

The image is a vertical composition. The top portion shows a winter scene of a mountain town with snow-covered roofs and buildings. The middle and bottom portions show a dense forest with a stream and a lynx walking across a fallen log. The text is overlaid on the middle section.

# Creation of ecological corridors in Ukraine

A manual on stakeholder involvement and landscape-ecological modelling  
to connect protected areas, based on a pilot in the Carpathians



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**State Agency for Protected Areas of the Ministry of Environmental Protection of Ukraine**

**Altenburg & Wymenga Ecological Consultants**

**InterEcoCentre**

**Kyiv 2010**

## Realisation

State Agency for Protected Areas of the Ministry of Environmental Protection of Ukraine

InterEcoCentre

Altenburg & Wymenga Ecological Consultants



## Funding

This manual was established with funds from the Netherlands International Biodiversity Policy Programme BBI-MATRA of the Netherlands Ministry of Agriculture, Nature and Food Quality and the Ministry of Foreign Affairs, through the project "Realising trans-boundary ecological connectivity in the Ukrainian Carpathians", which was carried out for the Ministry of Environmental Protection of Ukraine.

BBI-MATRA reference: BBI-Matra/2007/031



**agriculture, nature  
and food quality**

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## Scientific publication

The manual was approved at a meeting of the Scientific Council of the Institute of Urban Economy of the National Aviation University, Kiev, minutes #2 on April 22, 2010.

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**Ukrainian translation** Marina Khazan  
**Lay-out and Printing** Brandsma Offset Ferwerd  
**Printing English version** Copy Service Leeuwarden  
**Printing Ukrainian version** Raduga, Kyiv  
**Preparation of maps** Ivan Kruhlov

**Photos** A.-T. Bashta - figures 17, 62, and appendix 7 Bison; A.F. Petcu - figure 11; Archiv SCHKO Beskydy - figures 2, 38 and appendix 7 Bear; F. Deodatus - figures 1, 4, 5, 12-15, 19-21, 23, 25-29, 31, 32, 35, 37, 39, 42-46, 48-55, 57, 58, 60, 63-67, 69 and 73; F. Sulgan - figures 16; K. Broz - figure 7; M. Januszczak - figures 59 and 61; M. Palinchak collection - figure 24; M. Verghet - figures 3 and 10; R. Kurek - figure 70; S. Nowak - figure 72; S. Pcola - figure 18; T. Dumitru - figures 33, 74 and 75; T. Hulik ([www.tomashulik.sk](http://www.tomashulik.sk)) figures 30, 34, 36, 40, 41, 68, cover photo and appendix 7 Lynx and Wildcat; W. Jedrzejewski - figure 71;

**Citation** Deodatus F.D & Protsenko L. (eds.) 2010. Creation of ecological corridors in Ukraine. A manual on stakeholder involvement and landscape-ecological modelling to connect protected areas, based on a pilot in the Carpathians. State Agency for Protected Areas of the Ministry of Environmental Protection of Ukraine, Altenburg & Wymenga Ecological Consultants, InterEcoCentre. Kyiv.

**Citation of chapters** (example) Protsenko L., Tatum S., Bilokon M., Deodatus F., 2010. Framework for ecological corridor establishment. - In: Deodatus F.D. & Protsenko L. (2010). Creation of ecological corridors in Ukraine. A manual on stakeholder involvement and landscape-ecological modelling to connect protected areas, based on a pilot in the Carpathians. State Agency for Protected Areas of the Ministry of Environmental Protection of Ukraine, Altenburg & Wymenga Ecological Consultants, InterEcoCentre. Kyiv.

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## Acronyms and terminology

BBI	Netherlands International Biodiversity Policy
CMU	Cabinet of Ministers of Ukraine
Connectivity	accessibility of habitat for animal species
Corridor pilot project	The project “Realising trans-boundary ecological connectivity in the Ukrainian Carpathians”
Eco-corridor	ecological corridor
Ecological Corridor Scheme	File to be compiled and to be endorsed by authorities on the corridor development plan
Econet	the ecological network of Ukraine
GIS	Geographic Information Systems
MEP	Ministry of Environmental Protection
NNP	National Nature Park
NP	National Park
Oblast	Administrative province
PL	Poland
Rayon	Administrative district
RLP	Regional Landscape Park
RO	Romania
SAPA	State Agency of Protected Areas
SCF	State Committee of Forestry
SCLR	State Committee of Land Resources
SCW	State Committee of Water
SEI	State Environmental Inspection
Silrada	Administrative municipality
SK	Slovakia
UA	Ukraine
Verkhovna rada	Ukrainian Parliament



## Acknowledgements

The project which resulted in this manual was developed and carried out by InterEcoCentre and Altenburg & Wymenga Ecological Consultants in collaboration with the Ministry of Environmental Protection of Ukraine and its affiliated organisations. Support was generously provided during design and implementation by staff from the Royal Netherlands Embassy (Kyiv), CERI (Bratislava, Slovakia), Wageningen International (Wageningen University & Research, The Netherlands), Geomatics Department of the Humboldt University (Berlin, Germany), the Large Herbivore Foundation (The Netherlands), Vyzhnitsky National Nature Park, the Institute of Ecology of the Carpathians of the National Ukrainian Academy of Sciences of Ukraine and the Ivan Franko University at Lviv, other non-governmental organisations and Ukrainian governmental agencies. A crucial role liaising between the project team and the Ukrainian Government, as well as tuning the project activities in the Ukrainian administrative context, was played by Leonid Protsenko, Director of InterEcoCentre, whose contribution is greatly appreciated.

We would like to express our gratitude to the following people contributing to the process and assisting our team: Anatoliy Deyneka, Akke Harkema, Bohdan Prots, Borys Bagley, Dries Kuiper, Eddy Wymenga, Edith Oudt, Guus Schutjes, Hans Kampf, Harald Egerer, Harmanna Groothof, Henk Zingstra, Hieke van den Akker, Igor Ivanenko, Jan Seffer, Joep van den Vlasakker, Julia Chavdar, Maaïke Krol, Meeuwes Brouwer, Mike Baltzer, Mykhaylo Kokhanchuk, Mykhaylo Oprysko, Oksana Maryshevych, Oleg Kohan, Patrick Hostert, Tobias Kuemmerle, Ton Verhagen, Vasyl Pryndak, Victor Melnichuk, Volodymyr Domashlinets, Włodzimierz Jedrzejewski, Yuriy Lylo and Yuriy Zhebchuk.

Special thanks are expressed to the State Agency for Protected Areas (Dr.I.Ivanenko) of the Ministry of Environmental Protection of Ukraine and to the Departments of the MEP in Lviv and Chernivtsi Oblasts for their great support to the implementation of the project.



## Preface

Biodiversity conservation in Ukraine is gaining strategic direction through the development of a national ecological network (Econet). Factors associated with the problems encountered during the establishment of a national Econet include a high degree of agricultural expansion (agricultural land accounts for as much as 69.1% of Ukrainian territory), large-scale fragmentation of the natural landscape and its uneven distribution across the country. The Ukrainian policy and practice for Econet development is shaped by two legal acts, "On the State Programme for the Development of the National Ecological Network in Ukraine for 2000-2015" (2000) and "On the Ecological Network of Ukraine" (2004).

The focus of the National Programme is on expanding the country's natural landscapes to a point which will secure their biodiversity, maintaining habitats in a close to natural condition and ensuring a degree of landscape connectivity that facilitates animal migration and the dispersion of animal and plant species.

The State Programme target is to expand the protected area to 10.4% of the territory of Ukraine by 2015, compared to the current 6%. However, this does not address the problem that protected areas will remain isolated and disconnected on much of Ukrainian territory except in the Carpathians and in part of the Polissia region. Ecological corridors therefore provide a valuable law-based tool in combating the connectivity issues. Implementation of ecological corridors has been delayed for various reasons in the past, and therefore the State Agency of Protected Areas supported the project "Realising trans-boundary ecological connectivity in the Ukrainian Carpathians" with the view of creating two cross-boundary ecological corridors in Lviv and Chernivtsi Oblasts. The corridors were to connect the Skolivski Beskydy National Nature Park (NNP), the Uzhanskyi NNP and the Nadsianskyi Regional Landscape Park in Ukraine with the Bieszczady and Sian Valley National Parks in Poland, and the Vyzhnytsky NNP with the Vanatori Niamt Nature Park in Romania. These parks as well as the ecological corridors

are crucial to preserving the populations of many plant and animal species such as Bear, Bison and Lynx.

The project achieved its goal of ecological corridor establishment, and now hopes to share the knowledge gained with local and international stakeholders by means of this bilingual manual - a tool which may facilitate the future establishment of corridors. One important outcome worth noting is the support for the idea of creating ecological corridors received from within communities and from forest managers and local government. This was also reflected in the approval by village councils, seven of them within the Turkivskyi eco-corridor and two within the Bukovynskyi eco-corridor, and the approval by respective forest management organisations. On 26 February 2010, the Turka Rayon Council supported the establishment of the Turkivskyi eco-corridor, outlining measures for its further management. As a result of the same project, the Chernivtsi Oblast State Administration issued on 14 April 2010 the order for the establishment of the second corridor, the Bukovynskyi Eco-corridor.

This manual, along with other conclusions and recommendations stemming from the project, will underpin future work in the area of ecological corridor and Econet development and management. The manual can be recommended as a guide for good practices of ecological corridor creation. Our sincere gratitude is extended to the Dutch Ministry of Agriculture, Nature and Food Quality and the Dutch Ministry of Foreign Affairs for the financial support of the project and the assistance provided in the area of corridor development in Ukraine. Finally, special thanks to the project coordinator, Floris Deodatus, for maintaining a focussed and effective approach while implementing this project and for the valuable, practical outcome produced.

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# 1. Introduction

F. Deodatus, L. Protsenko, A.-T. Bashta



## 1.1. Background and problem analysis

### 1.1.1 Biodiversity and land use of the Carpathians

The Carpathians form one of the most extensive mountain ranges in Europe and harbour some of the least disturbed ecosystems of this continent. Due to their vastness, the Carpathians offer important refuges for animals with high habitat requirements, and viable populations of all large native herbivores like the European Bison, Red deer, Roe deer and Wild Boar, and all native large carnivores, including the Brown Bear, Wolf and Lynx can still be found here as well. As the Carpathians run from Serbia to the Czech Republic, they form a bridge between areas of high natural value and allow migration of animal populations as well as genetic exchange between East, Central and Western Europe (Map 1). Large parts of the Carpathians consist of a mosaic of undisturbed and extensively used areas. The traditional land use systems, such as extensive sheep and cattle grazing, increase biodiversity by creating open areas with a high floral diversity, contributing to optimal conditions for high animal diversity. Due to its position and habitat variation the Carpathians harbour more than half the biodiversity of Central Europe (Oleshko 2005) and deserve to be labelled as one of the most important wilderness areas of Europe.

### 1.1.2 Current threats

Land use of rural areas is subject to significant changes since the independence of Ukraine (1991). Large areas previously used by cooperative state farms have been abandoned, but since the adoption of the Land Code (2001) acquisition of private land is possible, which has resulted in increasing encroachment upon natural areas of the Carpathians. Within protected areas wildlife is relatively well protected, but the protection and law enforcement capacity outside protected areas is not adequate. Consequently, illegal resource use (logging, hunting) is high here, compared to other parts of the Carpa-



*Figure 2. Brown Bear is a flagship species of the Carpathians.*

thians. Additionally, road infrastructure development and increased traffic intensity, particularly from east to west and vice versa, have degraded natural conditions. Current pressures are rapidly converting the continuous Carpathian wilderness area into a fragmented landscape, leaving inadequate space for migration of and genetic exchange in large mammal species, resulting in their population decline and ultimately extinction. The absence of these crucial species in the Carpathian ecosystem would reduce the overall biodiversity of the Carpathians even more due to the interdependence of species. The survival of these ecologically important species could be assured by maintaining sufficient habitat for migration between core protected areas (connectivity), but the current land use planning practices are not yet adequate to cope with the threats mentioned.

### 1.1.3 Ukraine policy in relation to biodiversity and ecological networks

Ukraine is in the process of transforming since it abandoned the Soviet system in 1991. During this process, policy goals and instruments are being developed to deal with threats posed to the environment and biodiversity.

Immediately after gaining independence in 1991 the Verkhovna Rada (Ukrainian Parliament) adopted the Law "On Environmental Protection" (1991). The Law became base for the development of other new environment legislation and regulations. The first policy document on biodiversity was the Strategy (Concept) of Biodiversity Conservation in Ukraine, adopted by the Cabinet of Ministers of Ukraine (CMU) on 12 May 1997. As part of this Strategy, the CMU adopted a decision in 2004 "On Approval of a Concept of the State Programme on Biodiversity Conservation for 2005-2025". It envisages plans of action to be funded by the central Ukrainian Government and local governments. This Programme is currently being developed by the Ministry of Environmental Protection (MEP).

Realizing the risks resulting from landscape fragmentation in relation to biodiversity, the Ukrainian Government has given a high priority to the development of a National Ecological Network (Econet) in its biodiversity conservation policy. Three legal acts have formalised this concern: "On Nature Conservation Fund of Ukraine", "On the State Programme of Ukraine's National Ecological Network Development for 2000-2015", and "On the National Ecological Network of Ukraine". An overview of relevant legislation is found in Appendix 2.

In line with its efforts to comply with EU policies, the Ukrainian Government follows the requirements of the Pan-European Biological and Landscape Diversity Strategy (1995). Recognising the importance of the Carpathians, Ukraine played a key role in the establishment of the "Convention on the protection and sustainable development of the Carpathians" (Carpathians Convention 2003). In 2009 the Verkhovna Rada ratified the "Protocol on the conservation and sustainable use of biological and landscape diversity" of the Carpathians Convention. Ukraine thus accepted obligations such as the ones formulated in Article 9 "Continuity and connectivity of natural and semi-natural habitats, ecological network in the Carpathians" of the Protocol<sup>1</sup>:

- (1) Each Party shall take measures in its national territory with the objective to improve and ensure continuity and connectivity of natural and semi-natural habitats in the Carpathians, thus allowing dispersal and migration of wild species populations particularly of large carnivores, and genetic exchange between such populations.
- (2) The Parties shall cooperate on establishing an ecological network in the Carpathians, composed of protected areas and other areas significant for biological and landscape diversity of the Carpathians and for coherence of the network.

The Ukrainian ecological network, Econet, has been in development since 2000.

<sup>1</sup> Protocol on Conservation and Sustainable Use of Biological and Landscape Diversity to the Framework Convention on the Protection and Sustainable Development of the Carpathians done in Kyiv on 22 May 2003 ([www.carpathianconvention.org](http://www.carpathianconvention.org))

#### 1.1.4 Crucial problems of ecological network development

So far, over seven thousand protected areas have been established in Ukraine, shaping the Ecological Network. By 2009 the Ministry of Environmental Protection had realised 5.04% of the targeted 10.4% of protected area coverage of the country's territory by the year 2015. However, no ecological corridors had been established yet to connect these protected areas.

The practical implementation of ecological networks, i.e. the establishment of ecological corridors, has encountered difficulties, such as the lack of funding, and gaps and frictions in existing legislation with regard to essential elements of ecological networks, such as ecological corridors, buffer and rehabilitation zones. Effective and efficient realisa-



*Figure 3. In the 1960s European Bison of the hybrid Lowland-Caucasian line have been reintroduced into the Carpathians to replace the Carpathian Bison which has been extinct since the 18th century. The establishment of a viable population is the challenge of wildlife managers in the Carpathians today.*

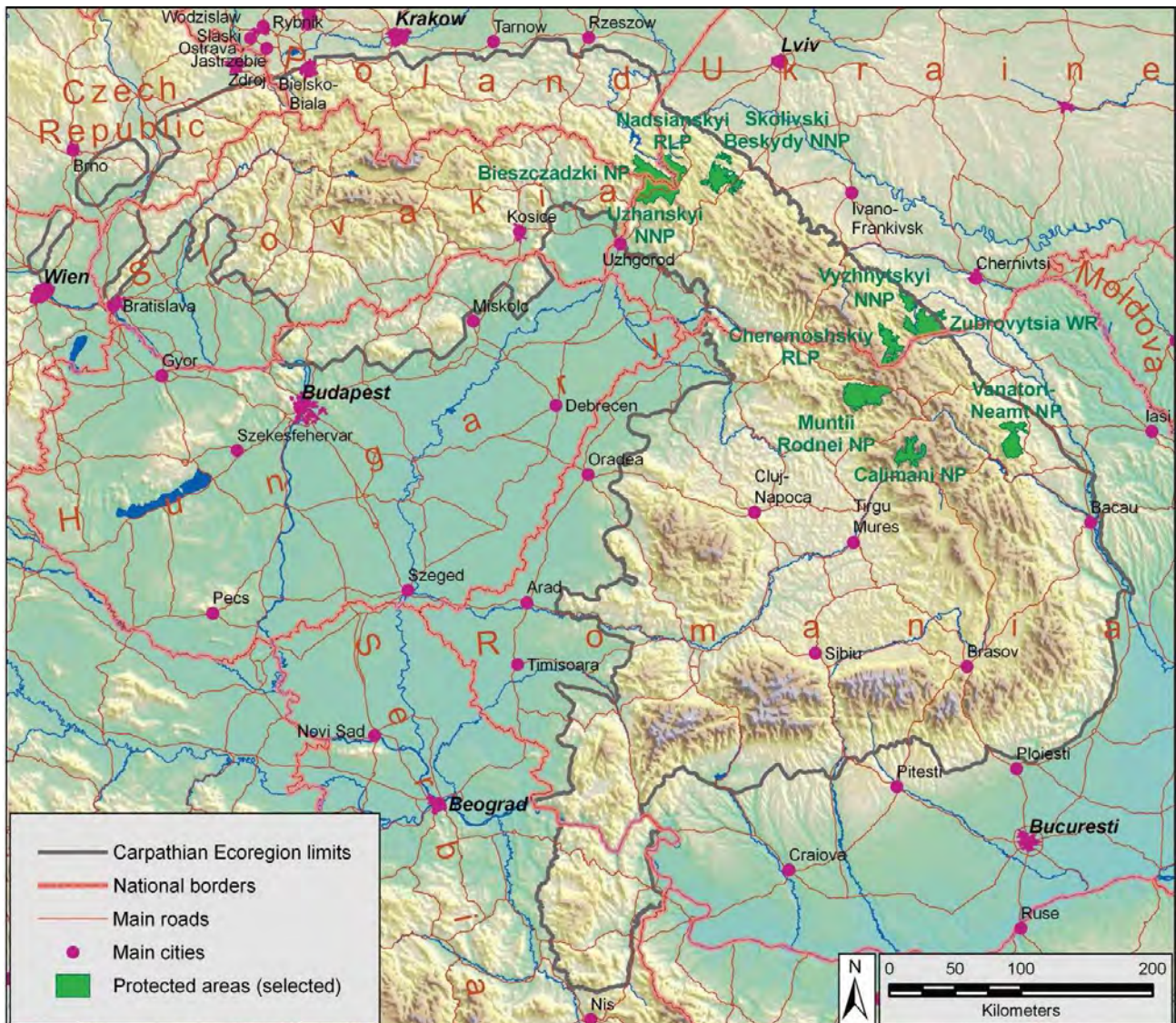
tion of ecological networks requires the development of the ecological definition of connectivity, as well as concepts and tools to fit the network into the current land use system, such as land use regimes, arrangements with landowners and land users, infrastructure, transboundary issues, etc.

#### 1.2. The project “Realising trans-boundary ecological connectivity in the Ukrainian Carpathians”

This corridor establishment manual is based on the experience gained in the project “Realising trans-boundary ecological connectivity in the Ukrainian Carpathians”. This pilot project ran from the beginning of 2008 to mid 2010, to support the Ministry of Environmental Protection with the development of a methodology for the establishment of ecological corridors.

This manual is one of the main outputs of the project. The purpose of the project was to realise two border crossing ecological corridors for large mammals, using two pilot exercises (Map 1) to connect Skolivski Beskydy National Nature Park (NPP) and Vyzhnytsky NNP in Ukraine with the nearest protected areas in Poland (Bieszczady NP) and in Romania (Vanatori NP, Calimani NP and Muntii Rodnei NP). The practical experience gained is used to develop a road map for ecological corridor establishment and to enhance existing policy instruments supporting ecological corridor development.

The pilot project used for the development of this manual did not necessarily intend to solve all identified connectivity issues, as some may require additional efforts in the case of specific obstacles beyond the project's budget or mandate (e.g. fundraising for wildlife crossings, exemption from moratorium on agricultural land ownership transactions in case of purchase). For complex connectivity issues and their solutions, separate plans need to be prepared and where funding is not available, this needs to be found.



Map 1. The Carpathian Eco-region with the protected areas involved in the pilot project.

### 1.3. General approach and assumptions

The methodology proposed here for the development of ecological corridors has adopted a landscape ecological approach. In landscape ecology, a basic landscape unit is formed by a patch which is a relatively homogeneous terrain area. The size of a landscape is dependent on research or management objectives and varies with the perception of the organisms concerned (Liu & Taylor 2002). Research methods in landscape ecology have shown remarkable progress over the last decades, due to the development of Geographic Information Systems (GIS). GIS has the ability to effectively integrate different types of information, such as geographical,

ecological, economic and administrative information, and make this information directly accessible for modelling and analysis, providing statistics and maps as output. For the development of ecological corridors, GIS has also proved to be very helpful, as well as cost-effective (Beier et al. 2007; van Maanen et al. 2006).

After the decision has been made that establishment of an ecological corridor is required, the process of establishment is comprised of the following four phases:

- Landscape ecological modelling of ecological corridor options.
- Stakeholder identification and consultation.
- Management plan development.



- Official establishment of ecological corridor.

The rationale behind this sequence is based on the fact that the second phase, stakeholder consultation, is logistically the most complex and expensive phase. Since information on landscape and ecology is usually readily available, and most of the modelling is desk work, it is more efficient to delineate ecological corridor options first, which will then limit the number of stakeholders to be consulted. The official endorsement of the ecological corridor boundaries and area is to be completed after agreement with stakeholders at the different levels.

The key ecological assumptions behind the modelling of ecological corridors are:

- (1) Continuous ecological corridors are particularly important for terrestrial animals and less so for flying animals.
- (2) In a mountainous area like the Carpathians, the requirements of aquatic and amphibious species with respect to ecological corridors are usually very different from those of terrestrial animals and require a separate approach. Amphibians and aquatic species tend to move perpendicular to the contours, following water courses, whereas terrestrial animals tend to move along the contours following habitats and avoiding human settlements in valleys.
- (3) Generally, large species (carnivores and herbivores) require more space than smaller species. Therefore, they are more vulnerable to fragmentation and their space requirements with regard to ecological corridors are stricter. Corridor establishment for these species is most urgent.
- (4) Large terrestrial animals, particularly carnivores may be considered as ambassadors or “umbrella species”, encompassing to a large degree the habitat requirements of other animals within their home range<sup>2</sup> (Simberloff 1998; Ray et al. 2005). Therefore, an ecological corridor based on the requirements of a limited number of these large mammals

would provide connectivity for most terrestrial species.

Hence, ecological corridor options are determined, using a GIS model based on the habitat requirements of a limited number of representative “umbrella” species, where habitat is an area where animals can move without obstruction or excessive danger from one part of their home range to another (or from one home range to another) through an area with limited connectivity. Following the identification of possible ecological corridor options, corridor boundaries and management options are agreed upon in consultation with the different stakeholders: administrators, land owners and land users. After stakeholders have agreed, a legal procedure needs to be followed in order to obtain official endorsement and inclusion of the ecological corridor in the land use and spatial planning system. The different steps to establish ecological corridors are explained in detail in Chapters 3 to 6.

## 1.4. Pilot areas

The mechanism for the establishment of ecological corridors has been developed in two pilot areas, connecting Skolivski Beskydy NNP and Vyzhnytsky NNP in Ukraine with protected areas in Poland and Romania, respectively (Map 1).

### 1.4.1 Skolivski Beskydy NNP

Skolivski Beskydy NNP (35,684 ha) is situated in the north-western Ukrainian Carpathians, close to the Polish border. The park was established in 1999 and is managed by the State Committee of Forestry. Forests in the park are mainly natural mountainous forests of pure spruce or mixed beech, fir, and spruce forests. Large areas are used for logging and primeval forest can only be found in inaccessible areas. Many valleys between the park and the Polish border are quite densely populated. Local communities created pastures in the higher mountain ranges, characterised by a high floral diversity.

<sup>2</sup> A home range is the area used by one social unit of animals or a solitary individual

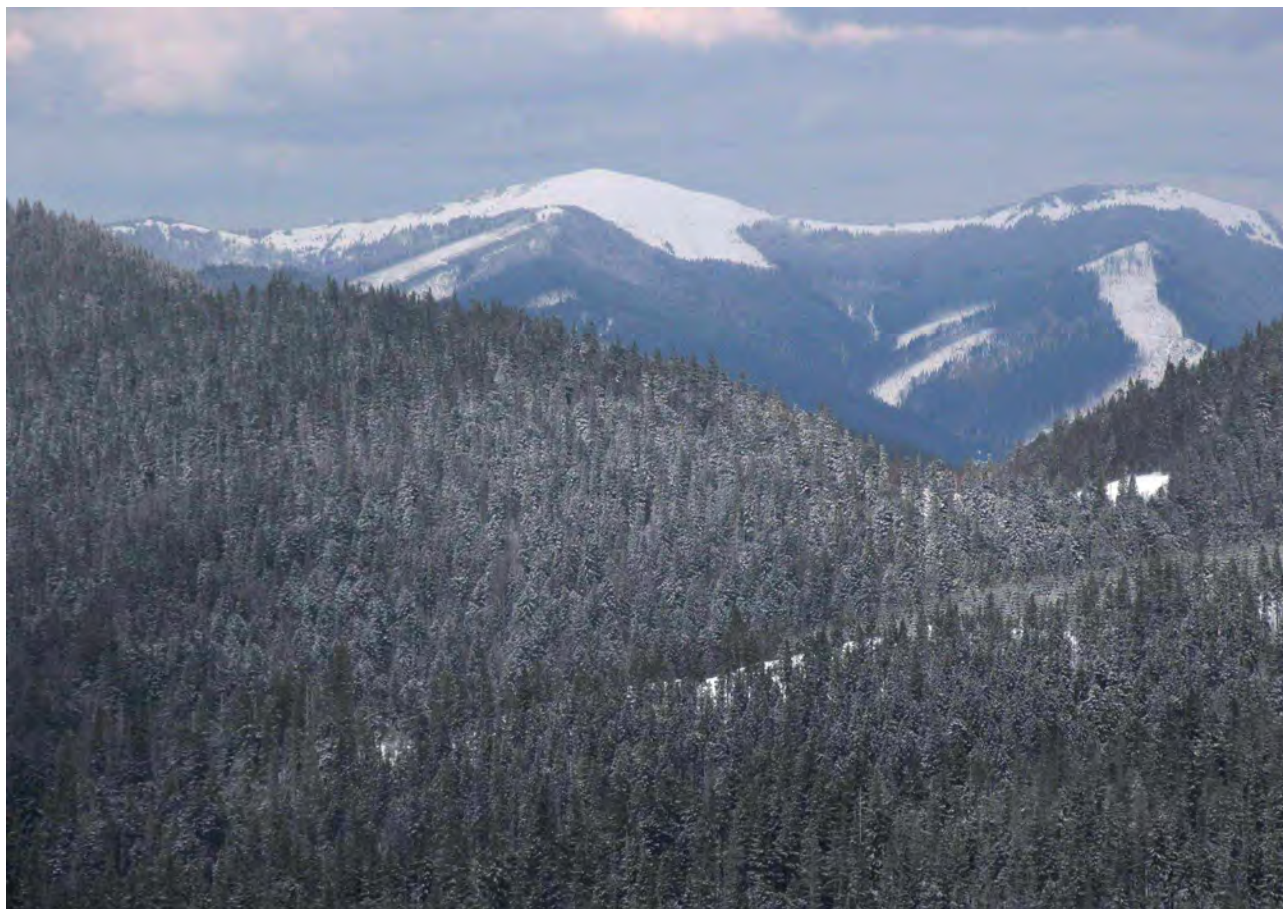


Figure 4. Skolivskyi Beskydy National Nature Park is located in the western Ukrainian Carpathians, approximately 30 km from the Polish border.

The park contains approximately 600 different plant species, of which more than 50 are listed in the Red Book of Ukraine. The fauna is also rich and includes 20 fish, 12 amphibian, 6 reptilian, and 154 bird species, as well as 52 different mammals, such as the Lynx, Brown Bear, Wolf, Wild Boar, Red deer and Bison. The area is popular with tourists, who are mainly concentrated around the winter season, skiing, and around the summer, making use of the many hiking trails. The park is separated from the East Carpathian Biosphere Reserve, which covers a number of protected areas in the border area between Poland, Slovakia and Ukraine, by a gap of about 30 km with a relatively high human population density.

#### 1.4.2 Vyzhnytsky NNP

Vyzhnytsky NNP (8,000 ha, created in 1995), is situated in the south-eastern Ukrainian Carpathians,

close to the Romanian border. The closest parks in Romania are Muntii Rodnei NP, Calimani NP and Vanatori Neamt NP. The park consists of low mountain areas with average altitudes of 750 - 1000 m. The landscape diversity of the park is very high due to its locality, between two rivers: the Cheremosh and the Siret. More than 80% of the National Park is covered with forest, mainly fir-beech forest. The forested areas are alternated with small meadows with a high floral diversity, created through logging of part of the forest. In total 800 plant species (34 of them listed in the Ukrainian Red Data Book) and 221 moss species have been recorded in the park. The park also has a high faunal diversity, including 127 species of birds, 41 mammals, 11 amphibians and 7 reptilians. The National Park area is traditionally known as a Mecca of tourism. Nowadays, green tourism is developing rapidly and the park is receiving 60 - 70,000 tourists annually.

### 1.5. The ecological corridor manual - reading guide

This manual is made to assist policy makers as well as those responsible for the establishment and management of ecological corridors, providing conceptual, procedural and practical support. Justification for its preparation is given in Chapter 1. Chapter 2 presents the landscape ecological context of fragmentation and the Ukrainian Carpathians. The framework for the establishment of ecological corridors, based on the current Ukrainian legislation is elaborated on in Chapter 3. Chapter 4 explains how a landscape ecological approach is applied to identify corridor options. The required involvement of stakeholders in the process which leads to the final agreement on the boundaries of the ecological corridor is described in Chapter 5. Chapter 6 highlights the management arrangements necessary to consolidate the ecological corridor in the current land use context. Policy is dynamic, and is perpetually developing in response to changing conditions and requirements, as well as to lessons learned. Na-

turally, this applies to policy development related to ecological networks as well. Therefore, the manual concludes, in Chapter 7, with some suggestions for further development and improvement of ecological corridors in the context of Econet. The appendices of this manual contain some extensive tables with background information as well as examples of formats used in the formal procedures. This information is meant, in particular, for practitioners involved in the establishment of ecological corridors.



*Figure 5. Vyzhnytskyi National Nature Park, an attractive park for tourists located about 20 km from the Romanian border.*



## 2. Connectivity and the Ukrainian Carpathians

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### 2.1. Habitat fragmentation, connectivity and population dynamics

For natural and sustainable survival of animal populations the individual animals must have space to move around (Hunter 1996, Jedrzejewski 2009). Three types of animal movement are often discerned. *Daily movements* within the animal's home range may concern feeding, use of shelters, territory maintenance or reproduction. *Seasonal migration* relates to seasonal fluctuation in resource availability which in turn often determines the reproduction cycle. *Dispersal* involves animals leaving their current home range in search of new areas for food and reproductive partners. In many species young animals leave their parents' territory to reduce intra-specific competition, but adult animals may also move away in response to environmental changes (e.g. climate change, human influence). Dispersion of young animals is of particular importance to maintain genetic variation in populations and for re-colonisation of abandoned areas.

The expansion of human influence on ecosystems through, for example, infrastructure develop-

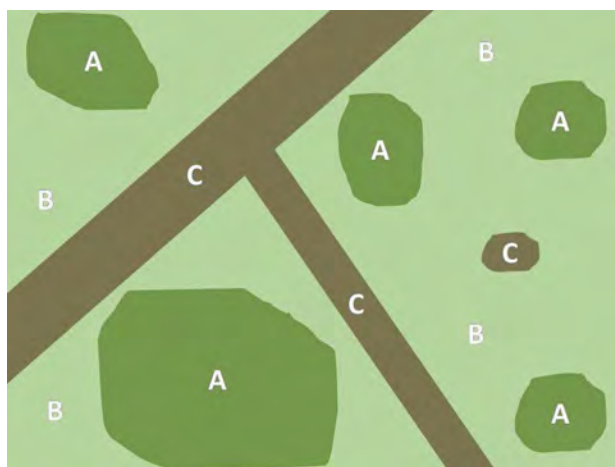


Figure 6. A simplified model for different habitat values: (a) accessible areas providing resources, (b) accessible areas without resources, and (c) inaccessible areas.



Figure 7. Although beautiful, the Wolf is still an unpopular animal in Ukraine, because of its reputation of raiding domestic animals. A pack of wolves needs a vast home range of up to 230 km<sup>2</sup>, as well these animals can cover huge gaps between habitat patches, by moving large distances at night.

ment and agricultural extension, reduces the continuity of the natural environment. This is usually called landscape or habitat fragmentation. The term "landscape" is generally used, but strictly spoken "habitat" would be better, as it refers to aspects of the landscape which are vital for specific organisms (Hobbs 1993; Arnold et al. 1993; Donovan et al. 1995; Saunders 1993). In reality the landscape does not fragmentise, but its structure changes.

In a simplified model (Figure 6), an environment may be subdivided from the perspective of an animal, into (a) areas providing resources, (b) areas accessible but not providing resources, and (c) inac-

cessible areas (Deodatus 1996). The first and second type are generally referred to as habitat. The difference between (a), (b) and/or (c) may be caused by just one key factor, such as the presence of a very specific food plant or a waterhole. The inaccessibility in (c) may be physical, but may also be caused by danger or resource limitation: a forest may be accessible to Lynx, but after some time they might starve, if no prey was available. Type (a) habitat may turn into (b) habitat, when a specific resource disappears, and type (b) habitat may turn into (c), when distance to crucial resources exceeds a certain threshold. Although (b) habitat should not be avoided, its distribution may reduce its capacity to support animal populations. Fragmentation of habitat (a) + (b) in a non habitat environment (c) is usually obvious, but fragmentation of (a) within (b) is often more difficult to detect.

Animals need sufficient space to satisfy their requirements (e.g. food, water). Their abundance is not only determined by resource availability, but

also by resource distribution, due to the fact that the effort per unit collected food is higher in an environment of increased resource dispersion (Arnold et al. 1993; Saunders 1993). Therefore, fragmentation decreases animal abundance and, when the food ingestion/effort balance becomes negative, (b) areas including patches of (a), may even be considered as (c). As food dispersion also affects group size (Clutton-Brock 1974), a reduction of the average animal group size may be a second result of fragmentation, which could consequently influence reproduction, foraging and defence strategies. Thirdly, fragmentation may affect animal distribution as a result of the home range area requirements of isolated populations. To avoid inbreeding and to minimise the risk of extinction, populations of each species require a minimum continuous area to sustain a specific minimum viable population size (Soulé 1987). Hence, the spatial continuity of an ecosystem is crucial for its organisms.

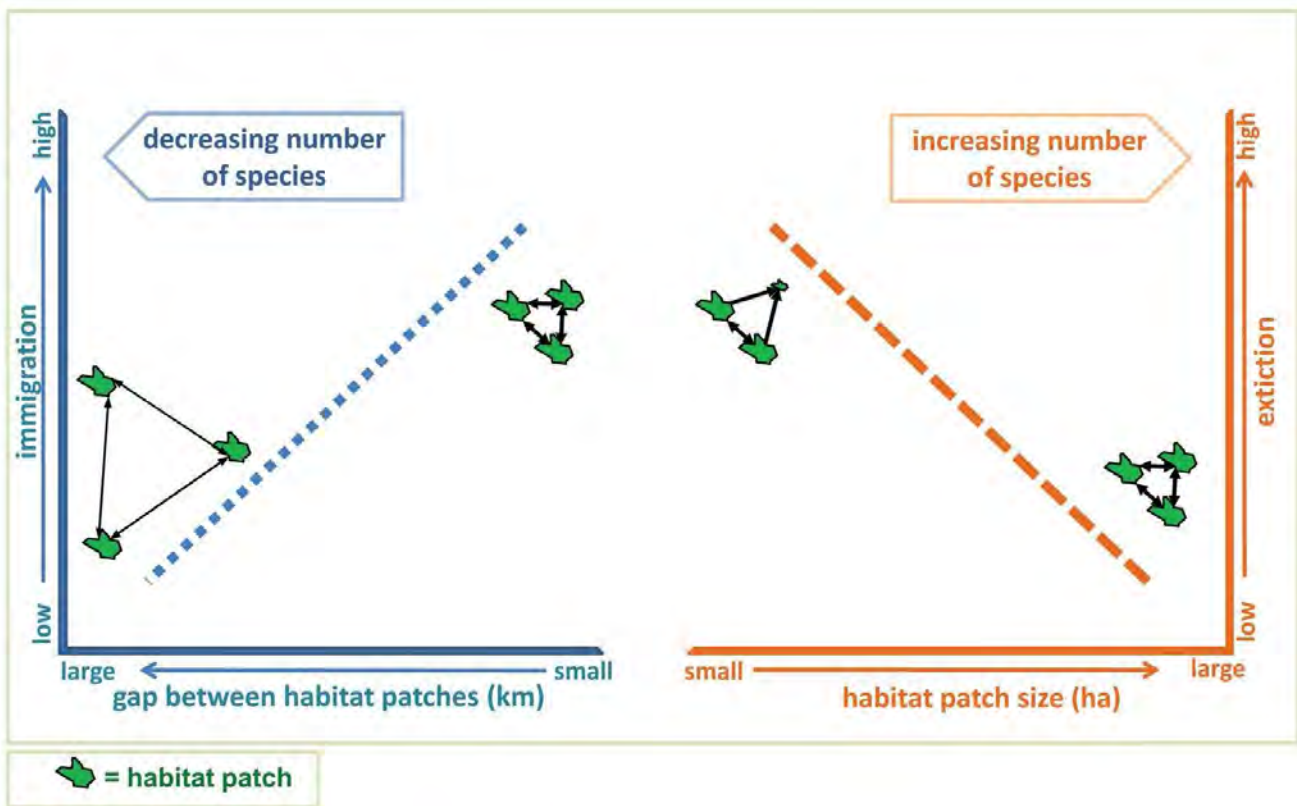


Figure 8. Graphic presentation of the Island theory showing the influence of the distance (gap) between habitat fragments (patch) and habitat fragment size through immigration and extinction rates on the number of species in habitat fragments.

Two biological theories deal with the impact of landscape fragmentation on biodiversity: the Island theory (MacArthur & Wilson 2001) and the Meta-population theory (Hanski 1998, 2005). The first theory explains the relationship between the size of areas where species survive, immigration, extinction and the rate of isolation, which is directly associated with connectivity (Figure 8). Biodiversity is assumed to be positively related to connectivity, according to this theory (Hunter 1996). The second theory emphasises the importance of connectivity between seemingly isolated local populations to reduce the chance of extinction of the metapopulation, as it encourages re-colonisation of areas with local populations after their eventual extinction, or helps reinforce (in size and genetic variability) small local populations with a high risk of extinction through migration. Hence, the conservation objective of improving connectivity is not in the first place “restoring traditional migration routes” but “enabling occasional contacts between local populations” in order to reduce the chance of extinction and to stabilise metapopulations.

The requirements in terms of habitat and home range area of species are rather complex. These requirements relate more or less to the size of the animal, as resource dependency and availability (during all seasons) for a species and the members of its social unit is an important determining factor of carrying capacity (Jedrzejewski 2009). This means that, generally speaking, larger animals are more vulnerable to fragmentation than smaller animals, and that species such as the European Brown Bear, European Bison and Red deer are more vulnerable to fragmentation than smaller animals. In addition, carnivores, which occupy a higher trophic level, need relatively larger areas than herbivores, and therefore they are more vulnerable to fragmentation. Animals with a more gregarious life style are also more vulnerable to fragmentation, unless they can adapt their social structure. Furthermore, the dispersion of food resources, water and other crucial habitat elements may have a specific influence on the vulnerability of species to fragmentation.

## 2.2. Ecological networks: policy, legislation and practice

### 2.2.1 Pan-European Ecological Network

The Pan-European Ecological Network (PEEN) is one of the most important implementation tools of the Pan-European Biological and Landscape Diversity Strategy (PEBLDS). PEEN aims to link the different European and national protected areas and ecological networks with the aim to ensure a favourable conservation status for Europe’s key ecosystems, habitats, species and landscapes (Sepp & Kaasik 2002; Bennett 2004).

Europe’s biodiversity occurs largely in ecosystems where humans have been playing a role for a long time. Over the past millennia, human activity has increased the number and variety of habitats and biodiversity has increased correspondingly. However over the last century, rapid increase in the use of natural resources and the spread of human habitation have reversed this trend, putting species and habitats under extreme pressure. As a result, habitats are becoming destroyed or fragmented, losing their ability to provide the required goods and services and species are reducing in numbers and geographic range. To counter biodiversity loss, human resource use must become sustainable and integrated with biodiversity conservation.

To restore ecosystems, habitats and species, it would be ideal if vast areas could be protected from human exploitation. However, the demand for economic development in Europe is such that this is not possible, even in the last remaining wilderness areas. The ecological network concept offers a way of reconciling these two conflicting demands by integrating biodiversity conservation with the exploitation of natural resources. This is done by embedding areas necessary to ensure the continued functioning of ecological processes or the viability of species populations, within a wider landscape of semi-natural and managed lands (Figure 9).

Ecological networks contain four main elements:

- (1) *Core areas*: These are areas with as primary function biodiversity conservation. They are usually legally protected under national or European legislation (e.g. Natura 2000 sites).

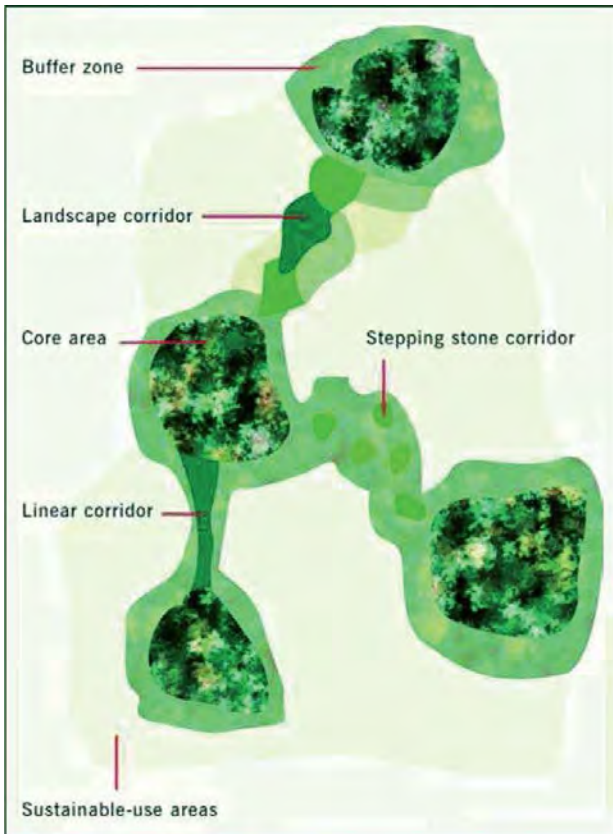


Figure 9. The basic elements of ecological networks © Syzygy.

These areas should provide a substantial representation of key natural or semi-natural ecosystems and contain viable populations of important or threatened species. Land use in these areas is managed to give priority to biodiversity conservation.

- (2) *Ecological corridors*: These are areas of suitable habitat providing functional linkages between core areas. For example, they may stimulate or allow species migration between areas. Ecological corridors may be continuous strips of land or 'stepping stones' forming patches of suitable habitat. Using ecological corridors to improve ecological coherence is one of the most important tools in combating the fragmentation threatening so many of Europe's habitats. Generally speaking, ecological corridors can be associated with higher levels of land use, as long as their function is maintained.
- (3) *Buffer zones*: Protected areas should not be considered islands, safe from negative exter-

nal effects. The resource use that occurs outside these areas can have serious impacts on species and habitats within, for example air/water pollution from industrial activity around a protected area can have serious effects on species inside the area. Buffer zones allow a smoother transition between core areas and surrounding land use. The size and utilisation of buffer zones depends heavily on the particular needs of the specific ecosystem and its local population.

- (4) *Sustainable use areas*: These are remaining areas which may be subject to more intensive land use. However, the successful provision of ecosystem goods and services should still be considered.

### 2.2.2 Romania

Both the general public and the authorities consider the Carpathian Mountains to be the most important region of Romania.

Nature protection in Romania resorts under the Ministry of Environment. This includes the Directorate for Biodiversity, the National Environmental Agency and the National Agency of Protected Areas. The latter is just a "paper" agency, which is



Figure 10. Foxes are found all over the Carpathians, from the plains to the alpine meadows. They usually inhabit mixed forests fragmented by old clear-cuttings, meadows or water. They avoid large coniferous monoculture forests and swampy areas.



not really functional. Surveillance and law enforcement related to nature conservation and environment protection is dealt with by the National Environmental Guard, subordinate to the Romanian Government.

Before the start of the accession process to the European Union, Romania began implementing the Emerald Network. This ecological network of protected areas and ecological corridors is mentioned in Governmental Ordinance no. 236/2000. Article 15 of this Ordinance describes ecological corridors as being the natural vegetation along rivers banks, lakes, railways and roads, and the edges along agricultural land, forested areas, wetlands and natural grasslands. The same article mentions that any action which can affect the integrity of these areas is forbidden, and exceptions and exemptions to the rule have to be approved by the environmental authority. In Law 462/2004, which endorsed Government Order 236/2000, this Article 15 was changed: ecological corridors have to be declared by environmental authority, approved by county council, and again any action which may affect the integrity of these areas is forbidden. In G.O. 57/2007 Article 5 paragraph 3f is explained that ecological corridors have to be defined and identified based on scientific studies, agreed upon by the Romanian Academy<sup>3</sup>. The article states that the management of ecological corridors should be defined. An ecological corridor may only be declared by the environmental authority, with approval by the Romanian Academy, as well as the agriculture, transport, landscape development and tourism authorities.

Apart from the fact that ecological connectivity is one of the main aims of the environmental national policy, Romania lacks a policy to secure the coherence of the network and to prevent fragmentation.

The Ministry of Agriculture, Forests and Rural Development has initiated specific policies and programmes related to agriculture and rural development. In many cases, the development initiatives are initiated by different ministries (tourism pro-

grammes, transport infrastructure programmes, energy programmes, etc.) and do not reflect the importance of the Carpathians as a European biodiversity reservoir. These initiatives often do not include environmental impact mitigation measures. This situation is due to a lack of integrated regional policies, which is one of the main challenges for the future.

ICAS (Romanian Forest Research Institute) carried out scientific studies on ecological corridors related to large carnivores, with BBI/Matra funding. A plan for an ecological network for carnivores has been prepared but this plan has not yet been implemented.

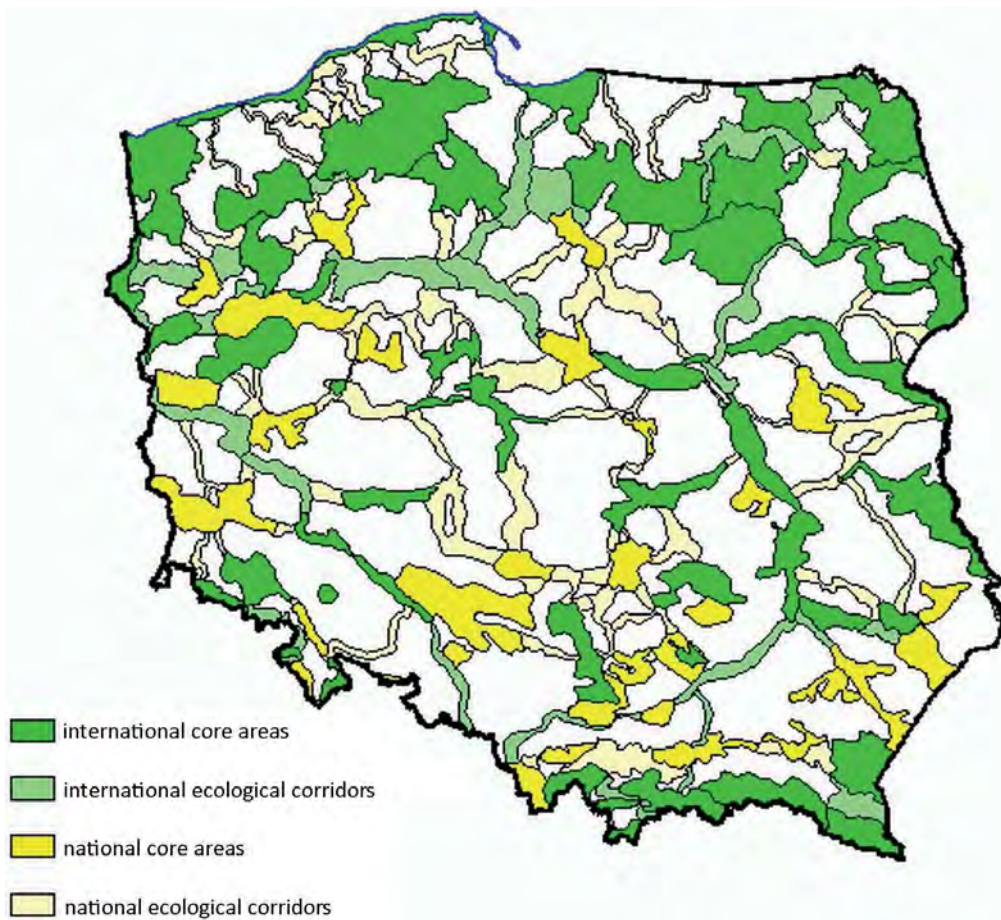


Figure 11. A Roe Deer couple in Spring.

### 2.2.3 Poland

In 1995, the Pan-European Strategy for Biodiversity was accepted in which eight large rivers were mentioned as potential European ecological corridors. Among these eight rivers two were Polish: the Vistula and Bug. In the same year the Polish Department of Nature Conservation designed a system of national ecological corridors based on the network of watercourses, followed in 2001 by the programme for the protection of river valleys. Between 1995 and 1996 the concept of ecological network Econet - Poland was elaborated (Liro 1998), based on a methodology in common with the Czech Republic, Slovakia and Hungary. It comprised 78 core areas, and 110 ecological corridors (Map 2). In 2001

<sup>3</sup> A forum of national recognition and active centre of scientific research and literary and artistic creation.



Map 2. The concept ecological network "Econet - Poland", developed in 1995-96 and based on methodology applied in the Czech Republic, Slovakia and Hungary, composed of 78 core areas and 110 ecological corridors (Jędrzejewski et al. 2009).

a proposed system of migration corridors was published for Lynx and Wolf based on the distribution of large forest complexes connected through stretches of forest. In the same year, the term "ecological corridor" was introduced in the Parliamentary Act as "the area between two or more protected territories, without settlements, being a migratory route of plants and animals".

The Natura 2000 network was introduced in Poland in 2000, then consisting of only two types of protected sites (Makomaska-Juchiewicz and Tworek 2003). In 2003, a supplement to this system was proposed with ecological corridors providing connectivity, having a protection status comparable to at least that of Protected Landscape (Wojciechowski 2004). These corridors would have a total area of 4315 ha. In 2005, the Ministry of Environment designed a complex of ecological corridors in Poland

(Jędrzejewski 2005). Its main aim was to assure connectivity between Natura 2000 sites and other protected areas in the country. Areas with possibly the largest degree of naturalness, a high percentage of forest cover and the least density of settlements were selected as corridors.

None of the above projects was implemented, which is partly due to the fact that neither a clear protection status nor institutional responsibilities for implementation were defined. However, ecological corridors are now included in the majority of spatial management plans prepared at provincial, county, and commune level. The last (2004) Parliamentary Act on nature Conservation defines ecological corridors as migration routes of plants, fungi and animals, but does not provide any indication how they should be designed nor defines their protective status.

#### 2.2.4 Ukraine

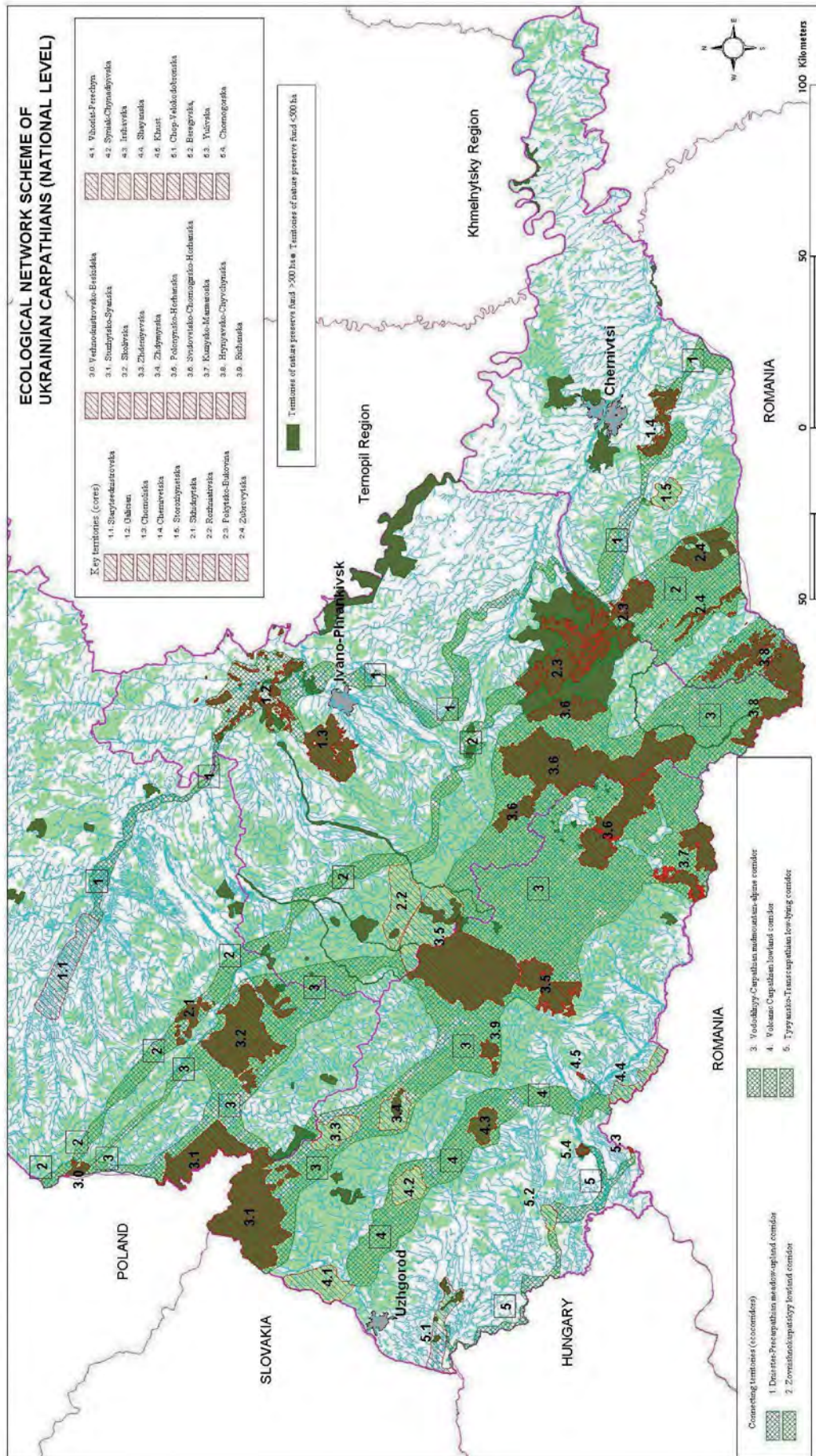
The development of a national ecological network has high priority in the Ukrainian conservation policy. The Strategy of Biodiversity Conservation in Ukraine (1997) underlined the creation of a national ecological network. The efforts of the MEP, NGOs, scientists and other stakeholders resulted in the preparation and approval by the Verkhovna Rada of the Law of Ukraine "On the State Programme of Ukraine's National Ecological Network Development for 2000-2015". The principal objective of this ecological network programme<sup>4</sup> is to increase the area in the country gazetted under "Natural landscapes" to a level sufficient for the preservation of their natural diversity close to their initial ecosystem conditions (Brusak 2006; Movchan 2004; Vakarenko 1999). This includes the development of a territorially integrated system ensuring natural ways of dispersion and movement for plant and animal species, which is essential for the maintenance of natural ecosystems and associated species. One of the aims of the programme is to agree on the integration of the Ukrainian ecological network elements with those of the neighbouring countries in order to develop the Pan-European Network (PEEN) (O'Donnell 2007). In the course of this programme, legislation has continued to be developed. An overview of legislation with reference to the establishment and management of the ecological network is presented in Appendix 2. Legislation knows four levels of approval: Verkhovna Rada (laws), Cabinet of Ministries of Ukraine (decrees, directives), Ministry of Environmental Protection (orders) and Oblast Councils and Administrations. Protected areas of national value, often being core areas of the ecological network, are established by Presidential decree (not mentioned in Appendix 2). NGOs, civil and scientific societies, and groups concerned welcomed the adoption of the Law "On the Ecological Network of Ukraine", which created a solid base for the development of an ecological network. The key steps for ecological network establishment covered by this law include:

(1) The identification of territories (areas) having

special environmental, ecological, aesthetic, recreation, historic and cultural value, and understanding limitations with regard to land use.

- (2) Justification and substantiation of the inclusion of specific territories and objects in the "Lists of Econet", the official catalogue of core areas, connecting areas (ecological corridors), buffer zones and rehabilitation areas, which form the elements of the ecological network (see Article 16 of this law for explanation).
- (3) Mapping of territories and objects included in these lists.
- (4) Elaboration of recommendations concerning management regimes for protected areas, land plots under special protection (e.g. protected zones along rivers), rehabilitation zones, buffer zones and proposed connecting areas. Elaboration of recommendations regarding changing of ownership and redemption of land.
- (5) The inclusion of territories and objects in these lists is based on decisions made by the bodies of executive power and bodies of local self-government, in accordance with the procedure established by the Cabinet of Ministers of Ukraine.
- (6) The ecological network is designed on the basis of "Regional schemes of Econet formation" of the Crimea Autonomous Republic and Oblasts, as well as of the "Local schemes of Econet formation" of Rayon, settlements and other territories of Ukraine.
- (7) Coordination between regional and local schemes of ecological network formation and the "Summary scheme of Econet formation of Ukraine" (national ecological network) and its integration into the Pan-European Ecological Network, accompanied by the approved documentation taking into account government, social and private interests.
- (8) Corresponding councils (Oblasts, Rayon) approve regional and local schemes of ecologi-

<sup>4</sup> The ecological network of Ukraine is referred to as "Econet" in Ukraine.



Map 3. The Econet of the Ukrainian Carpathian region developed in 2005-2006 (Brusak et al. 2006).



Figure 12. The Ukrainian Carpathians facing the Romanian border.

cal network formation after agreement by Oblast departments of the Ministry of Environmental Protection.

Since the adoption of the law the ecological network development has proceeded at national and regional level. The MEP arranged the elaboration of maps (schemes) to support ecological network development on national and regional level (Map 3). For the Carpathian region such a map (scale 1: 200 000) has been designed in 2005 - 2006 by expert team led by the National University "Kyiv-Mohyla Academy", and accompanied by a report (Brusak 2006). The report and scheme were accepted by the MEP in 2006. The map is used for the further development of regional and local maps at Oblast and Rayon level. The conceptual aspects of Econet maps and Econet development in Oblasts are to be discussed by the Ecological Network Coordination Councils. Subsequently, they are to be approved by the respective governmental institutions (land and spatial planning agencies, local authorities) and to be incorporated in relevant documents at different administrative level. The regional Programmes of Ecological Network formation have been adopted by all Oblasts of the Carpathian region, but the detailed Econet maps have not yet been elaborated, adopted or included in spatial development plans by all four oblasts covering Ukrainian Carpathians.

Since 2000 the development of an ecological network has been supported by various projects, such as through BBI-MATRA, within the framework

of the "Joint Working Programmes for Ukrainian-Netherlands Cooperation in the Field of Nature".

### 2.2.5 Achievements and constraints

The first stage of the "State Programme of Ukraine's National Ecological Network Development for 2000-2015" has been completed and some results were discussed during meetings of the "Coordinating Board for Development of the National Econet" in March 2007 and December 2009. During the first stage attention was mainly focussed on the development of relevant legislation and regulations, and the creation of new core protected areas. In December 2009 Ukraine had 7444 protected areas covering 3.7 million ha or 6,6% of the country. However, the policy target for 2005 of 4.2 million ha, or 7% of Ukrainian territory, has not been achieved, mainly due to the lack of funding and inadequate legislation. For example, only 2.2 million UAH (about 200 hundred thousand euro) was made available from the State Budget for implementation of the ecological network development in 2008. Authorities in Kyiv and 19 other Oblasts did pay attention to the development of regional ecological networks, but delays in the development of Oblast ecological networks are also caused by lack of funding, now from Oblast budgets. An example of missing legislation is the absence of a Decree by the CMU providing a procedure for the development of lists of core, connecting, buffer and rehabilitation territories in the



Figure 13. Even in protected areas forests are often a mosaic of planted commercial forests and natural fringe forests along streams.

national ecological network. The legal status of these structural elements of the ecological network needs further development and improvement, as no structural elements (core areas, ecological corridors, buffer zones or rehabilitation territories) have any specific restrictions on their land use regime once they have received their official status. Land use regimes and restrictions are mainly determined by the willingness of landowners and land users. Support for land use restrictions is difficult to obtain, as neither the Ukrainian Government nor the MEP provide any compensation for agricultural or other losses.

Other issues hindering the practical implementation of ecological network development are lack of technical assistance, frequent changes in the Land Code, Water Code, Forestry Code and others laws and regulative documents, which do not take the requirements of the development of the ecological network sufficiently into account. For example, the practicalities of the establishment and management of ecological corridors, with regard to land use and consequences for landowners and land users had not yet been elaborated before the implementation of the pilot corridor project. Similar uncertainties exist for buffer zones and rehabilitation zones.

Land ownership and land use issues are regulated by the Land Code. Among other things, the Land Code addresses protection of areas, wise land use, improvement of nature landscapes, creation of friendly ecological environment and land use planning. It also legalised ownership of private land by Ukrainian citizens in 2001. Subsequent land privatization complicated the creation of the ecological network drastically, because needs concerning nature protection were hardly taken into account. The Land Code ensures land ownership rights and states in Article 1, that land ownership rights may not infringe upon the rights and freedoms of individuals, and the interests of the society, or worsen the environmental situation and natural qualities of the land. However, significant areas of state land of high nature value became privately-owned and most of the new owners did not want any nature protection restrictions.

## 2.3. Ecology of the Carpathians

### 2.3.1 Physical environment

The Carpathians are a relatively young mountain complex formed in the Tertiary period. They stretch out over eight countries in Central Europe, in the form of an arc, from Serbia to the Czech Republic and Austria. The Ukrainian Carpathians cover approximately 21,000 km<sup>2</sup>, which is about 10% of the entire Carpathian Ecoregion (Oleshko et al. 2005; Kruhlov 2008).

They are formed by a series of low (up to 1000 m) and medium (up to 2000 m) parallel ridges, stretching in a north-west to south-east direction. Six peaks located on the Chornohora ridge just exceed 2000 m. The mountains predominantly consist of folded and thrust upon each other sandstone and siltstone strata (flysch formations), although in the south-west, volcanic and metamorphic rocks occur. The climate is temperate with a moderate continental influence and varies significantly depending on



Figure 14. Beech forests on the slopes of Vyzhnytsky NNP

topography - the mean monthly air temperature ranges from 6 to 20 °C in summer and from -3 °C to -10 °C in winter; annual precipitation is 900 - 1200 mm (Herenchuk 1968; Kubijovyc 1984).

### 2.3.2 Vegetation

The diversity in geology, geomorphology and related climatic and soil conditions results in a high variation of habitats, which can be classified as five vegetation belts (Holubets & Milkina 1988a, 1988b; Kruhlov 2008; Tasenkevich 2009; Malynovsky 1980):

- (1) Submontane belt (up to 350 m), characterized by broadleaf forests with species such as *Quercus robur*, *Q. petraea*, *Q. dalechampii*, *Q. cerris*, *Carpinus betulus*, *Acer platanoides*, *A. campestre*, *Tilia cordata*, *T. platyphyllos*, *T. tomentosa* and *Fraxinus ornus*.
- (2) Beech forest belt (350-1100 m), which extensively covers the Ukrainian Carpathians (Figure 14) and with more than 20,000 ha of it consisting of primeval forests, is mainly dominated by *Fagus sylvatica*. The primeval beech forest has been classified as UNESCO World Heritage Site (2007).
- (3) Spruce forest belt (1100-1500 m), which is found mainly on the large northern mountain slopes (Figure 15).
- (4) Sub-alpine belt (1500-1800 m), formed by shrub and dwarf shrubs associations of *Pinus mugo*, *Rhododendron myrtifolium*, *Juniperus communis* sp., *Alnus viridis*, *Sorbus aucuparia*, *Salix silesiaca*, by tall mountain grasslands with *Adenostylus alliaria*, *Cicerbita alpina*, *Cirium waldsteinni*, *Athyrium distentifolium* and by highland meadows with *Deschampsia cespitosa* and *Calamagrostis villosa*.
- (5) Alpine belt (1800-2061 m), dominated by *Festuca airoides*, *Juncus trifidus*, *Carex sempervirens* and *Sesleria coerulans*.

Grasslands occur in the Carpathians naturally, but they have expanded through human use of trees for fuel and timber and by pasturing. Natural and semi-natural highland grasslands in the Ukrainian Carpathians cover 970,000 ha (Tasenkevich 2009).



Figure 15. Spruce forests usually have limited vegetation cover on the ground and are therefore of low value as habitat for terrestrial species.

### 2.3.3 Wildlife

Biodiversity is high in the Carpathians, due to the variation in biotopes related to the relief (Bashta *et al.* 2006, Bashta and Potish 2007). The distribution of animals is determined by the vertical zoning of the landscape (Kubijovyc 1984). High-mountain species occur in the subalpine zone (e.g. Alpine Snow Vole (*Chionomys nivalis*) and Alpine Shrew (*Sorex alpinus*). Taiga species are found in the mountain forest zone (e.g. Capercaillie, *Tetrao urogallus*), Hazel Grouse (*Bonasa bonasia*), Nutcracker (*Nucifraga caryocatactes*), Black Grouse (*Lyrurus tetrix*) and Lynx (*Lynx lynx*). In the higher and lower forests typical mammals of the Central European forests are found, such as Brown Bear (*Ursus arctos*) and Wildcat (*Felis sylvestrus*) (both rare now), Red Deer (*Cervus elaphus*), Roe Deer (*Capreolus capreolus*), Wolf (*Canis lupus*), Fox (*Vulpes vulpes*), Forest Marten (*Martes martes*), Ermine (*Mustela erminea*), Carpathian Squirrel (*Sciurus vulgaris carpathiacus*), European Mink (*Mustela lutreola*), Otter (*Lutra lutra*) and Common Dormouse (*Muscardinus avellanarius*). European Elk (*Alces alces*) is occasionally reported in the Carpathian region, but good habitat for this species is limited here (Domnich 2009).

Golden Eagle (*Aquila chrysaetos*), Hawks (*Accipiter gentilis*, *Accipiter nisus*), Buzzard (*Buteo buteo*), Eagle-owl (*Bubo bubo*), Woodcock (*Scolopax rusticola*), Black Stork (*Ciconia ciconia*), Tawny Owl

(*Strix aluco*), Black Woodpecker (*Dryocopus martius*), White-backed Woodpecker (*Dendrocopos leucotos*), Water Pipit (*Anthus spinoletta*), White-throated Dipper (*Cinclus cinclus*), and Ring Ouzel (*Turdus torquatus*) are among birds of the Ukrainian Carpathians, some of them rare, however. Species of amphibians and reptiles include Carpathian Newt (*Lissotriton montadoni*), Alpine Newt (*Mesotriton alpestris*), Yellow-bellied Toad (*Bombina variegata*), Spotted Salamander (*Salamandra salamandra*), Aesculapian Snake (*Elaphe longissima*), and Smooth Snake (*Coronella austriaca*). Due to political and social changes over the past 18 years, populations of large mammals have decreased (Domnich 2009), particularly the Red and Roe Deer numbers have dropped drastically, and Elk have almost disappeared from the Ukrainian Carpathians.

#### **Some local wildlife records**

According to older residents still living in the forests near the villages Boberka, Shandrovets, Verkhnya Yablunka, Nyzhnia Yablunka and Nyzhniy Turiv in the Turka Rayon, the number of Bear, Lynx and Wildcat used to be higher than it is at present. European Bison still lived in the forest near Bahnuvate village in the recent past, as they had been released there in the 1960s. A count in 1994 came to 18 bisons. According to State Hunting Enterprise "Rozluch", this herd's home range covered 5,300 ha. In the cold winter of 1996, which saw 70 to 130 cm of snow cover, several young bison died. Since 1999 the number of bison started to decline, and since 2006 they have not been seen in the area anymore. The "Turka Association of Hunters and Fishermen" did a count in the winter of 2010, spotting: 4 Bears, 11 Lynx, 61 Wild Boar, 17 Deer, and 11 Wildcats. In the same period the hunting organisation "Bear", on the other hand, counted: 5 Bears, 6 Lynx, 80 Wild Boar, and 81 Deer. Mayor problems affecting wildlife according to these organisations are poaching, increased traffic and intensive deforestation.



Figure 16. The Wood Grouse occurs mainly in coniferous and mixed forest.

#### **2.3.4 European Bison**

The European Bison became extinct in the wild in 1921, but the Carpathian subspecies already disappeared in the 18<sup>th</sup> century (Pucek 2004). However, free-ranging herds were re-established at Białowieża (Poland) in 1952 through a captive breeding programme, and the first reintroduction to the Carpathians took place in 1963. From 1965 to 2004 the number of captive European Bison has increased from 562 to 1200 animals and the number of free-ranging animals has increased from 218 to 1955 animals (Krasinska 2007). Nowadays, over 30 free-ranging populations exist in Poland, Lithuania, Belarus, Ukraine, Russia and Slovakia. The Carpathian Mountains still offer sufficient continuous habitat for natural migration and genetic exchange between the isolated populations of the Lowland-Caucasian bloodline, which has been introduced in the area at several locations. The largest free-ranging European Bison population in the Carpathians is found in the Polish Bieszczady mountains (near the Ukrainian border), and consisted of almost 300 individuals in 2005. In Romania, the European Bison is only present in captivity and semi-liberty as part of a reintroduction programme co-ordinated by Vanatori Neamt NP. At the end of 2009, there were 22 animals living in an acclimatization enclosure of 170 ha, and 6 animals in captivity in a zoo. In the western Ukrainian Carpathians only one isolated free-ranging small herd (8 animals in 2009) occurs in Skolivski Beskydy NNP (Bashta 2004). However, an



acclimatisation enclosure has been established in this park, with 6 individuals in 2009. The largest Ukrainian herd can be found in the southern Ukrainian Carpathians in the Bukovyna area (Zubrovitsia) near Vyzhnytsky NNP, close to the Romanian border (70 - 80 animals, at present). The Bison of Skolivski Beskydy NNP are separated by only about 50 km from a well-established population in the Bieszczady Mountains in the East Carpathian Biosphere Reserve in Poland. The IUCN Action Plan for the European Bison (Pucek 2004) stresses the importance of extending the Bison range within the Carpathians and the creation of corridors between isolated herds to allow gene-flow, essential for their conservation.

According to the IUCN the European Bison is endangered; it is listed in Annex III of the Bern Convention, in Annex IV of the European Habitats Directive, classified as vulnerable on the European Red List, and in the Red Data Book of Ukraine it is classified as extinct from the wild.



Figure 17. A small herd of European Bison in the Skolivski Beskydy National Nature Park.

### 2.3.5 Brown Bear

Just as for European Bison, habitat destruction, hunting and poaching reduced the original distribution of Brown Bears to some remote corners in Europe.



Figure 18. Brown Bear in the Polish Beskyds with a collar transmitter for research.

The main stronghold of the species is situated in Eastern Europe. After the Russian population, the Carpathians harbour the largest Brown Bear population of Europe (Anon. 2004). The Romanian Brown Bear population is by far the largest in the Carpathians and was estimated at 4350 individuals in 2003. These high numbers are mainly the result of the effective management of hunting. The Brown Bear is very well represented in the area of Suceava (154 individuals) and Neamt county (160 individuals), close to the Ukrainian border<sup>5</sup>. In Romania Brown Bear has a strictly protected status. Normally hunting is prohibited, and exceptions can only be granted through ministerial approval. In the Ukrainian Carpathians the Brown Bear is endangered and listed in the Red Data Book of Ukraine since 2003.

<sup>5</sup> Survey results of wildlife assessments in hunting areas Suceava and Neamt County in 2009.

Only in the eastern Ukrainian Carpathians do the Brown Bear populations appear to be stable. In 1990 the number of Brown Bears was estimated at 600 individuals in Ukraine, but a considerable decline was recorded in subsequent years mainly as a result of poaching and degradation of favourable habitats, leading to more recent estimates of approximately 300 individuals (Anon. 2004, Slobodan 1988 and 1993). Estimates for the Brown Bear in Skolivski Beskydy NNP vary between 20 and 25 individuals. In Vyzhnytsky NNP the Brown Bear is only an occasional visitor. Brown Bears also occur in the Polish Bieszczady Mountains, right along the Ukrainian and Slovak borders, and are estimated in 2009 for about 80 individuals. The species is strictly protected in Poland since 1952.

The IUCN Action Plan for the Conservation of the Brown Bear (Servheen 1998) in Europe indicated that bear habitat fragmentation is one of the most serious threats to maintaining viable Brown Bear populations. In Ukraine an action plan has been drafted for the Brown Bear<sup>6</sup>. The Brown Bear is listed in Annex II of CITES, in Annex II of the Bern Convention and in Annex II/IV of the European Habitats Directive.

### 2.3.6 International borders and wildlife populations

Although the distribution of wildlife in the Carpathians is not in the first place determined by international boundaries, different management practices in particular countries result in varying conditions for wildlife. Safeguarding cross border movement of wildlife through ecological corridors would be beneficial for the genetic exchange between the Carpathian sub-populations and facilitate migration within home ranges intersected by international boundaries. Apart from the European Bison and the Brown Bear, other terrestrial animals, which occur in varying abundance along the Carpathians would also profit from sustainable ecological corridors between protected areas of different countries. The Lynx population in Romania is estimated to be 92 in-

dividuals in Suceava County and 70 individuals in Neamt County. The Wildcat is classified as a vulnerable species in Romania, but in Neamt and Suceava County, viable populations seem to survive, estimated at respectively 154 and 110 individuals.

## 2.4. Land use and development

### 2.4.1 Dynamics of land use development

Like the geological history, the political and social histories of the Ukrainian Carpathians have been very dynamic. Before the establishment of the current Ukrainian state boundaries, ownership of the area has shifted several times among the different nationalities of surrounding states. As a result, this part of the Carpathians has experienced the entire or partial authority of Poland, Austria, Hungary, Romania and the Soviet Union (Markus & Stebelsky 1993). Most of these shifts were associated with the movement of large numbers of people across the rearranged borders, resulting in sometimes dramatic changes in population density and land use. Hence, history also brought a variety of different ethnic groups into the area (Kubijovyc 1984), some of them cultivating crops in the valleys (e.g. Lemkos, Boikos and Zahorians) and others mainly practicing animal husbandry in the higher areas (e.g. Hutsuls).

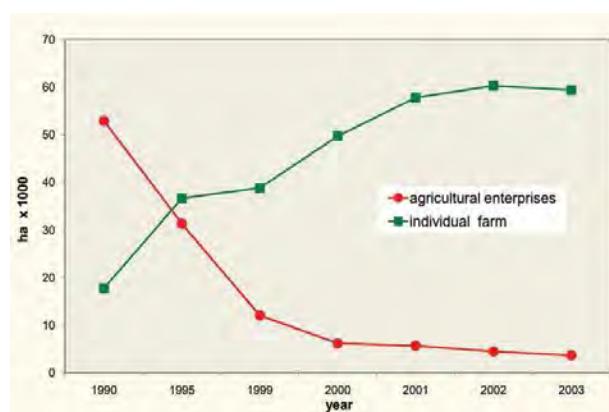


Figure 19. Dynamics of the cultivated area of agricultural enterprises and individual farms, Lviv region, 1990 - 2003 (Burdusel et al. 2006).

<sup>6</sup> [www.mehr.gov.ua/documents/nakaz\\_ursus.doc](http://www.mehr.gov.ua/documents/nakaz_ursus.doc)



Figure 20. The generalized land use pattern from valley to summit: (1) settlement, roads and gardens, (2) crops, (3) pastures, and (4) forestry and non timber forest products.

According to information from the regional managers of State forests (Burdusel 2006), the forest area in the Ukrainian Carpathians has increased by 38,100 ha (2.3%) in 15 years and constitutes 65.5% of the analyzed territory (Table 1). The extension of the forested area was caused not only by the increase in forest plantations, but also as a result of the inclusion of forest shelter belts along roads, railroads, etc. in this land category. Note that the area of arable land increased in the same period from 7.9 to 10.1%, which means an annual increase of 1.8% per year (Figure 19). This increase is mainly caused by the conversion of grassland into cultivated land during land privatisation in the beginning of the 1990s. Kuemmerle (Kuemmerle et al. 2006, 2007), arrives at seemingly different conclusions, presenting evidence of increased felling and fragmentation over the last two decades, and abandonment of

agricultural land, particularly in the higher altitude zones. Both trends, though, will presumably result in the increase of secondary shrub vegetation.

Table 1. Relative land use areas in the Ukrainian Carpathians in 1990 and 2004 (data derived from Burdusel 2006).

Land use	1990	2004
Arable land	7.9%	10.1%
Grassland	16.3%	16.5%
Forest	63.2%	65.5%
Other (buildings, roads, water, wetlands, bare)	12.6%	7.9%



Figure 21. Larger herds of livestock are often formed by associated farmers, who each own a few animals and delegate the herding to one or a few members of the association.

#### 2.4.2 Agriculture

Below 600 m, but sometimes up to 1000 m, depending on local conditions, maize, potato, oats, rye and wheat are cultivated (Kubijovyc 1984). Cultivation is concentrated near settlements on the lower foot slopes (Figure 20). The higher slopes are more used for pasturing. During the socialist Soviet period agricultural activities were concentrated in collective farms which usually managed large land areas. Since this period, land is being privatized and plots have been allocated to individual farmers. Land use and ownership are now regulated by the Land Code (2001), which defines land categories<sup>7</sup>. According to the Land Code, land use categories may not be changed by the owners without special government permission (Dells et al. 2006). Moreover, change of private ownership of agricultural land is currently prohibited by a moratorium on change of ownership to avoid speculation with land prices.

#### 2.4.3 Livestock

Traditional herding was important in the past, involving for example about 5000 herders in the Ukrai-

nian Carpathians in the 1930s (Kubijovyc 1984). During the socialist Soviet period, this traditional system was replaced by artels (associations on a voluntary basis) and collective farms (kolkhoz). Collective farms managed large tracts of the mountain meadows through intensive grazing by livestock, as well as mowing, and to a limited extent the application of fertilizers and pesticides (Tasenkevich 2009). Since the political and economic changes in 1991, however, intensity of the use of these grasslands has

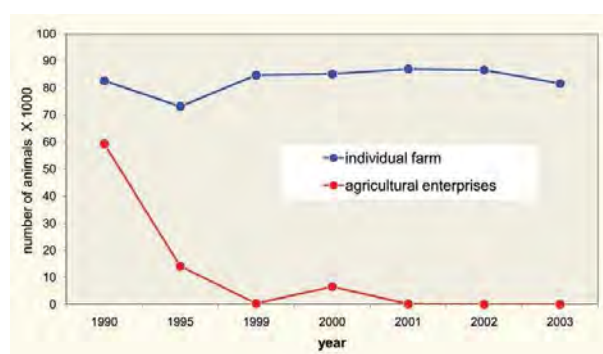


Figure 22. Dynamics of livestock numbers in the agricultural enterprises and individual farms, Lviv region, 1990 - 2003 (Burdusel et al. 2006).

<sup>7</sup> Land of agricultural use, Land of residential and public building-up, Land of natural conservation fund and other nature protection, Land of health-improving use, Land of recreational use, Land of historical and cultural use, Land of forestry, Land of water fund, Land of industry, transport, communications, energy, defence and others.

declined (Figure 22). In the period from 1990 to 2004, the number of pigs in the mountain districts of Ivano-Frankivsk and Lviv rose 60%, while the numbers of cattle and sheep/goats dropped by 33% and 65%, respectively (Burdusel et al. 2006). The changing livestock farming and pasture management practices have had an important impact on the landscape and the habitat quality of flora and fauna (Sitko & Troll 2008). The grasslands play an important role in the distribution of some wild herbivores as well as carnivores. European Bison for example prefer to feed on grasslands (Kuijper et al. 2009), but also Wildcat, Lynx and Wolf prefer the vicinity of meadows (Klar 2007; van Maanen et al. 2006).

#### 2.4.4 Forestry

Most of the area in the mountains is covered by forest managed by the Forest Enterprises of the State Committee of Forests, but some forests are mana-



*Figure 23. Forest exploitation is potentially compatible with wildlife if fragmentation is limited and diversity of the vegetation is maintained.*

ged by the Galsillis (former Agrolis), the remaining structures of the former collective agricultural farms. Some other forests, particularly along the international borders, are managed by the Ministry of Defence.



*Figure 24. A large Wild Boar shot by hunters in the Ukrainian Carpathians, recorded in the 1930s.*



Figure 25. Oil exploitation near the Turkvivskiyi corridor.

In the past, primeval forests in the Turka Rayon consisted mainly of mixed beech-fir forest (49.7%) or spruce-fir-beech forest (29.3%). In those days forests covered about 98% of the area.

During the period of economical development, forest cover has changed significantly (Holubets 2007). Nowadays it covers about 47% of the region. Only 12.5% of trees are over 80 years old. Primeval forest was felled or replaced by secondary forest, mainly spruce plantations, which are atypical for the Eastern Carpathians area. Nowadays, the primeval forest stands cover only 0.8% of the forested area, while about 27% consists of pure and mixed spruce plantations. Because the spruce does not originate in the area, forest managers face numerous problems. The spruce, not being adapted to local conditions, is not resistant to hard winds, and usually becomes old and dry within 50 years. Since 1990, forest exploitation and fragmentation has increased in the Ukrainian Carpathians (Kuemerle et al. 2007). Forest fragmentation and agricultural changes in the area have become the main obstacles for animal movement.

#### 2.4.5 Hunting

The Carpathians are rich in large wildlife species, particularly carnivores, compared to other parts of Europe, although the Ukrainian Carpathians have lower densities than neighbouring countries Romania and Poland (Salvatori et al. 2001). However, in recent years numbers of Red deer and Roe deer have decreased significantly in the Carpathians due to decreased control of illegal hunting (Domnich et al. 2009). Hunting is a common activity throughout

the Carpathians and is regulated by "The Law of Ukraine on Hunting Economy and Shooting" (No. 1478-III, 22/02/2000).

The entire hunting territory is subdivided into hunting management units (Hunting Grounds), which are managed by different bodies. In State Forests, hunting is controlled by the Hunting Economy Department of the State Committee of Forestry and its respective units in Oblast departments. In agricultural areas, hunting is managed by non-governmental hunting associations, but private hunting enterprises also exist. On some of the land hunting is managed by research institutions and in the remaining part by the Ministry of Defence. Largely, the management approach of all the hunting management units is similar.

There is a licence system for hunters limited by quota and each unit is divided into different zones. Some of the area is reserved as rehabilitation zone, where hunting is prohibited in order to allow sustainable hunting. Hunting of Brown Bear is entirely banned in Ukraine as well as Poland. In Romania, however, bear may be hunted with a licence. Lynx is protected in all three countries and because of its limited value for trophy hunting and as conflicts between Lynx and farming are few, poaching of this species is low in Ukraine. Wolf may be hunted without restriction in Ukraine, but has been strictly protected in Poland since 1998. In Romania, hunting



Figure 26. An important transport line cuts through the Carpathians from Skole to Mukacheve and contains a main road (the E50 from Vienna to Moscow), a rail road, an oil pipeline and a high tension power line. This barrier intersecting Skolyvsky Beskydy National Nature Park would be the right place to consider a wildlife crossing.



*Figure 27. Railroads, used at moderate intensity hardly form a threat to wildlife movement, if train speed is limited.*

Lynx and Wildcat is permitted from 15 September to 31 March with ministerial approval.



*Figure 28. The Carpathians form an important skiing area in Central Europe, giving the mountains a substantial economic value. However, unregulated establishment of ski runs may accelerate erosion and habitat fragmentation.*

Connectivity is essential to keep wildlife populations healthy and therefore the establishment of ecological corridors is also beneficial for hunting. Vice versa, hunting managers can play an essential role in the protection of ecological corridors by controlling poaching. Therefore, ecological corridor management matches very well with proper hunting management.

#### **2.4.6 Infrastructure and settlements**

Communication lines run in two directions through the Carpathians, from north-east to south-west,



*Figure 29. Tourism and sports infrastructure in the western Ukrainian Carpathians.*

crossing the mountain chains, and from north-west to south-east following the main valleys. The main roads are also located along these lines, whereas the main railroads only cross the mountain chains from north-east to south-west. Almost 30% of the population lives in towns located on the intersections of these communication lines. The main connectivity issues, the barriers for wild animals moving, are located along the north-west to south-east lines following the main valleys, which is illustrated clearly by the maps dealing with connectivity presented in Chapter 4 (Map 5). The most important transport line crossing the Ukrainian Carpathians is located along the line from Skole to Mukacheve and combines a principal rail road and main road (E50) from Lviv in the direction of Budapest, forming an important connection between Eastern and Western Europe (Figure 26). Plans are being developed to turn the road into a four lane motor way. Along the same route an oil pipe line and a high voltage power line are found. Other important transport lines involving railways and roads are from Ivano-Frankivsk to Rakhiv and from Turka to Uzhhorod.

#### 2.4.7 Other developments

Recent developments in the area of the pilot project include oil exploitation (Figure 25), and the infrastructure related to the establishment of the Paralympic training centre. Tourism is also increasing in the Ukrainian Carpathians, driven by motivations such as health, historic, and ethnic tourism, as well as ecotourism and winter sports (Figure 28). Quite a number of small ski resorts have been established, such as Dragobrat, Slavske, Tysoverts, Piddobovets, Pylypets, Syniak and Krasia. Bukovel is the main resort, receiving most international winter sport visitors.

Most of these activities do not necessarily have an impact on connectivity, but associated developments in the field of infrastructure and traffic may cause disturbances and hence reduce connectivity. The uncontrolled conversion of natural vegetation into ski runs may cause erosion and undesired habitat fragmentation. Finally, transport of toxic products along roads or pipelines entails the risk of disaster, and may impact upon wildlife directly or through the reduction of connectivity.



Figure 30. In winter Red Deer descend to lower elevations in search of food.



## 3. Framework for ecological corridor establishment

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### 3.1. Structure of the framework

This chapter provides a framework in support of the development of an ecological corridor, and includes



Figure 31. Colourful grasslands with high floristic diversity on the slopes of the Carpathians in Turka Rayon in late May, with Blue bugle (*Ajuga reptans*).

all formal and technical steps required. This framework is based on experience gained during the implementation of these steps in the pilot project on the Bukovynskiy and Turkivskiy eco-corridors.

To facilitate the implementation of an ecological network in Ukraine, the MEP has subsequently issued two directives for the establishment of the ecological network. The latest version, called “Methodological recommendations for the development of regional and local Econet schemes”, issued by Order of the MEP (13/11/2009 No. 604), has been used to shape the framework for ecological corridors presented here. For this purpose, all aspects of the Methodological Recommendations relevant to the establishment and management of ecological corridors have been extracted and integrated in section 3.4.

In section 3.4.6, Table 2, an overview is presented of all steps involved. Chapter 4 elaborates on the methodology used for the modelling of ecological corridors, based on habitat requirements of umbrella species. The modelling of corridor options is appropriate (and cheap!) when the distance between connected core areas is large and the quality of different options unclear. Modelling is not useful, and this step may be omitted, in cases where the distance between connected core areas is short, and landscape and socio-economic factors indicate one clear option for the location of the ecological corridor.

The stakeholder consultation approach adopted to reach final agreement on location and boundaries of the ecological-corridor, has been worked out in Chapter 5, while Chapter 6 deals with ecological corridor management.

### 3.2. Terminology

Ecological corridors are defined in two Ukrainian laws. The term “natural corridor” was initially intro-



Figure 32. Planted spruce forests are considered to be of lower habitat value than mixed broad leaf forests.

duced by the law “On the State Programme of Ukraine’s National Ecological Network development for 2000–2015” meaning an area of land or water either *being in or brought to* a natural condition, ensuring the environmental conditions for continuity, systematic unity and supporting bio-communication functions at various levels of the spatial organisation of the environmental network. In the law “On Ecological Network”, the term “structural Econet elements” refers to areas (territories) of the ecological network distinguished by different functions. Econet is the Ukrainian acronym for ecological network. Core territories, connecting territories, buffer territories, and rehabilitation territories belong to the structural elements of the ecological network. Core territories preserve areas with the most valuable and typical biodiversity and landscape in the region. Connecting territories interconnect core territories

and support the migration of animals and the exchange of genetic material. Buffer territories protect core and connecting territories from external influences. Rehabilitation territories are areas set aside to facilitate renewal of the initial natural conditions. Different names are in use for ecological corridors: natural corridor, connecting territory or eco-corridor. In Ukraine the term “eco-corridor” has become the accepted term and will be used as such in this chapter. Ecological corridors located within the boundaries of a single Rayon are classified as “local eco-corridors”. When they are located within the boundaries of two and more Rayons, they are referred to as “regional (Oblast) eco-corridors”. The official Ukrainian term used to indicate the file containing the plan to be compiled for the formal establishment of an eco-corridor is the Ecological Corridor Scheme.

### 3.3. Authority and responsibilities with regard to the Econet

Since eco-corridors are part of the ecological networks, they should be established and managed within the current framework for establishment and management of ecological networks. The legal base for the establishment of an ecological network is briefly described in section 2.2.4. The establishment of an ecological network and of eco-corridors requires the definition of the responsibilities of government authorities and other stakeholders during the process. The key players are the MEP and its Oblast departments. In the Autonomous Republic of Crimea, however, the Republic Environmental Protection Committee runs ecological corridor issues. The management of an ecological network is realized under the authority of the Cabinet of Ministers of Ukraine, and the Council of Ministers of the Autonomous Republic of Crimea. The development of ecological networks under the responsibility of local authorities of executive power and authorities of local self-governance (Oblast and Rayon state administrations and councils) should be substantiated with research. According to the law, stakeholders are required to be involved in the development and management of an ecological network, and should have full access to relevant information. More detailed descriptions on legal responsibilities of state administrations with regard to ecological network establishment are presented in Appendix 1.



*Figure 33. Roe deer is one of the species that adapts well to landscapes dominated by agriculture.*

Oblast councils are responsible for the establishment and management of an Oblast ecological network, while Rayon councils will be in charge of the establishment and management of local eco-corridors, located within their boundaries.

### 3.4. Methodological Recommendations

#### 3.4.1 General provisions

Methodological recommendations for Ecological Corridor Scheme (connecting area) development (further referred to as the Methodological Recommendations) have been made in accordance with the “Methodological recommendations for the development of regional and local ecological network schemes” issued by Order the Ministry of Environmental Protection of Ukraine (13.11.2009 №604). They have been prepared with the purpose of providing assistance to the territorial authorities of the Ministry of Environmental Protection and other organizations and individuals interested in guidance on procedures related to creating eco-corridors, and they have an advisory nature.

#### 3.4.2 Authority and responsibilities regarding the development of Ecological Corridor Schemes

The decisions on the compilation of Ecological Corridor Schemes are made at the relevant level by councils (village, community, Rayon and Oblast) authorized to give approval. If an eco-corridor is located within the territory of two and more village councils or beyond their boundaries, but within the territory of a single Rayon, the decision on the compilation of the Ecological Corridor Scheme is made by the council of that Rayon. If the eco-corridor is located in two or more Rayons, the decision is to be taken by the Oblast council.

The decision specifies responsibilities for implementation, time frames and funding sources for activities aimed at the Ecological Corridor Scheme development (Terms of Reference).

Within their power, the Council of Ministers of the “Autonomous Republic of Crimea” as well as local executive authorities ensure the development

and implementation of Ecological Corridor Schemes, pursuant to sub. par. 2 of art. 9 and sub. par. 2 of art. 11 of the Law of Ukraine “On the ecological network of Ukraine”. Those involved are the chief managers of funds of relevant local budgets and local environment protection funds, local governments and local executive authorities. The Ecological Corridor Scheme development may be financed by extra-budgetary funds and charity funds, enterprises, institutions, organizations, grants by international environmental organizations, citizens, and other sources which are not prohibited by law (sub. par. 1 of art. 19 of the Law of Ukraine “On the ecological network of Ukraine”).

The territorial authority of the Ministry of Environmental Protection is responsible for the general organization of development and quality control of the Ecological Network Scheme (particularly eco-corridors) pursuant to pp. c) and f) of art. 10 of the

Law of Ukraine “On Ecological Network of Ukraine”. They may undertake to do the work themselves, or delegate it .

Generally, in case of the development of a local Ecological Corridor Scheme, an application should be submitted to the council of the village, town, or Rayon within which the corridor area is located. Whoever is appointed to compile the Ecological Corridor Scheme is bound by the Land Code of Ukraine and has to take advice given by the council or administration responsible into account.

### 3.4.3 Text of the Ecological Corridor Scheme

It is expedient to present the text part of the Ecological Corridor Scheme as follows:

(a) *General information about the corridor area.*

Natural conditions (e.g. orography, geomorphology, climate, landscape, drainage, soil, wildlife and vegetation).



Figure 34. Beech Marten like rocky areas, but they can also be found in houses and barns.

<sup>8</sup> A draft decree on procedures to include areas and territories in lists of ecological network structural elements is in preparation and includes a system for the codification.

<sup>9</sup> These forms are provided by Land Resources Department in each Rayon.

*(b) General corridor features:*

- Code of eco-corridor<sup>8</sup>, and key characteristics of the eco-corridor (extension, spatial location (scheme), surface, connections between key territories, and integrity of the ecological network).
- Role, necessity, and conditions for ensuring animal migration, genetic exchange, or their independent role in the biodiversity conservation.
- Information about landowners and land users in accordance with Form No 2-land<sup>9</sup>: "Report on lands being owned or used", and Form No 6-land: "Report on land availability and distribution according to landowners, land users, land, and economic activities".
- Measures necessary to develop eco-corridors (which land is proposed to be included with the purpose of ensuring the ecological network's continuity and integrity). Description of obstacles (roads, electricity transmission lines, quarries, etc) which lead to discontinuity of the ecological network's integrity, and ways to overcome them.
- The eco-corridor's place in the system of eco-corridors of the national ecological networks and harmonization with the ecological network schemes of adjacent administrative and territorial units.

*(c) Characteristics (eco-corridor's information card).*

Main eco-corridor parameters and characteristics are best presented according to the following structure (for example see Appendix 11):

1. Assigned corridor code;
2. Corridor name;
3. Protected areas connected;
4. Eco-corridor level (national/regional/local);
5. Geographic coordinates;

6. Geographic location;
7. Area in ha;
8. Physical and geographic conditions;
9. Plant species (red list species);
10. Vegetation description (list, map);
11. Animal biodiversity;
12. Environmental, scientific, economic, social, and cultural values;
13. Criteria used to select eco-corridors for inclusion in the ecological network (Appendix 5);
14. Eco-corridor's components pursuant to art. 5 of the Law of Ukraine on the "Ecological network of Ukraine" (see Appendix 4);
15. Legal status (ownership type, security, etc.);
16. Name of owner;
17. Other stakeholders;
18. Land use categories<sup>10</sup> and actual type of use<sup>11</sup>;
19. Current management framework regarding protection and use of natural resources;
20. Proposals for the creation and extension of protected areas and structural elements of the ecological network, as well as their management; proposals on restrictions and the necessity of expropriation or purchase of land, taking Econet development into account;
21. Existing barriers for wildlife;
22. Present and future threats to the biodiversity and connectivity;
23. Required land use changes;
24. Required land status and ownership changes;
25. Required landscape changes;
26. Additional measures;
27. Literature;
28. Start of preparation;
29. Date of completion;

<sup>10</sup> Referring to the Land Code categories.

<sup>11</sup> Specify in more detail within one category e.g. crop, meadow, pasture or other use.

- 30. Date of approval;
- 31. Names of authors.

*(d) Justification of the Ecological Corridor Scheme.*

The justification for the chosen corridor options and solutions to connectivity issues in the Ecological Corridor Scheme has to be based on substantiated recommendations regarding biodiversity protection in areas connected by the eco-corridor, taking into account existing social and economic development programmes as well as programmes of environmental protection and natural resource use (national and regional), land development schemes, land use plans, regional spatial planning schemes and regional development regulations. Preparation of the Ecological Corridor Scheme takes into account land development documentation as specified in art. 25 of the Law of Ukraine “On land utilization” (Appendix 6). To ensure corridor formation, functioning, development, and sustainable use, the following may be undertaken:

- analysis of land use planning documentation (land use plans, scheduled cadastral plans) to list landowners and land users in the eco-corridor and investigate proposals regarding the corridor location;
- analysis of the legal status of land plots in the area of approximate location of eco-corridor and predicted additional areas and objects of the ecological network to be included from the perspective of ensuring the eco-corridor's integrity and continuity;
- evaluation of propositions identified by the relevant administrative and territorial authorities regarding the possible corridor location.
- justification of management regimes required for land use in corridor areas and their implementation mechanism in order to optimize connectivity for biological species.

*(e) Management plan.*

The eco-corridor management plan needs to be prepared in consultation with all stakeholders and attached to the scheme. It determines the measures (e.g. scientific, organizational, political, and technical) to be implemented to improve conditions for animals and plants, and to increase the efficiency of the eco-corridor in conserving biodiversity. The management plan has to be agreed upon by landowners and land users, the territorial authorities of the Ministry of Environmental Protection, and other relevant stakeholders dealing with corridor management. In order to be effective, the Management plan has to be approved by the relevant village, Rayon, and/or Oblast council, as well as the relevant state administration where land within the eco-corridor is owned by the State.

### **3.4.4 Cartographic materials attached to the Ecological Corridor Scheme**

It is recommended that Ecological Corridor Schemes are developed using Geographic Information Systems (GIS).<sup>12</sup> Eco-corridor boundaries are determined on the basis of existing boundaries formed by landownership, land user, communities, forest districts, roads, tree belt areas, rivers, streams, and other existing natural and human-made boundaries afield. Cartographic materials to be included in the Ecological Corridor Scheme are:

- (1) Eco-corridor landscape map, scale: 1:200,000; where necessary, larger scale maps may be made for particular sections (Map 9 and 10).
- (2) Land utilization map (Map 11) indicating ownership boundaries of private and state land, as well as territories with land use restrictions (e.g. protected areas, sanitary protection areas, and special land use areas). The map should include a table showing the names of land users and owners as well as the area of their land plots in ha.

<sup>12</sup> The Methodological Recommendations recommend licensed software of ESRI – ArcGIS, version 9.2 or higher.

- (3) Eco-corridor map clearly identifying the boundaries of the eco-corridor (Map 12 and 14). The map scale should be 1:200,000 or finer and if necessary detailed maps (1:25,000, 1:10,000, 1:5,000) may be made of particular sections. A situational plan based on the Oblast map should be placed in the upper right hand corner of the map. The eco-corridor map should be developed on a topographic basis. Where possible, the following features should be indicated: forests, meadows, glades, wetlands, rivers, lakes, sands, ravines, cultural landscapes (tillage, shelter-belt areas, near-ravine tree belt areas, ponds, canals), urban territories (cities and towns, villages, cemeteries, recreation and tourist complexes, industrial and communal enterprises, agricultural and production enterprises, forest protection borders, hunting facilities), engineering structures, landfills, water intake structures, engineering networks (gas mains, water pipelines, etc), highways, and railways. If the eco-corridor is divided in sections, their names and short descriptions should be provided in the legend.
- (4) The land protection scheme (available from Land Resource Authorities), indicating land with a special status with regard to conservation, exclusion from economic and other use, re-planting, etc.



*Figure 35. An effective approach to achieve agreement on the location of ecological corridors is to draw a concept map in conjunction with land owners and land users.*

- (5) Map of plant communities included in the Green Book of Ukraine (if possible).
- (6) Map of habitats of particular animal and plants species included in the Red Book of Ukraine (if possible).
- (7) Map of areas scheduled for reforestation pursuant to the Forests of Ukraine State Program for 2002-2015 (if possible).

#### **3.4.5 Endorsement and approval of the Ecological Corridor Scheme**

The territorial authority of the MEP (or Oblast Department, or the Republic Environment Committee in Crimea) evaluates and endorses the Ecological Corridor Scheme. It sends the scheme for initial endorsement and comments to the Oblast (or Rayon), the Development and Architecture Authority and to the Land Resource Authority. The involvement of these agencies is important as under the Law of Ukraine “On the Ecologic Network of Ukraine”, Ecological Network Schemes form the basis for the development of all types of planning documentation concerning land development, urban development, economic development, and other development related to spatial planning. These authorities provide comments on the Ecological Corridor Scheme and recommendations for endorsement depending on local conditions. In most cases an Ecological Corridor Scheme needs the endorsement of land users/landowners. Gaining endorsement is less complicated than the purchase of land for the creation of new protected areas, because according to the current legislation the establishment of ecological corridors does not change land ownership or land categories. Any changes in land use, however, can be made simply with prior agreement by the landowners/land users.

If specifically requested by a relevant council or state administration, the Ecological Corridor Scheme may also have to be endorsed by the Cultural Heritage Protection Authority, the Forest and Hunting Department, the Water Industry Department and/or other authorities and institutions.

The Ecological Corridor Scheme is subsequently passed on to the territorial authority of the MEP for consideration and approval, and then on to

the relevant council (either Oblast, city, village, town, or Rayon council), now for consideration and approval at council level.

Pursuant art. 9 and 11 of the Law of Ukraine “On the ecologic network of Ukraine”, local executive authorities and local governments ensure the implementation of the ecological corridor formation scheme within their jurisdiction.

#### 3.4.6 Recommended phases and steps of Ecological Corridor Scheme development

In the Terms of References of the development of an Ecological Corridor Scheme the following points are determined:

- objective;
- relevance;
- main technical requirements, such as the requirements regarding structure and contents of the text of the scheme as well as the composition and contents of maps, and the list of required endorsements;
- plan of action (in steps);

- procedure of acceptance of the Ecological Corridor Scheme and implementation of proposed measures and arrangements.

The development of the Ecological Corridor Scheme involves the following phases and steps (Table 2):

#### First phase - planning of activities and preparation

During the first phase the Terms of Reference are prepared, the substantiation of the establishment of the Ecological Corridor Scheme according to the Methodological Recommendations (see section 3.4.3) is drafted and materials for field studies are acquired. The following baseline information is collected to support a preliminary analysis:

- topographic maps and other cartographic materials on geology, geomorphology, landscape, soil, vegetation, environmental conditions, biodiversity, protected areas, land with a natural- health- recreational or historical-cultural designation;
- documentation and relevant scientific publi-



Figure 36. Bison settling land use and social issues at their level.





Figure 37. Mountain meadows have a very high floristic diversity, including orchids such as the Western marsh orchid (*Dactylorhiza majalis*).

cations on issues such as spatial planning and urban development, programmes on social-economic development and environmental programmes, land use plans, relevant feasibility studies, forestry plans, project plans on environment, conservation of cultural heritage, fisheries planning, rehabilitation of aquatic organisms, protected area establishment plans, wildlife distribution and conservation plans;

- information on policy and legal issues such as decisions by authorities on the establishment of protected areas, the reservation of land areas for protection, land ownership changes, cadastral survey, obligations and restrictions with regard to protection of natural resources and land use.

It is recommended to introduce the ecological corridor initiative to the stakeholders, such as the coordination council, local governments, state administrations, landowners, land users, other local stakeholders, experts and scientists, through media and other means of communication.

### Second phase - identification of ecological corridor boundaries

The second phase is explained in detail in Chapter 4. The actions taken during this phase will result in a draft corridor map:

- identification of umbrella species by an expert panel;
- establishment of ecological profiles of the umbrella species by the expert panel;
- obtaining a land cover classification and land cover map;
- habitat suitability modelling to produce habitat suitability maps for the umbrella species;
- corridor modelling based on the umbrella species;
- field verification of the results through surveys involving settlements, infrastructure, habitat suitability and information on current and past wildlife distribution;
- establishing draft ecological corridors in a meeting with experts, and drafting a corridor options map.

This methodology is recommended, if a large area between the core areas is to be covered, and if complex land characteristics are involved. However, if the distance to be bridged is small and without obstacles, corridor boundaries may be identified just by consultation.

### Third phase - stakeholder consultation and analysis

The third phase is elaborated in detail in Chapter 5. During this phase the precise boundaries are drawn, and the options for corridor management are negotiated with the stakeholders. Creating a corridor map ready to be endorsed is achieved by:

- conducting a land use and ownership survey to identify owners, users and their position with regard to ecological corridor development;
- collecting other information for the GIS database and maps;
- determining ecological corridor boundaries according to existing administrative and ownership boundaries, and subdividing eco-corridors into eco-corridor elements;

Table 2. Plan of action to realise eco-corridor development

	Steps	Approach	Product
Planning	(1) Justification and substantiation of eco-corridor establishment	collection of general information on biodiversity, conservation setting, land tenure, plans and strategies	terms of reference, including substantiation according to methodological recommendations <sup>13</sup>
	(2) Determination of, and agreement on approach	desktop and expert consultation	action plan
	(3) Informing key stakeholders	media and communication tools	leaflet or other communication instruments
Identification of eco-corridor boundaries	(4) Identification of umbrella species	expert panel	species list
	(5) Establishment of ecological profiles	expert panel	ecological profiles of umbrella species
	(6) Land cover classification and land cover map	existing or acquired	classification and map
	(7) Habitat suitability modelling for umbrella species	GIS modelling using ArcGIS	habitat suitability maps
	(8) Eco-corridor modelling for umbrella species	GIS modelling using Corridor designer	draft eco-corridor option maps for umbrella species
	(9) Field verification	field survey	updated species maps
	(10) Establishing draft eco-corridors in expert meeting	expert meeting	updated draft eco-corridor options map
Identification of eco-corridor boundaries	(11) Land use and ownership survey	field survey and consultations with local administration, land owners and land users	GIS database update, assessment of stakeholder's attitude towards eco-corridor
	(12) Collection of other information for GIS database and mapping	topographic maps, land use, land ownership, administrative boundaries	GIS database update
	(13) Eco-corridor mapping	tracing eco-corridors according to existing administrative and ownership boundaries	subdivision of eco-corridors into corridor units
	(14) Area analysis	connectivity analysis on separate eco-corridor units	area analysis report, including management recommendations

<sup>13</sup> Methodological Recommendations refer to the guidelines for the implementation of the Law on Econet (2000), but during this step any other formal requirement which may be demanded in the future has to be taken into account.

	Steps	Approach	Product
<b>Identification of eco-corridor boundaries</b>	(15) Stakeholder consultation	consultations to investigate connectivity issues	update area analysis report
	(16) Establishment of eco-corridor	stakeholder meeting	corridor map, management recommendations and follow-up agreed by land users and land owners
	(17) Preparation of corridor map for endorsement	expert team	corridor map to be endorsed
<b>Endorsement of eco-corridor (one Rayon involved per corridor)</b>	(18) Endorsement by village council	meetings of village council(s)	endorsement
	(19) Endorsement by Rayon level agencies: Development and Architecture Unit, - Cultural Heritage Protection Unit, Land Resource Department	letter(s) and meeting(s)	endorsement
	(20) Elaboration of corridor description	corridor characteristics description according to methodological recommendations	corridor information card
	(21) Preparation of maps for endorsement	expert team desk work according to methodological recommendations	landscape map, land use plan, corridor map
	(22) Elaboration and endorsement of management plan	expert team and meetings with land managers (owners, users)	management plan
	(23) Endorsement of Ecological Corridor Scheme and management plan by Oblast MEP Department	submission	endorsed eco-corridor
	(24) Approval of final eco-corridor by Rayon Council	Rayon Council meeting	final approval
	<b>Extra endorsement (if more Rayons per corridor)</b>	(25) Endorsements by Oblast departments: development and architecture, cultural heritage protection, land resources, forest and hunting, and Water Industry	letter of request from MEP to departments, meetings
(26) Preparation and issuing the Oblast State Administrative Decree/Decision of Oblast Council meeting on establishment of eco-corridor		letter of request to Oblast Council, Council meeting	decree/decision on establishment of eco-corridor

- analyzing connectivity of eco-corridor elements;
- consulting stakeholders to investigate connectivity issues;
- reaching agreement on the final boundaries of the eco-corridor during a stakeholder meeting;
- preparing of the ecological corridor map for further endorsement by the expert team.

#### **Fourth phase - endorsement and approval of the eco-corridor**

A description of the process of formal approval of the eco-corridor is given in section 3.4.5. Steps to be completed are:

- endorsement by all village councils involved;
- endorsement by Rayon level agencies: Architecture and Cultural Heritage Protection Units under the Rayon State Administration, Rayon Land Resource Department;
- elaboration of the ecological corridor description according to methodological recommendations (ecological corridor information card);
- preparation of maps for endorsement (landscape map, land use plan, ecological corridor map);

- elaboration of a management plan in consultation with land owners and users;
- endorsement of the management plan by organisations/private people in charge of its implementation;
- endorsement of the eco-corridor and its management plan by the Oblast MEP Department;
- approval of the eco-corridor by the Rayon Council.

The eco-corridor is established at this stage if it is located within the boundaries of a single Rayon. If the eco-corridor stretches across more Rayons, the following steps have to be completed as well:

- endorsement by the Oblast departments: Development and Architecture, Cultural Heritage Protection, Land Resources, Forest & Hunting Department and Department of Water Industry;
- preparation and issuing of the Administrative Decree/Decision by the Oblast Council/Oblast State Administration.

## 4. Identification of ecological corridor areas

I. Kruhlov, A.-T. Bashta, V. Korzhyk, M. Shkitak, L. Davids, K. Perzanowski, F. Deodatus

### 4.1. Collection and preparation of information for modelling

#### 4.1.1 Selecting umbrella species and establishing ecological profiles

Landscape ecological modelling of eco-corridor options involves the identification of the best habitat patches for specific species to form a continuous course from one core area (e.g. protected area) to another. Since the main function of eco-corridors is to facilitate movement, aspects such as accessibility and security are of principal importance. Food and water availability may play a role in eco-corridors where animals have to move significant distances along the corridor before reaching a next core area. The criteria for the selection of these patches are determined by mapping the requirements of a number of so called "umbrella species". The first step is therefore to determine which animals are to be used as "umbrella species" in the modelling exercise in order to establish the habitat criteria for corridor patches. This decision should be made by a panel of experts, based on expertise as well as a literature review. The same panel may also establish the eco-

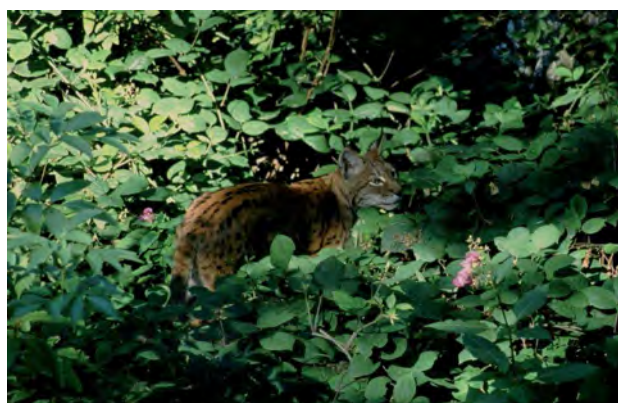


Figure 38. *Lynx* avoid open habitats and *Roe Deer* are among their favourite prey.



Figure 39. An expert panel of wildlife managers and ecologists determines umbrella species and ecological profiles.

logical profiles, according to the format presented in Appendix 7. The ecological profiles basically embrace landscape features determining the suitability as permanent habitat or for migration. It should also be noted that the characteristics in the ecological profiles are to a great extent determined by the availability of geo-spatial data - i.e., the development of the profiles should be done in close cooperation with GIS experts and landscape ecologists. To include as much expertise as possible and to reduce variation, profiles need to be reviewed by external experts (e.g. IUCN Species Specialist Group).

For the corridor pilot project the panel<sup>14</sup> selected the following species: European Brown Bear, European Bison, Lynx and Wildcat. The main arguments for the selection of these species were that they are the most fastidious in terms of food requirements and susceptibility to disturbance among the larger terrestrial mammals. Subsequently descriptive profiles (Appendix 7) were elaborated based on desk research (Bashta 2004; Bashta & Potish 2005, 2007; Klar et al. 2008; Maanen et al. 2006; Slobodian 1988, 1993) and reviewed by other experts<sup>15</sup>.

<sup>14</sup> A.-T. Bashta, Institute of Ecology of the Carpathians, I. Kruhlov, Lviv University, L. Davids, A & W, L. Protsenko, InterEcoCentre, V. Korzhyk, Vyzhnytsky NP, F. Deodatus, A & W, P. Hoetsky, Lviv Forestry University, S. Catanoiu, Vanatori NP Romania.

<sup>15</sup> reviewed by K. Perzanowski, G. Predoiu.

#### 4.1.2 Preparation of geo-data

Since the initial development of the ecological profiles for the umbrella species is done in close cooperation with GIS/landscape ecology experts, they already contain a structured list of the landscape features (geo-datasets) to be used for suitability assessment and subsequent delineation of the eco-corridors (see Appendix 7). Essentially, two primary categories of raster geo-datasets are used for the modelling: land cover and topography. They are supplemented by vector geo-data on human settlements, as well as by data on water and road networks (Table 3), being potential migration barriers, and data on proximity to human settlements. At this stage, administrative and landownership boundaries are not taken into consideration, since they do not directly define the ecological properties of the

landscape. All geo-datasets are projected onto the UTM grid, zone 34 with WGS84 datum.

#### Land cover data

Land cover information is crucial for the delineation of eco-corridors since it represents the most substantial characteristics of the habitat - availability or absence of vegetation, its type and spatial pattern. For most of Europe these geo-spatial data are provided by the CORINE Land Cover Project. This project of the European Environment Agency is aimed at gathering coherent information on land cover for the European Union and integrating this information in a geographical information system (GIS), providing comparable digital maps on land cover for EC countries such as Slovakia, Romania and Poland. The methodology is a computer-assisted visual inter-



Figure 40. Snow cover seems to be a limiting factor for Wildcat distribution.



Figure 41. Fat Dormouse (*Glis glis*) is one of the species that would benefit from some of the habitat conditions associated with the umbrella species Lynx and Wildcat.

Table 3. Initial geo-datasets used for modelling of eco-corridors

	Name	Source data	Geometric accuracy/scale	Format
1	Land cover for UA Carpathians (Hostert et al. 2008)	Landsat TM/ETM+	1:100,000	Raster 30m
2	Land cover for PL-SK-UA border region (Kuemmerle et al. 2006)	Landsat ETM+	1:100,000	Raster 30m
3	Land cover for RO - CORINE (Büttner 2002)	CORINE land cover classes 2000	1:100,000	Polygons
4	Global digital elevation model (Jarvis et al. 2006)	SRTM	1:75,000 Raster	(3 arc-second)
5	Hydrography for UA	Topographic map 1:200,000	1:200,000	Polygons
6	Hydrography for neighbouring countries	ESRI base map data Europe	1:500,000	Polygons
7	Road network for UA	Topographic map 1:200,000	1:200,000	Lines
8	Road network for neighbouring countries	ESRI base map data Europe	1:500,000	Lines
9	Settlements for UA	Topographic map 1:200,000	1:200,000	Polygons
10	Railway network for UA	Topographic map 1:200,000	1:200,000	Lines



Figure 42. Settlements usually have a quite open character.

pretation of earth observation satellite images, with simultaneous consultation of additional data, into the 44 categories of the CORINE Land Cover Classification. The scale of the database is 1:100,000. Data can be downloaded free (<http://www.eea.europa.eu/themes/landuse/clc-download>). However, CORINE is not available for Ukraine, except for a narrow zone along the borders with the EU. Therefore, a CORINE-compatible dataset was prepared for the

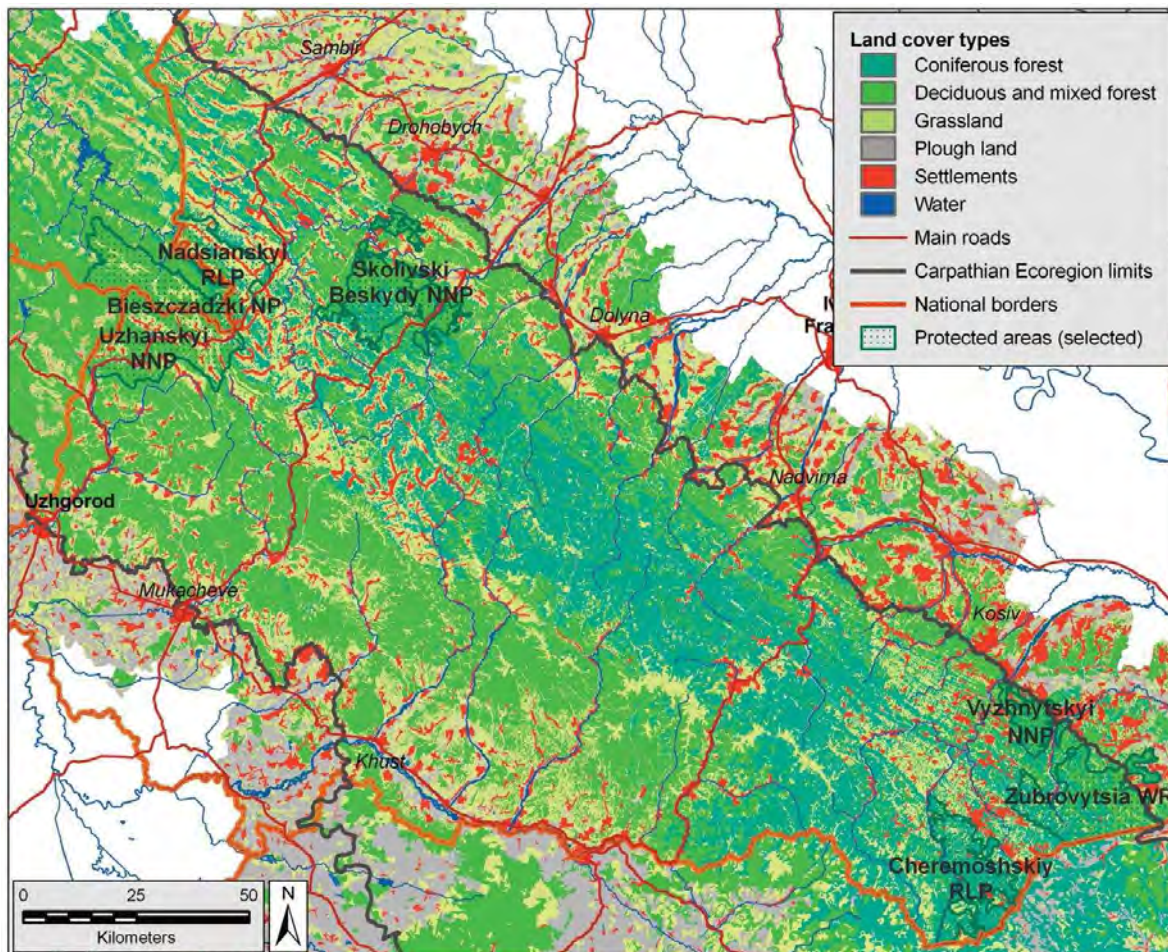
Ukrainian Carpathians by an international team headed by the Humboldt University of Berlin, using automated classification of multispectral and multitemporal Landsat images (Kuemmerle *et al.* 2006; Hostert *et al.* 2008; Table 4). These activities were partly supported by the grant from the BBI MATRA project No 2005/026.

The land cover dataset for the UA Carpathians (Hostert *et al.* 2008) was reclassified to decrease

Table 4. Land Cover Classification of the Ukrainian Carpathians according to Hostert *et al.* (2008)

Class	Description
Coniferous forest	Forest with more than 70% coniferous trees
Mixed forest	Forest with less than 70% coniferous and less than 70% broad-leaved trees
Broadleaved forest	Forest with more than 70% broad-leaved trees
Cropland	Agricultural land used for cultivating crops
Grassland	Managed (cut or intensively grazed) grasslands and mountain meadows
Succession areas	Successional shrubland, abandoned grassland and agricultural land, and clear cut regeneration areas
Dense settlements	Dense built-up / urban structures
Open settlements	Sparse settlements with gardens, dirt roads, small orchards, etc.
Water bodies	Large water bodies (rivers, lakes, etc.)
Bare rock	Rock outcrops above 1400m





Map 4. Land cover types of the Ukrainian Carpathians.

mistakes in the image classification and post-processing.

- The land cover classes "deciduous forest" and "mixed forest" were merged into a single class.
- The classes "managed grassland", "unmanaged grassland and succession areas", and "bare rock" were also merged.
- In the same way, the classes "dense settlements" and "open settlements" were united.
- The distribution of built-up areas (settlements) was limited to the polygons of settlements from the topographic map 1:200,000. The areas beyond the polygon limits which were originally classified as "settlement", were labelled as "plough land".
- The SRTM digital elevation data (Jarvis et al. 2006) and the derived slope data were used to delineate the plough land class more reli-

bly. The cells that were originally labelled as "plough land", but were located at elevations above 600 m or on slopes over 5 degrees were reclassified as "grassland".

The land cover datasets for the SK-PL-UA border region (Kuemmerle et al. 2006) and the Romanian CORINE data were re-classified accordingly, but omitting corrections to the distribution of settlements and plough land. The three datasets were merged into one raster. In the next step, this raster dataset was supplemented with the linear land cover features such as roads and watercourses, as well as with the precise regions of built-up areas, all derived from supplementary vector datasets (see Table 3). To achieve this, attributes of the international ESRI datasets on hydrography and roads were harmonised with the respective Ukrainian datasets, then merged and rasterized. Ukrainian datasets on railroads and boundaries of built-up areas were also

rasterized. Then, the rasterized linear and polygon features were superimposed on the raster land cover data. As a result, an integrated land cover raster layer with a 50x50m resolution was obtained (Map 4). It contains ten land cover classes:

- Coniferous forest.
- Deciduous and mixed forest.
- Grassland incl. shrub land.
- Plough land.
- Railways.
- Secondary roads.
- Main roads.
- Highways.
- Settlements.
- Water.

The land cover dataset also allowed computation of the forest/grassland patches ratio in a 250 m radius, which is important for species that favour a forest/open area ecotone.

#### Topographic data

Topography is another important habitat factor, especially in areas with pronounced relief, like the Carpathian Mountains. The Global digital elevation model based on Shuttle Radar Topography Mission (SRTM) data (Jarvis *et al.* 2006) was used to derive information on altitudinal bioclimatic zones, which give insight in the suitability of the local climate for the umbrella species. These data were also used to calculate slope as well as relative elevation within a 250 m radius. These parameters represent roughness of the terrain which, on the one hand, impedes the movement of some species, but, on the other hand, makes the area less accessible to humans. This was considered in the calculation of the remoteness, using a cost-distance approach. Slope data derived from the SRTM DEM were used as a cost surface. The slope values in degrees were divided by a factor 5 ( $\text{slope}/5 + 1$ ), and thus represented resistance of the terrain to human movement, i.e., flat terrain has a cost factor of 1, while a 30 degree slope has a cost factor of  $30/5 + 1 = 7$ . Remoteness from settlements and roads was calculated as  $\text{cost} \times \text{distance}$  units (meters\*slope factor). Finally, all values were reclassified (standardised) from 1 to 100.

#### Final geo-datasets used for corridor modelling

As a result of preliminary processing, five geo-datasets emerged to help assess the suitability of the habitat (landscape) to be designated ecological corridor, based on the ecological profiles of the four umbrella species:

- (1) Land cover (10 types).
- (2) Forest/open area ratio within a 250 m radius (%).
- (3) Altitude (m above sea level).
- (4) Relative elevation (terrain roughness) within a 250 m radius (m).
- (5) Human proximity (standardised values from 1 to 100).

These datasets are assumed to represent the most important ecological features of the landscape to be considered in the geo-spatial modelling of ecological corridors for the four umbrella species.

## 4.2. Ecological corridor modelling

### 4.2.1 Suitability assessment of separate habitat features

In order to proceed with the corridor modelling, it is important to establish the suitability value of each of the four ecological landscape features represented by the respective datasets (except the human



*Figure 43. Water levels in rivers in the Ukrainian Carpathians fluctuate in relation to seasonal rainfall. When water levels are high they may obstruct the movement of wildlife, but most rivers allow passage during at least part of the year.*

Table 5. Land cover suitability for the umbrella species (scores 1-100, 0 being a restrictive value)

Cell Value	Land cover type	Values for			
		Bison	Bear	Lynx	Wildcat
1	Coniferous forest	70	100	100	50
2	Deciduous and mixed forest	100	100	100	100
3	Grassland incl. shrub land	50	20	10	20
4	Plough land	0	0	0	0
5	Railways	0	0	0	0
6	Secondary roads	0	0	0	0
7	Main roads	0	0	0	0
8	Highways	0	0	0	0
9	Settlements	0	0	0	0
10	Water	0	0	0	0

Table 6. Suitability of different forest-open area ratios for umbrella species (scores 1-100, 0 being a restrictive value)

Forest/grassland ratio (%)	Values for			
	Bison	Bear	Lynx	Wildcat
100/0	75	100	100	75
75/25	100	75	50	100
50/50	75	50	10	75
25/75	50	25	0	25
0/100	10	0	0	0

Table 7. Suitability of altitudinal bioclimatic zones for umbrella species (scores 1-100, 0 being a restrictive value)

	Altitudinal bioclimatic zone	Elevation (m a.s.l.)	Values for			
			Bison	Bear	Lynx	Wildcat
1	Warm oak forests	0-350	100	50	50	100
2	Moderately warm beech forests	350-700	100	80	80	100
3	Moderately cool beech-spruce forests	700-1100	50	100	100	50
4	Cool spruce-beech forests	1100-1300	30	100	100	30
5	Very cool spruce forests	1300-1500	10	80	80	10
6	Moderately cold sub-Alpine	1500-1800	0	30	30	0
7	Cold Alpine	Above 1800	0	10	10	0

Table 8. Suitability of terrain roughness for the umbrella species (scores 1-100, 0 being a restrictive value)

Relative elevation within a 250 m radius (m)	Values for			
	Bison	Bear	Lynx	Wildcat
0-50 (25)	100	50	50	100
50-100 (75)	50	100	100	80
100-200 (150)	30	100	100	50
Over 200 (300)	10	100	100	30

proximity data - see previous paragraph) for the four umbrella species. For this purpose, animal experts were asked to evaluate the suitability of the landscape features for the species using standard scores from 0 to 100. Zero is considered as a restrictive value, i.e., even if only one ecological landscape feature scores "0", the whole habitat is classified as unsuitable. The results of these evaluations are presented in Table 5 to Table 8.

#### 4.2.2 Landscape ecological modelling of integral habitat suitability

To calculate the integral habitat suitability for each umbrella species, the five geo-datasets representing the respective suitability of the four separate habitat features (land cover types, forest/open area ratio, altitudinal belts, and terrain roughness) plus human proximity, were combined in a GIS environment using a weighted additive overlay procedure (e.g. Anon 2002). The procedure was run four times - once for each umbrella species. It was decided to use the same weight factor of 1.0 for each landscape feature and for all four species, but make an exception in the case of human proximity. Lynx was assumed to be the "shyest" species out of the four, and a weight factor of "3.0" was assigned implying relatively high sensitivity of the animal to human presence. At the same time, the Bison population in the Carpathians was considered to be most accustomed to humans, and therefore the human proximity

factor for this species was weighted as "1.0". For the other two species (Brown Bear and Wildcat) the intermediate human proximity weighting of "2.0" was applied (Table 9).

The results of the overlay calculations quantitatively representing the integral habitat suitability for each of the four species were standardised to a 1-100 value span (Map 5).

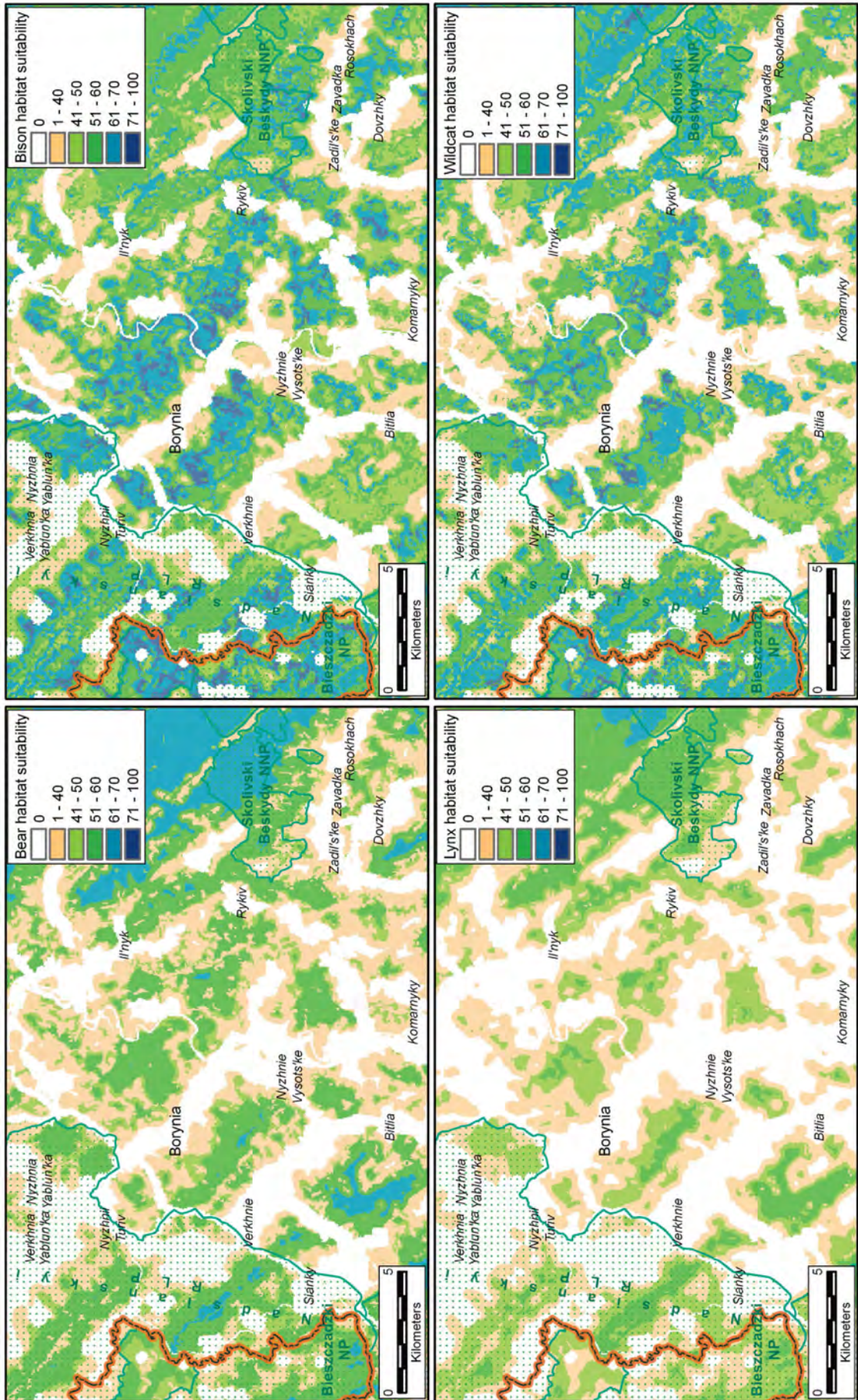
#### 4.2.3 Delineation of ecological corridors

This procedure was supported by special software called "Corridor Designer", which is a plug-in to the commercially available GIS software ArcGIS 9.x (Majka et al. 2007). Individual corridors were delineated for each of the four umbrella species. Firstly, to define areas suitable to become ecological corridors, it was important to establish thresholds for minimal habitat quality required for each of the umbrella species. These thresholds were set by a wildlife specialist<sup>16</sup> during the preliminary evaluation of the integral habitat suitability results (Table 10). For example, areas with a habitat suitability score of 50 or more were considered suitable habitats for Bison and only these areas were considered to be potential corridor parts for becoming breeding and population patches. Population patches are defined as areas large enough to support a breeding population for about 10 years, while a breeding patch should be large enough to support a single successful breeding event (Beier et al. 2007).

Table 9. Habitat modelling weightings (additive overlay)

	Bison	Bear	Lynx	Wildcat
1 Land cover	1	1	1	1
2 Neighbourhood setting	1	1	1	1
3 Altitude	1	1	1	1
4 Terrain roughness	1	1	1	1
5 Human proximity	1	2	3	2

<sup>16</sup> A.-T. Bashta



Map 5. Habitat suitability for Brown Bear, European Bison, Lynx and Wildcat in the Turkivskiy eco-corridor area.

Table 10. Habitat quality thresholds for delineation of breeding and population patches (conditional units 1-100)

	Bison	Bear	Lynx	Wildcat
Habitat quality (%)	50	55	55	55

Secondly, to delineate breeding and population patches for the umbrella species, the wildlife experts established requirements for their minimal size (Table 11). The areas constituting these patches were assumed to be allowed to contain small gaps, but the width of such a gap should not exceed the visibility range of the respective species. Therefore, to delineate habitat patches for the larger animals (Bison and Bear), a neighbourhood analysis was made with a radius of 250 m, while for the smaller animals (Lynx and Wildcat) the same analysis was applied with a 100 m radius.

Table 11. Minimal breeding and population patch size settings (ha)

	Bison	Bear	Lynx	Wildcat
1 Breeding	1,500	2,000	1,200	600
2 Population	8,000	10,000	6,000	3,000

Finally, the procedure of corridor delineation for each species took place. The software used the geo-dataset of integral habitat suitability as a cost surface (the lower the integral habitat score, the higher is the cost, or impedance, of the terrain for animal migration). The same geo-dataset, in combination with the parameters on habitat quality, neighbourhood setting, and minimal areas for habitat patches, was used to define population and breeding patches. These patches are considered as core areas and stepping stones, respectively, in the corridor/ecological network design. The software divided the corridor limits in so-called "slices", e.g. a 0.1% corridor slice represented the most permeable 0.1% of the terrain area between "wildland blocks", or core areas (Beier et al. 2007). In our case, the wildland blocks were represented by the national parks.



Figure 44. Bridges may become obstacles for wildlife, but conversely, they can be adapted to facilitate the passage of wildlife under roads.

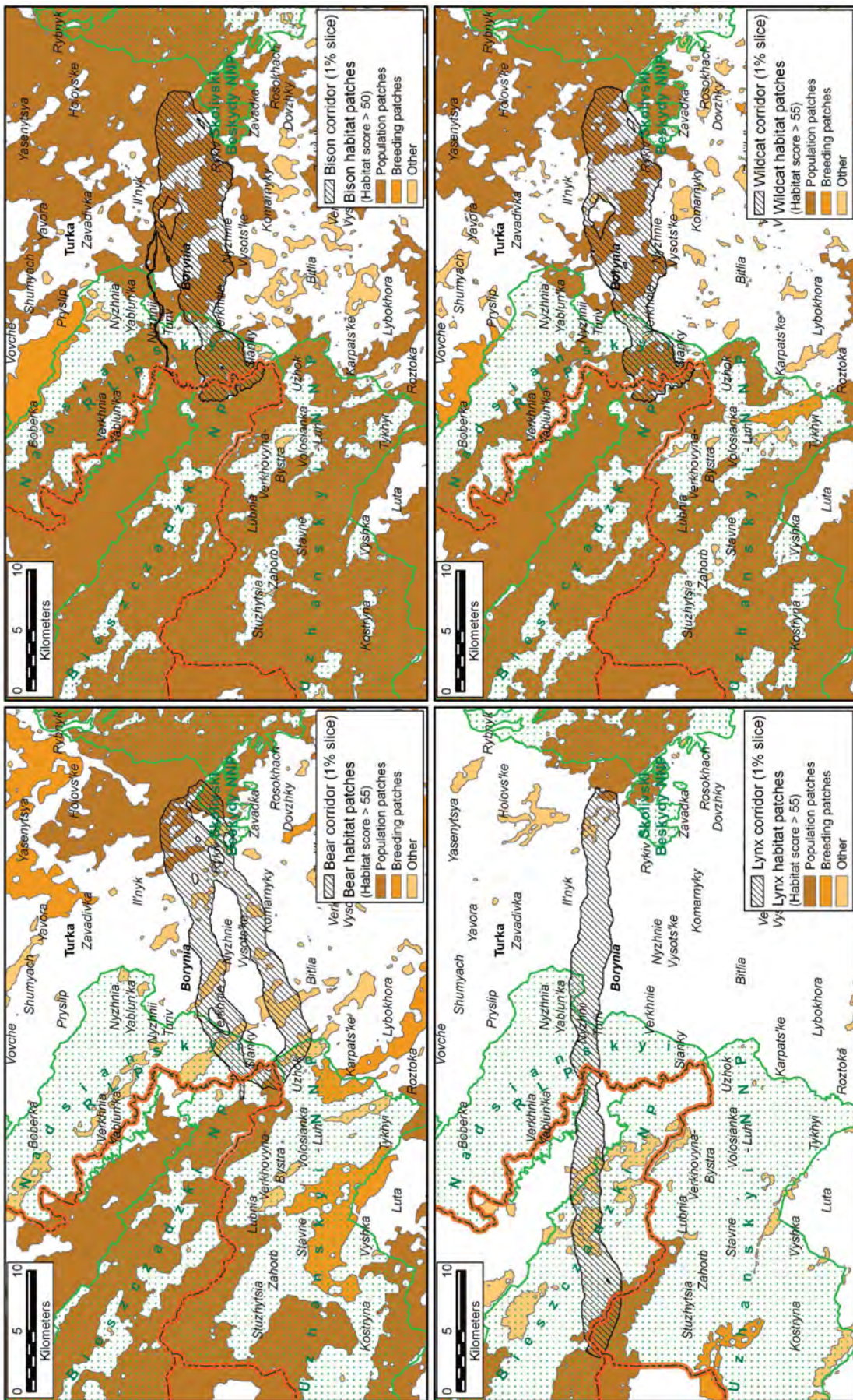
A 1.0% corridor slice was chosen for each species as a basis for the manual delineation of the robust (united) ecological corridor, which should be suitable for migration for all four species (Map 6).

### 4.3. Field verification and elaboration of corridor options

During the next step, the shapes of the integral (robust) ecological corridors suitable for all four umbrella species, were drafted manually (Map 7). The procedure considered the software modelling results as well as the field observations by wildlife experts, and resulted in a map showing all possible ecological corridor options (corridor options map, see Map 8). Based on this map surveys were planned and carried out with the following objectives:

- verification in the field of the mapped habitat suitability for the different species;
- assessment of connectivity issues (geomorphology, settlements, infrastructure, land use);
- assessment of the current and past situation with regard to wildlife (distribution, movements, conflicts).

It was deemed most appropriate to distribute questionnaires among the staff of protected areas and



Map 6. Corridor models for Brown Bear, European Bison, Lynx and Wildcat in the Turkivskiy eco-corridor area (output of Corridor Designer software).

hunting enterprises, hunters and other people well acquainted with the local situation, to obtain biodiversity information on the area, to be taken into account in the decision on the location of the ecological corridor. In the areas available to potentially become ecological corridor, roughly two different types of land can be distinguished:

(1) Land mainly under forest cover, interspersed with grassland and scattered secondary vegetation, mostly managed by Forest Enterprises. Generally, this land is found on footslopes, hills and mountains. The land use in these areas is reasonably compatible with the function of an ecological corridor.

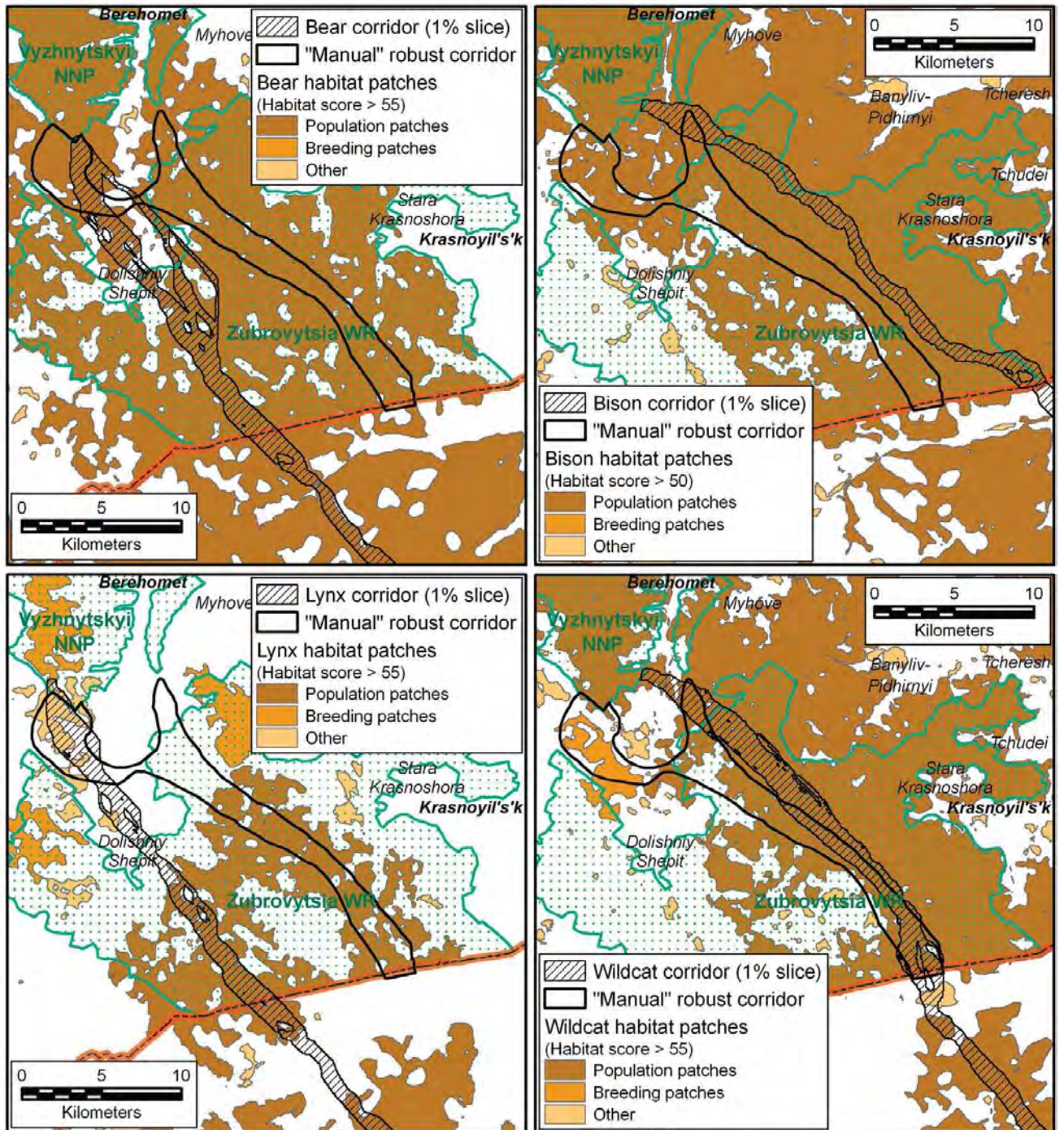
(2) Land in the river valleys close to villages. Most of this land is used for pasturing, hay making and small scale cultivation. Roads are often located in these areas. Potentially, there is a higher risk of friction between human land use and the function of ecological corridor in such areas, and therefore they are called "bottleneck areas".

During the field verification, the bottleneck areas received special attention. The land cover in these areas was briefly described, photographs were taken and, where possible, local people were interviewed regarding the land use. During the first stakeholder meeting, attended mainly by experts and

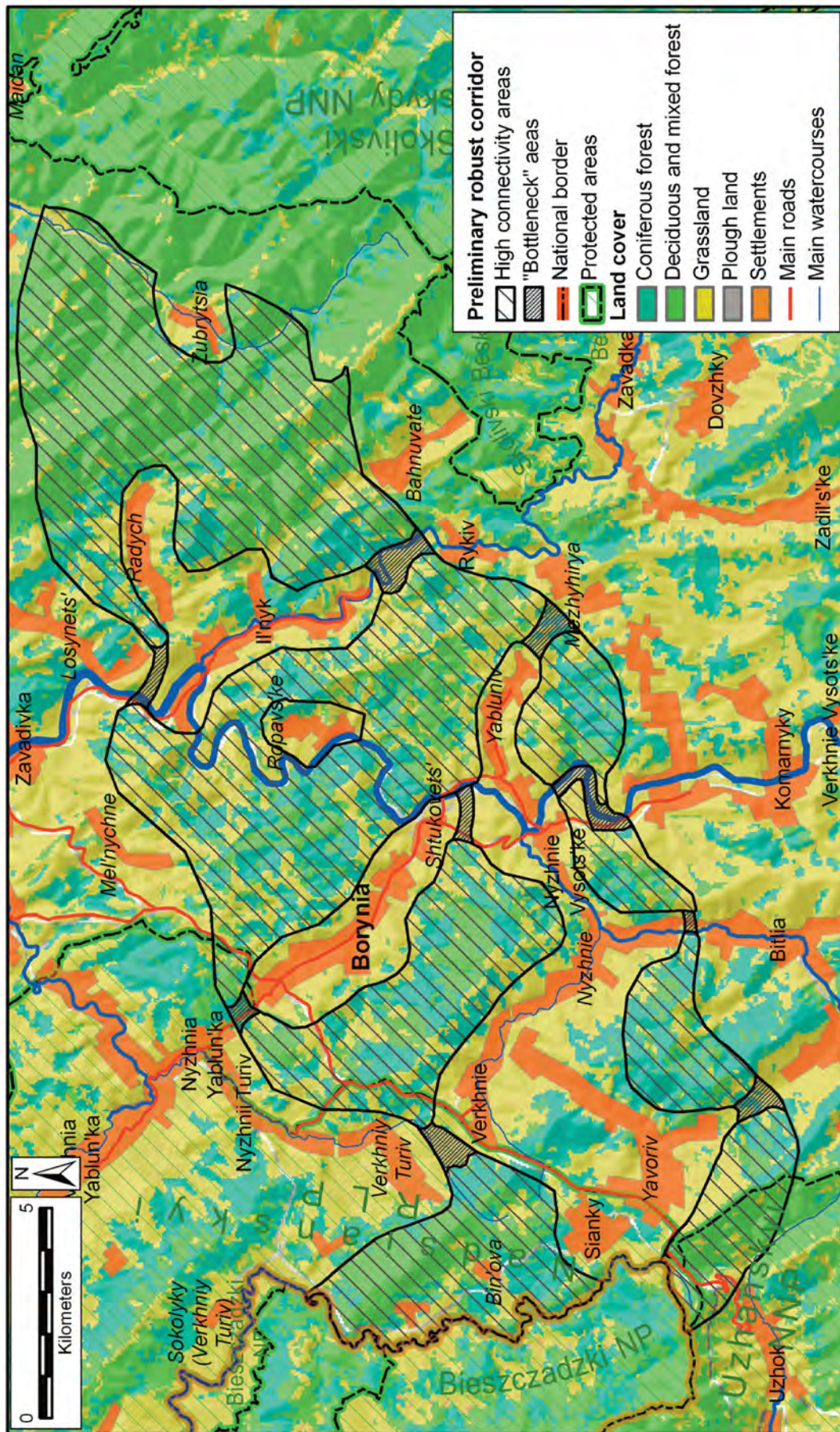


Figure 45. Medium intensity land use along bottlenecks makes the habitat less appropriate for animals such as Lynx and Wildcat, due to lack of cover.





Map 7. Corridor models for Brown Bear, European Bison, Lynx and Wildcat in the Bukovynskiy eco-corridor area (output of Corridor Designer software) and in each sub-scene the preliminary robust corridor delineated manually).



Map 8. Preliminary robust corridor options with potential "bottleneck" areas delineated manually in the Turkivskiy eco-corridor area).



*Figure 46. Good conditions for connectivity in bottleneck areas of river valleys: pristine meadows with high floral diversity, no fences and intersected by tree lines providing cover.*

local authorities, the connectivity of the different corridor areas was compared using the information thus collected. Based on this evaluation, the location with the lowest risk of friction and the best connectivity characteristics was selected for the ecological corridor. The connectivity of the bottleneck areas turned out to be crucial in the final choice of positioning of the ecological corridor. The different elements of this draft ecological corridor were subsequently investigated in a more detailed fashion, as described in section 5.4.



## 5. Communication, consultation and preparation of final maps

L. Protsenko, S. Tatush, M. Bilokon, I. Kruhlov, V. Korzhyk, M. Shkitak, P. Bakker, F. Deodatus

### 5.1. Purpose of communication

Appropriate communication with stakeholders is essential for the development and management of ecological corridors (Chettri *et al.* 2007). Communication involves informing stakeholders, collecting information from stakeholders and reaching agreement among stakeholders. During the development of ecological corridors the following issues are covered in meetings, interviews and by other means of communication:

- (1) Raising awareness among local authorities and other local stakeholders of the impor-



Figure 47. Besides using media and newspapers to reach a broad public, the awareness strategy may be to use specific journals such as "Living Ukraine" to reach essential stakeholders such as decision makers.

tance of ecological networks and connections for biodiversity and the economy.

- (2) Informing central, Oblast and Rayon level authorities, landowners and land user about the planning process for ecological corridors.
- (3) Making an inventory of land users, land owners and land boundaries through consultations with local authorities.
- (4) Collecting background information on biodiversity, its present state as well as trends in the area, through interviews.
- (5) Making an inventory of connectivity issues and conflicting interests through interviews;
- (6) Consulting with local land (rights) owners to reach consensus on the location of ecological corridors.
- (7) Consulting with local authorities to reach consensus on the location of ecological corridors.
- (8) Consulting stakeholders to reach agreement on management options for ecological corridors.
- (9) Liaising with the relevant local and regional authorities to come to formal endorsement of the ecological corridor.

### 5.2. Stakeholders and their relation to the land

A wide variety of individuals, groups and organisations has ties with the land through ownership, user rights and/or a form of authority. After the identification of possible corridor options, as explained in section 4.3, it is necessary to pay attention to all the different stakeholders and their area of interest. There are two broad categories of stakeholders:

- (1) Individuals, collectives, private companies and state agencies owning the land and/ or using its resources.

They need to be informed about the develop-

ment of the ecological corridors, as their support is crucial for the corridor's actual functioning. Therefore, these stakeholders have to be made aware of the importance of ecological networks and corridors. Agreement needs to be reached on the location of ecological corridors and on the eventual limitations involved. Corridor management options need to be elaborated with their participation.

(2) *Authorities playing a crucial role in the formal endorsement of the ecological corridor.*

In Ukraine the establishment of ecological corridors is normally initiated by the de-central agencies of the MEP (Appendix 3), but the formal approval procedure follows the political hierarchy from the lowest administrative level upwards, which means that first Local Councils (Sil'ska rada), then Rayon Council(s) and then the Oblast Council become involved. Apart from approval by the people's represen-



Figure 48. Nowadays, most land in the valleys is private or communal and the land use is generally traditional.

tatives, the ecological corridors have to be approved by the various relevant Governmental agencies at the administrative level at which the corridor is being developed (Rayon or Oblast).



Figure 49. Railroads of low frequency use do usually not intervene much with connectivity.

Protected areas in Ukraine are generally established and managed under the supervision of the State Agency for Protected Areas, which is at central government level but has affiliated staff at the Oblast MEP Departments. Management and land ownership of these areas, however, can be rather complex. Most National Nature Parks, Nature Parks and Biosphere Reserves are fully managed and funded by the MEP, but some of them as well as some protected areas in other protection categories resort under other Ministries, research institutes or even private ownership. Some protected areas such as the Skolivski Beskydy NNP are funded and managed by the State Committee of Forestry.

Most of the land located between protected areas in the Carpathians is managed by Forest Enterprises, which are State governed management bodies for forest exploitation, subordinate to the State Committee of Forestry, which is subordinate to the MEP. In these areas, wild animals are managed by hunting enterprises as part of the same ministerial structure. The State Administration of Railways Transport and the State Road Corporation, the operational agencies of the Ministry of Transport and Communication, manage the areas along roads and railroads. Other State agencies responsible for the management of some of these lands are the Ministry of Defence, research institutions and the State Committee of Water (Burdusel 2006; Salvatore 2002). Sporting Society “Dynamo” is the main body managing hunting in areas resorting under this Ministry. Some of the land with a protected status resorts under village councils, rayon councils or oblast state administrations.

Most of the land used for agriculture and settlements is located in the valleys and owned by private individuals or communes. Collective agricultural land has mainly been privatised, but there are still large uncultivated areas. Forests which were formerly part of collective farms are managed by Regional Departments of Agrolis, linked to the Ministry of Agriculture. Hunting on agricultural land is managed by hunting societies.

## 5.3. Communication approach

### 5.3.1 Media

The steps involved in the communication with the various stakeholders have been briefly summarized in Chapter 4 (Table 2) and the different means of communication which can be used to reach the different stakeholder groups are summarized in Table 12. Local media such as newspapers, radio and television are very appropriate means to create awareness amongst the general public and stakeholders of the importance of an ecological network and connecting corridors for biodiversity conservation. Specific material might also be prepared for to raise awareness or provide more targeted information. More detailed information on the plans in the area considered for corridor development may be provided in meetings with invited stakeholders. Such meetings can also be effective as media events for radio, television and the press.



*Figure 50. Good communication is essential during the process of ecological corridor establishment, and meetings are opportunities for the media to bring corridor development under the attention of a broader public.*

### 5.3.2 Interviews

As stated above, communication is an important instrument for informing stakeholders, gathering information, encouraging stakeholder involvement and reaching agreements. Information on land ownership and land use is mainly collected through local authorities such as Local Councils, heads of Village Councils and Rayon Land Resource Divisions. In order to acquire insight in issues and conflicts of interest regarding connectivity of protected areas,



*Figure 51. Farmers often own a small number of animals and arrange herding collectively within the community, delegating the responsibility of taking care of the animals to specific people, sometimes boys.*

structured interviews with land owners and land users is an adequate approach.

A structured interview is an open discussion with questions conducted along a set pattern in order to make sure that all essential issues are covered. The interviewer makes notes and writes a report after the interview, to make sure that all information is retained. A model (checklist) for this type of interview is given in Appendix 8. The objective of these interviews is to gain a clear understanding of the various obstacles, objections and other problems stakeholders identify and to investigate which measures should be taken to solve them. The interview should start with an explanation of the ecological corridor development initiative, including

the importance of ecological corridors, government policy with regard to such corridors, relevance to species such as Brown bear, Bison, Lynx and Wildcat, and current plans. The context of the interview should be made clear to the person interviewed, answering questions such as why the interview is done, who else is being interviewed, what will be done with the results, next steps to be taken, and when they will hear about the corridor project again. Since ecological corridors may imply certain limitations, it is very important to highlight possible benefits, and to jointly investigate opportunities arising from the corridor development, which may be of interest to stakeholders. Depending of the type of stakeholder (e.g. land owner, land user, resource



user group, local or public authority), information may be collected on:

- (1) The name of the interviewee, address, affiliations.
- (2) If the interviewee is either land owner or user, the area of interest or jurisdiction should be recorded as well as the size, area and location of owned or used land plots, and the location of plots.
- (3) Depending on his/her knowledge of the land, the interviewee may be able to provide information on the current use of plots (crops or other), tillage techniques, production and income realised, problems experienced with the current land use system, future plans for use of the land, existing local/regional land use policies and existing public plans that may support or be in conflict with the creation of an ecological corridor.
- (4) If the interviewee has information on wildlife in the area he/she owns or uses, it will be of interest to record abundance and frequency of species, his/her attitude towards these animals, and cases of conflict such as damage to crops and livestock as well as incidences of wildlife being killed by members of the community.
- (5) Subsequently, the interviewee should be

questioned about his/her attitude with regard to ecological corridors, including his/her perception of the government conservation policy, the establishment of ecological corridors, and the expected benefits, problems and bottlenecks due to the establishment of such corridors. It should be checked if the person knows if his/her land is indeed situated within the boundaries of the corridor and if he/she has objections to this.

- (6) Finally, the interviewee may be asked to help find solutions to possible problems related to the establishment of the ecological corridor, thus clarifying his/her expectations and conditions with regard to having land within the corridor. Where the stakeholder's land is involved various options on borders and management may be investigated. The interviewee may also have information on traditional biodiversity conservation methods applied and his/her willingness to be involved in the management of the ecological corridor may be assessed. In case the interviewee is a member of the local administration, the possibility may be discussed to integrate their eventual initiatives and plans into the corridor planning.

Table 12. The use of different means of communication in relation to goals and target groups

Purpose	Means of communication	Target group
Awareness	leaflet, radio, television, newspapers	all
Informing public	leaflet, stakeholder meeting, radio, television, newspapers	local stakeholders relating to ecological corridor
Land use and ownership inventory	interviews, meetings	local authorities
Connectivity issue inventory	structured interview	land owners and land users
Consultation and agreement on ecological corridor location	stakeholder meetings, (structured) interviews	land owners, land users, local authorities
Participatory development of corridor management	meetings with user groups	land users
Endorsement	meetings with relevant authorities	local and regional authorities

### 5.3.3 Connectivity analysis

The cartographic part of the connectivity analysis, i.e. the breakdown of the corridor area into corridor units of more or less uniform status with regard to ownership, management and land use has been described partly in section 4.2. In order to use the information gained from the interviews and consultations to evaluate the perspectives of the different corridor units and options, this information should be recorded systematically in an analytical table presenting the different characteristics of the corridor units such as name, legal status, ownership, stakeholders and their attitudes, land cover, land use, habitat suitability for umbrella species, other wildlife indications, barriers, threats, and required adaptations and measures. As an example such a matrix is

presented in Appendix 9. This matrix then forms the basis for development of the Ecological Corridor Scheme and the management plan.

## 5.4. Finalizing the ecological corridor map with the consultation results

### 5.4.1 General approach

The final maps of ecological corridors are based on:

- (1) the landscape-ecological modelling in the GIS environment (section 4.2),
- (2) the results of subsequent field verification/correction (section 4.3), and
- (3) the results of consultations with stakeholders (section 5.3.3).



Figure 52. Settlements often form zones with low connectivity interrupting higher areas which are used for pasture and forestry and having a higher connectivity.

However, in order to adopt ecological corridors at the official/legislative level and to be able to efficiently manage them in the future, it is important to properly "tailor" the ecological boundaries to administrative and landownership (cadastral) units. Therefore, the final corridor map will show ecological corridors with slightly corrected boundaries, aligned with administrative and cadastral units.



Figure 53. Low intensity farming practices on the lower slopes may result in a high floral diversity.

#### 5.4.2 Other information sources

The most useful data sources for the preparation of the final corridor maps have been:

- (1) Official land use and cadastral maps at municipality (Silska rada) level as used by the Land Resources Administration (Derzhkomzem). These originate from hand-drawn "wall type" paper maps at a scale of 1:10,000-25,000 without a coordinate grid, which have been

scanned and geo-referenced. These maps have legal status, and are used as basis for the corridor maps, for the official endorsement by the authorities.

- (2) Scanned topographic maps at a scale of 1:50,000 - 1:100,000, downloaded from the Internet<sup>17</sup>. These maps can be easily geo-referenced, since they are on a coordinate grid, but the quality of the scans is sometimes rather poor.
- (3) Official maps of state forestry enterprises with forest compartments and protected areas at a scale of 1:25,000-1:100,000. In some cases they are severely geometrically distorted and can hardly be geo-referenced. This material is mainly used as additional source of non-spatial information (e.g. to identify forestry compartments).
- (4) High-resolution images from Google Earth, which are very useful for field correction of corridor limits within "patchy" areas, such as near settlements.

In illustration the corridor maps of the Bukovynskiy and Turkivskiy eco-corridor will be briefly discussed in section 5.4.4 and 5.4.5.

#### 5.4.3 Landscape map

The Methodological Recommendation requires a so-called landscape map to be attached to the Ecological Corridor Scheme (section 3.4.4). A landscape map represents spatial differentiation of the natural landscape according to natural terrain complexes, or geo-systems/geo-ecosystems, which are integrated spatial units combining landforms with parent rock, local climate, soil, and (potential) natural vegetation (Isachenko 1991; Kruhlov et al. 2008). These units can be delineated manually using contour maps and information on parent rock, soils, vegetation, etc. Alternatively, geo-ecosystems can be delineated and classified based on GIS, using digital elevation data and their derivatives (slope, concavity) in combination with non-spatial published ecological information on relationships between

<sup>17</sup> <http://www.lib.berkeley.edu/EART/x-ussr/ukraine.html> and <http://en.poehali.org/maps>

landforms, elevation, soils, and vegetation (Kruhlov et al. 2008). In our case, 3 arc-second SRTM digital elevation data (Jarvis et al. 2006) were used to delineate landform elements, which were combined with an overlay of the altitudinal bioclimatic belts (Herenchuk 1968; Holubets & Milkina 1988; Kruhlov 2008; see also section 4.2.1, Table 7) to characterise potential natural vegetation (Map 9 and 10).

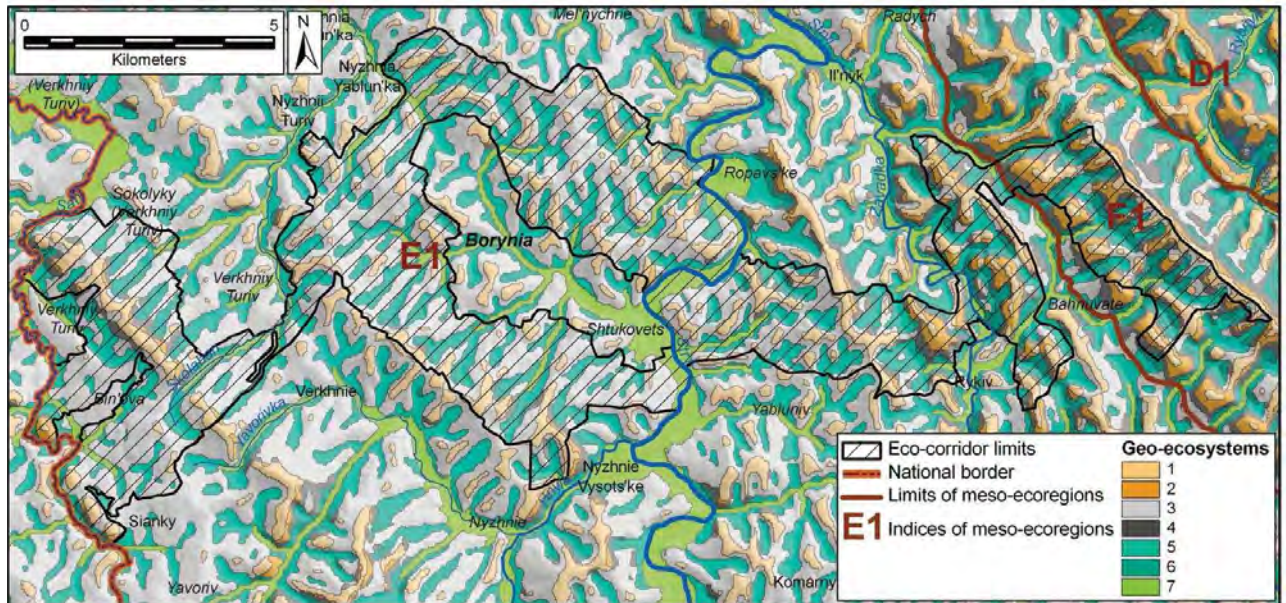
#### 5.4.4 Turkivskyi eco-corridor

The distance between Skolivski Beskydy NNP and the Polish border is approximately 28 km (Map 11 and 12). Most of the area is covered with forests managed by the State Forest Enterprises, but along the Polish border are two protected areas: the Nad-

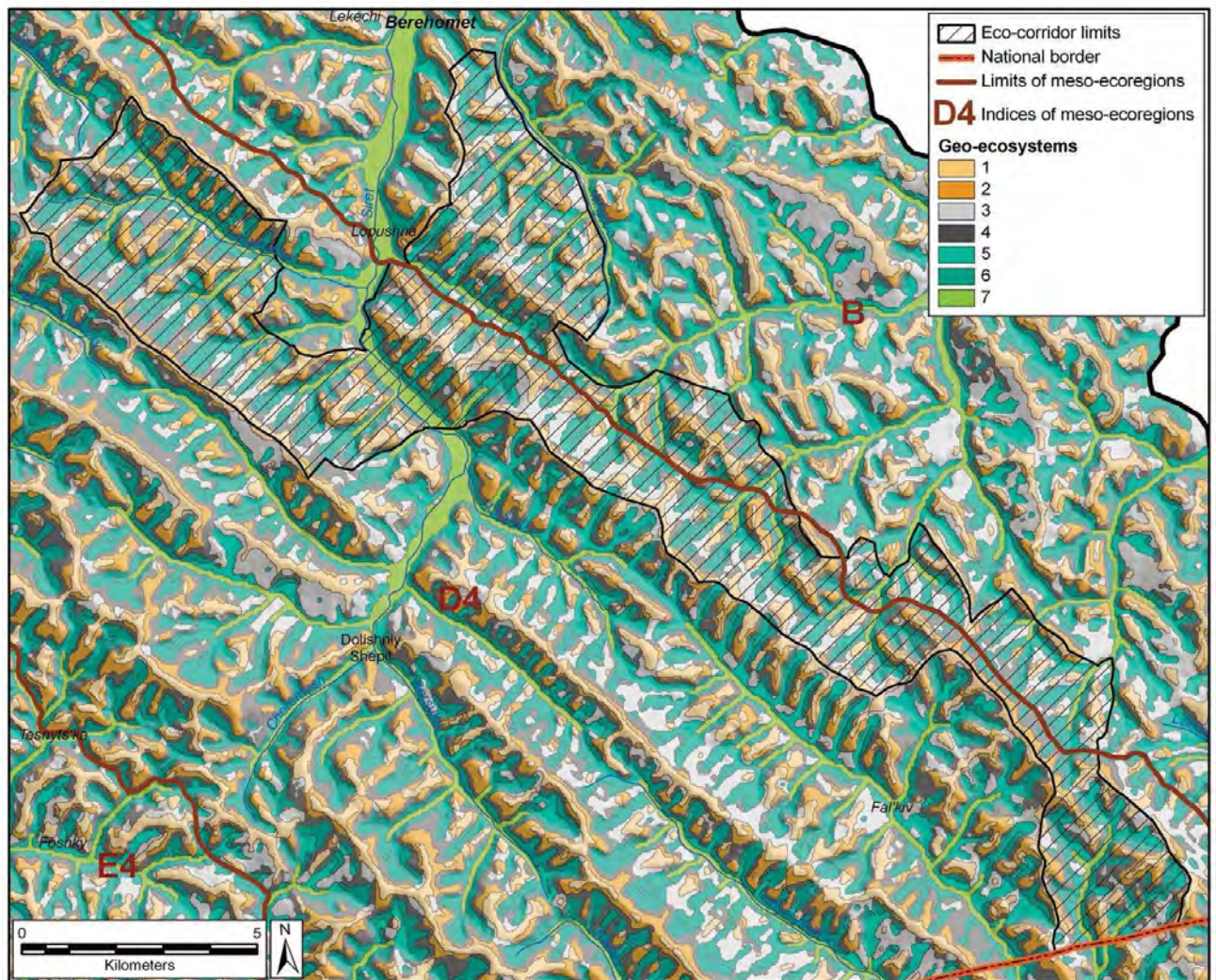
sianskyi Regional Landscape Park and the Uzhanskyi National Nature Park. The ecological corridor has been planned in a more or less east-westerly direction, following a zigzag pattern, due to the orientation of the mountain chains and valleys. Two local paved main roads cross the area, as well as the railroad from Lviv to Uzhhorod. Both the roads and the railroad are used very regularly but not intensively, though the level of utilisation may increase in the future. About twelve villages are located in the valleys around the corridor area. There are four bottleneck areas in valleys close to villages, but most of them do not appear to create serious connectivity problems. There is a bottleneck near Verkhnie where grassland is intersected by two small streams

### Legend of map 9 and 10

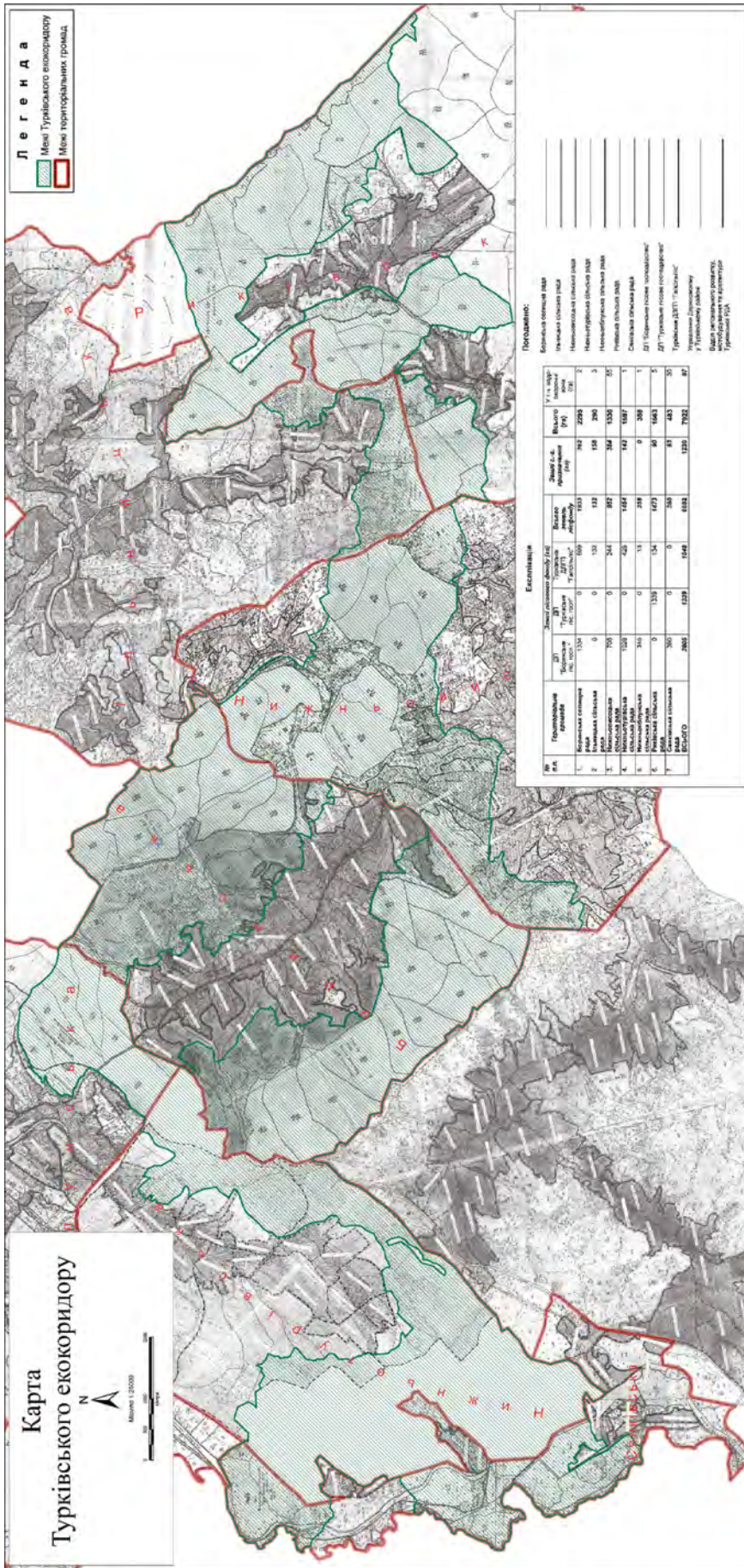
Geo-eco-systemtypes	Topographic position	Slope inclination	Soil moisture status	Soil nutrition status	Potential natural vegetation
1	Convex slope upper parts, including ridge tops and spurs	Moderate (<20°)	Xero-mesic	Mesotrophic	Fageta
2		Steep (>20°)	Xero-mesic	Mesotrophic	Fageta
3	Straight slope middle parts	Moderate (<20°)	Mesic	Eutrophic	Abieto-Fageta
4		Steep (>20°)	Xero-mesic	Mesotrophic	Fageta
5	Concave slope lower parts	Moderate (<20°)	Hydro-mesic	Eutrophic	Fageta-Abieta
6		Steep (>20°)	Mesic	Eutrophic	Abieto-Fageta
7	Valley bottoms (floodplains, terraces, v-shaped valleys)	Flat and gentle (<6°)	Hydric	Oligotrophic on floodplains and eutrophic on terraces	Saliceta et Alneta
Meso-ecoregions: B - Pokuttia-Bukovyna external mountains E1 - Sian-Stryi Verkhovyna (Kruhlov, 2008) D1 - Central Beskydy E4 - Hutsul Verkhovyna D4 - Bukovyna internal mountains F1 - Internal Beskydy					



Map 9. Ecological corridor landscape map of the Turktivskiyi eco-corridor area showing natural landscape units (geo-ecosystems).



Map 10. Ecological corridor landscape map of the Bukovynskiyi eco-corridor area showing natural landscape units (geo-ecosystems).

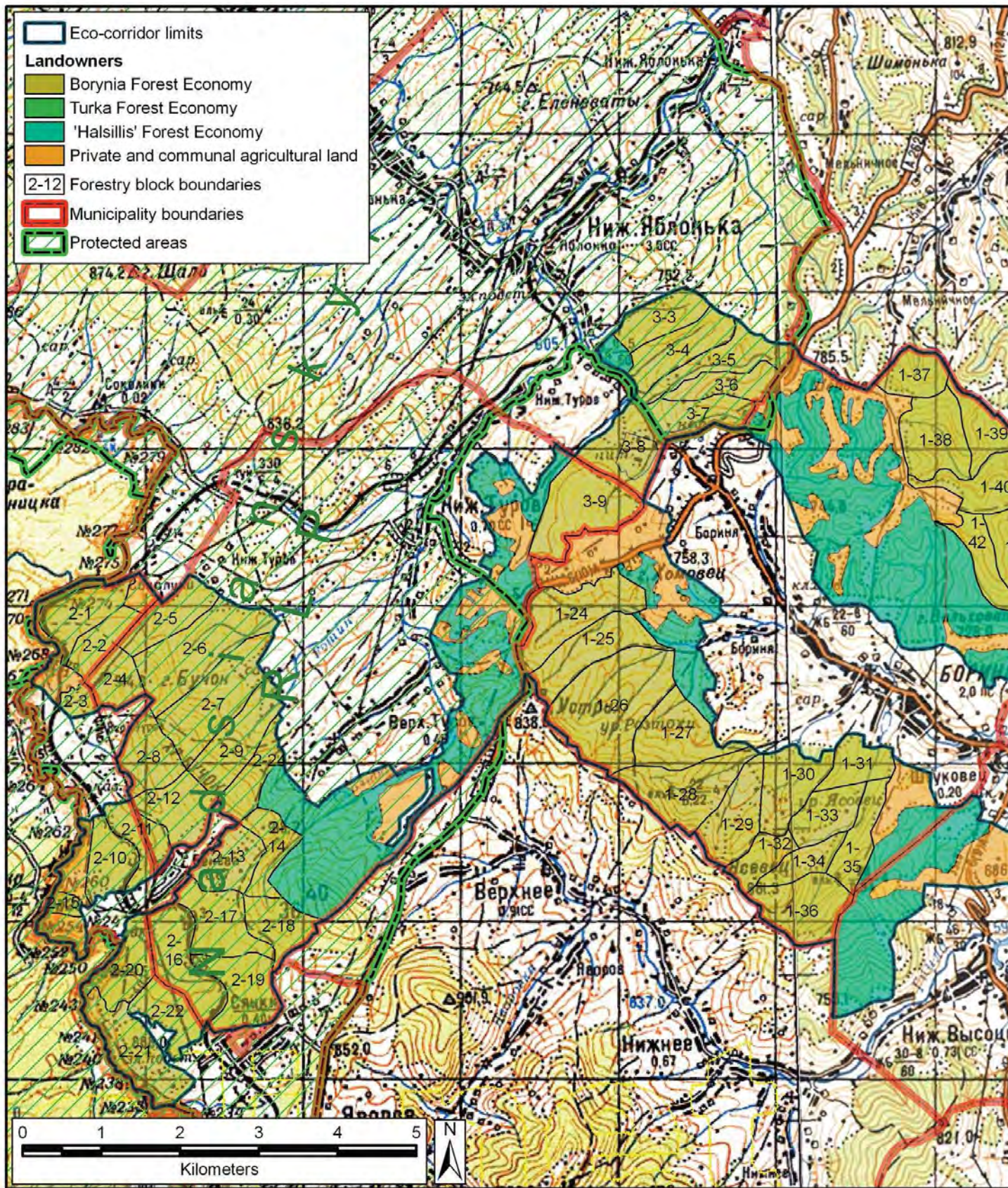


Map 11. Land utilisation scheme of the Turkivskiy eco-corridor according to specifications by the Land Resources Department.



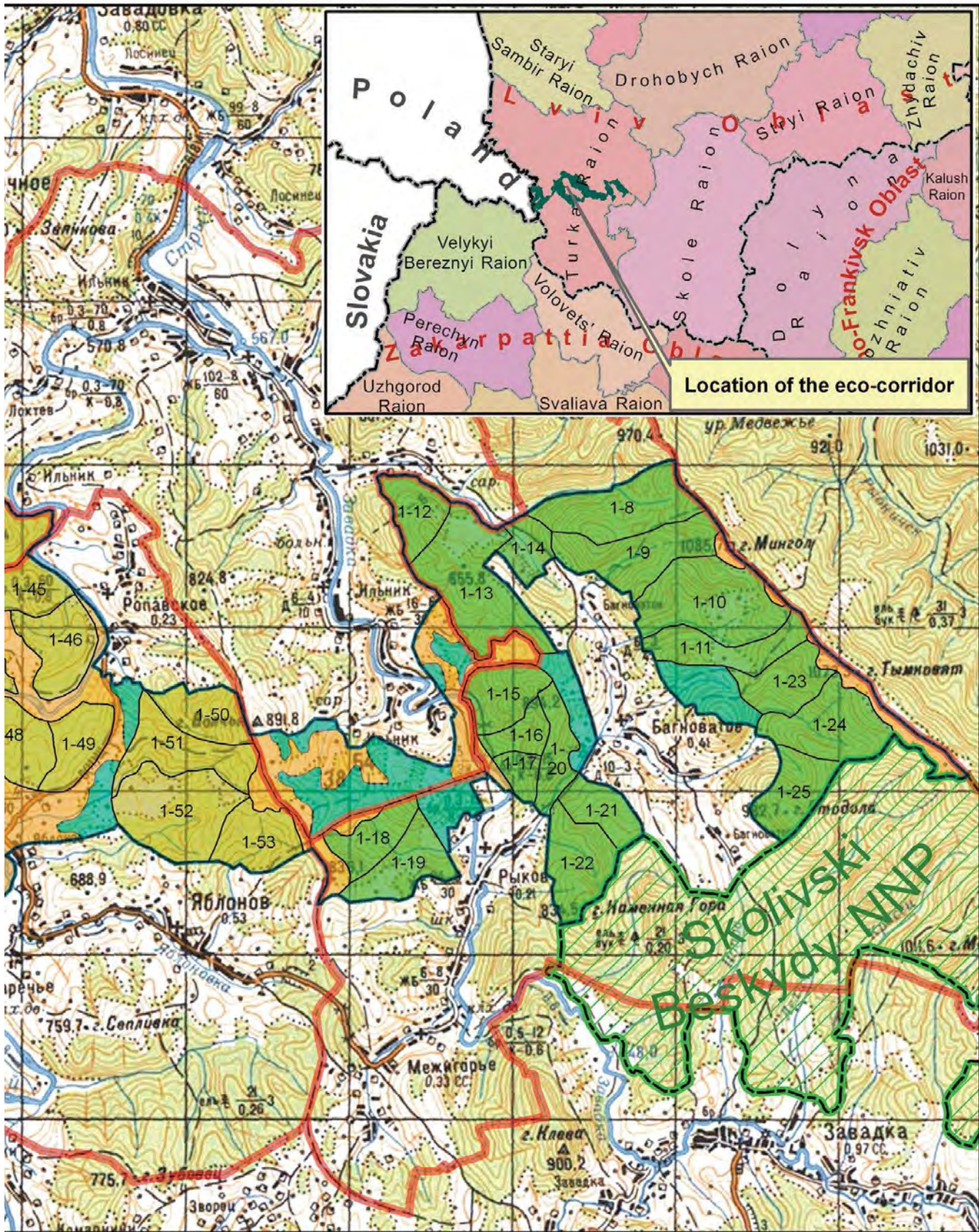
*Figure 54. Bottleneck area in the Turkivskyi corridor centrally depicting the two streams accompanied by fringe forest; the one on the right obviously being degraded.*

fringed by woody vegetation (Map 13). The vegetation along one of these streams is quite degraded due to abusive exploitation (trees along rivers are protected), the other still intact (Figure 54). Bottlenecks north of Borynia and north of Rykiv are quite forested and appear no limitations to wildlife passage. Only the bottleneck between Shtukovets and Yabluniv might form a problem, as it consists of a vast area of grassland without any vegetation for cover. There is some cultivation on the eastern slope and there are settlements nearby. Reforestation is recommended here and because of the limited connectivity for species such as Lynx and Wildcat, a northern loop has been planned for this ecological corridor, north of Borynia. The entire corridor is located in Turka Rayon, Lviv Oblast.



Map 12. Ecological corridor map of the Turkivskiyi eco-corridor based on USSR Topographic Maps with a scale of 1:100,000 (eastern part 1983, western part 1988).

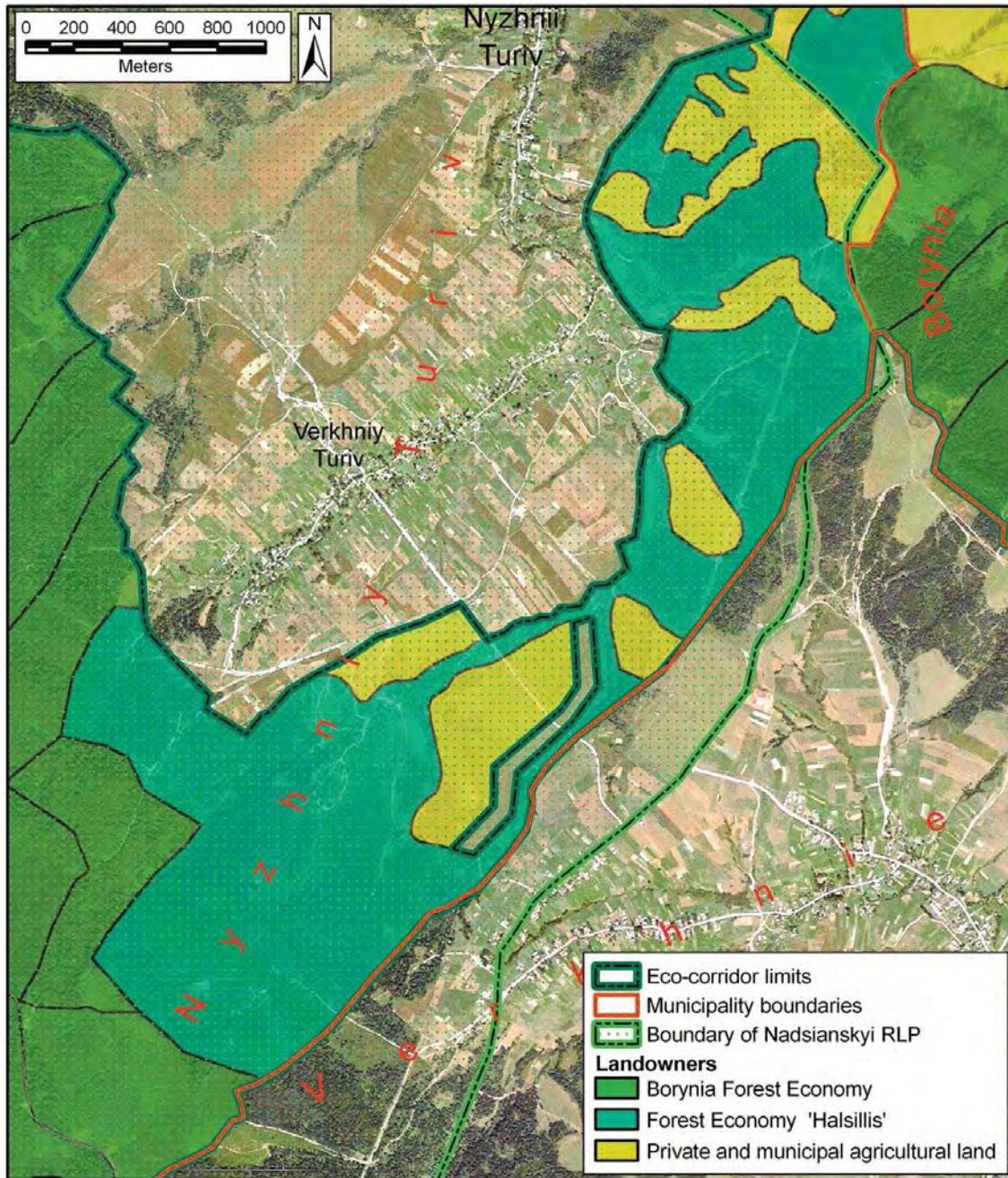




For endorsement of ecological corridors it is however recommended to use up-to-date Ukrainian topographic maps.



*Figure 55. As a result of the privatisation of land, people tend to fence their fields. These wooden fences in the Bukovynskyi eco-corridor "bottleneck area" will not intervene with connectivity too much, but when fencing is extended it may obstruct passage of certain species, particularly where barbed wire and mesh are used.*

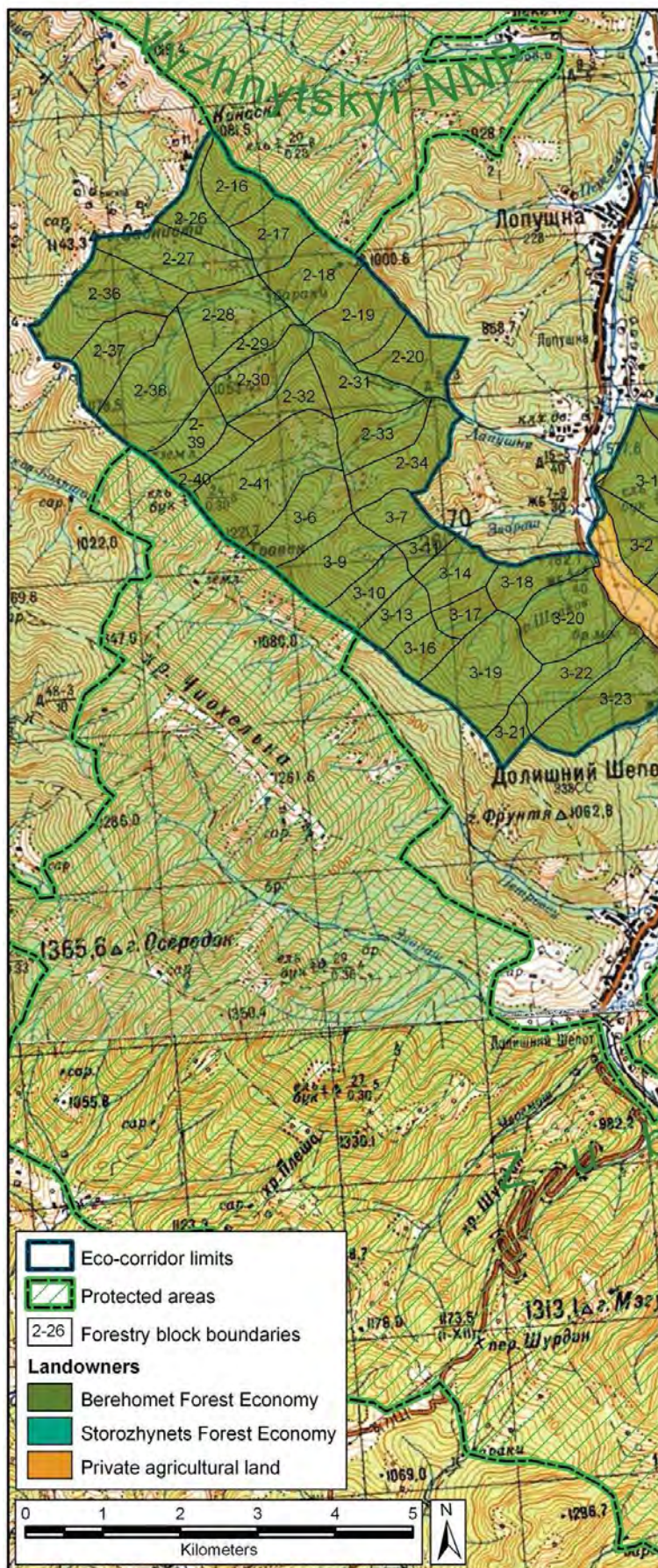


Map 13. Verkhniy Turiv bottleneck area in the Turkivskiy eco-corridor.

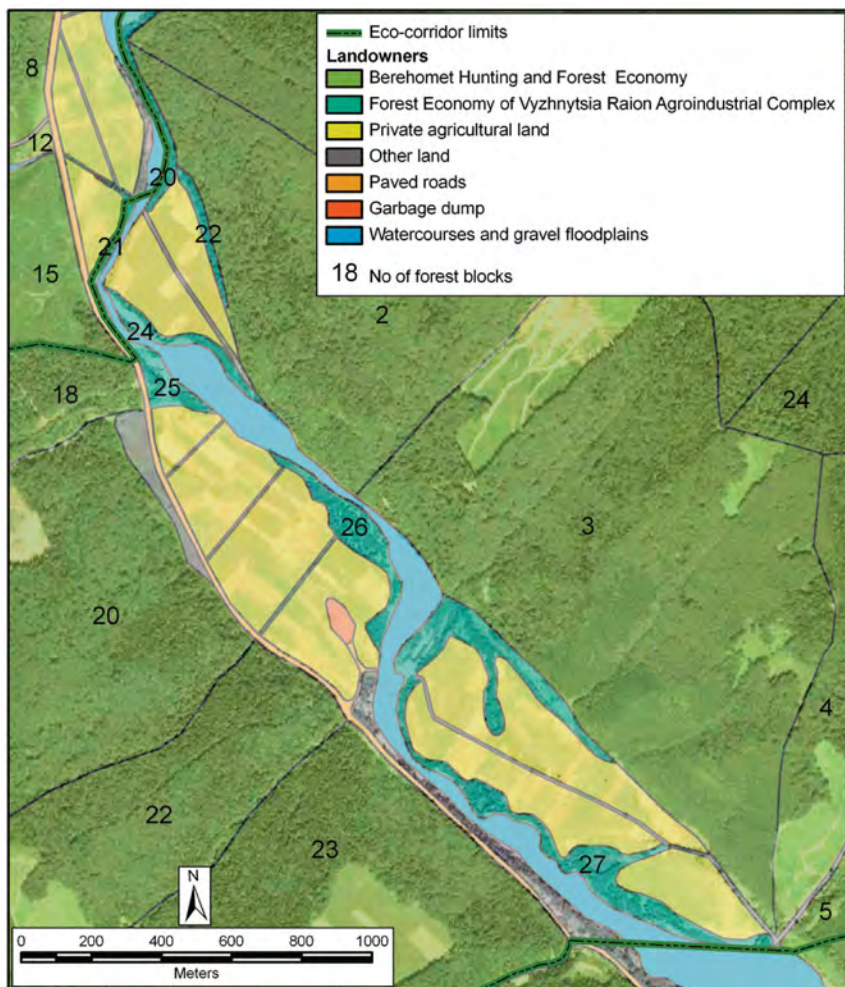
### 5.4.5 Bukovynskiy eco-corridor

The distance between the Vyzhnytsky NNP and the Romanian border is approximately 26 km. Most of that area is covered with forest managed by the State Forest Enterprises, but near the park some smaller protected areas are found (Zubrovytsia Wildlife Reserve (Zakaznyk) and Cheremosh Regional Landscape Park), as well as two villages Dolishniy Shepit and Lopushna (Map 14). Lopushna village is located on the national park boundary. The ecological corridor, as seen from the direction of the Romanian border, has been planned loop around this village on two sides, south-west as well as north-east. Both legs of the ecological corridor are intersected by the road from Beregomet to villages in the south towards the Romanian border, forming a so-called bottleneck area (Map 15) in the valley between Dolishniy Shepit and Lopushna, which is mainly covered by privately owned grassland and used for livestock and some cultivation (Figure 55). Traffic intensity is low and will currently not constitute a significant disturbance factor for the connectivity. However, in 2009 a garbage dump was observed in the area and increased fencing to mark private plots for livestock and hay making, both considered as interfering with connectivity. The ecological corridor is located in two different Rayons: the Storozhynets Rayon and the Vyzhnytsia Rayon, both part of Chernivtsi Oblast. During the pilot project, the Zubrovytsia Wildlife Reserve has been extended to cover the eastern part of this corridor in the Storozhynets Rayon.

*Map 14. Ecological corridor map of the Bukovynskiy eco-corridor based on USSR Topographic Maps with a scale of 1:100,000 (western part 1977, eastern part 1982). For endorsement of ecological corridors it is however recommended to use up-to-date Ukrainian topographic maps.*







Map 15. Bottleneck area between the villages Dolishniy Shepit and Lopushna in the Bukovynskiy eco-corridor.



### 5.5. Endorsement of the ecological corridors

After completion of the mapping and consultations, the different parts of the Ecological Corridor Scheme are completed and ready for endorsement by the different authorities, as required by law. This procedure is described in section 3.4.5. Provisions for the elaboration of an ecological corridor management plan, a required attachment to the Ecological Corridor Scheme, are explained in Chapter 6.

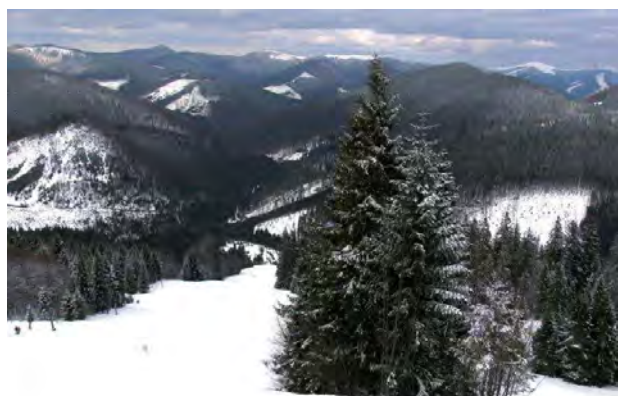
Figure 56. Example of endorsement of ecological corridor, in this case the Bukovynskiy eco-corridor by the Dolishniy-Shepit Silrada Council.

## 6. Ecological corridor management

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### 6.1. Current legal arrangements for ecological corridor management

Once ecological corridors have been defined, described and agreed upon, they need to be consolidated to assure their perpetual functioning (Jedrzejewski 2009). They have to be managed in a sustainable way to strike a balance between local social-economic development requirements and conservation targets. Ukrainian legislation and regulations do not provide recommendations for the management of Econet elements. The law “On the State Programme of Ukraine’s National Ecological Network development for 2000-2015” does prescribe the development of management plans for wetlands. The Law “On the Ecologic Network of Ukraine” does not mention management plans, but in article 14 it envisages “Elaboration of recommendations concerning determination of the (management) regimes of ... rehabilitation, buffer and connecting territories suggested” (section 2.2.4.). However, article 18 states “The order of protection



*Figure 57. Ski runs may bring about more diversity in the landscape by adding open vegetation elements, improving habitat quality and connectivity. However, when ski runs are established on steep slopes, they may accelerate erosion and contribute to landscapes fragmentation.*

and utilization of buffer, connecting and rehabilitation territories of the Econet is determined by the corresponding Econet scheme”. This should be interpreted as the requirement to include a management plan for the ecological corridor in the Ecological Corridor Scheme. The law does not specify its format, endorsement order, monitoring or termination. However, inclusion of a management plan in an Ecological Corridor Scheme means, that it has to be approved by the Local or Oblast Council (Rada or State Administration) which approves the Ecological Corridor Scheme, because according to article 11 of the Law “On the Ecologic Network of Ukraine”:

Local bodies of executive power and bodies of local self-government involved in formation, preservation and utilization of the Econet, provide within the limits of their authorities:

- elaboration and implementation of regional and local schemes and Econet development programs, including necessary research;
- financial and other support (according to the law) to the owners and users of land plots located within the boundaries of territories and objects of the Econet.

The legislation does not imply land owners and users have any obligations or responsibilities as far as management is concerned. This means that in practice the management of ecological corridors will depend on voluntary involvement of stakeholders.

### 6.2. Management zones and institutional responsibilities

The current management of the different corridor elements depends on the status of the land components comprising the ecological corridors. In many occasions the State Committee of Forests, the State Agency for Protected Areas or other agencies of the Ministry of Environmental Protection will be respon-



*Figure 58. Garbage dumps are dangerous for livestock and wildlife. Two dumping sites were found in the selected corridor areas of the pilot projects.*

sible. However, in some occasions agencies resorting under other Ministries, local communities, private land owners or other parties are in control of corridor elements. The responsibility of land users and owners with respect to corridor management is established after endorsement of the management plan by their authorized representatives. The responsibilities of staff for the management of ecological corridors should be amended, where possible, to the terms of service and staff rules of the agencies and bodies involved.

Managing ecological corridors may require the implementation of a variety of measures by different stakeholders and dealing with different connectivity issues at various levels. To restore order to this multitude of measures, they are arranged in a management matrix, classifying measures and assigning them to different management zones. Management zones are areas characterized by a more or less homogeneous managerial regime. The follo-

wing management zones are distinguished:

- (A) Border areas, a security zone mainly controlled by frontier troops.
- (B) Forestry enterprise areas, controlled by the forestry and hunting enterprises of SCF/MEP.
- (C) Protected areas, controlled by the State Agency of Protected Areas (MEP).
- (D) Agrolis, controlled by Agrolis Enterprise of the Ministry of Agriculture.
- (E) Agricultural areas, controlled by individual land owners and the Local Council.
- (F) Roads, railroads, controlled by the Ministry of Transport and Communications.
- (G) Water bodies, controlled by the State Committee of Water (MEP).

Appendix 10 presents a management matrix, indicating different management measures and the zones they may apply to. These measures are described in the following section to some detail. Ultimately, the management plan will be prepared and accepted jointly by the MEP and the landowners. Measures described in the following section are just meant to give an overview of possible management measures and arrangements. Appendix 12 presents the management plan agreed upon by the stakeholders for the Turkivskyi eco-corridor.

### 6.3. General measures

Some management measures have a general character and do not apply to specific zones, but to the



*Figure 59. Wildlife is attractive for tourists and should be considered as an economic asset, to be used to cover conservation costs.*





Figure 60. Commercial forests are divided into forest quarters to facilitate management. Generally eco-corridor management is less complex in these areas because of the limited number of stakeholders and relative compatibility of forestry and wildlife. Boundaries of forest quarters are often clearly indicated by signs along the roads. Similarly, eco-corridors should be indicated.

entire ecological corridor. To start with, as already mentioned earlier (section 5.1), communication is essential in gaining support and understanding for ecological networks and corridors. The need for the establishment of ecological corridors should be presented and explained in an information meeting. The existence and location of ecological corridors should be made public, and be clearly demarcated in the area by establishing signs in visible places, such as along roads and in other areas where wildlife and human activity strongly overlap.

Intensifying cross border cooperation with regard to the management of ecological corridors leads to synergy and higher efficiency by exchanging good practices, coordinating connectivity, common law enforcement, rules and practices.

The main challenge for corridor management is the identification of financial resources to cover management costs not funded by regular budgets. Development of innovative systems may be required. For example, revenues from tourism could contribute towards the cost of management. However, conflicts of interests between tourism and the principal objectives of ecological corridors should be minimized, and therefore, a tourism strategy needs to be developed. It has been proposed to keep tourists out of ecological corridors for the first three years to keep disturbance at a minimum.

It has been recommended that the management plan be reviewed every three years. This review, including an assessment of the effectiveness of the management measures, is the joint responsibility of the MEP department in the Oblast, Rayon councils, state administrations and land owners or managers. Where possible, hunting agencies, universities and research institutes should be involved in the development and implementation of a monitoring system for habitat quality and utilisation by wildlife of ecological corridors.

#### 6.4. Law enforcement

To make ecological corridors work, effective law enforcement on the ground is crucial. Econet elements are not subject to special legal restrictions apart



Figure 61. The combination of large animals and roads can be problematic. In specific areas where wildlife is expected to cross frequently, a speed limit needs to be introduced for cars.



*Figure 62. Wild Boar is one of the species which may cause human/wildlife conflicts due to its habit to raid agricultural crops.*

from restrictions to changes in land use category; and enforcement is based on current environmental legislation. Surveillance and law enforcement of corridor areas will be the responsibility of surveillance staff of the different branch agencies of the MEP (Appendix 3): environmental inspectors, forest guards and hunting guards of the forest and hunting enterprises, and game guards of the protected areas. It is recommended to include such responsibilities in the task description of the staff. It is convenient to concentrate law enforcement resources (staff, budget) on ecological corridors, as they form the spatial skeleton of the protected area network and conservation strategy. Effectiveness of law enforcement would benefit from involving villagers in intelligence on infractions by setting up a village based information system (Anon. 2010, Lewis et al. 1990) as well as from increased fines. Apart from protection and management of animals, law enforcement is meant to help conserve the environment or habitat in ecological corridors by preventing illegal construction, and illegal activities with regard to water, soil and vegetation. In this context, pollution control and the enforcement of the Water Code of Ukraine, particularly along the Stryi, Zawadka and Sian rivers, are relevant. For the security of animals and people and to avoid damage, the reduction of vehicle and train speeds to 50 km/hr when crossing eco-corridors is recommended.

## 6.5. Human-wildlife relations

The presence of people in wildlife areas has positive and negative aspects, which need to be managed. On the positive side, wildlife adds cultural and economic value to the land, often materializing as revenue from tourism or hunting. Less visible is the ecological value of having many species in the ecosystem, through vegetation maintenance by herbivores and population regulation by predators.

On the negative side, illegal and unsustainable exploitation (poaching) may occur, and wildlife may cause damage to property, for example by crop or livestock raiding and road collisions. If wildlife densities are high and no adequate mitigating measures are taken, human-wildlife conflicts may have serious consequences on both sides.

Managing human-wildlife relations requires communication on the cost and benefits of wildlife as well as on conflict prevention. In many countries, a financial compensation system has proved to be an effective strategy. In the Carpathians such a system could be funded partly or entirely by revenues from hunting and/or tourism. Hunting and tourism benefit from healthy wildlife populations and therefore it is reasonable to use profits from these sectors to compensate the losses caused by wildlife to individuals.



*Figure 63. The fence along the borders with Romania and Poland is no longer maintained and is becoming less and less of an obstacle for wildlife movement.*



*Figure 64. Tree lines along streams and rivers provide cover for animals and therefore play an important role in connectivity, particularly for animals preferring the presence of trees such as Wildcat, Lynx and Brown Bear. This picture shows a tree line in the Turkivskyi eco-corridor near Verkhnie village.*

## **6.6. Land use management (agriculture, forestry, hunting)**

Land cover and land use are probably the most important determinants of connectivity. Traditional agricultural land use, characterized mainly by cattle and sheep pasturing, hay making and limited cultivation, has low impact on wildlife and few conflicts between farming and wildlife will occur, if arable land in the corridor areas is kept to a minimum. Ecological corridors are in fact areas where so-called High Nature Value Agriculture should be promoted (Andrews & Rebane 2005; Hoogeveen et al. 2002) and any industrial development should be avoided.

Apart from forests, grasslands are crucial for many species. Meadows are threatened by degradation due to decreased livestock grazing and hay making which results from declining livestock numbers in the area (Figure 22). In particular, it is recommended to maintain high altitude meadows (or create in case they are absent) and stimulate traditional hay making for this purpose. Hay may be used as fodder for the vulnerable Bison populations which are being re-established in the Ukrainian Carpathians.

Partly as a result of land privatisation, the number of fences in the landscape is increasing. The current wooden fences are not obstructing passage for most species (accept perhaps European Bison) yet. However, if this phenomenon continues and if materials such as barbed wire and mesh are going to be used, the connectivity of ecological corridors may be affected. It is therefore recommended to discourage fencing, and eventually remove fences in crucial areas.

Forest exploitation may well be compatible with ecological corridors, if the requirements of wildlife are taken into account in the management system. It is essential to evaluate and if necessary adapt the size and pattern of logging areas to reduce forest fragmentation. To minimise disturbance, tree felling during periods of intensive movement by animals and in the vicinity of areas used for resting or hibernating should be limited. Forest areas which are part of ecological corridors may also be given special protection status based on scientific substantiation. An example is the establishment of the Zubrovytsia Wildlife Reserve in the Bukovynskyi eco-corridor.

The management plan is to be preceded by an inventory carried out by a special commission under state Rayon administration in order to develop a habitat improvement plan, which should include plans for afforestation (e.g. rehabilitation of fringe forest) and the removal of obstacles and pollution. The results are to be communicated to land owners and



*Figure 65. Generally the best habitat for wildlife is mixed forest alternated with meadows.*

users and included in the management plan which they have to implement.

Since ecological corridors will normally have a positive effect on wildlife numbers, they are beneficial for hunting. However, to make ecological corridors work, hunting should be limited as much as possible in the corridors themselves. Raid hunting, a very disturbing form of hunting, should be banned absolutely and hunting should at least be prohibited periodically based on scientific substantiation. Agencies responsible for the management of hunting (section 2.4), are obliged to set a proportion of their land aside for rehabilitation, with the aim to provide wildlife with a secure and stable area in their home range. Giving ecological corridors this status as often as possible should result in synergy between connectivity and population stabilisation.

The current law (Land Code, Law on Ecological Network) interdicts changes of land use category,

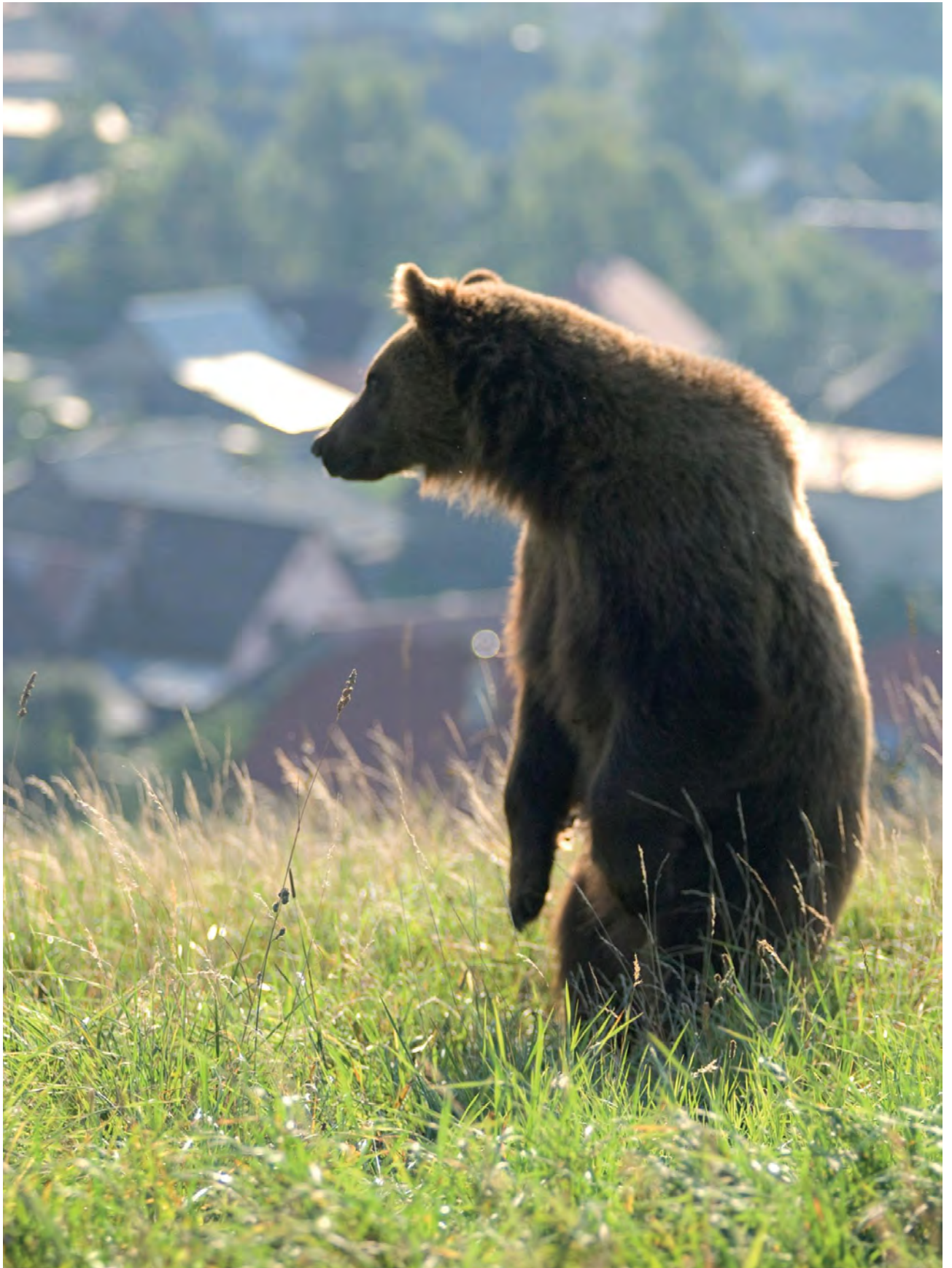


*Figure 66. Man-made meadows in the mountains improve habitat quality and connectivity of species such as Bison. Some of these meadows are especially maintained to facilitate Bison.*



*Figure 67. Regulations on clear-cutting need to be respected to avoid erosion and forest fragmentation.*

which means that, for example agricultural land may not be changed into forest land, without special permission from as high up as the CMU or Verkhovna Rada. When the legal framework concerning land tenure and land use becomes further developed, including an accurate cadastre, other options for corridor conservation such as the purchase of land for conservation and land swaps, may become feasible.



*Figure 68. If bears are well protected and not disturbed they may roam close to human settlements.*



## 7. Conclusions and perspectives

F. Deodatus, L. Protsenko, I. Movchan

### 7.1. Lessons learned

The actual establishment of ecological corridors can be powerful in creating awareness of biodiversity conservation among authorities and local populations. The inhabitants of the nine villages in the pilot project in Lviv and Chernivtsi Oblasts expressed their support for ecological corridors at village council meetings and started to understand and appreciate the ecological network concept. These projects also made it clear that it is not too late (yet) to realise connections between protected areas, even in the more populated areas of the western Ukrainian Carpathians, because land use intensity is still low. Therefore, now is the time to secure an ecological network for the Carpathians with sufficient connections between the core areas. The current commitment of the MEP agencies to the development of the Econet is another success factor, which is crucial for further development of the policy and legal framework.

GIS modelling can be very helpful to identify options for ecological corridor development, providing ecological substantiation and option maps for the consultation process. However, the actual realisation of ecological corridors requires considerable fine-tuning with local authorities, land owners and land users. Final corridor boundaries are therefore drawn "by hand at a desk".

A very basic constraint in the development of ecological corridors is the limited availability of thematic and topographic map information at an adequate scale. Another crucial issue is the absence of an accurate cadastre for the Ukrainian Carpathians, which makes spatial planning difficult due lack of consistent information on land ownership and boundaries.

According to the law "On Ecological Network of Ukraine" the Econet is an integral part of the General Schemes of Planning of Territories. To be sure that all elements (text, maps) of the Ecological Cor-



*Figure 69. Dams intervene with connectivity in two ways: they are an absolute barrier for aquatic species, but water level rises and lakes associated with dams have a serious effect on connectivity for terrestrial animals as well. Development plans for dams should therefore take corridors into account.*

ridor Development Scheme are used, the characteristics and quality should be adapted to the authorities and other users. Since this scheme has to be endorsed by the Land Resources Department and since one of the main goals of this scheme is that ecological corridors be taken into account in the schemes and plans elaborated by this Department, the final map of the Ecological Corridor Scheme should be developed based on maps approved by the Land Resources Department.

The collaboration between Government administration and research institutions is very important for appropriate policy development and implementation (Hanski 2002; O'Donnell 2007). Both fulfil an indispensable role in the realisation of the Econet and both have specific and highly complementary knowledge and experience. Since new technologies such as GIS have become relatively cheap and commonly used by researchers, their use will be increasingly significant in spatial planning. Administrators can benefit from qualified staff at research institutes and the availability of this techno-

logy. Increased collaboration would make research staff more familiar with the requirements of administrative procedures, leading to more effective application of scientific data. At the same time, collaboration could facilitate the extension of new approaches in the scientific environment to the administrative sector.



Figure 70. A passage for amphibians on a regional road near Kudowa Zdroj, south-western Poland (Jedrzejewski et al 2009).

## 7.2. Extension of the ecological network

The blueprint of ecological network development is formed by the current Econet legislation and the schemes developed accordingly. Section 7.3 offers a number of recommendations which may contribute to the framework. The present manual developed through the pilot project is primarily meant to assist with further action related to the completion of the Econet, and particularly with the elaboration of Ecological Corridor Development Schemes. In Lviv Oblast further development of the ecological corridors is vital. Large mammals still cross the borders from neighbouring countries, but the connecting areas between protected areas on both sides of the borders are not immediately protected. For example, movements have been identified between Poland and the two Regional Landscape Parks “Verkhniodnistrowski Beskydy” and “Ravske Roztochia”. Here, the next ecological corridors with a transboundary status should be developed.

Ecological corridors should be developed further, from the north-west to the south-east of the

Ukrainian Carpathians, to meet up with the Bukovynskyi eco-corridor and the Romanian border. A key area here is the Skolivski Beskydy NNP. This park is intersected by a main traffic route with a highway (M06/E50 -Vienna to Moscow), a railway, oil and gas pipelines and a high voltage power line, forming the main barrier between the Eastern and Western Carpathians. If measures are not taken soon, the development of infrastructure along this route, such as the establishment of a four lane highway and traffic related constructions will continue and extend. As time slips by, the efforts and costs to overcome this barrier for wildlife will increase accordingly. Therefore, the construction of a wildlife crossing to bridge this traffic artery needs to be investigated, with the objective to restore and maintain the ecological connectivity between the Eastern and Western Carpathians in the long term, which is a condition for survival of large mammal populations such as Brown Bear and European Bison. The key issue for such projects involving high investments is often funding (see section 7.4). Perhaps, in this case costs could be covered through mitigation obligations for infrastructure development, or by donor funding.

To the south, the development of an ecological corridor connecting Vyzhnytsky NNP with the Carpathian Biosphere Reserve deserves priority, in order to extend the current ecological corridors from the Romanian border westwards. The Carpathian Biosphere Reserve is also intersected by an important traffic artery, including a main road and a



Figure 71. Large overpass (green bridge) of 120 m wide on Highway A6 in Croatia (Jedrzejewski 2009).



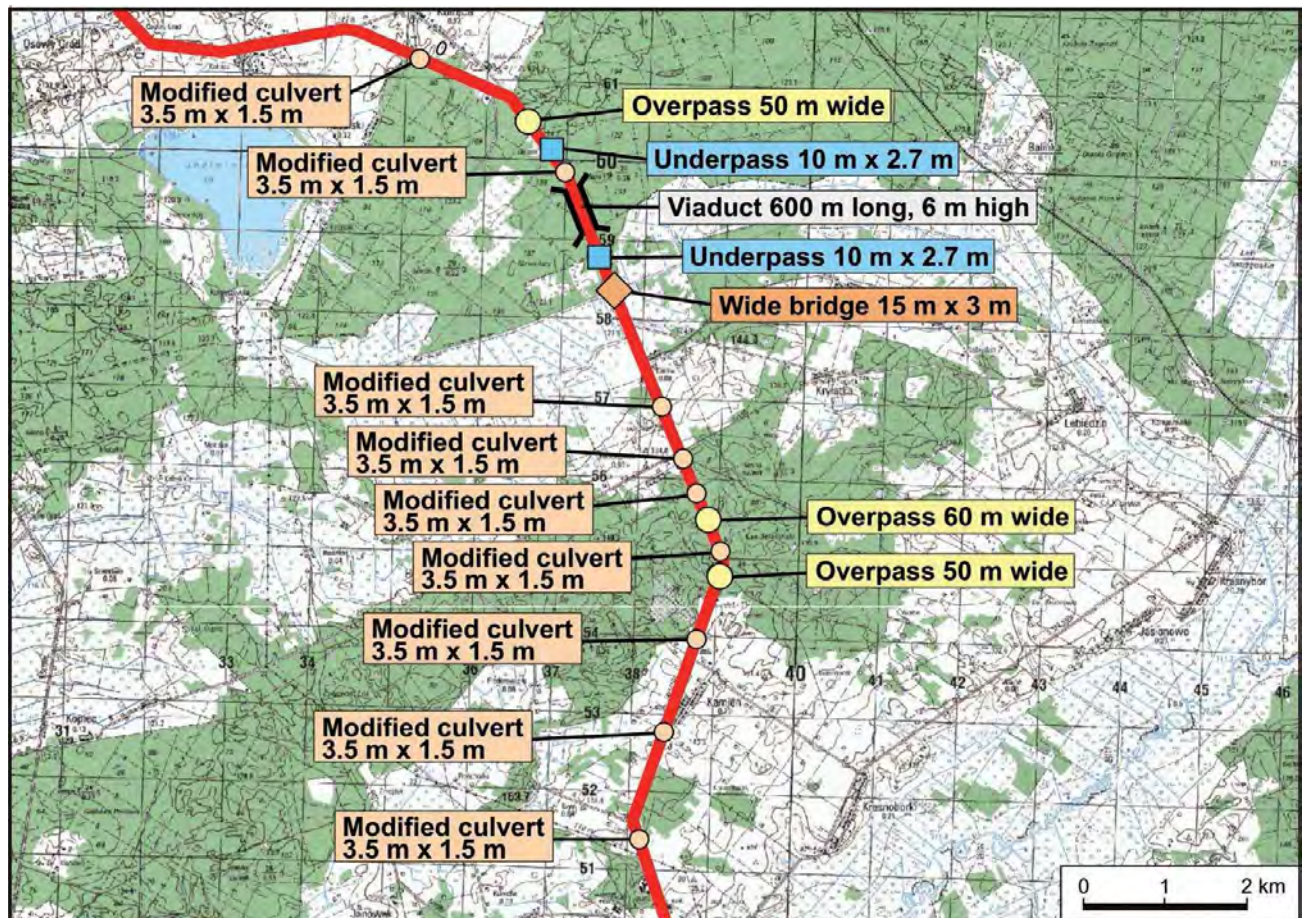
railway, and the construction of wildlife passages here should also be considered.

Ecological corridors developed according to the methodology used in the pilot project will provide connectivity for most terrestrial mammals. The selection of umbrella species, however, is not comprehensive. For instance, the ecological corridors presented here do not support aquatic and amphibious animals. This means that for each ecological corridor, the selection of umbrella species will have to be reconsidered, depending on the objectives of the specific corridor. The selection of umbrella species is not unchangeable as the modelling methodology does allow for testing and adapting of established corridors at a later stage for other species.

Infrastructure to facilitate wildlife crossing varies according to the type of target species and ac-



Figure 72. A wildlife passage under a 200 m long viaduct on Express Road S69 near Zwardoń, south Poland. Note the animal tracks in the snow (Jedrzejewski 2009).



Map 16. Proposed locations and types of wildlife passage on the modernized Motorway 8 in the Sztabin-Białobrzegi section, eastern Poland. The road crosses an internationally important forest corridor between Augustów Forest and Biebrza National Park here (Jedrzejewski et al. 2009).

cording to the landscape. In many countries (e.g. Canada, USA, Austria, the Netherlands, Croatia, and Poland) main roads are adapted in aid of connectivity (Beier et al. 2008; Jedrzejewski 2009). Some examples of structures used in different conditions for different objectives are given in Figures 70, 71 and 72. An example of connectivity infrastructure planning is given in Map 16.

Measures, undertaken in the area, aimed at achieving objectives of the Carpathian Convention and its first Protocol, created a basic platform to put a halt to degradation and start up conservation and recovery of the Carpathian ecosystem. To achieve these goals, it will be necessary to implement and develop adequate legal, financial, organizational, scientific, educational and informative measures.

Ecological networks have been developed in Romania and Poland (sections 2.2.2, 2.2.3), but ecological corridors have not been established in these countries yet. The success of the ecological corridor pilot project in Ukraine putting Econet into practice, suggests that the implementation of similar projects in these countries could help to overcome the current stagnation in the process of consolidating spatial continuity of ecological networks in Romania and Poland.

### 7.3. Policy recommendations

In a country in transition, like Ukraine, the priority of the majority of the population and many politicians is access to cheap goods and services, with sustainability being much lower on the list (Movchan 2007). All over the world, however, ignoring sustainability has proved to be expensive in the long term, the loss of biodiversity being one example. A developing unsustainable economy does not take the environment into account, resulting in habitat degradation and biodiversity decline due to factors such as pollution, traffic, habitat conversion, fragmentation and resource destruction. In mountainous areas like the Carpathians for example, tourism development and hydro-power infrastructure constitute serious threats to biodiversity, if the environment is not properly taken into account. It is



*Figure 73. Agricultural crops are generally grown on small plots, not interfering with connectivity due to their size and scattered distribution. However, the presence of wildlife, particularly Wild Boar in agricultural areas may result in human/wildlife conflicts.*

therefore essential to shift the economical objectives of the area towards sustainable utilisation, and to support this with appropriate policies in all sectors.

Based on the experiences of the pilot project a number of conclusions and recommendations have been formulated, which are presented in this section. At the end of the list, an option is indicated to promote these recommendations.

In Ukraine, no ecological corridors had been established before the implementation of the pilot project. Econet schemes have been prepared for Kyiv and Ternopil'ska Oblast. They have been approved by the respective councils but to this date, they have not been endorsed by land owners and users, as prescribed by the Methodological Recommendations for the Development of Regional and Local Ecological Network Schemes (section 3.4.5). Since the "Methodological Recommendation for the Development of Regional and Local Ecological Network Schemes" does not provide specific directives for the establishment of ecological corridors, an adapted version has been prepared, based on its principles, by the pilot project, named "Methodological recommendations for Ecological Corridor Scheme (connecting areas) development". The purpose of this document (Chapter 3) is to provide guidelines for anyone involved in ecological corridor develop-

ment, and it includes a section, "Plan of action to realise eco-corridor development" (Table 2), facilitating assessment of the required time frame, and resources.

Due to various obstacles and constraints, the targets for the establishment of the National Econet of Ukraine set in the Law "On the State Programme of Ukraine's National Ecological Network Development for 2000-2015", will probably not be met fully by 2015. The Programme determined that the total area of protected areas of Ukraine should cover 7% from the territory of Ukraine by 2005 and 10.4% by 2015. However, the total area of established protected areas was only 5.04% at the beginning of the year 2009 (Anon. 2009) and probably 5.5% by the end of that same year. Among the efforts of the MEP to accelerate the progress of the Econet development, a draft law has been prepared and submitted to the CMU for approval of the "State Ecological Programme on Development of Protected Areas Affairs" that should facilitate the establishment, management and capacity building of protected areas.

Econet schemes might not be implemented if they are not incorporated in existing General Schemes for Development of Oblasts according to the legislation. In some oblasts these Schemes have not



*Figure 74. Hunters benefit from well protected and maintained ecological corridors.*

been approved yet, in others they have been approved, but the General Schemes do not always include Econet Schemes. In Lviv Oblast the General Scheme had not been endorsed by the MEP department and does not include an Oblast Econet Scheme. Without endorsed Econet Schemes integrated in spatial planning, further privatisation of land of high nature value will occur outside protected areas and loss of biodiversity will continue. The MEP can reverse this trend by mainstreaming Econet into spatial planning by means of the General Development Schemes.

The ecological network cannot be effective without adequate law enforcement preventing poaching. Effectiveness of protection should be monitored using wildlife population numbers. At present, trends appear negative, indicating high levels of illegal and uncontrolled hunting. The law enforcement approach should be reviewed, surveillance efforts enhanced and legislation adapted, in particular enforcing higher penalties. In addition, an institutional review regarding the protection of the Econet would be useful to clarify responsibilities and gaps. Such a review might also evaluate the question if agencies such as the State Agency of Protected Areas and the MEP's staff in oblasts have sufficient mandate and status to deal with their tasks.

Small cultivated and fenced land plots may form an obstruction in narrow ecological corridors, becoming insuperable obstacles for animals, in particular in bottleneck areas. This problem highlights the need for the possibility to purchase and swap land, as envisaged in article 8 of the Law "On ecological Network of Ukraine", to facilitate the establishment of Econet elements such as crucial parts of ecological corridors. Government effort is required to develop regulations to enable such transactions, which are now obstructed by current legislation blocking change of land use and change of ownership of agricultural land. In some occasions land swap motivated stakeholders to support corridor development. The identification of other incentives in support of ecological corridor development also deserves attention (see section 7.4). If the interests of stakeholders are known, they may be addressed in the establishment and management (e.g. tour-

ism, employment, compensation and infrastructure).

According to the Law “On Ecological Network of Ukraine”, the protection of Econet elements outside protected areas is entirely based on voluntary agreements among stakeholders, without any obligations (section 2.2.5). The current legislation and regulations on Econet do not demand the elaboration, implementation and enforcement of a management plan for ecological corridors or other ecological network elements. Without the implementation of a management plan, however, the established corridor will only have formal status without any practical influence on the creation and maintenance of favourable conditions for wildlife and connectivity. Management plans may be established on a voluntary basis, which means that in practice the land users subject to this plan do not have any responsibility nor suffer any sanctions in a case of failure to respect the plan. It is therefore recommended to amend current legislation and regulations in order to make agreed management plans a compulsory part of the endorsement process of Econet elements. A framework should also be provided, ensuring the management arrangements and measures are respected by the land users/owners. The effectiveness and sustainability of the Econet and the ecological network elements would benefit from a further and more explicit elaboration of the protection status of these areas in the Law “On ecological Network of Ukraine”. A step in the right direction would be the mainstreaming of Econet development in the Land Code (section 2.2.5).

A major aspect of biodiversity conservation at site level is the “ecologization” of agricultural landscapes and agricultural practices (Andrews and Rebane 2005), and the existing practices in forestry, fishery, game, land and water management as well. Concepts such as High Nature Value Farming (Hoogeveen et al. 2002), organic farming and the development of Agri-environment measures are essential and require promotion and support in the Econet approach as well as in policies for rural development. Collaboration among different Ministries is essential in this aspect.

Policy reform requires opportunities for change, such as reviews of current policy and legislation or actual new policy and legislation development. Such a window of opportunity for reform has been created by the development of a draft decree by the MEP of the CMU “Procedure for Inclusion of Territories and Objects in Lists of Territories and Objects of Econet”. The decree will fill certain gaps in the regulations and facilitate further development of the Econet. The recommendations made on the basis of practical experience gained in the pilot project and presented in this chapter, may be of great value in the elaboration phase of this decree.

#### 7.4. Funding options

The cost of the development of ecological corridors varies depending on the corridor's characteristics. Some of the regular budgets available to cover these costs are the State Programme for Econet Development and the Oblast Environment Protection Funds. Budgets for ecological corridor development are also available at Rayon level.

Structural funding options could be incorporated in the management model for ecological corridors, covered by the economic beneficiaries of the corridor, such as the hunting and tourism sector. This would require the development of special new funding mechanisms within the existing policy and legal framework (O'Donnell 2007). Such mechanisms are increasingly being set up in other parts of the world, particularly in areas where Government funding is limited. The development of mechanisms linking benefits gained from wildlife by hunting and tourism, to the costs, such as resulting from land use limitations and wildlife damage, may be very instrumental in securing local support for ecological corridors.

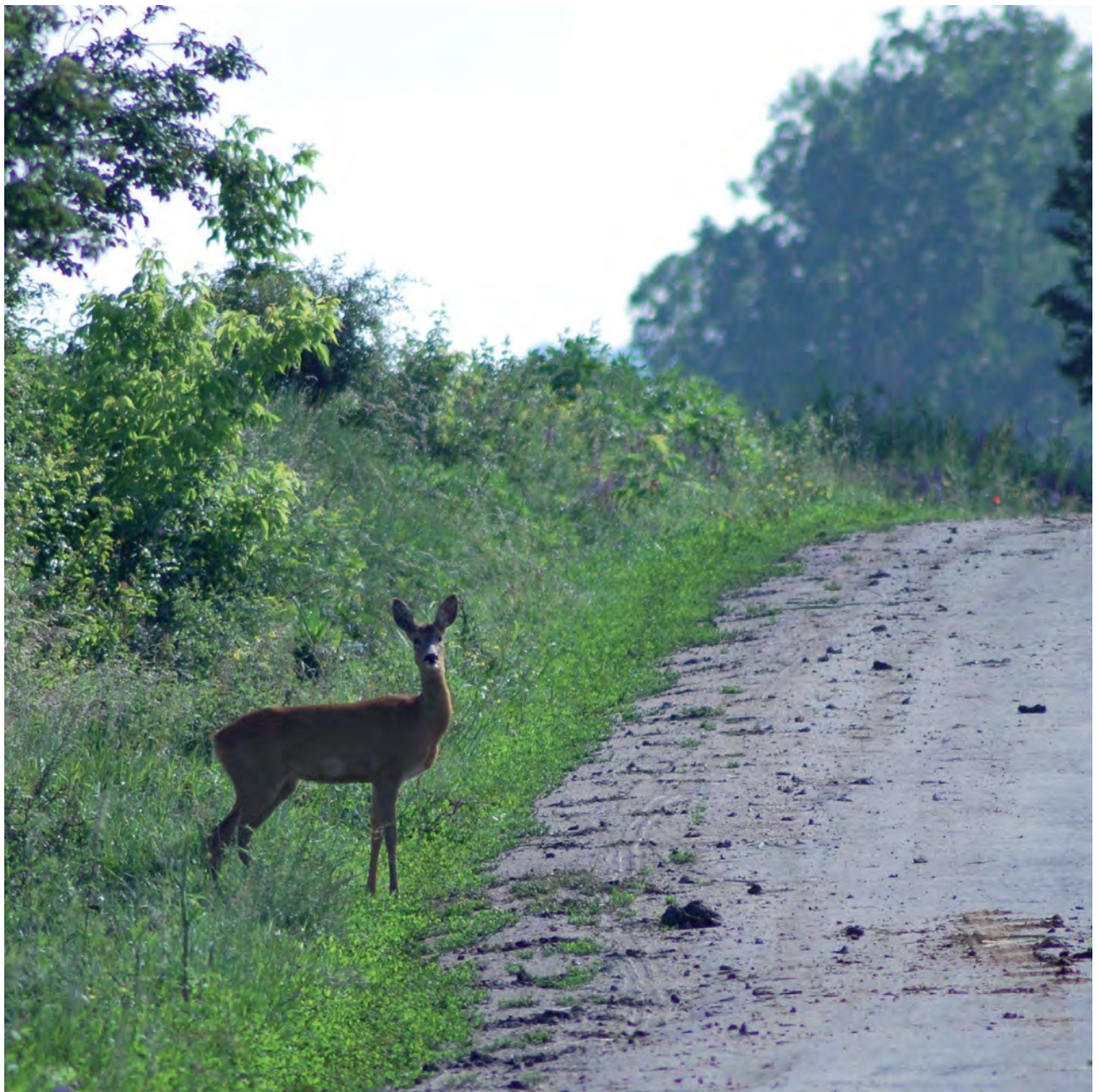
Another possible mechanism which does not exist in Ukraine yet, is the revolving fund. This is a fund sourced from donations and/or revenues from economic services delivered, which may grant or lend funds to projects according to criteria determined by the objectives of the fund. The Netherlands Ministry of Agriculture and Food Quality is actually

collaborating with the MEP to develop a fund to support the leasing of land for conservation, which could be very useful in consolidating ecological corridors.

Where infrastructure projects are planned which are expected to have an impact on natural areas or biodiversity, Environmental Impact Assessments (EIA) need to be carried out according to the Law “On the Ecological Expertise” (1995). If such an EIA concludes that impact will indeed occur, mitiga-

ting measures need to be included in and funded by the infrastructure project. This creates the opportunity to construct facilities improving connectivity, for example, across roads and railways.

A last funding opportunity is formed by donors committed to conservation, such as the EU, UNDP, and WWF. Potential EU sources are the EU Neighbourhood Policy, South East Europe Programme and TACIS.



*Figure 75. Preparing for a safe crossing.*



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## Appendices

### APPENDIX 1. Current institutional responsibilities the different authorities have concerning formation, preservation and utilization of the Ukrainian ecological network

Central level government authorities	Mandate
Cabinet of Ministers	<p>According to Article 8 of the Law “On Ecological Network”:</p> <ul style="list-style-type: none"> <li>• implement state policy on formation, preservation and utilization of Econet;</li> <li>• elaborate on the Summary scheme of the Econet formation, and implemente the State Programme Ukraine National Econet Formation 2000-2015;</li> <li>• supervise and coordinate the work of ministries and other central bodies with executive power concerning the formation, preservation and utilization of the Econet;</li> <li>• decide, in accordance with the law, on questions concerning financial and other support for owners and users of land areas included in the list of territories and objects included in the Econet;</li> <li>• fulfill other commitments in accordance with the law.</li> </ul>
Council of Ministers of the Autonomous Republic of Crimea	<p>According to Article 9 of the Law “On Ecological Network”:</p> <ul style="list-style-type: none"> <li>• participate and ensure the formation of the Econet is implemented in the Autonomous Republic of Crimea;</li> <li>• coordinate the actions of bodies with executive power in the Autonomous Republic of Crimea which execute the State Programme of Ukraine for National Econet Formation during 2000-2015;</li> <li>• supervise the allocation of money received for the realization of measures concerning the formation, preservation and utilization of the Econet.</li> </ul>
Ministry of Environmental Protection	<p>According to Article 10 of the Law “On Ecological Network”:</p> <ul style="list-style-type: none"> <li>• make suggestions concerning the formation of applicable state policy;</li> <li>• ensure development of corresponding research in coordination with the Ukrainian National Academy of Sciences;</li> <li>• organize documents assisting the design of the Econet;</li> <li>• function as state customer executing the Summary scheme of the Econet formation;</li> <li>• submit, in the established order, proposals concerning financing by the Ukraine State for the formation and preservation of the Econet;</li> <li>• coordinate activities by central and local bodies of executive power and bodies of local self-government in the field of formation, preservation and utilization of the Econet;</li> <li>• ensure state control over the formation, preservation and utilization of the ecosystem, and over regional and local Econet schemes;</li> <li>• realize international cooperation concerning the formation, preservation and utilization of the Econet of Ukraine.</li> </ul>

Ministry of Regional Development and Construction	<p>According to the Decree of the CMU #323 dated 01.03.2007</p> <ul style="list-style-type: none"> <li>• the Ministry undertakes actions towards realisation of the General Scheme of Planning of the Ukrainian Territory;</li> <li>• According to the Law “On the General Scheme for Planning the Ukrainian Territory” (2002) an Ecological Network Scheme is part of the General Scheme.</li> </ul>
State Committee for Land Resources	<p>According to the Decree of the CMU # 224 dated 19.03.2008 , the State Committee for Land Resources:</p> <ul style="list-style-type: none"> <li>• prepares and implements, economical, ecological and other measures aimed at sustainable landuse,..., maintaining landuse regimes for lands earmarked for nature protection, health, recreational, historical, cultural and other purposes,as well as other Econet areas and sites;</li> <li>• implements actions... on forming the Econet.</li> </ul>
Econet Coordination Board	<p>According to Article 12 of the Law “On Ecological Network”:</p> <p>The Econet Coordination Boards are consultative bodies established at the Cabinet of Ministers of Ukraine and at the Council of Ministers of Autonomous Republic of Crimea, regional governments and city governments of Kyiv and Sevastopol for the purpose of coordination of activities of central and local bodies with executive power in executing the State programme of the Ukrainian national Econet formation during 2000-2015.</p> <p>The main assignments of the coordinating boards are to:</p> <ul style="list-style-type: none"> <li>• analyse the condition of implementation of the State programme for the Ukrainian national Econet formation, 2000-2015;</li> <li>• organize the elaboration of the Summary Econet Schemes, combining regional and local Econet schemes;</li> <li>• prepare a National report on the condition of the Econet formation once every five years;</li> <li>• support the development of international programmes and projects of technical assistance, involving foreign investments, and directed towards the formation of a national Econet;</li> <li>• raise public awareness about the condition and prospects of the Econet formation;</li> <li>• prepare proposals concerning the formation of the basic principles of state policy and mechanism of its realization in the sphere of preservation of landscape and biodiversity;</li> <li>• introduce the principles of the Econet approach as environment protection activity.</li> </ul>
MEP Directorate of Biotic Resources and Econet	<p>Provides, within its competence, ensures protection of landscape and biological diversity by the development, the protection and use of the national ecological network, and the maintainance of the Red and Green Book of Ukraine.</p> <p><a href="http://ecoline.kyiv.ua/participants/2008/43/">http://ecoline.kyiv.ua/participants/2008/43/</a></p>
State Agency for Protected Areas	<p>According to the Decree of the CMU # 1000 dated 9.08.2001 one of the main objectives of the State Agency for Protected Areas is the preparation of proposals on sustainable development of the representative network of protected areas and development of the national ecological network.</p>

State Ecological Inspection	According to the Decree of the CMU # 1520 dated 17.11.2001 one of the main objectives of the State Ecological Inspection is enforcement of demands of legislation in the area of environmental protection, rational use, rehabilitation and protection of nature resources, as well as ecological safety.
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<b>Regional and local level agencies</b>	<b>Mandate</b>
Local authorities of executive power and authorities of local self-governance	According to Article 11 of the Law “On Ecological Network”: <ul style="list-style-type: none"> <li>• elaborate and implement regional and local schemes and development programmes of Econet, and conduct the necessary research activities;</li> <li>• in accordance with the law, give financial and other support to owners and users of land areas located within the bounds of territories and objects of the Econet.</li> </ul>
Oblast Department of Land Resources	According to the Decree of the CMU # 200 dated 24.02.2003 the Oblast Main Department of Land Resources submits to the State Committee of Land Resources on development and realisation of organisational, economical, ecological and other actions, directed to the rational use of lands,..., maintaining landuse regimes for land set aside for nature protection, health, recreational and historical-cultural purposes.
Oblast MEP Department	According to the Order of the MEP #548 dated 19.12.2006 two of its main objectives are: <ul style="list-style-type: none"> <li>• Implementing the state policy in the area of environmental protection, sustainable use, rehabilitation and protection of nature resources,..., forming, protection and use of the ecological network;</li> <li>• managing and regulating environmental protection, sustainable use, rehabilitation and protection of nature resources, creation, protection and use of objects of the nature protected fund of Ukraine, forming, protection and use of the ecological network.</li> </ul>
Protected area administrations, State enterprises and associations of fisheries, hunting, forestry or Agrolis, NGO and private enterprises	At present, all entities mentioned in this category have no direct responsibility with regard to the establishment of eco-corridors mentioned in the law. Their role and contribution with regard to corridor development is established based on mutual agreement.

## APPENDIX 2. Overview of the current legal instruments related to the Ukrainian Ecological Network and eco-corridors

Instrument	Name	Responsible agency	Brief description of area covered
Law	On the Ratification of the European Landscape Convention (2005)	MEP	Subject to state protection and regulation in Ukraine are: environment; natural resources (land, water, soil, air, forest and other flora, fauna); landscapes; other natural complexes. The Law sets the ecological rights and duties of Ukrainian citizens. It determines authority, and standardization and normalization issues concerning environmental protection. The Law stipulates ecological requirements to be taken into account as part of development.
Law	Land code (2001 and amendments)	State Committee on Land Resources, adhering to requirements of legislation on land protection by the MEP.	<p>According to the Law the Nature Conservation Fund covers areas of special environmental, scientific, aesthetic, recreational and other value, with the purpose of preserving a natural variety of landscapes, flora and fauna, maintaining a general ecological balance and ensuring environmental monitoring. The Law refers to:</p> <ul style="list-style-type: none"> <li>• natural features (natural reserves, biosphere reserves, national parks, regional landscape parks, game reserves, natural monuments, unique terrain feature reserves;</li> <li>• artificial features (botanical gardens, dendrology parks, zoological parks, monuments of park and garden planning).</li> </ul> <p>The Law regulates the management, i.e. the organization, protection and use, of the natural conservation fund.</p> <p>The Law stipulates the regimentation of nature conservation fund territories and objects, according to scientifically grounded ecological requirements, and norms and rules determining legal status. It designates territories and objects and stipulates permissible activities (e.g. recreation).</p>
Law	On land utilization (2003) (On Land Management)	State Committee on Land Resources	The Strategy constitutes four main directives on biodiversity protection in Ukraine, including the creation of the National Econet. The Strategy sets out to establish Econets in the Carpathians and the Crimea mountain forests, endemic areas in need of biodiversity protection.

Instrument	Name	Responsible agency	Brief description of area covered
Directive of the CMU	On Approval of a Concept of the State Programme on Biodiversity Conservation for 2005-2025 (2004)	MEP	The decision approves the contours of a Concept of the State Programme on Biodiversity Conservation for 2005-2025 to be developed by the MEP, which is a mechanism for financing biodiversity conservation activities.
Law	On the State Programme of Ukraine's National Ecological Network Development for 2000-2015 (2000)	MEP	<p>The State Programme for Development of a Ukrainian National Ecological Network 2000-2015 has been developed in line with recommendations by the Pan-European Biological and Landscape Diversity Strategy (1995) on the development of a Pan-European Environmental Network. The principal goal of the Programme is to increase the area of Ukraine's natural landscapes to a level sufficient for the preservation of their diversity and as close to their initial natural condition as possible, to ensure natural migration and propagation of plant and animal species.</p> <p>The Programme formulates the objectives:</p> <ul style="list-style-type: none"> <li>• development of the national ecological network;</li> <li>• protection and restoration of land resources;</li> <li>• protection and restoration of water resources;</li> <li>• protection, use and restoration of the flora and fauna.</li> </ul> <p>The implementation of the Programme's actions shall be financed with funds from the State Budget of Ukraine, the Autonomous Republic of Crimea, local budgets, budgets labelled for environmental protection, as well as from other sources.</p>
Law	On the Ecologic Network of Ukraine (2004)	MEP	<p>The objective of the Econet legislation is to regulate the formation, preservation and inexhaustible utilization of the Econet, which is one of the most important preconditions to ensuring a stable, ecologically balanced development of Ukraine, protection of the environment, as well as satisfaction of present-day and prospective economic, social, ecological and other interests of society.</p> <p>The Law contains:</p> <ul style="list-style-type: none"> <li>• Definition of terms;</li> <li>• Principles of formation, preservation and utilization of the Econet;</li> </ul>

Instrument	Name	Responsible agency	Brief description of area covered
			<ul style="list-style-type: none"> <li>• Constituents of the Econet;</li> <li>• Right of property of lands and other natural resources in the Econet;</li> <li>• Administration of the Formation, Preservation and Utilization of the Econet;</li> <li>• Means of Providing for Formation, Preservation and Rational Utilization of the Econet;</li> <li>• Coordinating Board on Econet Formation;</li> <li>• Design strategies for the Econet;</li> <li>• Schemes on the Econet formation;</li> <li>• Lists of Territories and Objects of the Econet;</li> <li>• The order of inclusion into the Lists of Territories and Objects of the Econet;</li> <li>• Ensure finance for measures connected with formation, preservation and inexhaustible utilization of the Econet;</li> <li>• Access for citizens and civil organisations to information concerning the Econet;</li> <li>• International cooperation on formation, preservation and utilization of the Econet.</li> </ul>
Directive of the CMU	On establishment of the Coordinating Board for Development of the National Econet (2001)	MEP	The resolution established the Coordinating Board for Development of the National Econet, chaired by the Minister of Environmental Protection.
Directives of the MEP	Methodological recommendations (MR) for the development of regional and local ecological network schemes	MEP	The MR issued by the MEP of Ukraine (13.11.2009 №604). The MR have been prepared to provide assistance to the territorial authorities of the Ministry of Environmental Protection and other organizations and individuals interested in creating the Econet, and are recom-mandatory.
Law	On the moratorium on total logging on the slopes in fir (Abies)-beech forests in the Carpathian region (2000)	State Committee on Forestry and other owners or users of forested areas	Ban on logging as main use in forests, limitation on certain methods of logging and enforcement of moratoriums on logging.



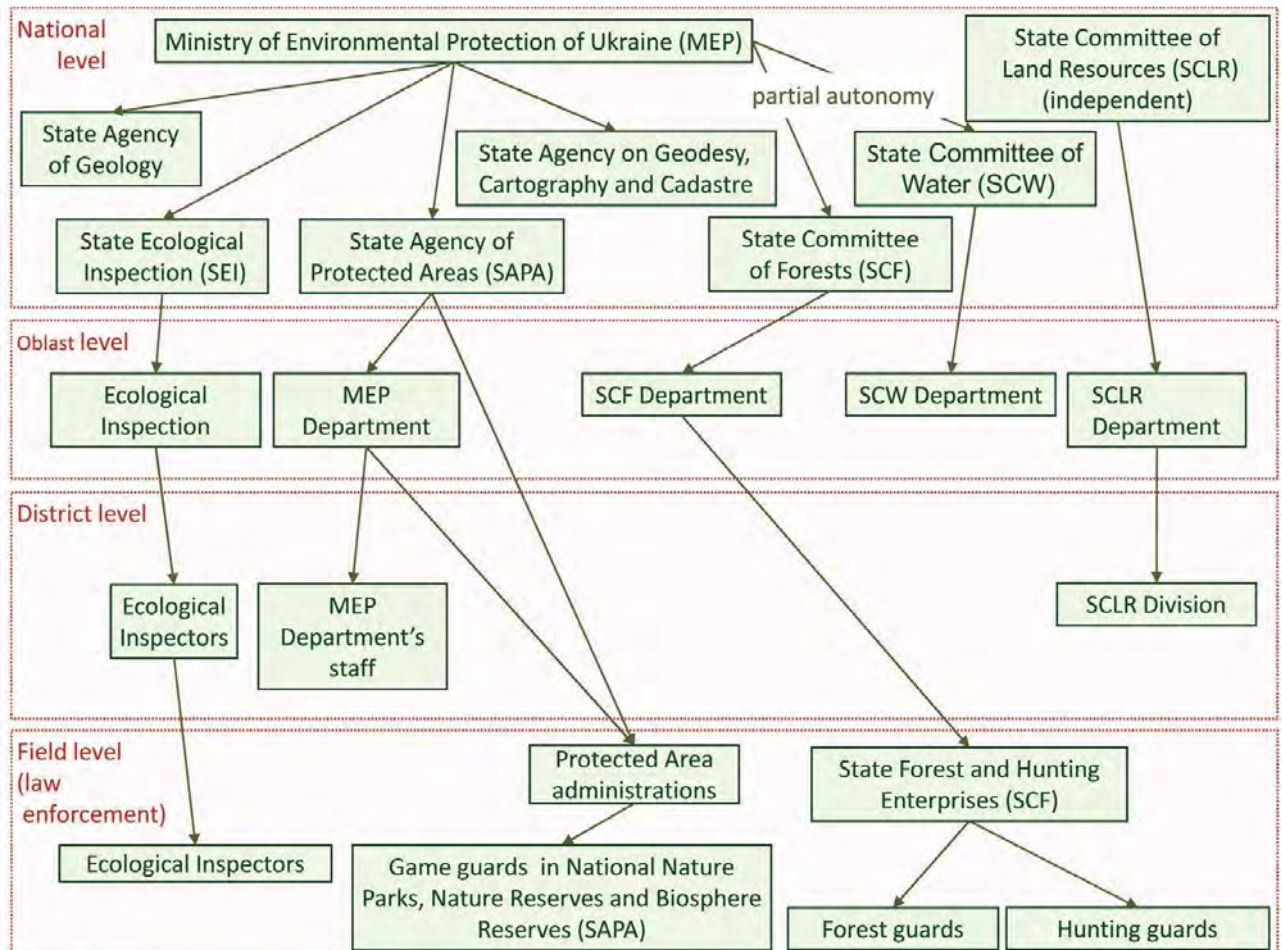
Instrument	Name	Responsible agency	Brief description of area covered
Law	On the General Scheme for Planning in the Ukrainian Territory (2002)	Ministry of Regional Development and Building of Ukraine, MEP	The Law approves the General Scheme for Planning in the Ukrainian Territory. The General Scheme will identify priorities in, and conceptual solutions for, the planning and use of areas of the country, to improve the system of settlement and ensure sustainable development of settlements, to develop industrial, social, engineering and transport infrastructure, and form the national ecological network. The Econet Schemes constitute part of the General Scheme for Planning the Ukrainian Territory, the Oblast General Schemes and Local General Schemes.
Law	On the Red Book of Ukraine	MEP	In accordance with the Red Book, the Law regulates protection, use and reproduction of rare and threatened biological species. The Red Book of Ukraine is an official state document, containing a list of rare biological species within the territory of Ukraine, its continental shelf and exclusive economic zone, as well as generalized data on the current state of these species, and measures taken to preserve and reproduce them.
Decree of the CMU	On the Green Book of Ukraine (2002)	MEP	The Green Book lists plant communities in need of protection, as well as measures for their protection, rehabilitation and use.
International Convention	The Framework Convention for the Protection and Sustainable Development of the Carpathians (2003)	MEP	The Carpathian Convention provides a framework for cooperation and multi-sectoral policy coordination, a platform for joint strategies in sustainable development, and a forum for dialogue between all stakeholders.
Ratification of the Protocol	The Protocol on Biodiversity Conservation to the Framework Convention for the Protection and Sustainable Development of the Carpathians (2009).	MEP	The objective of the Protocol on Conservation and Sustainable Use of Biological and Landscape Diversity is to enhance conservation, restoration and sustainable use of biological and landscape diversity in the Carpathians, bringing benefits to present and future generations.

Instrument	Name	Responsible agency	Brief description of area covered
Law	On the Ratification of the European Landscape Convention (2005)	MEP	The goals of the Convention are to promote landscape protection, management and planning, and to organize European co-operation on landscape issues.
Law	Land code (2001 and amendments)	State Committee on Land Resources, adhering to requirements of legislation on land protection by the MEP.	The Land Code of Ukraine regulates ownership, use and disposal of land. Ukraine land is divided into 9 categories, defined according to their land use designation. One category is formed by land earmarked as natural reserve or under other environmental protection. These are areas of ecological, scientific, aesthetic, recreational and other value, and may be in state, communal, or private ownership. Ukraine territory is protected by the state. State control over use and protection of lands will be carried out by authorized bodies with executive power, adhering to the requirements by legislation on land protection. Change in land use category of lands shall be authorized by bodies of executive power or bodies of local self-government. Change of land use category of lands owned by legal entities or natural persons shall be conducted on their initiative.
Law	On land utilization (2003) (On Land Management)	State Committee on Land Resources	The present Law determines legal and organizational frameworks for activities in the field of land utilization. The Law aims to regulate relations between government, bodies of local self-governance, legal entities and individuals, to ensure sustainable development and land utilization. The Law establishes the right to utilize land, regardless of the form of ownership, in particular, when establishing and changing borders of land utilization objects, including identifying and establishing Ukraine's state border, and when allocating, withdrawing (buying out), and alienating land plots. The Law also identifies the procedure for land utilization at state, regional and local level. Forests located within the border of the Ukrainian territory are subject to ownership rights by the Ukrainian People. On behalf of the Ukrainian People, for forests rights of owners are exercised by government bodies and bodies of local self-government.

Instrument	Name	Responsible agency	Brief description of area covered
Law	Forest Code (1994 and amendments)	State Committee on Forestry	<p>Articles 26-33 of the Forest Code establish powers of government bodies and bodies of local self-government in dealing with forests.</p> <p>Section 11 of the Forest Code shows the procedure for changing the designation of land forest plots, and for identifying places for building, which influence the state and reproduction of forests.</p> <p>The procedure for managing forests is identified in its Chapter V.</p> <p>Forest resources can be used according to the procedure for general or special use of forests.</p> <p>Citizens have the right to freely stay in forests, to collect wild grasses, herbs, flowers, berries, nuts, and mushrooms in forests in state and municipal ownership without a special permit and free of charge, as well as upon consent of the owner of forests that are private property.</p>
Law	Water Code (1995)	State Committee on Water Industry	<p>All waters in Ukraine are part of the national wealth of the Ukrainian people, a natural ground for their economic development and social welfare. Waters are exclusive property of the Ukrainian people and can only be granted for use.</p> <p>Water protection zones are established along rivers, seas and around lakes, water reservoirs and other ponds for their favourable treatment, to prevent pollution, litter, exhaustion, elimination of water plants and animals, as well as to reduce variation in flow and water level. In some cases mining of sand and gravel may be permitted in a water protection zone, upon agreement between the state bodies on environmental protection, protection of water economy and geology.</p>
Direction of a Head of the Lviv Oblast State administration	On approval of membership of the Coordination Board on Econet development in Lviv Oblast (2007)	MEP department in Lviv Oblast	<p>The structure and members of the Coordination Board on Econet Development in Lviv Oblast were approved.</p>

Instrument	Name	Responsible agency	Brief description of area covered
Decision by the Lviv Oblast Council	On actions directed to gain special protection of rare plants in Lviv Oblast (2003)	MEP department in Lviv Oblast	The actions directed to gain special protection of rare plants in Lviv Oblast were approved.
Decision by the Lviv Oblast Council	On actions directed to gain special protection of rare and endangered fauna species in Lviv Oblast (2007)	MEP department in Lviv Oblast	The actions directed to gain special protection of rare and endangered fauna species in Lviv Oblast were approved.
Decision by the Lviv Oblast Council	On approval of regional programme for Econet Development in Lviv Oblast for 2007-2015 (2007)	MEP department in Lviv Oblast	The Regional Programme for Econet Development in Lviv Oblast for 2007-2015 was approved.
Decision by the Lviv Oblast Council	On approval by the Regional Programme on Development of Protected Areas in Lviv Oblast for 2009-2020 (2008)	MEP department in Lviv Oblast	The Regional Programme on development of protected areas in Lviv Oblast for 2009-2020 was approved.

**APPENDIX 3. Organigramme MEP (with reference to corridor establishment and management)**



#### **APPENDIX 4. Article 5 of the Law of Ukraine “On the ecologic network of Ukraine” (2004)**

The ecological network structural components include:

- (a) territories and objects of the natural-reserved fund;
- (b) water fund lands, water and wetlands, water protection areas;
- (c) forest fund lands;
- (d) tree belt areas and other protected planting not included in the forest fund lands;
- (e) health resort lands and their natural resources;
- (f) recreation lands used for the organization of mass recreation, tourism, and sports events;
- (g) other natural territories and areas (step registration areas, pastures, hayfields, stone fields, sands, saline fields, and land plots containing objects of particular natural value);
- (h) land plots with natural vegetation as included in the Green Book of Ukraine;
- (i) territories harbouring fauna and flora species included in the Red Book of Ukraine;
- (j) selected types of agricultural land including: pastures, meadows, hay fields, etc;
- (k) radioactively polluted lands which are not used and are to be specially protected as natural regions with a separate status.

**APPENDIX 5. System of criteria for the selection of eco-corridors (source: Methodological Recommendations of the MEP, MEP's Order of 13.11.2009 № 604)**

<b>Index</b>	<b>Criterion of</b>	<b>Signs of criteria correspondence</b>
Ec-n	Naturalness	An eco-corridor must have natural boundaries.
Ec-l	Efficient length	The length of an eco-corridor must not exceed nor be shorter than the distance migrated and the area inhabited by the species the ecological network is meant to preserve; the eco-corridor must contain islands where this species can stay temporarily, before continuing migration or dispersal.
Ec-w	Efficient width	The width of an eco-corridor must enable populations to disperse and migrate within its boundaries with the necessary efficiency.
Ec-e	Ecotopic	The eco-corridor must be similar in edaphic conditions to key territories it connects, or provide conditions for temporary stay (overnight stay, feeding, etc.) for species covering long distances when migrating (i.e., birds).
Ec-t	Territorial connection	The eco-corridor territory must be continuous, or in case of disruptions: their length must not prevent species from migrating.
Ec-d	Biodiversity	The eco-corridor must have vegetation which is quite well preserved and with a high level of biodiversity.
Ec-s	Bio-sociologic	The eco-corridor may include sections with rare, endemic, or relict species of animals and plants, or rare plant groups which, for some reason, are absent in the ecological network's key territories.

## APPENDIX 6. Article 25 of the Law of Ukraine “On Landuse Management Documentation” (2003)

### Article 25: Land development documentation

There are programmes, schemes, projects, special theme maps, atlases, as well as technical documentation, dealing with land development. Types of land development documentation used, are:

- (a) national and regional (republican) programmes for land use and protection;
- (b) schemes of land development and technical and economic justifications for the use and protection of land as used by administrative and territorial units;
- (c) land development projects for establishing and changing boundaries of administrative and territorial units;
- (d) land development projects for organizing and establishing boundaries of natural-reserved fund areas and of areas with other nature protection purposes, or health, recreation, historic and cultural purposes;
- (e) land development projects for the forming of land under communal ownership by territorial communities and projects for the separation of land between state and communal ownership;
- (f) land development projects for the allocation of land plots;
- (g) land development projects for creating new and improving existing land ownership and land use;
- (h) land development projects for ensuring environmental and economic justification for crop rotation and land improvement;
- (i) land development projects for improving community territories;
- (j) working land development projects for the recultivation of disturbed land, the improvement of land with low productivity, the protection from erosion, floods, waterlogging, secondary salination, drying, landslides, oxidation, pollution with industrial and other waste, radioactive and chemical substances, as well as the improvement of agricultural land and soil fertility (hereinafter referred to as the working land development projects);
- (k) land development technical documentation for establishing the boundaries of a land plot (field);
- (l) land development technical documentation certifying the rights to a plot of land;
- (m) special theme maps and atlases of land condition and its use.

The composition and content of land development documentation, as well as the rules on its preparation and utilisation, are established in specific and relevant normative and technical land development documents.



## APPENDIX 7. Ecological profiles of the European Brown Bear, European Bison, Lynx and Wildcat



### Ecological profile

#### Conservation status

#### Brown Bear (*Ursus arctos* Linnaeus, 1758)

- Bern Convention: Annex II
- CITES: Annex II
- Habitats Directive: Annex II/IV
- Red Data Book of Ukraine (2009): vanishing

#### Status in the Carpathians

The total Carpathian bear population was estimated in 2004 at approximately 8100 animals<sup>18</sup>. The Brown Bear occurs in two areas of the Ukrainian Carpathians, in the western Carpathians (the mountain region near the Polish border) and in the eastern Carpathians (near the Romanian border).

#### Status in Ukraine

In the 1970s the population of the Brown Bear consisted of more than 1300 individuals in the Ukrainian Carpathians (0.5-0.7 bears per 10 km<sup>2</sup>), but a considerable decline was recorded in subsequent years. The current Ukrainian population is estimated at 350 individuals. The highest densities were found in

<sup>18</sup> this estimate is based on older data than the estimates presented in section Error! Reference source not found.

<sup>19</sup> spending part of their life cycle underground in holes

	the north-western areas (Skolivski Beskydy): 0.43-0.54 bears per 10 km <sup>2</sup> . The estimated maximum home range needed for male and female bears in the Carpathians is 200 and 50 km <sup>2</sup> , respectively.
Relief	Steep slopes with cavy rock formations and gorges covering at least 10-20% of the area, providing daily refuges and dens for hibernation and breeding.
Forest cover preference	Bears prefer mature to aged forests, covering at least 70% of their home range, with dense forest, shrubs, fallen trees, quills and gorges to provide sufficient shelter and hideouts. They do not show real preference for a specific forest composition. Some individuals (especially females) hibernate in periods of strong frost (January to February). Before hibernating they stay close to beech forests (particularly in mast years), or in the river valleys, where the Artiodactyls concentrate.
Food availability	The Brown Bear is omnivorous. Its diet changes with seasonal availability of food sources. The bears feed on a wide variety of plant foods, including grasses, roots, moss, and bulbs. Fruits, nuts, berries, bulbs, and tubers are consumed during the summer and in the early autumn. Carrion, insects, fungi, and roots, as well as mice and other fossorial <sup>19</sup> animals, are consumed year round. Bears move up and down the mountain slopes seasonally, following the phenology.
Human activity and related factors	Selective cutting and small scale clear-cutting without soil disturbance stimulate herbal and sapling growth, which has a positive effect on bear habitat. Bears may be responsible for inducing wildlife-human conflicts when preying on livestock to supplement their natural diet. Often concentrated near road infrastructure, human activities, such as hunting, recreation and transport, cause disturbance.
<b>Ecological profile</b>	<b>European Bison (<i>Bison bonasus</i>, Linnaeus, 1758)</b>
References	Anon. 2004, Maanen et al. 2006, Ray et al. 2005, Servheem 1998, Slobodian 1988 and 1993.
Conservation status	<ul style="list-style-type: none"> <li>• Bern Convention: Annex III</li> <li>• Habitats Directive: Annex IV</li> <li>• European Red List: V</li> <li>• Red Data Book of Ukraine (2009): extinct in the wild</li> </ul>
Status in the Carpathians	The Carpathian subspecies of the European Bison is extinct, but a hybrid of the Lowland/Caucasian subspecies has been reintroduced in the Carpathians in several places.
Status in Ukraine	Two populations remain, in Beskydy and Bukovyna, totalling approximately 100 individuals.
Relief	In the Carpathians the European Bison prefers foothill forests. During winter the sunny slopes are preferred, in hot summers, the cold slopes. Bison avoid areas with a snow cover over 70-100 cm; for this reason 1000 m altitude usually forms its limit. Rivers form no barrier for bison, however they rather avoid swimming.



Forest cover preference	<p>Natural habitats of the European Bison are temperate forests and forest-steppe areas. Deciduous and mixed forests are the most suitable habitats, but coniferous stands and young coniferous stands (e.g. thickets with a close canopy, which can provide shelter in harsh conditions) are often selected by the bison in winter. In mountains, animals usually concentrate in river valleys which include open areas (meadows, glades, young plantations of up to 10 years old). In the Carpathians, preferred European Bison habitat consists of about 80% forest and 20% open pasture or glades.</p>
Food availability	<p>Its diet shows seasonal variability. Bison aggregate into large groups during winter, normally around areas where humans regularly leave hay out for them. During the rest of the year, bison are primarily grazers (accounting for 95% of feeding time), though they occasionally browse (3%) or eat bark (2%). Important winter food in the Carpathians is bramble (<i>Rubus hirtus</i>).</p>
Human activity and related factors	<p>Extensive and rotated grazing by livestock contributes to maintenance of meadows through continuous regrowth of nutritious herbs and grasses. Selective cutting and small scale clear-cutting without soil disturbance stimulate herbal and sapling growth. Disturbance by hunters, recreants, and transport, facilitated by road infrastructure, has a negative impact on bison.</p>
References	<p>Bashta 2004, Krasinska 2007, Kuijper <i>et al.</i> 2009, Pucek 2004.</p>

**Ecological profile****Lynx (*Lynx lynx*, Linnaeus, 1758)**

## Conservation status

- Bern Convention: Appendix III
- CITES: Appendix II
- Habitats Directive: Annex II/IV
- Red Data Book of Ukraine (2009): rare

## Status in the Carpathians

The Carpathian population is estimated at about 2500 individuals. Male territories are maximally 200 km<sup>2</sup> and female territories 100 km<sup>2</sup>. The smallest home range found in the Carpathians is 20 km<sup>2</sup>. The lynx is a rare species in the Eastern Carpathians. It sporadically occurs throughout the region, mainly in the Gorgany, Svydovets, Chornohora, and Beskydy mountain massifs.

## Status in Ukraine

The lynx population has stabilized in recent years in the Ukrainian Carpathians and this population is estimated at about 300 individuals. The density of the Lynx is estimated at 1.3 individuals per 100 km<sup>2</sup> in the Skolivski Beskydy NNP, which is lower than the density in the Romanian Carpathians (3.9 indiv./10 km<sup>2</sup>).

## Relief

The Lynx occurs in forested, mountainous regions, but avoids areas which have high snow cover for long periods of time in winter. Lynx prefer steep slopes and ridges, which may be used to monitor the area. The largest mountain rivers may be almost insuperable barriers for the Lynx.

## Forest cover preference

Lynx occur in large forests with plenty of dense shrub, fallen trees, caverns as well as forests intercalated with patches of meadow and pasture. They show a preference for coniferous forests in the Carpathians, and often live in border zones between deciduous and coniferous forests as well as in swamp areas.



Food availability	Lynx are strictly carnivorous, feeding primarily on mammals and ground-dwelling birds. Mammalian prey includes roe deer, hares, squirrels and sometimes chamois, chamois or red deer calves, and Wild Boar piglets. Lynx may also kill other small predators like foxes, wildcats, and racoon dogs. Roe deer are regarded as main prey species and should be present in a density higher than 25 animals per 10 km <sup>2</sup> .
Human activity and related factors	Lynx are found far from dense human populations, since they are very sensitive to human disturbance.
References	Anon. 2004, Maanen <i>et al.</i> 2006, Ray <i>et al.</i> 2005, Turianyn 1988



<b>Ecological profile</b>	<b>Wildcat (<i>Felis silvestris</i> Schreber, 1775)</b>
Conservation status	<ul style="list-style-type: none"> <li>• CITES: Appendix II</li> <li>• Bern Convention: Appendix II</li> <li>• Habitats Directive: Annex IV</li> <li>• Red Data Book of Ukraine (2009): vulnerable</li> </ul>
Status in the Carpathians	Little is known about the population status of this animal, but the Carpathian population is considered important for conservation, as the degree of hybridisation with the domestic cat is low. Generally the Wildcat is vulnerable.
Status in Ukraine	The largest Wildcat population of Ukraine is found in the Carpathian region, but their density is very low (0.13 indiv./10km <sup>2</sup> ) in the Skolivski Beskydy NNP.

Relief	Clear preferences for relief peculiarities were not discovered, high densities could be found in hilly areas, where the concentration of prey species is higher. Snow cover seems to be the most critical factor affecting distribution. A snow layer of more than 20 cm impairs locomotion. Wider mountain rivers may be almost insuperable barriers for the Wildcat.
Forest cover preference	The Wildcat is associated with deciduous and mixed forests with rich undergrowth. It avoids entering dense and large forests. It often uses ecotonal areas: forest edges bordering fields and meadows, forest glades, riparian bush thickets, borders of swamps and mountains with pastures and scrubs. In the Carpathian region, riparian forests and their surroundings are key elements for Wildcat presence.
Food availability	The Wildcat is an adept predator, feeding on rodents, hares, and to a lesser extent on birds, young ungulates, reptiles, amphibians, eggs, large insects and arachnids.
Human activity and related factors	Small scale clear-cutting seems to be favourable for the Wildcat. One of the most serious threats to the species seems to come from feral domestic cats, not only through hybridisation, but also because of the spread of diseases such as the feline leukaemia virus. Other threats are poaching and habitat alteration (especially the cutting of riparian forests).
References	Bashta and Potish 2005, Klar 2008, Nowel and Jackson 1996, Turianyn 1988.

**APPENDIX 8. Guidelines for interviews with stakeholders**

	Stakeholders				
	(1) land-owners	(2) land users	(3) resource user groups	(4) local and regional public authorities	(5) other stakeholders
<b>Interviewee</b>					
Name, Surname	x	x	x	x	x
Organization			x	x	x
Address	x	x	x	x	x
Area of interest or jurisdiction			x	x	x
<b>Geography</b>					
Area (ha) of owned or used land plots	x	x			
Location of plots	x	x			
Identification of plot borders on the map	x	x			
<b>Land use</b>					
Current use of plots (species of cultures, the best cultures for his plot, etc)	x	x			
Stakeholder's interests and plans to own and/or use the plot in perspective	x	x			
Technologies used for tillage	x	x			
Production and income of the plot	x	x			
Machineries used for tillage		x			
Problems experienced in current land use			x	x	x
Existing local/regional land use policy				x	
Existing public plans that may support or conflict with eco-corridor creation				x	
<b>Wildlife</b>					
Cases of wild animals crossing through the plots (species, frequency, timeframe)	x	x			
Relation of a farmer and his neighbours to these cases	x	x			
Cases of killing of animals in communities					

	Stakeholders				
	(1) land-owners	(2) land users	(3) resource user groups	(4) local and regional public authorities	(5) other stakeholders
<b>Attitude</b>					
Stakeholder's perception of government policy					
Stakeholder's attitude towards establishment of eco-corridors	x	x	x	x	x
Stakeholder's identification of problems and bottlenecks in establishment of eco-corridors	x	x	x	x	x
Investigate various options for eco-corridor borders and management	x	x	x	x	x
Stakeholder's opinion if his plot is within an eco-corridor	x	x			
Stakeholder's objections to be within an eco-corridor	x	x			
(Political) attitude/opinion towards eco-corridors			x	x	x
<b>Solutions</b>					
Stakeholder's expectations from establishment of an eco-corridor	x	x	x	x	x
Stakeholder's conditions to be within an eco-corridor	x	x			
Investigate various options for eco-corridor borders and management if stakeholder's plots are within the eco-corridor	x	x			
Formulate solutions (or: identify possible solutions) in consultation with the stakeholder on establishment and management of eco-corridors	x	x	x	x	x
Which methods of natural habitats management are used by landowners and land users.	x	x			
What are recommendations on involvement of stakeholders with natural habitats management in the eco-corridor management	x	x	x	x	x
Possibilities for joint realization of local plans and eco-corridors				x	



### APPENDIX 9. Corridor connectivity analysis of Turkivskiy eco-corridor

Survey and analysis August 2008 to May 2009 by Andriy-Taras Bashta, Stefan Tatukh

Name	(I) Area between Polish border, Sianky and Verkhniy Turiv	(II) Verkhniy -Turiv bottleneck area	(III) Area between Borynia and Verkhniy Turiv villages	(IV) Nyhnia Yablunka - Borynia bottleneck area)
Legal status	Lands owned by state agencies as well as private. Mainly under protection of Nadsianskyi RLP	State, private. No conservation area	State, private. No nature protection objects	State
Name of owner	State forest administration in Lviv region; Galsillis, Sianky and Nyzhniy Turiv village councils	Nyzhniy Turiv village council	State forest administration in Lviv region; Galsillis, Borynia and Verkhniy village councils	State forest administration in Lviv region
Other stakeholders	Frontier troops, Nadsianskyi RLP	Enterprise Halsillis	Private owners	No (excepting the road)
Attitude of owner and users to eco-corridor	Mainly positive	Different	Different, mainly positive	Rather positive
Land cover	About 80-90% forest, as well as pasture, cultivated land	Forest 10%, pasture 90%	About 65% forest, as well as pasture, cultivated land	Forest 100%
Land use	Forestry, cultivation	Livestock grazing	Forestry, cultivation	Forestry
Bison habitat suitability status	About 90% of the area has over 50% suitability	25% of the area has up to 40%, and 75% has over 41% suitability	About 50% of the area has over 51% suitability	About 100% of the area has over 61% suitability
Bear habitat suitability status	About 50% of the area has over 50% suitability	About 25% of the area has no suitability, 65% has 1-40, and 10% has 41-50% suitability	Up to 45% of the area has over 41% suitability	About 50% of the area has 51-60%, 25% has 1-40%, and 25% has 41-50% suitability
Lynx habitat suitability status	About 25% of the area has 51-60% and 20% has 41-50% suitability	About 75% of the area has no suitability	About 30% of the area has 41-50% suitability	About 50% of the area has 1-40% suitability and 50% has 41-50%

Name	(I) Area between Polish border, Sianky and Verkhniy Turiv	(II) Verkhniy -Turiv bottleneck area	(III) Area between Borynia and Verkhniy Turiv villages	(IV) Nynhia Yablunka - Borynia bottleneck area)
Wildcat habitat suitability status	About 80% of the area has over 50% suitability	About 35% of the area has 1-40% suitability , 65% has more than 41% suitability	About 45% of the area has over 50% suitability	About 90% of the area has over 51% suitability
Presence of wildlife and related incidents	Brown Bear, Wildcat, Red deer, Roe deer, Wild Boar	?	Red deer, Roe deer, Wild Boar	Red deer, Roe deer, Wild Boar
Current barriers	The border fence in some places	Narrowness of eco-corridors (tree and bush lines) in some places	Roads, pastures	Local road between the villages Nyzhnia, Yablunka and Borynia
Current and future threats	Poaching, railway accidents, changes of land use methods, conflict with people, livestock predation, fragmentation of forest habitats	Poaching, livestock predation, railway accidents, agriculture intensification, forest destruction, fence establishment (especially across forest strips)	Poaching, large clear felling, increase in traffic; different types of disturbances; fragmentation of forest habitats	Collisions with cars, poaching, livestock predation, agriculture intensification and extension, deforestation
Required land use changes	Removal of border fences	Avoidance of field creation close to the tree-bush lines	Creation of continuity of forested areas	No
Required land status and ownership changes	No	Purchase of land in areas with private ownership of forest strips	No	No
Required landscape changes	No	Broadening and extension of forest strips	No	Increasing the forest area in the south-western part of the bottleneck
Additional measures	Limitation of train speed, law enforcement, limitation of forestry activities during periods of increased animal movement	Prohibition to destruct forest strips, limitation of continuous fences (especially across forest strips), creation of new forest and forest strips, law enforcement, establishment of signs indicating eco-corridors	Law enforcement, establishment of signs indicating eco-corridors	law enforcement; establishment of signs to indicate eco-corridors

Name	(V) North-eastward of Borynia	(VI) Ilnyk - Rykiv Bottleneck area	(VII) Rykiv - Bahnuvate bottleneck area	(VIII) Area bordering Skolivski Beskydy NP
Legal status	State	State	State. Very close to the NP "Skolivski Beskydy".	State and private
Name of owner	State forest administration in Lviv region, Galsillis, Borynia, Yabluniv and Ilnyk village councils	Galsillis	State forest administration in Lviv region	State forest administration in Lviv region
Other stakeholders		Ilnyk and Rykiv village councils	Rykiv village council	Galsillis, Rykiv village council
Attitude of owner and users to eco-corridor	Different. Mainly uncertain	Different. Mainly positive	Rather positive	Rather positive
Land cover	Forest: 70%	Forest: 50%, meadows: 50%	Forest: 90%, meadows: 10%	Forest: > 90%
Land use	Forestry, cultivation, pasturing	Forestry, pasturing	Forestry	Forestry
Bison habitat status	About 90% of the area has over 50% suitability	About 45% of the area has over 40% suitability and 55% has less than 40% suitability	100% of the area has over 50% suitability	More 90% of the area has over 50% suitability
Bear habitat status	About 50% of the area has over 50% suitability	About 35% of the area has over 40% and 65% has less than 40% suitability	About 70% of the area has 41-50% suitability	About 80% of the area has over 50% suitability
Lynx habitat status	About 40% of the area has 41-60% suitability	About 45% of the area has < 40%, 45% has 0%, the rest has > 41% suitability	About 65% of the area has 41-50% suitability	About 80% of the area has over 50% suitability

Name	(V) North-eastward of Borynia	(VI) Ilnyk - Rykiv Bottleneck area	(VII) Rykiv - Bahnuvate bottleneck area	(VIII) Area bordering Skolivski Beskydy NP
Wildcat habitat status	About 90% of the area has over 50% suitability	About 55% of the area has over 40% and 45% has less than 40% suitability	About 70% of the area has 50% suitability	About 90% of the area has over 50% suitability
Presence of wildlife and related incidents	Artiodactyls	Wildcat, Red deer, Roe deer, Wild Boar; Lynx and Bear in the past	Bison, Wildcat	Bison, Brown Bear, Wildcat, Lynx
Current barriers	No insurmountable barriers. River for cat	Small river, open areas	No insurmountable barriers, apart from road.	No insurmountable barriers
Current and future threats	Poaching, collisions with cars, forest fragmentation	Poaching, livestock predation, agricultural intensification, large scale deforestation.	Poaching, livestock predation, agricultural intensification, large scale deforestation.	Poaching, forest fragmentation
Required land use changes	No	No	No	No
Required land status and ownership changes	?	?	No	No
Required landscape changes	Creation of continuity of forested areas	Increasing of the forest areas	No	No
Additional measures	Law enforcement, establishment of signs to indicate eco-corridors	Limit fences between forest and crop land, law enforcement against poaching	Law enforcement	Law enforcement

### APPENDIX 10. Corridor management matrix

	Measures	(I) Border	(II) Forestry area	(III) Protected enterprise area	(IV) Agrolis area	(V) Agricultural area	(VI) Roads, railroads	(VII) Water bodies
<b>1. General</b>	a. Promote public awareness on ecological networks and eco-corridors	<b>(everywhere)</b>						
	b. Establish corridor signs in crucial and visible places							
	c. Monitor and assess environment and management							
	d. Evaluate management plan every 3 years							
	e. Organise information meeting for stakeholders on establishment of eco-corridor							
	f. Amend job responsibilities related to eco-corridor							
	g. Promote cross border cooperation by exchanging good practices, coordinating connectivity, and by common law enforcement							
	h. Develop funding mechanisms							
	i. Establish a tourism strategy (proposed : no tourism in eco-corridor for the first three years)							
<b>2. Law enforcement</b>	a. Enforce water code of Ukraine along Stryi, Zawadka, and Sian	yes	yes	no	yes	yes	no	yes
	b. Support law enforcement in eco-corridors	yes	yes	yes	yes	yes	yes	yes
	c. Reduce vehicle and train speed on roads and railways crossing eco-corridors	no	no	if applicable	no	no	yes	no
	d. Strengthen anti poaching: reallocate law enforcement resources, establish village based information network	yes	yes	yes	yes	yes	no	no
	e. Control pollution	yes	yes	yes	yes	yes	yes	yes
	f. Increase fines for poaching	yes	yes	yes	yes	yes	yes	yes
<b>3. Land use management</b>	a. Traditional agricultural land use (recommended mainly cattle and sheep, hay making, pasturing, and limited cultivation to avoid conflicts between farming and wildlife)	yes	no	no	no	yes	no	no



## APPENDIX 11. Corridor information card of the Turkivskiy eco-corridor

Corridor code	1-s/m-LV
Corridor name	Turka eco-corridor
Protected areas connected	Skolivski Beskydy NNP, Nadsianskyi RLP, Bieszczady National Park (Poland), Skhidni Karpaty Biosphere Reserve
Eco-corridor level (national/regional/local)	Local
Geographic coordinates	From the West: 49°04.573'N, 22°52.162'E From the East: 49°02.828'N, 23°13.494'E
Geographic location	Turka Rayon; Lviv region; Borynia, Nizhniy Turiv, Verkhniy Turiv, Rykiv, Verkhnie, Nyzhnie Vysotske, Nyzhnia Yablunka, Ilynyk, and Bahnovate village
Area in ha	7922
Physical and geographic conditions	<p>According to the <u>tectonic</u> regionalisation of the Ukrainian Carpathians, the eco-corridor is located in the Silesian (Krosno) zone (Burov, 1972). The area is characterized by alluvial, eluvial, deluvial, proluvial, and gravitational deposits of the Lower, Middle, and Upper Pleistocene, as well as the Holocene and by modern deposits. Valleys of small streams are normally filled with sand and loam containing pebbles (Prots-Kravchuk, 1972). According to the <u>geomorphological</u> regionalisation of the Ukrainian Carpathians, the eco-corridor is located in the Stryi-Sian Verkhovyna region of the Vododil-Verkhovyna province (Tsys, 1972).</p> <p><u>Hydrological Conditions and Water Resources.</u> The hydrological network is part of the Dniester basin and only the extreme western part lies in the Baltic Sea basin (the Sian-Vistula river basin). The eco-corridor territory is intersected by the Main European Water Divide. All the rivers flow along the Carpathians, their beds in easily erodible rocks. River alimentation is mixed: snow contributes 50%, rain 44%, and ground alimentation is just 6%. Water levels rise three times a year in all rivers. There are spring floods, summer floods caused by precipitation, and winter level rises due to thaw. The eco-corridor is intersected by two rivers: the Stryi and the Zavadka, which are the largest tributaries of the Dniester River.</p> <p><u>Climate.</u> The number of sunshine hours totals 1,480 to 1,500 hours at 400 - 700 m above river level, and up to 1,100 to 1,200 hours at 1,000 - 1,300 m above river level. Western winds are dominant. The average annual wind speed is between 1.8 and 2.7 m/s. The territory has a temperate continental climate with warm summers, soft winters, warm autumns, and excessive and sufficient moistening. The average annual air temperature varies from 5.2 to 7°C. The temperature regime is not stable, with winter thaws during which the air temperature may be higher than 10°C, even in January. The average daily air temperature is above 0°C (warm period) for a period of 249 - 267 days a year. The average duration of the period without frost is less than 120 days a year.</p> <p>The annual amount of precipitation ranges from 844 to 1,673 mm with the average amount of precipitation being 841 - 960 mm. Snow occurs in valleys for 100 - 110 days and for less than 130 days on mountain tops. On average,</p>

	<p>snow depth is 33 - 80 cm, while soil freezes to between 33 and 45 cm. <u>Soil</u> cover in the region. The region is dominated by brown forest, sod-brown, and brown podzolic soils; small areas are covered with meadow brown soils as well as sod, bog, and mountain soils (Andrushchenko, 1958). Brown forest soil, which has formed on slopes of varying steepness and aspect under beech, fir, spruce, and mixed forests, covers 54% of the area in Turka Rayon.</p>
Plant biodiversity	<p>This region belongs to the floristic region of the Eastern Beskydy and Low Polonyny, which is dominated forest species. Some alpine plants occur at relatively low altitudes (1000-1500 m a.s.l.) such as Alpine Leek <i>Allium victorialis</i>, Stemless <i>Gentian</i> <i>Gentiana acaulis</i>, Viper's Grass <i>Scorzonera rosea</i>. Endemic and sub-endemic plant species are <i>Aconitum moldavicum</i>, <i>Campanula abietina</i>, <i>Carduus bicolorifolius</i>, <i>Rumex carpathicus</i>, <i>Sedum carpathicum</i>, <i>Dianthus compactus</i>, <i>Dentaria glandulosa</i>, <i>Leucanthemum rotundifolium</i>, <i>Petasites kablikianus</i>, <i>Symphytum cordatum</i> and <i>Viola declinata</i>. Vascular plants includes about 850 species from 370 genera and 100 families. The vegetation structure has the characteristics of moderate forest vegetation of low mountain systems with undeveloped subalpine and alpine altitudinal belts. The floristic vegetation composition is typical for the forest belt of the Ukrainian Carpathians. About 60 plant species of the region are included to the Ukrainian Red Data Book (2009).</p>
Vegetation description	<p>Originally, the area was almost fully covered with forest, dominated by beech-fir (50%) and spruce-fir-beech (29%) stands. Currently these account for only 0.8%, their surface having been reduced more than 10 fold (i.e. 10.9). Planted spruce forests now cover 14 - 21% of the area. As a result of economic activities, the forested area has been reduced to 47.5%. Forests have been transformed into shrub lands, meadows, and fields, as well as into land plots for building development. In all, 40.5% of land has been transformed into agricultural land, with cultivated land and meadows in near equal measure.</p> <p>The forested area in the eco-corridor amounts to 6,690 ha; agricultural land covers 1,232 ha; water 96 ha.</p>
Animal biodiversity	<p>The region has a rich and varied animal biodiversity including lowland and mountain species occur due to the variation in the landscape. Twelve amphibian species are found and fire salamander <i>Salamandra salamandra</i>, Carpathian newt <i>Lissotriton montadoni</i>, Alpine newt <i>Mesotriton alpestris</i>, Fire-bellied toad <i>Bombina variegata</i> are included to the Ukrainian Red Data Book (2009). Grass snake <i>Natrix natrix</i>, Common viper <i>Vipera berus</i>, Aesculapian snake <i>Zamenis longissimus</i>, Sand lizard <i>Lacerta agilis</i>, Viviparous lizard <i>Zootoca vivipara</i> are typical reptilian species of the area. The birds of the region includes about 170 bird species and 24 of them are included in the Red Data Book (e.g. Golden eagle <i>Aquila chrysaetos</i>, Lesser spotted eagle <i>Aquila pomarina</i>, Black Stork <i>Ciconia nigra</i>, Ural owl <i>Strix uralensis</i>, Great grey shrike <i>Lanius excubitor</i>). Buzzard <i>Buteo buteo</i>, Hazel grouse <i>Bonasa bonasia</i>, Black woodpecker <i>Dryocopus martius</i>, Tree-toed woodpecker <i>Picoides tridactylus</i>, Dipper <i>Cinclus cinclus</i>, Crossbill <i>Loxia curvirostra</i>, Grey wagtail <i>Motacilla cinerea</i>, Tawny owl <i>Strix aluco</i> are typical bird species of the region. Mammals in-</p>



	<p>clude about 60 species; the most common are Rod deer <i>Cervus elaphus</i>, Roe deer <i>Capreolus capreolus</i>, Wild boar <i>Sus scrofa</i>, European hare <i>Lepus europaeus</i>, Red squirrel <i>Sciurus vulgaris carpathicus</i>, Red fox <i>Vulpes vulpes</i>, Badger <i>Meles meles</i>, Pine marten <i>Martes martes</i>, Beech marten <i>Martes foina</i>, Wolf <i>Canis lupus</i>. Miller's water shrew <i>Neomys anomalus</i>, Otter <i>Lutra lutra</i>, Stoat <i>Mustela erminea</i>, Wild cat <i>Felis silvestris</i>, Lynx <i>Lynx lynx</i>, Brown bear <i>Ursus arctos</i> are rare here.</p>
Environmental, scientific, economic, social, and cultural values	<p>Typical and unique natural complexes and highland marshes with rare flora and fauna have been preserved in the corridor area in their natural condition. No full flora inventory has been performed here, but according to the preliminary data, over 750 species of vascular plants grow here and about 50 of them are rare and must be protected. Rare fauna is represented well here too, namely: amphibians/reptiles - Spotted salamander, Wood snake; avifauna - Lesser eagle, owl, Black stork; large mammals - European Bison, Brown Bear, Lynx, Wildcat, Wolf (Bashta et al. 2006).</p> <p>From a scientific and natural perspective, the eco-corridor harbours most precious wood phytocenoses and unique fauna, which must be protected. The first written records on inhabitation in the Upper Nadsiania date from the 16th century. In the late 19th century and the early 20th century, a railway from Uzhgorod to San linked this area with the industrial centres of the Austro-Hungarian Empire.</p> <p>The 1904 construction of the railway from San to Sambir was important for this region in economic terms.</p> <p>During WW1, battles took place in Beskydy between the Russian Empire and the Austro-Hungarian Empire.</p> <p>During WW2 and the post-war period, battles took place in this area as well. The territory the eco-corridor passes through is interesting in ethnographic terms. Original monuments of the sacral architecture of the 18th and 19th century, with samples of Boykivsky iconography, have been preserved in many villages.</p>
Selection criteria of eco-corridor Eco-corridor components	<p>Based on modelling, using the habitat of the Brown Bear, Wisent, Wildcat, and Lynx as umbrella species.</p> <p>(I) Border area (II) Forest husbandry (III) Protected nature areas (IV) Galsillis Forestry (V) Agricultural land (VI) Highways, railways (VII) Water bodies</p>
Legal status (ownership type, security, etc.)	<p>Land is the property of state organizations (I, II, III, VI, VII); there are also private and community lands (I, IV, V). Part of the territory is protected by the Nadsianskyi RLP (I). The border area (I) is a strip (0.5 - 1.5 km wide) between the state border and the line of engineering structures, located along the Polish border.</p>
Name of owner	<p>The Lviv regional state administration for forestry and hunting (II), Galsillis SFC, Sianky (I, II, III, and V), Nizhniy Turiv ((II, IV, V), Nyzhnia Yablunka (II), Bo-</p>

	rynia (II, IV, V), Nyzhnie Vysotske (II, IV, V), Rykiv (II, IV, V), and Ilnyk (II, IV, V) village councils, private owners
Other stakeholders	Border squad (I), Nadsianskyi RLP (III, overlapping with I), Skolivski Beskydy NNP (III), village councils (I, II, III, IV, V, VI, VII), Turka Rayon society of the Ukrainian society of hunters and fishermen (I, II, IV, V), Lviv regional organization of sports society Dynamo (I).
Land use	Arboriculture (II, IV), agriculture (V), hunting (I, II, III, V, VII), grazing (I, II, V, VII)
Current protection measures	Control (supervision) by the border squad (I), control (supervision) by the State administration for environmental protection in the Lviv region, State environment inspection in the Lviv region (I, II, III, IV, VII), State administration for forestry and hunting (I, II, III, V, VII), preservation of the Skolivski Beskydy NNP (III), supervision of Vedmezha LLC (I, III, IV)
Existing barriers for wildlife	Barbed wire in some places along the border (I), pasture land fencing (V). Motorways and railways used a few times per day.
Present and future threats to the biodiversity and connectivity	Poaching, increased road traffic, collisions with trains and vehicles, intensified agriculture, conflict with humans due to preying on livestock and crop damaging, forest fragmentation.
Required land use changes	Creation of more possibilities for animals to migrate by removing border fencing and pasture land fencing.
Required land status and ownership changes	In the future: exchange or purchase of land may be considered upon consent of land owners.
Required landscape changes	Some areas need restoration, where vegetation has deteriorated, in particular along streams.
Additional measures	Speed restriction on roads and railway in the eco-corridor to 50 km/h; maintaining order more intensively; use of forestry systems with reduced fragmentation; reduced forestry activities in the eco-corridor during animal migration; restoration and preservation of mountain meadows; sign posting of corridor area.
Literature	Andrushchenko G. A. On vertical soil zoning of the Soviet Carpathians // Geogr. coll. - 1957. - Ed. 4. Bashta A.-T. V., Kanarsky Yu. V., Reshetylo O. S., Lesnik V. V., Martynov V. V., Martynov O. V., Gural R. I., Sverlova N. V., Grynchyshyn T. Yu., Girna A. Ya. Rare animal species of Lviv region. - Lviv, 2006. - 220 p. Burov V. S. Geologic structure and minerals. Nature of Lviv region. - Lviv: Lviv University publ., 1972. - P. 12-26. Tsyp P. M. Geomorphologic areas. Nature of Lviv region. - Lviv: Lviv University publ., 1972. - P. 27-39. Prots-Kravchuk G. L. Climate. Surface and ground waters. Nature of Lviv region. - Lviv: Lviv University publ., 1972. - P. 40-72.
Start of preparation	January 2008
Date of completion	25 December 2009
Date of approval	26 February 2010
Authors names	Stephan Tatukh, Andriy-Taras Bashta, Floris Deodatus

**APPENDIX 12. Ecological corridor management plan for the Turkivskyyi eco-corridor**

Management objectives	Management measures	Responsibility	Time frame
Reduce the negative impact caused by the barbed wire border fencing	Do not repair fencing, but facilitate its destruction within the eco-corridor	Border squad	2010 - 2012
Reduce the negative impact of cattle fences erected by farmers	<ul style="list-style-type: none"> <li>- Ask landowners to remove fencing (in particular barbed wire) which may form an obstacle for the migration of Wisent, Bears, Deer, and Lynxes;</li> <li>- Promote environmental education among the local population to prevent new fencing;</li> <li>- Prevent fencing of common pasture lands and land plots to avoid obstruction of animal migration</li> </ul>	Village councils, State administration for environmental protection in Lviv region	2010 - 2012
Improve the condition of open lands, in particular pasture lands, for animal migration	Preserve belts and groups of trees on hay fields and pasture lands	Village councils, land owners, and land users	On a permanent basis
Protect existing landscapes and natural conditions from deterioration, in aid of animal migration	Prevent change of land use respecting the land use categories according to the Land Code in the eco-corridor; take measures to restore vegetation, particularly afforestation	Village councils, Galsillis FSC, Turka state district administration, state forest husbandries	On a permanent basis
Logging/fragmentation	Prevent landscape fragmentation and environmental degradation in the corridor area; employ traditional agricultural and forestry methods, based on sustainable management principles	Village councils	On a permanent basis

Management objectives	Management measures	Responsibility	Time frame
Solve conflicts between farmers and wildlife (i.e., damage to agriculture caused by wild animals)	<ul style="list-style-type: none"> <li>- Insist on the development of compensation mechanisms in case of damage</li> <li>- Restrict the area of arable lands in the eco-corridor</li> </ul>	Ministry of Environmental Protection of Ukraine	Starting from 2011
Reduce the negative impact of forestry on wildlife	Carry out forestry work seasonally, adapted to the behaviour and reproduction of wildlife	State forest husbandries, Galsillis FSC	On a permanent basis
Create conditions for safer animal migration across land not covered by woods	Prevent cutting of trees and shrubs in the “narrow” sections of the eco-corridor. Leave belts and groups of trees and shrubs on open land to ensure safe animal migration.	State forest husbandries, Galsillis FSC, village councils	On a permanent basis
Curb poaching	<ul style="list-style-type: none"> <li>- Educate the population to prevent poaching;</li> <li>- Engage forest guards and forest management staff in surveillance;</li> <li>- Criticize poaching and contribute to poacher punishment.</li> </ul>	State administration for environmental protection in Lviv region, district state administrations, village councils, hunting societies, state forest husbandries, Galsillis FSC	On a permanent basis
Stop poaching	Improve wildlife protection. In order to optimize protection, attract additional funds (possibly from the Regional environmental protection fund) and closely cooperate with the MIA agencies to help arrest and punish perpetrators.	State administration for environmental protection in Lviv region	2011
Improve conditions for wildlife	Provide supplemental food for herbivores, particularly in winter.	Hunting societies, state forest husbandries, Galsillis FSC	On a permanent basis

Management objectives	Management measures	Responsibility	Time frame
Improve conditions for wildlife	Consider the possibility of additional financing of land users supporting endangered animals, particularly red book species, using the Regional environmental protection fund, in order to improve the animal food supply, enhance surveillance.	State administration for environmental protection in Lviv region	For 2011
Reduce the negative impact of hunting	Ban hunting raids within the eco-corridor.	Hunting societies, state forest husbandries, Galsillis FSC	On a permanent basis
Reduce the negative impact of hunting	State forest husbandries should create rehabilitation sections, mainly in the corridor territory.	Hunting societies, state forest husbandries, Galsillis FSC	Until 2012
Reduce the negative impact of hunting	Ban hunting in the specified eco-corridors (sections Tarnava-Dzviniache, Dydiovo-Dzviniache, etc.), except for organized hunting necessary to regulate fox and wolf numbers.	Hunting societies, state forest husbandries, Galsillis FSC	Starting from 2010
Reduce the negative impact of railway traffic	Ask the railway administration to restrict train speed in the eco-corridor and place signs for train drivers to alert them to animal migrations.	State administration for environmental protection in Lviv region	2010
Rivers may be an obstacle for Wildcat migrations	Recommend restrictions on river dam building, which may form an obstacle for migration	Oblvodhosp state production administration, Turka state Rayon administration	On a permanent basis
Reduce the negative impact of road traffic	Ask the Motor Vehicle Inspection Unit to place road signs restricting speed and road signs 1.36 "Wild animals".	State administration for environmental protection in Lviv region, Oblavtodor, district state motor vehicle inspection unit	Starting from 2012
Inform the population and tourists of the eco-corridor's existence	Place signs warning about the eco-corridor existence and its functions, asking not to disturb for animals.	State forestry enterprise, Galsillis FSC	2010-2011

<b>Management objectives</b>	<b>Management measures</b>	<b>Responsibility</b>	<b>Time frame</b>
Monitor the number and movement of wildlife	Research institutions must conduct surveys controlling the number, composition, and migrations of animals in the eco-corridor and propose modifications regarding its boundaries and operation improvement.	State administration for environmental protection in Lviv region, research institutions	Starting from 2010
Improve wildlife monitoring	Ask state forest husbandries and Galsillis to organize surveillance of animal migrations, trace their routes on the map, reveal and remove obstacles to ensure their free movement and growth of their number, inform the authorities and the State Administration of the Ministry of Environmental Protection thereof.	State forest husbandries, Galsillis FSC	Starting from 2010
Enhance the corridor territory nature protection status	Examine the terms of granting a natural reserve status to sections where the eco-corridor will pass.	State administration for environmental protection in Lviv region	Until 2012
Enhance the environmental literacy among the population	Inform the population about the eco-corridor condition and recommended measures to improve animal migrations.	State administration for environmental protection in Lviv region	On a permanent basis
Analyze corridor condition and management, and seek improvement	Analyze condition and management of the eco-corridor, and develop recommendations for improvement.	State administration for environmental protection in Lviv region	2012





## Creation of ecological corridors in Ukraine

### A manual on stakeholder involvement and landscape-ecological modelling to connect protected areas, based on a pilot in the Carpathians

To cope with increasing habitat fragmentation, biodiversity conservation in the Carpathians needs to interconnect protected areas, facilitating migration and genetic exchange between wildlife populations to secure their long term survival. The Ukrainian government, striving for harmonization with European policy and legislation such as the Pan-European Ecological Network, is aware of this need. During the past decade, the development of a Ukrainian ecological network has been initiated, but the realisation is hampered by lack of practical experience and insufficient policy and legislation related to ecological corridors. The approach presented in this manual aims to design and formalise ecological corridors given the social and legal realities. The manual is based on a pilot exercise, which involved the establishment of ecological corridors connecting selected protected areas in Ukraine, Romania and Poland, in order to investigate the best policies and practices for their development. In the manual, the experiences gained from this pilot study are translated into directives for corridor development and related policies and legislation, which are made accessible for use by Government staff and other stakeholders. Ecological corridor establishment as presented in this manual consists of five main steps: (1) modeling of ecological corridor options based on landscape and habitat requirements of so called "umbrella species", (2) legal analysis to formally pave the way for ecological corridor establishment, (3) consultations with authorities, land owners and land users to identify an optimal location for the ecological corridor supported by all, (4) participative elaboration of ecological corridor management plans, and (5) official approval of the ecological corridor by the authorities. One of the main achievements of the process that resulted in this manual was the establishment of the first wildlife corridors in Ukraine, connecting the Vyzhnytskyi and Skolivski Beskydy National Nature Parks to protected areas in Romania and Poland, respectively.

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