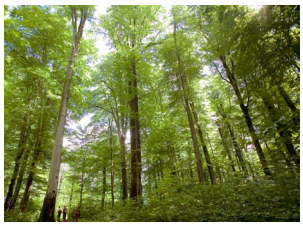
STUDY

DEVELOPMENT OF COMMON INTEGRATED MANAGEMENT MEASURES FOR KEY NATURAL ASSETS IN THE CARPATHIANS

'Integrated Management of Biological and Landscape Diversity for Sustainable Regional Development and Ecological Connectivity in the Carpathians'

(ETC Programme South East Europe, Project: BioREGIO Carpathians, EoI Reference number: SEE/B/0010/2.3/X, Work Package 4)







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IMPRESSUM

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Sarajevo, June 2014

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The study is the result of a coordinated effort by the BioREGIO Carpathians project consortium, led by the WWF Danube-Carpathian Programme (WWF-DCP), under the guidance of project manager, Hildegard Meyer. Specific acknowledgements should be made to the following working group members and experts:

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This study was developed within the framework of the EU-SEE co-funded project BioREGIO Carpathians, which has the aim of enhancing the integrated management of protected areas and natural assets of the Carpathian Mountains. Under the project, it is anticipated that sustainable regional development will be promoted and ecological connectivity will overcome legal and ecological barriers while considering transboundary and transnational needs. BioREGIO builds on the existing framework of the Carpathian Convention, its Biodiversity Protocol and other related transnational networks and initiatives. National and local partners and scientific institutions have joined forces to contribute to the improvement of connectivity and continuity of the largest mountain range of Europe, harbouring a unique natural heritage and acting as a major ecological link within Europe. BioREGIO Carpathians is an EU project, which is co-funded by the ERDF within the South East Europe Transnational Cooperation Programme. For more information, see www.bioregio-carpathians.eu

Maps displayed in this study are derived from the Carpathian Biodiversity Information System (CBIS), which is the result of two projects: 'Development of an Ecological Network for the Carpathians' funded by the BBI/Matra Programme and 'Building of Carpathian Biodiversity Information System and design of the ecological network for the Western Carpathians', funded by Deutsche Bundesstiftung Umwelt (DBU) from 2006 to 2010. See www.carpates.org/cbis.html or www.ccibis.org

AEWA	African-Eurasian Waterbird Agreement
asl	Above sea level
ATV	All terrain vehicle
CBIS	Carpathian Biodiversity Information System
CERI	Carpathian EcoRegion Initiative
CGMI	County Game Management Inspectorate
CGMC	County Game Management Committee
CIMM	Common integrated management measure
CNPA	Carpathian Network of Protected Areas
CMS	(Bonn) Convention on Migratory Species
CWI	Carpathian Wetland Initiative
CZ	Czech Republic
EEA	European Economic Area
EIA	Environmental Impact Assessment
ERDF	European Regional Development Fund
EU	European Union
EUNIS	European University Information Systems
EUTR	European Union Timber Regulation
FSC	Forest Stewardship Council
GEF	Global Environmental Facility
GMU	Game management unit
ha(s)	Hectare(s)
HCVF	High conservation value forest
HNVF	High nature value farmland
HU	Hungary
IAS	Invasive alien species
ICPDR	International Commission for the Protection of the Danube River
IRBM	Integrated river basin management
IRBMP	Integrated river basin management plan
IWRM	Integrated water resources management
LC	Large Carnivore
LFA	Less-favoured Area

LH	Large Herbivore
LM	Large Mammal
LU	Livestock Unit
m	Metre(s)
max.	Maximum
Mt	Mount
NGO	Non-governmental organization
NOBANIS	European Network on Invasive Alien Species
NP	National Park
NR	Nature Reserve
NTFP	Non-timber forest product
OGF	Old growth forest
PA	Protected Area
PES	Payments for ecosystem services
PLA	Protected Landscape Area
PP	Project Partner
PS	Pro Silva
RO	Romania
SCALP	Status and Conservation of the Alpine Lynx Population
SIU IWC	Szent István University, Institute for Wildlife Conservation
SK	Slovak Republic
SPA	Special Protection Area
SRB	Serbia
t	Tonne(s)
TEEB	The Economics of Ecosystems and Biodiversity
UA	Ukraine
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WFD	Water Framework Directive
WP	Work package
WWII	Second World War
WWF-DCP	Worldwide Fund for Nature - Danube-Carpathian Programme

1. INTRODUCTION

Picture 1: High Tatra Mountains, Slovakia (photo: Zuzana Okaniková)

1.1. SUMMARY

This study was prepared under Work Package 4 of the BioREGIO project, which promotes the harmonised management of natural assets and protected areas (including Natura 2000 sites) in the Carpathians, by involving all relevant stakeholders and by building on the existing framework of cooperation of the Carpathian Convention, its Biodiversity Protocol and other related transnational networks and initiatives. The scope of the project covers the Carpathian Mountain Ecoregion, spanning over an area of more than 200,000 km^2 in Central and Eastern Europe and including territory of seven countries: Czech Republic, Hungary, Poland, Romania, Serbia, Slovakia and Ukraine.

The study was prepared over a period of 18 months by a group of over 50 experts from all participating countries, and through much wider consultation within expert communities in each country and at a number of specialist consultation workshops. It includes four main sections related to each of the focal areas (biodiversity assets) of Work Package 4. The assets are: forests, high nature value grasslands, wetlands and large mammals. Each of these sections has a similar (but not identical) structure; first, it provides an overview of the current status of the asset in the Carpathians, its various subunits, its values and the threats it faces. It then specifies the basic strategic framework for future management of the asset based on the assessment and on the current policy framework. Finally, each section specifies a number of Common Integrated Management Measures (CIMMs) for the asset. These CIMMs are arranged in a similar way for each section. First, measures are specified that contribute to the practical management and protection of the asset by those charged with its day-to-day management at the site, scale and the ecosystem scale (protective measures, active management measures, ecosystem/landscape scale measures). The next sets of measures concern the enabling environment for management; the legal framework, planning measures, administrative arrangements, financing, awareness and capacity development. The final groups of measures specified relate to research and monitoring. The structure of each section varies slightly according to the specific context and the priorities identified by the experts responsible. Finally, a set of cross cutting measures and general policy recommendations is outlined, based on common issues arising from each of the sections.

The study includes a large number of case studies from the region highlighting examples of good practice, major issues faced in the management of species and ecosystems and outcomes of major projects. Most case studies include web references for further investigation and a comprehensive reference list is also provided.

1.2. SUMMARY OF COMMON INTEGRATED MANAGEMENT MEASURES

The recommended measures from this report are summarised in the table below

1.2.1. MEASURES FOR FORESTS

<table>
<tr><th colspan="2">Conservation management measures for implementation by protected area and forestry administrations and other forest managers.</th></tr>
<tr><td>Protection measures.
F1. Identify and protect all near-natural, old growth and virgin forests
F2. Establish non-intervention zones in all large forest protected areas.
F3. Maintain different structural elements in forests: deadwood, hollow trees, microhabitats, rare tree species.
F4. Extend the network of Forest reserves (outside the PA system) and establish forest corridors
F5. Ensure special protection of the full range of habitats in forest ecosystems
F6. Establish fire detection and response systems.
Active management measures.
F7. Intensify efforts to control Invasive species, especially in core zones and sensitive areas.</td><td>F8. Increase support for traditional low intensity forest management practices.
F9. Adopt and implement close-to-nature forest management more widely in the Carpathians.
F10. Regulate and limit sanitary cuttings
F11. Extend the forestry road networks where necessary to improve access for extensive forest management systems.
Ecosystem/landscape scale measures.
F12. Ensure the overall maintenance of forest cover.
F13. Prioritise maintenance of natural forests.
F14. Prevent forest fragmentation and maintain the integrity of forest ecological corridors</td></tr>
<tr><th colspan="2">Measures related to the enabling environment.</th></tr>
<tr><td>Planning and designations.
F15. Establish a regional model for multifunctional forest management plans.
F16. Establish a common, harmonised approach to zonation and management of forest protected areas.
Legal issues.
F17. Strengthen procedures for EIA and assessment in Natura 2000 sites.
F18. Ensure full implementation of the EU Timber Regulation (EUTR).
Economic issues.
F19. Institute credible forest certification schemes.</td><td>F20. Promote production of high quality timber.
F21. Promote local use and processing of wood.
F22. Provide compensation for owners for restrictions on use of priority forest areas.
F23. Promote recreational use of forests
F24. Establish pilot projects for payment of forest ecosystem services.
F25. Provide incentives for environmentally friendly technologies for forest management.
F26. Establish pilot projects for the regulation and sustainable management of fuel wood and non-timber forest products.</td></tr>
<tr><th colspan="2">Awareness and capacity development measures</th></tr>
<tr><td>F27. Improve capacity and awareness among all stakeholders about the value of forests and sustainable forest management.</td><td>F28. Improve access to training for all involved in forest management.</td></tr>
<tr><th colspan="2">Research and monitoring measures</th></tr>
<tr><td>F29. Establish regional methods for assessment of forest naturalness.
F30. Establish a region-wide long-term monitoring programme of forest biodiversity.</td><td>F31. Establish a Carpathian-wide network of permanent long-term forest monitoring areas.</td></tr>
</table>

1.2.2. MEASURES FOR HIGH NATURE VALUE GRASSLANDS

<table>
<tr><th colspan="2">Specific conservation management measures for implementation
by protected area administrations and other grassland managers.</th></tr>
<tr><td>Management of alpine and subalpine grasslands.
G1. Adopt non-intervention management for alpine and remote subalpine grasslands.
G2. Maintain low intensity grazing in traditionally managed subalpine grasslands.
G3. Limit use and development on alpine and subalpine grasslands and conduct restoration in priority areas.
Management of dry grasslands.
G4. Maintain traditional low-intensity grazing on dry grasslands.</td><td>Management of mesic grasslands.
G5. Maintain traditional mowing and grazing regimes.
Management of Nardus grasslands.
G6. Maintain extensive grazing of Nardus grasslands (apart from in alpine zones).
Management of wet grasslands.
See Chapter 4 (Wetlands) and, specifically CIMM W10.</td></tr>
<tr><th colspan="2">General management and planning measures.</th></tr>
<tr><td>G7. Management prescriptions must be adapted to local conditions and practices.
G8. Ensure that grazing is carefully planned and regulated.</td><td>G9. Plan for the introduction of cutting, restoration and mulching programmes.</td></tr>
<tr><th colspan="2">Research and monitoring measures.</th></tr>
<tr><td>G10. Develop management models which propose appropriate management measures for various types of Carpathian grasslands, based on best practices from different Carpathian and EU countries.</td><td>G11. Develop a common typology for grassland vegetation that can be used across the Carpathian region.
G12. Identify grassland indicators that are easy measurable and can be used at local and regional levels.</td></tr>
<tr><th colspan="2">Policy measures.</th></tr>
<tr><td>G13. Develop a strategy for adoption in all Carpathian countries for the conservation and management of small-scale farms and mosaic landscapes with traditional management practices.</td><td></td></tr>
</table>

1.2.3. MEASURES FOR WETLANDS

Specific conservation management measures for implementation by protected area administrations and other wetland managers.	
Protective measures. W1. Adopt passive (minimal intervention) management for suitable sites (e.g. wetland forests, raised bogs, swamps). W2. Establish wetland buffer zones. W3. Regulate and manage water abstraction and use. W4. Manage sewage, waste water and surface water pollution. W5. Develop guidelines and introduce measures to regulate the hydroenergetic use of rivers and to limit and mitigate its impacts. W6. Limit peat exploitation. W7. Protect karst area sby restricting intensive agriculture. W8. Restrict afforestation of wetlands (especially wet grasslands and peatlands). W9. Exclude or restrict grazing around springs and on sensitive wetland sites.	**Active management measures.** W10. Maintain and extend mowing and grazing of wet grasslands. W11. Introduce mulching on an experimental basis as an alternative to grazing and cutting. W12. Remove trees and shrubs on non-forest wetland habitats. W13. Manage peatlands sustainably and Restore them after use. W14. Develop measures and Introduce programmes to Remove or control invasive species. W15. Restore hydrological regimes and river dynamics. W16. Prevent sedimentation.
Ecosystem/landscape scale measures.	
W17. Introduce and extend integrated water resources management. W18. Establish ecological networks and restoration of river and wetland connectivity.	W19. Incorporate conservation considerations into flood mitigation measures. W20. Introduce regional (Carpathian-wide) measures for improved wetland management.
Legal, planning and administrative measures.	
W21. Strengthen the policy environment for wetlands in the region. W22. Designate and establish new wetland protected areas. W23. Improve and extend conservation management planning for wetlands.	W24. Introduce land purchase for the most sensitive wetland sites. W25. Improve regulation and land use planning in order to protect wetlands. W26. Strengthen EIA and Natura 2000 assessment for wetland sites.
Economic measures.	
W27. Promote and implement cross-compliance rules and measures for wetland management. W28. Mobilise payments for wetland management from rural development programmes. W29. Introduce compensatory measures to support wetland restoration.	W30. Implement conservation and restoration projects on wetlands. W31. Introduce market-based instruments to protect water and wetland ecosystem services. W32. Seek new markets for products from sustainably managed wetlands.
Awareness and capacity development measures.	
W33. Improve cross-sectora training of wetland managers and stakeholder groups. W34. Provide up to date guidance on wetland management across the region.	W35. Conduct wetland awareness campaigns. W36. Promote 'soft tourism' activities in wetlands.
Research and monitoring measures.	
W37. Mobilise support for standardised inventories and management oriented research. W38. Improve monitoring of wetlands.	W39. Improve information management and availability.

1.2.4. MEASURES FOR LARGE CARNIVORES AND HERBIVORES

<table>
<tr><th colspan="2">Specific conservation management measures for implementation
by protected area administrations and game and wildlife managers.</th></tr>
<tr><td>Intensifying and coordinating efforts in the field to stop poaching.
LM1. Increase cooperation between protected area administrations, law enforcement authorities, police, judiciary and border guards.
LM2. Encourage cooperation of local people in anti poaching activities and other measures.
LM3. Standardise and tighten legal procedures concerning illegal killing (poaching).</td><td>Improving species management.
LM4. Plan a coordinated extension of the bison breeding and reintroduction programme.
LM5. Establish reliable and common damage mitigation, estimation, and compensation systems.
Improving ecosystem and habitat management.
LM6. Identify priority areas for threatened species and apply special protective measures.
LM7. Establish an ecological corridor system based on habitat use data.</td></tr>
<tr><th colspan="2">Legal measures.</th></tr>
<tr><td>LM8. Increase penalties for poaching, especially of protected species.</td><td>LM9. Strengthen legal provisions for intersectoral coordination of protection and management.</td></tr>
<tr><th colspan="2">Planning measures.</th></tr>
<tr><td>LM10. Agree regional species management strategies to provide an overall common framework for the conservation and management of large mammals.
LM11. Develop national multi-sectora species management plans.</td><td>LM12. As a priority, establish a special regional project for lynx conservation.</td></tr>
<tr><th colspan="2">Awareness and capacity development measures.</th></tr>
<tr><td>LM13. Conduct programmes to improve the image of carnivores.</td><td>LM14. Build capacity for large carnivore protection and management.</td></tr>
<tr><th colspan="2">Monitoring, research and information management.</th></tr>
<tr><td>LM15. Establish reliable and common monitoring systems at the regional and national levels.
LM16. Develop new methods for monitoring.
LM17. Establish a network of long-term monitoring sites in order to monitor the impact of the measures.</td><td>LM18. Establish a regional data centre for large mammals.
LM19. Encourage research projects.</td></tr>
<tr><th colspan="2">Financial support.</th></tr>
<tr><td>LM20. Secure funding for large mammal conservation</td><td></td></tr>
</table>

1.2.5. CROSS CUTTING AND POLICY MEASURES

Planning and management measures.	
CC1. Improve planning and management at the ecosystem/landscape scale. CC2. Improve planning and management of protected areas (including transboundary sites). CC3. Promote improved intersectoral cooperation and integration of management of natural resources.	CC4. Elaborate regional action plans for key species and ecosystems. CC5. Integrate protected areas into spatial planning/ rural development plans.
Economic measures.	
CC6. Adapt European funding mechanisms more specifically to the conservation needs of the Carpathians. CC7. Improve funding for conservation measures in non-EU member states.	CC8. Mobilise financing related to services provided by ecosystems of the Carpathians. CC9. Improve financial sustainability of protected areas.
Legal measures.	
CC10. Improve compatibility of basic legislation.	CC11. Implement existing legislation.
Capacity development measures.	
CC12. Improve provision of and access to capacity development for biodiversity conservation, sustainable natural resource management and protected area management.	
Research and monitoring measures.	
CC13. Develop and support establishment of basic common monitoring systems. CC14. Promote management oriented research and monitoring.	CC15. Establish a network of regional monitoring sites. CC16. Improve access to and submission of data and information.

1.3. BACKGROUND TO THE STUDY

The Carpathian Mountains harbour a wealth of natural treasures. Forest, grassland and wetland habitats are rich in biodiversity, and large carnivores and herbivores that are close to extinction in other parts of Europe still range the landscape. The mountain range covers seven countries, which have developed and adopted a range of different approaches for the use and management of natural resources. Five out of the seven countries (Czech Republic, Hungary, Poland, Romania, and Slovakia) are members of the European Union, committed and obliged to implement EU Directives, whereas two countries (Serbia, Ukraine) are not EU Member States, but are currently developing systems for nature conservation in line with EU Directives. While national legislation and management practices vary from country to country, protected area and natural resource managers face similar problems across the Carpathians. Examples of good solutions for general and specific problems might be found in one country, but may be lacking in others. Migrating species, forested areas or rivers that cover more than one country may be managed sustainably in one country and differently in the other, resulting in an imbalance of species and habitat structure.

Based on these circumstances, stakeholders of the Carpathian Convention have recognised the need for harmonization of standards and management measures of natural resources within and outside protected areas, in order to guarantee responsible management and development of the region in ways that respect nature, protect biodiversity and support human well-being. Managers should cooperate across the borders, supported by the Parties to the Carpathian Convention.

Sixteen international, national, and local authorities, organizations and scientific institutions have joined forces, through the BioREGIO Carpathians project to contribute to the protection and development of the Carpathian mountain region. They are convinced that protection and regional development in the Carpathians can go hand in hand if natural assets are managed in an integrated way, and if relevant stakeholders are involved. BioREGIO Carpathians builds on the existing framework of the Carpathian Convention, its Biodiversity Protocol and other related transnational networks and initiatives. It is an EU project that is co-funded by the ERDF, within the South East Europe Transnational Cooperation Programme. For details, see www.bioregio-carpathians.eu.

The project promotes the harmonised management of natural assets and protected areas (including Natura 2000 sites) in the Carpathians, by involving all relevant stakeholders and by building on the existing framework of cooperation of the Carpathian Convention, its Biodiversity Protocol and other related transnational networks and initiatives. The scope of the project covers the Carpathian Mountain Ecoregion, spanning over an area of more than 200,000 km^2 in Central and Eastern Europe and including territory of seven countries: Czech Republic (CZ), Hungary (HU), Poland (PL), Romania (RO), Serbia (SRB), Slovakia (SK) and Ukraine (UA).

Work Package 4 (WP4) of BioREGIO addresses the integrated management of Carpathian natural assets and protected areas. Objective 4.2 of WP4 focuses on 'Common integrated management measures elaboration and follow up' and provides the basis for this study. It requires the identification of common standards for the integrated management of natural assets and protected areas, based on partners' experience and results and information collected. Common integrated management measures (CIMMs) are to be developed for the management of natural assets and protected areas, in particular transboundary natural areas, and including integrated forest and wetland management. The measures identified under WP4 are planned to be implemented in the pilot areas established under Work Package 6.

This study defines the required CIMMs and identifies needs and priorities for overcoming differences in legislation and management practices, providing directions for harmonizing the management of protected areas and natural resources. Experts and working group members on forests, wetlands, grasslands and large mammals assessed the current state of conservation of the respective features, including management approaches and threats. Taking into account the Protocol on Biodiversity and Landscape Protection and the Protocol on Forestry of the Carpathian Convention (which are in turn based on the Convention on Biological Diversity), experts and working groups have worked towards their implementation, showing how responsible management could look across the Carpathians. Many case studies were collected to give examples of both management and legislation.

The target groups for this study are managers of natural resources and protected areas at the practical level, and Parties to the Carpathian Convention at the political level. Recommendations formulated in this document will be presented at the Fourth Conference of the Parties to the Carpathian Convention, to be held in Mikulov, Czech Republic, in September 2014.

1.4. OVERALL METHODOLOGY

A large number of experts and almost all the partners of the BioREGIO Carpathians project were involved in the three working groups established to work on the following assets; forests, wetlands, and large carnivores and herbivores. During the project's lifetime the working groups met three times, firstly to agree on a definition of common integrated management measures and the structure of the study, secondly to discuss and agree on the management measures to be demonstrated in the study and finally to discuss the management measures applicable for protected area managers and recommendations for improvements. The meetings were facilitated by Michael Appleton, an expert who compiled this study based on the reports that the working groups delivered. The section on high nature conservation value grasslands was prepared separately by two experts, based on desktop research and their extensive experience in nature conservation of grasslands in the Carpathians.

Additionally, stakeholder consultation meetings were organised by the respective project partners in Hungary, Romania, Serbia and Slovakia. The aim of these meetings was to introduce local stakeholders from the field of forest, wetlands and wildlife management to the aims of the study, to obtain case studies from the local level and to develop a good understanding of the needs of site managers and the relevance of the study to their work.

1.4.1. WHAT ARE COMMON INTEGRATED MANAGEMENT MEASURES?

As agreed by project partners and experts during the Joint WP4 & WP6 Meeting in Budapest (25-27 June 2012), Common Integrated Management Measures (CIMMs) should be concrete strategic approaches and actions that can be implemented by one or more target groups, directly contributing to the long-term favourable conservation status of biodiversity asset.

CIMMs should be

- Potentially common to all Carpathian countries and commonly applied across borders.
- Generic enough to be relevant across the entire range of the asset (subject to local variations and adaption).
- Specific enough to be practical, measurable (monitor-able) and commonly understood by all relevant target groups.
- Formulated to include examples/case studies of how they have been used and adapted in specific contexts.

In order to ensure that CIMMs are 'integrated':

- Measures should be compatible with each other (i.e. without contradictions and inconsistencies).
- Measures should be compatible (as far as possible) with existing policy frameworks relevant to the region.
- Measures should be relevant and useable across different sectors.

2. FORESTS IN THE CARPATHIANS

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Picture 2: Old growth forest, Lászlo Gálhidy

2.1. ASSESSMENT

2.1.1. OVERVIEW

The forested area of the Carpathian Mountains covers over 11 million hectares, with more than half of the area found in Romania. Table 1 shows that forest cover is stable or slightly increasing in all Carpathian countries, mainly as a result of strict prescription and control of forest regeneration in all countries, prohibition of deforestation and spontaneous afforestation of formerly used pasturelands.

Country/Year	1990	2000	2011
Czech Republic	Not available	Not available	251,552
Hungary	387,523	424,092	435,520
Poland	Not available	691,392	Not available
Romania	6,103,000	6,098,000	6,245,000
Slovakia	1,921,705	1,921,414	1,940,108
Serbia	40,973	44,071	44,071
Ukraine	1,709,863	1,720,521	1,753,270

Table 1. Forest areas in the Carpathian countries (hectares).

Because of their large area and elevation range, reflected in various climatic regimes, the Carpathians support many forest types (Figure 1). Regional differences in the proportions of dominant tree species are quite significant. Poland, where the northernmost ridges of the Carpathians occur and the climate is relatively cold, is characterised by beech, fir and spruce. In the warmer, dryer conditions of Hungary, oak mainly dominates and stands of invasive black locust (*Robinia pseudoacacia*) are widespread.

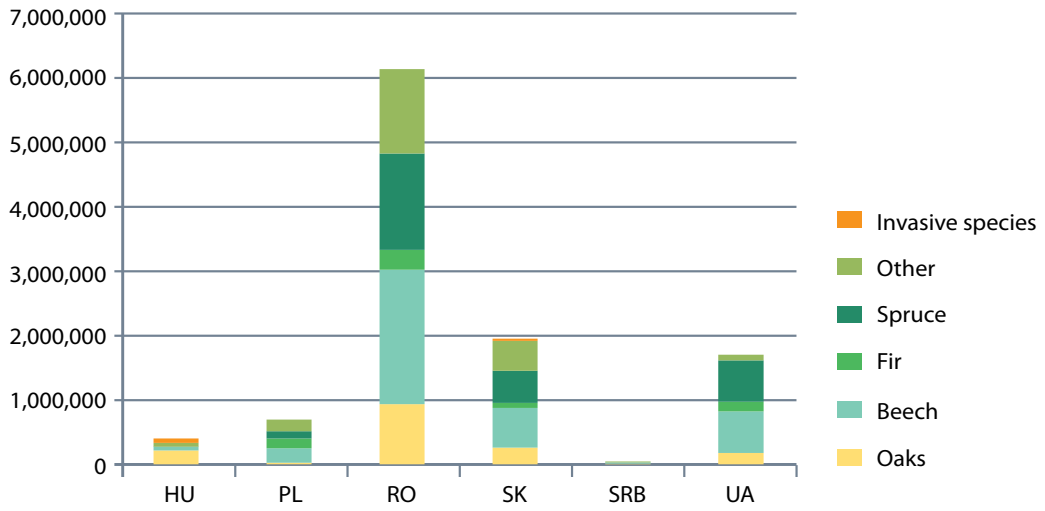


Figure 1. Distribution of dominant tree species and species-groups in six Carpathian countries (ha).

2.1.2. BIODIVERSITY VALUES OF FORESTS

In Western Europe, large areas of truly natural forest subject to natural ecosystem dynamics are today almost completely absent. It is estimated that at present nearly 300,000 hectares of such forests exist in the Carpathians, including the largest tracts of virgin forests in Europe. From low mountain oak forests, through beech-oak mixtures, pure beech stands, beech-conifer mixtures to conifer woodland, the forests show a remarkable natural diversity, supporting a large number of plant, animal fungal and microbial communities that have remained largely intact and unchanged. Notable species include lynx, wolf and bear populations that are

unsurpassed in Europe, a rich bird fauna and numerous insect species. Virgin forests (whose development has not been influenced by man) are found throughout the Carpathians, generally in remote areas where they have been protected from human interventions. In Ukraine, it is estimated that there are still around 20,000 ha of virgin forests.

2.1.3. DETAILED CLASSIFICATION OF FOREST TYPES

Different classifications of forest types are available, based on national and international systems. Here we use a categorization of forest types based on the Carpathian Ecoregion Initiative habitat type list, and the EEA classification of forests (See Map 1). Annex 1 shows the correspondences, overlaps and gaps between this classification and the Natura 2000 and the EUNIS classifications.

Alpine coniferous forest

Alpine coniferous forests occupy the highest montane and subalpine zones of the Carpathians on both acidic and calcareous soils. Forest stands at lower elevations have a complex structure; in subalpine zones forests are less complex usually comprising one dominant tree species. This forest type is typically dominated by *Picea abies*, mixed with *Abies alba* in more mesic conditions, while *Pinus sylvestris* is the dominant conifer species in harsher conditions. In subalpine zones, *Pinus mugo* and *Juniperus* species are dominant. Notable relict conifer species are *Pinus cembra* and *Taxus baccata*, which can be found very locally. At lower elevations, conifers are usually mixed with deciduous tree species (*Fagus, Acer, Betula).* Notable forest types are:

- *Abieti-Piceion* (Br.-Bl. In Br.-Bl. et al. 1939) Soó 1964 (Mesophilous spruce and fir forests on brown forest soils).
- *Athyrio alpestris*-Piceion Sýkora 1971 (Montane Athyrium distentifolium spruce forests).
- *Juniperion nanae* Br.-Bl. et al. 1939 (Juniper scrub of dry, exposed habitats).
- *Oxalido-Piceion* Krajina (1933) Březina et Hadač in Hadač 1962 (Alpine spruce forest at the upper limit).
- *Piceion excelsae* Pawłovski in Pawłovski et al. 1928 (Spruce and birch related woodland communities).
- *Pinion mugo* Pawł. 1928 (Subalpine silicicolous bushes with *Pinus mugo*).
- *Vaccinio-Pinion* (Libbert 1933) Pass. et Hoffm. 1968 (Pine forests [*Pinus sylvestris*] on serpentine or limestone, at altitudes between 1050 and 1250 m).

Picture 3: ***Gorgany Nature Reserve (photo: Olena Slobodyan)***

Hemiboreal forest and nemoral coniferous; mixed broadleaved coniferous forest; acidophilous oak and oak-birch forest

In more continental climatic regions of the North-Carpathians, pine (*Pinus sylvestris*) dominated forest can be found, especially on acidic soils. Pine also can form forests with oak (*Quercus petraea*) on drier sites. These forests are similar to the pine forests found north of the Carpathians on the East-European plain. The forest stand structure is usually less complex, due to the harsh site conditions. Silvicultural methods (usually clear cuts) can alter its structure profoundly, creating even-aged stands.

Notable types are:

- *Dicrano-Pinion* (Libbert 1933) Matuszkiewicz 1962 (Pine and juniper woodland communities of acid soils).
- *Pino-Quercion* Kozl. 1925 em. Mat. et Pol. 1955 (Acidophilous pine-oak woods).

Mountainous beech forest and beech forest

Beech dominated forests are one of the most characteristic forest types of the Carpathians. They are found on more mesic sites, both on acidic and calcareous substrates. Some types of beech forest form the treeline in more mesic areas, and are also found in dry rocky areas. Beech usually forms monodominant stands, with very few admixed tree species. At higher elevations, beech can be admixed with spruce and fir, and on certain sites, other deciduous tree genera (*Acer, Tilia, Fraxinus, Carpinus* etc.) can be co-dominant.

Forest stand structure is less complex compared to types with more species, but is also dependent on silvicultural methods. Even-aged stands are formed using clear cuts or shelterwood forest management. The structure of virgin or old growth beech forests can be very complex with a lot of deadwood.

Notable types are:

- *Symphyto-Fagion* Vida 1959 (Beech and mixed beech-fir woods of the Carpathians).
- *Fagion sylvaticae* Luquet 1926 (Beech and mixed beech-fir woods).
- *Luzulo-Fagion* Lohm. et R. Tx. in R. Tx. 1954 (Acidophilous beech forests).

Mesophytic deciduous forest

Different mesophytic deciduous forest types are found at middle elevations of the Carpathians, especially in valleys, by streams or on rocky substrates, embedded in larger zonal forest types. Some types are dominated by *Alnus, Carpinus, Tilia and Populus* spp.

Notable types are:

- *Alnion incanae Pawłowski in Pawłowski, Sokolowski et Walisch* 1928 (Ash and alder woodland communities of flushed lime-rich soils).
- *Alnion viridis* Aichinger 1933 (Subalpine shrubs with *Alnus viridis*).
- *Carpinion betuli illiyrico-moesiacum* Ht. 1956 (*Thermophilous Quercus petraea-Carpinus betulus* forests, widespread in Central and East part of Balkan peninsula, in lower altitudes (200-700 m)).
- *Carpinion betuli* Issler 1931 (Broadleaved woodlands rich in hornbeam on lime-rich and neutral soils).
- *Populo tremulae-Corylion* Br.-Bl. 1961 (Secondary forests of disturbed areas).
- *Tilio-Acerion* Klika 1955 (Sub-montane maple and lime woods on steep slopes with a mild and humid mesoclimate).

Thermophilous deciduous forest

Diverse forest types are found in this group. Dry forests of lowlands and foothills with subcontinental species are included, as are sub-Mediterranean forests of south-facing, usually rocky slopes. These forest types, mostly

dominated by oak species (*Quercus petraea, Q. robur, Q. cerris, Q. pubescens, Q. frainetto* etc.) are located on both acidic and calcareous soils. They usually exhibit a diverse, open stand structure, although clear cut and shelterwood forest management can create denser, even-aged stands. Some types are threatened by invasive tree species such as *Robinia pseudoacacia, Elaeagnus angustifolia, Celtis occidentalis* etc.

Some important types are:

- *Aceri tatarici-Quercion* Zólyomi 1957 (Xerophilous oak woods with dominance of *Quercus robur, Quercus cerris* and *Quercus pubescens* of deep soils).
- *Castaneo-Quercion petraeae* Soó 1962 em. 1971 (Submediterranean acidophilous chestnut-oak woods).
- *Quercion frainetto* Ht. 1954 (Communities with *Quercus frainetto* in south and central parts of Balkan peninsula).
- *Quercion petraeae-cerris* (Lakušic 1976) Lakušic et B. Jovanovic 1980 (Xero-mesophilous oak woods with dominance of *Quercus petraea* and *Quercus cerris*).
- *Quercion pubescenti-petrae* Br.-Bl. 1932 (Peri-Alpidic basiphilous thermophilous oak forests).
- *Syringo-Carpinion orientalis* Jakucs 1960 (Thermophilous mantle communities of the central Balkan oak woodlands).

Picture 4: ***Oak forest in Hungary (photo: László Gálhidy)***

Mire and swamp forests

Mire and swamp forests are found on sites that are wet or flooded for all or large parts of the year. Such forests occur along rivers and streams, and also at higher elevations in small depressions without runoff. They are dominated by short-lived softwood tree genera, such as *Alnus, Betula, Salix,* and *Populus*.

Important types include:

- *Alnion glutinosae* Malcuit 1929 (Alder and willow woodlands of swamps, fens and wet pastures).
- *Betulion pubescentis* Lohmayer et Tx. in Tx. 1955 (Birch-dominated swampy woodlands).
- *Salicion cinereae* Th. Müll. & Görs ex Passarge 1961 (Willow scrub and woodland of mires).

Floodplain forest

Mainly softwood forests along flowing rivers and streams. Stand structure is diverse, with abundant coarse woody debris. Most of these forest types are usually threatened by invasive tree species, such as *Acer negundo, Fraxinus pennsylvanica*, shrubs e.g. *Amorpha fruticosa* and herbs e.g. *Reynoutria* spp.

Important types are:

- *Salicion albae* Soó 1930 (Willow scrub and woodland of sub-montane and lowland river shoals and terraces).
- *Salicion eleagno-daphnoidis* (Moor 1958) Grass in Mucina *et al*. 1993 (Willow scrub of montane stream banks).
- *Salicion incanae* Aichinger 1933 (Alpine and subalpine river gravel communities).
- *Salicion triandrae* Th. Muller et Gors. 1958 (Willow scrub of river banks below levées).

Artificial forest types

Besides natural forest types, different artificial forests and plantations can be found throughout the region. On higher elevations especially, beech forests were replaced by spruce in the past. In the lowlands and foothills different native and non-native forests occur, most notably Scots pine (*Pinus sylvestris*), hybrid poplar plantations (*Populus x* spp.) and black locust (*Robinia pseudoacacia*) forests.

Virgin/Primeval and old growth forests

Virgin/primeval forests are probably the most important forest ecosystems in the Carpathians. They are defined as '*natural forests which did not undergo direct human activities during their existence, able to influence their development/ecological processes*' (Carpathian Convention, Forest Protocol). The term 'old growth forest' (OGF) is usually less strict, referring mainly to natural forest with characteristics are similar to those of 'true' virgin forests (e.g. large diameter old trees, large amount of standing and lying dead wood, diverse structure and composition etc.). In some countries there is no differentiation between the two terms (in the field, true virgin, and old growth forests are often difficult to differentiate).

Virgin forests are virtually untouched by humans, some of the last places on the continent where nature survives in its pure state. They are rich, complex systems where seedlings, young, mature and old trees are interspersed by very large, old living, imposing trees. Dead trees and decaying logs are just as important as the living trees, building up together an environment that is home for many different flora and fauna species. Virgin forests are an important part of Europe's natural patrimony that has been almost lost, mostly due to bad management. Their scientific, educational, and ecological value is undisputed.

The values of intact ecosystems of virgin and old growth forests in Europe have only recently been recognised: even in the 1980s, strategies were developed in some countries to 'renew' the stands, resulting in large-scale losses. Nowadays, their ecological, scientific and cultural values are not disputed, but because of lack of protection and compensation measures, large areas of virgin and old growth forests are still harvested every year.

Comprehensive studies of virgin and old growth forests are still lacking in most of the countries. Because of the absence of data and common definitions, exact areas and locations are still not available for the whole Carpathians. In 2002-2003, a mapping project financed by the Dutch government through the PIN Matra project identified about 300,000 ha of virgin and old growth forests in the Carpathians. The criteria used for determination of these forests are not accepted entirely today and ongoing investigations indicate that only a part of these forests still exists today. The information that follows is derived from current estimates from various more recent studies.

Figure 2 shows that most of the surviving virgin and old growth forests are found in Romania and Ukraine.

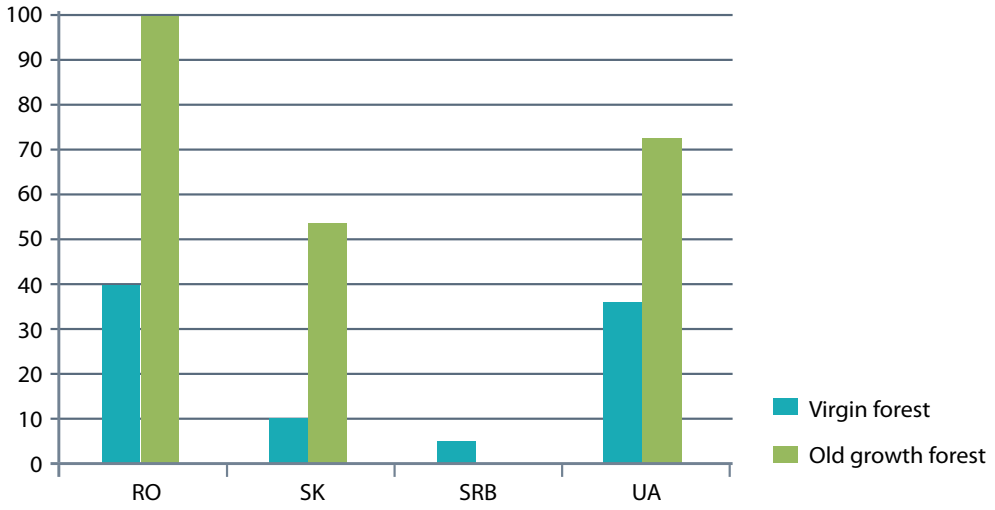


Figure 2. Estimates of virgin and old growth forests in some Carpathian countries (1,000 ha).

The largest remaining virgin forest block of the Carpathians (and also the largest broadleaved virgin forest in Europe) is the ca. 10,000 ha Uholka in the Carpathian Biosphere Reserve, Ukraine. In Romania, almost 40,000 hectares of virgin forests remain, along with a further 100,000 hectares of old growth forest. In Slovakia, a national survey conducted in 2009-2010 revealed that only 10,000 hectares of virgin forests remain in the country, while in Poland only smaller scattered fragments of virgin/old growth forests survive. In the small Carpathian part of Serbia some thousands of hectares remain, while in Hungary, due to intensive forest management, less than 60 ha of virgin forest remains in just one location (Mt. Kékes, Matra Mountains).

Despite possessing World Heritage Status across some of their range *(Primeval Beech Forests of the Carpathians and the Ancient Beech Forests of Germany)*, most Carpathian virgin and old growth forests are not legally protected, and may still be subject to legal or illegal logging. Systematic research has started in some of the stands, but more knowledge on the structural, compositional and dynamical characteristics of virgin and old growth forests is necessary. Protection of all sites of these unmanaged forests is of the utmost importance.

Beech primeval forest in the Uholka-Shyrokyi Luh, Ukraine

Beech primeval forest in the Uholka-Shyrokyi Luh massif of Ukraine covers an area of around 10,000 ha and is one of the largest massifs of near natural forests in the whole of Europe. The forest is located in the upper basins of the Uholka and Shyrokyi Luh rivers in Transcarpathia and comprises uneven-aged beech (*Fagus sylvatica*) stands with some admixtures of sycamore *(Acer pseudoplatanus)*, ash (*Fraxinus excelsior*), Norway maple (*Acer platanoides*) and wych elm (*Ulmus glabra*). Birch (*Betula* spp.), cherry (*Prunus avium*), grey alder (*Alnus incana*) and aspen (*Populus tremulus*) occur as well.

The massif is an outstanding example of undisturbed, complex temperate forests and exhibits the most complete and comprehensive ecological patterns and processes of pure stands of European beech across a variety of environmental conditions. It contains an invaluable genetic reservoir of beech and many other associated species that are dependent on these forest habitats. At least 20 plant associations have been found in the area, the rarest of which are *Fagetum (sylvaticae) lunariosum (redivivae)* and *Ulmeto (glabrae)–Fagetum (sylvaticae) phyllitidosum (scolopendrii)*.

Long-term protection and management is ensured through national legal protection, as the area belongs to the core zone of the Carpathian Biosphere Reserve. A strict non-intervention management is applied to the massif, which is the major part of the UNESCO World Heritage Site 'Primeval Beech Forests of the Carpathians and the Ancient Beech Forests of Germany'.

References: http://cbr.nature.org.ua/new_u.htm; http://cbr.nature.org.ua/whc/whc.htm; http://whc.unesco.org/en/list/1133

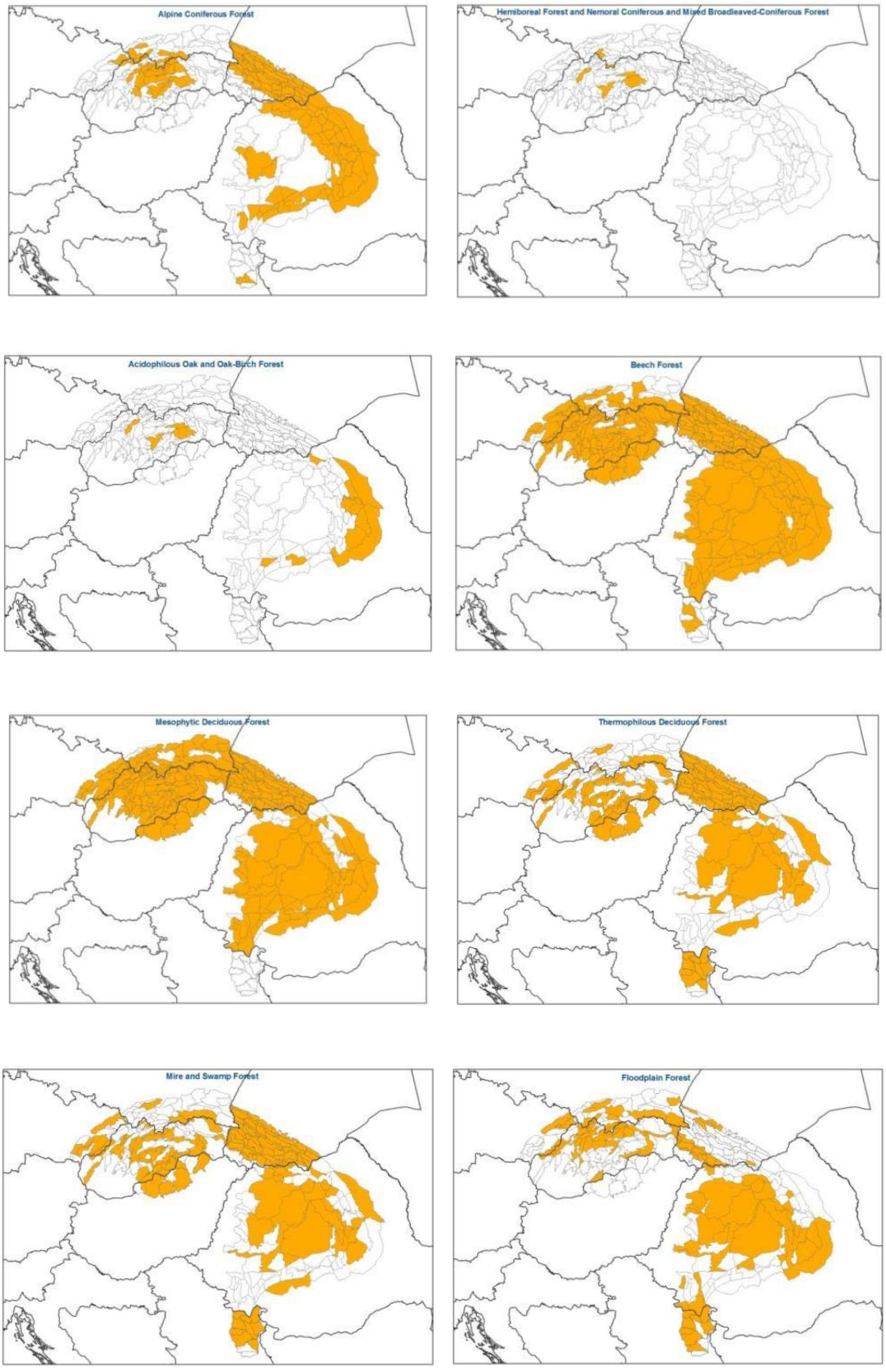
Picture 5: ***Virgin forest in Slovakia (photo: László Gálhidy)***

2.1.4. CULTURAL VALUES OF CARPATHIAN FORESTS

Wood civilisation/architecture

Wood has a profound effect on local culture in the Carpathians; from the everyday tools and firewood stacks, to means of transport and construction of houses and churches. There are still regions in the Carpathians, notably Maramures (Romania), Szeklerland (Romania), Eastern-Slovakia, South-East Poland and Transcarpathia in Ukraine, where wooden architecture is still a living tradition. Wooden churches are the masterpieces of the wood civilisation; some are hundreds of years old (e.g. at Hervartov, Slovakia, late 15th century, Ieud, Romania, 14th century) and are included in the UNESCO World Heritage list (e.g. 'Wooden churches of Maramures', 'Wooden Churches of the Slovak part of the Carpathian Mountain Area'). Besides village architecture, wood is also an important material in houses of towns, cities and holiday resorts. Good examples of such wooden architecture can be found in Transylvanian cities, or in the High Tatra settlements.

Unfortunately, traditional architecture and other uses of wood are changing, and some regions have lost their characteristic identity. Concrete, bricks and tin are replacing wooden houses in the villages, while plastic replaces wood for household tools and wire for fencing. Traditional architecture and handicrafts can still be found in *skanzens* (village museums) which are attractive for tourism. In some cases, attempts to revive local wood traditions can be seen in newly built houses, pensions and protected area visitor centres.



Map 1. Forest type distributions in the Carpathians.

(Maps are based on presence/absence in the orographic units of the Carpathian Biodiversity Information System (CBIS) www.carpates.org/cbis.html)

Forestry heritage

Forestry has a long tradition in Central Europe. Traditional farm-forestry practices can be found in some regions, based on low-impact use of wood and mostly using locally developed versions of the selection system of silviculture. The roots of modern forestry can be found in the Carpathians; one of the earliest centres of forestry education, founded in 1762, is situated in the Carpathian mining town of Banská Štiavnica (Schemnitz, Selmecbánya) in Slovakia. Regular forest management was a major step towards avoiding the depletion of wood resources and in establishing sustainable use of forests. The forestry heritage and the high level of expertise of foresters in the region is still a valuable resource for development of forest management approaches that use more appropriate, multifunctional silvicultural methods.

Tourism

Forests are a very important resource for tourism in the Carpathians. Large forest areas include networks of well-marked tourist trails and different touristic facilities (hotels, pensions, mountain huts etc.) can be found in most Carpathian countries, maintained and operated by different organizations (national parks, forest companies, NGOs, private owners, touristic associations etc.). Maintenance and sustainable development of tourism in forests is an important factor in their conservation, since those involved support better forest management and protection, which in turn improves the living standards for the whole society.

Ecosystem services

Forests provide important ecosystem services, which are important for the life in rural areas and for national populations and economies.

- Regulating and supporting ecosystem services include the maintenance of soil, erosion regulation, water purification (even for large cities), flood prevention, modification of local climate, air purification and pest control. Forests store considerable amounts of carbon, and their role in global climate regulation is well documented.
- Provisioning ecosystem services include the different raw materials (e.g. timber, charcoal, bark, resin), fruits, medicinal plants, mushrooms, and meat provided by forests.
- Cultural ecosystem services relate to recreational, spiritual, aesthetic and educational experiences, and are also of great importance.

Most of these ecosystem services can be maintained in the Carpathians if healthy forest ecosystems are preserved. Healthy, stable, resistant and resilient ecosystems can only be maintained by proper management methods. Some of the ecosystem services (e.g. spiritual values) are best provided by virgin forest, which are also highly important from a conservation point of view.

2.1.5. FOREST OWNERSHIP

After the communist regimes took control in the region soon after World War II, most of the Carpathian forests were owned by the state and were managed by large state owned forest companies and agri-cooperatives. The only exceptions were Serbia (former Yugoslavia), where private ownership of forests was possible, and Hungary, where a few thousand hectares of forest were left in the hands of private owners in the westernmost part of the country, where farm forestry is still a continuous tradition. After the political changes in the region the restitution processes started, and in Romania, Slovakia and Hungary, more than 40% of the forests were given back to their former owners. In Ukraine, the entire forest area is still owned by the State. See Table 2.

	1990		2000		2011	
	State	Non-state	State	Non-state	State	Non-state
Hungary	383,648	3,875	254,455	169,637	261,312	174,208
Romania	6,103,418	0	5,757,580	341,048	3,146,000	3,099,000
Slovakia	1,921,705	0	1,090,626	830,788	1,057,822	861,297
Serbia	34,071	6,901	37,053	7,018	37,053	7,018
Ukraine	1,709,863	0	1,720,521	0	1,753,270	0

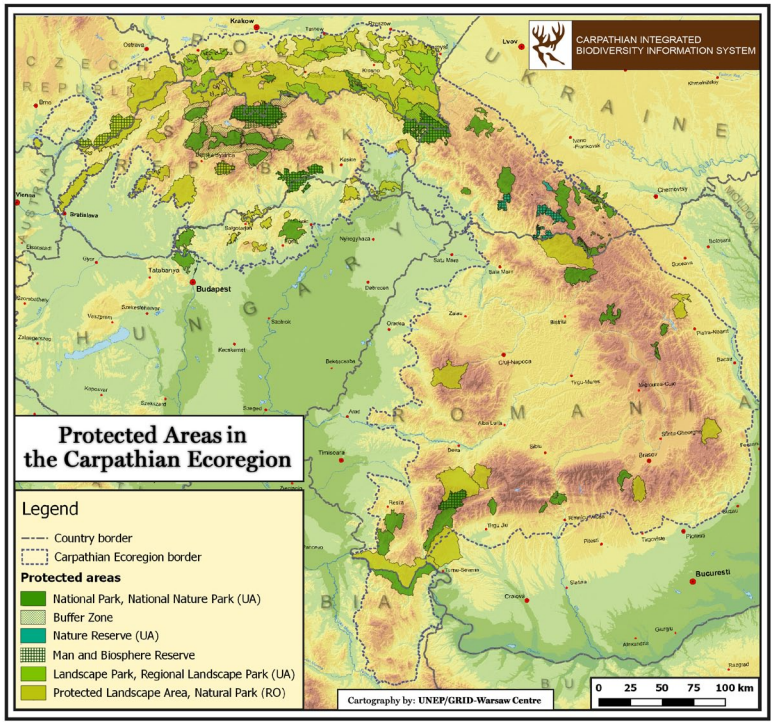
Table 2. Changes of ownership of forests in some Carpathian countries, 1990-2011 (ha).

There are considerable differences between the ownership structures in Carpathian countries. For example, the proportion of forests owned by individuals or municipalities is much higher in Slovakia than Romania, where associative forms of ownership are more dominant.

2.1.6. FOREST MANAGEMENT

Forest protected areas and Natura 2000 sites

In the seven Carpathian countries there are 35 National Parks covering over 1 million hectares, mostly dominated by forests. The first national parks in the region were Retezat National Park in Romania (established in 1935) and Tatra National Park in Slovakia (established in 1948), but most national parks were established in the early 2000s. The largest is Tatra National Park, covering (with its buffer zone) over 100,000 hectares, while several other parks exceed 60,000 hectares (Djerdap in Serbia, Domogled-Valea Cernei in Romania, Duna-Ipoly in Hungary and Karpatskij in Ukraine). Many other protected areas of different management categories have been established or are proposed across the region).



Map 2. Major protected areas of the Carpathians (2010), not including Natura 2000 sites.

A considerable amount of forest land is included in Natura 2000 sites in the Carpathians, which frequently (but not always) overlap partly or completely with nationally designated protected areas of national designation. Designation of Natura 2000 sites has encountered major public resistance, mainly because of lack of proper information about associated regulations and restrictions. Private forest owners in particular have protested against restrictions, due to lack of compensation.

National parks are spectacular natural landscapes and include many of the most valuable parts of the region for nature conservation. National park directorates are, in most of the countries, responsible for conservation management and also for forest management in certain parts of the national park. In some countries (e.g. Hungary, Slovakia) the directorates are regionally responsible for nature conservation outside national park boundaries.

One of the fundamental approaches in national park management is zonation, which spatially defines areas with different management objectives. Ideally, national parks should include a strictly protected inner zone with little or no human influence. Establishment of zoning systems differs widely across the Carpathians; in some countries, creation of zones is obligatory, and all national parks operate accordingly (Romania, Ukraine). In Poland, zoning is not obligatory, but in some national parks as much as 60% of the area is in a strictly protected, unmanaged zone. In Hungary, there is no established zoning system, and consequently no areas of non-(or minimal-) intervention management. The highest proportion of non-intervention zones is found in Serbia, while the largest total area (over 200,000 ha.) is in Romania, (see Figure 3).

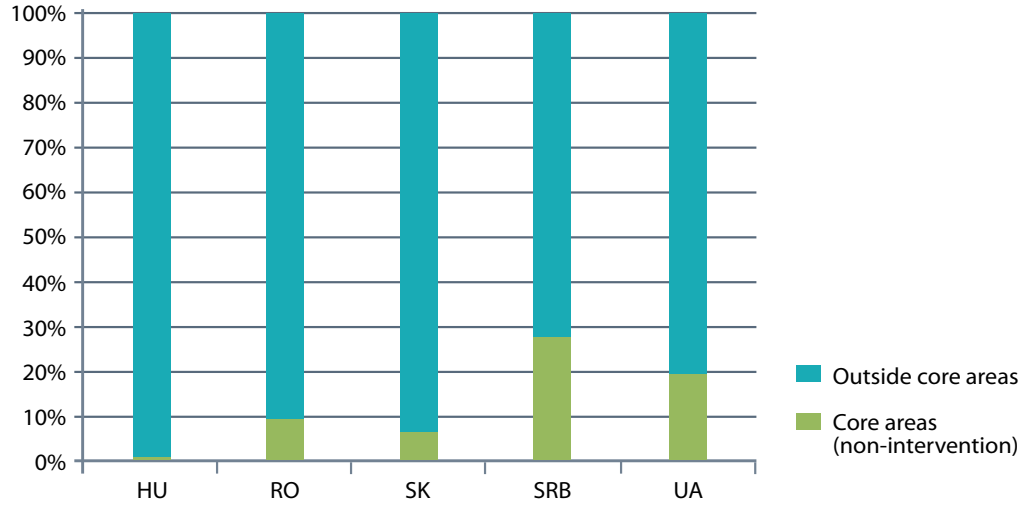


Figure 3. ***Proportions of non-intervention zones in protected areas in National Parks in the Carpathian countries (%).***

Production and protection roles in forests

Although different designations of forest use types have been adopted in the various Carpathian countries, the most important common distinction is between production forests, and protection forests, which are designated for nature conservation purposes (e.g. protection of certain species or habitat types, landscapes etc.). Protection forests are different to the so-called protective forests, which are designated mainly to protect vulnerable site conditions, such as soils on steep slopes, water courses etc. The proportions of production and protection forest vary in the Carpathian countries; the highest proportion of protection forests is found in Poland, but in Romania and Ukraine it also exceeds 50%. In Slovakia and Serbia, less than 20% is classified as protection forest, while in the Czech Republic only 108 ha of protection forest exist (Figure 4).

Figure 4. ***Proportions of protective and commercial forests in Carpathian countries in 2011 (%).***

The proportions of protection forest depend on many factors, including geomorphology (on steep slopes productive forest management is not beneficial or even possible), forest types and importance of other forest functions, such as tourism. In some respects, management of some types of protection forest is quite similar to that of production areas; for example, sanitary cuts are regularly permitted in most protection forests, while in some regeneration cuttings are also permitted, although possibly with tighter restrictions than

normal. Important restrictions can however be imposed in relation to the size of felling sites and periodicity of interventions in protection forests. Differences in age-structure of protection and production forests of three Carpathian countries are shown in Figure 5, revealing wide variations across the region, from Ukraine where they are very similar, to Slovakia, where there are significant differences, and where the proportion of stands over 120 years in protection forests is more than 20%. It should be borne in mind that the recent age structure of forests is not only dependent on current management policies, but also reflects centuries of management. Furthermore, age-structure is calculated using the 'ages' of individual forest compartments since their last treatment under traditional cyclical forest management. However close-to-nature managed forests, virgin forests and OGFs have no 'age', because they comprise trees of all ages; such forests are usually recorded in the >120 years age class.

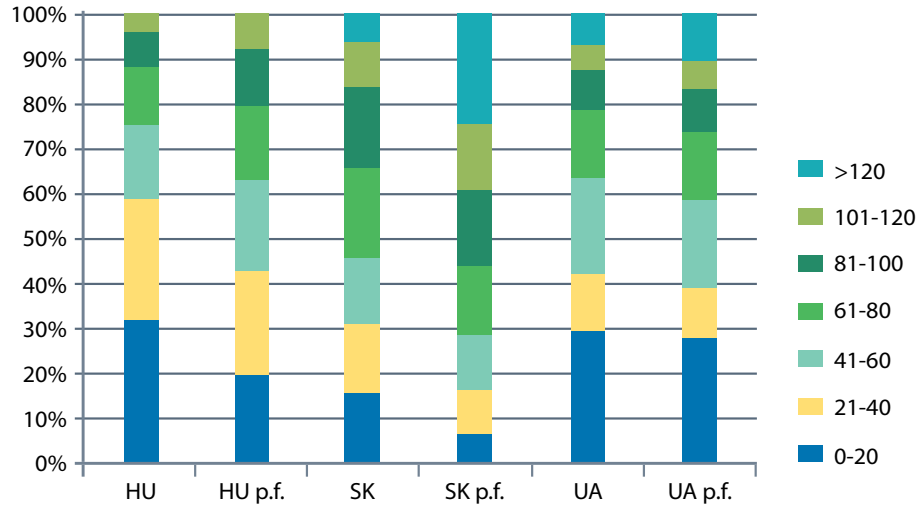


Figure 5. Age structures of production forests and protection forest (p.f.) in three Carpathian countries (% occurrence of different age classes).

Production forestry

After a long history of irregular, mostly extensive use of forests, the new discipline of forest management came into existence in the Carpathian countries during the 18th century. Regular forest management was a great step forward in avoiding the depletion of wood as a natural resource, but forest management methods have changed many attributes of forests, such as tree species composition, age-class distribution, stand structure, amount of dead wood etc. Because of widely applied clear felling and management methods based on natural regeneration over a relatively short time period, many of the forests are even-aged and simply structured. Many forest landscapes in the Carpathians comprise blocks of even-aged forests, lacking dead wood, canopy openings, patches with young tree regenerations and stratified shrub layers. Large areas have been reforested with spruce, pine or non-native species.

Timber stocks

The total timber stock of the Carpathian forests is over 2,500 million m^3, more than half of which is in Romania (1,354 million m^3). The growing stock is increasing in most of Carpathian countries, due to reforestation, spontaneous afforestation, less intensive forest management in some regions and establishment of protected areas. See Figure 6.

The volume of harvested wood in the Carpathian countries is stable or slightly increasing (Figure 7). Taking into consideration that the forested area and growing stock is increasing significantly, the figures indicate overall less intensive use. Incidental felling is less than quota in all countries.

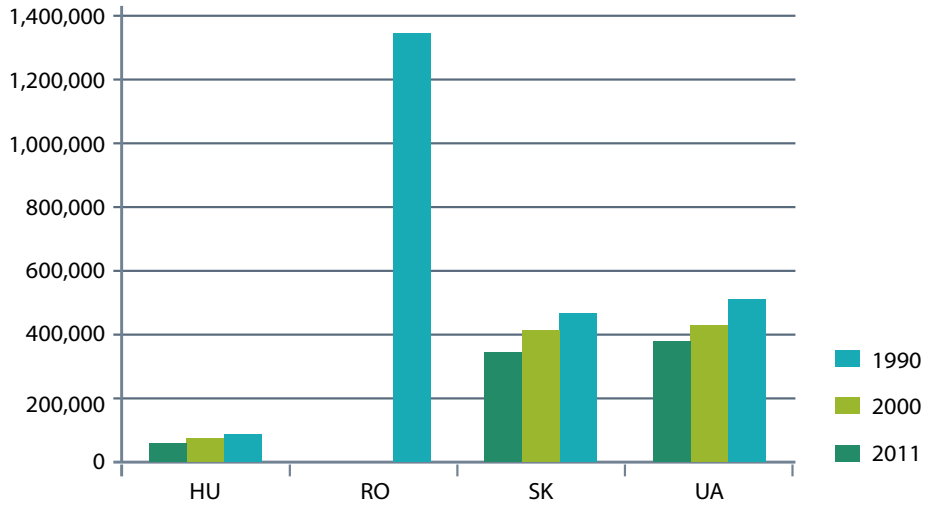


Figure 6. Timber stocks in selected Carpathian countries between 1990 and 2011 (m³).

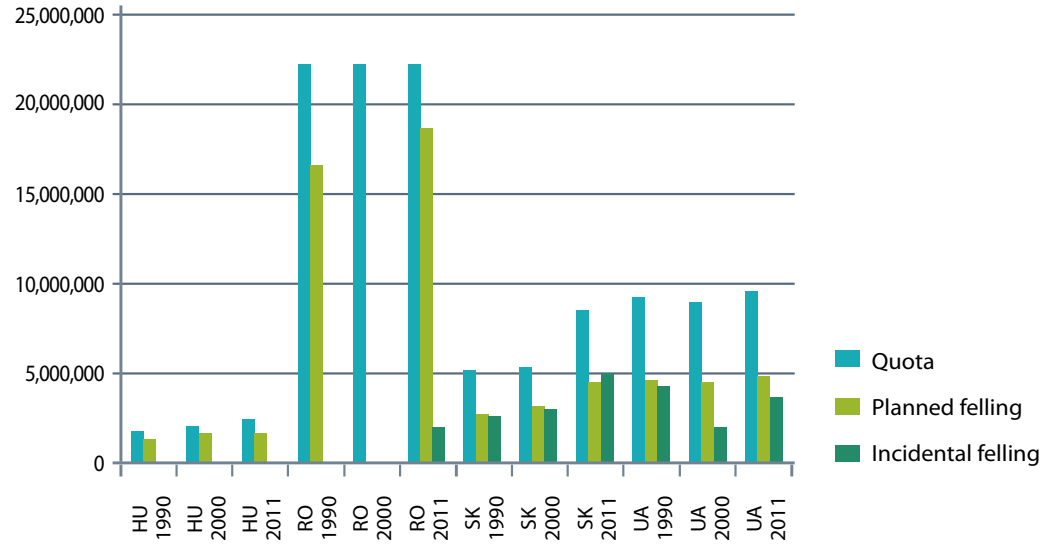


Figure 7. Volume of harvested timber (m³) in Carpathian countries between 1990 and 2011.

Silvicultural methods

General principles of forest management related to different forest types are similar in all the Carpathian countries. Apart from core areas, forest management in protected areas is generally similar to those of production forests in most countries with some additional restrictions.

Clear cutting

During clear cutting, the stand is harvested in a single operation, resulting in an 'empty' felling area, which is then usually replanted. Clear cutting takes place mostly in spruce forests, lowland oak, alder and riparian forests and also in non-native forests or plantations. The resulting stands are even-aged, are not of local provenance, and have been subject to profound changes in site conditions; consequently, conservationists and ecologists criticise this method, although some foresters maintain that clear cutting is also 'mimicking nature'. Because of its profound effects, clear cutting was generally forbidden in the former Yugoslavia after WWII. In Slovakia, the use of clear cuts is (with some exceptions) prohibited, while in Romania it is permitted only on small areas (max 3 ha usually and not more than 1 ha in protected areas), and only in certain situations (unique species forest: spruce, black locust, poplar and willow).

Shelterwood

This is the most widely used silvicultural method in the Carpathians, applied mainly to beech and mixed beech forests. Under the shelterwood system, the forest stand is usually harvested in three steps, which allows for natural regeneration over a period of 10-15 years. From a conservation point of view this is more acceptable than clear cutting, because of the less profound effect on site conditions, and because it promotes natural regeneration. However, this system results in an even-aged stand structure, similar to clear cutting.

Selection

This is the least used forest management method, partly because of its complexity. Practiced for centuries by farmers and other smallholders, especially in mountainous areas of Central-Europe, it is also a traditional method, which was developed as a recognised scheme in the 19th century. Selection forestry is mainly used in beech and mixed beech forests, but as a 'close-to-nature' method, it is increasingly applied in other forest types, especially in protected or recreational forests. In the former Yugoslavian countries, it is a more widely used silvicultural system.

From a conservation point of view, selection is the most acceptable forest management method. Gentle operations influence site conditions only slightly, and a diverse stand structure can be maintained permanently. However, there are still some debates about the frequency of interventions and harmonizing the felling periods with the requirements of some species, for example nesting birds. With some restrictions, selection can be recommended in some (but not all) protected areas as well.

The disadvantages of this method are the need for qualified experts, developed machinery and a road system. Proper management of the game population is also important to avoid over populating the area, since protective fencing is generally not practical.

Picture 6: ***Selection forestry in Hungary (photo: László Gálhidy)***

Close-to-nature forest management and Pro Silva

'Close-to-nature forestry' signifies a system of forest management which provides continuous restoration, development and treatment of stands similar in species composition, structure and dynamics to natural forests specific for the site conditions (Protocol on Sustainable Forest Management to the Framework Convention on the Protection and Sustainable Development of the Carpathians). This is a relatively new concept of forest management in Europe (sometimes also known as 'continuous cover forestry'). Pro Silva (PS) is a European federation of foresters, which advocates forest management based on natural processes. PS was founded in Slovenia in 1989 and has national federations in the Czech Republic, Hungary, Romania and Slovakia, supported

by foresters and forest ecologists. The objective of the 'movement' is to support a paradigm shift in forest management. PS recommends continuous forest cover and full use of natural dynamic forest processes, as an alternative to conventional methods. Opponents of PS principles and selection forestry emphasise the lack of sufficient field research results to confirm the advantages of these approaches.

In the last 15 years, supporters of PS have introduced forest management practices based fully or partly on PS principles with the cooperation of state and private owners and forest authorities. Conservation managers, NGOs and other stakeholders have also welcomed PS methods, since continuous cover forests are generally better habitats for most forest dwelling species, and are more suitable for recreational purposes.

One important obstacle to adopting the PS approach in the Carpathian region is the accessibility of the forests.

Pro Silva

www.prosilvaeurope.org/

Slovakia

The movement started in Slovakia in 1995 and the first demonstrations of Pro Silva practices were made in 1996. The objective is to achieve natural stand conditions and to establish rich, structured forest with continuous cover. The main protagonists are Slovak State Forests, but some private owners are also involved.

See: www.lesy.sk/showdoc.do?docid=2522 and www.lesy.sk/showdoc.do?docid=2645

Hungary

In Hungary the Pro Silva movement started in 1999. The principles of Pro Silva in selection forest management have been adopted by many state forest companies, especially on hilly and mountainous areas (including the Carpathian region). Private forest owners are also following PS principles, notably in the Zemplén Mountains. See www.prosilva.hu/

Regional differences in silvicultural systems

The balance of silvicultural systems varies across the region varies, and shows a major shift away from clear cutting to shelterwood systems, apart from in Ukraine (Figure 8). Selection systems, which have more of a tradition in Alpine and Balkan countries, are most widely used in Serbia, and increasingly in Slovakia and Hungary. In Romania, area of selection forest is decreasing because of the preferred group shelterwood methods.

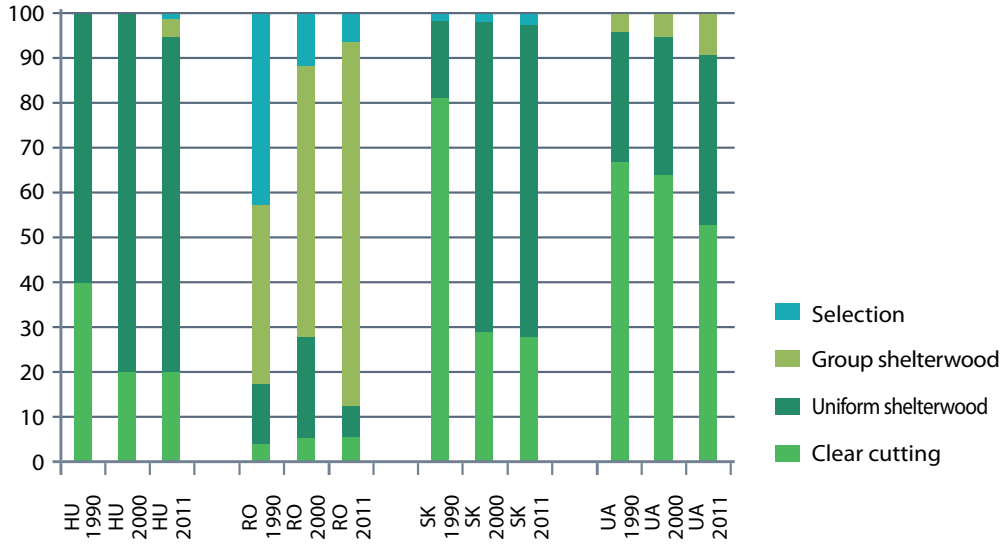


Figure 8. Silvicultural methods used in Carpathian countries between 1990 and 2011 (%).

2.1.7. MAIN THREATS TO FOREST ECOSYSTEMS

Based on the Natura 2000 list of threats to natural habitats, the main problems in forests of the Carpathians are the following:

Forestry practices

Several elements of conventional clear cut and shelterwood forest management are potential threats to biodiversity.

- *Forestry planting, replanting* and *artificial planting* are significant threats, especially in the Carpathian foothills. Artificial forests and plantations occupy large areas at lower altitudes, while on non-protected sites, non-native species are free to be planted or regenerated. Where intensive methods of soil preparation are used, these cause profound disturbances and may completely destroy the herb layer and soil structure.
- *Forestry clearances, removal of undergrowth, removal of dead and dying trees* are part of conventional forest management, even in semi-natural forest stands of protected areas. Several microhabitats and different structural elements of forests disappear during tending and harvesting operations.

Fragmentation

Fragmentation of natural habitats is a major threat. In small forest fragments, the edge effect increases, with a range of consequences including altered forest climate, increasing pollution, more pressure by predators, diseases and invasive species. In turn these changes lead to changes in species composition and biodiversity loss. Fragmentation is especially harmful for species groups with low dispersal capacity and special habitat needs. It also limits the possibility for plant and animal species to shift their ranges in response to climate change.

Animal breeding and stock feeding

These practices are forbidden in forests in most Carpathian countries, but can happen illegally, especially in the vicinity settlements.

Burning

Burning on agricultural land represents a serious threat. Legally, burning is only allowed with specific permission and with strict precautionary measures to prevent spreading to neighbouring areas. Protective strips where fires are completely forbidden are established around the edges of forests. However, illegal or irresponsible burning of pastures in spring and of arable land after harvest causes occasional forest fires. Burning in forest (residual material) is allowed in Hungary, but normally needs permission.

Hunting (poaching)

This is a major problem in the case of some of the large carnivores (wolf, lynx), since their numbers are very low and unstable in some Carpathian regions. Ungulates are also subject to heavy hunting and poaching pressure in some areas. See Chapter 5 for further details.

Game management

In most Carpathian countries, large carnivores still have an important role in regulating populations of grazing species. Consequently, in Romania, Ukraine, Slovakia, Czech Republic, Poland and Serbia, most forest areas are not subject to significant damage by ungulates. Excessive populations of game species are a greater threat to forest conservation in lower elevations of the Carpathians, especially in Hungary. Grazing and browsing by red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), fallow deer (*Dama dama*) and mouflon (*Ovis*

aries musimon) or feeding on acorns by wild boar (*Sus scrofa*) degrades the vegetation and soil, and in severe cases can completely stop forest regeneration. Trampling can have a profound effect on fragile ecosystems (e.g. rocky grasslands on southern facing slopes of the North Hungarian Mountains). Debarking kills trees and reduces their value to that of fuel wood. In some regions, use of fences is essential, and forest owners are deterred from using selection forestry and other close-to-nature forest management methods where fencing is not a viable option.

Views on the cause of this problem and the possible solutions vary widely, and it is hard to evaluate or separate the arguments of the scientific community and lobby groups. Scarcity of reliable data is also a basic problem. High game densities, poor quality of habitat as a consequence of conventional forest management methods, absence of large carnivores (brown bear, wolf, lynx), feeding of game, and climate change (mild winters) have all been suggested as contributory factors.

Expanding habitation, industrial or commercial areas

This is a growing threat all over the Carpathians range, leading to habitat loss, disturbance and fragmentation. Population growth and infrastructural density are major problems, especially for those species which requires large, intact habitats for breeding and feeding (e.g. large carnivores, birds of prey).

Impact of use and visitation

Human intrusion in forests can cause disturbance and physical damage. This can vary from badly designed and overused forest roads, poorly planned and executed forest operations, use of off-road vehicles and damage by intensive tourism and sporting events that attract many visitors. Intrusive recreation, for example using ATVs or off-road vehicles is a growing threat, disturbing forest dependent species.

Invasive species

These constitute a major threat in some areas. The best known threats are tree and shrub species, such as black locust (*Robinia pseudoacacia*), box elder (*Acer negundo*), American ash (*Fraxinus pensylvanica*) and indigo bush (*Amorpha fruticosa*), that are altering habitats on a large scale. Introduced game species (e.g. mouflon) can also cause problems.

2.1.8. ROOT CAUSES OF THREATS

The root causes of the threats are various, and sometimes differ from region to region.

- In general, the most profound threats stem from the continued prevalence of unsustainable forest and game management practices. The most problematic methods in forest management, especially clear cuts, have started to decline in the past 20-30 years in some countries, but are still widely used in others (Ukraine, Slovakia, Hungary).
- A very important root cause is the lack of national strategies for responsible/sustainable forest management. Alongside this is a lack of financial support for forest management in most countries, especially in areas where forest production cannot be high, either because forests have been degraded through long-term unsustainable use, or where the main role of the forests is to provide critical ecosystem services rather than wood. At the local level, lack of integrated management and lack of compensation payments for restricted use in protected areas and protective forests lead to continued inappropriate management and use of forests.
- The use of subsidies and incentives can have a profound effect on forest management. There are examples of beneficial effects (e.g. support of close-to-nature forest management), but there are also negative examples (e.g. support for black locust plantations).
- There have been few attempts in legislation to solve the problems of game density in forests, which is one of the most obvious root causes of forest degradation and is an obstacle of close-to-nature forest management in some parts of the Carpathians, especially in Hungary. Where legislation does exist, legislative measures often fail because of weak law enforcement.

- A range of legal problems exists in relation to forest protected areas. Despite the relatively high proportion of forests within protected areas, in many cases management differs little from that in production forests. Lack of a zoning system in national parks is a special problem in Hungary, but forest management approaches in protected areas, especially in the case of natural calamities, which are usually followed by sanitary cuts, are also problematic in most countries.
- Weak law enforcement is a widespread issue. Rangers are insufficient in number or capacity to prevent illegal logging and poaching in the field, while in some areas organised major mismanagement of forests is allowed to continue.
- Lack of capacity among managers is a common problem. Generally, there is a lack of knowledge and understanding about the role of forests in maintaining ecosystem functions and providing services, and about virgin forests, wilderness concepts, restoration and conservation focused forest management practices. Many of these issues are often misinterpreted, leading to conflict and confusion. Consideration of different threat types is also unbalanced (for example garbage at the forest edge is considered to be a major problem, while management methods with clear negative effects are not). In some cases information is misinterpreted by different lobby groups.

Picture 7: Old growth forest in Romania (photo: László Gálhidy)

2.2. STRATEGIC APPROACH

2.2.1. IDEAL MANAGEMENT REQUIREMENTS

From the economic, ecological and social perspectives, extensive, stable, healthy forest ecosystems should be maintained, which can provide a wide range of functions and services alongside wood production, in particular biodiversity conservation, climate regulation, creation and protection of soil, purification of air and water and provision of recreational areas.

To fulfil this goal, responsible forest management should be adopted all over the Carpathian range. Forest management should as far as possible, allow these natural processes to continue (close-to-nature forest management), ensuring the long-term stability and resilience of the ecosystem against different abiotic and biotic disturbances. It is also important to acknowledge that local tree species can respond to the challenges of climate change much better than species of other origin. Representative sites of different forest types should be set aside and if necessary, habitat restoration should be carried out in such places.

2.2.2. EXISTING TARGETS, OBLIGATIONS AND OBJECTIVES

On a regional basis, the main policy framework is determined by the Protocol on Sustainable Forest Management to the Framework Convention on the Protection and Sustainable Development of the Carpathians, dated 27 May 2011.

Article 1 of the Protocol on Sustainable Forest Management to the Framework Convention on the Protection and Sustainable Development of the Carpathians

General Objective and Principles

1. The objective of the protocol on sustainable forest management (hereinafter referred to as the protocol) is to promote the sustainable management and protection of Carpathian forests, bringing benefits to present and future generations.

2. In order to achieve the above objective, the parties shall carry out activities and cooperate on:

(a) Maintaining or enlarging forest cover.

(b) Ensuring the productive functions of the forests and their role in rural development.

(c) Promoting the sound use of wood as an environmentally friendly and renewable material.

(d) Promoting sustainable use of non-wood forest products.

(e) Improving the health and vitality of the forests.

(f) Improving the conservation and sustainable use of components of forest biological diversity.

(g) Identification and protection of natural, especially virgin forests.

(h) Promoting the restoration of close to nature forests.

(i) Enhancing the role of the forest-based sector in mitigating climate change.

(j) Improving the protected forest functions such as preventing floods, landslides and in general water cycle regulation.

(k) Promoting the cultural heritage of the forests.

(l) Enhancing the social functions of the forests.

(m) Promoting the participation of regional and local authorities and communities in forest management.

(n) Identifying, developing and applying appropriate schemes for payment for environmental goods and services provided by forests.

(o) Strengthening the governance of the forestry sector and enforcing forest law, with particular attention to combating illegal logging and associated trade.

(p) Identification, development and implementation of best practices in forest management and close to nature, forestry.

(q) Promoting and coordinating scientific research and information exchange on Carpathian forests.

National strategies related to the forestry sector exist in most Carpathian countries, and although the documents differ in their content and level of elaboration, sustainable use of resources based on harmonization of production and protection objectives is generally a common principle in all strategies.

Goal for forest management in the Ukrainian Carpathians

The ideal requirements for the maintenance and restoration of the favourable status and values of the Ukrainian Carpathian forests are their sustainable use as complex of active management, nature conservation and population management depending on categories of the forest.

The main objectives are as follows:

1) Universal protection of forests.

2) Durability of sustained forests.

3) Sustained and balanced utilization of all functions of forests.

4) Increase of forest resources.

Other important common elements of forestry strategies are:

- The use of close-to-nature silviculture methods (selection, advanced forms of shelterwood forest management) instead of clear cutting.
- Restoration of natural forests, especially on degraded sites, and where non-native or invasive tree species occur.
- Effective preservation of the most prominent natural values (e.g. virgin forests) is also reflected in forestry strategies.
- Forest protection to strengthen the resilience and self-regulating potential of forests.
- To increase the contribution of forests and forestry to the development of the rural economy.
- To improve the utilization of wood in industry and households, as a renewable, environmental friendly material.
- To support research, education and production development.

2.3. COMMON INTEGRATED MANAGEMENT MEASURES FOR FORESTS

2.3.1. CONSERVATION MANAGEMENT MEASURES FOR IMPLEMENTATION BY PROTECTED AREA AND FORESTRY ADMINISTRATIONS AND OTHER FOREST MANAGERS

These are measures associated directly with the management of forest species, habitats and ecosystems. They can and should be implemented both through protected area systems and through work of agencies and organisations managing forest land and resources beyond protected areas.

The main goal of the proposed conservation measures is to secure and increase the high level on naturalness found in Carpathian forests and to improve conditions to maintain species and habitats of conservation value, even in forest areas under intensive management. Specific conservation measures (e.g. establishment of large untouched forests) are particularly relevant to some categories of protected areas, such as national parks. In managed forests, close-to-nature forest management methods that imitate natural processes should be preferred, in order to maintain forest naturalness and support biodiversity.

Detailed recommendations can be found for some of the Carpathian countries (Romania, Ukraine) in guidelines for the identification and management of High Conservation Value Forests.

Protection measures

F1. Identify and protect all near-natural, old growth and virgin forests

Virgin and old growth forests[1] are some of the most important natural values of the Carpathians and all such forests should be identified, mapped and legally protected in all Carpathian countries.

Identification and protection of virgin forests in Romania

In September 2012, Romania welcomed the signing of a Ministerial order by the Minister of Environment and Forests, spelling out the criteria for identification of virgin forests, a key measure that will lead to the full protection of this important European treasure.

Establishing the criteria was the first objective in the Memorandum of Understanding signed in December 2011 between the Romanian Ministry of Environment and Forests and WWF Romania. The Ministerial Order and the Memorandum were the consequences of a powerful public campaign launched by WWF-Romania October 2011, aiming to protect the last Romanian virgin forests. More than 106,000 people signed a petition in support of the cause (www.padurivirgine.ro).

To solve the problem of compensation for private owners of virgin forests, the Ministry of Environment and WWF Romania intend to submit a proposal to the European Commission to include compensation payments for virgin forests owners in the programming period 2014-2020. In the short-term, the Ministry of Environment and WWF Romania will identify alternative financial mechanisms to compensate virgin forests owners.

Protection of old growth forests in Slovakia

Slovakia is one of a few European countries where forests still survive that have remained free from management and other significant impacts of human activities, and that can be defined as old growth forests.

During 2009 and 2010 FSC Slovakia conducted a complex survey to identify and map these old growth forests, within the project 'Protection of old growth forests in Slovakia'. Other activities of the project included improving the protection of old growth forests, increasing public awareness and exploring possibilities for sensitive use of old growth forests for research and ecotourism.

48 experts and professionals from the forestry, biology and ecology sectors were directly or indirectly involved in project implementation. The professional quality of the project was verified by eight members of a Scientific Board that included experts and scientists from renowned scientific institutions in Slovakia.

Using the database of forest stands of the National Forestry Centre and a survey of orthophotomaps, 324 localities covering over 53,000 ha were selected for field mapping, which identified the borders of the old growth forests and completed data forms for each locality. These data were processed using GIS and the database of old growth forests in Slovakia was created.

[1] According to Art. 7(k) of the 'Protocol on Sustainable Forest Management to the Framework Convention on the Protection and Sustainable Development of the Carpathians', 'virgin forests' are understood to be natural forests which have not undergone direct human activities during their existence, able to influence their development/ecological processes.

The results of the mapping show that the total area of old growth forests is significantly lower than was originally expected. Earlier estimates ranged between 18,000 ha and 24,000 ha, but the latest survey identified 122 locations with a total area of just 10,104 ha (only 0.47% of the forests of Slovakia). Of this area, only 6,925 ha (68.5%) is strictly protected. Out of the 122 localities, 68 are situated in National Parks, two in the buffer zones of National Parks, and 24 in Protected Landscape Areas. 118 sites are included in the Natura 2000 network.

However, the level of protection in National Parks, strictly protected zones and the Natura 2000 network is still inadequate and allows the possibility of logging and other management activities that may result in the loss of the virgin character of the old growth forests. Forest exploitation is being planned in previously inaccessible forest areas, new roads are being constructed and there are numerous applications for exceptions to protected status, mainly for the purpose of logging and for chemical use to prevent bark beetle outbreaks, even within UNESCO World Heritage Sites.

The project was funded by EEA Financial Mechanism, Norway Financial Mechanism and the State budget of the Slovak republic through the Ekopolis Foundation (www.ekopolis.sk). The project was also supported by WWF.

Picture 8: ***Old growth forest in Slovakia (photo: László Gálhidy)***

F2. Establish non-intervention zones in all large forest protected areas

Within all major forest protected areas, strict, non-intervention core zones should be established representing each natural forest type, and sufficiently large to ensure ecological processes and viability. Creation of these zones is not just important for virgin forest areas; it is also required in areas where relatively untouched ecosystems are absent, so that natural processes can be restored.

F3. Maintain different structural elements in forests: deadwood, hollow trees, microhabitats, rare tree species

There should be a general policy applied in the management plans and filed practices to preserve special structural and compositional elements in forests, which can significantly contribute to the maintenance of forest naturalness and biodiversity. This is an important measure not just in protected zones, but also in production forests, where the manager can enhance naturalness by preserving these elements, without significant loss of income.

F4. Extend the network of forest reserves (outside the PA system) and establish forest corridors

Non-intervention forest reserves, as well as reserves for the maintenance of certain species, should be designated in forest estates across the region, representing all natural forest types. Establishing corridors, especially in areas with high habitat fragmentation should become a priority. These reserves and corridors would supplement the PA network, enable the creation/maintenance of functional ecological networks and serving as reference areas for different fields of research related to forest ecology, forest management, climate change, zoology, botany, mycology, etc.

Forest reserves in Hungary

Forest reserves were established in Hungary in the late 1990s to create areas for researching natural forest dynamic processes; they include several plots for long-term monitoring. There are 63 sites of different forest types and naturalness (from artificial forest to old growth stands), with a total area of ca. 13,000 ha, all with core and buffer zones. Forest reserves are currently the only areas in Hungary where non-intervention management is in place.

F5. Ensure special protection of the full range of habitats in forest ecosystems

Forest ecosystems do not just comprise the main forest types described in Section 2.1.3., they also include a range of associated habitat types that support a much wider diversity of species, many of which do not occur in typical forest stands. The following are of particular importance.

Rare, threatened and endangered forest habitats

Rare, threatened, endangered forest types are special elements of Carpathian forest ecosystems, mostly relicts of former climatic periods. They usually harbour rare forest species complexes, and other important biodiversity features. Their identification and preservation, possibly as part of wider landscapes, are important goals for conservation.

Protecting rare species (European yew and capercaillie) by Municipal Forests of Banská Bystrica in Slovakia

The Municipal Forests of Banská Bystrica operate on 7,363 ha of forest land, partly in Veľká Fatra National Park. This includes the largest area in Slovakia and in Europe with a high density of European yew *(Taxus baccata)*. The managers of the Municipal Forests of Banská Bystrica ensure regeneration and conservation of the yew tree and its protection against damage by red deer, not only in protected zones, but also in managed forests. Protected areas and non-intervention zones are also established in the breeding season for the capercaillie (*Tetrao urogallus*).

Marginal habitats

Marginal habitats (e.g. streamside vegetation, vegetation on rocky outcrops, debris swamps, springs and other wetland types and heaths) often support higher biodiversity than the matrix of other forest habitats in which they can be found. Specialised, sparsely distributed species, are characteristic to these habitats, which can serve as permanent refuges for them. These habitats also often have roles as protective buffer zones or green corridors, which are important in landscape scale conservation.

Riparian forests

Riparian forests are special marginal habitats providing a series of ecosystem services besides their prominent conservation values. Their role in flood control and water purification is of great importance. However, they are extremely prone to invasive woody and herbaceous species, leading to a requirement for active conservation measures that should be implemented to protect them across the region.

Riparian forests in Ukraine

Riparian forests in Ukraine are highly valued, particularly for their role in riverbank protection and floodplain stability, and are recognised in forest legislation. These forests extend up to 300 m either side of the river and are mapped and managed specifically to maximise their protection role. Conservation cuts are allowed, but they are very seldom put into practice; most of these forests remain untouched.

F6. Establish fire detection and response systems

In general, many of the experts did not consider fire to be a major threat to the Carpathian forests at present, but certain forest habitats, notably pine plantations, are considered vulnerable. However, changes in the climate and increases in recreational use of forests are likely to increase the risk of fire in the future. There is therefore a need to develop risk mitigation plans and actions, and to establish systems and equipment for rapid response where necessary. Specifically the following measures are required in vulnerable locations:

- Public awareness programmes about fire.
- Training and equipping of fire response teams and coordination with responsible authorities.
- Establishment of cross border cooperation on fire prevention and control, specifically between Iron Gates Nature Park in Romania and Djerdap National Park in Serbia.

Active management measures

F7. Intensify efforts to control invasive species, especially in core zones and sensitive areas

Removal or effective suppression of alien and aggressively invasive species in protected areas should be a priority, where feasible, for foresters and protected area managers. Invasive animal and plant species are one of the greatest threats to protected and non-protected forest habitats, especially on lowlands and near rivers, streams and other wetlands, but also on rocky outcrops or sites near to plantations of invasive species (especially *Robinia pseudoacacia*). Eradication of invasive species is often costly and challenging and there is little experience of suitable techniques. The following actions should be prioritised.

- Focusing on removal or suppression of invasive species in all core areas of protected areas. While in some areas this may be unfeasible, early eradication of small stands, patches and invasive fronts is far more cost effective than later measures for extensive rehabilitation.
- Improved integration of monitoring of the occurrence and spread of invasive species as a part of routine forest and protected area survey and monitoring programmes.
- Interdiction of plantations of *Robinia pseudoacacia* in the vicinity of established reserves in forest areas.
- Research and dissemination of information about the impacts of the most pernicious species and techniques for their removal. However, it should be noted here that there is already extensive experience and expertise on invasive species management in Europe, which should be consulted and made use of before any new research is commissioned.
  - The European Union has already assembled extensive information and guidance on alien invasive species (AIS) and their management (http://ec.europa.eu/environment/nature/invasivealien/index_en.htm).
  - The IUCN Invasive Species Specialist Group provides extensive guidance and a network of expertise on AIS (http://www.issg.org/).
  - The European Network on Invasive Species (NOBANIS) provides detailed information and guidance on invasive species in Europe (http://www.nobanis.org/)

F8. Increase support for traditional low intensity forest management practices

Traditional sustainable forest management practices (less intensive practices developed and maintained over long periods with limited impacts on biodiversity and landscapes) should be identified, documented and supported. Some of these practices (e.g. agro-forestry) have been maintained by private owners or

communities for centuries in parts of the Carpathians, closely associated with other land uses such as grassland management. These practices should be supported; they are important in preserving landscapes, forest stand structure and biodiversity and also help maintain the relationship between local resources and local communities. Funding and improved awareness are essential for maintaining such fragile management systems, especially in changing economic conditions.

Picture 9: ***Transport of wood on a steam train in Maramures, Romania (photo: WWF)***

F9. Adopt and implement close-to-nature forest management more widely in the Carpathians

In contrast to conventional methods (clear cut, irregular shelterwood forest management), close-to-nature forest management means that silvicultural systems are applied which mimic natural processes of the forest ecosystem in which it is implemented. Usually this means smaller-scale and more irregular interventions in the forest, similar to natural disturbances. In the former Yugoslavian countries (e.g. Serbia) close-to-nature forest management had strong support after WWII, but there are traditions of such management in the other Carpathian countries as well. This approach reflects the multifunctional role of modern forest management (in contrast to the conventional purely productive role). It allows the combination of production, protection, research, amenity use and provision of ecosystem services, which when combined may more than compensate for the additional costs of management. There is however a need to create a harmonised language and common terminology for close-to-nature forest management and to improve its acceptance as a valid tool for combining forest management and nature conservation on a large scale, especially outside strictly protected areas.

Close-to-nature forest management in Hungary

Under the new Forestry Code of Hungary (2009) use of close-to-nature forest management is obligatory for 20% of the area of state owned forests of special designation (protective or recreational). The percentage increases to 25% and 30% in the following planning periods. The obligation is valid for all 150 forest management districts of Hungary. The following silviculture systems are considered to be 'close-to-nature'.

- Selection system
- Transforming system (a transitive silviculture system used to switch from regular shelterwood to selection system)
- Non-timber harvest system (mostly used in less accessible areas in protective forests, where only sanitary cuttings are allowed)

Changes of silviculture in erosion prevention forests, Ukraine

The latest edition of the Forest Code of Ukraine was approved in 2006 and a new Procedure for Assigning Categories to Forests was approved in 2007, which prescribed assigning a category of 'erosion prevention forests' to stands located at altitudes above 1,100 m asl. These areas are dominated in different regions by spruce or beech forests.

The objective of establishing this forest category was enhancement of protective forest functions, especially for watershed protection, since catastrophic floods occurred in the region in 1998 and 2001. The stands were commercial before 2007, but by changing the category, clear cutting was banned. The changes were introduced in 2008 in all relevant forestry units, and have resulted in enhancement of the water regulation and protective functions of high-altitude forests, leading to a significant decrease in soil erosion in the mountains.

F10. Regulate and limit sanitary cuttings

Misuse of sanitary cuttings should be forbidden in the Carpathian forests. Sanitary cuttings are widely used as exceptional harvesting operations, mostly after calamities and pest outbreaks. They are typically used in spruce forests, during and after bark-beetle outbreaks and are often applied across large areas often without adequate justification and even in strictly protected areas in some Carpathian countries. Sanitary cutting can make up as much as 50-60% of the total harvest, and is frequently used as a means to 'legally' exceed normal quotas (in some regions the bark beetle is named as the 'golden worm'). There is a need for a widespread agreement on the precise purpose and norms for sanitary cutting and a general presumption against all such practices in protected areas and especially in core zones and virgin or old growth forests.

Agreement among regional stakeholders regarding management in virgin forest reserve Zadná Poľana, Slovakia

The Nature Reserve (NR) Zadná Poľana belongs to the Protected Landscape Area (PLA) and Biosphere Reserve Poľana. In Slovakia there is a legal conflict between Forestry and Nature Conservation Law regarding bark beetle outbreaks, even in strict protected areas. Following the initiative of the Administration of the PLA Poľana there were long discussions between forest owners and protected area managers, resulting in a non-intervention regime in NR Zadná Poľana when bark beetle outbreaks occur.

F11. Extend the forestry road networks where necessary to improve access for extensive forest management systems

The forest road density may need to be extended where necessary, especially to allow 'close-to-nature' forest management and to avoid unsustainable logging practises. This is because single or group selection systems and more extensive and complex forest management methods require access to individual trees. Access can also be improved through use of new forest technologies and even reversion to old technologies (e.g. use of horses), but in some cases roads are necessary.

However new roads must be carefully planned and designed to cause minimum impact and should be properly gated and controlled to restrict illegal access. Special attention should be given to the movement of wild animals; ecological corridors should not be intersected by such new roads, nor should critical habitats for large carnivores for instance be disturbed (e.g. traffic in denning areas can affect the winter sleep of bears).

Ecosystem/landscape scale measures

These measures generally need to be adopted at higher levels by planning and regulatory authorities.

F 12. Ensure the overall maintenance of forest cover

Preserving the entire remaining forest cover in the Carpathian countries is of utmost importance and is a basic condition for maintaining biodiversity and all forest related ecosystem services. In some countries (e.g. Hungary), forest cover cannot be reduced by law; if any forest area is used for development, reforestation of other land is compulsory.

As well as through direct legal measures, preservation of existing forests can also be achieved by creating disincentives for forest land use changes. The area can be increased in a number of ways, such as:

- Planting degraded lands with locally adapted species.
- Inclusion of marginal (and often ecologically important) forest ecosystems in the forest land use category (e.g. low-density complexes of *Picea abies*, *Pinus cembra*, *Larix decidua* and *Pinus mugo* shrubs in the sub-alpine zone, *Alnus* spp. forests galleries along river banks).
- Establishing protective forest belts along permanent transport pathways and agricultural land.

Preservation of forest cover in Romania

According to the Forest Code, reduction of forest land area is prohibited, except in cases of prevailing national interest. The removal of an area from the forest is possible, but is very costly and complex, requiring compensatory establishment of another area of the same size, and an advance payment for the damage caused. In recent years in Romania there has been a slight increase in the forest estate as a result of afforestation on degraded land.

F 13. Prioritise maintenance of natural forests

Natural forests consist of local species and natural structures, which increases resilience of ecosystems to biotic and abiotic disturbances, including climate change. Modern sustainable forest management is based on this resilience and on the self-regulating potential of forests, which can only be applied in natural forests. Site adapted species will play an essential role in mitigating the consequences of climate change and to enabling adaptation of forests to its impacts.

Promotion and presence of natural forest types according to the climate and soil conditions should therefore be a fundamental principle for all forestry operations in the Carpathians (in production as well as protection forests) and should be a legal requirement.

Forestry measures in areas of spruce decline, Ukraine

In large areas of Ukrainian Beskydy, the dominant tree species was changed from beech (*Fagus sylvatica*) to spruce (*Picea abies*) by large-scale establishment of artificial plantations after harvesting of natural forests in past centuries. The total area of such artificial secondary stands in the region was more than 100,000 ha.

These stands comprised mainly middle-aged, mature and over-mature pure spruce and were highly productive, allowing a reduction in the rotation period for producing commercial timber. However, the spruce stands were severely impacted by drought in 2003, resulting in widespread die back. Consequently, selection sanitary cutting was undertaken in areas of spruce decline between 2005 and 2012. As a result, the dominant tree species has reverted to beech, and structures and species composition of the new beech stands are very diverse. This practice is now being applied in other regions of the Ukrainian Carpathians (e.g. Chornohora, Verkhovyna, Bukovyna).

The lesson has been that establishment of secondary commercial stands significantly decreases environmental stability of the landscape and the resistance of forests to stresses. Fast-growing commercial spruce plantations should be significantly limited and kept within scientifically justified programs.

Forest naturalness in the Forest Code, Hungary

Six forest naturalness categories were established under the new Forest Code of Hungary (2009), based on the share of non-native and invasive species in forest compartments. By law, levels of naturalness may not decrease through forest management.

F14. Prevent forest fragmentation and maintain the integrity of forest ecological corridors

Forest fragmentation should be avoided in all cases, and special attention should be devoted to maintaining critical ecological corridors, areas of forest that ensure connectivity between larger ecosystem blocks (including protected areas). Forest ecological corridors are of paramount importance, since many forest-dwelling species need connectivity to move and disperse through the landscape and forest connectivity and continuity is essential to ensure that sensitive animal populations have the possibility to exchange genetic material with other viable populations from the region.

- Priority forest corridors should be identified, defined and agreed in the Carpathians and should be protected.
- Forest planning, design and operations should maintain forest cover in all circumstances, and linear infrastructures such as roads, railroads should not be allowed to cut corridors or bisect large forest areas. Where there is no alternative, green infrastructure (e.g. eco ducts, viaducts) should become compulsory.

2.3.2. MEASURES RELATED TO THE ENABLING ENVIRONMENT

Planning and designations

F15. Establish a regional model for multifunctional forest management plans

A model set of regional technical guidance materials should be produced in consultation with foresters and conservation specialists to support production of special management plans for forests in protected areas and for other sensitive and important forest areas.

There is an urgent need to create legal, technical and economic conditions for active, differentiated forest ecosystem management within protected areas and for integrated management in all forest areas, This requires development and implementation of management measures that secure high production of timber and non-timber forest products, secure high quality environmental and social services and conserves biodiversity. In some countries (e.g. Hungary) special conservation management plans do not exist for forests in protected areas; only the normal forest management plan is used. Proper, scientifically based conservation management measures should be included in forest management plans. These conservation measures are essential in maintaining or restoring different habitats, specific processes, or in supporting certain species.

It is also necessary to strengthen cross-sectoral cooperation and coordination over management policies affecting forests and forestry (e.g. nature conservation, game management, tourism, etc.). Stakeholder participation, intersectoral consultations in the management planning for forests should become compulsory considering the importance for forests for society and for sustainable development.

F16. Establish a common, harmonised approach to zonation and management of forest protected areas

Core zones have not been widely established in most protected areas across the Carpathian region and there are considerable differences among Carpathian countries regarding zoning systems and the principles of their management.

Establishment of zoning system of national parks in Hungary

Hungarian national parks are lacking zoning systems. Since 1996, creation of zoning systems is a legal requirement, but it has not been implemented. There have been several attempts in some national parks to create zones, but all of them have failed because of objections by other stakeholders, especially state owned forest companies. After an effective WWF campaign in 2012 to prevent logging in the Csarna valley (a 1,000 ha strictly protected forest), political will increased for establishing national park zones by the end of 2013. However, strong debates, especially on the management of natural zones, are delaying the process once more.

Legal measures

F17. Strengthen procedures for EIA and assessment in Natura 2000 sites[2]

There is a need to develop consistent, transparent and practical Carpathian-wide standards for EIA and Natura 2000 assessments in forests.

The Habitat and Birds Directives have strengthened the role of impact assessment, which is obligatory for many projects and for major developments in Natura 2000 sites, but there are significant differences in the implementation of Natura 2000 impact assessment. A very strict regime is applied in the Czech Republic, where only authorised biologists can prepare the assessment. In Romania, relatively independent Regional Scientific Councils are established specially for large protected areas (all national and nature parks, and large Natura 2000 sites) comprising mainly scientists, which are authorised to make recommendations for the final decision on the investments, based on studies conducted by authorised experts.

A different situation applies in Slovakia, where the selection of authorised persons for the assessment is not so strict, and the country has been subject to interventions from the European Commission concerning improper implementation of the Habitats Directive concerning assessment of impact on Natura 2000 sites. In the whole process, there are still many gaps and the quality of evaluations is not ensured, leading to approval of harmful investments in Natura 2000 sites.

F18. Ensure full implementation of the EU Timber Regulation (EUTR)

The EU Timber Regulation (EUTR) should be properly implemented in the Carpathian countries, especially through effective traceability tools and 'due diligence' systems based on risk assessment. Recently, most of the countries are behind the schedule of implementation of the regulation; generally only some elements of EUTR are being fully implemented.

2.3.3. ECONOMIC MEASURES

F20. Institute credible forest certification schemes

Credible certification systems (e.g. Forest Management Certification, Chain of Custody, Controlled Wood Risk Assessment) should be promoted in the Carpathians, as these can have positive environmental, social and economic impacts. Certification systems should improve forest management practices from the environmental, social and production points of view.

[2] This measure is also recommended for Wetlands. See Measure W25.

High Conservation Value Forest (HCVF)

High conservation value forest (HCVF) is a Forest Stewardship Council (FSC) forest management designation used to describe those forests, which meet criteria defined by the FSC Principles and Criteria of Forest Stewardship.

Specifically, high conservation value forests are those that possess one or more of the following attributes:

- Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia) and/or large landscape-level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance.
- Forest areas that are in or contain rare, threatened or endangered ecosystems.
- Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control).
- Forest areas fundamental to meeting basic needs of local communities (e.g. subsistence, health) and/or critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities).

The HCVF concept has been introduced to some Carpathian countries (Romania, Ukraine) but not to others. As a useful tool it should be introduced to every Carpathian country in a harmonised way.

Introduction of FSC in Romania

Three different restitution laws were passed in Romania after the fall of communism in 1989. They have dramatically fragmented the forest property, challenging new forest owners, foresters and the government to properly manage this outstanding natural asset.

The FSC certification system was introduced and promoted in Romania more than ten years ago, with support from civil society. Forest certification was promoted as an incentive for both forest managers and for wood processing companies, meeting their expectations for responsible management. In only few years, the High Conservation Value Forest (HCVF) Toolkit was developed and revised and has been used at the national level for the identification and proper management of more than 100,000 ha of HCVFs.

The impact has constantly increased; at the moment 2.4 million hectares out of 6.3 million are certified in Romania, ensuring high standards for both state and private forest management.

F20. Promote production of high quality timber

Promotion of high quality timber on long rotations should be encouraged because of the wider uses of large dimension, high quality timber, and also because of the benefits of mature forest for biodiversity. Increasing demand for diverse timber products encourages establishment of uneven-aged forests with complex structures that include large diameter specimen trees. The selection system is one of the best measures to maintain valuable, quality timber with a special attention on every single tree through its life cycle.

High quality timber in Romania

In Romania, management of forests for production of high quality timber of large dimensions allows wood to be processed into high value products and creates forests aged 120 years or more, which is highly beneficial for biodiversity. This is one of the main reasons why Romania still has a rich forest biodiversity. In comparison, forests managed to produce pulp and paper on much shorter cycles (60 years) are more intensively managed and are distinctly poorer in biological diversity.

F21. Promote local use and processing of wood

Harvested timber should remain in Carpathian countries (the continuity principle); it should not be exported as raw timber, but should be processed into high value products in the region which can then be exported. This means that products have more value, helping to maintaining national economies and the living standards of local communities.

The principle of continuity in Romania

One of the basic principles of timber exploitation in Romania is to ensure the continuity of timber resources. This principle is mentioned in the Forest Code and forest norms, and aims at rational exploitation of timber resources so as to ensure the continuous and sustainable supply of wood resources from the same area.

In some cases, local processors have difficulty in accessing raw timber, as it is sold to larger producers in bulk. It is important to secure long-term access to raw timber for secondary wood processors to keep local industry permanently viable. This supports the efficient use of wood and provides better living standards for local communities, which can be beneficial for the whole forest environment.

Picture 10: Spruce forest in Slovakia (photo: László Gálhidy)

F22. Provide compensation for owners for restrictions on use of priority forest areas

Functional mechanisms are required in some countries to ensure compensation for restrictions imposed on private owners of pristine forests and threatened, rare or endangered forest habitats. Private owners should be compensated, if they have to fully or partly write off income from their property in favour of wider society. Compensation can take various forms

- Direct payments on the basis of 'profit foregone'.
- Land purchase.
- 'Land swaps' where an equivalent area of production forest is provided.
- Incentives for development of alternative, non-extractive uses of the forest (e.g. recreation, payment for ecosystem services).

F23. Promote recreational use of forests

There is great potential for extending recreational and educational use of forests in the region. Establishing 'Forest Schools', as has been done in Hungary, can significantly contribute to raising awareness about the exceptional role and importance of forests for society, creating a new generation that will really understand the complexity and sensitivity of these ecosystems. Low impact activities in forest such as informal day trips, hiking, cycling and horseback-riding on designated roads are important measures for education and awareness-raising and can bring significant income to protected area administrations, private owners, businesses and local people.

F24. Establish pilot projects for payment of forest ecosystem services

The direct beneficiaries of the forest ecosystem services should pay for them. The legal framework payment for forest ecosystem services has to be explored and developed, and the funds should be used mainly for compensation. In Hungary, there are some promising examples of compensatory measures (e.g. forest-environmental payments and Natura 2000 compensations) which involve private forest owners.

F25. Provide incentives for environmentally friendly technologies for forest management

Development and use of environmentally friendly technologies should be encouraged and supported. In order to introduce more developed forest management methods, special vehicles (e.g. small forwarders, low ground pressure vehicles) and other tools are necessary. While the profitability of new forest management methods is no lower than that of conventional ones, investment required for the shift to the newer methods can be high, which could discourage managers. Proper subsidy systems (for example tax relief on new technologies) may help to promote technological changes. In some cases reversion to traditional technologies such as the use of horses may become an efficient means of extracting timber from sensitive sites.

F26. Establish pilot projects for the regulation and sustainable management of fuel wood and non-timber forest products

The importance of non-timber forest products should not be overlooked. Generally, management of NTFPs is the responsibility of forestry authorities but receives much less attention than commercial timber production.

The harvesting and sale of products such as forest fruits, berries, mushrooms, wildflowers and medicinal plants is considered a 'hidden economy' that is often difficult to monitor and regulate. Many local communities rely on the income from gathering forest products, but commercial concerns (both legal and non-legal) also undertake harvesting or purchase products in commercial quantities. It can be difficult to distinguish between local subsistence users (who may hold customary rights to forest products) from commercial harvesters. It is also very difficult to ascertain whether rates of harvesting are sustainable and what damage harvesting is causing. Regulation of harvesting is also problematic, as the costs of establishing licensing schemes and conducting field assessments and control measures probably outweigh the income that can be derived.

Harvesting of fuel wood can also be problematic. Many communities rely on fuel for cooking and heating and often resort to illegal cutting or the black market to secure a supply, especially when fossil fuel prices are high and/or supplies are limited.

There are some good examples of well-regulated harvesting in the region (e.g. in Ukraine and the Czech Republic), but in many areas management of NTFPs is neglected. The consequence of this is not only potential environmental damage, but also loss of potential income from the forests and erosion of local rights and livelihoods as illegal or inadequately regulated commercial harvesting becomes more prevalent.

There is therefore an urgent need to identify best practices for regulating and monitoring harvesting of forest products and ensuring fair distribution of the benefits.

2.3.4. AWARENESS AND CAPACITY DEVELOPMENT MEASURES

F27. Improve capacity and awareness among all stakeholders about the value of forests and Sustainable forest management

Permanent programs that raise awareness of the role/importance of forest ecosystems are required. Table 3 summarises the main target groups that should be prioritised.

Group	Awareness priorities
Forest managers and owners	■ New techniques for planning and implementing low impact, environmentally friendly forestry ■ Virgin forests and wilderness concepts ■ Non-extractive values of forests and opportunities for marketing these values ■ Sources of support and advice
Planners and decision makers	■ The full economic value of forests and forest ecosystems ■ The range of available planning, policy and decision support instruments available to support multifunctional forest management
Wider public	■ The value of forests and the opportunities for enjoying and learning about forest ecosystems

Table 3. Awareness and capacity priorities for forest management and conservation.

F28. Improve access to training for all involved in forest management

There is a major requirement for technical training among foresters, forest owners, conservation managers, authorities, ecotourism operators, green NGOs, etc. Training providers (forestry colleges, NGOs, projects etc.) should be encouraged to develop accessible and practical training packages for owners and managers on modern, multifunctional forestry management and on special techniques for biodiversity friendly forestry.

2.3.5. RESEARCH AND MONITORING MEASURES

F29. Establish regional methods for assessment of forest naturalness

There is a need to develop consistent and comparable methods and standards for assessment of forest biodiversity and forest naturalness across the Carpathians. The first step should be to conduct a comparative desk-top assessment of existing criteria and practices for forest assessment and identification of high nature value forests. Based on this, a set of proposed harmonised measures should be proposed, tested and adopted across the region.

Forest naturalness assessment in Hungary

Forest naturalness assessment is a relatively new concept, and was first adopted in Hungary in the early 1990s (Bartha *et al.* 2004). The basic principle is the comparison of several variables of a managed forest habitat related to forest structure and composition with an ideal, 'natural' state of the same forest habitat. The main variables studied are: (i) species composition of the canopy layer, shrub layer, herb layer and of regeneration; (ii) structural characteristics of the canopy layer, shrub layer, herb layer and of regeneration; (iii) site features. Based on a protocol (TERMERD), more than 3,000 forest compartments were sampled and analysed all over the country.

Forest naturalness survey at forest compartment scale in the mountainous part of Duna-Ipoly National Park

A more detailed forest naturalness survey at the forest compartment scale was conducted in two study sites in a mountainous part of Duna-Ipoly National Park within the SEE project: 'Integrated management of biological and landscape diversity for sustainable regional development and ecological connectivity in the Carpathians'. The main objective of the survey was to test the applicability of the TERMERD protocol for non-conventional (close-to-nature) forest management regimes. The main research questions were as follows:

- How far do conventional habitat and vegetation maps support the biotic evaluation of forests?
- How far is the TERMERD protocol applicable for the biotic evaluation of forests at a finer landscape scale?
- What is the impact of non-conventional forest management?
- What are the lessons learned related to the establishment of long-term conservation monitoring systems of forests?

The following main conclusions were drawn from the study:

1. Management that maintains continuous forest cover (avoiding clear felling) can improve forest naturalness considerably. However, it is important to emphasise that even with continuous cover forestry, additional measures can be taken to improve the biodiversity value of forests.
2. Compositional characteristics (e.g. tree species composition) should be improved by leaving more admixed tree species (*Fraxinus excelsior, Acer pseudoplatanus*).
3. Structural characteristics should also be improved by leaving more dead wood. Closed patches are also to be untouched temporally, in order to avoid the creation of two-layered forest stands.
4. Functional characteristics should be improved by supressing the game effect, preventing erosion, and maintaining microhabitats.

See Standovár (2011) and Standovár (2012).

F30. Establish a region-wide long-term monitoring programme of forest biodiversity

There is a need to establish mid- or long-term forest condition monitoring (species diversity and forest structure) to clarify the wide range of effects on forest diversity and naturalness caused by different forest uses/managements. It is proposed that a set of regional forest monitoring plots and locations are established and monitored using a standard method.

Multipurpose assessment supporting forest biodiversity conservation in the Carpathian region of Hungary

The aim of this project (2012-2016) is the detailed survey and evaluation of forest habitats and animal groups (birds, bats and insects) in the Carpathian region of Hungary. These surveys were intended to fill gaps in knowledge about biodiversity (Natura 2000) and sustainable management of the forest resources. A large spectrum of forest services (wood production, ecosystem services) are taken into account and intersectoral cooperation is promoted through the project. In the case of bats, innovative, low cost developments (such as bat towers) will be installed as a medium-term means of halting population decline due to currently unfavourable forest conditions. The project also includes the development of a monitoring system of the effects of forest management on ecosystems and the services they provide. http://karpatierdeink.hu/news/ENG

F31. Establish a Carpathian-wide network of permanent long-term forest monitoring areas

Monitoring of certain parameters of forests in the Carpathians has a long tradition in the forestry sector. Changes in volume, species composition, health, biotic and abiotic disturbances etc. have been regularly surveyed by forestry authorities in the different countries for many decades. Detailed data at the forest compartment level is collected and stored in most of the countries and aggregated data related to forest management made available to the general public and decision makers.

However, data availability and transparency should be improved, in order to acquire better insights into the processes, both for expert and popular purposes[3]. Harmonization of terminology (using a 'common language') and basic data processing between the countries is essential for developing a common understanding of the whole asset throughout the region and of the impacts of management.

Although ideal, it is unrealistic to expect that all the countries in the region will harmonise all of their methods for forest monitoring and freely ensure sharing of all data. Therefore, a limited set of special forest monitoring areas should be established in the Carpathians that are representative of the main ecosystem types and different forest management approaches. For these areas standard monitoring protocols should be established and systematic and coordinated monitoring should take place in order to provide regular, reliable and comparable data on the state of Carpathian forests. This network should be established initially on a few sites and later expanded.

- The following aspects of forest monitoring should be prioritised in these areas.
- Standard systematic 'traditional' monitoring conducted by forest management authorities.
- Monitoring of the impacts on both production and the environment of different forest management systems and practices. For example, close to nature forestry, different approaches to game management, natural regeneration in response to different treatments etc.
- Monitoring of forest biodiversity, in particular a set of common indicator species.
- Monitoring of special elements of the forest structure (soil structure, dead wood, coarse woody debris, large trees, microhabitats etc.) that are important for biodiversity.
- Monitoring of impacts of long-term trends change on forest communities.
- Monitoring of the occurrence and impact of forest pests and diseases in relation to different management systems (including non-intervention).
- Monitoring of common threats to forests and their impacts (for example illegal logging, fire, invasive species).
- The monitoring process should be centrally coordinated and monitoring results freely and transparently shared.

[3] Difficulties encountered in collecting very general data from the Carpathians for this report illustrate this problem.

3. HIGH NATURE VALUE GRASSLANDS IN THE CARPATHIANS

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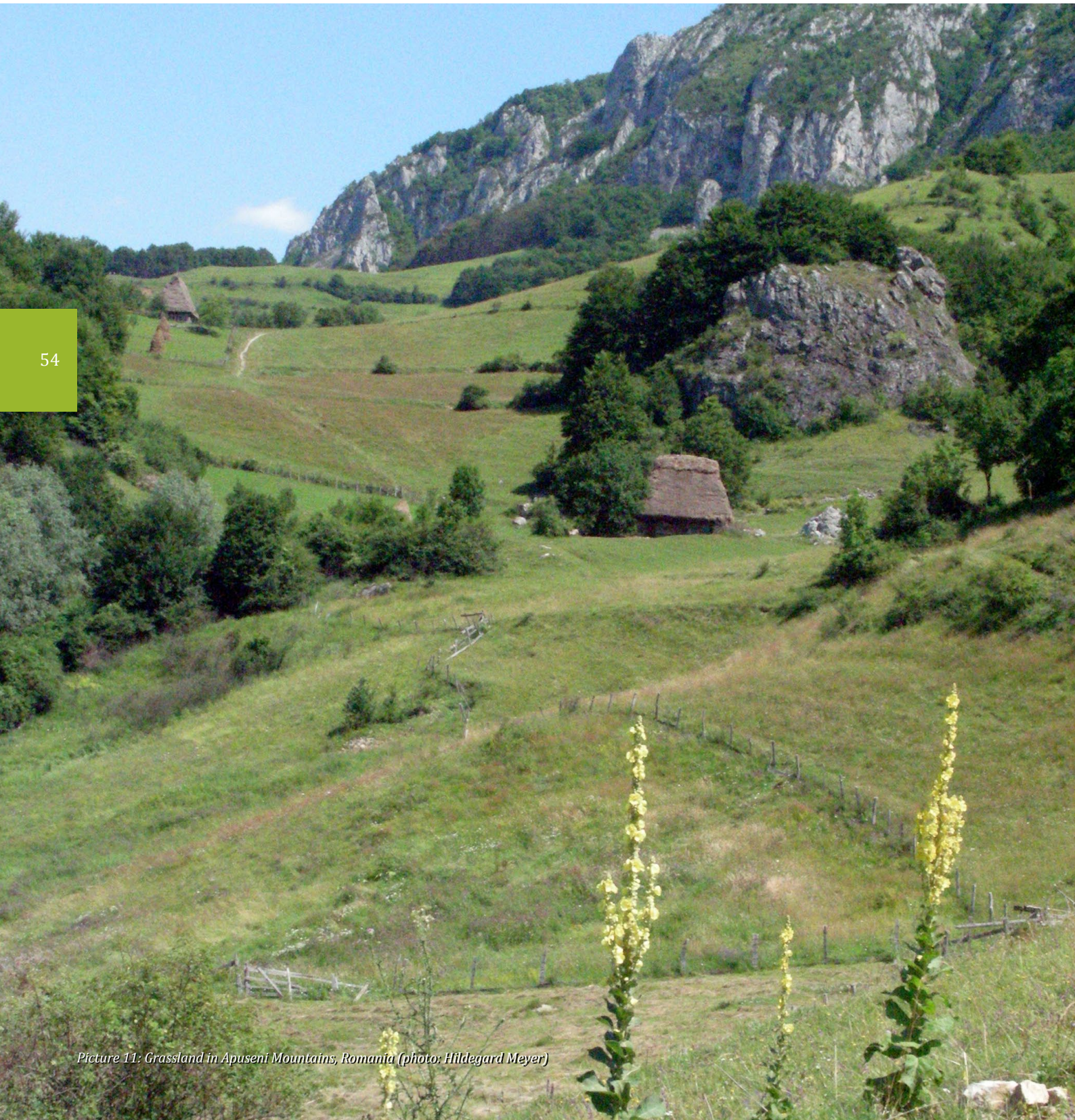


Picture 11: Grassland in Apuseni Mountains, Romania (photo: Hildegard Meyer)

3.1. ASSESSMENT

3.1.1. GRASSLAND TYPES IN THE CARPATHIANS

The grasslands of the Carpathians are among the most important habitats of Europe, due to their high species diversity. Meadows and pastures are an integral part of Carpathian landscapes, representing an inseparable part of their history. Some grassland types have a very long history, dating back hundreds or even thousands of years; they contribute significantly to agricultural production, and provide places for recreation. In addition, grasslands offer suitable conditions for the survival of numerous rare and threatened species of plants and animals and host a high number of endemic species. For example in Slovakia, more than 75% of endemic species grow in grasslands (Šeffer *et al*. 2002); more than 60% of Romanian vascular plants are grassland species and over 90% of the endemic, sub-endemic and threatened species in Romania are found in the Carpathian grasslands (Institutule de Cercetari si Amenajari Silvice, 1996).

The most species-rich habitats in the world!

Semi-dry grasslands of the White Carpathians (Bílé Karpaty), a mountain range on the border between the Czech Republic and Slovakia, have exceptionally high local species richness. In the grasslands in the Čertoryje National Nature Reserve in the southwestern part of the White Carpathians, Klimeš *et al*. (2001) recorded at least 67 and 88 vascular plant species in plots of 1 m^2 and 4 m^2, respectively.

Merunková *et al*. (2012) (www.sci.muni.cz/botany/chytry/Merunkova_etal2012_Preslia.pdf) recorded 105 vascular plant species per 16 m^2, 116 per 25 m^2, 131 per 49 m^2 and 133 per 100 m^2 at the same site, which holds the world record for species richness at five spatial scales (0.004 m^2, 0.25 m^2, 16 m^2, 25 m^2 and 49 m^2) (Wilson *et al.* 2012). The most common management of these grasslands has been mowing, practiced regularly for many years. Continuity as a managed grassland since Neolithic times has, according to Hájková *et al*. (2011), allowed thousands of years for the immigration and sorting of species, and for evolution to occur locally.

Many of the dry grasslands in Transylvania have been shown to be exceptionally rich in vascular plants when compared to other dry grasslands in Europe (Dengler *et al*. 2009). In a recent review, Wilson *et al*. (2012) found that the richness values recorded in one particular site close to Cluj-Napoca were the highest ever recorded at two spatial scales (0.1 m^2 and 10 m^2) in any vegetation type worldwide. This review generally found that below 100 m^2, extensively managed nutrient poor grasslands of the temperate zone (subcontinental Europe and Argentina) show higher maximum plant species richness than tropical rainforests.

We can conclude that semi-natural dry grasslands in the Carpathians belong to the most species-rich plant communities of the world!

Grasslands, however are strongly influenced by land use change, intensification of agriculture and land abandonment and currently belong to the most threatened habitat types (Kozak *et al*. 2011). In order to address these threats, a range of EU-level agricultural and nature conservation policies are in place to ensure sustainable land use and conservation of biodiversity and ecosystem services. Most relevant for grassland conservation are the agri-environmental subsidies and the Natura 2000 network. Due to their species richness and high levels of endemism a significant proportion of sites including various types of grasslands have been included into protected area networks at the national or European level (Natura 2000 network, excluding Ukraine and Serbia).

The Habitats Directive has proved to be an effective policy instrument, which has helped to delineate biodiversity hotspots in the Carpathians. Annex I to the Habitats Directive lists 45 grassland and meadow habitats of different types: natural, semi-natural, calcareous, dry, mesophile and humid, reflecting the

high diversity of grasslands and the fact that most of them have been modified, created or maintained by agricultural activities (EEA 2010). Fourteen grassland habitat types (four of them priority habitats) from Annex I have been recorded in the Carpathians, which amounts to 31% of all grassland habitat types of the EU. These habitat types contain 27 plant associations (well defined ecological groups). A further 11 vegetation types are not listed under the Habitats Directive, but have significant biodiversity and socio-economic value for the Carpathians. In total, therefore 38 vegetation types are known to be present (Table 4).

Habitats (including code) according to Annex I of the EU Habitats Directive	Vegetation types (plant associations)
1340 Inland salt meadows	*Festucion pseudovinae* Soó 1933
6150 Siliceous alpine and boreal grasslands	*Juncion trifidi* Krajina 1933, *Festucion picturatae Krajina 1933 corr. Dúbravcová in Kliment et al.* 2007, *Festucion versicoloris* Krajina 1933, *Caricion curvulae* Br.-Bl. 1925
6170 Alpine and subalpine calcareous grasslands	*Caricion firmae* Gams. 1926, *Festuco saxatilis-Seslerion bielzii* (Pawl. Et Walas 1949) Coldea 1984, *Seslerion tatrae* Pawłowski 1935 corr. Klika 1955
6190 Rupicolous pannonic grasslands (*Stipo-Festucetalia pallentis*)	*Bromo pannonici-Festucion pallentis* Zólyomi 1966, *Diantho lumnitzeri-Seslerion* (Soó 1971) Chytrý et Mucina 1993 in Mucina *et al.* 1993, *Seslerion rigidae* Zoly. 1939
6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (important orchid sites)	*Bromion erecti* Koch 1926, *Koelerio-Phleion phleoidis* Korneck 1974, *Cirsio-Brachypodion pinnati* Hadač et Klika ex Klika 1951
6230 Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas	*Nardion strictae* Br.-Bl. 1926, *Nardo-Agrostion tenuis* Sillinger 1933, *Nardo-Juncion squarrosi* (Oberd. 1957) Passarge 1964, *Potentillo-Nardion* Simon 1957
6240* Sub-continental steppic grasslands	*Asplenio-Festucion glaucae* Zólyomi 1936
6250 Pannonic loess steppic grasslands	*Festucion valesiacae* Klika 1931
62C0* Ponto-Sarmatic steppes	*Stipion lessingianae* Soó 1947
6410 *Molinia* meadows on calcareous, peaty or clavey-silt-laden soils	*Molinion coerulae* Koch 1926
6440 Alluvial meadows of river valleys of the *Cnidion dubii*	*Deschampsion caespitosae* Horvatić 1930
6510 Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)	*Arrhenatherion* Koch 1926
6520 Mountain hay meadows	*Polygono-Trisetion* Br.-Bl. et R. Tx. ex Marshall 1947
7230 Alkaline fens	*Caricion davallianae* Klika 1934

Table 4. ***Grassland habitat and vegetation types of the Carpathians.***

In order to facilitate local monitoring and management by site managers and non-expert botanists these associations can be broadly categorised into six ecological groups which form the basis for the management measures proposed in this report (Table 5).

Ecological group	Vegetation types included in the ecological group
Alpine and subalpine grasslands	*Astero alpini-Seslerion calcariae* Hadač ex Hadač *et al.* 1969 *Calamagrostion arundinaceae* (Luquet 1926) Jeník 1961 *Calamagrostion variae* Sillinger 1931 *Calamagrostion villosae* Pawł. *et al*. 1928 *Caricion curvulae* Br.-Bl. 1925 *Caricion firmae* Gams. 1926 *Festucion carpaticae* Bělohlávková et Fišerová 1989 *Festucion picturatae* Krajina 1933 corr. Dúbravcová in Kliment *et al*. 2007 *Festucion versicoloris* Krajina 1933 *Festuco saxatilis-Seslerion bielzii* (Pawl. Et Walas 1949) Coldea 1984 *Juncion trifidi* Krajina 1933 *Poion alpinae* Oberd. 1950 *Poion violaceae* Horv. 1937 *Seslerion tatrae* Pawłowski 1935 corr. Klika 1955
Dry grasslands	*Asplenio-Festucion glaucae* Zólyomi 1936 *Bromion erecti* Koch 1926 *Bromo pannonici-Festucion pallentis* Zólyomi 1966 *Cirsio-Brachypodion pinnati* Hadač et Klika ex Klika 1951 *Diantho lumnitzeri-Seslerion* (Soó 1971) Chytrý et Mucina 1993 in Mucina *et al*. 1993 *Festucion valesiacae* Klika 1931 *Koelerio-Phleion phleoidis* Korneck 1974 *Seslerion rigidae* Zoly. 1939 *Stipion lessingianae* Soó 1947 *Thymio comosi-Festucion rupicolae* Pop 1968
Mesic grasslands	*Cynosurion* R. Tx. 1947 *Arrhenatherion* Koch 1926 *Polygono-Trisetion* Br.-Bl. et R. Tx. ex Marshall 1947
***Nardus* grasslands**	*Nardion strictae* Br.-Bl. 1926 *Nardo-Agrostion tenuis* Sillinger 1933 *Nardo-Juncion squarrosi* (Oberd. 1957) Passarge 1964 *Potentillo-Nardion* Simon 1957 *Violion caninae* Schwickerath 1944
Saline grasslands	*Festucion pseudovinae* Soó 1933 *Juncion gerardii* Wendelberger 1943
Wet grasslands	*Calthion* R. Tx. 1937 *Caricion davallianae* Klika 1934 *Deschampsion caespitosae* Horvatić 1930 *Molinion coerulae* Koch 1926

Table 5. Main grassland ecological groups in the Carpathians.

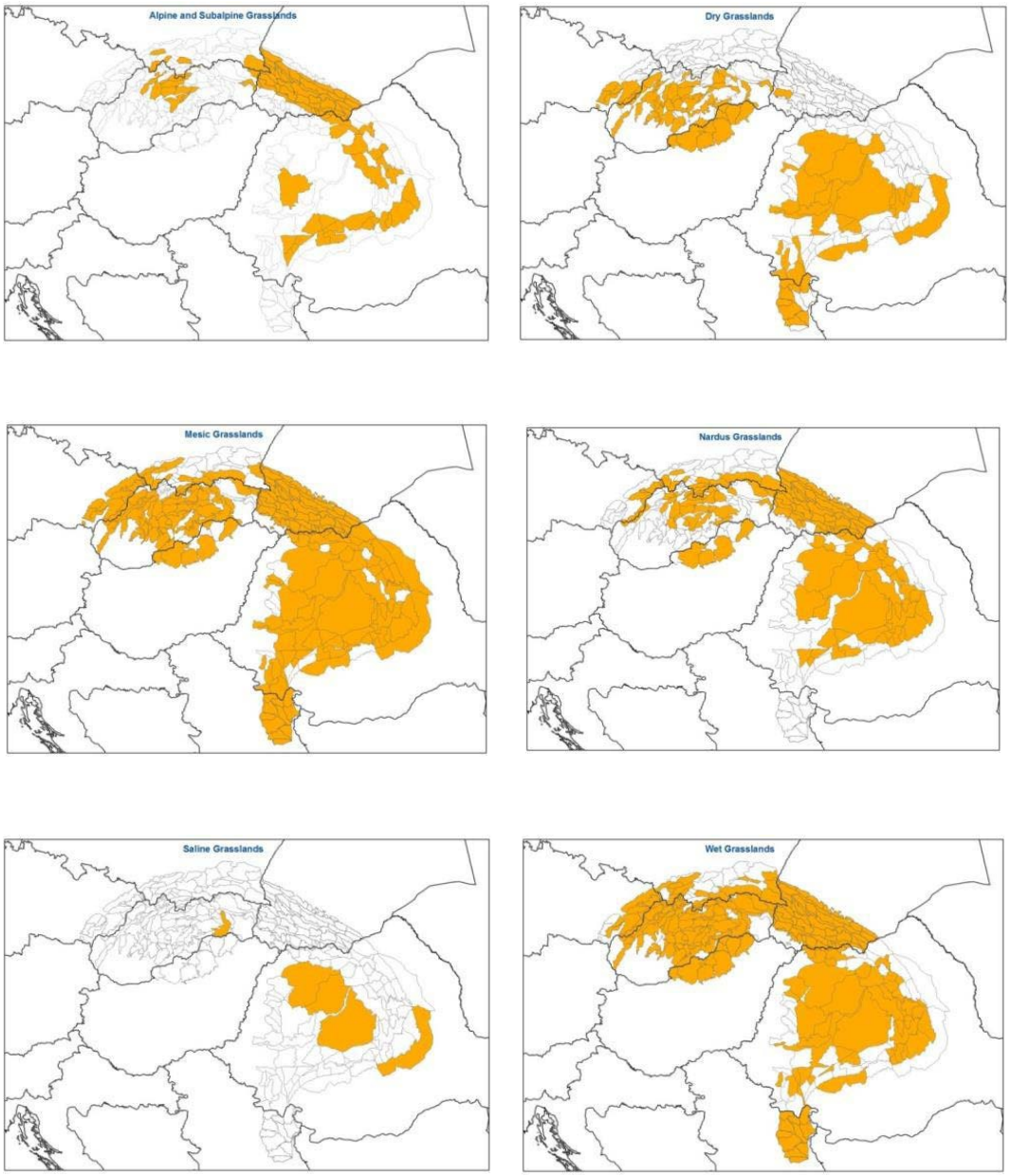
3.1.2. CURRENT STATUS AND MANAGEMENT OF CARPATHIAN GRASSLANDS

Distribution of grassland types

Map 3 shows the distribution of the main grassland types, based on orographic units. Data for these analyses were taken from the Carpathian Biodiversity Information System (CBIS), a tool for gathering published or recorded and not yet published data on the occurrence of plant and animal species and habitats in the Carpathians. The CBIS is managed by Daphne-Institute of Applied Ecology on behalf of CERI.

For the purpose of this study, we have assembled data on distribution of grassland habitats from the Carpathians and have analysed 38 grassland habitat types (27 classified as HD Annex I, and 11 other habitat types). The data are presented in terms of presence/absence within the orographical units of the Carpathians.

Assessments on the conservation status of the habitat types and species of Community interest are included in the maps, based on assessments conducted in EU-25 for the period 2001-2006 as part of the Habitats Directive, Article 17 reporting process (http://bd.eionet.europa.eu/article17/index_html/habitatsummary). In this assessment, data is missing from Romania, because of the country's late accession date. There also are limits to the relevance of assessments from the Czech Republic and Hungary because the Carpathian region is only small part of a larger biogeographical region. The assessments are better for Slovakia and Poland, as their limits for the alpine biogeographical region correspond closely with the delineation of the Carpathian Mountains.



Map 3. ***Grassland distributions in the Carpathians.***
(Maps are based on presence/absence in the orographic units of the Carpathian Biodiversity Information System (CBIS) www.carpates.org/cbis.html)

Changes in management of grassland

In recent years, considerable attention has been paid to the management and conservation of grassland habitats in the Carpathians. This is the result of recognition of the international importance of these habitats and of the commitments which Member States of the European Union are bound to follow in the field of nature conservation. However, it is also a consequence of the significant loss and degradation of rich-in-species grasslands.

Most of the grasslands have been maintained through long-term extensive management, but in recent decades grassland biodiversity has faced several threats. During the communist era, farmers in many countries were forced to join cooperative farms, leading to dramatic changes in the landscape. Management of many types of grassland was intensified; they were ploughed, re-seeded with commercial seed mixtures and enriched with artificial fertilisers in order to increase yields. At lower altitudes, many grasslands were transformed to arable land. Traditional management by individual farmers persisted only in remote mountain areas, where cooperative farming would not be effective, or because of a strong resistance from local people. Intensification was one side of the coin; the other side was land abandonment. Some remote areas, which were inaccessible for the machinery of cooperative farms, were abandoned or afforested.

Political and economic transition in the Carpathian countries started after 1990. The agricultural sector, which was highly dependent on financial support from the state, showed significant changes in its economic structures. State subsidies dropped substantially, leading to a dramatic decline in the numbers of livestock. Privatization of the majority of state-owned enterprises and cooperative farms started, and small farmers got the chance to re-establish their holdings. By that time however, younger generations had lost their relationship with the land and their interest in agriculture. Therefore in some areas, and especially in the Western Carpathians, most of the land is still managed by large enterprises (private companies or transformed cooperative farms). The area of grassland keeps shrinking, and in remote mountain areas and localities with adverse natural factors (such as bad accessibility or waterlogged soil), farmers are leaving their lands. Decreases in state subsidies have also accelerated land abandonment and led to dramatic decreases in livestock numbers. Consequently, large areas of biodiversity importance dependent on grazing are threatened, and the nature conservation value of many natural types of grassland has reduced.

Particularly important for biodiversity are small-scale farms in Central, Eastern and Southern Europe, which are responsible for creating and maintaining species-rich semi-natural grasslands. Smallholding-based production remains a key component of livelihoods in the mountain areas of Romania and Ukraine and the abandonment of these small farm systems results in the loss of dependent grasslands species and habitats (EC 2008).

High Nature Value grasslands

Starting in 2004, agri-environment payments were introduced in the Czech Republic, Slovakia, Poland and Hungary and in 2008 these payments were also introduced in Romania. It was an important process for Carpathian EU Member State countries to establish and design national agri-environmental schemes, focused on maintaining the existing, low-input, farming systems, which contribute so much to the character and conservation value of the region.

High Nature Value (HNV) farmland can be defined as those areas in Europe where agriculture is a major (usually the dominant) land use and where that agriculture supports or is associated with either a high species and habitat diversity or the presence of species of European conservation concern, or both (Andersen *et al*. 2003). The identification of HNV farmland has been one of the most significant steps towards biodiversity conservation within European agricultural policy. Under recent rural development legislation, HNV grasslands are identified as areas in Europe requiring special attention, and their total area is one of the indicators evaluated under the Rural Development Programme of Member States. The definition and application of agri-environmental programmes represent important steps in the right direction. However, such programmes do not necessarily specify target areas with a higher abundance of habitats that are important for biodiversity conservation. This means that the more accurate delineation of the High Nature Value grassland areas is particularly important, as it can lead to better targeted application of measures for maintenance of habitats and species dependent on agricultural management (Halada *et al*. 2011).

Picture 12: Grassland in Apuseni Mountains, Romania (photo: Hildegard Meyer)

Wet grassland restoration and introduction of agri-environmental schemes in Slovakia

Belianske lúky Meadows (located in the foothills of the High Tatra Mountains in the Western Carpathians, Slovakia), is the largest and best-preserved calacareous spring-fed fen in Slovakia, and includes rare wet grasslands of high ecological value. It has been protected as a National Nature Reserve since 1983, and in 2004 was established as a Site of Community Importance with an area of 106 hectares.

The reserve has been a meadow complex for a long time. The cadastral map of 1878 indicates that the area was divided into narrow plots and was used by a large number of small farmers. According to those who remember, the meadows were cut late in summer, or even in autumn. Since the terrain was very wet, the hay was carried out by hand and used as bedding or fodder for horses.

By the 1970s, interest in farming had declined, but most plots were still regularly mown, albeit not every year. This led to a process of forest encroachment. Paradoxically, the total abandonment of the meadows only started after the territory was declared a nature reserve. Since the locality had not been used for a long time, restoration management was implemented before the reintroduction of a regular mowing regime, and included cutting down shrubs and trees and mulching (mowing without removing the hay). Since the locality is extensive and difficult to access by machine, it was not feasible to remove all the wood from the area, so that most of the material was mulched during the season following cutting, using a light machine with wide tyres; traditional tractors would compress the wet surface, and create deep furrows.

Mulching requires that the wet surface is flattened, and the tree stumps removed, preparing the area for regular subsequent mowing. It is recommended that this method of land management is used only for a maximum of two consecutive years. Between 2006 and 2009, the majority of secondary forest was removed from an area of 34 ha, and an additional 46 ha of fen meadows with shrub encroachment was mulched. Restoration management was financed using project money from the Global Environmental Facility. One local farmer involved in the restoration management also applied for regular subsidies from agri-environmental schemes for mowing around 40 ha of wet meadows, which ensure the continued use of the site.

The funding from agri-environmental subsidies for farmers in Slovakia includes direct payments of € 120/ha for permanent grassland. In addition, payment may be requested due to difficult conditions in mountain areas, increasing the basic amount to € 135.53/ha. This amount can be further increased by claiming compensation funding in the framework of NATURA 2000 (€ 94.50/ha) or by applying agri-environmental payments (€ 186.58/ha for nutrient poor wet fen meadows and fen). In this way, funding can amount to a total of approximately € 330/ha, and as much as € 420/ha, when hand mowing or mowing by light machinery is used (Madaras *et al*. 2012).

Conservation status of habitats of European importance

Member States have a clear responsibility under the Habitats Directive to ensure that all habitats of Community interest are maintained or restored to favourable conservation status. Natura 2000 sites have a crucial role to play in achieving this overall objective, since they harbour the most important core sites for these species and habitats. Each site must be managed in a way that ensures it contributes as effectively as possible to helping the species and habitats for which it has been designated reach a favourable conservation status within the EU. However, 76% of the assessments of grassland habitats of European interest are unfavourable and only 5% of the assessments are favourable (EEA 2012), indicating that much remains to be done in these sites.

SPECIFIC CHARACTERISTICS OF MAIN GRASSLAND TYPES AND THE THREATS THEY FACE

Alpine and subalpine grasslands

Ecological characteristics

Alpine and subalpine grasslands are natural ecosystems of the Carpathians, limited in their occurrence to the high mountains. The majority remains very close to a natural state and exhibit a high biodiversity that includes many endemic species. Most of the alpine and subalpine grasslands are relic types of vegetation, with a long-term, stable floristic structure, exhibiting only local changes caused by natural factors. The large diversity of plant communities that are included in this ecological group is the result of a high variability in ecological conditions, especially in terms of plant cover, topography, edaphic conditions, and climate. Calcareous grasslands are rich in species and communities, while diversity is even higher in the siliceous grasslands.

They are unique habitats, with high aesthetic, scientific and biodiversity value. At present, the majority of these grasslands are located in national parks and protected areas, often on sites subject to strict protection.

Threats

In the alpine grasslands of the Southern Carpathians, intensive sheep grazing has caused a dramatic decrease in biodiversity and led to soil erosion in many places in recent decades. Because of limited food resources, sheep are increasingly forced to graze on steep slopes, which were formerly not grazed and are considered as local biodiversity hotspots (Baur *et al*. 2007). In the Western Carpathians, grazing is very limited. Adverse changes in the floristic composition of the grasslands lead to a decline in previous traditional farming practices, mainly grazing by livestock and afforestation (against avalanches) by spruce and dwarf pines.

Undergrazing on subalpine pastures can lead to the spread of competitive tall grasses such as *Deschampsia cespitosa, Avenula planiculmis, Calamagrostis arundinacea*. Areas are increasingly becoming overgrown by trees and shrubs or have been afforested artificially.

A further growing threat to alpine and subalpine grasslands is the development of mass tourism, leading to trampling and erosion.

Picture 13: ***Alpine meadows along the treeline in Romania (photo: Dan Dinu)***

Dry grasslands

Ecological characteristics

Carpathian dry grasslands are among the most species-rich plant communities in Europe, and contain a large number of endemic, rare and endangered species. This ecological group includes dry to semi-dry grasslands, occurring from the planar to the mountain levels and comprising several clearly different vegetation types. Dry grasslands include narrow-leaved continental steppe grasslands dominated by tussocky fescues and various species of *Stipa*. Semi-dry grasslands are dominated by several species of tall grasses and a variety of colourful herbs, and are often rich in orchids. They grow mainly on neutral to alkaline soil over limestone, dolomite, fluvial sediments, loess and neo-volcanic bedrock, but also on acidic soils. These communities inhabit south-to-west-facing slopes and flat areas.

Traditionally, dry and semi-dry grasslands were extensively grazed or mown once a year. These dry and warm locations have poor soils and are low in nutrients, so they are of little importance for present-day agriculture, as production of biomass is quite low.

Threats

Three general threats affect dry grasslands:

- Lack of grazing or inappropriate grazing, leading to changes in the microclimate, a change in the characteristic vegetation and thus in the structure and function of the habitat type.
- Fragmentation of the areas of grassland, leading to isolation and local extinction of key species.
- Abandonment, following the recent cessation of traditional management, many of these grasslands are changing towards more mesic vegetation as they become overgrown with bushes and trees, changing the structure and function of the ecosystem, resulting in an increase in soil nutrients and a decline in grassland species richness.

Mesic grasslands

Ecological characteristics

Communities of mesophilous meadows and pastures are widespread in the Carpathians. This ecological group is very heterogenic and includes three vegetation types with different ecological and management requirements. They occur on various types of substrate, from lower elevations to high mountains. Since the ecological spectrum of their occurrence is relatively wide, their species structure is variable, being influenced not only by ecological factors, but also by management practices. The most rich-in-species vegetation can be found in long-term, traditionally managed sites.

Threats

The presence of mesic grasslands is linked to traditional agricultural systems, but the intensification of farming has led to a decrease in the area of these valuable habitats. In remote areas they are threatened by lack of management caused by abandonment.

Nardus grasslands

Ecological characteristics

Nardus grasslands are short-grass habitats occurring on poor soils. They differ from other grassland types because of their position along the ecological gradient of nutrient content in soils. This habitat is found on different substrates, from the uplands to the sub-alpine vegetation belt in most mountainous areas of the Carpathians.

Threats

Nardus grasslands are low productivity grasslands, which persist due to extensive farming with low inputs. Intensification of agriculture has promoted their conversion into grassland types with a higher biomass production. *Nardus* grasslands are traditionally used as seasonal pastures, and transhumance is frequent. The marginalisation of rural areas and land abandonment in the mountainous areas where most *Nardus* grasslands occur has led to their deterioration and transformation into heath or shrub communities, or to succession to forest (Galvánek, Janák 2008).

Saline grasslands

Saline grasslands occur near salty and semi-salty surface and ground water. Many of the plant species growing in salt meadows are obligatory or facultative halophytes. These habitats are usually wet in the springtime, and occur on small sites as part of a mosaic with other communities. Saline grasslands are reported mainly from Romanian Carpathians, and marginally from Slovakia. This habitat type is infrequent in the Carpathians and is not considered in detail in this study.

Wet grasslands

Ecological characteristics

These grow on mineralised fen soils, ranging from alkaline to acid in character. Here, fluctuation of the underground water level is typical throughout the year; there are no surface floods, and these areas dry to a greater depth during summer. For the rest of the year, the water table remains close to the soil surface.

Threats

Fertilization and grazing are not recommended, as high nutrient inflow leads to colonisation of wet meadows by reeds (*Phragmites)*. Currently, most localities are unmanaged and becoming overgrown by shrub willows and voluntary woody plants. Their removal is necessary for the restoration of this habitat, but this is very time-consuming and expensive.

Picture 14: ***Grassland in Slovakia (Ján Šeffer)***

3.2. COMMON INTEGRATED MANAGEMENT MEASURES FOR HIGH NATURE VALUE GRASSLANDS

3.2.1. SPECIFIC CONSERVATION MANAGEMENT MEASURES FOR IMPLEMENTATION BY PROTECTED AREA ADMINISTRATIONS AND OTHER GRASSLAND MANAGERS

These measures are arranged according to the different grassland types described in the previous section.

Management of alpine and subalpine grasslands

G1. Adopt non-intervention management for alpine and remote subalpine grasslands

In general, the majority of alpine and subalpine communities do not need active management in order to preserve their good condition. The main form of management should be to minimise trampling and disturbance by livestock and by visitors to the mountains.

In the Western Carpathians, there is little or no interest in the management of grasslands at such altitudes, grazing is considered unsuitable because of erosion and is therefore prohibited in some national parks. In some areas of the Southern Carpathians too, grazing has been forbidden in zones where alpine habitats are present (projects LIFE 03 NAT/000032 'Natura 2000 sites in Piatra Craiului National Park').

G2. Maintain low intensity grazing in traditionally managed subalpine grasslands

Subalpine pastures tolerate and may benefit from moderate grazing. The elimination of grazing can lead to the disappearance of some species, while overgrazing and overstocking in certain areas (e.g. resting and watering places) profoundly alter the vegetation and cause soil erosion (García-González 2008). The overgrazing of alpine grasslands can lead to significant changes in biomass, floristic composition, diversity, and the recycling of nutrients in the community. Management plans for particular sites should indicate whether and where grazing by livestock should be maintained, and what should be intensity of grazing (García-González 2008).

G3. Limit use and development on alpine and subalpine grasslands and conduct restoration in priority areas

Restoration management interventions are important, particularly in cases when these areas have been afforested or otherwise damaged in the past (e.g. by the felling of mountain pine or construction of ski resorts). Preventative management includes, above all, following observing visitor regulations in protected areas, maintaining hiking trails on set routes, limiting inappropriate forest plantings and last, but not least, avoiding any further building of recreation facilities in these rare habitats.

Management of dry grasslands

G4. Maintain traditional low-intensity grazing on dry grasslands

Slightly different management regimes are suitable for dry and semi-dry grasslands.

Dry steppic grasslands

According to the Czech Rural Development programme, dry steppic grasslands should be grazed at least once a year by sheep or goats only within a set period. After the end of grazing, specified undesirable expansive weeds should be mowed. The mowing of ungrazed vegetation is not obligatory, unless a Nature Conservation Authority stipulates otherwise. (http://eagri.cz/public/web/file/10574/RDP_November_2008.pdf).

In Poland, within the agri-environmental support scheme, the maximum permitted livestock density is between 0.4 and 0.6 Livestock Units (LU) per hectare, with maximum pasture load amounting to 5 LU/ha (2.5 t/ha).

Semi-dry grasslands

Semi-dry grasslands were traditionally managed as unfertilised, annually mown meadows, where the animals grazed on the aftermath in the autumn. Grazing by a mixed flock of sheep, goats and cattle is optimal, while the size of the flock should be directly proportional to the length of grazing time. The main prerequisite for preserving these communities is the exclusion of fertilization. Mowing of the grasslands usually takes place at the beginning of July (Šefferová Stanová, Plassman Čierna eds. 2011).

In addition to active management, restoration management is also very important, including removal of voluntary woody plants, and subsequent regular mowing or extensive grazing.

Extensive management of dry grasslands in Transylvania

The Transylvanian Plateau in Romania is well known for its large areas of a variety of dry grassland types, still traditionally managed by low-intensity mowing or grazing. Traditional agricultural practices that have mostly been lost in Western Europe, such as common grazing and hand scything of meadows, are still part of everyday farming life (Akeroyd 2006).

Transylvanian dry grasslands face two main threats. First, land use change through afforestation with non-native pines or conversion into arable fields in more productive areas. Second, cessation of traditional use as pastures or hay meadows due to changes in the socio-economic situation, leading to accumulation of dead material, shrub encroachment, diversity losses and changes in vegetation structure (Ruprecht *et al*. 2009). The open and unfenced grasslands are currently managed by extensive sheep and cattle grazing, and by hay cutting and occasional burning to control scrub (Jones 2010).

The ADEPT foundation in Romania supports small scale farming communities in the southern Transylvania region to diversify and increase their income from extensively grazed grasslands, to improve livelihoods and to conserve species. They encourage projects involving local products and branding, from foodstuffs (cheese, jam, honey, herbs) to crafts, tourism and local markets. They also help with processing equipment, hygiene standards and effective marketing.

See www.fundatia-adept.org for more details.

Is burning a suitable management option for dry and semi-dry grasslands?

Burning generates much debate and a wide range of opinions. In Hungary and Romania, it is customary practice that if a grassland or fallow land is not used, local people burn it irregularly or even every year.

Burning is considered as being highly dangerous for the diversity of grasslands from a scientific point of view, but the real effects of burning on semi-dry grasslands are hard to estimate accurately. Some areas that have been burnt regularly are very species-rich and maintain high conservation values; and at the same time, some sites are strikingly species-poor, supposedly again because of burning. Most probably, burning is only one factor among many (e.g. historical land use, time of abandonment, surrounding landscape) which shape the conservation status of a semi-dry grassland stand. More detailed analysis of these many factors would be needed in order to reveal the real effect of burning (Illyés 2009).

If burning is carried out as a one-off action in limited problem areas, and as early in the year as the disappearance of snow cover allows (late February/early March), then we believe that it may be a viable way of restoring dry grasslands suffering from profound effects of abandonment (thatch of dead material at ground level, invasive scrub etc.).

Management of mesic grasslands

G5. Maintain traditional mowing and grazing regimes

Traditional management is a combination of mowing once or twice a year with occasional extensive grazing in communities with a high biomass production. These meadows can be fertilised using small amounts of manure, especially if they are mown two or three times a year. In the case of agriculturally unused meadows, it is necessary to maintain rotational management (mowing, grazing and fallow). Extensive grazing by cattle or sheep is the most appropriate management for larger areas. Based on experimental observations, a short period of grazing is recommended (maximum 4 weeks). Even more appropriate is the rotation of grazing and mowing.

Nutrient-poor pasture communities (*Cynosurion*) with intensive grazing regimes are also worthy of protection.

Picture 15: ***Mowing in Apuseni Mountains, Romania (photo: Hildegard Meyer)***

Management of mesic grasslands in Poland

Agri-environmental requirements of mesic grasslands in Poland are as follows:

Mowing

- Every year between 15 June and 30 September; after 15 July a second mowing is allowed (or controlled grazing).
- Leaving 5-10 % of the area unmown for the whole year, with the requirement that it is a different part every year. This allows the survival of overwintering insects and their eggs and larvae and the persistence of a wider diversity of plant species.
- Mowing height: 5-15 cm.
- Mowing technique: in a manner preventing the destruction of the plant and soil structure. A ban on circular mowing from the outside to the inside of an agricultural parcel.
- Obligation to remove or stack the cut biomass no longer than 2 weeks after mowing (except in justified cases).

Grazing

- The maximum livestock density is from up to 1 LU per ha, with maximum pasture load amounting to 10 LU/ha (5 t/ha).
- End date of the grazing period: 15 October.

Fertilization

- Nitrogen fertilization allowed up to 60 kg/ha/year.

See www.minrol.gov.pl/eng/content/view/full/18575

Management of Nardus grasslands

G6. Maintain extensive grazing of Nardus grasslands (apart from in alpine zones)

Alpine *Nardus* grasslands do not require any active management; all other types persist due to regular management activities. The most appropriate way of management is extensive grazing. All traditionally-used grazing animals (cattle, sheep, horses, and even goats) are suitable. Regular mowing once a year with biomass removal is also appropriate, and a combination of mowing and grazing is ideal. The recommended livestock density in Poland is between 0.4-0.6 LU per ha, with maximum pasture load amounting to 5 LU/ha (2.5 t/ha) (www.minrol.gov.pl/eng/content/view/full/18575).

Mulching is suitable only as a restoration measure, to remove shrubs, but repetition is not recommended for a number of subsequent years. Limited organic fertilizing is acceptable and even necessary, in order to maintain species richness if the *Nardus* grasslands are mown only. It is not suitable to use mineral fertilizer or liming. If possible, it is not advisable to practice sheep-folding on *Nardus* grasslands (Šefferová Stanová, Plassman Čierna eds. 2011).

Management of wet grasslands

See Chapter 4 (Wetlands) and, specifically CIMM W10.

3.2.2. GENERAL MANAGEMENT AND PLANNING MEASURES

These measures generally need to be adopted at higher levels by planning and regulatory authorities.

G7. Management prescriptions must be adapted to local conditions and practices

As the habitat features of conservation values and context (history and development) are very different between the various countries, it is important when planning grassland management to take into account

the following general aspects which will allow sensible management decisions to be taken (Calaciura, Spinelli 2008).

- Site-specific objectives and targets with reference to the conservation status of habitats and species.
- Local/regional land use and livestock husbandry traditions, practices and techniques; the conservation values of today are often the result of the land use and grazing regimes of the past.
- Although it is often impossible and unnecessary to mimic historical management, if possible, it should be informed by existing knowledge and experience.

Development of management models for grasslands

EU level

Active management of certain habitats is considered necessary for the conservation of Natura 2000 sites. The documents elaborated for a selected 25 habitats (8 of them grasslands) contain detailed descriptions of practical management techniques designed to help site managers prepare their own site-specific management plans for the habitat types and species targeted, and to implement these 'in the field', taking into account local constraints.

The best available information has been used for the elaboration of these documents, which take into account previous experience and best practice developed in different countries, results of management activities implemented in conservation projects and management guidelines produced at national and regional levels.

Each document includes information on the distribution, ecological requirements of the habitat, main trends and threats. Relevant management actions and prescriptions are described in detail. Main constraints, risks and modifiers of the proposed management have been also included. Finally, relevant parameters for cost estimates, cost estimate examples and potential sources of EU financing are illustrated.

For more information see: http://ec.europa.eu/environment/nature/natura2000/management/best_practice_en.htm

Slovakia

Similar management models were developed for 20 grassland habitat types occurring in Slovakia. In a number of cases, the models include several related habitats, which have similar management and restoration needs. Each model offers complete information on the ecology of a particular habitat, its distribution in Slovakia, and its development trends and threats. In addition, it recommends measures for both active and restoration management, and summarises the ecological and management demands of particular species of fauna and flora. At the end, examples of calculating the habitat management and restoration costs are provided. The proposed procedures for management and restoration of a habitat's natural values provide information on the appropriate regime of mowing or extensive grazing for each habitat, all of which are based on the latest knowledge from research completed in Slovakia and elsewhere in Europe.

Despite the exceptional importance of grassland communities, neither the legislative framework nor financial resources have so far provided sufficient tools for their preservation and conservation. One of the financial tools, which has had a significant impact on the state of habitats in Slovakia is the agri-environmental programme (part of the Rural Development Programme www.mpsr.sk), under which extensive forms of meadow and grassland management are financially compensated for. The programme also defines the agricultural measures for seven ecological categories.

For more information in English see
www.daphne.sk/sites/daphne.sk/files/uploads/MM_brozura_angl_web.pdf

G8. Ensure that grazing is carefully planned and regulated

- The introduction of grazing as a management tool for grasslands requires careful planning.
- The first requirement is to determine the precise grazing regime in terms of area to be grazed, livestock to be used, grazing periods and livestock densities.
- The next consideration is where the grazing animals will come from. In some cases, local farmers may already be using the area, while in others, graziers will have to be located. Some protected areas have even purchased their own livestock, which then leads to a requirement for good husbandry throughout the year, veterinary care, winter feeding etc.
- Conclusion of a grazing agreement with graziers is also necessary. This should determine not only the required parameters for grazing (species, period, density etc.), but also additional stipulations that should apply. These include means and routes for taking the livestock to and from the grazing area, folding areas, watering areas, regulations for shepherds living and sleeping in the pastures, presence of dogs, regulations concerning conflict with wild animals and other considerations. Financial aspects should also be agreed. Will there be any payment in either direction, or will the benefits to both parties be equal? The grazing agreement should also include stipulations for what should happen in the case of unexpected events. For example, droughts and floods may require cessation of grazing in some areas; wild animals may kill livestock; or graziers may breach the terms of the agreement. In these cases, clear responses and responsibilities should be agreed in advance.
- Some protected areas hold an annual meeting of graziers before the grazing season in order to reinforce the terms of the agreements and to address any specific issues related to the upcoming grazing season.
- Finally, regular monitoring visits will be required in order to ensure that graziers are complying with the agreement, and to work with them in order to resolve any problems that are occurring.

Example of grazing regulations

In the Czech Republic, farmers can apply for agri-environmental support where the intensity of herbivore livestock production is at least 0.2 LU (Livestock Units)/ha of grassland and maximally 1.5 LU/ha of agricultural land.

See http://eagri.cz/public/web/file/10574/RDP_November_2008.pdf

Within the Polish agri-environmental schemes, following rules apply for farmers:

- Maximum livestock density is 1 LU per ha.
- In the case of hay and pasture land maximum livestock density is 0.3 LU per ha.
- In the case of pasture land, minimum livestock density is 0.5 LU per ha and the maximum is 1.0 LU per ha.
- Maximum pasture load is up to 10 LU per ha (5 t per ha).
- Grazing period lasts 20 May to 1 October in the areas located above 300 m above the sea level.
- It is permitted to mow the aftermath only from August to September.

See www.minrol.gov.pl/eng/content/view/full/18575

Picture 16: ***Grassland in Ukraine (photo: Bohdan Prots)***

G9. Plan for the introduction of cutting, restoration and mulching programmes

Introduction of cutting programmes also requires careful planning. The following should be considered:

- The ideal cutting period should be determined. It should be kept in mind that the actual cutting period may vary from year to year according to ground conditions.
- The cutting technique should be determined. It may be necessary to decide the target cutting height and to determine what will be done with the cut material. Will it be mulched or collected? What will be done with vegetation that has been collected?
- The type of machinery to be used should also be decided. For wet grassland sites, special lightweight machinery may be required. It will be necessary to decide whether to buy the machinery, to rent it, or to contract local farmers to do the work.
- As with grazing, the financial aspects should be planned. Will the managing agency pay for cutting, or will it assist farmers in securing agri-environmental payments to cover their costs?

Example of mowing regulations from Poland

- Mowing is allowed between 1 June and 30 September, no more than two harvest cuts a year, obligation to leave 5-10% of the agricultural parcel unmown, where it should be rotated each year.
- Mowing height 5-15 cm.
- Mowing technique: mowing in circles from the outside to the inside of the parcel is prohibited.
- Obligation to remove or stack the cut biomass no more than 2 weeks after mowing (except in justified cases).

(http://www.minrol.gov.pl/eng/content/view/full/18575)

3.2.3. RESEARCH AND MONITORING MEASURES

G10. Develop management models which propose appropriate management measures for various types of Carpathian grasslands, based on best practices from different Carpathian and EU countries

The lack of experimentally verified recommendations for the management of individual types of habitats, which would constitute a sound basis for the more effective use of financial resources in the management of these habitats, is a serious problem. Field experiments are required, which focus on examining the influence of mowing, grazing, impact of fertilization and other management practices on the vegetation structure of different plant communities.

G11. Develop a common typology for grassland vegetation that can be used across the Carpathian region

In order to meet standards of Europe (proper phytosociological habitat description and use of the typology of the Habitats Directive), it is necessary to develop an updated vegetation typology based on Braun-Blanquet method, which can be used in all Carpathian countries, including those not in the EU. (Tasenkevich 2009)

G12. Identify grassland indicators that are easy measurable and can be used at local and regional levels

With respect to the rapid socio-economic changes instigated by the fall of the Iron Curtain and EU accession, the provision of homogeneous information on past and future land use and land cover change and its drivers is important for both research and policy. Continued monitoring at the pan-Carpathian scale complemented with results from small-scale case studies and supported by sound socio-economic knowledge (e.g. on urbanization processes and depopulation of rural areas, accessibility and economic performance) could contribute to the necessary understanding of human-environmental systems. Going one step further, homogenised datasets with improved thematic and spatial resolution spanning all Carpathian countries are needed. (Kozak *et al*. 2011)

3.2.4. POLICY MEASURES

G13. Develop a strategy for adoption in all Carpathian countries for the conservation and management of small-scale farms and mosaic landscapes with traditional management practices

Ukraine and Serbia are not members of EU and therefore the main policy instruments for grassland protection (the Habitats Directive and the Rural Development Programme) are not implemented in those countries. Even within the EU, large areas of HNV grasslands may have little protection unless they are located within other nationally designated protection areas.

The biodiversity impact of agri-environmental payments is not always clear. While the system is administratively functional, affecting hundreds of thousands of farmers and large areas of land, the biodiversity benefits are not fully understood. Nor is this support for grassland conservation secure; EU policies and priorities may change and divert funds away from existing schemes.

It is important therefore to secure a Carpathian-wide agreement on grassland protection in the landscape context, determining regional priorities and identifying a range of instruments that can be used by the various countries to ensure suitable management.

4. WETLANDS IN THE CARPATHIANS

Prepared by Dobromil Galvánek & Ján Kadlečík.

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Picture 17: Wet grasslands in Slovakia (photo: Dobromil Galvánek)

4.1. ASSESSMENT

4.1.1. WETLAND TYPES IN THE CARPATHIANS

Table 6 characterises the hydrology and ecology of Natura 2000 wetland types occurring in the Carpathians, and identifies the factors that maintain each type and the main threats it faces.

Habitat and code	Hydrology	Special requirements	Land use threats
1340 Inland salt meadows	Fed by groundwater with salt content, or by water from highly mineralised springs.	Content of the salts in the groundwater is very high, fluctuation of groundwater is necessary.	Drainage, abandonment, eutrophication from fields, changes of hydrological regime on landscape level.
3130 Oligotrophic to mesotrophic standing waters of plains to subalpine levels with vegetation belonging to *Littorelletea uniflorae* and/or *Isoeto-Nanojuncetea*	Various, may be fed by surface water from the rivers (lower altitudes) or from the springs or from melting snow (oligotrophic lakes in the mountains).	Fluctuation of water level, bare land in dry periods.	Drainage, river regulations.
3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* formations	Dependent on surface water with low content of nutrients.	Ephemeral habitat requiring oligotrophic surface water.	Drainage, eutrophication.
3150 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* type vegetation	Dependent on surface water with higher content of nutrient.	Habitat with relatively broad ecological requirements, sensitive mostly to water quality and quantity.	River regulation, changes of hydrological regime, eutrophication.
3160 Natural dystrophic lakes and ponds	Dependent on water from springs or on rain water.	Partly ephemeral habitat of pools on fens.	Drainage, changes in hydrological regime.
3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	Dependent on clean, non-polluted running water.	Clean oxygenised running water.	River regulation, changes of hydrological regime, eutrophication.
3220 Alpine rivers and the herbaceous vegetation along their banks	Dependent on running water and natural dynamics of mountain rivers.	Preserved river dynamics with occasional floods.	River regulation, changes of hydrological regime.
3230 Alpine rivers and their ligneous vegetation with *Myricaria germanica*	Dependent on running water and natural dynamics of mountain rivers.	Preserved river dynamics with occasional floods.	River regulation, changes of hydrological regime.
3240 Alpine rivers and their ligneous vegetation with *Salix eleagnos*	Dependent on running water and natural dynamics of mountain rivers.	Preserved river dynamics with occasional floods.	River regulation, changes of hydrological regime.
3270 Muddy river banks with *Chenopodion rubri* p.p. and *Bidention* p.p. vegetation	Dependent on natural river dynamics; low river flow in dry periods.	Dependent on river dynamics - bare land of the river banks during droughts.	River regulation, changes of hydrological regime.
4080 Sub-Arctic willow scrub	Based on areas of snow accumulation and avalanche tracks.	Moisture from snow.	Development of tourism infrastructure.
6410 *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caerulae*)	Fed by fluctuating groundwater, low content of nutrients in the soil.	Fluctuating groundwater level.	Abandonment, intensification of agriculture, d rainage, eutrophication.
6430 Hygrophilous tall herb fringe communities of plains and of the montane to alpine belts	Fed by groundwater or influenced by floods.	Soil saturated by groundwater.	Abandonment, intensification of agriculture, drainage.

Habitat and code	Hydrology	Special requirements	Land use threats
6440 Alluvial meadows of river valleys of the *Cnidion dubii* alliance	Dependent on regular floods.	Regular floods.	Abandonment, changes of flood regime, transformation to arable land.
7110 Active raised bogs	Dependent mostly on rain water.	Sufficient water supply from rainfall.	Drainage, changes in hydrological regime, eutrophication.
7120 Degraded raised bogs (still capable of natural regeneration)	Dependent mostly on rain water.	Sufficient rainfall; restoration of hydrological regime (stabilization of groundwater level).	Drainage, changes in hydrological regime, eutrophication.
7140 Transition mires and quaking bogs	Dependent on mineral-poor groundwater.	Groundwater nearby the surface during the whole year, low contents of nutrients in the water.	Drainage, changes in hydrological regime, eutrophication, abandonment.
7150 Depressions on peat substrate of the *Rhynchosporion*	Fed by mineral-poor groundwater.	Groundwater nearby the surface during the whole year, low contents of nutrients in the water.	Drainage, changes in hydrological regime, eutrophication.
7210 Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*	Dependent on highly-mineralised groundwater.	Highly-mineralised groundwater near the surface year-round.	Drainage, changes in hydrological regime, eutrophication.
7220 Petrifying springs with tufa formation (*Cratoneurion*)	Dependent on highly-mineralised underground water.	Outflow of mineralised groundwater with high content of calcium.	Drainage, changes in hydrological regime, eutrophication.
7230 Alkaline fens	Dependent on underground water.	Ground water level close to the surface during the whole year, minimal fluctuations, calcium-rich water.	Drainage, abandonment, eutrophication, changes of hydrological regime.
7240 Alpine pioneer formations of *Caricion bicoloris-atrofuscae*	Fed by underground water.	Outflow of groundwater, sufficient soil moisture during vegetation season.	Changes of hydrological regime, development of tourism infrastructure.
8310 Caves not open to public	Created by underground water.	Preserved water regime on landscape level, no water pollution.	Pollution.
9190 Old acidophilous oak woods with *Quercus robur* on sandy plains	Fed by stagnating rain water (slow run-off of rain water due to high clay content in the soil).	Sufficient rainfall, fluctuating of rainfall.	Changes of hydrological regime, changes of forest management.
91D0* Bog woodland	Fed by stagnating rain water.	Groundwater nearby the surface during the whole year, low contents of nutrients in the water.	Drainage, changes of hydrological regime, eutrophication.
91E0* Mixed ash-alder alluvial forests of temperate and boreal Europe (*Alno-Padion, Alnion incanae, Salicion albae)*	Dependent on regular floods.	Regular dynamic floods.	Changes of flood regime, drainage, intensive forestry, change of tree species composition.
91F0 Riparian mixed forests of *Quercus robur, Ulmus laevis, Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers of the Atlantic and Middle-European provinces (*Ulmenion minoris*)	Dependent on occasional floods.	Occasional floods.	Changes of flood regime, intensive forestry, change of tree species composition.

Habitat and code	Hydrology	Special requirements	Land use threats
91E0 Euro-Siberian steppe oak woods	Dependent on stagnating rain water in spring.	Stagnating rain water in spring, dry conditions during the summer.	Change of hydrological regime, intensive forestry activities.
9410 Acidophilous *Picea* forests of the montane to alpine levels (*Vaccinio-Piceetea*)	Influenced by high groundwater level.	Groundwater close to the surface.	Intensive forestry activities.

Table 6. ***Ecological and hydrological characterisation of wetland habitats in the Carpathians.***

Based on this detailed categorisation and according to the hydrology and physiognomy of the wetland habitats, a simplified set of broad ecological groups of wetland habitats can be determined as follows. Their distributions are shown in Map 4.

Aquatic (open water) habitats

Habitats occur on standing and flowing waters across the whole Carpathians. These include several Natura 2000 habitat types (3130, 3140, 3150, 3160, 3260). They occupy both natural and artificial water bodies and very often occur in a dynamic mosaic with river-bank habitats. A special sub-type is alpine lakes of glacial origin, located in the highest altitudes.

Non-forest river bank habitats

Habitats related to mountain rivers, from smaller streams to larger rivers. Most of them are Natura 2000 habitats (3220, 3230, 3240, 3270, 6430). They occur throughout the Carpathians along rivers, very often in a mosaic with open water habitats.

Wet grasslands

These occur in small patches across the whole Carpathians. They include Natura 2000 habitat types 6410, 6430 and 6440. They can occur in the floodplain or in places at higher elevations with restricted drainage and influenced by ground water. See also Chapter 3.

Peatland habitats

These tend to occur in small patches, but are very important from a biodiversity point of view. Nearly all of them are Natura 2000 habitats (7110, 7120, 7140, 7210, 7230). They are sparsely distributed in the whole Carpathians.

Picture 18: ***Peatland in Slaná Voda, Slovakia (photo: Dobromil Gálvanek)***

Wetland forests

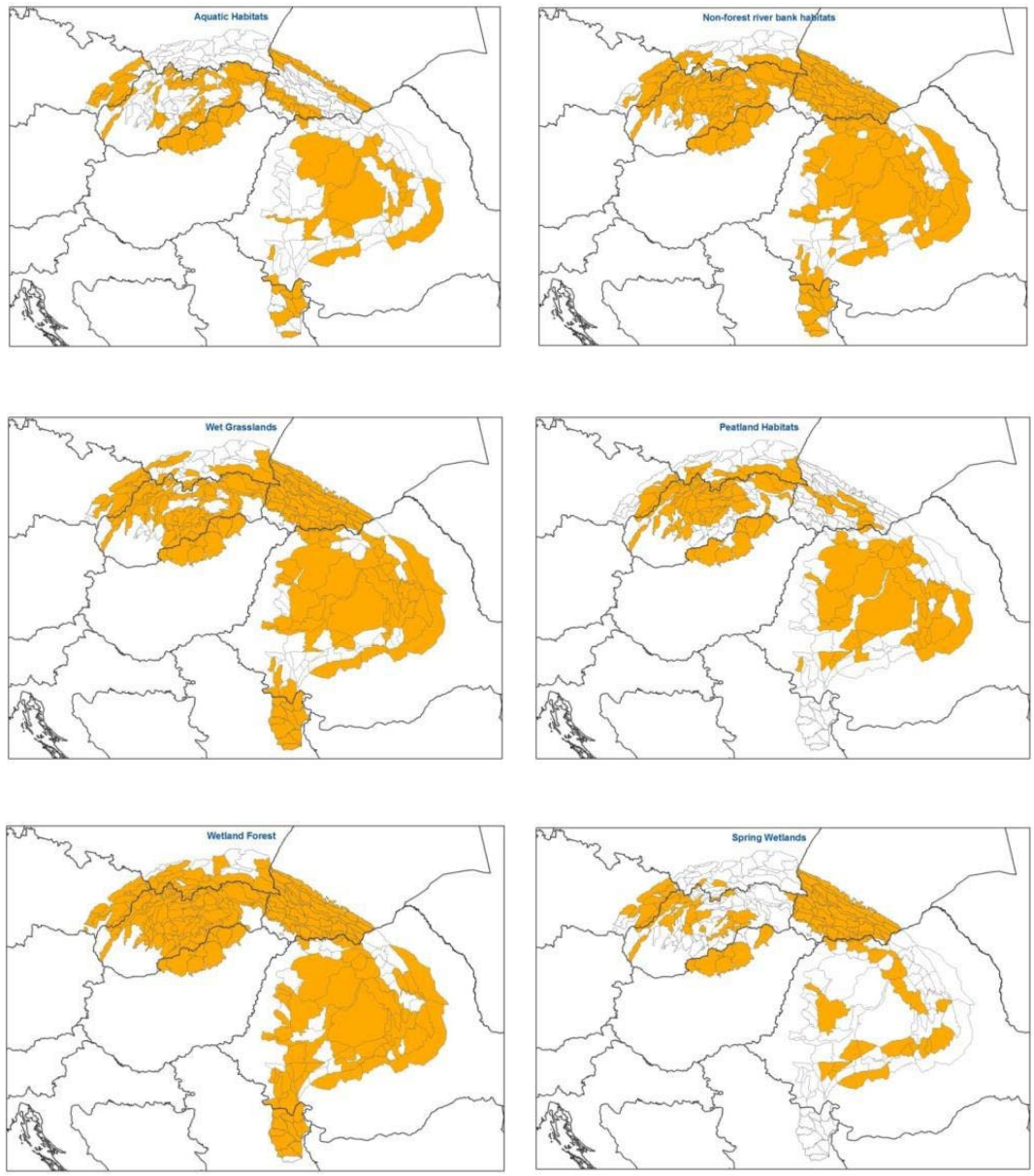
Habitats related to streams and rivers (floodplain forests) and to depressions influenced by ground water (forests on peatlands). Some of them are included in the list of Natura 2000 habitats (91E0, 91F0, 91D0, 9410). Their occurrence is rather fragmented throughout the Carpathians.

Spring wetlands

Wetland habitats related to springs with different water chemistry. Two types are listed among Natura 2000 habitats (7220, 7240). This type of wetlands occurs in very small patches across the whole region.

Subterranean wetlands

Specific habitats located mostly in karst areas including one Natura 2000 habitat (8310). They are typical of limestone areas, which can be quite expensive large in some parts of the Carpathians. Smaller examples of the habitat (so called pseudo-karst) are also found on Flysch or volcanic rocks.



Map 4. ***Wetland distributions in the Carpathians.***
(Maps are based on presence/absence in the orographic units
of the Carpathian Biodiversity Information System (CBIS) www.carpates.org/cbis.html)

4.2.1. SPECIFIC VALUES OF WETLANDS

Wetland habitats are important because of their typical site biodiversity, which depends on a functioning hydrological regime. While not generally species-rich, these habitats support characteristic species and communities, adapted to the particular site conditions. Many of these species are officially classified as threatened. Changes in the hydrological regime or in the hydro-morphology (in case of rivers and streams) may lead to changes in the site, leading to a loss of sensitive habitat specialists and an increase in generalists.

The ecosystems services provided by Carpathian wetlands can be summarised as follows, according to the classification of the Millennium Ecosystem Assessment.

Provisioning services

The waters from the Carpathians flow into the Black and Baltic Seas via the four large catchments of the Danube, Dniester, Vistula and Oder rivers. Accordingly, the main product of mountain wetlands is a supply of abundant, clean water for people, agriculture, industry and nature. Within the mountains, spring habitats are of the highest importance, because they are often used as sources for water supply. Several springs also provide high-quality mineral water.

Carpathian wetlands also provide a range of specific physical products: gravel from riverbeds (extraction is a problem in some areas), peat (in some areas in Romania), reeds (now rarely harvested) and hay from wet grasslands (although this is of poor quality, a reason for abandonment of wet grasslands).

Rivers, lakes and water reservoirs are important suppliers of fish; the long tradition of fishing in the Carpathians has strongly influenced aquatic communities, because of widespread stocking of fish. Some important artificial fishponds and fish farms are located in the Carpathians; some of these are designated as Ramsar Sites (e.g. Dumbrăvița fishpond complex in Romania) or Natura 2000 sites.

Rivers in the Carpathians are increasingly being dammed to produce energy in hydropower plants, a practice that is causing controversy in several countries (Slovakia, Hungary, Romania, Ukraine). In many areas also, micro-hydropower plants are being established, which do not involve dam construction, but which have significant effects on river channels and on water flows.

Regulating services

Carpathian wetlands are crucial in maintaining the water cycle which underpins all ecosystem services and therefore sustainable development. The water cycle is also influenced by nutrient cycling (which influences water quality) and carbon cycling (which influences land cover and organic carbon in soils, including high carbon ecosystems such as peatlands, which also influence water flows). Wetlands provide vital water-related ecosystem services at different scales (e.g. clean water provision, waste water treatment, groundwater replenishment), which are critical for life and for the economy. Wetlands are also very important in flood prevention and mitigation of extreme weather events. They may accumulate water from the precipitation and thus slow down the run-off from the landscape.

In many cases, the ecosystem services offered by wetlands deliver benefits to humans more cost effectively and sustainably than alternative man-made infrastructures (Russi *et al*. 2013).

Cultural services

Wetlands play an important role in local culture and folk traditions across the Carpathians. They have been an inspiration for numerous traditions, folk songs, and a wide variety of local events.

The recreational and touristic value of wetlands is quite high. Lakes, reservoirs and rivers are traditionally used for swimming and other water sports and larger touristic centres are often located near to water, hosting very large numbers of tourists. Caves belong to the most visited touristic attractions, with thousands of visitors per year. Other wetland types are less visited but there is a growing trend to provide touristic facilities on less visited habitats like peatlands and to promote their biodiversity to the wider public. Wooden trails (boardwalks) have been built in many localities, offering the possibility to visit these less accessible habitats. Angling and partially hunting are also considered a recreational activity in some wetlands.

4.1.3. STRATEGIC AND LEGAL FRAMEWORK

Protected areas

Wetlands are quite well covered by national networks of protected areas in the region, and some countries (e.g. Czech Republic, Slovakia) even have general protection of wetlands specified in nature conservation legislation. However this does not ensure wetland protection in the Carpathians. Frequently, no active site management takes place, and many wetland protected areas do not have an approved management plan (e.g. in Romania), which means that specific management measures for the conservation of wetland habitats inside these areas are not being implemented.

National strategies and action plans

Some countries have defined targets and objectives related to wetlands in national strategies and plans. For example, the National Wetland Management Programme in Slovakia was first developed in the early 1990s, and is regularly updated and reviewed. The most recent Action Plan (2012-2014) was adopted by the Slovak Government in 2011. Activities and measures include a wetland inventory and database, designation of sites, integration of wetlands into strategies, laws, planning processes and practices, development of wetland restoration programmes, implementation of restoration activities, raising awareness about wetlands, management planning, monitoring, control of invasive species, development of guidelines, international cooperation as well as training and capacity building.

No information has been gathered about other specific national wetland strategies in other Carpathian countries, but they are required by the Ramsar Convention and they should reflect the Ramsar Strategic Plan. They can be also a part of National Biodiversity Strategies and Action Plans, which must be prepared under the Convention on Biological Diversity.

EU legislation

The most important instruments for wetland management in the EU are the Habitats Directive, the Birds Directive and the Water Framework Directive. These are implemented in Carpathian EU Member States, with penalties applied for non-compliance.

The Habitats Directive covers in its annexes most of the wetland habitats occurring in the Carpathians. Member states are obliged to keep them in a favourable conservation status or improve them if the status is unfavourable. There are currently hundreds of wetland Sites of Community Importance in the region. The main instruments for conservation and management of water birds (including migratory birds) are the Birds Directive and the network of Special Protection Areas (SPAs).

The Water Framework Directive requires preparation of management plans based on river basins. The plans should be prepared in close cooperation with all relevant stakeholder groups, with the intention of achieving good status for water bodies by 2015. Good status means not only quality of water, but also the ecological quality of the body of water from hydromorphological and biological perspectives. Wetlands play an extremely important role in the system as an important integral part of well-preserved river systems. The status of water bodies is also regularly monitored and reported to the European Commission.

Non EU Member States

Only five of the seven Carpathian countries are EU members, so EU tools are not obligatory for Ukraine and Serbia. However, these countries have voluntarily adopted the principles of the WFD within the Danube River Protection Convention and the activities under various projects on integrated river basin management (e.g. the Tisa/Tisza river basin). Furthermore, both countries are signatories of the Bern Convention, in which the Emerald Network is analogous to the Natura 2000 Network of the EU, although there is not such a strict legal obligation to maintain Emerald sites in favourable conservation status.

Ramsar Convention

All Carpathian countries are signatories of the Ramsar Convention, which should be a good platform for a common approach to wetland management. It is not as strong a legal instrument as the EU legislation, but

is a well-established, internationally respected Convention. At present however, coverage of Carpathian wetlands by Ramsar sites is still inadequate, and some countries have no Ramsar sites in the Carpathians (e.g. the Czech Republic, Poland, Serbia). This is probably because these countries have large wetland systems in other parts of the country, and the Carpathian wetlands may appear to be marginal from the national perspective.

Exchange of knowledge between countries and provision of guidance for member states are important roles of the Convention. Updated guidelines for management planning have been prepared and handbooks published on topics including wise use of wetlands, river basin management and water allocation and management (www.ramsar.org).

The Carpathian Wetland Initiative is a regional initiative of the Ramsar Convention that seeks to ensure and support the effective conservation and wise use of wetlands in the Carpathians and beyond. The CWI focuses on creating a database of Carpathian wetlands, including data from wetland inventories, research and projects.

Picture 19: ***Riverine forest along the River Latorytsya, Transcarpatia, Ukraine (photo: Bohdan Prots)***

4.1.4. CONSERVATION STATUS OF WETLANDS

Information about wetland distribution and condition is still very inadequate, and while habitat inventories have been carried out in several Carpathian countries in recent years (Šeffer *et al*. 2002, Sarbu *et al*. 2004, Takács & Molnár 2009), these have only partially covered wetlands. The only exception is the Czech Republic, where very precise mapping covers the whole Carpathian part of the country and is still being updated (www.biomonitoring.cz). Under a project funded from EU structural funds (2009-2014), the State Nature Conservancy of the Slovak Republic is focusing on wetland inventories, which have the potential to act as a model for other Carpathian countries.

The Carpathian EcoRegion Initiative has produced distribution maps of semi-natural and natural habitat types in the Carpathians (www.carpates.org), but due to numerous gaps in the knowledge, distribution maps only show orographic units where particular habitat types occur, and in many cases the distributions shown are only a prediction of habitat occurrence based on CORINE Landcover data, combined with expert input.

Carpathian countries that are members of the EU (Czech Republic, Hungary, Slovakia, Poland, Romania) are obliged to report the state of habitats protected by the Habitats Directive to the European Commission every 6 years. The first set of reports was prepared in 2007 by four countries (Czech Republic, Hungary, Slovakia and Poland); a new set of new reports were due for submission in 2013.[4] The conservation status of Natura 2000 wetland habitats in the Carpathians in the 2007 report (www.cdr.eionet.eu) is generally unfavourable, except for three cases (two habitat types in the Alpine region of Poland and one habitat in the Alpine region of Slovakia). Romania was not obliged to prepare a report in 2007, so comprehensive information is missing so far, but according to expert evaluation (Bănăduc *et al*. unpublished), most wetlands in the higher altitudes (montane, sub-alpine and alpine zone) are in a favourable state, while the state of lowland wetlands is unfavourable.

We can conclude that the conservation status of wetlands in the Carpathians is critical, particularly at lower elevations, and they urgently need active implementation of effective protection management and restoration measures.

4.1.5. CURRENT WETLAND MANAGEMENT

Outside protected areas, some wetlands are still maintained in relatively good condition through traditional economic management, but such areas are decreasing. Agricultural land was used more extensively than now and farmers had very strong relationship with the land. Most wet grasslands and fens were managed to provide some hay, and lower quality material for use as animal bedding.

Traditional farming on wet grasslands started to decline after WWII, when collectivisation was introduced, especially in the Western Carpathians (former Czechoslovakia). Many wet grasslands were abandoned because they were not suitable for intensive agriculture using heavy machinery. Large areas of wet grasslands were also drained and the species composition heavily altered.

The situation was somewhat different in other parts of the Carpathians (Romania, Poland), where collectivisation was not applied. Decline of traditional management practices on wet grasslands has been slower, but traditional management (e.g. mowing by scythe, low intensity cattle grazing) is now very rare in the Carpathians and the trend is declining. This is especially the case in mountainous areas, where remoteness and the low quality of the hay makes wet grassland management unprofitable for farmers.

Reeds from wetlands are still used in some regions for the construction of roofs and other structures. Local inhabitants also extracted gravel from the rivers, which was used for the construction of buildings. This practice was particularly prevalent in the Flysch parts of the Carpathians, where the water flow in the rivers is highly variable, creating extensive gravel terraces. Such extraction still continues in some areas, and can be very damaging to river ecosystems. Wetlands were also used for fishing and hunting, which still continue, but which are much more regulated than in the past.

Management of wetlands in protected areas is more focused on protection, although increasingly, managers are re-establishing traditional management techniques (such as low intensity grazing, haymaking and reed harvesting) as conservation tools. Nature conservation organisations have tried to organise conservation management on wet grasslands and peatlands (mowing, removal of shrubs or restoration of hydrological regimes), but lack of funding means that only a small proportion of sites are managed in such a way.

Waterways and riparian habitats on major watercourses are usually subject to regular clearance of vegetation by water management authorities, which are obliged to ensure that no obstacles are present in the rivers or on their banks; this may help in flood control, but can be harmful to biodiversity and can accelerate erosion.

Increasing numbers of rivers have been dammed for hydropower generation, interrupting the connectivity of river systems and having a very negative impact on water flow and on biodiversity.

[4] The 2013 reports were not available at the time of publication of this study.

Wetland forests are usually only of marginal importance for forestry, because of wet soil and bad access. They are often designated as protective forests with a primary function of controlling erosion of forest soil. However in recent years, demand for alternative energy sources such as wood chips or pellets has led to massive clear cuts along some water courses and major damage to non-forest woody vegetation in the landscape. Efforts to harvest forests on peatlands have led to drainage of some valuable mires (e.g. transboundary peatlands in Poland and Slovakia), even in Natura 2000 sites.

Management of wetlands may depend also on their ownership, which is very diverse. Water courses are very often owned by the state and managed by state water management enterprises. This can be an advantage, but also a disadvantage because of many conflicts between conservation and nature management authorities. Agricultural habitats are often privately owned, so any management activities have to be agreed with the owners. State ownership may be an advantage for the implementation of different management measures on wetlands. Some countries are trying to increase the proportion of state-owned land in protected areas (e.g. Hungary), but others (e.g. Slovakia) have no programme for state land purchase and there are many conflicts between land owners and nature conservation because of badly-functioning compensation systems.

An integrated approach to wetland management is considered as the best option, but the reality in the Carpathian countries is far from this ideal and wetland management responsibilities are scattered among different sectors. Each sector has its own approaches and goals, which often conflict with nature conservation objectives (and each other). Examples of good cooperation and integration of different sectors are still uncommon, and frequent conflicts are reported from nearly all countries. One good example of the integrated approach is the development of the Tisa/Tisza River Basin Management Plan (ICPDR 2011).

NGOs and academic institutions can play very important roles in the promotion of cross-sectoral co-operation. They are very often considered as neutral, not belonging directly to any sector. Thus, they are able to implement projects that combine organisations from different sectors, requiring them to cooperate.

Some countries have compiled extensive manuals for conservation management of different habitats including wetlands (e.g. http://www.sopsr.sk/natura/index1.php?p=9&c=16&lang=sk, www.daphne.sk/mm/manazmentove-modely, Háková *et al.* 2004). These are helpful for site managers, but there are still many differences in the approaches to wetland management, which may differ very significantly from site to site.

Picture 20: ***Wet grassland in Cerová Vrchovina Mountains, Slovakia (photo: Dobromil Gálvanek)***

4.1.6. MAIN THREATS TO WETLANDS AND ISSUES AFFECTING THEIR MAINTENANCE

Table 7 shows an example of a complex evaluation of threats to a specific wetland site, according to Natura 2000 threat categories.

Code	Threat Type	Code	Threat Type
A	Agriculture	*J02.02*	*Removal of sediments (mud...)*
A04.03	*Abandonment of pastoral systems, lack of grazing*	*J02.02.01*	*Dredging/ removal of limnic sediments*
B	Silviculture, forestry	*J02.03*	*Canalisation & water deviation*
B02.01.02	*Forest replanting (non-native trees)*	*J02.03.02*	*Canalisation*
B02.02	*Forestry clearance*	*J02.04*	*Flooding modifications*
B02.03	*Removal of forest undergrowth*	*J02.04.01*	*Flooding*
B02.04	*Removal of dead and dying trees*	*J02.04.02*	*Lack of flooding*
B03	*Forest exploitation without replanting or natural regrowth*	*J02.05*	*Modification of hydrographic functioning, general*
C	Mining, extraction of materials and energy production	*J02.05.02*	*Modifying structures of inland water courses*
C01.01.01	*Sand and gravel quarries*	*J02.05.03*	*Modification of standing water bodies*
D	Transportation and service corridors	*J02.05.04*	*Reservoirs*
D01	*Roads, paths and railroads*	*J02.05.05*	*Small hydropower projects, weirs*
D01.01	*Paths, tracks, cycling tracks*	*J02.06*	*Water abstractions from surface waters*
E	Urbanisation, residential and commercial development	*J02.06.01*	*Surface water abstractions for agriculture*
E02	*Industrial or commercial areas*	*J02.06.02*	*Surface water abstractions for public water supply*
E03	*Discharges*	*J02.07*	*Water abstractions from groundwater*
E03.01	*Disposal of household / recreational facility waste*	*J02.07.01*	*Groundwater abstractions for agriculture*
E03.02	*Disposal of industrial waste*	*J02.07.02*	*Groundwater abstractions for public water supply*
E03.03	*Disposal of inert materials*	*J02.07.03*	*Groundwater abstractions by industry*
E06	*Other urbanisation, industrial and similar activities*	*J02.08*	*Raising the groundwater table /artificial recharge of groundwater*
E06.01	*Demolishment of buildings & human structures*	*J02.08.01*	*Discharges to groundwater for artificial recharge purposes*
E06.02	*Reconstruction, renovation of buildings*	*J02.08.02*	*Returns of groundwater to GWB from which it was abstracted*

Code	Threat Type	Code	Threat Type
F	Biological resource use other than agriculture & forestry	*J02.11*	*Siltation rate changes, dumping, depositing of dredged deposits*
F02	*Fishing and harvesting aquatic resources*	*J02.11.01*	*Dumping, depositing of dredged deposits*
F02.03	*Leisure fishing*	*J02.12*	*Dykes, embankments, artificial beaches, general*
G	Human intrusions and disturbances	*J02.12.02*	*Dykes and flooding defence in inland water systems*
01	*Outdoor sports and leisure activities, recreational activities*	*J02.13*	*Abandonment of management of water bodies*
G02	*Sport and leisure structures*	K	Natural biotic and abiotic processes (without catastrophes)
H	Pollution	*K01*	*Abiotic (slow) natural processes*
H01	*Pollution of surface waters (limnic, terrestrial, marine & brackish)*	*K01.01*	*Erosion*
H01.02	*Pollution of surface waters by storm overflows*	*K01.02*	*Silting up*
H01.04	*Diffuse pollution of surface waters via storm overflows or urban run-off*	*K01.03*	*Drying out*
H01.05	*Diffuse pollution of surface waters due to agricultural and forestry activities*	*K02*	*Biocenotic evolution, succession*
H01.06	*Diffuse pollution of surface waters due to transport and infrastructure without connection to canalization/sweepers*	*K02.01*	*Species composition change (succession)*
H01.07	*Diffuse pollution of surface waters due to abandoned industrial sites*	*K02.02*	*Accumulation of organic material*
H01.08	*Diffuse pollution of surface waters due to household sewage and waste waters*	*K02.03*	*Eutrophication (natural)*
H02	*Pollution to groundwater (point sources and diffuse sources)*	*K02.04*	*Acidification (natural)*
H02.02	*Groundwater pollution by leakages from waste disposal sites*	L	Geological events, natural catastrophes
I	Invasive, other problematic species and genes	*L05*	*Collapse of terrain, landslide*
I01	*Invasive non-native species*	M	Climate change
I02	*Problematic native species*	*M01*	*Changes in abiotic conditions*
J	Natural System modifications	*M01.01*	*Temperature changes (e.g. rise of temperature & extremes)*
J01	*Fire and fire suppression*	*M01.02*	*Droughts and less precipitations*
J01.01	*Burning down*	*M01.03*	*Flooding and rising precipitations*
J02	*Human induced changes in hydraulic conditions*	*M01.05*	*Water flow changes (limnic, tidal and oceanic)*
J02.01	*Landfill, land reclamation and drying out, general*		
J02.01.03	*Infilling of ditches, dykes, ponds, pools, marshes or pits*		

Table 7. Example of a complex evaluation of wetland threats in National Park Bükk, Hungary (Schmotzer unpublished).

Across the region, the main threats can be summarised as follows.

Changes in hydrological conditions due to drainage, abstraction and hydropower

Large areas of the landscape were drained during the communist era and many wetlands were totally destroyed or heavily altered. The effect of these activities is still present in the landscape. More recently, large scale drainage is less common, but can be a problem locally. The alterations of rivers and the building of large reservoirs have been very harmful to river ecosystems.

Production of electric energy in hydro-power plants on Carpathian rivers started many decades ago. Construction of dams and hydro-power plants usually has a very serious impact on river connectivity, because the river corridors are interrupted by dams and the velocity of the flow is slowed down in the reservoir. In addition, sedimentation starts before the dam and the section below the power station is influenced by cold water from the bottom part of the reservoir, and by the removal of sediments.

Abstraction of surface and underground water for industrial or agricultural purposes remains a major threat to rivers and wetlands, particularly in periods of droughts, when the flows in the rivers are very low.

Sedimentation

Erosion and sedimentation are processes that normally occur in natural riverine systems. Rivers may behave dynamically and, during floods, may totally change their courses. However, human activities have altered most river systems in the Carpathians and increased sedimentation has been a major consequence. This changes the ecological characteristics of rivers, destroys the feeding and breeding grounds of many ecologically and economically important fish species, and increases the threat of flooding.

Agriculture and forestry

Intensive activities can harm wetlands directly or indirectly through drainage, eutrophication and pollution. On the other hand, cessation of grazing and mowing on wet grasslands and peatlands can cause a loss in biodiversity value.

Fisheries may also have negative impact on some rivers and fishponds due to maintaining excessive fish populations through continual restocking. This may harm the natural equilibrium in the rivers and lakes. Some intensively used fishpond areas are at the same time important habitats for birds, and balance should be found between these interests.

Transport infrastructure

Road construction is a growing threat, especially as protection of wetlands is not always sufficiently evaluated and respected in the process of impact assessment. Transport infrastructure may directly destroy wetlands or impact negatively on their water regime. Sometimes watercourses are modified to facilitate construction of highways and roads, which can modify the dynamics of rivers and the species they support.

Tourism and recreation

Tourism itself has a generally low impact on wetlands, because they are usually not visited so much by tourists. However, the impact may be very negative on larger water reservoirs and fragile mountain lakes. The main threats are disturbance, pollution and establishment of tourism infrastructure.

Pollution

Eutrophication and pollution have a very negative impact on wetlands and, in combination with abandonment, may accelerate degradation of some wetland systems. The consequences of eutrophication are decreased species richness, increase of tall vegetation species, which respond to the increased supply of nutrients, and loss of some wetland specialists with lower competitive ability. The situation has improved in the last 20 years due to the implementation of strict rules for maintenance of water quality, but adequate enforcement and monitoring are still lacking.

Waste and sewage waters are mostly produced by industrial sector, agriculture and urban areas. Due to implementation of strict environmental rules in EU countries, the quality of water in water bodies has improved significantly in the past 20 years. Industrial enterprises are obliged to establish proper cleaning systems and cities and larger villages must build treatment stations for domestic sewage. However, problems still occur in smaller villages where such systems are not established.

In agriculture, the Nitrate Directive is implemented in EU countries. Sensitive areas are defined and farmers are obliged to build sufficient capacities for storing organic fertilisers or slurry, especially in liquid form. The rules are incorporated into cross-compliance measures[5] and thus they are one of the pre-conditions to receive single area payments. Such requirements are quite strict for farmers.

Another specific problem is pollution arising from mining operations, specifically caused by poor management of mine waters and wastes from mine operations (e.g. Baia Mare and Baia Borsa, Romania, where accidental spills occurred of chemicals from gold mining tailing dams in 2000). Threats from mines are now greatly reduced, and uneconomic mines have been closed down, but efforts of some international companies to open new mines, or re-start mining of some metals (especially gold or uranium) are increasing in the Carpathians.

Picture 21: ***Plastic waste in riverine forest, Ukraine (photo: Bohdan Prots)***

Alien invasive species

Spreading of invasive alien plants (e.g. *Reynoutria japonica*) is a very serious threat, especially for riparian habitats and floodplain forests. Rivers are natural corridors for their expansion and the trend is very negative especially on larger rivers. Spreading of some invasive animal species (e.g. American mink, some fish, turtles) can also change the biodiversity of wetlands. Fishponds can be also a source of some fish diseases spreading to natural waters.

4.1.7. ROOT CAUSES OF THE THREATS

Land use changes

The huge landscape transformations that took place during the communist era had severe impacts on the landscape. Areas at lower altitudes were most affected, because of their better accessibility and fertility. Intensive agricultural use of the landscape was a priority and many wetlands were drained or had their water regimes seriously disrupted.

[5] Cross-compliance is a mechanism of the European Union that links direct payments to compliance by farmers with basic standards concerning the environment, food safety, animal and plant health and animal welfare, as well as the requirement of maintaining land in good agricultural and environmental condition. Since 2005, all farmers receiving direct payments are subject to compulsory cross-compliance.
http://ec.europa.eu/agriculture/envir/cross-compliance/index_en.htm

At the same time, urban settlements on flood plains have grown, both increasing pollution and requiring river channel modifications to prevent flooding. Some of these impacts have reduced during the last 10-20 years, and some wetland ecosystems have spontaneously reverted towards former conditions. However wetland drainage, pollution and eutrophication caused by intensification of agriculture and forestry continue to be threats, and in some cases the changes have been irreversible or the sites require active restoration.

Land abandonment

This has been a growing problem for the past 20 years, due to the decline of traditional farming for economic and social reasons. As a result of abandonment, many non-forest wetlands lose their values and are threatened by secondary successional changes. Land abandonment is also closely connected with the issue of invasive plants. River banks were formerly managed regularly in the floodplains, and invasive species were usually well controlled. However, lack of management (for economic reasons) has led to increased invasions. Furthermore, the higher content of nutrients in the soils and waters causes eutrophication and opens a niche for the spread of invasive or ruderal species.

Promotion of hydropower

In some cases, regional policy is an underlying threat. The European Union, through the Renewable Energy Directive, has recently introduced a programme to support renewable energy sources as an alternative to conventional coal burning power plants. Establishment of enterprises producing energy from renewable sources attracts subsidies from EU funds. As a result, interest in building new hydropower plants has risen dramatically in recent years. Many planned plants are located on well-preserved rivers, which were minimally influenced by dams or water abstraction in the past. The rapid growth of micro-hydropower plants is becoming a major threat in Romania, Slovakia and Ukraine.

Lack of regulation and enforcement

In many cases improved regulations (especially in EU countries) are reducing many of the threats, but the lack of monitoring and enforcement limits their effectiveness.

Inadequate planning and management of wetlands

Establishment of the coordinated and integrated approaches required for river system and watershed management has been very limited. Water and wetland management generally focuses on individual management objectives aimed at maximising provisioning services (e.g. agricultural production). The sectoral approach to water management is still dominant; approaches tend to be piecemeal and poorly coordinated, and communication between and among the sectors is usually quite weak. Conflicts occur, particularly between conservationists and water managers, due to widely differing views on water management measures.

At the site level, management plans should define long-term management strategies for protected areas and should direct management activities towards defined objectives. Experience from the Carpathian countries shows that management planning suffers from many shortcomings and is not functional in countries such as Slovakia and Romania. There are several reasons for this. First is the lack of a clear methodology of management planning. For example in Slovakia, there are several existing methodologies for different types of protected areas, but they are considered too complicated and complex to be practical, especially for larger protected areas. In Romania, many plans are prepared by external companies without sufficient interaction with protected area administrations and stakeholders. Another serious problem is insufficient approval and implementation of the management plans. In Slovakia, the financial sources for implementation of management plans from the Operational Programme Environment are not spent, because management plans are blocked by stakeholders, and the Ministry of Environment does not wish to approve the plans without the approval of all stakeholders.

Inadequate capacities and resources for management

Lack of capacity is a major issue at many levels. There is, in many cases, insufficient capacity to formulate effective intersectoral strategies and policies that respect the balance between needs and resources. Where adequate strategies, legislation and regulations are in place, there may not be the political will or the required sanctions and incentives for them to be effective. Furthermore, when a well-prepared management plan is approved, successful implementation is strongly dependent on available financial sources, which are

often limited. Wetland management can be expensive, especially where it includes restoration. While some countries have been successful in directing various forms of EU funds towards wetlands, this form of support has not been taken up by others, and is not available in Ukraine or Serbia.

Insufficient attention has been paid to valuing the important services provided by wetlands and to finding ways to market those values to provide long-term, sustainable funding for wetland management and protection.

Picture 22: Alder forest in Slovakia (photo: Dobromil Gálvanek)

4.2. COMMON INTEGRATED MANAGEMENT MEASURES FOR WETLANDS

4.2.1. IDEAL WETLAND MANAGEMENT OBJECTIVES

The main requirement for the favourable status of wetlands is the maintenance or restoration of their natural (or near natural) hydrological regime. Depending on the type of wetland and on its management history, a range of general management approaches are required for this.

- Total protection and non-intervention are usually the best conservation options for many natural wetland habitats, in particular those which have low productivity and where the quantity and quality of water is adequate. Such areas include oligotrophic rivers, lakes, wet forests, peatlands, fens and mires.
- Restoration of the hydrological regime is required where the natural water balance has been adversely affected or the water supply diminished, for example where wetland habitats have been drained for peat excavations or agriculture.

- Maintenance and/or restoration of the natural hydro-morphodynamics of rivers and wetland systems, and in particular ensuring that at least some rivers and streams are maintained without any interruptions of their flow or modifications to their channels.
- Maintenance or restoration of connectivity of wetland and riverine habitats and of the river continuum.
- Regular maintenance (mowing or extensive grazing) of productive wet grasslands and fen grasslands whose existence is conditioned by regular low-intensity human interventions.
- Measures to ensure the quality and quantity of water entering the site. Such measures require collaboration with other sectors, with upstream land owners and with regulatory authorities.

Restoration and the associated improvement in ecosystem services of degraded wetlands can often provide new or improved benefits to people, as well as to biodiversity. These benefits include climate change mitigation and adaptation, protection from extreme events, water security, water treatment and soil stabilisation. Restoration also helps achieve biodiversity targets for depleted ecosystem types and threatened species (Russi *et al*. 2013). While often expensive, restoration and rehabilitation of degraded wetland ecosystems can bring considerable benefits to people at a lower cost than alternative man-made infrastructures. Depending on the extent of the degradation suffered by wetlands, restoration can sometimes be achieved through 'passive restoration' (strategies to allow ecosystems to regenerate themselves by eliminating key threatening processes), or when spontaneous self-regeneration is not possible, active interventions (TEEB 2011).

4.2.2. SPECIFIC CONSERVATION MANAGEMENT MEASURES FOR IMPLEMENTATION BY PROTECTED AREA ADMINISTRATIONS AND OTHER WETLAND MANAGERS

These are measures associated directly with the management of species, habitats and ecosystems. They are most likely to be implemented through protected area systems and through work of agencies and organisations managing land and resources.

Protective measures

W1. Adopt passive (minimal intervention) management for suitable sites (e.g. wetland forests, raised bogs, swamps)

Passive management means that no management interventions are conducted on the site (except in some cases for visitor management). This should be the preferred measure for wetlands with relatively good conservation status and with functional hydrological regimes that maintain the condition of the habitat through natural processes (e.g. wetland forests and oligotrophic or low productivity sites such as raised bogs, swamps etc.).

Although this is the default management option for many wetlands (due to the lack of resources for management), non-intervention it is not suitable for the majority of wetlands in the Carpathians, which are damaged or influenced by human activities.

W2. Establish wetland buffer zones

This is especially suitable for wetlands surrounded by intensively used agricultural land where fertilisers and pesticides are used and where polluted water may flow from the fields into the wetlands, causing eutrophication and chemical pollution. Buffer zones may be established in different ways, for example through restriction of use of fertilisers and pesticides, creation of grass strips alongside wetlands, or planting of shrub hedges. Similar measures are included in cross-compliance rules in some countries (e.g. Slovakia).

W3. Regulate and manage water abstraction and use

Maintaining an ecological minimum water level is a priority in all types of water body and wetland. This requires regulation of water abstraction and adequate enforcement of these regulations. The various approaches required to manage water abstraction are provided in detail in *Ramsar Convention Handbook No.*

10. Water allocation and management. Guidelines for the allocation and management of water for maintaining the ecological functions of wetlands (www.ramsar.org/cda/en/ramsar-pubs-handbooks-handbooks4-e/main/ramsar/1-30-33%5E21323_4000_0__).

W4. Manage sewage, waste water and surface water pollution

Measures are required to ensure the effective implementation and enforcement of existing legislation regarding sewage, waste water and pollution. However implementing these regulations is difficult and challenging in more remote mountain areas of the Carpathians, where pollution of springs and headwaters of important catchments may be a major threat. In these cases local authorities or protected area authorities can introduce a number of measures including:

- Constructing local sewage treatment plants for villages. Creation of artificial wetlands for waste water treatment can be a viable and ecologically sustainable option in these cases.
- Preventing garbage dumping along waterways.
- Establishing watering areas for livestock away from sensitive streams and springs.

Management of water quality and quantity in Szinva-stream (Hungary)

The upper sections of the Szinva River upstream of Miskolc are little regulated: its source is in the Bükk Mountain and has one significant tributary, the Garadna stream. This is a part of the Bükk National Park and is also a Natura 2000 site.

The downstream area passes through settlements were heavily polluted in the past. Today they are better regulated, but although water pollution has decreased, it is still necessary to prevent any new sources of pollution, introduce better licensing, and prohibit harmful human activities.

In recent years, the local government in partnership with the NGO 'Miskolci Öko-Kör' has assessed and monitored the tributaries of the river and the sources of contamination. Due to the development of the town of Miskolc, it has not been possible to recreate the meandering status of the original riverbed in the lower stretches, but a number of measures can be introduced to help re-establish an ecologically favourable watercourse.

- The straight stretches of the stream need to be shallower in some sections and deeper in other stretches, because the existing uniform channel is of low biodiversity value. This can be achieved by small interventions in the channelised bed that will cause variations in flow, but which will not block the migration of animals, primarily fish, including the very rare, protected Petenyi's barbel (*Barbus peloponnesius petenyi*).
- The ecological status can be improved if trees are planted along the stream on some sections.
- Measures are required to maintain the ecological water balance. The river is the main source of household water for Miskolc, and during dry periods, water demand is high and an ecological minimum water discharge is not maintained. Unfortunately, even karst ground water levels have been decreased.

(Dukay & Gruber 2013)

W5. Develop guidelines and introduce measures to regulate the hydroenergetic use of rivers and to limit and mitigate its impacts

Clear guidelines are required on how to solve the conflict between energy and conservation policies in the Carpathians because several controversial investments have been made in recent years (especially in Slovakia, Romania and Ukraine) and there are many plans for new ones. The Danube River Protection Convention is currently working on the 'Guiding Principles on Sustainable Hydropower Development in the Danube Basin' within the framework of the ICPDR. In support of the development of this document, a broad participatory process was established with involvement of various stakeholders, and there is a chance to influence this process with participation of the Carpathian Wetland Initiative and national experts.

There are also benefits to be derived from production of relatively clean electric energy, but energy should not be produced at any cost; no-go areas should be determined for each country to preserve important wetland biodiversity elements, for instance in protected areas, to keep the balance between conservation and production of electricity.

W6. Limit peat exploitation

The ideal measure should be to stop all peat extraction, both for ecological reasons and because drainage and exploitation of peatlands turns them from a carbon sink to a carbon source. For this reason restoration and conservation of peatlands represent a key strategy for climate change mitigation (Russi *et al*. 2013) and should be a priority in the Carpathians. Given their importance as stores of carbon, conservation and restoration of peatlands should be given high priority.

W7. Protect karst areas by restricting intensive agriculture

Subterranean wetlands in the karst area are very specific ecosystems, which are strongly influenced by any human activities on the ground. The most harmful may be intensive use of arable land, which may cause silting of caves and pollution of subterranean waters by nutrients or chemical residues. Therefore, it is necessary to practice only extensive agriculture in karst areas and to prevent ploughing and fertilizing. Karst areas are also unsuitable for intensive livestock farming. Several of these actions are also required by the laws concerning protection of drinking water sources.

Buffer zones to protect caves in Slovakia

Cave systems contain very sensitive subterranean wetlands, which are highly dependent on surface management. Intensive agricultural activities or intensive forestry may have very negative impact on this fragile system. Therefore buffer zones should be proclaimed on the surface above and around caves to protect their environment. In the buffer zone it is, for example prohibited to use fertilisers and pesticides, to plough grasslands, and to apply clear-cutting. Seventeen such buffer zones have been proclaimed in different parts of the Slovak Western Carpathians (www.ssj.sk). In some cases, the borders of the buffer zone were the basis for delineation of the boundaries of Ramsar Sites on subterranean karst wetlands (e.g. Domica Cave Ramsar Site in Slovakia).

W8. Restrict afforestation of wetlands (especially wet grasslands and peatlands)

Afforestation can be a very harmful to some wetland types, especially wet grasslands and peatlands; it destroys wetland communities and can accelerate evapotranspiration, promoting degradation and desiccation of peatland sites. Continued afforestation reflects the fact that awareness about non-forest wetland values is still very low and they are considered by some as 'waste land' with no direct benefit.

W9. Exclude or restrict grazing around springs and on sensitive wetland sites

Carefully regulated grazing may be a good option for some types of wet grasslands, but large scale livestock farming can cause massive soil erosion and eutrophication in wetlands. Exclusion of grazing from wetland localities may be required in sensitive sites, for example on spring fens, which should be fenced and then only mown. On the other hand, some wetland species benefit from disturbance for their regeneration, so low intensity grazing by a very limited number of animals may be possible in some cases.

Fencing of spring fens in Protected Landscape area Bílé Karpaty, Czech Republic

The Bílé Karpaty Protected Landscape Area in the Czech Carpathians is one the most famous centres of grassland diversity in Europe. The Administration tries to promote regular use of grasslands by supporting mowing and grazing, but intensive grazing may have devastating effect on fragile ecosystems of fen springs, causing them to change to species-poor tall-herb wetlands. Therefore, the Administration protects valuable spring fens using permanent wooden fences, excluding them from grazing. These areas are mown by farmers, by protected area staff, or by NGOs.

Active management measures

Many sustainable management practices were traditionally used on Carpathian wetlands, and while some of these persist, others are disappearing. Today, conservation managers are attempting to maintain, extend and adapt traditional practices that conserve biodiversity. Alongside these measures, new techniques and activities are being developed and adopted.

W10. Maintain and extend mowing and grazing of wet grasslands

Mowing and grazing are frequently the best means for maintaining wetland habitats; when they cease, wet grasslands may change very quickly, especially the types with high biomass production (e.g. floodplain grasslands). Because of abandonment of regular agricultural practices, mowing and grazing on wet grasslands is often organised by responsible conservation agencies or NGOs. Such management is demanding in terms of finance and time, however, and only the most important sites can be managed by this approach.

Wet grasslands are adapted to extensive methods of management, usually taking place at the end of summer when the soil is dry and the localities more accessible. In general, it is recommended that they are mown once a year using light weight machinery adjusted to wetland conditions with double tyres to avoid soil compaction. The hay should be collected and removed after mowing. Should grazing be considered, it must be very extensive and take place in the autumn.

Wet grassland management in the Czech Republic

Under the Czech Rural Development Programme following rules apply for wet grasslands: (http://eagri.cz/public/web/file/10574/RDP_November_2008.pdf)

- No fertilisers or farm manure may be applied.
- The grassland shall be mowed at least once a year within a set deadline. The mowing shall be carried out by light machinery. The grassland may not be grazed after the mowing.
- The mowed biomass shall be removed from the parcel.
- Mulching, grassland restoration, supplementary sowing, liming and draining of the grassland may not be carried out. Rolling and dragging may be carried out only with a prior approval of a Nature Conservation Authority.

W11. Introduce mulching on an experimental basis as an alternative to grazing and cutting

Mulching is a technique of grassland management in which the biomass is cut into small pieces and left as a layer on the ground. This is less labour intensive and therefore less expensive than grazing and haymaking, and is effective in removing and preventing colonisation by trees and shrubs. Mulching is however still quite controversial, because biomass is not exported from the system and may cause eutrophication of grassland in the long-term. Experiments on fen grasslands in Slovakia show that repeated mulching over 5 years has no difference in impact from mowing and harvesting on grassland. However, knowledge about the impacts of mulching on wetland biodiversity is still insufficient and long-term research is needed. Due to uncertainties about its effects on biodiversity, the method is restricted in some countries and is prohibited on areas under agri-environmental schemes in the Czech Republic and Slovakia.

Picture 23: ***Example of mulching in Slovakia (photo: Dobromil Gálvanek)***

W12. Remove trees and shrubs on non-forest wetland habitats

Abandonment of regular use of wet grasslands may cause fast secondary succession and the site may be rapidly overgrown by trees and shrubs (especially willows and alder), reducing its biodiversity value. Manual cutting is particularly suitable for very wet sites, but is very labour intensive and expensive, so cheaper mulching by light machinery may be a good alternative in many cases, especially for trees of up to 8 cm diameter.

Reintroduction of regular management (mowing or grazing) is necessary after the removal of trees and shrubs, particularly in the first years after restoration, because willows may re-grow very fast if they are not regularly cut.

It is also important to mention that trees and shrubs may, in some cases, have a very positive impact on wetland habitats, such as river banks, where their removal is not an appropriate management measure.

W13. Manage peatlands sustainably and restore them after use

Where peat extraction continues (mostly in Romania), the techniques currently employed are not sustainable, and cut over peatlands are often planted with trees. New, more sustainable and sensitive techniques of peat extraction and post extraction restoration (rewetting) should be introduced. Some useful techniques for this have been developed and introduced in Belarus; these should be studied for their applicability in the Carpathians (see http://www.ecologic.eu/sites/files/publication/2013/RewettingPeatlands_FinalReport_18Nov2011_WEB.pdf).

W14. Develop measures and introduce programmes to remove or control invasive species

The most problematic areas are riverine corridors and floodplain forests, which are naturally rich in nutrients. Invasive plants include *Impatiens glandulifera, Helianthus tuberosus* and the tree *Acer negundo.* Some fishes e.g. *Ameiurus melas* are able to spread quickly and suppress local flora and fauna typical of river banks, floodplain grasslands or rivers.

There are some attempts to control invasive plants by point application of herbicides or by underwater cutting, but in general, there is no comprehensive programme for dealing with invasive plants on Carpathian wetlands, and the situation seems to be worsening. Measures are required to limit the spread of these species in the most sensitive sites.

Specific guidance on management of invasive species in Europe can be obtained from NOBANIS, the European Network on Invasive Species (http://www.nobanis.org/Regulations_international.asp).

Eliminating invasive trees species in Romanian wetlands

The EU Life Project 'Improving the conservation status for priority species in the Iron Gates wetlands' in Romania includes measures for control of invasive species including *Robinia pseudoacacia*, *Rhus hirta* and *Alianthus altissima*. Activities include identifying problem areas, tree marking, cutting, extraction and transportation to storage locations. Furthermore, leaves and seeds are being collected and burnt to reduce dissemination possibilities. The harvested wood will be donated to schools located in the area of project.

See http://cormoran.portiledefier.ro/en/action/ecological-restoration-of-wetlands

Removal of invasive plants in the watershed of the Morávka River, Czech Republic

A combination of mechanical and chemical methods were used for the control of the spread of invasive plants *Reynoutria japonica* and *Impatiens glandulifera* along the river Morávka in the north-eastern part of the Czech Republic as an activity under a LIFE-Nature project. Contact herbicide was applied to plants using special injectors, and the treatment was followed by sowing grass strips and planting shrubs and trees on river banks. Project activities helped to reduce significantly the abundance of invasive plants and to restore the river ecosystem of the Morávka River.

See www.life-moravka.cz

W15. Restore hydrological regimes and river dynamics

The ideal long-term option for restoring wetlands is probably restoration at the catchment or river system level. However, such an approach is often unfeasible due to financial, technical and social constraints. Therefore only partial restoration projects are usually implemented, such as construction of small dams on drained peatlands to raise groundwater level, reintroduction of flooding into selected parts of the floodplain using small dams or barriers, or re-connecting of oxbows with rivers and reconstruction of river meanders. Even such partial measures may have a very positive impact on wetland habitats and species.

Hydrological restoration on the peat bogs in Upper San Valley (Bieszczady NP, Poland)

Peat bogs in the Upper San Valley in the Bieszczady National Park in Poland are very important habitats and include bogs more than 10,000 years old. The peatlands were negatively affected by drainage, which caused a significant lowering of groundwater levels. A system of sluices on former drainage ditches was established, enabling an increase in water level in the ditches and thus positively influencing the groundwater level in the bogs (Szary, unpublished).

Ecological restoration of a small tributary, the Dorman Stream (Transylvania, Romania)

In the Dorman Stream watershed, two sites have been restored. Pilot works were introduced to increase the quantity of water in the stream during the dry season and to ensure better oxygenation of the water in the stream. Three types of weirs were constructed, one from rocks and stones, and the other two from wood. The positive effects of these works have been the restoration of habitats, increases in biodiversity, increased quantity of water in dry seasons and improvement of water quality. The restoration works also contributed to the regularisation of the water flow, improved the microclimate and helped to control erosion (Bănăduc *et al*., unpublished).

W16. Prevent sedimentation

The ideal option is always restoration of full natural river system dynamics, but such a solution is normally not possible, so in order to preserve diverse aquatic habitats, it is necessary to simulate natural erosive processes. Upstream of dams, removal of sediments from the beds of water bodies can help restart natural processes, preventing eutrophication, preventing later stages of natural succession and opening new spaces for succession. This is, however expensive. Downstream of dams, riverbed erosion is the main problem, reloading of sediment or measures to slow the flow, such as improving meandering capacity of rivers can help to decrease riverbed erosion and enable deposition.

Local sedimentation in rivers, creeks and other wetland habitats can be prevented in a number of ways.

- Maintaining riverbank vegetation prevents excessive erosion and also limits run-off of sediment from agricultural and forest land.
- Careful planning of roads and construction projects can limit subsequent erosion and sedimentation.
- Introduction of appropriate agricultural and forest management techniques on slopes can prevent erosion and sedimentation of rivers. In particular, ploughing and clear cutting should not be permitted.

4.2.3. ECOSYSTEM/LANDSCAPE SCALE MEASURES

These measures generally need to be adopted at higher levels by planning and regulatory authorities.

W17. Introduce and extend integrated water resources management

Integrated Water Resources Management (IWRM) has been introduced mainly through the Water Framework Directive and allows simultaneous achievement of multiple objectives (e.g. ensuring water, food and energy security, mitigating and adapting to climate change). IWRM expects that water bodies will be managed across the sectors, with strong involvement of all relevant stakeholders, combining a range of different instruments and management approaches to better manage and protect water and wetland ecosystem services. These approaches include improving site management, regulation and land use planning, property rights, incentives, and direct investments (Russi *et al.* 2013). Similar approaches, such as Integrated River Basin Management (IRBM), are being promoted by the Carpathian Wetland Initiative. In order to further the implementation of IWRM, a number of measures can be adopted:

- Implementation of joint projects with broader partnerships in order to improve inter-sectoral communication and collaboration.
- Improved promotion of model projects which can be used as the basis for replication in other countries. This approach requires facilitation of experience sharing and study visits to examples of good practice.
- Development of clear guidelines for land use planners on biodiversity priorities for inclusion in IWRM projects.

Integrated Tisza River Basin Management Plan

The Tisza IRBMP was developed in 2011 by five Carpathian/Tisza River basin countries. It considers both water quality and water quantity issues, taking into consideration threats, including those to wetlands. It includes a vision and management objectives and programmes of measures to achieve future goals.

The Memorandum of Understanding *'Towards the implementation of the Integrated Tisza River Basin Management Plan'* supporting the sustainable development of the region was signed in April 2011 by relevant ministers (ICPDR 2011). See www.icpdr.org/main/danube-basin/tisza-basin

W18. Establish ecological networks and restoration of river and wetland connectivity

Fragmentation of wetlands and existence of barriers on rivers are among the most serious problems in the Carpathians. Examples of complex restoration of river systems and their connectivity are not available from the region, but there are several examples where barriers have been removed from rivers and fish migration enabled. It is necessary to promote further similar projects and to implement more complex projects for restoration of whole floodplain systems. Further experience of such projects should be gained from countries where they have been successfully implemented.

Fish-passes on the Ipoly/Ipeľ River (Hungary, Slovakia)

If well designed, fish-passes on dams usually improve migration of fish species to their spawning sites, but it is a solution that does not solve the source of the problem. Removal of dams or re-meandering of the river would be much more beneficial to nature conservation.

The project for improving migration and building fish-passes was completed by the Middle-Danube Water Management Authority of Hungary, together with the Slovak Water Management Authority on the river Ipoly/Ipeľ. It is a good example of a restoration project executed on a border river between two States. According to the investigations of the Danube Research Institute of Hungarian Academy of Sciences, fish species are now using the fish-passes of the Ipoly and finding spawning sites upstream (Dukay & Gruber 2013).

W19. Incorporate conservation considerations into flood mitigation measures

The Carpathian region has suffered from many flood events in recent years. There have been two main types of flood. Flash floods are typical of small mountain watersheds, where the surface water may increase very rapidly after heavy rainfalls; and extensive floods, which affect large areas especially in wider valleys or lowlands. Implementation of flood control and mitigation measures provides an opportunity for the restoration of wetlands, which are integral part of flood mitigation measures.

Flash floods are closely connected to landscape changes, such as enlargement of production blocks during collectivisation. Features such as hedges and small wetlands, which slowed down run-off, were removed and land was cultivated on steep slopes, where there was a high risk of erosion. Land abandonment also promotes rapid run-off due to a so called 'roof effect', where tall unmown grass is flattened by the water and functions as a thatched roof. Complex restoration of the landscape, including restoration of small wetlands, can slow down run-off after extreme rainfall events. Some countries like Slovakia have already implemented such measures.

The main cause of major floods along lower rivers is that the rivers no longer have space to flood, because they are restricted by dikes, which cannot hold the excess flow during extreme events. The solution could be enlargement of floodplain areas or identification of areas, which are used only extensively and filled by water during flood events (regulated flooding). Identification of such areas is again closely connected with restoration of wetlands, which could be integral parts of such occasionally flooded areas.

Decentralised flood protection measures, for example, small technical interventions distributed throughout an entire drainage area can significantly reduce the occurrence and intensity of floods. Examples of these include retention basins, small dams, artificial lakes, restoration of meanders and vegetation near river channels, afforestation of flood plains and better soil management. The damage potential of storms can be considerably reduced through a combination of careful land use planning and ecosystem maintenance or restoration to enhance buffering capacity (Russi *et al*. 2013).

Programme of landscape revitalization in Slovakia

A programme financed by the Government operated in Slovakia in the years 2010-12, with the aim of reducing the risk of floods through revitalization of the landscape and through construction of many new small features, such as small wooden dams, drainage on forest roads and small water bodies. The idea of the programme was very innovative, but the execution was very controversial. No EIA process was conducted before the practical implementation of the measures, water management scientists and practitioners and nature conservation bodies were inadequately consulted over the design of the programme, and many features were built without permission and proper planning. As a result, some small rivers with intact river bank habitats were damaged, and the programme was heavily criticised by some water managers. In 2012 the newly elected Government stopped the programme, which is now being re-evaluated. As this experience has shown, unilaterally applied solutions cannot be successful, and wider consensus has to be achieved.

W20. Introduce regional (Carpathian-wide) measures for improved wetland management

The Carpathian Convention is taking action to '*ensure the integrated management of water resources and river basins. In this context all aspects of water management, from pollution and sanitation to flood control and wetlands protection are interdependent and need to be addressed simultaneously*'. The Convention provides the necessary framework for the implementation of the required integrated wetland management measures; according to its Article 6 on sustainable and integrated water/river basin management the Parties should:

(a) Take appropriate measures to promote policies integrating sustainable use of water resources with land use planning and aim at pursuing policies and plans based on an integrated river basin management approach, recognizing the importance of pollution and flood management, prevention and control, and reducing water habitat fragmentation.

(b) Pursue policies aiming at sustainable management of surface and groundwater resources, ensuring adequate supply of good quality surface and groundwater as needed for sustainable, balanced and equitable water use, and adequate sanitation and treatment of waste water.

(c) Pursue policies aiming at conserving natural watercourses, springs, lakes and groundwater resources as well as preserving and protecting wetlands and wetland ecosystems, and protecting against natural and anthropogenic detrimental effects such as flooding and accidental water pollution.

(d) Further develop a coordinated or joint system of measures, activities and early warning for transboundary impacts on the water regime of flooding and accidental water pollution, as well as cooperate in preventing and reducing the damages and giving assistance in restoration works.

A number of related and parallel initiatives are underway in the Carpathians:

- The regional initiative of the Ramsar Convention, the Carpathian Wetland Initiative, is working to facilitate the cooperation between the Ramsar and the Carpathian Conventions and to integrate the conservation and sustainable use of biodiversity, including wetlands, into river basin management.
- Guidance for the Carpathian Convention and for Governments and protected areas in the Carpathians on wetland ecosystem conservation, wise use and management can be found in the Protocol on the Conservation and Sustainable Use of Biological and Landscape Diversity, its strategy, the CNPA medium-term strategy, and the CNPA medium-term work plan.
- For conservation and management of migratory water birds and their habitats, the provisions and tools of the Bonn Convention on Migratory Species (CMS) should be consulted and applied, especially the Waterbird Agreement (AEWA), which promotes establishment and maintenance of the Critical Sites Network in the most important wetlands on water bird migratory routes in the Carpathians.

4.2.4. LEGAL, PLANNING AND ADMINISTRATIVE MEASURES

W21. Strengthen the policy environment for wetlands in the region

All Carpathian countries should establish national wetland policies/strategies (as part of their updated Biodiversity Strategies, Action Plans, or as separate documents) and should support functioning and efficient multi-sectoral and multi-stakeholder national Ramsar Committees with representation of relevant NGOs.

When implementing measures for water and wetland conservation and sustainable use, policy makers, decision makers, protected area authorities and other relevant stakeholders in the Carpathian region should take into account relevant provisions of EU directives, the Bern Convention, the Bonn Convention, the Carpathian Convention, the Protocol on Conservation and Sustainable Use of Biological and Landscape Diversity, the Ramsar Convention and the Ramsar Strategic Plan 2009-2015 and other agreements and strategies.

Wetland restoration should be emphasised at the policy level and added to national priorities for the next EU 2014-2020 Priority Action Frameworks, sectoral operational programmes and strategies. Protection and restoration solutions should be integrated into water, food, energy, climate adaptation and mitigation and development policies, into spatial planning and into new initiatives such as Green Infrastructure Development.

W22. Designate and establish new wetland protected areas

The new Aichi target for protected area coverage is 17% of non-marine areas, and wetlands should be included into the expanded national systems that are required. Indeed, achieving the Aichi target in Europe is likely to require designation of very large multifunctional landscape scale protected areas (IUCN Category V), which are perfectly suited for protecting catchments, river valley corridors and extensive mountain wetlands, while allowing continued sustainable use.

Protected area systems in some countries in the region such as the Czech Republic and Slovakia have quite good coverage of wetlands. However, countries like Ukraine or Serbia have inadequate coverage of wetland protected areas and there is still potential for designation of new sites. Some new Ramsar Sites (including transboundary sites) have been proposed during recent years in some Carpathian countries. There is also a need to identify and designate new Natura 2000 sites, Emerald sites and elements of the Critical Sites Network. Although the designation of a wetland protected area does not automatically mean implementation of proper management measures, it may serve as a barrier to large unsuitable investments and may attract funds for future management.

Designation of new Ramsar sites in Ukrainian Carpathians

Designation of new Ramsar sites in Ukraine is one of the priorities of the Ukrainian environmental policy, and a proposal for the designation of five new Ramsar sites has been prepared, representing typical mountain wetlands, rivers and alpine lakes in the Carpathian Biosphere Reserve. These habitats are currently relatively poorly covered by Ramsar sites in the Carpathians. Three of the proposed sites have already been approved by the Ukrainian government and sent to the Secretariat of the Ramsar Convention, which should provide official approval.

W23. Improve and extend conservation management planning for wetlands

On-site integrated management is crucial for the restoration and protection of wetland areas. There is a need to establish a consistent and practical methodology for preparing management plans for wetlands that can be readily adapted and adopted by countries in the region. Effective management in many countries is being limited by the expense and complication of preparing management plans. Wider use of the management planning guidelines of the Ramsar Convention may be a useful solution, but there may also be a place for a much simpler strategic plan that can be relatively quickly approved for wetland protected areas and that can provide a mandate for basic management while more complex plans are elaborated.

In the new Operational Programme Quality of Environment for the period 2014-2020, development and implementation of management plans for protected areas and Natura 2000 sites and species will be important indicators in Slovakia, and increased work on this already started in the last call of the programming period 2007-2013.

W24. Introduce land purchase for the most sensitive wetland sites

Lack of clearly defined property rights and the degree of fit with ecosystem structure and processes that underpin ecosystem services can accentuate wetland degradation and loss through conflicts, non-cooperative behaviour and inefficient management (Russi *et al*. 2013). Refusal of owners is one of the most critical factors, which may limit plans for wetland restoration. Therefore, some countries try to systematically promote purchase of land in protected areas, either by state agencies or NGOs. One positive example is Hungary, where the land purchased is systematically included in Ramsar sites, enabling better implementation of restoration measures.

W25. Improve regulation and land use planning in order to protect wetlands

Effective and efficient regulation of activities that impact water and wetlands is necessary to halt losses, stimulate restoration, and maintain the integrity of ecosystems and the ecosystem services (Russi *et al*. 2013). This includes the basic legal and institutional frameworks for regulatory action, but also implementation of laws.

There is a need to develop and promote models of good practice that start with existing regulations and demonstrate how they can be built into spatial planning processes at the national and local levels to improve water and wetland management. State agencies responsible for monitoring and enforcement also require improved resources and capacity building. This is a particular challenge, because corruption can be a major impediment, especially where built infrastructure involves large capital and operational investment.

W26. Strengthen EIA and Natura 2000 assessment for wetland sites

There is a need to develop consistent, transparent and practical Carpathian-wide standards for EIA and Natura 2000 assessments. The Habitat and Birds Directives have strengthened the role of impact assessment, which is obligatory for larger activities in Natura 2000 sites, but there are significant differences in the implementation of these assessments. A very strict regime is applied in the Czech Republic, where only authorised biologists can prepare the assessment. In Romania a system of regional Scientific Councils composed mainly of scientists may approve different plans, activities and investments in Natura 2000 areas. Due to involvement of experts from the academic sphere, the decisions of the councils are rather independent. A different situation applies in Slovakia, where the selection of authorised persons for the assessment is less strict and the country has undergone interventions from the European Commission concerning improper implementation of the Habitats Directive concerning assessment of impact on Natura 2000 sites. In the whole process there are still many gaps, and the quality of evaluations is not ensured, leading to approval of harmful investments in Natura 2000 sites.

Involvement of scientists into the process of impact assessment on NATURA 2000 sites

Regional Scientific Councils were established in Romania, involving people from the academic environment into decision-making processes in Natura 2000 sites. The Councils have the right to approve different investment plans in Natura 2000 areas. Due to the existence of the Councils, several harmful plans in Natura 2000 sites have been stopped (Bănăduc *et al*. unpublished).

4.2.5. ECONOMIC MEASURES

W27. Promote and implement cross-compliance rules and measures for wetland management

EU agricultural subsidies are very important incentives, which motivate farmers and promote agricultural use of mountain areas. The Common Agricultural Policy (CAP) has undergone many changes in recent years, which have led to an increase of environmental benefits from farming. Farmers are obliged to respect rules defined by cross-compliance (e.g. buffer zones along the rivers and wetlands, limits of fertilizing, restrictions for the storing of fertilisers). When they respect the rules, they may receive single area payments, which are basic agricultural payments.

Awareness and understanding of such measures is however limited in the Carpathians. Efforts are required to promote these schemes and emphasis the benefits they can bring for biodiversity.

W28. Mobilise payments for wetland management from rural development programmes

The Carpathian countries should use the period of preparation of the new agri-environmental schemes and other EU funding schemes (such as the Operational Programme of the European Fisheries Fund) for inclusion of wetland conservation interests into their national priorities for the 2014-2020 funding period.

The most important payments related to wetland management are probably agri-environmental payments. Farmers can voluntarily apply for the defined schemes and agree a contract with the Paying Agency, usually for 5 years. Agri-environmental programmes in some Carpathian countries such as Poland, Czech Republic or Slovakia include several schemes focused on wet grasslands and their biodiversity-friendly management, providing a very strong tool to motivate farmers to manage wet grasslands. However, the experience of biodiversity monitoring of agri-environmental schemes in Slovakia shows, that in spite of their good design, there are still some shortcomings in their implementation.

W29. Introduce compensatory measures to support wetland restoration

A further possibility for financing management and restoration measures on wetlands are compensation measures defined by the Habitats Directive. Investors are obliged to compensate loss of habitats and species caused by any investment. The compensation should be mostly used for the restoration of equivalent habitat to that which was destroyed by the activity. Compensatory measures are, for example, used for the reintroduction of regular mowing on different types of fen and wet grasslands in Slovakia.

W30. Implement conservation and restoration projects on wetlands

European Operational Programmes, as well as the programmes of other donors, provide several funding schemes for the restoration of wetland habitats. However, definition of some funding schemes, especially using EU funds, can be problematic, as they are often defined by a very narrow sectoral approach, project partnership is not always allowed and there is not enough time allowed for inter-sectoral discussions and consultations. One of the options for the inter-sectoral approach can be national ecosystem-based strategies for adaptation to climate change, recently developed in some countries where wetlands have a crucial role.

W31. Introduce market-based instruments to protect water and wetland ecosystem services

The behaviour of companies, nations and citizens is strongly influenced by the prices they pay for goods and services. However, the prices often do not take into account of the economic losses caused by the degradation of water and wetland ecosystems and the loss of value from degraded ecosystem services. A range of market-based instruments can play an important role in integrating the costs associated with such loss of value into decision-making, and consequently influencing the behaviour of citizens and companies. Examples include taxes and charges, phasing out or reforming environmentally harmful subsidies, quantity-based instruments, liability rules, and payment for ecosystem services (Russi *et al.* 2013, TEEB 2011). Study and implementation of these instruments in the Carpathian region are necessary to support environmental-friendly practices and to enable the values of water and wetland ecosystem services to be recognised.

W32. Seek new markets for products from sustainably managed wetlands

Decision makers should ensure that sustainable use of products (fish, peat, reed, timber, basket willow, berries) are included in biodiversity components of national strategic plans for aquaculture and the EU Operational Programme of the European Fisheries Fund.

Picture 24: ***Mosaic mowing in Malá Fatra National Park (photo: Dobromil Gálvanek)***

4.2.6. AWARENESS AND CAPACITY DEVELOPMENT MEASURES

W33. Improve cross-sectoral training of wetland managers and stakeholder groups

Many professionals such as PA staff, experts from NGOs and decision makers still have gaps in their knowledge about wetland management. Integrated water management as required by the Water Framework Directive is still not fully accepted by relevant groups of professionals, and the aims of the WFD are not properly understood. NGOs can play a very important role in increasing understanding, and have organised several successful series of seminars and workshops promoting integrated wetland management and the aims of the Water Framework Directive. It is very important that such training is cross-sectoral, reflecting the perspectives of all relevant sectors. This could be an important part of the work of the Carpathian Wetland Initiative in the region, possibly implemented through the Carpathian Wetland Centre.

W34. Provide up to date guidance on wetland management across the region

The Ramsar Convention (and other) guidelines on integrated wetland management should be translated and disseminated across the region as an approach for national guidance in management planning. In addition, there is a need to translate and distribute management standards/guidelines/models/toolkits for different wetland habitats as recommended tools for establishing programmes, targets, management objectives and guidelines in the Carpathians.

W35. Conduct wetland awareness campaigns

Much of the population still considers wetlands to be unproductive wastelands which provide few benefits for society. Disseminating knowledge on the benefits that wetlands provide to local communities can help counterbalance the negative vision on wetlands some stakeholders may have, and increase acceptance and participation in required policies and actions (Russi *et al.* 2013).

Awareness campaigns should focus on the services provided by wetland ecosystems, in particular, their role as sources of drinking water. The educational programme 'World of the Carpathian and Danube Wetlands', provided by DAPHNE – Institute of Applied Ecology and the Carpathian Wetland Initiative (available in English and some Carpathian languages) is an example of the well-developed, popular and successful training programme which can be distributed for use in the Carpathian region.

W36. Promote 'soft tourism' activities in wetlands

Promoting educational and sustainable tourism in wetlands can contribute to management, since it can support local people while generating incentives for conservation and management. In many cases, it also facilitates the acceptance and enforcement of environmental regulations by local populations and businesses, and can be combined with communication and education activities targeted both at local communities and at tourists.

Lakes and rivers especially attract visitors in the summer, but more effort has recently been invested in building infrastructure for tourists on mountain wetlands such as peatlands or wet grasslands. Wooden trails (boardwalks) with educational panels on peatland areas are very interesting and attractive for tourists, which presents areas that are usually inaccessible. Guided tours for visitors can also generate income for local guides and for protected area administrations. Key elements of sustainable tourism are appropriate planning, regulating and monitoring of tourist activities, as well as involvement of local communities, for example through training activities and credit schemes to help set up small tourism businesses (UNEP 2011).

Soft tourism in wetlands should be included in the Strategy for Tourism Development in the Carpathians to the Protocol on Sustainable Tourism, currently under development.

Guided bird watching trips in NP Djerdap, Serbia

Djerdap National Park organises very popular bird watching trips led by skilled local guides. The Park also offers transport facilities and accommodation at reasonable prices. The income from this service can be re-invested into nature conservation activities in the Park, and local communities can also profit. This activity shows that nature protection does not mean only restrictions, but is also a chance for sustainable development of the area.

See www.djerdap.org

4.2.7. RESEARCH AND MONITORING MEASURES

W37. Mobilise support for standardised inventories and management oriented research

There are still only very rough ideas about the distribution and state of the wetlands in the Carpathians; the existing information system is limited by the high cost of inventory work and relies largely on extrapolation from the few studies that exist. A standardised approach is required to wetland inventory in the Carpathian countries. After testing of the wetland methodology in Slovakia, this approach can be adopted in other countries with lack of data on the distribution and condition of wetlands.

Although wetlands are the focus of various academic research activities, there is still lack of research activities oriented on wetland management and restoration. Applied ecological research in Carpathian countries is poorly developed, except for in the Czech Republic, which is probably one of the European leaders in ecological research. There are only a few studies which test different management concepts and best practices in the long-term, and there is also a lack of serious research oriented on ecosystem services provided by wetlands. More attention should also be paid also to wetland fragmentation and its impact on wetland biodiversity.

Research oriented on wetland ecology and management in Lucian Blaga University in Sibiu, Romania

Lucian Blaga University in Sibiu is paying considerable attention to research focused on wetland ecology and management. They have produced numerous studies of, among others, changes in wetland ecological status, optimal management of wetlands and whole watersheds, monitoring of target fish species. They produce several scientific journals and reviews, which regularly publish wetland-oriented scientific contributions from the Carpathian region. More information can be found on the following links:

Transylvanian Review of Systematical and Ecological Research http://stiinte.ulbsibiu.ro/trser/index.html

Acta Oecologica Carpatica http://reviste.ulbsibiu.ro/actaoc/index.html

Romanian Journal of Aquatic Ecology http://reviste.ulbsibiu.ro/revista.rjae/html/index.html

Acta Ichtiologica Romanica http://reviste.ulbsibiu.ro/actair/index.html

W38. Improve monitoring of wetlands

Biodiversity monitoring of wetlands is an important activity, required by under the EU Habitats and Birds Directives and the Water Framework Directive. Monitoring programmes are mostly focused on surveys of current habitat distribution, changes in their status and changes in populations of target species. The Water Framework Directive also requires extensive monitoring of water quantity and quality, obligatory for EU member states.

It would be advantageous to share approaches for implementation of monitoring requirements across the Carpathian countries, so that best practices can be shared and common standards developed and implemented. Resources invested into these monitoring programmes are rather high, so it makes little sense to build parallel monitoring systems for wetlands, based for example on the Ramsar Convention platform. Instead, the best strategy is to fill the gaps of these large official monitoring programmes with smaller, more targeted projects.

Besides obligatory national monitoring, it is also important to organise local monitoring as an integral part of wetland restoration or management projects. The academic sector should be more involved in these activities, as such local monitoring programmes have potential to improve quality of ecological research in the region.

It is also necessary to find good platforms for sharing research results among Carpathian countries; scientific conferences and workshops focused on wetland management should be encouraged, aimed not only at scientists, but also at conservation practitioners and protected area managers.

The Parties to the Carpathian Convention agreed in the Convention and its Biodiversity Protocol on cooperation and harmonisation of their environmental monitoring systems, and on development of a joint information system. Each Party should cooperate in order to ensure that the national results of public research are integrated into the joint information system when it is developed.

Regularly updated biotope mapping in the Czech Republic

Biotope mapping is carried out by the Nature Conservation Agency of the Czech Republic. During the first period (2000-2005), all the natural and semi-natural biotopes were mapped in the field using 1:10,000 scale maps. The second mapping period has been running since 2006 (planned for 12 years). All the data are digitised, resulting in a biotope layer for the whole Czech territory, providing key basic data on the occurrence and quality of all natural and semi-natural biotopes in the country. The biotope mapping layer and derived products, such as a habitat layer (using categories of habitats according to the Habitats Directive) are publicly available on the site http://mapy.nature.cz. Because mapping is regularly renewed, it can also provide relevant monitoring data about the changes in quality and distribution of wetland habitats.

White stork database in Hungary

A good example of extensive and long-term monitoring in the region is the database of BirdLife Hungary on white stork monitoring data and on management of the bird's habitats. Operating for around 10 years, this database includes very detailed inputs about nesting sites, nesting numbers, status of the environment in the vicinity of nesting sites (mainly in settlements) and details of extreme weather events that threaten the nests. Using this database, conclusions can be drawn about the status of wetlands around nesting sites where the storks feed. Data about migration is also available from previous years. Finally, a major benefit of this data base is that it is online (www.golya.mme.hu), available and easy to understand. A similar white stork programme exists in Slovakia (www.bociany.sk).

W39. Improve information management and availability

The compilation of this study has shown that the exchange of information among the Carpathian countries about wetland management is still inadequate. There are many interesting and important cases and projects in different countries, which are not widely known or easily available. The Carpathian Wetland Initiative should be supported to continue its coordination, facilitation and catalytic role, to promote information-sharing and awareness, and to support synergies with other frameworks and initiatives (ICPDR, WWF-DCP, DANUBEPARKS, Wetlands International, BirdLife partners, IUCN Water and Nature Initiative, Science for Carpathians). The CWI could also establish a database of successful wetland management case studies from the Carpathian countries with short annotations and contact details of responsible persons, web pages or final reports. Production of a regular newsletter with links to coming events and interesting projects could be also a very positive activity in this field.

Information can also be shared by exchange of experience between different administrators of sites, by comparison of results of monitoring and of monitoring methods used.

An INSPIRE-compatible Ipoly/Ipeľ project

There have been several projects on the Ipoly catchment in recent years. One of them has proposed to create a new map-based, integrated system that includes all available data. It was coordinated by the Middle-Danube Environmental Inspectorate, in partnership with the University of Gödöllö (Szent István University), the Technical University from Zvolen (SK) and some institutes of the Hungarian and Slovak Academies of Science.

The pilot area was the whole Ipoly catchment, the result of the project was a map with 300 layers, and an integrated data management system, that was intended to be published for experts of the inspectorate and for national and local authorities (Dukay & Gruber 2013).

5. LARGE MAMMALS IN THE CARPATHIANS

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Picture 25: Chamois in Retezat National Park, Romania (photo: WWF)

5.1. OVERVIEW

The Carpathians are one of the strongholds of large carnivores in Europe, where the density of bears, wolves and lynxes is among the highest in the world (Zibordi *et al*. 2012), serving as an important reservoir of large carnivores for the continent (Breitenmoser *et al*. 2000). It has been estimated that the pan-Carpathian populations of brown bear, wolf and Eurasian lynx still exist in considerable numbers (7,000, 4,000, and 2,400 individuals, respectively). Generally, Romania and Slovakia have the largest populations, Poland and Ukraine moderate numbers, while the Czech Republic, Serbia (Paunovic *et al*. 2007; Cirovic *et al*. 2007; Milenkovic *et al*. 2007) and Hungary have only small numbers of individuals (Okarma *et al*. 2000).

Large herbivores are key species in the web of life, many of whose survival is closely linked to the presence of large herbivores. Red and roe deer are today among the most common European ungulates, and are the most important game species. The European bison is an ungulates that nearly became extinct, which is not recovering, but which may still be in a vulnerable status due to its limited gene pool (Linnell and Zachos 2011). Based on advice and assessment by bison experts (members of the IUCN Bison Specialist Group) in the Large Herbivore Foundation network, it was decided to nominate the Carpathian Mountains as a hotspot for bison conservation and restoration.

As well as having a significant ecological role, large carnivores and herbivores are important indicator species for the quality and the quantity of natural and the human-disturbed habitats. The basis of successful management (both protection and harvest) should be the zoological knowledge (habitat use, feeding habits, population dynamics etc.) and the monitoring of the target species' populations, which should be the best indicator of the results of protection and management activities.

The study and its recommendations are based on three main data sources

- Questionnaires circulated to experts across the region.[6]
- Results of stakeholder consultation meetings held in Hungary, Romania, Slovakia and Serbia.
- A review of relevant literature.

5.1.1. WOLF *(CANIS LUPUS)*

Picture 26: ***Wolf (photo: WWF)***

[6] Full details of the questionnaires and methods used may be obtained from the authors.

Zoological background

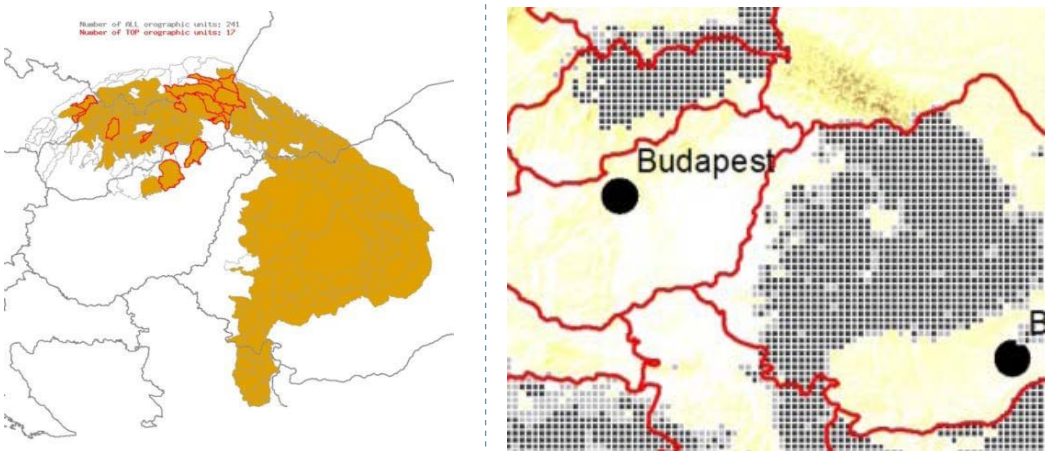
Wolves normally live in packs, which comprise family groups in the wild or instead, alone as individual animals for around 10 years. As a top carnivore, the wolf plays a significant selective role in the food web. Their main diet is large ungulates (red deer, roe deer and wild boar), but they also eat smaller prey items, livestock, carrion and garbage. Food composition depends on the density of the wolf population, on the habitat, on food availability and on the time of year. Although they can live in diverse habitats, wolves in the Carpathians tend to prefer large closed forests to exposed open areas.

Wolves are territorial and each pack actively defends its territory from animals in neighbouring packs. Territory size varies greatly, depending on wolf and prey densities, geographical features, human disturbance, and human-related infrastructure. Territories can be between 50 km^2 and 500 km^2 for regular activities, and they normally hunt within a circle of 6-10 km radius (Boitani 2000).

Distribution and population trends

The distribution of the wolf in the Carpathians covers the entire mountainous range except the Hungarian part (Map 5), although wolves have also been regularly observed in the north-east part of Hungary, spreading from the Slovak Carpathians. The total number of wolves in geographic Europe may exceed 10,000, with around 4,000-5,000 in the EU-25 countries. The central Carpathian Mountains support one of the healthiest and numerous wolf populations in Europe (LCIE 2007), although estimates of actual numbers vary. Breitenmoser *et al.* (2000) and Okarma *et al.* (2000) estimated the Carpathian population to be 4,000 individuals, the majority of them living in Romania (2,300 to 2,700 individuals) and Ukraine. Slovakia has been estimated to host about 400-500 wolves and the population of the Polish Carpathians has been estimated at 180-220 individuals (LCIE 2007).

The EC large carnivore status report from 2013, estimated a population of 3,000 individuals[7]. Experts contributing to this study estimate the Carpathian wolf population to be about 3,200 individuals (Figure 9), but local stakeholders and managers generally perceive a higher population density. The significant differences among the different estimates of population sizes is, according to our experts' opinion, a result of inadequate monitoring methods and the lack of simple monitoring systems and methods that can be carried out continuously and consistently.



Map 5. ***Wolf distribution according to CBIS (left) and Kaczensky et al. (2013) (right). Dark cells: permanent occurrence, grey cells: sporadic occurrence.***

[7] http://ec.europa.eu/environment/nature/conservation/species/carnivores/pdf/task_1_part2_species_country_reports.pdf

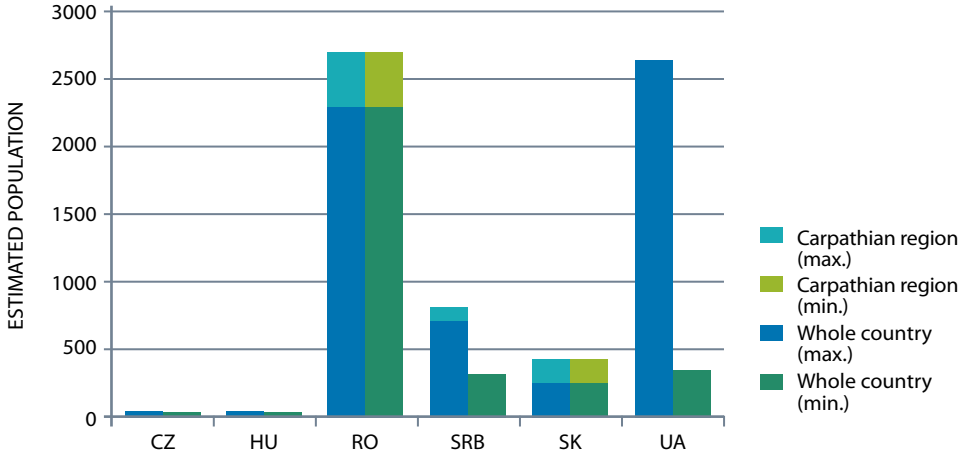


Figure 9. ***Wolf population abundance estimated by the experts in 2012.***

Values

The main ecological value of the species identified by the experts and stakeholders who were consulted is its regulatory effect on the ecosystem. The control and selective effect of the wolf can be a significant factor in both keeping the size of the prey population in check and in maintaining its quality. Wolves maintain the stability of the ecosystem and act as a bio-indicator of the quality of that area. The wolf is also an umbrella species whose presence can lead to an overall increase in biodiversity. Control of herbivores by wolves may have a beneficial effect on tree regeneration and forest structural diversity. Wolves are also seen as beneficial by some because they control stray dogs.

The main socio-economic values of wolves are said to be ecotourism and hunting tourism, which can provide income for local people and opportunities for employment. However, opinions vary sharply over whether the species should be hunted at all. What is not disputed, is that wolves have a major symbolic and historic value throughout the region.

Threats

The main threats to wolves are as follows.

Habitat loss and fragmentation: The large habitat requirement of this species is seriously compromised and fragmented by expanding towns and villages, and by the network of roads and railways. Forest management, in particular logging, reduces cover, the transportation of timber requires new roads which further fragment the area and cause increased disturbance. Heavy traffic and associated major disturbance and accidents are particular issues in Hungary and Romania.

Human-wolf conflict: Human intolerance is perhaps the greatest threat facing wolves in Europe today, and conflict between wolves and humans increases with fragmentation and human encroachment on wolf territories. Large and poorly protected sheep herds present an easy and abundant prey for the wolf. Fear, misunderstanding and killing of livestock have given rise to an uneasy relationship with people in many areas, leading to direct conflict and persecution. Illegal killing (through shooting, trapping and poisoning) is reported to be one of the most serious problems, most notably in Hungary and Romania.

However, the local stakeholders consulted in Slovakia thought that the wolf is not threatened in their country, because they have enough food, hunting is regulated and the population is increasing. The Serbian expert and stakeholders were of the same opinion. The Ukrainian expert in our study noted that the species is very ecologically plastic and there are no natural threats to its existence there.

Conservation status

Because of the relatively large number of animals and stable or increasing population, the status of the wolf is Least Concern in the IUCN Global Red List, and also in the European, the EU-25 and the Carpathian regional assessments. The Carpathian wolf population (ca. 3-4,000 animals) appears to be in favourable conservation status, mainly due to the conservation measures implemented in Romania (LCIE 2007).

The wolf is in Annex IV of the EU Habitats Directive (strict protection) as well as in Annex II (conservation of the species requires Natura 2000 sites). It is protected in Poland, and strictly protected in Hungary and the Czech Republic. In Romania wolves are protected, but can be hunted for 6 months of the year under a derogation from the EU Habitats Directive, applicable only where there is proven human animal conflict. Wolves can be hunted all year round in Serbia, during a 5-month season in Ukraine and for only 2.5 months in Slovakia (except in two protected areas along the Hungarian and Czech border, where no hunting is allowed). See Figure 10.

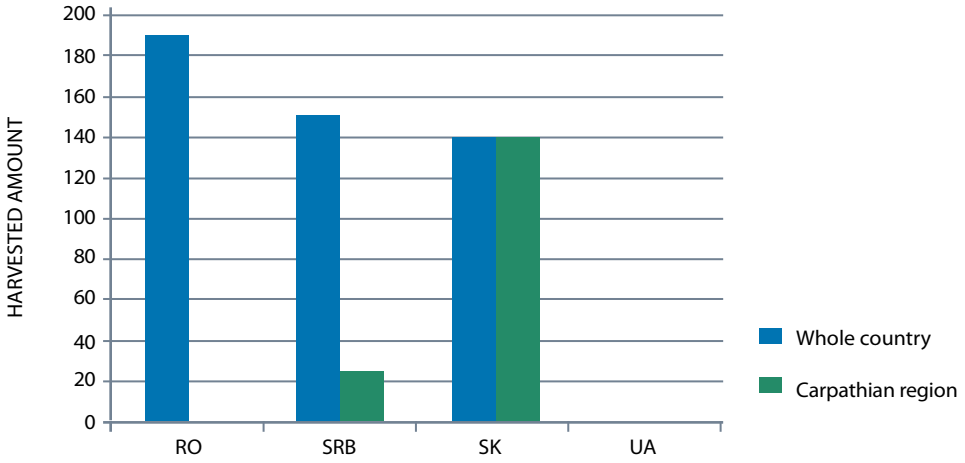


Figure 10. ***Harvest data for wolves in 2011.***

Management plans

Less than half of the countries (HU, SRB) have an approved conservation plan for the wolf. In Serbia there is only at present a 'Strategic Management Plan' as a first step towards a full species Action Plan. In Romania, a management plan for wolves was started in 2006 under the coordination of the Ministry of Environment, but the final document is not accessible to the public. The plan has not been officially adopted by central public authorities and (as far as is known) has not been subject to any monitoring in order to assess the success of conservation measures.

Different stakeholder groups are involved in the planning but in different ways in each country. However, the quality of the conservation plans is reported to differ widely and the overall level of implementation of species conservation plans is very low, even they have been accepted.

According to the responses of the experts in our study, nature conservation planning, game management planning and in some cases the forest management planning (SRB, SK, UA) all take wolf conservation into consideration.

Compensation systems

There is no compensation system in Ukraine, but in Slovakia, the Czech Republic and Romania the state pays for the damage caused by wolves. However, in Romania the complexity of the compensation system is reported to discourage affected people from applying for compensation. In Serbia, game managers are responsible for compensation. A compensation system was established in Hungary during a LIFE project (Silva *et al*. 2013), but the damages are currently not assessed or paid.

Monitoring

Only Serbia lacks a species-specific system for monitoring of wolves. According to our questionnaire, monitoring is mainly based on personal opinion/guesswork instead of scientific methods. In general, governmental organisations are mainly responsible for monitoring, followed by hunters, national parks and NGOs.

5.1.2. LYNX *(LYNX LYNX)*

Picture 27: ***Two lynxes (photo: WWF)***

Zoological background

The lynx is poorly studied and its conservation is targeted in fewer projects than wolves and bears. (Silva *et al*. 2013) It is a mainly solitary, nocturnal forest predator, preferring rocky locations or areas with good forest cover. Lynx territories vary from 100 km^2 to 1000 km^2 depending on prey density. Lynx form pairs only during the breeding season in February and March. They prey mainly on wild ungulates such as roe deer and chamois; in areas with low ungulate availability, lagomorphs, birds and rodents are also hunted. (Silva *et al*. 2013; von Arx *et al*. 2004) Predation on livestock in the Carpathians appears to be quite rare, and studies on diet composition do not support the view from the Alps that the main limit on lynx distribution is human-predator conflict due to the widespread attacks on livestock. (Breitenmoser 1998 and 2000, Stahl *et al.* 2001)

Population density depends on habitat quality, and especially on the density of the main prey species. The highest population density occurs in areas where roe deer also exist in higher densities; where the European hare is the main prey species (due to the lack of roe deer), lynx population density is lower. (Mitchel-Jones *et al.* 1999)

Mean distances travelled by lynx per night ranged from 1-45 km. The highest movement activities are observed in males during the mating season. Females with kittens, on the other hand, usually travel over short distances. When a lynx has a fresh kill, it stays in its proximity for several days. (von Arx *et al*. 2004)

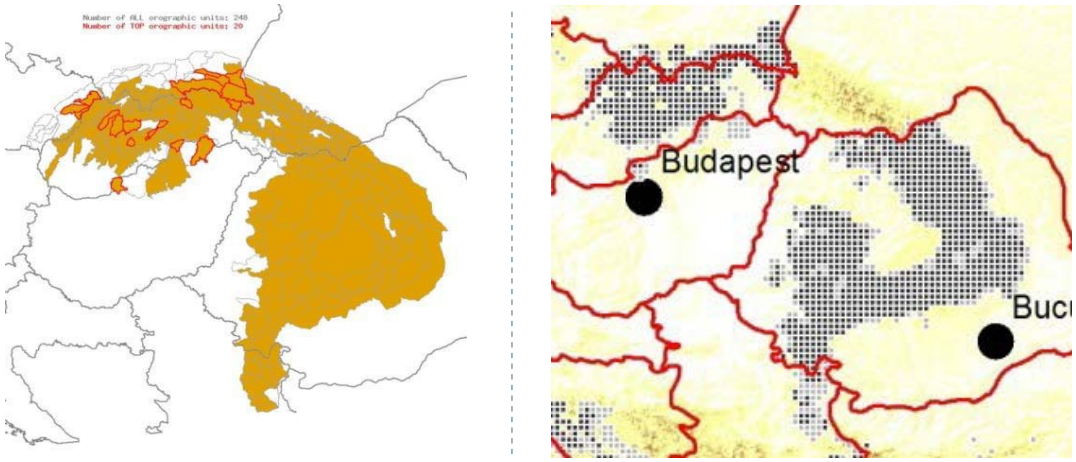
Distribution and population trends

The current distribution covers almost the entire mountain chain of the Carpathians, and is further expanding into Serbia, and most probably south into Bulgaria (von Arx 2007). Kaczensky *et al*. (2013) suggest that lynx occur in the western part of the northern middle altitude mountains in Hungary too (Map 6).

Population estimates range from 1,800 to 2,500. Breitenmoser *et al*. (2000) estimated 2,000 individuals. In 2007 von Arx estimated 2,500 individuals in the same area, Ionescu *et al*. (2009) gave an estimate of 2,400, and in 2013 Kaczensky *et al*. estimated 2,300. Our study among the BioREGIO partners estimated about 1,800 individuals in the Carpathians in 2012 (Figure 11).

The population trend appears to be stable or slightly increasing. (Okarma *et al*. 2000; Kaczensky *et al*. 2013) Our study supports this finding across the region, except in the Czech Republic, where a decrease was reported. This is in contrast with reports from the 1990s of increasing populations and ranges in Slovakia

(Hell *et al.* 1997), in the Šumava mountains in the border area of the Czech Republic, Austria and Germany (Wölfl *et al.* 2001) and in the Alps. (Stahl & Vandel 1999)



Map 6. Lynx distribution according to CBIS (left) and Kaczensky et al. (2013) (right). Dark cells: permanent occurrence, grey cells: sporadic occurrence.

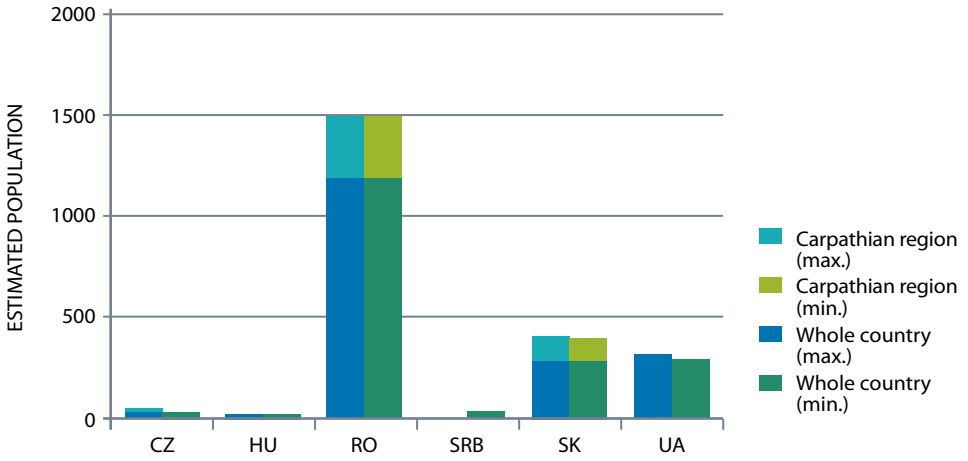


Figure 11. Lynx population abundance estimated by the experts in 2012.

Values of lynx

The ecological value of the species is mainly its regulatory effect on the ecosystem. The control and selective effect of the lynx can be a significant factor in both keeping the size of the prey population in check and maintaining its quality and good health. In turn, this helps maintain the stability of the ecosystem. The lynx can therefore be regarded as a bio-indicator that shows the quality of an area and an umbrella species whose presence can maintain biodiversity.

The main socio-economic values of lynx are as follows.

- Control of herbivores that may cause damage to forests (although in reality the lynx population is often too low to be having a significant impact).
- Nature based tourism, although it hard for visitors to see lynx, the presence of these animals can be an important factor in marketing area where they live to nature loving tourists.
- Hunting, there are disagreements in the region about the suitability of lynx as a sports hunting species, and about the potential income that may be generated from hunting where it is permitted, since the lynx is a very elusive and sparsely distributed species.

Conservation and management of lynx

According to the IUCN Red List for Europe, the pan European status of the population is Least Concern (mainly due to the large population in boreal forests in Russia and Scandinavia); in the EU-25 area, the status is Near Threatened. The species was almost extirpated from much of western and central Europe over the last few centuries, but in recent decades, and as a result of conservation action, the status of the species has improved in the EU-25. However this assessment can be misleading, as the population in the Carpathians is isolated from the boreal population (as are the other populations in western and southern Europe).

The lynx is listed in Annex IV of the Habitats Directive (strict protection) and in Annex II (species conservation requires Natura 2000 sites). National legislation and management regimes are similar across the region. The lynx is protected in Poland and Slovakia, strictly protected in Hungary, Ukraine, Serbia and the Czech Republic. In Romania, the species is protected, but up to 2013, under a derogation from the EU Habitats Directive, lynx could be hunted where there was proven human animal conflict. Since the 2012-2013 hunting season, the lynx hunt has been completely suspended for at least four years, or until new research is conducted on the population status. When hunting was allowed, it was reportedly non-selective, had little or no impact on damage reduction and probably had a negative impact on the size, area of distribution and structure of the lynx population (http://apmsb.anpm.ro/upload/114134_Raport%20CIMM_EN.pdf).

Threats

The main threats to lynx are as follows.

Habitat loss and fragmentation: According to the opinion of the Romanian and Hungarian stakeholders and experts, the size of habitats suitable for this species has been severely affected by urbanisation and the network of roads. Forest management, mainly logging and transportation also reduce habitat quality.

Disturbance: Lynx are sensitive to disturbance. Forestry operations, intensive mushroom and wild berry picking, the expansion of winter sports zones, tourism and heavy traffic are all identified as threats.

Persecution: The negative human attitude towards lynx arises mainly from two conflicts. Hunters blame lynx for reducing game abundance and availability, and livestock breeders do not like them because of predation on livestock (Breitenmoser *et al*. 2000). Consequently, persecution is mentioned as a major threat in Romania and in Hungary.

Poaching: Lynx fur and trophies can be highly valuable. Where trophy hunting was mentioned as a threat in Hungary and Ukraine, poachers were reported to shoot at lynx at any opportunity. In contrast, 50 % of local stakeholders in Slovakia thought that the lynx was not threatened in their country; the others thought that poaching or wolves could be threatening factors.

Management plans

Only Hungary and Serbia have an approved species conservation plan for the lynx. A document prepared in 2007 in Romania is considered by some stakeholders as the management plan for lynx, but has not been officially approved.

According to our study, only nature conservation and game management planning take lynx conservation into consideration, but lynx conservation is not adequately considered in forestry, agriculture and land use planning. In some senses the lynx seems to be a 'forgotten species'.

Compensation systems

There is no compensation system in Ukraine, but in Slovakia, the Czech Republic, Serbia and Romania the state pays for damages. A compensation system was established in Hungary during a LIFE project (Silva *et al*. 2013), but the damages were not assessed or paid.

Monitoring

The situation of the lynx is similar to that for the wolf. Governmental organisations, hunters and national parks are responsible for monitoring, however, in decreasing order. Monitoring systems reportedly operate best in the Czech Republic and worst in Romania.

5.1.3. BROWN BEAR *(URSUS ARCTOS)*

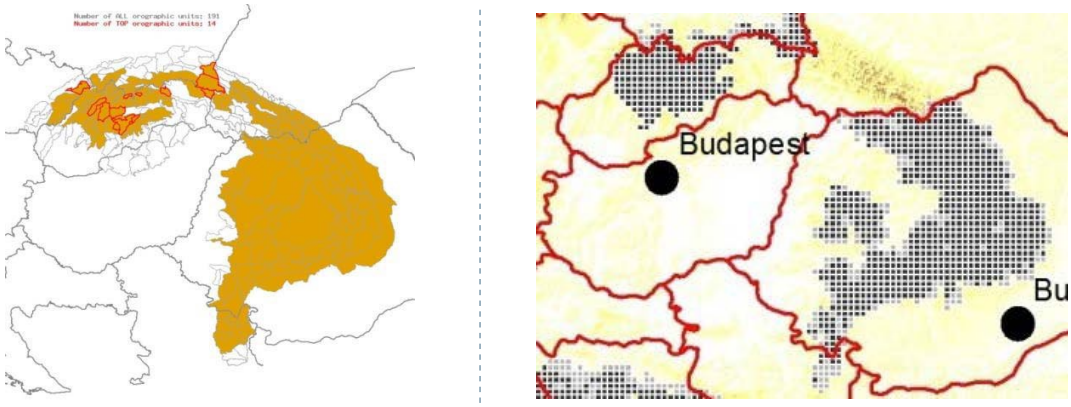
Picture 28: ***Brown bear (photo: WWF)***

Zoological background

The brown bear is the largest mammalian predator in the Carpathians. Bear population density, movements, habitat use, reproduction and survival are strongly affected by food availability. They are omnivorous, with a diet consisting largely of vegetation, although invertebrates, fish, and mammals are also frequently eaten. Habitat choice is also affected by availability of cover (mainly dense forests) and availability of undisturbed den sites for reproduction (Swenson *et al*. 2000). Bear home ranges vary widely, and individuals disperse long distances. Jerina *et al*. (2012) found that the mean bear home range size in Slovenia was 350 km^2. In late autumn, bears start their hibernation for three to seven months. Cubs are born in the den during hibernation in January and February and leave the den in April-May.

Distribution and population trends

The Carpathian Mountains population is the second largest in Europe and covers the whole mountain range extending from hilly areas to sub-alpine habitats (Huber 2007), with populations in Slovakia, Poland, Ukraine, Serbia and Romania. Some occurrences are also reported from Hungary. See Map 7.



Map 7. ***Brown bear distribution according to CBIS (left) and Kaczensky et al. (2013) (right). Dark cells: permanent occurrence, grey cells: sporadic occurrence.***

The Carpathian Mountains population has been estimated to be between 7,000 and 8,000 (Mitchel-Jones *et al.* 1999; Zedrosser *et al.* 2001; Ionescu *et al.* 2009), with the majority in Romania, functioning also as a source population for Serbia and Bulgaria. The results of an on-going LIFE project in Romania suggest that the population has been overestimated and highlight the weaknesses of traditional monitoring methods.

According to the literature, the population appears to be stable (Okarma *et al.* 2000, Kaczensky *et al.* 2013) or slightly decreasing (Mitchel-Jones *et al.* 1999, Ionescu et al. 2009). Our expert data indicates an overall stable population, that is decreasing in the Czech Republic and Serbia, increasing in Slovakia and stable in Romania and Ukraine. See Figure 12.

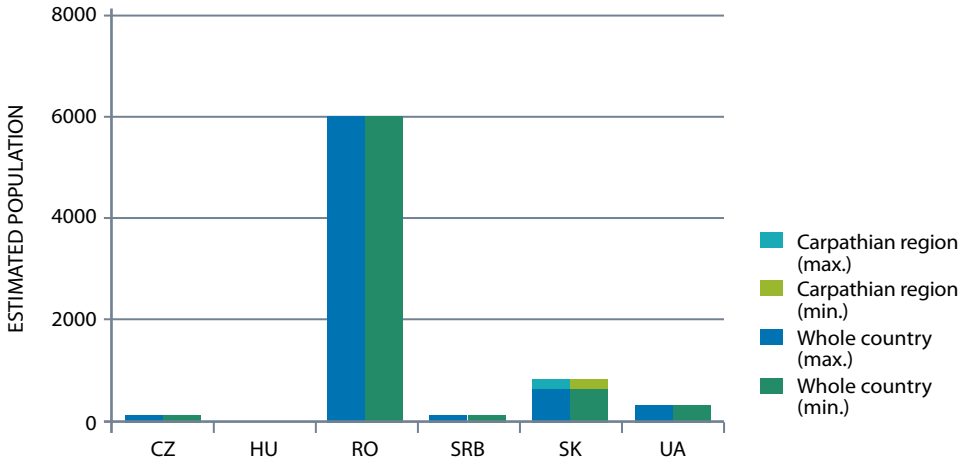


Figure 12. ***Bear population abundance estimated by the experts in 2012.***

Values of the brown bear

The ecological value of the species as mentioned by the experts and stakeholders is mainly its regulatory effect on the ecosystem. The control and selective effect of the bear can be a significant factor in both keeping the size of the prey population in check and maintaining its quality and healthy status. Bears also influence the stability of the ecosystem and are a bio-indicator that shows the quality of that area. Brown bear can be considered an umbrella species, which plays an important role in dissemination of the seeds of plants, trees and shrubs.

The socio-economic values of bears relate to ecotourism and hunting tourism (fur, trophy), which can provide income for local people and opportunities for more employment. Bears also have symbolic and historical values (i.e. in Romania). There are also disagreements among experts about the value and appropriateness of bear hunting as a sport.

Conservation status

The status of the population is Least Concern on the IUCN Red List for Europe. However, it is assessed as Near Threatened in EU-25, because there were fewer than 10,000 mature bears and many remnant populations are tiny and fragmented. The Carpathian population is assessed as Vulnerable (Huber 2007), but as Near Threatened by Kaczensky *et al*. (2013).

The brown bear is in the Annex IV of the Habitats Directive (strict protection) and in Annex II (species conservation requires Natura 2000 sites). National legislation and management regimes are very similar across the region. The brown bear is protected in Poland and Slovakia, and strictly protected in Hungary, Ukraine, Serbia and the Czech Republic. In Romania the bear is a strictly protected, but under a derogation from the EU Habitats Directive, can be hunted during a 6 months season where there is proven human animal conflict. In Slovakia, up to 10% of the estimated bear population can be hunted with special permission. In 2012 the harvest was 243 specimens in Romania and 8 in Slovakia.

Threats

Habitat degradation and fragmentation: In the opinion of the Romanian and Serbian experts, bear habitat is subject to continuous degradation and fragmentation due to human activities. Forest management, mainly large clear cuts, damages habitat and destroys or disturbs den sites. Road construction and urbanisation cause fragmentation and increase the risk of conflict with humans.

Disturbance: Forestry operations, road construction and tourism can all cause major disturbance and increase the risk of attacks by bears on people. Increased traffic leads to more collision accidents.

Conflict and persecution: The large and poorly protected sheep flocks present an easy and abundant prey for the brown bear. Bears can also cause significant damage in orchards and apiaries, which may lead to the illegal 'revenge killing'. Bears may also become habituated to humans, particularly where they are fed or where garbage is dumped. These bears may then attack humans, which may lead again to illegal killing or the need to cull dangerous individuals.

Poorly regulated hunting/poaching: Hunting in Romania is considered to be selective, oriented towards big adults and therefore having little impact on damage mitigation (the reason for the derogation). While poaching is considered a less serious problem and threat for brown bears in the Carpathians by many publications (Huber 2007, Swenson *et al*. 2000, Kaczensky *et al*. 2013), in Romania many stakeholders consider poaching to be a major threat that is severely under reported. In Ukraine, poaching is reported to be a major threat to bears that prevents the growth of the population. Local stakeholders in Slovakia consider that the bear is not threatened in their country because they have enough food, hunting is regulated, and the population is increasing. In general, the growing demand for bear products from Asia may in the near future start to encourage more poaching in the region.

Management plans

Romania, Serbia and Ukraine have species conservation plan for the brown bear. For Serbia and Ukraine, these plans contain similar goals and measurable actions, as for the wolf and lynx.

The management plan for bears in Romania

The general goal of this plan is to conserve a stable brown bear population in Romania in numbers that will ensure its viability and coexistence with humans. Special objectives for achieving the general goal include (not in order of priority):

1. Conservation of the habitat and the quality of the bear population.
2. Application of international regulations.
3. Avoiding the danger for humans and their property.
4. Achieving the desirable bear numbers.
5. Achieving of economic profit for local inhabitants through tourism and hunting.
6. Finding more data about bears in Romania (more research, better monitoring).
7. Increasing public awareness and involvement of the interest groups in decision making related to bear management.

Management planning goals

The plan was developed in accordance with studies and research, in compliance with existing legal regulations, and through widespread consultation with, among others, the Ministry of Agriculture, Forest and Rural Development the Ministry of Environmental Protection and Waters Management, Universities, NGOs, the State Forest Administration and Hunting Organizations. The following measures were agreed and approved through a Ministerial Order.

- Classifying the areas in which there are bears at present or which have the possibility of supporting bears (according to the suitability of habitats).

- Evaluation of the impact of the existing or planned infrastructure on the bear habitats and mitigation of the negative impact.
- Protection of brown bears by law: hunting is only used to benefit the wild population, where its validity is proven.
- Establishing an efficient system of compensation. The existence of the compensatory systems should be correlated with preventative measures (e.g. guard dogs, electric fence etc.).
- Making garbage disposal facilities inaccessible to bears.
- Initiation of information, education and public awareness campaigns for different target groups at local and national levels, as well as promotion of and support for educational and informative programmes to change the negative attitudes towards the bear.
- Establishing a protocol for permanent consultation with local populations regarding necessary management actions.
- Moving or culling of 'problem bears' in cases where prevention efforts fail.
- Applying in certain periods, of 'diversionary feeding', depending on species requirements and respecting the legal regulations for the bear's baiting.
- Implementation of the new population size monitoring system.
- Developing of special areas for bear conservation with a minimum size of 30,000-40,000 ha. each, with reduced anthropic impact in order to insure the stability of the population. In the identification of such area will be take into account areas from Harghita, Covasna, Mureş and Braşov.

Management of bears features mainly in nature conservation and game management planning, but not in the planning of other sectors. This result is surprising considering the wide distribution of bears and their predation on livestock, beehives, orchards and crops.

Compensation systems

There is no compensation system in Ukraine, but in Slovakia, the Czech Republic, Serbia and Romania, the state pays for damages. However, agricultural damages are normally not compensated, apart from in Slovakia.

Monitoring

Monitoring methods are similar to the wolf and lynx. Mainly governmental organisations are responsible for the monitoring, followed by hunters, national parks and NGOs. Monitoring reportedly is strongest in the Czech Republic and weakest in Romania.

5.1.4. GOLDEN JACKAL *(CANIS AUREUS)*

Picture 29: ***Golden jackal (photo: László Szemethy)***

Zoological background

The golden jackal is the least well-known carnivore species of the region. It was extirpated from the region in the past, but is now recolonizing. Jackals are 'searcher hunters' feeding upon a broad range of small-sized prey, such as rodents, hares, birds, reptiles and arthropods (Lawick-Goodall 1970), but also frequently consuming plants (Balasubramanian and Bole 1993, Mukherjee *et al*. 2004) and scavenging on domestic animal remains (Macdonald 1979, Poché *et al*. 1987, Amroun *et al*. 2006) or carcasses left by large predators (Kruuk 1972). Jackals preferring to hunt more in open country than in forests, either alone, in pairs or in groups (Lamprecht 1978, Macdonald 1979, Admasu *et al*. 2004). Groups of jackals can successfully hunt medium-sized ungulates such as roe deer (*Capreolus capreolus*) (Demeter and Spassov 1993) and wild boar (*Sus scrofa*). (Lanszki and Heltai 2002, Lanszki *et al*. 2009)

Distribution and population trends

In Europe, the golden jackal is considered as a resident species in the Caucasus, Turkish Thrace, Bulgaria, Albania and the eastern coast of the Adriatic Sea. (Mitchell-Jones *et al*. 1999, European Mammal Assessment Group IUCN 2007, Macdonald and Sillero-Zubiri 2004) The golden jackal has spontaneously recolonised the Balkans and several parts of Central Europe during recent decades, possibly because of climate change. Observations have been increasing in Serbia (Milenkovic and Paunovic 2003), in Slovakia (Hell and Rajsky 2000, Krištofík and Danko 2012), in Romania (Kiss 2000, Papp *et al*. 2013) and in Ukraine (Rozhenko and Volokh 2000). Jackals appear occasionally in Slovenia, northeastern Italy, Austria (Mitchell-Jones *et al*. 1999) and in Germany (Reinhard 2000). Recolonization has brought jackals into conflict with people, for example, hunters, farmers, and even nature conservation activists have been complaining about the damage to wildlife and domestic animals caused by jackals. See Map 8.

Map 8. ***The distribution of the golden jackal in Europe (Arnold et al. 2010.)***

Population abundance was estimated by experts in two countries in 2012. In Hungary, the total population is considered to be 5,531 individuals, with 75 in the Carpathian region. Sixteen individuals were reported from Slovakia. Population sizes are reported to be increasing in the Czech Republic, Hungary, Serbia and in the Slovak Republic. In Romania, the golden jackal population is increasing; in 2013, the estimated total number of golden jackals was 6,431 (Papp *et al.* 2013). No data are available from Ukraine.

Values of golden jackal

The relatively recent arrival of the species in the area makes an evaluation difficult. Hunting tourism (where the species is managed as game) has been mentioned by experts and stakeholders as a possible socio-economic value. Photo-tourism could be another possibility.

Management of jackals

The status of the species is Least Concern on the IUCN Red List, because of jackal is a widespread and opportunistic species. National legislation and management regimes vary in the region. The jackal is a game

species in Hungary, Serbia, and Romania. They are strictly protected in the Czech Republic. There is practically no hunting pressure on them in Slovakia, where the jackal is a protected species under environmental law and a game species in hunting law, with a 5-month hunting season. In Hungary the harvest was 1,129 (0 in the Carpathian Region) according to the National Game Management Database in 2012. According to national statistics in Romania, 2,502 individuals were killed during the 2012/2013 hunting season. In the Carpathian Region of Serbia, a kill of 105 was reported, with the comment that this is incomplete and doubtful data.

Threats

Persecution: Because of its damage to game (e.g. ungulate offspring and sometimes domestic animals) the species is often considered as a pest and comes into conflict with hunters and game managers. However, studies on food composition show that jackals feed mainly on smaller prey such as rodents, and generally avoid wild boar and cervids. (Lanszki and Heltai 2002, 2010, Lanszki *et al*. 2009) The spread of jackals may cause the spread of disease to wild animals. As a recent arrival, the interactions between jackals and other carnivores and herbivores in the Carpathians are not understood, but there is a widespread assumption that this is a harmful species. However, additional monitoring and observations are needed to understand the ecological interactions of the golden jackals in our region.

Habitat destruction: In Greece, the jackal population used to be considerable (Demeter and Spassov 1993), but today, mainly due to habitat destruction, it has become by far the rarest canid there. (Giannatos *et al*. 2005)

Management plans

None of the countries have a species conservation or management plan for the jackal.

Compensation systems

There is no compensation system in the Czech Republic, Hungary or Ukraine, but in Romania and Serbia the game manager pays for the damage.

Monitoring

Species-specific monitoring for jackals exists in three countries (Hungary, Romania, Slovakia). There is no monitoring in Serbia, despite its importance as a corridor for recolonization. A combination of scientific methods (e.g. snow tracking, howling surveys) and personal opinion (e.g. population assessment by hunters) is used. Hunters and governmental organisations are mainly responsible for monitoring.

5.1.5. RED DEER *(CERVUS ELAPHUS)*

Picture 30: ***Red deer (photo: Norbert Bleier)***

Zoological background

The red deer is one of the most important ruminant game species in the Carpathian region. It inhabits open deciduous woodland, upland moors and open mountainous areas (sometimes above the tree line), natural grasslands, pastures and meadows. In woodland, its diet consists mainly of shrub and tree shoots, but in other habitats it also consumes grasses, sedges and shrubs (Hofmann 1985).

Red deer live in large herds. The maximum herd size is in wintertime, when several hundred might be together, and smallest in early summer in the calving period, when only maternal groups (families) move together. The red deer is a highly mobile species, but in spite of the common belief of hunters, true periodic migration of whole population has not been proven.

Distribution and population trends

The red deer occurs almost everywhere in the Balkans and Central Europe, but the highest density is situated outside the Carpathian region (Mitchel-Jones *et al.* 1999). The average population density is between 2 and 10 specimens/km^2. During the last 50 years, red deer populations and harvests have increased all over Europe (Milner *et al.* 2006), except the Balkans, where the population has largely been extirpated due to overhunting. The distribution of the red deer in the Carpathians covers the entire mountain range and also the Carpathian Basin. See Map 9.

Map 9. ***The distribution of the red deer (Cervus elaphus) in the Carpathians (Lovari et al. 2008b).***

According to our questionnaire survey, the estimated population in the BioREGIO partner countries consists of about 242,000 individuals (Figure 13). Around one third of this population is estimated to live in the Carpathians.

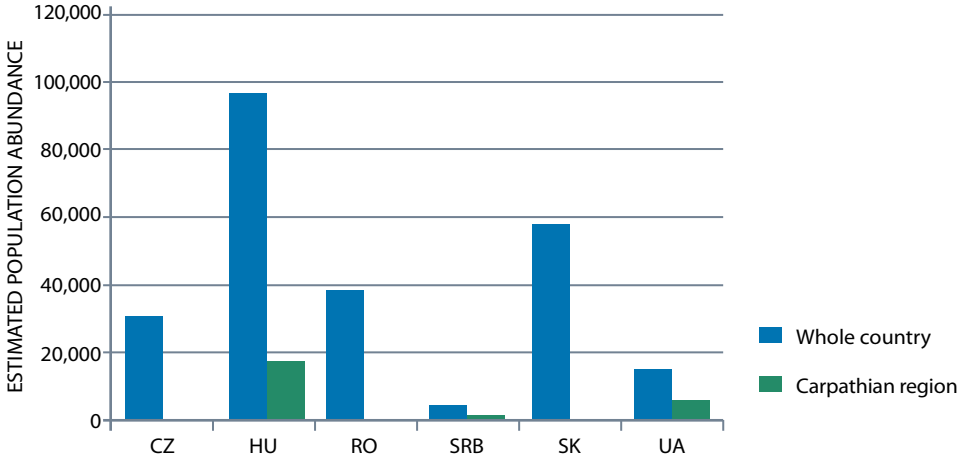


Figure 13. ***Red deer population abundance estimated by the experts in 2011/2012.***

Values of red deer

The main ecological values of the red deer are considered by the experts to be they contribute to increasing biodiversity, maintaining the stability of the ecosystem, are an important factor in the trophic chain, are important prey for large carnivores, contribute to the regulation of the cenotic system and have a potential role as a bio-indicator.

The socio-economic values are mostly in connection with game management, forestry and agriculture. Red deer are a highly important game species for both trophy hunting and venison production. The red deer can be flagship species for conservation programmes because of its traditional values (e.g. spiritual beliefs), and is attractive for tourism (photography, filming). However, large populations have a marked impact on forestry and agriculture, where the species can cause significant damage.

Conservation and management of red deer

The status of red deer is Least Concern on the IUCN Red List, due to its wide distribution and large populations. It is protected under Appendix III of the Bern Convention. According to national legislation, red deer is a game species with a limited hunting season in all the Carpathian countries. The length of the hunting season differs between the countries and in Slovakia, there is also a bag limit.

The bag was 95,457 specimens in the subset of Carpathian countries in 2011/2012 (Figure 14). However, there were no Carpathian specific data from the Czech Republic, Romania and Slovakia. Respectively, 40, 64 and 6,844 specimens were reported from the Carpathian part of Serbia, Ukraine and Hungary. Forest and game management planning take into consideration the conservation of the species throughout the region.

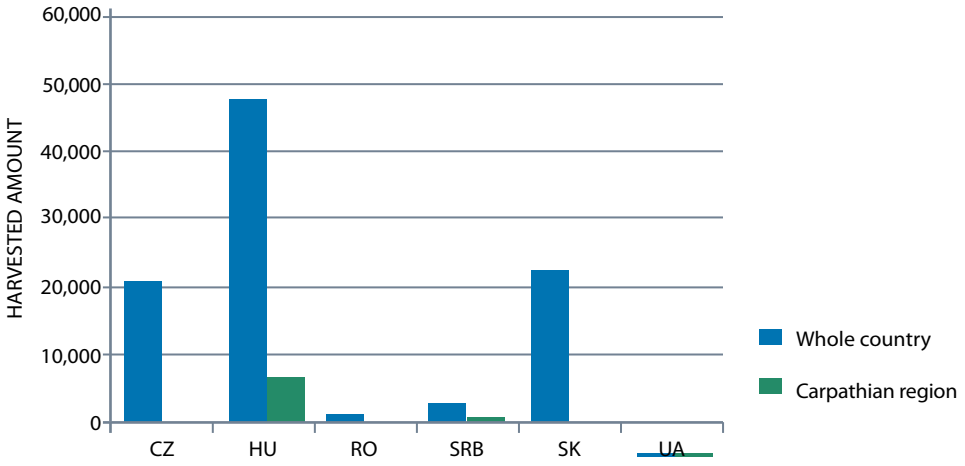


Figure 14. ***Red deer harvest data of the Carpathian countries in 2011/2012.***

Threats

Conflict. The so-called 'game effect' caused by high deer population is identified by foresters throughout the region as a threat to forest regeneration and to the introduction of certain types of forestry (e.g. selection).

Disturbance. Disturbance can be caused during intensive mushroom and wild berry picking activities and also because of extension of winter sport zones and tourism.

Poaching/poorly controlled hunting. Widespread illegal hunting of red deer has been reported from protected areas in Romania and in the Carpathian part of Ukraine.

Differing views on the impact of herbivores

The ecological role of ungulate species in forest ecosystems and their impact on vegetation dynamics is a complex, controversial issue causing many conflicts and debates (Putman and Moore 1998; Gill and Beardall 2001). Two main approaches dominate the evaluation of ungulate-forest relationships. One considers ungulates to be predominantly pests that are 'universally overabundant' and 'natural but not elementary parts of forest ecosystems', due to perceived damage caused by them in forests. In the Carpathians region, this view is the most popular in Hungary (Katona *et al*. 2011) and is reflected in the strict regulations on compensation for forest damage in that country. However, in some Carpathian countries forest damage is not considered, or only partly or not at all compensated (Reimoser and Putman 2011).

Several investigations support the theory that increasing forest biodiversity decreases negative game effects. Studies by Jactel *et al.* (2012) comparing the risk of damage associated with various forest management systems demonstrated that intensive even-aged forestry appeared to be subject to the greatest risk, irrespective of tree species and bioclimatic zone. Katona *et al*. (2013) stated that ungulate browsing took place on all the different woody plants of the understorey of even-aged forests, not only on the main tree species. Based on these investigations, the native target tree species of Hungarian forest management (European beech *Fagus sylvatica,* oak species *Quercus petraea, Q. robur*) were generally avoided. Only non-native black locust *Robinia pseudoacacia* was preferred irregularly. In general species of low or no economic importance were preferred; therefore biodiversity conservation (i.e. maintaining or establishing a multi-species understorey layer), can be a good solution to diminish the attractiveness to herbivores of the main tree species.

The other, much more holistic approach considers ungulate species as essential elements of forest ecosystems, where they have necessary regulatory impacts on vegetation structure, composition and dynamics (Smit and Putman 2011). The temporal and spatial variability in local impact of ungulates on the vegetation, and the diverse responses of plant species and individuals to herbivory may increase forest biodiversity (Gordon and Prins 2008). Large predators have a crucial influence on selective herbivory at the landscape-scale, since predation risk may have profound effects on patch selection by herbivores and thus on the structure of ecosystems (Ripple and Beschta 2004). In the established 'landscape of fear' (Laundré *et al*. 2010), both large carnivores and herbivores become important constituents of native biodiversity.

As a conclusion, we recommend managing forest ecosystems in a holistic way, integrating wildlife management and biodiversity conservation aims into forest management practices. Increasing naturalness of forest ecosystems can benefit biodiversity, decrease conflicts arising from forest game damage, and at the same time can be economically competitive (see e.g. Csépányi 2013). To help those joint efforts, understorey removal should be forbidden in Carpathian forests, field-collected data on understorey browse species should be incorporated into the forest management databases and mixed-species plantations and reforestations with native species should be promoted. Monitoring of the pattern of browsing selectivity can be important to follow reliably the balance between forest habitat quality and ungulate impact. When ungulates show selectivity for woody species that are generally avoided, we can suppose that the ungulate population is actually 'locally overabundant' and/or understorey food supply is scarce, generally preferred woody species are not available. The problem should be managed from both sides, by close-to-nature forestry practices and control of game populations (and their impact). However, we emphasise that a moderate herbivore impact is an important function in the natural dynamics of forest vegetation and that moderate pressure from a multispecies herbivore community on forest vegetation is elementary in forest biodiversity conservation!

Management plans

Only half of the countries have a specific species conservation/management plan for the red deer (Czech Republic, Hungary, Slovakia). Different stakeholder groups (mainly game managers) are involved in the

planning. According to the experts' reports, a good conservation plan exists in Slovakia, but this is not applied in practice. In Hungary, the management plan is of good quality and is applied well. In the Czech Republic (as with the other two countries) the planning of hunting depends on spring counts, which is said not to be at all reliable.

Compensation systems

There is no compensation system in the Czech Republic and in Ukraine, but in Hungary, Serbia, Slovakia and Romania, the game manager pays for the damages.

Monitoring

Species-specific monitoring of red deer takes place in every country. The methods used are a combination of personal opinion (e.g. population assessment by hunters) and, to a lesser extent, scientific methods (e.g. snow tracking, counts on sample plots). Hunters and governmental organisations are mainly responsible for monitoring. Monitoring systems functioning between countries; they are reported to work best in Hungary and Serbia, and worst in the Czech Republic and Romania.

5.1.6. ROE DEER *(CAPREOLUS CAPREOLUS)*

Picture 31: ***Roe deer (photo: Norbert Bleier)***

Zoological background

The roe deer is the smallest deer species in Carpathian region. It prefers landscapes with a mosaic of woodland and farmland and occupies a wide variety of habitats, including most types of forest, moorland, pastures, arable land, and suburban areas with large gardens. Roe deer live in small groups or solitarily, but in open areas exist in larger groups. The bucks protect a territory from April to August. The roe deer is a non-migratory species; individuals show high fidelity to their home ranges, which vary from 20-300 hectares. Young males can roam for up to 10-12 kilometres. Roe deer is a concentrate selector species, meaning that its diet comprises high quality, easy to digest, low fibre content plant parts such as young shoots, fruits, seeds and buds. (Hofmann 1985) The roe deer is an important prey species for the lynx and the wolf.

Distribution and population trends

The roe deer is the most common deer species across Europe, as well as in the Carpathian region, where its distribution covers the entire mountain range and also the Carpathian Basin. The population density is 10-

20 individuals/km^2 (Mitchel-Jones *et al.* 1999) and is increasing, amounting to at least 15 million individuals in Central Europe. See Map 10.

Map 10. ***Distribution of roe deer (Capreolus capreolus) in the Carpathians (Lovari et al. 2008a).***

According to our questionnaire survey the estimated population in the BioREGIO partner countries is about 1,182 000 individuals (Figure 15). Existing databases about the populations are quite poor and cannot currently provide reliable data, but the populations are said by the experts consulted to be stable (Romania, Ukraine) or increasing (Hungary, Serbia, Slovakia, Czech Republic).

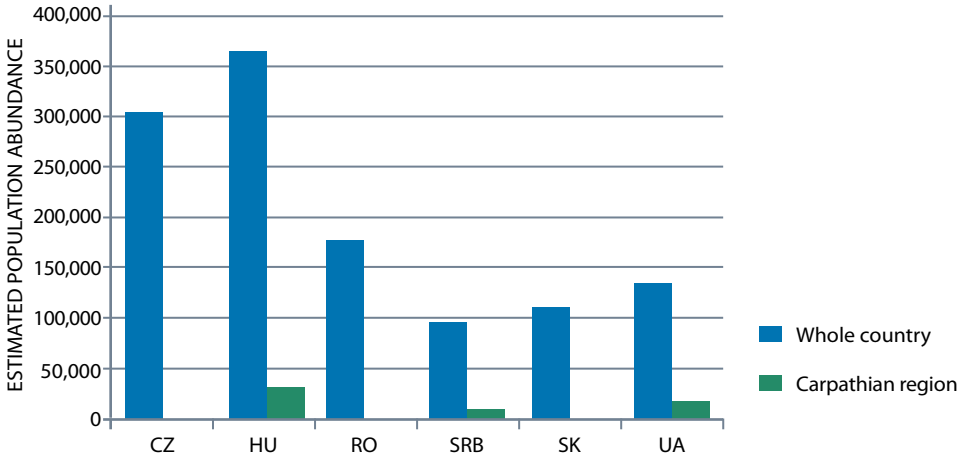


Figure 15. ***Roe deer population abundance estimated by the experts in 2012.***

Values of roe deer

The main ecological values of the roe deer are considered by the experts to be they contribute to increasing biodiversity, maintaining the stability of the ecosystem, are an important factor in the trophic chain, are important prey for large carnivores (particularly lynx), contribute to the regulation of the cenotic system and have a potential role as a bio-indicator.

From a socio-economic perspective, the roe deer is an important game species for trophy hunting and selling venison. The species are also valued culturally (e.g. spiritual beliefs), and are an attraction for tourism (photography, filming). Roe deer has an impact on forestry and agriculture, where it can cause damage.

Management of roe deer

The status of the population is Least Concern on the IUCN Red List, since it is considered to be a widespread and common species with no major threats. The roe deer is listed under the Bern Convention (Appendix

III). According to national legislation, roe deer is a game species and has a limited hunting season in all Carpathian countries. The length of the hunting season is different from country by country, and in Slovakia, there is also a bag limit.

In 2011/2012, 241,199 roe deer were reportedly shot in the partner countries (apart from Romania, where no data were available). Data were not provided for the Carpathian Region of the Czech Republic, Romania and Slovakia. Hungary, Serbia and Ukraine reported 9,527 specimens (Figure 16).

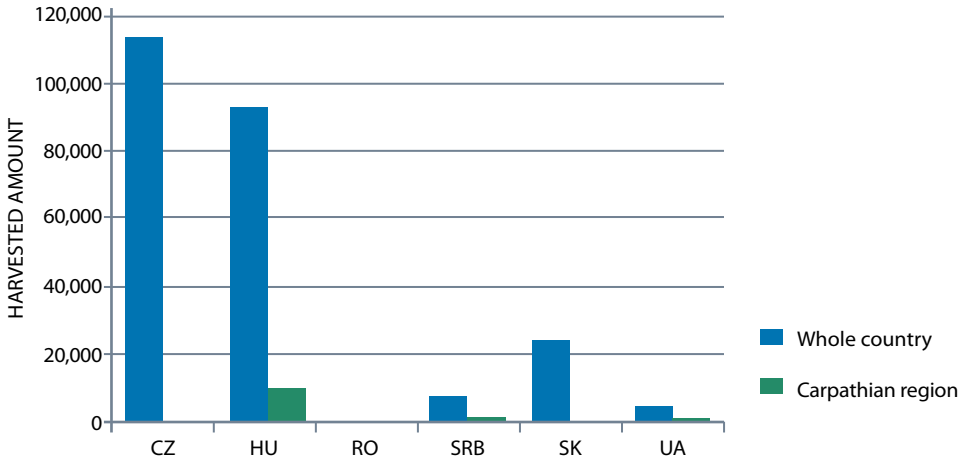


Figure 16. ***Roe deer harvest data of the countries in 2011.***

Forest management and the game management planning take into consideration the conservation of the species throughout the region.

Threats

Conflict. Conflicts can occur between roe deer and humans, mainly due to the damage caused by the animals. There is no compensation system in the Czech Republic or Ukraine, but in Hungary, Serbia, Slovakia and Romania, the game manager pays for the damages. The so-called 'game effect' caused by high deer populations is identified by foresters throughout the region as a threat to forest regeneration and to the introduction of certain types of forestry (e.g. selection).

Habitat degradation. Degradation of the quality of habitats suitable for this species was mentioned by the BioREGIO partners and stakeholders as a problem.

Disturbance. Disturbance can be caused during intensive mushroom and wild berry picking activities and also because of expansion of winter sport zones and tourism.

Poaching/poorly controlled hunting. This is a problem in some areas, especially in Ukraine.

Management plans

The situation of management planning of roe deer is very similar to that for red deer.

Compensation systems

There is no compensation system in the Czech Republic and in Ukraine, but in Hungary, Serbia, Slovakia and Romania, the game manager pays for the damages.

Monitoring

The monitoring of roe deer is very similar to that of red deer.

5.1.7. CHAMOIS *(RUPICAPRA RUPICAPRA)*

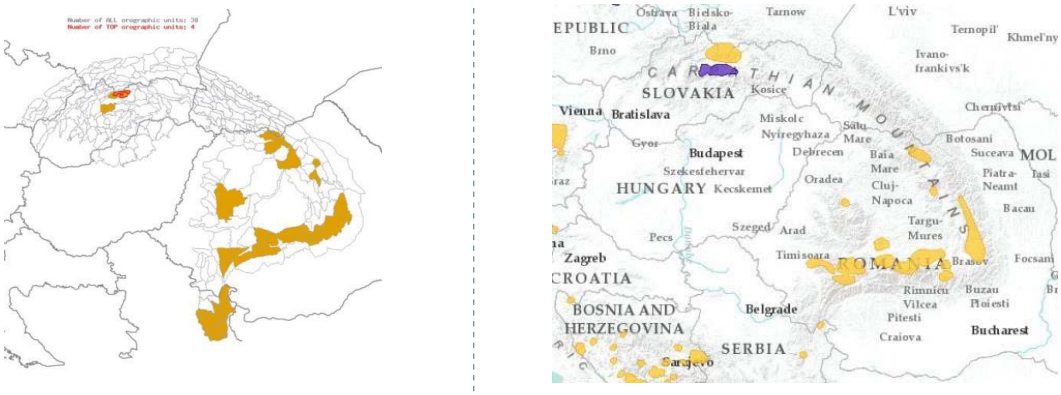
Picture 32: ***Chamois (photo: Dan Dinu)***

Zoological background

The chamois is a typical mountain species, inhabiting steep, rocky areas in the mountains, using a variety of habitats including alpine meadows, open rocky areas, mixed broadleaf woodland, and coniferous woodland (Pedrotti and Lovari 1999). Females and young occur in herds of 5-30 animals, while adult males remain solitary. During the summer, chamois herds use alpine meadows above 1,800 meters. In winter, due to thick snow coverage, they move to the lower regions (below 1,100 meters), where forest cover is denser and provides shelter and better hiding places for them. The average home range size is 74 hectares. Their dominant food sources are grasses, leaves, shoots, fungi and buds. The main predators of the chamois are humans, feral dogs, lynx and occasionally wolves.

Distribution and population trends

In Europe currently, the species is widely distributed and is generally increasing. The most important populations in Europe are in the Alps and the Balkans, while lower density populations occur in the Carpathians. In some areas the population density can be as high as 20 individuals/ha, and the estimated number of the European population is close to 440,000 (Aulagnier *et al.* 2008). The distribution of the chamois in the Carpathians covers only widely separated, isolated areas of the mountainous range in Romania, Slovakia, Poland and Serbia. See Map 11.



Map 11. ***Chamois distribution according to CBIS (left) and Aulagnier et al. (2008). Yellow: extant; purple: introduced***

According to our survey, the estimated population in the BioREGIO partner countries is about 8,200 individuals (Figure 17). The populations in the Czech Republic (an introduced population, not in the Carpathians) and Romania are said to be stable, while in Serbia and Slovakia they are increasing according to the BioREGIO experts. In Slovakia, there is a native subspecies, and the Alpine subspecies has been introduced to some mountains.

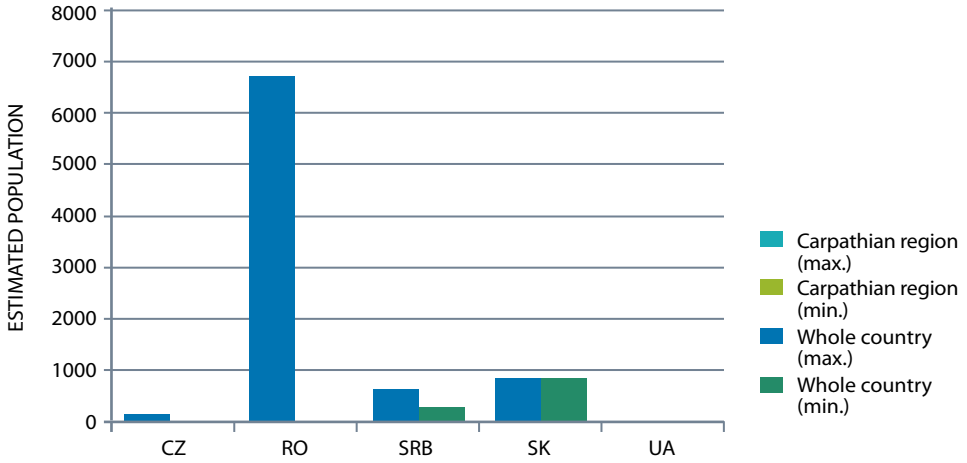


Figure 17. ***Chamois population abundance estimated by the experts in 2012.***

Values of chamois

The ecological values of the chamois identified by the experts and stakeholders are: increasing biodiversity, maintaining the stability of the ecosystem, being an important factor of the trophic chain, contributing to the regulation of the cenotic system; maintaining grasslands; potential role as a bio-indicator; prey species of large carnivores (wolf, lynx).

The socio-economic values of chamois are mainly connected with the ecotourism and photo tourism, which can provide income. Hunting tourism has an important economic role. Moreover, chamois has symbolic and historic values and can be a flagship species of conservation programmes.

Management of chamois

The status of the population is Least Concern on the IUCN Red List. However, several chamois subspecies qualify as globally threatened. The species is listed in Appendix III of the Bern Convention. The subspecies *R. r. tatrica* is listed in Annexes II and IV of the EU Habitats and Species Directives. The Carpathian part of Serbia is inhabited by chamois originating from Mt. Prenj (Bosnia and Herzegovina), belonging to subspecies *R.r. balcanica*, which is also listed in Annexes II and IV of the Habitats and Species Directives. The chamois is a game species with a limited hunting season in the Czech Republic, Romania and Serbia, and for the introduced *R. r. rupicapra* subspecies in Slovakia. The subspecies *R. r. tatrica* is protected in Slovakia and Poland. See Figure 18.

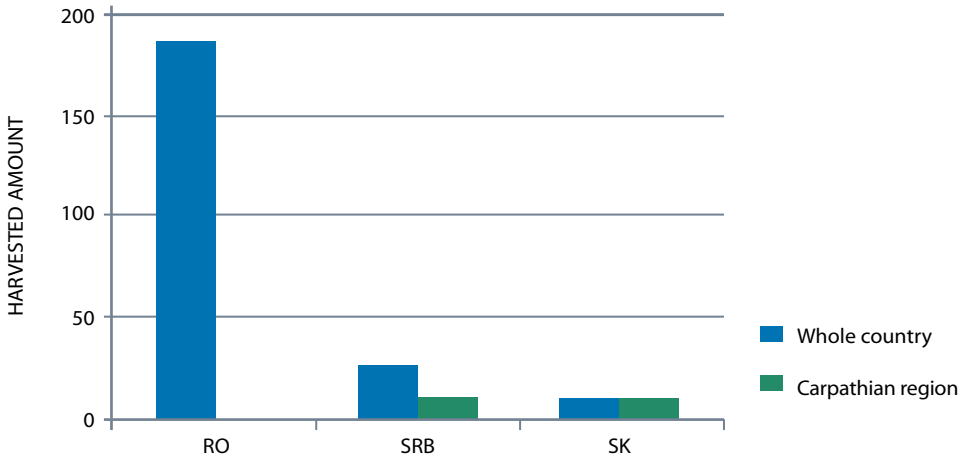


Figure 18. ***Chamois harvest data of the countries in 2011.***

According to the answers of the experts in our study, planning for nature conservation, forest management and game management all take into consideration the conservation of chamois.

Threats

Habitat degradation and fragmentation. Chamois are vulnerable to the degradation of their summer habitats in the high mountains and their winter habitat in higher elevation forests. Establishment of high-level ski resorts and infrastructure is a particular threat.

Disturbance. Increased mountain tourism (both winter and summer) can cause disturbance and affect breeding and feeding of chamois.

Habitat sharing with grazing animals. Use of alpine pastures for livestock grazing can limit access for chamois, and lead to transmission of disease between domestic and wild animals.

Inbreeding. Because the various populations of chamois are isolated from each other, outbreeding is impossible and populations may be subject to the effects of inbreeding.

Interbreeding. Interbreeding with introduced alpine chamois may affect the genetic integrity and specific local adaptations of local Carpathian races.

Poaching and poorly regulated hunting. In some areas, chamois are subject to illegal killing.

Management plans

Only the Czech Republic and Slovakia have a specific species conservation/management plan for the chamois. The planning process in these states includes foresters, game managers and nature conservationists. According to experts' reports, Slovakia has a good conservation plan, in actuality however, is not implemented in practice. In the Czech Republic, the planning of hunting depends on spring counts, which are said to be unreliable.

Compensation systems

There is no compensation system in the Czech Republic and Slovakia, but in Romania game managers pay for the damages.

Monitoring

Specific monitoring of chamois functions in every country in its range (Czech Republic, Romania, Slovakia, Poland, Serbia). The methods used combine scientific methods (e.g. snow tracking, spot counts) and personal opinions (e.g. population assessment by hunters). Hunters and governmental organisations are mainly responsible for monitoring, but in some cases National Parks are responsible as well. Overall, monitoring systems are reported to function quite poorly.

5.1.8. EUROPEAN BISON *(BISON BONASUS)*

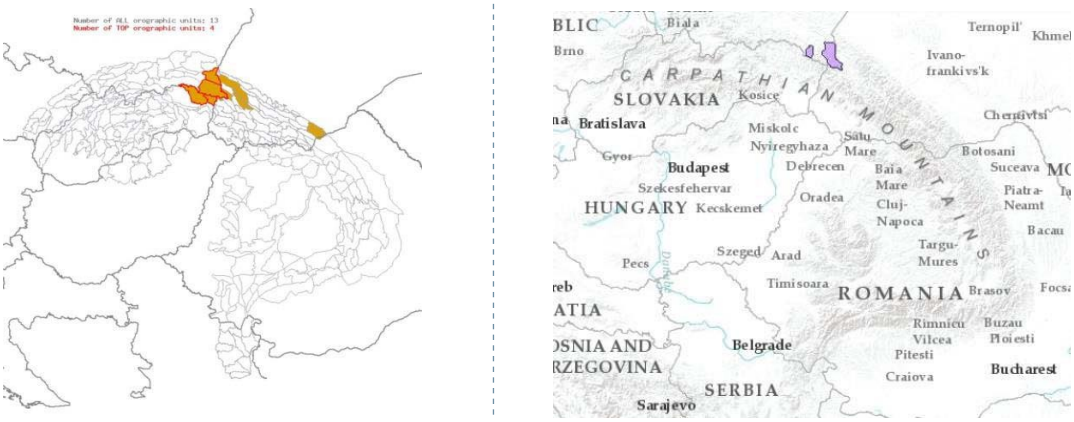
Picture 33: ***European bison in Vânători Neamț Nature Park, Romania (photo: Razvan Deju)***

Zoological background

The European bison is the largest ungulate in the region, with a mean body mass of 634.1 kg for bulls and 423.7 kg for cows (Krasińska and Krasiński 2002). It is a social animal; mixed groups and bull groups are the basic units (Puce *et al*. 2004). European bison mainly forage in moist deciduous forests and in mixed coniferous forests. In the Carpathians they select forest-dominated habitats, with a preference for complex mosaics of forests and grassland patches in areas of low human disturbance. (Kemmerer *et al*. 2010)

Distribution and population trends

The species became extinct in the wild in the 1920s and was saved by captive breeding programmes. The total European bison population is currently about 3,100 individuals, with some 1,900 living in the wild and 1,200 in captivity (Linnell and Zachos 2011, Olech 2007). At present, populations are being established along the Carpathian mountain chain in Poland, Slovakia, Ukraine and Romania, aimed at establishing a viable metapopulation of interconnected stocks (Linnel and Zachos 2011). Ziółkowska *et al*. (2012) estimated that around 350 European bison live in the Carpathians in five free-ranging herds (2 in Poland, 1 in Slovakia, 2 in Ukraine). In Romania, there are captive herds in three national parks awaiting reintroduction and a free ranging herd of 5 individuals in Vânători Neamț Natural Park. See Map 12.



Map 12. ***Bison distribution according to CBIS (left) and Olech (2007).***

The total Carpathian population is estimated by the experts in this study to be about 96 individuals (excluding the Polish Carpathians) (Figure 19).

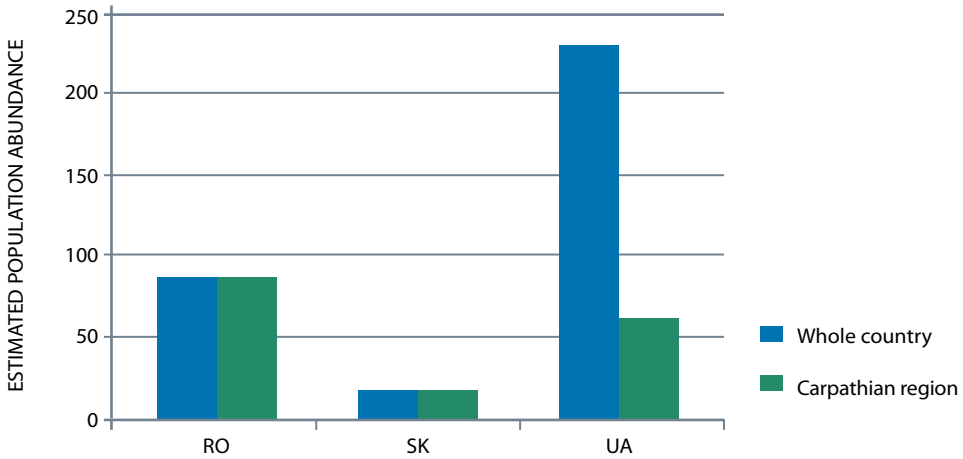


Figure 19. ***Bison population abundance estimated by the experts in 2012 (excluding Poland).***

Values of bison

The main ecological value of the species identified by the experts and stakeholders is its role in the formation of the prehistoric European broad-leaf forest and forested steppe ecosystems. Bisons are an important surviving component of the original European fauna. In the places of permanent occurrence, bison can cause considerable harm to the undergrowth of broadleaved forests.

The main socio-economic value is likely to be ecotourism. The bison has a long history and is connected with many communities that use it as a symbol. The European bison also appears on the old Moldavian and Romanian blazon. Its symbol can be also used to attract tourists and to promote traditional products.

Management of bison

The status of the whole population is Vulnerable according to the IUCN Red List for Europe and for the EU-25, because of the low number of mature animals. The Lowland line is assessed as Vulnerable and its numbers have increased in the last 10 years, but the Lowland-Caucasian line is assessed as Endangered, because it has been declining since 1990. (Olech 2007)

The European bison is listed in Annex IV of the Habitats Directive (strict protection) and in Annex II (species conservation requires Natura 2000 sites). National legislation and management regimes are the same across the region; it is strictly protected in all countries.

Threats

The main threats are as follows:

Inbreeding and diseases. These are consequences of the low genetic variability and include balanoposthitis (the inflammation of the penis and prepuce).

Small isolated populations. Low populations make the bison very vulnerable to a range of catastrophic events that could eliminate entire breeding groups. Such events might include disease outbreaks, poaching and accidents.

Conflicts with landowners. This may be a problem as herds increase (Hofman-Kamińska and Kowalczyk 2012). Specific issues may be hybridization with cattle, disease transmission and competition effects (Kuemmerle *et al*. 2011). It should be noted that in northeastern Poland, where the population is higher, large amounts of compensation are paid for bison damage to crops (over € 90,000 in 2010; Hofman-Kamińska and Kowalczyk 2012).

Management plans

Three countries have conservation plans for bison (Ukraine, Slovakia, Romania). Mainly nature conservationists and game managers participated in the planning (farmers were not involved). Evaluating the planning quality, we concluded that participation was better in Ukraine, but the plan was more reliable in Romania.

Compensation systems

There is a compensation system in Romania and Slovakia, where the state pays for the damages caused by bison, but in Ukraine, where many more free-ranging bison can be found, no compensation is paid, which may lead to illegal killing.

Monitoring

Only the Slovak Republic reported an existing monitoring system, under which an annual countrywide survey takes place, conducted by government hunters. The quality is reported to be quite low.

5.1.9. CONCLUSIONS FROM THE SPECIES ASSESSMENTS

Overall status and protection of large mammals

In general, the status of all the species assessed was reported by the consulted experts to be quite stable; none of the species were assessed as being seriously threatened at the moment, and the Carpathians remain a stronghold of European large mammal fauna. However, this is no motivation of complacency, the pressure and threats are increasing (Table 8) and much of the available information is not particularly accurate or reliable. The protection status of large mammals is variable and inconsistent in Carpathian countries; regulations for hunting differ widely, as to perceptions as to whether hunting should be allowed at all for the carnivores. Although in some cases it may be quite acceptable to adapt protection status and management to national conditions, national assessments may not be taking into account the overall regional status of species and the distribution and movement of species across international boundaries. Applying Europe-wide directions and categories to regional populations can be confusing, and leads to anomalies, such as the derogation of the protection status for some species in Romania.

Code	Threat description	Wolf	Lynx	Bear	Jackal	Red Deer	Roe Deer	Chamois	Bison
A04	Grazing							X	X
B02.02	Forestry clearance	X	X	X		X	X		X
B02.03	Removal of undergrowth					X	X		
A05	Animal breeding	X	X	X	X		X		
F03.02.03	Trapping, poisoning, poaching	X	X	X	X	X	X	X	
F03.02.04	Predator control	X	X	X	X				
D01	Roads, paths and railroads	X	X	X	X	X	X	X	X
E (most sub categories)	Urbanised areas, human habitation	X	X	X	X	X	X		X
G01.02	Walking, horse-riding and non-motorised vehicles	X	X	X				X	X
G01.03	Motorised vehicles	X	X	X		X	X		
G01.04	Mountaineering, rock climbing, speleology							X	
G01.06	Skiing, off-piste	X	X	X				X	
G02.02	Skiing complex	X	X	X				X	
K03.03	Introduction of disease					X	X	X	X
K03.06	Antagonism with domestic animals	X	X	X					X
K05.01	Inbreeding							X	X
M01	Climate Change (change in abiotic conditions)							X	
M02	Climate Change (change in biotic conditions)							X	

Table 8. Summary of main threats to large carnivores and herbivores (EU threat codes).

Planning

Less than half of the total possible number of national management plans are in place for the species assessed; many of these plans are considered to be weak (especially for carnivores) and poorly implemented. The integration of large mammal conservation into management plans of different sectors is also generally weak. Very important sectors that strongly influence the conservation of the large mammals, such as land use planning, infrastructure and settlement development do not specify conservation actions and do not take into account conservation requirements.

Data availability, quality and reliability

The regional questionnaire also asked experts to assess the availability, reliability and quality of population estimates and harvest data from their countries (the full results are available from the authors). In summary, there are great variations across the region. There are numerous data gaps and several experts have noted that it is very complicated and takes long time to acquire data, as a result of administrative bureaucracy. In general however, the harvest data appear to be more reliable than the population estimates, and population data is more reliable in countries where species are rare and less widespread.

Overall, insufficient data on large mammal populations are available to evaluate accurately their current status, plan appropriate conservation, management and sustainable use measures, monitor and assess the threats (especially illegal killings) and monitor the results of management measures. There is also lack of data from different administrative authorities nationally and on the EU level. The present field surveys are carried out in different ways in Carpathian countries, so that data are not comparable across species ranges. Despite these well-known limitations, insufficient attention is paid to the improvement of population estimations and to basic research.

The lack of a 'common language' and different understandings of terminologies often causes problems in the coordination of conservation/management measures. Lack of common methods of measuring and reporting basic parameters prevents accurate regional assessments.

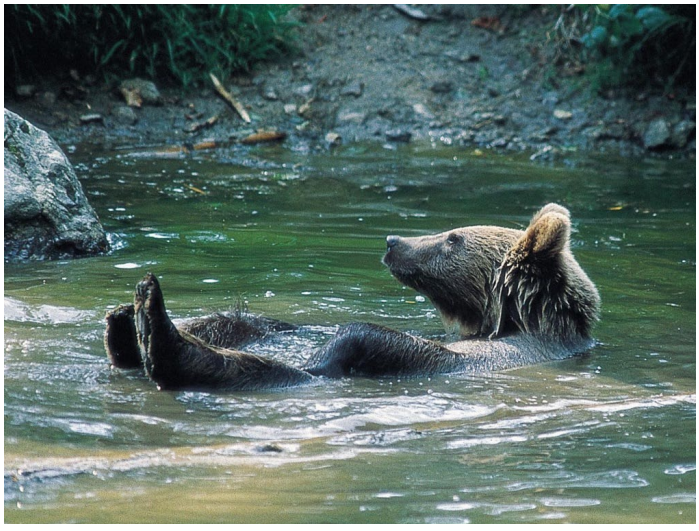
Monitoring

Monitoring systems exist for all large herbivores and most large carnivores (jackals are not monitored in a systematic way), and systems are quite similar across the region. However, monitoring methods are based mainly on personal, subjective judgement rather than scientifically tested methods. Some methods that were listed as being 'scientific' are in fact far from fulfilling the requirements of an objective, replicable survey method relying on representative sampling. It is impossible to determine the bias, accuracy and precision of these methods. It can be concluded that the overall quality and reliability of monitoring data is quite low and that the existing databases are generally quite poor and cannot provide reliable data, meaning that adequate information is not available for good quality management planning. In addition, other important associated factors such as habitat quality and threat impacts are not monitored.

Compensation systems

Compensation is a common way to mitigate conflicts, to increase tolerance and to decrease illegal killings. Most Carpathian countries have compensation systems for damage caused by both large carnivores and herbivores. The damages are paid mainly by the state in case of protected carnivores (unless they are also game species), but always by the game managers in case of the herbivores.

Estimation of damages is mainly through field examination by an expert (especially in case of carnivores), but sometimes (mainly in the case of herbivores) the relevant stakeholders and managers make an agreement. However, many stakeholders are apparently not satisfied with the system, which is often not fully functional.



Picture 34: ***Brown bear, Romania (photo: WWF-Canon)***

5.2. COMMON INTEGRATED MANAGEMENT MEASURES FOR LARGE MAMMALS

5.2.1. OVERALL GOAL

The Carpathians should remain a stronghold for viable populations of the full range of European large mammals native to the region.

5.2.2. IDEAL MANAGEMENT REQUIREMENTS

Total protection and non-intervention alone will not be effective means for achieving the overall goal; a range of strategies are required, both at national and regional levels.

- Adequate protective measures are required for all species, especially those with restricted ranges and/or low populations. Conservation of large carnivores also requires healthy populations of prey species.
- Management of species should be integrated across their ranges, rather than being determined at the country level. It cannot be expected that each country will adopt identical laws and management practices, but national practice should conform to general regional strategic approaches.
- Management should be based on reliable and holistic knowledge, including the basic data about population parameters, the roles of species role in ecosystems and interactions with different management sectors. Data collection should be reliable, replicable and representative using scientifically tested and generally accepted standard methods.
- Sustainable use through regulated hunting can play an important role in population management of certain species, in mobilising support for conservation and in generating income. However, such hunting must take place within an adequate and effective regime of monitoring, scientific setting of quotas and control of both poaching and breaches of regulations during authorised hunting.
- There are differing views on the hunting of large carnivores. While some consider that carnivore hunting should be an integral part of a wildlife management, many also consider that hunting of large carnivores should only be permitted where there is proven human wildlife conflict. However, in the case of disagreement and as a basic principle, the precautionary principle should apply.
- Efforts are required to increase support and tolerance of local people towards living alongside large carnivores and herbivores.

5.2.3. SPECIFIC CONSERVATION MANAGEMENT MEASURES FOR IMPLEMENTATION BY PROTECTED AREA ADMINISTRATIONS AND GAME AND WILDLIFE MANAGERS

These are measures associated directly with the management of species, habitats and ecosystems. They are most likely to be implemented through protected area systems and through the work of agencies and organisations managing land and resources.

Intensifying and coordinating efforts in the field to stop poaching

There is a fundamental need to decrease illegal killing and poaching. This is one of the most threatening factors and also the one that is hardest to address. The following measures should be adopted.

LM1. Increase cooperation between protected area administrations, law enforcement authorities, police, judiciary and border guards

Protected area administrations cannot ensure adequate protection of large mammals by themselves. These species are wide-ranging and many of the threats to them originate from outside protected area boundaries. Effective protection requires coordinated action, for example:

- Keeping local law enforcement authorities informed about threats and illegal activity.
- Working with judiciary in order to emphasise the severity of the threats and encourage appropriate action.

- Organising joint patrols and information sharing between the protected area rangers and other law enforcement agencies.
- Sharing information and expertise about threats and violators.
- Improving transboundary cooperation and information sharing.

LM2. Encourage cooperation of local people in anti poaching activities and other measures

It is important to enlist the support of the general public in the fight against poaching. Successful measures can include:

- Conducting awareness raising campaigns.
- Setting up means for citizens to report poaching and illegal activities (for example, telephone hotlines).
- Setting up voluntary patrol systems to discourage poaching.
- Making use of media to publicise the impacts of poaching and successes in anti-poaching activities.

LM3. Standardise and tighten legal procedures concerning illegal killing (poaching)

There is a need not only to increase penalties for poaching, but also to improve the rate of convictions. This requires not only stronger laws, but improved cooperation from police and judiciary in tackling wildlife crime.

Poaching in Ukraine

In the Ukrainian Carpathians, populations of wild ungulates have for many years remained far below optimal levels. Analysis of the population dynamics of wild ungulates, their food supply, the level of official shooting and the number of predators has shown that forage is at an optimal level, official shooting is 6-8 times lower than the annual increase in population and the number of predators is low. The only factor that can significantly affect the number of game animals, and which goes unrecorded is poaching, which must therefore be considered as the greatest threat.

A critical factor that promotes poaching is absence of state financing of state forest enterprises, which have reduced numbers of forest guards, so that each guard is responsible for protecting ever larger areas (currently around 4,000 ha per guard). Forest guards have very low salaries (< € 100 per month) and are poorly qualified. The quality of protection is only likely to increase if the prestige of the profession is enhanced by increasing wages, providing better equipment and improving individual capacity.

The system of forest protection in Ukraine focuses on illegal woodcutting and not on poaching. Many poachers are well armed and work in groups, making it impossible for isolated guards to act against them. The introduction of coordinated anti-poaching teams may improve protection of wild animals from poachers. It is also important to increase the level of environmental awareness of the local population, including informing of relevant public authorities about cases of poaching. At the judicial level, reported high level of corruption in the Ukrainian court system also promotes poaching.

Improving species management

LM4. Plan a coordinated extension of the bison breeding and reintroduction programme

There is a need to ensure coordinated management, captive breeding and reintroduction programs for bison, in order to maximise genetic diversity and to exchange information and lessons learned about the reintroduction process.

Picture 35: ***Bisons release in Romania (photo: WWF DCP)***

Bison reintroduction in Romania

The last records of free-ranging European bison in Romania date from the beginning of the 19th century in Romania's Calimani Mountains, Bargaului Mountains and Maramuresului Mountains (Cătănoiu and Deju, 2012).

Since May 2005, Vânători Neamț Nature Park (VNNP), a 30,000 ha protected area in the north-east of Romania, has been implementing a European bison reintroduction programme, which aims to establish free ranging, viable bison herds in the Romanian Carpathians (Perzanowski and Deju 2005; Kuemmerle *et al*. 2010). This programme, respecting the IUCN guidelines regarding reintroductions, was developed in four phases. The first phase, addressing feasibility studies, was fulfilled with the support of The Zoological Society of London and Polish specialists (Dixon *et al*. 1997). During the preparation phase, the main facilities for European bison acclimatization and pre-release where installed and staff training and public awareness activities were conducted. In addition, 15 animals of the Lowland-Caucasus line were imported from Western zoos. The release and post-release monitoring phases are on-going; the first releases in the park took place in spring 2012 and spring 2013 (Cătănoiu and Deju 2013). The release area comprised the Cracau valley, 5,000 ha of forested area, with low human impact. Monitoring by radio telemetry revealed that in the first year the European bison explored around 2,000 ha, in the second year this increased to around 5,000 ha, and in some cases the animals ranged beyond the Cracau valley ridges into the neighbouring valleys. The actual free herd comprises 11 animals, including two bison calves born in the wild in 2012. A new release is expected in spring 2014.

Because of the specific characteristics of VNNP's heritage (natural, cultural and spiritual), the park's intention regarding the European bison reintroduction is not only to re-establish a keystone species in the ecological sense, but also in a spiritual and cultural sense. The managers are convinced that emphasizing the cultural and spiritual properties of an endangered species represents an essential step towards effective conservation (Cătănoiu 2007; Cătănoiu 2012).

Useful websites:
http://www.bisonbonasus.ro/
www.vanatoripark.ro
www.waza.org/en/site/conservation/waza-conservation-projects/overview/european-bison-reintroduction_1
www.europeanrewildingnetwork.com/projects/26/
www.truenaturefoundation.org/project/romania/cracau-valley-wildlife-reserve/

LM5. Establish reliable and common damage mitigation, estimation, and compensation systems

Dealing with human wildlife conflict, and specifically the economic damage caused by wildlife, is a challenge in the region that is likely to increase. Approaches to dealing with conflict vary between countries and in many cases are considered to be ineffective. There is a need for improved information sharing and development of best practices for dealing with conflict, at the local (protected area), national and regional levels. Specifically, further information and testing is required for a number of approaches.

Prevention and mitigation. Locally applicable and (wherever possible) low-cost measures are required for preventing or minimising damage. Possible measures might include use of electric fences (to protect sheep, crops and beehives), use of shepherd dogs, use of various deterrent methods. The Romanian experiences have shown that 'electric shepherds' are successfully protecting flocks from bears and wolves. Since this is not a cheap solution, environmental charities and NGOs could help shepherds in acquiring electric fences.

Compensation. Fair and transparent methods are required for assessing damage, assigning responsibility and calculating compensation. Special support should be made available through agri-environmental schemes in the EU.

Special measures. An emergency derogation system is required for dealing with specific major problems on a case by case basis. Derogation should not be used generically as a means for enabling hunting of protected species.

Compensation system in the Slovak Republic

In the Slovak Republic, a balanced compensation system functions. The regulation determines the goods and circumstances that can be compensated. The stakeholders share the responsibility for damages; the state takes responsibility when one of the defined, protected species causes the damage, while the hunters (game managers) are responsible for damages caused by hunted species.

The regulation also clarifies the responsibility of the owner, who is expected to defend his or her goods and properties as needed with legal methods. There are detailed guidelines for damage prevention and there is no compensation for game and protected species damage in fenced areas. The owner has to cooperate with the nature conservation bodies and hunters to prevent damages and does not qualify for compensation if he/she is to blame for the damage. Several further factors, which can affect compensation (e.g. circumstances of damaged animals in animal breeding, agro technical factors), are also clarified.

The State does not pay for the damage when there is an official appointee, who is responsible for damage prevention. The hunters do not have to pay compensation if they manage the game population in accordance with the regulations, especially if they shoot the defined quota completely.

Damage caused by protected animals must be reported to the Nature Conservation Authority in writing. The Authority holds an inquiry into the case, and if the request is legitimate, pays compensation. In case of game, local stakeholders have to come to an agreement with each other on the means and amount of compensation. If the plaintiff is not satisfied or there is no agreement, the stakeholders can ask for a court judgement. The court can employ an independent expert if necessary.

Improving ecosystem and habitat management

It is widely understood that protected areas alone are not sufficient to protect populations of large mammals; therefore, ecosystem and landscape scale measures are required based on population ranges of species rather than protected area and international boundaries. The following measures are recommended:

LM6. Identify priority areas for threatened species and apply special protective measures

Priority conservation areas for threatened large mammal species should be identified across the region and made subject to special measures for protection. These areas should comprise:

1. Strongholds of species (core areas which are inhabited by breeding individuals), which can act as secure source populations for dispersal more widely across the region and, where appropriate, for sustainable harvesting in designated hunting zones.

2. Stepping-stone areas (areas used temporarily during movement between core areas). These areas should be identified on the basis of populations and are likely to include:

- Nationally/internationally protected areas including Natura 2000 sites (or parts of them) and zoning systems should be designed accordingly.
- Zones along international borders; it has been suggested that a general agreement to stop hunting within a fixed distance of state borders would create a network of corridors that would allow for the migration and expansion of species ranges.
- Protection forest (as designated in forest management plans).
- Creation of new or enlargement of existing protected areas, protected forest zones etc. where an adequate level of protection does not exist.

These priority conservation areas would then act as nodes for the system of ecological corridors (see next measure). As a first step, areas for lynx and chamois should be identified and established.

LM7. Establish an ecological corridor system based on habitat use data

One of the main threats to large mammals is habitat loss and fragmentation due to anthropogenic interventions (e.g. highways, urban sprawl, ski resorts). Connectivity between suitable habitat patches is a basic pre-condition for species dispersal, colonisation and enables linking of meta populations. A set of possible corridors has been elaborated in Work Package 5 in this project.

Once these corridors have been identified, the next step should be to plan and to carry out practical measures to establish them and develop common regulations for their management. For example they must be protected against infrastructure and settlement development and construction in order to allow free animal movement through the corridor areas.

Ecological network between the Apuseni Mountains and South West Carpathians, Romania

This initiative focused on large carnivore species, especially brown bears, the most critical issue being related to the isolation of the (sub) population of bears in the Apuseni Mountains. Studies to assess the suitability of habitats for large carnivores in the Carpathians and to verify the distribution and abundance of the species in the field led to the identification of core zones, of potential re-colonisation areas and of ecological corridors.

The field studies revealed both the critical areas for structural connectivity based on the actual permeability of the landscape, as well as the local factors that influence functional connectivity. In addition, the presence of the brown bear in the ecological corridor was documented for the first time outside its 'official' distribution. The analysis of these areas in relation to existing Natura 2000 sites allowed the elaboration of proposals to achieve the conservation objectives of existing protected areas and the declaration of new Natura 2000 sites.

The LIFE+ Connect Carpathians project (2013) implemented by Fauna & Flora International (FFI) and the Zarand Association aims at the identification of conservation objectives for large carnivore species and elaboration of a regional action plan in the corridor area with the involvement of stakeholders. Concrete conservation measures will be demonstrated and implemented, including measures for reconstructing structural connectivity by creating micro-corridors, identifying measures for limiting poaching, preventing damage and harmonising game and forest management plans with conservation objectives.

The actions from the regional plan will be adapted and included in the management plans of the Natura 2000 sites that are part of the ecological corridors, allowing coherent management. An efficient monitoring system of the species will allow both tracking of the achievement of the conservation objectives and adaptation of conservation measures for ensuring the efficiency of the ecological corridors and, consequently, of the favourable conservation status of the large carnivore species.

See Salvatori (2004) and Mot *et al.* (2010).

5.2.4. LEGAL MEASURES

LM8. Increase penalties for poaching, especially of protected species

To support measures for reducing poaching, it is necessary to increase penalties for poaching and illegal trading of large mammals. At present, many of the penalties do not act as sufficient deterrents.

LM9. Strengthen legal provisions for intersectoral coordination of protection and management

Special legislative acts should be adopted concerning land use planning, infrastructure and settlement development where conservation requirements will be included into planning process.

5.2.5. PLANNING MEASURES

LM10. Agree regional species management strategies to provide an overall common framework for the conservation and management of large mammals

According to the conclusions of the recent large carnivore LIFE project, management actions should be shifted from the local to the population (regional or larger) level, but currently no Carpathian large mammal population is managed through a joint management plan (Silva *et al.* 2013).

The European Commission published guidelines for population-level management plans for large carnivores in 2008, because of the importance of the transboundary approach. However this is not possible without wide and detailed cooperation of different governments and synchronisation of policies and actions. As a priority, regional plans should be developed first for the large carnivore species, bison and chamois.

Transboundary cooperation in bear conservation between Romania and Ukraine

The 'Open borders for bears between the Romanian and Ukrainian Carpathians' project was implemented in the region of Maramures (Romanian-Ukrainian region of the Carpathians) between May 2012 and April 2013. The project's aim was to establish a critical stepping-stone for the connectivity of the Carpathian Mountains by reducing the risks of habitat fragmentation, restoring ecological corridors for bears as an umbrella species and securing responsible use of natural resources. The project was implemented by WWF DCP Romania (Maramures Branch) and the NGO RachivEcoTur from Ukraine.

No systematic research into large carnivore populations had previously been conducted in the region; the only available information came from hunting units and partly from protected area administrations. The project has now significantly improved the level of information and knowledge about bears in Maramures and their habitats.

The critical habitats for bears in the project area have been identified using several methods, such as capturing and monitoring 5 bears with GPS-GSM technology, use of infrared sensor motion cameras, monitoring with a network of volunteers and experts, and workshops and meetings with key stakeholders. The information gathered allowed for the identification of both critical habitats and corridors for the movement of bears between the two countries.

To ensure the long-term conservation of the natural values in the region, several tools have been used, including the High Conservation Value Forest Toolkit, and High Nature Value Farmlands Toolkit, which have contributed both to the conservation of critical habitats and corridors for bears and to the sustainable development of local communities.

The major threats and pressures affecting large carnivores have been identified, analysed and addressed on both sides. After collecting information from various sources, management measures for the long-term conservation of bears have started to be defined in a participatory way, targeting the transboundary area, as well as locations either side of the border, where major differences between the two countries have been identified.

Examples of management measures for corridors to allow the movement of bears across the landscapes include:

- Establishing the minimum width of the identified corridors (monitoring is needed for each critical corridor).
- Agreement for maintaining/responsible management of the corridors with all key stakeholders.
- Legal establishment of the critical corridors.
- Assumptiom of legal responsibility for the management of the corridors.
- Establishing 'quiet zones' within hunting units for protecting the identified critical corridors.
- Maintain the land use categories and prohibiting any changes.
- Controlling and monitoring the establishment of sheepfolds and the collection of forest fruits and forest related products.
- Controlling human activities and issuance of authorizations for building houses, constructing roads etc. Inclusion of the corridors in the General Urbanistic Plan (land use planning document).
- Limiting/banning off-road activities and limiting the speed of vehicles in critical areas.
- Forbidding the provision of supplementary food.
- Visual delimitation of corridors (e.g. panels) and other information/awareness raising activities.
- Diversion of touristic trails from the corridor areas.

The identified management measures will be agreed with the main stakeholders in the upcoming period. For further information, see www.openbordersforbears.org/ or contact the project team at www.openbordersforbears.org/noi/

LM11. Develop national multi-sectoral species management plans that take into account national priorities and conditions

Species management should be integrated into the management practice not only of nature conservation bodies, but also of other sectors, especially, forestry, hunting, agriculture and land use. Plans should:

- Follow a more holistic approach, addressing not only one single species, but also populations and ecosystems. There have been many successful local actions, but their influence on a wider scale is limited.
- Large mammal populations cover large areas and connect different habitats and many other species, as well as human activities. A really successful plan has to cover all of these factors.
- Be adapted to local contexts.
- Involve stakeholders in planning processes. The only positive correlation in the questionnaire survey was found between the number of stakeholders involved and the quality of plans.
- Be integrated into the plans of other sectors and stakeholders.
- Address conflicts among the stakeholders.
- Consider sustainable economic exploitation if the species population size allows it, based on a strict planning and control system.
- Be widely available; they can only be put into the practice if they are available and known.
- Include more concrete actions and goals that are understandable and feasible in practice.

Management planning and the National Game Management Database in Hungary

In Hungary, game is state property, but hunting rights belong to the landowner. Three levels of management planning have been established to harmonise the different interests, with the following main goals: long-term survival, improvement and sustainable use of game populations and habitats; mitigation of the conflicts between game management and other land use interests (agriculture, forestry); administrative support for the interest of nature conservation.

The Ministry of Rural Development is responsible for the state game management strategy. The National Game Management Council, representing the main stakeholder groups (state and private game managers, foresters, nature conservationists, NGOs and scientists), serves as advisory body for the Minister.

Game management regions and sub-regions were defined by a multifactorial analysis of game population and management data and then synchronised to administrative regions. Regional management plans were elaborated for game management sub-regions by the regional County Game Management Inspectorate (CGMI, a state administration body) with the help of County Game Management Councils (CGMC), which represent the stakeholders regionally. These documents set long-term goals and directions for game and habitat conservation and management for the regions and sub regions, and are the basis for developing 10-year plans for Game Management Units (GMU).

These 10-year management plans must be prepared by qualified and registered experts. They summarise the relevant information from the regional plans and contain information on the GMUs, on game species, habitats and their conservation and management and on nature conservation rules and special game conservation/management activities. GMUs also prepare annual plans and reports on management and harvesting, which contain the spring population estimates, harvest quotas/plans, data on trophy scoring, hand-rearing and release, game feeding, game field management and measures to reduce/avoid game damages. Both plans must be accepted and altered, if necessary, by the CGMI with the consultation of CGMC.

The National Game Management Database serves as a background data souce for game management and planning. The database collects the data on the 3-level planning system, game management and trophy scoring reports and monitoring programmes, prepares statistical analyses and annual publications of game populations and bag statistics, maintains GIS databases and provides data to administrators and game managers.

LIFE projects to support action for large carnivore conservation in Romania

The LIFE EX-TRA Project 'Improving the conditions for large carnivore conservation' was an international initiative for the conservation of wolves and brown bears that operated between 2009 and 2013. The project had seven partners, coordinated by the National Park Gran Sasso e Monti della Laga, and worked in four countries: Italy, Romania, Bulgaria and Greece.

In Romania, the project was implemented in areas that represent all the main issues concerning local large carnivore management and where wide range of stakeholders operate: game units, hunters' associations, state forest offices and universities/research institutions. The focal areas were:

- Herculian (ROSCI0091), a Natura 2000 site for large carnivores.
- Dalnic, a hilly area with high densities of large carnivores and significant livestock grazing activities.
- Sacele, a typical large carnivore mountain area partially included in two Natura 2000 sites.

Project activities focused on the following:

- Assessment of the damage caused by carnivores on livestock, prevention of damage (livestock guarding dogs, promotion of best practices) and development of damage prevention and monitoring strategies as models for Romania.

- Monitoring protocols for large carnivores and prey species.
- Improving conditions for large carnivores and prey species management (poaching control, feeding conditions).
- Implementation of a Bear Emergency Team (BET), a national group of specialists who work for reduction of bear-human incidents and implement prevention methods.
- Enhancing the cooperation between different interest groups: livestock breeders and livestock guard-dog breeders, hunters, conservationists, local and national authorities, NGOs and nature conservation authorities.
- Supporting the national working group for large carnivores.
- Information and experience exchanges: national and international field trips, training of the main actors, compilation and distribution of best practice manuals.
- Raising public awareness regarding the coexistence issues, problems and solutions for improving the existing situation.

For further information see www.lifextra.it/index.php?option=com_content&view=frontpage&Itemid=1&lang=en

The website http://www.carnivoremari.ro/home.php provides information from implementation of three other LIFE projects concerning large carnivore conservation in Romania and the Carpathian region. Notable outputs have included:

- Good practice guidance at the regional scale:
  - Guide for population assessment (new methods).
  - Guide for assessing the risk of conflict.
  - Guide for land owners on how to prevent conflict with carnivores.
  - Guidelines for assessing the ecological corridors and how the authorities should work on preserving them.
- Information dissemination and education http://www.lifeursus.carnivoremari.ro/systems-for-reducing-damages-produced-by-bears.php.
  - Establishment of the first GIS open portal for the general public related to large carnivores. (http://www.lifeursus.carnivoremari.ro/gis-database.php)
  - Development of a thematic and virtual tour of a protected area especially for large carnivores.
  - Promotion of local bear friendly products.
- Practical measures:
  - Over 200 farms equipped with electric fences to protect livestock.
  - Two rehabilitation centres for bears and other mammals.
  - Work in over 15 Natura 2000 sites and elaboration of seven management plans for protected areas related to large mammal conservation.

LM12. As a priority establish a special regional project for lynx conservation

Lynx is a 'forgotten species'. The relatively low protection status of lynx in Europe is misleading because it does not reflect the status of the isolated populations. The species is the most vulnerable large carnivore in the Carpathian region and the least studied. Their secretive, solitary behaviour, high fidelity to territory, special habitat and food requirements make lynx highly sensitive. Habitat alteration and destruction, especially in large old growth forests, threaten lynxes more than the other large carnivores.

A special lynx conservation project should be established for the Carpathians similar to that successfully operating in the Balkans. (See http://www.catsg.org/balkanlynx/20_blx-compendium/home/index_en.htm) with the following main objectives:

- To act as a central point for collecting, collating and publishing data about the lynx observations, threats to lynx, and conservation activities.
- To develop and coordinate standard monitoring systems for lynx.
- To organise regional training and information exchange for all those involved in the protection, management and study of lynx.
- To lobby for improved protection measures at national and regional levels.

Picture 36: ***Lynx (photo: WWF DCP)***

5.2.6. AWARENESS AND CAPACITY DEVELOPMENT MEASURES

LM13. Conduct programmes to improve the image of carnivores

Long-term conservation of large carnivores requires the support of the public and decision makers and communication with stakeholders at the local, regional, and country levels. This can increase the sensitivity of other sectors and help stakeholders understand the importance of large mammals. A range of activities is recommended:

- Production of educational material (leaflets, lectures, websites) and their distribution through different stakeholder networks.
- Establishing dialogues and cooperation with farmers, hunters and other local stakeholders. Organising meetings and lectures.
- Increasing involvement of interest groups in decision making related to large mammal management.
- Increasing local, regional and transboundary cooperation in order to share information.

LM14. Build capacity for large carnivore protection and management

Capacity development is required for a range of groups:

Local farmers. Training is required for methods to prevent or mitigate damage caused by large mammals.

Field monitoring staff. This group requires training in the skills needed to recognise the traces and signs of target animals (footprints, tracks, prey remains, faeces, urine, hair, den and voice). Training is also required in basic survey and recording techniques.

Experts. The main need is for knowledge sharing. It would be useful to establish a forum where experts can exchange experiences, good and bad practices, research results, etc. It would also be useful to build international relations with groups working on large mammal conservation in other parts of Europe.

Law enforcement authorities. Training is required on the law and effective measures to stop poaching and illegal wildlife trade.

Hunters. Hunters play a crucial role in game management in most Carpathian countries. They are often relied on to provide population estimates of game species, from which hunting quotas are set. Hunters are also relied on to be self-regulating with respect to observing regulations, adhering to quotas, remaining within permitted hunting areas, reporting bags and avoiding opportunistic killing of protected species. Although many hunters do act responsibly, programmes of education and awareness raising may be required to help all hunters become better stewards and monitors of wildlife and important contributors to conservation efforts.

5.2.7. MONITORING, RESEARCH AND INFORMATION MANAGEMENT

LM15. Establish reliable and common monitoring systems at the regional and national levels

One of the main limitations to effective management is the lack of reliable knowledge acquired through monitoring that is regular, representative, replicable and reliable and standardised. It was the unanimous recommendation of the experts in this study to establish a reliable common monitoring system at bioregional and national levels that provides replicable and comparable results on population sizes and densities.

It is now generally accepted by experts that it is impossible to determine the absolute numbers of species using traditional methods. The focus should be on presence/absence and relative abundance, which can be measured through sampling and using more practical methods. This approach is in fact already being used in many countries; the problem is that field surveys are carried out in different ways in different Carpathian countries, so that data are not comparable across species ranges.

Therefore, a basic minimum monitoring method should be established for all species that can be readily used across the region and that identifies and addresses factors that cause bias in monitoring. Monitoring experts should prepare and test a detailed field guide on the recommended methods. One possibility is the application of synchronised counts on sample plots and track counts on sampling routes, using routes and plots that are representative samples of the distribution area of the population. This should be accompanied by comprehensive, user-friendly guides for identification of large mammals in the field.

LM16. Develop new methods for monitoring

In parallel with the basic actions recommended under the previous measure, a range of new monitoring methods should be tested and publicised (several projects in this field are in progress in Romania, Slovakia, the Czech Republic Hungary and Serbia). Methods include:

- Camera trapping.
- Telemetry using satellites and GPS.
- DNA analysis from hairs, scats and urine.
- Use of questionnaires and public surveys.

The use of many of these new techniques is limited by the associated expenses; their use should complement, not substitute lower cost, more sustainable methods.

LM17. Establish a network of long-term monitoring sites in order to monitor the impact of the measures for long period.

Selected large areas should be identified as 'regional samples' of species ranges and be subject to systematic monitoring using a common method. These sites could be integrated with the Priority Areas proposed in CIMM as control areas.

It would be good practice to conduct joint surveys of these areas involving conservation biologists, hunters and foresters (this approach is already used in Slovakia).

LM18. Establish a regional data centre for large mammals

One centre is required that will enable experts to submit and access data from across the region using a multilevel GIS based monitoring database. This approach was first used in a lynx project in the Swiss Alps (SCALP), but the Hungarian large carnivore LIFE project and the Romanian bear LIFE project have also developed similar GIS based databases[8]. This data centre should allow:

- Uploading of data.
- Free access to data for experts.
- Links to national databases.
- Access to case studies, reports, training materials, etc.
- Data should not only include scientific monitoring data, but also management and threat data (e.g. locations of conflicts).

LM19. Encourage research projects

Universities, research institutions and individual researchers should be encouraged to conduct management-oriented studies about large carnivores and herbivores. These should include:

- Ecological studies of particular species (population parameters, habitat use and requirements).
- Causes and possible solutions of conflicts.
- Impact and effectiveness of various management interventions.
- Sociological and economic aspects that would allow elaboration of models for the implantation of large mammal conservation and management into rural development.

5.2.8. FINANCIAL SUPPORT

LM20. Secure funding for large mammal conservation

Funding is required for many of the proposed CIMMs. Possibilities include:

- Promoting transboundary projects financed by Transnational Cooperation Programmes and LIFE+.
- Developing a financial instrument between Carpathian countries to support small grants for mammal conservation/research projects whose results will be integrated in the developed common database.

[8] Examples of databases from Romania can be found at
http://www.lifeursus.carnivoremari.ro/baza-de-date-gis.php
http://carnivore.biodiversitate.ro/
http://www.forestdesign.eu:81/VOLUNTARI/site/

6. CROSS CUTTING COMMON INTEGRATED MANAGEMENT MEASURES: RECOMMENDATIONS FOR THE POLICY LEVEL

Picture 37: Retezat National Park, Romania (photo: WWF).

The Common Integrated Management Measures presented in the previous sections are intended to be stand-alone provisions related to the relevant topic. Arising from these, however, are a number of cross cutting measures that apply to all aspects of natural heritage management in the Carpathians. These are presented below.

6.1. PLANNING AND MANAGEMENT MEASURES

CC1. Improve planning and management at the ecosystem/landscape scale

The effective management of the entire Carpathian region requires Carpathian-wide approaches, rather than the fragmented approaches that prevail now. This requires not only improved intersectoral collaboration and coordination, it also requires the adoption of larger planning and management units based on ecosystems and landscapes rather than international borders and internal administrative boundaries. Ideally, a set of general ecosystem/landscape plans should be agreed upon within the framework of the Carpathian Convention, which would then establish some basic principles and former framework for natural resource and development planning across the region. Some progress has been made on this with transboundary watershed planning in the Tisza River Basin[9].

CC2. Improve planning and management of protected areas (including transboundary sites)

The overall framework for planning and management of protected areas in the region requires improvement.

The categories and functions of protected areas should be better harmonised across the region, using the IUCN PA management categories and associated guidance on categorisation and governance. (Dudley 2008; Day 2012; Stolton *et al*. 2013) It is not necessary for countries to have identical categorisations, but those that are used should be readily associated with an IUCN category.

Many protected areas in the Carpathians have developed management plans that have not been officially approved or adopted. In some cases, management planning formats and processes are too cumbersome and expensive to be practical. Where plans exist, the process of adoption is time-consuming and as a consequence many protected areas work without officially recognised management plans. In some countries, protected area administrations are not involved in the development of the management plan and propose a more participatory way of management development.

Transboundary sites and projects could be used to test the pilot integration of planning and management systems.

CC3. Promote improved intersectoral cooperation and integration of management of natural resources

A common issue raised by all the working groups is the need for improved intersectoral cooperation. Many of the threats identified cannot be addressed by the actions of one sector alone; they require an integrated approach. There are some good examples from the region of cooperation, but very seldom do different agencies collaborate and cooperate efficiently. Some integrated collaborations are beginning to emerge between the conservation and forestry sectors, but integrated management of wetlands and watersheds is lacking across most of the region.

CC4. Elaborate regional action plans for key species and ecosystems

Agreements of regional plans should be prepared and endorsed at the national level for the management and protection of populations of large carnivores, bison and chamois, and for the most important habitat types of the Carpathians, in particular old growth forest and peatlands.

[9] http://www.icpdr.org/main/danube-basin/tisza-basin

CC5. Integrate protected areas into spatial planning/rural development plans

A common issue in the region is that protected areas (and ecological networks) are not adequately integrated with, or recognised by spatial plans and rural development plans. This can result in planning decisions that have direct negative impacts on protected areas. Furthermore, if recommended measures concerning development of corridors and ecological networks are to be implemented, planning systems need to recognise these features and ensure that they are taken into consideration.

6.2. ECONOMIC MEASURES

CC6. Adapt European funding mechanisms more specifically to the conservation needs of the Carpathians

Support from the European Union, particularly in the form of agri-environmental schemes, is recognised as being vital for the continued conservation and sustainable use of traditional farmland and wetlands in the Carpathians. However, there is a need to fine-tune this support in order to ensure that funded measures have the desired conservation benefits, and are targeted where they are most needed. It would be useful within the framework of the Carpathian Convention to prepare specific guidance that would enable EU Member States to ensure the most effective use of agri-environmental schemes.

CC7. Improve funding for conservation measures in non-EU member states

Ukraine and Serbia are not currently benefitting from the agri-environmental schemes available to EU member states, and are unlikely unilaterally to be able to develop parallel and compatible programmes. However, the threats to Carpathian ecosystems are significant in these countries (particularly Ukraine), and they should not be overlooked. There is a need to develop funded models for sustainable management and restoration of critical Carpathian habitats in these countries, possibly with EU funding and cooperation with neighbouring Member States.

CC8. Mobilise financing related to services provided by ecosystems of the Carpathians

It is apparent that the ecosystems of the Carpathians provide essential services for local and national economies and for millions of people; however, these services have not been comprehensively assessed and mechanisms do not exist that enable generation of income from these services (although some local case studies have been developed). Payments for ecosystem services (PES)[10] have the potential for covering many of the costs of conservation and sustainable management of Carpathian ecosystems and landscapes. It is recommended that a Carpathian-wide project for PES is developed (or alternatively a pilot project in one of the Carpathian countries). An example of such a recent study is the 'Analysis of PES needs and feasibility in Serbia' (www.surf-nature.eu). The comprehensive and widely consulted Economics of Ecosystems and Biodiversity (TEEB) initiative provides an ideal framework and extensive guidance material for developing an approach that can help decision-makers recognise, demonstrate and capture the values of ecosystem services & biodiversity (see www.teebweb.org/). A special TEEB project for the Carpathians should be developed and the funding sources sought out.

CC9. Improve financial sustainability of protected areas

Protected areas are of high importance for biodiversity and people for various reasons. They are the cornerstone of ecological networks and provide many services that are not recognised at the moment. Opportunities for additional income should be explored based on the services a protected areas provides for the general public and specific beneficiaries that are in line with the legal framework of the respective countries.

[10] Payments for ecosystem services (PES) are one of the principal ways in which a market for ecosystem services can be established. They can be essentially defined in terms of payments to land managers and others to undertake actions that increase the quantity and quality of desired ecosystem services, which benefit specific or general users, often remotely. http://archive.defra.gov.uk/environment/policy/natural-environ/documents/payments-ecosystem.pdf

6.3. LEGAL MEASURES

CC10. Improve compatibility of basic legislation

It cannot be expected that the Carpathian countries would harmonise their legislation and regulations concerning all aspects of natural resource management. However, there is a need to address issues where differences and anomalies in legislation and regulations are having a negative effect on biodiversity conservation; for example, resolving incompatibilities in the protected status and hunting regulations of species with cross border populations, harmonising zonation and management regulations in transboundary protected areas, and agreeing regional protection measures for certain ecosystem categories (especially old growth forest).

CC11. Implement existing legislation

In many Carpathian countries there is adequate legislation for the management of natural assets and protected areas but is not fully implemented yet. For example, the legislation for participatory management of protected areas in Romania comes into force at a slow pace.

6.4. CAPACITY DEVELOPMENT MEASURES

CC12. Improve provision of and access to capacity development for biodiversity conservation, sustainable natural resource management and protected area management

While many universities in the region have been extending their curricula to include conservation and natural resources management, there is a need to improve access to learning for professionals and practitioners from all relevant sectors. Provision should be promoted of professional short courses, special modules within forestry training, learning materials in national languages and opportunities for exchanges and experience sharing. One example of this approach is the work of the ProPark Foundation in Romania, which offers vocational training courses in all fields of protected area planning and management (see http://propark.ro/en/despre-noi.html).

6.5. RESEARCH AND MONITORING MEASURES

CC13. Develop and support establishment of basic common monitoring systems

All the working groups highlighted the need for common, compatible monitoring systems. However, it should also be recognised that the various Carpathian countries have developed their own systems, that experts within those countries have their own approaches and that capacities vary across the region. Therefore, it is not practical for common systems to be highly complex. What is required is a basic set of robust monitoring indicators and clear protocols for monitoring those indicators that can be applied by field staff and practitioners as well as by expert scientists. The Natura 2000/Emerald network would provide a solid basis for this.

CC14. Promote management oriented research and monitoring

Support should be targeted at research and monitoring, which provides information for managers of species, habitats and ecosystems, rather than pure scientific research. Scientists and managers should work together to identify research topics, and design programmes. Research should focus more on the impacts of threats and the applicability of different management measures.

Measures to achieve this should include improved support for the Forum Carpaticum (www.forumcarpaticum.org) which is an open meeting of the Science for the Carpathians (S4C) initiative to integrate different fields of expertise to generate value for the Carpathian mountain region.

CC15. Establish a network of regional monitoring sites

A network of sites for long-term detailed monitoring should be established for each major ecosystem in the Carpathians. Each country in the region could adopt one or more sites and make a commitment for gathering and sharing detailed information about ecosystem conditions and processes, impact and effectiveness of different management measures and effects of long-term trends, such as climate change.

CC16. Improve access to and submission of data and information

Centralised availability of data is improving in the Carpathian region, mainly through the activities of the Carpathian Biodiversity Information System. However, the difficulties encountered by many of the experts participating in this project in obtaining reliable data and information (from individuals, national agencies and regional initiatives) indicates a continuing problem. The issue does not only relate to information being available in readily accessible locations and platforms, it also relates to the efforts and willingness of projects and individuals to share and make that information available. This problem is not unique to the Carpathians; it is normally unrealistic to expect data holders to submit information to centralised databases; it requires proactive efforts on the part of the database administrators to seek information. Within the framework of the Carpathian Convention, it would be beneficial to establish a set of minimum requirements for data sharing and common data standards.

Picture 38: Gentiana pneumonanthe (photo: Dobromil Gálvanek)

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Picture 39: Beech forest in Slovakia (photo: László Galhidy)

CORRESPONDENCE OF CLASSIFICATIONS OF FOREST TYPES

EFT class	EFT type (2010)	EUNIS code	Habitats Directive Annexe 1 Code	
2. Hemiboreal forest and nemoral coniferous and mixed broadleaved-coniferous forest				
	2.5 Mixed Scots pine-birch forest	G4.4		
	2.6 Mixed Scots pine-pedunculate oak forest	G4.7		
3. Alpine forest	3.1 Subalpine larch-arolla pine and dwarf pine forest	G3.2	9420	Alpine *Larix decidua* and/or *Pinus cembra* forests
	3.2 Subalpine and mountainous spruce and mountainous mixed spruce-silver fir forest	G3.1	9410	*Acidophilous Picea* forests of the montane to alpine levels (*Vaccinio-Piceetea*)
	3.3 Alpine Scots pine and Black pine forest	G3.4	91Q0	Western Carpathian calcicolous *Pinus sylvestris* forests
	3.4 Mountainous birch forest	G1.9		
4. Acidophylous oakwood and oak-birch forest	4.1 Acidophylous oakwood	G1.8	9190	Old acidophilous oak woods with *Quercus robur* on sandy plains
	4.2 Oak-birch forest	G1.8		

5. Mesophytic deciduous forest	5.1 Pedunculate oak-hornbeam forest	G1.A		
	5.2 Sessile oak-hornbeam forest	G1.A	9160	Sub-Atlantic and medio-European oak or oak-hornbeam forests of the *Carpinion betuli*
	5.3 Ashwood and oak-ash forest	G1.A	9170	*Galio-Carpinetum* oak-hornbeam forests
	5.4 Maple-oak forest	G1.A	9180	*Tilio-Acerion* forests of slopes, screes and ravines
	5.5 Lime-oak forest	G1.A	91G0	Pannonic woods with *Quercus petraea* and *Carpinus betulus*
	5.6 Maple-lime forest	G1.A	91L0	Illyrian oak-hornbeam forests (*Erythronio-carpinion*)
	5.7 Lime forest	G1.A	91Y0	Dacian oak & hornbeam forests
	5.8 Ravine and slope forest	G1.A		
	5.9 Other mesohpytic deciduous forests	G1.A		
6. Beech forest	6.1 Lowland beech forest of southern Scandinavia and north central Europe	G1.6	9110	*Luzulo-Fagetum* beech forests
	6.2 Atlantic and subatlantic lowland beech forest	G1.6	9120	Atlantic acidophilous beech forests with *Ilex* and sometimes also *Taxus* in the shrublayer (*Quercion robori-petraeae* or *Ilicio-Fagenion*)
	6.3 Subatlantic to Atlanto Mediterranean submountainous beech forest	G1.6	9130	*Asperulo-Fagetum* beech forests
	6.4 Central European submountainous beech forest	G1.6	9140	Medio-European subalpine beech woods with *Acer* and *Rumex arifolius*
	6.5 Carpathian submountainous beech forest	G1.6	9150	Medio-European limestone beech forests of the *Cephalanthero-Fagion*

7. Mountainous beech forest			91K0	Illyrian *Fagus sylvatica* forests (*Aremonio-Fagion*)
	7.2 Central European mountainous beech forest	G1.6	91V0	Dacian beech forests (*Symphyto-Fagion*)
	7.5 Carpathian mountainous beech forest	G1.6	91W0	Moesian beech forests
8. Thermophilous deciduous forest	8.1 Downy oak forest	G1.7	91H0	Pannonian woods with *Quercus pubescens*
	8.2 Turkey oak, Hungarian oak and Sessile oak forest	G1.7	91M0	Pannonian-Balkanic turkey oak–sessile oak forests
	8.7 Chestnut forest	G1.7	9260	*Castanea sativa* woods
	8.8 Other thermophilous deciduous forests	G1.7	91I0	Euro-Siberian steppic woods with *Quercus spp.*
			91B0	Thermophilous *Fraxinus angustifolia* woods
			91Z0	Moesian silver lime woods
11. Mire and swamp forest	11.1 Spruce mire forest	G3.D		
	11.2 Pine mire forest	G3.D		
	11.2 Alder swamp forest	G1.4	91E0	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae*, *Salicion albae*)
	11.3 Birch swamp forest	G1.5	91D0	Bog woodland
	11.4 Pedunculate oak swamp forest	G1.4		
	11.5 Aspen swamp forest	G1.4		
12. Floodplain forest	12.1 Riparian forest	G1.1	9030	Natural forests of primary succession stages of landupheaval coast
	12.2 Fluvial forest	G1.2	91E0	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae*, *Salicion albae*)
13. Non-riverine alder, birch or aspen forest	13.1 Alder forest	G1.B	92A0	*Salix alba* and *Populus alba* galleries
	13.3 Mountain birch forest			
	13.3 Birch forest	G1.9		
	13.4 Aspen forest	G1.9		
14. Introduced tree species forest	no types given	G1.C		
		G2.8		
		G3.F		

Parcul Natural PIATRA CRAIULUI

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Parcul Natural PORȚILE DE FIER

Parcul Natural MUNȚII MARAMUREȘULUI

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