which the Carpathians represent an important refuge in Europe.

According to the 2000 IUCN Red Data List, a total of 1,183 bird species in the world are considered to be vulnerable, endangered or critically endangered. Only two species nesting in the Carpathians are considered to be globally threatened or conservation dependant: the Imperial eagle *Aquila heliaca* and the Corncrake *Crex crex* (IUCN Red Data List 2000, Tucker and Heath 1994).

Eight bird species were identified as flagship species for the Carpathians:

- Imperial eagle *Aquila heliaca*
- Lesser spotted eagle *Aquila pomarina*
- Corncrake *Crex crex*
- White-backed woodpecker *Dendrocopos leucotos*
- Rock thrush *Monticola saxatilis*
- Ural owl *Strix uralensis*
- Capercaillie *Tetrao urogallus*
- Wallcreeper *Tichodroma muraria*

State of Knowledge

In the Czech Republic, Hungary, Poland and Slovakia, knowledge about the distribution of most species is fairly good. In these countries national censuses have been carried out and detailed research undertaken for different species (e.g. birds of prey, Corncrake). The situation in the Ukraine and Romania is different. The relatively small group of qualified ornithologists and the inaccessibility of the mountains contribute to the fact that the precise distribution and density of most bird species is not known; this applies particularly to birds of prey, owls and grouse. However, the Romanian Red List of birds is due to be published in 2003.

Red lists on birds of the Czech Republic date back to 1988, covering the former Czechoslovakia. Similarly, in Hungary the red list was published in 1989. The latest ver-

sion of the Slovakian Red List was published in 1998. New red lists for the Czech Republic, Slovakia and Romania are due to be published in 2003. The Red book for the Ukraine was published in 1994. The latest version of the Polish Red Data Book was recently published (Głowaciński 2001).

The Carpathians are a refuge for nesting species such as the Lesser spotted eagle and the globally threatened Imperial eagle. The region represents a real stronghold for these species, hosting nearly 28–40% (1,500–2,700 pairs) and 20% to 45% (85 pairs) of their European populations, respectively. The dense deciduous and mixed forests provide a home for species such as the White-backed woodpecker and the Ural owl. The population of the White-backed woodpecker in the Carpathians is estimated to include up to 30% (11,400 pairs) of its entire European population. The number of pairs of the Ural owl living in the Carpathians represents nearly 20% (2,285 pairs) of the entire European population (excluding Russia).

It is very difficult to estimate the total Carpathian population of Capercaillie, mainly because of a lack of precise data from Romania and the Ukraine. Nevertheless, the Carpathians, particularly Romania, undoubtedly represent a very important region for the species in Europe. Other noteworthy species of the Carpathian forests include the Black stork *Ciconia nigra*, Grey-headed woodpecker *Picus canus*, Black woodpecker *Dryocopus martius*, Three-toed woodpecker *Picoides tridactylus*, Tengmalm's owl *Aegolius funereus* and Red-breasted flycatcher *Ficedula parva*.

Typical mountain species, such as the Rock thrush and Wallcreeper, also find a valuable habitat in the Carpathians, reaching the northern limit of their range here. Other valuable mountain species include the Water pipit *Anthus spinoletta* (20% of the European population) and the Alpine accentor *Prunella collaris*.

It is not only the forests and mountains which provide a valuable habitat for birds. The globally threatened Corncrake, a species which has been in steep and continuing population decline in Western Europe for the last 20 years, is found in the Carpathian meadows. The Carpathians represent a very important refuge for this species in Europe thanks to extensive agricultural practices.

Interestingly, the Carpathians are an important European stronghold for the steppe species Saker *Falco cherrug* (15% to 25% of the European population, or 80 to 85 pairs, nest in lower ranges and depressions in the Carpathians).

Quite a unique migrating population of a few pairs of Horned Lark (*Eremophila alpestris balcanica*) nest in the Romanian mountains of Munti Cindrel, Bucegi and Parâng (Munteanu and Szabó 2001). It is an isolated and northern most nesting location of this sub-species.

Main Threats to Birds in the Carpathians

Most birds are not dependent on small-sized habitats and can easily move to other similar habitats when their original one changes. Nevertheless, habitat alteration, fragmentation and destruction have been identified as the worst threats, especially for birds of prey, woodpeckers, grouses and Corncrakes. Destruction of old growth forests, which constitute important nesting habitats for most birds of prey, owls and woodpeckers, has particu-

larly adverse effects. On the European scale, extensive beech and fir forests are the most valuable nesting habitats for White-backed, Black and Three-toed woodpeckers, and also for some passerines such as Red-breasted Flycatcher.

The very specific habitat requirements of the Capercaillie — coniferous forests with open areas and undergrowth of Bilberry *Vaccinium myrtillus* — together with intensive forest management practices, pollution by DDT and hunting, has made this species almost extinct in most of the Carpathian countries, and virtually extinct in Hungary. Only in Romania is the Capercaillie still fairly common and hunted.

In addition to habitat destruction, bird crime is also a serious threat, especially for rare birds of prey. Egg collection, stealing chicks for falconry and shooting birds for taxidermy can play a significant role in the decrease of populations of rare birds of prey. Bird crime has been monitored in Slovakia since 1965. Nests of some birds of prey (e.g. Golden eagle *Aquila chrysaetos*, Lesser spotted eagle, Saker) have been guarded there since 1990 resulting in lower numbers of robbed nests, at times a 70% decrease, and the occasional prosecution of robbers. Although data on bird crime from other countries is absent, it is probable that the possible may significantly affect bird of prey populations also in the Ukraine and Romania.

Top predators, such as birds of prey and owls, are especially vulnerable to pollution. Larger bird species are also threatened by collisions, usually fatal, with overhead wires and poorly designed electric poles.

Acknowledgements

The following ornithologists helped the author and provided data and recommendations for the Carpathian List of Endangered Species:

Vojtech Mrlik, Academy of Science, Brno, Czech Republic

Sandor Barati, CEEWEB, Miskolc, Hungary

Zbigniew Głowaciński, Institute of Nature Conservation PAS, Krakow, Poland

Jozef Chavko, State Nature Conservation of Slovak Republic, Bratislava, Slovakia

Atilla Sandor, Retezat National Park, Deva, Romania

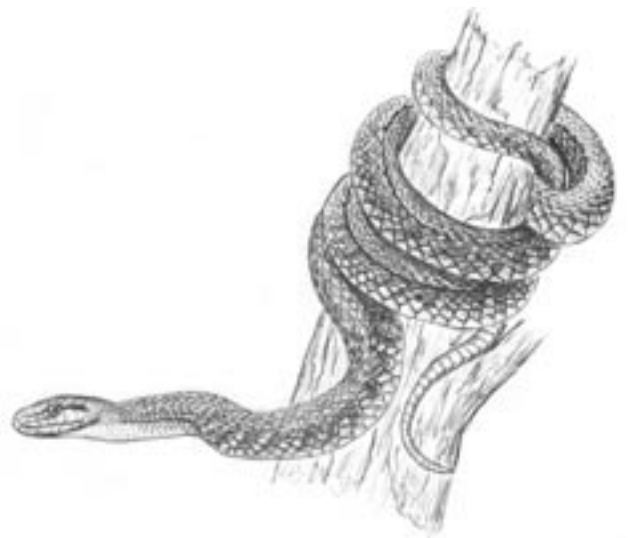
Bohdan Hodovanets, Carpathian Biosphere Reserve, Rakhiv, Ukraine

References

- Anonymus 1991. Materialy ornitofaunistychnykh sposterezhen', zatverdzhennykh Ukrainskoyu rehionalnoyu OFK v 1982–1986 r. Kataloh ornitofauny Zakhidnykh oblastey Ukrainy, Lutsk..
- Anonymus 1993. Materialy ornitofaunistychnykh sposterezhen', zatverdzhennykh Ukrainskoyu rehionalnoyu OFK v 1987–1988 r. Volove ochko – Troglodytes (Kataloh ornitofauny Zakhidnykh oblastey Ukrainy), Lutsk.
- Bartosova D., 2000. History and perspectives of Capercaillie (*Tetrao urogallus* L.) in the protected Landscape Area Beskydy Mountains. Pp. 44–51. In: (P. Málková ed.) Proceedings of the Inter. Conf. Tetraonids – Tetraonidae at the break of millennium. České Budějovice, Czech Republic, 24–26 March 2000.
- Danko Š., Chavko J. 1995. Hniezdenie orla kráľovského (*Aquila heliaca*) na Slovensku v r. 1993 a 1994. Buteo 7: 182–190.
- Del Hoyo, J. Elliott, A. & Sargatal, J. (eds.), 1994. Handbook of the Birds of the World. Vol. 2. New World Vultures to Guinea-fowl. Lynx Edicions. Barcelona.
- Głowaciński Z. (ed.) 2001. Polska czerwona księga zwierząt. Kręgowce. PWRiL, Warszawa.
- Głowaciński Z., Profus P. 1992. Structure and vertical distribution of the breeding bird alliances in the Polish Tatra National Park. Ochrona Przyrody 50: 65–94.
- Hagemeijer W. J. M., Blair M. J. 1997. The EBCC Atlas of European Breeding Birds: Their Distribution and Abundance. T & A D Poyser, London.
- Hilton-Taylor, Craig. (ed.), 2000. IUCN Red List of Threatened Species. IUCN, Species Survival Commission
- Horban' I., Hryshenko V., Vetrov V., Kostin S., Pilyuha V. 1999. Pro chyselnist' khyzzykhyh ptakhiv v Ukraini. Ekolohichni aspekty okhorony ptakhiv (Materialy VII narady ornitolohev Zakhidnoi Ukrainy prysvyachenoi pamyati V. Dzudushynskoho, m. Ivano-Frankivsk, 4–7 lyutoho 1999 r.), Lviv.

Distribution of the Red Data List birds in the Carpathians (for explanations, see chapter on *How to Use This Book*)

| Species | Physiographic Units |
|---|---|
| Aegolius funereus (Linnaeus, 1758) | 513.2, 513.412, 513.43-44, 513.51-52, 513.55-57, 513.71, 514.9, 514.11, 514.13-14, 514.42-43, 514.51-53, 514.62, 514.64, 514.71-74, 514.85, 515.11-14, 515.23-28, 516.2, 516.4a, 522, 523.1-2, 523.51-55 |
| Anthus spinoletta (Linnaeus, 1758) | 513.44-46, 513.51-52, 513.55, 513.71, 514.9, 514.14, 514.42-43, 514.51-53, 514.63, 514.74, 514.84-85, 515.26-29, 522, 523.1-2, 523.31, 523.42-47, 523.51-57, 523.61-63, 523.66, 523.71-73, 524.2-3, 524.5, 525.3, 531.4, 531.11-15, 531.21-22, 531.25-26, 531.31-36, 533.2-3, 533.5, 542.1, 542.21-23, 542.32, 542.34, 542.42 |
| Aquila chrysaetos (Linnaeus, 1758) | 513.55, 513.71, 514.9, 514.11-13, 514.42-43, 514.51-53, 514.63-64, 514.74, 514.84-85, 515.25-29, 516.2, 516.4a, 517.1-2, 522, 523.1-2, 523.31, 523.45-47, 523.51-56, 523.62-64, 523.71-73, 524.3, 524.5-6, 531.4, 531.11, 531.13, 531.15, 531.17, 531.22, 531.25-26, 531.31-36, 533.1, 533.6-7, 541.1-2, 542.1, 542.21-23, 542.31-34, 542.42 |
| Aquila heliaca Saviigny, 1809 | 513.411, 514.2, 514.41-42, 514.81, 514.83, 515.21, 515.28, 516.2, 516.4, 517.1-2, 523.41, 523.51, 523.63-65, 523.71, 523.73, 531.24, 531.32, 541.2-4 |
| Aquila pomarina Brehm, 1831 | 513.411, 513.51, 513.55-57, 513.64-65, 513.71-72, 514.9, 514.11-14, 514.34, 514.41-43, 514.51-53, 514.62-63, 514.71-74, 514.82-85, 515.12-15, 515.21-29, 516.2, 516.4, 516.4a, 516.11, 517.1-2, 522, 523.1-2, 523.31, 523.41, 523.44-47, 523.51-57, 523.62-66, 523.71-73, 524.5-6, 525.1-2, 526.1, 531.4, 531.11-12, 531.16-17, 531.21-26, 531.31-37, 532.1, 532.3, 533.1, 533.3, 533.5-7, 541, 542.1, 542.21-23, 542.31-33, 542.42-43 |
| Bonasa bonasia (Linnaeus, 1758) | 513.31-34, 513.411-412, 513.43-49, 513.51-57, 513.61-65, 513.67-69, 513.71-72, 514.9, 514.11-14, 514.33-34, 514.43, 514.51-53, 514.62-63, 514.71-72, 514.74, 514.82, 514.84-85, 515.11-15, 515.21, 515.23-26, 515.28-29, 516.2, 516.4a, 517.1, 522, 523.1-2, 523.31, 523.42-47, 523.51-57, 523.61-64, 523.66, 524.1-3, 524.5-6, 525.1, 525.3, 526, 531.4, 531.11, 531.13-15, 531.17, 531.21-22, 531.24-26, 531.31-37, 532.3, 533.1-3, 533.5-6, 533.8, 542.1, 542.21-23, 542.31-34, 542.41-42 |
| Caprimulgus europaeus Linnaeus, 1758 | 513.411, 513.44, 513.54, 513.71-72, 514.2, 514.9, 514.11, 514.13, 514.41, 514.43, 514.51-53, 514.71-74, 514.81, 514.85, 515.21-23, 515.25-27, 515.29, 516.2-4, 516.11-14, 517.1-2, 517.4-5, 522.12, 523.51 |
| Charadrius morinellus (Linnaeus, 1758) | 514.12, 514.52-53, 531.25 |
| Ciconia nigra (Linnaeus, 1758) | 513.2, 513.32-34, 513.411-412, 513.43-49, 513.51-57, 513.61-65, 513.67-69, 513.71-72, 514.2, 514.9, 514.11-14, 514.31, 514.33-34, 514.41-43, 514.51-53, 514.62-64, 514.71-74, 514.81-85, 515.12-15, 515.17, 515.21-29, 516, 517.1-2, 517.4-5, 522.11-12, 523.1-2, 523.31, 523.41, 523.44, 523.46, 523.51, 523.62-65, 523.71-73, 524.5-6, 525.2, 526.2, 531.17, 531.22, 531.24-26, 531.32, 531.35, 531.37, 532.1, 532.3, 533.1, 533.3, 541, 542.1, 542.21-23, 542.32-34, 542.42 |
| Crex crex (Linnaeus, 1758) | 513.2, 513.31-34, 513.411-412, 513.43-49, 513.51-57, 513.61-65, 513.67-69, 513.71-72, 514, 515, 516, 517.1, 517.4-5, 522.11-12, 522.24, 523.2, 523.31, 523.41-42, 523.45, 523.51, 523.63-65, 523.71-73, 524.1, 524.5-6, 525.2, 526, 531.16-17, 531.23-26, 531.31-32, 531.35, 531.37, 532.1, 532.3, 533.1, 533.4, 533.7, 533.7a, 541, 542.21, 542.23, 542.32, 542.42-43 |
| Dendrocopos leucotos (Bechstein, 1803) | 513.2, 513.31, 513.411-412, 513.43-44, 513.49, 513.51-52, 513.55-57, 513.61, 513.71-72, 514.2, 514.9, 514.13-14, 514.32-34, 514.41-43, 514.51-52, 514.62-64, 514.71, 514.73-74, 514.81-85, 515.11-15, 515.21-28, 516.2, 516.4, 516.4a, 516.14, 517.1-2, 517.4-5, 522, 523.1-2, 523.31, 523.42, 523.44-46, 523.51-55, 523.57, 523.62-64, 523.71-72, 524.3, 524.6, 525.1, 531.15, 531.24-26, 531.31-33, 541.3-4, 542.1, 542.22-23, 542.33, 542.42 |
| Emberiza cia Linnaeus, 1766 | 514.2, 514.51, 515.26, 515.28, 516.2, 517.1, 517.4-5, 523.31, 523.42, 523.45, 523.47, 523.51, 523.62, 523.66, 524.3, 524.5, 531.11, 531.13-15, 531.17, 531.22, 531.25-26, 531.32-33, 531.35-36, 533.1, 533.6-7, 542.1, 542.21-23, 542.41-42 |
| Eremophila alpestris (Linnaeus, 1785) | 513.11, 531.22, 531.25 |
| Falco cherrug Gray, 1834 | 513.1, 514.2, 514.41-42, 514.81, 515.26, 515.28, 516.2-4, 517.1-2, 517.4-5, 531.37, 533.1, 542.21 |
| Falco peregrinus Tunstall, 1771 | 514.2, 514.9, 514.12, 514.42-43, 514.51-53, 514.63, 514.82, 514.85, 515.26, 516.2, 517.1-2, 517.4-5, 522, 523.1-2, 523.31, 523.45-46, 523.51-55, 523.62-63, 523.71, 524.3, 531.22, 531.31-32, 532.3, 533.1, 541.4, 542.1, 542.22-23, 542.33, 542.42 |
| Ficedula parva (Bechstein, 1794) | 513.2, 513.32-34, 513.411-412, 513.42-49, 513.51-57, 513.61-65, 513.67-69, 513.71-72, 514.2, 514.11-14, 514.32-34, 514.41, 514.43, 514.52-53, 514.63-64, 514.71, 514.74, 514.84-85, 515.12-15, 515.23, 515.25-28, 516.2, 516.4, 516.4a, 516.11-12, 516.14, 517.1-2, 517.5, 522, 523.1-2, 523.31, 523.42-43, 523.45-46, 523.51-57, 523.61, 523.64, 523.71-73, 524.1, 524.3, 525, 526.2, 531.4, 531.11, 531.13, 531.16-17, 531.24-26, 531.32, 531.34-35, 531.37, 532.1, 532.3, 533.2-3, 533.6-7, 533.8, 541.1, 541.3-4, 542.1, 542.21, 542.23, 542.32-33, 542.42-43 |
| Glaucidium passerinum (Linnaeus, 1758) | 513.32-34, 513.412, 513.43-49, 513.51-57, 513.61-65, 513.67-69, 513.71, 514.9, 514.11-14, 514.33-34, 514.43, 514.51-53, 514.62-64, 514.71-74, 514.82, 514.84-85, 515.11-15, 515.23-29, 516.2, 516.4, 516.4a, 522, 523.1-2, 523.51-55 |
| Hieraaetus pennatus (Gmelin, 1788) | 517.1, 522.13-16, 522.21-25, 523.51 |
| Lullula arborea (Linnaeus, 1758) | 513.1, 513.52, 513.55-56, 513.71-72, 514.2, 514.9, 514.41-42, 514.51, 514.62, 514.64, 514.73, 514.81, 514.83-85, 515.11-12, 515.14, 515.21-26, 515.28-29, 516, 517.1-2, 517.4-5, 522, 523.1-2, 523.51-55 |
| Monticola saxatilis (Linnaeus, 1766) | 514.2, 514.41-43, 514.52, 514.63, 514.85, 515.25-26, 515.28, 516.2, 517.2, 517.5, 522.12, 522.24-25, 523.51, 523.66, 524.2-3, 531.12-13, 531.17, 531.22, 531.24, 531.31-33, 531.35, 531.37, 532.3, 533.1, 533.6-7, 541.1, 542.1, 542.21-23, 542.31, 542.33, 542.42 |
| Otus scops (Linnaeus, 1758) | 513.411, 515.25, 516.2-4, 516.12, 516.14, 517.1, 517.4-5, 522, 523.1-2, 523.51-55 |
| Picoides tridactylus (Linnaeus, 1758) | 513.32-34, 513.412, 513.43-49, 513.51-57, 513.61-65, 513.67-69, 513.71, 514.9, 514.11-14, 514.42-43, 514.51-53, 514.62-64, 514.71-74, 514.84-85, 515.11-15, 515.23-28, 516.2, 516.4, 522, 523.1-2, 523.31, 523.42-47, 523.51-57, 523.61-66, 523.71-72, 524.1-3, 524.5-6, 525.1, 525.3, 531.4, 531.13-17, 531.21, 531.23-26, 531.31-34, 531.36-37, 533.3, 533.5, 541.1, 541.4, 542.1, 542.21-23, 542.31, 542.33-34, 542.41-42 |
| Picus canus Gmelin, 1758 | 513.2, 513.31-34, 513.411-412, 513.43-45, 513.47-49, 513.51-52, 513.54-57, 513.61-65, 513.68-69, 513.71-72, 514, 515.11-14, 515.17, 515.21-29, 516, 517.1-2, 517.4-5, 522, 523.1-2, 523.31, 523.41-42, 523.45-46, 523.51-57, 523.61-66, 523.71-73, 524, 525, 526, 531.4, 531.11-13, 531.16-17, 531.21-26, 531.31-37, 532.1, 532.3, 533, 541, 542.1, 542.21-23, 542.31-33, 542.41-43 |
| Prunella collaris (Scopoli, 1769) | 513.51, 513.56-57, 514.9, 514.13, 514.43, 514.51-53, 514.63, 514.71-72, 514.84-85, 515.26, 522.12, 522.15, 522.24-25, 523.1, 523.31, 523.42, 523.45, 523.56, 523.62, 524.3, 524.5, 525.3, 531.11, 531.13-15, 531.22, 531.25, 531.32-34, 542.1, 542.23 |
| Scolopax rusticola Linnaeus, 1758 | 513.2, 513.31-34, 513.411-412, 513.42-49, 513.51-57, 513.61-65, 513.67-69, 513.71-72, 514.2, 514.9, 514.12, 514.14, 514.32-34, 514.41-43, 514.51-53, 514.62-64, 514.71-74, 514.81-85, 515.12-15, 515.17, 515.21-26, 515.28-29, 516.2-4, 516.4a, 516.11-13, 517.1, 517.5, 522, 523.1-2, 523.51-55 |
| Strix uralensis Pallas, 1771 | 513.32-34, 513.44-49, 513.51-55, 513.57, 513.61-65, 513.67-69, 513.71-72, 514.9, 514.11-14, 514.43, 514.51-53, 514.62, 514.64, 514.71-72, 514.85, 515.11-13, 515.23-29, 516.2, 516.4, 516.4a, 517.1-2, 522, 523.1-2, 523.31, 523.42, 523.45-47, 523.51-55, 523.57, 523.62-66, 523.71-73, 524.1, 524.3, 524.5-6, 525.1-2, 531.4, 531.11-14, 531.17, 531.21-22, 531.24-26, 531.31-34, 531.36-37, 532.1, 532.3, 533.6-7, 541.1, 541.3-4, 542.1, 542.21-23, 542.33, 542.42 |
| Tetrao tetrix Linnaeus, 1758 | 513.45-46, 513.49, 513.51-52, 513.54-55, 514.9, 514.11, 514.13, 514.42-43, 514.51-53, 514.72-74, 514.84-85, 515.25-29, 516.4a |
| Tetrao urogallus Linnaeus, 1758 | 513.412, 513.44, 513.51, 513.56-57, 514.9, 514.11, 514.13-14, 514.42-43, 514.51-53, 514.63-64, 514.71-74, 514.82, 514.84-85, 515.11-13, 515.23-24, 515.26-28, 522.13, 522.15-16, 522.24-25, 523.1-2, 523.31, 523.42-47, 523.56-57, 523.61-66, 523.72, 524.1-3, 524.5-6, 525.1, 525.3, 526.2, 531.4, 531.11, 531.13-15, 531.17, 531.21-22, 531.24-26, 531.32-37, 532.1, 532.3, 533.2-3, 533.5-6, 533.8, 542.1, 542.21-23, 542.31, 542.33-34, 542.41-42 |
| Tichodroma muraria (Linnaeus, 1766) | 513.52, 513.54, 514.9, 514.12, 514.14, 514.42-43, 514.51-53, 514.63, 514.84-85, 516.2, 523.31, 523.45, 523.47, 523.56, 523.66, 524.3, 531.11, 531.13, 531.15, 531.21-22, 531.24-26, 531.32-37, 533.5-6, 542.1, 542.21, 542.23, 542.42 |



Reptiles and Amphibians

by Mojmir Vlašín

Detailed knowledge about the distribution of most species of reptiles and amphibians is not very good. In most countries, national censuses have not been carried out. However, red lists are available in all countries. New red lists for some countries are due to be published.

Out of a total of 31 reptile and amphibian species recorded in the Carpathians, 17 species have been recognized as endangered and/or characteristic for the region. Only one reptile and one amphibian species were selected as flagship species.

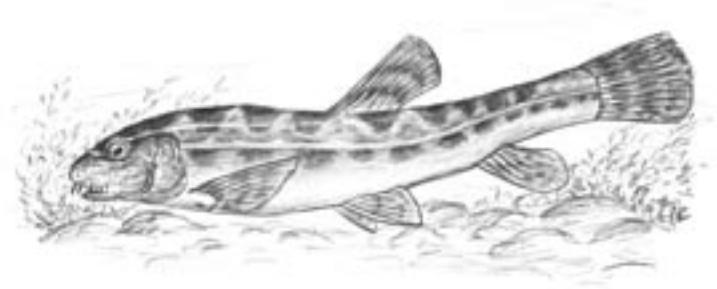
The Aesculapian snake *Elaphe longissima* is the longest Carpathian snake reaching up to 2m. The body is relatively slender, smooth, and in old specimens, slightly keeled. Although mostly terrestrial, it is a good climber. It hibernates in rocky crevices, in rodent burrows, manure and in the cellars of ruins. In most states in the Carpathian region it is classified as a critically endangered species. It is protected within the EU *Habitat Directive* (Annex 4) and the *Bern Convention* (Annex 2).

The Carpathian newt *Triturus montandoni* is a small newt reaching a maximum length of 10 cm (although it is usually smaller). The head is relatively flat and wide with 3 grooves. The back is sand–yellow to dark brown and sometimes greenish. The belly is always uniformly yellow to orange. The tail has pale streaks on the sides and its lower edge is orange with black spots. This newt is endemic to the Carpathians and inhabits humid, shaded slopes in deciduous forests. Although it mostly lives under stones, woods and leaves, the species reproduces in small water bodies near springs on wet meadows. Due to its endemism in the Carpathian region and environs, it is not mentioned in the EU's *Habitat Directive* but it is protected by the *Bern Convention* (Annex 2). In most Carpathian states it is protected as an endangered species.

The following reptiles and amphibians, found in the Carpathians, can be selected as species of particular interest: Green lizard *Lacerta viridis*, Moor frog *Rana arvalis*, Fire-bellied toad *Bombina variegata*, European tree frog *Hyla arborea* and Swamp turtle *Emys orbicularis*.

Main Threats for Reptiles and Amphibians

The main threat for reptiles is the deterioration of habitats including clear-cutting, drainage and habitat fragmentation in general. Similar factors pose the greatest threats for



Fishes and Lampreys

by Krzysztof Kukuła and Judit Sandor

The waters of the Carpathians are mainly fast-flowing mountain rivers and streams with a bedrock bottom. River slope ranges between less than 10‰ to over 100‰. The occurrence of macrophytes is rather restricted, due in part to fast currents and considerable changes in water level. Such hydrological conditions determine fish composition, with the dominant share of rheophilous species. Fish preferring a bedrock bottom are a characteristic group.

State of knowledge

For the past several decades, studies on the Carpathian ichthyofauna have been carried out with varying intensity. Relatively extensive data is available from the Polish (eg. Rolik 1971; Bieniarz, Epler 1972; Skóra, Włodek 1988, 1989, 1991; Starmach et al. 1988; Kukuła 1999; Włodek, Skóra 1999), Czech and Slovakian parts of the range (Weisz, Kux 1959; Kux, Weisz 1964; Holčík 1966, 1996; Holčík, Hensel 1972; Kirka et al. 1976, 1981; Baruš et al. 1981; Koščo, Košuth 1995a, 1995b).

Threats for Fishes and Lampreys

The impact of anthropogenic changes on ichthyofauna is evident in a number of river catchment basins of the Carpathians. Data gathered in the 1980s and 1990s points to increasing threats including: pollution, changes in river beds caused by hydrotechnical constructions (dams), poaching, extensive angling pressure and introduction of alien fish species (Lelek 1987; Witkowski 1992, 1996; Schiemer, Waidbacher 1992; Banarescu 1993; Lusk 1996; Sych 1996; Starmach 1998; Amirowicz 2001; Kukuła 2001). In the 1990s, comprehensive research into fish conservation began in the region. Red lists for most threatened species were also drawn up (Głowaciński 1992, 2001; Witkowski 1995, 2001; Holčík 1996; Lusk, Hanel 1996; Witkowski et al. 1999).

The greatest numbers of threatened fish species belong to Cyprinids *Cypriniformes*. Particularly alarming is a strong decrease in those fish that were once dominant species in the Carpathian rivers, for instance, Common barbel *Barbus barbus* and Nase *Chondrostoma nasus*. The population of anadromic Vimba *Vimba vimba* has also decreased markedly.

Migratory fish are particularly affected by anthropogenic alternations of the environment. Hydrotechnical constructions isolate them from their spawning grounds which in many cases are additionally degraded by pollution. For these reasons, Atlantic sturgeon *Acipenser sturio*, Atlantic salmon *Salmo salar* and probably also Sea trout *Salmo trutta m. trutta* can be classified in this list as extinct species in the Carpathians.

Acknowledgements

Dr A. Amirowicz, Institute of Freshwater Biology Polish Academy of Sciences, helped in determining the category of threat of some species in the Polish Carpathians.

References

- Amirowicz A. 2001. Zagrożone gatunki ryb i minogów w ichtiofaunie województw małopolskiego i śląskiego. *Roczniki Naukowe PZW*, 14: 249–296.
- Banarescu P. 1993. Considerations on the threatened freshwater fishes of Europe. *Ocot. Nat. Med. Inconj.*, 37: 87–98.
- Baruš V., Lusk S., Gajdušek J. 1981. Fauna ryb a její zachování v Československu. *Památky a příroda* 1981: 619–623.
- Bieniarz K., Epler P. 1972. Ichtiofauna niektórych rzek Polski Południowej. *Acta Hydrobiol.*, 14: 419–444.
- Brylińska M. (ed.) 2000. *Ryby słodkowodne Polski*. PWN, Warszawa.
- Głowaciński Z. (red.) 1992. *Czerwona lista zwierząt ginących i zagrożonych w Polsce*. PWRiL, Warszawa – Kraków.
- Głowaciński Z. (red.) 2001. *Polska czerwona księga zwierząt. Kręgowce*. PWRiL, Warszawa.
- Holčík J. 1966. Vývoj a formovanie ichtyofauny v Oravskej priehrade. *Biol. Prace*, 12: 5–79.
- Holčík J. 1996. Vanishing freshwater fish species of Slovakia. In: (A. Kirchhofer, D. Hefti eds.), *Conservation of endangered freshwater fish in Europe* 79–88, Bern.
- Kirka A., Bastl I., Holčík J. 1976. Ichthyocenozy povodia Vahu v oblasti nadsze Liptowska Mara, prognoza formovania jej ichtyofauny a návrhy na prvotne zarybnenie. *Biol. Prace*, 22: 9–79.
- Kirka A., Mészáros J., Nagy Š. 1981. Ichthyocenozy a bentos v riekach Východého Slovenska vo flyšovom pásme. *Poľnohospodárska Veda*. A: 1.
- Koščo J., Košuth P. 1995a. Ichtiofauna potoków zasilających zbiornik zaporowy Starina. *Roczniki Bieszczadzkie*, 4: 143–154.
- Koščo J., Košuth P. 1995b. Ichtiofauna Stuzicy i dopływów Ublianki. *Roczniki Bieszczadzkie*, 4: 155–162.
- Kukuła K. 1999. Ichthyofauna of the upper San drainage basin. *Arch. Ryb. Pol.*, 7: 307–319.
- Kukuła K. 2001. Zagrożone gatunki ryb i minogów w województwie podkarpackim. *Roczniki Naukowe PZW*, 14: 235–248.
- Kux Z., Weisz T. 1964. Příspevek k poznání ichtyofauny slovenských řek. *Časopis Moravského Musea*, 49: 191–246.
- Lelek A. 1987. Threatened fishes of Europe. In: Europe (J. Holčík ed.) *The freshwater fishes of Europe*. Vol. 9, Aula – Verlag GmbH, Wiesbaden.
- Lusk S. 1996. The status of the fish fauna in the Czech Republic In: (A. Kirchhofer D. Hefti eds.), *Conservation of endangered freshwater fish in Europe*, 89–98, Bern.
- Lusk S., Hanel L. 1996. Cervený seznam mihuli a ryb České Republiky – verze 1995. *Biodiverzita ichtyofauny*, 1: 16–25.
- Rolik H. 1971. Ichtiofauna dorzecza górnego i środkowego Sanu. *Fragm. Faun.*, 21: 559–584.
- Schiemer F., Waidbacher H. 1992. Strategies for conservation of a Danubian fish fauna. In: (P.J. Boon, P. Calow, G.A. Petts eds.), *River conservation and management* John Wiley & Sons Ltd, London.
- Skóra S., Włodek J.M. 1988. Ichtiofauna rzeki Soły i jej dopływów. *Roczniki Naukowe PZW*, 1: 97–121.
- Skóra S., Włodek J. M. 1989. Ichtiofauna dorzecza górnego Wisłoka. *Studia Ośr. Dokument. Fizjograf.*, 17: 321–344.
- Skóra S., Włodek J. M. 1991. Ichtiofauna dorzecza rzeki Skawy. *Roczniki Naukowe PZW*, 4: 47–64.
- Starmach J. 1998. Ichthyofauna of the River Dunajec in the region of the Czorsztyń - Niedzica and Sromowce Wyżne dam reservoirs (southern Poland). *Acta Hydrobiol.*, 40: 199–205.
- Starmach J., Jelonek M., Mazurkiewicz G., Fleituch T., Amirowicz A. 1988 – Ocena aktualnego stanu ichtyofauny i możliwości produkcyjnych dorzecza rzeki Raby. 1. Biologiczno-rybacka charakterystyka górnego odcinka rzeki Raby i jej dopływów. *Roczniki Naukowe PZW* 1: 75–96.
- Sych R. 1996. O projekcie restytucji ryb wędrownych w Polsce. *Zoologica Poloniae*, 41 (Suppl.): 47–59.
- Weisz T., Kux Z. 1959. Příspevek k poznání ichtyofauny řek Laborce, Tople a Poprad. *Časopis Moravského musea*, 44: 119–138.
- Witkowski A. 1992. Threats and protection of freshwater fishes in Poland. *Netherl. J. Zool.* 42: 243 – 259.
- Witkowski A. 1995. Stan obecny i perspektywy ochrony minogów *Petromyzonidae* w Polsce. *Chrońmy Przyr. Ojcz.*, 51: 19–29.
- Witkowski A. 1996. Zmiany w ichtiofaunie polskich rzek: gatunki rodzime i introdukowane. *Zoologica Poloniae*, 41 (suppl.): 29–40.
- Witkowski A. 2001. Zarys historii ochrony gatunkowej ryb w Polsce. *Roczniki Naukowe PZW*, 14: 45–54.
- Witkowski A., Błachuta J., Kotusz J., Heese T. 1999. Czerwona lista słodkowodnej ichtyofauny Polski. *Chrońmy Przyr. Ojcz.*, 55: 5 – 19.
- Włodek J.M., Skóra S. 1999. Badania ichtyofaunistyczne w rzece i dorzeczu Wisłoki w latach 1994–1995. *Roczniki Naukowe PZW*, 12: 29–60.

Carpathian List of Endangered Species – fishes and lampreys (for explanations, see chapter on *How to Use This Book*)

| Species | Category of Threat for Entire Carpathians | Category of Threat in Carpathian Countries | | | | | | | Protection in Carpathian Countries | | | | | | | Arctic/Alpine | Bern Convention | Carpathian hold large proportion of world population | Endemic | Habitat Directive | High Mountain Species | Relic | | | | | | | | | | | | |
|--|---|--|----|---|----|----|----|----|------------------------------------|----|---|----|----|----|----|---------------|-----------------|--|---------|-------------------|-----------------------|-------|---|---|---|--|--|--|--|--|--|--|--|--|
| | | A | CZ | H | PL | RO | SK | UA | A | CZ | H | PL | RO | SK | UA | | | | | | | | | | | | | | | | | | | |
| | | Fishes | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Acipenser ruthenus</i> Linnaeus, 1758 | VU | | | + | | VU | + | VU | | | | | | | | PP | | SP | | + | | | | | | | | | | | | | | |
| <i>Acipenser sturio</i> Linnaeus, 1758 | EX | | EX | | EX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Alburnoides bipunctatus</i> Bloch, 1782 | CR | | VU | + | CR | + | VU | + | | | | | | | PP | PP | SP | | SP | PP | | + | | | | | | | | | | | | |
| <i>Barbus barbus</i> Linnaeus, 1758 | VU | | VU | + | VU | + | + | + | | | | | | | PP | PP | PP | | | | | | | + | | | | | | | | | | |
| <i>Barbus peloponnesius</i> Valenciennes, 1842 | VU | | | | CR | VU | + | VU | + | | | | | | | PP | PP | | SP | | | | + | | | | | | | | | | | |
| <i>Chondrostoma nasus</i> Linnaeus, 1758 | EN | | CR | + | VU | + | + | + | | | | | | | PP | PP | PP | | SP | PP | | + | | | | | | | | | | | | |
| <i>Cobitis taenia</i> Linnaeus, 1758 | EN | | EN | + | VU | + | CR | + | | | | | | | | PP | SP | | SP | PP | | + | | | | | | | | | | | | |
| <i>Cottus gobio</i> Linnaeus, 1758 | VU | | VU | + | VU | + | + | + | | | | | | | PP | PP | NP | | | | | | | | + | | | | | | | | | |
| <i>Cottus poecilopus</i> Heckel, 1836 | VU | | VU | + | EN | + | + | + | | | | | | | PP | PP | SP | | SP | PP | | + | | | | | | | | | | | | |
| <i>Gobio kessleri</i> Dybowski, 1862 | EN | | CR | + | + | + | CR | + | | | | | | | PP | SP | | | SP | | | + | | | | | | | | | | | | |
| <i>Gobio uranoscopus</i> Agassiz, 1828 | EN | | + | + | | CR | + | | | | | | | | PP | | | | SP | SP | | + | | | | | | | | | | | | |
| <i>Gymnocephalus baloni</i> Holcik & Hensel, 1974 | EN | | | + | | | | EN | | | | | | | | | | | SP | | | + | | | | | | | | | | | | |
| <i>Gymnocephalus schraetzer</i> Linnaeus, 1758 | EN | | CR | + | | EN | EN | VU | | | | | | | PP | | PP | SP | SP | SP | | + | | + | | | | | | | | | | |
| <i>Hucho hucho</i> Linnaeus, 1758 | CR | | EX | + | EW | EN | CR | EN | | | | | | | SP | PP | PP | | PP | PP | | + | | | | | | | | | | | | |
| <i>Leuciscus souffia</i> Risso, 1826 | VU | | | + | | + | + | VU | | | | | | | PP | | | | | | | | | | + | | | | | | | | | |
| <i>Lota lota</i> Linnaeus, 1758 | VU | | VU | + | VU | + | + | + | | | | | | | PP | | PP | | | | | | | | | | | | | | | | | |
| <i>Phoxinus phoxinus</i> Linnaeus, 1758 | VU | | VU | + | VU | + | VU | + | | | | | | | PP | PP | SP | | | | | | | | | | | | | | | | | |
| <i>Proterorhinus marmoratus</i> Pallas, 1814 | VU | | | + | | | | VU | | | | | | | | | | | SP | | | + | | | | | | | | | | | | |
| <i>Rhodeus sericeus</i> (Pallas, 1776) | EN | | | + | EN | + | + | + | | | | | | | | | | | SP | | | + | | | | | | | | | | | | |
| <i>Romanichthys valsanicola</i> Dumitrescu et Banarescu & Stoica, 1957 | EN | | | | | | EN | | | | | | | | | | | | PP | | | + | | | | | | | | | | | | |
| <i>Sabanejewia aurata</i> (Filippi, 1865) | EN | | CR | + | EN | + | EN | + | | | | | | | PP | PP | SP | | SP | PP | | + | | | + | | | | | | | | | |
| <i>Sabanejewia romanica</i> Bacescu, 1943 | VU | | | | | | + | | | | | | | | | | | | | | | + | | | | | | | | | | | | |
| <i>Salmo salar</i> Linnaeus, 1758 | EX | | EX | | EX | | | | | | | | | | | | | | PP | | | | | | + | | | | | | | | | |
| <i>Thymallus thymallus</i> Linnaeus, 1758 | VU | | + | + | VU | + | + | VU | | | | | | | PP | PP | PP | | SP | SP | | + | | | + | | | | | | | | | |
| <i>Vimba vimba</i> Linnaeus, 1758 | CR | | EN | + | CR | + | + | + | | | | | | | | PP | | | SP | PP | | + | | | | | | | | | | | | |
| <i>Zingel streber</i> Siebold, 1863 | EN | | EX | + | | EN | CR | + | | | | | | | | PP | | PP | SP | SP | | + | | | | | | | | | | | | |
| <i>Zingel zingel</i> Linnaeus, 1758 | EN | | | + | | EN | + | + | | | | | | | PP | | PP | | SP | SP | | + | | | | | | | | | | | | |

Lampreys

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|----|--|----|---|----|---|----|---|--|--|--|--|--|--|----|----|--|--|----|----|----|--|---|--|--|--|--|--|--|--|--|--|--|--|
| <i>Eudontomyzon danfordi</i> Regan, 1911 | EN | | | + | + | + | CR | + | | | | | | | SP | | | | SP | SP | | | + | | | | | | | | | | | |
| <i>Eudontomyzon mariae</i> Berg, 1931 | EN | | CR | + | EN | + | + | + | | | | | | | SP | SP | | | | SP | SP | | + | | | | | | | | | | | |
| <i>Lampetra planeri</i> Bloch, 1784 | EN | | EN | | VU | | CR | + | | | | | | | | SP | | | | SP | SP | | + | | | | | | | | | | | |

Distribution of the Red Data List fishes and lampreys in the Carpathians (for explanations, see chapter on *How to Use This Book*)

| Species | Physiographic Units |
|--|---|
| Fishes | |
| <i>Acipenser ruthenus</i> Linnaeus, 1758 | 516.4, 517.1, 517.5, 523.51-52, 523.54, 541, 542.34 |
| <i>Alburnoides bipunctatus</i> Bloch, 1782 | 513.33-34, 513.411-412, 513.43-44, 513.46-49, 513.51-52, 513.54-57, 513.61-65, 513.67-69, 513.71-72, 514.2, 514.9, 514.12-13, 514.32-34, 514.43, 514.62, 514.64, 514.71-74, 514.81-82, 514.84-85, 515.11-15, 515.17, 515.21-23, 515.25-29, 516, 517, 522.11-12, 522.21-23, 523.2, 523.41, 523.51-53, 523.61, 523.65, 523.71-73, 524.4, 526.1, 531.4, 531.12, 531.16-17, 531.23, 531.31, 531.35, 532.1-2, 533.1, 533.4, 533.7, 533.7a, 541, 542.1, 542.32, 542.34, 542.43 |
| <i>Barbus barbus</i> Linnaeus, 1758 | 513.32-34, 513.411-412, 513.43-44, 513.46-47, 513.53-57, 513.61-65, 513.67, 513.71-72, 514.2, 514.9, 514.11-13, 514.31-34, 514.41-43, 514.62, 514.71-74, 514.81-85, 515.11-15, 515.17, 515.21-22, 515.26, 515.28-29, 516, 517, 522.12, 523.2, 523.31, 523.41, 523.43, 523.46, 523.51, 523.56, 523.61-66, 523.71-73, 524.1, 524.4-6, 525.1-2, 526, 531.4, 531.11-13, 531.16-17, 531.21-26, 531.31-33, 531.35-37, 532.1-2, 533.1-7, 533.7a, 541, 542 |
| <i>Barbus peloponnesius</i> Valenciennes, 1842 | 513.32-34, 513.45-49, 513.51-55, 513.61-65, 513.67-69, 513.71-72, 514.9, 514.12-13, 514.72-74, 514.84-85, 515.12-15, 515.17, 515.21, 515.25-29, 516, 517, 522.11-12, 523.2, 523.31, 523.41, 523.43, 523.46, 523.51, 523.56, 523.61-66, 523.71-73, 524.1, 524.4-6, 525.1-2, 526.1, 531.4, 531.11-13, 531.16-17, 531.21-26, 531.31-33, 531.35-37, 532.1-2, 533.1-7, 533.7a, 541, 542 |
| <i>Chondrostoma nasus</i> Linnaeus, 1758 | 513.32-34, 513.411-412, 513.44, 513.46-49, 513.52-57, 513.61-65, 513.67-68, 513.71-72, 514.2, 514.9, 514.11-12, 514.31-34, 514.42-43, 514.62, 514.64, 514.71-74, 514.82, 514.85, 515.12-15, 515.17, 515.21-22, 515.25-28, 516.2-4, 516.11-14, 517, 522.11-12, 522.21-25, 523.1-2, 523.31, 523.41, 523.43, 523.46, 523.51-53, 523.56, 523.61-66, 523.71-73, 524.1, 524.4-6, 525.1-2, 526.1, 531.4, 531.11-13, 531.16-17, 531.21-26, 531.31-33, 531.35-37, 532.1-2, 533.1-7, 533.7a, 541, 542 |
| <i>Cobitis taenia</i> Linnaeus, 1758 | 513.32-34, 513.411-412, 513.46, 513.55, 513.61-62, 513.64-65, 513.71-72, 514.11, 514.62, 514.64, 514.72-74, 514.85, 515.15, 515.25-26, 515.28, 516.2-4, 516.12-14, 517.1-2, 517.4, 522.11-12, 522.21-23, 523.51-53, 526.2, 531.17, 531.35, 531.37, 533.1, 533.6, 533.7a |
| <i>Cottus gobio</i> Linnaeus, 1758 | 513.32-34, 513.411-412, 513.44-49, 513.51-57, 513.61-65, 513.67-69, 513.71-72, 514.2, 514.9, 514.11-13, 514.32-34, 514.42-43, 514.62, 514.64, 514.71-74, 514.82, 514.85, 515.11-14, 515.25-29, 516.4, 516.4a, 516.13, 517.5, 522.11-12, 523.1-2, 523.31, 523.41-43, 523.45-47, 523.51, 523.55-57, 523.61-66, 523.71-73, 524, 525, 526.1, 531, 532.1, 533.1-3, 533.5-7, 533.7a, 533.8, 541, 542.1, 542.21-23, 542.31-34, 542.41-42 |

38 | Carpathian List Of Endangered Species

Fishes and Lampreys

| Species | Physiographic Units |
|--|--|
| Cottus poecilopus Heckel, 1836 | 513.411-412, 513.44-49, 513.51-52, 513.54-57, 513.67-69, 513.71-72, 514.2, 514.9, 514.11-13, 514.32-34, 514.41-43, 514.51-53, 514.62-64, 514.71-74, 514.82, 514.84-85, 515.11-15, 515.17, 515.23-29, 516.2, 516.4, 516.4a, 516.12, 516.14, 517.1, 517.3, 522.11-13, 522.15, 522.23-25, 523.1-2, 523.31, 523.41-43, 523.45-47, 523.51, 523.55-57, 523.61-66, 523.71-73, 524, 525, 526.1, 531, 532.1, 533.1-3, 533.5-7, 533.7a, 533.8, 541, 542.1, 542.21-23, 542.31-34, 542.41-42 |
| Gobio kessleri Dybowski, 1862 | 513.33, 513.44, 513.55, 513.64-65, 513.72, 514.11, 515.12-14, 516.2-4, 516.12-14, 522.11-12, 523.51, 523.73, 526.1, 532.1, 533.7, 541, 542.34, 542.43 |
| Gobio uranoscopus Agassiz, 1828 | 513.411, 513.55, 513.57, 513.72, 514.32, 514.72, 514.74, 514.85, 516.2-4, 517.5, 522.23, 523.1-2, 523.31, 523.41-43, 523.45-47, 523.51, 523.53, 523.55-57, 523.61-66, 523.71-73, 524, 525, 526.1, 531, 532.1, 533.1-3, 533.5-7, 533.7a, 533.8, 541, 542.1, 542.21-23, 542.31-34, 542.41-42 |
| Gymnocephalus baloni Holcik & Hensel, 1974 | 516.12-13 |
| Gymnocephalus schraetzer Linnaeus, 1758 | 514.31, 514.64, 515.15, 515.21, 516.2-3, 516.12-13, 517.5, 522.22, 523.53, 523.73, 541, 542.43 |
| Hucho hucho Linnaeus, 1758 | 513.411-412, 513.54-57, 513.64-65, 514.9, 514.11-13, 514.31-34, 514.43, 514.51, 514.62, 514.64, 514.71-72, 514.74, 514.85, 515.12-15, 515.22, 515.25-26, 515.28, 517.1, 517.5, 522.23-25, 523.1-2, 523.43, 523.46-47, 523.57, 523.61-62, 523.71-72, 524.1, 524.3, 524.5, 526.1, 531.14, 531.24, 541, 542.33-34 |
| Leuciscus souffia Risso, 1826 | 517.1, 522.22-23, 523.1-2, 523.31, 523.43, 523.52-53, 523.55, 523.57, 523.61, 524.1, 541.1, 542.42 |
| Lota lota Linnaeus, 1758 | 513.32-34, 513.411, 513.43, 513.46-47, 513.51, 513.53, 513.55, 513.57, 513.61-65, 513.71-72, 514.2, 514.11, 514.64, 514.71, 515.12, 515.14-15, 515.25-26, 516.2-4, 516.12-14, 517, 522.12, 523.51, 523.73, 541, 542.43 |
| Phoxinus phoxinus Linnaeus, 1758 | 513.32-34, 513.411-412, 513.43-49, 513.51-57, 513.61-65, 513.67-69, 513.71-72, 514.2, 514.9, 514.11-13, 514.31-34, 514.41-43, 514.51, 514.53, 514.62-64, 514.71-74, 514.82, 514.85, 515.11-15, 515.17, 515.21-22, 515.24-29, 516, 517, 522.11-12, 523.51, 523.73, 541, 542.43 |
| Proterorhinus marmoratus Pallas, 1814 | 516.12-13, 517.1, 517.5 |
| Rhodeus sericeus (Pallas, 1776) | 513.32, 513.46, 513.55, 513.63-65, 513.67-68, 513.71-72, 514.62, 515.15, 516.2-4, 516.11-14, 517.1-2, 517.5, 523.51, 523.73, 541, 542.43 |
| Romanichthys valsanicola Dumitrescu et Banarescu & Stoica, 1957 | 532.1 |
| Sabanejewia aurata (Filippi, 1865) | 513.411-412, 513.44, 513.55-56, 513.61, 513.71-72, 514.11, 514.13, 514.32, 514.34, 514.72-74, 515.15, 516.2-3, 516.12-14, 517, 522.11-12, 522.22-23, 522.25, 523.1-2, 523.31, 523.41-43, 523.45-47, 523.51-53, 523.55-57, 523.61-66, 523.71-73, 524, 525, 526.1, 531, 532.1, 533.1-3, 533.5-7, 533.7a, 533.8, 541, 542 |
| Sabanejewia romanica Bacescu, 1943 | 523.66, 531.16-17, 531.22-24, 531.26, 531.32, 531.34-37, 533.1, 533.6, 533.7a, 541.3, 542.21-22, 542.41-42 |
| Thymallus thymallus Linnaeus, 1758 | 513.32, 513.411-412, 513.43-45, 513.47-49, 513.51-52, 513.54-57, 513.64-65, 513.68, 513.71-72, 514.2, 514.9, 514.11-13, 514.34, 514.42-43, 514.51-52, 514.62-64, 514.71-74, 514.85, 515.11-15, 515.23-29, 516.2, 516.4, 516.4a, 516.12, 517.1, 522.11-13, 522.21, 522.23, 523.1-2, 523.31, 523.41-47, 523.51, 523.53, 523.55-57, 523.61-66, 523.71-73, 524, 525, 526.1, 531, 532.1, 533.1-3, 533.5-7, 533.7a, 533.8, 541, 542.1, 542.21-23, 542.31-34, 542.41-42 |
| Vimba vimba Linnaeus, 1758 | 513.411-412, 513.51, 513.53-57, 513.61, 513.63-65, 513.71-72, 514.11, 514.31-34, 514.43, 514.62, 514.64, 514.71, 514.85, 515.12, 515.15, 515.17, 515.21, 515.24, 515.28, 516.2-4, 516.11-12, 516.14, 517, 522.22, 523.51-53, 523.73, 541, 542.43 |
| Zingel streber Siebold, 1863 | 513.412, 513.55-57, 513.72, 514.31-32, 514.43, 514.62, 514.64, 514.85, 515.15, 516.2-4, 516.12-14, 517.1-2, 517.5, 522.22, 523.51, 523.53, 523.73, 541, 542.43 |
| Zingel zingel Linnaeus, 1758 | 513.55, 513.72, 516.4, 516.12, 516.14, 517.1, 517.3, 517.5, 522.22-23, 523.51, 523.53, 523.73, 541, 542.43 |
| Lampreys | |
| Eudontomyzon danfordi Regan, 1911 | 513.55, 513.72, 514.72-74, 515.25-26, 515.28-29, 516.2-4, 516.4a, 516.13-14, 517.1-2, 517.5, 522.12, 522.23-24, 523.1-2, 523.31, 523.41-43, 523.45-47, 523.51, 523.55-57, 523.61-66, 523.71-73, 524, 525, 526.1, 531, 532.1, 533.1-3, 533.5-7, 533.7a, 533.8, 541, 542.1, 542.21-23, 542.31-34, 542.41-42 |
| Eudontomyzon mariae Berg, 1931 | 513.32-33, 513.47-48, 514.11, 517.5, 522.11, 522.13, 531.17, 531.31, 531.35-37, 532.1, 533.1, 533.6, 533.7a |
| Lampetra planeri Bloch, 1784 | 513.32-34, 513.45-49, 513.51, 513.54-55, 513.61-65, 513.67, 513.71, 514.9, 514.12-13, 514.72, 514.74, 522.11-12 |



Invertebrates

by Jerzy Pawłowski

In order to develop a Carpathian List of Endangered Species, former classification concerning Carpathian species in the previously published national red data books or lists were transformed into new IUCN categories of threat (Table 4). However, only species classified as E or V (according to the earlier classification of IUCN) were selected from national red lists, and only species classified as E were selected from regional (provincial) red lists according to evaluations on the country scale. Moreover, some new species were introduced by the author.

Table 4. Approximated relation between threat categories in different Carpathian countries (after national or regional red data books or red lists: CSRB'92 = (Škapec ed. 1992), PLRB'92 = (Głowaciński ed.1992), PLRL'92 = (Głowaciński ed. 1992), SURB'84 = (Borodin ed. 1984), UArB'94 = (Shcherbak ed. 1994),

| New-WCU status | Old-IUCN status accepted in CSRB '92, PLRB '92, PLRL '92 | Categories accepted for Ukraine | |
|----------------|--|---------------------------------|----------|
| | | SURB '84 | UARB '94 |
| EX + EW | EX (also EXP) | | O |
| CR | E | I | I |
| EN / VU | V | II | II |
| LR (NT) | R | III | III |
| | I | IV | IV / V |
| LR (CD) | O | V | VI |

The systematic nomenclature accepted in the present Carpathian List of Endangered Species was based mainly on the “Checklist of Animals of Poland” vol. I–V (Razowski 1990–1997), apart from *Lepidoptera* which were arranged according to “The Lepidoptera of Europe. A distributional checklist” (Karsholt, Razowski 1996). Higher taxa (classes) are presented in systematic order, while lower taxa (genera, species) are presented in alphabetical order.

The large number of invertebrate species requires well-trained experts in each Carpathian country. As the number of invertebrate experts is still limited, the data col-

lected for this list is dramatically insufficient. It is particularly evident when data collected by the author is compared in different countries. Lack of knowledge of Carpathian invertebrate fauna is not an exception — this problem can be found all over the world. The invertebrate fauna of the Carpathians, divided among seven countries, still needs a fundamental inventory in order to draw any solid conclusions about the list of species, their distribution and threats. Any conclusions based on the initial material presented here could be misleading.

References

- Bajdashnikow A. A. 1988. Fauna Karpatskiego zapovednika. [Fauna of the Carpathian Biosphere Reserve] – In: *Flora i fauna zapovednikow SSSR*. Komissia An SSSR, Moscow. p.43.
- Banaszak J. 1992. Pszczoły *Apoidea*. [In:] Z. Głowaciński (ed.), Red List of Threatened Animals in Poland: 49–58.
- Borodin A.M.(ed.). 1984. Красная книга СССР [Krasnaya kniga SSSR – Red Data Book of USSR]. Том первый, “Лесная промышленность”, Moskva.
- Buszko J. 1998. Czerwona lista motyli dziennych (*Rhopalocera*) Górnego Śląska [Red List of Upper Silesian Butterflies (*Rhopalocera*)]. Centrum Dziedzictwa Przyrody Górnego Śląska. Raporty Opinii, Katowice, 3: 69–82.
- Czachorowski S., Buczyński P. 2000. Zagrożenia i ochrona owadów wodnych w Polsce [Threats and protection of water insects in Poland]. Wiadomości entomologiczne, Poznań, 18 (1999), supl. 2: 95–120.
- Dąbrowski J.S., Śliwiński Z. 1992. Motyle *Lepidoptera*. [In:] Z. Głowaciński (ed.), Red List of Threatened Animals in Poland: 65–83.
- Decou V.G., Negrea Ş. 1969. Aperçu zoogéographique sur la faune cavernicole terrestre de Roumanie. Acta zoologica cracoviensia, 14 (20): 471–546.
- Fiałkowski W., Sowa R. 1992. Widelnice *Plecoptera*. In:] Z. Głowaciński (ed.), Red List of Threatened Animals in Poland: 93–96.
- Głowaciński Z. (ed.). 1992. Polska czerwona księga zwierząt [Polish Red Data Book of Animals]. PWRiL, Warszawa.
- Głowaciński Z. (ed.). 1992. Czerwona lista zwierząt ginących i zagrożonych w Polsce. [Red List of Threatened Animals in Poland]. Zakład Ochrony Przyrody i Zasobów Naturalnych PAN, Kraków.
- Głowaciński Z. 2000. Wyznaczanie zagrożonych gatunków owadów i innych zwierząt w świetle nowych kryteriów IUCN/WCU [Identification of threatened species of insects and other animals in the light of new IUCN criteria]. Wiadomości entomologiczne, Poznań, 18 (1999), supl. 2: 233–249.
- Haslett J.R. 1998. Suggested additions to the invertebrate species listed in appendix II of the Bern Convention – Final report to the Council of Europe. Council of Europe – Conseil de l’Europe. Convention on the conservation of European wildlife and natural habitats. Strasbourg, 20 January 1998. T–PVS (98) 9, 113 pp.
- Holdhaus K., Deubel F. 1910. Untersuchungen über die Zoogeographie der Karpathen (unter besonderer Berücksichtigung der Coleopteren). Abhandlungen zool.–bot. Gesellschaft Wien, Jena, 6, 1: VI+202 pp, 1 mp.
- Jażdżewska T., Wiedeńska J. 1992. Pijawki *Hirudinea*. [In:] Z. Głowaciński (ed.), Red List of Threatened Animals in Poland: 111–113.
- Jażdżewski K. 1992. Pancierzowce *Malacostraca*. [In:] Z. Głowaciński (ed.), Red List of Threatened Animals in Poland: 105–109.
- Kubisz D., Kuśka A., Pawłowski J. 1998. Czerwona lista chrząszczy (*Coleoptera*) Górnego Śląska. [Red List of Upper Silesian beetles (*Coleoptera*)]. Centrum Dziedzictwa Przyrody Górnego Śląska. Raporty Opinii, Katowice, 3: 8–68.
- Liana A. 1992. Owady prostoskrzydłe *Orthoptera*. [In:] Z. Głowaciński (ed.), Red List of Threatened Animals in Poland: 85–91.
- Łabędzki A., Buczyński P., Tończyk G. 1999. Zagrożenia i ochrona ważek w Polsce [Threats and protection of dragonflies in Poland]. [W:] Polskie Towarzystwo Entomologiczne Poznań, Instytut Ochrony Przyrody PAN Kraków. Konferencja naukowa “Ochrona owadów w Polsce u progu integracji z Unią Europejską”, Kraków, 23–24 września 1999. Streszczenia (abstrakty) referatów, Poznań–Kraków: 21–23.
- Ministerstwo Ochrony Środowiska, Zasobów Naturalnych i Leśnictwa. 1999. Natura 2000 – Europejska sieć ekologiczna. Warszawa, 93 pp.
- Pawłowski J. 1999. Ocena stanu poznania bezkręgowców polskiej części Międzynarodowego Rezerwatu Biosfery “Karpaty Wschodnie” [Present knowledge of the invertebrate fauna in the Polish part of the International Biosphere Reserve “Eastern Carpathians”]. Roczniki Bieszczadzkie 1998 (7): 37–58.
- Pawłowski J., Sterzyńska M. 1995. Cenne gatunki i zagrożone nisze lądowych bezkręgowców w polskiej części MRB “Karpaty Wschodnie” [Valuable and endangered niches of terrestrial invertebrates in Polish part of International Biosphere Reserve “Eastern Carpathians”]. Roczniki Bieszczadzkie 1994 (3): 57–74.
- Pawłowski J., Witkowski Z. 2000. Formy ochrony owadów w Polsce w świetle doświadczeń innych krajów i zaleceń Unii Europejskiej [Forms of insect conservation in Poland in the light of experience of other countries and recommendations of European Union]. Wiadomości entomologiczne, Poznań, 18, Supl. 2: 15–26.
- Pelbárt J. 2000. Data to the molluscs fauna of the Carpathian Biosphere Reserve, Ukraine (Mollusca). Miscellanea Zoologica Hungarica. T.13. p. 85–90.
- Rafalski J. 1992. Pajęczaki *Arachnida*. [In:] Z.Głowaciński (ed.) Red List of Threatened Animals in Poland: 97–101.
- Різун В.Б., Коновалова І.Б., Яницький Т.Р. [Rizun V.B., Konovalova I.B., Yanytsky T.P.] 2000. Рідкісні і зникаючі види комах України в ентомологічних колекціях Державного природознавчого музею [Rare and vanishing species of insects from Ukraine in collection of State Museum of Natural History]. Наукове видання Національна академія наук України. Державний природознавчий музей, Lviv.
- Shcherbak M.M. (ed.). 1994. Червона книга України. Тваринний світ. [Chervona knyha Ukrainy. Tvarynnyi svit. – Red Data Book of Ukraine. Animal Kingdom]. Видавництво “Українська енциклопедія”, Київ

- Skapec L. (ed.). 1992. Červená kniha ohrožených a vzácných druhů rostlin a živočichů ČSFR. 3. Bezobratlí. [Red Data Book of Threatened and Valuable Plants and Animals of Czechoslovak Federal Republic. 3. Invertebrates]. Příroda, Bratislava.
- Sowa R. 1992. Jętki *Ephemeroptera*. [In:] Z.Głowaciński (ed.) Red List of Threatened Animals in Poland: 97–101.
- Swaay Ch.v., Warren M., Grill A. 1998. Threatened Butterflies in Europe – provisional report. Council of Europe – Conseil de l'Europe, Strasbourg, 16 January 1998, T–PVS (98) 8, 95 pp.
- Szczęśny B. 1992. Chruściki *Trichoptera*. [In:] Z.Głowaciński (ed.) Red List of Threatened Animals in Poland: 59–63.
- Trojan P. 2000. Wyznaczenie gatunków owadów zagrożonych wyginięciem [Distinguishing endangered insect species]. Wiadomości entomologiczne, Poznań, 18, Supl. 2: 221–232.
- Wiktor A., Riedel A. 1992. Ślimaki lądowe *Gastropoda terrestria*. [In:] Z. Głowaciński (ed.) Red List of Threatened Animals in Poland: 31–38.

Carpathian List of Endangered Species – invertebrates; + species recorded from the country, but hitherto not protected (or not threatened); ? – species hitherto not found in the country, but its presence is probable (for explanations, see Table 4 and chapter on How to Use This Book)

| Class | Ordo | Species | Category of Threat for Entire Carpathians | Category of Threat in Carpathian Countries | | | | | | Protection in Carpathian Countries | | | Bern Convention | Endemic | Relic | Alpine |
|-------------|------|---|---|--|---|----|----|----|----|------------------------------------|----|----|-----------------|---------|-------|--------|
| | | | | CZ | H | PL | RO | SK | UA | CZ | PL | SK | | | | |
| Gastropoda | | <i>Abida secale</i> (Draparnaud, 1801) | CR | | | | | | CR | | | | | | | |
| Gastropoda | | <i>Alopia clathrata</i> (Rossmässler, 1857) | CR | | | | | + | CR | | | | | | + | |
| Gastropoda | | <i>Argna bielzi</i> (Rossmässler, 1859) | EN | | | | VU | | CR | + | | | | | | |
| Gastropoda | | <i>Balea perversa</i> (Linnaeus, 1758) | CR | + | | | CR | | + | + | | | | | | |
| Gastropoda | | <i>Bielzia coerulans</i> (M.Bielz, 1851) | VU | + | + | + | + | + | + | + | | | | | + | |
| Gastropoda | | <i>Candidula unifasciata</i> (Poirot, 1801) | EN | + | | | VU | | | | | | | | | |
| Gastropoda | | <i>Causa holosericum</i> (Studer, 1820) | VU | + | | | VU | | + | | | | | | | |
| Gastropoda | | <i>Chilostoma rosmaessleri</i> (L.Pfeiffer, 1842) | EN | | | | VU | | + | | | | | | | |
| Gastropoda | | <i>Chondrina clienta</i> (Westerlund, 1883) | VU | | | | VU | + | + | + | | | | | | |
| Gastropoda | | <i>Clausilia cruciata</i> (Studer, 1820) | EN | + | | | VU | + | + | + | | | | | | |
| Gastropoda | | <i>Cochlicopa nitens</i> (Gallenstein, 1848) | CR | CR | | | | | | CR | | | | | | + |
| Gastropoda | | <i>Cochlodina fimbriata remota</i> Ložek, 1952 | CR | | | | | | | CR | | | | | + | |
| Gastropoda | | <i>Deroceras moldavicum</i> (Grossu & Lupu, 1961) | EN | | | | VU | + | + | + | | | | | + | |
| Gastropoda | | <i>Drobacia banaticum</i> (Rossmässler, 1838) | CR | Ex | + | | Ex | + | Ex | II | | | | | + | |
| Gastropoda | | <i>Gonyodiscus perspectivus</i> (Megeyer v. Mühlfeld, 1818) | VU | + | | | VU | + | + | + | | | | | | |
| Gastropoda | | <i>Granaria frumentum</i> (Draparnaud, 1801) | CR | | | | CR | | | I | | | | | | |
| Gastropoda | | <i>Helix lutescens</i> Rossmässler, 1837 | CR | | + | | CR | + | + | + | | | | | | |
| Gastropoda | | <i>Hygromia transylvanica</i> (Westerlund, 1876) | EN | | | | | + | VU | | | | | | + | |
| Gastropoda | | <i>Lehmannia macroflagellata</i> Grossu & Lupu, 1962 | VU | + | | | VU | + | + | + | | | | | | |
| Gastropoda | | <i>Lehmannia nyctelia</i> (Bourguignat, 1861) | EN | | | | VU | + | + | | | | | | | |
| Gastropoda | | <i>Macrogastra latestriata</i> (A.Schmidt, 1857) | VU | + | | | VU | + | + | + | | | | | | |
| Gastropoda | | <i>Nesovitrea petronella</i> (L.Pfeiffer, 1853) | CR | CR | | | VU | + | CR | | | | | | | |
| Gastropoda | | <i>Oxychilus inopinatus</i> (Uličný, 1887) | VU | + | + | | VU | + | + | + | | | | | | |
| Gastropoda | | <i>Pagodulina pagodula</i> (Desmoulin, 1830) | CR | VU | | | CR | | | VU | | | | | | + |
| Gastropoda | | <i>Perforatella dibothrion</i> (M.Kimakowicz, 1884) | EN | | | | VU | + | + | + | | | | | + | |
| Gastropoda | | <i>Prostenomphalia carpathica</i> Baidaschnikov, 1985 | EN | | | | | ? | | II | | | | | + | |
| Gastropoda | | <i>Pseudalinda fallax</i> (Rossmässler, 1836) | VU | | | | VU | + | + | + | | | | | | |
| Gastropoda | | <i>Pseudalinda stabilis</i> (L.Pfeiffer, 1847) | VU | | | | VU | + | + | + | | | | | + | |
| Gastropoda | | <i>Pseudofusculus varians</i> (C.Pfeiffer, 1828) | CR | CR | | | | | | CR | | | | | | |
| Gastropoda | | <i>Pupilla alpicola</i> (Charpentier, 1837) | CR | | | | | | | CR | | | | | | + |
| Gastropoda | | <i>Pupilla sterri</i> (Voith, 1840) | CR | | | | VU | | + | + | | | | | | |
| Gastropoda | | <i>Pupilla triplicata</i> (Studer, 1820) | VU | | | | VU | + | + | | | | | | | |
| Gastropoda | | <i>Semilimax kotulae</i> (Westerlund, 1883) | EN | + | | | VU | | + | + | | | | | | |
| Gastropoda | | <i>Serrulina serrulata</i> (L.Pfeiffer, 1874) | CR | | | | | | | I | | | | | | + |
| Gastropoda | | <i>Trichia bakowskii</i> (Poliński, 1924) | VU | | | | VU | | + | + | | | | | | |
| Gastropoda | | <i>Trichia bielzi</i> (E.A.Bielz) | VU | | | | VU | + | + | + | | | | | + | |
| Gastropoda | | <i>Trichia filicina</i> (L.Pfeiffer, 1841) | EN | | | | | | | VU | | | | | | |
| Gastropoda | | <i>Trichia lubomirskii</i> (Ślósarski, 1881) | EN | + | | | VU | | + | + | | | | | + | |
| Gastropoda | | <i>Trichia villosula</i> (Rossmässler, 1838) | VU | | | | + | | + | + | | | | | | |
| Gastropoda | | <i>Truncatellina costulata</i> (Nilsson, 1822) | EN | | | | + | | | VU | | | | | | + |
| Gastropoda | | <i>Vertigo angustior</i> Jeffreys, 1830 | VU | | | | VU | | + | | | | | | + | |
| Gastropoda | | <i>Vertigo geyeri</i> Lindholm, 1925 | CR | CR | | | + | | | CR | | | | | | |
| Gastropoda | | <i>Vertigo modesta</i> (Say, 1824) | VU | | | | VU | | + | + | | | | | | |
| Gastropoda | | <i>Vertigo moulinsiana</i> (Dupuy, 1849) | CR | CR | | | CR | | | CR | | | | | | + |
| Gastropoda | | <i>Vestia elata</i> (Rossmässler, 1836) | CR | | | | CR | + | + | | | | | | + | |
| Gastropoda | | <i>Vestia ranjevici</i> moravica (Brabenec, 1952) | CR | CR | | | | | | CR | | | | | | |
| Oligochaeta | | <i>Allolobophora carpathica</i> Cognetti, 1927 | VU | | | | + | ? | + | + | | | | | + | |
| Oligochaeta | | <i>Fitzingeria platyura</i> (Fitzinger, 1833) | VU | + | + | + | + | + | + | + | | | | | | |
| Oligochaeta | | <i>Helodrilus cernovsitovianus</i> (Zicsi, 1967) | VU | | + | + | + | + | + | + | | | | | + | |
| Hirudinea | | <i>Trocheta bykowskii</i> Gedroyc, 1913 | VU | | + | + | | | ? | + | | | | | | |
| Crustacea | | <i>Astacus astacus</i> (Linnaeus, 1758) | VU | + | + | | VU | + | + | + | | | | | | |
| Crustacea | | <i>Astacus torrentium</i> (Schrank, 1803) | EN | CR | ? | | | + | | CR | | | | | | |

Plant Alliances

by *Viera Stanova*



Vegetation encompasses a very broad scale of synecologically and structurally distinct types — grasslands, forests, aquatic vegetation, alpine vegetation etc. An attempt was made to compile a list of all available Carpathian plant communities on the level of alliances (syntaxon in the terminology of the Braun–Blanquet approach), which have appeared in the literature of focal Carpathian countries — Slovak Republic, Czech Republic, Hungary, Poland, Ukraine and Romania. Since Austria holds only a small fraction of the Carpathians, it was excluded.

Methodology

It was decided to gather data on the level of alliance, because this phytosociological unit has a very good ecological characteristic. Selecting a more detailed phytosociological level (association) would make the data gathering process unrealistic within the time span. The following information was collected: name of the alliance (with class and order), distribution and threat.

Experts within focal countries collected the data and country databases were sent to a Carpathian Ecoregion Initiative sectoral coordinator. The names were checked for nomenclature and a common database was designed.

The second step was to collect data on the geographical distribution of Carpathian endemic plants (selected by Lydia Tassenkevich), in alliances, in order to obtain Carpathian communities in which the proportion of endemic species is significant. The following information was collected: species name, distribution, type of community on the basis of alliance in which a species occurs, threats and management (information whether a given community requires any management to protect it effectively or not).

On the basis of national data, a database was developed and used for the final evaluation. The list of top 20 alliances was created on the basis of occurrence of the endemic plants within alliances or endemic character of communities.

Evaluation and results

The total number of alliances provided by the countries was 190. Ruderal plant communities were excluded due to an uneven level of information between the countries and due

to the fact that these communities are not important for evaluation of biodiversity value. Communities with marginal occurrence in the Carpathians were likewise excluded, giving a final number of 129 plant alliances.

In the countries concerned, there is a difference in the levels of knowledge about communities studied using the Braun–Blanquet approach. There is a long history of such research in Western Carpathian countries, while in Eastern and Southern Carpathian countries it has a shorter tradition. This is particularly true of Ukraine, where a different scientific approach was used; here the Braun–Blanquet approach is quite new and additional communities may exist and even be described within different orographical units.

List of Carpathian plant alliances and their distribution in Carpathian countries.

| Alliances | CZ | SK | RO | HU | PL | UA |
|--|----|----|----|----|----|----|
| <i>Abietion albae</i> Březina et Hadač in Hadač 1962 | | + | | | + | |
| <i>Aceri tatarici–Quercion</i> Zólyomi & Jakucs 1957 | | + | | + | | + |
| <i>Adenostylien</i> Br.–Bl. 1926 | + | + | + | | + | + |
| <i>Achnatherion calamagrostis</i> Br.–Bl. 1918 | | | + | | | |
| <i>Alnion glutinosae</i> Malcuit 1929 | + | + | + | + | + | + |
| <i>Alnion incanae</i> Pawlowski in Pawlowski, Sokolowski et Walisch 1928 | + | + | + | + | + | + |
| <i>Alopecurion</i> Passarge 1964 | + | + | | | | + |
| <i>Androsacion alpinae</i> Br.–Bl. in Br.–Bl. et Jenny 1926 | | + | | | + | |
| <i>Androsacion vandellii</i> Br.–Bl. in Br.–Bl. et Jenny 1926 corr. Br.–Bl. 1948 | | + | + | | | |
| <i>Arabidion alpinae</i> Beguin 1972 | | + | | | + | |
| <i>Arabidopsidion thalianae</i> Passarge 1964 | | + | | + | | |
| <i>Arrhenatherion</i> Koch 1926 | + | + | + | + | + | + |
| <i>Asplenio–Festucion glaucae</i> Zólyomi 1936 | | + | | + | | |
| <i>Asplenio septentrionalis</i> Oberd. 1938 | | + | + | + | + | |
| <i>Athyrio alpestris–Piceion</i> Sýkora 1971 | + | + | | | | + |
| <i>Berberidion</i> Br.–Bl. 1950 | + | | | + | + | |
| <i>Bromion erecti</i> W. Koch 1926 | + | + | | + | | |
| <i>Calamagrostion arundinaceae</i> (Luquet 1926) Jeník 1961 | | + | | | + | + |
| <i>Calamagrostion villosae</i> Pawl. et al. 1928 | + | + | + | | + | + |
| <i>Calthion</i> R. Tx. 1937 em. Bal.–Tul. 1978 | + | + | + | + | + | + |
| <i>Cardaminion amarae</i> Maas 1959 | | + | | | | + |
| <i>Cardamino–Montion</i> Br.–Bl. 1926 | + | + | + | + | + | + |
| <i>Caricion curvulae</i> Br.–Bl. 1925 | | | + | | + | + |
| <i>Caricion davallianae</i> Klika 1934 | + | + | + | + | + | |
| <i>Caricion firmae</i> Gams. 1926 | | + | | | | |
| <i>Caricion fuscae</i> Koch 1926 em. Klika 1934 | + | + | + | + | + | + |
| <i>Caricion gracilis</i> Neuhausl 1959 em. Balátová–Tuláčková 1963 | + | | | | | |
| <i>Caricion lasiocarpae</i> Vanden Berghen ap. Lebrun & al. 1949 | | + | + | + | | + |
| <i>Caricion remotae</i> Kastner 1941 | + | + | | + | | + |
| <i>Caricion rostratae</i> Balátová–Tuláčková 1963 | + | | | | | + |
| <i>Carpinion</i> Issler 1931 | + | + | | + | + | + |
| <i>Ceratophyllion</i> Den Hartog et Segal 1964 | | | + | + | | + |
| <i>Cirsio–Brachypodion pinnati</i> Hadač et Klika 1944 | + | + | | + | + | |
| <i>Cratoneurion commutati</i> Koch 1928 | | + | + | + | + | + |
| <i>Cratoneuro filicini–Calthion laetae</i> Hadač 1983 | + | + | | | | + |
| <i>Cymbalarion–Asplenion</i> Segal 1969 em. Mucina 1993 | | + | + | + | | |
| <i>Cynosurion</i> R. Tx. 1947 | + | + | + | + | + | + |
| <i>Cystopteridion</i> Richard 1972 | + | + | + | + | + | + |
| <i>Dicrano–Pinion</i> (Libbert 1933) Matuszk. 1962 | | + | + | | + | |
| <i>Drapanocladion exannulati</i> Krajina 1933 | | + | | | | |
| <i>Eriophoro–Pinion sylvestris</i> Pass. et Hoffm. 1968 | | | + | | | |
| <i>Erysimo–Hackelion deflexae</i> Bernátová et Ůbuch 1991 | | + | | | | |
| <i>Fagion</i> Luquet 1926 | + | + | | + | + | + |
| <i>Festucion carpaticae</i> Bělohávková et Fišerová 1989 | | + | | | + | + |
| <i>Festucion pictae</i> Kraj. 1933 | | + | | | | |
| <i>Festucion pseudovinae</i> Soó 1933 | | | + | | | |
| <i>Festucion rupicolae</i> Soó 1940 corr. 1964 | | | | + | | |
| <i>Festucion vaginatae</i> Soó 1929 | | | + | | | |
| <i>Festucion vallesiacae</i> Klika 1931 | + | + | | | | + |
| <i>Festucion versicoloris</i> Krajina 1933 | | + | | | | |
| <i>Festuco saxatilis–Seslerion bielzii</i> (Pawl. Et Walas 1949) Coldea 1984 | | | + | | | + |
| <i>Genistion pilosae</i> Duvigneaud 1942 | | | + | + | | |
| <i>Gonisto germanicae–Quercion</i> Neuhausl & Neuhauslová–Novotná 1967 | + | + | + | + | + | |
| <i>Geranion sanguinei</i> R. Tx. in Th. Muller 1961 | + | + | | + | | |
| <i>Glycerio–Sparganion</i> Br.–Bl. et Sissingh in Boer 1942 | + | | + | + | + | + |
| <i>Gypsophilion petraeae</i> Borhidi et Pocs 1957 | | | + | | | |
| <i>Hyperico perforato–Scleranthion perennis</i> Moravec 1967 | | | + | | | |
| <i>Hypno–Polypodion vulgaris</i> Mucina 1993 | | + | | + | | |
| <i>Chrysanthemion rotundifolii</i> Kraj. 1933 | | + | | | | + |
| <i>Juncion trifidi</i> Krajina 1933 | | + | | | + | + |
| <i>Juniperion nana</i> Br.–Bl. et al. 1939 | | | | | | + |
| <i>Koelerio–Phleion phleoidis</i> Korneck 1974 | | + | | | | |
| <i>Lathyro–Carpinion</i> Boşcaiu 1974 | | | + | | | |
| <i>Lemnion minoris</i> de Bolós et Masclans 1955 | + | + | | + | + | + |
| <i>Lemno–Salvinion natantis</i> Slavnic 1956 | | | + | | | |

| | | | | | | | |
|---|--|---|---|---|---|---|---|
| Loiseleurio–Vaccinon Br.–Bl. 1926 | | | + | | | | + |
| Luzulo–Fagion Lohm. et R. Tx. in R. Tx. 1954 | | + | + | | | + | + |
| Lycopodio–Cratoneurion commutati Hadač 1983 | | + | | | | | |
| Magnocaricion elatae W. Koch 1926 | | | + | + | + | + | + |
| Micromerion pulegii Boşcaiu (1971) 1979 | | | | + | | | |
| Molinion coeruleae Koch 1926 | | + | + | + | | + | + |
| Nanocyperion Koch ex Libbert 1932 | | | | | + | + | |
| Nardion strictae Br.–Bl. 1926 | | | | + | | | + |
| Nardo–Agrostion tenuis Sillinger 1933 | | + | + | | | | + |
| Nymphaeion albae Oberd. 1957 | | + | + | + | | + | |
| Oenanthion aquaticae Hejný ex neuhausl 1959 | | + | | + | + | | |
| Orno–Cotinion Soó 1960 | | | | + | + | | |
| Oxycocco–Empetron hermaphroditi Nordh. 1936 | | | + | | | | + |
| Oxytropido–Elynon Br.–Bl. 1949 | | | | + | | | + |
| Papaverion tatrici Pawlowski 1928 corr. Valachovič 1995 | | | + | | | + | |
| Papavero–Thymion pulcherrimi I. Pop 1968 | | | | + | | | + |
| Petasion officinalis Sillinger 1933 em. Kopecký 1969 | | + | | | + | | |
| Phragmition communis Koch 1926 | | + | | + | + | + | |
| Piceion excelsae Pawlovski in Pawlovski et al. 1928 | | + | + | + | | + | |
| Pinion mugii Pawl. 1928 | | | | + | + | | + |
| Pino–Quercion Kozl. 1925 em. Mat. et Pol. 1955 | | | | | | + | |
| Poion alpinae Oberd. 1950 | | | + | | | | |
| Poion violaceae Horv. 1937 | | | | + | | | |
| Polygono–Trisetion Br.–Bl. et R. Tx. ex Marshall 1947 | | | + | | | + | |
| Potamion lucentis Rivas–Martínez 1973 | | + | | | + | | |
| Potamion pusillii Hejný 1978 | | + | + | | + | | |
| Potentillion caulescentis Br.–Bl. in Br.–Bl. et Jenny 1926 em. Sutter 1969 | | + | + | | | + | |
| Potentillo albae–Quercion petraeae Jakucs in Zólyomi et al. 1967 | | | | + | + | | |
| Potentillo–Nardion Simon 1957 | | | | + | | | + |
| Prunion spinosae Soó 1947 | | + | + | | + | | + |
| Pulsatillo slavicae–Pinion Fajmonová 1978 | | | + | | | + | |
| Quercion petraeae Zólyomi et Jakucs ex Jakucs 1960 | | + | + | | | | |
| Quercion pubescenti–petraeae Br.–Bl. 1932 | | + | + | | | | |
| Rhododendro–Vaccinon Br.–Bl. 1926 | | | | | | + | + |
| Rhynchosporion albae Koch 1926 | | | + | + | | + | + |
| Rumicion alpini Rubel ex Klika in Klika et Hadač 1944 | | | + | + | | + | + |
| Salicion albae Soó 1930 | | + | | | + | + | |
| Salicion cineruae Th. Müll. & Görs ex Passarge 1961 | | + | + | + | + | | |
| Salicion eleagno–daphnoidis (Moor 1958) Grass in Mucina et al. 1993 | | + | + | + | | + | |
| Salicion herbaceae Br.–Bl. in Br.–Bl. et Jenny 1926 | | | + | + | | + | + |
| Salicion incanae Aichinger 1933 | | | + | + | | + | + |
| Salicion retusae Horv. 1949 | | | + | + | | + | + |
| Salicion silesiaca Rejmánek, Šykora et Štursa 1971 | | | + | | | | + |
| Salicion triandrae Th. Muller et Gors. 1958 | | + | + | | | | |
| Senecion fluviatilis R. Tx. 1950 | | | | | + | + | |
| Seslerio rigidae–Pinion Coldea 1991 | | | | + | | | |
| Seslerio–Asterion Hadač ex Hadač et al. 1969 | | | + | | | + | |
| Seslerio–Festucion pallentis Klika 1931 corr. Zólyomi 1966 | | + | + | + | + | + | |
| Seslerion rigidae Zoly. 1939 | | | | + | | | |
| Seslerion tatrae Hadač ex Hadač et al. 1969 | | | + | | | + | |
| Silenion lichenfeldiana Simon 1957 | | | | + | | | |
| Sphagnion magellanici Kastner et Flossner 1933 | | | | + | | + | + |
| Sphagnion medii Kástner & Flössner 1933 | | + | + | | + | | |
| Sphagno recurvi–Caricion canescentis Passarge 1964 | | + | + | | | + | |
| Sphagno warnstorffiani–Tomenthypnion Dahl 1957 | | + | + | | | + | |
| Sphagno–Utricularion Th. Muller et Gors. 1960 | | | + | | + | + | |
| Spiraeion mediae Borhidi & Varga Z. 1998 | | | | | + | | |
| Stipion calamagrostis Jenny–Lips ex Br.–Bl. Et al. 1952 | | + | + | | | + | |
| Symphyto–Fagion Vida 1959 | | | | + | | | + |
| Syringo–Carpinion orientalis Jakucs 1960 | | | | + | | | |
| Thero–Airion Tx. ex Oberd. 1957 | | | + | | + | | |
| Tilio–Acerion Klika 1955 | | + | + | + | + | + | + |
| Trifolion medii Th. Muller 1962 | | + | + | | + | + | |
| Trisetion fusci Krajina 1933 | | | + | | | | |
| Utricularion vulgaris Passarge 1964 | | | | + | + | | + |
| Vaccinon Bocher 1943 | | + | | | | + | |
| Veronicion baumgartenii Coldea 1991 | | | | + | | | |
| Violon caninae Schwickerath 1944 | | + | | | + | + | |

Endemic plant species

Originally, 455 endemic plant species were selected by Lydia Tasenkevich. National experts commented on the original list, adding new species on the basis of the most recent data. Altogether, the final list includes 486 endemic plants recorded within the alliances.

List of endemic plant species recorded within Carpathian alliances.

- Acinus alpinus* (L.) Moench ssp. *baumgartenii* (Simonk.) S. Pawlowska
Aconitum anthora L. ssp. *jacquinii* (Rchb.) Domin
Aconitum lasiocarpum (Rchb.) Gayler
Aconitum lycoctonum L. ssp. *moldavicum* (Hacq.) Jalas
Aconitum moldavicum ssp. *hosteanum* (Schur) Asch. et Graeb.
Aconitum napellus L. ssp. *firmum* (Rchb.) Gayler
Aconitum napellus ssp. *moravicum* (Skalicky) Tasen.
Achillea oxyloba (DC.) Schultz Bip. ssp. *schurii* (Schultz Bip.) Heimerl
Achillea tuzsonii Ujh.
Alchemilla acrostegia Plocek
Alchemilla aequidens Pawl..
Alchemilla amauroptera Plocek
Alchemilla amblyodes Plocek
Alchemilla amicomum Pawl.
Alchemilla anceps Plocek
Alchemilla animosa Plocek
Alchemilla aspera Plocek
Alchemilla babiogorensis Pawl.
Alchemilla bogumilii Pawlus
Alchemilla boleslai Pawl..
Alchemilla brachycodon Plocek
Alchemilla braun-blanquetii Pawl.
Alchemilla bucovinensis Sytschak
Alchemilla contractilis (Plocek) S.Fröhner
Alchemilla crassa (Plocek) Plocek
Alchemilla curtischista Plocek
Alchemilla czywczynensis Pawl.
Alchemilla decurrens Plocek
Alchemilla delitescens Plocek
Alchemilla dostalii Plocek
Alchemilla echinoglobosa Plocek
Alchemilla eugenii Pawl.
Alchemilla exaperta Plocek
Alchemilla fusoides Plocek
Alchemilla giewontica Pawl.
Alchemilla gorcensis Pawl.
Alchemilla grandiceps Plocek
Alchemilla gruneica Plocek
Alchemilla gymnopoda Plocek
Alchemilla hyperptycha Plocek
Alchemilla chalarodesma Plocek
Alchemilla chilitricha Plocek
Alchemilla intermedia Haller ssp. *sooi* Palitz
Alchemilla isodonta Plocek
Alchemilla jasiewiczii Pawl..
Alchemilla kornasiana Pawl..
Alchemilla kosiarensis Plocek
Alchemilla kulczynskii Pawl.
Alchemilla ladislai Pawl..
Alchemilla laevipes Plocek
Alchemilla laxa Plocek
Alchemilla longidens Plocek
Alchemilla lorata Plocek
Alchemilla loxotropa Plocek
Alchemilla ludovitiana Plocek
Alchemilla marginata Plocek
Alchemilla megalodonta Plocek
Alchemilla microsphaerica S.Fröhner
Alchemilla mollifolia Plocek et Zlinska
Alchemilla monocophila Plocek
Alchemilla multiloba Plocek
Alchemilla obesa Plocek
Alchemilla oculimarina Pawl..
Alchemilla patens Plocek
Alchemilla polonica Pawl..
Alchemilla pseudincisa Pawl..
Alchemilla pseudothmari Pawl..
Alchemilla pungentiflora (Plocek) Plocek
Alchemilla reversantha Plocek
Alchemilla rhodobasis Plocek
Alchemilla rhodocycla Plocek
Alchemilla sejuncta Plocek
Alchemilla sericoneuroides Pawl..
Alchemilla smaragdina Plocek
Alchemilla smytniensis
Alchemilla sojakii Plocek
Alchemilla sokolowskii Pawl..
Alchemilla stanislae Pawl..
Alchemilla stenoleuca Plocek
Alchemilla suavis Plocek
Alchemilla subconnivens Pawl..
Alchemilla subsessilis Plocek
Alchemilla subtrtica Pawl..
Alchemilla superata Plocek
Alchemilla szaferi Pawl..
Alchemilla tacikii Plocek
Alchemilla tatricola Pawl..
Alchemilla thaumasia Plocek
Alchemilla turculensis Pawl..
Alchemilla versipiloides Pawl..
Alchemilla virginea Plocek
Alchemilla walasii Pawl..
Alchemilla wallischii Pawl..
Alchemilla zapalowiczii Pawl..
Alchemilla zmudae Pawl..
Alpecurus pratensis L.ssp. *laguriformis* (Schur) Tzvelev
Alyssum montanum L.ssp. *brymii* (Dostál) Soó
Alyssum repens Baumg. ssp. *repens*
Androsace villosa L. ssp. *arachnoidea* (Schott, Nyman et Kotschy) Knuth
Andryala levitomentosa (Nyár.) P.D.Sell
Antennaria carpatca (Wahlenb.) Bluff et Fingerh. ssp. *carpatca*
Anthemis carpatca Kit. ssp. *pyrethroides* (Schur) Beldie
Anthemis tinctoria L.ssp. *fussii* (Griseb.) Beldie
Aquilegia nigricans Baumg.ssp. *subscaposa* (Borbás) Soó
Aquilegia transilvanica Schur
Arenaria ciliata L. ssp. *tatrensis* (Zapal.) Favarger
Armeria maritima (Mill.) Willd. ssp. *barcensis* (Simonk.) P.Silva
Armeria pocutica Pawl..
Armoracia macrocarpa (W. et K.) Baumg.
Artemisia absinthium L. var. *calcigena* Rehman
Asperula carpatca Morariu
Astragalus australis (L.) Lam.ssp. *krajinae* Domin
Astragalus peterfii Jav.
Astragalus pseudopurpureus Gusul.
Astragalus roemeri Simonk.
Athamanta turbith (L.) Broth. ssp. *hungarica* (Borbás) Tutin
Aubrieta intermedia Helder. et Orph. ex Boiss. ssp. *falcata* Ciocârlan
Barbarea lepuznica Nyár.
Biscutella laevigata ssp. *hungarica* Soó
Bromus pannonicus Kummer et Sendtner ssp. *monocladus* (Domin) P.M.Sm.
Bupleurum falcatum L. ssp. *dilatatum* Schur
Bupleurum longifolium L.ssp. *vapincense* (Vill.)Todor
Campanula carpatca Jacq.
Campanula crassipes Heuff.
Campanula kladniana (Schur) Witasek
Campanula rotundifolia L. ssp. *polymorpha* (Witasek) Tacik

- Campanula serrata* (Kit.) Hendrych
Campanula subcapitata Popov
Campanula tatrae Borbás
Campanula xylocarpa Kovanda
Cardaminopsis halleri (L.) Hayek ssp. *tatrica* (Pawl.) Dostál
Cardaminopsis neglecta (Schultes) Hayek
Carduus collinus W. et K.
Carduus kernerii Simonk. ssp. *kernerii*
Carduus kernerii ssp. *lobulatiformis* (Csuros et Nyár.) Soó
Carduus lobulatus Borbás
Carex sempervirens Vill. ssp. *tatorum* (Zapal.) Pawł.
Centaurea coziensis Nyár.
Centaurea globurensis Nyár.
Centaurea maramarosiensis (Jav.) Czerep.
Centaurea phrygia L. ssp. *carpatica* (Porc.) Dostál
Centaurea phrygia ssp. *melanocalathia* (Borbás) Dostál
Centaurea phrygia ssp. *nigriceps* (Dobroc.) Dostál
Centaurea phrygia ssp. *rarauensis* (Prodan) Dostál
Centaurea phrygia ssp. *retezatensis* (Prodan) Dostál
Centaurea pinnatifida Schur ssp. *sooana* (Borhidi) Soó
Centaurea reichenbachii DC.
Centaurea sadleriana Janka
Centaurea trichocephala Bieb. ex Willd. ssp. *simonkaiana* (Hayek) Dostal
Centaurea triumfettii All. ssp. *dominii* Dostál
Cephalaria radiata Griseb. et Schenk
Cerastium arvense L. ssp. *glandulosum* (Kit.) Soó
Cerastium arvense ssp. *lerchenfeldianum* (Schur) Asch. et Graeb.
Cerastium transsilvanicum Schur
Cerinthe glabra Mill subsp. *tatrica* Hadač
Cirsium boujartii (Piller et Mitterp.) Schultz. Bip ssp. *boujartii*
Cirsium brachycephalum Juratzka
Cirsium decussatum Janka
Cirsium furiens Griseb. et Schenk
Cirsium grecescui Rouy
Cochlearia tatrae Borbás
Cotoneaster matrensis Domokos
Crocus scepusiensis (Rehmann et Wol.) Borbás
Cyclamen fatrense Halda et Soják
Dactylorhiza fuchsii (Druce) Soó ssp. *sooana* (Borsos) Borsos
Dactylorhiza maculata (L.) Soó ssp. *schurii* (Klinge) Soó
Daphne arbuscula Celak.
Delphinium oxysepalum Borbás et Pax
Delphinium simonkaianum Pawł.
Dendranthema zawadzki (Herbich) Tzvelev
Dentaria glandulosa W. et K.
Dianthus callizonus Schott et Kotschy
Dianthus carthusianorum L. ssp. *saxigenus* (Shur) Jav.
Dianthus giganteus D'Urv. ssp. *banaticus* (Heuffel) Tutin
Dianthus glacialis Haenke ssp. *gelidus* (Schott, Nyman et Kotschy) Tutin
Dianthus henteri Heuffel ex Griseb.
Dianthus lumnitzeri Wiesb.
Dianthus nitidus Waldst. et Kit.
Dianthus plumarius ssp. *praecox* (Kit.) Pawł.
Dianthus spiculifolius Schur
Dianthus tenuifolius Schur
Doronicum carpaticum (Griseb. et Schenk) Nyman
Draba aizoides L. ssp. *zmudae* Zapal.
Draba dorneri Heuffel
Draba haynaldii Stur
Draba kotschyi Stur
Draba lasiocarpa Rochel ssp. *klasterskyi* (Chrtek) Chrtek
Draba stellata Jacq. ssp. *simonkaiana* (Jav.) Beldie
Erigeron nanus Schur
Eritrichium nanum (All.) Schrad. ssp. *jankae* (Simonk.) Jav.
Erysimum pieninicum (Zapal.) Pawł.
Erysimum wahlenbergii (Asch. et Engl.) Borbás
Erysimum witmannii Zawadzki ssp. *pallidiflorum* (Jav.) Jav.
Erysimum witmannii ssp. *transsilvanicum* (Schur) P.W.Ball
Erysimum witmannii ssp. *vagicum* (Holub et Tomsovic) Dostál
Erysimum witmannii ssp. *witmannii*
Euphorbia carpatica Wol.
Euphrasia exaristata Smejkal
Euphrasia slovacica (Yeo) Holub ssp. *slovaca*
Euphrasia stipitata Smejkal
Euphrasia tatrae Wettst.
Ferula sadleriana Ledeb.
Festuca bucegiensis Markgr.-Dannenb.
Festuca carpatica F.G.Dietr
Festuca nitida Kit. ssp. *flaccida* (Schur) Markgr.-Dannenb.
Festuca pachyphylla Degen ex Nyár.
Festuca porcii Hackel
Festuca rupicola Heuff. ssp. *saxatilis* (Schur) Rauschert
Festuca scoparia (A.Kern. et Hackel) ssp. *lutea* K.Richter
Festuca tatrae (Czako) Degen
Festuca versicolor Tausch ssp. *dominii* Krajina
Galium abaujense Borbás
Galium anisophyllum Vill. ssp. *fatrense* Ehrend. et Šipošova
Galium baillonii Brandza
Galium pawlowskii Kucowa
Galium transcarpaticum Stoyko et Tasen.
Genista tinctoria L. ssp. *oligosperma* (Andrae) Prodan
Gentiana cruciata L. ssp. *phlogifolia* (Schott et Kotschy) Tutin
Gentianella amarella (L.) Börn. ssp. *reussii* (Toel) Holub
Gentianella austriaca (A. et J.Kern.) ssp. *fatrae* A. et D.Löve
Gentianella lutescens (Velen.) ssp. *tatrae* (Ronniger) Holub
Gypsophila petraea (Baumg.) Rchb.
Helictotrichon decorum (Janka) Henrard
Hepatica transsilvanica Fuss
Heracleum carpaticum Porc.
Heracleum sphondylium L. ssp. *trachycarpum* (Soják) Holub
Heracleum sphondylium ssp. *transsilvanicum* (Schur) Brummitt
Hesperis matronalis L. ssp. *moniliformis* (Schur) Borza
Hesperis matronalis ssp. *vrabelyiana* (Schur) Soó
Hesperis nivea Baumg
Hesperis oblongifolia Schur
Hesperis slovacica (F.Dvorak) F.Dvorak
Hieracium amoenanthos Nyár. et Zahn
Hieracium atrellum (Zahn) Juxip
Hieracium biharianum Prodan
Hieracium bohatschianum Zahn
Hieracium borzae Nyár. et Zahn
Hieracium breazense Nyár.
Hieracium bucuranum Nyár.
Hieracium buianum Prodan
Hieracium caesiogenum Wol. et Zahn
Hieracium carpaticum Besser
Hieracium catenatum Sennik.
Hieracium crassipedilium (Pawl. et Zahn) Chrtek jr.
Hieracium czeremoszense Wol. et Zahn
Hieracium dacicum Uechtr.
Hieracium filarszkyi Jav.
Hieracium fritzeiforme Zahn
Hieracium goemorense Borbás
Hieracium grabowskianum Naegeli et Peter
Hieracium grecescui Nyár. et Zahn
Hieracium grofae Wol.
Hieracium chlorobracteum Degen et Zahn
Hieracium jankae Uechtr.
Hieracium krasanii Wol.
Hieracium lomnicense Wol.
Hieracium longifoliosum Nyár.
Hieracium melananthum (Naegeli et Peter) P.D.Sell et C.West

- Hieracium mukacevense* Juxip
Hieracium muscelii Prodan
Hieracium napaeum Zahn
Hieracium negoienae (Ravarut et Nyár.) Soó
Hieracium nyaradyanum Zahn
Hieracium occidentale Nyár.
Hieracium paltinae jav. Et Zahn
Hieracium pawlowskianum Nyár.
Hieracium paxianum Nyár.et Zahn
Hieracium pelagae Degen et Zahn
Hieracium pelesii Grecsec.
Hieracium perfoliosum Nyár.
Hieracium peterfii Nyár.et Zahn
Hieracium phaedrocheilon Zahn
Hieracium pinetophilum (Degen et Zahn) Chrtek jr.
Hieracium pisaturense Nyár.
Hieracium pocuticum Wol.
Hieracium pojoritense Wol.
Hieracium praebiharicum Boros
Hieracium prodanianum Nyár.et Zahn
Hieracium pseudeffusum (Naegeli et Peter) Nyár.
Hieracium pseudocaeisiforme Nyár.et Zahn
Hieracium pseudocaesium Degen et Zahn
Hieracium pseudonigratum Pax
Hieracium pseudopaltinae Nyár.et Zahn
Hieracium pseudoratezatense Nyár.et Zahn
Hieracium pseudotranssilvanicum (Zahn) Zahn
Hieracium pseudovagneri Zahn
Hieracium rapunculoidiforme Wol. et Zahn
Hieracium riumarense Nyár.
Hieracium scitulum Wol.
Hieracium simonkaianum (Zahn) P.D.Sell et C.West
Hieracium slovacum Chrtek jr.
Hieracium speciosum Willd. ex Hornem
Hieracium stenodontophyllum Nyár.et Zahn
Hieracium subpojoritense Prodan
Hieracium subserratosinuatum Zahn
Hieracium tajanum K.Maly et Zahn
Hieracium telekianum Boros et Lengyel
Hieracium tephroglaucum Naegely et Peter
Hieracium tomasiae Nyár.et Zahn
Hieracium tomasiaeforme Nyár.
Hieracium trischistum Nyár.et Zahn
Hieracium virgicuale Naegely et Peter
Hieracium vladeasae Prodan
Hieracium vurtopicum Zahn
Hylotelephium argutum (Haw.) Holub
Chenopodium wolffii Simonk.
Chrysosplenium alpinum Schur
Jovibarba globifera ssp. *preissiana* (Domin) Holub
Jurinea mollis ssp. *transsilvanica* (Sprengel) Hayek
Knautia dipsacifolia Kreutzer ssp. *lancifolia* (Heuffel) Ehrend.
Knautia dipsacifolia ssp. *pocutica* (Szabo) Ehrend.
Knautia dipsacifolia ssp. *turocensis* (Borbás) Jav. ex Kiss
Knautia kitaibelii (Schultes) Borbás
Knautia slovacica Stepanek
Koeleria macrantha (Ledeb.) Schultes ssp. *transsilvanica* (Schur) Beldie
Koeleria tristis Domin
Lathyrus transsilvanicus (Sprengel) Fritsch
Leontodon pseudotaraxaci Schur
Leontodon repens Schur
Leucanthemopsis alpina (L.) Heywood ssp. *tatrae* (Vierh.)Holub
Leucanthemum waldsteinii (Schultz Bip.) Pouzar
Leucojum vernum L. ssp. *carpaticum* (Spring) O.Schwarz
Linum uninerve (Rochel) Jav.
Luzula alpinopilosa (Chaix) Breistr. ssp. *obscura* Frohner
Lychnis nivalis Kit.
Melampyrum ambiguum Soó
Melampyrum herbichii Wol.
Melampyrum saxosum Baumg.
Micromeria pulegium (Rochel) Benthham
Minuartia frutescens (Kit.) Tuzson
Minuartia setacea (Thuill.) Hayek var. *pienina* (Zapal.) Pawl..
Minuartia verna (L.) Hiern. ssp. *oxypetala* (Wol.) Halliday
Molinia horanszkyi Milkovits
Molinia hungarica Milkovits
Molinia ujhelyii Milkovits
Myosotis transsilvanica Porcius
Nigritella carpatica (Zapal.) Teppner, Klein et Zagulski
Onobrychis montana DC. ssp. *transsilvanica* (Simonk.) Jav.
Onosma pseudarenaria Schur
Onosma tornensis Jav.
Ophrys holubyana Andras.
Ornithogalum orthophyllum Ten.ssp. *acuminatum* (Schur) Zahar.
Oxytropis carpatica Uechtr.
Papaver alpinum L. ssp. *corona-sancti-stephani* (Zapal.) Borza
Papaver alpinum ssp. *tatricum* Nyár.
Pedicularis baumgartenii Simonk.
Peucedanum rochelianum Heuffel
Phyteuma tetramerum Schur
Phyteuma vagneri A.Kern.
Pilosella alpica (Schleich. ex Gaudin) F. W. Schultz et Schultz Bip. subsp.
ullepitschii (Blocki) Zahn
Pinus nigra Arnold ssp. *banatica* (Borbás) Novak
Plantago atrata Hoppe subsp. *carpathica* (Soó) Soó
Poa granitica Br.-Bl. ssp. *disparilis* (Nyár.) Nyár.
Poa granitica ssp. *granitica*
Poa laxa Haenke ssp. *pruinosa* Nyár.
Poa margilicola Bernátová et Májovský
Poa molinerii Balbis ssp. *glacialis* Beldie
Poa nemoralis L. ssp. *carpatica* Jirasek
Poa nobilis Skalinska
Poa pannonica A.Kern. ssp. *scabra* (Asch. et Graeb.) Soó
Poa rehmannii (Asch. et Graeb.) Wol.
Poa sejuncta Bernatova, Majovsky, Obuch
Prangos ferulacea (L.) Lindley ssp. *carinata* (Griseb. ex Degen) Dihoru
Primula auricula L. ssp. *hungarica* (Borbás) Soó
Primula auricula ssp. *serratifolia* (Rochel) Jav.
Primula elatior (L.) Hill. ssp. *carpatica* (Fuss) W.W.Sm. et Forrest
Primula elatior ssp. *leucophylla* (Pax) H.-Harrison ex W.W.Sm. et Fletcher
Primula elatior ssp. *poloninensis* (Domin) Dostál
Primula wulfeniana Schott ssp. *baumgarteniana* (Degen et Moesz) Ludi
Pulmonaria filarszkyana Jav.
Pulsatilla halleri (All.) Willd. ssp. *slavica* (G.Reuss) Zamels
Pulsatilla subslavica Futák ex Goliášová
Pyrola carpatica Holub et Krísa
Ranunculus altitatis Paclova et Murin
Ranunculus auricomus L. ssp. *binatus* Jasiewicz
Ranunculus carpaticus Herbich
Ranunculus malinovskii Jelen. et Derv.-Sokol.
Rosa heterostyla Chrshan.
Rubus banaticus Nyár.
Rubus bicolorispinosus Nyár.
Rubus ciriloare Nyár.
Rubus crispomarginatus Holub
Rubus cuiedensis Nyár.
Rubus doftanensis Nyár.
Rubus exornatus Nyár.
Rubus fagetanus Nyár.
Rubus grandiflorus Nyár.
Rubus henrici-egonis Holub
Rubus chloroclados Sabr.

- Rubus laetecoloratus* Nyár.
Rubus lipovensis Nyár.
Rubus longibracteatus Nyár.
Rubus magurensis Nyár.
Rubus margaritae Gayer
Rubus moestus Holub
Rubus neopyramidalis Nyár.
Rubus niveoserpens Nyár.
Rubus ocnensis Nyár.
Rubus opiparus Nyár.
Rubus perrobustus
Rubus persanimontis Nyár.
Rubus petnicensis Nyár.
Rubus pseudodoftanensis Nyár.
Rubus romanicus Nyár.
Rubus rubristamineus Nyár.
Rubus saxosus Nyár.
Rubus seciurensis Nyár.
Rubus severinensis Nyár.
Rubus slatinensis Nyár.
Rubus subcoriaceus Nyár.
Rubus subvillicaulis Nyár.
Rubus tenuispinosus Nyár.
Rubus teregovensis Nyár.
Rubus vaccarum Nyár.
Rumex arifolius All. ssp. *carpaticus* (Zapal.) Pawl..
Salix kitaibeliana Willd.
Salvia transsilvanica (Schur ex Griseb.) Schur
Saussurea porcii Degen
Saxifraga carpatica Sternb.
Saxifraga moschata Wulf. ssp. *dominii* Soó
Saxifraga moschata ssp. *kotulae* S.Pawlowska
Saxifraga moschata ssp. *transsilvanica* S.Pawlowska
Saxifraga mutata L. ssp. *demissa* (Schott et Kotschy) D.A.Webb
Saxifraga wahlenbergii Ball
Scabiosa columbaria L. ssp. *pseudobanatica* (Schur) Jav. et Csapody
Scabiosa lucida Vill. ssp. *barbata* Nyár.
Scabiosa lucida ssp. *pseudobanatica* (Schur) Chrtek
Scilla bifolia L. ssp. *subtriphylla* (Schur) Domin
Sedum krajinae Domin
Sempervivum wettsteinii Letz ssp. *heterophyllum* (Hazsl.) Letz
Sempervivum wettsteinii ssp. *wettsteinii*
Seseli gracile Waldst. et Kit.
Sesleria heuflerana Schur ssp. *hungarica* (Ujhelyi) Deyl
Sesleria heuflerana ssp. *heufleriana*
Sesleria sadlerana Janka ssp. *tatrae* (Degen) Deyl
Silene dinarica Sprengel
Silene nutans L. ssp. *dubia* (Herbich) Zapal.
Silene zawadzkyi Herbich
Soldanella carpatica Vierh.
Soldanella hungarica Simonk. subsp. *hungarica*
Soldanella hungarica ssp. *major* (Neir.) S.Pawlowska
Soldanella pseudomontana F.K.Mey
Sorbus austriaca (Beck) Hedl. ssp. *hazslinszkiana* Soó
Sorbus borbassii Jav.
Sorbus buekkensis Soó
Sorbus dacica Borbás
Sorbus javorkae (Soó) Karpaty
Sorbus margittaiana (Jav.) Karpati
Sorbus paxiana Jav.
Sorbus pekarovae Majovsky et Bernatova
Sorbus scepusiensis Kovanda
Sorbus sooi (Mathe) Karpati
Sorbus umbellata (Desf.) Fritsch ssp. *banatica* (Jav.) Karpati
Stipa crassiculmis P.Smirnow ssp. *heterotricha* Dihoru et Roman
Stipa danubialis Dihoru et Roman
Symphytum cordatum Waldst. et Kit.
Syringa josikaea Jacq. fil. ex Rchb.
Taraxacum erythrocarpum Kirschner et Stepanek
Taraxacum nigricans (Kit.) Rchb.
Taraxacum pawlowskii Van Soest
Taraxacum pieninicum Pawl..
Tephrosia longifolia (Jacq.) Griseb. et Schenk ssp. *moravica* Holub
Thalictrum minus L. ssp. *carpaticum* (Kotula) Osvacilova
Thalictrum minus ssp. *pseudominus* (Borbás) Soó
Thesium kernerianum Simonk.
Thlaspi caeruleum J. et C. Presl ssp. *tatrense* (Zapal.) Dvorakova
Thlaspi dacicum Heuffel ssp. *banaticum* (Uechtr.) Jav.
Thlaspi dacicum ssp. *dacicum*
Thlaspi jankae A.Kern.
Thlaspi kovatsii Heuffel ssp. *schudichii* Soó
Thymus alternans Klokov
Thymus bihoriensis J alas
Thymus comosus Heuffel ex Griseb.
Thymus pulcherrimus Schur ssp. *pulcherrimus*
Thymus pulcherrimus ssp. *sudeticus* (Lyka) P.A.Schmidt
Tithymalus sojakii (Chrtek et Křisa) Holub
Trifolium medium L. ssp. *banaticum* (Heuffel) Hendrych
Trifolium medium ssp. *sarosiense* (Hazsl.) Simonk.
Trifolium pratense L. ssp. *kotulae* (Pawl.) Soják
Trisetum flavescens (L.) Beauv. ssp. *tatricum* Chrtek
Trisetum fuscum (Kit. ex Schultes) Schultes
Trisetum macrotrichum Hackel
Trollius altissimus Crantz ssp. *tatrae* (Borbás) Pocs et Balogh
Tulipa hungarica Borbás
Viola declinata Waldst. et Kit. et Kit.

Top alliances

On the basis of the occurrence of endemic plants, the following 20 alliances were selected as the most valuable in the Carpathians.

1 *Festuco saxatilis*–*Seslerion bielzii* (Pawł. et Walas 1949) Coldea 1984 — Eastern Carpathian cushion sedge carpets

Aconitum anthora ssp. *jacquinii*, *Aconitum moldavicum* ssp. *hosteanum*, *Achillea oxyloba* ssp. *schurii*, *Alchemilla szaferi*, *Alyssum repens* ssp. *repens*, *Androsace villosa* ssp. *arachnoidea*, *Campanula rotundifolia* ssp. *polymorpha*, *Campanula serrata*, *Carduus kernerii* ssp. *kernerii*, *Carduus kernerii* ssp. *lobulatiformis*, *Centaurea pinnatifida*, *Cerastium arvense* ssp. *lerchenfeldianum*, *Cerastium transsilvanicum*, *Dianthus callizonus*, *Dianthus glacialis* ssp. *gelidus*, *Dianthus spiculifolius*, *Dianthus tenuifolius*, *Doronicum carpaticum*, *Draba haynaldii*, *Festuca carpatica*, *Festuca nitida* ssp. *flaccida*, *Festuca pachyphylla*, *Festuca rupicola* ssp. *saxatilis*, *Festuca versicolor* ssp. *dominii*, *Genista tinctoria* ssp. *oligosperma*, *Gentiana cruciata* ssp. *phlogifolia*, *Gypsophila petraea*, *Heracleum carpaticum*, *Koeleria macrantha* ssp. *transsilvanica*, *Leontodon pseudotaraxaci*, *Leontodon repens*, *Minuartia verna* ssp. *oxypetala*, *Nigritella carpatica*, *Onobrychis montana* ssp. *transsilvanica*, *Oxytropis carpatica*, *Poa granitica* ssp. *disparilis*, *Poa rehmannii*, *Primula elatior* ssp. *poloninensis*, *Primula wulfeniana* ssp. *baumgarteniana*, *Saxifraga mutata* ssp. *demissa*, *Scabiosa lucida* ssp. *barbata*, *Sesleria heuflerana*, *Silene nutans* ssp. *dubia*, *Soldanella hungarica* ssp. *major*, *Thesium kernerianum*, *Thlaspi dacicum* ssp. *banaticum*, *Thlaspi dacicum* ssp. *dacicum*, *Thymus comosus*, *Thymus pulcherrimus pulcherrimus*, *Trisetum fuscum*

2 *Calamagrostion villosae* Pawł. et al. 1928 — Woolly small–reed tall grass communities

Aconitum moldavicum ssp. *hosteanum*, *Aconitum napellus* ssp. *firmum*, *Alchemilla czywczynensis*, *Alchemilla decurrens*, *Alchemilla gorcensis*, *Alchemilla lorata*, *Alchemilla multiloba*, *Alchemilla obesa*, *Alchemilla sericoneuroides*, *Alchemilla stanislae*, *Alchemilla subtatrica*, *Alchemilla tatricola*, *Alopecurus pratensis* ssp. *laguriformis*, *Campanula rotundifolia* ssp. *polymorpha*, *Campanula serrata*, *Campanula tatrae*, *Cardaminopsis halleri* ssp. *tatrica*, *Dianthus spiculifolius*, *Festuca carpatica*, *Festuca porcii*, *Heracleum carpaticum*, *Heracleum sphondylium* ssp. *transsilvanicum*, *Hesperis matronalis* ssp. *moniliformis*, *Knautia dipsacifolia* ssp. *pocutica*, *Leucanthemum waldsteinii*, *Leucojum vernum* ssp. *carpaticum*, *Melampyrum saxosum*, *Phyteuma vagneri*, *Poa granitica* ssp. *disparilis*, *Primula elatior* ssp. *carpatica*, *Primula elatior* ssp. *poloninensis*, *Pulmonaria filarszkyana*, *Ranunculus carpaticus*, *Rumex arifolius* ssp. *carpaticus*, *Scabiosa columbaria* ssp. *pseudobanatica*, *Silene nutans* ssp. *dubia*, *Soldanella hungarica* ssp. *major*, *Thymus alternans*, *Thymus pulcherrimus* ssp. *pulcherrimus*, *Trifolium pratense* ssp. *kotulae*, *Trisetum flavescens* ssp. *tatricum*, *Trisetum fuscum*, *Trollius europaeus* ssp. *tatrae*, *Viola declinata*, *Gentianella lutescens* ssp. *tatrae*

3 *Seslerion tatrae* Hadač 1962 — West Carpathian alpine calciphilous grasslands

Alchemilla braun-blanquetii, *Alchemilla pseudothmari*, *Alchemilla smytzniensis*, *Alchemilla subconivens*, *Alchemilla tatricola*, *Antennaria carpatica* ssp. *carpatica*, *Arenaria ciliata* ssp. *tatrensis*, *Artemisia absinthium* var. *calcigena*, *Campanula rotundifolia* ssp. *polymorpha*, *Campanula tatrae*, *Cardaminopsis halleri* ssp. *tatrica*, *Carex sempervirens* ssp. *tatrorum*, *Dendranthema zawadzki*, *Dianthus nitidus*, *Dianthus plumarius* ssp. *praecox*, *Draba aizoides* ssp. *zmudae*, *Erigeron nanus*, *Erysimum pieninicum*, *Erysimum wahlenbergii*, *Erysimum witmannii* ssp. *witmannii*, *Festuca tatrae*, *Festuca versicolor* ssp. *dominii*, *Hieracium carpaticum*, *Hieracium melananthum*, *Hieracium*

virgicaule, *Jovibarba globifera* ssp. *preissiana*, *Knautia kitaibelii*, *Oxytropis carpatica*, *Plantago atrata* ssp. *carpatica*, *Poa molinerii* ssp. *glacialis*, *Poa nemoralis* ssp. *carpatica*, *Primula auricula* ssp. *hungarica*, *Pulsatilla halleri* ssp. *slavica*, *Pyrola carpatica*, *Saxifraga moschata* ssp. *dominii*, *Sesleria sadlerana* ssp. *tatrae*, *Soldanella carpatica*, *Taraxacum pieninicum*, *Thalictrum minus* ssp. *carpaticum*, *Thymus pulcherrimus* ssp. *pulcherrimus*, *Thymus pulcherrimus* ssp. *sudeticus*, *Trifolium pratense* ssp. *kotulae*

4 *Adenostylion alliariae* Br. — Bl. 1926 — Carpathian tall herb communities

Aconitum lasiocarpum, *Aconitum lycoctonum* ssp. *moldavicum*, *Aconitum napellus* ssp. *firmum*, *Alchemilla babiogorensis*, *Alchemilla czywczynensis*, *Campanula rotundifolia* ssp. *polymorpha*, *Cardaminopsis halleri* ssp. *tatrica*, *Centaurea maramarosensis*, *Centaurea phrygia* ssp. *nigriceps*, *Cerintho glabra* ssp. *tatrica*, *Delphinium oxysepalum*, *Euphorbia carpatica*, *Festuca carpatica*, *Heracleum carpaticum*, *Heracleum sphondylium* ssp. *transsilvanicum*, *Hesperis matronalis* ssp. *moniliformis*, *Hesperis nivea*, *Hesperis oblongifolia*, *Chrysosplenium alpinum*, *Knautia dipsacifolia* ssp. *pocutica*, *Leucanthemum waldsteinii*, *Phyteuma vagneri*, *Poa granitica* ssp. *disparilis*, *Primula elatior* ssp. *carpatica*, *Pulmonaria filarszkyana*, *Ranunculus carpaticus*, *Soldanella hungarica* ssp. *major*

5 *Seslerion rigidae* Zoly. 1939 — East Carpathian [*Sesleria rigida*] grasslands

Achillea oxyloba ssp. *schurii*, *Alyssum repens* ssp. *repens*, *Anthemis tinctoria* ssp. *fussii*, *Aquilegia nigricans* ssp. *subscaposa*, *Aquilegia transsilvanica*, *Asperula carpatica*, *Astragalus pseudopureus*, *Astragalus roemeri*, *Athamanta turbith* ssp. *hungarica*, *Campanula kladniana*, *Carduus kernerii* ssp. *lobulatifolius*, *Centaurea reichenbachii*, *Cephalaria radiata*, *Dianthus spiculifolius*, *Dianthus tenuifolius*, *Helictotrichon decorum*, *Linum uninerve*, *Melampyrum herbichii*, *Melampyrum saxosum*, *Pedicularis baumgartenii*, *Primula auricula* ssp. *serratifolia*, *Primula elatior* ssp. *leucophylla*, *Scabiosa columbaria* ssp. *pseudobanatica*, *Silene nutans* ssp. *dubia*, *Thymus comosus*, *Trisetum macrotrichum*

6 *Cystopteridion* Richard 1972 — Middle-European calcareous fern cliffs

Acinos alpinus ssp. *baumgartenii*, *Aconitum moldavicum* ssp. *hosteanum*, *Achillea oxyloba* ssp. *schurii*, *Alopecurus pratensis* ssp. *laguriformis*, *Bupleurum longifolium* ssp. *vapincense*, *Campanula carpatica*, *Campanula rotundifolia* ssp. *polymorpha*, *Dianthus carthusianorum* ssp. *saxigenus*, *Festuca carpatica*, *Festuca rupicola* ssp. *saxatilis*, *Galium pawlowskii*, *Galium transcarpaticum*, *Hieracium caesiogenum*, *Knautia dipsacifolia* ssp. *pocutica*, *Leontodon pseudotaraxaci*, *Poa granitica* ssp. *disparilis*, *Poa rehmannii*, *Poa sejuncta*, *Scabiosa lucida* ssp. *pseudobanatica*, *Sempervivum wettsteinii* ssp. *wettsteinii*, *Silene nutans* ssp. *dubia*, *Silene zawadzki*, *Thymus alternans*

7 *Fagion* Luquet 1926 — Medio-European acidophilous beech forest

Aconitum lasiocarpum, *Aconitum moldavicum* ssp. *hosteanum*, *Aquilegia transsilvanica*, *Centaurea maramarosensis*, *Cyclamen fatrense*, *Dentaria glandulosa*, *Erysimum witmannii* ssp. *witmannii*, *Gentianella austriaca* ssp. *fatrae*, *Hesperis matronalis* ssp. *vrabelyiana*, *Hesperis nivea*, *Hieracium mukacevense*, *Hieracium pocuticum*, *Hylotelephium argutum*, *Molinia ujhelyii*, *Leucojum vernum* ssp. *carpaticum*, *Pulsatilla halleri* ssp. *slavica*, *Pulsatilla subslavica*, *Ranunculus carpaticus*, *Rubus crispomarginatus*, *Rumex arifolius* ssp. *carpaticus*, *Scilla bifolia* ssp. *subtriphylla*, *Sorbus pekarovae*, *Symphytum cordatum*

- 8 *Seslerio–Festucion pallentis* Klika 1931 corr. Zólyomi 1966 — Dealpine calciphile pale fescue grasslands
Anthemis tinctoria ssp. *fussii*, *Biscutella laevigata* ssp. *hungarica*, *Bupleurum falcatum* ssp. *dilatatum*, *Centaurea phrygia* ssp. *retezatensis*, *Centaurea reichenbachii*, *Cotoneaster matrensis*, *Daphne arbuscula*, *Dianthus lumnitzeri*, *Draba lasiocarpa* ssp. *klasterskyi*, *Ferula sadlerana*, *Ornithogalum orthophyllum* ssp. *acuminatum*, *Prangos ferulacea* ssp. *carinata*, *Primula auricula* ssp. *hungarica*, *Pulsatilla halleri* ssp. *slavica*, *Pulsatilla subslavica*, *Seseli gracile*, *Silene nutans* ssp. *dubia*, *Stipa crassiculmis* ssp. *heterotricha*, *Sesleria heufleriana*, *Thalictrum minus* ssp. *pseudominus*, *Thlaspi jankae*
- 9 *Papavero–Thymion pulcherrimi* I. Pop 1968 — Alpine screes of Eastern Carpathians
Alyssum repens ssp. *repens*, *Aubrieta intermedia* ssp. *falcate*, *Campanula kladniana*, *Cardaminopsis neglecta*, *Carduus kernerii* ssp. *kernerii*, *Cerastium arvense* ssp. *lerchenfeldianum*, *Dianthus glacialis* ssp. *gelidus*, *Doronicum carpaticum*, *Erysimum witmannii* ssp. *transsilvanicum*, *Festuca carpatica*, *Festuca nitida* ssp. *flaccida*, *Jovibarba globifera* ssp. *preissiana*, *Papaver alpinum* ssp. *corona–sancti–stephani*, *Poa granitica* ssp. *disparilis*, *Primula elatior* ssp. *poloninensis*, *Silene nutans* ssp. *dubia*, *Silene zawadzki*, *Thlaspi dacicum* ssp. *dacicum*, *Thymus bihoriensis*, *Thymus pulcherrimus*
- 10 *Salicion herbaceae* Br.–Bl. in Br.–Bl. et Jenny 1926 – snow-bed communities of siliceous substrates
Achillea oxyloba ssp. *schurii*, *Alchemilla stanislavae*, *Alchemilla szaferi*, *Alchemilla tatricola*, *Alchemilla versipiloides*, *Alchemilla wallischii*, *Alchemilla zapalowiczii*, *Dianthus spiculifolius*, *Festuca carpatica*, *Chrysosplenium alpinum*, *Leucanthemopsis alpina* ssp. *tatrae*, *Luzula alpinopilosa* ssp. *obscura*, *Poa granitica* ssp. *granitica*, *Poa granitica* ssp. *disparilis*, *Poa nobilis*, *Primula elatior* ssp. *poloninensis*, *Rumex arifolius* ssp. *carpaticus*, *Soldanella hungarica* ssp. *major*, *Taraxacum pawlowskii*
- 11 *Potentillo–Nardion* Simon 1957 — Carpathian mat–grass swards
Bupleurum longifolium ssp. *vapincense*, *Campanula rotundifolia* ssp. *polymorpha*, *Centaurea phrygia* ssp. *carpatica*, *Centaurea phrygia* ssp. *melanocalathia*, *Genista tinctoria* ssp. *oligosperma*, *Hesperis nivea*, *Hieracium krasanii*, *Hieracium lomnicense*, *Hieracium mukacevense*, *Leucanthemum waldsteinii*, *Luzula alpinopilosa* ssp. *obscura*, *Phyteuma tetramerum*, *Phyteuma vagneri*, *Rumex arifolius* ssp. *carpaticus*, *Scabiosa lucida* ssp. *barbata*, *Soldanella hungarica* ssp. *major*, *Trifolium pratense* ssp. *kotulae*, *Viola declinata*
- 12 *Seslerio–Asterion* Hadač 1962 — West Carpathian subalpine calciphilous grasslands
Biscutella laevigata ssp. *hungarica*, *Bromus pannonicus* ssp. *monocladus*, *Campanula carpatica*, *Campanula rotundifolia* ssp. *polymorpha*, *Campanula tatrae*, *Carex sempervirens* ssp. *tatorum*, *Daphne arbuscula*, *Dendranthema zawadzki*, *Dianthus plumarius* ssp. *praecox*, *Knautia kitaibelii*, *Oxytropis carpatica*, *Poa margilicola*, *Poa sejuncta*, *Primula auricula* ssp. *hungarica*, *Pulsatilla halleri* ssp. *slavica*, *Thalictrum minus* ssp. *carpaticum*, *Thalictrum minus* ssp. *pseudominus*
- 13 *Cardamino–Montion* Br. — Bl. 1926 — Montane soft water springs
Aconitum napellus ssp. *moravicum*, *Alchemilla aequidens*, *Alchemilla gorcensis*, *Alchemilla stanislavae*, *Alchemilla subtatrica*, *Alchemilla tatricola*, *Alchemilla zmudae*, *Armeria pocutica*, *Barbarea*

lepuznica, *Cardaminopsis neglecta*, *Festuca porcii*, *Chrysosplenium alpinum*, *Leucanthemum waldsteini*, *Poa granitica* ssp. *disparilis*, *Pulmonaria filarszkyana*, *Saussurea porcii*

- 14** *Pulsatillo slavicae*–*Pinion* Fajmonová 1978 — Western Carpathian calcicolous Scots pine forests

Biscutella laevigata ssp. *hungarica*, *Daphne arbuscula*, *Dendranthema zawadzki*, *Dianthus nitidus*, *Erysimum witmannii* ssp. *witmannii*, *Gentianella austriaca* ssp. *fatrae*, *Knautia slovacica*, *Koeleria tristis*, *Pulsatilla halleri* ssp. *slavica*, *Sorbus pekarovae*, *Dianthus plumarius* ssp. *praecox*, *Festuca tatrae*, *Soldanella carpatica*, *Campanula carpatica*, *Campanula serrata*, *Thymus pulcherrimus* ssp. *sudeticus*

- 15** *Gypsophilion petraeae* Borhidi et Pocs 1957 — Eastern Carpathian calcareous cliff xero-heliophile communities

Achillea oxyloba ssp. *schurii*, *Androsace villosa* ssp. *arachnoidea*, *Andryala levitomentosa*, *Campanula carpatica*, *Campanula kladniana*, *Dianthus spiculifolius*, *Dianthus tenuifolius*, *Draba kotschyi*, *Eritrichium nanum* ssp. *jankae*, *Festuca nitida* ssp. *flaccida*, *Festuca rupicola* ssp. *saxatilis*, *Gypsophila petraea*, *Saxifraga mutata* ssp. *demissa*, *Silene nutans* ssp. *dubia*, *Silene zawadzki*, *Thesium kernerianum*

- 16** *Trisetion fuscii* Krajina 1933 — Carpathian tall-herb meadows

Alchemilla subtatrica, *Leucanthemopsis alpina* ssp. *tatrae*, *Ranunculus altitatisensis*, *Trisetum fuscum*, *Campanula serrata*, *Cochlearia tatrae*, *Cerastium arvense* ssp. *glandulosum* (*Cerastium tatrae*), *Delphinium oxysepalum*, *Soldanella carpatica*, *Trollius altissimus* ssp. *tatrae*, *Sesleria sadlerana* ssp. *tatrae*, *Saxifraga carpatica*

- 17** *Papaverion tatrici* Pawł. et al. 1928 corr. Valachovič 1995 — West Carpathian calcareous screes

Arenaria ciliata ssp. *tatrensis*, *Cerastium arvense* ssp. *glandulosum*, *Delphinium oxysepalum*, *Papaver alpinum* ssp. *tatricum*, *Sesleria sadlerana* ssp. *tatrae*, *Saxifraga moschata* ssp. *dominii*, *Saxifraga wahlenbergii*, *Carex sempervirens* ssp. *tatrorum*, *Festuca carpatica*, *Thymus pulcherrimus* ssp. *pulcherrimus*, *Campanula tatrae*

- 18** *Symphyto-Fagion* Vida 1959 — Trans-Carpathian beech forest

Aconitum lycoctonum ssp. *moldavicum*, *Centaurea maramarosiensis*, *Galium baillonii*, *Hepatica transsilvanica*, *Leucanthemum waldsteini*, *Phyteuma tetramerum*, *Primula auricula* ssp. *serratifolia*, *Ranunculus carpaticus*, *Symphytum cordatum*

- 19** *Festucion versicoloris* Krajina 1933 — West Carpathian garland grasslands

Antennaria carpatica ssp. *carpatica*, *Arenaria ciliata* ssp. *tatrensis*, *Campanula rotundifolia* ssp. *polymorpha*, *Campanula tatrae*, *Pyrola carpatica*, *Soldanella hungarica* ssp. *hungarica*, *Gentianella lutescens* ssp. *tatrae*

- 20** *Festucion carpaticae* Bělohávková et Fišerová 1989 — Carpathian fescue tall grass communities

Carex sempervirens ssp. *tatrorum*, *Festuca carpatica*, *Pulsatilla halleri* ssp. *slavica*, *Trisetum flavescens* ssp. *tatricum*

Acknowledgements

Following experts were responsible for data collection within focal countries:

Michal Hájek, Masaryk University, Brno, Czech Republic

Viera Stanova, Dobromil Galvánek, DAPHNE Institute for Applied Ecology, Bratislava, Slovak Republic

Judit Sándor, CEEWEB, Miskolc, Hungary

Zbigniew Mirek, Institute of Botany, PAS, Kraków, Poland

Halina Piękoś-Mirkowa, Institute of Nature Conservation, PAS, Kraków, Poland

Lydia Tassenkevich, Konstantyn Malynovski, State Museum of Natural History, Lviv, Ukraine

Dan Gurean, Darie Parascan and Marius Danciu, Transilvania University, Brasov, Romania

References

CZECH REPUBLIC

- Balátová–Tuláčková E. 1987. Beitrag zur Kenntnis der Feuchtwiesen des Gebirges Hostýnské vrchy. – Tuexenia, Göttingen, 7: 199–213.
- Balátová–Tuláčková E. et Hájek M. 1998. Feuchtwiesengesellschaften des südlichen Teiles des Landschaftsschutzgebietes Bílé Karpaty Südost–Mähren. – Verh. Zool. – Bot. Ges., Wien, 135: 1–40.
- Duda J. 1950. Beskydská vrchoviště a rašelinné louky. – Přír. Sbor. Ostrav. Kraje, Opava, 11: 66–92.
- Gogela J. 1971. Rostlinná společenstva luční a pastvinné vegetace Hostýnských vrchů. – Ms., dipl. pr., PřF MU Brno.
- Hájek M. 1998. Mokřadní vegetace Bílých Karpat. – Sborn. Přírod. Klubu, Uherské Hradiště, suppl. 4: 1–158.
- Hájková P. & Hájek M. 2000. Streuwiesengesellschaften des Gebirges Hostýnské vrchy und ihre synchorologischen Beziehungen in den mährischen Karpaten. – Linzer Biol. Beitr., 32/2: in press.
- Hájková P. 2000a. Rostlinná společenstva mokřadních luk (svaz *Calthion*) a třídy *Phragmito-Magnocaricetea* v Hostýnských vrších. – Sborník Přírodovědeckého klubu, Uherské Hradiště, 5: sub prelo.
- Havlová M. 2000. Lesní vegetace Chřibů. Ms. – dipl. pr., depon. PřF MU, Brno.
- Chytrý M. et Horák J. 1996. Plant communities of the thermophilous oak forests in Moravia. – Preslia, Praha, 68/1996. 193–240.
- Kubíková J. et Kučera T. 1999. Diverzita vegetace Bílých Karpat na příkladu Předních luk a okolí. – Sborn. Přírodověd. Klubu v Uh. Hradišti, 4: 19–58.
- Kuželová I. 1999. Lesní vegetace Hostýnských vrchů. – Ms., dipl. pr., depon. in PřF MU, Brno.
- Malina P. 1997. Geobotanická charakteristika masívu Lysé hory. Ms., dipl. pr., depon. PřF UP, Olomouc.
- Moravec J. 1995. [ed.]: Rostlinná společenstva České republiky a jejich ohrožení. 2. ed., Severočes. Přír., Litoměřice, suppl. 1995.
- Němec J. 2000. Lesní vegetace severovýchodní části Bílých Karpat. – Ms., dipl. pr., depon. PřF MU, Brno.
- Neuhäuslová Z. et al. 1998. Mapa potenciální přirozené vegetace České republiky. – Academia, Praha.
- Novosadová J. 1999. Vegetace lesních prameništ' Hostýnských vrchů, Vsetínských vrchů a Javorníků. – Ms., dipl. pr., depon. PřF MU, Brno.
- Otýpková Z. 1999. Segetální vegetace Bílých Karpat. – Ms., dipl. pr., depon. PřF MU, Brno.
- Pospíšil V. 1962. Jak pronikaly termofyty do nitra severozápadních Karpat. – Čas. Morav. Mus., Brno, 47: 69–108.
- Rybníček K., Balátová–Tuláčková E. et Neuhäusl R. 1984. Přehled rostlinných společenstev rašeliništ' a mokřadních luk Československa. – Stud. ČSAV, Praha, 1984/8: 1–123.
- Říčan G. 1932. Pastviny okresu vsetínského v moravských Karpatech. – Sborn. Přírod. Společ. Mor., Ostrava, 7: 25–59.
- Sedláčková M. 1978. Lesní společenstva radhoštské skupiny Moravskoslezských Beskyd (Západní Karpaty). Preslia, Praha, 50: 26–47.
- Sedláčková M. 1980. Floristická a fytoocenologická charakteristika státní přírodní rezervace Trojačka (Moravskoslezské Beskydy). – Čas. Slezsk. Muz., Opava, ser. A., 29: 37–51.
- Tlusták V. 1972. Xerothermní travinná společenstva lesostepního obvodu Bílých Karpat. – Ms., dipl. pr., PřF UJEP Brno.
- Toman M. 1976. Materiál k fytoocenologii společenstev třídy Festuco–Brometea na Pavlovských kopcích (jižní Morava). – Zborn. Ped. Fak. Prešov, Univ. P. J. Šafárika Košice, Bratislava, Přír. Vedy 14/1: 127–134.
- Trávníček B. 1987. Fytoocenologická studie xerothermních a semixerothermních travinných a bylinných společenstev střední Moravy (Středomoravské Karpaty). – Dipl. pr., PrF UP Olomouc.

ROMANIA

- Beldie A. 1967. Flora și vegetația Munților Bucegi. Ed. Acad. R.S.R., București, .
- Beldie A. 1979. Flora României. Determinator ilustrat al plantelor vasculare. Ed. Acad. R.S.R., București, vol. I – 1977, vol. II.
- Burduja C. 1962. Muntele Ceahlău – Flora și vegetația. În Rev. "Ocotirea Naturii" nr. 6.
- Boșcaiu N. 1971. Flora și vegetația Munților Țarcu, Godeanu și Cernei. Ed. Acad. R.S.R., București.
- Ciocârlan V. 1988. Flora ilustrată a României. Determinarea și descrierea speciilor spontane și cultivate. Ed. Ceres, București, vol. I.

- Ciocârlan V. 1990. Flora ilustrată a României. Determinarea și descrierea speciilor spontane și cultivate. Ed. Ceres, București, vol. II.
- Coldea G. 1991. Prodrome des associations végétales des Carpates de sud-est (Carpates Roumaines), Camerino, Università degli Studi, Nouvelle Série, vol. XIII.
- Coldea G., Sanda V., Popescu A., Ștefan N. 2000. Les associations végétales de Roumanie. Tome 1 – Les associations herbacées naturelles, Presses Universitaires de Cluj.
- Danciu M. 1974. Studii geobotanice în sudul Munților Baraolt. Teză de doctorat, București.
- Danciu M., Parascan D., Gurean D., Ularu Pant. 2000. Contribuții la cunoașterea răspândirii în România și a fitocenologiei speciei *Genista germanica* L., Rev. de Silvicultură nr.1-2 (11-12), Brașov.
- Dihoru G., Pârvu C. 1987. Plante endemice în flora României. Ed. Ceres, București.
- Lehrer A., Lehrer M. 1990. Cartografierea faunei și florei României (Coordonate arealografice). Ed. Ceres, București.
- Mihăilescu V. 1963. Carpații sud-estici de pe teritoriul R.P.R. Studiu de geografie fizică cu privire specială la relief. Ed. Științifică.
- Morariu M., Danciu M., Kovacs Att. 1984. Corologia speciei *Cardamine glanduligera* O. Schwarz (*Dentaria glandulosa* W. et K.) în România. În "Studii și cercetări de biologie", Seria "Biologie vegetală", Tom 36, nr.1, Ed. Acad. R.S.R.
- Nyarady E.I. 1958. Flora și vegetația Munților Retezat. Ed. Acad. R.P.R.
- Oltean M., Negrean G., Popescu A., Roman N., Dihoru G., Sanda V., Mihăilescu S. 1994. Lista roșie a plantelor superioare din România. În "Studii, sinteze, documentații de ecologie", Ed. Acad. Rom., Institut. de Biologie, nr. 1.
- Rațiu O., Sălăgeanu Gh. 1968. Cenoze caracteristice vegetației cursului superior al Văii Drăganului (Munții Apuseni). În "Contribuții botanice", Univ. Babeș-Bolyai, Cluj, Grădina Botanică.
- Sanda V., Popescu A., Arcuș, M. 1999. Revizia critică a comunităților de plante din România. Ed. "Tilia Press International", Constanța.
- Săvulescu T. et al. 1952-1976. Flora R.P.R. – Flora R.S.R., vol. I – XIII, Ed. Acad.
- Șuteu Șt. 1968. Vegetația ierboasă de stâncărie din Cheile Râmețului (jud. Alba). În "Contribuții botanice", Univ. Babeș-Bolyai, Cluj, Grădina Botanică.
- Șuteu Șt. 1970. Aspecte ale vegetației lemnoase de stâncărie din Cheile Râmețului. Idem.,
- Tutin T.G. et al. 1991 – 1994. Flora Europaea, Second Edition, Cambridge, University Press, vol. I – V.
- Ularu Pant. 1972. Cercetări asupra cormofitelor din Munții Perșani. Teză de doctorat, București.
- ***** – Herbarul științific al Facultății de Silvicultură și Exploatarea Forestiere din Brașov

SLOVAK REPUBLIC

- Bako J. et al., 1972. Slovensko 2. Príroda. – Obzor, Bratislava, 920 p.
- Bernátová D., Kliment J. 1990. *Astragalo australis-Seslerietum tatrae* ass. nova. in exposures of mesozoic Krížná sheat in Veľká Fatra Mts. (in Slovak). Biológia, Bratislava, 45: 723-729.
- Čerovský J., Feráková V., Holub J., Maglocký Š., Prochádzka F. 1999. Červená kniha ohrozených a vzácnych druhov rastlín a živočíchov SR a ČR Vol. 5. Vyššie rastliny. –Príroda a. s., Bratislava, 456 p.
- Devillers P., Devillers-Terschuren J. 1998. A classification of Palearctic habitats. Natre and environment, No. 78. Council of Europe Publishing.
- Dostál J., Červenka M. 1991. Veľký kľúč na určovanie vyšších rastlín I. – SPN, Bratislava, 777 p.
- Dostál J., Červenka M. 1992. Veľký kľúč na určovanie vyšších rastlín II. – SPN, Bratislava, 777-1568 p.
- Jarolímek I., Zaliberová M., Mucina L., Mochnacký S. 1997. Vegetácia Slovenska. Rastlinné spoločenstvá Slovenska. 2. Synantropná vegetácia. – Veda, Bratislava, 420 p.
- Kliment J. 1999. Komentovaný prehľad vyšších rastlín flóry Slovenska, uvádzaných v literatúre ako endemické taxóny. I., II. – Bulletin Slovenskej botanickej spoločnosti, ročník 21, supplement č. 4, Slovenská botanická spoločnosť pri SAV a Botanická Záhrada UK, Bratislava, 434 p.
- Marhold K., Hindák F. 1998. Checklist of Non-Vascular and Vascular Plants of Slovakia. – Veda, Bratislava, 688 p.
- Michalko J., Magic D., Berta J., Rybníček K., Rybníčková E. 1987. Geobotanical Map of C.S.S.R. Slovak Socialist Republic. Text Part. – Veda, Bratislava, 168 p.
- Mucina L. 1997. Conspectus of Classes of European Vegetation. – Folia Geobot. Phytotax., Praha, 32/2: 117-172 p.
- Rybníček K., Balátová – Tuláčková E. et Neuhäusl R. 1984. Přehled rostlinných společenstev rašeliníšť a mokřadních luk Československa. – Stud. ČSAV, Praha, 1984/8: 1-123.
- Šeffler J., Šefflerová E., Dúbravcová Z., 1989. Numerical syntaxonomy of the tall-forb and tall-grass communities in the Tatra Mountains. Vegetatio, 81: 181-187.
- Tasenkevich L. 1998. Flora of the Carpathians. Checklist of the native vascular plant species. National Academy of Sciences of Ukraine, Lviv, 609 p.
- Uhlířová J. 1992. Reliktne kalcifilné boriny a smrekovcové boriny Veľkej Fatry. I. zväz *Pulsatillo slavicae-Pinion* Fajmonová 1978. Zbor. SNM, Prír. Vedy, Bratislava. 38: 11-42.
- Uhlířová J., 1999. *Festuco tatrae-Pinetum* ass. nova – a new association of the alliance *Pulsatillo slavicae-Pinion* (in Slovak). Bull. SBS, Bratislava, 21: 161-171.
- Valachovič M. 1995. *Papaverion tatrici*, a vicarious alliance of alpine limestone scree communities in the Western Carpathians. Biologia, Bratislava, 50: 377-390.
- Valachovič M., Janovicová K. 1999. Altitudinal differentiation of oligotrophic water-spring vegetation in Slovakia. Thaiszia – J. Bot., Košice, 9: 49-62.
- Valachovič M., Otáhelová H., Stanová V., Maglocký Š. 1995. Vegetácia Slovenska. Rastlinné spoločenstvá Slovenska. 1. Pionierska vegetácia. – Veda, Bratislava, 185 p.
- Valachovič M., Dierssen K., Dimopoulos P., Hadač E., Loidi J., Mucina L., Rossi G., Tendero V.F., Tomaselli M. 1997. The vegetation on screes – a synopsis of higher syntaxa in Europe. Folia Geobot. Phytotax., Praha, 32: 173-192.

HUNGARY

- Borhidi A., Santa A. 1999. Red Book of Hungarian Plant Communities I-II. Termesztudományi Alapítvány Kiado, Budapest.
- Farkas S. 1999. Protected Plants of Hungary. Mezőgazda Kiadó, Budapest.

- Fekete G. Molnár Zs. Horváth F. 1991. Nemzeti Biodiverzitás-monitorozó Rendszer II. A magyarországi élőhelyek leírása, határozója és a Nemzeti Élőhelyosztályozási Rendszer. National Biodiversity Monitoring System II. Description and identifier of the Hungarian habitats and the national Habitat Categorising System. Magyar Természettudományi Múzeum, Budapest.
- Hortobágyi T Simon T. 1981. Növényföldrajz, társulástan és ökológia Plant geography, coenology and ecology. Tankönyvkiadó, Budapest
- Kovácsné Láng E. Török K. 1997. Nemzeti Biodiverzitás-monitorozó Rendszer III. Növénytársulások, társuláskomplexek és élőhelymosaik. National Biodiversity Monitoring System III. Plant communities, community complexes and habitat mosaics. Magyar Természettudományi Múzeum, Budapest.
- Simon T. 1992. Identifier of the Hungarian Vascular Flora. Tankönyvkiadó Vallalat, Budapest.
- Török K. 1997. Nemzeti Biodiverzitás-monitorozó Rendszer IV. Növényfajok. National Biodiversity Monitoring System IV. Plant species. Magyar Természettudományi Múzeum, Budapest.

UKRAINE

- Biodiversity of the Carpathian Biosphere Reserve. 1997. Kyiv, 711 p.
- Vegetation of the Ukr SR. 1973. Naukova Dumka, Kyiv, 428 p.
- Stoyko S. M., Milkina L. I., Solodkova T. I., Tasenkevich L. O., Zayets Z. L., Zhyzhyn M. P. 1980. Nature conservation in the Ukrainian Carpathians and adjacent areas. Naukova Dumka, Kyiv, 261 p.
- Stoyko S. M., Tasenkevich L. O., Milkina L. I., Malynov's'ky K. A. 1982. Flora and vegetation of Carpathian Reserve. Naukova Dumka, Kyiv, 219 p.
- Chopyk V.I. High-mountain flora of the Ukrainian Carpathians. 1976. Naukova Dumka, Kyiv, 267 p.
- Green Book of the UkrSSR (ed. Yu. Shelag-Sosonko). 1987. Naukova Dumka, Kyiv, 213 p.
- Malynov's'ky K.A. 1980. Vegetation of the high-mountain part of the Ukrainian Carpathians. Naukova Dumka, Kyiv, 276 p.
- Malynov's'ky K.A., Kricsfalusy V.V. 2000. High mountain vegetation //Vegetation of Ukraine. Vol. 1. Phytosociocentre, Kyiv, 230 p.
- Stoyko S. M., Milkina L. I., Yashchenko P. T., Kagalo A. A., Tasenkevich L. O. 1997. Rare phytocoenoses of the western regions of Ukraine (The Regional "Green Book"). "Polli", Lviv, 190 p.
- Stoyko S. M., Hadach E., Simon T., Mikhalik S. 1991. Protected ecosystems in the Carpathians. "Svit", Lviv, 248 p.

POLAND

- Balcerkiewicz S. 1984. High-mountain vegetation of the Five Polish Lakes Valley in the Tatra Mts. and its anthropogenic changes. Uniwersytet im. Adama Mickiewicza w Poznaniu, Ser. Biologia 25: 1–191.
- Denisiuk Z., Korzeniak J. 1999. Zbiorowiska nieleśne krainy dolin Bieszczadzkiego Parku Narodowego. Monografie Bieszczadzkie 5: 1–161.
- Dzwonko Z. 1977. Zbiorowiska leśne Gór Słonnych (polskie Karpaty Wschodnie). *Fragm. Flor. Geobot.* 23(2): 161–200.
- Flora polska. 1919–1980. T.I–XIV.
- Jasiewicz A. 1965. Rośliny naczyniowe Bieszczadów Zachodnich. *Monogr. Bot.* 20: 1–338.
- Każmierczakowa R., Zarzycki K. (eds) 2001. Polska Czerwona księga roślin [Polish Plant Red Data Book]. P. 664, W. Szafer Institute of Botany and Institute of Nature Conservation Polish Academy of Sciences, Kraków.
- Kornaś J. 1957. Rośliny naczyniowe Gorców. *Monogr. Bot.* 5: 1–259.
- Kornaś J., Medwecka-Kornaś A. 1967. Zespoły roślinne Gorców. I. Naturalne i na wpół naturalne zespoły nieleśne. *Fragm. Flor. Geobot.* 13(2): 167–316.
- Kulczyński S. 1928. Die Pflanzenassoziationen der Pieninen. *Bulletin international de l'Academie Polonaise des Sciences et des Lettres, Classe des sciences mathématiques et naturelles, Série B Suppl 2: 57–203.*
- Matuszkiewicz W. 1981. Przewodnik do oznaczania zbiorowisk roślinnych Polski. Państwowe Wydawnictwo Naukowe, Warszawa.
- Medwecka-Kornaś A. 1955. Zespoły leśne Gorców. *Ochrona Przyrody* 25: 1–112.
- Michalik S., Szary A. 1997. Zbiorowiska leśne Bieszczadzkiego Parku Narodowego. Monografie Bieszczadzkie 1: 1–175.
- Mirek Z., Piękoś-Mirkowa H. 1992a. Flora and vegetation of the Polish Tatra Mts. *Mountain Research and Development* 12(2): 147–173.
- Mirek Z., Piękoś-Mirkowa H. 1992b. Plant cover of the Western Carpathians (S. Poland). *Veröffentlichungen des Geobotanischen Institutes der Eidg. Tech. Hochschule, Stiftung Rübel, Zürich* 107: 116–150.
- Mirek Z., Piękoś-Mirkowa H. 1992c. Plant cover of the Polish Tatra Mts. (S. Poland). *Veröffentlichungen des Geobotanischen Institutes der Eidg. Tech. Hochschule, Stiftung Rübel, Zürich* 107: 177–199.
- Mirek Z., Piękoś-Mirkowa H. 1992d. Contemporary threat to the vascular flora of the Polish Carpathians (S. Poland). *Veröffentlichungen des Geobotanischen Institutes der Eidg. Tech. Hochschule, Stiftung Rübel, Zürich* 107: 151–162.
- Mirek Z., Piękoś-Mirkowa H., Zajac A., Zajac M. 1995. Vascular plants of Poland. A checklist. *Polish Botanical Studies, Guidebook Series* 15: 1–303.
- Pawłowska S. 1953. Les espèces endémique en Pologne et leur protection. *Ochrona Przyrody* 21: 1–33.
- Pawłowska S. 1972. Charakterystyka statystyczna i elementy flory polskiej. In: W. Szafer, K. Zarzycki (eds.), *Szata roślinna Polski* 2: 129–206. Państwowe Wydawnictwo Naukowe, Warszawa.
- Pawłowski B. 1927. Endemity karpaccie we florze Tatr i ich znaczenie dla historii tej flory. II Zjazd Słowackich Geografów i Etnografów w Polsce 1927. Sekcja III.
- Pawłowski B. 1956. Flora Tatr. Rośliny naczyniowe. Tom I. Flora Tatorum. Plantae vasculares. I. PWN, Warszawa.
- Pawłowski B. 1970. Remarques sur l'endemisme dans la flore des Alpes et des Carpatés. *Vegetatio* 21(4–6): 181–243.
- Pawłowski B. 1972. Szata roślinna gór polskich. In: W Szafer, K. Zarzycki (eds.), *Szata roślinna Polski* 2: 189–252. Państwowe Wydawnictwo Naukowe, Warszawa.
- Pawłowski B., Sokołowski M., Wallisch K. 1928. Die Pflanzenassoziationen des Tatra-Gebirges. VII Teil. Die Pflanzenassoziationen und die Flora des Morskie Oko Tales. *Bulletin international de l'Academie Polonaise des Sciences et des Lettres, Classe des sciences mathématiques et naturelles, Série B Suppl. 2: 205–272.*

- Pawłowski B., Stecki K. 1927. Die Pflanzenassoziationen des Tatra-Gebirges. IV. Teil. Die Pflanzenassoziationen des Miętusia Tales und des Hauptmassivs der Czerwone Wierchy. Bulletin international de l'Academie Polonaise des Sciences et des Lettres, Classe des sciences mathématiques et naturelles, Série B Suppl. 2 (1926): 79–121.
- Piękoś-Mirkowa H., Mirek Z. 1996. Zbiorowiska roślinne. In: Z. Mirek, Z. Głowaciński, K. Klimek, H. Piękoś-Mirkowa (eds), *Przyroda Tatrzańskiego Parku Narodowego. Tatry i Podtatrze 3*: 237–274, Wyd. Tatrzański Park Narodowy; Zakopane – Kraków.
- Piękoś-Mirkowa H., Mirek Z., Miechówka A. 1996. Endemic vascular plants in the Polish Tatra Mts. – distribution and ecology. *Polish Bot. Stud.* 12: 1–107.
- Szafer W., Kulczyński S., Pawłowski B. 1953. *Rośliny polskie*. Państwowe Wydawnictwo Naukowe, Warszawa.
- Szafer W., Pawłowski B., Kulczyński S. 1923. Die Pflanzenassoziationen des Tatra Gebirges. I Teil. Die Pflanzenassoziationen des Chochołowska-tales. Bulletin international de l'Academie Polonaise des Sciences et des Lettres, Classe des sciences mathématiques et naturelles, Série B Suppl. 1–66.
- Szafer W., Pawłowski B., Kulczyński S. 1927. Die Pflanzenassoziationen des Tatra Gebirges. III Teil. Die Pflanzenassoziationen des kościeliska-Tales. Bulletin international de l'Academie Polonaise des Sciences et des Lettres, Classe des sciences mathématiques et naturelles, Série B Suppl. 2: 13–78.
- Walas J. 1933. *Roślinność Babiej Góry*. PROP, Mon. Nauk., Nr. 2, Warszawa.
- Zarzycki K. 1963. *Lasy Bieszczadów Zachodnich (polskie Karpaty Wschodnie)*. Acta Agr. Silvestria, Ser. Silv. 3: 4–132.
- Zarzycki K. 1981. *The vascular plants of the Pieniny Mts. (Western Carpathians). Distribution and habitats*. Państwowe Wydawnictwo Naukowe, Kraków–Warszawa.
- Zarzycki K., Kaźmierczakowa R. (eds) 1993. *Polska Czerwona księga roślin [Polish Plant Red Data Book]*. P. 310, W. Szafer Institute of Botany and Institute of Nature Conservation Polish Academy of Sciences, Kraków.
- Zarzycki K., Szelaż Z. 1992. Red list of threatened vascular plants in Poland. In: K. Zarzycki, W. Wojewoda, Z. Heinrich (eds.), *List of threatened plants in Poland*. pp. 87–98. Instytut Botaniki PAN, Kraków (in Polish with English summary).
- Zemanek B. 1989. *Rośliny naczyniowe Bieszczadów Niskich i Otrytu (polskie Karpaty Wschodnie)*. Zesz. Nauk. Uniw. Jagiell., Prace Bot. 20: 1–185.
- Zemanek B., Winnicki T. 1999. *Rośliny naczyniowe Bieszczadzkiego Parku Narodowego*. Monografie Bieszczadzkie 3: 1–249.

WWF International Danube–Carpathian Programme and the Carpathian Ecoregion Initiative

About the WWF International Danube–Carpathian Programme

WWF recognizes both the Carpathian Mountains and Danube as Global 200 Ecoregions. These are the priority ecoregions identified by WWF as the most valuable, and sometimes most vulnerable, ecoregions in the world which best represent the breadth of biodiversity and ecological processes.

Before the Carpathians and Danube became Global 200 ecoregions, WWF recognised its duty to create its own trans–boundary protection programme to protect the Danube and its threatened wetlands and floodplains. The opportunity arose over a decade ago with the fall of the Iron Curtain, allowing WWF to become more active in the Central and Eastern European countries. In 1992, WWF projects and political activities in the Danube River Basin began with 5 model projects located in natural areas critical for the survival of the river.

In 1998, WWF work in the region was expanded to include an additional focus on the Carpathian Mountains and ecologically sustainable forestry. That same year, the *WWF International Danube-Carpathian Programme* was officially established to co-ordinate WWF activities in the Carpathian Mountains and Danube River Basin.

Today, the mission of the WWF International Danube-Carpathian Programme is to support the conservation, restoration and sustainable management of nature, primarily of freshwater and forest resources, in the Danube River Basin and Carpathian Mountains. This is achieved through an ecoregion planning approach based on model projects, influencing policy, communications, networking, capacity building and crisis response.

About the Carpathian Ecoregion Initiative

The Carpathian Ecoregion Initiative (CEI) was launched in 1999 in response to increasing threats to the unique and valuable Carpathian Mountains ecoregion — an area of

global importance stretching across seven countries and forming a mountainous link between the forests of northern, southern, eastern and western Europe.

The unique character of the Carpathians is also tied to its heritage values, cultural richness and diversity. Maintaining this diversity while sustainably using the natural capital of the region requires the adoption of an inclusive, holistic approach to development planning involving all stakeholders.

Today the CEI is a unique international partnership achieving conservation of nature in the globally important Carpathian region and, at the same time, supporting local economy and culture for the lasting benefit of the people living in the heart of Europe.

Facilitated by WWF, the CEI is an alliance of governmental, non-governmental, funding, scientific and academic organisations, both national and international, seeking to influence the development of the region over the next 50 years. The CEI approach is new, large-scale, long-term and in partnership with local people. It is the first time a project of this magnitude has ever been attempted in the Carpathian region and the first time its conservation has been planned on a 'natural scale' across political boundaries.

As a result of an intensive two-year process, including a major data gathering exercise, it is now possible to demonstrate the true value of the Carpathians for the first time and to prepare this *Carpathian Red List* of threatened species and ecosystems.

- The CEI has a number of achievements since its launch. Key ones include:
 - Agreed *Carpathian Vision* outlining long-term goals for conservation and sustainable development with a specific vision for a protected areas network.
 - Detailed *Status of the Carpathians* report and mini-GIS CD-ROM summarising the results of the Initiative's detailed assessments and GIS analysis, as well as key issues affecting biodiversity and sustainable development in the Carpathians — the first ever overall view of the Carpathians.
 - 30 *Priority Areas* for Biodiversity identified across the region.
 - The *Declaration on Environment and Sustainable Development* signed by 14 Heads of State or their representatives through co-hosting the Summit on Environment and Sustainable Development in the Danube and Carpathian Region (April 2001).
 - Major progress towards the development of a legal structure for the region — working with UNEP on the drafting of a Carpathian Convention.
 - Agreement on basic themes for a *Conservation and Action Plan* for the region.
 - Commitment from major international donors to discuss the development of funding mechanisms for the region.
 - Four Model Project Areas identified, demonstrating the benefits of combining sustainable development and conservation on a local scale.
 - Small local sustainable development projects funded in the Czech Republic, Hungary, Poland, Romania, Slovakia and Ukraine, according to criteria developed by the CEI.
 - Carpathian carnivore reports published, in preparation for the creation of a *Pan-Carpathian Large Carnivore Conservation and Management Plan*.
 - A report on the results of an independent NGO evaluation of the European Union's SAPARD plans and processes.
-

The Carpathian Ecoregion Initiative

- A comprehensive range of communication materials to bring international attention to the importance, vulnerability and opportunities in the region (including a comprehensive website: www.carpathians.org).
- A 2.5 year, comprehensive programme of workshops on Carpathians issues, facilitating cross border co-operation and highlighting the region internationally.

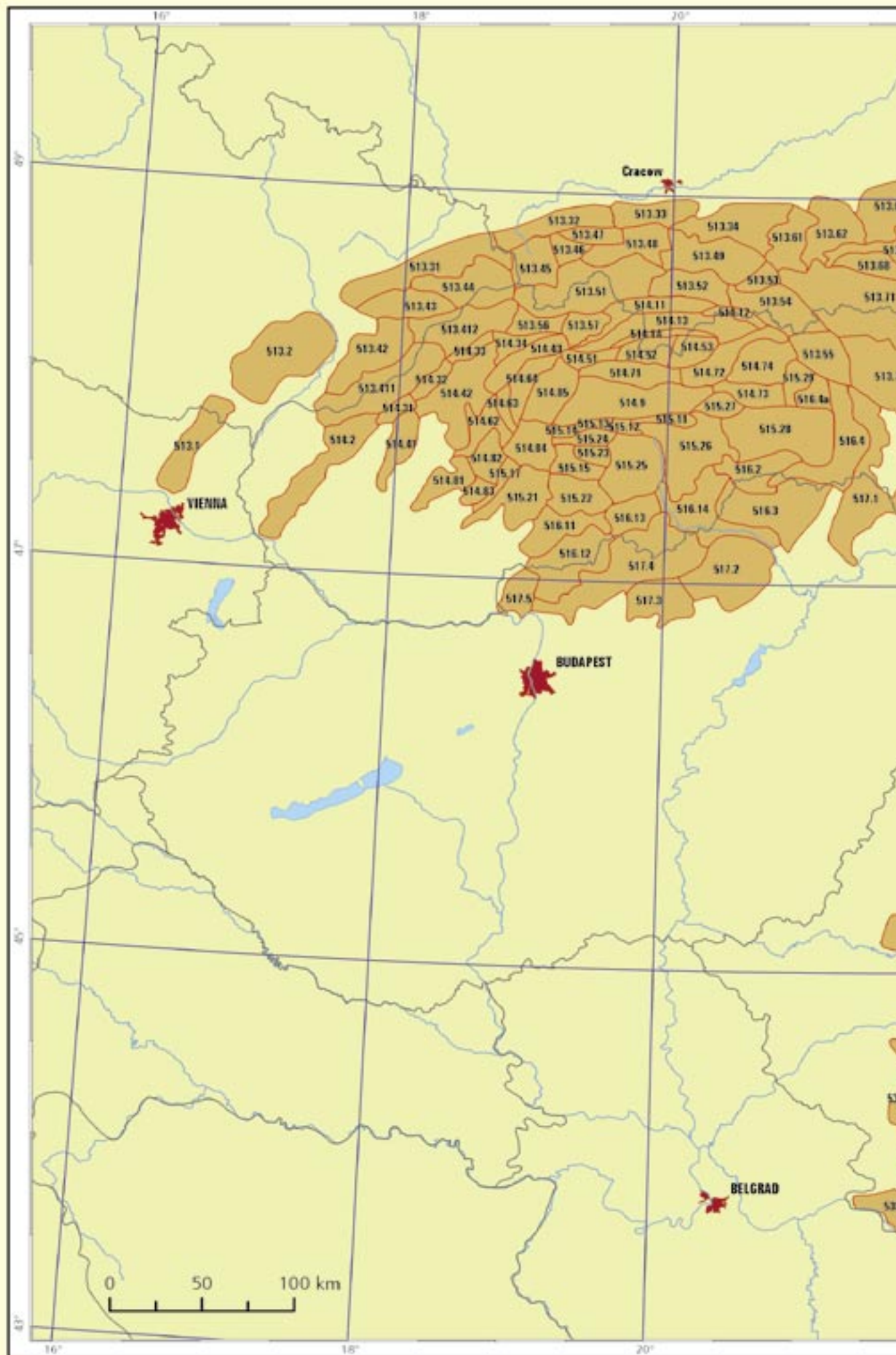
Future activities

The next stage of the Initiative will focus on the agreement and implementation of the Conservation and Action Plan, to feed into the developing Carpathian Convention. The work of the Initiative will fall into 7 categories:

- Biodiversity conservation: protected areas network, effective management of protected areas, large carnivore conservation and management strategy.
 - Sustainable economic and social development: market mechanisms for sustainable production, nature & culture based tourism strategy, pilot projects demonstrating economic benefits
 - Sustainable forestry (including certification)
 - Sustainable agriculture
 - Integrated river basin management
 - Institutional development: strengthening legislation, promoting flexible co-operation, enhancing community participation, capacity building
 - Financial mechanisms: develop co-ordinated investment programme e.g. “Green Carpathian Fund”, together with international donor agencies and national governments
-

Detailed information on the contributors

| | |
|-----------------------|---|
| Holt Suzie | 28 Mill Street, Torrington, Devon, EX 388 AW, United Kingdom ssuzie@carpathians.fsnet.co.uk |
| Król Wiesław | Institute of Nature Conservation PAS, al. A. Mickiewicza 33, 31-120 Krakow, Poland, +48 12 6320549 ext.123, krol@iop.krakow.pl |
| Kukuła Krzysztof | University of Rzeszów, Faculty of Mathematics and Natural Sciences, ul. Rejtana 16c, 35-310 Rzeszow, Poland+48 17 8625628 ext. 1594; kkukula@univ.rzeszow.pl |
| Lasak Rastislav | Daphne – Institute of Applied Ecology, Hanulova 5/d, 844 40 Bratislava, +421 765412162, +421 7654121 33, daphne@changenet.sk |
| Okarma Henryk | Institute of Nature Conservation, al. A. Mickiewicza 33, 31-120 Krakow, Poland, +48 12 4210348, okarma@iop.krakow.pl |
| Pawłowski Jerzy | Institute of Systematics and Evolution of Animals PAS, Natural History Museum, Sw. Sebastiana 9, 31-049 Krakow, +48 12 4225937, +48 12 4225959, pawlowski@isez.pan.krakow.pl |
| Perzanowski Kajetan | The Carpathian Branch, International Centre of Ecology, PAS, Beska 24, 38-700 Ustrzyki Dolne +48 13 4612255,+48 13 4613203, icepas@mikrotech.com.pl |
| Ruzicka Tomas | Environmental Partnership for Central Europe – Czech Republic, Panska 7, 602 00 Brno, +420 542422771, fax +420 542422777, tomas.ruzicka@ecn.cz |
| Samec Sissi | Kaiserbrunnerstr. 73, 3021 Pressbaum, Austria sissi.samec@aon.at |
| Sandor Judit | CEEWEB, 3525 Miskolc, Kossuth u. 13, Hungary, +36 46 413390, +36 46 352010, sandor@ceeweb.org |
| Seffer Jan | Daphne – Institute of Applied Ecology, Hanulova 5/d, 844 40 Bratislava, +421 765412162, +421 765412133 daphne@changenet.sk |
| Solarz Wojciech | Institute of Nature Conservation PAS, al. A. Mickiewicza 33, 31-120 Krakow, Poland, +48 12 6320549 ext.122, solarz@iop.krakow.pl |
| Stanova Viera | Daphne – Institute of Applied Ecology, Hanulova 5/d, 844 40 Bratislava, +421 765412162, +421 7654121 33n daphne@changenet.sk |
| Tasenkevich Lydia | State Museum of Natural History, National Academy of Sciences of Ukraine, 18 Teatralna Str., 79008, Lviv, Ukraine, +380 322 723120, +380 322 742307, tasen@mail.lviv.ua |
| Vlasin Mojmir | Veronica Ecological Institute, Czech Republic, Panska 7, 602 00 Brno, +420 5 422 1 8351, +420 5 422 10 561, mojmir.vlasin@ecn.cz |
| Witkowski Zbigniew J. | Institute of Nature Conservation PAS, al. A. Mickiewicza 33, 31-120 Krakow, Poland, +48 12 6320549 ext.121, witkowski@iop.krakow.pl |



List of mesoregions ordered by codes

| | | | | | |
|---------|-------------------------------|--------|--------------------------------------|--------|--------------------------|
| 513.1 | Rakusko-Jihomoravke Karpaty | 515.23 | Polana | 531.4 | Poiana Rusca |
| 513.2 | Stredomoravske Karpaty | 515.24 | Bystricka vrchovina | 531.11 | Muntii Bucegi |
| 513.31 | Podbeskydska pahorkatina | 515.25 | Veporske vrchy | 531.12 | Leaota |
| 513.32 | Pogorze Slaskie | 515.26 | Stolice vrchy | 531.13 | Piatra Craiului |
| 513.33 | Pogorze Wielickie | 515.27 | Slovensky Raj | 531.14 | Muntii Iezer |
| 513.34 | Pogorze Wisnickie | 515.28 | Volovske vrchy | 531.15 | Muntii Fagarusului |
| 513.411 | Bile a Biele Karpaty | 515.29 | Branisko a Bachure | 531.16 | Depresiunea Lovistei |
| 513.412 | Javorniky | 516.2 | Slovensky kras | 531.17 | Cozia |
| 513.42 | Vizovicka vrchovina | 516.3 | Cserhati dombsag | 531.21 | Muntii Capatini |
| 513.43 | Hostynsko-Vsetynska hornatina | 516.4 | Kosicka kotlina | 531.22 | Muntii Paringului |
| 513.44 | Moravsko-Sliezke Beskydy | 516.4a | Sarisska vrchovina | 531.23 | Depresiunea Lotrului |
| 513.45 | Beskid Slaski | 516.11 | Krupinska planina | 531.24 | Muntii Lotrului |
| 513.46 | Kotlina Zywiecka | 516.12 | Ipelska kotlina | 531.25 | Muntii Cindrel |
| 513.47 | Beskid Maly | 516.13 | Lucenecka kotlina | 531.26 | Muntii Sureanu |
| 513.48 | Beskid Makowski | 516.14 | Rimavska kotlina | 531.31 | Depresiunea Petrosani |
| 513.49 | Beskid Wyspowy | 517.1 | Slanske vrchy | 531.32 | Muntii Retezatului |
| 513.51 | Beskid Zywiecki | 517.2 | Bukk | 531.33 | Muntii Godeanu |
| 513.52 | Gorce | 517.3 | Matra | 531.34 | Muntii Tarcu |
| 513.53 | Kotlina Sadecka | 517.4 | Cserhat-hegyseg | 531.35 | Culoarul Cerna |
| 513.54 | Beskid Sadecki | 517.5 | Borzony a Burda | 531.36 | Muntii Vilcanului |
| 513.55 | Cergov | 522.11 | Grzbiety Sanocko-Turczanskie | 531.37 | Muntii Mehedinti |
| 513.56 | Kysucka vrchovina | 522.12 | Bieszczady Zachodnie | 532.1 | Subcarpatii Ardzeszu |
| 513.57 | Oravska Magura | 522.13 | Skolivski Beskidy | 532.2 | Subcarpatii Aluty |
| 513.61 | Pogorze Roznowskie | 522.14 | Verchno-Dnistrivski Beskydy | 532.3 | Subcarpatii Oltenskie |
| 513.62 | Pogorze Cieczkowskie | 522.15 | Gorgany | 533.1 | Culoarul Timis-Cerna |
| 513.63 | Pogorze Stryzowskie | 522.16 | Pokutsko-Bukovynski Karpaty | 533.2 | Muntii Sureajului |
| 513.64 | Pogorze Dynowskie | 522.21 | Polonyna Rivna | 533.3 | Muntii Locvei |
| 513.65 | Pogorze Przemyskie | 522.22 | Polonyna Borzava | 533.4 | Depresiunea Almajului |
| 513.67 | Kotlina Jasielsko-Krosnienska | 522.23 | Polonyna Krasna | 533.5 | Muntii Semenic |
| 513.68 | Pogorze Jasieskie | 522.24 | Sydyvec | 533.6 | Muntii Aninei |
| 513.69 | Pogorze Bukowskie | 522.25 | Czarnohora | 533.7 | Depresiunea Caras-Resita |
| 513.71 | Beskid Niski | 522.26 | Hyrnjavski hory | 533.7a | Dealurile Carasului |
| 513.72 | Ondavska vrchovina | 523.1 | Muntii Maramuresului | 533.8 | Muntii Dognecei |
| 514.2 | Male Karpaty | 523.2 | Depresiunea Maramuresului | 541.1 | Podisul Somesan |
| 514.9 | Nizke Tatry | 523.31 | Muntii Rodnei | 541.2 | Podisul Transilvan |
| 514.11 | Kotlina Orawsko-Nowotarska | 523.41 | Mestecanis | 541.3 | Depresiunea Mures-Turda |
| 514.12 | Pieniny | 523.42 | Muntii Giumalaul-Raraul | 541.4 | Podisul Tirnavelor |
| 514.13 | Pogorze Spisko-Gubalowskie | 523.43 | Pietros | 542.1 | Muntii Bihorulului |
| 514.14 | Podtatranska brazda | 523.44 | Budacu | 542.21 | Muntii Zarandului |
| 514.31 | Trencianska kotlina | 523.45 | Ceahlau | 542.22 | Muntii Metaliferi |
| 514.32 | Ilavska kotlina | 523.46 | Muntii Giurgeului | 542.23 | Muntii Trascaului |
| 514.33 | Bytcianska kotlina | 523.47 | Muntii Hasmas | 542.31 | Muntii Codrului |
| 514.34 | Zilinska kotlina | 523.51 | Vihorlat | 542.32 | Depresiunea Beiusului |
| 514.41 | Povazsky Inovec | 523.52 | Makovycja | 542.33 | Padurea Craiului |
| 514.42 | Strazovske vrchy | 523.53 | Buzora | 542.34 | Depresiunea Vad |
| 514.43 | Mala Fatra | 523.54 | Tupyj | 542.41 | Muntii Muntele Ses |
| 514.51 | Chocske vrchy | 523.55 | Muntii Oasului | 542.42 | Muntii Mesesului |
| 514.52 | Zapadne Tatry | 523.56 | Muntii Gutiiului | 542.43 | Depresiunea Simleu |
| 514.53 | Vysoke a Belianske Tatry | 523.57 | Muntii Tiblesului | | |
| 514.62 | Hornonitrianska kotlina | 523.61 | Muntii Birgaului | | |
| 514.63 | Ziar | 523.62 | Muntii Calimani | | |
| 514.64 | Turcianska kotlina | 523.63 | Muntii Harghita | | |
| 514.71 | Liptovska kotlina | 523.64 | Muntii Baraolt | | |
| 514.72 | Popradska kotlina | 523.65 | Bodoc | | |
| 514.73 | Hornadska kotlina | 523.66 | Muntii Persani | | |
| 514.74 | Levocske vrchy | 523.71 | Depresiunea Giurgeului | | |
| 514.81 | Tribec | 523.72 | Depresiunea Ciucului | | |
| 514.82 | Vtacnik | 523.73 | Depresiunea Brasov | | |
| 514.83 | Pohronsky Inovec | 524.1 | Obcinele | | |
| 514.84 | Kremnicke vrchy | 524.2 | Muntii Stinisoarei | | |
| 514.85 | Velka Fatra | 524.3 | Muntii Tarcaului | | |
| 515.11 | Helpianska kotlina | 524.4 | Dolina Trotuszu i Kotlina Darmanesti | | |
| 515.12 | Breznianska kotlina | 524.5 | Muntii Ciucului | | |
| 515.13 | Lopejska kotlina | 524.6 | Muntii Nemira | | |
| 515.14 | Bystricke podolie | 525.1 | Muntii Vrancei | | |
| 515.15 | Zvolenska kotlina | 525.2 | Muntii Buzaului | | |
| 515.17 | Ziarska kotlina | 525.3 | Muntii Girbova | | |
| 515.21 | Stiavnicke vrchy | 526.1 | Subcarpatii Moldovei | | |
| 515.22 | Javorie | 526.2 | Subcarpatii Munteniei | | |