Fundamentals for a modern management concept for the Carpathian Biosphere Reserve (Transcarpathia, Ukraine – including the Ukrainian parts of the UNESCO World Heritage Site "Primeval Beech Forests of the Carpathians")

Final Project Report

Eberswalde, January 2011

HNE Eberswalde
Hochschule für nachhaltige Entwicklung (FH)
Eberswalde University for Sustainable Development
University of Applied Sciences

КАРПАТСЬКИЙ БІОСФЕРНИЙ ЗАПОВІДНИК

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Fundamentals for a modern management concept for the Carpathian Biosphere Reserve (Transcarpathia, Ukraine – including the Ukrainian parts of the UNESCO World Heritage Site “Primeval Beech Forests of the Carpathians“)

Project period: 01.07.2009 - 31.10.2010

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Contributions to the report

The project report is a joint product of all project partners. The main contributions are divided among the project partners as follows:

Overall coordination and supervision over the development of the project report: Juliane Geyer and Pierre L. Ibisch, Eberswalde University for Sustainable Development.

Introduction, *material and methods*, *general results*, *institutional networking and generation of new opportunities* and *conclusion* by Juliane Geyer, Lars Schmidt, Felix Cybulla and Pierre L. Ibisch, Eberswalde University for Sustainable Development.

Application of the extended Open Standards for the Practice of Conservation to the CBR by Fedir Hamor, Vasyl Pokynchereda, Yaroslav Dovhanych and Victoria Gubko, Carpathian Biosphere Reserve and the valuable training support of Lena Strixner, Eberswalde University for Sustainable Development.

Spatial analysis in *material and methods* and *application of the extended Open Standards for the Practice of Conservation to the CBR* by Lars Schmidt and Ivan Kruhlov, Lviv University.

Tourism-related issues as part of the *application of the extended Open Standards for the Practice of Conservation to the CBR* by Judith Kloiber and Hartmut Rein, BTE Tourism management.

Contribution to the stakeholder analysis in *application of the extended Open Standards for the Practice of Conservation to the CBR* by Juliane Geyer, Eberswalde University for Sustainable Development and Hanns Kirchmeir, E.C.O. Institute of Ecology.

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Furthermore, we would like to thank the following people and institutions whose contributions have helped in making this project a success:

- The Michael Succow Foundation, Prof. Dr. Michael Succow and Sebastian Schmidt, for advice and support in the development phase of the project as well as for conceptual support for follow-up projects.
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- Peter Hobson and Catherine Norris for their active participation in the initial stakeholder workshop, follow-up project development (and for never missing an opportunity to cheer us up with their British sense of humour).
- The Schorfheide-Chorin Biosphere Reserve, especially Uwe Graumann,and Dr. Michael Luthardt (formerreferent for ecological forestry at the Brandenburg Ministerium für Ländliche Entwicklung, Umwelt und Verbraucherschutz) for their warm reception and professional assistance of our Ukrainian colleagues during their visit to the Biosphere Reserve.
- All people that took the time to attend and actively participate in the project workshops, thereby strengthening the communication between stakeholders and the CBR administration.

Executive Summary

The overarching aim of the project was to support the CBR to effectively implement current strategies and action plans of the UNESCO Biosphere Reserve and World Heritage Network and to develop its management in line with eco-regional initiatives like the Carpathian Convention. This includes the development and implementation of strategies for integrating stakeholders into decision-making processes and increasing the local acceptance of the CBR, improving protected area management effectiveness, strengthening the role of the CBR as an engine for sustainable development in the region as well as the mutual and shared learning between Ukrainian and German protected area administrations.

The *Open Standards for the Practice of Conservation*, a methodological framework for adaptive conservation management integrating the idea of stakeholder participation, largely guided the systematic procedure and iterative process of the project. Several expert consultations and meetings as well as two stakeholder workshops facilitated the interaction of the project team, regional stakeholders and international experts and informed the process. Those joint efforts have led to a range of successful achievements including the following:

- The **introduction and application of the *Open Standard for the Practise of Conservation*** isan important step for the CBR towards a more systematic and adaptive conservation management approach.
- The enthusiasm of the CBR's senior management in testing and adopting this approach is stressed by the fact that the **software MIRADI™ was translated into Ukrainian** and promises **high institutional sustainability** and continuity of the project results.
- A range of potentially **future** challenges to and opportunities for conservation in the region have been identified together with a range of stakeholders. Especially the impacts of climate change will be further researched in future.
- The **method developed within the project to support the Open Standards process through spatial analysis** has provided an innovative input to CBR'S management and is thought to stimulate a new type of research and application of GIS data.
- The project has made an important contribution towards fulfilling the requests of UNESCO's Man and the Biosphere Programme for a **stronger integration of stakeholders as set out in the Seville strategy in 1995**.
- Furthermore, **the decision of the CBR to extend the scope of its management activities beyond its formally protected massifs can be seen as another milestone**. With regard to supporting the implementation of the international Biosphere Reserve agenda, the consideration of climate change impacts and how to adapt to them fulfils a central demand of the Madrid Action Plan (2008).
- The **project succeeded in generating project ideas and applications** that could build on the results achieved within this project and implement a range of identified draft strategies.
- Within the project **significant institutional networking** was carried out by the project partners. This strengthens the **role of the CBR as a political actor and socio-economic factor in the region and** is likely to increase the recognition, understanding and acceptance in the region for conservation in general and the importance of the primeval forests as an outstanding conservation target in particular.

The range of outcomes proves that the project has not only succeeded but exceeded its aim of creating the fundamentals for a modern management concept for the Carpathian Biosphere Reserve.

1 Introduction

1.1 Background

Figure 1: Diversity of the Carpathian Biosphere Reserve (top: Uholka primeval beech forest, Narcissus poeticus; bottom: Bielza coerulans, mountain sheep farm in Svydovets Massif).

Besides the Alps and Balkans, the Carpathian Mountains are one of the most biologically diverse regions in Europe and Europe's last great wilderness area. In addition to many elsewhere rare or even endemic species they also harbour large areas of near-natural ecosystems and the greatest remaining reserve of old growth forests outside of Russia, especially pristine forests in the eastern Carpathians. The largest remaining old-growth beech forest in Europe is situated on the southern slopes of the Ukrainian Carpathians in the eastern Transcarpathian Region. The old-growth beech forest in the massif Uholka-Shyrokiy Luh with 8,800 ha is the largest coherent piece of its kind in Europe (Commarmot et al. 2007). Together with relicts of old-growth beech forests in Slovakia it represents European natural heritage and has been included into the UNESCO World Heritage Site Primeval Beech Forests of the Carpathians since 2007 (UNESCO 2010). For European forest ecological research the Transcarpathian old-growth forest is of highest value representing a unique reference area for conservation and management (Commarmot et al. 2007).

The ecosystems of Ukrainian Transcarpathia play a significant and strategic role in nature conservation serving as key corridor between the western and the south-eastern Carpathians for numerous species. However, despite being subject of the Carpathian Convention, the Ukrainian sector is the only part of the Carpathians (along with some minor south-western stretches in Serbia) outside of EU borders and thus does not enjoy an internationally standardized protection status such as EU Natura 2000 sites.

Figure 2: Scenic view in Chornohora Massif.

Large tracts of old-growth forests and other areas of exceptional conservation value are included in the Carpathian Biosphere Reserve (CBR), which makes it one of the most important protected areas in the Carpathian Region. Its outstanding importance is further reflected in its recognition as a UNESCO Biosphere Reserve in 1992 and the repeated award of the European Diploma for Protected Areas in 1997 and 2007. Originally, it was established as a *zapovidnyk* (strict nature reserve) in 1968 and gradually enlarged up to its current size of 53600 ha. Nearly all the main landscapes, ecosystems, vegetation zones and forest associations of the Ukrainian Carpathians are represented within the borders of the CBR (Hamor 2005).

This includes mixed oak forests, montane beech forests and fir-beech forests, mixed and pure spruce forests and a montane dwarf scrub zone of alder, juniper and mountain pine. Additionally, the CBR is characterised by subalpine and alpine meadows, which have greatly been formed by human activities.

CBR's biotic array illustrates the very good conservation status: Over 80% of the area is covered with forest, large parts being considered old-growth forests. CBR accommodates a very high diversity of species (1,200 vascular plants, 1,500 species ofmosses, algae, lichens and mushrooms, 64 mammals, 173 bird species, 9 reptiles, 13 amphibians and 23 species of fish) many of which are listed in the Red Data Books of Ukraine and Europe. This also includes a high number of endemic species; some of these are exclusively known from single massifs of the reserve, such as *Calosoma inquisitor, Carabus transsylvanicus, Trechus plicatulus, Duvalius ruthenus, Duvalius transcarpaticus* or*Willemia virae* (Brändli & Dowhanytsch 2003; Hamor 2005).

CBR's territory consists of five semi-detached massifs and three isolated nature reserves creating a cluster (Hamor 2005) or 'archipelago-like' structure which challenges long-term connectivity between the areas. The southern areas are located at the Romanian border connecting to Romanian protected areas such as the Maramureş Mountains Nature Park. Conservation management beyond the EU-border poses a particular challenge. CBR's functional territorial zoning comprises the core zone (strict protection) and three zones where extensive land uses like selective logging, grazing, picking of berries and mushrooms and hay-making are allowed in a restricted regime. CBR directly owns 31,995 ha of the territory (Hamor 2005). CBR is highly significant for local communities depending on ecosystem services which are provided locally as well as preserving traditional land use as the area's cultural heritage (Geyer et al. 2009). In line with the objectives of the UNESCO MAB programme and being one of the region's key players, the CBR wants to align regional development with the conservation of biological and cultural diversity.

Since 1991, Ukraine has been facing rapid and drastic political and socioeconomic changes and continues the process of transformation. In eastern Transcarpathia the decollectivisation of agriculture and a general decline in industrial and agricultural output has led to high unemployment rates and work migration. Uncontrolled infrastructure and tourism development

as well as the abandonment of mountain pastures and other traditional land uses are clear signs of approaching globalisation and associated major socioeconomic changes. A decline in governmental control is partly responsible for uncontrolled land privatisation and overexploitation of natural resources. Furthermore, an increasing (forest) resource demand, especially from global markets, exacerbates this trend. Unsustainable forest use and illegal logging have persisted and even increased in post-soviet times, resulting in continued fragmentation and loss of olderforests and their services as well as in the on-going fragmentation of some ofEurope's last large mountain forests as found in and around the CBR(Kuemmerle et al. 2009). Also climatic changes might influence the area enhancing river floods and calamities. The succession of abandoned mountain pastures by forest and subsequent displacement of grassland communities might also be accelerated by climate change (Björnsen Gurung et al. 2009).

The archipelago-like structure of the CBR poses a great challenge for its management. On the one hand, the conservation of long-term viability and adaptation capacity of forest species and ecosystems to climate change, among others, depends on good connectivity. On the other hand, management of such fragmented conservation areas and the exclusion of areas managed for land use and settlements a strategic influence on threatening factors is near to impossible. Further, those global, regional and local changes and uncertainties raise enormous challenges for conventional management approaches in the CBR. Additionally, the improvement of so far lacking communication with and the (spatial) integration of land users and stakeholders into decision making processes and management strategies (as required by UNESCO) pose additional tasks for the management of the CBR (Geyer et al. 2009). For the CBR it is becoming increasingly difficult to reconcile biodiversity conservation and regional development, both favouring quite opposite futures of the region. Thus, there is a clear need for strategic alignment of the CBR management.

1.2 Project idea and aim

Following several years of studying and visiting this area and on the basis of initial research work undertaken by the Eberswalde University for Sustainable Development, the idea about an applied research project regarding the development of the reserve's management emerged from conversations and close contact with the reserve's administration.

The overarching aim of the project is to support CBR to effectively implement current strategies and action plans of the UNESCO biosphere reserve and World Heritage Network (i.e., Seville Strategy and Madrid Action Plan) and to develop its management in line with eco-regional initiatives like the Carpathian Convention. This includes the development and implementation of strategies for

- integrating stakeholders into decision-making processes and increasing the local acceptance of the CBR
- improving protected area management effectiveness
- strengthening the role of the CBR as an engine for sustainable development in the region
- mutual and shared learning between Ukrainian and German protected area administrations.

The need for a more integrated and strategic management approach is getting ever more apparent and is in line with various international conservation concepts, such as the ecosystem

approach as an implementation tool for the Convention of Biological Diversity (CBD) and the concept of Biosphere Reserves. Following the Seville Strategy and the Madrid Action Plan, the Ecosystem Approach is included in the Biosphere Reserve concept under the UNESCO Man and the Biosphere (MAB) Programme. Besides those international frameworks, also regional initiatives are facilitating and promoting a more approach to integrative conservation and sustainable development especially in the Carpathian Ecoregion. Founded in 1998, the Carpathian Ecoregion Initiative (CERI) is a platform of NGOs and institutes working for the conservation of the globally important Carpathian Mountains. Their objective is to lead and coordinate ecoregion-scale biodiversity conservation and sustainable development within the framework of the Carpathian Convention in order to secure long-term benefits in the Carpathians (CERI 2010). Induced by the Ukrainian government the *Framework Convention on Protection and Sustainable Development of the Carpathians* was signed in 2003 in Kyiv by the Ministers of the Environment of all eight countries sharing the Carpathians. It was finally enforced in 2007. The Carpathian Convention provides the framework for transboundary cooperation and multi-sectoral policy coordination, a platform for joint strategies for sustainable development and a forum for dialogue between all stakeholders involved in the Carpathian ecoregion (The Carpathian Convention 2010). Conforming to those international frameworks modern conservation management tools (e.g. *Conservation Action Planning*, The Nature Conservancy) seem most promising because they follow a strategic, integrative and adaptive approach and have pro-active character. Those concepts integrate the idea of participative and co-management acknowledging that sustainability and the achievement of long-term conservation goals are only possible with integrating communities and other stakeholders into decision-making and sharing of benefits.

1.3 Project partners

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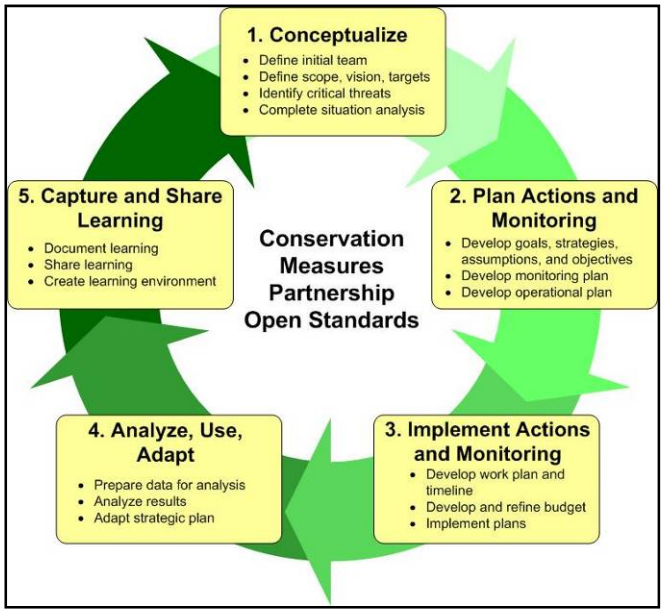
2 Material and methods

2.1 General approach, methods and data sources

For the effective realisation of the project and to enable further continuation we decided to apply an adaptive management approach. Adaptive management is a fundamental part of the Ecosystem Approach of the Convention on Biological Diversity (CBD 2000) and considered the current state of the art. Many international organisations apply and implement adaptive management in their conservation project management and planning work and even work together to develop this methodology further. The Conservation Measures Partnership, a joint venture of many conservation organisations such as the WWF or The Nature Conservancy has developed a set of common guidelines for strategic adaptive conservation management – the Open Standards for the Practice of Conservation. We applied the Open Standard process to the project and worked with different methods and materials within this framework.

2.1.1 Methodological framework: The Open Standards for the Practice of Conservation

The methodological framework for the project was provided by the *Open Standards for the Practice of Conservation* (CMP 2007*)*. The associated software MIRADI™ was used as a central tool throughout the project. The Open Standards provide guidance through clearly defined key steps for the strategic and adaptive planning of conservation management and its successful implementation. It is a cyclic approach consisting of the five steps and their correlating substeps (Figure 3).



1. Conceptualise
2. Plan actions and monitoring
3. Implement actions and monitoring
4. Analyse, use, adapt
5. Capture and share learning.

Figure 3: Work cycle - Open Standards for the Practice of Conservation (CMP 2007).

The Open Standards for the Practice of Conservation were developed by the *Conservation Measures Partnership* (CMP), a joint venture of many conservation organisations such as the

WWF or The Nature Conservancy. They follow a clearly defined taxonomy and thus make international comparison of conservation efforts as well as failure and success possible. The methodology suggests assumption-based action planning rather than evidence-based planning, which allows failures to happen during all project steps. The cyclic approach is meant to allow for a constant revision of the planning process and shall lead to adaptation or even the eradication of the failures encountered. This concept follows the idea of adaptive management.

In the first phase, the conceptualisation phase, the project itself is designed by defining the initial team and important stakeholders. Then, the geographical scope of the project is being identified and a vision is formulated, which shall guide the team and its project throughout the course of actions.

In step two, the different key elements within the project are being identified, starting out with the election of a maximum of eight biological conservation targets for the area. They are meant to comprise the full array of biodiversity of the area in terms of species, ecosystems and important biological processes. After the conservation targets have been defined, their correlating direct threats are identified and assessed. Direct threats are "primarily human activities that immediately affect a target (e.g., unsustainable fishing, hunting, oil drilling, construction of roads, pollution or introduction of exotic invasive species), but they can be natural phenomena altered by human activities (e.g., increase in water temperature caused by global warming) or natural phenomena whose impact is increased by other human activities (e.g., a potential tsunami that threatens the last remaining population of an Asian rhino)" (CMP 2007). They are directly degrading one or more targets, in some cases even threatening their existence as such.

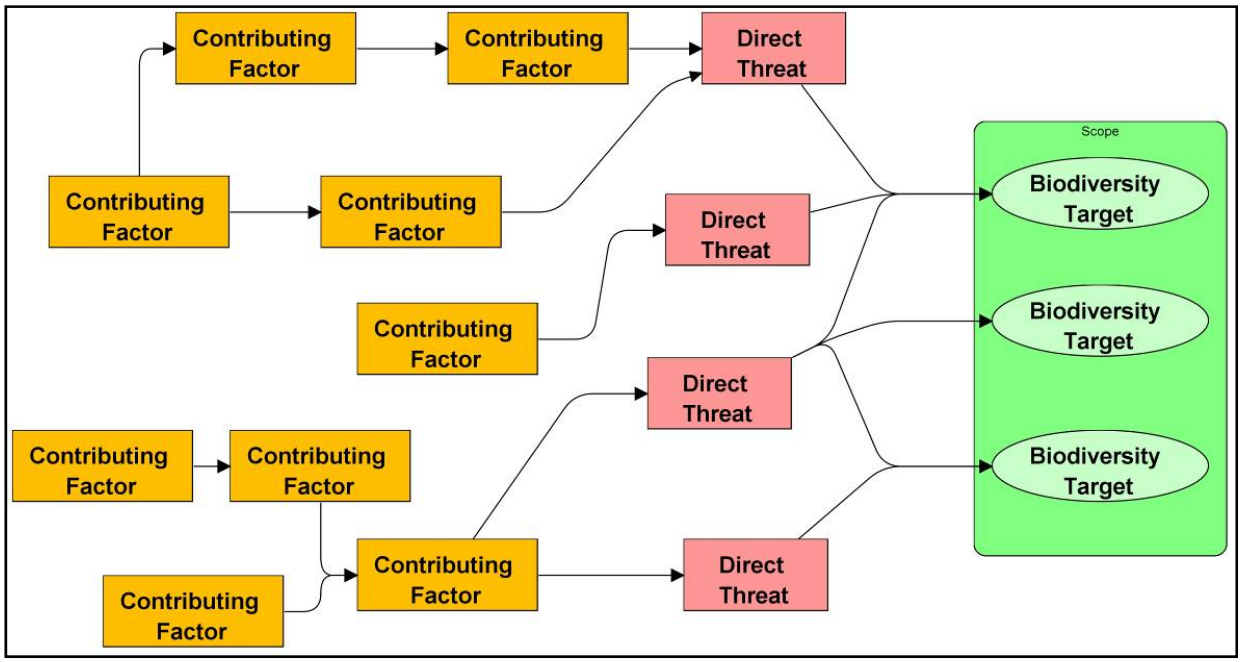


Figure 4: General structure of a conceptual model as used in the Open Standards.

Furthermore, a complete situation analysis is conducted, identifying underlying causes and opportunities leading to direct threats and influencing the project as such. The resulting conceptual model is based on the current state of knowledge and resulting assumptions and should be complemented in the ongoing course of the project, as integral part of an adaptive management strategy.

During the second phase of the Open Standard cycle, practitioners are meant to formulate conservation goals and correlating strategies to reach those goals. Furthermore, monitoring and operational plans are being developed in order to be able to measure the expected success.

In the third phase, a workplan is created, the projects' budget is being allocated and actions formulated in the previous step are being implemented. While the fourth step is focusing on the analysis of results and the adaptation of the projects' strategic plan, the fifth step is meant to share the lessons learned, both on success and failure in order to give advice and guidance to other conservation projects using the Open Standards for the Practice of Conservation. The gathered information can furthermore be fed into a global database which serves the purpose of comparing similarities within different projects and getting inspiration on how shared problems were solved elsewhere.

The software MIRADI™ supports conservation management planning applying the Open Standards and was introduced to the administration of the CBR in the course of the project. The main focus in this project was on the first step – conceptualisation. The project team was identified, including all relevant stakeholders, the scope of the project was defined and ideas for a long-term vision compiled. Seven conservation targets were then identified, representing the array of biodiversity within the CBR region. For all identified conservation targets, their individual critical direct threats were analysed and rated in a matrix resulting in a threat rating giving a first hint on which threats are probably the most urgent ones to tackle. To complete the step of conceptualisation, the underlying causes leading to the threats identified where analysed and depicted in a conceptual model (Figure 11).

During this project, the second step of the Open Standards, the planning of actions, was also partly accomplished; conservation goals were formulated and first strategies identified in order to reach those goals.

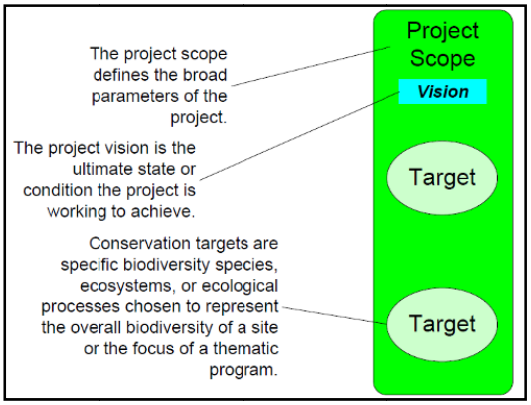


Figure 5: Biodiversity targets, project scope and vision (CMP 2007).

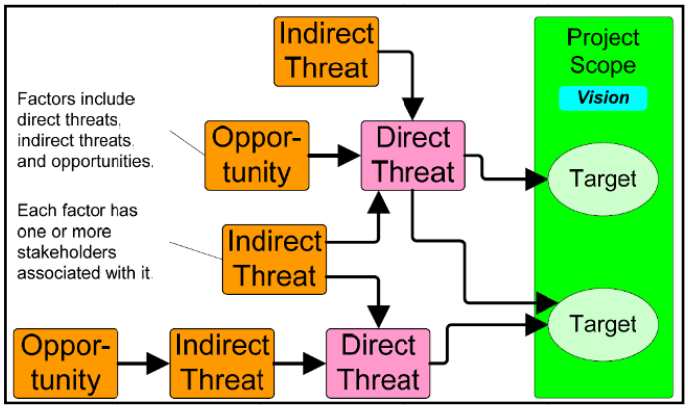


Figure 6: Direct and indirect threats (CMP 2007).

2.1.2 Development and adaptation of the Open Standards

Additional to the Open Standards (Vers. 2.0) procedure we incorporated an analysis of stresses of conservation targets, an identification of cultural as well as natural values of the region and deduced some human welfare targets. We also included a spatial analysis of targets and their threats and discussed potential future developments of threats and their drivers for the first three targets (primeval forests, forest ecosystems, alpine grasslands). In order to enable all CBR staff to work with the Open Standards and MIRADI™ and to ensure its applicability, the software was translated into Ukrainian in the course of the project.

2.1.3 Data sources

Throughout the project, data in various formats and from varying sources were used to inform the various steps of the Open Standards. Data were also used to complement the information provided during stakeholder workshops and expert meetings. In the following data and data sources are grouped into 'ancillary literature', 'bio-ecological data', 'socio-economic data', 'meteorological data' and 'spatial data'. The latter is listed according to the ISO 19115 standard.

2.1.3.1 Ancillary literature

Literature that is cited in this report is listed in the bibliography at the end of the document. The following table lists ancillary literature that was not cited but still provided valuable background information for the project and use in the Open Standards process. Besides scientific literature, project reports and other grey literature especially in the context of tourism brochures, travel books and webpages were consulted.

Table 1: Ancillary literature and information sources not cited in the report

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Wallner, A., N. Bauer & M. Hunziker (2007): Perceptions and evaluations of biosphere reserves by local residents in Switzerland and Ukraine. Landscape and Urban Planning 83:104–114.	
www.transcarpathiatour.com.ua	Tourism portal of the provincal administration
www.adm.rakhiv.com	Rakhiv Administration
www.forza.org.ua	FORZA
www.rakhiv-tour.info	Rakhiv Tourism Information Centre
www.turkul.com	Tour operators and tourism service providers
www.karpaty.com.ua	
www.tourism-carpathian.com.ua	
www.all.zakarpattya.net	
www.dragobrat.poltava.ua	
www.cbr.nature.org.ua	CBR administration

2.1.3.2 Bio-ecological data

Bio-ecological data was mainly used to describe conservation targets, their key ecological attributes and status. Bio-ecological data presented in the report are mostly owned by the CBR and have been obtained in the result of long-lasting research and investigations or taken from the literary sources (see references above). Further sources include the BBI-Matra database and project report.

2.1.3.3 Socio-economic data

Socio-economic data was mainly used to complete and verify the Open Standards' situation analysis. The socio-economic data were obtained from the Rakhiv District Statistics Agency and from the Transcarpathian Regional Statistics Department.

2.1.3.4 Meteorological data

Meteorological data was obtained to provide regional-scale information on changes in temperature and precipitation patterns that could be the result of climate change. Data was obtained from the following meteorological stations in Transcarpathia (TC) and Ivano-Frankivsk (IF) Oblast:

- Pozhyzhevska (IF) – 1959-2009
- Rakhiv station (TC) – 1947-2009
- Khust (TC) – 1946-2009
- Mizhgirya (TC) – 1961-2009

2.1.3.5 Spatial data sets and sources

For spatial analysis in support of the Open Standards and the production of general maps, a range of existing spatial datasets was used. Furthermore, some new spatial datasets were produced. Table 2 lists all spatial datasets used by the project according to the ISO 19115 standard.

Table 2: List of spatial datasets used in the project.

Dataset title	Dataset reference date	Dataset language	Dataset topic category	Abstract	Metadata point of contact	Metadata date stamp
Transcarpathia Oblast	26/01/2010	Ukrainian	Boundaries	Official boundary of Transcarpathia Oblast	CBR, Yuriy Berkela	26/01/2010
Rayons	26/01/2010	Ukrainian	Boundaries	Official district boundaries of the state of Transcarpathia, Ukraine	CBR, Yuriy Berkela	26/01/2010
Roads	26/01/2010	English	Infrastructure	Manually vectorised from 1:50,000 military topographic maps (period 1970-80s). Differentiates six categories of roads.	Ivan Kruhlov, Lviv University	26/01/2010
Settlements	17/11/2010	Ukrainian		Digitised settlement dataset from Ukrainian 1:250,000 dataset for parts of eastern Transcarpathia. Includes population data from the 2005 census.	Ivan Kruhlov, Lviv University	17/11/2010
Rivers and streams	01/07/2010	English	Hydrology	Manually vectorised from 1:50,000 military topographic maps (period 1970-80s) and 1:200,000 topographic maps.	Ivan Kruhlov, Lviv University	26/01/2010
Old growth forests	26/01/2010	English	Ecology	Old-growth forests areas delineated by the BBI-Matra Project 'Virgin Forests of Transcarpathia'.	CBR, Yuriy Berkela	26/01/2010
Land Cover 2000	01/07/2010	English	Land cover	A subset of the "rough" (non-postprocessed) landcover classification based on Landsat TM/ETM images of 2000 The dataset is reclassified to merge deciduous and mixed forest classes into one Class values are: 1. Coniferous forest 2. Deciduous and mixed forest 3. Shrubland 4. Grassland 5. Plough land 6. Sparse building 7. Dense building 8. Water	Ivan Kruhlov, Lviv University	01/07/2010
Ukrainian protected areas (including Synevyr NNP and CBR)	26/01/2010	English	Boundaries	Ukrainian protected areas in Transcarpathia	CBR, Yuriy Berkela	26/01/2010
CBR Scope	01/07/2010	English	Boundaries	Manually delineated using SRTM data and Ecoregion data. The accuracy of a 1:100,000 map	Ivan Kruhlov, Lviv University	01/07/2010

Lynx habitat suitability	01/07/2010	English	Ecology	This layer represents habitat suitability for lynx. It is a clip of a larger layer produced in the framework of the BBI-MATRA project on ecological corridors in UA (Kruhlov et al. 2010).	Ivan Kruhlov, Lviv University	01/07/2010
Bear habitat suitability	01/07/2010	English	Ecology	This layer represents habitat suitability for brown bear. It is a clip of a larger layer produced in the framework of the BBI-MATRA project on ecological corridors in UA (Kruhlov et al. 2010)	Ivan Kruhlov, Lviv University	01/07/2010
HUM_PRX_EUC	01/07/2010	English	Infrastructure	This raster dataset represents Euclidian distance (meters) from the "human network" (human_net)	Ivan Kruhlov, Lviv University	01/07/2010
HUMAN_NET	01/07/2010	English	Infrastructure	Paved and earth roads were rasterised from the vector roads coverage of 1:50,000 accuracy. Settlement regions were rasterised from the 1:200,000 vector dataset for UA. On the Romanian side, the settled areas were extracted from the CORINE dataset. The roads and settlements datasets were merged and reclassified to produce a "human network", which is used as a source grid for the calculation of the "human proximity" layer.	Ivan Kruhlov, Lviv University	01/07/2010
SLOPE_COST	01/07/2010	English	Terrain	A slope layer was derived from the SRTM DEM (Jarvis et al. 2006) to produce a cost surface for human proximity calculations. It is considered that the slope (inclination) can impede human movement over the landscape up to six (6) times over the steepest sections (56 degrees – according to the SRTM-derived dataset). To reach this a calculation was applied: ***Slope value / max slope value * 5 + 1*** This calculation defines areas with "0" slope having impedance "1", and the areas with the max slope (56 deg) has the impedance of "6", while the slopes in-between have intermediate values from 1 to 6.	Ivan Kruhlov, Lviv University	01/07/2010
HUM_PRX_CST	01/07/2010	English	Terrain	This raster dataset represents cost-distance from the "Human network" (human_net) in conditional meters. The Euclidian distance is weighted with the cost factor represented by a slope-cost layer (slope_cost).	Ivan Kruhlov, Lviv University	01/07/2010
Accessibility	01/11/2010	English	Conservation	Raster dataset based on HUM_PRX_CST. Shows accessibility in conditional meters (resolution 100m)	Lars Schmidt, freelance consultant	01/11/2010
Conservation target	01/11/2010	English	Conservation	Raster dataset showing an overlay of CBR	Lars Schmidt,	01/11/2010

density				conservation targets (resolution 100m)	freelance consultant	
Conservation management priority map	01/11/2010	English	Conservation	Raster dataset depicting 9 different areas according to an accessibility – conservation target density matrix. Intersection of the accessibility and the conservation target density layer (resolution 100m).	Lars Schmidt, freelance consultant	01/11/2010

2.1.4 Stakeholder and expert workshops

Table 3: Project-related stakeholder and expert meetings.

Date	Place	Type of meeting	Content
13-15 July 2009	Eberswalde, Germany	Expert workshop	Kick-off workshop
21-23 January 2010	Lviv, Ukraine	Expert workshop	Introduction of the Open Standards and MIRADI™
17-18 March 2010	Rakhiv, Ukraine	Stakeholder workshop	Situation analysis of the CBR area
19 March 2010	Rakhiv, Ukraine	Expert workshop	
7-10 June 2010	Rakhiv, Ukraine	Expert workshop	Finalising the situation analysis and development of draft strategies
5-6 October 2010	Rakhiv, Ukraine	Stakeholder workshop	Presentation and discussion of project results and future activities
7 October 2010	Rakhiv, Ukraine	Expert workshop	The Open Standards and MIRADI™ as working tool for CBR staff

The fundamentals for a modern management concept for the CBR were largely elaborated in four expert workshops with participating representatives from all project partner institutions and two stakeholder events with representatives of local and regional administrations, local communities, forestry enterprises, private businesses and neighbouring protected areas that were invited directly by the CBR administration.

The basis for the conceptualisation phase was provided in the expert meeting in Lviv in January 2010 where the project team (including advisors and stakeholders), the project scope, visions for the project and seven conservation targets were defined. Direct threats for all conservation targets were identified and ranked according to their severity. Furthermore, for one conservation target underlying causes and driving factors were discussed and added to the situation analysis in a conceptual model.

During the first stakeholder workshop on 17th/18th March 2010 in Rakhiv (Ukraine) the situation analysis and the conceptual model were further developed by the almost 70 participants comprised of local communities, state forestry enterprises, different regional administration departments, neighbouring protected areas, the State Agency for Protected Areas, the tourism sector, regional NGOs and CBR ground staff as well as the project team. The aim of the workshop was to analyse the current and future situation of the Carpathian Biosphere Reserve together with various local stakeholders and conservation experts. Initiating and facilitating an active stakeholder dialogue was thereby a major objective. Additionally to the Open Standards identification and discussion of current direct threats and driving factors degrading one or more conservation targets of the Carpathian Biosphere Reserve we also discussed other (cultural) valuable features of the region and expected future developments of those features and conservation targets. Besides some introductory and guiding presentations about the project itself, the Carpathian Biosphere Reserve and the methodology of the Open Standards for the Practice of Conservation, the workshop was mainly characterised by interactive group work and plenary discussions. In a first set of group sessions, stakeholders and CBR staff conducted a general situation analysis of the eastern Transcarpathian region detached from the Open Standards methodology. In six mixed groups, valuable natural and cultural features of the region, their threats and possible future developments where identified.

Group work results were presented and discussed in the plenary afterwards. In a second set of group sessions the Open Standards methodology was used as guidance to conduct an extended situation analysis of the region of the Carpathian Biosphere Reserve. First, conservation targets were defined in the plenary based on the results of day one and ideas from the initial expert workshop in January. Three mixed groups then analysed target viability, direct threats and underlying causes as well as their potential future developments for three conservation targets.

In an expert workshop in June 2010, the conceptual model (situation analysis) was revised again and further completed. Additionally, the concept of key ecological attributes, conservation goals and indicators was discussed and applied for two conservation targets. We also developed draft strategies for two conservation targets and assessed their feasibility and effectiveness. Conservation strategies for all targets were then developed by members of the core project team.

The second stakeholder event took place in the final project phase on 6th October in Rakhiv with a participation of 15 representatives of local authorities, neighbouring protected areas, the tourism sector and non-governmental organisations. At this event, project results were presented and put up for open discussion to all participants. This included the full results of the situation analysis and strategy identification as well as the main results of the tourism analysis and spatial analysis.

Figure 7: Project stakeholder workshop in March 2010 in Rakhiv.

2.1.5 Field surveys

The approach for collecting relevant information, especially regarding the topic tourism, included qualitative field research based on two visits to the Carpathian Biosphere Region in March and Mai/June 2010. A one-day excursion provided first impressions about the area (Rakhiv town, Tysa valley, Yasinya, Kuziy Massif). During a furthervisitto the area (29th May until June 9th June 2010) the Massifs of Uholka, Chornohora and Svydovets were visited. During two multiple hiking tours and excursions to different ecosystems identified as conservation targets (*polonynas*, primeval forest and other forest ecosystems) (compare chapter 3.2.4.4), also guest houses and tourism facilities, cultural sites and visitor facilities of the Biosphere Reserve were visited. This included for instance the new visitor centre at the Centre of Europe and the Museum of Mountain Ecology in Rakhiv. Semi-structured interviews with 15 selected tourism stakeholders were conducted. This included representatives from:

- Hotel and guest house managers from Rakhiv, Yasinya and Dragobrat
- FORZA
- Rakhiv District Administration
- Transcarpathian Regional Centre of Rural Tourism Development in Uzhgorod

- Rakhiv Agency of Agro-Eco-Tourism
- Local communities
- Board of European integration issues, Dep. of tourism and resorts
- Uzhansky National Nature Park

Thanks to the support of the CBR administration, the willingness of contacted stakeholders to take part in the interviews was very high.

2.1.6 Spatial analysis

Spatial analysis methods were applied to give a geographic dimension to the results achieved during the Open Standards process. The Open Standards and MIRADI™ so far are restricted to conceptual analysis and do not yet feature methods and tools to spatially differentiate between target viability and direct threats, for example. Given the size of the scope that was chosen by the CBR administration staff (c. 380,000 ha), the distribution of conservation targets, target viability and threats differ necessarily. While conceptualisation provides the much needed bigger picture, it also tends to generalise. For directing and prioritising conservation actions, the generalised conceptual approach of the Open Standards can be improved through spatial analysis. In the course of the project and as a first step, a preliminary method on how to support the Open Standards process through spatial analysis was developed. In a second step, the part of the method that could be supplemented through existing spatial datasets was applied. The results can be found in chapter 3.2.4.6.

The aim of the following method is to provide Open Standards users in general and the CBR administration in particular with a complementary method to support conservation management and decision making on a spatial scale. Specifically, the method will help conservation managers to identify priority locations for conservation action. Prioritisation builds on certain aspects of the Open Standards (e.g. viability rating, threat rating), but the interpretation (what should be prioritised) is left to the decision maker.

As a side-effect, the method can generate a variety of maps that may provide the user with new perspectives on conservation issues within the chosen scope. These maps can also prove to be useful in public relations and communication with non-conservation stakeholders.

Prior to the application of the method, both targets and direct threats must be identified through the Open Standards process, including the conduction of a target viability assessment. To support prioritisation of conservation actions, the method locates and assesses both conservation targets and direct threats within the chosen scope, to some extent through the use of proxy indicators. The spatial distribution of conservation targets is one aspect of prioritisation. Consequently, a conservation target density index is developed, which is based on target occurrence, target viability and an assigned anthropogenic value.

While the conservation target density index could largely be calculated based on the results of the Open Standards process, the spatial differentiation of direct threats was hindered by data constraints. Consequently, accessibility or more specifically access from roads was considered a suitable, however limited, alternative to a full threat exposure index. The underlying assumption here is that the higher the road access, the higher the potential threat to most conservation targets. A look at the conceptual model and the threat rating (in chapter 3.2.4.1and

3.2.4.5 respectively) confirms this assumption. Many, if not all, threats are related to (road) access. Examples include, but are not restricted to:

- logging (both legal and illegal),
- hunting and poaching, mining,
- vandalism and speleological activities in caves
- changes to riverbeds as a result of gravel extraction and
- overuse of NTFPs (for commercial purposes).

The resulting accessibility index shows the access from paved and dirt roads in conditional meters, i.e. the impediment of certain terrain features (steep slopes) has been taken into account.

Based on both indices, a conservation target density – accessibility matrix was developed, where accessibility stands as a proxy indicator for threat exposure. Initial analysis allows the user to see where conservation target density and threat exposure are low or high respectively. Applying the matrix through the overlay of both, conservation target density and accessibility, the user is provided with a map showing the following area classifications:

1. Areas with a low conservation target density, and a high accessibility
2. Areas with a medium conservation target density, and a high accessibility
3. Areas with a high conservation target density, and a high accessibility
4. Areas with a low conservation target density, and a medium accessibility
5. Areas with a medium conservation target density, and a medium accessibility
6. Areas with a high conservation target density, and a medium accessibility
7. Areas with a low conservation target density, and a low accessibility
8. Areas with a medium conservation target density, and a low accessibility
9. Areas with a high conservation target density, and a low accessibility

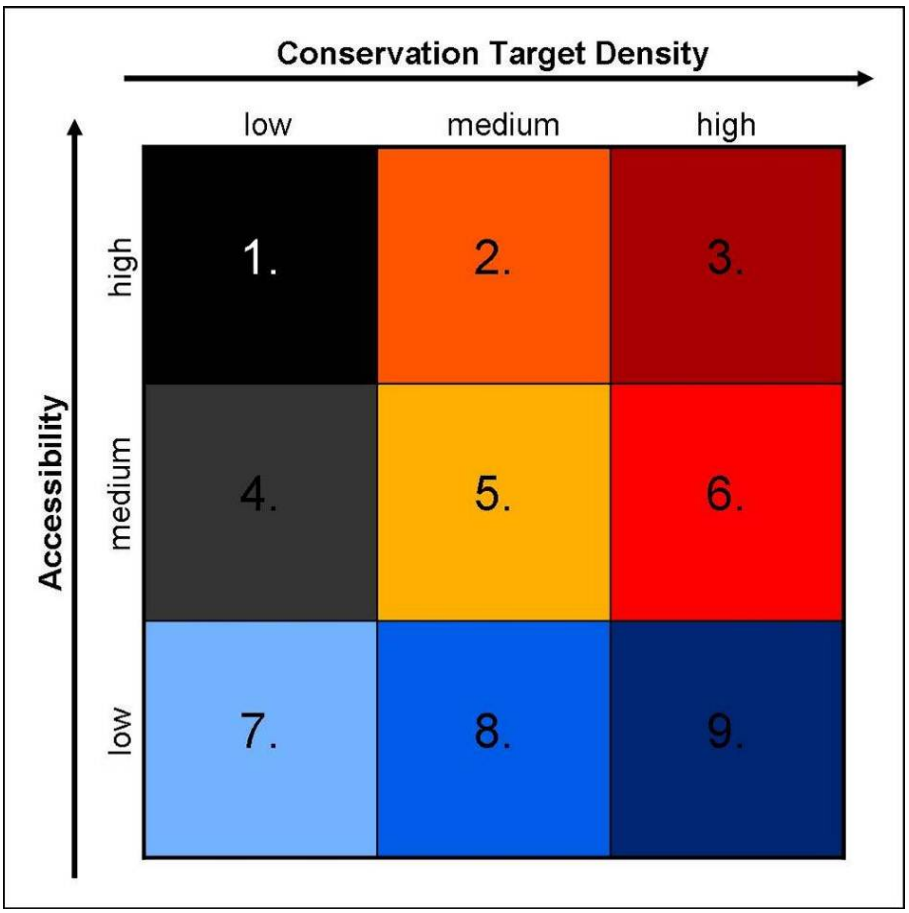


Figure 8: 'Immediate priority' matrix to direct conservation actions.

Areas in black and grey are of little priority due to their low conservation target density and medium to high accessibility. Areas in shades of red feature both a medium to high conservation target density and accessibility. They are of high conservation value but due to their medium to high accessibility they may require significant resources to protect. They are in principle comparable to the so-called conservation hot-spots (compare Myers 1988, Myers 2000, Conservation International 2010). Areas in shades of blue have a low to high conservation target density (the darker the higher) and a generally low accessibility. The two darker blue areas are conservation priority areas that may be protected relative easily, while the areas in light blue may not be a conservation priority area but may still be worth protecting from an opportunistic point of view. The latter three areas are comparable to so-called cold-spots (sensu Kareiva & Marvier 2003).

It has to be noted that this classification refers to the current situation and is thus the basis for choosing areas of immediate priority. While it indicates where immediate-priority areas could be (re)set in existing protected areas, the lack of the fourth dimension (time) limits its applicability e.g. for choosing future areas for conservation. As target occurrence, target viability as well as the extent and 'quality' of threats change over time, so should conservation priorities. Consequently, the approach needs to be further developed and dynamically adapted to incorporate results from scenario-building that show where and how target occurrence, viability and threats are likely to change within a given timeframe.

In the following section, the method for producing the conservation target density and accessibility index as well as the intersection of both maps is described in detail.

Developing a conservation target density layer

Step 1: Spatial extent of conservation targets

In this first step the spatial extent and value of all chosen conservation targets is defined. In some cases this is comparatively easy (e.g. forests), but it can be challenging for targets with changing locations and/or large ranges (e.g. larger mammals) and targets with more or less arbitrarily defined boundaries (e.g. hydrological systems). While the extent of the former could be delineated using observed or modelled ranges, the latter conservation target would need to be defined more specifically. For delineation, data on the spatial distribution of the conservation targets must be available. In case of the CBR, data for the following conservation targets was available:

- Old-growth forests: polygon layer from the BBI-Matra funded project 'Virgin Forests of Transcarpathia – Inventory and management' (Hamor et al. 2008)
- Forest ecosystems: classified Landsat 2000 raster image
- Alpine meadows: classified Landsat 2000 raster image
- Large carnivores, nested target of the conservation target 'Large mammals, carnivores and birds of prey'. modelled ranges of bear and lynx (from Kruhlov et al. 2010)
- Water and riparian ecosystems: this target was further defined as all rivers and streams and the areas within a radius of 50m around them. Rivers and streams were delineated from Ukrainian topographical maps 1:50,000 and 1:200,000.

Step 2: Valuation of conservation targets

This step offers the option to assign different values to the conservation targets. This value does neither have a unit nor does it represent a total value. It is rather a measure of the target's relative importance to conservation management or stakeholders. The value may be set by the responsible conservation entity or could be derived through participatory stakeholder consultations. In any case, it must be made clear who sets the value since this determines whose conservation priorities are later displayed. The values are given by assigning each conservation target its specific value ranging from e.g. 10 to 100. In case nested targets are used, these are assigned a fractional value of the conservation target they belong to. The sum of all nested targets should again be within the given value range, e.g. between 10 and 100). In case all conservation targets are considered equal, each conservation target is assigned the value '10' (for vector data in the attribute table, for raster data through the 'reclassify' function). In case of the CBR, all conservation targets were assigned the value 10.

Then all datasets are converted to raster format for further processing (conservation target value datasets). All raster datasets should have the same spatial resolution (e.g. 100 x 100 m). In order to not lose accuracy, the highest resolution should be used as a default for all other raster datasets.

Step 3: Qualification of the conservation target value datasets

This step is serves the further improvement of the prioritisation of conservation actions. It is potentially very data-intensive and should thus be considered optional. The implicit assumption here is that the higher the viability of a conservation target is, the higher its conservation value will be (and vice versa). This can of course not be generalised and may need consideration of further data (e.g. abundance of a conservation target) to take a decision. For example, should a certain species population have a poor viability in one area, but other viable populations do exist in other areas of the scope, this 'valuation by viability' could be applicable. However, should this species population with poor viability be the only remaining population within the scope (and beyond), this might increase the value of this population in the opinion of many conservationists, although different opinions do also exist (see e.g. Ibisch et al. 2006).

This 'valuation by viability'-step builds on the viability assessment conducted within MIRADI™, which is therefore a required step to be taken beforehand. It can build on both, the simple and more complex viability assessment, the latter using indicators related to key ecological attributes.

1. If the simple viability assessment has been used in MIRADI™, this classification (poor, fair, good, very good) needs to be applied across the full spatial extent of the target (all raster cells). For this purpose, a twin dataset (of the conservation target value dataset) is created, the target viability dataset. The classification can be applied on the basis of literature, expert judgement and/or by using proxy indicators that could indicate the viability of the target (e.g. proximity to settlements and roads, if applicable). The viability classification scheme is then converted to a numerical classification (e.g. poor: 0.25, fair: 0.5, good: 0.75, very good: 1). The values of the conservation targets are then qualified by their viability status. For that purpose, the conservation target value dataset is multiplied by its twin, the target viability dataset (e.g. using the raster calculator within ArcGIS). The result is a dataset displaying the conservation value of all conservation targets, 'qualified' by their viability status.
2. If key ecological attributes and associated indicators are used in MIRADI™, these should also be used to assess target viability across the full spatial extent. For example, if "forest ecosystems" was the conservation target and indicators of key ecological attributes would comprise 'amount of deadwood', then deadwood would need to be sampled across all forest ecosystems. In case direct measurement of indicators is not possible or too time and/or cost intensive, proxy indicators could again be used. The applicability of proxy indicators should be verified where possible. As described above, indicator classes corresponding to a certain viability condition (e.g. < 10m³ of deadwood per ha = poor) are then converted to a numerical classification (e.g. poor: 0.25, fair: 0.5, good: 0.75, very good: 1). For this purpose, a twin dataset (of the conservation value dataset) is created, the target viability dataset. The value of the conservation targets is then qualified by their viability status. For that purpose, the conservation target value dataset is multiplied by the target viability dataset. The result is a dataset displaying the conservation value of all conservation targets, 'qualified' by their viability status.

We acknowledge that the second option is comparatively time and cost-intensive and thus unlikely to be realised during an initial viability assessment, especially in countries where spatial data availability is comparatively low. However, data availability can be improved over time, also through regular monitoring, making it an option for a second or third revision of target viability.

Finally, there is always the question to what extent a higher data resolution/quality improves conservation management. This should always be considered before embarking on time and cost-intensive assessments. For the CBR, neither option could be realised at this point due to data constraints.

Step 4: Calculating conservation target density

As a result of the previous three steps, a raster layer for each conservation target is available displaying the assigned (and if applicable also qualified) target value. In case of the CBR, raster layers for old-growth forests, forest ecosystems, alpine meadows, water and riparian ecosystems and carnivores are available, all with a resolution of 100m. With the exception of the carnivore layer (value 2, nested target), each of these target raster layers displays a value of 10. To calculate conservation target density, all raster layers are added-up (e.g. raster calculator

function in ArcGIS). The output raster displays the conservation target density on a scale from 0 to 32 (since only 4 targets with an added value of 32 may spatially overlap). The classification scheme of table 4 was then applied.

Table 4: Conservation target density values and correlating categories.

Conservation target density value	Classification category
0	No targets
1-10	Low conservation target density
11-20	Medium conservation target density
21-32	High conservation target density

The layer can be used for a variety of purposes, e.g. to determine whether or not areas with a high conservation target density are protected or not and for identification of valuable areas for expansion of the protected area network. For this purposes, the conservation target density layer can e.g. be aggregated by the official cadastral vector layer to display conservation target density per parcel of land or a by a user-defined grid.

Development of an accessibility layer

The accessibility map that was produced shows the distance of each location to settlements and roads (paved and dirt roads). The distance is not shown in Euclidian meters but in conditional meters. This means that topography (slope) as a barrier to human movement over the terrain has been taken into account when defining accessibility. The accessibility map, produced by Ivan Kruhlov from Lviv University, was developed as follows:

1. Paved and earth roads were rasterised from the vector roads coverage with a 1:50,000 accuracy. Settlement regions were rasterised from the 1:200,000 vector dataset for Ukraine. On the Romanian side, the settled areas were extracted from the CORINE dataset. The roads and settlements datasets were merged and reclassified to produce a "human network", which is used as a source grid for the calculation of the "human proximity" layer. The "human proximity" layer (HUM_PRX_EUC**)** represents Euclidian distance (meters) from the "human network" (human_net)

2. A slope layer was derived from the SRTM DEM (Jarvis et al. 2006) to produce a cost surface for human proximity calculations. It is considered that the slope (inclination) can impede human movement over the landscape up to six times over the steepest sections (56 degrees – according to the SRTM-derived dataset). To produce a slope-cost layer (SLOPE_COST), the following calculation was applied:

   *Slope value / max slope value * 5 + 1*

   This calculation defines areas with "0" slope having impedance "1", and the areas with the max slope (56 deg) has the impedance of "6", while the slopes in-between have intermediate values from 1 to 6.

3. Building on this, the Euclidian distance is weighted with the cost factor represented by the slope-cost layer (slope_cost). The resulting raster dataset (HUM_PRX_CST) represents cost-distance from the "Human network" (human_net) in conditional meters.

Within the scope of the Carpathian Biosphere Reserve, accessibility in conditional meters ranges from 0 – 15,645. For the purpose of producing the conservation priority map, the layer was classified into low, medium and high accessibility. The classes were defined as follows:

Table 5: Conservation target accessibility in conditional meters and correlating categories.

Accessibility in conditional meters	Classification category
0 – 1,000	High accessibility
1001 – 5,000	Medium accessibility
5,001 – 15,645	Low accessibility

Producing the conservation management priority map

To generate the conservation management priority map, both the conservation target density and accessibility layer are overlaid. The resulting layer is classified into nine different areas according to the priority matrix (Figure 8).

2.2 Institutional networking and generation of new opportunities

One important aim of the project was to initiate and support further networking of the Carpathian Biosphere Reserve, increase its visibility and to create new opportunities. This was realised by inviting representatives of external institutions to project-related workshops and visits to the area, but also by seizing various opportunities of public outreach in several formats like in presentations at international workshops and conferences or international publications.

3 Results

3.1 General results

In the course of the project, results on various levels have been achieved that together form a basis for a modern management concept for the CBR. Besides the results directly connected to the framework of the Open Standards for the Practice of Conservation, possibly the most important achievement is the initiation of a stakeholder dialogue and the active integration of various stakeholder groups and different levels of CBR staff into the process of creating a new management plan. This process was a new approach for all participants and was highly appreciated and valuated by all parties. Around 100 stakeholders altogether were consulted during the process of developing the fundamentals for a modern management plan. Stakeholders included the following:

- Representatives from the State Agency for Protected Areas of the Ministry of Environment,
- Senior staff from other protected areas in Transcarpathia and from neighbouring provinces (oblasts)
- Managing directors from several State Forest Enterprises
- Mayors from several towns/villages close to the CBR
- Representatives from regional and local authorities
- NGOs
- Representatives from the media
- Private sector tourism operators
- Field staff from the CBR
- Representatives from education and research

The participatory project approach and the Open Standards process itself can thus be seen as very valuable concerning the contribution to the CBR's efforts to maintain and improve its relationships with the various stakeholder groups and develop as a key promoter of sustainable development in Transcarpathia.

A further (secondary) result includes the translation of the software for adaptive conservation management MIRADI™ into Ukrainian. The translation of MIRADI™ was initiated and conducted by the CBR to facilitate the acceptance and use of the software within the Carpathian Biosphere Reserve. By the end of the project, three senior management staff members are well familiar with the Open Standards as well as with the accompanying software MIRADI™ and further scientific staff have been trained in the basic use of the software.

The project did also manage to acquire weather datasets from four weather stations in eastern Transcarpathia for the last 4-5 decades:

- Pozhyzhevska (IF) – 1959-2009
- Rakhiv station (TC) – 1947-2009
- Khust (TC) – 1946-2009
- Mizhgirya (TC) – 1961-2009

The datasets included the following parameters:

- A – daily sum of precipitation, mm
- B – daily absolute minimum of the air temperature, ºC
- C – daily absolute maximum of air temperature, ºC.

The weather datasets were pre-processed for further climate-change relevant research that will be part of follow-up projects with the Carpathian Biosphere Reserve. The climate datasets will also prove important to identify changes in surface temperature and precipitation patters over the last decades to determine the scope and severity of climate change impacts in more detail on the CBR's conservation targets.

Finally, a range of new spatial datasets was created mostly covering the scope of the Carpathian Biosphere Reserve. Exemplary use of these spatial datasets is illustrated in the following chapter, but they may also prove valuable for further spatial analysis and management decisions. These datasets include:

- Several detailed hydrological vector datasets. These datasets will be useful in defining the spatial extent of the conservation target 'water and riparian ecosystems and processes'. It will also allow determining the risk of water contamination from settlements and industry (threats) as well as identifying important areas for the provision of ecosystem services such as water retention.
    - A vector dataset of all rivers and streams digitized from 1:50,000 topographic maps.
    - An attributed vector dataset of all rivers and streams that feature names. Names were taken from 1:50,000 topographic maps.
    - A dataset of all watersheds. Watersheds were derived from SRTM data.
- A detailed road vector dataset featuring six different road categories from paved roads to hiking paths digitised from 1:50,000 datasets. Among other issues, the detailed road dataset facilitated the development of the accessibility layer which in some cases stands as a proxy indicator for threats to conservation targets. The dataset will also be of importance for further work and projects of the CBR, e.g. to determine unfragmented and inaccessible areas for the expansion of the protected area network and to plan monitoring activities along tourism trails.
- A settlement vector dataset digitised from 1:200,000 containing population data from 2005. The dataset will be helpful in determining spatial priorities for the expansion of the protected area network and setting monitoring priorities, considering size and associated anthropogenic pressure on natural resources from the settlements.
- A conservation target density raster dataset with a resolution of 100m. The development of this dataset is explained in chapter 2.1.6, the results are presented in chapter 3.2.4.6. The dataset depicts the density of conservation targets across the scope of the CBR. Again this can be used for achieving conservation synergies e.g. in areas with a high conservation density.
- An accessibility raster dataset with a resolution of 100m. The development of this dataset is explained in chapter 2.1.6, the results are presented in chapter 3.2.4.6. The dataset illustrates accessibility from roads (paved and earth roads) in conditional meters, i.e. distance from roads taking into account the slope of the terrain as a barrier to human movement. The dataset may be used to prioritize conservation actions (expansion, protection, monitoring) depending on the accessibility of the area.
- A conservation management priority raster dataset with a resolution of 100m based on the conservation target density and accessibility dataset, the development of this dataset is explained in chapter 2.1.6, the results are presented in chapter 3.2.4.6. The dataset is an overlay of the two previously described datasets, illustrating how conservation target density and accessibility coincide using a nine-fold scale.

3.2 Application of the extended Open Standards for the Practice of Conservation to the CBR

3.2.1 Project team and stakeholders of the CBR

3.2.1.1 Core team

For the core team – a small group of people (typically 3-8 people) who are ultimately responsible for designing and managing the project of protected area management planning – the needed skills and roles were first identified and followed by the selection of suitable persons. Core team members where primarily chosen from existing CBR staff and all skills and roles could be adequately covered. This identified core team can always be extended by other CBR staff members or external experts if needed.

Table 6: Core team members and their roles.

Person	Org.	Position	Skills	Roles
Prof. Fedir Hamor	CBR	Director	Strategic vision	Team leader
Vasyl Pokynchereda	CBR	Deputy Director Research Department	Organisational skills	Coordinator (practical)
Victoria G. & Victoria B., Andrey Blumer (additional help)	CBR, Ecoromania			Tourism expert
Yaroslav Dovhanych	CBR	Researcher; Leader Zoological Department	Expertise on biodiversity	Information on biodiversity
Dmytro S.	CBR	Forest Scientist	Expertise on forest and forestry	Forest scientist, information on forest ecology and management
Victoria Gubko	CBR	Head of Department Tourism & Recreation, International Cooperation and Public Outreach	Communication skills and experience with stakeholders	Community outreach and public relations
Vasyl Pokynchereda	CBR	GIS Expert	Experience in monitoring	Coordination of project monitoring
Victoria B.	CBR	Head of Environmental Education Department	Skills and expertise in environmental education	Environmental education expert
Yuriy Berkela	CBR	Head of GIS Department	GIS skills	GIS expert

3.2.1.2 Advisors

Table 7: Potential advisors identified by the core team.

Person	Organisation	Field of support / advice
Ivan Kruhlov	Lviv University	Support in the area of spatial analysis and remote sensing
Stefan Pop	Faculty of Geography, University of Uzhgorod	Research
Andriy Hamor	Faculty of Geography, University of Uzhgorod	Research
tba	Institute of Mountain Forestry in Ivano-Frankivsk	Forest related research and forest management
tba	Lviv Nature Museum (part of National Academy of Sciences in Ukraine)	
Andrey Blumer		Ecological Tourism
tba	Agency for regional development and European integration – ARDEI – in Lviv	Community outreach
tba	Lviv State Forestry University	Forest management
Prof. Dr. Pierre Ibisch Juliane Geyer Lena Strixner Lars Schmidt	Eberswalde University for Sustainable Development	- Systematic and adaptive biodiversity conservation and PA management - Global and climate change research - Forest carbon projects
Hanns Kirchmeir	Institute for Ecology - E.C.O.	Database management Stakeholder participation

3.2.1.3 Stakeholders

3.2.1.3.1 Stakeholders relevant for the management of the CBR

The following stakeholders have been identified by the extended project team to play an important role for the management of the CBR within the defined geographical scope and should be integrated into the planning process:

Ministry for Environmental Protection (MEP)
The Ministry for Environmental Protection is in charge of the Carpathian Biosphere Reserve (CBR). New management steps and matters of extension have to be proposed to the Ministry first. The CBR is directly financed and its staff employed by the Ministry for Environmental Protection. Further, they give permission for specific undertakings in the region that may create environmental hazards, such as gold mining.

District administrations
The administration of the four districts connected to the CBR (Khust District, Rakhiv District, Tyachiv District and Vynohradiv District) is twofold and carried out by district councils and district administrations. The executive district administration represents higher government levels. The district councils are elected by local people and in charge of most of the land outside the CBR. They have a legislative function. The district councils have decisive power concerning the extension of the CBR as far as their land is concerned. Some regional development strategies are elaborated and executed on district levels that also affect villages in any case and maybe land users in general.

Village councils
Village councils are elected by the inhabitants of the village and are their official representatives. They are key actors in decision-making at local level. The importance of village councils lies in their position of owning and administrating village land as well as their representation of the local people. The latter also implies relatively high importance. Being fairly autonomous institutions, their power can be categorised as high. They have some influence on decisions concerning conservation in the area, e.g. through their vote in the matter of CBR extension. They also organize and administer a major part of the agricultural land use.

Local population
Local people are the main agricultural land users and the majority of inhabitants are engaged in small-scale agricultural activities for self-supply. Almost all of them live outside the CBR, but a major part of their land use takes place inside the CBR, especially cattle and sheep grazing on *polonynas*. Each family usually owns a hay meadow in the mountains and a great part of them also keeps sheep on the alpine meadows where they are collectively managed by a shepherd over the summer. The traditional making and using of sheep products still plays an important role in many villages. Hence utilisation rights of and guaranteed access to grazing areas is crucial to most inhabitants. People depend very much on the availability of wood for heating and as construction material, which they mainly buy from state but also some private forestry enterprises. Unemployment rates are high. Most locally employed people work in the forestry sector. Additional local income is generated from small-scale tourism activities, fishing, the sale of non-timber forest products and illegal logging. The local population carries a high potential for the development of the CBR and the region, since a substantial part of their livelihood still depends on the land. The influence of local people is rather low since they are rather marginalised in decision-making, partly by the lack of direct decisive power.

They are the main conservators of the traditional cultivated lands but often not seen as a specific stakeholder group since there is almost no professional farming in the area. Experience from western Europe shows that economic development might lead to higher income and abandonment or at least change of the traditional land use. This should be seen as an important topic for the management of the CBR. The change of traditional land use will not only have a major impact on the agricultural landscape in the lowland, but, as can be seen in the Alps, an even stronger impact on the traditional land use on the mountain grasslands (*polonynas*). Agricultural activities of local dwellers are also linked to the riparian ecosystems. The flat lowland areas along the rivers are highly productive and in the focus of intensive agriculture. Besides the interest of logging, the interest to turn the riparian forest into farm land is a severe threat to these ecosystems.

State Forestry Enterprises (SFE)

The State Forestry Enterprises are the most important land managers surrounding the area of the CBR as most of the land is forested. They are economically autonomous and receive almost no subsidies from the state. Forestry operations and the resulting income are the basis of existence. Almost all forest resource users depend on them. Probably the highest importance is the provision of firewood for local dwellers. Less frequently wood is also sold locally for other purposes such as construction. Furthermore, SFEs provide jobs for local dwellers and pay comparably high wages. Some villages depend totally on forestry, both as a source of income and as employer for their inhabitants. SFEs rent land to private forest and wood processing enterprises. Forestry enterprises also have a great influence on the extension of CBR territory because only with their agreement their territory can be included. Their importance as well as their potential can be categorized as high. Thus their interests could constitute to a major impediment for sustainable use of resources and conservation in the area. Being state institutions and only bound to higher forestry authorities, they enjoy considerable power in the region.

Private wood-processing enterprises

Private wood-processing businesses make up the main branch of private businesses in the region. They are dependent on forest resources by either buying wood from the state forest enterprises or by direct logging concessions on state territory. They provide jobs, local income as well as some wood for local use and bring money into the region. Their political power is relatively low, but due to their important socio-economic role in local communities they have a relatively high influence.

Tourism sector

Stakeholders within the tourism sector have a negative as well as a positive attitude towards nature conservation and the CBR. Tourism is a growing economic sector in the region. The severity of the influence depends on *how many* tourists are *where* and for *whatkind of* activity and *how* tourism planners and service providers are following the principles of sustainable tourism. Individual stakeholder groups and main actors within the tourism sector include the following:

- Private tourism service providers
- District and Oblast administrations, tourism departments
- FORZA Project Coordination Unit in Uzhgorod
- Transcarpathian Regional Centre of Rural Tourism Development
- Rakhiv agency of Agro Eco Tourism,
- Initiative group in Kostylivka
- Tourists

Private Businesses
There are some other private businesses and undertakings that create local income. This includes the increasing number of local shops, bars, restaurants, tourism businesses and hotels but also bigger enterprises such as quarries and mining companies. Some of them depend on the use of and access to local resources.

Education and research institutions
Schools and universities are already important partners of the CBR and are generally supporting the goals and vision of the biosphere reserve. The CBR cooperates with several universities in Ukraine (Lviv, Uzhgorod, Kyiv) but also with international research organisations like the Swiss Federal Research Institute WSL, the University for Sustainable Development Eberswalde in Germany or the Royal Dutch Society for Nature Conservation. This provides good access to scientific knowledge and international networks. These international research institutions benefit from the local logistic support and translation. The CBR on the other hand receives access to data and information gathered in the biosphere reserve.

Schools are an important target group for education. The main access points for schools are the Museum of mountain ecology and the information centre in the Narcissi Valley.
The general attitude of the schools is very positive, but they have on the short term level no major impact on the future development of the biosphere reserve. On the long term, this cooperation with schools plays an important role concerning the regional acceptance of the CBR.

Other groups
Other stakeholders include governmental actors, such as administrations and different ministries. Further there are regional environmental agencies and administrative departments that play an important role for CBR management. Local and regional NGOs and hunting and fishing societies are not numerous but certainly have an interest in local land use and conservation management. Also non-local and international actors are rather important for the development of the CBR, since most of them are already concerned with issues of sustainable development in the area (e.g. FORZA, WWF) and could be valuable partners. There are also other protected areas very close or even bordering the CBR (Synevyr National Nature Park, Carpathian National Nature Park, Gorgany Nature Reserve, Munții Maramureşului Nature Park in Romania) whose management may directly and indirectly influence the CBR and which could be considered beneficial partners.

3.2.1.3.2 Stakeholder analysis

A stakeholder analysis workshop within the WWF-Danube Carpathian Program in 2008 produced a model on different stakeholder groups classified by their attitude towards and their strength of influence on CBR management (Kirchmeir et al. 2008).Figure 9 shows all persons and organisations interacting with the CBR arranged by the strength of their influence on the activities of the biosphere reserve administration and the inclination of their influence (positive = supporting the objectives of the CBR administration or negative = opposing the objectives of CBR management). Strong positive influence can be attributed mainly to scientific research and educational institutions; whereas almost all land users exert strong negative influence. From the economic sector, only tourism actors have a slightly positive but only medium influence on the management of the CBR.

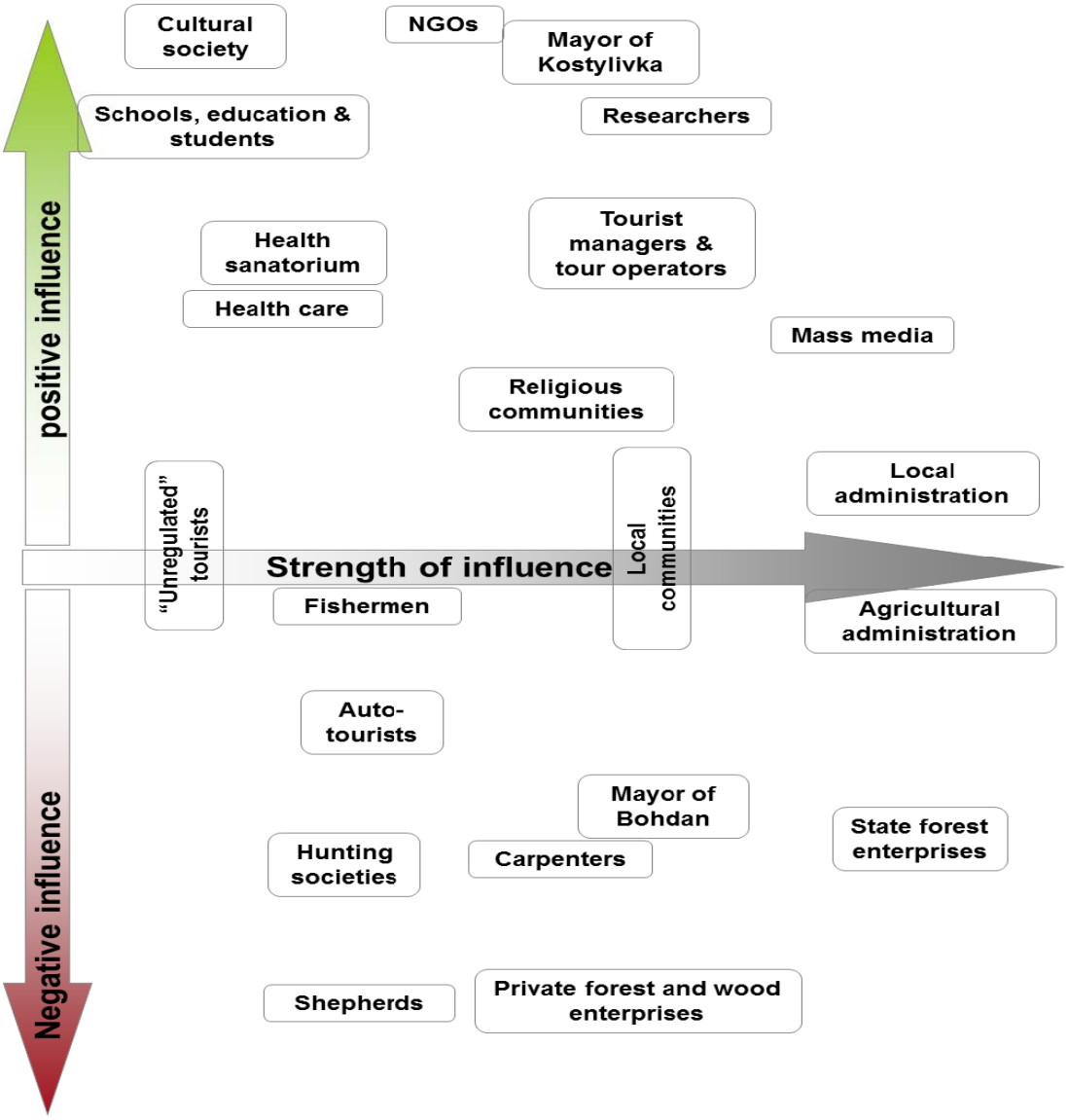


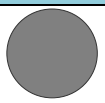
Figure 9: Result of the stakeholder analysis workshop 2008 in CBR (Kirchmeir et al. 2008).

Table 8 and Table 9 show the outcomes of a stakeholder analysis based on over 50 qualitative interviews with stakeholders connected to the CBR management. Table 8 summarises identified stakeholders of the area of the CBR classified into four main groups. Table 9 depicts the conflict potential between the main land user groups (including the CBR) in the area of the CBR as extracted from the interviews. The highest conflict potential exists between the CBR and private wood-processing businesses, State Forestry Enterprises and the local population (in terms of land use). Village councils bear the highest potential for common ground and cooperation with the CBR administration.

Table 8: Stakeholders in the area of the CBR (Geyer et al. 2009).

Local land users	Other local actors	Non-local government actors	Non-local/international actors acting locally
Local population Village councils State Forestry Enterprises Private wood-processing businesses	Private non-forestry businesses*(e.g. tourism)* Saulyak LLC gold mine Local NGOs *(Tysa, Ecological Club "Carpathians")* Private hunting and fishing associations Protected areas bordering the CBR*(Carpathian National Nature Park in Ivano-Frankivsk District, Maramures Mountains Nature Park in Romania (Parcul Natural Muntii Maramuresului))*	Ministry of Environmental Protection of Ukraine State Committee of Forestry District Council and District Administration State Administration of Environmental Protection in the Transcarpathia Region	FORZA*(Swiss-Ukrainian Forest Development Project in Zakarpattya)* WWF Heifer International Scientific institutions, universities*(e.g. Lviv and Kyiv Universities)* International scientists and funds*(e.g. Royal Dutch Society for Nature Conservation, Swiss Federal Institute for Forest, Snow and Landscape Research WSL)* Tourists

Table 9: Overall conflict potential between the main land users as assessed from evaluating conflicting and common interests (Geyer et al. 2009).

	Local population	Village councils	State Forestry Enterprises	Private wood-processing companies
Carpathian Biosphere Reserve				
Private wood-processing companies				
State Forestry Enterprises				
Village councils				

3.2.1.3.3 Stakeholder participation in the project workshops

Table 10 summarises the participation of stakeholders in the two participatory project workshops in March and October 2010. In the first workshop all major stakeholder groups were represented by several people. In the final project workshop especially local authorities and representatives of State Forestry Enterprises were almost totally absent. Representatives of the tourism sector, neighbouring protected areas and local or national NGOs eagerly participated in both workshops.

Table 10: Participation of stakeholders in the two project workshops.

Stakeholder	Workshop March 2010		Workshop October 2010	
Local authorities	Vasyl Dimych	Kvasy village mayor	Vasyl Kokerch	Bohdan Village Council
	Olga Smetanyuk	Kostylivka village mayor	Olga Smetanyuk	Kostylivka mayor
	Ivan Prannychuk	Lazeshchyna village mayor		
	Mykola Bochkor	Luhy village mayor		
	Dmytro Andriyuk	Rakhiv council member		
	Fedir Mytryuk	Kosivska Poliana village mayor		
	Igor Savchuk	Rakhiv District Administration		
	Volodymyr Kokerch	Responsible for highland meadows of the village Bohdan		
Regional authorities	Dmytro Ihnatyuk	Head of Agriculture Department, Rakhiv	Dmytro Ihnatyuk	Head of the agricultural department, Rakhiv District State Administration (RDSA)
	Mykola Tkhoruk	Regional Water Management Department, Uzhgorod		
State Forestry Enterprises	Vasyl Kuvik	Yasinia SFE, senior forester		
	Hanna Andrusevych	Velykyi Bychkiv SFE, forest cultures engineer,		
	Anatoliy Firtsai	Bushtyno SFE, director		
	Ivan Bogosta	Khust SFE		
Tourism sector	Petro Popovych	Director of "Europe Hotel" Rakhiv	Vasyl Khoma	Tourism business sector
	Hanna Slyusarchuk	Head of Rakhiv Rural Tourism Association, guesthouse owner Rakhiv	Hanna Slyusarchuk	Head of the local Green Tourism Association
Neighbouring protected areas	Oleksandr Kyselyuk	Carpathian National Nature Park, deputy director	Oleksandr Kyselyuk	Deputy director, Carpathian NNP
	Yaroslav Holynskyi	Gorgany Nature Reserve, director	Yaroslav Holynskyi	Director of the Gorgany nature reserve
	Valentyn Voloshyn	Uzhanskyi National Nature Park, deputy director	Myron Shpilchak	Deputy director, Gorgany nature reserve
	Volodymyr Buchko	Halytskyi NNP, deputy director	Yuriy Tyukh	Deputy director of the Synevyr NNP
			Vasyl Matichyn	Head of the department, Synevyr NNP
State Agency for Protected Areas	Hryhoriy Parchuk	State Agency for Protected Areas, Kyiv, Head of Department		
	Petro Vakulenko	State Agency for Protected Areas, Kyiv		
	Anastasia Drapalyuk	State Agency for Protected Areas, Kyiv		

NGOs	Yuriy Derbal	FORZA		
	Vasyl Kuzma	Ecological NGO, Uzhgorod	Oleg Dudkin	Director, Ukrainian Society of Birds Protection
	Oleksandr Bokotei	NGO, Zoological Museum Uzhgorod	Olena Hirnik	Head of the department, Ukrainian Society of Birds Protection
			Oleg Luhovyi	NGO from Uzhgorod
Education and Research	Ivan Buntushak	Lazeshchyna school		
	Mykola Cherniavskyi	Lviv Forest Technical University		
Media	Andriy Mykhailyk	Journalist		

3.2.2 Project scope

The geographic scope of potential future conservation planning in the CBR, i.e. the area of interest in planning strategies to protect conservation targets and reducing connected threats, was identified during an open discussion among senior staff of the CBR, representatives from the Eberswalde University for Sustainable Development and Ivan Kruhlov from Lviv University using a map of the area as a basis.

Three scope areas were defined and marked on the map (see red delineation in Figure 10). One large area includes the five mountain massifs of the CBR and the Narcissi Valley. The two smaller scope areas were defined as the two lowland protected areas Chorna Hora and Yulivska Hora including a buffer around them. Ecological connectivity between the three scopes is presently not given, mainly due to infrastructure development and settlements but also due to natural barriers such as the river Tysa. Connectivity between the areas will and need not be strived for.

The large scope area – and the main scope for this project – was delineated on the map pursuing a watershed approach. One important aspect for the decision of the scope was the present and aspired ecological connectivity both between the CBR massifs and to neighbouring protected areas. The aim will not necessarily be to formally protect the whole scope area but rather to develop strategies for maintaining a functional ecological network embedded into the Transcarpathian Ecological Network, the Carpathian Network of Protected areas and the Pan-European Ecological Network. The scope includes Synevyr National Nature Park and connects to neighbouring protected areas such as the Carpathian National Nature Park and Muntii Maramureşului Nature Park in Romania. An extension of the scope towards Gorgany Nature Reserve in Ivano-Frankivsk Oblast might be reconsidered to enhance ecological connectivity. Besides the aspect of connectivity, neighbouring protected areas also impose threats in form of tourism upon the scope and targets of the CBR. That is a second reason why they were partly included into the project scope. The scope's extent is defined as follows:

West
- Watershed boundary west of river Tereblya
- Including the Narcissus Valley due to its importance
- Also including town of Khust due to its influence on the Narcissus Valley

South-West

- Geomorphologic border between the Upper Tysa Basin and the Low Mountain Belt
- Also border between advanced and low infrastructural development
- The area in the south has no influence on the area north of the scope limit and is heavily developed

South

- Scope includes a narrow strip of Romania including the opposite slopes of Maramures Massif in the Munții Maramureşului Nature Park mainly because of tourism impact

East

- Extending into Ivano-Frankivsk Oblast following the oblast border but including the eastern ridges of Chornohora Mountains up to Yasinya level (impact of tourism)

North

- From Yasinya to Synevyr Lake along the oblast border (watershed border) including Synevyr National Nature Park (not necessarily the area itself, but as an administrative structure)

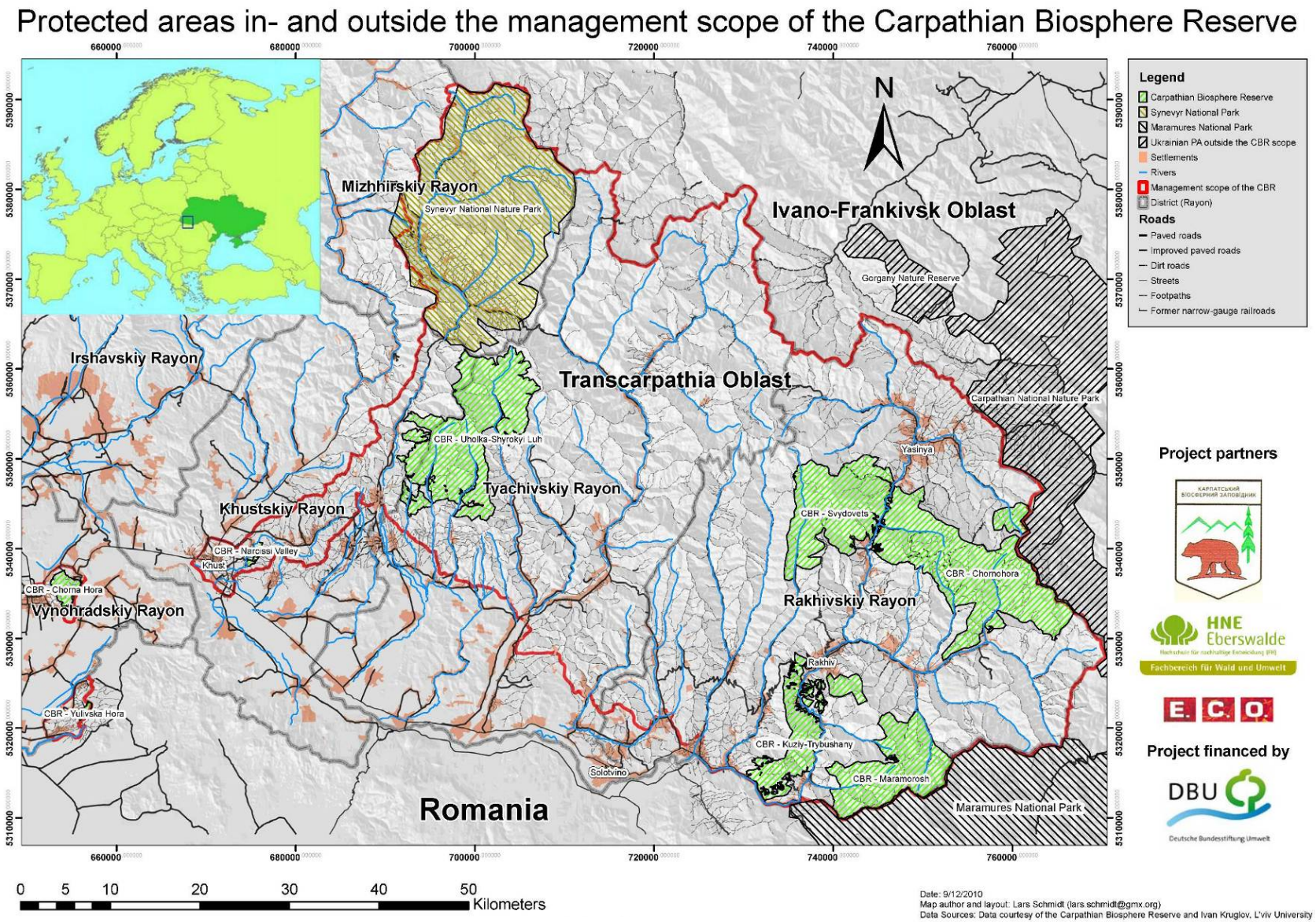


Figure 10: Protected areas in- and outside the management scope of the Carpathian Biosphere Reserve.

3.2.3 Long-term vision

During expert consultations with the CBR, a range of aspects that could form part of a common vision were formulated. These aspects naturally include issues of conservation but also community cooperation, sustainable development and cultural identity and heritage. Further details are shown in Table 11.

Table 11: Vision statements for the CBR region from CBR staff and experts.

Conservation	Community cooperation	Sustainable development	Cultural heritage and identity
Enlarged core zones	Partnership and good cooperation with and support by local communities established	Regulation and steering of tourism improved.	The area's interesting cultural identity in form of traditional land use and cultural traditions is preserved
Destroyed ecosystems restored	Communities integrated into management planning.	Touristic carrying capacity of the reserve is known and not exceeded	
Ecological connectivity between all CBR clusters and neighbouring PAs e.g. through ecological corridors established		Sustainable development of communities through ecotourism achieved.	
Ecological monitoring improved		Responsible and balanced use of natural resources, especially forest resources, established	
Illegal hunting and logging reduced.			
Rich biological and landscape diversity, with great share of endemic species maintained.			
Large areas of primeval forests maintained			
The scope identified will be the core area of Pan-Carpathian and therewith part of the Pan-European Ecological Network			

In addition, during the first stakeholder workshop, participants communicated slightly different visions for the future (Table 12).

Table 12: Stakeholder vision statements for the CBR region.

Conservation	Community cooperation	Sustainable development	Cultural heritage and identity	Cross-cutting issues
Biodiversity is protected	Cooperation between PA and local population established	Welfare and quality of life of local population improved	Cultural values are preserved	Adapted to changing climatic conditions
		Sustainable development is implemented	National and ethnic consciousness developed	
		Marketing as a tourism destination improved	Education programmes , restoration of and support for traditional handicraft and arts	
		A hydroenergy supply of at least 50% achieved		
		Use of alternative energies		
		Ecological responsibility raised, changes in mentality towards more sustainable resource use achieved		
		Ecological tourism developed, high no. of foreign tourists		
		Positive investment climate realised		

The results of both consultations indicate that – expectedly – conservationists put a much stronger focus on conservation in the vision while communities, the private sector and the public administration focus to a large extent on development issues. A joint vision could not be finalised during the project but will eventually be developed by the CBR together with all relevant stakeholders, as the Open Standard process continues.

3.2.4 Complete situation analysis

The following chapters present the core findings of the project. In contrast to the chronology of the Open Standards, we first present the conceptual model and a general description of the political and socio-economic framework conditions that apply to the project region (eastern Transcarpathia). In addition, background information on tourism is supplied. This is to provide the reader with a better overview, prior to the detailed presentation of each conservation target and its associated threats and factors.

Throughout the project, the conceptual model was continuously developed, reviewed and updated. Given the adaptive nature of the Open Standards, this process of developing, reviewing and updating is never concluded – this is the essence of adaptive management. The conceptual model displayed here is the latest version from 28th October 2010.

Oval boxes in light green show conservation targets, while red and orange rectangles show direct threats and factors respectively. Some factors could be grouped into 'factor chains' or 'factor-complexes' and are shown as large grey boxes. Yellow hexagons represent strategies. The conceptual model gives a first impression of the interconnectedness of all the various factors and the overall complexity of the conservation situation in the region.

3.2.4.1 Conceptual Model

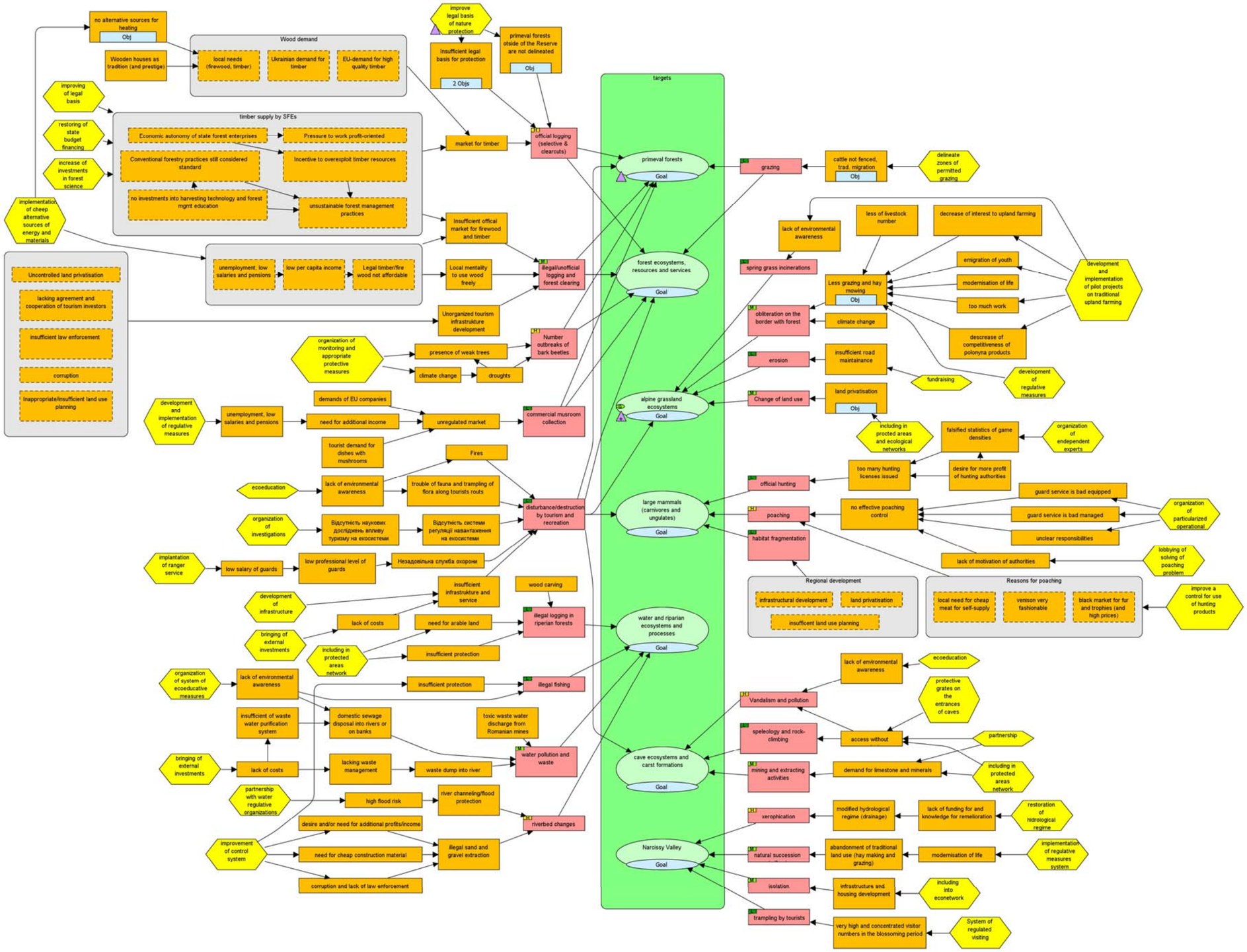


Figure 11: Conceptual model for the situation of biodiversity conservation in the Carpathian Biosphere Reserve.

3.2.4.2 General description of the political and socio-economic framework conditions

Following its independence in 1990 in the wake of the Soviet Union's disintegration, Ukraine entered an era of dramatic **political and socio-economic change**. The phase of temporary dis- and reorientation of the political system and the breakdown of the socialist economy with its rigid planning resulted in wide-spread unemployment, a shortfall in supply of daily goods and services, suspension of wage and pension payments and a general loss of both governmental services and control. Even though the Ukrainian Carpathians were not an industrial or agricultural production centre of great importance, its main economic sectors were still affected. The comparatively small industry which had been developed subsequently collapsed, sending tens of thousands of workers into **unemployment**. To give an example, in the district capital Rakhiv in Transcarpathia Oblast, all four major enterprises - a cardboard factory, a furniture factory, a dairy and condenser plant and several timber processing companies – closed down. Several thousands of people, a high percentage of the local workforce, lost their jobs.

Similarly, many of the **large collective farms** in the Pannonian lowlands of Transcarpathia – as elsewhere – did not survive this era. As in many other former soviet countries, this transformation was accompanied by further phenomena like inflation, rural depopulation and work migration to urban centres or neighbouring countries (Geyer et al. 2009). One or sometimes even both parents would leave their children behind for years in search for work in Poland, Hungary, the Czech Republic and Slovakia. Exact figures are not available but many never returned. This migration caused or amplified a variety of societal problems such as alcoholism, lack of education and criminalisation. It also led to a **decline in traditional agriculture, especially in the upland livestock breeding**. This physically hard but low-profit work ceased to attract people, who rather preferred to work in more comfortable conditions in other European countries. In return, this contributed to a reduction of secondary (post-forest) grasslands – including alpine grasslands and meadows - which became subject to natural succession. Following the widespread loss of jobs and employment opportunities in the early nineties, poverty especially in rural areas increased (UNEP 2007).

Figure 12: Industrial ruin near Rakhiv.

Figure 13: Typical rural homestead with subsistence farming near the house.

Although declining, people's most important response to unemployment was and continues to be **subsistence farming**. In combination with comparatively easy access to the rich supply of wood, non-timber forest resources, fish and game, people were and are relatively well-provided also throughout harsh times. Today, traditional small-scale agriculture and livestock remain important sources of food for local rural communities. Most families have a garden

and domestic animals like cows, goats, pigs and chicken. Their fodder is being grown in the garden and hay is mown on meadows adjacent to the house or higher up in the mountains. Agricultural activities are comparatively basic without the use of high-tech equipment, fertilisers or pesticides. People are therefore very much dependent upon supporting ecosystem services like soil formation and nutrient cycling or regulating services like pollination and water regulation. A wide variety of animals and plants, specially adapted to the harsh mountain climate, is bred for agricultural purposes (amongst them the Hutsul horse, the Carpathian sheep and the Hutsul bee (UNEP 2007), but are losing importance. Additionally, most families also have 3-7 livestock (sheep or cows), which are herded collectively on the alpine pastures (*polonyna*) over the summer. The existence and access to these natural resources as well as the knowledge of how to use them served and still serves as a kind of socio-economic safety net in times of crisis (Geyer et al. 2010a).

Figure 14: Mountain sheep farm in Chornohora.

On the other hand, the weak governmental control during the transformation process also created, facilitated or amplified a number of societal and ecological problems. Weak law enforcement for example gave local people the opportunity to buy and use long-range **hunting** weapons, which facilitated **poaching** of large predators as well as many game species.

At the same time, the introduction of the market economy resulted in the **privatisation of many state properties and assets.** Given the lack of governmental control at that time this process of privatisation was often not transparent and allowed political influential and affluent people to acquire significant areas of state land or other assets for comparatively little money. In addition, the sale of private property did also increase, especially in areas attractive for e.g. skiing resorts. In eastern Transcarpathia and Ivano-Frankivsk Oblast, this applies for example to areas near developing ski and mineral water resorts like Dragobrat, Bukovel and Skhidnytsia. Tourism is welcomed even by most conservationists as a preferred development option, though the way in which for example ski resort development takes place often presents a significant threat to biodiversity.

Figure 15: Tourism infrastructure development in Bukovel.

While the **ski resort of Bukovel** in neighbouring Ivano-Frankivsk Oblasthas been properly planned and is being developed in accordance with regulations, the sheer scale of it as well as secondary effects have negative impacts on biodiversity. Large scale clearing of forests,

channelling of rivers and snow cannons are likely to increase erosion, sedimentation, downstream floods and possibly also water shortages. In addition, to improve access to the ski resort from other areas, a road is planned that would cut the nearby strict protected Gorgany Nature Reserve in two.

Another expanding ski resort is **Dragobrat** to the south-west of Yasinya, directly bordering the Carpathian Biosphere Reserve. Here the problem is the uncontrolled spread of hotels and infrastructure. Most constructions have not been approved by the responsible authorities, but expansion continues. Although personal gain and corruption play a role, there is also a lack of understanding of what sustainable and ecological tourism means. The importance of well-preserved nature for ecological tourism is also underestimated. Poorly developed tourism infrastructure and large-scale littering and pollution of natural and anthropogenic landscapes greatly impede the development of ecological tourism. Colourful folklore festivals that are increasingly conducted in the region cannot compensate for these shortcomings. Although there are numerous regional and district tourism development programmes (the current one will be over in 2011, and a new one is about to be launched in Transcarpathia), they seem to have little apparent effect on private sector tourism development. The most harmful results of these chaotic developments are erosion processes on highland ski resorts (like Dragobrat and Bukovel) and mountain roads, pollution and a great visitor pressure on vulnerable ecosystems.

Figure 16: Tourism infrastructure development in Dragobrat.

Other state companies such as the **state forest enterprises** were not privatised. They ceased to receive governmental funding though operating today as economically independent entities with little effective governmental control. This structural arrangement has increased the incentive for SFE to overexploit their assigned forest resources and facilitated corruption, as the profit remains within the company.

Remote sensing analysis for the period 1988 – 1994 showed that **forest disturbance in Transcarpathia**, but also in the bordering areas of Slovakia and Ukraine, increased by 80% compared to Soviet times. Interestingly, in the area sampled protected areas in Ukraine made little difference in terms of logging and there is evidence of logging prior to the designation of protected areas (Kuemmerle et al. 2007). While many areas formerly used for grazing or agriculture went out of use and became subject to natural succession, there was forest loss in the interior Carpathians and increased logging in remote areas. Kuemmerle et al. (2009) conclude that *[…] unsustainable forest use from socialist times likely persisted in the post-socialist period, resulting in a continued loss of older forests and forest fragmentation […]*. Comparison of these remote sensing based findings with official forest resource statistics have shown that increased harvesting rates did not show up in the latter, underlining their limited

reliability. It appears that illegal logging was at least as extensive as legal and documented harvesting during the early 1990s and that so-called sanitary cuttings (often clear-cuts) often served as an excuse for overharvesting and logging in restricted areas. As a matter of fact, sanitary cuttings have remained as a legislative loophole, allowing many state forest enterprises to even conduct logging operations within protected areas.

Conservation in the Ukrainian Carpathians is solidly founded on Ukrainian national environmental legislation and policies, but due to the area's international importance conservation is also shaped by (eco)regional conservation efforts and initiatives. Protected areas as institutions play a very important role in biodiversity conservation and sustainable development in the Ukrainian Carpathians. The Law "On Nature Conservation Fund [protected territories and objects] of Ukraine" from 1992 includes the following **protected area categories**: strict nature reserve (*zapovidnyk*), biosphere reserve, national nature park, regional landscape park, and nature (botanical, wildlife) reserve. In the Ukrainian Carpathians there are eight National Nature Parks (NNP), eight Regional Landscape Parks, two Strict Nature Reserves and two UNESCO Biosphere Reserves (CNPA 2008).

The Carpathian Biosphere Reserve is the main protected area in eastern Transcarpathia and is bordering Synevyr NNP in the west, the Carpathian NNP in Ivano-Frankivsk Oblast in the east, Maramures Nature Park in Romania in the south. Gorgany Nature Reserve is situated in close vicinity in Ivano-Frankivsk Oblast. The already mentioned Carpathian Network of Protected Areas (CNPA) is a very important tool for the cooperation among protected area managers.

Ukraine has also ratified the Convention on Biological Diversity in 1995 and the United Nations Framework Convention on Climate Change in 1997. In addition, following the example of the Alpine Convention, the Carpathian countries adopted the Framework Convention on the Protection and Sustainable Development of the Carpathians (the "Carpathian Convention"), which was born in the Ukrainian Carpathians at a conference in the Carpathian Biosphere Reserve in 2002 and signed and ratified by all seven Carpathian countries in 2003. The **Carpathian Convention** provides the strategic framework for cooperation and multi-sectoral policy coordination, a platform for joint strategies for protection and sustainable development of the Carpathians, and a forum for dialogue between all stake-holders involved. It supports the Carpathian countries in a common vision and in integrating development and environmental goals (UNEP 2007; Borsa et al. 2009; The Carpathian Convention 2010). The Carpathian Convention has a special function for Ukraine, not being an EU member, as it facilitates close economic, social and environmental interactions with the Carpathian EU member states (UNEP 2007). The Carpathian Convention's strongest instrument for forwarding the conservation of biodiversity is the biodiversity protocol (Protocol on Conservation of Biological and Landscape Diversity) adopted at the last Meeting of the Ministers and already ratified by five countries (Ukraine ratified in 2009).

In stark contrast to these international and regional political efforts, conservation in the Carpathians is plagued – first and foremost – by state budget constraints and spending cuts. From year to year funding plans are not met, impeding the performance and functionality of the CBR and other protected areas.

Twenty years after the disintegration of the Soviet Union and gaining independence, Ukraine remains, both politically and economically, a rather vulnerable country in transformation. In economic terms, neither its industrial and agricultural output, nor level of employment and per-capita purchasing power has reached Soviet levels. From a political perspective, Ukraine today is a politically divided and thus unstable country, walking a thin line between the EU and

NATO on the one side, and the revitalised Russian Federation on the other. In addition, while its state structures and public administration have largely survived, they often fail to meet their responsibilities and new challenges, also as a result of their partly outdated structures and lack of financial resources. Ukraine's total state deficit stood at around 43-44% of present GDP in late 2010, while the new indebtedness is estimated to be 5.5% of the GDP in 2011. Even before the financial crisis, which hit the Ukraine hard, the country had been receiving support from the International Monetary Fund (IMF). Although the government is determined to reduce spending – e.g. through cuts on pensions and wages of public employees – the IMF still sees a risk of hyperinflation should the economy not recover soon. This would certainly see the country's fragile political and socio-economic stability further deteriorate.

In Transcarpathia, the high unemployment, unsustainable forest use and unregulated tourism development present major challenges to conservation, which as a result of notorious underfunding struggles to retain its full functionality.

3.2.4.3 Tourism framework conditions of the CBR

In the Soviet Union, the Ukrainian part of the Carpathian Mountains was one of the most attractive places in the USSR for tourism and recreation. Every year millions of visitors came to the area of today's CBR, which offers a range of interesting natural attractions and cultural sites – alpine grasslands (*polonynas*) with the highest peaks of Ukraine, snow covered mountains with skiing infrastructure, old-growth forests, numerous karst formations, mineral water springs and health resorts.

After the collapse of the USSR, however, the number of visitors of the CBR scope decreased greatly. Since Ukrainian independence Transcarpathia is again in a border position. Accessibility, particularly of the CBR region, is limited due to the external EU-borders in the west, rather limited road access and long lasting train connections from other districts and oblasts of Ukraine. Still, during the recent years, there has been a clear and steady revival of tourism, particularly regarding visitors from the neighbouring EU countries like Czech Republic and Poland.

Figure 17: Selected tourist attractions of the CBR territory (top left: Pip Ivan peak (1936m) acknowledged as the most beautiful peak of the Ukrainian Carpathians; top right: old-growth beech and mixed forests; bottom left: Narcissi Valley with Narcissus meadows

Looking at different territories of the CBR the attractiveness and promotion of the Narcissi Valley refer to a significant tourism demand. Data collected at the entry point of the Narcissi Valley indicate an increase from 30,000 (registered) visitors in 2005 to more than 50,000 (registered) visitors in 2009. The decrease of registered visitors at other CBR entry points might link to the overall economic crisis, which generally affected the tourism demand.

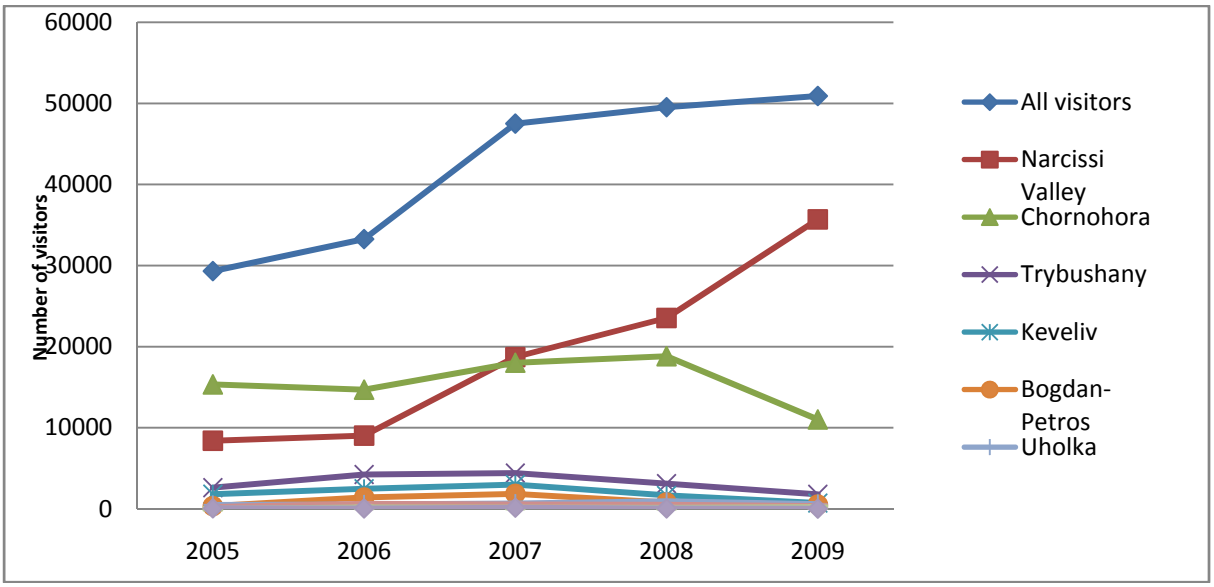


Figure 18: Number of registered visitors entering the CBR territory.

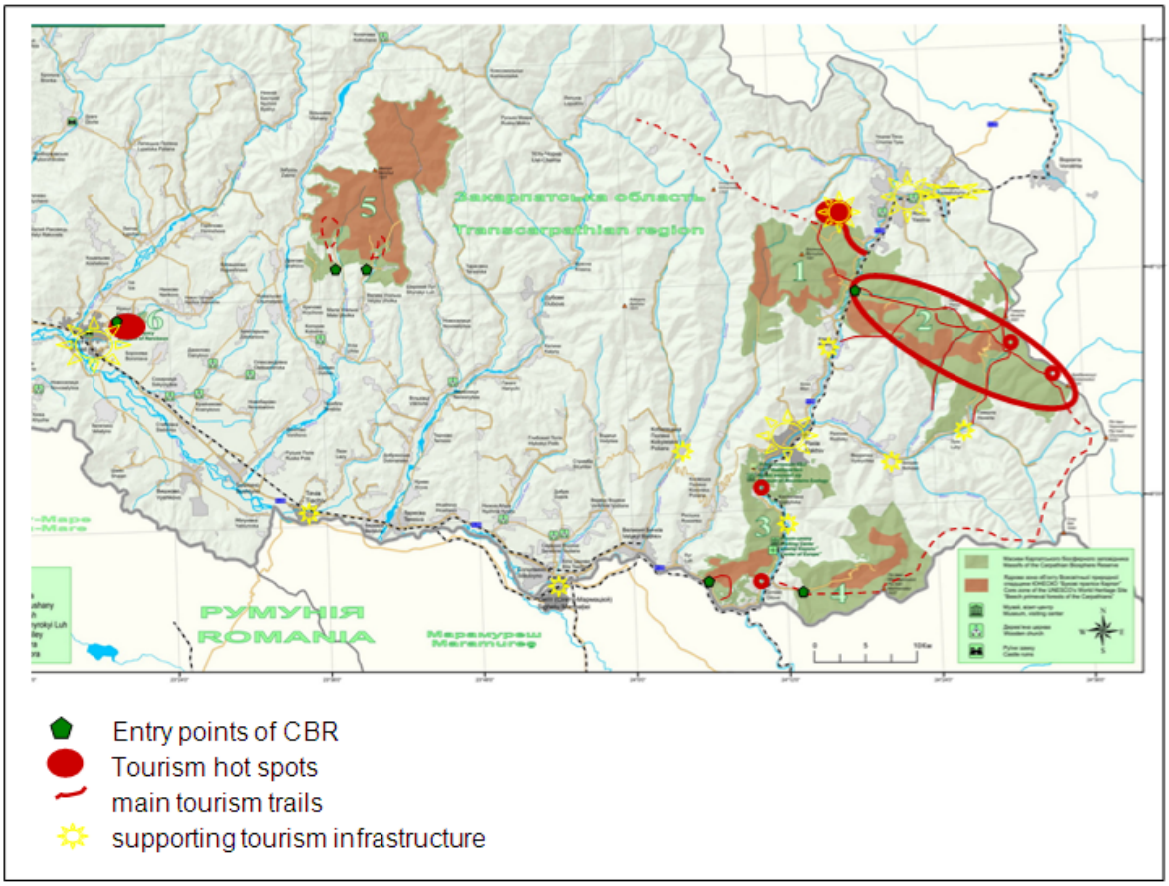


Figure 19: Geographical distribution of the most frequented tourism sites, hiking trails and supporting tourism infrastructure within the CBR region.

Within the CBR territory the following visitor services and infrastructure are currently provided:

- Checkpoint buildings at all CBR entrances;
- Mountain Ecology Museum in Rakhiv, Narcissi Valley visitor centre; Centre of Europe visitor centre (opened in 2010); rangers' station at the bottom of peak Hoverla (currently under construction)
- Hiking trails in the mountains;
- Transcapathian Hiking Trail (THT) with sign posts and basic infrastructure
- Available staff for different fields of expertise;
- Information boards, leaflets, postcards, website

From 2003 to 2010 the Ukrainian-Swiss development organisation FORZA together with the CBR and local initiatives implemented project activities aiming, amongst others, at the improvement of local livelihoods based on ecotourism development.

In 2008 a thorough tourism analysis of the CBR was conducted. Besides an analysis of the current management and recreation approach corresponding to different CBR territories this report also concludes a range of practical recommendations to strengthen visitor management capacities and sustainable tourism in the area (compare Blumer 2008).

Limitations of sustainable tourism development within the CBR management scope include:

- Insufficient waste management within Rakhiv District
- Deficient environmental awareness among locals and guests
- Unregulated land use management, uncontrolled building (e.g. Dragobrat)
- Limited range of tourism accommodation with accepted international standard;
- Lack of a destination management organisation (steering body) in terms of destination planning and marketing
- Insufficient cooperation between tourism stakeholders (private sector as well as administration)
- Missing tourism strategy on district level

3.2.4.4 Situation analysis by conservation targets

The following section contains information on the conservation targets as well as associated threats and factors. Where available, information on key ecological attributes and conservation target viability is also included. The information has been compiled by the CBR based on the readily available data sources. Availability of information conservation targets was not equal across targets and not all information could be used in this report. The description of conservation targets will be frequently updated as more information becomes available and will be further systemised in future.

3.2.4.4.1 Primeval forests

Rationale for choosing primeval forest ecosystems as a conservation targets

Primeval or old-growth forests perform a range of important functions and services that make them valuable conservation targets. The old-growth beech forests of eastern Transcarpathia are unique in Europe and have a very high biodiversity value. They provide many ecosystem services (e.g. climate regulation, water purification or photosynthesis locally and carbon sequestration and storage, climate regulation and educational services globally) that many managed forests might not equally provide.

The old-growth forests of Transcarpathia – especially those of Uholka - serve as a reference model for sustainable forest management and as an important research site for natural forest ecology as they have largely retained their natural structure. As any model, the primeval forests should be protected from anthropogenic disturbance, otherwise they would lose this important function.

Figure 20: Primeval beech forest in Uholka.

General description

With approximately 39,000 ha, the management scope of the CBR contains Europe's highest

concentration of primeval forests. The largest part of them is protected by the reserve. These primeval forests are of global significance, which is underlined by their status as UNESCO World Natural Heritage Site. Primeval forests not protected within the massifs of the CBR are located within the territory of state forestry enterprises. Having no special protection status these forests are managed as any other forest and are included into the annual operation plans of the SFEs. Only their comparatively low accessibility currently ensures their protection.

Table 13: Primeval forest sites distribution by landusers in 2007.

Land ownership / jurisdictional responsibility	Area in ha	Number of sites
CBR	14591.6	21
SFHE „Mokraianske'*	8829.8	25
Velykobychkivske SFHE	4203.2	21
Rakhivske SFE**	3849.3	22
Brusturianske SFHE	3724.1	16
Khustske SFHE	1457.6	3
Bushtynske SFE	1074.7	2
Yasinianske SFHE	942.0	13
Total	**38672.3**	**123**

*SFHE – State forestry and hunting enterprise
** SFE – State forestry enterprise

There are ten forest types classified by dominating species in the management scope area. Figure 21 shows, that pure forests of *Fagus sylvatica* (16639.6 ha) in comparison to pure stands of *Picea abies* (8292.6 ha) are twice as large size. The least surface is covered by deciduous forests with domination of *Quercus petraea* (totally 10 ha) (Hamor et al. 2008).

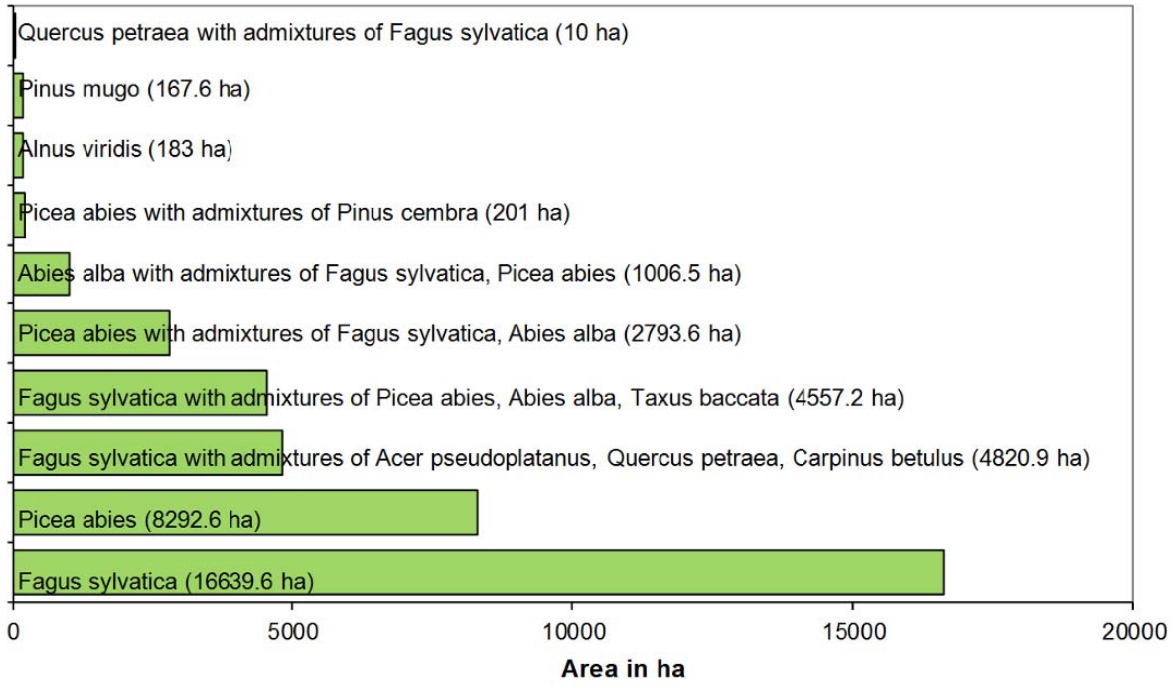


Figure 21: Distribution of primeval forest by stand types.

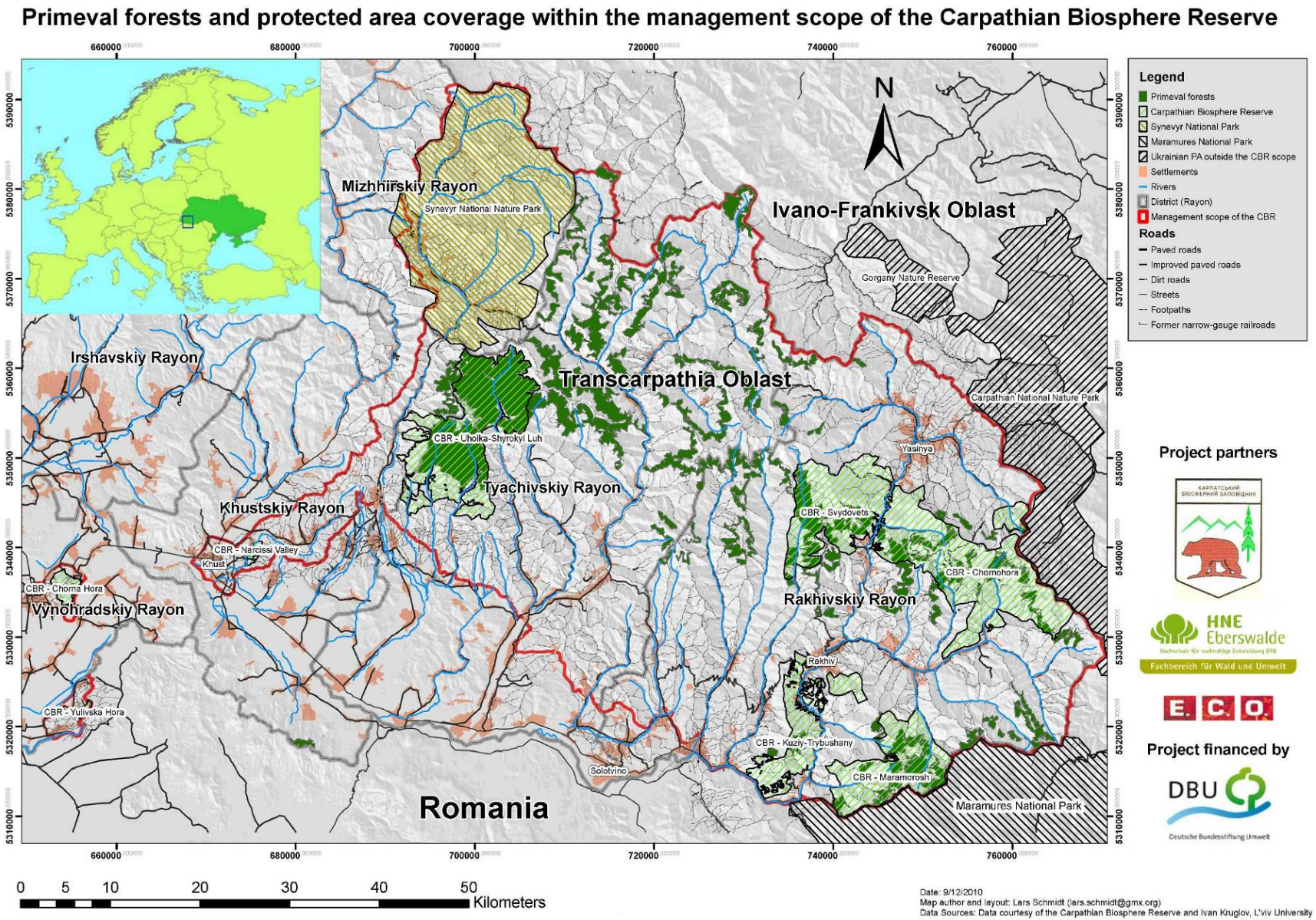


Figure 22: Primeval forests and protected area coverage within the management scope of the Carpathian Biosphere Reserve.

The size and distribution of primeval forest sites, as can be observed in Figure 22 above, is characterised by fragmentation and isolation (Hamor et al. 2008).

Old-growth forest ecosystems within the scope of the CBR contain over one thousand vascular plant species, around 450 moss species and over 430 species of lichen. In addition, they shelter a great number of species, which are either rare or endangered beyond their boundaries. In particular these are xylobiont species of fungi, insects and birds dependent on deadwood and hollow trees. All European wood-destructing fungi are distributed here (Brändli & Dowhanytsch 2003).

Key ecological attributes and indicators

Monodominant beech and fir primeval forests and polydominant coniferous-beech, beech-coniferous, beech-oak, beech-sycamore maple and others are distributed within the project scope. All of them have a complex vertical and horizontal, age and spatial structure with different development stages.

A multi-layered structure is one of the key characteristics of primeval forests. Roughly, four different horizontal layers can be distinguished. Each of them is characterised by peculiar structures and functions.

1. In the first (upper) layer the main productive (reproduction) potential is concentrated with overgrowth, old and mature fructiferous trees.
2. In the second layer a comparatively young group of fructiferous trees is dominating.
3. Pre-generation (not yet productive) trees belong to the third layer.
4. The fourth layer represents undergrowth from juvenile to some pre-regeneration trees.

Figure 23: Standing deadwood in Uholka primeval forest.

In addition to the layered structure, primeval forest ecosystems are characterised by a great multi-aged structural diversity (Parpan & Stoyko 1999). There are six different age groups (generations) singled out in a forest:

1. A senile hardly fructiferous group with the age 201-360 years,
2. The oldest fructiferous - 161-200 years,
3. Old fructiferous - 121-160 years,
4. Mature fructiferous - 81-120 years,
5. Fructiferous and pre-fructiferous - 41-80 years and
6. Pre-fructiferous and juvenile - under 40 years.

In general it can be stated that a dynamic and mosaic process is occurring in primeval forest ecosystems. An integral turning point for functional dynamics and regeneration of primeval forest ecosystems is the light factor, which is closely connected to mortality intensity and gap dynamics e.g. as a result of windfalls and other disturbances. The continuous occurrence of

gaps results in new biogroups in the undergrowth, increasing diversity in terms of age and composition.

Primeval forest ecosystems are also characterised by a mosaic structure of tree stands both in terms of tree number and volume even within small sites. Data from a 10 ha inventory plot established within the Swiss-Ukrainian cooperation project in Uholka (750 m a.s.l.) can serve as an example here. The mean number of trees per 1 ha is 270. The standing volume fluctuates from 423 to 1042 m^3/ha (mean 768 m^3/ha), and the volume of deadwood ranges from 0 to 308 m^3/ha (mean amount 73 m^3/ha) (Commarmot et al. 2005).

The location of trees by biogroups is very obvious here. Specifically this concerns thin stems (diameter 6-16 cm). Trees with a diameter over 40 cm are scattered more evenly. The height ranges from 33.6 to 42.8 m. Some trees reach a maximum of 52 m in height and 135 cm in diameter.

25% to 45% of trees are concentrated in the first layer, 15-35 % in the second one, and 35-65 % in the third one correspondingly. The horizontal surface of the first layer is dominated by crowns, while gaps within this layer are filled-in first of all with the crowns from the second layer. The sizes of the crowns decrease from the first to the third layer. Generally, all tree crowns overlap, resulting in a high vertical tree crown density. In comparison to the monodominant primeval forests the structure of mixed primeval tree stands is much more complex. The tree layers here differ not only by the number of trees and the standing volume, but also by species composition. Complex succession processes take place in mixed forests and their structure is influenced by various factors. For example, in a beech-spruce-fir primeval forest site, spruce and fir dominate in the first layer, and beech dominates in the undergrowth.

The herbaceous layer in primeval forests is diverse, too. It covers 5% to 70% of the ground depending on the site. Basically it is composed of *Oxalis acetosella*, *Rubus hirtus*, *Anemone nemorosa*, *Dentaria glandulosa*, *Galium odoratum* and some other species. Population density fluctuates from 7 to 46 specimens/m^2. Also species like *Polygonatum verticilatum*, *Senecio nemorensis*, *Luzula sylvatica*, *Festuca sylvatica* are often growing there.

Filicoid species are very diverse, and the most widely spread ones are *Athyrium filix-femina*, *Dryopteris filix-mas*, *Phegopteris connectilis*, and *Polypodium vulgare*.

Figure 24: Deadwood and xylobiont fungi in Uholka primeval forest.

Also ephemeral species grow here with a high population density (3-32 spec/m^2): *Galanthus nivalis*, *Leucojum vernum*, *Scilla bifolia*, red-listed species: *Atropa belladonna*, *Lunaria rediviva*, *Epipactis helleborine*, *Lilium martagon*, *Scopolia carniolica*, and also the endemic species: *Symphytum cordatum*, *Mellitis carpatica*.

Significant segments of primeval forest ecosystems do also serve as habitat for a number of animal populations. Transcarpathian primeval forests harbour 73 species of mammals and 101 species of birds. All European woodpecker species can be found in these primeval forest ecosystems. The Carpathian primeval forests are also characterised by endemic amphibian species, such as *Rana dalmatina, Triturus montandoni* and *Salamandra salamandra*, reptiles (*Elaphe longissima* and *Coronella austriaca*), birds (*Ciconia nigra*, *Aquila pomarina*, *Grus grus* and *Strix uralensis*), and mammals (*Rhinolophus hipposideros*, *Plecotus auritus*, *Felis silvestris*).

Primeval forests play an enormously important role for the conservation of species which are dependent on deadwood and hollow trees: *Strigiformes*, *Columbiformis*, *Passeriniformes*, some mammal species and bats *(Chiroptera*) – like *Sciurus vulgaris*, *Driomys* sp., *Martes*sp. In turn, many animals feed on deadwood species, mostly *Piciiforme*, *Sitta europea*, *Certhia familiaris* and others. Windfalls and storms are necessary for red-listed species such as *Bubo bubo*, which is nesting on the ground. Also, brown bears do often hibernate in the midst of fallen trees. Lynx and wildcat often find their shelter in old-growth forests. The availability of big old trees provides nesting places for black stock (*Ciconia nigra*) and many predator bird species, in particular *Aquila chrysaetos*, *Aquila pomarina*, *Hieratus pennatus*, and *Ferox gallicus*. A rare species of *Rosalia alpine* is also distributed in the primeval forests due to the presence of the deadwood which is important for its larvae (Brändli & Dowhanytsch 2003).

Table 14: Key ecological attributes and indicators that can be defined for primeval forests on the basis of the general characterisation.

Key ecological attribute	Indicator	Unit of measurement
High structural diversity	Tree layers	No of tree layers (sample plot)
High age diversity	Age layers	No of age layers (sample plot)
Mosaic pattern	Heterogeneity	No of different patterns per unit area (transect)
High average amount of deadwood	Deadwood	m² per ha
High species diversity	Simpson or Shannon index?	Corresponding formula

Viability assessment

At this stage, viability was assessed applying the 'simple mode' rather than using the defined key ecological attributes. Both ways are possible in the Open Standards. As monitoring data will become available, the viability rating will be reviewed based on key ecological attributes.

The viability for primeval forests is rated *good*. All primeval forest sites still possess a full set of regulation mechanisms, which secure a high stability no matter what abiotic and biotic factors are influencing them.

Direct threats

Primeval forests are threatened by a range of anthropogenic factors:

- various types of logging,
- use of the deadwood as firewood,
- cattle and sheep grazing,
- mass mushroom collection,
- disturbance caused by scientists and tourists.

Biomass removal disturbs nutrient circulation, and logging damages both the age and structural diversity of the stands. Grazing results in the destruction of the herbaceous layer and undergrowth, while on steep slopes it removes the litter and disturbs the soil. Mass mushroom

collection does also lead to trampling of the herbaceous layer, it disturbs animals, and has impacts on selected fungi populations (e.g. disturbs natural correlation between fungi species).

As a result of climate changes (in particular rise of temperature and longer drought seasons) coniferous trees are weakened which make them more susceptible to bark beetle infestations. At the same time, warmer temperatures in spring and autumn increase their number of reproductive cycles. Primeval forests are not as prone to bark beetle infestations as spruce monocultural stands, although mass infestations may still cause severe damage.

Planned interventions such as logging by SFE represent the most crucial threat for primeval forests. In some areas primeval forests do only continue to exist due to their inaccessibility. As forest road density increases and new forestry technology becomes available, these primeval forest sites will eventually become accessible. Official logging beyond the reserve represents a significant threat for primeval forests as long as they are still included into forestry management plans. This applies to all primeval forest sites outside the CBR, the scope is thus rated as *high.*Illegal logging is a significantly lower threat to primeval forests than planned official logging (*low scope*) but should not be neglected.

No matter how low the disturbance, any intervention posts a threat for this conservation target, since nearly all management measures will lead to the loss of the status as primeval forest. Consequently, the severity and irreversibility for primeval forests is rated*very high*both for legal and illegal logging.

Grazing of livestock in primeval forests occurs occasionally when flocks of cattle and sheep are taken upwards to the alpine meadows through forest sites (very local problem, thus*low scope*).Nevertheless, through regular grazing these places can also lose their primeval forest status. Again, that is why the level of severity and irreversibility from pasturing for primeval forests is considered *very high*.

Figure 25: Flock of sheep grazing in the forest.

Mushroom collection is a minor problem within the CBR, although beyond the protected area it is an issue for every primeval forest site. As a result, the scope of this threat is considered *high* while both severity and irreversibility is *low*.

Disturbance caused by tourism is – in the case of Uholka – mainly limited to researchers, students and other visitors with specific scientific interest. The access roads to the entrance point of the Uholka primeval forest sites are in bad condition and long-lasting (approximately 4 hours drive from Rakhiv). Within the CBR territory visitor management is focusing on two trails with very soft infrastructure (compare Brändli & Dowhanytsch 2003):

1. The first – more frequented – trail starts in Mala Uholka and leads to a karst bridge passing along the karst cave "Druzhba".
2. The second trail starts in Velyka Uholka and leads to Molochnyi Kamin, another karst cave.

However, according to data collected by the CBR the annual number of (registered) visitors does has not exceeded 800 over the past five years. Most of them have been guided by CBR staff members, which further reduced the risk of disturbance in the core zone. In case of other primeval forest sites the impact of tourism might be more intensive. Within the Chornohora massif for example, the number of tourists is much higher and less regulated. Missing education and information but also ignorance can lead to littering and disturbance of flora and fauna along the hiking trails. However, regulated visitor management can avoid tourists accessing core zones of primeval forests sites. Consequently, the scope of this threat is rated as*low*, with *low*severity and *low* irreversibility.

Contributing factors and underlying causes

Primeval forest sites beyond the border of the CBR are not marked in any way and have no conservation status whatsoever. The SFEs consider them common managed forests for exploitation. They are subject to various intervention plans, and these management measures will eventually take place there.

The demand for wood both on the national and especially international markets is a main driver behind forest exploitation. At the national and regional level, wooden houses as well as interior design and furniture of traditional wooden style have become more popular lately. This fashion trend makes prices go higher, in turn causing logging operations to intensify.

In addition, there is a high need for firewood within the management scope of the CBR, as it constitutes the basic energy source for heating and often even cooking. Other energy sources (oil, coal, electricity) make up a considerably smaller share. Gas is practically not used for heating within the management scope of the CBR as no central gas supply system has been constructed.

State forestry enterprises are the basic suppliers of timber within the scope. Economic independence, i.e. SFE work profit-oriented, creates a strong incentive to overuse forest resources. Outdated machinery and harvesting practices result in even higher impact than necessary.

Illegal logging is connected to the generally high unemployment rate. The low income of a great part of the population within the scope makes official purchasing of timber almost impossible for these people. On top of illegal logging by individuals also SFE employees are sometimes entwined in this matter. Falsification of timber statistics is a common phenomenon, i.e. assigned harvesting sites are officially recorded to contain less timber than is actually the case. This gives the SFEs an excuse to log further areas while the remaining timber is sold on the black market. One driver behind the black market for timber and fuelwood is that the official market does not match present needs. The timber contingency that SFE are allowed to harvest for fuelwood is quickly exhausted. Illegal logging on a large scale does also occur during the realisation of infrastructure projects, especially in case of tourism. Both in Bukovel and Dragobrat significant areas of forest have been cleared without prior approval of the authorities to create hotels and skiing infrastructure. This in turn is linked to the uncontrolled land privatisation process, lack of spatial planning and corruption.

Potential future developments

Unless primeval forest sites outside the CBR will not receive a special conservation status, these sites will gradually decrease as a result of planned forest management interventions. It is rather likely that this process would continue even in case that conservation legislation is adopted, since SFEs would want to exploit the future protected areas prior to their designation.

Research by Kuemmerle et al. (2009) supports this hypothesis: in the period 1988 – 1994 protected areas have been subject to logging prior to their designation.

It is estimated that only about 70% of the primeval forest areas beyond the borders of the CBR or about 80% of the primeval forest sites of the management scope will still exist when a primeval forest conservation law comes into force. A lack of funding for their protection will result in further losses, although to a lesser extent.

3.2.4.4.2 Forest ecosystems

Rationale for choosing forests ecosystems as a conservation targets

Figure 26: Different types of forest ecosystems.

With a forest cover of approximately 54% the province of Transcarpathia (Zakarpatska Oblast) is the most forested in Ukraine. For the eastern part of the region (Tyachiv and Rakhiv Districts), which makes up most part of the scope, the forest cover is even higher (around two thirds). The total management scope of the CBR retains a forest cover of 74%, while the massifs of the CBR reach 82.3% of forest cover and are thus the dominating ecosystem type within the management scope of the CBR.

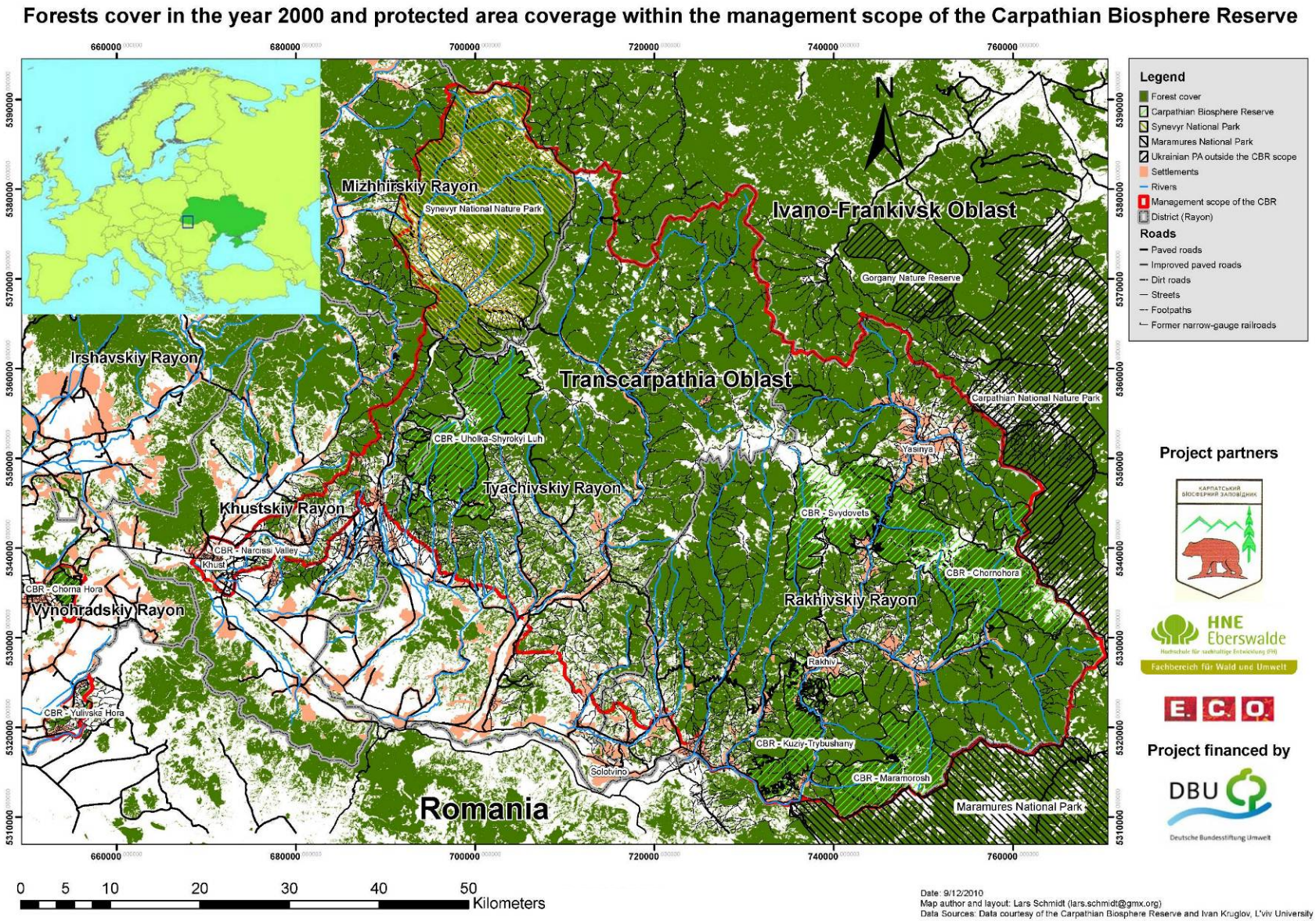


Figure 27: Forest cover in the year 2000 and protected area coverage within the management scope of the Carpathian Biosphere Reserve.

Over 60 % of the region's forests fall under different kinds of protection, either belonging to the CBR and other protected areas or having the status of soil or water protection, water regulation or resort areas.

Exploited or managed forests constitute only 40% of the total forest, although their role within the scope is great. They perform a climate regulation and water regulation function while these forests are also an important source of building materials and firewood for the local population. For SFEs these managed forests are their only assets for economic activities. Given the SFE's role as employers and tax payers, they are very important to the local economies. Consequently, sustainable management and protection of these forests is essential for the present and future of the region.

General description

Managed forests occupy the surface of more than 197,000 ha. On the lower hypsometric levels mixed deciduous-coniferous forests are distributed with a domination of beech (*Fagetum*), beech-fir-spruce (*Fageto-Abieto-Piceetum*) and spruce-fir-beech (*Piceeto-Abieto-Fagetum*) phytocoenoses. The upper tree line (1,600 – 1,700 m a.s.l.) is made up by pure climax spruce forests (*Piceetum*). Above them crooked woodland with green alder (*Alnus viridis),* Siberian juniper *(Juniperus sibirica)* and mountain pine (*Pinus mugo)* is located Forest stands are mostly characterised by a high productivity. The mean standing volume is 310m^3/ha. The mean annual increment is 5 m^3/ha, which is slightly higher for coniferous stands (6 m^3/ha), and lower for deciduous stands (4.7 m^3/ha).

Managed forest types are similar to those described for primeval forests. Pure beech forests cover twice as much area as pure spruce stands. The least amount belongs to stands dominated by oak. Deciduous forests and mixed forests dominated by beech have almost equal shares. To the group of mixed forests with beech domination we include a unique forest type with yew-tree, and also another type rarely found in Transcarpathia - mixed forests with participation of cedar pine. The least are is covered by mixed forests dominated by spruce and fir.

Key ecological attributes and indicators

The most common forest types are humid megatrophic and mesotrophic pure beech forests, and also beech forests with maple, hornbeam and other tree species. The region of the scope currently presents the eastern edge of the oak-beech and beech-oak forest range. Thermophilic species grow in the underbrush: *Cornus mas* and *Swida sanguinea*. The following species are bound to this rich site conditions: *Ranunculus cassubius,Melica nutans*, *Clemalis vitalba*, and calciphilous ones like *Hedera helix*, *Campanula carpatica*, *Helleborus purpurescens*, and *Phyllitis scolopendrium*.

Among zonal beech forests on soils with limestone and dolomite bedrocks, beech forests with ash tree-elm, maple and yew-tree are distributed. These stands are comparatively simply structured. The first layer is represented by beech with sycamore maple admixtures. The mean height is 20-24 m, yield class is II-III. There is no second layer. Yew tree (*Taxus baccata*) is found in the third layer. The underbrush is made up of *Viburnum opulus*, *Swida sanguinea*, *Rhamnus cathartica*. There are single specimens of oak (*Quercus petraea)*, fir (*Picea abies*), birch (*Betula pendula*), mountain ash (*Sorbus aucuparia*), and aspen (*Populus tremula*). The herbaceous layer is extremely rich. Except for the basic ecosystem-constituting species the following species are found here: *Festuca altissima*, orchid species like *Epipactis atrorubens* and *Cephalanthera longifolia*, also *Campanula persicifolia*, *Melittis melissophyllum*, *Libanotis montana*, *Digitalis grandiflora*, *Polypodium vulgare* and many others.

Also, the forest fauna is very rich. The Tysa river basin provides favourable conditions for otter *(Lutra lutra),* which is listed in the red data book of Ukraine. Furthermore, certain red-listed species are also found here such as wildcat *(Felis silvestris),* lynx *(Lynx lynx)*, bear *(Ursus arctos),* ermine *(Mustela erminea)* and polecat *(Putorius putorius).* Caves and underground galleries shelter red-listed bat species.

Due to the forest type diversity, the avifauna within the scope is also very diverse. Birds bound both to deciduous and coniferous forests are distributed here as well as some taiga species such as: *Dryocopus martius* and *Nucifraga caryocatacte*. Red-listed birds within the scope are: *Circaetus gallicus, Aquila pomarina, Aquila chrysaetos, Tetrao urogallus, Tetrastes bonasia, Columba oenas, Aegolius funereus, Glaucidium passerinum, Strix uralensis, Picus viridis, Dendrocopos leucotos*, and *Picoides tridactylus.*

Amongst other rare reptiles there are *Elaphe longissima* and *Coronella austriaca,* which are both listed in the Red Book of Ukraine together with fire salamander *(Salamandra salamandra),* the Carpathian newt *(Triturus montandoni),* the Alpine newt *(Triturus alpestris)* and the yellow-bellied toad *(Bombina variegata).*

Key ecological attributes and indicators are the same as for primeval forests, underlining the need to actively convert and let present forest stands revert back into more natural forest stands. Benchmarks will of course be set lower than in case of primeval forests.

Table 15: Key ecological attributes and indicators for forest ecosystems.

Key ecological attribute	Indicator	Unit of measurement
High structural diversity	Tree layers	No of tree layers (sample plot)
High age diversity	Age layers	No of age layers (sample plot)
Mosaic pattern	Heterogeneity	No of different patterns per unit area (transect)
High average amount of deadwood	Deadwood	m² per ha
High species diversity	Simpson or Shannon index?	Corresponding formula

Viability assessment

From an ecological point of view the managed forests, unlike the primeval ones, are more or less disturbed ecosystems. All processes here are directed towards recovery from disturbances caused by human intervention. They are less resistant to different biotic and abiotic factors because of their disturbed regulation mechanism. As for the forest plantations – mostly pure spruce stands - they are characterised by a poor species composition, simplified structure and even less resistance than other managed natural forest stands. These plantations are especially prone to windfall, vermin invasions and bark beetle infestations (Smahlyuk 1969; Stoyko et al. 1982; Cherniavskyi 2000). In order to produce high quality timber from these forest plantations, it is necessary to invest much efforts and money into a variety of treatment measures (weeding, thinning and pruning). In the absence of such measures these plantations do usually break down over time and revert to more natural forest stands.

Areas of monoculture spruce forests, a heritage of questionable value from the 19th and 20th century, today cover more than 2.5 times the area they would naturally do. Forest stands of this kind are greatly damaged by root sponge and stemrot. They are regularly subject to catastrophic windfalls resulting in great losses to the forest economy.

Taking this into account, the viability of the managed forests within the scope can be classified as *medium*.

Direct threats

Threats to managed forests are similar to those of the primeval forests. SFEs implement forest management and forest exploitation. The usable volume is defined as a result of field surveys and analysis of each SFE's harvesting activities and is regularly carried out by the State Forest Planning Agency.

Figure 28: Forest management of different types.

A situation analysis of the forest management system of the region comes to the conclusion that forest harvesting and management systems should be changed. In the current transition period a centralised forestry planning system is not working anymore and a new one has not been successfully applied. The lack of appropriate forestry organisation and management under the current conditions of a largely unregulated market economy constitutes a serious threat and is responsible for the ecological misbalance and forest degradation in the region. One of the main problems with forest use is the way of harvesting. Out-of-date technologies and means are still used today. The available machinery restricts forest management interventions to clear-cuts only. An effective forestry and forest resource use is not possible without a corresponding road system. For today the density of the road network is only 0.36 km per 100 ha, which is 5-9 times less than in other European countries. Furthermore, even the available roads are constructed not on the slopes but along rivers and streams. Practically all roads and hydro-technical constructions are built without adhering to official regulations or plans, resulting in a frequent destruction of forest roads and bridges in spring time (flood seasons). However, a

good road system also needs to be accompanied by proper regulation and enforcement; otherwise it will only exacerbate forest exploitation.

Due to the insufficient road system the forest resources are managed unevenly. The most accessible places are used exhaustively while many forest stands remain inaccessible. However, low accessibility has and continues to protect areas of primeval forests. Firewood and building timber supply for the local population does not meet the demand, which leads to illegal logging.

Like for conservation, funding of the forestry sector from the central budget has rapidly decreased within the recent years. No treatment measures are taken for young stands and there is no money for restorations after natural calamities.

Transcarpathian authorities understand that the forestry sector is in a poor condition; still they find the only solution in increasing logging volumes. According to the oblast administration, the income to the regional budget from forestry is minor (around 1% of the gross income). This is hard to bear given the rich forest resources of the region.

However, forests are not only exploited for their timber. Improvements in economic relationships with western European countries have lead to commercial mushroom gathering. The population views it as an important income source. Mass mushroom collection has an impact on forest ecosystems, as the fauna is greatly disturbed.

Unorganised tourism infrastructure development can be observed on specific sites like for example the evolving Dragobrat skiing resort. New facilities are constructed every year without a proper management and infrastructure plan for the settlement leading to a reduction of forest areas.

In recent years bark beetle invasions have also become a great issue, which is also likely to be related to global climate change. If not considered properly, this problem will create large-scale economic losses for forestry in the future.

Figure 29: Dead spruce stand (caused by bark beetle and droughts).

Threat rating

Forests are considerably threatened by logging, which is linked to a complex of factors ranging from market demand over institutional weaknesses to poor forestry practices. The international timber market stimulates SFEs to harvest and sell round timber abroad rather than in Ukraine, since prices there are much higher than on the national or local market(s). The export of logs is often illegal and supported by corrupt individuals within state authorities.

Another driver behind forest exploitation is the current forestry system operated by the SFEs. Forestry enterprises, although run by the state, are economically self-sustained. As mentioned

before, this has greatly incentivised forest overuse, while laborious work such as reforestation, pruning, thinning and road maintenance has been largely neglected. Likewise, investments into modern and ecologically less damaging harvesting equipment (horses, wheeled tractors, cable winching systems) has not been made, as it would reduce profits. Out-of-date harvesting technologies represent a big threat for the given conservation target. Big areas of sanitary clear cuts, skidding along stream beds, and large-scale sanitary selective cuts which end up in clear-cut areas, use of caterpillar machinery etc – all these things are actively used within the scope causing unnecessary damage to the managed forests. Any consideration of the future consequences of forest overuse seems largely absent. This is exemplified by the recent bankruptcy of a SFE in Khust District near Uholka. As a result, the scope is rated as *very high*, while severity is considered *high* and irreversibility is considered *medium*.

Illegal logging and mass mushroom collection are minor threats in comparison to the poor forestry system.So the scope is rated*very high*, and severity and irreversibility are rated *medium*.

The bark beetle threat is significant with a high potential and likelihood to increase in both scope and severity. The scope is thus considered *very high*, severity and irreversibility are rated *medium*.

Contributing factors and underlying causes

The economic independence of SFEs is a consequence of insufficient state funding in the past. However, the elaboration and implementation of advanced forestry methods would demand funding, which is currently not available from public sources.

Low effectiveness of legislation, and corrupt controlling authorities support abuses in forestry planning, logging as well as in timber trading.

The driver behind mass mushroom collection is a high demand for this product on the international market and also the poor economic situation in the region causing local people to take any available opportunity for income generation.

The threat of bark beetle invasions is largely caused by historic mistakes in forest management, though climate change is further amplifying the problem.

Potential future developments

It is worth mentioning that a new vision for forestry is already slowly moving into the region. The concept of close-to-nature forestry gradually takes hold in Ukraine – at least on a theoretical level. The fact that forestry has to be implemented in a way that future generations will benefit from forest resources as well is largely understood. Ukraine demonstrates its will to implements this idea through its participation in a number of different international programs on forest management based on sustainable principles, as well as by joining systems of forest certification.

A Swiss-Ukrainian forestry development project of FORZA has been implemented in Transcarpathia since 2003. The following outcomes were achieved in the pilot areas:

- close-to-nature forestry
- improvement of market approaches
- livelihood improvement for the local population from natural resource use.

During this project, the participating Ukrainian forestry practitioners have understood that the close-to-nature forestry system is – though more labour and time consuming – the more viable alternative. In particular, the approach to road construction has significantly changed in the pilot areas. Now roads are constructed based on the relief principle and not along the streams and mountain rivers.

Of equal importance and value was the livelihood improvement for the local population from forest resources use, sustainable tourism development, firewood efficiency improvement and participation in strategic forestry planning.

126 inventory plots were established in Transcarpathia in order to get practical information for introducing the close-to-nature forestry concept into practice. The necessary documentation, rules and regulations were elaborated. An analysis of the economical component of forestry in the Carpathian region was made.

The Ukrainian government is willing to implement the concept of close-to-nature forestry with wide public participation. To underline this commitment, the State Forestry Committee initiated a regulation in the Forest Code of Ukraine (2008) to ensure that communities receive compensation for the forest logged by the state (50% of revenues) and logged-over areas, especially clear-cuts are reforested.

These tendencies in forestry are mostly welcomed. Although as the western European experience shows, shifting the practice of forestry towards the close-to-nature concept demands a transformation of the managed forest stands into a multi-aged ones, changing its vertical structure. This is a very complex task, which needs time and regular interventions. Its implementation requires not only great experience, but also it is necessary to be able to make long-term planning to ensure further changes and processes to take place after the first conversion interventions have been implemented.

As for the practice of transforming forest management in the Ukrainian Carpathians, there is no unanimous assent within both the SFEs and the authorities until this day. Opponents of the close-to-nature-forestry concept state that there is no sufficient experience in this field, no proper legal platform, an underdeveloped road network and the lack of proper machinery. While not all of these claims hold true, some need to be taken into account when addressing the problems of current forest exploitation and transforming the forest sector.

3.2.4.4.3 Alpine Grasslands

Rationale for choosing alpine grasslands as conservation target

In the Ukrainian Carpathians alpine grassland are called *polonynas*. Since the Middle Ages the *polonynas* have been closely intertwined with people's livelihoods. As a cultural landscape they have been formed by mountain livestock pasturing, which still exists today. All the livelihoods of Carpathian highland people are somehow associated with these grasslands. This is reflected in the economy, culture and traditions. People throughout history have been influencing these pastures, and the grasslands were shaping the people's way of life.

However, the human impact on meadow ecosystems was not entirely beneficial. Haphazard grazing has led to intensive development of grazing digressions - extinction of cereal grasses, replacing them with thick sod met grass (*Nardus stricta*) and tussock (*Deschamsia caespitosa*) thickets. These abandoned meadows now occupy 40-50% of the grassland surface. They are very common in the upper belt of the forest zone and their economic value is small, as they give only 7.8 kg of low quality hey per 1 ha. Thus the problem of rehabilitation of degraded meadows arises.

Figure 30: Alpine grasslands

On the other hand, the strong decline of grazing on the secondary grasslands, formed in places of cleared forests, lead to a gradual natural succession. Foresters welcome this process (Solodkiy et al. 2009), as in this case the forested area increases, while farmers lose the feed base for their livestock. This shows that preserving and restoring alpine grasslands is a difficult task given the different perspectives on this issue.

General description

The alpine grasslands represent one of the vegetation types that have an extremely complex and mosaic spatial distribution in the Carpathians. The pattern of vegetation distribution is mainly determined by the differences in elevation causing changes in the hydrothermal conditions. Each type of vegetation has adapted its germination to a specific elevation – a stage with the most favourable correlation of warmth and moisture. The mountain grassland-shrub zone occupies the height of 1500 m to the top. This zone is divided into 2 sub-zones: 1) subzone of subalpine shrubs and crooked woodland (1500 - 1800 m), 2) sub alpine shrubs and grasslands (1800 m and above). The scope includes the highest ranges of the Ukrainian Carpathians, so all

forest subzones and alpine zones are well represented here. Alpine grasslands of the Krasna mountain range are adjacent to the Uholka-Shyrokiy Luh massif of the CBR. They have a secondary origin, like many other *polonynas* in Rakhiv and Tyachiv Districts.

With regard to *polonyna* conservation measures, each single case should be treated separately. It should be decided where conservation measures make sense both from an ecological and cultural point of view and where it is more appropriate to let natural succession take place and slowly revert *polonynas* back to forest.

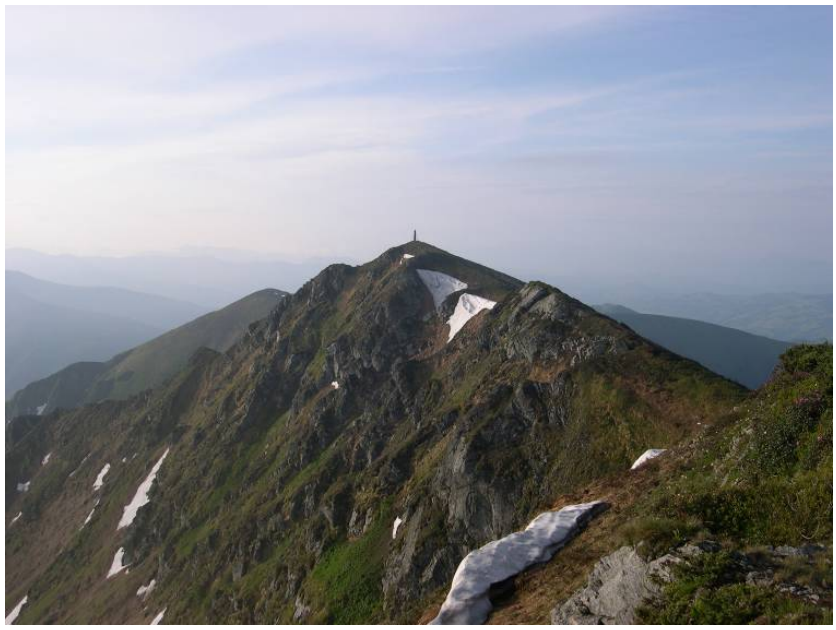


Figure 31: Pip Ivan (Maramorosh).

The largest area belongs to the grasslands with domination of *Agrostis tenuis* Sibth, *Festuca rubra L., Anthoxanthum odoratum L*. The floristic composition consists mainly of species typical for Ukrainian meadows, but there are many meadow species typcial for the Carpathian arch: *Hieracium aurantiacum L*., *Thymus alpestris Tausch* and *Helictotrichon praeustum* (Riechenb) Tzvel. In natural grass stands of pastures and hayfields in mountain-forest zones and the foothills the most common are perennial grasses - they make up 60-70% of the grass stands (Solodkiy et al. 2009).

Figure 32: Tourists hiking in Chornohora.

The *polonynas* are one of the most attractive natural potentials of the Carpathian Mountains. More than that, the CBR territory includes the highest and most famous peaks of Ukraine: peak Hoverla (2061 m) and peak Petros (2020 m). The most frequented sites and roads, which affect the alpine grasslands are concentrated around these two peaks. Individual as well as organised groups, regional, national as well as international visitors travel to the Chornohora for multi-day hiking trips (Blumer 2008). Additionally, a Transcarpathian Hiking Trail has been developed and promoted by FORZA. It provides visitors the opportunity for multiple day hikes, offers basic infrastructures, sign boards and shelters along the trail.

In 2009 almost 12,000 visitors were (officially) registered at the CBR entrance points around Chornohora. However, the number is likely to be much higher, as unregistered arrivals entering the area from the eastern oblast Ivano-Frankivsk were not considered (Blumer 2008).

Key ecological attributes and indicators

The flora species composition of the *polonynas* within the scope is diverse and very interesting. According to Professor Malinowski (1980), in the flora of the Carpathian alpine zone there is a high proportion of species and habitats, which are completely or almost completely absent in the forest belt below. This applies to 9.3% of arctic-alpine, 7% of montane and 31.9% of the total number of species.

Typical habitats for the growth of alpine species are the crest of ridges, sheer walls and flat bottoms of ancient glacial basins. These habitats are often isolated and few in number, each separated by great distances, therefore they need special protection. Many of these species are flowering rather colourful, attracting the attention of tourists. By trampling and picking, these tourists could become the main driver of their gradual extinction.

Among the vascular plants of the alpine meadows is a large proportion of rare and endangered species, relics of past paleogeographic eras, and endemic species that grow on the edge of their range. In the alpine zone of Chornohora, Svydovets and Maramorosh ridges the following group of relict glacial period species are distributed: *Dryas octopetala, Linnaea borealis, Salix herbacea, Pedicularis oederi, Rhodiola rosea, Polygonum viviparum* and others.

A special group among the rare plants in the Carpathian alpine area is that of caciphilous species. Their rarity is explained by the limited distribution of carbonate rocks in the Ukrainian Carpathians. The most prominent example is the Edelweiss (*Lontopodium alpinum*).

Among alpine plants that grow only in the subalpine and alpine zones, many occur only on few mountain ranges. Some species are known from only one or two massifs, and some only from two or three habitats - *Aster alpinus, Oxyria dygina, Saxifraga aizoides, Aconitum jacquinii*, or just from one habitat *Antennaria carpatica, Callianthemum coriandrifolium* and *Linnaea borealis* (Nesteruk 2000).

Table 16: Key ecological attributes and corresponding indicators for the conservation target "alpine grasslands".

Key ecological attribute	Indicator	Unit of measurement
No succession	succession	Area of succession in %
Endemism richness	Index	Index

Viability assessment

Overall, the viability of the alpine grasslands is considered as *fair*.

Direct threats

In the past, the most serious threat to the *polonynas* was grazing. Grazing was excessive within many areas, which resulted in the exhaustion of the grass stand. Species that were well resistant to trampling started to dominate: matt grass (*Nardus stricta*) and soddy tussock grass (*Deschamsia caespitosa*). In places with a high concentration of sheep, sorrel (*Rumex alpines*) areas were formed. With the collapse of the centrally planned economy however, the intensity of grazing rapidly declined and has stopped being a threat for mountain meadows. Instead, mountain tourism is rapidly developing, which causes trampling and erosion of the grassland along the tracks. Tourists do also cut down mountain pine (*Pinus mugo*) thickets to use as

firewood. They can also be considered as a significant disturbance factor for the *polonyna* fauna.

Natural succession – as result of reduced or abandoned grazing activities - has become a significant threat for secondary meadows. Most vividly this is expressed in the areas where the current treeline meets alpine grasslands. It is likely that many meadows will eventually revert to forest over time. Furthermore, climate change contributes to raising the upper forest line, leading to a reduction of the natural subalpine and alpine grasslands.

A serious threat to the *polonynas* is the spring burnings organised by shepherds. Through burning of the dry grass from the previous year they hope to improve the productivity of the mountain pastures. In fact, the fires destroy a large number of mountain grass seeds, reducing the reproductive potential of the grasslands. They also kill many species of alpine fauna.

Figure 33: Succession of polonyna by shrubs and small trees (mainly alder and juniper).

Recently a number of dirt roads have been constructed on the *polonynas*. As a result of poor maintenance they cause significant soil erosion. Furthermore, eroded roads increase the speed of flowing melt and rain water contributing to flood intensity.

Privatisation is another threat to alpine grassland ecosystems. Many owners start developing tourism infrastructure and associated access roads, destroying large parts of alpine grasslands and further increasing erosion and pressure by tourists.

Destruction of flora and fauna by tourism on the *polonynas* can be observed almost on the entire area. However, the impact of tourists in most areas is less than those of local shepherds. High visitor concentration takes place around the Chornohora massif during summer time. In winter skiing tourism is concentrated around Dragobrat. Additionally litter and can frequently be encountered along the main trails, including the Transcarpathian Hiking trail, which is attributed to the low environmental awareness of regional tourists as well as local people.

Threat rating

The most intensive succession occurs on the verge of the forest and secondary alpine grassland ecosystems and in areas where intensity of grazing has sharply decreased. The scope of this threat is considered to be *medium*, while the level of severity of secondary meadows' succession and the irreversibility can be assessed as *high*.

For natural subalpine and alpine meadows the threat of global climate change, which accelerates forest succession is rated *low* in terms of scope, but has a *high* severity and *very high* irreversibility.

Burning of grasslands is largely a local phenomenon, so the scope is *low*, severity is *high*, and the irreversibility is *medium*.

Tourism and recreation affect almost the entire area of *polonynas*, i.e. the scope is considered to be *high*. Impacts of tourism on the alpine meadows are not too intense, so the severity level can be estimated as *medium* with a *low* irreversibility.

The threat from soil erosion has a *medium* scope, *high* severity and a *very high* irreversibility.

Landuse change is *high* in terms of scope and rated *medium* for both severity and irreversibility.

Contributing factors and underlying causes

The trampling of flora and the disturbance of fauna by tourists can be attributed to the low ecological awareness of most tourists. Also, tourist infrastructure (trails, huts) is comparatively low developed and there is a lack of control on behalf of the protected area ranger service. The comparatively low level of tourism infrastructure, tourism services and control is connected to the low professional level of relevant staff and poor funding.

The main factor for the reduction of grazing and mowing is the reduction in the number of livestock in the region. For example, in Rakhiv District, the total number of livestock has decreased from around 13,000 pieces of livestock in the year 2000 to around 10,000 individuals today (23% decline over 10 years). A main factor here is the decline of competitiveness of *polonyna*-made products, which has reduced interest in mountain farming. Modernisation of life and the reluctance of young people to engage in this very labour consuming work do also play a role.

Climate change contributes to the raise of the upper forest line and a gradual occupation of the former meadows by the forest ecosystems.

Soil erosion on *polonynas* is caused by poor maintenance of roads, which is the responsibility of farm owners and communities, which either do not have the funds or are not willing to invest into road maintenance.

Land privatisation is one of the factors behind unregulated tourism infrastructure development on *polonynas*. It is a socio-political process that has begun in the transition period to the market economy in Ukraine and is virtually irreversible. Privatization as such needs not to be negative, but corruption in public bodies and poorly arranged land legislation ensured that it did.

Potential future developments

The demand for environmentally friendly products from alpine farming will be kept at a certain level, especially since there is an increase of conventional agricultural products in the market. As in many western European countries, it is likely that there will be a part of society who will want to consume healthy products and will be ready to pay a lot for them. This could develop into environmentally friendly alpine farming with good labour conditions and higher profits. Livestock breeders would be interested in maintaining high productivity of mountain pastures and would have the financial capacity to maintain them.

Likewise, the demand for eco-tourism such as hiking will stay at a certain level that will stimulate development of tourism infrastructure and facilitate the organisation of tourism services. At the same time, tourism could provide some funds for ranger services in protected areas like national parks and biosphere reserves. Hopefully, the CBR will be better funded from

the state budget by then, which would enable an increase in the level of scientific research on tourism pressures on the alpine ecosystem and respond to it through the ranger service, for example.

3.2.4.4.4 Large mammals (esp. carnivores) and birds of prey

Rationale for choosing large mammals and birds of prey as conservation targets

Ungulates and large carnivores are important components of the Carpathian forest ecosystems. Ungulates that are feeding on forest vegetation (both herbaceous and arboreal) can have a significant impact on the forest ecosystem. In turn, large carnivores feeding on ungulates (brown bear, lynx, and wolf) also have an indirect impact on the vegetation status, regulating the population of ungulates.

Apart from that, these two mammal groups have a very close connection to people. Ungulates are hunting targets and also a significant biotic factor for forest structure due to their browsing impacts, while carnivores are not merely hunting targets but also seen as competitors to hunters and as enemies to stock-breeders.

Due to this very peculiar attitude of local people, these animals are often threatened. This is exactly why two out of three Ukrainian Carpathian carnivore species are red-listed (*Ursus arctos* and *Lynx lynx*). The third one (*Canis lupus*) is a matter of big and constant dispute among scientists, conservationists and resource users. All of these three carnivore species are distributed within the scope, as are the three ungulate species (*Capreolus capreolus, Cervus elaphus*, and *Sus scrofa*). The population of ungulates within the scope has been on a critically low level during the recent 20 years, so it has been forbidden to hunt these animals in the period 2000-2005.

General description

All ungulates undertake seasonal vertical migration. In wintertime, when the snow cover is very deep in the upper mountain belts, they move down to lower sites with less snow. In summer period this process is reversed, moving higher up to the alpine meadows where they stay till the first snow falls. Since the CBR massifs are mostly located in the upper mountain belts, in winter the ungulates find themselves beyond CBR's protection.

Red deer and roe deer to a great degree feed on arboreal plants. Young sprouts of trees and bushes make up the basis of their food especially in wintertime. That is why the territories of the SFEs are the most attractive sites for them, where unlike in the CBR they find lots of logged sites with young succession stages. On the other hand, there is a greater disturbance factor within SFE's areas then in the reserve. As census data shows, the mean population density for red deer for SFEs and the CBR is about the same, as forage and disturbance factors level out. Daily migrations of red deer take place within the adjacent areas to the reserve for resting and to SFE for foraging.

Red deer (*Cervus elaphus*)

In summer this animal is active both early in the morning and late in the evening. In cloudy weather it is also active in daytime too. This rhythm of activity is an adaptation to decades if not centuries of anthropogenic pressure and disturbance (including hunting). During wintertime, red deer dedicates almost all its time to feeding. When a snow cover of 50-70 cm is reached, it becomes difficult for red deer to move around on the *polonynas*, and its feeding area is reduced from 4-6 km^2 down to 0.6-1 km^2. If snow depth exceeds 1 m (which is quite normal

for the Carpathians) red deer gathers in forest sites with a dense network of paths. In this period of time, red deer is very vulnerable to predators. As soon as an ice-crust appears on the snow, red deer does either migrate into thick forests or onto the northern slopes where snow is comparatively loose. A characteristic feature of red deer ecology is their concentration on certain permanent sites in the mating season. In this time period (mid-September to mid-October) mature males send voice signals so that their location can be identified. In addition, in the mating season the males' antlers have hardened out and are at their full size, making them an attractive hunting trophy. This makes red deer, especially the males, very vulnerable to hunting and poaching during the mating season. Red deer has a habit of accepting and re-using artificial feeding places. SFEs and hunter associations often construct these feedlots in the forest to increase hunting success. As the CBR does not construct any artificial feeding lots, adhering to the principle of not disturbing natural processes, these feeding lots outside the CBR territory are very attractive for the CBR's population of ungulates, which consequently diminishes.

European roe deer (*Capreolus capreolus*)
For feeding, it prefers open places, which it mostly visits in the morning and evening times. In summer it usually stays in small groups or alone. In spring the males gather harems of 2-3 females. Before winter, these may merge into larger groups. In December, flocks break up again into small groups. Most of the year roe deer lives settled in one territory of around 2-3 km², in winter sometimes even less. Roe deer feeds on herbaceous plants, berries and mushrooms, winter - shoots, buds and dry leaves of trees and shrubs. It also feeds on oak acorns and beech nuts. In spring, the female gives birth to 1-3 calves. Their ecology is a peculiar one due to the territorial aspect. Males divide territories between themselves in the time period from spring to autumn. They mark their individual territories, sharing it usually with 1-2 females and their young calves. Very often males indicate their territory with voice signals especially when other males or even people approach. These peculiarities make it easier for poachers to find these animals in the snowless season. Early in summer, when their antlers reach maturity, they become very attractive for trophy hunters and poachers.

Wild boar (Sus scrofa)
Boars stay in small herds, while old males and females with piglets are staying separately. There are usually 4-6 piglets in a pack, sometimes even up to 12. By night a flock may cover an area of up to 5 km, rarely more. Occasionally, in case of fodder shortages, boars embark on mass migrations, which may take them several hundred kilometres away. For a successful survival in winter, they need to accumulate a thick layer of fat. Given their physiology, it is difficult for them to move in deep snow. In winter they thus make a network of trails in the snow, along which they move frequently. If the soil is frozen it becomes impossible for this animal to feed on larvae and roots in the ground. Boars thus rarely take up food and live mostly of their fat deposits. In the Carpathians, many of them die from exhaustion. A mature male is able to cope with several wolves, but still wild boar, especially the young ones, do often die from wolf attacks. Wild boars feed on roots and plant bulbs, fallen fruit, beech and hazel nuts, acorns, worms and insects, and sometimes even smaller animals of other species such as offspring from rodents, snakes, frogs, chicks and eggs of birds. A characteristic feature of boars' ecology is that they feed on beech nuts and acorns which are mostly found in primeval forests or old-growth forests of the reserve. So in the most fertile years their population density significantly grows within the reserve in comparison to SFEs. Ungulates are 'aware' of the protective status they enjoy within the CBR. Ungulates usually have their shelter within the CBR and in numerous cases have fled into CBR territory when hunted or wounded by poachers.

Wolf (*Canis lupus*)
Most parts of the year, wolves migrate either alone or in family packs. A pack always consists of a pair of mature wolves and a few young ones born in the same year. In a pack they can have from 2 to 19 cubs, mostly around 3-9. Young wolves born in the previous year can join the pack also, as well as other individuals. Communication with neighbouring packs or pack members takes place through howling, which has been found to contain a diversity of information. Wolves feed on ungulates and other animals including insects, rodents, and even bears, hibernating in a den. It is normal for this animal to eat carrion or attack domestic animals. A wolf moves long distances with up to 25-40 km per day. Wolf packs occupy vast areas, which go far beyond the boundaries of the protected area. That is why it is hard to produce exact figures on the CBR's wolf population. As with the ungulates and other predators, wolves equally use both the reserve's territory as well as the adjacent areas. Given the low ungulate population, they often attack domestic animals – livestock or even dogs.

Bear (*Ursus arctos*)
Bears are active mostly at night and dusk, sometimes at daytime, too, depending on the disturbance and forage situation. In winter they hibernate in a den made in some pit, hollow tree or something alike. Bears have a light sleep and, when disturbed, leave their den and roam around before falling into hibernation again. Frequent disturbance of the hibernation process may significantly weaken the bear, as powering-up the metabolism consumes significant amounts of energy. Should a bear have not stored up enough fat before winter it can stay awake the whole season. These individuals will usually search for carrion or attack ungulates. They can also be dangerous for people. In summer period males mark boundaries of their individual territories e.g. by removing bark from the trees. These "border signs" can be used by different bears for dozens of years. Bears basically feed on plants, insect larvae, ants and sometimes also on rodents or forage stored by them, and carrion. Very rarely, and only in wintertime, they hunt ungulates. Within the management scope of the CBR, there were a number of cases where bears attacked livestock, which had been pasturing on alpine meadows. Generally, once every two years female bears give birth to 1-2 cubs, rarely up to 4. They are born in a den at the end of winter.

Lynx (*Felis lynx*)
Lynx prefer thick old-growth forests. They are very cautious animals and as a rule, usually disappear in places, which start to be often visited by people. They are considered a very skilful predator, whose favourite prey is roe deer and hares. From time to time, lynxes also hunt smaller red deer as well as wood grouse or field vole. A lynx has a rather big hunting range, making it a rather rare animal. Females can give birth to 1-5 cubs (in general 2-3), which stay with their mother till midwinter when the new mating season starts. The population density for lynx within the scope is continuously low. Lynx does neither influence the ungulate population to a significant degree nor does it inflict serious damage to domestic animals. Given its rarity and red-list status, lynx is not specifically hunted. It is occasionally shot though while hunting ungulates. Given the lynx's need for a large range, habitat fragmentation is the major threat for this species while poaching and hunting is comparatively insignificant.

Key ecological attributes and indicators
The main indicators for the population status of large carnivores are their number and density. Age and sex structure can tell much about roe deer and red deer populations' tendencies. A large number of young individuals indicate growth, and domination of old ones indicates decline of the population. In case females strongly dominate the sex ratio, then the population is strongly influenced by trophy hunting or poaching. A reduction of the poaching and hunting pressure usually allows the population to revert to its pre-disturbance balance. In case males do

greatly dominate the sex ratio, this can be an indicator for the need of meat supply, which is the basic reason for local people to go hunting and poaching. If this factor is removed the population will gradually be restored.

Footprints' size can give important information about bear's population. Bears are growing for the whole of their lives, so their footprints are very individual. If measurements of this kind are included into inventory it is very easy to identify the number of individuals within the population and also their migration routes.

Viability assessment

Viability for the ungulates' population within CBR can be defined as *fair*, although their number is below optimum (table 2). Habitat size and suitability is not an issue, and in case poaching and hunting can be stopped their numbers are likely to increase again.

Table 17: Average population density for ungulates and large carnivores within the scope during the period 2001-2009 (individuals per 1000 ha).

Species	1994	2001	2002	2003	2004	2005	2006	2007	2008	2009
Red deer	9	3.6	3.0	3.0	4.8	3.6	4.4	4.4	5.2	4.6
Roe deer	10	3.6	2.7	4.2	4.4	5.2	4.4	4.4	6.1	6.1
Wild boar	8	1.2	0.8	1.2	1.8	1.7	2.7	2.2	3.0	5.3
Wolf	---	0.7	0.3	0.6	0.3	0.5	0.7	0.5	0.2	0.9
Bear	---	0.1	0.4	0.3	0.4	0.3	0.3	0.5	0.7	0.6
Lynx	---	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2

Compared to 2001 levels, the population of ungulates in 2009 seems to have slightly recovered over the last decade. It has however not yet reached the numbers of 1994, when ungulate population density was up to 200% of 2009 levels. The CBR attributes this to a decline in poaching pressure, which may have resulted from out-migration.

The viability of bear and wolf populations is rated as *fair*, the lynx population as *low*.

Direct threats

Official hunting of ungulates within the scope is conducted on a rather small scale due to the low population numbers, although there are more than 600 officially registered hunters. Hunting concentrates on foxes and wolves, as both species are not subject to hunting quotas. As the number of hunting licences in a given region depends on the population size of all game species, there is a strong incentive to falsify game statistics. This is common practice and further increases the pressure on ungulates and large predators.

Poaching is a far greater risk for both ungulates and large carnivores than official hunting, as poachers do not respect any legal provisions such as the species' conservation status or a low hunting quota.

Another threat ungulates and large carnivores face, is habitat fragmentation, mainly through the development of transportation and tourism infrastructure. This threat is not yet of great importance, but it is likely to turn into one as soon as further economic development progresses. Establishment of ecological corridors in order to increase connectivity between protected areas could prevent this threat from gaining too much significance. The process of land and forest privatization, which will probably increase in the near future, could have similar impacts on ungulates and large predators.

Tourism and recreation, in terms of disturbing ungulates and predators, can also be considered a threat. Tourist facilities are furthermore sources of waste that may attract predators, especially bears. This may result in abnormal behaviour of e.g. bears and increase the number of conflicts.

Threat rating

Official hunting affects the entire scope (*very high*). Severity is considered *low*, since the falsification of game statistics does result in more hunting licenses being issued and not necessarily in better hunting success. The irreversibility is rated *low* as populations are deemed viable enough to recover.

Poaching does also cover the entire scope (*very high*). Unlike hunting, its severity and irreversibility level is rate as *very high*, as poachers may completely annihilate a population.

Habitat fragmentation affects the entire scope (*high*). The current level of severity is considered low, while irreversibility is rated *very high*, as infrastructure once built is very unlikely to be removed.

Privatisation of land, including forests, can lead not only to changes in ownership, but also to changes in landuse. For example, forested areas may be cut down and converted into farmlands or housing land. It is difficult to predict how the privatisation scenario will play out. So far this threat is rated *low* in terms of scope and severity, while irreversibility is *high* because of the difficulty to undo the privatisation process.

The threat from tourism and recreation is *low* in terms of the scope, severity and irreversibility.

Figure 34: Furs and stuffed animals as tourist souvenirs offered for sale.

Contributing factors and underlying causes

The prospect of trophies and meat as well as prestige generates a high demand for hunting licenses. State licensing authorities are cashing in on this demand (for personal gain), by falsifying game statistics. Corruption in the public administration is – as with other threats – a major factor.

Factors driving poaching include those of hunting, although a range of further factors do also plays a role here which differ by the people involved. One can roughly distinguish between two groups of poachers. The first group consists of affluent people with a high social status or high positions in the public administration. These people illegally hunt (poach) for leisure and prestigious trophies. They openly break the law without being afraid of being held responsible for their contraventions. These are the most difficult poachers to tackle. The second group of poachers are usually poor local people. Low income or unemployment drives them to poach for both meat and trophies. The latter are sold to intermediaries before e.g. being offered as game products (hides, antlers) at souvenir stands at major tourist sites.

Furthermore, the easy availability of hunting weapons both on the official and black market also facilitate poaching and it is quite likely that there is a significant overlap between hunters (with licenses) and poachers.

An increase of tourist arrivals, also in neighbouring districts such as for example in Bukovel, could lead to a higher demand in trophy-souvenirs and meat from wildlife.

Finally, the poor organisation and equipment of the ranger service do also contribute to the high level of poaching.

Habitat fragmentation occurs in the process of infrastructure and housing development. The responsible institutions and authorities do not take this issue into account when planning and realising infrastructure projects. How and where exactly habitat fragmentation will occur in the future depends largely on the socio-economic development of the region. It is likely that road density and tourism infrastructure will increase in some areas, while in other areas rural exodus may actually decrease habitat fragmentation.

Land privatisation is a political process at the highest political level, and it is quite likely that Ukraine's precarious financial situation will have an influence on the scope and timeline of privatisation. Dependency on loans granted by the IMF, which has been known for its economic structuring programmes in the past, may also influence this process.

Potential future developments

Lobbying ideas to increase the number of wild animals and development for the program for restructuring the ranger service (articles in the media, proposals to the Ministry and the State Forest Committee) could get some support from the environmental community and generate interest in the competent state authorities. It could be possible to start this transformation; however, this process will be slowed down by the poaching-hunting lobby. The situation may be complicated by the emergence of private game farms within the scope, which can greatly raise the number of wild animals in order to organise "elite" hunting. The local population is allowed to use resources of wild animals in these farms and using imperfect protection system and the possibility to acquire long-range hunting weapons, continue to illegally undermine the game reserves in state forests. If the in the result of the privatisation process a large proportion of state forests remains, it will be still possible to organise a reliable system of hunting and it could be possible to reduce poaching and slightly increase the number of wild ungulates and large predators in these forests. However, the process of economic development will not

contribute to the preservation of wildlife. So in 2040, the game in the region is likely to decrease from current numbers.

If the hunting and poaching pressures are stopped, these animals' populations can recover to a natural number that corresponds to the carrying capacity of the lands. And if the appropriate level of biotechnical measures (establishment of forage fields, artificial feeding, etc.) are in place, their number may be even higher than natural. It would make sense to produce some hunting-oriented products or to introduce tourism-oriented observation of wild animals in natural conditions.

3.2.4.4.5 Water and riparian ecosystems and processes

Rationale for choosing water and riparian ecosystems and processes as a conservation targets

Water and riparian ecosystems cover a comparatively small area of the scope, but their importance can hardly be overstated. They harbour unique landscapes and biodiversity, which even within the Ukrainian Carpathians are only found in this specific area.

The heterogeneity in landscape and habitats supports an abundance of vegetation types and species of flora and fauna, especially rare and relict ones. Exactly this characteristic determines the Tysa floodplain as a "hot spot" for biodiversity conservation.

Riparian ecosystems do also provide a range of important ecosystem goods and services, namely:

- Fish
- building material such as gravel that has accumulated on riverbanks
- drinking water for the majority of settlements located in the foothills and plains of Transcarpathia
- areas for recreation

General description

In Soviet times practically all riparian ecosystems within the scope of the CBR were located within the border zone to Romania and were strictly protected. They were fenced with razor wire, which guaranteed a rather reliable protection. Due to their 'border status' they had been preserved in a rather natural state until the late 1980's. With Ukraine gaining independence in 1991, the border protection regime was changed and among other things became less stringent. Consequently, the riparian ecosystems became accessible to the local population.

During the last 20 years, they have suffered heavily from exploitation. Many riparian forests, especially along the settlements, were completely cut down, also to access the riverbed for gravel extraction. Intensive gravel extraction from rivers, mostly illegal, has by now led to significant changes in riverbeds and the floodplain as a whole. In turn, this has had impacts on local biota, especially on aquatic organisms. The biggest impact though can be attributed to the change in ownership of the riverside properties, which were given either to state (forest) enterprises or to village and town councils. While the former usually logged the riparian forests, the latter did also lease riverside properties to private entrepreneurs for gravel extraction. Today, this is largely out of control.

Most riparian ecosystems within the scope were negatively influenced by the disastrous floods of Tysa River in 1998 and 2001. These floods did also cause significant damage to the economy of the region, which prompted the government of Ukraine to develop and implement a special programme of flood protection. The programme is based on a variety of hydrological infrastructure (e.g. dams, polders, gateways, gabions) along the riverbed, to protect the settlements from further floods. The programme has been lasting for about a decade and within its framework dozens of kilometres of dykes have been built. In this process of building dykes, lots of floodplain forest sites were logged, riparian areas were physically destroyed and another great change in the hydrological regime associated with regular seasonal flooding took place. The overall implementation of the flood protection programme has resulted in "channelisation" of the Tysa River with all the associated negative environmental consequences.

Figure 35: Riparian ecosystems.

In recent decades, water and flood ecosystems are suffering from hard waste and sewage water pollutions, and to a lesser extent, from industrial discharge.

Key ecological attributes and indicators

The riparian ecosystems are quite rare in the area of the reserve and are localised in the narrow riverbank strip of the Tysa River and its main tributaries. Their total area amounts to about 1% of the management scope.

In the floodplain of the Tysa river basin the relief has been and continuous to be formed through cumulative-fluvial processes which during the Quaternary period have stored an alluvium layer of great thickness. The final phases of the relief formation were dominated by an alluvial accumulation trend, which resulted in forming numerous creeks and the lateral and deep erosions, particularly within the Solotvyno Basin (Hofstein 1995).

The riparian ecosystems are characterised by a complex spatial organisation and represent a mosaic of aquatic and terrestrial habitats. Within the Tysa river floodplain and its major tributaries the massifs of natural forest vegetation is formed of the phytocoenoses formations *Saliceta albae, Populeta nigrae* and *Alneta glutinosae*. On vast territories along the river willow-poplar forest-galleries stretch and form thickets in impenetrable places. Also worth mentioning are the big clusters of *Populus nigra*, which in some cases consist of 120-150 year old stands of giant trees. The pre-Tysa poplar population has a high value, since it has remained genetically unchanged, not clogged with hybrids of American poplar species (Hamor et al. 2010).

Natural Tysa flood systems are characterised, above all, by a great variety of unique hydrobiont organisms. Fish alone are represented here by more than 30 species, among which there is a large proportion of rare and endemic species including *Hucho hucho, Zingel zingel, Zingel streber, Gobio uranoscopus, Gymnocephalus schraetser* and others.

The meandering of the Tysa river has created meander lakes, creeks, bayous, and temporary ponds, which provide habitat for a large range of species. It is specifically in bayous, backwaters, and in shallow places that the greatest concentration of flora species can be observed, including many rare and red-listed plant species. These are: *Trapa natans, Salvinia natans, Hottonia palustris, Urticularia vulgaris, Nymphaea alba* and others. These habitats contain a considerable diversity of animals including birds, reptiles, amphibians and many species of invertebrates. These include: otter (*Lutra lutra*), European mink (*Mustela lutreola*), wild cat (*Felis silvestris*), water bat (*Myotis daubentonii*) and others (Dovhanych & Pokynchereda 2006).

According to the resolution No. 4 (1996) on endangered habitats, which require the introduction of special measures for their protection, endorsed by the Standing Committee of the Bern Convention on December 6th, 1996, a registry of the endangered habitats types is to be established. Within the riparian areas of the CBR scope some habitats listed in this registry are present. The list and the environmental assessment for each habitat are given in table…:

Table 18: Habitat types and their environmental assessment for the riparian areas of the CBR

Habitat type	Environmental assessment
STAGNANT FRESHWATER RESERVOIRS	
Air-water plan communities	
European-Siberian dwarf annual	
With domination if *Juncus bufonius*	Decline of the ecological situation
Euhydrophilous communities	
Floating vegetation	
With domination of *Utricularia vulgaris*	Decline of the ecological situation
Rooted floating plants	
In shallow places	
Ranonculacea	Decline of the ecological situation
With domination of *Hottonia palustris*	Decline of the ecological situation
WATER COURSES	
River gravel ecotopes	Decline of the ecological situation
RIVER RIPARIAN FORESTS AND SHRUBS OF THE TEMPERATE ZONE	
Riverbank willow formations	Decline of the ecological situation
Black-alder, willow and oak flood forests	
Black alder forests	Decline of the ecological situation

The riparian ecosystems are of vital importance for water and soil protection (anti-erosion value). They prevent erosion within the areas adjacent to a river and act as natural dams during floods.

Viability assessment

The viability status of riparian ecosystems is rated as *fair*.

Direct threats

As a result of ineffective management in and of the Tysa floodplain, significant changes in landscapes and habitats can be observed. In particular, the area occupied by natural formations is reduced. The significant changes are observed in the local hydrological conditions in connection with the construction of hydrological fortifications, uncontrolled gravel extraction from rivers and so on. Anthropogenic pollution of large areas is also a crucial issue, and not just by solid waste, but also heavy metals, radionuclides and persistent organic compounds. The devastation and synanthropisation of riparian ecosystems is observed, threatening the loss of genetic, coenotic and ecological pools, and it also leads to social and environmental discomfort among the local population.

The riparian ecosystems, once characterised by a great biological diversity, have been severely impacted by a range of anthropogenic factors. A gradual decrease in the number of almost all species of fish, amphibians, aquatic mammals, birds and insects is observed. Negative changes in the flora and fauna were also caused by the introduction of non-local species. Anthropogenic transformation of natural systems leads not only to the impoverishment of biodiversity or ecosystem destruction, but it also contributes to the introduction of invasive species. Their expansion is causing huge damage not only to the environment but also to the economy and to public health. In today's riparian ecosystems dozens of invasive plant species can be found. Here, in the Tysa floodplain, these include e.g. *Polygonum sachalinense*, which forms monodominant thickets on large areas. Such species as *Acer negundo* and *Robinia pseudoacacia* joined the local forest communities. Two invasive species, *Heracleum sosnowskyi* and *Ambrosia artemisiifolia*, have become not only an integral part of the floodplain plant associations, but also represent a significant threat to human health, causing severe burns and allergies.

Illegal logging is a rather common practice in floodplain forests along the Tysa River. It serves to satisfy the need for firewood but also for wood-carving, which is a very developed trade within the CBR scope. Roots of *Alnus glutinosa* and timber of *Populus nigra*, especially those taken from old trees,are the most suitable materials for craftsmen. Riparian forests are also logged for conversion into arable land and pastures, which are in high demand in a region that is characterized by lack of flat land. Absence of conservation law enforcement contributes to illegal logging here.

The riparian ecosystems suffer from poaching as well, especially illegal fishing. The Tysa river floodplain is rich in fish and a significant part of the local population is fond of fishing. Amateur fishing dominates, though illegal fishing is a popular practice too. It is considered to be illegal because no regulations or rules are kept up to, and some forbidden tools and methods such as electric fishing rods and various nets for mass fishing are used.

A serious threat to the riparian ecosystems is represented by gravel extraction from the Tysa riverbed and its tributaries. Its negative environmental effects were mentioned above. Today it has become a profitable business, though it remains largely illegal. Even legal gravel extractions leads to serious environmental problems, not to mention the fact that several restrictions and regulations are ignored. Together - legal and illegal gravel extraction - create one of the biggest environmental problems for this conservation target.

Another big threat to the wetlands is littering (solid waste) and sewage pollution. In the CBR scope, there is practically no plant or landfill for recycling and disposal of hard waste. A huge amount of waste that is produced is either discharged directly into the rivers or is stored on their banks. When the water rises, the garbage from the banks is washed away and is

transported downstream. Much of the waste settles on the riverbanks, creating an unpleasant picture of the riverside, and part of it floats along the Tysa river all the way to the Hungarian border.

The situation with chemical and biological pollutions is even worse. None of the settlements within the scope (except for larger ones like Rakhiv, Velykyi Bychkiv and Tyachiv) have sewage water treatment plants. All sewage waters go directly into the river without any treatment. As a result, the lower downstream an area is located, the worse its water quality is. This kind of pollution does not only represent a threat to the ecosystem, but also to a great proportion of the local population, as the Tysa and its tributaries are the only source of fresh water for people.

Threat rating

Illegal logging is an issue for practically all the riparian forest sites, so the scope is *high*, and severity is *medium* with *low* irreversibility.

Illegal fishing is practiced almost at the whole Tysa and its tributaries, so the scope is *high*, but severity and irreversibility is *medium*.

Littering and pollution are a crucial issue for the whole floodplain, so the scope is *high*, severity is *medium* and the irreversibility is *low*.

The conversion of the riverbed and the floodplain as a result of gravel extraction and building of hydrological infrastructure has a *high* scope with *very high* severity and irreversibility.

Contributing factors and underlying causes

Illegal logging is primarily caused by the demand for firewood from the local population and by the need for raw materials from carpenters and carvers. Another important factor is the demand for arable, hay mowing and grazing land, which are in short supply. Finally, an almost complete lack of enforcement of environmental legislation does facilitate illegal logging.

Figure 36: Tysa river: remains of a major flood in 2008.

Illegal fishing, like poaching, is certainly connected to the poor socio-economic situation of the region. It is however amplified again by the total absence of public control over the Tysa river and its tributaries.

Littering and pollution of water and riparian ecosystems can be attributed to the lack of a proper system for garbage collection, recycling, waste disposal and wastewater treatment facilities in the settlements within the CBR scope. The poor financial situation of the

municipalities does simply not allow for the construction and implementation of any of these. Furthermore, the low ecological responsibility of local people does also play a role, as they often dump garbage directly into rivers and streams.

The riverbed and floodplain changes are generally caused by the following factors. The strong flood events, which have taken place a number of times during the recent 12 years. Only the construction of the flood-protection items can be seen as an efficient measure, though it means changes in the riverbeds and floodplains. On the other hand, there is a need for cheap building materials like sand and gravel. They are widely used in different building works and the demand is rather high. The third driver is the lack of money and the possibility to make easy and quick money. Another major driver is corruption, which allows people to get permission for gravel and sand extraction strongly exceeding its limits.

Potential future developments
The situation with water and riparian ecosystems can evolve as follows. The most valuable localities will be included into the Nature Protected Fund of Transcarpathia and become the elements of a regional ecological network. Such projects already exist and can be implemented over the coming years.

Other territories, less valuable in terms of landscape and biological diversity conservation will be developed as recreational areas because here their potential is high enough.

Illegal logging, poaching and illegal fishing as well as gravel extraction from rivers will be minimised as soon as the system of state control works effectively. It is possible after the economy of Ukraine is released of the crisis. Improving the financial situation in the country along with involvement of international funds also will solve the problem of littering and pollution by creating an effective system of collection, recycling and waste disposal and construction of treatment facilities in major towns of the CBR scope.

The problem of negative impact on water caused by the flood protection constructions will be solved through the partnership with the Transcarpathian Water Management Department - an organisation that is responsible for constructions and practical implementation of the concept of flood protection within the scope.

The problems of the international character are connected to the Romanian impact on the Tysa wetland ecosystems, are they are going to be solved by means of international agreements are consultations.

3.2.4.4.6 Cave ecosystems and karst formations

Rationale for choosing cave ecosystems and karst formations as a conservation targets
The CBR is rich in limestone karst formations and underground cavities, both of natural and artificial origin. They are of particular interest as natural attractions. They are represented almost in the full range of aboveground and underground karst formations. Special attention should be paid to rocky cliffs, which reach gigantic size and form a unique landscape, and limestone caves, grottos and wells, some of which have retained their rich interior in almost original state, made up of various calcitic formations (stalactites, stalagmites, helictites etc.)(Dublyanskyi & Lomayev 1980). The area is also rich, not only in natural caves, but also in karst formations and numerous galleries created as the result of mining and geological

prospecting. Some of them represent a significant cultural and historical value, as they have been established in the time of the Turkish expansion in Europe.

Figure 37: Karst arch in Uholka.

Specific biotic complexes are closely related to the above mentioned objects of inanimate nature. The calciphilous flora and vegetation, including many rare, relict and endemic species and communities in national and international dimension are bound to the limestone cliffs, ridges and crests.

Special attention should also be devoted to the animal population of caves and tunnels of this territory. Wildlife of the caves can be divided into: the permanent residents - troglobiont, temporary - troglophilous, and random - trogloxenic. The greatest scientific interest is certainly given to troglobionts – the organisms that can exist only in specific conditions of the cave. Natural caves of the scope have a long history and are isolated, thus becoming the centres of endemism. Unique and rich troglobiont complexes containing strictly endemic species known only from here are formed in these sites. A significant portion of cave fauna is not known and not described hitherto.

Figure 38: Cave systems and inhabiting bats.

The underground cavities of the scope are important places for various bat species. These are places for hibernation for thousands colonies of bats that include 15 species listed in national and international red books and lists of conservation. In the protected cave *Druzhba* (friendship) lives the biggest winter colony of bats in

Ukraine numbering fifteen hundred individuals.

It is essential to mark here that both limestone and karst formations together with the vegetation characteristic for them in the Ukrainian Carpathians are distributed exclusively within the CBR.

General description

Considering karstological zoning, the CBR scope is located within the Carpathian karst area, which includes three areas: Rocky (600 km^2), Rakhiv-Chyvchynska (800 km^2) and flysch-folded (15,300 km^2). Also located in this area are the northern (Maramorosh) and the southern (or Rocky Peninnian) tectonic zones, which are the two narrow parallel strips. The northern or Maramorosh zone stretches from the village Dovha up to the Rakhiv mountain ridge, and the southern or Rocky zone stretches from Perechyn to the river Teresva. The cliffs of the southern zone are composed of different limestone with thickness of 5 to 50 m. In the northern zone the rocks are composed of Jurassic limestone, Triassic dolomite, crystalline rocks associated with the front Maramorosh overthrust (Dublyanskyi & Lomayev 1980).

Most of the karst underground cavities are in the north (Rocky) area between the rivers Tereblya and the Teresva both in the Tyachiv District. These are primarily karst caves of the Uholka massif of the CBR and caves of the Cherlenyi Kamin area. The caves of Uholka are located among the rocky mid-montane area, made up of limestone-marl and carbonate sediments of Jurassic age. Powerful blocks of Jurassic limestone are characteristic for this area. Numerous tectonic cracks in them and large amount of precipitation with up to 1600 mm per year, contributed to the intensive development of karst processes, including the formation of caves. Karst caves of the Uholka massif in the CBR, more than 30, differ in origin, internal structure, volume and number of floors, presence and type of secondary deposits. Their length ranges from 5 to 1000 meters. Some of them have almost completely retained its characteristic limestone karst interior and represent the major interest to tourists and cave explorers.

Somewhat different are the caves of the Cherlenyi Kamin area. They also belong to the zone of Penine cliffs and the Carpathian speleological region. Here, at a distance of about 1 km, there are two major caves, one of which has a length of over 1 km.

Artificial underground cavities are the galleries confined to the Rakhiv mountain range and rich in minerals. This area is characterised by large deposits of iron ore, gold, uranium, heavy metals and building materials (e.g., dolomite, limestone, marble). Some of them, especially iron, have been mined here since the 17th century. The most active surveys of the geological structure and presence of minerals in the area were studied in the Soviet period - the second half of the 20th century. The geological exploration works were held for the whole Rakhiv mountain range and the southern Svydovets ridge, which were continuous in respect of the geomorphological structure. As a result of a long historical period, there were dozens of galleries of different sizes and shapes. Many of them tumbled due to landslides or special actions (undermining of inlets), but some have been preserved in pristine form until now.

Cave habitats are characterised by relative isolation and by a set of the following not typical for terrestrial abiotic factors such as lack of light, permanent temperature rate, high humidity and others. Thanks to these conditions the specific underground ecosystems have been formed, containing a specific cavern fauna. A characteristic feature of the cave organisms is the presence of morphological, physiological and ethological adaptations.

The cave fauna of the Carpathians is peculiar, although it is to a great degree similar to the west-European one. And in its turn, the east Carpathian speleofauna differs from the Carpathian

one by a number of components: type Platyhelmintes: *Turbellaria*; type Nemathelmintes: *Nematoda*; type Annelida: *Oligochaeta*, *Hirudinea*; type Arthropoda: Myriapoda (*Diplopoda, Chilopoda*), Crustacea (*Copepoda*, *Ostracoda*, *Isopoda*, *Amphipoda*), Arachnida (*Aranei*, *Opiliones*, *Pseudoscorpiones*, *Acari*), Collembola, Diplura, Insecta Thysanura, (*Plecoptera*, *Trichoptera*, *Psocoptera*, *Homoptera*, *Lepidoptera Diptera*, *Hymenoptera*, *Coleoptera*); type Mollusca: Gastropoda, Bivalvia; type Chordata: Amphibia (*Caudata*, *Salientia*), Aves, Mammalia (*Rodentia, Insectivora, Chiroptera, Carnivora*). The total number of species found in the scope's caves is about 200. A great number of invertebrates are not identified till now.

The fauna bound to cave entrances is mostly made up of the associations, which individuals are mostly noted on ceilings and walls of the cavities where some diffused light is available. The most typical species of these associations are: spiders *Meta merianae* (Scopoli 1763), *Meta menardi* (Latreille, 1804), *Tegenaria silvestris* L. Koch, 1872, *Histopona torpida* (C. L. Koch, 1834), *Nesticus cellulanus* (Clerck, 1757);butterflies *Triphosa dubitata* (L., 1758), *Scoliopteryx libatrix* (L., 1758), *Inachis io* (L., 1758);волохокрильці *Stenophylax permistus* McLachlan, 1895; millepedes *Polydesmus complanatus* (L., 1761) and *Lithobius erythrocephalus* C. L. Koch, 1847; mollusks *Oxychilus depressus* (Sterki, 1880), *Oxychilus orientalis* (Clessin, 1877) and *Limax* sp., and others.

In remote parts of caves there are more specific species, their presence and territorial division is largely dependent on the availability of water and energy sources, such as guano of bats, organic material that is brought to the caves by streams or water or is seeping through cracks and fissures in rock, carcasses of animals killed in caves, bacteria and others. Typical representatives of the caves deep zone in the Ukrainian Carpathians are: spiders of the genera *Porrhomma*, *Leptyphanthes*, and *Cybeaus*; beetle families *Carabidae* (Duvalius), *Leiodidae* (Catops, Choleva, Bathyscia), *Staphylinidae* (Quedius, Ocalea); families *Arrhopallites*, *Oncopodura*, *Megalothorax*, *Neelus*, *Plutomurus*, *Heteromurus*, *Folsomia*, *Kalaphorura*, *Protaphorura*, *Orthonychiurus*, Willemia et al.), wood louse (*Oniscoidea*). The aquatic environment of the deep zone of caves (streams, lakes, pools, basins) is inhabited by the planarian family *Dendrocellidae*, *Cyclops, Acanthocyclops*, *Niphargus*, aquatic *GastropodaTerrestribythynella* and others.

The speleofaunas' highlight of any cave in the region that determines its specificity relative to other regions is troglobiont and endemic species. In caves and mine shafts of the CBR scope the endemics are represented by the following categories: *Acanthocyclops kieferi* (Chappuis, 1925) (*Crustacea: Copepoda*); *Carpathonesticus galotshkai* Evtushenko, 1993 (*Aranei: Nesticidae*); *Arrhopalites carpathicus* Vargovitsh, 1999 (*Collembola: Symphypleona*); *Arrhopalites kristiani* Vargovitsh, 2005 (*Collembola: Symphypleona*); *Willemia virae* Kaprus, 1997 (*Collembola: Poduromorpha*); *Duvalius transcarpathicus* Shilenkov et Rizun, 1989 (*Coleoptera: Trechini*) and others.

Vertebrate animals in the caves and tunnels are represented by a number of species of amphibians, birds and mammals. But a key group of vertebrates that live in underground cavities are bats. Within the scope the caves are used by bats mainly as refuges for hibernation. 15 species of bats are found here: *Rhinolophus hipposideros* (Bechstein, 1800), *Rhinolophus ferrumequinum* (Schreber, 1774), *Plecotus auritus* (L., 1758), *Plecotus austriacus* (Fischer, 1829), *Barbastella barbastellus* (Schreber, 1774), *Eptesicus serotinus* (Schreber, 1774), *Myotis myotis* (Borkhausen, 1797), *Myotis blythii* (Tomes, 1857), *Myotis mystacinus* (Kuhl, 1817), *Myotis brandtii* (Eversmann, 1845), *Myotis nattereri* (Kuhl, 1817), *Myotis emarginatus* (Geoffroy, 1806), *Myotis bechsteinii* (Kuhl, 1817), *Leuconoe daubentonii* (Kuhl, 1817), *Miniopterus schreibersii* (Kuhl, 1817) (Pokynchereda, 1997). All of them are included into the

Red Book of Ukraine (2009) and the Berne Convention Annexes, and some species - the European Red List and Red Book of IUCN.

Within the CBR scope the karst rocks are made up of isolated sawn-off cliffs of different genesis (USSR Academy of Science 1966). In particular this is slacking of mica Triassic limestone and blue-gray marble up to 10-15 m. The northern Zone is characterised by rocks formed by Jurassic limestone, Triassic dolomite and marble. Between the Mala and Velyka Uholka rivers (the southern zone) the rocks are composed of grey, sometimes pink reef limestones and limestone breccias on calcareous conglomerates with pebbles of quartz. north of the Uhlia village there are dozens of cliffs, some of which reach 80-100 m in length, 30-50 m in width and the heights up to 50-80 m. Some of them stretch along the local watersheds between the side tributaries of the Vayla and Mala Uholkas. Rocks and cliffs form the exotic landscapes of this territory, which attracts many tourists and climbers.

The unique calciphilous flora and vegetation are bound to these above-ground karst formations. The rocky limestone slopes are covered with natural yew-beech forests, including sporadic rare plant communities listed in the Green Book of Ukraine (2009). Among them are: beech forest communities with yew tree *Fagetum* (*sylvaticae*) *taxosum* (*baccatae*), beech forest communities with domination of calciphilous species in the grass stand: (*Fagetum (sylvaticae) phyllitidosum* (*scolopendrii*), (*Fagetum* (*sylvaticae*) *lunariosum* (*redivivae*), (*Fagetum* (*sylvaticae*) *hederosum* (*helicis*), (*Fagetum* (*sylvaticae*) *scopoliosum* (*carniolicae*) and others.

Over 200 calciphilous species grow on limestone outcrops, many of which are rare, endemic or relict. Among the arboreal and bush rarities here belong: *Cotoneaster integerrimus*, *Juniperus sabina*, *Taxus baccata*, *Rhamnus cathartica* etc. The rare calciphilous grass species are: *Campanula carpatica*, *Cephalanthera rubra*, *Coronilla elegans*, *Cortusa mattiolii*, *Iris pseudocyperus*, *Jovibarba preissiana*, *Scabiosa opaca*, *Sedum hispanicum*, *Arum alpinum*, *Corallorhiza trifida*, *Epipogium aphyllum*, *Erythronium dens-canis*, *Ophyoglossum vulgatum*, *Viola dacica* and others (Carpathian Biosphere Reserve 2009).

Direct threats

In the historical past the karst formations were threatened by the traditional occupation, which used to lower the development of limestone cells for burning lime. However, the scope of these activities were minor and local

Significantly more threats appeared after the World War II. During this time intensive use of the rich local resources, especially minerals started. Since the late 40s to 60s this area (including the scope of CBR) was the subject for large-scale mining and hundreds of galleries, pits, etc were established. According to the results of surveys commercial reserves of many minerals for this area have been identified. However, due to various reasons, primarily economic, the industrial extraction of most of these resources had not been started. The exceptions were a few pits where the mining of marble as a decorative element began, and limestone for lime producing and other materials for construction needs.

During the Soviet period, the Ukrainian part of the Carpathian Mountains became one of the most attractive places in the USSR for tourism and recreation. Every year millions of visitors came to the CBR scope, some of whom wanted to visit interesting natural sites, among which were the karst formations. Some of them (rocks, caves, etc.) that were located in easily accessible places were greatly disturbed as a result of long and mass visiting, so there were significant negative changes. These changes have led to degradation of these objects as a specific habitat and the reduction of the characteristic biodiversity.

In the same period the development of various forms of nature based activities were promoted. Numerous groups, sections and societies had been formed, including speleological or climbing associations. As a result, natural attractions like caves and cliffs, which were virtually inaccessible for ordinary tourists, had been visited more frequently. Although this specialised tourism was not of a mass character, its influence had been significant. Speleological activities were accompanied by pollutions of the caves, including light pollutions, which negatively affected the cave ecosystem and its components. In winter it was especially dangerous, since visiting had been becoming a powerful factor of disturbance for vulnerable winter colonies of bats.

Another threat from the tourism in the broadest sense is vandalism. It is visible on any tourist trail or a recreational facility. Mostly it comes down to destruction of a separate natural object, and usually does not pose a serious threat. However, there are exceptions, which include vandalism in winter bats' refuges. These animals, being in a state of hibernation, are extremely vulnerable. An attacker can destroy dozens and sometimes hundreds of animals in a few minutes, which entails liquidation of both the colonies, and the hibernation site.

Over the years of independence of Ukraine there have been significant social and economic changes in society and the state. Within the last decade there has been an economic interest in the development of certain mineral deposits, which in Soviet times were not profitable. This particularly applies to gold fields, localised in the Maramorosh zone. There have been preliminary works on one of the most promising fields (Saulyak) that is located on the border of the CBR in Dilove village. The system of tunnels, laid here in the postwar period is characterised by numerous winter colonies of bats and the massive presence of troglophilous and troglozenic, which would suffer significantly and possibly would be critically damaged by the commercial gold mining.

The shift from the planned to the market economy in the post-Soviet period has activated business, including development of new fields of building materials within the CBR scope, especially marble, limestone and dolomite. All of them were developed in an open way, leading to the destruction of the aboveground karst formations and associated habitats. Now, these careers are relatively small and the damage they are causing is insignificant, although there is a dangerous tendency to increase their number and scale of production.

Threat rating

Threats associated with mining operations apply to a great part of the CBR area located in the north and south tectonic zones and rich in minerals. Its scope can be classified as *high*. Impact of this activity is currently *low*, but with a clear perspective of intensification. In this regard the severity is *medium* but considering the specific features of mining the irreversibility can be assessed as *high*.

The threat of destruction and degradation of ecosystems and karst cave formations as a result of tourism and recreation activity is also relevant for many areas of CBR and the scope is *medium.* Impact of tourism and recreation is not high now, but with a clear tendency to increase. Therefore, the severity can be described as *average*, as well as the level of irreversibility.

Speleology is clearly dedicated to the underground cavities, which determines its specific localisation. So the scope is *low*. However, it covers all, without exception, underground cavities, both natural and artificial, so the severity is *high*. Irreversibility can be estimated as

medium as basically the cave explorers carefully refer to the caves and cave inhabitants, and damage inflicted by them, is not direct. This is true for rock climbing as well.

Vandalism and pollutions are characteristic only for certain sites of the given target and the scope can be considered to be *low*. Severity of vandalism is also *low* but irreversibility is *high*.

Contributing factors and underlying causes

Extraction of minerals within the CBR scope is associated with the crucial need for raw materials and resources at the national and regional levels. In Ukraine the gold deposits are very limited and one of the largest industrial stocks is concentrated in the area of the reserve. Great demand on the national level exists for another local product - marble and marble-limestone used for decorating. Large demand for mining products exists on the local market too. It is associated with construction materials - local limestone, dolomite, and others.

The driver of the destruction and degradation of ecosystems and karst cave formations due to tourist and recreation activities is the low ecological awareness of tourists and the poor control on behalf of the rangers' service. Outside the reserve such control is completely absent, although there are relevant services (e.g. forest rangers) with the relevant authorities. For the underground cavities it is important to note the possibility of free access to anyone interested as one of the drivers.

Problems associated with caving and rock climbing occur due to, primarily, insufficient environmental awareness and secondly, the lack of the documentary regulation to visit and use rock-cliffs and underground cavities in their needs. The problem lies also in the free access to many caves and tunnels, and lack of control.

Vandalism and littering are directly related to low environmental awareness, free access to sites, including caves, and inadequate control.

Potential future developments

The future of the karst formations and underground cavities is a rather optimistic one. The most valuable and the most important of them (e.g. the Cherlenyi Kamin underground system or the Dovharunya gallery) will become parts of the Transcarpathian econetwork, which will give them a relevant protection status.

As for the prospects of mining in the area of the reserve, these perspectives are rather great, due to the presence of significant mineral resources. The need for these raw materials is growing in the course of time. However, taking into account that Transcarpathia, and the Ukrainian Carpathians as a whole, are resort and recreation areas, and that these minerals are located within CBR scope (and sometimes, directly under the protected area), development of this industry will be held in view of these circumstances. Extraction of most minerals will be held only in predefined and agreed with all stakeholders localities, held mostly in a closed method (career will be minimised), and enrichment, reprocessing and transportation of raw materials will take place using environmentally friendly technologies.

Ecotourism will remain dominant in the CBR scope, where on the one hand many unique natural objects are concentrated; on the other hand natural systems have not undergone great changes. The number of visitors and tourists in the area will grow, particularly by visitors from abroad, although in a short term it will not reach the Soviet-time level, which amounted to millions of tourists annually. Increasing the number of visitors will not lead to a serious

aggravation of environmental problems. Active environmental education and training will raise the environmental awareness of the population. More efficient works of the guarding service at the reserve should be organized on the ranger-style basis – fewer workers, but better trained and equipped. In this way the vandalism will be reduced.

Collaboration with organised speleologists, climbers, rock-climbing will significantly reduce the negative impacts during their professional activities.

All this together will ensure conservation of karst formations and underground cavities as unique objects of inanimate nature and the centres of rich and unique biodiversity.

3.2.4.4.7 Narcissi Valley

Rationale for choosing the Narcissi Valley as a conservation target

The Narcissi Valley is a unique and important site that belongs to the Carpathian Biosphere Reserve. *Narcissus poeticus* is a Mid-European highland species distributed in the Alps, the Balkans and the Carpathians. The Narcissi Valley is considered the biggest lowland population of this species globally. There are two scientifically grounded hypotheses of the *Narcissus poeticus* lowland population origination. According to one of them, the Narcissi Valley was formed in the glacial period as *Narcissus* had been ousted here by the glacier shifting from the Maramorosh and Svydovets mountain ranges down to the lowland areas of Transcarpathia. In the course of time the glacier shifted back and the highland population of this species had been restored. Still, it has partially remained in the lowland as a glacial refuge till nowadays. Other scientists consider that the lowland population is a derived one, which means that it has been transplanted from the mountains by man. There are also assumptions that the valley originated on the site where an ancient cemetery used to be. Also a local legend supports the latter hypothesis. When the plague came to Transcarpathia most dwellers of Khust castle and many people of neighbouring villages died. The bodies were buried and their graveyard marked with narcissi flowers brought from the highlands. Due to the favourable conditions the flowers grew into a vast valley blossoming white.

Figure 39: Narcissi Valley.

The botanically unique valley harbours almost 10% of the Ukrainian flora and 25% of the Transcarpathian flora species, some of which are rare and listed in the Red Data Book of Ukraine. The vegetation of the Narcissi Valley is mostly comprised of cereals and grass formations with a number of species such as *Thymus alternans*, *Tragopogon transcarpaticus* and *Melittis carpatica*. Populations of valuable medicinal herbs are numerous. They include species such as *Valeriana officinalis*, *Sanguisorba officinalis*, *Betonica officinalis* and other. On

boggy sites there more common species like *Hottonia palustris*, *Urticularia vulgaris*, *Sagittaria sagittifolia*, *Typha angustifolia* and *Sparganium emersum*(Komendar 2007; Voloshchuk & Paparyha 2010).

From spring to late autumn the vegetation offers a broad colour spectrum. In April *Leucojum vernum*, *Crocus heuffelianus* and *Erythronium dens-canis* start blossoming, and in early May a continuous white carpet of *Narcissus angustifolia* appear. In summer boggy sites are yellow with blossoming *Caltha palustris* and other *Ranunculus* species, and some patches of blue are made by *Iris sibirica*. The pink shade of the Valley is created by a great number of *Orchids*, which are listed in the Red Data Book of Ukraine. Light-violet flowers of *Colchicum autumnale* and *Crocus banaticus* contribute to the autumn aspect of this protected site.

The Narcissi Valley provides habitat for numerous birds and insects. About 110 species of avifauna are found here in different seasons including the nightingales *Luscinia luscinia,* tomtits *Remiz pendulinus,* pheasants *Phasianus colchicus* and the common kingfisher *Alcedo atthis* but also different migrating species of ducks, sandpipers and sparrows. Red-listed species also find their shelter here: *Ciconia nigra*, *Falco peregrinus*, *Circus cyaneus*(Hodovanets 1997). Additionally, there are 350 species of insects found in the valley. About 150 species of butterfly find suitable habitat in the Narcissi Valley. Among them there are red-listed butterflies such as *Papilio machaon, Iphiclides podarilium*, *Calopterix virgo*, *Cordulegaster annulatus* and *Oryctes nasicornis.* Hedgehogs, hares, red deer, snakes, different species of toads and about 50 species of other vertebrates found in the valley greatly contribute to the biodiversity of Transcarpathia.

General description

The Narcissi Valley is located close to the town of Khust in the Keshi area, in the western part of the Khust-Solotvyno basin on the ancient terraces of the Tysa River. The relief of the valley is not flat but surrounded with hills from the east, south and west, and its altitude comprises 180-200 m.a.s.l. It covers an area of 256 ha. The Valley is characterised by mild and temperate moist climate. The mean annual amount of precipitation is 1,027 mm, the mean annual air temperature is around +8.8°C, the mean temperature of the coldest month (January) is –4.6°C and that of the warmest month (July) is around +20.1°C.

The Khustets River flows across the Narcissi Valley and is its most important way of water inflow and effluence. Besides, some extra melioration channels were maintained here for additional drainange in the 1970ies.

In former times this area used to be covered with oak-hornbeam forests typical for the Khust-Solotvyno basin. Turf acid brownsoil formed on alluvial sediments dominate here.

The history of the Valley as a protected site started back in 1960ies when a local floristic reserve was established here (80 ha). In 1979, the protected areas' surface was enlarged up to 256.5 ha and became part of the Carpathian State Reserve (presently CBR). The site was planned to be drained in order to turn it into arable land for one of the collective farms. Thanks to the efforts of Prof. Vasyl Komendar from the Uzhgorod University this unique natural habitat is under protection now. Nevertheless some drainage work had already been held deteriorating the hydrological regime of the valley until today. The disturbed hydrological regime has to be restored now by CBR staff, otherwise the valley would soon dry out.

Key ecological attributes and indicators

The Narcissi Valley is one of the few lowland sites in Transcarpathia, which preserves the ecological attributes of natural grasslands with characteristic meadow vegetation. This continuous lowland massif (180-200 m a.s.l.) represents a river valley (the Khustets River) with moderate humid and over humid meadows with sod-clay soils. Its peculiarity is reveled by the presence of one of the biggest lowland population of a rare mountain species *Narcissus poeticus* L.

In the Narcissi Valley this species grows in humid (rarely dry) locations covering the area, which used to be a thinned oak forest. At the same time its usual habitats are humid subalpine meadows or crooked woodlands.

Over 10 plant communities are described for the Narcissi Valley (Krichfalushi 1980) with 15 to 30 correlating species. In most of these communities the narcissus takes a significant share and has a special aspect in the blossom season. Most importantly, the narcissus is subdominant for almost half of the communities, and dominant for one third, resulting in a total coverage during blooming season ranging from 10% to 40%.

Altogether the surface of the *Narcissus*-dominating communities is no more than 50% of the total area of the valley. These localities are shaped as spots or stripes on the background of the grass stand of the field.

There are drainage channels on the grassland along the stream flowing from Kireshi. The hydrologic regime of the Narcissi Valley appears to be a quick responding system. This is obviously indicated by the river level that fluctuates strongly in short time intervals. Apparently, there is only a short time needed for precipitation to reach the river. It is assumed that precipitation flows off underground and there is not surface erosion.

The grassland ecosystem of the Narcissi Valley exists because the whole area is being mowed once or even twice a year. The grass is cut, dried and removed to serve as fodder for cattle. Without the mowing, the valley would naturally turn into a willow shrubland\forest and later into a moist forest ecosystem with ash, elm, alder and some oak. The growth of willows is quick and once they are established the willows are very hard to remove, because they have strong resprouting capabilities, which make them very resistant to cutting and mowing. Already after two consecutive years without mowing, removing willows may require intensive measures. Apart from the willows, without mowing and removal of hay, the natural vegetation accumulates aboveground biomass restricting the spring growth of narcissus and other fragile species.

Viability assessment

Taking into account the aforementioned facts, the viability can be assessed as *good* since the valley is under the management of the experts of the CBR.

Direct threats

Drying

The narcissus plantshave been observed to decline. One of the possible causes is that the hydrology changed, mainly through deepening of the river, turning the area drier than before. Dry conditions are less desirable for Narcissus. The river has been deepened artificially and since then, the riverbed has been incising into the easily erosive loam. The active incising

process will cause the riverbed to become even deeper in the future. When the riverbed is lowered, also the river level is lowered and consequently the groundwater level moves deeper (figure…) and thus, making the valley drier. The second explanation for the area to become drier is that ditches have been made along the roads. The groundwater of the valley flows towards these ditches and then to the river, actively draining the valley. Because the riverbed is deeper the ditches and creeks are eroding at the point where they enter the river and this process is followed by backward erosion into the creeks and ditches (personal comm. Guido Nijland, Ake Nauta & Wiebe Nijland, 2008).

Figure 40: Melioration channel in the Narcissi Valley.

The scope of this threat can be identified as *very high* as it covers the whole surface of the site. The severity is *high*, and the irreversibility is *medium*.

Willow succession

Natural succession of willows poses a threat in areas that are not being mowed. Especially in those areas that have not been mowed for over 2 years, willow starts to grow rapidly. Also in the creeks, which are not mowed, willow starts to overgrow the creek, thereby diminishing the creek capacity to store excess water from the river. These willow bushes also threatening the vegetation of the meadows and the species like *Narcissus*. The willow *Salix alba* is well adjusted to these conditions which can now be observed in the valley, leading to an aggressive occupation of the area by this species. CBR staff tries to oppose this process through means of logging and hay mowing on the site, but the willow's viability is very high and the most effective measure has not been found yet.

The scope of this threat is *high*, severity is *high* as well, and irreversibility is *fair*.

Isolation

The Narcissi Valley is located not far from Kireshi village. In the past the urban development was not so intense, but with the political change in the country, land privatisation has started leading to a rapid development of residential areas. The hills around the valley once used to be covered with oak forests, and later became collective farm gardens. Nowadays, they are privately owned. They served as a buffer between the villages and the Narcissi Valley. Nowadays the situation gradually changes and the process of isolation of the valley from its natural environment has started.

The scope and severity of this threat are *fair*, and a *very high* irreversibility.

Trampling

The valley is one of the greatest tourism attractions in Transcarpathia with thousands of people visiting the Narcissi Valley during the blooming period. Especially as the number of visitors is not spread evenly throughout the whole year, but concentrated during the 2-3 weeks when the narcissus plants are flowering. In 2010 for example, the number of visitors was 21,251 (2,841 children). During the past five years the number of registered visitors has risen from less than 10,000 to more than 35,000 per year (compare Figure 18).

As a result, there is damage from trampling in some areas, leading to a reduction of the amount of narcissus coverage in the following year. Effort from the rangers to prevent the damage are not enough, as many visitors lack awareness and pick flowers or take pictures in the fields regardless to the damage they inflict.

This leads to a scope rated *very high* as it concerns the whole protected massif, and the severity rated *medium* (fair) as well as the irreversibility.

Contributing factors and underlying causes

The drivers for the drying are: drainage of the valley in the past, which contributed to the disturbance of the overall hydrological regime within the site and a lack of proper funding for hydrological reconstruction measures. In fact, CBR experts work hard on hydrological regime reconstruction, but all measures are funded solely from the very limited CBR's budget.

Willow succession occurs because of the changes taking place in land use practices. And these changes in their turn happened due to the life modernisation process. Cattle breeding for which hay mowing is needed is a labour consuming practice which is not sufficiently economically beneficial. This results in people abandoning these traditional practices and thus indirectly affecting the natural grasslands, in particular the Narcissi Valley, as it allows succession to keep on developing.

The isolation from surrounding ecosystems is mainly driven by the active infrastructural and residential development adjacent to the valley leading to the site being more isolated from its natural environment and getting surrounded by housing areas.

The trampling of the narcissus is driven by recreation and tourism pressure. There is a very high concentration of visitors within a short period of time, even exceeding the carrying capacity. The number of viewing points is not enough to satisfy all the visitors, so they go into the field to enjoy the white carpet of flowers trampling down the valley. The following year, the trampled sites have a very insignificant concentration of the narcissi. That is why there are years, when you can see just a small amount of flowers along the perimeter of this grassland in the places, which are accessible for visitors.

Potential future developments

Unfortunately, during the past few years a decline of the *Narcissus* has been observed. The conditions in the Narcissi Valley might be changing and the valley might become less attractive to the exclusive species, which make the Narcissi Valley very unique.

If no hydrological reconstruction measures are taken until 2040 there could be just a small portion of the Narcissus plant in comparison to other species in the grassland (less than 10%); leading to a change in species composition from the present to a more xerophilous one.

If the visitor management system remains the same, every upcoming year more and more locations deprived of narcissus will appear, because no seeding have taken place the previous year and the soil has become harder as well as the topsoil being disturbed through trampling.

3.2.4.5 Summary/threat rating, integrative consideration

The threat rating function in MIRADI™ depicts the relationship between the different threats and the conservation targets they affect. As each threat can affect multiple conservation targets, and each to a different extend, the individual threat is rated by 3 different categories, namely the threats scope of occurrence, its severity and its irreversibility, allowing a sophisticated threat analysis. It furthermore calculates the overall threat intensity by adding the individual values of targets it affects showing its overall value on the right hand side of the table. As for the conservation targets, they are assigned a summary target value (as depicted in the bottom line of Figure 42) composed of the number of threats affecting the target and their individual overall intensity.

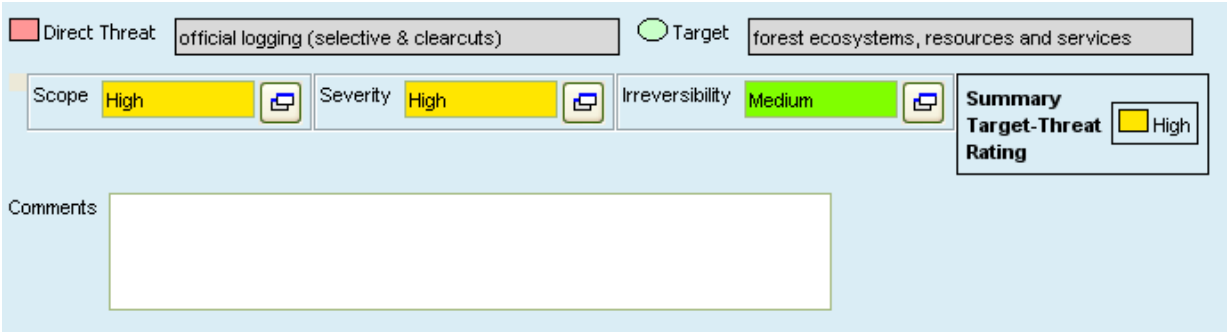


Figure 41: Scope, severity and irreversibility in threat rating.

For the CBR it resulted that the highest rated threats within the scope are: deforestation, bark beetle invasions, poaching, alteration of river bottom as a result of extraction of gravel and building of hydrological facilities, vandalism in caves, littering, and drying out of the Narcissi Valley. All these threats were rated as *high*.

Medium rated threats are: mining, water pollution by hard waste and sewage waters, illegal logging, succession of the secondary meadows, landuse changes, and infrastructure development and natural succession due to decrease in mowing and grazing.

Low-rated threats include tourism and recreation, commercial mushroom collection, illegal logging in the riparian forests, illegal fishing, habitats fragmentation, soil erosion, legal hunting, trampling by tourists, cattle and sheep pasturing and dry grass stand burning in spring.

The threat ranking allows defining priority challenges more precisely and indicates where conservation measures of the CBR should be concentrated.

Over time, depending on the CBR activities undertaken and changes in external conditions the intensity of threats can vary. The right measures to overcome threats can minimise or completely eliminate them, but climatic changes and political and socio-economic conditions can aggravate existing threats or generate new ones.

Threats, such as illegal logging, poaching, pollution of the territory, water pollutions, illegal fishing can be eliminated almost completely. Commercial logging, extraction of gravel from

rivers, changes in land use types will largely depend on the political and economic situation in the country. Threats related to climate change may intensify in the future and it will become very difficult or sometimes even impossible to overcome them.

Threats \ Targets	alpine grasslan...	cave ecosyste...	forest ecosyste...	large mammals (carnivores and ungulates)	Narcissy Valley	primeval forests	water and ripari...	Summary Threat Rating
speleology and rock-climbing		Medium						Low
trampling by tourists					Low			Low
illegal fishing							Low	Low
habitat fragmentation				Medium				Low
grazing			Low			Low		Low
spring grass incinerations	Medium							Low
disturbance/destruction by tourism and recreation	Medium	Low	Low	Low		Low		Low
commercial musroom collection			Low			Medium		Low
erosion	Low							Low
official hunting				Medium				Low
illegal logging in riperian forests							Medium	Low
Change of land use	High							Medium
mining and extracting activities		High						Medium
water pollution and waste							High	Medium
isolation					High			Medium
natural succession (willow)					High			Medium
illegal/unofficial logging and forest clearing			Low			High		Medium
obliteration on the border with forest	High							Medium
Number outbreaks of bark beetles			Very High			High		High
xerophication					Very High			High
riverbed changes							Very High	High
poaching				Very High				High
Vandalism and pollution		Very High						High
official logging (selective & clearcuts)			High			Very High		High
Summary Target Ratings:	High	High	High	High	High	High	High	**Overall Project Rating** Very High

Figure 42: Threat rating elaborated in the expert meeting in January 2010 in Lviv.

3.2.4.6 Spatial analysis

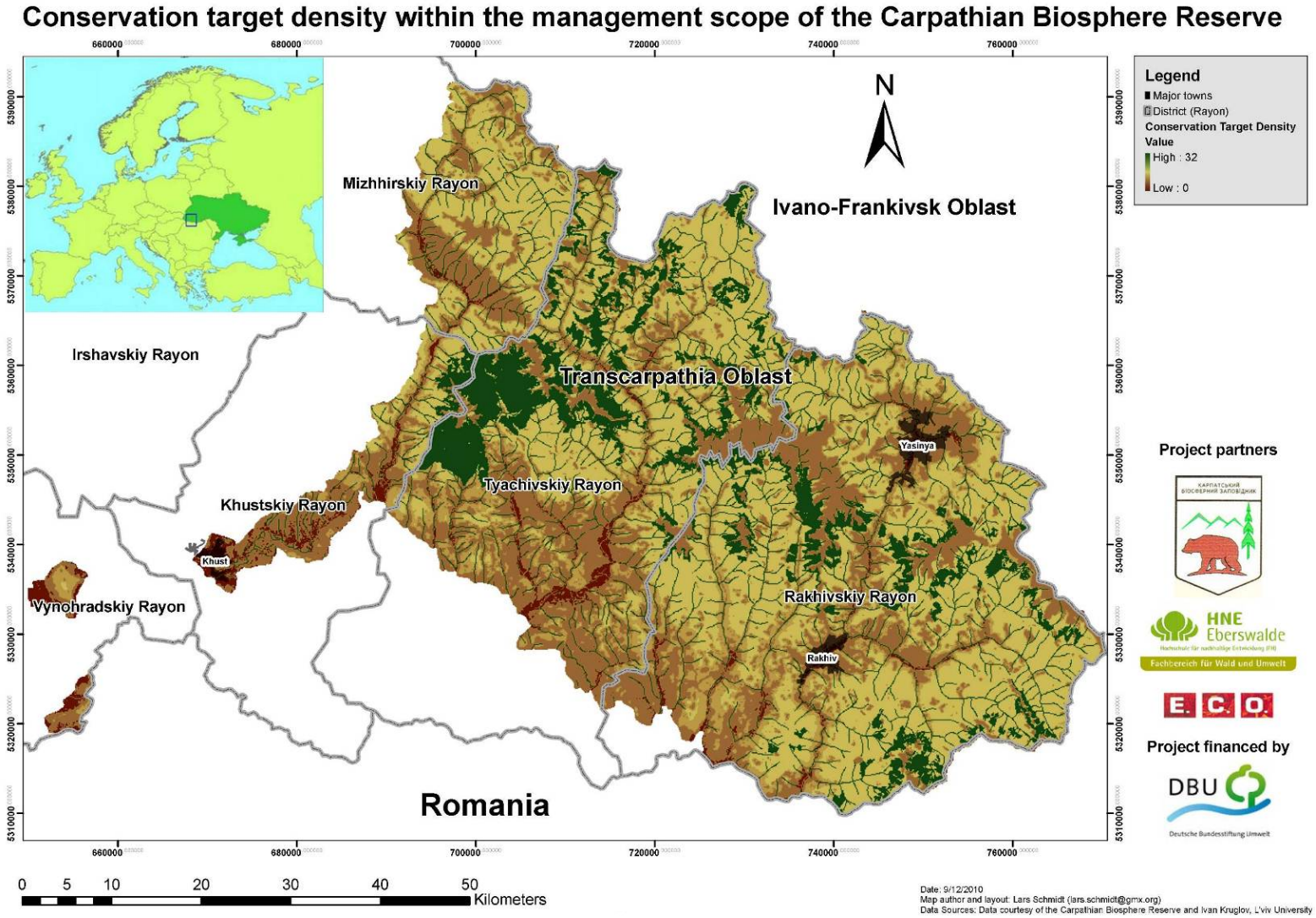


Figure 43: Conservation target density (continuous values) within the scope of the Carpathian Biosphere Reserve.

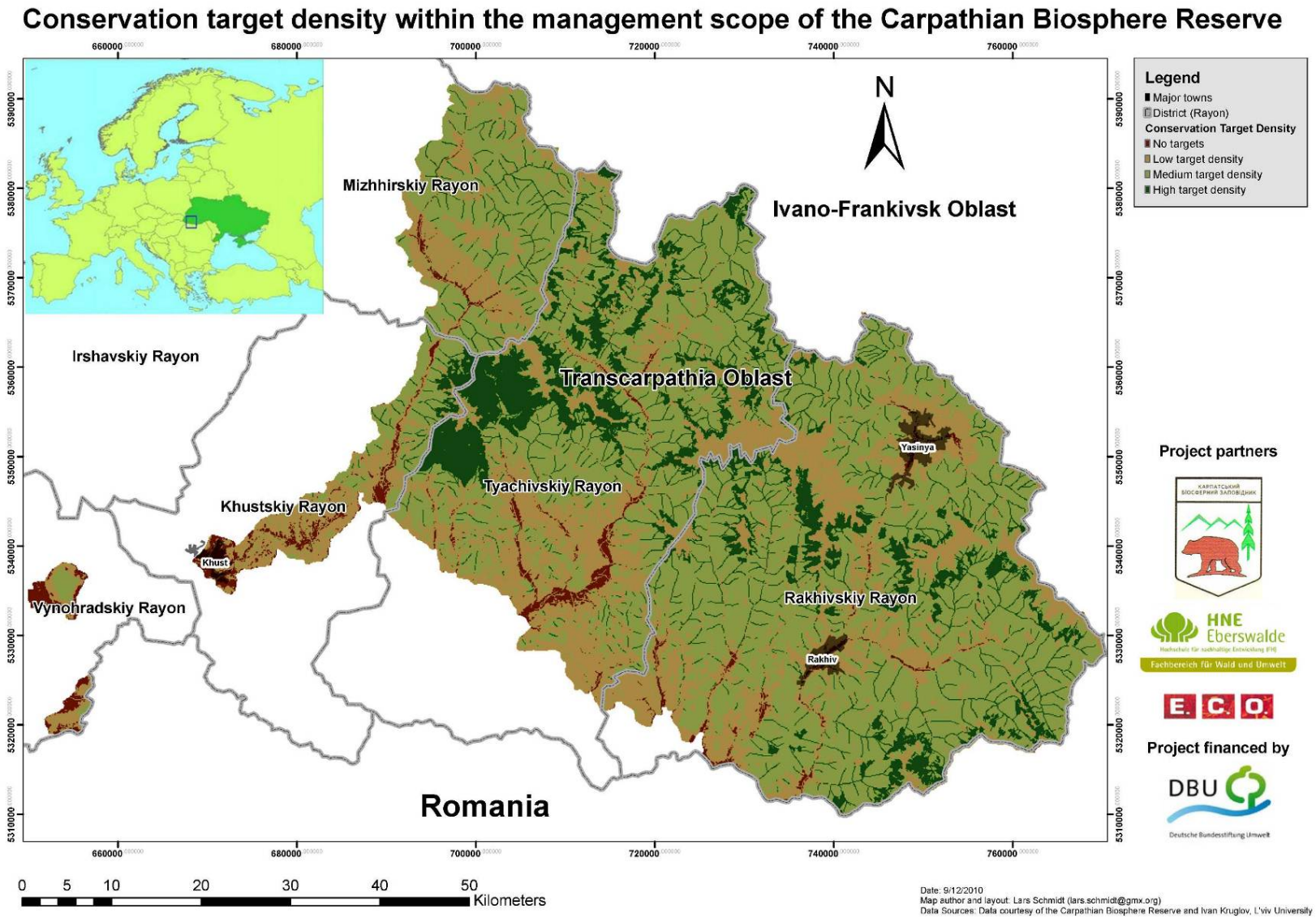


Figure 44: Conservation target density (classified) within the scope of the Carpathian Biosphere Reserve.

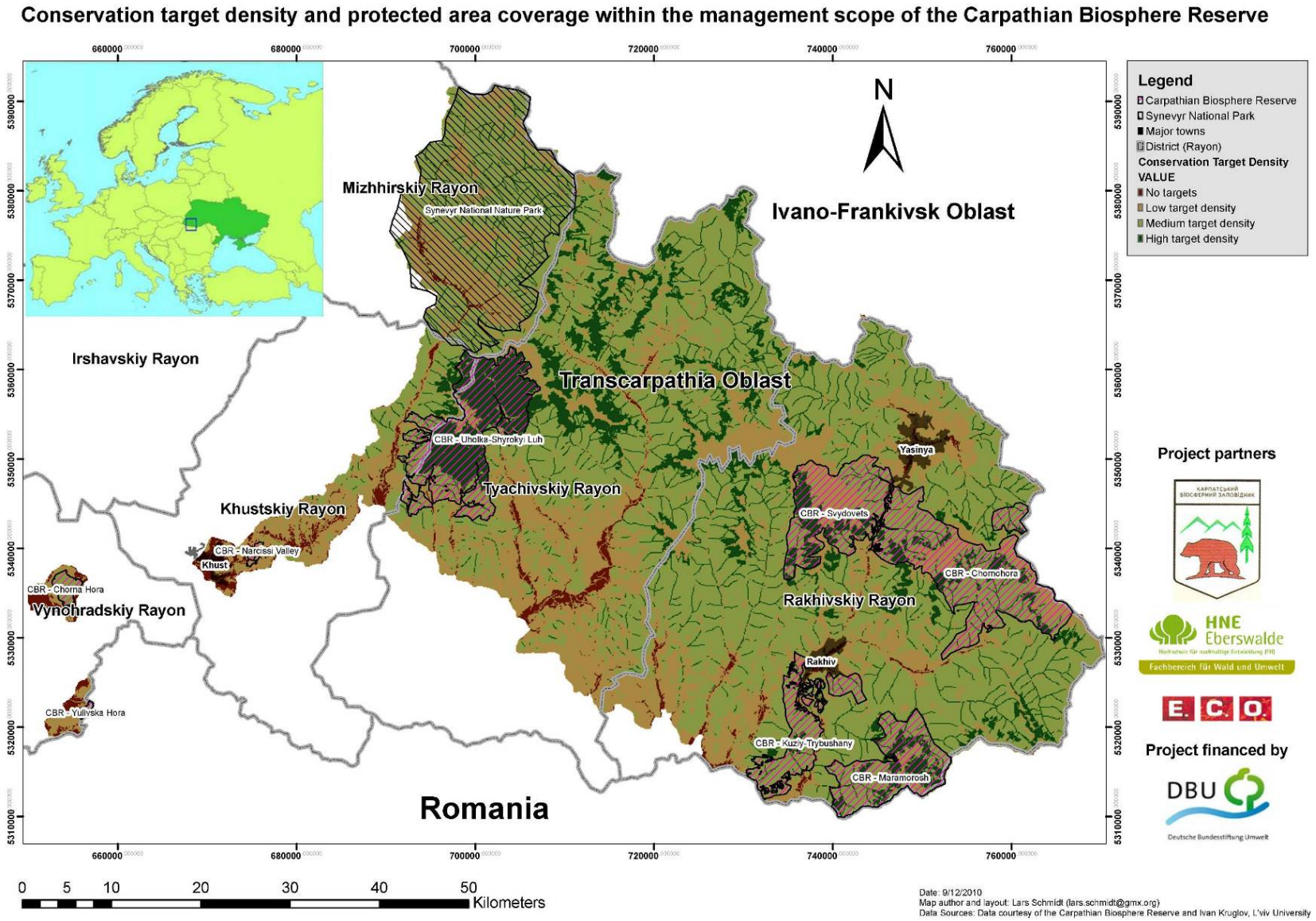


Figure 45: Conservation target density and protected area coverage within the scope of the Carpathian Biosphere Reserve.

Figure 43, Figure 44 and Figure 45 show the conservation target density within the scope of the Carpathian Biosphere Reserve. Figure 43 shows conservation target density as a continuous value from 0-32, while Figure 44 shows conservation target density classified into four categories. With regard to Figure 44, areas with zero and low conservation target density are settlements and associated cropland and grassland as well as alpine meadows (red and brown colours). Areas in light green show zones of medium conservation target density, while areas in dark green depict zones of high conservation target density. The former are mostly forest areas which do also serve as habitats for most carnivores. The latter are areas of old-growth forests and watercourses in forested areas. One can see that areas of high conservation target density are rather fragmented (with the exception of old-growth forest areas in Uholka), while large and mostly un-fragmented areas of medium conservation target density still exist.

Figure 45 displays how conservation target density and protected areas coincide. The protected areas displayed show the seven massifs of the Carpathian Biosphere Reserve (pink) and the Synevyr National Nature Park (black) to the north of Uholka. Spatial analysis shows that conservation target density within the Carpathian Biosphere is as follows:

- Low: 10,217 ha or 17.50%
- Medium: 29,366 ha or 50.25%
- High: 18,854 ha or 32.25%

In Synevyr National Nature Park the distribution of conservation target density is as follows:

- Low: 11,412 ha or 30%
- Medium: 23,876 ha or 62.50%
- High: 2,001 ha or 5%
- No data: 931 ha or 2.50%

At the same time, Figure 45shows that large and un-fragmented areas of both medium and high conservation target density within the scope of the Carpathian Biosphere Reserve are not protected.

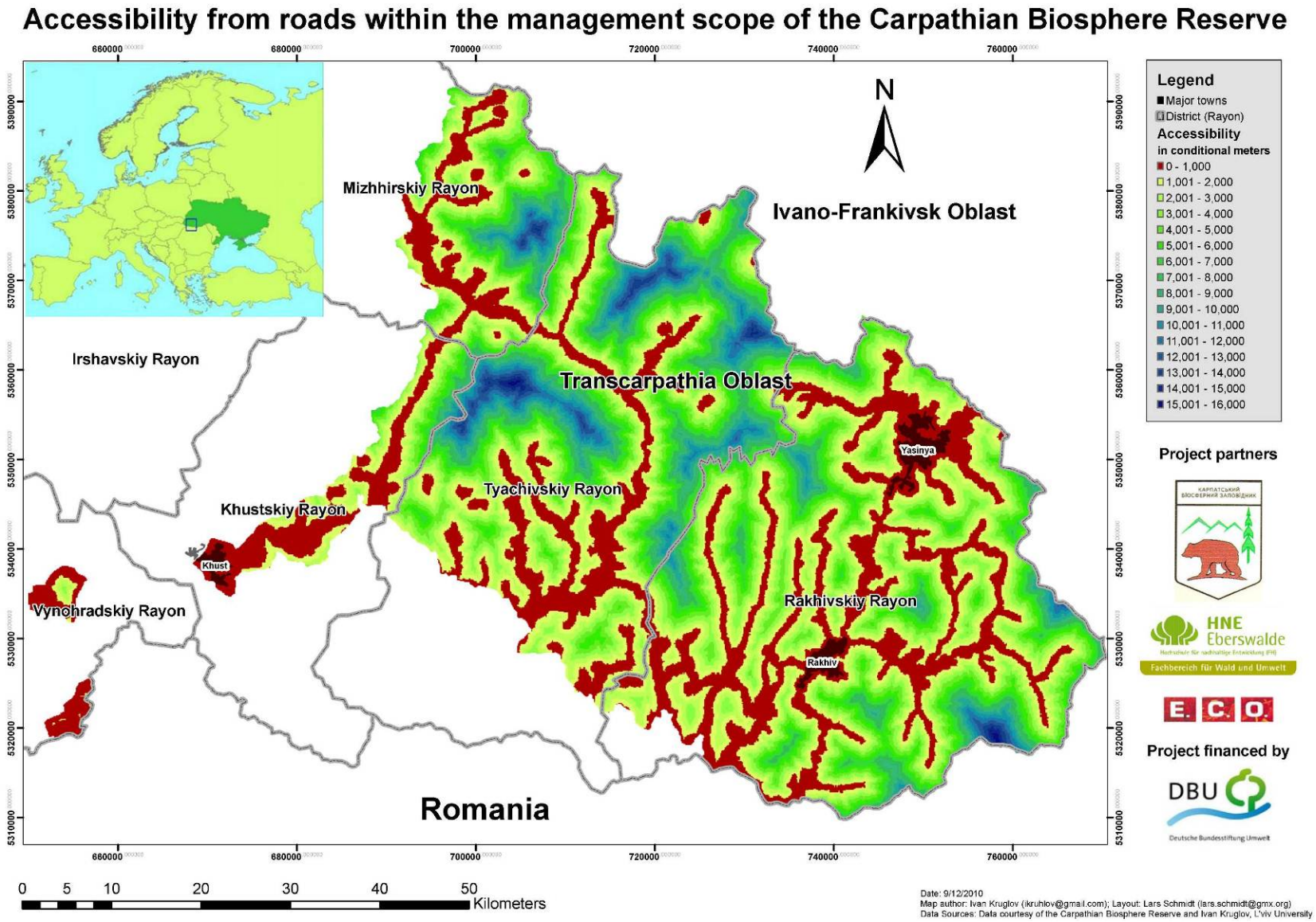


Figure 46: Accessibility from roads in conditional meters within the scope of the Carpathian Biosphere Reserve.

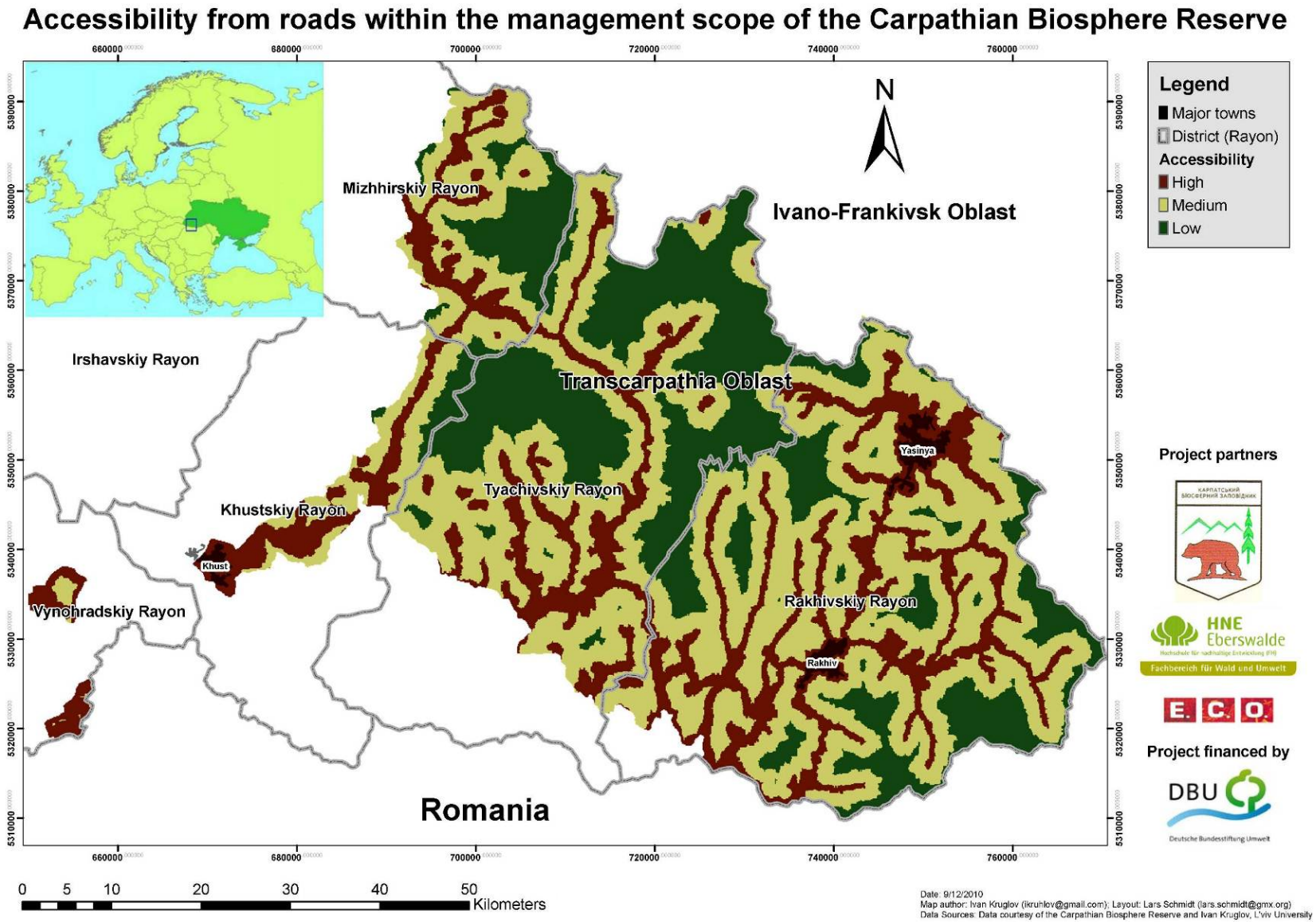


Figure 47: Accessibility from roads (classified) within the scope of the Carpathian Biosphere Reserve.

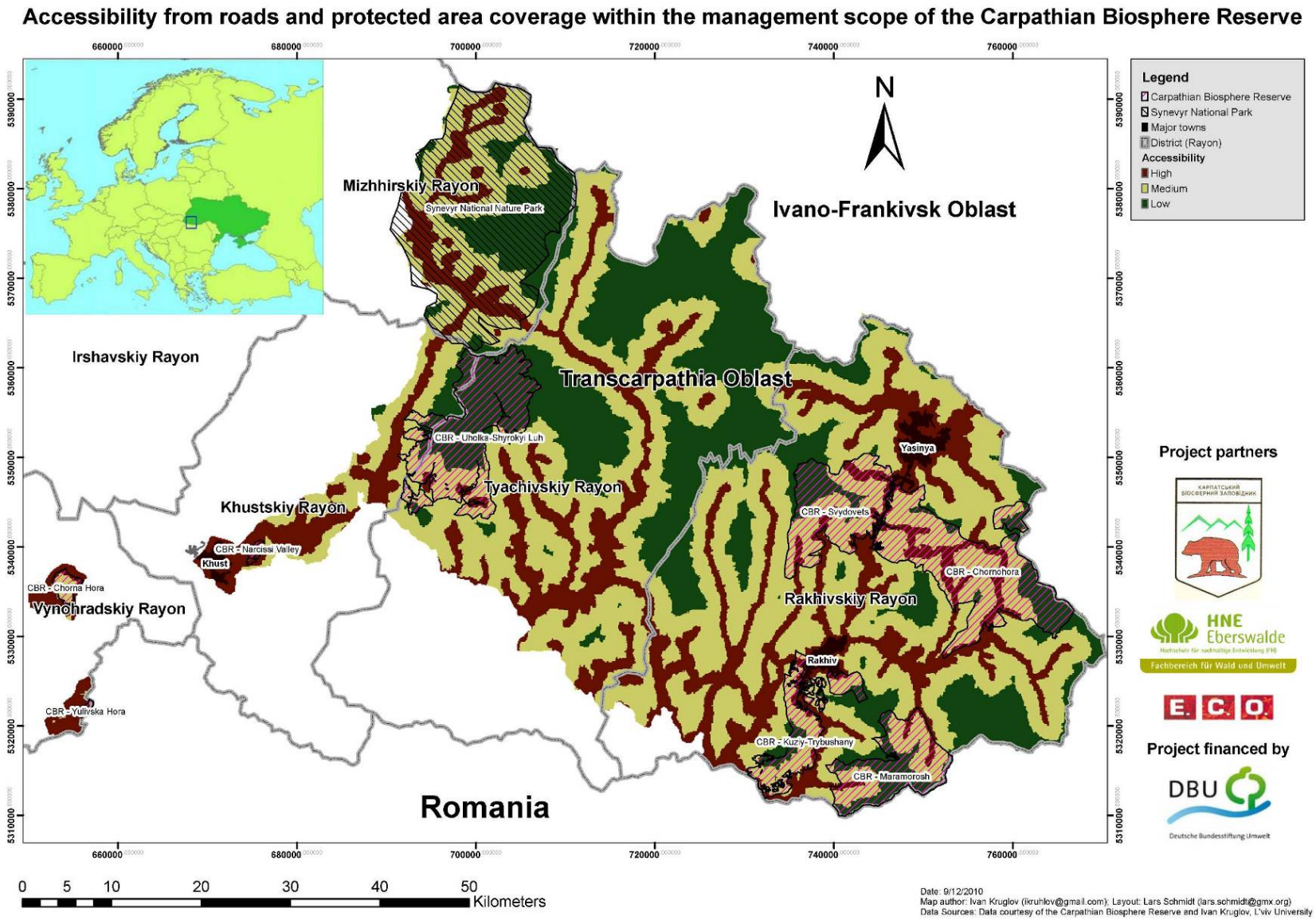


Figure 48: Accessibility from roads (classified) and protected area coverage within the scope of the Carpathian Biosphere Reserve.

Figure 46, Figure 47and Figure 48 show the accessibility within the scope of the Carpathian Biosphere Reserve. Figure 46 depicts accessibility in conditional meters while Figure 47 shows accessibility classified into three categories (low, medium, high). Both figures show that the area within the scope of the Carpathian Biosphere Reserve is fragmented in terms of accessibility and that the western part is less accessible that the eastern part. Further spatial analysis reveals that:

- 108,168 ha or 28.10% have a low accessibility (more than 5 km from settlements, paved or earth roads),
- 186,385 ha or 48,50% have a medium accessibility (between 1 and 5 km from settlements, paved or earth roads),
- 89,546 ha or 23.40% have a high accessibility (between 0 and 1 km from settlements, paved or earth roads.

Figure 48 depicts accessibility and protected area coverage within the scope of the Carpathian Biosphere Reserve. One can see e.g. that except for large parts of Uholka, most other massifs of the Carpathian Biosphere Reserve's territory have a medium to high accessibility. Likewise, a large proportion of Synevyr National Nature Park is also rather accessible. Specifically:

- 20,340 ha or 35% of the CBR have a low accessibility
- 28,870 ha or 50% of the CBR have a medium accessibility
- 8,526 ha or 15% of the CBR have a high accessibility

For Synevyr National Park, accessibility in relative terms looks quite similar:

- 10,793 ha or 28.10% of the Synevyr National Nature Park have a low accessibility
- 17,913 ha or 46.70% of the Synevyr National Nature Park have a medium accessibility
- 8,601 ha or 22.4% of the Synevyr National Nature Park have a high accessibility

For 2.80% of Synevyr National Nature Park's area no accessibility data could be obtained.

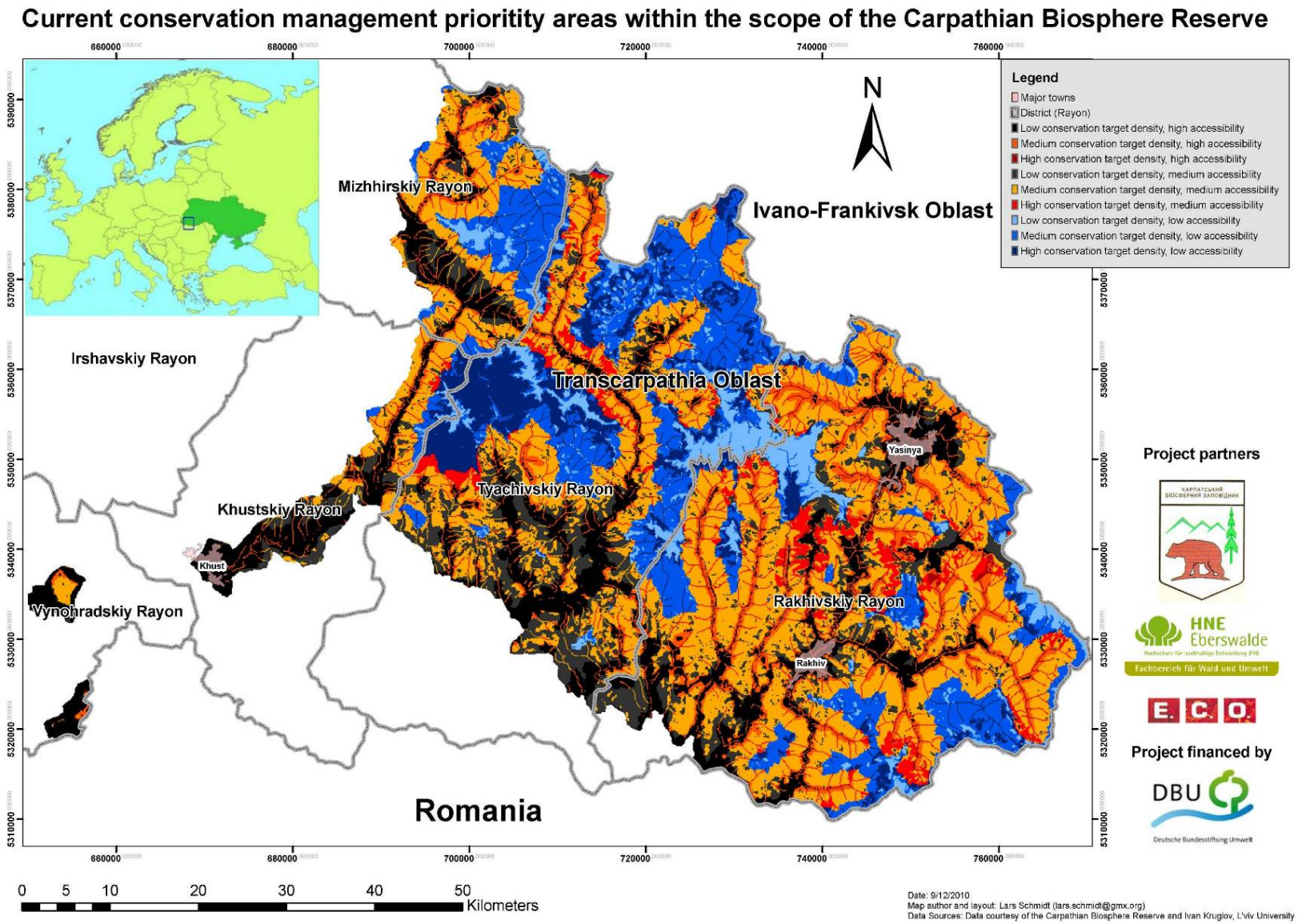


Figure 49: Current conservation management priority areas within the scope of the Carpathian Biosphere Reserve.

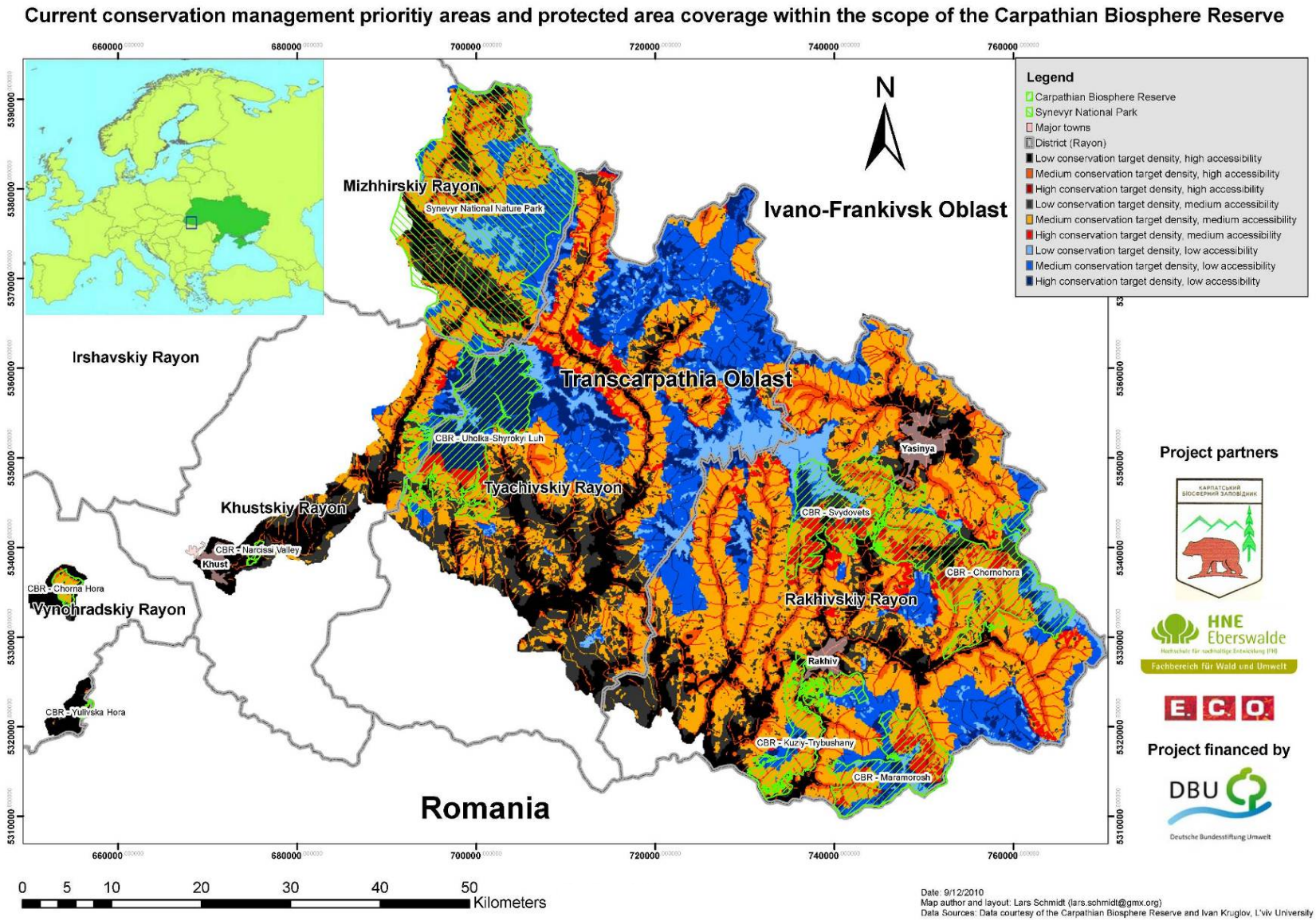


Figure 50: Current conservation management priority areas and protected area coverage within the scope of the Carpathian Biosphere Reserve.

Figure 49 displays a conservation management priority map, which was produced through creating an intersection of the conservation target density and accessibility layer (compare Figure 8).

Areas in black and grey are of little priority due to their low conservation target density and medium to high accessibility. Areas in shades of red feature both, a medium to high conservation target density and accessibility. They are of high conservation value but due to their medium to high accessibility, they potentially face significant pressure and may thus require significant resources to protect. Areas in shades of blue have a low to high conservation target density (the darker the higher) and a generally low accessibility. Both darker blue areas are conservation priority areas that may be protected relatively easily (low pressure), while the areas in light blue may not be conservation priority areas but could still be protected comparatively easily.

Figure 49 shows that the central and north-western parts within the scope of the Carpathian Biosphere Reserve contain large areas with a medium to high conservation density and low accessibility, while the eastern part is dominated by areas with both a medium to high conservation target density and accessibility. Priority areas are distributed as follows across the scope of the Carpathian Biosphere Reserve:

- Areas of low priority (black and grey): 96,364 ha or 25%
- Priority areas, hot spots: Areas of both medium to high conservation target density and accessibility (shades of red): 179,567 ha or 47%
- Priority areas, cold spots: Areas of low to high conservation target density and low accessibility: 108,167 ha or 28%

Figure 50 displays how conservation management priorities according to the matrix in Figure 49 coincide with existing protected areas, i.e. the Carpathian Biosphere Reserve and Synevyr National Nature Park (both in green). The massifs of the Carpathian Biosphere Reserve do largely cover hot spot areas with the exception of Uholka, which is largely a cold spot. There are little low-priority areas inside the Carpathian Biosphere Reserve, which can be attributed to the fact that the CBR does not include any settlements. Synevyr National Nature Park contains significant proportions of all three categories. In detail, the distribution of priority areas within the CBR and Synevyr National Nature Park is as follows:

Carpathian Biosphere Reserve:

- Areas of low priority (black and grey): 6,371 ha or 11%
- Priority areas, hot spots: Areas of both medium to high conservation target density and accessibility (shades of red): 31,025 ha or 54%
- Priority areas, cold spots: Areas of low to high conservation target density and low accessibility: 20,340 ha or 35%

Synevyr National Nature Park:

- Areas of low priority (black and grey): 9,404 ha or 24.50%
- Priority areas, hot spots: Areas of both medium to high conservation target density and accessibility (shades of red): 17,110 ha or 44.60%
- Priority areas, cold spots: Areas of low to high conservation target density and low accessibility: 10,793 ha or 28.10%

For 2.80% of Synevyr National Nature Park's area no data on management priorities could be obtained.

This analysis indicates two major issues. First of all, that around half the area of both the CBR and Synevyr National Nature Park is classified as hot spots. This underlines the importance of both protected areas for biodiversity conservation. And second, around 77,000 ha of cold spots and more than 130,000 ha of hot spots within the scope of the Carpathian Biosphere Reserve do not yet enjoy any kind of formal protection. Especially the former may present an opportunity to further develop and expand the Transcarpathian Protected Area Network.

3.2.5 Strategies

This chapter briefly summarises draft strategies and ideas that have been identified by CBR staff and project participants in the course of the project. Some strategies do also take up recommendation from previous projects in the region as well as ideas that have been voiced during stakeholder consultations.

Strategies are organised by conservation targets and – following the Open Standard guidelines – have been rated according to their potential impact and feasibility to judge their effectiveness.

Table 19: Description of draft strategies.

Applies to conservation target:	Draft strategy & description	MIRADI™ strategy rating		
		Potential impact	Feasibility	Effectiveness rating
Primeval forests	**Lobbying for formal protection and strengthening of forest law enforcement** The lack of any formal protection for primeval forests and their integration into routine forest management planning remains the biggest threat and a legislative loophole that SFEs are and will keep exploiting until all accessible valuable primeval forest sites have been logged. The idea of putting all primeval forest sited under formal protection is thus an appealing one. Apparently primeval forests are already mentioned in the forest code as especially valuable areas, but this is too vague to warrant any kind of formal protection. To achieve a formal protection status for primeval forest sites would need intensive lobbying at the national level. Such an initiative could be carried forward by protected areas in the region, although the participation and support of other parts of society are likely to increase its success. Non-conservation actors that could support the initiative are tourism operators, mayors from towns that profit from (ecological) tourism, research institutions, international partners and, surprisingly, even some SFEs under certain conditions. During stakeholder consultations SFEs declared their readiness to set-aside primeval forest sites, if they receive compensation or incentives. Lobbying would first need to target the State Agency for Protected Areas and the Ministry for the Environment that would have to develop draft legislation. From there, draft legislation could either be fed into the parliamentary process of decision-making or to the president to be developed into a presidential decree. In both cases, such legislation is likely to be confronted by opposition at this stage latest, as they will see economic opportunities dwindle. Provided primeval forests would be formally protected by law, this would certainly not be enough to ensure their protection. Corruption and	*High*	*Medium*	*Less effective*

	lack of forest law enforcement would still see primeval forests exploited. This is why legislation would need to be accompanied by a government programme that would strengthen control and provide the necessary funding to do so. This however seems rather unrealistic given Ukraine's present financial situation.			
Primeval forests & forest ecosystems	**Mobilising international carbon finance for primeval forest conservation** International climate negotiations in Cancun have mandated a series of actions, including the development of a comprehensive (tropical) forest protection mechanism for developing countries called REDD+[1]. Although not applicable to Ukraine as a country in transition and as an Annex B country to the Kyoto Protocol (KP), the concept of REDD+ can also be realised through the voluntary carbon market. In fact, the voluntary carbon market is so far the only working 'market' where emission reductions from avoided deforestation and forest degradation and improved forest management can be generated and sold. In addition to the voluntary market, other international forest carbon finance opportunities are available. They include the Kyoto Protocol KP mechanism Green Investment Schemes (GIS), Land Use, Land Use Change and Forestry (LULUCF) in a post-2012 agreement and possibly bilateral emission trading between countries in a post-2012 climate agreement. Each of the approaches has its advantages and disadvantages. While the voluntary carbon market provides the framework to market emission reductions and methodologies either exist or can be developed, the voluntary emission reductions from Ukraine are deemed less attractive than those from projects in Africa, Asia or South America. The other approaches may have less trouble selling emission reductions, but their governing political frameworks are rife with uncertainty. Despite the recent revitalisation of international climate policy in Cancun, core issues such as the extension of the KP remain unsolved. At the same time a comprehensive and legally binding post-2012 agreement is likely to come into force later than 2012, potentially creating a vacuum where none of the aforementioned approaches could soon be realised.	*Very high*	*High*	*Effective*

[1] REDD+ stands for Reducing Emissions from Deforestation and Forest Degradation, and Conservation, Sustainable Forest Management and Enhancement of Forest Carbon Stocks. It is to be a significant mitigation pillar of a post-2012 climate agreement and seen as the most promising option to protect (tropical) forests worldwide at a large scale.

	Altogether international carbon finance is seen as feasible approach with a high potential impact, as it could provide incentives to SFEs to set-aside valuable forest areas for conservation and improve forest management. Given the effectiveness of this approach, this strategy has been further developed into project application to BMU's International Climate Initiative (compare chapter 3.3.3).			
Primeval forests in particular, but generally to all conservation targets	**Strengthen and extend international partnerships** Scientific exchange and collaboration with other protected areas, especially those with primeval beech forests in the Slovak Republic and in Germany (NP Hainich, Kellersee, Müritz, Jasmund, BR Schorfheide-Chorin) that are or may become part of the serial UNESCO world heritage site 'Primeval Beech Forests of the Carpathians' could help to further raise international attention for the protection of primeval (beech) forests in particular and conservation in general and create opportunities for joint fund raising and projects. This promising draft strategy has already been turned into an approved project that started in October 2010.	*High*	*High*	*Effective*
Primeval forests & forest ecosystems	**Supporting energy efficiency and access to fuelwood** Most of the settlements within the scope of the CBR do strongly rely on firewood for heating. Although enough firewood for local use is theoretically available, unequal distribution of resources and mismanagement do in some areas lead to illegal logging and fuelwood collection, especially by poorer people. Supporting energy efficiency measures and alternative energy use to reduce the consumption of fuelwood while providing and directing access to fuelwood could thus make a significant contribution to the conservation of forest ecosystems, including primeval forests. This strategy has been included in a still open project application.	*High*	*High*	*Effective*
Primeval forests in particular, generally all conservation targets	**Establishment of an 'International Competence Centre for Primeval Forest Ecosystems Research and Conservation'** The establishment of such a centre in Rakhiv district could support the lobbying effort for the protection of primeval forests as well as facilitating the exchange of researchers and strengthening international cooperation. It could also contribute to higher level education in the field of forest ecology and generally raise the level of recognition of the	*Medium*	*High*	*Less effective*

	important role of primeval forests for the region. Despite the medium impact of this strategy, the establishment of a research and training centre has still been included in a project application as part of a larger strategy.			
All conservation targets negatively affected by tourism	**Improving the visitor management of the CBR** In some areas of the CBR tourism is negatively impacting on several conservation targets. Although the impact is mostly low to medium, improving the visitor management may further reduce the impacts and prove valuable in case of an increase in tourism in the future. Specifically, improvements should include the elaboration of a visitor management concept in close cooperation between the CBR administration, the tourism sector and local authorities. The visitor management concept should be a component of an overall tourism concept, which needs to be developed and implemented on destination level (=scope). It should include the planning, implementation and maintenance of trails and guiding systems, the development and maintenance of basic infrastructure and educational elements. The visitor management concept needs to be adapted to the zoning concept of the protected areas and the scope. Access to primeval forests and other conservation targets should be limited by opening only selected trails. Effective enforcement through rangers provided, tourism activities can be channelled, guided and controlled on this manner.			
Potentially all conservation targets	**Support to ecotourism development** Supporting ecotourism aims at developing alternative job opportunities and income for the local population. Activities need to address the planning, product development and marketing of ecotourism services. Concrete and strategic development approaches could be e.g. to support Dragobrat/Yasinya to become a 'sustainable winter tourism destination' (Eco skiing resort). Activities could include: - Defining a joint vision of all stakeholders - Excursions to good-practice communities in Austria, Germany - Close cooperation with Rakhiv district administration and Yasinya municipality - Supporting waste and sewage management - Developing a joint development plan - Based on the vision, develop a tourism concept and guidelines for			

	Dragobrat/Yasinya - Developing strategies and action plan, e.g. a cable lift from Yasinya to 'car free' Dragobrat - Strengthening of the profile for summer season activities such as horseback-riding, paragliding, mountain biking, Spa to gain more visitors through seasonal extension - Develop a common branding/corporate identity and profile to set an antipole to Bukovel, e.g. CO2 neutral destination, energy efficiency aspects - Raise service quality to gain higher benefits per visitor			
Alpine grasslands	**Demonstration project: Conservation, traditional farming and sustainable mountain tourism on alpine grasslands** To preserve the unique biodiversity of the alpine grasslands it is necessary to include the most valuable and most vulnerable *polonynas* into the network of protected areas. At the same time, there is a need to demonstrate how traditional farming, adapted to the carrying capacity of the alpine grasslands, and tourism can help preserve this traditional landscape, ensuring a high species diversity and providing local people with an adequate income. Here, best practice guidelines from other countries such as Austria could be used. Distinguishing between valuable and vulnerable areas for conservation and areas for pasturing would require prior zoning, while additional research is needed to determine the carrying capacity of each alpine meadow. Furthermore, improving the marketing and increasing the value of *polonyna* products and improving the working conditions of *polonyna* shepherds is another crucial issue to ensure that this traditional livelihood will persist. The tourism aspect could be covered by an ecotourism development project in cooperation with local and international tourism consulting services (e.g. FORZA, ECEAT Netherlands, BTE Berlin, CIM-advisor) in order to strengthen capacities in product development and marketing of ecotourism services.			

Further ideas that have not yet been elaborated into draft strategies are shown in table Table 20.

Table 20: Further ideas for target-oriented conservation strategies and actions in the CBR management scope.

Conservation target	Ideas
Forest ecosystems	- Lobbying for improving forest legislation towards the use of the close-to-nature forestry concept with the participation of communities. This could partly be realised through international projects that include the necessary capacity building and investments into modern harvesting technology. It should also include actions to improvement the supervision system for use and protection of forest resources. - Lobbying for a return to the fund-based scheme (state budget) for SFEs - Organisation of an efficient monitoring system for better bark beetle regulation - Promotion and implementation of cheap alternative energy sources and materials use
Large mammals	- Organisation of an independent expert group responsible for the implementation of the game fauna inventory. This would include the development of an effective assessment system. - Organisation of specialised mobile teams consisting of PA and SFE rangers to capture poachers. - Lobbying for an improvement of legislation that would forbid the sale of trophies and other hunting products and mandate PA to confiscate such products and arrest the salesmen.
Water and riparian ecosystems	- Establishment of a permanent monitoring and observation system of the Tysa riparian ecosystems and its tributaries and work towards their gradual inclusion into the Transcarpathian Ecological Network - Lobbying for a regional programme for collection, utilisation and disposal of hard waste and construction of a sewage water treatment facility. This should include environmental education and awareness raiding among the local population. Funding could come from an international cooperation project. - Cooperate with the Transcarpathian Water Management Department to find a compromise as for the location of flood prevention infrastructure.
Cave ecosystems and karst formations	- Inclusion of further valuable sites into the protected areas system - Installation of metal grids on entrances to the most fragile underground cavities - Establish cooperation and partnerships with associations and organisations that regularly and professionally organise cave-tours for tourists, climbers and cave explorers to reach an understanding and regulate their use. This would include active ecological education and awareness rising among all relevant stakeholders. - Establish relations to mining companies to reach a compromise for the preservation of particularly valuable natural and artificial cave objects
Narcissi valley	- Elaboration and implementation of an effective hydrological restoration action plan to raise the groundwater level - Introduction of regulation measures e.g. close to traditional management of the Valley (mowing, grazing etc) - Inclusion of the Valley into the regional, and further the National Ecological Network

3.3 Institutional networking and generation of new opportunities

3.3.1 International public outreach

Project proceedings, the project area and research results were presented at several international platforms providing Ukrainian project partners the opportunity of co-authoring international publications.

On 5th June 2010 the project was presented at the **International Round Table on "Transboundary management of sustainable development in the Carpathians"** at the Centre of Europe near Rakhiv in Ukraine. The CBR hosted this round table with participants of various institutions, authorities and organisations from Transcarpathia, Romania and Hungary:

- Transcarpathian Regional Water Management Agency
- Protected area managers from Uzhanskiy NNP, Carpathian NNP, Synevyr NNP
- representative of the Hungarian Consulate- delegation from Romania (NGO "Ivan Krevan" representatives; regional TV channel)
- Transcarpathian Agro-Ecotourism Association (NGO)
- Transcarpathian Regional Agency for Tourism (oblast authority)
- mayor from Deszk town, Hungary
- district authorities (head of the administration and deputies)
- Ukrainian ambassador in Hungary with colleagues
- regional NGO VIZA (dealing with investments from Czech republic)
- local NGO "Common House" (who have a strong cooperation with Hungary)

The aim of this round table was strengthen the transboundary cooperation between border regions of Ukraine, Romania and Hungary, to exchange experience with those who already have strong contacts on the other side of the border as well as to establish new contacts and plans for further cooperation.

At the **international conference "Global Change and the World's Mountains" in Perth**, UK, 26-30 September 2010 we were invited to present the project at a session on "Mountain Biosphere Reserves as learning sites for research, adaptation and mitigation in the context of global change". Our presentation was about the "Carpathian Biosphere Reserve, Ukraine: proactive and strategic conservation planning under regional and global change" and was co-authored by CBR staff (Geyer et al. 2010b).

At an **international workshop on the "Implementation of the Ukrainian State Nature Conservation Programme 2020"** 3-6 December in Vilm, Germany, we contributed with a presentation on "Adaptive and strategic conservation planning for the Carpathian Biosphere Reserve" (Schmidt et al. 2010).

In the course of producing **the 54th volume of the Technical Series of the Convention on Biological Diversity** a case study on development, biodiversity conservation and global change (Ibisch et al. 2010) the Ukrainian Carpathians was conducted including research results from the project (Geyer et al. 2010a). This case study was also orally presented in a **Side Event at the CBD-COP10 in Nagoya, Japan** (Kiefer et al. 2010).

3.3.2 Extension of the institutional network and establishment of new cooperation

In order to extend and solidify the institutional network around the CBR, to initiate new cooperation and to facilitate exchange between similar efforts, different activities were undertaken. Special emphasis was given to activities in the context of the extension of the UNESCO World Heritage Site "Primeval Beech Forests of the Carpathians". Several steps were taken to actively support communication and cooperation between nominated German and Ukrainian World Heritage Site. At the project's kick-off meeting in Juli 2009, for example, a delegation of Ukrainian project partners visited the **Schorfheide-Chorin Biosphere Reserve** with its nominated WH Site Grumsiner Forst and started an active exchange with Uwe Graumann, a referent for the Biosphere Reserve. To extend the cooperation with German nominated sites we also invited Manfred Großmann (Hainich National Park) and Manfred Bauer (Kellerwald-Edersee National Park) along with Uwe Graumann to the large project workshop in March. Uwe Graumann participated in the final workshop. Also in the context of WH Sites we invited Viliam Pichler as a representative of the Slovakian parts of the serial site and Prof. Dr. Hans Dieter Knapp as a German expert.

Some project team members had been involved in preceding projects in the project region or together with the CBR, which helped to connect to those endevours. E.C.O. has collaborated with the **WWF** who is now active in the Carpathian National Nature Park and Gorgany Nature Reserve. **Ivan Kruhlov** has been involved in ample research on ecosystems and land use in the Ukrainian Carpathians like in the project on "Transformation processes in the western Ukraine - Concepts for a sustainable land use" together with the TU Dresden. Additionally to that we also tried to connect to (other) active institutions in the area and invited Brigitte Commarmot from the Swiss Federal Institute for Forest, Snow and Landscape Research WSL and Prof. Dr. Peter A. Schmidt of the TU Dresden to our large project workshop in March. We also intensified contacts to the **Michael Succow Foundation** and invited Prof. Michael Succow and Sebastian Schmidt to our large project workshops in Rakhiv. Also the exchange with our donor DBU was actively supported by **Wilhelm Kulke** participating in the March workshop.

In order to strengthen the contact between different conservation actors in the project region we invited representatives of the **CBR's neighbouring protected areas** (Synevyr National Nature Park, Carpathian National Nature Park, Gorgany Nature Reserve) to the project workshops. We also tried to establish a contact or even cooperation with **NABU** International. A delegation of German and Ukrainian project partners visited NABU International in July 2009 and invited them to the first project workshop, but this contact could not really be established. However, in the end the **USPB** (Ukrainian Society for the Protection of Birds) participated in the final project workshop

New scientific partners were introduced to the CBR and the project region by the participation of the conservation scientists **Dr. Peter Hobson and Catherine Norris of Writtle College (UK)** in one of the project workshops. They started collaborating with the CBR administration and incorporated the CBR as one study site for their research on ecosystem function/resilience in the context of climate change. During their stays they became very interested in the project area and are preparing a project proposal for research on and conservation of the alpine meadows (*polonynas*).

3.3.3 Follow-up projects and project proposals

Together with the partners of this project as well as new partners, the HNEE aims at several follow-up projects with different states of preparation and organisation. Those projects largely follow the needs of action and necessary strategies identified throughout the project (compare chapter3.2.5). One project has been started in order to join management efforts of the World Heritage Site "Primeval Beech Forests of the Carpathians" with Slovakia and Germany. One other idea centres on the important carbon retention and sequestration function that specifically old-growth forests have and their importance for climate change mitigation. The third idea focuses on capacity building towards making existing livelihoods more sustainable.

1. **The project '*World Heritage Beech Forests – Sustainable land use in the surroundings of the UNESCO World Heritage Site "Primeval Beech Forests of the Carpathians" in the Slovak Republic und Ukraine*'** was proposed for shortly after the final workshop and granted at the end of October. The project is funded by the **UBA** (Umweltbundesamt Germany) and will run for 15 months starting in November 2010. It aims at intensifying the cooperation of all managing institutions of the ten individual protected areas in the Slovak Republic and Ukraine belonging to the serial transnational World Heritage Site "Primeval Beech forests of the Carpathians", their transboundary exchange and the initiation of joint projects to create and support a "corporate identity". Additionally to the Slovak and Ukrainian sites, also all five nominated sites in Germany will be integrated into the project. Core activities of the projects include five international workshops with all ten protected area administrations and external experts on different topics. This project is a cooperation of the HNEE, the CBR and E.C.O. Institute of Ecology.

2. **The project proposal 'Climate change mitigation and biodiversity conservation through forest *conservation easements, improved forest management and technology transfer in the Ukrainian Carpathians*'** will be submitted to the **International Climate Initiative (ICI) of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety**.

   The goal of the project is to reduce forest carbon emissions and improve biodiversity conservation in the Ukrainian Carpathians. This will be achieved through a portfolio of both, conventional and comparatively innovative measures targeting currently unprotected carbon rich and biodiverse natural and old-growth forest areas. Measures include i) forest conservation easements with private landowners and state forest enterprises paid through a revolving fund, ii) investments into and capacity building in sustainable forest management, iii) support to the development and expansion of the Transcarpathian Protected Area Network and legislative improvements for forest protection in Ukraine in general, iv) investments into energy efficiency and alternative energy supply to reduce the pressure on valuable forest areas. The establishment of an independent non-governmental institution funded in the long-term through the sale of emission reductions (voluntary market, after project conclusion) and contributions from Green Investment Schemes will ensure the financial and institutional sustainability of the project.

   The idea for the project emerged during the strategy development process for the Carpathian Biosphere Reserve, specifically when developing strategies for old-growth forest protection. Forest protection and sustainable forest management for climate change mitigation have received increasing attention over the last three to four years through the

international climate change negotiations under the United Nations Framework Convention on Climate Change. As a result, the topic has also become a focal area of funding under the ICI.

In the course of the project, the proposal was developed together with the CBR as well as other organisations, including Writtle College, E.C.O. Institute of Ecology, the Michael Succow Foundation, UNDP Bratislava and GFA Envest. Consultations with relevant stakeholders were held during the concluding project workshop in October 2010. The project will be submitted to the ICI in December 2010.

3. **The second project proposal *'Sustainable Upland Management in Transcarpathia (SUMiT)'*** is thought to be submitted under the EU's FP7 Corporation Work Programme 'Sustainable Management of Resources'.

   The core concept is to build capacity for more sustainable livelihood improvement into the local community.This includes e.g. support to the sustainable management of forests within the CBR and surrounding landscape and the restoration and sustainable management of the 'alpine meadows'. It is envisaged to develop workable, more sustainable livelihood models in close consultations with stakeholders and experts. The most promising livelihood models will be piloted to create demonstration sites of good practice (e.g. sustainable forest and meadow management). This will be complemented by market chain management; aligning local community practices and industry with common standards and certification systems that incentivise sustainable development.

   The project proposal is developed by **Writtle College** in consultation with the CBR and the University for Sustainable Development Eberswalde. The proposal will be submitted in November 2010.

Within this project one more action is planned for March 2011. It comprises a continuation of applying and developing the planning cycle of the Open Standards, adopting MIRADI™ as a planning tool supporting the CBR in designing and implementing a concrete management. This would encompass further training of staff, further development of proactive conservation strategies, development of work and monitoring plans for the CBR and an active introduction of the methodology to neighbouring protected areas and the initiation of cooperative management planning between the protected areas.

4 Conclusion and outlook

Considering the project aim and objectives as set out in the original application, we consider the project to be a full success. Specifically, we would like to point towards and reflect on what we consider to be the major achievements of the project.

- First of all, we consider the **introduction and application of the *Open Standard for the Practise of Conservation***as an important step for the CBR towards a more systematic and adaptive conservation management approach. Given the dynamic political and socio-economic situation that Ukraine is undergoing, we believe that this approach will help the CBR in anticipating future developments more systematically and thus enabling them to more pro-actively take action. Through the **integration of potential future developments** into the first workshop, a range of potentially future challenges to and opportunities for conservation in the region have already been identified. These include increased demand for (energy) wood and climate change (challenges) and international carbon finance and strengthening of international partnerships (opportunities). These challenges and opportunities have been taken into account during the development of both draft strategies and follow-up projects, consequently increasing the resilience of the CBR towards these challenges while realizing the opportunities. We would also like to underline the openness – sometimes even enthusiasm - of the CBR's senior management in testing and adopting this approach, which is stressed further by the fact that the software MIRADI^{TM} was translated into Ukrainian. Also, the CBR did strongly express its interest in continuing the work started through the project. This is also to address a range of difficulties that the project encountered, first and foremost the lack of systematically gathered data on conservation targets and threats. Concluding the full Open Standards cycle, including systematic monitoring of conservation targets and threats, would increase data availability also for the purpose of re-evaluating conservation target viability based on key ecological attributes as well as the scope, intensity and irreversibility of threats. Although the project did succeed e.g. in creating a range of new and useful spatial datasets for conservation management, these could also be complemented and updated further.

- Given the **lasting interest** of the CBR's senior management team in the Open Standards, the institutional sustainability and continuity of the project results is considered very high. In this respect, we are of the opinion that the project has not only succeeded but exceeded its aim of creating the fundamentals for a modern management plan for the Carpathian Biosphere Reserve.

- The **method developed here to support the Open Standards process through spatial analysis** could not be fully applied due to data constraints. Further refining it and feeding it with updated and complementary data would increase its worth for CBR's decision making. However, the preliminary analysis has provided an innovative input to CBR'S management and is thought to stimulate a new type of research and application of GIS data.

- Through the application of the Open Standards, the project has also made an important contribution towards fulfilling the requests of UNESCO's Man and the Biosphere Programme for a **stronger integration of stakeholders as set out in the Seville**

strategy in 1995. Though the CBR maintains good relations with most of its major stakeholders, the active integration of stakeholders into management planning through a stakeholder workshop was a first-time experience. During both consultations, stakeholders expressed their appreciation for being consulted and used the opportunity of actively engaging in the management planning process.

- Furthermore, **the decision of the CBR to extend the scope of its management activities beyond its protected massifs can be seen as another milestone**. Though by no means a formal expansion of its territory, the broadly defined scope underlines the CBR's aspiration and intention to address challenges and shape development outside its protected massifs. With regard to supporting the implementation of the international Biosphere Reserve agenda, the consideration of climate change impacts and how to adapt to them fulfils a central demand of the Madrid Action Plan (2008).

- Finally, the **project succeeded in generating project ideas and applications** that - if approved – will build on the results achieved within this project and implement a range of identified draft strategies. This can also be attributed to the **significant institutional networking** carried out by the project partners. While the UBA-financed project on joint management of the serial UNESCO World Heritage Site "Primeval Beech Forests of the Carpathians" will help to expand and tighten the international relationship of the CBR and draw further attention to the region, another project application to be submitted to the BMU's International Climate Initiative would mobilise international carbon finance to further protect valuable forest areas, expand the Transcarpathian Protected Area network and help incentivise sustainable forest management. Additional project ideas in the pipeline include the development of more sustainable livelihood options for the population of selected towns and villages within the newly defined scope of the Carpathian Biosphere Reserve, thereby effectively implementing the Seville Strategy and meeting its own aspirations of shaping development towards more sustainability.

- Further areas of cooperation do also include **research on the impacts of climate change**. This will be facilitated through the meteorological datasets acquired during the project. And last but not least the dissemination of the Ukrainian Version of the Open Standards/MIRADI™ to other protected area managers in Transcarpathia and Ukraine.

- Beyond the usefulness of the respective outcomes of the projects for the CBR and the region, we firmly believe that through continuous international cooperation the **role of the CBR as a political actor and socio-economic factor in the region will increase**. This is likely to increase the recognition, understanding and acceptance in the region for conservation in general and the importance of the primeval forests as an outstanding conservation target in particular.

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