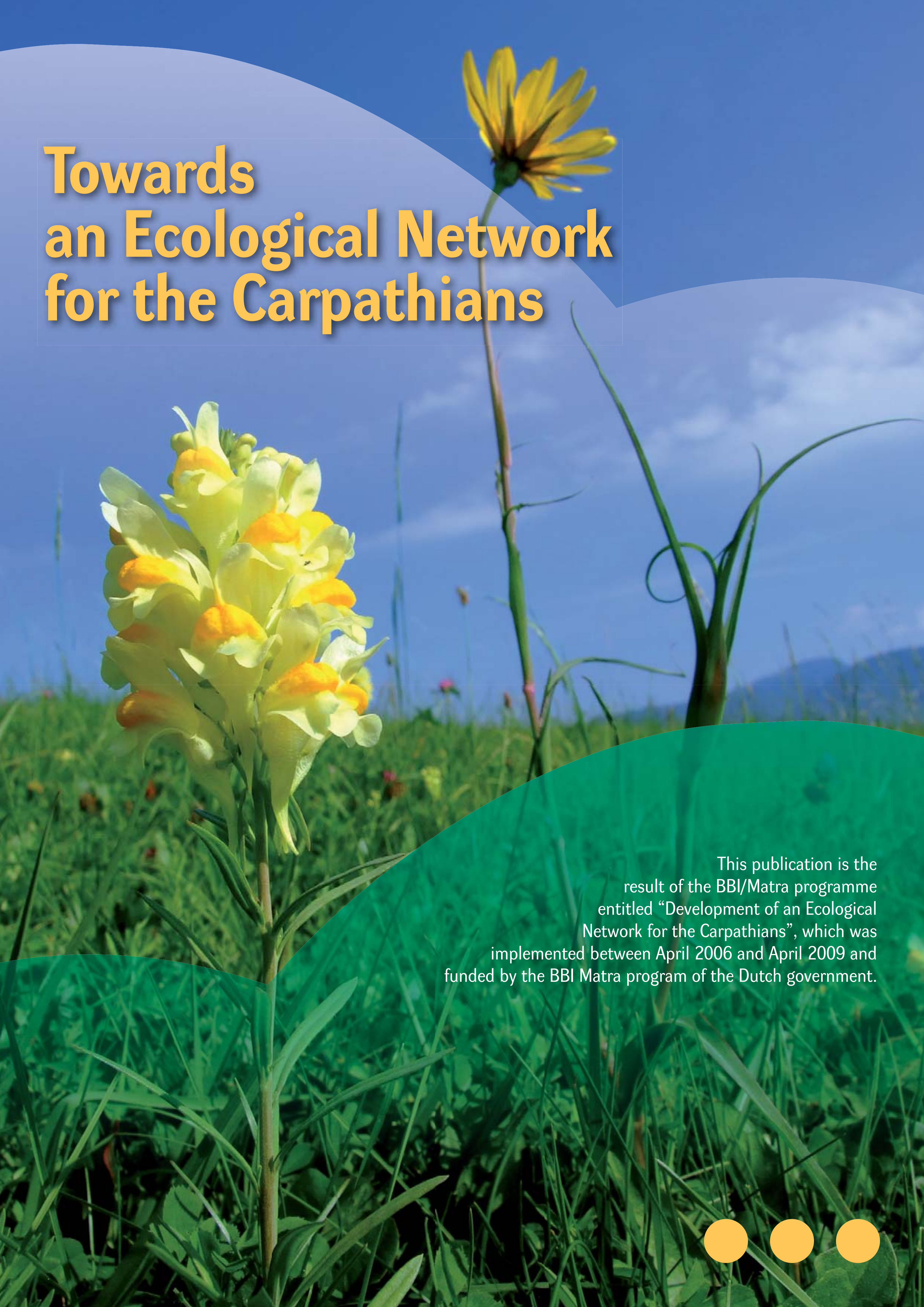

Towards an Ecological Network for the Carpathians

This publication is the result of the BBI/Matra programme entitled “Development of an Ecological Network for the Carpathians”, which was implemented between April 2006 and April 2009 and funded by the BBI Matra program of the Dutch government.

Preface

The purpose of the project was to support the implementation of the 'Convention on the Protection and Sustainable Development of the Carpathians' (hereinafter Carpathian Convention) that entered into force in January 2006 after ratification by four contracting parties. The development of an ecological network in the Carpathians, as a constituent part of the Pan-European Ecological Network, is one of the important objectives of the Convention.

The ecological network designed, serves as an important tool for governments and the Interim Secretariat of the Carpathian Convention for the planning of sustainable development.

The project was carried out under the overall responsibility of Wageningen International (part of Wageningen University) and in cooperation with the Carpathian Ecoregion Initiative (CERI), which was responsible for the project implementation in the three target countries.

Partner organisations were WWF – The Danube Carpathian Program (Austria), Daphne – Institute for Applied Ecology (Slovakia), and Orbicon (Denmark) Participating organsations were Alterra (Netherlands), the Durrell Institute of Conservation and Ecology and (England), ECNC (Netherlands).

Wageningen International wishes to thank the CERI experts in Romania, Ukraine and Serbia who contributed to the project and, in particular, Anna Guttova, the local project manager, who did a tremendous job in keeping the experts focused and meeting the deadlines. Important for the success of the project were also Jan Seffer and Rastislav Lasak for their work in the development of the Carpathian Biodiversity Information System, Mike Baltzer, Irene Bouwma and Bob Smith for their work on the Ecological Network, and Karina Kitnaes and Monika Chrenkova for their contribution to capacity building and the organisational strengthening of the CERI network.

Henk Zingstra
August 2009

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Table of Contents

1. Introduction

The Carpathian Biodiversity Information System (CBIS) and the proposal for an ecological network for the eastern part of the Carpathians are the two main outcomes of the project funded by the BBI Matra program of the Dutch government. This brochure presents information on how the CBIS was designed, and how the data stored can be retrieved and used. It also clarifies how the CBIS data were used to design the ecological network and, last but not least, it offers recommendations for the use of the proposed ecological network in supporting sustainable development in the Carpathians.

Due to funding restrictions, the project focused on three east Carpathian countries: Romania, Serbia and Ukraine, which together host the largest area of the Carpathians (Fig. 2). Geographically, the Eastern Carpathians also include parts of the Carpathians located in Poland and Slovakia. Data collection in the Western Carpathians (Czech Republic, Poland, Slovakia and Hungary) will be completed by 2010 and is funded by a parallel project.

The proposed ecological network needs to be used with caution, as it is based on the best available information concerning the distribution of biodiversity elements (habitats, species) found in literature and in databases. No field work has been carried out in the framework of the project (see chapter 2 on information concerning the methodology applied).

Ecological networks are crucial in preventing the extinction of habitats and species caused by their isolation, fragmentation and the loss of living space, because networks help to maintain and restore the migration routes between core areas of biodiversity. In the framework of the project, the key requirements for the survival of the important species and habitats occurring in the Carpathians are described and used to identify the core areas in the network. The more conditions vital for the survival of species and habitats an area offers, the more important the area will become in the ecological network. But it is not only the quantity or diversity of the conditions of an area that count; an area with limited diversity but offering conditions which are crucial for the survival of rare or typical species in the Carpathians is also crucial in the ecological network design.

The ecological network concept is an important tool which supports the planning of infrastructure and tourist facilities, the development of agriculture and forestry and the development of housing and industrial complexes. In the event that the construction of one of these elements in an important area of the ecological network is unavoidable, the concept of ecological networks helps to plan to mitigate its potential impact.

The project applied the Systematic Conservation Planning Approach in the ecological network design. This is a long-term process that combines conservation assessment with the process of developing an implementation strategy in collaboration with relevant stakeholders. Conservation assessment is a short-term activity aimed at identifying spatially-explicit priority areas for conservation action.

The ecological network was developed through the application of the most widely used conservation planning software Marxan. (See chapter 3.)

As a first step towards the design of the ecological network, relevant biodiversity data were collected and processed to create the Carpathian Biodiversity Information System (CBIS; see chapter 2). The development of the CBIS builds upon information that was collected for the publication "The Status of The Carpathians" (2001).

The data gathering performed in the framework of this project resulted in the creation of a unique database holding information essential for every organization involved in the planning and sustainable development of the Carpathians; there is no other database holding such a vital amount of up-to-date biodiversity data on the Carpathians.

In addition to the biodiversity data used in designing the ecological network, socio-economic information was used to avoid conflicts with existing infrastructure, trends and approved plans. The information used includes data on the existing road network, ski and tourist resorts, railroads, cities and settlements.

The data stored in the CBIS are freely accessible through the web-site of CERI. Detailed information, such as the precise locations of species and habitats can be made available on request to the Carpathian Convention (interim) secretariat, the governments concerned, and other organizations involved in planning issues in the Carpathians.

The methodology developed to plan the ecological network for the eastern Carpathians, including the use of the Marxan software, will be applied in designing a comprehensive ecological network for the whole of the Carpathians as soon as the data for the western Carpathians becomes available.

The project took into account two other parallel projects: the PIN-MATRA project "Development of an ecological network for large carnivores in Romania" and the PIN-MATRA project "Supporting the development of a National Ecological Network in Ukraine in the framework of the Pan European Ecological Network".

1.1 Rationale and background

The Carpathian Mountains represent one of the most biologically outstanding ecosystems in the world. The Carpathians cover an area of about 210,000 square km, which is approximately five times the size of the Netherlands. The Carpathians have a complex geology, magnificent scenery, vast tracks of forests and meadows, and a wealth of natural biodiversity, unparalleled in Europe. One significant manifestation is the extensive surface of grasslands and meadows, which have been created by clearing the upper level forests for sheep grazing from around the 15th century onwards.

With the exception of Ukraine and Serbia, the Carpathian countries have become members of the European Union, thereby opening the door to increased investments in tourism, agriculture and infrastructure. During last decades, the rural areas have rapidly changed in appearance through, inter alia, the depopulation of villages, the disappearance of traditional land use, the abandonment of extensively-used agricultural areas, and increased tourism and mining activities. All this has had a significant impact on the landscape and biodiversity, and clever planning is required to reduce the negative impact, while allowing for desirable development of the rural economies.

The enlargement of the European Union has led to forming a closed border between the EU and the non-member states (Ukraine and Serbia), sometimes impeding ecological connectivity. The strict border regulations hamper joint and coordinated planning of biodiversity protection and management. For the EU countries, the Birds and Habitats Directives give strict guidance on the way protected areas are identified, designated and managed, but this does not apply to Ukraine and Serbia. It is therefore rather difficult to make a comparable and equal assessment of the value of biodiversity, and to plan a coherent ecological network. Training activities have therefore been included in the project to increase the understanding of the two directives and to encourage the experts from Ukraine and Serbia to apply standardized methods for data gathering and data analyses.

Efforts to protect, maintain and sustainably manage the natural resources of the Carpathians cannot be carried out by one country alone; they require regional cooperation. Transboundary cooperation in achieving and maintaining ecological coherence is a prerequisite. International cooperation in the protection and sustainable development of the Carpathians is also of great importance in the context of the 'Environment for Europe' process and the creation of a Pan European Ecological Network.

The Carpathian Convention gave a boost to cooperation amongst the Carpathian countries in promoting sustainable development. The Convention was initiated by the WWF Danube Carpathian Program and is based on the fact that the Carpathians are a unique natural treasure of great beauty and ecological value, an important reservoir of biodiversity, the headwaters of major rivers, an essential habitat and refuge for many endangered species of plants and animals and Europe's largest area of virgin forests.

The Carpathian Convention aims at ensuring a more effective implementation of already existing instruments, building upon various international programmes, such as the Pan European Biological and Landscape Diversity Strategy, the Ramsar Convention, the CBD and the EU Birds and Habitats Directive.

In order to promote the conservation and sustainable use of biological and landscape diversity, the Parties of the Convention agreed on the following:

- To pursue policies aiming at conservation, sustainable use and restoration of biological and landscape diversity throughout the Carpathians.
- To promote adequate maintenance of semi-natural habitats, the restoration of degraded habitats, and support the development and implementation of relevant management plans.
- To pursue policies aiming at the prevention of introduction of alien invasive species and release of genetically

modified organisms threatening ecosystems, habitats or species, their control or eradication.

- To develop and/or promote compatible monitoring systems, coordinated regional inventories of species and habitats, coordinated scientific research, and their networking.
- To cooperate in developing an ecological network in the Carpathians, as a constituent part of the Pan-European Ecological Network, in establishing and supporting a Carpathian Network of Protected Areas, as well as enhance conservation and sustainable management in the areas outside of protected areas.
- To take appropriate measures to integrate the objective of conservation and sustainable use of biological and landscape diversity into sectoral policies, such as mountain agriculture, mountain forestry, river basin management, tourism, transport and energy, industry and mining activities.

Careful planning requires that reliable data on the occurrence and distribution of biodiversity data are available and accessible. The Carpathian Biodiversity Information System (CBIS) that was developed in the framework of this project, and is hosted by Daphne (Bratislava, Slovakia) and managed by the Carpathian Eco-region Initiative (CERI), is a window to reliable information on the biodiversity of the Carpathians. In this project the data were used to design an ecological network for the Eastern Carpathians.

The Carpathian Eco-region Initiative

In 1999, the Carpathian Ecoregion Initiative (CEI) began as an informal network of more than 50 organizations (governmental, non-governmental, funding, scientific and academic organisations) from the seven Carpathian countries with the shared aim of conserving the globally-important biodiversity of the Carpathians, and at the same time, ensure sustainable livelihoods. The CEI evolved out of the WWF's Global 2000 Programme. The main output in the early stages of CEI was the drafting of the "Status of the Carpathians" in 2001. The document presented for the first time the threats and values of the whole Carpathian region, and helped to pave the way for two important events in the Carpathians:

- The Bucharest Summit in 2001 with the adoption of the Declaration on Environment and Sustainable Development in the Carpathian-Danube region.
- The negotiation process for the Carpathian Convention, which was signed in 2003 in Kiev.

After a period of decline in membership and restructuring, the Carpathian Eco-region Initiative (CERI) was re-established in March 2005 as an independent legal entity. On 1st March 2006, a CERI Secretariat was established in Bratislava, Slovakia. Since then, CERI has functioned as a network of equal members where their potential, experience, skills and focus have set the direction in which CERI develops its activities.

The aim of CERI is to secure lasting measures for conservation and sustainable development in the Carpathian mountain range. It is only through a sound scientific knowledge of the region that actions for the future can be effectively planned. This project supported the preparation and finalization of the CERI Development Strategy, which was approved at the 4th General Assembly in Brasov, Romania in autumn 2007.

The CERI experts in the three target countries were contracted by the CERI secretariat to collect and analyse biodiversity data and to help to process these data into the CBIS. CERI experts played a crucial role in analysing the data and making them applicable for the design of the ecological network.

Since CERI is a network organisation, its survival depends both on getting projects supported and on "selling" its knowledge and experience.

2. Carpathian Biodiversity Information System

2.1 Introduction

The development of the Carpathian Biodiversity Information System (CBIS) is based on existing biodiversity data in published and/or non-published information sources in the Carpathian countries. The development of the CBIS started in 1999, established on the assumption that careful planning in the Carpathians would need to be based on a full overview of the unique wealth of biodiversity in the area. In order to be able to distinguish areas with high biodiversity values from areas which are less important for biodiversity, the Carpathians were split up in orographic units. For Annex I and II priority habitats and species of the EU Habitats Directive, more precise information about the location was gathered and stored. Additional spatial information from national and/or international sources (CORINE Landcover and the Digital Elevation Model) was used for data analyses and mapping outputs. The first results of the data gathering, analysing and storing were published in 2001 in the "Status of The Carpathians". (The publication is available at www.carpates.org/docs/publications/status.pdf).

GIS technology was used to identify the 30 "Priority Areas for Biodiversity" across the region by combining the biodiversity distribution data with CORINE and ESRI databases (Fig. 1). Figure 1 provides also an overview of the number of species within various species groups, including focal ones, as well as the number of habitats, including focal ones.

The process of data collection in the current project was organised and coordinated by Daphne, Institute for Applied Ecology in Bratislava. The actual data collection was carried out by members of the Carpathian Ecoregion Initiative, with the focal organisations of CERI in each country being responsible for contracting the required experts and processing the data.

The main purpose of the data collection and analyses was to use the results for the design of an ecological network, which is to be used as a planning instrument for sustainable development in the Carpathians. (See chapter 3.)

GIS and computer technology were also used in designing the ecological network, using Marxan software. The main advantage of Marxan software is that it can select the best areas to fit all nature conservation objectives, while integrating socio-economic data into the planning process, thus minimising the likelihood of corridors conflicting with, for instance, densely populated areas. For that reason, socio-economic data were collected and processed into the database. (See 2.5.)

Besides information on socio-economic aspects, such as the location and size of cities and roads, information about conservation features is the most important and outstanding quality of the CBIS.

Conservation features are the central building blocks of an ecological network and include species, habitats (or plant associations) and ecological network processes. To act as building blocks of the network, these conservation features should help to define the areas that must be included in the network. There must be sufficient knowledge of the features, including distribution and status, to allow them to be mapped and understood. It is best to have as few features as possible in order to simplify the planning and, therefore, the features selected should ideally represent other, non-selected, features. See chapter 3 for an explanation of the method for designing an ecological network.

Data were collected for each of the selected conservation feature to be processed and included in the Carpathian Biodiversity Information System.

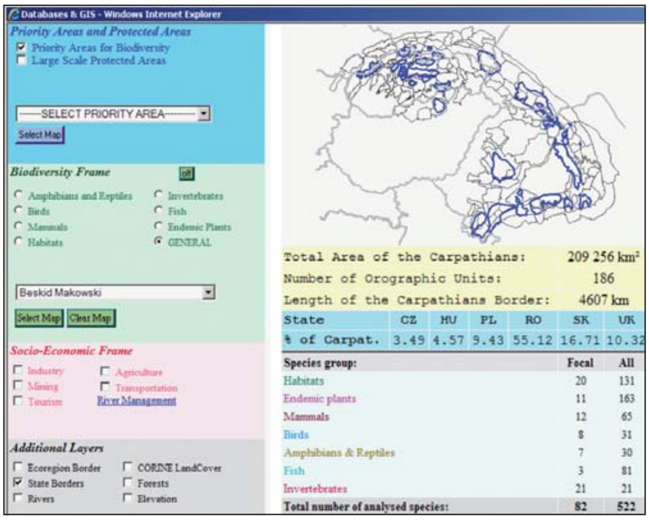


Fig. 1. Carpathian database with simple GIS as published in the Status of the Carpathians.

The information stored in the CBIS is available for anyone interested through http://www.carpates.org/cbis.html. The CBIS is a living system and the information will be regularly updated. Full access to all information (including layers of precise location of species and habitats) is possible through the CERI focal points; Transylvania University in Brasov (responsible Prof. Ioan Abrudan); The State Museum of Natural History in Lviv (Dr. Bohdan Prots) and The Institute for Nature Conservation of Serbia (Dr. Goran Sekulic). They will also have the right to update/correct the information in the CBIS. The overall responsibility rests with CERI, and the CBIS will be managed by DAPHNE – Institute of Applied Ecology (Rasto Lasak) on behalf of CERI.

Access to information about the precise location of species and habitats is also possible for organisations involved in planning in the Carpathians, including governmental and research organisations. To get access to these data, the manager of the CBIS at DAPHNE or the focal points in the respective countries need to be addressed. CERI can be contacted through ceri@changenet.sk

Given the value of the CBIS for planning sustainable development in the Carpathians, it is strongly recommended that the Carpathian Convention and/or Carpathian countries make money available to maintain and update the CBIS. This should be based on an agreement between the Carpathian Convention and the CERI which outlines the purpose of the CBIS, the data requirements and its accessibility.

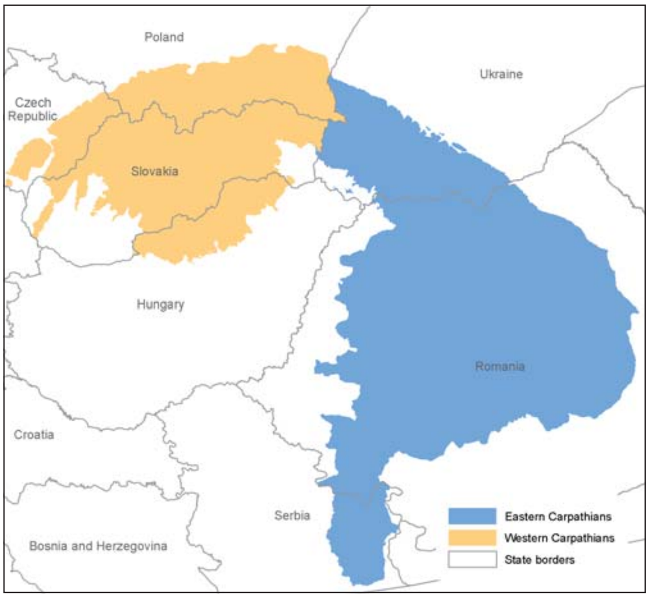


Fig. 2: Division of the Carpathian region into subregions

2.2 Organisation of the data collection

As a first step in the data gathering process, reference lists of species and habitats per country were developed which were used to check the information in the database. The checklist includes:

- 148 semi-natural and natural alliances[1], including Habitat Directive Annex I habitat types of which 84 were selected as priority conservation features for the ecological network design.
- 201 endemic and Habitat Directive Annex II plant species of which 160 were selected to be used for the development of the ecological network.
- 133 pre-selected focal (important for biodiversity of the Carpathians) and Habitat Directive Annex II animal species which were all selected as conservation features for the design of the ecological network.

It transpired that the division into orographic units, used as a base for harmonisation in the Carpathians was too general, especially concerning the borders of particular units. It was, therefore, replaced by a more adequate scheme of landscape regionalization. This scheme was developed manually by using the digital elevation model, with some corrections in the GIS environment (Fig. 3). The estimated geometric accuracy of the obtained geo-dataset of the orographic units corresponds approximately with a 1:100,000 map scale. Each unit was assigned a unique landscape name. In total, 159 orographic units were delineated, covering 147,860 km^2 (Fig. 4).

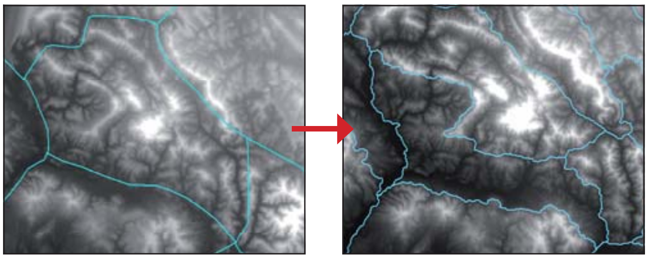


Fig. 3: Refining of orographical units borders base on DEM

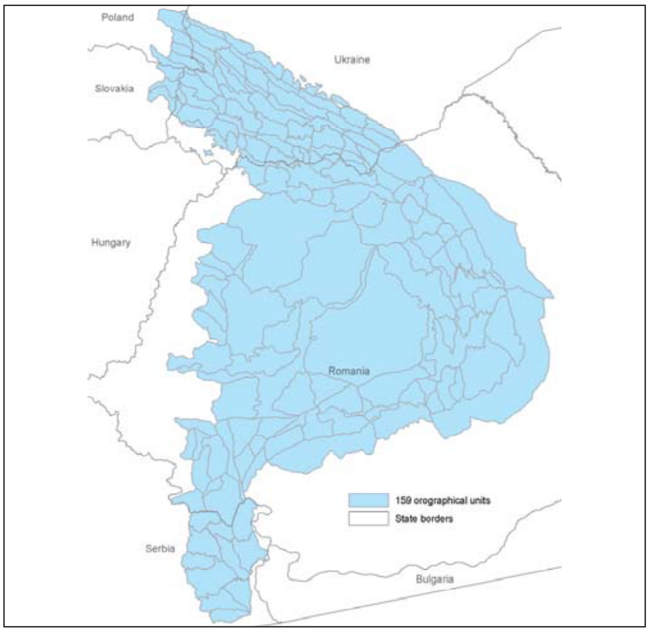


Fig. 4: Orographical units in the Eastern Carpathians

1 An alliance is a unit within the classification of the vegetation used in the Braun-Blanquet approach of habitat mapping, which provides a basis for the description of habitat types of Annex I of the Habitat Directive.

2.3 Information system development

For the purpose of the database development, three national databases were developed in order to enter information on the occurrence of species and habitats per orographic unit (Fig. 5). Linking data with orographic units enables the production of distribution maps. Following this, the affinity of the species and habitats to main CORINE Landcover types and to altitudinal range has been analysed to produce a more precise distribution map. A manual was developed to help the national experts to work with the database.

This working material was put on the CERI website (www.carpates.org). The distribution maps were prepared in cooperation with national GIS experts who provided the GIS files, together with the metadata, for the manager of the CBIS in Bratislava. In summary, the following information per habitat and species was recorded:

- occurrence in orographic units
- affinity to CORINE Land Cover units
- altitudinal range of distribution (based on the affinity of habitats and species to altitude)

Another task for the national experts was to collect precise spatial data (in the scale 1:100,000) on the occurrence of priority species and alliances. Alliance is the most common vegetation unit used in habitat mapping and can be easily linked with priority habitats of the Habitats Directive. The minimal requirement was to indicate as least one precise locality per orographic unit. For freshwater species and habitats, the affinity to stream orders (the size of the stream in terms of width and discharge) was indicated as a means of obtaining more detailed information about the occurrence of freshwater habitats and species.

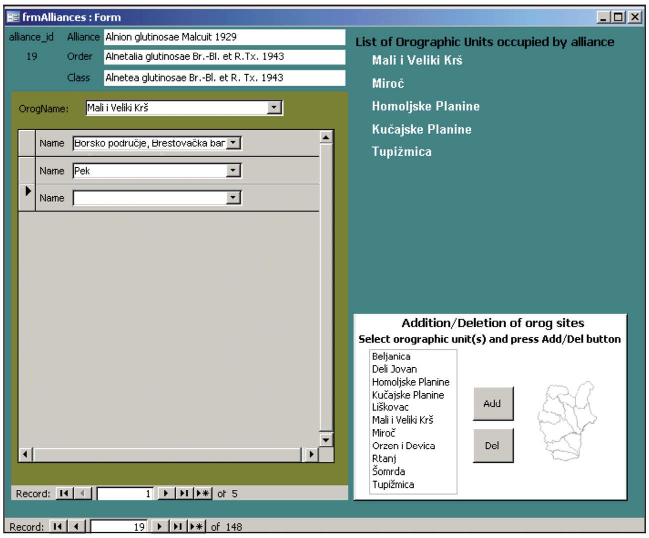


Fig. 5: User data form of the Serbian database

2.4 Content of the CBIS

The development of the CBIS was a step by step process involving national experts on vegetation, habitats and GIS expertise. In summary, the process went as follows:

1. National experts filled in national databases via a user form provided by the CBIS manager to ensure data consistency
2. National GIS experts refined the borders of orographic units to a scale 1:100,000 and prepared GIS layers of more precise occurrence of priority conservation features.
3. CERI experts checked the data provided by national experts during joint meetings.
4. Data were processed to form the central database of CBIS.

As a result of this intensive process of data gathering, analysing and processing, the CBIS holds information on the distribution of 513 species and alliances (habitats) in more than 13 thousand sites (Table 1).

Habitats

- Number of alliances: 148
- Number of alliances used for eco-network design: 84
- Number of occurences in orounits: 4363
- Number of precise locations GIS layers: 43

Plant species

- Number of plant species: 201
- Number of plants used for eco-network design: 160
- Number of occurences in orounits: 2031
- Number of precise locations GIS layers: 8

Animal species

- Number of animal species: 133
- Number of animals used for eco-network design: 133
- Number of occurences in orounits: 5613
- Number of precise locations GIS layers: 14

Freshwater features

- Number of freshwater features: 31
- Number of freshwater features used for eco-network design: 30
- Number of occurences in orounits: 1121
- Freshwater features precise locations GIS layers are included in above groups.

Table 1: Content of CBIS for the Eastern Carpathians in December 2008

2.5 Socio-economic data

The aim was not only to take biodiversity values into account when designing the ecological network but also try to incorporate threats and opportunities arising from various different land-uses. In order to do so, a map was developed that outlined the current threats and pressures on biodiversity in the area.

To create a map of threats, the following information on land use has been gathered:

- location of roads and information available about the number of vehicles on European roads
- location of railroads
- location of settlements (based on land cover information)
- location of ski-resorts
- overall land use
- less favorable areas for agriculture

In order to develop the general threat map, pressure values have been assigned to the various land uses (see table 2). Also, for some land uses a buffer zone surrounding the area has been created and assigned a certain pressure value, since it is anticipated that certain types of land use will also affect the surrounding area.

Land Cover information combined with other data	
Agricultural Areas outside Less Favorable Areas (LFA)	2
Agricultural Areas inside LFA	1
Grasslands outside LFA	2
Grasslands inside LFA	1
Forests	2
Water Bodies	1
Wetlands	1
Urban Areas/ settlements	5
Roads	5
Railways	5

Table 2: Pressure values assigned to various land uses

The threat map (Fig. 6) was designed by combining land use data with information about the location of roads, cities and settlements, the location of railroads and ski resorts and the pressure values assigned to each land use.

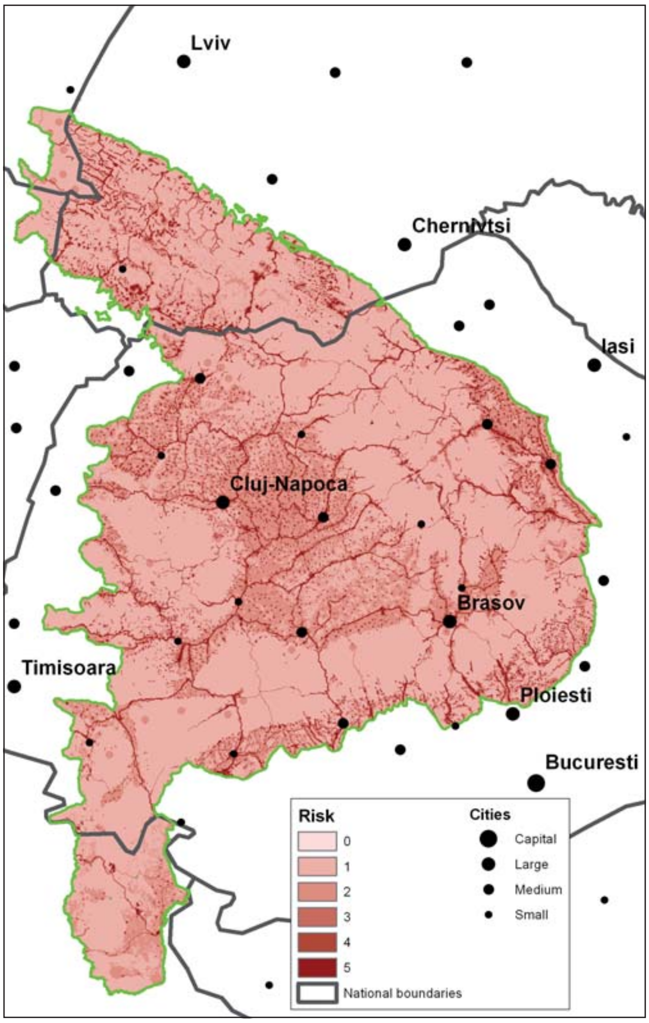


Fig 6: Pressure on biodiversity map

By incorporating this map in the Marxan, the program will, if there are options for choice, preferably choose the areas which are under less pressure.

2.6 From CBIS to ecological network design

The data stored in the CBIS needed to be processed into information that would be manageable for the Marxan software. For this purpose, the following was required:

1. An overview of the distribution of 148 alliances (habitats), 201 plant species and 133 animal species and 31 freshwater species per orographic unit;
2. Information on affinity to land cover units (three categories: low, medium and high);
3. Information on affinity to (range of) altitude;
4. Preparation of polygon layers of precise localities for 84 alliances (habitats), 8 plants species, 14 animal species and 30 freshwater features to be used for the design of the ecological network.

Next, for each conservation feature, the possibility of occurrence in a certain orographic unit was given a "high probability"and a "normal probability" score. In total, 402 targets were set; 355 based on "high probability", 47 based on "normal probability" and 9 species had national targets.

Steps taken in preparing the information stored in the CBIS for use in the Marxan model are elucidated below (Fig. 7).

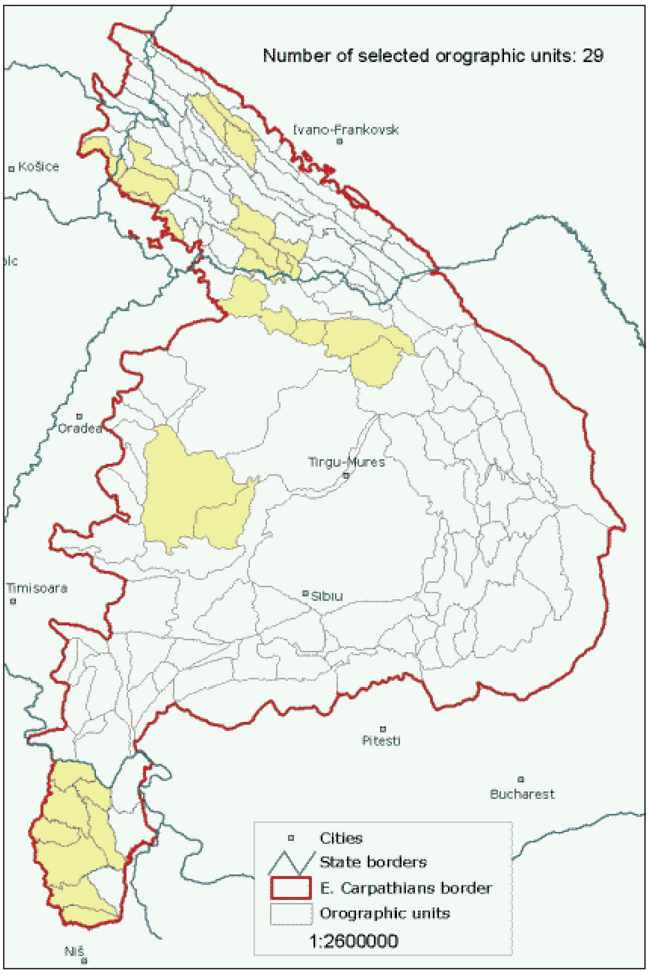


Fig 7: Occurrence of *Myotis bechsteini* per orographic unit

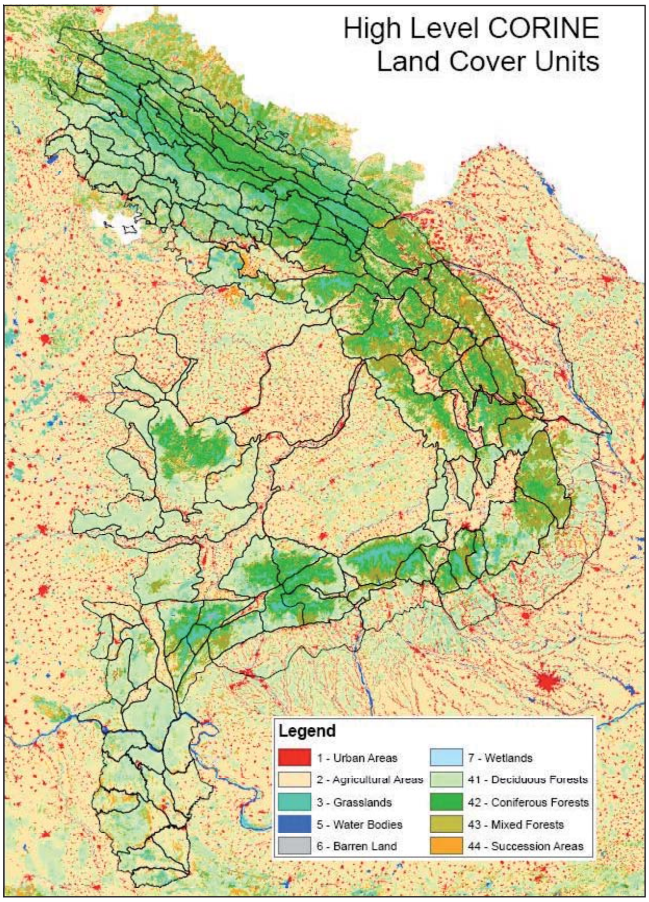


Fig. 8: CORINE Land Cover classes used for modelling of species and habitats distribution

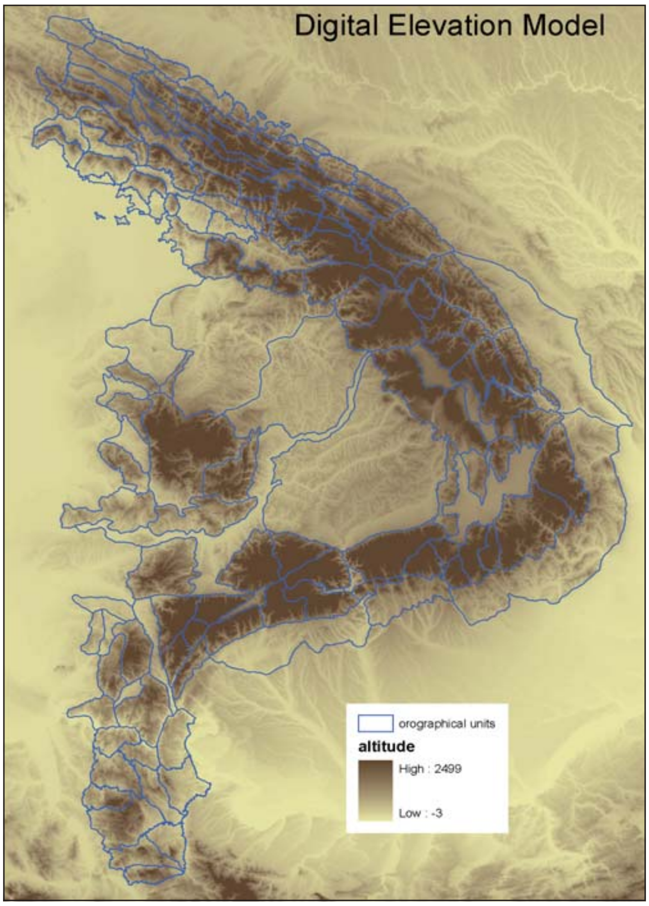


Fig 9: Digital Elevation Model

Land use data

Corine landcover and landuse data are crucial features in an ecological network design. These, however, were lacking in the case of Ukraine. To fill this gap, the Humboldt University of Berlin, together with local experts, were contracted to design GIS layers of the major landcover types, including arable land, broadleaved forest, coniferous forest, mixed forests, dense settlements, open settlements, grasslands, scrubland, water and wetlands on the basis of available satellite Landsat images of Ukraine. Together with the land cover data from Romania and Serbia, the land cover map of the Carpathians was compiled (Fig. 8). In indicating the affinity of species and habitats to a certain form of land use, a more precise indication of the occurrence of the species or habitat can be given. This process is explained in the following sections.

Affinity to altitude

In order to be more precise about the location of the species and habitats, next to the affinity to land use also the affinity to altitude was employed. This was done by using the Digital Elevation Model map (Fig. 9).

Table used to focus on the more precise location of conservation features

Below is an example of how the information on affinity to land use and affinity to altitude was processed into the data base in order to decide on a more precise location for the selected conservation feature. The following table provides information on *Ligularia sibirica* (Fig. 10).

Ligularia sibirica (L.) Cass.

Presence in national lists:

Romania	Serbia	Ukraine
yes		yes

Natura 2000 species: yes

Affinity to CORINE Land Cover units and altitude:

Affinity to Land Cover units			
Land Cover unit	**RO**	**SB**	**UA**
agricultural	0 - not important		0 - not important
barren land	0 - not important		0 - not important
coniferous forests	1 - low		0 - not important
deciduos forests	0 - not important		0 - not important
mixed forests	0 - not important		0 - not important
succesion areas	0 - not important		0 - not important
grasslands	3 - high		3 - high
wetlands	3 - high		0 - not important
water bodies	2 - medium		0 - not important
urban areas	0 - not important		0 - not important
Affinity to altitude			
minimal	500		
maximal	1500		

Reclassification codes and targets (needed for MARXAN)

Reclassification codes (codes from general map of distribution)			
Codes for:	**RO**	**SB**	**UA**
high probability		1120+1130	
normal probability		10x0+1100	
Targets			
Targets for:	**RO**	**SB**	**UA**
high probability		80%	
normal probability		0%	

Fig 10: Table used to decide on more precise location of species and habitats.

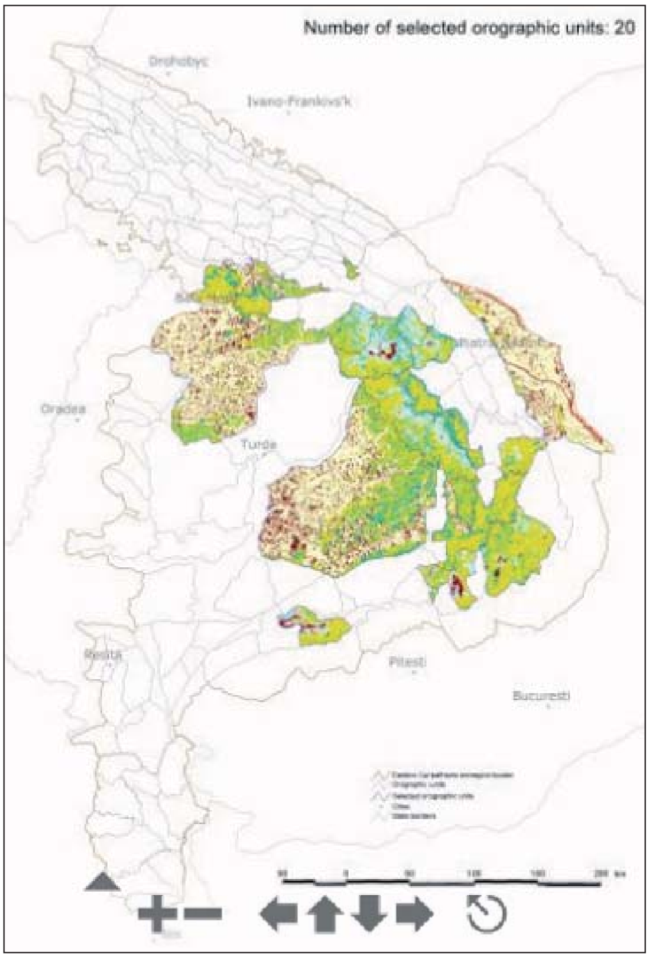


Fig. 11: An example of model distribution of the plant species *Ligularia sibirica*; different colours show different probability of occurrence – blue is the highest one and red the lowest

Distribution maps

Based on the affinity of the selected species and alliances to CORINE Land Cover (CLC) units and altitude, more precise distribution information about these conservation features in the orographic units was produced. The maps which result from this process are potential distribution maps, as they are based on the known relation of the occurrence of species and alliances to altitude and land use (Fig. 11). To link habitats and species with altitude and land use, scientific knowledge concerning the distribution of these conservation features was used, supplemented by estimates from experts. This information was used by the Marxan software to design the ecological network. The distribution maps are available on http://www.carpates.org/cbis.

Ligularia sibirica

2.7 Purpose, benefits and limitations of the CBIS

The Carpathian Biodiversity Information System is a unique database presenting information about the wealth of biological diversity for the whole of the Carpathians. As a result of this project, the information shown for the eastern part of the Carpathians is by far more accurate than the information shown for the western Carpathians but in due course the information for the western Carpathians will be equally accurate.

The database provides a solid basis for the creation of a list of (eastern) Carpathian endemic plants, animals and habitats.

For Serbia in particular, the project helped significantly to gain more insight into the potential value of biodiversity in the Serbian part of the Carpathians.

As outlined above, the purpose of the project goes beyond the mere design of the ecological network for which the data were used in this project. First of all, the CBIS is an indispensable tool for careful planning of various kinds of infrastructure, the development of tourism, mining activities and the development of agriculture.

Overall, the advantage of the CBIS is that it presents a compatible habitat description and interpretation across country borders and, in particular, across the border between Ukraine and Romania.

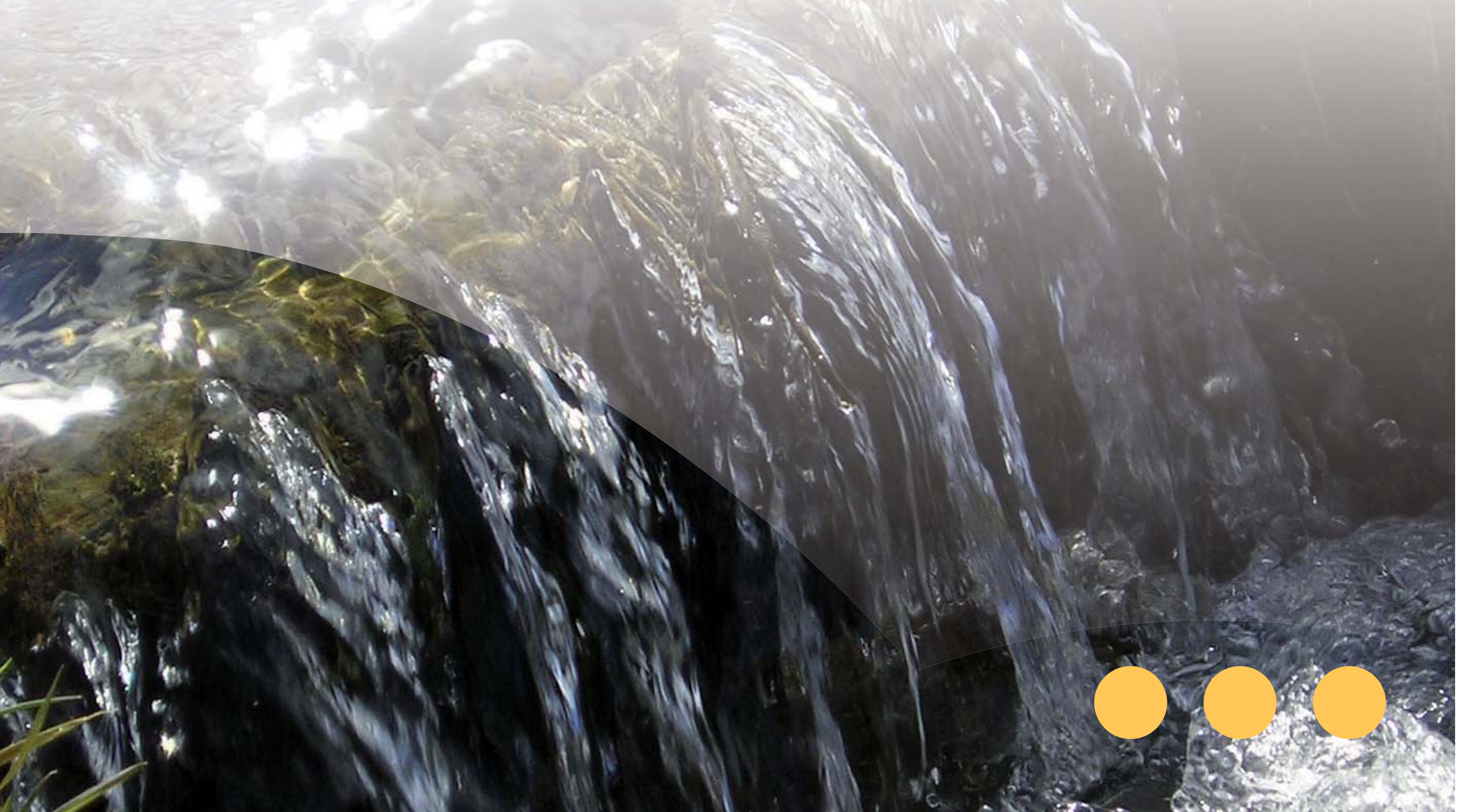
Besides the fact that the CBIS is the best available data source for the distribution of biodiversity data across the Carpathians, the following should be taken into account:

1. Only literature and historical data are used;
2. The methodologies of gathering and assessing the data in the three countries differ slightly;
3. Blank spots on the distribution maps (indicating no records of that conservation target) occur possibly due to a lack of research in that area, with the result that there may be no data available;
4. Old data were not verified in the field;
5. Land cover and altitude affinities result in potential distributions;
6. Affinities to land use and altitude are based partly on estimates;
7. As a result of 5 and 6, potential distribution can be overestimated;
8. Interpretation of habitat types differs slightly in the three countries.

The distribution data of some animal species were verified across national borders.

The fact that slightly different methods of data-gathering and data assessment were used in the three countries has had a minor impact on the overall quality of the database and the distribution maps that have been produced.

The ecological network that has been designed, based on the information stored in the database, is thus a first step in the identification of core areas and corridors. Furthermore, work on data collection and data analyses needs to be carried out to refine the delineation of the proposed network and to decide on the planning of infrastructure and other activities.



3. The Carpathian Ecological Network

3.1 The role of ecological networks

In the 1970s, it became clear that habitat fragmentation was a major cause of biodiversity decline. In response, nature conservationists and policy makers started to develop ecological networks in order to counteract fragmentation (Jongman et al, 2004, Bennet, 2001). The development of ecological networks is primarily based on the Theory of Island Biogeography by McArthur and Wilson (1967). This theory demonstrated that wildlife populations cannot survive in smaller, fragmented (unconnected) patches and that biodiversity depended on the size, shape and connectivity of the habitats available. The larger, more connected and more robust the habitats are, the more likely it is that species populations will survive. Hence, it was from this science that designing connected networks of habitats became a new basis for conservation planning.

One definition of an ecological network is:

'A system of areas between which not only ecological but also physical links exist. Usually such a system consists of the following elements: core areas, corridors, buffer areas and, in some cases, nature development or restoration areas' (adapted from Bennett, 2001).

Ecological network designs are now used as a planning tool aimed at making the conservation activities of various stakeholders in a landscape more focused. The ecological network concept was developed as a way of reconciling the two conflicting demands of economic development and conservation by integrating biodiversity conservation with the exploitation of natural resources. Ecological network plans have become useful tools for mitigating possible future impacts from developments such as, for example, roads. For instance, in the Netherlands and Hungary, the national ecological networks are used by the Ministry of Transport to assess where mitigation measures for National Highways (ecoducts, ecotunnels) are required. In some countries, the ecological network is also used as a tool to identify the areas which are applicable for agri-environmental schemes.

In Europe, habitat fragmentation (and consequent biodiversity loss) has been underway for hundreds of years. The promotion of ecological networks in Europe, therefore, was not only about ensuring the integrity of the natural systems and persistence of biodiversity but was also often a plan for the restoration of the continent's former biodiversity.

Various authors have worked on developing the pros and cons of ecological networks (see text box).

Pros and cons of ecological networks

Arguments in favour of ecological network development

- Flexible in view of landscape development and land use change;
- Alternative funding and resources/tools from those normally used for nature conservation can be applied to achieve conservation results;
- High political and social appeal;
- Helps to promote the need to protect nature outside protected areas, and offers new changes for socio-economic development;
- Offensive strategy in areas where nature restoration is required;
- Better resilience to the stress caused by climate change;
- Provides a long term (inspiring) vision for nature conservation on a larger scale.

Arguments questioning the benefit of ecological networks

- Immobile species or species of old habitats do not benefit from networks in the short term;
- Fragmentation is not the most serious threat to nature. Other factors, such as direct habitat destruction or poaching, are more important;
- Corridors might not be able to alleviate fragmentation;
- Increases demand on scarce resources for nature conservation
- Network may benefit invasive alien species.

In the 1990s, a flurry of nature conservation policies incorporated and acknowledged the ideas and principles of the concept of ecological networks. Globally, there are more than 250 government endorsed ecological networks. (PEBLDS, 1995).

Today, ecological networks are perceived in an integrated and sophisticated way. An increase in natural disasters, including biodiversity loss and the ever-growing consequences of climate change, has led to a broader understanding of the need for robust, intact natural systems that not only support biodiversity but also provide critical ecosystem services and facilitate opportunities for both mitigating and adapting to climate change. There is an increasing recognition of the fact that an ecological network, designed to incorporate these factors, and aimed at achieving a broad set of objectives, is a fundamental component of a sustainable socio-economic development strategy and may even give a region an economic advantage over other areas, when applied creatively.

3.2 The Pan European Ecological Network – lessons learned

In 1995, 57 European countries agreed to the establishment of the Pan-European Ecological Network (PEEN) as part of the PEBLDS (Pan-European Biodiversity and Landscape Diversity Strategy under the Council of Europe (coordinated by the European Centre for Nature Conservation – ECNC).

Within the PEEN, the entire Carpathian region is mapped as a core zone (see Figure 12 below). While this constitutes a clear recognition of both the importance and the relative intactness of the ecosystems in the Carpathians within Europe, it is not a useful practical design for implementation, or in guiding conservation policy in the Carpathians. A more detailed analysis is required for the Carpathians that builds on the CERI work in 2001, and provides a clearer prioritization than the PEEN design.

Across Europe, ecological networks and green veining projects are being planned and integrated into national and regional spatial plans. Forty-two national and regional ecological network initiatives have now been developed across Europe, but are at varying stages of implementation (POST 2008). Within the Carpathian region, Ukraine, Hungary, Slovakia, Czech Republic and Poland have developed national ecological networks.[2]

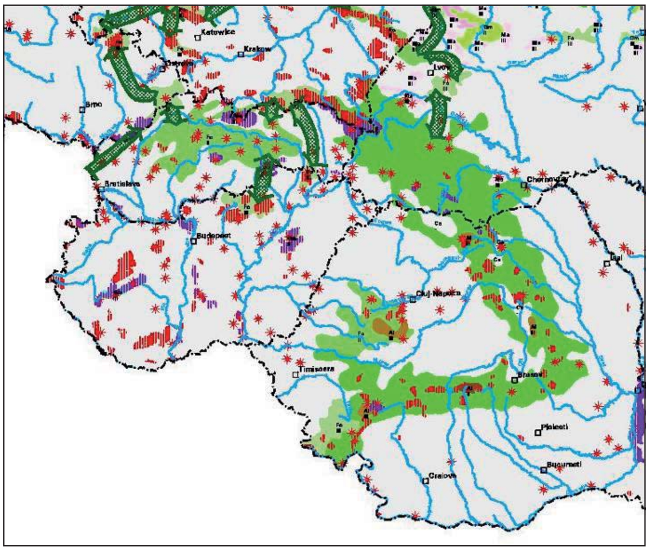


Fig.12: The Carpathian Mountains as core area in the Pan European Ecological Network. (Source; Indicative map for a Pan European Ecological Network; ECNC)

2 Ukraine: PEBLDS implementation – setting the basis for national network in Ukraine, Sepp et al (publication nr. 3 on http://www.iucn-ce.org/publications.php-); Poland: IUCN, 1995a.; Hungary: Erdi, R (ed), 2001. IUCN 1995b.; Slovakia: IUCN, 1996.; Czech Republic: Buček, A., J. Lacina & I. Michal, 1996.

However, the implementation of ecological networks can be complex, as it involves a wide range of stakeholders, with often conflicting views and interests. In consequence, progress in the practical implementation of ecological network projects has so far been quite slow.

Two projects: SPEN – "Spatial Planning and Ecological Networks"; and KEN – "Knowledge for ecological networks – Catalyzing the involvement of stakeholders in the implementation of ecological networks in Europe", carried out by the ECNC in Tilburg, is about increasing our understanding of the process of spatial planning and stakeholder participation in the delivery of ecological networks, respectively, with the objective of identifying critical success factors and common obstacles, as a guide for future action by practitioners and policy makers. The ECNC project has led to an increased understanding of the process of ecological network implementation across Europe, in particular the role of the different stakeholders, and how to secure their positive engagement in the process. It yielded significant new insights, and expertise in ensuring the successful implementation of ecological networks.

The following represents a summary of the main findings of these two ECNC projects.

Three dimensional delivery – The implementation of ecological networks takes place through the three dimensions of: 1) integration of different disciplines and sectors; 2) the forming and integration of strategies and plans at different levels, culminating in implementation plans; 3) all as a step-by-step process, taking place over time.

No universal solutions – Implementation needs to address many facets of the complex social, political and ecological systems which differ according to cultural circumstances. There is no universal recipe for resolving the challenges of successful ecological network implementation. Each region and mix of stakeholders requires a tailored approach and unique solution. However, based on the results of both projects, a number of recommendations on how best to guide the process appear to be widely applicable in the European context.

Scale matters – Strategic decision-making procedures and guidelines are developed at country level, aligning objectives with international and European priorities, with the involvement of a limited number of stakeholders. Depending on the size and governance structure of the country in question, these national strategic guidelines are directly or indirectly (through incorporation into regional plans) translated into land use plans at local level where the actual implementation, with the involvement of stakeholders, takes place. Thus, planning and implementation are part of the same step-by-step cross scale process, where the relative importance of key stakeholder groups changes along the way fluctuates, from the strategic national agenda setting and outlining, down to the actual field level management decisions.

Flexible, open and pragmatic – A successful project owner (the organization or individual responsible for the process) will have to rely on his or her open-minded approach and attitude to achieve good results in the implementation of ecological networks. Proponents of increased ecological connectivity (be it through ecological corridors, stepping stones or green-blue veining can benefit from adopting an open mind and adapting to make the most of opportunities. There are number of steps that can help to create a successful approach, but this guidance needs to be applied in a flexible, open and pragmatic manner.

Specific recommendations for policymaking

Policy makers have an essential role in creating a suitable policy framework to underpin the work of the practitioners in implementing ecological networks. The following main recommendations have been identified:

At national and regional levels:

- Introducing a legally binding status on ecological networks at all geographical levels;
- Ensuring coherence between the planning and establishment of ecological networks at all levels (while taking into account current decentralization processes, in terms of the widespread devolvement of responsibility from national to regional governmental level);
- Recognizing the need (emphasized by the above), for a cross-sectoral approach to ecological network and landscape connectivity implementation, including at EU level (e.g. DG Environment, DG Transport);
- Supporting the generation of new, and dissemination of existing, scientific knowledge, to underpin the argument for, and implementation of, ecological networks;
- Integrating ecological networks in key processes and land use sectors and operations, including:
  - Agriculture: Common Agricultural Policy (CAP) with priority given to agricultural management, connectivity, land abandonment and biofuel production;
  - Transport: with the priority of balancing the green and grey networks;
  - Climate change: with priority given to adaptation measures and connectivity requirements;
  - Water management: exploring the synergies with the implementation of the Water Framework Directive;
  - Marine and coastal issues: with priority given to marine protected areas and marine corridors.
- Creating an ecological network knowledge base with inspiring best practice cases and methodologies, including wider countryside applications; identifying and filling any gaps in the science/knowledge base;
- Creating specific budget lines and innovative funding schemes for the establishment and management of ecological networks at all geographical levels.
- In terms of stakeholder involvement and communication:
- “Holding up the mirror” – rather than always looking at other sectors and suggesting that the relevant sectors are not doing enough (e.g. spatial planning), and considering a broader level of integration of such issues when framing policy and practice;
- Developing targeted European, national and sub-national communication plans for the establishment and management of ecological networks, and the involvement of the public, the various governmental levels, the spatial planning sector, land use sectors and other vital stakeholders, including NGOs.

3.3 Methodology for designing the Carpathian Ecological Network

The science and technology for the design of ecological networks has become increasingly sophisticated. Powerful computers, new software design, and improvements in conservation planning methodologies, allow the design to meet the needs and consideration for implementation, whilst incorporating extensive data and objectivity.

In the early stages of the project, a meeting was held (April 2006) to decide on the methodology and process of the ecological network design. The outcomes of the meeting are listed below.

It was agreed that the aim of the process should be to design a plan for an ecological network covering the eastern part of the Carpathians which would ensure the long-term integrity of the Carpathian ecosystems for nature conservation, climate change adaptation and for provision of ecosystem services.

The following were identified as the main broad goals of the network**:**

- conserving the important features that have been identified as part of existing legislation and planning processes
- attempting to represent all of the biodiversity in the eastern Carpathians, including those habitats, species and ecological processes that are not currently listed for conservation action;
- conserving the components of the Carpathians that provide valuable ecosystem services
- ensuring that the network provides a robust and adaptable system to buffer the impacts of climate change
- increasing the likelihood of effective implementation of the ecological network

- providing the most efficient network possible in order to reduce as far as possible the area of land required for conservation
- making a specific attempt to incorporate freshwater biodiversity wherever possible
- link with existing networks
- provide a platform for the improved implementation of PEEN and EU policies (N-2000)

The step-by-step procedure to develop the ecological network is shown in the box below.

1: select and design the process and methodology
that would best suit the needs of the Carpathian Ecoregion and would achieve the aims and objectives listed above.

2: Identification of Conservation and Socio-economic features
The next stage of the process was to identify a small set of Conservation and Socio-economic features that would act as building blocks for the network.

- **Conservation features** are species, habitats (or plant associations) or ecological network processes. To act as building blocks of the network, these conservation features need to help define the areas that should be included within the network. There must be sufficient knowledge of the features, including distribution and status, to allow them to be mapped and understood. It is best to have as few features as possible, in order to simplify the planning. The features should, therefore, ideally represent a set of other non-selected features.
- **Socio-economic features** are those elements that play a key role in determining the feasibility of successful implementation, and can be mapped. While there are usually a multitude of factors that can be attributed to the success or failure of implementation, the limitation of this process is that it must be possible to map these factors in order to show their link to the distribution of the features.

3: Data collection and collation
For each of the conservation features, data were collected as part of the compilation of data for the Carpathian Biodiversity Database. It was necessary to identify and collect data on those features not already listed for the database. In addition, data on the socio-economic features were collected.

4: Setting conservation targets and parameters for conservation feasibility.
The critical stage of the methodology is the designation of conservation targets to each of the features. Conservation targets set the scope of habitat required to conserve that feature (see the information below on Setting Conservation Targets). In addition to designating conservation targets, a conservation feasibility score was assigned for each area of the eastern Carpathians. This score is based on a system of identifying a ranking according to the probability of achieving conservation in these areas. A low score is gained for an area where it is assumed that conservation has a higher chance of success, such as in protected areas. A higher score was given to those areas where it was considered very unlikely to achieve conservation success such as the centre of cities.

5: Analysis and refinement of targets
Once all the targets are set, the analysis using the Marxan software was made in order to design the most efficient network of places where the targets could be met. The software chooses those areas where the cost is the lowest (i.e. the conservation feasibility score is lowest) against those where the cost is highest. Once the software produced the model ecological network, an examination was made to see if the targets set were realistic and relevant. Final adjustments were made and vital corridors were added where the software had not produced them.

The chosen approach required intensive communication between the data base designers, the experts who collected the data and the experts responsible for the design of the ecological network.

Setting conservation targets

Systematic conservation planning involves setting explicit, quantitative targets for each conservation feature in the planning system.

E.g. 124 km^2 of broad leaved forest
6 populations of at least 50 brown bears
10 freshwater dispersal corridors

These targets need to be based on the best available research and should ensure long-term persistence. The process is designed to avoid political derailment.

By the end of 2008, an expert meeting was organized to set targets for the conservation features mapped and to be processed into the CBIS. The targets to be set have to ensure the long-term survival of the species in the Carpathians.

The following recommendations for the target-setting process were elaborated:

Species:

- Targets are needed for each species mapped in the planning system;
- For most species these must ensure the long-term survival of the species in the Carpathians;
- For some wide-ranging species (e.g. large raptors) the target must ensure the long-term survival of important sub-populations.

  The best approach is to:
  - Divide the species into groups with similar characteristics;
  - Estimate a viable population size for each group (or viable sub-population);
  - Estimate the amount of habitat needed to contain a viable population size;
  - Where appropriate, estimate the amount needed for a population, and draw a map showing the distribution of the population.

Landcover and habitat types

- The final target is calculated as:
  Original extent (ha) * target proportion;
  For example: 3,500 ha * 0.4 = 1,400 ha

  Because targets should be based on the original extent this value needs to be estimated.

  The recommended approach is to:
  - Divide landcover and habitat types into groups with similar characteristics
  - Set percentage of original area of habitat needed for target-setting
  - Estimate percentage which has disappeared

The approach chosen for developing the ecological network required intensive communication between the data base designers, the experts who collected the data and the experts responsible for the design of the ecological network and the application of the Marxan software. Various meetings were organized to harmonize the data collection with the requirements for the ecological network development, and to integrate the socio-economic data into the network design.

3.4 Systematic conservation planning and the use of Marxan software

Systematic conservation planning is an approach to designing Protected Areas systems and other conservation networks. This is a long-term process that combines a conservation assessment with a process for developing an implementation strategy in collaboration with relevant stakeholders. A conservation assessment is a short-term activity for identifying spatially-explicit priority areas for conservation action, so this report describes a conservation assessment for the Eastern Carpathians.

Conservation assessments involve defining the planning region boundaries, and then dividing this region into a series of planning units. The aim of the assessment is to identify a portfolio of these planning units which, if conserved, would achieve the conservation goals of the planning process. There is no specific method for conducting conservation assessments, as they need to be tailored to local conditions (Knight et al., 2006b), but they all share the following four characteristics:

A. ***Spatially explicit.*** Conservation assessments identify priority areas, and so are based on spatial data. This means that any relevant information that cannot be converted into a spatial format has to be excluded from the assessment process.

B. ***Representation and persistence.*** Conservation assessments aim to identify PA systems or other ecological networks that fully represent the planning region's biodiversity, and ensure its long-term maintenance (Knight et al., 2007). Mapping all of this biodiversity is beyond the scope of any assessment, so a set of biodiversity surrogates is used instead. These biodiversity elements, also known as conservation features, are selected based on local conditions and data availability, but they typically include broad environmental surrogates, such as habitat or landcover types, as well as key species and ecological processes (Cowling et al., 2004).

C. ***Target driven.*** Conservation assessments are based on explicit numerical representation targets, so that the priority areas are designed to conserve the specified amount of each conservation feature. This helps ensure that the conservation planning process is not derailed by implicit or explicit political pressures (Cowling et al., 2003). Each target should be developed to ensure the long-term persistence of its associated conservation feature (Pressey et al., 2003).

D. ***Complementarity.*** Conservation assessments recognize that conservation is only one of a number of competing land-uses, and that any priority area system should minimize its impacts on other sectors. The most efficient methods for meeting the conservation targets are based on the concept of complementarity. These methods aim to identify the smallest group of areas which, when combined, meet all of the representation targets (Csuti et al., 1997).

3.5 Using Marxan for conservation planning

The specific feature of Marxan is that it selects planning units to meet representation targets, but it also considers two other factors. First, each planning unit is assigned a "cost" and Marxan acts to minimize the combined planning unit cost of the portfolio, although it will still select expensive planning units, if they are needed to meet the targets. This cost can be a measure of any aspect of the planning unit, such as its area, its risk of being transformed, or the opportunity costs resulting from its protection (Wilson et al., 2005; Richardson et al., 2006). See chapter 2 fig 9 for the cost map. Second, Marxan can be set to select "patches" of planning units preferentially, rather than a series of unconnected units, which might be less ecologically viable and more difficult to manage. Reducing fragmentation levels inevitably results in more planning units being added to the portfolio, so Marxan allows the user to adjust this trade-off by weighting the importance of minimizing the combined external edge of the selected patches by setting a boundary length modifier (BLM) value (Ball and Possingham, 2000).

Every time Marxan is run, it produces two output types. The first shows the 'best solution', i.e. the portfolio with the lowest cost. The second counts the number of times each planning unit was chosen across all portfolios. Units that appear in every portfolio are considered irreplaceable as they were always needed to meet the targets, whereas other units could be swapped with similar units, while still meeting the targets. Those units required to meet targets that cannot be met elsewhere are referred to as irreplaceable. Irreplaceability is thereby used a basis for designing the core building blocks of the ecological network.

In summary, Marxan chooses near-optimal portfolios for planning units which

- Maintain connectivity
- Meet representation targets
- Minimise planning unit costs
- Maintain population viability

Mapping conservation feasibility

The methodology incorporated a system to identify the conservation feasibility score for each planning unit. This score was considered as a cost and this cost was made up of the threat and opportunity for conservation. There are many threats and opportunities for conservation in the Carpathians, but the main limitation for this work was the fact that they needed to be mapped accurately. This meant that the threats and opportunities used for the analysis were all related to different land-use.

In the framework of the development of the conservation feasibility map, socio-economic data were gathered and processed into GIS layers to produce a pressure map. (See part 2.5.)

Incorporating freshwater features

Most ecological networks have not had freshwater factors considered in their design. This is partly due to the focus on large, mobile mammals (and their dispersal needs) but also often due to the difficulties in matching freshwater systems to terrestrial systems. Bearing in mind the importance of freshwater biodiversity in the Carpathians, the opportunities that exist for freshwater conservation, and the critical role the Carpathians play in the drainage systems of the region, it was decided that an attempt should be made to incorporate freshwater factors into the process.

A group of experts was brought together specifically to discuss how to tackle this special issue. The experts identified a separate methodology to incorporate the freshwater factors. This is explained in the following box:

Stepwise procedure, to include freshwater habitats and species in the ecological network design (see also chapter 2.4).

- Identification of occurrence of freshwater habitats and species in ororgraphical units
- Affinity to High Level CORINE Land Cover units (Fig. 8)
- Altitudinal range of distribution (based on the affinity of habitats and species to altitude)
- Affinity to stream orders (the size of the stream in terms of width and discharge) to have more detailed information about the occurrence of freshwater habitats and species
- Indication of naturalness of rivers and streams (natural and undisturbed rivers would get a higher score for inclusion in the ecological network)

Benefits and limitations of the chosen methodology

As described above, the system and methodology used was the most appropriate and most "state-of-the-art" possible, bearing in mind the requirements and limitations. The proposed ecological network is a powerful tool in harmonizing economic development with nature protection. The use and application of new (Marxan) software offered a better insight into the combined use of socio-economic and biological data for planning purposes.

The benefits and limitations of the CBIS and the ecological network which was designed are described in chapter 2.4.

3.6 Results of the analyses and the proposed ecological network

Once all the data and targets had been adjusted to reflect the most accurate assessment of the situation (bearing in mind the limitations listed in 3.5), Marxan was run under various scenarios to identify the optimum ecological network. Some of the results are presented below in order to demonstrate the possible use of the assessment.

Distribution of the number of targets met

As described in chapter 2, targets have to be set for each conservation feature, indicating the minimum area of a habitat, or the population size which will have to be maintained through the establishment of the ecological network. For instance, the target can protect 40% of the original cover of endemic and threatened alliances.

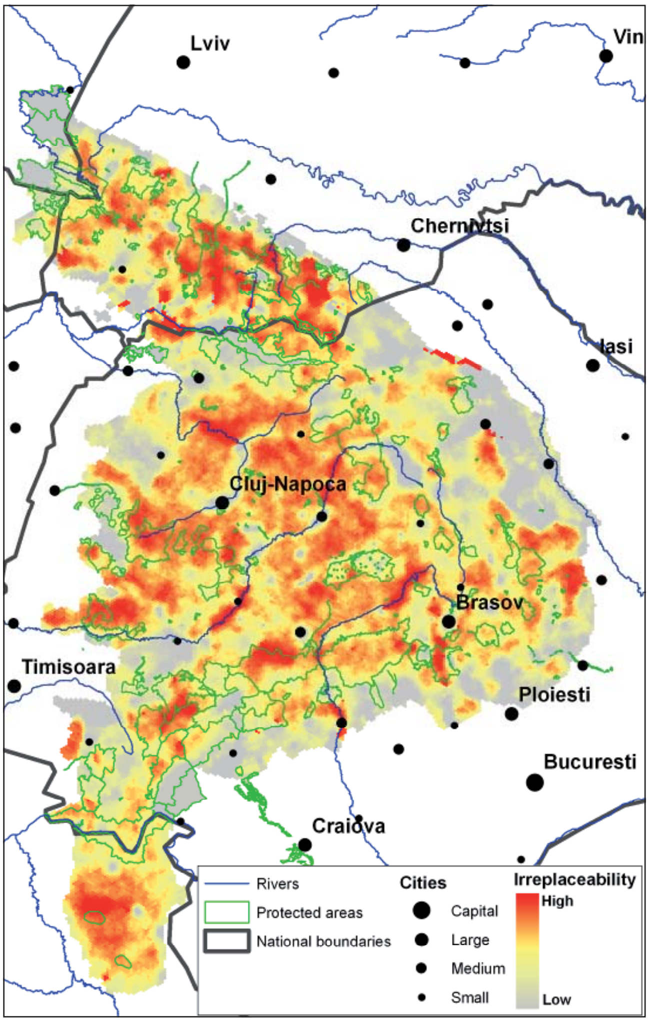


Fig13: Distribution of targets (before conservation feasibility)

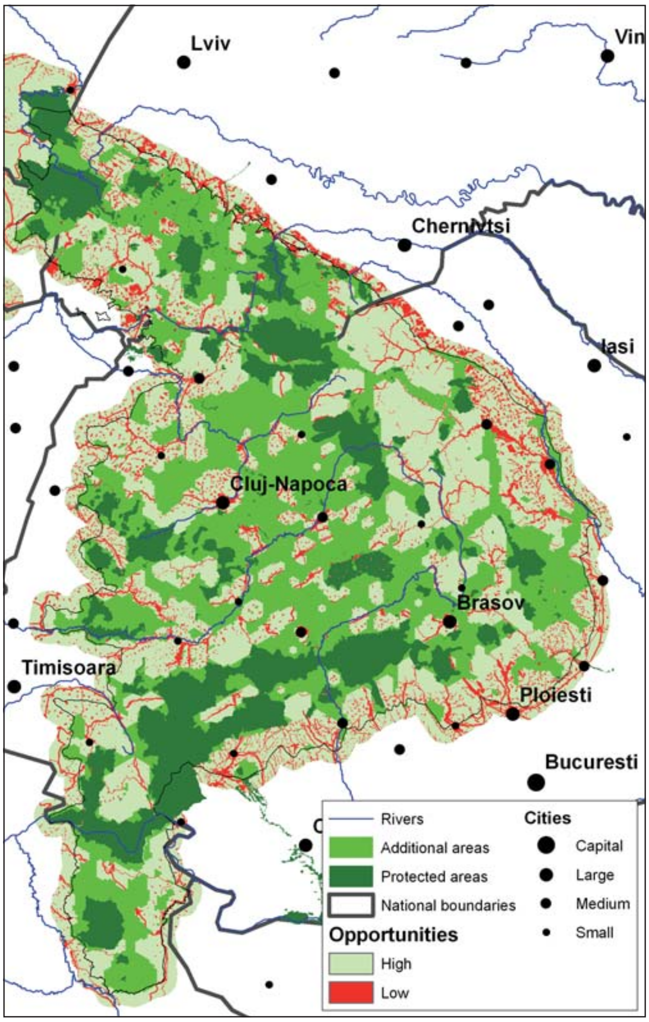


Fig 14: Areas with high importance for biodiversity and high chance of success (high conservation feasibility).

Figure 13 presents the distribution of the frequency that targets are met, according to each planning unit. This provides an indication of those areas that would, under perfect conditions, most likely be the best places for conservation, as most of the conservation targets will be met there. This is not necessarily a map of species richness, but shows where there is the greatest complementarity between the different targets. The distribution will, of course, be biased towards those areas where most of the survey work has been carried out. This is unavoidable, however, in all conservation planning processes, unless there is perfect knowledge of species distribution at any given time.

Distribution of feasibility scores

The next important map shows the distribution of the ranking according to conservation feasibility (Fig. 14). The red areas indicate where it is likely that conservation is the least feasible. These areas would, therefore, not be selected under ideal conditions for conservation, as investment in conservation in those areas is unlikely to bring positive results and the targets will probably not be met. The white areas will be selected by Marxan as the optimal place to try and meet targets.

The proposed Ecological Network

After running Marxan, using the data on targets and costs, the design of the ecological network produced represents the most efficient way to meet all the targets across an ecological network. In some places, critical corridors were planned, where they were not already present, by examining the distribution of costs and the areas meeting the most targets.

While Marxan will select the areas to meet the targets where the cost is minimal, in some cases there will be no choice. The map below shows the distribution of major roads currently in existence, or planned; these roads will present significant challenges to the implementation and success of the ecological network (Fig. 15).

Ecological network showing the distribution of selected targets

The following selection of five maps shows how some of the targets are distributed within the ecological network and how the ecological network assists in meeting the targets (Fig. 16, 17, 18, 19, 20).

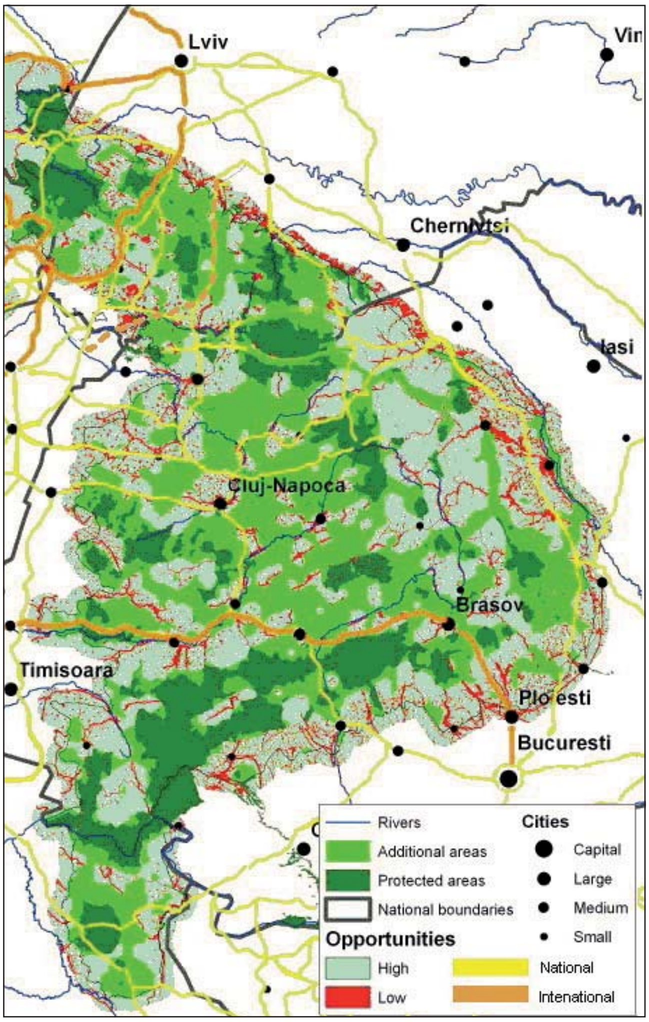


Fig15: Ecological network map with major roads highlighted

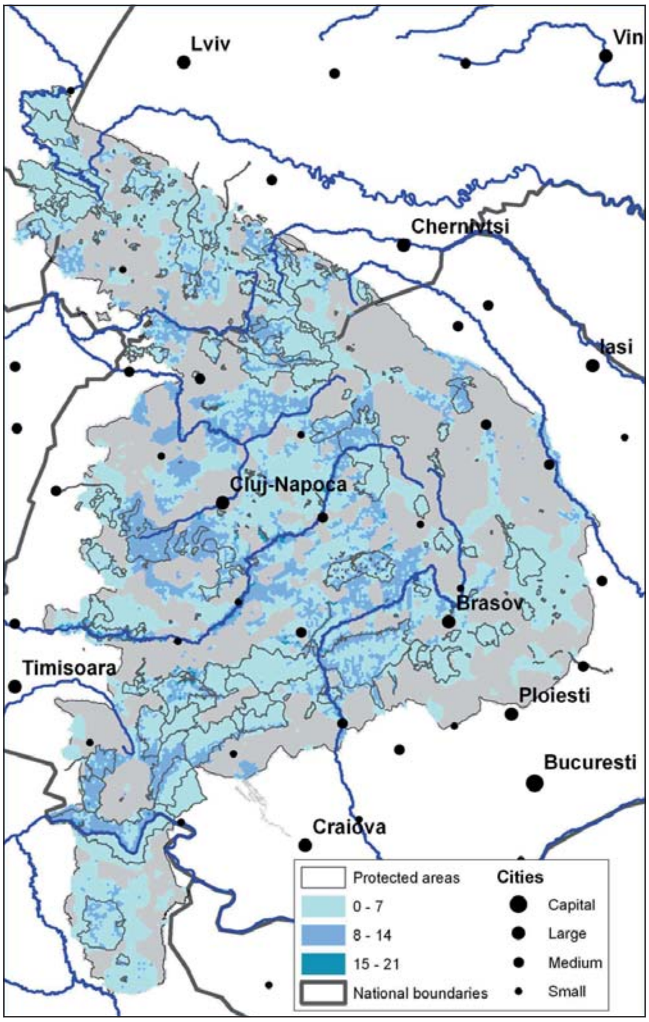


Fig 16: Map showing priority freshwater areas.

Ukraine and Serbia

While it has long been appreciated that Romania is a critical country for biodiversity conservation in the Carpathians, the importance of Ukraine and Serbia have been less evident. This work firstly shows the critical position of Ukraine. Not only do the Ukrainian Carpathians provide an essential link between the east and the west, but also the north and the south of the Carpathians. It is a vital cornerstone for the entire network. Additionally, the analysis has shown that the Ukrainian Carpathians is still (relatively speaking) quite intact, and that the country is of great importance in meeting the targets.

Serbia was not included in the first conservation assessment for the Carpathians. The Serbian Carpathians represent a cross between the northern Carpathians and the southern Balkans, as well as the Mediterranean flora and fauna. The assessment, therefore, indicates the critical importance of Serbia within the ecological network. A specific and immediate focus to ensure that this component of the network is well managed and protected is required.

Distribution of critical "bottlenecks"

One of the most important aspects of designing an ecological network on any scale is the identification of critical bottlenecks. These are points within the network where connectivity cannot be compromised, as they provide vital link points. If these link points are broken, then the network as a whole becomes dysfunctional. There are too many critical bottlenecks in the Carpathian network to describe here and to map. However, some are as follows:

1. Major highways existing and planned which dissect the north-south and east-west connections. The network cannot be designed without including these areas, unfortunately, despite the conservation feasibility approach. There are a number of key points where highways threaten to break up major connectivity points in the region, such as those between the southern Carpathians and the eastern range running north from Brasov, between the Apuseni mountains, the Transylvanian plateau and the southern Carpathians and at the highways which may bisect the Ukrainian Carpathians.
2. The Danube River, the impact of which as a natural barrier will significantly increase, should not careful planning and the protection of existing natural bridges or crossing points be implemented.

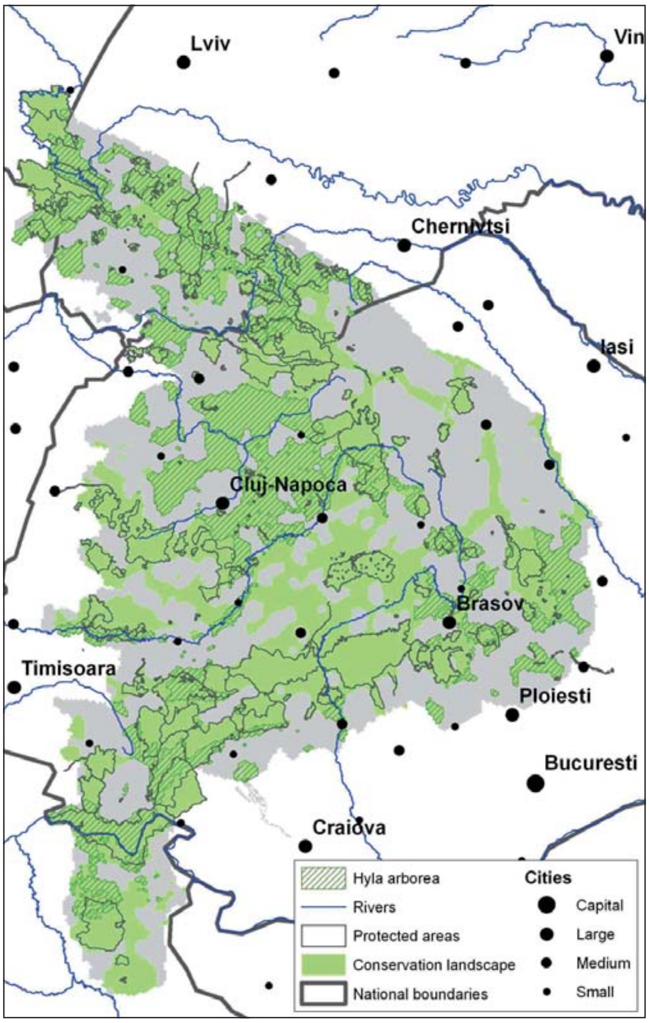


Fig 17: Map showing distribution of *Hyla arborea* in the ecological network

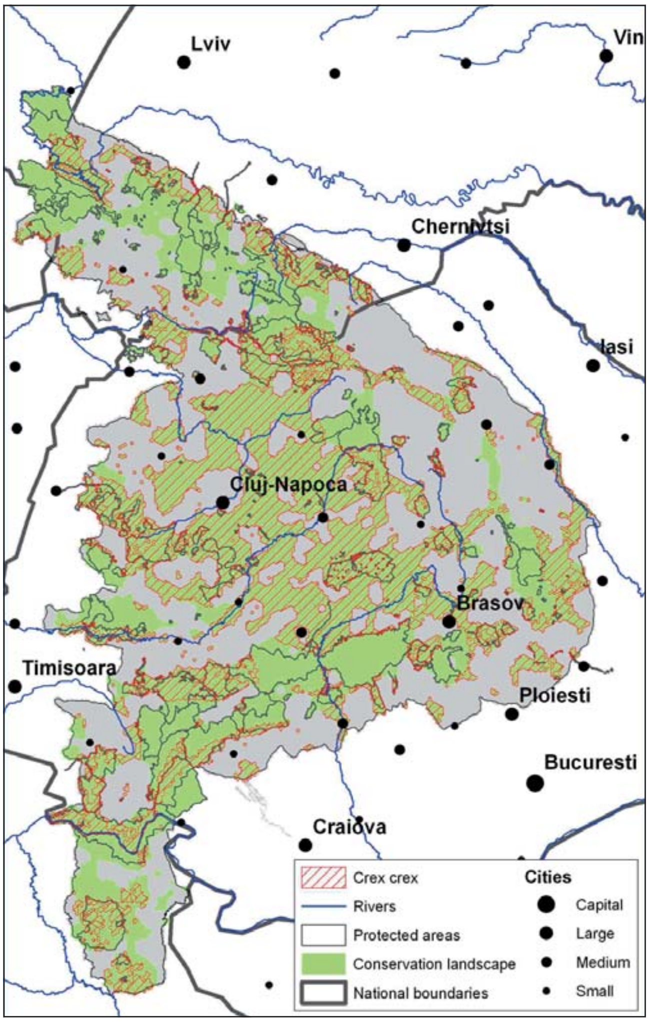


Fig 18: Map showing the distribution of *Crex crex* in the ecological network

Hyla arborea

Crex crex

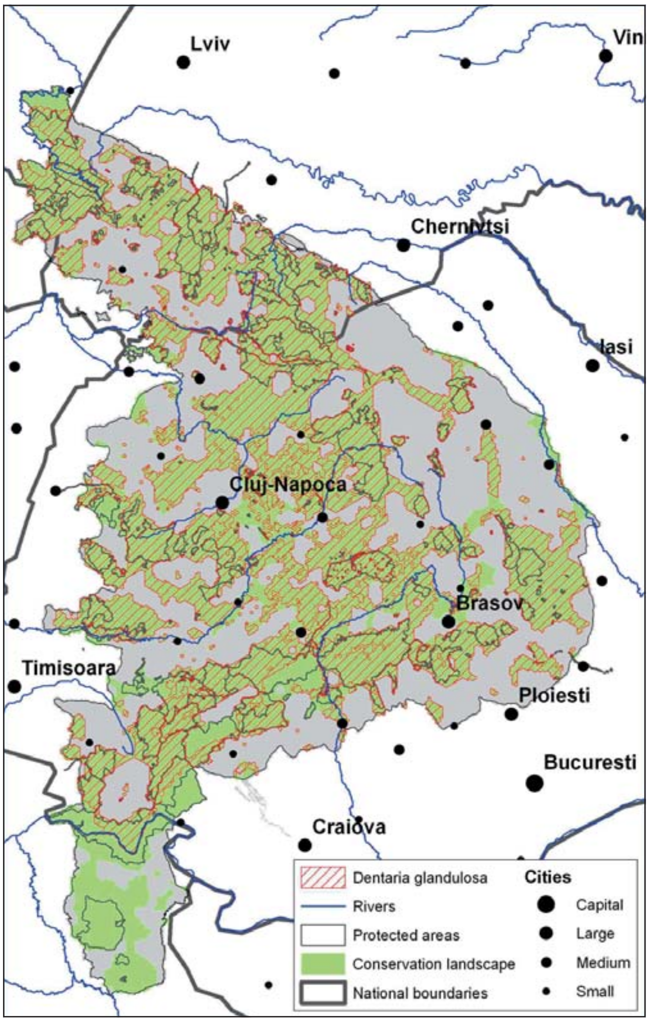


Fig 19: Map showing the distribution of *Dentaria glandulosa* in the ecological network

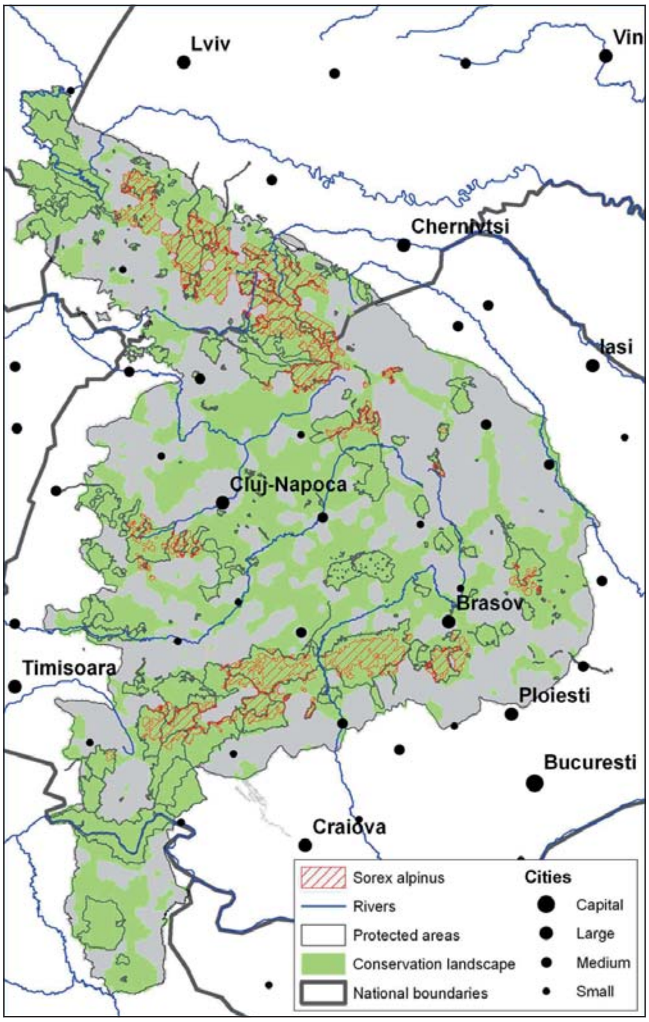


Fig 20: Map showing the distribution of *Sorex alpinus* in the ecological network

Dentaria glandulosa

3. Linkages between the Carpathians and other major ecological regions, such as the Balkan range in the south and the Alps in the east.
4. Species specific barriers, such as the European Bison, which may have a very limited set of opportunities for connectivity, may result either in losing any hope of ensuring connectivity, or lead to massive restoration costs at some future date.

Transboundary areas

As the Carpathian region spans seven countries, potential transboundary conservation areas feature heavily within the ecological network design. Cooperation between Romania and Ukraine in the greater Maramures region, Romania and Serbia across the Danube at the Iron Gates, Hungary/Romania/Ukraine and Slovakia in the Upper Tisza region, and amongst Ukraine/Poland/Slovakia in the Eastern Carpathians, will allow firstly expansive blocks of habitats to be protected under the network and, secondly, ensure the protection of critical bottlenecks. Effective transboundary cooperation has to be a key and immediate priority for any implementation of the network.

Large intact landscapes

The Carpathians is still blessed with many relatively large intact landscapes. While it takes a small stretch of the imagination to call these areas a 'wilderness', there are many areas that offer the last remnants of very large, relatively wild, habitats. These areas remain amongst the few places in Europe where intact populations of species, such as large carnivores, still prosper, and mark the Carpathians as globally important for conservation. These intact landscapes also offer very significant economic and social opportunities, such as the provision of natural resources, protection of watersheds, and adaptation to, and mitigation of, future impacts resulting from climate change.

Three very significant large intact landscapes are of note (Fig. 21). The first is the Southern Carpathians. There is, at present, an opportunity for perhaps Europe's largest conservation landscape, stretching from the very southern point of the Carpathians in Serbia, north to the critical junction close to Brasov. Much of this landscape is already, to some degree, under protected area status. The landscape includes flagship national parks, such as Retezat in Romania and Djerdap in Serbia. The second largest intact landscape falls across the border between Romania and Ukraine in the greater Maramures area. This is a very significant landscape in the Carpathians and offers an excellent opportunity for conservation, particularly for forested mosaic habitats. The third landscape is that falling across the borders of Ukraine, Poland and Slovakia in the Eastern Carpathians. This is an area already recognized for this quality and therefore attention needs to be continued and strengthened, to maintain large-scale integrity.

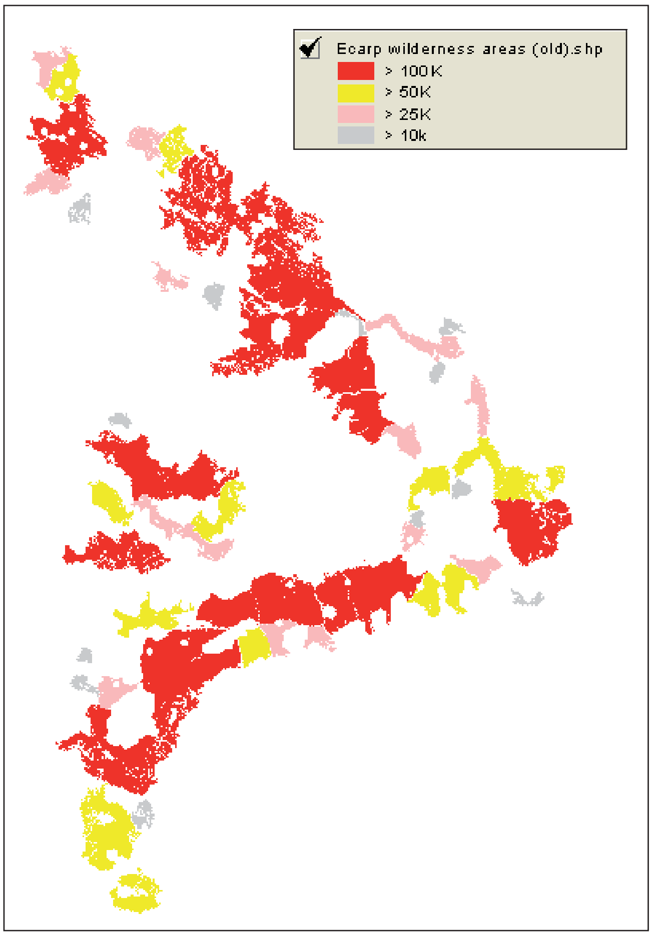


Fig 21: Large blocks of relatively intact extensive ecosystem areas

4. Recommendations

4.1 General recommendations

The Carpathian ecoregion is still largely intact and a vast majority of the region is highly “nature supportive”. This is demonstrated by the fact that the majority of the Carpathians is shown as positive for conservation in the feasibility map. The area where conservation is impossible is smaller than in many other areas in Europe. This is why nature remains relatively rich and intact in the Carpathians when compared to other places. This makes the design of an ecological network in one sense easier than other areas, since there is a greater number of conservation areas to choose from, but at the same time it makes precise allocation of core areas and corridors more tricky. It means that implementing an ecological network in the Carpathians is more about finding management solutions to existing habitats than the restoration or creation of artificial corridors. This is seldom the case in Europe (and in fact in many areas of the world). More often it is a case of holding onto the last remnants and undertaking major restoration of corridors. This is not the situation in the Carpathians, where the design of the ecological network is more a case of predicting the decline of natural habitats and species populations. The implementation of the ecological network is, therefore, more about controlling and managing this decline, so it does not have a negative impact on the connectivity and core areas of the network.

The design of the ecological network presented in Chapter 3 does not specifically follow the most commonly used components of ecological networks, such as core areas and corridors. The design presented in Chapter 3 is aimed at providing a more flexible indication of an ecological network. As stated in the section on target setting – that all targets must be met – the design also implies that conservation has to be successful in all the areas mapped in the ecological network design. This does not imply that the entire network must be placed under strict protection. This is firstly not necessary, and secondly not feasible. The specific management tools used for the individual areas within the network will depend on what is appropriate and feasible at the local level. As protected areas have been used as the building blocks of the network, it can be assumed that these are the “core zones” and therefore need to managed and resourced with this in mind.

It is also important to understand that the ecological network design presented in Chapter 3 is not final. The map has been produced with the data currently available. New data on the distribution of species, habitats and ecosystem services will be required and this may change the priorities. Furthermore, the parameters that determine conservation feasibility will change and be refined. This will be needed particularly at the finer scales, which will mean that the most effective ecological network may change over time. This is the advantage of using a flexible planning tool, such as Marxan, that can help find new solutions based on new data. However, the design presented in Chapter 3 is the best, based on the understanding we have now. It should, therefore, be the main guide for designing management plans and principles for the ecological network.

It should also be noted very strongly that there are many important areas that need conservation in the Carpathians, and many more important corridors. The design represents the most effective way to meet the conservation targets across the entire Eastern Carpathians. The design is therefore aimed to view the ecological network from a very large scale, appropriate to large scale action across the Carpathians.

It therefore does not replace finer scale plans, such as the ecological network designed for the Ukrainian Carpathians (Fig. 22), but should complement that network and other spatial plans for conservation in the Carpathians and adjacent areas.

Fig 22: Ecological network design for the Ukrainian Carpathians

Data bias

The results of the planning have been based on a limited set of data that is also in many ways biased (see chapter 2.4). While it is important to recognize these limitations, it is also important to recognize the need to take action based on the data and information available. There are few areas, if any, in the world that do not have serious data bias when it comes to medium to large scale conservation planning. Planning, therefore, has to be based on the data available and future actions and management decisions will need to be adapted as more data and information becomes available. The bias and lack of data cannot, however, be used as a reason for inaction now. The data available in the CBIS and the ecological network based on these data provide guidance to the planning of infrastructure, tourism development, mining, agriculture and forestry. At the same time, however, the assessment makes it clear that, for the purpose of detailed planning additional data-gathering is required.

Protected areas and Natura 2000 sites

The ecological network is built on the foundations provided by the existing protected area network, including the network of Natura 2000 sites (only relevant for Romania).

The assumption has been made within the methodology that protected areas provide the highest chance of conservation success and, therefore, these areas will be selected first. This assumption, however, is certainly not always the case, and seldom the reality. Most of the protected areas in the eastern part of the Carpathians are presently managed ineffectively and it would be very dangerous to assume that the targets will be easily met here. However, as these areas have been designated specifically for nature conservation, they cannot be ignored in the design of the network.

The conclusion there is that if the ecological network is to function effectively and to meet its objectives, significant attention and resources must be given to the protected area network. This is the highest priority for immediate resource allocation.

Transboundary cooperation

The ecological network shows significant need and opportunities for transboundary cooperation (Fig. 23).

This type of cooperation will be essential to ensure that there is efficiency in terms of conservation action, and to ensure linkage across the borders. Many national ecological networks are designed without appreciating the need to consider adjacent areas across the border, and opportunities for linking areas or expanding existing protected areas are often missed. This plan has been designed to consider a network that not only spans the three countries but also links to major ecosystems adjacent to the Carpathians such as the Balkans and the Danube River system.

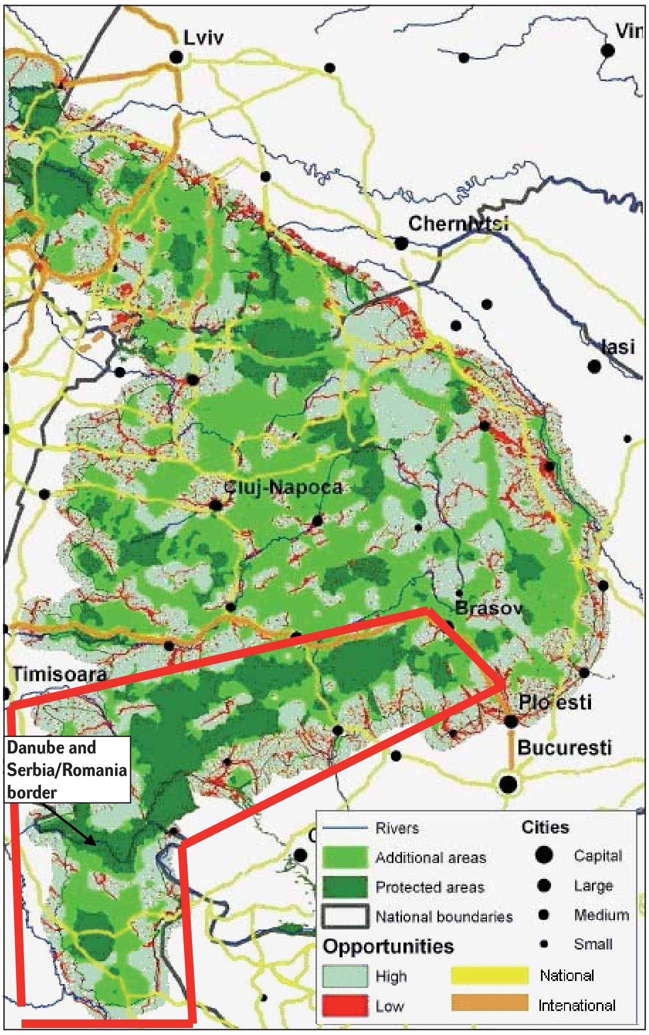


Fig 23: Ecological network map, with opportunities for cooperation in the Southern Carpathian landscape highlighted

Mosaic landscapes

The Carpathian biodiversity is characterized by very extensive areas of complex landscapes of woodland, forests, meadows, farmland and other nature rich habitats. While there is a significant debate about how natural this landscape is (many believe that the mosaic landscape is not so distant from the original landscape before significant alteration by man), the landscape as it is now is mainly maintained through direct interventions of man. Domesticated farm animals, fruit trees, etc. have simply replaced the natural mechanisms that once made this mosaic landscape. This landscape is enormously important for the biodiversity in the Carpathians and without it there would be a very serious deterioration of the biodiversity value of the region. Large areas in the network have been demarcated to maintain this landscape diversity and it will be critically important to finding management solutions for these areas. This will be impossible to secure through protected areas alone, and so any solution will need to be systemic. The promotion of extensive farming systems and sustainable forestry practices will be significant management tools for these areas.

4.2 Sectoral recommendations

Spatial planning

The key to the successful implementation of the ecological network will be the national policies on spatial planning. This will be important at many different scales. At the larger scale, it will be important to consider the design of the network, particularly the bottlenecks and transboundary corridors, when national and regional scale infrastructure planning is made. The design of the ecological corridor provides broad scale indications where there will be major issues for spatial planning, such as for motorways, economic corridors, as well as national sectoral plans such as tourism, mining and transport. The ecological network map can provide information to the local planning processes that the specific area may have an important regional role and, therefore, nature conservation and ecosystem maintenance will require higher consideration.

Agriculture

Linked to the issue of mosaic landscapes is the need to ensure that localities which are not within protected areas, or have restrictions on their utilization, will need to be managed to support nature. Agriculture is a critical economic activity to maintain the landscape and biodiversity, but there is at the same time a steady decline in agricultural activities. High altitude grasslands in particular are being abandoned at a high pace, thus allowing for forest encroachment and the loss of species linked to open spaces.

The landscape and biodiversity of the Carpathians cannot be maintained without the farmers who have shaped and managed these areas for centuries. Organic certification, while, of course, important for many reasons, is not enough to guarantee that the agricultural areas in the network support the conservation targets. Targeted programs need to be developed to halt the process of land abandonment and to help farmers to maintain their farming activities, as well as to maintain the biodiversity of the area. For European Union member states, like Romania, the Common Agricultural Policy (CAP) and the Rural Development Plans offer a good base to set up support schemes for farmers in less favourable areas like the Carpathians. But this is not enough, as the CAP does not apply to Serbia and Ukraine, and support is only available to limited areas. Apart from the area support farmers receive through the CAP, the so called single area payments, governments can choose to compensate farmers for restrictions in developing modern intensive forms of agriculture that collide with the requirements for the protection of landscape and biodiversity.

More sustainable, and for the farmer satisfying, solutions lie in adapting farming to the local situation, and focusing on the delivery of products specific for the region through so-called low input systems, using various incentives also provided by the CAP. This should be combined with the introduction of a certification scheme that guarantees the origin of the products, as well as the application of sustainable and nature-sensitive production methods. Challenges to be met by farmers include the production of high quality products, ensuring food safety and animal welfare, meeting consumer preferences and maintaining quality jobs.

It is an important task for the respective governments and the Carpathian Convention to explore the possibilities for developing sustainable agriculture, based on the conditions the Carpathians offer. Opportunities in the development of sustainable forms of agriculture in the Carpathians are in the delivery of region-specific meat and dairy products from (traditional) goat, cow and sheep breeds, and fruit from sustainably managed orchards.

Also, the system of payments for ecosystem services needs further exploration for its possible introduction in the Carpathians.

Forestry

Certification schemes such as by the Forest Stewardship Council (FSC) are a useful tool to harmonize forest management with the protection of biodiversity. Governments, therefore, should be encouraged to ensure that any forest management within the ecological network should meet these standards.

The following general recommendations can be given:

1. Adapt the silviculture practises to the principles of close-to-nature forestry;
2. Maintain continuous forest cover and avoid large-scale clear cuttings;
3. Build varied age and species structures;
4. Leave dead and dying wood in the forest after forest operations, in sufficient amounts and dimensions for natural decay;
5. Increase the share of natural regeneration instead of planting;
6. Choose only native tree species and site-adapted proveniences;

7. Carry out a woodland key habitats and elements registration to identify important nature values in forest stands;
8. Perform site impact assessments before and after forest operations, to secure minimum damage to standing volume and to the natural values identified in forest stands (nesting trees, hollow trees and other important woodland key elements and habitats);
9. Invest in FSC forest certification to secure monitoring of the forestry.

Tourism

The development of tourism is often considered to be the main driving force for the development of the rural economies, and for increasing the income of rural livelihoods. Indeed, the unique landscape and biodiversity of the Carpathian Mountains are tremendously attractive for hiking, skiing, mountain biking, nature exploration and other active forms of holiday spending. Apart from a splendid landscape, historic and romantic villages and medieval towns, modern-day tourists require an effective infrastructure with good beds, tasteful food and up-to-date hygienic provisions. This counts for camping, hotels, guest houses and bed and breakfast facilities alike.

Eco tourists are focused on visiting protected areas and enjoying nature. The challenge for eco-tourism is to balance the number of visitors with the carrying capacity of the protected area which can often be achieved by designing a clever zoning system. The number of tourists in most of the protected areas is, however, still below the carrying capacity of the areas, although locally negative impacts might be observed. Further, it is believed that eco-tourism should support nature conservation objectives and not the other way around.

On the other end of the tourist industry there are the large ski resorts that are scattered across some parts of the Carpathians. While skiing itself does not damage the landscape, the construction of ski resorts and ski trails may and, therefore, requires careful planning to avoid conflicts with the long-term protection of the landscape and biodiversity.

Sustainable tourism, including eco tourism, implies the maintenance of the integrity of the regional culture and ecologically sensitive areas. The development of sustainable tourism is one of the cornerstones of the Carpathian Convention.

All Carpathian governments have adopted policies and action plans to develop tourism, but the funds needed to develop the infrastructure are often lacking, which is why many plans are on hold, sometimes for several years. Time and resources did not allow for a full analysis of these plans, but it is strongly recommended to assess their impacts on the long-term protection of the landscape and biodiversity, using the data and outcomes of this project. In addition, national plans need further detailing into regional and local development plans, where tourism development is integrated with nature protection, land use planning and agricultural development, as well as supported by additional data on biodiversity. Another important aspect related to the development of tourism is the development of an effective system of waste collection and disposal, and effective waste water treatment facilities.

A critically important issue is to agree on the zoning of tourism activities and investments across the Carpathians to harmonize tourism development with nature protection concerns. It is recommended to propose core areas for tourism development in areas where the nature is less fragile and vulnerable to human activities.

The introduction of an eco-label for tourism entrepreneurs and facilities can offer ways to support the development of sustainable tourism and to avoid degradation of the natural values of the Carpathians.

Other relevant measures include the training of tourism entrepreneurs in hospitality and consumer friendliness, and in learning about the needs and wishes of tourists.

Also, setting up a small investment scheme for entrepreneurs who would like to invest in improving their facilities can help to increase the offer of good small-scale tourist facilities.

4.3 Relevance for Carpathian Convention and some further steps

In order to promote the conservation and sustainable use of biological and landscape diversity, the Parties of the Convention agreed, inter alia, the following: to cooperate in developing an ecological network for the Carpathians and to take appropriate measures to integrate the protection of the landscape and biodiversity into sectoral policies such as agriculture, forestry and tourism. (See chapter 1.1)

The Carpathian Convention aims at ensuring a more effective implementation of already existing instruments, building upon various international programmes, such as the pan European Biological and Landscape Diversity Strategy, the Ramsar Convention, the CBD and the EU Birds and Habitats Directive.

The scope of the Carpathian Convention covers a substantial component of the Carpathian Ecological Network presented in this report and, therefore, many of the results and recommendations presented in this report should be incorporated into plans for the implementation of the Convention. Because the aims and ambitions of the Convention and the network are perfectly aligned, implementation of the network through targeted planning can be highly synergized and synchronized with the work of the Convention.

It is also highly recommended that the Carpathian Network of Protected Areas takes the recommendations into consideration in trying to establish a network of protected areas in the Carpathians.

As indicated before, the results shown are based on the best information available and using the best techniques available. But one has to bear in mind that there are data gaps and, therefore, additional data gathering to improve the ecological network and planning needs be given the highest priority.

In addition to the general and sectoral recommendations presented in chapter 4, the following recommendations are given to improve the design of the ecological network**:**

- Support to the improving and regular updating of information stored in the CBIS;
- Prioritize the funding of research and management in the "red areas" (the now known biodiversity hotspots);
- Investigate the occurrence of species in areas not investigated; the so called "white" areas;
- Develop more precise Corine land cover/land use map;
- Develop a method on how to detail the delineation of the network using GIS technology and to make precise the borders of the network in the field;
- Make further investigation into the taxonomy, distribution and morphology of some selected species and habitats (across border);
- Carry out research on the impact of climate change on the biodiversity, and on the design of the ecological network, to mitigate impacts (possible changes in the distribution of precipitation and discharge patterns, changes in the distribution of species and habitats);
- Carry out research on the impact of infrastructure on the biodiversity;
- Develop and implement pilot projects for detailing and implementing the ecological network;
- Carry out research into the possibilities of maintaining farming methods compatible with biodiversity protection (important for the protection of biodiversity and improving the socio-economic situation in the countryside).

5. Status and recommendations per target country

In the following chapter, information on the current status of ecological network development, the system of protected areas, and policies and attitudes towards the Carpathians in each of the three target countries is presented, as well as information about sectoral threats and the impact on biodiversity.

Specific recommendations on ecological network development and implementation in each country are presented in section 5.5.

5.1 Status of ecological network development

Romania

From 2006 onward, the Romanian accession process to the EU intensified, and the Romanian authorities and other institutions developed initiatives which aimed to support the Natura 2000 sites designation and management. Thus, projects such as LIFE Nature "Priority alpine, sub alpine and forest habitats" (2005–2009), PHARE "Implementation of Natura 2000 Network in Romania" (2006–2007), BBI Matra "Information and communication regarding Natura 2000 in Romania" and PHARE TAPPP "Technical Assistance for Pipeline Project Proposals" (2007–2009) were carried out at national level, involving experts, government authorities and relevant institutions.

Today, the Natura 2000 species and habitat types occurring in Romania in five bioregions (alpine, continental, stepic, pannonian and black sea) have been identified, and the Natura 2000 sites designated, covering more than 15% of the national territory. But there is still a need to secure proper management and administration of the pSCIs and SPAs. Under the Regional Development Fund, IV axis, the "Sectorial Operational Program for Environment" projects, focused on the management of Natura 2000 sites, have been initiated.

Although ecological connectivity is one of the main goals of the national environmental policy, Romania lacks a policy to secure the coherence of the network, and to prevent fragmentation.

Serbia

Ecological networks have only recently become a topic of interest in Serbia. The developing interest in ecological networks is mainly the result of intensified activities in relation to Serbia's EU accession process, which includes action to implement the EU Birds and Habitats Directives. The main constraint in setting-up a national system of ecological networks is the current national legislation on nature conservation, which does not recognize that concept.

The new Serbian Law on Nature Protection, which was adopted in May 2009, refers to the concept of ecological networks, and enables it to be established in accordance with current EU regulations and practice.

The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), which also introduces the concept of ecological networks through the Emerald network, was ratified by Serbia in 2007. The activities started as a pilot project in 2005 with the establishment of the Emerald Network in Serbia. Within this project, 61 sites in Serbia were designated as Areas of Special Conservation Interest (ASCI sites) forming part of the Emerald Network. The sites were identified mainly by using the existing system of protected areas, as opposed to mapping the actual distribution of internationally important habitats and plants. So 84% of these 61 sites were already protected at national level, and the remaining 10 sites are in the process of being protected. Also, international categories, such as the UNESCO MAB site, Ramsar sites, Important Plant Areas, Important Bird Areas and Prime Butterfly Areas were selected. The total coverage of Emerald sites in Serbia is 10.140 km^2, which comprises 11.5% of the national territory. It is clear, however, that the Emerald network has not yet been completed in Serbia, and that it does not cover all the areas with important habitats and species, according to EU standards. The Emerald network in Serbia could, however, be used as a basis for further ecological network development but, in order to create a more functional network structure, connectivity and coherence between sites should be considered.

Ukraine

The development of a National Ecological Network has enjoyed high priority in Ukraine's conservation policy over the last 10 years. It was first initiated in 1995, when European environment ministers endorsed the Pan-European Biological and Landscape Diversity Strategy and its Action Theme, to establish a Pan-European Ecological Network (PEEN). Later, this goal was reinforced through a Ministerial Statement at the Ministerial 'Environment for Europe' conference in 2003 in Kyiv where two specific targets for the establishment of the European Ecological Network were adopted. PEEN was prepared as an annex to the Kyiv Biodiversity Resolution, for adoption at the 5th "Environment for Europe" Conference in Kyiv, Ukraine, in May 2003. Ukraine is crucially important for PEEN because it hosts a considerable and unique share of Europe's biodiversity. The first pilot project on Emerald network development was initiated in 2000.

The development of the ecological network started with the publication of the book "Development of Ecological Network" (1999), which offered extensive information and ideas for the development of an ecological network in Ukraine. This book has provided the scientific background for the development of the „State Programme of Ukraine's National Ecological Network Development for 2000-2015", which is a framework programme for the creation of a national network over an area of 22,825,000 ha, with the core areas covering 24% of the entire area of the network by 2015. This also assisted in the preparation of a law "On ecological network development" (2004). Since 2000, an Econet programme has been in the process of development, supported, among others, by the PIN-MATRA programme of the Dutch government and, currently, by the "Joint Working Programme for Ukrainian-Netherlands Cooperation in the Field of Environmental Protection for the Period 2009–2010".

The practical implementation of ecological networks, i.e. the establishment of corridors has come across obstacles, such as a lack of funding, gaps in existing legislation and problems with land users. The effective and efficient realization of ecological networks requires agreement on the definition of "connectivity", as well as concepts and tools to harmonise land use with the aims of the network, and to make arrangements with landowners, land users, developers etc. Sharing experiences with other European countries which are further advanced in this process would accelerate the development of the required expertise in this regard.

5.2 Positions and policies towards the Carpathians

Romania

The Carpathians are the backbone of Romanian nature, hosting the major part of the natural ecosystems, and covering a quarter of the country's surface. The climate, soil and hydrology of the country are influenced considerably by the Carpathian Mountains. In the Carpathians, there are two biogeographical regions, the alpine and the continental, which together incorporate the major part of Romanian biodiversity, including large carnivores, high diversity grasslands and valuable forests. A significant part of the Romanian economy is based on natural resources from the mountain region (timber, livestock, water, berries, etc.). More than half the Romanian population lives in the Carpathian area of Romania, including the foothills and internal plateaus.

For the above reasons, the Carpathian Mountains are considered both by the people as a whole, and by the authorities, as the most important region of Romania. In this respect, the Ministry of Agriculture, Forest and Rural Development has initiated specific policies and programmes related to agriculture and rural development. In many cases, the development initiatives started up by different ministries (tourism, transport infrastructure and energy programmes, etc.) and are not associated with the importance of the Carpathians as a European biodiversity reservoir. Often, these initiatives do not include environmental impact mitigation measures. This situation is due to the lack of integrated policies for the region, and is one of the main challenges for the future.

Serbia

The scope of the Carpathians in Serbia has been interpreted in various ways. One recent study, which is accepted by the majority of experts and policy makers, was carried out by the Geographical Institute and the Serbian Academy of Science in 2002. According to this study, the Carpathian part of Serbia begins at the Danube Gorge in the North and stretches to the Sokobanja basin in the South, covering approximately 8.400 km^2 (9.5% of Serbian territory). But the official area of the Carpathians in Serbia, which has been adopted by the Secretariat of the Carpathian Convention, is much smaller and covers only 636 km^2 (the territory of the National Park Djerdap). Such an inconsistent interpretation of the Carpathians in Serbia has meant that this region of Serbia was never considered as a unique region in terms of policy making. Even now, when Serbia has ratified the Framework Convention on the Protection and Sustainable Development of the Carpathians, a coherent and targeted policy for this region is lacking. Initiatives for enlarging the scope of the Carpathian Convention in Serbia exist, and are anticipated to attract attention in the coming years.

Another serious problem in Serbia is the low awareness of the Carpathian Convention and its importance for the development of this region. From the perspective of nature conservation, it is clear that this region has immense value since it contains large natural areas with many important habitat and species. It one of the country's largest reservoirs of natural resources like wood, water, mineral resources.

Ukraine

Recognising the importance of the Carpathians, Ukraine has ratified the "Framework Convention on the protection and sustainable development of the Carpathians" and is committed to its implementation. In line with its efforts to comply with EU policies, it follows the requirements of the Pan-European Biological and Landscape Diversity Strategy. Ukraine also ratified conventions such as CBD, WHC, CITES, Bern and Ramsar. Although Ukraine is not a candidate for membership of the European Union in the short term, the country is aligning its national laws and policies to important aspects of EU legislation, including the Water Framework Directive, and Habitats and Birds Directives.

In 1998, the first trilateral Biosphere Reserve – 'the East Carpathians' – was formed, including protected areas from Poland, Slovakia and Ukraine, to protect the unique natural and cultural values of this area. The present EU eastern border divides this Biosphere Reserve. Polish and Slovakian protected areas which are part of this Biosphere Reserve protect and manage the area in accordance with the EU Habitats and Bird Directives, whereas neighbouring Ukraine does not yet apply these principles. The same is true for the Ukrainian-Romanian transboundary area of the Carpathians. Both areas, however, should be treated as trans-boundary-units, coherent both in terms of planning and management practices. Continued harmonisation of both Ukrainian and EU policies and legislation provides opportunities for improved transboundary cooperation and strengthened policies towards sustainable development in the Carpathians.

5.3 The national systems of protected areas

Romania

Nature protection in Romania falls under the Ministry of Environment and Sustainable Development, with agencies such as the Directorate for Biodiversity, the National Environmental Agency and the National Agency of Protected Areas. The Ministry, however, plans to reorganize the Agency for Protected Areas, to increase its effectiveness. The National Environmental Guard is responsible for the inspection and control of legislation in the field of nature conservation and environment protection.

Most of the Romanian national parks and natural parks, together with the Natura 2000 sites, are located in the Carpathians. Some of the counties in the region, such as Brasov and Sibiu, have more than 60% of their surface included in Natura 2000 sites. In such circumstances, the physical planning, rural development and management of the Natura 2000 sites pose major challenges to the local and regional authorities.

The 22 national and natural parks located in the Romanian Carpathians are administrated by the RNP Romsilva, which is the National Forest Administration. The park administrations are independent entities, coordinated and financed by RNP Romsilva. In fact, RNP Romsilva is the main financer of nature conservation in Romania, together with the Ministry of the Environment and Sustainable Development through Structural Funds. Besides these parks, there are natural reserves and Natura 2000 sites of which only a small part has administration and management plans in place. The Local Environmental Protection Agencies (LEPA) are the main bodies responsible for conservation of nature reserves and Natura 2000 sites, but does not have any inspection units. Due to the large number of such areas, and the lack of institutional capacity of the LEPAs, management of the nature reserves and the Natura 2000 sites is less efficient than for the sites that have administrations.

According to existing legislation in Romania, the natural parks, national parks, nature reserves and Natura 2000 sites are all considered "protected areas". The protection regimes vary considerably, however. This has often caused confusion amongst stakeholders who consider all areas under protection, including the Natura 2000 sites with the same strict protection as a national park. Such confusion generates negative attitudes and a lack of participation in implementing management measures for species and habitats of community interest. Following the Natura 2000 site selection process and the bio-geographical seminars held in June 2008, it became clear that there is a need for a legal document which will officially declare the Natura 2000 sites designated as SCIs and SPAs under national law. This will assist the management of such sites and the future development of an ecological network in the Carpathians.

New infrastructure and expanding urban areas are planned across the mountain range. There is a need to integrate and harmonize this with the nature conservation strategies and plans. Physical planning is indispensable in Romania in securing this integration, and local and regional authorities play a key role in physical planning. Unfortunately, in many cases, nature conservation needs are not taken into account because of the lack of information and low institutional capacities regarding nature conservation and ecological networks at regional level.

Serbia

Nature conservation activities are mainly structured through the new Law on Nature Protection adopted in May 2009. The system of protected areas is however regulated through the Law on Environment which recognizes the following categories of protected area: national park (IUCN-II), nature park (IUCN-VI), protected landscape (IUCN-V), nature reserve (IUCN- Ia), special nature reserve (IUCN-IV) and natural monument (IUCN-III).

All categories of protected areas cover nearly 9% of the territory of Serbia. It is planned to increase this territory to 11%

by 2010. One of the biggest problems in designating new protected areas is the slow administrative procedure. Proposals with complete documentation have been prepared for a number of areas but they are being processed very slowly. The Institute for Nature conservation of Serbia is preparing a proposal for the protection of the Kucajske Mountains of more than 10,000ha. The Homoljske Mountains are also interesting and valuable, representing a huge forested area which links with the Kucajske Mountains in the South and the National Park Djerdap in the North. These mountains are clearly recognized as an important area in the Carpathian ecological network proposed in this report. Other important areas are Deli Jovan, Veliki and Mali Krš and Stol which are situated in the eastern part of the region.

The management of a protected area differs considerably from site to site, because there is no single governmental body authorized for this task. Instead, any organization (state or NGO), which has sufficient capacities can become manager of a protected area. An organisation can be authorized as manager of a protected area following a proposal prepared by the Institute of Nature Conservation of Serbia. However, the majority of managers are public enterprises and other state-controlled institutions. Srbijasume, the public enterprise for forest management, manages the largest percentage of protected areas.

One major difficulty is financing the protected areas. Finance is mostly insufficient and received on an irregular basis; therefore, planning and effective management are difficult to carry out. This results in weak human resources and low capacity, although there are a couple of positive examples of good management practice. Common to all of them is the recognition on the part of managers of the protected areas in Serbia of the importance of other sources of funding, and of the development of marketing and tourism.

Ukraine

In January 2006, Ukraine had 7,243 protected areas covering 2.8 million ha or 4.65% of the country's surface. However, the current policy target of 4.2 million ha, or 7% of Ukrainian territory is under pressure mainly because of the lack of necessary funding and adequate legislation. The total area of protected territories in the Ukrainian Carpathians is 14%.

The Ministry of Environmental Protection of Ukraine is responsible for the designation of new protected areas, the implementation of the international treaties, and of relevant legislation. The State Agency for Protected Areas is an executive body of the Ministry which manages 77 protected areas (larger than 1,000 ha) in the Carpathians on territory of 355,880 ha. This includes 6 National Nature Parks, 1 Nature Reserve, 1 Biosphere Reserve and 2 Landscape Parks. A number of National Nature Parks and Landscape Parks are in the process of being established. However, not all protected areas are under the direct management of the State Agency for Protected Areas. The National Academy of Sciences, the State Committee for Forestry and the Presidential Administration are also responsible for managing the protected areas. The „Skolivski Beskydy" National Nature Park in the Carpathians is under the direct management of the State Committee for Forestry, while the State Agency for Protected Areas has an advisory and monitoring role for this park.

The Law on Environmental Protection (1991) provides the legislative base for nature protection in Ukraine.

The categorisation of protected areas in Ukraine dates from before 1990, and has not been adequately revised. The existing categorisation is hard to compare with IUCN and European protected units. The "Law on Nature Conservation Fund of Ukraine" recognizes the following categories of protected area; Nature Reserves, Wilderness Areas and National Parks (IUCN categories Ia, Ib, II), Natural Monuments, Species Management Areas, Protected landscapes and Seascapes (categories III, IV, V), Areas Managed for Sustainable Use (categories VI and other). Botanical gardens and zoos are also part of this system.

Land use issues are regulated by the new Land Code (2001), which has legalised ownership of private land by Ukrainian citizens. The Land code also addresses protected areas, wise land use and land use planning. Other relevant legal instruments and documents are the Forest Code, the Water Code and the Mineral Resources Code, the "Strategy of Biodiversity Conservation in Ukraine" (1997), and the "Concept of the State Programme on Biodiversity Conservation for 2005--2025" (2004).

In general, the existing protected areas have very low levels of financial and political support for protection and management activities.

National Nature Parks and the Biosphere Reserve include not only areas which are strictly protected to safeguard natural treasures, but also areas with human settlements and activities, where the interests of people and nature protection need to be harmonised. There is a lack of practical models which can demonstrate economic development while protecting natural resources. Additionally, protected areas currently lack the capacity, and especially the know-how, for working in partnership with local stakeholders to identify and develop win-win solutions for nature and development. Protected Area authorities have identified community and stakeholder relations and involvement as a major challenge.

5.4 Assessment of threats, impacts and opportunities

Forestry

Romania

As a result of the land reforms, the forestry sector has changed and, nowadays, private forestry plays a significant role in the Carpathian Mountains. A forest management plan is obligatory and the basis for forestry activities both in state and private forests. These plans are revised on a 10-year basis and have to be approved by the Ministry of Agriculture, Forests and Rural Development. The management plans include many regulations that take biodiversity conservation into account. The potential negative impact of forestry is related to the practical implementation of the forest management plans, for example, a lack of correlation between harvesting activities and species requirements for breeding, nesting and refuge areas.

Due to the high level of forest inaccessibility and mountain conditions in the Romanian Carpathians, intensive harvesting techniques are not implemented. Instead, most of the harvesting activities are coordinated and carried out by small and medium size companies using extensive and partly traditional harvesting methods.

But one of the main threats related to forestry remains the deforestation of some areas. Usually these areas are reforested, based on existing reforestation programmes. But if some of these areas are not part of the reforestation, the local balance could be dramatically influenced on the long term, destroying, for instance, the important role forests play in retaining precipitation and accelerating the process of erosion. This has been the case with some of the riparian forest patches located in the close vicinity of human settlements which were harvested, and are the cause of flooding, involving significant damage during periods of heavy rainfall.

The harvest quotas in both the private and state forests are more or less stable and, as such, do not pose a threat to biodiversity. But some small-scale illegal harvesting has occurred in the Romanian Carpathians, which has had a negative impact on biodiversity at local level. The system is not in place for properly monitoring and controlling illegal harvesting, but its extent is fortunately limited.

Serbia

Probably the most widespread activity of local people in recent times in the Serbian Carpathians is forestry. The region has a high percentage of forest coverage, with good quality beech forests. The most valuable forests are in the Homoljske Mountains, Kucajske Mountains and Djerdap. Clear cutting is not allowed in Serbia, but the forests which are under exploitation are being strongly impacted, due to the applied forest management methods which have led to decreased variation in age structure and naturalness. A considerable proportion of the forests is private, and control of their use is much weaker than in the case of public forests. Indirectly, forestry has a negative impact through increased disturbance of animals by workers and machines, and by building the roads needed for forest exploitation.

Ukraine

Current forestry practices are causing damage to biodiversity, but forestry nonetheless offers considerable potential for local economic development. With nearly a third of the country forested, the Carpathians are Ukraine's most heavily forested area, with the highest value in timber. The Ukrainian forests and forestry sector are in the process of transition from a command to a market-driven economy, with the pressure of the market on forest management steadily increasing. Ukrainian government policy and management generally favours sustainable forestry management. But there are significant problems with illegal logging, as well as a high degree of "sanitary felling" (i.e. old, dead or diseased trees that need to be removed to avoid loss or further damage to the forest), involving as much as 33% of the current annual harvest from lands of the State Committee on Forestry which controls 68% of Ukrainian forest areas. Clear cutting is forbidden by law but still happens in remote areas.

A recent investigation by a World Bank team found that the forestry sector could more than double its contribution to the national economy, while also better ensuring sustainable provision of public good functions, including biodiversity conservation, watershed maintenance and erosion control, as well as other environmental services.

Foreign demand for Ukrainian wood is increasing, particularly with the introduction of Western European wood processors into the region, as well as a growing demand for biomass for energy. At the same time, there is decreasing state support for the forestry sector, forcing the forestry enterprises to generate an increasing proportion of their incomes from commercial forestry operations.

Identification of the most valuable forest areas for biodiversity is needed, together with the introduction of sustainable management techniques. The challenge is to develop forestry management techniques that benefit the long term maintenance of the ecosystem services of the forests, while providing income to local communities. National standards for certification of sustainable forest management through the independent Forest Stewardship Council (FSC) are already in place, and are being promoted by a Ukrainian FSC working group, with support from IKEA. Also with IKEA support, WWF-DCPO is currently developing a Ukrainian Toolkit for identifying high conservation value forests (HCVF). Areas identified as high conservation value forests will be included in FSC-certification criteria.

Besides the production of timber, the Eastern Carpathians of Ukraine also have significant potential for harvesting a range of Non-Wood Forest Products (NWFP). The production of these NWFP is based on historical traditions, and includes handicrafts and the collection of berries and mushrooms to supplement diets and to complement the income of local households. Leading factors currently impeding the development, especially of small- and medium-sized enterprises in the harvesting of non-wood forest products, is the lack of market research and demand.

Infrastructure

Romania

Most of the infrastructure plans are not linked closely enough with nature conservation in the Romanian Carpathians. Public consultations and EIAs are carried out formally on paper, but the detailed field situation is not known in many cases. There is a lack of scientific information in many Carpathian areas, and also the lack of a network of experts. The main infrastructure projects in the Carpathians are related to the construction of the highways Bucharest–Brasov-Oradea and Bucharest–Sibiu–Timisoara. The first project has already started in the Transylvanian Plateau, but the second lacks financing sources for its completion. Though mitigation measures are included in the design of these highways, such measures need further expertise and are not checked by nature conservation experts.

Another issue which has led to negative impacts related to biodiversity is the expansion of human settlements and the establishment of tourist areas in the natural ecosystem of the Carpathians. Thus, roads and electricity projects are carried out across the mountain range, and the impact on biodiversity is often unknown.

Serbia

The biggest industrial center in the Carpathian region is Bor, which is one of the largest mining centers of Serbia. In the last two decades, recession has reduced industrial production, which has led the industrial centers to cease production almost entirely. In the past couple of years, some foreign investors have showed interest in the extraction of mineral resources in the Bor region, but currently all activity has ceased, due to the global economic crisis. Nevertheless, intensification of mining could pose a serious threat to nature conservation in the future. Industrial pollution and land devastation are creating serious problems in some parts, such as in the vicinity of Bor and Majdanpek, where huge areas have been devastated by open-cut mining, and water and soil resources have been strongly polluted by industrial waste. Considerable air pollution is present in the Bor region.

Besides the Djerdap hydro power plant located on the Danube, the region has no other significant energy facilities. Infrastructure is also not highly developed. There are only a couple of highways with high traffic frequency. The international route E 761, which transverses the region, poses the most significant impact. The total road network in the Carpathians is 3.500 km long, with an average of 0.8 km/km^2.

One of the biggest problems for nature protection in the Carpathian region is illegal construction. Some protected areas and biodiversity hotspots are considerably impacted by illegal activity, including the construction of houses, illegal stream regulations, terrain cultivation, wood cutting etc. The most threatened areas are the Resava Gorge, NP „Djerdap", Ozren and Devica.

Waste management has also not been efficiently resolved in the region, causing some areas near towns and cities to be burdened with waste. Adequate waste water treatment is also lacking, so many of the waterways are charged with untreated communal and industrial waste water.

Ukraine

There are no major highways crossing the Ukrainian Carpathians (East-West), and during the last 20 years no new roads have been built. However, realization of the Madrid to Kiev TransEuropean Network (TEN) Highway (funded by the EU) will have an impact on the landscape and biodiversity of the Carpathians despite being projected outside biodiversity hotspots. With increasing development, trade and integration with the EU, traffic intensity is likely to increase, and the development of transport networks has high priority.

Implementation of large infrastructure projects, such as the planned ski resort in Bukovel, and recreation centres, especially near protected areas, may pose a threat to the landscape and ecology of the area, and therefore need to be evaluated against the impact on the environment.

Ukraine is considered to be a transportation country for electricity, gas and oil from Russia to the EU. Roads are often lined with electric power cables and huge gas/oil pipe lines. Accidental spills of oil through the destruction of pipes has occurred a number of times in the past, destroying river ecosystems.

The problem of waste management is also a serious issue for the Ukrainian Carpathians. Most settlements have no efficient waste collection and processing system, resulting in illegal waste disposal in rivers and elsewhere. Untreated communal and industrial waste water can create a problem for river ecosystems and for the production of drinking water.

Agriculture

Romania

The Carpathian grasslands, meadows and pastures have high biodiversity, related to traditional agricultural practices, such as hay cutting and livestock grazing. Due to the migration of people from the countryside to towns, agriculture is on the decrease, and the lands are being abandoned. The implementation of the European agricultural policy is only in its initial stages in Romania, and there are significant practical problems in implementing the measures.

On the other hand, an interesting aspect of land abandonment is that it induces the process of succession, leading to the formation of new forest ecosystems. These processes are positive for certain species (herbivores and large carnivores) and habitat types, and negative for others. Further investigation into these aspects is needed, in order to assess the importance of this issue to biodiversity protection and ecological networks.

Serbia

Generally, the Carpathian area in Serbia is sparsely populated and poorly urbanized. Average population density is in the range of 20 inhabitants/km^2, and most of these are concentrated in just a couple of larger towns (Bor, Majdanpek, Zaječar and Sokobanja). The Serbian Carpathians have large unpopulated parts, especially in the region of the Homoljske Mountains. There has been a clear negative population trend over recent decades, causing intensive land abandonment.

Agriculture was one of the main activities of the local people, but in recent decades it has been declining, due to land abandonment. Cattle breeding has almost disappeared in some parts, which has caused a high impact on the open habitats and species connected to them. In fact, open habitats, like meadows and pastures, are becoming overgrown, due to the lack of grazing and mowing, causing the areas to undergo a succession process, forming forest habitats.

Ukraine

Agriculture of the UA Carpathians has changed in the course of the last 20 years. Soviet style collective farms (so-called "kolkhos") have been replaced by independently-run collective farms. This transition has led to a decrease in population density, as well as a decline in the income of rural households. The migration of young people from rural areas in search of work, the ageing of the rural population, and a decline in traditional lifestyles are continuing processes impacting the main features of the countryside.

Land abandonment poses a threat to biodiversity, as scrub takes over the traditional pattern of biodiversity-rich mountain pastures. Some villages are making use of fires in spring to keep the pastures free from trees and bushes.

The persistence of traditional agriculture is due to the difficult economic situation. Hay cutting/drying, livestock grazing and the use of horses in the field are a part of this agriculture, and stimulate the development of rich biodiversity meadow habitats.

Despite current problems with the agricultural sector, most people in the rural UA Carpathians still make their living from farming, though in a few areas their income is supplemented by revenue from tourism.

Tourism

Romania

The development of tourism is an important challenge for the Romanian Government. The traditions and lifestyle in the Romanian Carpathians offer tourists not only impressive scenery and biodiversity, but also attractive cultural activities. Strategies and plans are being developed and implementation funds acquired. However, in times of political change, these strategies and plans are altered, resulting in a different set of initiatives and programs. In such a situation it is difficult to evaluate the impact of tourism activities in the Romanian Carpathians. The territory is large and the initiatives numerous.

One of the prime problems for tourist development in the Carpathians is the lack of good infrastructure, especially the road network. Many major investments in tourism have been placed on standby, due to the lack of adequate infrastructure. The programme "Super Ski in Carpathians" is a good example: the large-scale development programme for skiing facilities in the Romanian Carpathians has been the subject of intensive debate in recent years, but is still in its initial phase.

Tourists mainly visit the well-known resorts, and they depend heavily on access roads. Weekend picnics and barbeques are still the most common tourist activities in the mountains. In recent years, off-road motor cycling and ATV courses have become increasingly present in the region. Although special authorization and permits are required for these activities, the extensive scale on which they are carried out makes it difficult for the authorities to control.

Serbia

Tourism consists mainly of short-term arrangements for domestic tourists. The most attractive sites are on the Danube, where higher numbers of overnight stays are recorded, com-

pared to other parts of the region. Most of the tourist activity occurs in the area of the Djerdap National Park, but also weekend tourism affects some important and valuable sites, such as the Resava Gorge, Rtanj, Beljanica and Ozren. The Republic Government developed a master plan for tourist development in the Beljanica Mountain, where a big ski resort has been planned, which would probably impact negatively on the natural resources of this area of the Serbian Carpathians.

Ukraine

Tourism is one of the fastest growing industries in the region. Yaremche city and its surroundings cater for around 1 million tourists annually. The development of ski tourism has priority in many planning documents for regional and local development. Little or no attention is given to the development of eco-tourism.

There is a boom in the construction of new, and the expansion of existing, facilities for downhill skiing across many parts of the UA Carpathian Mountains. A number of factors, including rising energy costs, climate change and external costs, such as water abstraction and biodiversity loss, suggest that many of these areas warrant a critical appraisal of long-term costs and benefits, both in terms of profitability and public interest.

There is no evaluation of the overall carrying capacity of the areas for tourism – how much is too much, and under what conditions – nor corresponding strategies and planning. Beyond this, there is a lack of market research and know how for developing commercially successful tourism ventures.

A WWF-DCPO survey has identified 30 active ski facilities in the Ukrainian part of the Carpathians. Investments are aimed at improving existing and creating new facilities. Bukovel represents a newly developed ski area, located south-west of Ivano-Frankivsk, near the Carpathian Biosphere Reserve and Carpathian National Nature Park. The ski area there is expected to become one of the largest in Europe, and indeed of the world, with 100,000 beds, and 66 lifts. The total investment in the development is expected to reach 3 billion. A second "Bukovel" will possibly be developed near the "Gorgany" Nature Reserve.

The Ukrainian government is promoting the Bukovel ski area in particular, viewing the area as the cornerstone for a possible Ukrainian bid to stage the Winter Olympics in 2018. The steadily growing number of recreation centres and hotels has changed the face of the Carpathians. Due to the absence of sound environmental impact assessments, the impact on the environment is unknown.

5.5 Recommendations at national level

Romania

Based on discussions between relevant Romanian experts and authorities, the following recommendations have been elaborated:

1. Carry out further field work in the hot spots of the ecological network, which has been identified by the Marxan model, especially in the areas influenced by current development projects and plans;
2. Use more local expertise for the practical planning and implementation of the ecological network, as well as involve more local actors, when planning implementation of the ecological networks on regional scale;
3. Integrate the ecological network development and planning with other sectors and other policies (transport, tourism, physical planning);
4. Increase and intensify institutional cooperation between sectors to secure exchange of knowledge and harmonization of plans in forest management, tourism, infrastructure development, etc.;
5. Support the integration and harmonization between nature protection policies and policies related to agriculture, game management and forestry;
6. Create a legislative base for establishing and implementing ecological networks, i.e. special laws instead of only regulations in and of different existing laws;
7. Create a group of experts in ecological network development who could assist the existing initiatives on the ground (Ecological Networks Experts Group).

Serbia

Based on discussions between relevant experts and authorities in Serbia, the following recommendations have been elaborated:

1. Enlarge the scope of the Carpathian Framework Convention in accordance with the recommendations of the Serbian Academy of Science in 2002 so that the whole eco-region is part of the Convention, which would create a legislative opportunity for better conservation, and would increase the interest of stakeholders and policy makers;
2. Seek harmonization between nature protection and utilization of natural resources, which can only be reached through sustainable use of resources;
3. Improve funding possibilities in the region for different environmental projects;
4. Perform further ecological network development and nature protection planning with caution, due to the existential problems of the inhabitants in the region, i.e. low development, depopulation, unemployment, industry in recession, etc.;

5. Avoid as much as possible increasing the burden on the local inhabitants when implementing the ecological network management;
6. Plan the ecological network management with two main components: nature conservation and creation of opportunities for rural people who live in the area;
7. Concentrate the management components of an ecological network towards two main goals: enlarge the areas under protection and improve the management of new and existing protected areas;
8. Improve the protected area management structures as a crucial step towards an efficient ecological network in this region by raising human capacities and capabilities and secure sufficient funding;
9. Plan and carry out research with more focus on the principles of ecological networks and with priority given to corridors and connecting areas;
10. Encourage the local population to continue and/or activate traditional agriculture, cattle breeding and rural eco-tourism, and provide assistance to local inhabitants with branding and promoting organic and/or regional products from areas of interest;
11. Promote small scale rural and eco tourism as a supplemental source of income for local people, and convince managers of protected areas and relevant ministries for tourism, environment and agriculture to assist farmers in acquiring sufficient knowledge and resources for initiating this brand of tourism;
12. Support forest certification in the Carpathian region to control and lessen the impact of forestry on biodiversity.

Ukraine

Based on discussions between relevant experts and authorities in Ukraine, the following recommendations have been elaborated:

1. Incorporate the areas of the newly proposed Parks, as laid down in the recent Presidential Decree on establishment of new Protected Areas in the ecological network based on the Marxan model;
2. Consider inclusion of freshwater indicator species, such as mayflies, to improve location of the important rivers as ecological corridors in the ecological network based on the Marxan model;
3. Incorporate the flora and habitats refuge areas (small scaled protected areas for protection of rare plant species/habitats) into ecological network designed by Marxan, especially those which appear outside the “green” area of the network;
4. Compare different regional versions (models) of an ecological network, such as the networks of the Transcarpathian and Lviv provinces, with the Marxan generated network;
5. Supply more detail, both in terms of information and in terms of delineating the network, when developing the ecological network at regional level;
6. Consider developing a realistic compromise model, which will consider proposed and real situation models of the ecological network;
7. Build capacity at local and regional level in the methodologies for designing ecological networks and secure coherence between the various initiatives at regional (Oblast) level;
8. Link the Natura 2000 implementation and the Ukrainian ecological network legislation;
9. Prioritise the ecosystem approach and habitat type definitions when protecting areas in Ukraine;
10. Improve dialogue and cooperation between scientists and the regional and national authorities;
11. Further develop the geo-information database on biodiversity, amongst others, by linking up with Ukrainian Chronicle of Nature;
12. Improve awareness of the ecological network of the Ukrainian Carpathians as part of Pan-European Ecological network.

6. References

Ball, I. and Possingham, H. (2000). Marxan (v1.8.2) – Marine Reserve Design using Spatially Explicit Annealing. University of Queensland, Brisbane, Australia.

Bennet. G. P. Wit, 2001. The Development and Application of Ecological Networks. IUCN/ AIDEnvironment.

Buček, A., J. Lacina and I. Michal, 1996. An ecological network in the Czech Republic. Veronica. 11th special issue.

Cowling, R.M., Pressey, R.L., Sims-Castley, R., le Roux, A., Baard, E., Burgers, C.J. and Palmer, G. (2003). The expert or the algorithm? – comparison of priority conservation areas in the Cape Floristic Region identified by park managers and reserve selection software. Biological Conservation, 112, 147-167.

Cowling, R.M., Knight, A.T., Faith, D.P., Ferrier, S., Lombard, A.T., Driver, A., Rouget, M., Maze, K. and Desmet, P.G. (2004). Nature conservation requires more than a passion for species. Conservation Biology, 18, 1674-1676.

Csuti, B., Polasky, S., Williams, P.H., Pressey, R.L., Camm, J.D., Kershaw, M., Kiester, A.R., Downs, B., Hamilton, R., Huso, M. and Sahr, K. (1997). A comparison of reserve selection algorithms using data on terrestrial vertebrates in Oregon. Biological Conservation, 80, 83-97.

EEA, 2007: Areas remote from urban and transport pressures.

Erdi, R (ed), 2001. Report to the Council of Europe on the establishment of the National Ecological Network and the status of its national programme in Hungary. Ministry for Environment, Authority for Nature Conservation. Budapest.

Formann R.T.T., D.S. Friedmann, D.S. Fritzhenry, J.D. Martin, A.S. Chen and L.E. Alexander.

Ecological effects of roads; towards three summary indices and an aoverview for \North-America. In: Canters, K., A.G. Piepers & A. Hendriks Heerema. Proceedings of the international conference on 'Habitat fragmentation and the role of civil engineering. RWS, Delft 1997.

Jongman,R.H.J, M. Külvik, I. Kristiansen, 2004 European ecological networks and greenways.. Landscape and Urban Planning 68 (2004) 305–319.

Knight, A.T., Cowling, R.M. and Campbell, B.M. (2006a). An operational model for implementing conservation action. Conservation Biology, 20, 408-419.

Knight, A.T., Driver, A., Cowling, R.M., Maze, K., Desmet, P.G., T Lombard, A., Rouget, M., Botha, M.A., Boshoff, A.E., Castley, G., Goodman, P.S., MacKinnon, K., Pierce, S.M., Sims-Castley, R., Stewart, W.I. and Von Hase, A. (2006b). Designing systematic conservation assessments that promote effective implementation: Best practice from South Africa. Conservation Biology, 20, 739-750.

Knight, A., Smith, R., Cowling, R., Desmet, P., Faith, D., Ferrier, S., Gelderblom, C., Grantham, H., Lombard, A., Maze, K., Nel, J., Parrish, J., Pence, G., Possingham, H., Reyers, B., Rouget, M., Roux, D. and Wilson, K. (2007). Improving the Key Biodiversity Areas approach for effective conservation planning. Bioscience, 57, 256-261.

POST, 2008. Ecological Networks. Special edition of Postnote from the UK Parliamentary Office of Science and Technology. February 2008 Number 300.

Pressey, R.L., Cowling, R.M. and Rouget, M. (2003). Formulating conservation targets for biodiversity pattern and process in the Cape Floristic Region, South Africa. Biological Conservation, 112, 99-127.

Richardson, E., Kaiser, M., Edwards-Jones, G. and Possingham, H.P. (2006). Sensitivity of Marine-Reserve Design to the Spatial Resolution of Socioeconomic Data. Conservation Biology, 20, 1191-1202.

Rooij S.A.M. van, T. van der Sluis & E.G. Steingröver, 2003a. Networks for Life; Development of an ecological network for Persiceto (Emilia-Romagna, Italy); Alterra, Wageningen.

Rooij, S.A.M. van, E.G. Steingröver & P.F.M. Opdam, 2003b. Networks for Life. Scenario development of an ecological network in Cheshire County. Alterra, Wageningen.

IUCN, 1996. National ecological network Slovakia. P. Sabo (ed). IUCN, Bratislava.

IUCN, 1995a. National ecological Network EECONET-Poland. A. Liro (ed). IUCN, Warsaw. Poland.

IUCN 1995b, National Ecological Network- proposal for environmental and nature friendly regional planning, IUCN, Gland, Svájc és Budapest, Magyarország.

Wilson, K., Pressey, R.L., Newton, A., Burgman, M., Possingham, H. and Weston, C. (2005). Measuring and incorporating vulnerability into conservation planning. Environmental Management, 35, 527-543.

Annex: Full list of conservation features and conservation targets

Probability of occurrence = of species/habitat model distribution based on affinity to landcover units and altitude

Group (bot = plant species; frw = freshwater species; hab = habitat; zoo = animal species)

Conservation target = the target % needed to secure the long term conservation of the conservation feature; the lower the target percentage is the less endangered the conservation feature is.

Name of species/habitat	Probability of occurrence	Group	Conservation target in %
Aconitum anthora L. subsp. jacquinii (Rchb. ex Beck) Domin	high	bot	80
Aconitum bucovinense Zapał.	high	bot	60
Aconitum degenii Gáyer subsp. degenii	high	bot	40
Aconitum firmum Rchb. subsp. firmum	high	bot	40
Aconitum firmum Rchb. subsp. fissurae Nyár.	high	bot	60
Aconitum firmum Rchb. subsp. skerisorae (Gáyer) Starmühl.	high	bot	80
Aconitum lasiocarpum (Richb.) Gáyer	high	bot	40
Aconitum nanum (Baumg.) Simonk.	high	bot	60
Adenophora lilifolia (L.) Ledeb.	high	bot	40
Agrimonia pilosa Ledebour	high	bot	40
Achillea schurii Schultz Bip.	high	bot	60
Aldrovanda vesiculosa L.	high	bot	100
Alopecurus pratensis L. subsp. laguriformis (Schur) Tzvelev	high	bot	80
Angelica palustris (Besser) Hoffm.	high	bot	60
Anthemis carpatica Willd. subsp. pyrethriformis (Schur) Bel	high	bot	60
Aquilegia nigricans Baumg. subsp. subscaposa (Borbás) Soó	high	bot	80
Aquilegia transsilvanica Schur	high	bot	60
Armeria pocutica Pawł.	high	bot	100
Asplenium adulterinum Milde	high	bot	100
Astragalus australis (L.) Lam. subsp. krajinae Domin	high	bot	100
Buxbaumia viridis (Moug.) Moug. & Nestl.	high	bot	40
Caldesia parnassifolia (L.) Parl.	high	bot	80
Campanula carpatica Jacq.	high	bot	60
Campanula crassipes Heuff.	high	bot	60
Campanula rotundifolia subsp. polymorpha (Witasek) Tacik	high	bot	60
Campanula serrata (Kit.) Hendrych	high	bot	80
Cardaminopsis neglecta (Schultes) Hayek	high	bot	60
Carduus kerneri Simonkai subsp. lobulatiformis (Csürös et E.I.Nyarady) Soó	high	bot	60
Centaurea phrygia L. subsp. carpatica (Porc.) Dostál	high	bot	40
Centaurea phrygia L. subsp. melanocalathia (Borbas) Dostál	high	bot	60
Centaurea phrygia L. subsp. rarauensis (Prodan) Dostál	high	bot	80
Centaurea phrygia L. subsp. retezatensis (Prodan) Dostál	high	bot	80
Centaurea pinnatifida Schur	high	bot	60
Cerastium transsilvanicum Schur	high	bot	60
Crambe tataria Sebeok	high	bot	80
Cypripedium calceolus L.	high	bot	40
Dactylorhiza maculata subsp. schurii (Klinge) Soó	high	bot	60
Delphinium nacladense Zapał.	high	bot	100
Dentaria glandulosa W. et K.	high	bot	20
Dianthus callizonus Schott et Kotschy	high	bot	100
Dianthus glacialis Haenke subsp. gelidus (Schott, Nyman et Kotschy) Tutin	high	bot	60
Dianthus henteri Heuffel ex Griseb. et Schenk	high	bot	60
Dianthus spiculifolius Schur	high	bot	60

Name of species/habitat	Probability of occurrence	Group	Conservation target in %
Dianthus tenuifolius Schur	high	bot	40
Dicranum viride (Sull. & Lesq.) Lindb.	high	bot	80
Doronicum carpaticum (Griseb. et Schenk) Nyman	high	bot	60
Draba dorneri Heuffel	high	bot	100
Draba haynaldii Stur	high	bot	100
Dracocephalum austriacum L.	high	bot	100
Drepanocladus vernicosus (Mitt.) Warnst.	high	bot	100
Echium russicum J.F.Gemlin	high	bot	60
Eleocharis carniolica Koch	high	bot	60
Erigeron hungaricus (Vierh.) Pawł.	high	bot	80
Eritrichium nanum (L.) Schrader ex Gaudin ssp. jankae (Simonkai) Jav.	high	bot	100
Erysimum hungaricum Zapał.	high	bot	100
Erysimum witmannii Zawadzki subsp. witmannii	high	bot	100
Euphorbia carpatica Woloszczak	high	bot	60
Euphrasia slovaca (Yeo) Holub	high	bot	60
Ferula sadleriana Ledeb.	high	bot	100
Festuca bucegiensis Markgr.-Dannenb.	high	bot	80
Festuca carpatica F.G.Dietr	high	bot	40
Festuca porcii Hackel	high	bot	80
Festuca rupicola Heuffel subsp. saxatilis (Schur) Rauschert	high	bot	60
Festuca tatrae (Czakó) Degen	high	bot	100
Festuca versicolor Tausch subsp. dominii Krajina	high	bot	80
Galium transcarpaticum Stojko et Tasen.	high	bot	100
Genista tinctoria L. subsp. oligosperma (Andrae) Prodan	high	bot	60
Gentiana cruciata L. subsp. phlogifolia (Schott et Kotschy)	high	bot	60
Gypsophila petraea (Baumg.) Rchb.	high	bot	100
Hepatica transsilvanica Fuss	high	bot	20
Heracleum carpaticum Porcius	high	bot	80
Heracleum sphondylium subsp. transsilvanicum (Schur) Brummi	high	bot	40
Hesperis nivea Baumg	high	bot	100
Hesperis oblongifolia Schur	high	bot	80
Himantoglossum caprinum (Bieb.) V.Koch	high	bot	60
Iris aphylla L. subsp. hungarica Hegi	high	bot	80
Iris humilis Georgi subsp. arenaria (Waldst. et Kit.) A.e	high	bot	100
Leontodon montanus Lam. subsp. pseudotaraxaci (Schur) Finch	high	bot	60
Leontodon repens Schur	high	bot	40
Leucanthemum raciborskii M.Pop. et Chrshan.	high	bot	80
Leucanthemum waldsteinii (Schultz Bip.) Pouzar	high	bot	20
Leucojum vernum L. subsp. carpaticum (Spring) O.Schwarz	high	bot	40
Ligularia sibirica (L.) Cass.	high	bot	80
Liparis loeselii (L.) Rich.	high	bot	60
Lychnis nivalis Kit.	high	bot	100
Marsilea quadrifolia L.	high	bot	100
Meesia longiseta Hedw.	high	bot	80
Melampyrum herbichii Woloszczak	high	bot	40
Melampyrum saxosum Baumg.	high	bot	60
Micromeria pulegium (Rochel) Bentham	high	bot	100
Minuartia verna subsp. oxypetala (Woloszczak) Halliday	high	bot	80
Nepeta rtanjensis Diklic & Milojevic	high	bot	80
Onosma arenaria Waldst. et Kit. subsp. pseudoarenaria (Schur) Jáv	high	bot	80
Ornithogalum orthophyllum Ten. subsp. acuminatum (Schur) Zahar.	high	bot	60

Name of species/habitat	Probability of occurrence	Group	Conservation target in %
Oxytropis carpatica Uechtr.	high	bot	60
Papaver alpinum L. subsp. corona-sancti-stephani (Zapał.) Borza	high	bot	60
Pedicularis baumgartenii Simonkai	high	bot	60
Phyteuma tetramerum Schur	high	bot	20
Phyteuma vagneri A.Kerner	high	bot	40
Plantago atrata Hoppe subsp. carpathica (Soó) Soó	high	bot	100
Poa granitica Br.-Bl. subsp. disparilis (E.I.Nyárády) E.I.	high	bot	60
Poa granitica Br.-Bl. subsp. granitica	high	bot	80
Poa molinerii Balbis subsp. glacialis Beldie	high	bot	100
Poa rehmannii (Ascherson et Graebner) Woloszczak	high	bot	60
Primula wulfeniana Schott subsp. baumgarteniana (Degen et Moesz) Lüdi	high	bot	100
Pulmonaria filarszkyana Jáv.	high	bot	40
Pulsatilla grandis Wenderoth	high	bot	80
Pulsatilla patens (L.) Miller	high	bot	80
Pyrola carpatica J.Holub et Křísa	high	bot	60
Ranunculus carpaticus Herbich	high	bot	40
Ranunculus malinovskii Jelen. et Derv.-Sokol.	high	bot	80
Rosa heterostyla Chrshan.	high	bot	80
Salix kitaibeliana Willd.	high	bot	60
Salvia transsylvanica (Schur ex Griseb.) Schur	high	bot	80
Satureja montana L. subsp. kitaibelii (Wierzb.) P.W. Ball	high	bot	60
Saxifraga demissa Schott et Kotschy	high	bot	100
Scabiosa lucida Vill. subsp. barbata E.I.Nyárády	high	bot	60
Sempervivum wettsteinii Letz	high	bot	100
Senecio ucrainicus Hodálova	high	bot	60
Serratula lycopifolia (Vill.) A.Kern	high	bot	60
Seseli gracile Waldst. et Kit.	high	bot	60
Sesleria heufleriana Schur	high	bot	60
Silene dinarica Sprengel	high	bot	80
Silene nutans L. subsp. dubia (Herbich) Zapał.	high	bot	40
Silene zawadzkii Herbich	high	bot	100
Soldanella hungarica Simonk. subsp. hungarica	high	bot	60
Soldanella pseudomontana F.K.Mey	high	bot	60
Sorbus borbasii Jáv.	high	bot	80
Sorbus dacica Borbás	high	bot	100
Sorbus umbellata (Desf.) Fritsch subsp. banatica (Jav.) Kar	high	bot	80
Symphytum cordatum Waldst. et Kit.	high	bot	20
Syringa josikaea Jacq. fil. ex Reichenb.	high	bot	80
Thesium ebracteatum Hayne	high	bot	100
Thesium kernerianum Simonkai	high	bot	100
Thlaspi dacicum Heuffel subsp. banaticum (Uechtr.) Jáv.	high	bot	60
Thlaspi dacicum Heuffel subsp. dacicum	high	bot	40
Thlaspi pawlowskii Dvořáková	high	bot	80
Thymus alternans Klok.	high	bot	60
Thymus bihoriensis Jalas	high	bot	40
Thymus comosus Heuffel ex Griseb.	high	bot	60
Thymus pulcherrimus Schur	high	bot	40
Trifolium medium L. subsp. sarosiense (Hazsl.) Simonkai	high	bot	60
Trifolium pratense subsp. kotulae (Pawl.) Soják	high	bot	80
Trisetum fuscum (Kit. ex Schultes) Schultes	high	bot	40
Trisetum macrotrichum Hackel	high	bot	80

Name of species/habitat	Probability of occurrence	Group	Conservation target in %
Trollius europaeus subsp. transsilvanicus Schur	high	bot	60
Tulipa hungarica Borbas	high	bot	100
Viola declinata Waldst. et Kit.	high	bot	40
Viola jooi Janka	high	bot	100
Woodsia ilvensis (L.) R.Br.	high	bot	100
Aceri tatarici-Quercion Zólyomi & Jakucs 1957	high	hab	80
Adenostylion alliariae Br.-Bl. 1926	high	hab	60
Alnion glutinosae Malcuit 1929	high	hab	80
Alnion incanae Pawłowski in Pawłowski, Sokolowski et Walisz	high	hab	80
Alysso alyssoidis-Sedion albi Oberdorfer et Müller	high	hab	100
Arrhenatherion Koch 1926	high	hab	80
Asplenio-Festucion glaucae Zólyomi 1936	high	hab	60
Atropion Br.-Bl. 1930 emend. Oberd. 1957	high	hab	20
Berberidion vulgaris Br.-Bl. 1950	high	hab	80
Betulion pubescentis Lohmayer et Tx. in Tx. 1955	high	hab	80
Bromion erecti Koch 1926	high	hab	80
Bromo pannonici-Festucion pallentis Zólyomi 1966	high	hab	80
Calamagrostion arundinaceae (Luquet 1926) Jeník 1961	high	hab	40
Calamagrostion villosae Pawł. et al. 1928	high	hab	20
Caricion curvulae Br.-Bl. 1925	high	hab	40
Caricion davallianae Klika 1934	high	hab	60
Caricion fuscae Koch 1926 em. Klika 1934	high	hab	100
Carpinion betuli illiyrico-moesiacum Ht. 1956	high	hab	60
Carpinion betuli Issler 1931	high	hab	80
Cirsio-Brachypodion pinnati Hadač et Klika 1944	high	hab	80
Deschampsion caespitosae Horvatic 1930	high	hab	20
Festucion pseudovinae Soó 1933	high	hab	80
Festucion valesiacae Klika 1931	high	hab	60
Genisto germanicae-Quercion Neuhäusl & Neuhäuslová-Novotná	high	hab	80
Koelerio-Phleion phleoidis Korneck 1974	high	hab	80
Magnocaricion elatae W. Koch 1926	high	hab	80
Nardion strictae Br.-Bl. 1926	high	hab	80
Nardo-Agrostion tenuis Sillinger 1933	high	hab	80
Orno-Cotinion Soo 1960	high	hab	80
Oxycocco-Empetrion hermaphroditi Nordh. 1936	high	hab	100
Piceion excelsae Pawłovski in Pawłovski et al. 1928	high	hab	80
Pinion mugo Pawł. 1928	high	hab	100
Pino-Quercion Kozl. 1925 em. Mat. et Pol. 1955	high	hab	60
Potentillo-Nardion Simon 1957	high	hab	80
Prunion spinosae Soó 1951	high	hab	40
Quercion frainetto Ht. 1954	high	hab	80
Quercion pubescenti-petrae Br.-Bl. 1932	high	hab	60
Ramondion nathaliae Ht. 1935	high	hab	60
Salicion triandrae Th. Müller et Gors. 1958	high	hab	80
Seslerio rigidae-Pinion Coldea 2001	high	hab	80
Sphagnion medii Kästner et Flössner 1933	high	hab	100
Stipion calamagrostis Jenny-Lips ex Br.-Bl. et al. 1952	high	hab	80
Stipion lessingianae Soó 1947	high	hab	80
Symphyto-Fagion Vida 1959	high	hab	80
Syringo-Carpinion orientalis Jakucs 1960	high	hab	80
Thero-Airion Tx. ex Oberd. 1957	high	hab	80

Name of species/habitat	Probability of occurrence	Group	Conservation target in %
Aegolius funereus	high	zoo	60
Anthus spinoletta	high	zoo	80
Aquila chrysaetos	high	zoo	100
Aquila pomarina	high	zoo	30
Arytrura musculus	high	zoo	80
Barbastella barbastellus	high	zoo	60
Bielzia coerulans	high	zoo	40
Bolbelasmus unicornis	high	zoo	60
Bombina bombina	high	zoo	100
Bombina bombina	normal	zoo	10
Bombina variegata	high	zoo	100
Bombina variegata	normal	zoo	10
Bombus pyrenaeus	high	zoo	80
Bombus pyrenaeus	normal	zoo	60
Bonasa bonasia	high	zoo	40
Bubo bubo	high	zoo	20
Callimorpha (Euplagia, Panaxia) quadripunctaria	high	zoo	80
Callimorpha (Euplagia, Panaxia) quadripunctaria	normal	zoo	10
Canis lupus	high RO	zoo	50
Canis lupus	high SB	zoo	10
Canis lupus	high UA	zoo	50
Caprimulgus europaeus	high	zoo	10
Carabus fabricii	high	zoo	100
Carabus hampei	high	zoo	60
Carabus planicollis	high	zoo	10
Carabus ullrichi	high	zoo	100
Carabus variolosus	high	zoo	20
Carabus versicolor simulator	high	zoo	100
Carabus violaceus krajnensis	high	zoo	100
Carabus zawadszkii	high	zoo	60
Carilia (* Pseudogaurotina) excellens	high	zoo	60
Castor fiber	high	zoo	100
Catopta thrips	high	zoo	100
Catopta thrips	normal	zoo	20
Cerambyx cerdo	high	zoo	60
Cerambyx cerdo	normal	zoo	10
Ciconia nigra	high	zoo	50
Coenonympha tullia	high	zoo	80
Coenonympha tullia	normal	zoo	10
Colias myrmidone	high	zoo	100
Colias myrmidone	normal	zoo	10
Crex crex	high	zoo	30
Cucujus cinnaberinus	high RO	zoo	60
Cucujus cinnaberinus	high SB	zoo	60
Cucujus cinnaberinus	high UA	zoo	80
Cucullia mixta	high	zoo	100
Cucullia mixta	normal	zoo	20
Deltomerus carpathicus	high	zoo	80
Dendrocopos leucotos	high	zoo	40
Dioszeghyana schmidtii	high	zoo	60
Duvalius subterraneus	high	zoo	100

Name of species/habitat	Probability of occurrence	Group	Conservation target in %
Duvalius subterraneus	normal	zoo	30
Elaphe longissima	high	zoo	40
Emberiza cia	high	zoo	50
Emys orbicularis	high	zoo	100
Emys orbicularis	normal	zoo	20
Erebia sudetica	high	zoo	40
Eriogaster catax	high	zoo	60
Euphydryas (Eurodryas, Hypodryas) aurinia	high	zoo	100
Euphydryas (Eurodryas, Hypodryas) aurinia	normal	zoo	10
Falco peregrinus	high	zoo	30
Felis sylvestris	high	zoo	30
Glaucidium passerinum	high	zoo	60
Glyphipterix loricatella	high	zoo	60
Gortyna borelii lunata	high	zoo	60
Graphoderus bilineatus	high	zoo	100
Graphoderus bilineatus	normal	zoo	10
Helix lutescens	high	zoo	50
Helix lutescens	normal	zoo	10
Hieraaetus pennatus	high	zoo	40
Hyla arborea	high	zoo	20
Hypodryas maturna	high	zoo	60
Isophya costata	high	zoo	60
Isophya stysi	high	zoo	60
Lacerta viridis	high RO	zoo	40
Lacerta viridis	high SB	zoo	30
Lacerta viridis	high UA	zoo	60
Lanius minor	high	zoo	30
Leistus montanus ucrainicus	high	zoo	100
Leptidea morsei	high RO	zoo	40
Leptidea morsei	high UA	zoo	70
Lucanus cervus	high	zoo	40
Luscinia svecica svecica	high	zoo	40
Lutra lutra	high	zoo	100
Lutreola (Mustela) lutreola	high UA	zoo	100
Lycaena dispar	high	zoo	60
Lycaena helle	high	zoo	100
Lycaena helle	normal	zoo	20
Lynx lynx	high	zoo	50
Maculinea alcon	high	zoo	40
Maculinea arion	high	zoo	40
Maculinea nausithous	high	zoo	60
Maculinea teleius	high	zoo	60
Mantis religiosa	high	zoo	100
Mantis religiosa	normal	zoo	20
Microtus tatricus	high	zoo	80
Miniopterus schreibersi	high	zoo	30
Monticola saxatilis	high	zoo	50
Morimus funereus	high RO	zoo	60
Morimus funereus	high SB	zoo	40
Mustela erminea	high RO	zoo	20
Mustela erminea	high UA	zoo	70

Name of species/habitat	Probability of occurrence	Group	Conservation target in %
Myotis bechsteini	high	zoo	60
Myotis blythii	high	zoo	50
Myotis dasycneme	high	zoo	20
Myotis emarginatus	high	zoo	50
Myotis myotis	high	zoo	20
Nyctalus leisleri	high	zoo	70
Nymphalis vaualbum	high	zoo	80
Nymphalis vaualbum	normal	zoo	20
Odontopodisma rubripes	high	zoo	30
Osmoderma eremita	high	zoo	100
Osmoderma eremita	normal	zoo	40
Paracaloptenus caloptenoides	high	zoo	60
Parnassius apollo	high	zoo	70
Parnassius mnemosyne	high	zoo	20
Pholidoptera transsylvanica	high	zoo	30
Phryganophilus ruficollis	high	zoo	80
Phryganophilus ruficollis	normal	zoo	10
Pilemia tigrina	high RO	zoo	60
Pilemia tigrina	high SB	zoo	40
Plicuteria lubomirskii	high RO	zoo	80
Plicuteria lubomirskii	high UA	zoo	40
Pseudanophthalmus pilosellus	high	zoo	80
Rana arvalis	high	zoo	30
Rhinolophus blasii	high	zoo	30
Rhinolophus euryale	high	zoo	30
Rhinolophus ferrumequinum	high	zoo	40
Rhinolophus hipposideros	high	zoo	30
Rhinolophus mehelyi	high	zoo	50
Rhysodes sulcatus	high	zoo	50
Rosalia alpina	high	zoo	60
Rupicapra rupicapra	high	zoo	80
Rupicapra rupicapra	normal	zoo	30
Scolopax rusticola	high	zoo	20
Sorex alpinus	high	zoo	30
Spermophilus (Citellus) citellus	high	zoo	20
Stenobothrus (Stenobothrodes) eurasius	high	zoo	60
Strix uralensis	high	zoo	20
Tetrao tetrix	high	zoo	40
Tetrao urogallus	high	zoo	30
Tichodroma muraria	high	zoo	100
Trechus carpaticus	high	zoo	100
Trechus carpaticus	normal	zoo	10
Trechus latus	high	zoo	30
Triturus cristatus	high	zoo	100
Triturus cristatus	normal	zoo	10
Triturus dobrogicus	high	zoo	100
Triturus dobrogicus	normal	zoo	10
Triturus montandoni	high	zoo	100
Upupa epops	high	zoo	20
Ursus arctos	high	zoo	50
Vertigo genesii	high	zoo	80

Name of species/habitat	Probability of occurrence	Group	Conservation target in %
Vertigo moulinsiana	high	zoo	80
Vestia elata	high	zoo	10
Vestia gulo	high	zoo	10
Vestia turgida	high	zoo	10
Vipera berus	high	zoo	10
Vipera ursinii rakosiensis	high	zoo	100
Alburniodes bipunctatus	high	frw	70
Alburniodes bipunctatus	normal	frw	25
Aspius aspius	high	frw	50
Aspius aspius	normal	frw	20
Austropotamobius torrentium	high	frw	80
Austropotamobius torrentium	normal	frw	30
Barbus meridionalis	high	frw	60
Barbus meridionalis	normal	frw	20
Cobitis elongata	high	frw	100
Cobitis elongata	normal	frw	80
Cobitis taenia	high	frw	65
Cobitis taenia	normal	frw	20
Cordulegaster heros	normal	frw	50
Cottus gobio	high	frw	60
Cottus gobio	normal	frw	30
Eudontomyzon danfordi	high	frw	90
Eudontomyzon danfordi	normal	frw	50
Eudontomyzon mariae	high	frw	90
Eudontomyzon mariae	normal	frw	50
Eudontomyzon vladykovi	high	frw	80
Gobio albipinnatus	high	frw	65
Gobio albipinnatus	normal	frw	35
Gobio kessleri	high	frw	75
Gobio kessleri	normal	frw	25
Gobio uranoscopus	high	frw	80
Gobio uranoscopus	normal	frw	25
Gymnocephalus baloni	normal	frw	25
Gymnocephalus schraetzer	high	frw	70
Gymnocephalus schraetzer	normal	frw	20
Hucho hucho	high	frw	100
Hucho hucho	normal	frw	50
Leuciscus souffia agassizi	high	frw	80
Leucorrhinia pectoralis	high	frw	100
Leucorrhinia pectoralis	normal	frw	20
Ophiogomphus cecilia	high	frw	70
Ophiogomphus cecilia	normal	frw	25
Pelecus cultratus	high	frw	70
Pelecus cultratus	normal	frw	20
Rhodeus sericeus amarus	high	frw	70
Rhodeus sericeus amarus	normal	frw	20
Sabanejewia aurata	high	frw	60
Sabanejewia aurata	normal	frw	20
Unio crassus	normal	frw	20
Zingel streber	high	frw	60
Zingel streber	normal	frw	20
Zingel zingel	high	frw	60
Zingel zingel	normal	frw	20

DAPHNE
Inštitút aplikovanej ekológie

WWF

CARPATHIAN ECOREGION INITIATIVE

WAGENINGEN UR
For quality of life
WAGENINGEN INTERNATIONAL

Orbicon