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TRANSGREEN

State of the Art Report and Gap Analysis

in the field of environmentally-friendly transport infrastructure development

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State of the Art Report and Gap Analysis in the field of environmentally-friendly transport infrastructure development

Part of Output 3.2 Planning Toolkit

TRANSGREEN Project "Integrated Transport and Green Infrastructure Planning in the Danube-Carpathian Region for the Benefit of People and Nature"

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Authors

Cristian-Remus Papp
(WWF Danube-Carpathian Programme, Romania)

Marius Gavril Berchi
(WWF Danube-Carpathian Programme, Romania)

Contributors

Csaba Domokos
(Association Milvus Group, Romania)

Ivo Dostál
(Transport Research Centre, the Czech Republic)

Maroš Finka
(Slovak University of Technology in Bratislava – SPECTRA Centre for Excellence of EU)

Katarína Gáliková
(National Motorway Company, Slovakia)

Adrian Grancea
(WWF Danube-Carpathian Programme, Romania)

Barbara Immerová
(WWF Danube-Carpathian Programme consultant, Slovakia)

Ján Kadlečík
(State Nature Conservancy of the Slovak Republic)

Ivan Koubek
(State Nature Conservancy of the Slovak Republic)

Radu Moț
(Association Zarand, initiator of GreenWEB – Connecting people and landscapes, Romania)

Gabriella Nagy
(CEEweb for Biodiversity, Hungary)

Erzsebét Ohegyi
(CEEweb for Biodiversity, Hungary)

Vladimír Ondrejička
(Slovak University of Technology in Bratislava – SPECTRA Centre for Excellence of EU)

Anatoliy Pavelko
(Consultant, lawyer, EIA and environmental specialist, Ukraine)

Goran Sekulić
(WWF Adria, Serbia)

Valeria Shcherba
(WWF Danube-Carpathian Programme, Consultant)

Michaela Skuban
(State Nature Conservancy of the Slovak Republic)

Andrzej Sieminski
(Ministry of Infrastructure and Construction, Poland)
András Szirányi
(National Infrastructure Developing Private Company Ltd., Hungary)

Martin Strnad
(Nature Conservation Agency, the Czech Republic)

Tereza Thompson
(State Nature Conservancy of the Slovak Republic)

András Weiperth
(Szent Istvan University, Hungary)

Taras Yamelynets
(WWF Danube-Carpathian Programme consultant, Ukraine)

Supervision

Elke Hahn
(Austrian Ministry of Transport, Innovation and Technology, IENE – Infra Eco Network Europe Governance Board Member, Member of the Conference of European Directors of Roads)

Lazaros Georgiadis
(Biologist, Environmental Consultant, IENE – Infra Eco Network Europe Governance Board Member, Greece)

Layout and graphic design:

Alex Spineanu
(Graphic designer, Romania)

Marián Špacír
(SPECTRA)

with the support of Catalina Murariu
(WWF Romania)

English proofreading:
Private Language School BS SCHOOL, Ondrej Straka, BSBA

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About TRANSGREEN

TRANSGREEN means a better connected Carpathian region with transport infrastructure that takes nature into account. The project aims to contribute to safer and environmentally-friendly road and rail networks that are being developed in the Czech Republic, Hungary, Romania, Slovakia, and Ukraine. www.interreg-danube.eu/transgreen

Output 3.2 Planning Toolkit consists of the following parts:

- Wildlife and Traffic in the Carpathians - Guidelines how to minimize the impact of transport infrastructure development on nature in the Carpathian countries
- TRANSGREEN Policy Recommendations on integrated road and rail transportation planning in the Carpathians
- State of the Art Report and Gap Analysis in the field of environmentally-friendly transport infrastructure development
- Keeping Nature Connected – Environmental Impact Assessment (EIA) for Integrated Green Infrastructure Planning
- Public Participation – Scheme for an integrated linear transport infrastructure development/ planning
- Tools for registering animal-vehicle collisions

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FOREWORD

Lazaros Georgiadis
Elke Hahn

Members of IENE
Governance Board

The Carpathian area is one of the mountain areas with great importance at European and international level hosting people from different countries, but also rich biodiversity with a considerable number of species, a lot of which are endemic and unique globally. Throughout the entire European history, people used to grow and live using the natural resources and natural capital of the biodiversity of the Carpathians. Carpathian Nature has supported people to survive in and outside the Carpathian zone and has provided water for all the nations distributed in the surrounding countries for centuries. For all the time in the past, there has been a wildlife-human co-existence and wildlife has been preserved in a balanced way. Vulnerable species for instance, like large carnivores, have survived and the Carpathians has played a crucial role in their conservation at European level as flag mountain species. Today the Carpathian citizens have demands for economic and social development, and keeping the balance of the co-existence with all wildlife creatures will be one of the great challenges for the rest of the 21st century.

In this struggle for surviving, there have always been conflicts and problems making wildlife and humans' co-existence difficult, but most of the problems and impacts of humans' activities were reversible. Today, large scale tasks and mainly infrastructures tend to increase the environmental impact in an irreversible way. It is mainly the linear transportation infrastructure that connects people, but disconnects wildlife in an irreversible way, building up in the natural landscape an artificial "grey" wall of fragmentation. The decrease in the availability of mobility and communication of wildlife species gives basic background to increase the intensive status of the global Biodiversity loss we are facing today.

At the same time, we - as Homo sapiens, the wisest creature on this planet – are proud of making great and fast steps meeting our mobility and communication needs, we have to feel and be responsible for the communication of all other species with whom we live together. This means that responding to the challenges of coexistence we have to recognize specific problems, look for and find correspondingly specific and applied solutions in the best suitable way while securing the sustainability for society, ecology and economy.

The fragmentation of ecosystems has been recognized as a global environmental problem described as the particular target 5 (In Strategic goal B) of the Convention on Biological Diversity 2011-2020 Aichi Targets, aiming: "by 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced".

Additionally, the Carpathian Convention is a crucial responsible initiative towards transforming this Global thinking into local acting at trans-national and cross-border level in the Carpathian range. More precisely, the Sustainable Transportation Protocol of the Carpathian Convention shapes the

baseline for the Strategy and following the Action Plan translates the global concerns into local actions on finding a solution for particular problems of ecological connectivity. Both are not only filling the gap created by lack of funds as permanent demand, but also the lack of availability of human resources' with the involvement of experts and crucial stakeholders with multi sectoral background, the TRANSGREEN project is an initiative of great importance which gives the framework for joining efforts between all Carpathians countries while maximizing the reduction of fragmentation close to zero where feasible.

From the IENE point of view, as an arena of interaction and cooperation between ecology, engineering and policy, we fully support the TRANSGREEN in giving advice and promoting its actions, deliverables and results aiming to achieve the global targets of environmental sustainability of transportation on each meter of roads or railways within the Carpathian range. In this overall perspective, the State of Art Report of the TRANSGREEN project describes the international and national legal framework, as well as the situation of the fragmentation status and conflict points between grey and green infrastructure and highlights the national needs of each country.

Finally, the tool of the best and worst practices creates a productive framework of implementing one of the basic "principles" of IENE for environmentally friendly linear transport infrastructures of "any case a unique case", adapting previous experience and know-how to the local needs for securing ecological connectivity in the Carpathian landscape. We are looking forward to promoting and using this State of Art Report at both the European and International level as a useful Case Study tool to increase a balanced co-existence with all wildlife creatures and to meet the great challenges in the field of harmonization of transportation and nature, while keeping environmental impacts of construction and operation of transportation networks in a most possible sustainable way.

1 Introduction

The report has been prepared within the frame of the "Integrated Transport and Green Infrastructure Planning in the Danube-Carpathian Region for the Benefit of People and Nature (TRANSGREEN)" Project, co-Funded by the European Rural Development Funds, the Danube Transnational Programme, period of implementation January 2017 – June 2019.

The project's main objective is to contribute to an environmentally-friendly and safer road and rail network in the Carpathians as part of the wider Danube river basin by integrating green infrastructure elements into TEN-T related transport infrastructure development at the local, national and transnational level across relevant sectors. This will contribute to (1) improved plans and planning security for transport infrastructure projects, taking Green Infrastructure into account, (2) deepened coordination and cooperation of relevant players across the sectors and across the macro-region, and (3) elaboration and implementation of practical solutions for an environmentally-friendly and safer transport network in the Danube region with a focus on the Carpathian mountains and the TEN-T network.

1.1 General Context

The report has been prepared as a need to present an up-to-date overview of the current level of knowledge, information and practices in the field of environmentally-friendly transport infrastructure development in the different countries of the Carpathian Ecoregion.

The report highlights the current practices related to the planning and development of transport infrastructure projects, and summarizes the actual level of knowledge and information related to the topic of ecological connectivity and its preservation in the Carpathians. It also highlights the main European Directives and strategies and relevant conventions concerning biodiversity conservation and transportation relevant to each country, and presents some examples related to the transportation infrastructure development.

1.2 To whom is the report addressed?

The report is addressed to all those involved in the development of transport infrastructure projects and preservation of ecological connectivity in the Carpathian Ecoregion, serving as a basic reference for improving and greening the transport infrastructure for the benefits of both humans and wildlife. It is intended to start an open and transparent dialogue between the representatives of the transport infrastructure development and biodiversity conservation sectors in order to reduce the "classical conflicts" and find ways for harmonization and cooperation to meet the demands for economic and social development while preserving our natural heritage from the region.

2 Legislative Context

2.1 European Directives and strategies, relevant conventions

2.1.1 EU Nature Directives (FFH, BD) and the Biodiversity Strategy

At the EU level, nature and biodiversity are protected through several directives.

The EU has been committed to the protection of nature since the adoption of **the Birds Directive**[1] 79/409/EEC in April 1979. It provides a comprehensive protection to all wild bird species naturally occurring in the Union.

Europe is home to more than 500 wild bird species and at least 32% of the EU's birds' species are currently not in a favourable conservation status. The Birds Directive aims to protect all of the 500 wild bird species naturally occurring in the European Union.

Often migratory, wild bird species can only be protected by cooperating across borders. Urban sprawl and transport networks have fragmented and reduced their habitats; intensive agriculture, forestry, fisheries and the use of pesticides have diminished their food supplies, and hunting needed to be regulated in order not to damage populations. Concerned with their decline, the Member States unanimously adopted the Directive. It is the oldest piece of EU legislation on the environment and one of its cornerstones. Amended in 2009, it became the Directive 2009/147/EC[2].

Habitat loss and degradation are the most serious threats to the conservation of wild birds. The Directive therefore places a great emphasis on the protection of habitats for endangered and migratory species. It establishes a network of Special Protection Areas (SPAs), including all the most suitable territories for these species. Since 1994, all SPAs are included in the Natura 2000 ecological network, set up under the Habitats Directive 92/43/EEC.

All Member States have to submit periodical reports on the status and trend of bird populations (article 12) as well as on derogations (article 9) they may apply to the directive's obligations.

The annexes to the Birds Directive have been adapted each time a new country joined the European Union. The ORNIS Committee assists the Commission in the implementation of the Birds Directive.

The Habitats Directive[3] 92/43/EEC on the conservation of natural habitats and of wild fauna and flora was adopted in 1992 to ensure the conservation of a wide range of rare, threatened or endemic animal and plant species. It protects over 1,000 animal and plant species and some 200 rare and characteristic habitats. The Directive aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements. It forms the cornerstone of Europe's nature conservation policy with the Birds Directive and establishes the EU wide Natura 2000 ecological network of protected areas, safeguarded against potentially damaging developments.

The Interpretation Manual of European Union Habitats - EUR28 aims to help clear any ambiguities in the interpretation of the Annex 1 of the directive by developing common definitions for all habitat types.

The European Commission has published guidance on species protection to help Member States implement the directive's provisions

1 http://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm
2 http://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm
3 http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm

correctly. The EU Species Action Plans are developed to restore the populations of certain species across their range within the EU. The European Commission also promotes the conservation of Europe's 5 species of large carnivores and supports the European Red Lists of Threatened Species, developed by the IUCN to provide an overview of the conservation status of c. 6,000 European species, so that appropriate action can be taken to protect those threatened with extinction.

Certain articles of the Habitats Directive (Art. 6, 12, 16 and 17) require that the Member States report on the conservation status of habitats and species, on compensation measures taken for projects having a negative impact on Natura 2000 sites or on derogations they may have applied to the strict protection measures.

The Habitats Committee assists the Commission in the implementation of the Habitats' Directive and delivers an opinion on the draft list of LIFE-Nature projects to be financed each year.

Each new country joining the EU has brought new species and habitats with it. The EU nature law has had to be adapted to reflect the impact of enlargement.

The EU Biodiversity Strategy [4] aims to halt the loss of biodiversity and ecosystem services in the EU and help stop global biodiversity loss by 2020. It reflects the commitments taken by the EU in 2010, within the international Convention on Biological Diversity.

In 2011, the EU adopted an ambitious strategy setting out 6 targets and 20 actions to halt the loss of biodiversity and ecosystem services in the EU by 2020 (read the Strategy). The mid-term review of the Strategy assesses whether the EU is on track to achieve this objective. It shows progress in many areas but highlights the need for much greater effort.

By 2020, the EU has raised its contribution to avert global biodiversity loss.

2.1.2 Transportation Directives (road and rail)

Transport and mobility play a fundamental role in today's world and the aim of the Commission is to promote mobility that is efficient, safe, secure and environmentally friendly and to create the conditions for a competitive industry generating growth and jobs. The issues and challenges connected to this require action at European or even international level; no national government can address them successfully alone[5].

The EU's Trans-European Networks policy links regional and national infrastructure to create coherent European systems. This includes both interconnection and interoperability, mainly for transport and energy, but also Information and Communications Technology.

The Trans-European Transport Network (TEN-T) (Fig. 1) is a European Commission policy directed towards the implementation and development of a Europe-wide network of roads, railway lines, inland waterways, maritime shipping routes, ports, airports and rail-road terminals. It consists of two planning layers:

4 http://ec.europa.eu/environment/nature/biodiversity/strategy/index_en.htm
5 https://ec.europa.eu/transport

- The Comprehensive Network: Covering all European regions;

- The Core Network: Most important connections within the Comprehensive Network linking the most important nodes.

The ultimate objective of TEN-T is to close gaps, remove bottlenecks and eliminate technical barriers that exist between the transport networks of EU Member States, strengthening the social, economic and territorial cohesion of the Union and contributing to the creation of a single European transport area. The policy seeks to achieve this aim through the construction of new physical infrastructures; the adoption of innovative digital technologies, alternative fuels and universal standards; and the modernizing and upgrading of existing infrastructures and platforms.

Following a 2013 review of the TEN-T policy, nine Core Network Corridors were identified to streamline and facilitate the coordinated development of the TEN-T Core Network. These are complemented by two Horizontal Priorities, the European Railway Traffic Management System (ERTMS) deployment and Motorways of the Sea; both established to carry forward the strategic implementation of the objectives of the Core Network, in-line with the funding period, 2014 to 2020.

Oversight of the Corridors and the implementation of the two Horizontal Priorities lie with the European Coordinators.

First generation Work Plans for each Corridor and Horizontal Priority were presented in 2014, outlining exact objectives for each Corridor and Horizontal Priority, within the framework of the TEN-T Core Network. This is a continuous process, which takes into consideration current developments.

EU funding for projects on each Corridor and Horizontal Priority is provided by the Connecting Europe Facility (CEF), with relevant Member States obliged to align national infrastructure investment policy with European priorities. Other sources of funding and financing include the European Structural and Investment Funds and the European Fund for Strategic Investment[6] .

6 https://ec.europa.eu/transport/themes/infrastructure/about-ten-t_el

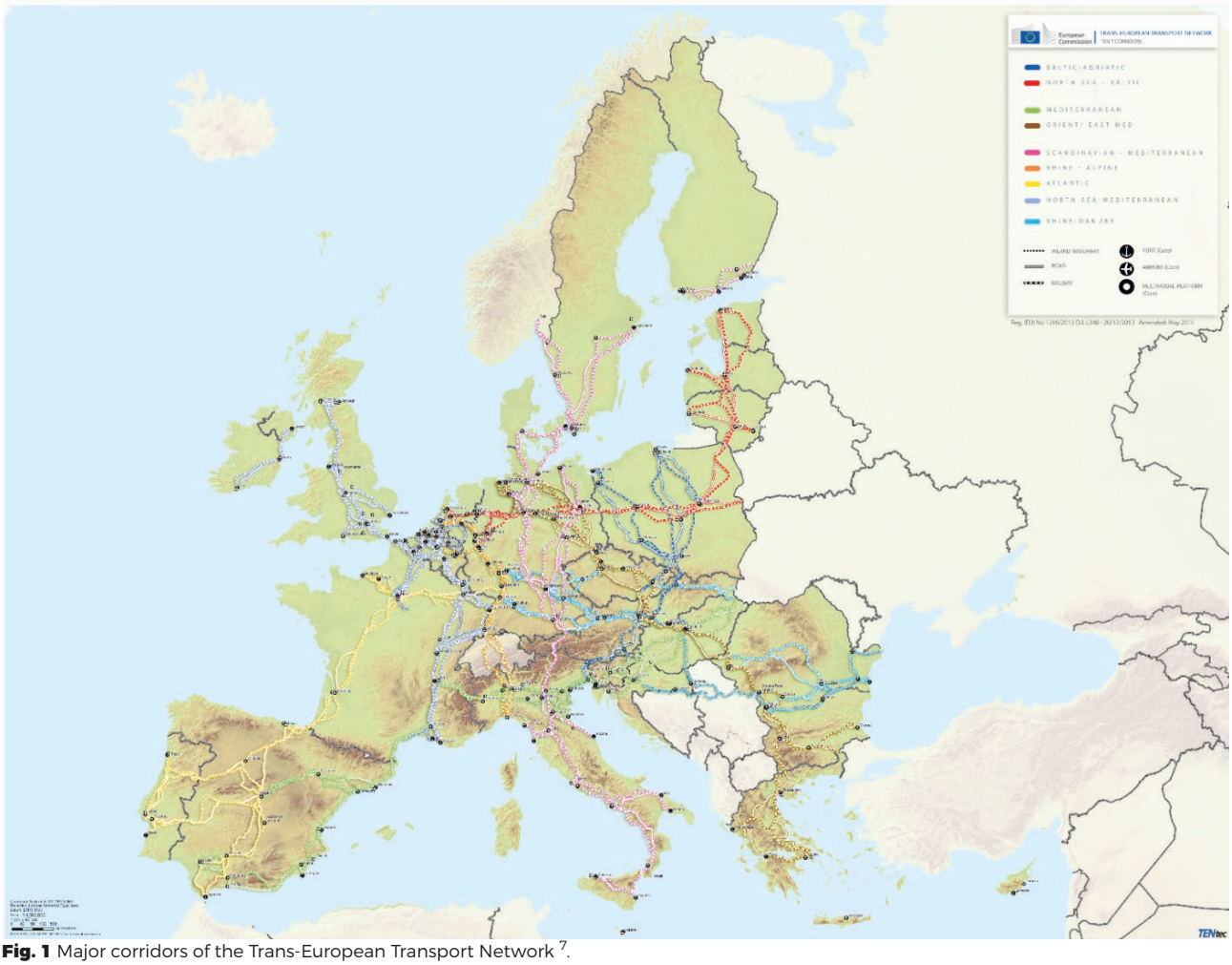


Fig. 1 Major corridors of the Trans-European Transport Network [7].

Relevant EU regulations concerning transportation:

- Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013 on Union guidelines for the development of the trans-European transport network and repealing Decision No 661/2010/EU.
- Regulation (EU) No 1316/2013 of the European Parliament and of the Council of 11 December 2013 establishing the Connecting Europe Facility, amending Regulation (EU) No 913/2010 and repealing Regulations (EC) No 680/2007 and (EC) No 67/2010

Across the EU, the TEN-T core network is organised in 9 corridors out of which 2 are crossing the Project area, namely: Rhine-Danube Corridor and Orient/ East Mediterranean Corridor.

7 http://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/site/en/maps.html

The EU Strategy on Green Infrastructure

We need to develop, preserve and enhance healthy green infrastructure to help stop the loss of biodiversity and enable ecosystems to deliver their many services to people and nature. The greater the scale, coherence and connectivity of the green infrastructure network, the greater its benefits. The EU Strategy on green infrastructure aims to outline how to deploy such a network and encourages action at all levels.

Developing green infrastructure is a key step towards the success of the EU 2020 Biodiversity Strategy. The Strategy's target 2 requires that 'by 2020, ecosystems and their services be maintained and enhanced by establishing green infrastructure and restoring at least 15% of degraded ecosystems'. However, green infrastructure contributes to all 6 targets of the Strategy – the full implementation of the Birds and Habitats Directive (target 1) in particular and to maintaining and enhancing biodiversity in the wider countryside and the marine environment (targets 3 and 4).

On 6 May, 2013, the Commission adopted an EU-wide strategy **promoting investments in green infrastructure**, in order to restore the health of ecosystems, ensure that natural areas remain connected together, and allow species to thrive across their entire natural habitat, **so that nature keeps on delivering its many benefits to us**. The strategy promotes the deployment of green infrastructure across Europe as well as the **development of a Trans-European Network for Green Infrastructure in Europe**, a so-called TEN-G, equivalent to the existing networks for transport, energy and Information and communications technology (ICT). This can also help enhance the health and well-being of EU citizens, provide jobs, and boost our economy[8].

The Green Infrastructure Strategy proposed by the European Commission promotes the development of Green Infrastructure across the EU, delivering economic, social and ecological benefits and contributing to sustainable growth. It guides the implementation of Green Infrastructure at EU, regional, national and local levels. One of the main features of the Green Infrastructure Strategy is its integration into relevant policies through: ecosystem-based adaptation into climate change policies; nature based solutions into research and innovation policies; natural water retention measures into water policies; and through its focus on delivering multiple ecosystem services and their underlying factor – a rich biodiversity – into nature policies. The Natura 2000 network in particular plays a major role in protecting many of the core areas with healthy ecosystems. The Green Infrastructure approach is also reflected in regional and cohesion policies, disaster prevention and the greening of the Common Agriculture Policy. Since Green Infrastructure can make a significant contribution to many sectors and EU policy objectives, it is being integrated into many funding streams including Structural Funds (the European Regional Development Fund (ERDF); the European Social Fund (ESF)), the Cohesion Fund (CF), the European Maritime and the Fisheries Fund (EMFF), the European Agricultural Fund for Rural Development (EAFRD), LIFE+ and Horizon 2020 project funds and the Natural Capital Financing Facility (NCFF) of the European Investment Bank (EIB)[9].

Green Infrastructure and the Biodiversity Strategy

The Green Infrastructure Strategy is supported by other actions under target 2 of the Biodiversity Strategy, such as work underway to establish a Restoration Prioritization Framework (RPF) (action 6a) or on biodiversity-proofing the EU budget (action 7a). MAES, the Mapping and Assessment of Ecosystems and their Services (action 5) will help provide an accurate valuation of the benefits that nature provides to human society, so that the investments in green infrastructure can be measured. As for NNL, or No-Net-Loss (Action 7b), it develops an initiative to ensure that there is no net loss of ecosystems and their services e.g. through compensation or

8 http://ec.europa.eu/environment/nature/ecosystems/strategy/index_en.html
9 http://ec.europa.eu/environment/nature/ecosystems/pdf/Green%20Infrastructure/GI_RO.pdf

offsetting schemes. The documents produced by the working group on green infrastructure implementation and restoration can support national and regional planners and decision-makers working on green infrastructure[10] .

Policy setting & ongoing implementation

The 2014-2020 Partnership Agreement between the European Commission and Romania (PA) reiterates the need to promote Green Infrastructure giving ecological corridors, green bridges and eco-passages as examples to reconnect natural areas that have been artificially divided and to maintain corridors and landscape elements that connect protected areas in order to form a functioning network[11]. Connectivity through Green Infrastructure is a priority action also under the European Strategy for the Danube region. The PA has identified the following funding sources in conformity with the Thematic Objective 6 – Conservation and protection of the environment and promotion of efficient use of resources: the National Rural Development Programme (EARDF) for restoring, conserving and extending agriculture and forestry dependent ecosystems; and the Large Infrastructure Operational Programme (ERDF) for protecting biodiversity by elaborating management plans and investments in renovation and conservation measures. In addition, the Hungary-Romania Cross-Border Cooperation Programme aims at identifying relations between landscape, habitats quality and ecosystem services as perceived by local communities.

10 http://ec.europa.eu/environment/nature/ecosystems/strategy/index_en.htm
11 http://www.fonduri-ue.ro/files/documente-relevante/acord/Acord_de_Parteneriat_2014-2020_EN.pdf

2.2 Carpathian Convention

The Framework Convention on the Protection and Sustainable Development of the Carpathians (Carpathian Convention) was adopted and signed by 7 Parties (the Czech Republic, Hungary, Poland, Romania, Serbia, the Slovak Republic, Ukraine) in May 2003 in Kiev, Ukraine, and entered into force in January 2006. It is the only multi-level governance mechanism covering the whole of the Carpathian area and besides the Alpine Convention, it constitutes the second sub-regional treaty-based regime for the protection and sustainable development of a mountain region worldwide.

The common vision of the Parties to the Carpathian Convention is to pursue comprehensive policy and cooperation in order to guarantee protection and sustainable development of the Carpathians. The improvement of the quality of life, the strengthening of local economies and communities, and the conservation of natural values and cultural heritage should go hand in hand in the Carpathian area.

The Convention provides a framework for cooperation and multi-sectoral policy coordination, a platform for joint strategies for sustainable development, and a forum for dialogue between all stakeholders involved – from the local community and various NGO's up to the regional and national Governments, Institutions of the European Union and the United Nations[12].

Article 8 of the Convention states that:

1) The Parties shall pursue policies of sustainable transport and infrastructure planning and development, which take into account the specificities of the mountain environment, by considering the protection of sensitive areas, biodiversity-rich areas, migration routes or areas of international importance in particular, the protection of biodiversity and landscapes, and of areas of particular importance for tourism.

2) The Parties shall cooperate towards developing sustainable transport policies which provide the benefits of mobility and access in the Carpathians, while minimizing harmful effects on human health, landscapes, plants, animals, and their habitats, and incorporating sustainable transport demand management in all stages of transport planning in the Carpathians.

3) In environmentally sensitive areas the Parties shall cooperate towards developing models of environmentally friendly transportation[13].

To the present date 5 Protocols have been adopted, including one on sustainable transport - Protocol on Sustainable Transport to the Framework Convention on the Protection and Sustainable Development of the Carpathians. The general objective of the Protocol is: "In accordance with Article 8 of the Carpathian Convention, the objective of the Protocol on Sustainable Transport [...] is to enhance and facilitate cooperation of the Parties for the development of sustainable freight and passenger transport and related infrastructure in the Carpathians for the benefit of present and future generations with the objective to contribute to the sustainable development of the region while avoiding, minimizing and, where necessary, mitigating and compensating negative environmental and socio-economic impacts of transport and related infrastructure development."[14]

Parties of the Carpathian Convention have agreed on general objectives and principles, a geographical scope, the definitions, integration of the objectives of sustainable transport and transport infrastructure development in the Carpathians, participation of regional and local au-

12 http://www.carpathianconvention.org/
13 http://www.carpathianconvention.org/text-of-the-convention.html
14 http://www.carpathianconvention.org/tl_files/carpathiancon/Downloads/03%20Meetings%20and%20Events/

thorities, and other stakeholders, international cooperation, general transport-policies and strategies, transport infrastructure networks and their connectivity, road, rail, water and air transports, non-motorized transportation, traffic management systems, safety standards, real costs, implementation, education, information and public awareness, and other issues in 28 Articles.

Environmental threats do not respect national borders. Governments have realized that to avert this danger they must notify and consult each other on all major projects under consideration that might have adverse environmental impact across borders. The Espoo Convention is a key step to bringing together all stakeholders to prevent environmental damage before it occurs. The Convention was adopted in 1991 and entered into force on September 10, 1997.

2.3 Espoo Convention

It was complemented by the Protocol on Strategic Environmental Assessment (Kiev, 2003).

The Espoo (EIA) Convention sets out the obligations of Parties to assess the environmental impact of certain activities at an early stage of planning. It also lays down the general obligation of States to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental impact across boundaries.

Parties of the Espoo Convention have agreed on the definitions, preparation of the environmental impact assessment documentation, consultations on the basis of the environmental impact assessment documentation, bilateral and multilateral cooperation, research programmes, and other issues in 19 Articles[15].

The second amendment adopted in 2004 extends the list of activities subject to the Convention, aligning it with the European Union Directive on environmental impact assessment. The application of the Convention to an extended list of activities in areas ranging from transport and energy infrastructure to industrial installations is expected to further strengthen the role of environmental impact assessment in the region.

15 https://www.unece.org/env/eia/eia.html

2.4 National legislation in the field of nature protection and transport infrastructure development

2.4.1 The Czech Republic

On May 1, 2004, the Czech Republic (CZ) became a full member of the European Union (EU). Since that date, the EU legislation is binding for the CZ. Therefore, since joining the EU, gradual harmonization of the Czech legislation with EU regulations takes place so that to simplify it, eliminate unjustified toughening of Czech national regulations and achieve equal competitive conditions with other EU member states. All legislative amendments must comply with the current environmental standards.

Based on previous experience in the construction of linear structures, especially motorways, the biggest problems are seen in assessing the impact of the corridor on sustainable land development (SEA process as part of land-use planning documentation) and environmental impact assessment (EIA) in subsequent procedures. A major problem is the impact of the new infrastructure on the environment, in particular the elimination of noise and vibrations, the location of the linear construction in the landscape and the solution to the issue of landscape fragmentation, the interruption of natural paths and movement routes of wildlife. Valid environmental legislation is often abused by different interest groups to resist any new construction, especially in urbanized areas, which significantly prolongs the deadlines set by the Building Act for the preparation of the construction.

Act Nr. 183/2006 Col., on town and country planning and building code (Building Act)

This Act governs, in the matters of town and country planning, particularly the objectives and tasks of town and country planning, the system of authorities of town and country planning, the town and country planning instruments, the assessment of the impacts on area sustainable development, decision making within the area, possibilities of consolidation of procedures pursuant to this Act with procedures of the environmental impact assessment, conditions for construction, land development and for preparation of the public infrastructure, records of planning activity and qualification requirements for planning activity.

Also this Act governs, in the matters of the building code, particularly the permission of buildings and their alterations, landscaping and facilities, use and removal of structures, supervision and special powers of building offices, position and authorisation of the authorized inspectors, system of building offices, duties and responsibilities of persons within the preparation and realization of structures.

Furthermore, the Act governs the conditions for the design activity and the structures realizations, general conditions for construction, purpose of expropriation, entry to the grounds and into the structures, protection of public priorities and some other issues related to the subject-matter of this legislation.

On January 1, 2018 a comprehensive amendment to the Building Act entered into force. The main purpose of this legislative change is to accelerate and simplify the procedures for all necessary approvals/permits, which take extremely long time in the CZ. Under the new law, the procedures for spatial permit, EIA and building permit are combined into one coordinated procedure, which will result in a single permit for the construction.

This law does not directly address the concepts of landscape fragmentation or connectivity; however, it for example takes into account the sustainable development of the territory and public interests, including the protection of nature and the landscape (§ 18, par. 1, 4 and 5). These public interests are reflected in spatial planning decisions through so-called territorial analytical documents, which are defined in § 26 and their specific content is determined by Decree No. 500/2006 Coll. on Territorial Analytical Documents, Territorial Planning Documents and on the Means of Registration of Territorial Planning Activities, as amended. Territorial analytical documents include, among other things, so-called limitations toland use, which include various restrictions on changes in the territory due to the protection of public interests, arising from legal regulations or established under special legal regulations or resulting from the characteristics of the territory.

One of the categories of these legal limits (in particular the Nature and Landscape Protection Act No. 114/1992 Coll., as amended and the related Decree No. 395/1992 Coll., as amended) are also the limitations arising from landscape protection, divided thematically to special territorial protection, general landscape protection, forest and geology protection. In Decree No. 500/2006 Coll. they are expressed in the form of the so-called observed phenomena. Thus, when deciding on spatial planning, there is an obligation to acquire and use the set of listed phenomena. The limits for the individual phenomena can be of three different types: a) interval (boundary determining limits, interval of permissible values of a certain indicator of land use), b) expressed as commands and prohibitions (mostly resulting directly from the related legislation), c) preliminary administrative conditions (the limit is not accurately stated, but for the design of the use of the territory in the land-use planning documentation, it is necessary to have an opinion of the respective Authority or the concerned body).

At the national level, the main conceptual document in this area is the "Territorial Development Policy of the Czech Republic, as amended by Update No. 1" (approved by Government Resolution No. 276 of April 15, 2015). It contains the issue of migration permeability of the landscape and minimizing the extent of landscape fragmentation states in its national priorities (priorities 20a, 23).

- Paragraph 20a: *Create territorial conditions to ensure migration permeability of the landscape for wildlife and humans, especially during the process of planning and building of transport and other technical infrastructure. In the context of land-use planning, it is necessary to limit the unwanted merging of settlements in order to ensure the accessibility and permeability of the landscape.*

- Paragraph 23: *Under local conditions, it is necessary to create conditions for better accessibility of the area and improvement of the transport and technical infrastructure with regard to the permeability of the landscape. When positioning transport and technical infrastructure, maintain the permeability of the landscape and minimize the extent of fragmentation of the landscape; if it is expedient to do so, place these linear infrastructures concurrently.*

Act No. 114/1992 Coll. on Nature and Landscape Protection as amended by later regulations

Decree of the Ministry of the Environment of the CR No 395/1992 Coll. implementing of the Nature Conservation Act. The Decree lists selected threatened species and defines it´s level of endangerment in three levels: threatened, endangered, critically endangered.

Act. No. 289/1995 Coll. on forests as amended by later regulations.

Act No. 449/2001 Coll. on hunting as amended by later regulations.

Decree of the Ministry of Agriculture of the CR No. 350/2003 Coll. implementing of the Act on Hunting

Act No.254/2001 Coll. on waters as amended by later regulations.

National Biodiversity Strategy in the Czech Republic valid until 2016-2025 approved by the Czech Government of March 9, no. 193.

Plan of sustainable development of the Czech Republic until 2030.

2.4.2 Hungary

Legislation, ecological corridors

1996. LIII. Act on nature protection (53. §).

1995. LXXXI. Convention on Biological diversity.

1998. XXVIII. Act on the protection and conservation of animals.

2003. XXVI. Act on national spatial planning plan (4., 9., 12., 13., 19., 22.).

275/2004. (X. 8.) Decree over protected areas that are of significant importance to the European state.

2/2002. (I. 23.) Decree over vulnerable natural areas.

132/2003. XII. 11. Parliamentary Decision on the II. National Environmental Program.

12/2005. (VI. 17.) Decree on the restrictions of natural habitats and their surroundings for protected flora and fauna species.

46/1999. (III.18) Decree on flood areas, riparian zones.

Legislation, infrastructure

Basic laws related to infrastructure development which are among others taken into account during an infrastructure development are the 314/2005 Government Regulation which is equal to the EIA Directive as well as the 275/2004 Government Regulation which is equal to the Birds and Habitat Directive. The 221/2004 Government Regulation on the **river basin management** is implementing the Water Framework Directive. Besides these regulations, many others are taken into account as well, but these are the reg-

ulations which are fundamental for an impact assessment. The other regulations regulate the requirements in detail. 284/2007 Government Regulation and 27/2008 KvVm-EüM Joint Ministerial Decision deals with the details of **noise related restrictions**; and 306/2010 Government Regulation deals with **air pollution**.

Legislation, spatial planning

Acts:

1997. Year LXXVIII. Act on the protection and conversion of built-in environments.

1996. XXI. Act on spatial planning and development.

2003. XXVI. Act on the national spatial management plan.

Governmental decrees:

77/2010. (III. 25.) Decree about the permissions for spatial planning and for the appointment of inspectoral authorities over spatial management activities.

37/2010. (II. 26.) Decree on the spatial monitoring system.

Institutions involved in spatial planning:

State Secretariat for Planning Coordination.

State Secretariat for Architectural and Construction Affairs.

Governmental Office of Pest County, Department of Environmental and Nature Protection.

Regional and Rural Development Committee.

Hungarian Road Authority.

Relevant spatial planning institutions: Lechner Nonprofit Kft. (mapping works).

Spatial planning

Regarding spatial planning in Hungary, there are 7 levels: European level, National level (Hungary), Regional level, Priority areas, Districts, and Settlements. The Parliament, the Government, the National Forum of Regional Development, the Minister and other Ministers, the County Government, the Regional Development Consultation Forum, the County Development Consultation Forum, the Regional Development Agency, the regional administrative bodies, and the local residents are involved in developing the spatial plans. Land use plans have to be reviewed in every 10 years. Public comments are allowed in the planning processes.

2.4.3 Poland

The Act on the Protection of the Environment, 27 April 2001. Defines nature compensation as: a set of activities including construction works, earthworks, soil remediation, afforestation, afforestation or creation of vegetation clusters in particular, leading to the restoration of natural balance in a given area, compensation of damage done to the environment by the implementation of the enterprise and preservation of landscape values.

The Act on the Prevention of Damage to the Environment and its Remediation, April 13, 2007.

The Act on the Protection of Nature, April 16, 2004.

The Act on the Protection of Animals, August 21, 1997.

Regulation of the Minister of the Environment (28 September 2004), in which methods are provided for the protection of species of wild animals, which consists in:

1. Creating and maintaining movement/ migration corridors,

2. Ensuring patency of movement/ migration paths, including the construction of passes and channels,

3. Disassembly of obstacles and constant maintenance of fish passes,

4. Installation of animal passages under and over public roads and railway lines;

Legislation, spatial planning and infrastructure

Law on spatial planning and development, March 27, 2003;

Transport Development Strategy until 2020 (from the perspective until 2030), January 22, 2013;

Program of Construction of National Roads for the years 2014 - 2023 (with a prospect until 2025), September 4, 2015;

The Act on special rules for the preparation and implementation of investments in the field of public roads, April 10, 2003;

Regulation of the Council of Ministers on the network of motorways and expressways, May 15, 2004

2.4.4 Romania

Romania has significantly improved its environmental performance since its accession in 2007. While Romanian legislation accurately reflects the environmental requirements agreed at EU level, their implementation on the ground is in general a challenge, prompted inter alia by a lack of planning, coordination and appropriate funding[16].

Relevant legislation in terms of nature protection[17]:

- Law no. 5/2000 regarding the planning of the national territory (section III is dealing with protected areas).
- Emergency Government Ordinance no. 195/2005 for environmental protection approved with changes through Law no 245/2006.
- Ministerial Order no. 1338/2008 regarding the procedure for issuing the Natura 2000 permit.
- Emergency Government Ordinance no. 57/2007 regarding the regime of protected areas, conservation of natural habitats and of wild flora and fauna.
- Ministerial Order no. 19/2010 for approving the methodological guidelines on the appropriate assessment of the potential effects of plans and projects on protected areas of community interest.
- Ministerial Order no. 135/2010 for approving the methodology for environmental impact assessments for public and private projects.
- Law no. 137/2010 for ratifying the Protocol on the conservation and sustainable use of biological and landscape diversity, adopted and signed in Bucharest on June 19, 2008, at the Framework Convention on the protection and sustainable development of the Carpathians, adopted in Kiev on May 22, 2003.

16 http://ec.europa.eu/environment/eir/pdf/factsheet_ro_en.pdf
17 http://www.mmediu.ro/articol/legislatie/433

Laws for ratifying relevant Conventions and Protocols:

- Law no. 187/1990 for ratifying the Convention on the Protection of World Cultural and Natural Heritage (Paris).
- Law no. 5/1991 for ratifying the Convention on Wetlands of International Importance (RAMSAR).
- Law no. 13/1993 for ratifying the Convention on the Conservation of European Wildlife and Natural Habitats (Bern).
- Law no. 58/1994 for ratifying the Biodiversity Convention (Rio de Janeiro).
- Law no. 69/1994 for ratifying the Convention on the International Trade with Endangered Species (Washington).
- Law no. 13/1998 for ratifying the Convention on the Conservation of Wild Migratory Species (Bonn).
- Law no. 389/2006 for ratifying the Framework Convention on the protection and sustainable development of the Carpathians, adopted in Kiev on May 22, 2003.
- Law no. 137/2010 for ratifying the Protocol on the conservation and sustainable use of biological and landscape diversity, adopted and signed in Bucharest on June 19, 2008, at the Framework Convention on the protection and sustainable development of the Carpathians, adopted in Kiev on May 22, 2003.

Regarding Transportation, the Master Plan for Transport in Romania 2030 mentions the need to respect conservation measures in future projects, including the integration of non-structural and Green Infrastructure measures, and avoiding negative impacts on protected areas, forested areas and non-protected areas where species of community interest are identified, by reconsidering planning of routes. The Territorial Development Strategy of Romania 2035 clearly refers to Green Infrastructure as an efficient way to adapt to climate change and to diminish natural risks compared to physical or grey infrastructure. Specific measures include protecting natural habitats (by ensuring diversity of and interconnectivity between natural areas, particularly in the context of Natural 2000 management) and developing green spaces in urban areas and green belts around major cities[18].

The Transport White Paper 'Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system' (2011) represents the vision of the EU's transport policy for the 2050 time horizon, focusing on the sustainable development of this sector, thereby understanding the need to reduce the environmental impact, the drastic reduction of greenhouse gas emissions with a view to limiting climate change, increasing investment in road infrastructure to support economic growth, fostering geographic accessibility and mobility, increasing social welfare, increasing traffic safety, reducing accidents, increasing the quality of road infrastructure systems (implementing Intelligent Transport Systems – ITS), and improving traffic management systems. The White Paper is the basic document on the development of the national policies and strategies of the member states, Romania correlating and integrating the European objectives with the national policies in the strategic document finalized in 2015 – the **General Transport Master Plan**.

18 https://biodiversity.europa.eu/countries/gi/romania

2.4.5 Serbia

The main laws and regulations currently in force in Republic of Serbia which are relevant to the environmental protection during planning, design, construction and operating of road transport projects are listed below:

- Decree on the ecological network ("Official Gazette of RS " No. 102/2010)
- Law on nature protection ("Official Gazette of RS", 36/09, 88/10 i 91/10, 14/16)
- Law on environmental protection ("Official Gazette of RS" No. 135/04, 36/09, 72/09, 43/11,14/16)
- Law on forest ("Official Gazette of RS", 30/10, 93/12, 89/15)
- Law on planning and construction ("Official Gazette of RS" No. 72/2009, 81/2009, 64/10, 24/11,121/12, 42/13, 50/13, 98/13, 132/14, 145/14)
- Law on EIA ("Official Gazette of RS" No. 135/2004, 36/2009)
- Law on Strategic EIA ("Official Gazette of RS" No. 135/2004, 88/10)
- Regulations established on the basis of the Law on EIA include the following:
    - Decree on establishing the List of Projects for which the Impact Assessment is mandatory
    - List of projects for which the EIA can be requested ("Official Gazette of RS" No. 114/08)
    - Rulebook on the contents of the EIA Study ("Official Gazette of RS" No. 69/05)
    - **Rulebook on the work of the Technical Committee for the EIA Study** ("Official Gazette of RS" No.69/05)

Other relevant Serbian legislation

- Law on confirmation of convention on information disclosure, public involvement in process of decision making and legal protection in the environmental area ("Official Gazette of RS", 38/09)
- Law on public roads ("Official Gazette of RS" No. 101/2005, 123/07)

2.4.6 Slovakia

Key legislation:

- **Act No. 543/2002 Coll. on Nature and Landscape Protection of June 25, 2002 as amended by later regulations**

This Act regulates competencies of state administration bodies and municipalities, and rights and obligations of legal persons and natural persons in nature and landscape protection with the aim to secure preservation of natural balance and conservation of diverse living conditions and life forms on the Earth, nature values and beauties to create conditions for long-term sustainable use of natural resources and for providing ecosystem services, taking into account economic, social and cultural needs, as well as regional and local conditions.

This act characterizes a bio corridor as an adjacent set of ecosystems which connects bio centres and allows the migration and exchange of genetic information between wildlife and its communities connected to interactive elements.

- **Decree of the Ministry of the Environment of the SR No 24/2003 Coll.** implementing the Nature Conservation Act
- **Act. No. 326/2005 Coll.** on forests of June 23, 2005, as amended by later regulations

This Act determinates forest land and its protection, regulates ownership of forest land and its use, forest management, supports sustainable management of forests out of public sources, regulates competencies of state administration and control bodies, sanctions for breach of duties imposed by this Act in order a) to preserve, enhance and protect forest as integral part of the environment and of country´s wealth for fulfilment of its irreplaceable functions, b) to ensure differentiated, professional and sustainable management of forest, c) to combine interests of society and owners of the forest, d) to build up economic conditions for sustainable management of forest.

- **Decree of the Ministry of Agriculture of the SR No. 12/2009 Coll.** on forest land protection in the spatial planning
- **Act No. 274/2009 Coll.** on hunting of July 10, 2009, as amended by later regulations

This Act regulates a) conditions of conservation of generic diversity and health of populations of wild animals and their natural habitats, b) designation, changes and utilization of the hunting grounds, c) hunting management, planning and documentation, d) game management, improvement of living conditions for animals and competences of hunting guards, e) formation, registration and ending of hunting organization, f) conditions on hunting and exploitation of game animals, g) compensation of damages caused by game animals, h) responsibilities of state administration bodies with respect to hunting.

- **Decree of the Ministry of Agriculture and Rural Development of the SR No. 489/2013 Coll.** implementing the Act on Hunting
- **Act No. 364/2004 Coll.** on waters as amended by later regulations

This act establishes conditions for a) broad protection of waters including water ecosystems and water-depending ecosystems, b) preservation and improvement of the status of water systems, c) rational and sustainable use of waters, d) management of catchment areas and for the improvement of environment, e) reduction of the adverse effects of floods and droughts periods, f) preserve the functions of water courses, g) safety of waterworks, h) use of water in regard to its strategic and safety-related importance.

- **Act No. 330/1991 Coll.** on land reform

The purpose of land reform is rational, spatial organization of land ownership in a given area in accordance with the demands of environment, development of terrestrial system of ecological stability and functions of agricultural landscape.

- **Act No. 24/2006 Col.** on Environmental Impact Assessment

This act regulates: a) procedure of expert and public assessment of potential impact on environment of all strategic documents in the process of its development and before the approval and proposed activities before decision on structure location is taken, b) competences of state administration bodies and communities, c) rights and duties of all the participants of the process of environmental impact assessment. The purpose of the act is a) to safeguard high level of protection of the environment and integration of environmental aspects into the strategic documents, b) to identify, describe and evaluate direct and indirect impacts of proposed strategic documents on environment, c) to explain and compare advantages and disadvantages of the proposed strategic documents in comparison to the zero variant, d) to define the measures which will prevent the environmental pollution, e) to develop a professional background document for the approval of strategic documentation.

- **National Biodiversity Strategy in Slovakia** until 2020 approved by the Decree of the Slovak Government no. 12/2014 of January 8, 2014.

The main reason of the strategy is to stop the loss of biodiversity and degradation of the ecosystems and their services in Slovakia until 2020, to safeguard the restoration of biodiversity and ecosystems and increase our contribution to stopping the loss of biodiversity in the world.

- Action Plan for the implementation of the Updated National Biodiversity Strategy until 2020 approved by the Decree of the Slovak Government no. 442/2014 of September 10, 2014.
- Strategy, Principles and Priorities of the State Environmental policy approved by the Decree of the Slovak Government no. 619/1993 of September 7, 1993 and Decree of National Council of the Slovak Republic no 339/1993
- National Strategy for Sustainable Development approved by the Decree of the Slovak Government no. 978/2001 of October 10, 2001
- Updated Slovak Water Management Plan approved by the Decree of the Slovak Government no. 6/2016 of January 13, 2016

2.4.7 Ukraine

Key legislation in Ukraine:

- **Law of Ukraine on the Protection of Natural Environment**, June 25, 1991

The law establishes main principles of environmental protection and use of natural resources, responsibilities of authorities, monitoring and control systems, categories of protected areas, economic tools to be used to protect the environment etc.

- **Law of Ukraine on the Environmental Impact Assessment,** May 23, 2017

The Law establishes procedure of EIA in Ukraine, categories of activities subject to EIA and scope of EIA, authorities responsible for EIA, public consultations, and liability for violation of EIA legislation.

- **Law of Ukraine on the Strategic Environmental Assessment,** March 20, 2018

The Law establishes procedure of SEA in Ukraine, documents which are subject to SEA, parties of SEA process, peculiarities of transboundary consultations, public participation in SEA process.

- **Law of Ukraine on the Natural Protected Areas of Ukraine**, June 16, 1992

The Law defines categories and regime of natural protected areas in Ukraine, management of protected areas, order of establishment of new protected areas, protection measures, types of violation of law on protected areas.

- **Law of Ukraine on the Ecological Network of Ukraine**, June 24, 2004

The Law includes terminology related to ecological network, principles of its formation, protection and use, elements of ecological network, management, funding, monitoring and control.

- **Law of Ukraine on the Red Book of Ukraine,** February 7, 2002

The Law establishes the regime of protection of rare and endangered species of fauna and flora in Ukraine, proprietary rights, management bodies, categories of species and order of identification and approval of species peculiarities of use of flora and fauna subject to the Red Book of Ukraine.

- **Law of Ukraine on Fauna**, December 13, 2001

The Law established main principles of use and protection of fauna in Ukraine, protection of habitats, reproduction sites and migration routes, necessity to respect these issues in the process of EIA.

- **Law of Ukraine on Flora**, April 9, 1999

The Law established main principles of use and protection of flora in Ukraine.

- **Law of Ukraine on Regulation of Urban Planning**, February 17, 2011

The Law includes terminology, principles of planning of sites development, management, planning of development of areas at different levels, public participation, monitoring and recording, permitting and documentation, obligatory conditions and limits, categories of buildings, expertise procedure, control and liability.

- **Law of Ukraine on Transport,** November10, 1994

The Law regulates the management of transport sphere in Ukraine, as well as regime of lands of transport, safety measures and control system.

- **Law of Ukraine on Road Traffic**, June 30, 1993
- **State Construction Norms** (DBN B.2.3-4:2007). Motorways., 2007
- **State Construction Norms** (DBN B.2.3-19-2008). Railways 1520 mm gauge, 2008
- **Branch Construction Norms** (GBN B.2.3-218-007:2012). Ecologic Requirements to Motorways, 2012.
- **Land Code of Ukraine,** October 25, 2001

Main legal act, which regulates relations in the sphere of use of lands in Ukraine.

- **Water Code of Ukraine**, June 6, 1995

Main legal act, which regulates waters use and protection in Ukraine.

- **Forest Code of Ukraine**, January 21, 1994

Main legal act, which establishes the principles of forestry policy in Ukraine, regime of forest use and forest protection, categories of forest, proprietary rights, regime of special and general use of forest, forest management, forest monitoring and certification, control etc.

- **Law of Ukraine on Air Protection**, October 16, 1992

The Law establishes the main principles of air protection in Ukraine.

Signed conventions and protocols:

- Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), 19 Sept. 1979
- Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention), 02 Feb. 1971
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), November 1, 1983
- Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention), February 25, 1991
- Protocol on Strategic Environmental Assessment to the Convention on Environmental Impact Assessment in a Transboundary Context, 21 May 2003
- The Framework Convention on the Protection and Sustainable Development of the Carpathians (Carpathian Convention), May 22, 2003
- Protocol on Sustainable Transport to the Framework Convention on the Protection and Sustainable Development of the Carpathians, September 26, 2014

2.5 Environmental procedures

2.5.1 SEA procedure

Directive 2001/42/EC of the European Parliament and of the Council on the assessment of the effects of certain plans and programmes on the environment, known as the "SEA" (strategic environmental assessment), requires that an environmental assessment be performed of certain plans and programmes which are likely to have significant effects on the environment (e.g. on land use, transport, energy, waste, agriculture, etc.). It entered into force on 21 July 2001 and the Member States had to implement it by 21 July 2004. The Directive applies to public plans and programmes, i.e. the ones which are subject to preparation and/or adoption by an authority and which are required by national legislative, regulatory or administrative provisions. The objective of the SEA Directive (as stated in Article 1) is to provide for a high level of protection of the environment and contribute to the integration of environmental considerations into the preparation, adoption and implementation of plans and programmes, with a view of promoting sustainable development. This objective should be achieved by ensuring that environmental assessment is carried out, in accordance with the provisions of the Directive, for those plans and programmes which are identified as likely to have significant effects on the environment[19].

The major importance of environmental assessment lies in the possibility of early identification of potential incompatibilities between the proposed plan and environmental policies, offering the advantage of strategic planning, allowing potential negative effects to be avoided as early as possible in the project life cycle. However, unlike the EIA procedure, the SEA procedure shows low stringency and analysis requirements, given that, in this stage of the environmental procedure, no details are available for projects.

In case of the SEA procedure, there is a series of stages in which adequate information and public participation is provided. The most common ways to inform the public are publishing advertisements in the mass media, on the website of the competent authority for environmental protection and on the website of the plan owner. In case of covering the full procedure, by preparing the Environmental Report and the appropriate assessment study, as appropriate, they shall be subject to public debate, together with the plan/programme draft.

The administrative document issued at the end of this procedure is the Environmental approval.

19 http://ec.europa.eu/environment/eia/pdf/EIA_rulings_web.pdf

2.5.2 EIA procedure

Directive 2011/92/EU of the European Parliament and the Council of 13 December, 2011 on the assessment of the effects of certain public and private projects on the environment, as amended, known as the "EIA" (environmental impact assessment) Directive, requires that an environmental assessment be carried out by the competent national authority for certain projects which are likely to have significant effects on the environment by virtue, inter alia, of their nature, size or location, before a development consent is given. The projects may be proposed by a public or private person. An assessment is obligatory for projects listed in Annex I of the Directive, which are considered as having significant effects on the environment. These projects include for example: long-distance railway lines, airports with a basic runway length of 2,100 m or more, motorways, express roads, roads of four lanes or more (of at least 10 km), waste disposal installations for hazardous waste, waste disposal installations for non-hazardous waste (with a capacity of more than 100 tonnes per day), waste water treatment plants (with a capacity exceeding 150,000 population equivalent)[20].

In case of the EIA procedure, there is also a series of stages in which adequate information and public participation is provided, like in the case of SEA.

The administrative document obtained at the end of this procedure is the Environmental agreement.

2.5.3 AA procedure

The Appropriate assessment (AA) is required by Article 6(3) of the European Habitats Directive when a project or plan, either alone or in combination with other projects or plans, may have an impact on the integrity of a Natura 2000 site, with respect to the site structure and function and its conservation objectives. Appropriate assessments can thus be conducted for both plans and projects and it shall constitute an integral part of SEA and EIA procedures. There are also situations when the competent authority for environmental protection may decide only to cover the appropriate assessment procedure, in this case, being completed by issuing a Decision for the screening stage, or with issuing the Natura 2000 approval in case of the full procedure.

The administrative document obtained at the end of this procedure is the Natura 2000 approval or, where appropriate, the Environmental approval or the Environmental agreement, respectively, when the appropriate assessment was conducted simultaneously with the SEA or EIA procedure.

20 http://ec.europa.eu/environment/eia/pdf/EIA_rulings_web.pdf

3

Key Ecological Aspects

3.1 Ecological connectivity, networks and corridors

Habitat loss and fragmentation are among the most pervasive threats to biological diversity. Landscape fragmentation is a transformation of large habitat patch into smaller more isolated fragments of habitats, mainly caused by human activities. The large-scale natural and semi-natural habitat fragmentation and loss caused by agricultural intensification and transport infrastructure and urban development have significantly changed the landscape across the world [21,22].

In spite of the planning concept of preserving large unfragmented areas, fragmentation has continued in Europe during the last 20 years and its rate is projected even to increase in the future[23].

As the landscape has been to run out of large tracks of intact habitats, interest is growing in increasing the connectivity of remaining habitat blocks, thereby facilitating movement, e.g. natal dispersal, seasonal migration, exploration, searching for a mate or daily foraging of individuals among patches. It has become increasingly recognised that the relationship between dispersal capacity and spatial arrangement of habitat patches in the landscape can affect species' persistence on a regional scale[24,25].

In addition, maintaining and improving connectivity by i.e. increasing connectivity through designing and managing corridors, removing barriers for wildlife dispersal, locating reserves close each other and promoting restoration is one of the most favoured option[26,27,28,29].

The connectivity is the degree to which the structure of a landscape helps or impedes the movement of wildlife[30,31]. Connectivity is a parameter of landscape function, which measures the processes by which sub-populations of the particular species are interconnected into a functional demographic unit. A landscape is well connected when organisms or natural ecological/evolutionary processes can readily move among habitat patches over a long time. Thus, connectivity refers to the ease with which organisms move between particular landscape elements, or within the landscape as such[32]. It depends on several attributes of the species, as well as the interaction between the species and the landscape.

Worboys et al. (2010) [33] further refine the concept of connectivity very well and define four major types of connectivity commonly used in conservation science. These include:

1. Habitat connectivity – connecting patches of suitable habitat for a particular species or species group

2. Landscape connectivity – connecting patterns of vegetation cover in a landscape

3. Ecological connectivity – connecting ecological processes across landscapes at varying scales. Ecological processes include trophic relationships, disturbance processes, nutrient flows and hydro-ecological flows.

21 CBD, 2010
22 Kareiva & Marvier, 2011
23 EEA, 2011
24 Wiens et al, 1993
25 Lindenmayer et al, 1997
26 Donald, 2005
27 Kettunen et al, 2007
28 Heller & Zavaletta, 2009
29 Doswald & Osti, 2011
30 Taylor et al, 1993
31 Tischendorf & Fahring, 2000
32 Kindlmann & Burel, 2008
33 Worboys et al, 2010

Evolutionary process connectivity – this is about maintaining the natural evolutionary processes including evolutionary diversification, natural selection and genetic differentiation operating at larger scales. Typically, evolutionary processes require movement of species over long distances, long time-frames and management of unnatural selection forces.

Biological corridors have a relatively long history in nature conservation and management. They have been used as a conservation technique since the early 20th century. In the late 1970s and early 1980s, a concept of ecological network was raised and developed to be applied in various parts of the world[34,35,36].

Biological corridors are physical landscape elements that facilitate and provide connectivity and coherence at various spatial and time scales. They usually consist of lower quality habitats that may be highly influenced by edge effects but that nonetheless allow movement of individuals among higher quality patches. Together with core areas, they are key spatial structural and functional elements of ecological networks.

Ideally, biological corridors support all the above types of connectivity, not only habitat connectivity, as often suggested. The primary ecological rationale for biological corridors in nature conservation and landscape management is to increase population persistence by allowing continued exchange of individuals within a previously connected population. Movement of individuals among sub-populations may reduce regional and local extinction rates by a number of mechanisms[37]:

- Decreasing variability in birth and death rates;
- Increasing (re)colonization rates of unoccupied patches;
- Decreasing inbreeding depression, i.e. increasing gene flow;
- Increasing potentially adaptive genetic variance for maintaining population fitness.

Therefore, main functions of biological corridors include[38]:

- Permit colonization of new sites as they become suitable;
- Allow organisms to move out of sites as they become unsuitable;
- Permit re-colonization of sites where wildlife populations have become extinct;
- Allow species to move between separate areas needed to different stages of their life cycles;
- Increase overall extent of habitat, particularly for species with extensive space requirements.

As a result, fragmentation of the landscape is perceived today as one of the hot issues as it was mentioned above. The open landscape composing of natural and semi-natural habitats, supposed to act as a connecting element between various populations, is now losing its capacities. In many cases, this is an irreversible process making the protection of the existing linear connections a key task within nature conservation. Ecological networks in the broadest sense are hence coming to the fore with their basic attribute of suitable habitats and desired continuity.

The **ecological network** is a model that has been developed over the past years with the broad aim of maintaining the integrity of environmental processes. Based on this, the landscape should be zoned in such a way that intensively used areas are balanced by natural zones functioning as a coherent, self-regulating whole. The approaches usually classified as ecological networks share two generic goals, namely (1) maintaining the functioning of ecosystems as a means of facilitating the conservation of species and habitats and (2) promoting the sustainable use of natural resources in order to reduce the impacts of human activities on biodiversity and/or to increase the biodiversity value of managed landscapes[37]. In achieving these goals, a number of elements can be discerned which together characterize all ecological networks. These are: (a) a focus on con-

34 Jongman & Pungetti, 2001
35 Bennett & Mulongoy, 2006
36 Bonnin et al, 2007
37 Rosenberg et al, 1997
38 Hess & Fischer, 2001
39 Bennett & Wit, 2001

serving biodiversity at the landscape, ecosystem or regional scale; (b) an emphasis on maintaining or strengthening ecological coherence, primarily through providing for connectivity (c) ensuring that critical areas are buffered from the effects of potentially damaging external activities; (d) restoring degraded ecosystems where appropriate (e) promoting the sustainable use of natural resources in areas of importance to biodiversity conservation. These functions are reflected in a coherent system of areal components:

- core areas, where the conservation of biodiversity takes primary importance, even if the area is not legally protected
- corridors, which serve to maintain vital ecological or environmental connections by maintaining physical (though not necessarily linear) linkages between the core areas
- buffer zones, which protect the network from potentially damaging external influences and which are essentially transitional areas characterized by compatible land uses[40].

3.2 Role and importance of ecological corridors for animal movement and/or dispersal

Ecological corridors are an important component of functional ecological networks. Ecological corridors primarily connect wildlife habitats and improve the functional connectivity of habitats. Corridors keep landscapes permeable for animal movements and reduce habitat resistance. Ecological corridors are used for different purposes, in different patterns, and at different scales, depending on the species. One way to identify a corridor is by the species-specific needs and the movement function they provide.

Animals need to move due to three different reasons: daily movement secures search for food, shelter, and breeding partners. For this, they must find movement paths in order to connect suitable patches of food or shelter in their particular home ranges. Daily movement paths sustain normal life of wildlife and are often of shorter distances. Migration/ large movements are a special defined movement pattern resulting in minimal two different home ranges which are not overlapping. Reasons for migration are various, either the animals are overcoming lack of food by migrating/moving to a different place, or they try to find better breeding places for their offspring. Prominent examples are migrating birds or great migration of wildebeest on the Great Plains. However, even in Europe, several wildlife species undertake migration in order to avoid harsh winter conditions, e.g. the red deer (*Cervus elaphus*).

In an optimal or primary habitat, wildlife can move freely without overcoming obstacles. However, various obstacles can hinder wildlife movements including natural barriers like rivers, steep slopes, canyons or other non-suitable topography. In a human-dominated landscape, human structures including settlements, railroad, and especially road infrastructure can seriously impede wildlife movement. We can even find many examples where wildlife movement is no longer possible, often also in combination with natural barriers. Functional corridors are straight line structures connecting suitable habitat. Highly functional corridors have a low level of fragmentation whereas minimal functional corridors are characterized by high fragmentation and little movement (see Fig. 2).

40 Bennett & Mulongoy, 2006

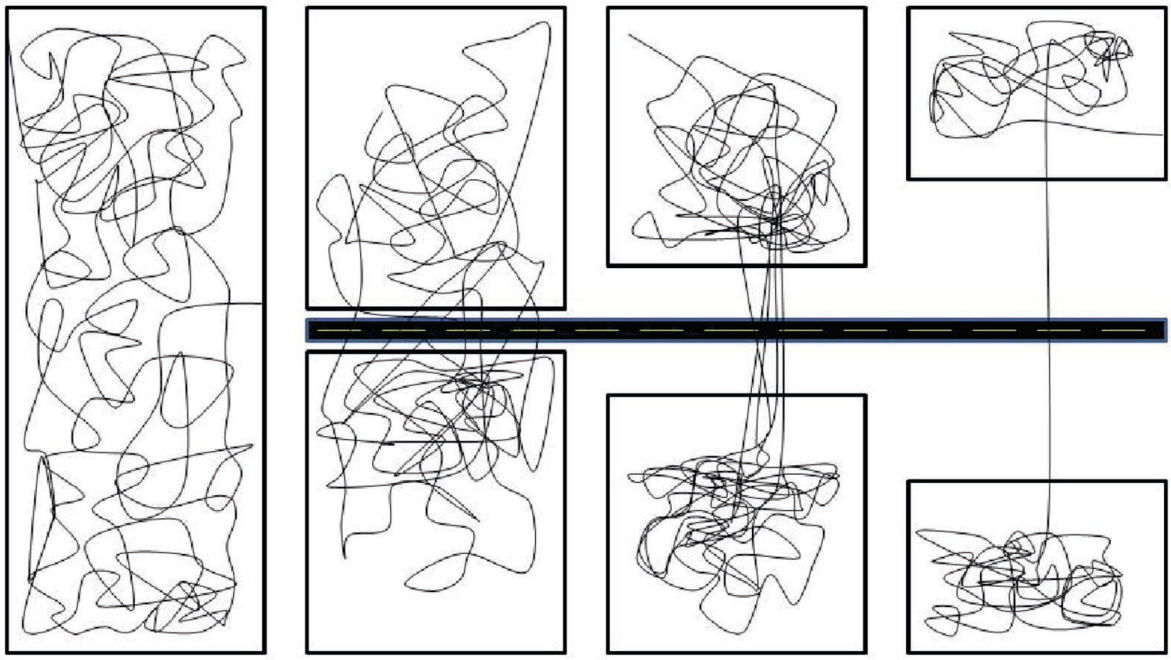


Fig. 2 Examples of animal movement in (A) primary habitat with high amounts of movement, high angular deviation and little fragmentation, (B) a linkage zone with potential fragmentation, but movement similar to primary habitat, (C) a highly functional corridor with fragmentation but high amounts of directional (low angular deviation) movement, (D) a minimally functional corridor with high fragmentation and little movement (according to Graves et al. 2007 [41]).

In suitable habitats, wildlife can move unlimited and does not necessarily use movement corridors. In fragmented landscapes, however, wildlife movement is often limited by human infrastructure. Therefore, it is very important to identify ecological corridors in order to implement mitigation measures which keep them functional. The originally continuous distribution of many animal species is being disintegrated by rapid landscape fragmentation. The most affected groups of species influenced by fragmentation of the landscape are those bounded to the well-preserved natural environment and have great demands for the size of the home range or their biology include regular or occasional migration. Especially the three species of large carnivores, the wolf, the lynx and the brown bear are coming into fore. Large carnivores are very similar in ecological requirements as these species are strictly tied to large forested areas with low human disturbance. Furthermore, long distance migration is an integral part of their biology[42]. They strictly occur in forested mountain or foothill areas. Their spatial demand for home range size is large and usually comprises hundreds of square kilometres. Their core and relatively continuous population inhabits the Northern, Eastern and Southern Europe (Scandinavia, the Carpathians and Dinaric mountains), but the population density is low due to territorial aggression. Sub-adult individuals are forced to seek free niche for reproduction and they have to migrate considerable distances often across national borders. Long-term survival of these populations is considerably threatened by other factors such as illegal hunting and many populations would probably have disappeared without strengthening through the process of natural immigration of new individuals (or even by reintroduction interventions). Small populations are generally more prone to disturbances such as the emergence of new barriers, habitat loss and change, increase in illegal hunting[43], etc.

Migratory behaviour is also typical of species of large European ungulates as already stated above. This includes especially long migration of the moose and the red deer or the European bison rather migrate on short or middle distances up to a few tens of kilometres. Given that large

41 Graves et al, 2007
42 Andersen et al, 2003
43 Anděl & Hlaváč, 2008

ungulates have similar environmental requirements as large predators, this fact can be taken as an indicator of environmental status in areas where large carnivores are absent. Large carnivores and ungulates demands for the quality and structure of habitats will also cover the demands of another smaller species which are also closely bounded to forested habitats. If we ensure the protection and mutual connectivity of habitats by ecological corridors for umbrella species, then we will also address the issue of protection of entire forest species ecosystems composition, including a number of other endangered species of mammals and birds[44].

Several projects and studies focused on identifying ecological networks and ecological corridors in the Carpathians.

1) BioREGIO Carpathians project

The project was supported by the DTP Programme. One of the project outputs was to identify the most probable habitat and core areas as well as ecological corridors for several umbrella species to move through the landscape (Figs 3, 4).

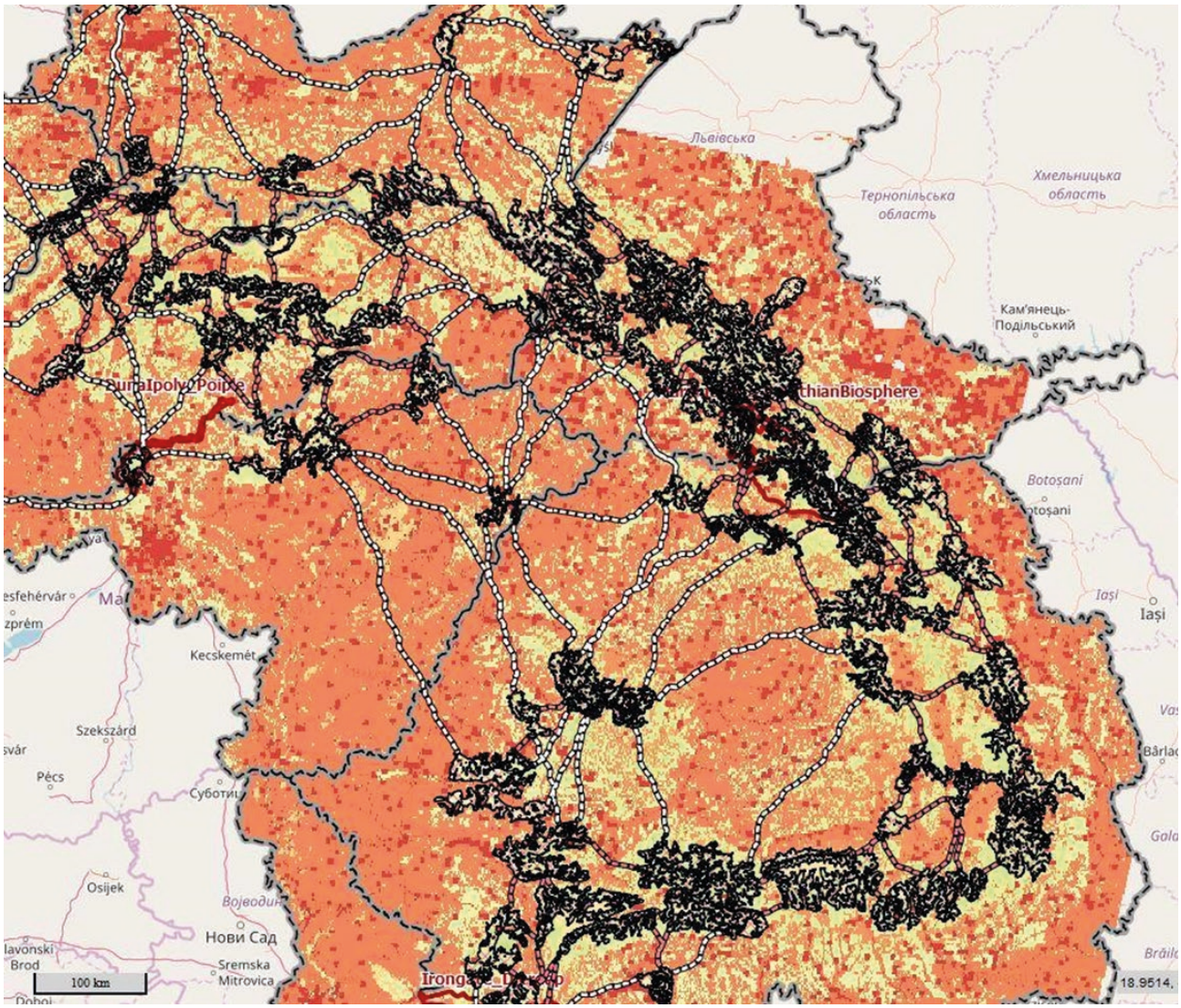


Fig. 3 Habitat suitability model and possible ecological corridors (least cost path) for the brown bear.

44 Lambeck, 1997

The chosen species were: the Eurasian lynx, the brown bear, the European wolf, the European otter, the western capercaillie, the Carpathian chamois and the European hare. Two levels of analyses were adopted within the framework of the project: a general one, which seeks to investigate the ecological network through all the Carpathians countries for all the umbrella species and a detailed one applied in the three pilot areas located at the borders Hungary/Slovakia, Romania/Ukraine and Romania/Serbia. For more information and maps please visit: http://webgis.eurac.edu/bioregio/ .

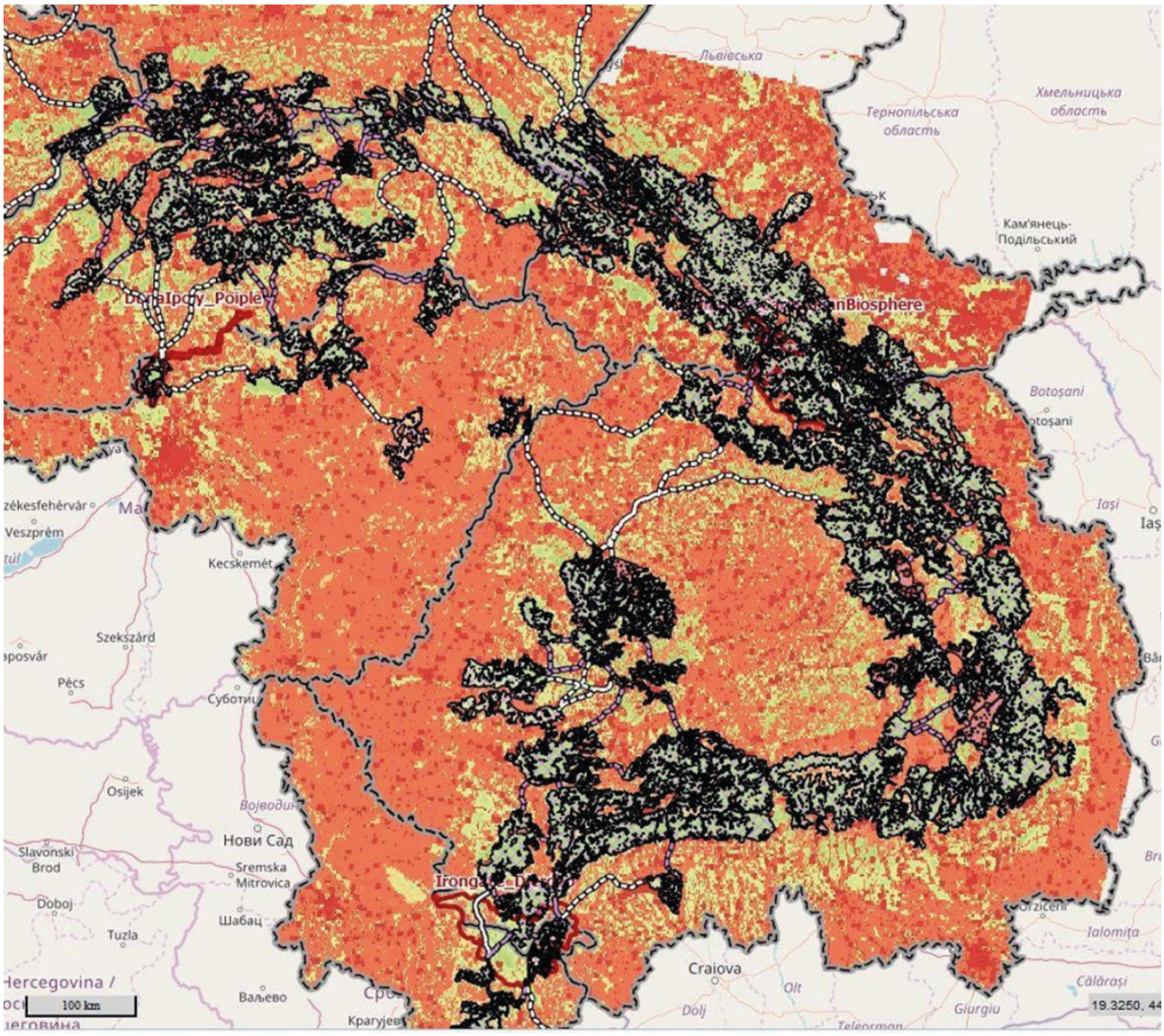


Fig. 4 Habitat suitability model and possible ecological corridors (least cost path) for the Eurasian lynx.

2) Potential habitat connectivity of the European bison (*Bison bonasus*) in the Carpathians

The main aim of this study was to prepare a model predicting potentially suitable corridors connecting five Carpathian areas, where the European bison herds were reintroduced. This study identified potential corridors between five European bison herds in the Carpathians. There were identified 36 connections between suitable habitat patches. It was stated that almost half of connections in the habitat network were blocked by at least one total barrier. The largest blocks of continuous suitable habitat were found in the Eastern Carpathians in the Gorgany and Czornohora Mountains. Other important areas identified to hosts suitable habitat were Rodna and Maramureș Mountains in the eastern Romania, Făgăraș Mountains in the southern Carpathians and areas in the Bieszczady (Poland) and Bukovské Mountains (Slovakia). Three areas being identified as well-connected between each other with high probability of bison movement: ranges located close to the Polish–Slovak border (two in the Bieszczady Mountains and one in the Bukovské Mountains), range of the Skole herd and range of the Bukovynska herd. On the contrary, a weak connection exists between the Eastern Bieszczady herd and the Ukrainian Skole herd (Figs. 5, 6).

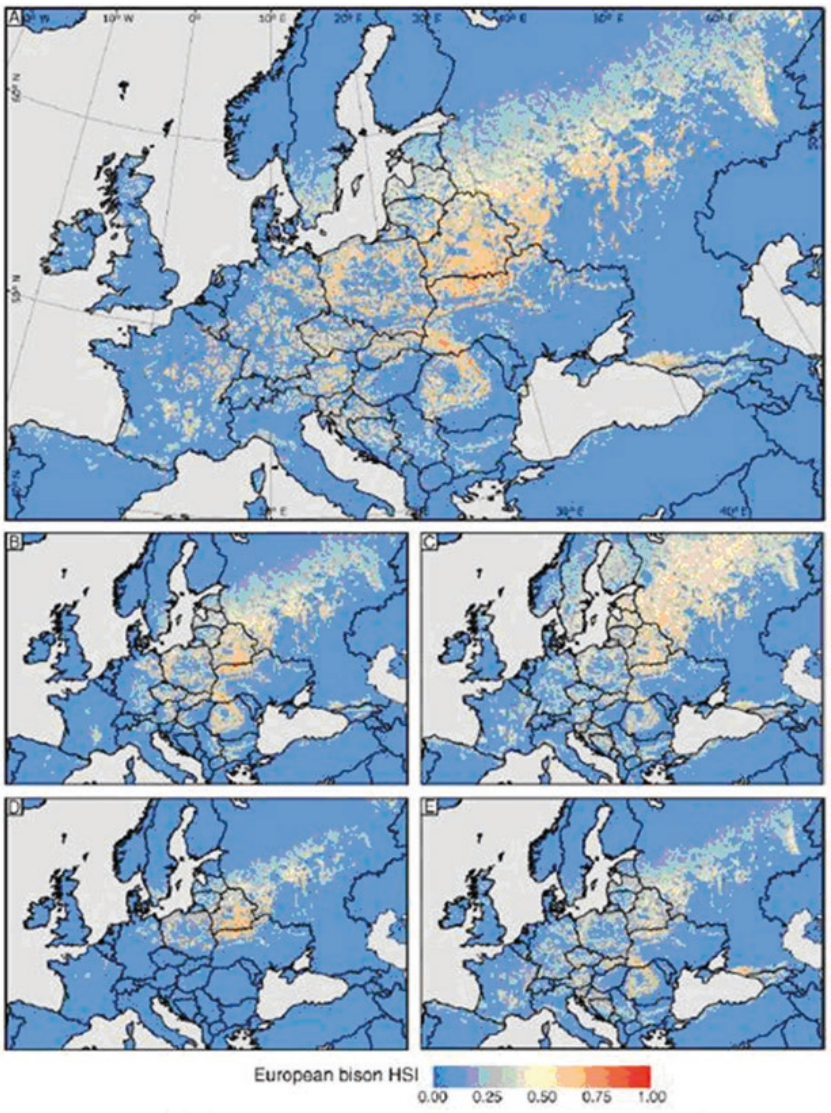


Fig. 5 Map predicting potential European bison habitat in Europe[45].

45 Kuemmerle et al, 2011

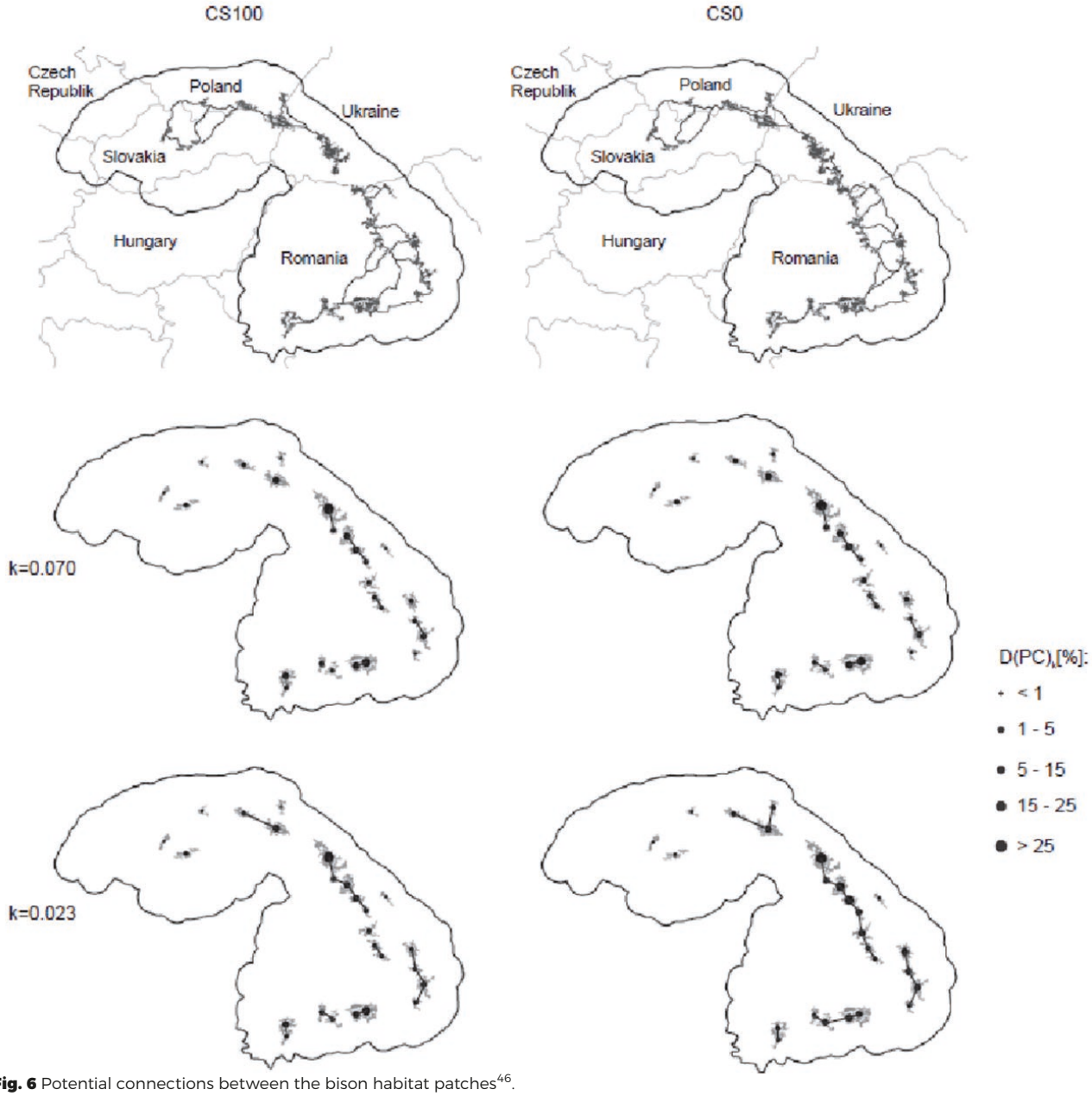


Fig. 6 Potential connections between the bison habitat patches[46].

46 Ziółkowska et al, 2012

3) Mapping conservation areas for carnivores in the Carpathian Mountains

The PhD thesis of Valeria Salvatori[47] gives a comprehensive overview of habitats suitable for large mammals in the Carpathian area. The habitat potentially suitable for the bear, the lynx and the wolf was modelled using GIS predictive methods.

The main objective of the present study was to produce maps that showed the geographical distribution of suitable areas for the conservation of large carnivores (the bear, the lynx and the wolf) in the Carpathian Ecoregion. The bear distribution was predicted over mountainous areas with the occurrence no lower than 200 m a.s.l. The Mureş river valley was identified as the main natural migration/ movement barrier to the central part of Bihor massif, which is more or less isolated (Fig. 7). The area with the highest suitability for the bear was estimated to 36,384 km2 in the whole Carpathians.

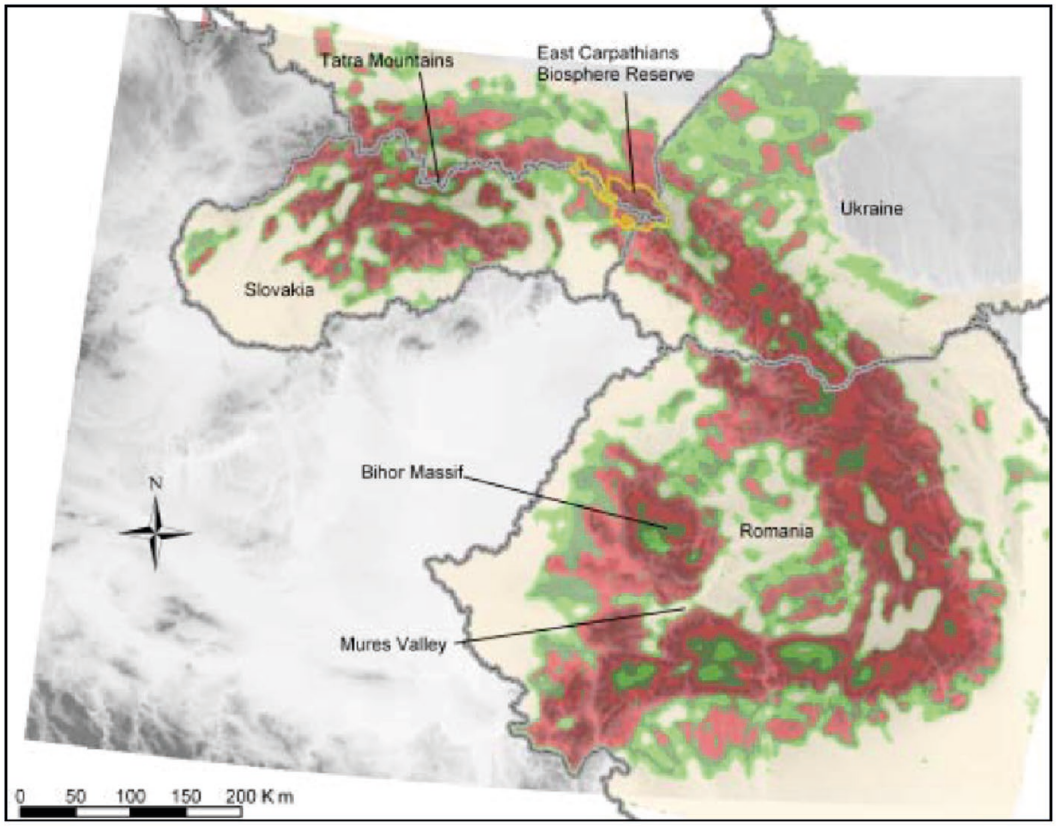


Fig. 7 The habitat suitability map for the brown bear (*Ursus arctos*) in the Carpathians.

The lynx potential distribution was estimated to nearly half of the Carpathian region (Fig. 8). Two most suitable classes were located in Romania and Slovakia. Two best suitable classes cover 58% of the whole Carpathians.

The first and second suitability classes of the wolf habitat cover areas of 124,056 km2, whichis 65% of the Carpathians (Fig. 9). Only 14% of Carpathians is not suitable. It is especially due to wolf's broad ecological niche which is used by the species during the migration/movement.

47 Salvatori, 2004

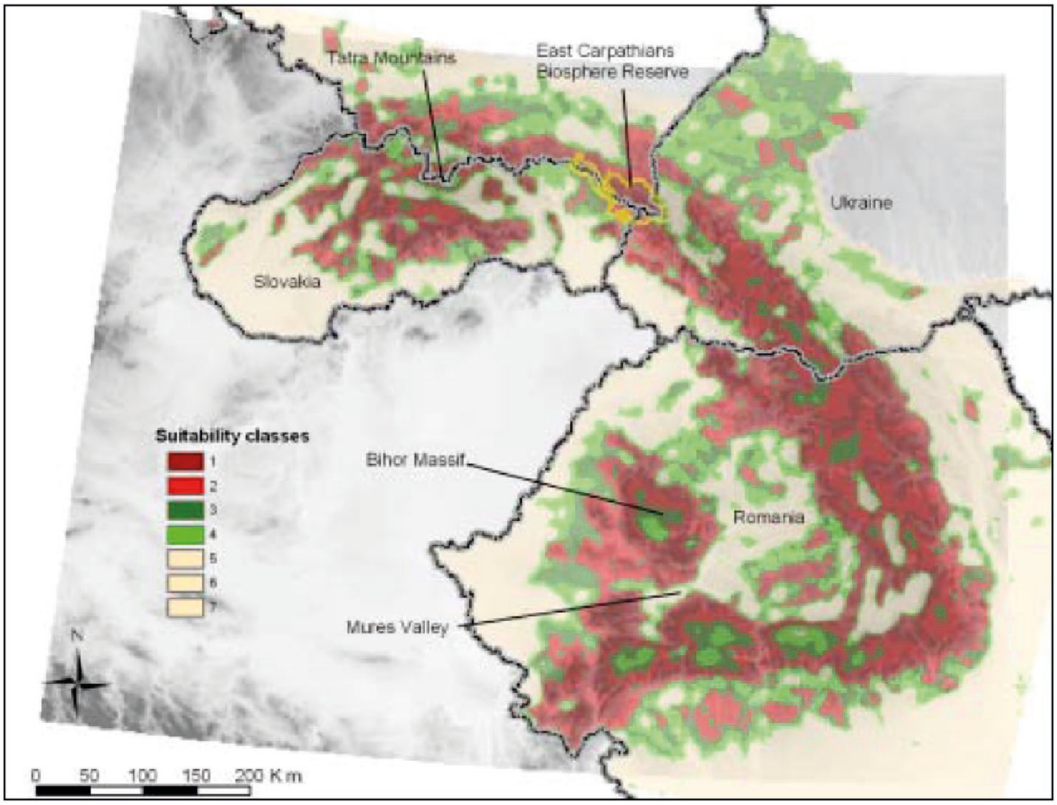


Fig. 8 The habitat suitability map for the Eurasian lynx (*Lynx Lynx*) in the Carpathians.

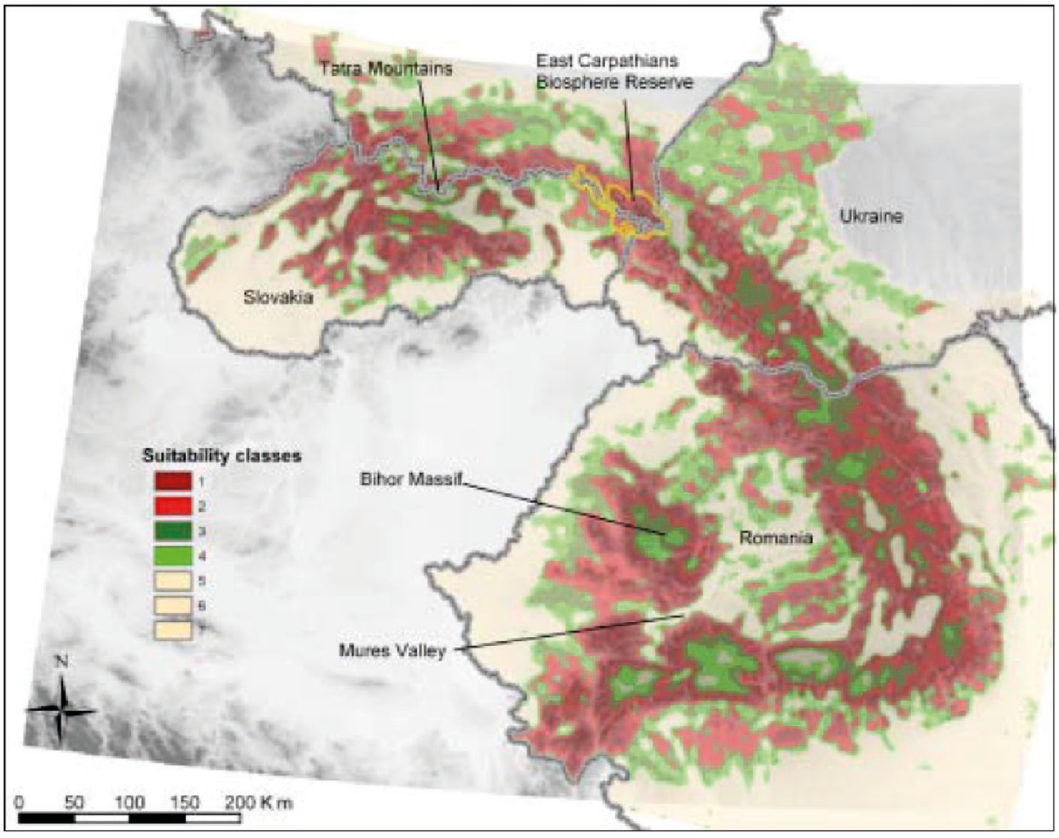


Fig. 9 The habitat suitability map for the wolf (*Canis lupus*) in the Carpathians.

4) Identification and assessment of the potential movement routes for European bison in the North-East of Romania

The author focused on identifying possible migration routes for the European bison (Bison bonasus) from Vânători Neamț Nature Park to other five neighbouring parks[48]. One herd of about five animals is planned to be reintroduced to the Chitele area in the Vânători Neamț Nature Park. This study took into account simple landscape characteristics to define large scale areas called corridors, which are free from migration barriers and possibly suitable for movement of bison herds.

The study depicts the possible situation that will favour migration of the European bison in small-scale areas in NE Romania (Fig. 10). Several possible corridors were proposed from the Vânători Neamț Nature Park connecting other five protected parks: Călimani, Ceahlău, Cheile Bicazului-Hășmaș, Rodnei Mountains and Maramureș Mountains, which are 55-140 km far from the European bison releasing area. Main migration barriers and threats within identified corridors were described. This includes mainly rivers, national roads and settlements. The corridor heading towards the Rodnei Mountains was identified as the most suitable for bison movement. The biggest disadvantage of this study is the lack of a detailed methodology that wasn't described in detail.

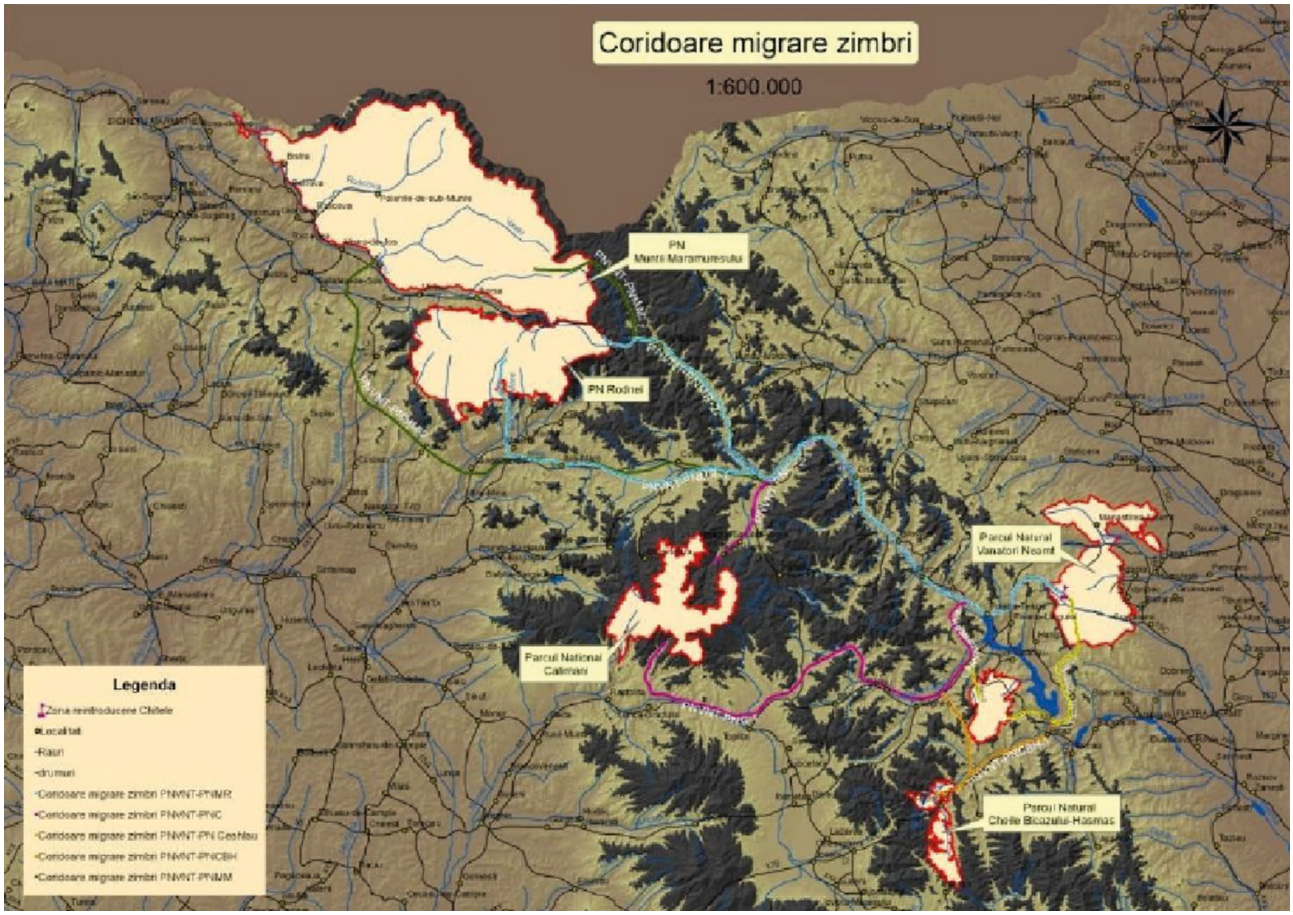


Fig. 10 Map of potential corridors for the European bison movement in NE of Romania.

48 Deju, 2011

5) Creation of ecological corridors in Ukraine

Three institutions have cooperated in this study: State agency for protected areas of the Ministry of Environmental Protection of Ukraine, Altenburg & Wymenga Ecological Consultants and InterEcoCentre. Corridors were proposed in two regions: Turkivskyi eco-corridor between the Skolivski Beskydy National park and the Polish border and Bukovynskyi eco-corridor between the Vyzhnytsky National park and the Romanian border. The brown bear, the European bison, the lynx and the wildcat were selected as umbrella species for corridor modelling in two pilot regions. Final maps were drafted manually, taking into consideration modelled corridors and expert field experiences. In the final step the verification took place in the field with the aim to examine the corridor bottlenecks and to map the already existing barriers and to assess the land use with stakeholders and real connectivity (Fig. 11, 12).

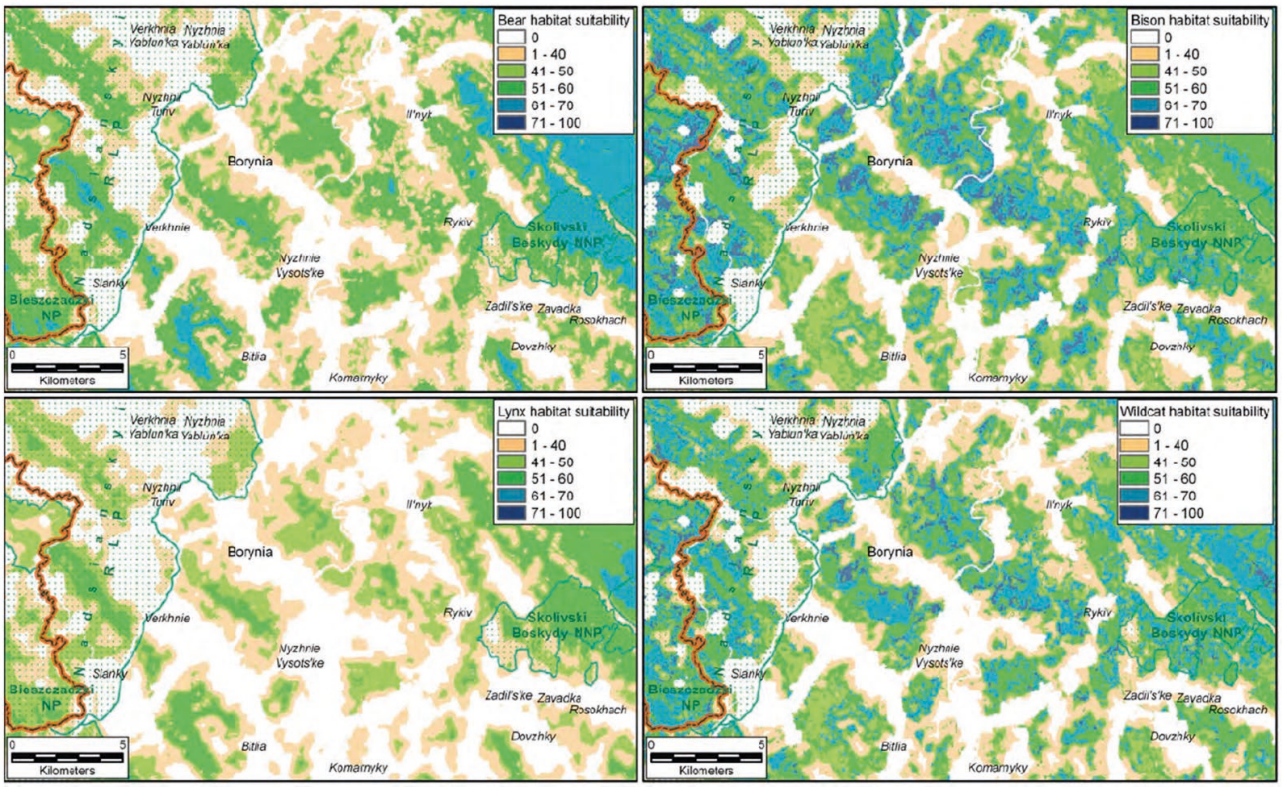


Fig. 11 Habitat suitability classification of the Turkivskyi corridor area for four umbrella species[49].

49 Deodatus & Protsenko, 2010

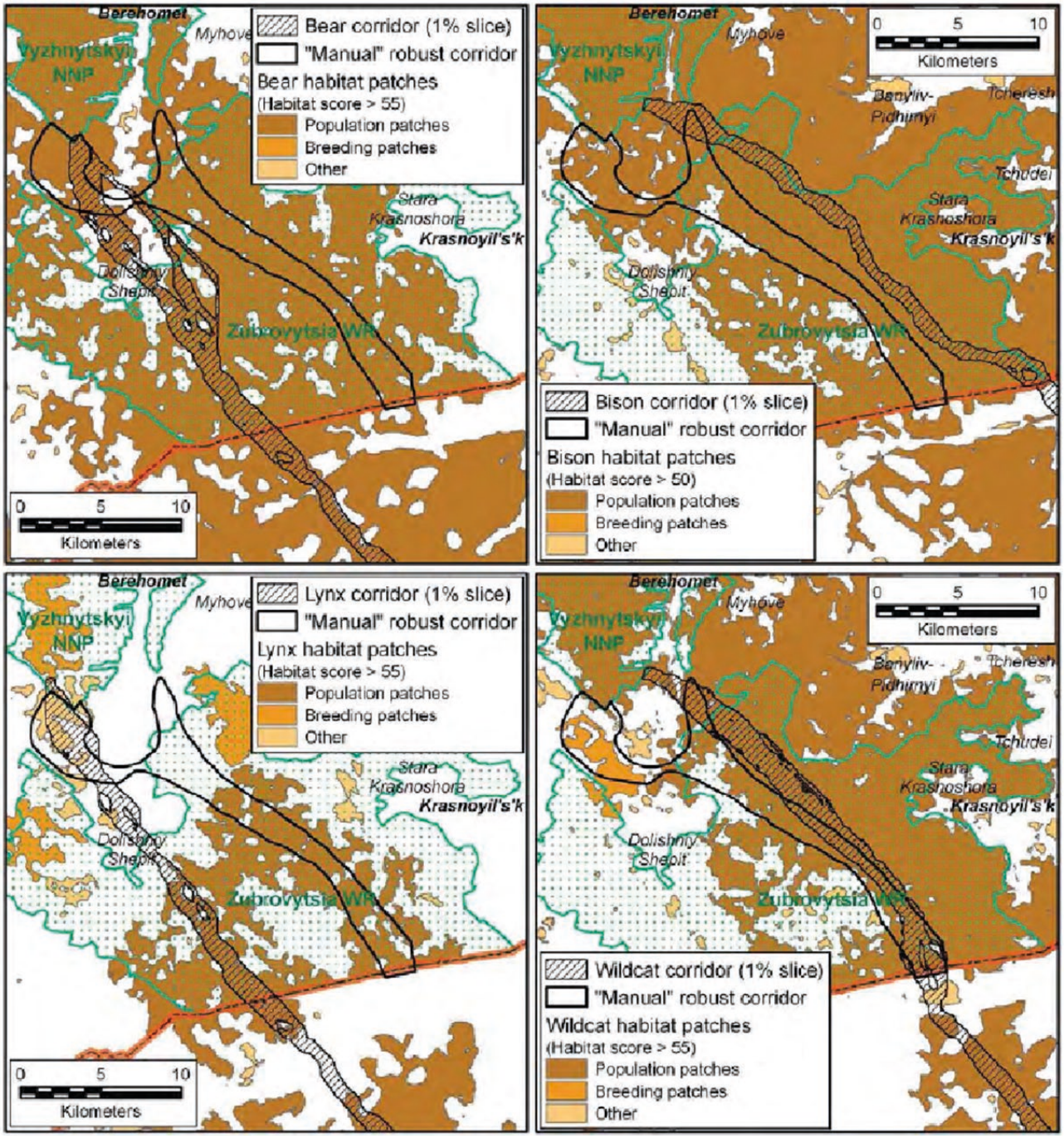


Fig. 12 Corridor models delineated by Corridor designer software for four umbrella species in the Turkivskyi corridor area. Preliminary robust corridors were also drawn manually[49].

Recommendations on ecological corridors management

Connectivity fundamentally depends on interactions of species and landscape. This dynamic interaction is primarily expressed through relationship of species, habitats and human impacts within those habitats. Different landscapes may have different connectivity values to the same species and certainly to different species. The connectivity property of a landscape may even be different for the same species at different times. Recent studies show that structural measures of landscape intactness are inconsistent predictors of connectivity for all species and in all situations.

A large-size interconnected landscape of natural and semi-natural habitats with embedded protected areas can provide opportunities for many species and through them, ecosystems and ecosystem processes/functions/services to respond to climate change and increasing human pressures. Moreover, connectivity is essential to conservation regardless of a changing climate.

The nature context, i.e. what nature needs, should be the principle driver in initiating and maintaining connectivity through ecological corridors. Although it remains uncertain how much connectivity is enough, it is clear that nature needs extensive connectivity.

Natural corridors (those existing in the landscape a priori) show more wildlife movement than manipulated corridors, which had been created. This suggests that it is better to protect natural landscape features that function as corridors, rather than create new corridors. Generally, the complexity and multifunctional components of undisturbed landscapes are difficult to replicate using constructed nature and ecosystems. Therefore it is necessary to think about mitigation measures that allow species migration/dispersal already in infrastructure planning phase before the barrier is built.

3.3 Main threats to ecological connectivity

General drivers that significantly influence ecological connectivity are land-use and land-cover change, climate change, pollution, fragmentation and infrastructure development.

However, as the main anthropogenic barriers for wildlife and ecological connectivity of their populations can be the identified roads – mainly expressways, highways and planned high-speed railways and rapidly expanding urban development. The most obvious impact is perceived especially due to fauna mortality on roads which can even result in migration impossibility in some smaller species. Another negative influence is direct loss of suitable habitats and disturbance (noise, lighting, etc.). Due to the character of the building, resp. expanding human settlements and related infrastructure, it is especially important to prevent its negative effects through better planning which takes into account the needs of all the species living in the surrounding landscape.

The building of road infrastructure has dramatically increased in the Carpathians and the traffic infrastructure is planned to be rapidly expanded and/or upgraded. However, in lots of cases, it is happening without the implementation of any suitable mitigation measures. Main reasoning is a long term negligence of wildlife-traffic-collision problem in the past, absence of studies on wildlife movement and absence of proper biological assessment in the area of planned infrastructure. It is absolutely necessary to plan and build wildlife mitigation measures on planned roads/railways and also enhance migration permeability during the upgrading process of the existing ones. One of the main outputs of the TRANSGREEN project is the Wildlife and Transportation in the Carpathian Countries Guidelines summarising the existing approaches on how to mitigate barrier effects of traffic infrastructures for wildlife.

Another significant factor which negatively influences ecological connectivity is increasing urbanization, including building of houses as well as huge shopping and logistic centres at the edge of towns and villages. Such urban sprawl has to be planned to leave free space between villages/towns to allow for free animal movement.

Also rapid increase in human disturbance, especially around big cities and/or touristic attractive places, can negatively influence wildlife biotopes. Recreational activities of people have seriously increased during last decades. This includes jogging also during dusk and dawn, biking and hiking even out of touristic trails, mushrooming or berry picking preferably in dense vegetation, hunting, skiing, cross-country skiing, building of ski slopes, ski lifts and supporting roads in untouched areas etc. Despite potential suitable habitat, scientific results indicate that bears cannot establish a sub-population in the White Carpathians near Bratislava owing to high recreational rates[50].

Moreover, increasing agricultural activities and therefore systematic loss of valuable wildlife habitat is taking place in many countries in the Carpathians. Changes in agricultural policies favour intensive maize cultivation (Fig. 13). Maize is not only grown for human or animal food production, but also to fuel biogas plants.

50 Deodatus & Protsenko, 2010

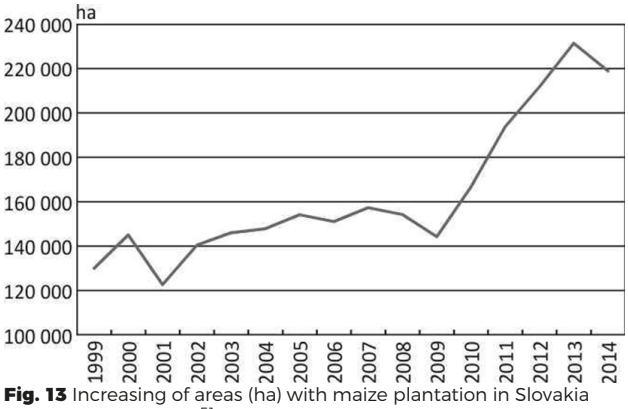


Fig. 13 Increasing of areas (ha) with maize plantation in Slovakia over the last 15 years [51].

Other threats are often mentioned such as intensive and large-scale clear cutting of forests, and large scale (electric) fencing in the landscape including crops on arable fields (e.g. against wild boars).

Finally, the edge effect is considered as threat, which possibly could sometimes cause increased predation, increased mortality within corridors, and the spread of invasive species and diseases. Some investigations confirm it to varying degrees[52].

3.4 Effects of road infrastructure on biodiversity

Transportation is a significant current phenomenon as it was pronounced in this chapter already. The construction of transport infrastructure is a prerequisite for economic development, which then brings about a rapid increase in transport performance and growth of traffic intensity on roads. The most commonly reported impacts of roads include habitat loss, intrusion of edge effects in natural areas, isolation of populations, barrier effects, road mortality and increased human access[53].

The impact of environmental fragmentation is very difficult to quantify over a short period of time, but this factor is generally considered to be the main cause of the threat to many species across Europe. The most obvious is the fauna mortality on the roads. The causes of mortality can generally be divided into two groups: 1) technical factors reflecting the status of the road (width of communication, number of lanes, barriers, anti-noise walls, fencing, traffic intensity and its daytime distribution, average vehicle speed, etc.); 2) biological factors, reflecting the status of the animal populations in the vicinity of road and their migratory behaviour. The situation is also influenced by local terrain configurations, the composition of forests and agricultural crops etc.

Therefore, a study was conducted which aimed to quantify fauna mortality on roads in the Czech Republic. Altogether 1,282 km of roads and motorways were checked evenly every month during the survey. It included 321 km of motorways and expressways, 302 km of first class roads, 355 km of second class roads and 304 km of third class roads. As a result of the fauna monitoring, 2,149 animals belonging to 103 vertebrate species were found killed during one year period. Of these, the most affected by traffic were mammals (54%), birds (25%), amphibians (17%) and the least reptiles (4%)[54]. An estimated number of the total annual mortality for selected species on the Czech road network is shown in Table 1. The highest relative mortality (the number of killed individuals per 1 km) for selected mammalian species is on motorways and express roads, fewer on I. class roads, II. class roads and fewest on III. class road category. After recalculating of the mortality to the total length of each type of road, it is clear that the most animals die on lower class roads.

51 Skuban, 2018
52 Haddad et al, 2015
53 Forman & Alexander, 1998
54 Anděl & Hlaváč, 2008

Table 1

Relative mortality of selected species on different classes of roads and total estimated mortality in the Czech Republic[55].

Species	Mortality on different road class (number/km/year)				
	Highway + Express road	I. class	II. class	III. class	Total estimated mortality in CZ (number/year)
Roe deer	3,4	1,7	0,8	0,8	51,900
European hare	15	12,6	10,3	9,6	566,400
Hedgehog (*E.erinaceus+E.concolor*)	15,7	10,1	7,9	4,6	346,800
Stone Marten	8,7	3,6	1	0,2	49,700
Blackbird	4,9	4,5	5,5	6	316,400
Common Chaffinch	3,4	5,1	2,4	1,2	109,400

The estimated number of mortality for the European hare exceeded almost twice the spring population counts reported by hunters (they count individuals on hunting grounds each year, but the methodology is questionable and unreliable). Although mortality affects not only adult individuals included in spring counts, but also yearlings, it is clear that from a population ecology perspective, such a condition would not be sustainable and the only explanation is that data on the spring numbers of the hare are significantly underestimated. However, it is clear that for hares, road mortality is a factor that significantly affects the population development of this species. In the roe deer, road losses account for about half of the annual uptake from nature by hunters and about 1/6 of reported spring counts. To sum up, it is necessary to consider the observed mortality on the roads as a factor which has a significant impact in terms of population development[55].

This above mentioned fact was also reported from Slovakia. Every year, several thousands of ungulate species become victims to traffic accidents with vehicles (Slovak Hunting Statistics). Consequently, wildlife-traffic collisions lead to high economic losses, but also human injuries or even fatalities. Further, several protected species are hit by vehicles, which also include large predator species of the wolf, the bear, and the lynx. Since 2007, around 12 bears a year lose their lives on Slovak roads on average (Database of the State Nature Conservancy of the Slovak Republic). It is highly probable that bears in Slovakia have difficulties to reconnect the Central and Eastern Slovak sub-populations due to the unresolved situation with R4 road in Eastern Slovakia (North-South connection between Poland – Hungary). This road has high potential to split the eastern bear population from the central bear population (Fig. 14). Genetic differences between the two sub-populations of brown bears have already been detected[56].

55 Anděl & Hlaváč, 2008
56 Straka et al, 2012

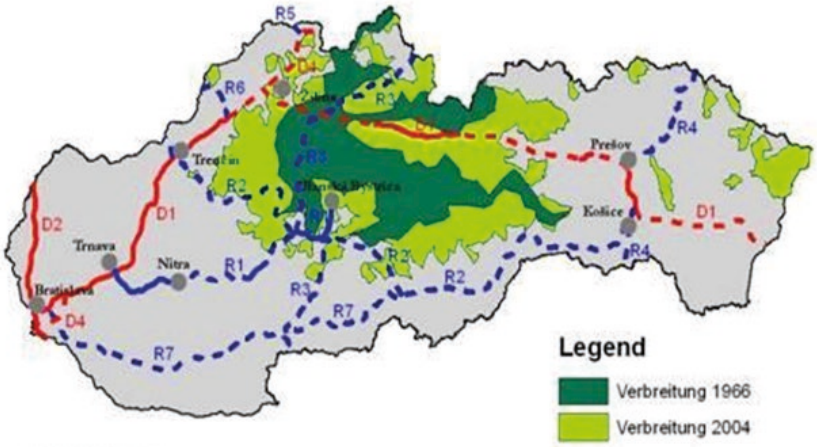


Fig. 14 Brown bear distribution in the past (dark green) and now (light green) overlaid with the planned and already realized infrastructure network of highways (D) and dual-carriage ways (R) in Slovakia[57]. Especially the dual-carriage way R4 is suspected to seriously contribute to the fragmentation of the brown bear range into central and eastern subpopulation[58,59].

Similar situation could be expected in the central-north of the country between the two national parks Malá Fatra and Veľká Fatra. A genetic study has proved so far that Northern Slovakia and Central Slovakia harbour two different genetic clusters which are already partially split due to the Váh River in combination with D1 highway[59]. Telemetric studies also indicate that the secondary road I18, connecting Northern Slovakia with Poland, seriously limits movements of large mammal species[60] (see Fig. 15).

Not all species and ecosystems are equally affected by roads, but overall effects of the presence of roads is highly correlated with changes in species composition, population sizes, and hydrologic and geomorphic processes that also shape the aquatic and riparian systems[61].

57 Finďo et al, 2007
58 Koreň et al, 2011
59 Straka et al, 2011
60 Skuban et al, 2017
61 Trombulak & Frissell, 2000

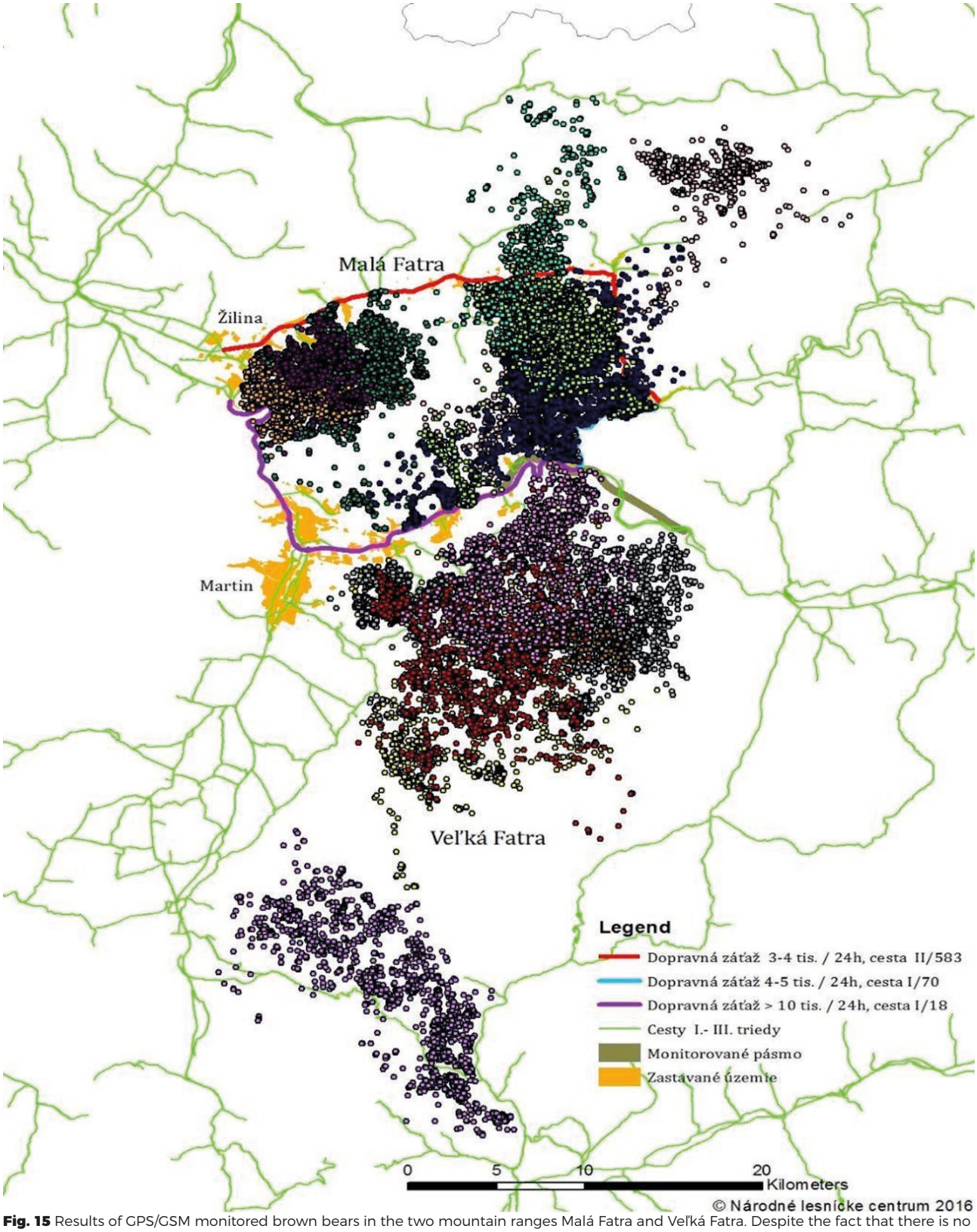


Fig. 15 Results of GPS/GSM monitored brown bears in the two mountain ranges Malá Fatra and Veľká Fatra. Despite the fact that there is no highway so far, the high traffic volume on secondary roads (especially I 18) heavily impedes movements of the brown bear. No radio-collared bear was able to successfully move into the neighbouring national park[62,63].

62 Finďo et al, 2014
63 Finďo et al, 2007

4

Status of Ecological Corridors in the Project Area

So far, the knowledge about ecological corridors in the project areas varies greatly. There are great differences in the status of the identification, existence of a methodology, as well as in the system of protection and management. The TRANSGREEN project collected all important information from the 7 Carpathian Countries – the Czech Republic, Hungary, Poland, Romania, Serbia, Slovakia, and the Ukraine and discovered advantages, but also gaps in the status of ecological corridors. This knowledge can bring insight where and how to improve the identification, protection, and management of ecological networks.

4.1 Ecological corridors in the Czech Republic – status of identification (including the existence of a methodology), protection and management

The State Nature Conservation Agency of the Czech Republic conducted intensive research in order to identify migration routes, long-distance migration corridors, but also core area sides of 5 large mammal species including the three predators – the bear, the wolf, and the lynx, but also the red deer, and the moose. The following data was considered in the analysis: occurrence, but also ecological and behavioural requirements of the focal species, assessment of migration barriers (human infrastructure but also natural barriers), mathematical models of landscape potential e.g. habitat suitability, and evaluation of functionality of corridor sites in the field.

The first study was realized during 2008–2010, and was later updated in 2015–2017. However, the map identified sites and ecological corridors are indeed available for building engineers, but it is not compulsory to protect them. Therefore, there is an ongoing process to prepare a legislative act to protect the "biotopes of selected specially protected species of large mammals of national importance".

Resume: ecological corridors in the Czech Republic were reliably identified by using various data sources and statistical methods. Maybe this approach can be adopted by other project countries in the future. It would be very helpful if the ecological network were better protected and its implementation compulsory in the landscape planning processes. This last step can seriously contribute to keeping the landscape permeable for movements of various wildlife species.

4.2 Ecological corridors in Hungary – status of identification (including the existence of a methodology), protection and management

The National Ecological Network of Hungary was carried out in cooperation with the IUCN and published in 1996. During the analysis, various data sources were used including e.g. protected areas, records of floodplains, forestry schedules, important bird areas, existing and planned NATURA 2000 sites, sensitive areas, and results from field research. The digital database is available in 1:50000 scale. It is an ongoing process to implement the map as compulsory into landscape planning processes.

Resume: the process of generating the map of national ecological network in Hungary is fairly well. However, it could be actualized in the near future. Especially large carnivore species significantly increased their range in Europe. Nowadays, even few wolves and lynxes are resident in the country. The bear does occur just occasionally. An update of the map and reinforcement into the law can help to keep the landscape suitable for wildlife and their movements.

4.3 Ecological corridors in Poland – status of identification (including the existence of a methodology), protection and management

Several projects dealing with ecological corridors have been carried out in Poland. A number of analysis were implemented including continuity of forests, land use forms in non-forested areas, continuity of water bodies, historical and current migration routes of indicator species, genetics, and the network of protected areas. The final map was derived by the Mammal Research Institute PAS in Białowieża.

Resume: the identification of the ecological network was done in a scientific way and updated with new data. It would be very important to improve legislation aiming at a compulsory implementation of ecological corridors in any landscape planning processes.

4.4 Ecological corridors in Romania – status of identification (including the existence of a methodology), protection and management

A number of projects dealing with the identification of ecological corridors having as umbrella species the brown bear as well as other large carnivores' species were implemented, including:

- "Open borders for brown bears between Romanian and Ukrainian Carpathians",
- "South-western Carpathian Wilderness and Sustainable development initiatives",
- COREHABS ("Ecological Corridors for habitats and species in Romania"),
- "Development of the methodology for establishing corridors and training the administrators of the protected areas for their better management"
- LIFE "Connect Carpathians" focusing on maintaining ecological connectivity between Apuseni and SW Carpathians.

Resume: Romania still has a weak overview of the ecological network and core areas and needs further work not only in identifying ecological corridors, but also in officially designating them. Considering that there is no official methodology for the identification and designation of ecological corridors, several actors including NGOs work on this issue and develop proposals and submit them to the Ministry of Environment in this respect.

4.5 Ecological corridors in Serbia – status of identification (including the existence of a methodology), protection and management

Currently, there is an ongoing process in Serbia aiming at identifying the ecological network in Serbia, which currently includes 101 corridor areas. The goal is to increase protected areas in the entire country including implementation of ecological corridors.

Resume: Serbia could work more on the identification of ecological corridors in order to secure wildlife movement across the landscapes. Further, it would be important to integrate ecological networks to the landscape planning processes.

4.6 Ecological corridors in Slovakia – status of identification (including the existence of a methodology), protection and management

In Slovakia, the identification of ecological corridors has so far been underestimated. However, there is one map developed, the so-called "Concept of Territorial System of Ecological Stability (TSES)", which was accepted by the Slovak Government by the Decree no. 394/1991 of July 23, 1991 as an answer to an urgent need to solve the problems connected to ecological stability, the connectivity of natural areas and the protection of habitats and representative species in their home areas of occurrence. Unfortunately, mainly aquatic species were taken into account and the map rather focuses on water courses. Many of the identified corridors are nowadays no longer functional due to urbanization or road and train infrastructure. This was one important aspect to deal with in the TRANSGREEN project. Moreover, the range of the three large carnivore species the bear, the wolf, and the lynx in Slovakia significantly increased during the last two decades and this is not integrated or reflected in the existing map.

There is one publication dealing with habitat suitability of the brown bear in Slovakia[64], but official bodies do not take it into account. Nevertheless, according to the Act on Nature and Landscape Protection no.543/2002 Coll., the development and maintenance of Territorial Systems of Ecological Stability (TSES) is a public concern. TSES is elaborated on three levels: general supra regional, regional TSES and local TSES. It should be integrated in the landscape planning processes.

The Project BioRegio Carpathians was realized but the outputs are not really used by official landscape ecologists or planners. So far, it is not compulsory.

Resume: it would be important for Slovakia to work more intensive on the identification of ecological corridors in order to keep the landscape permeable. Slovakia harbours many species of European interest and it would be sad if their movement routes were interrupted.

64 Koreň et al, 2011

4.7 Ecological corridors in Ukraine – status of identification (including the existence of a methodology), protection and management

So far, there is only one region in Ukraine, namely Zakarpattya, where ecological corridors had been identified. Therefore, core areas, stepping stones and connecting or ecological corridors are widely used in the country. Ukraine also participated in the project "Open borders for brown bears between Romanian and Ukrainian Carpathians" and identified some movement corridors for bears in the border area to Romania.

Resume: it would be very important to set up a national wide project dealing with the identification of ecological corridors in the entire Ukraine. Further, the country should strengthen the legislation for protecting the ecological corridors against different threats and pressures. In Ukraine, there are several endangered species of European interest and it would be important to keep the landscape permeable in the future as well.

4.8 Final conclusion

Among all participating project partners, the Czech Republic has the most accurate network of ecological corridors identified, followed by Poland. Three countries carried out intensive research and integrated also studies on animal movement behaviour into their analyses. Nowadays, it is often possible to observe that responsible nature conservation agencies preferably involve networks of protected areas in their country in their work to identify and manage ecological corridors. Nevertheless, protected areas were designated by people, but many times animals have different needs from what we might expect. Field research and monitoring of selected species can help us to verify/ identify potential ecological corridors but also to discover other important sites for feeding, resting, and moving.

In the Czech Republic, core areas and migration/ movement corridors are overlapped with human infrastructure including cities, 1st class roads, and highways. Beside the protected large carnivores, scientific studies should involve also red deer or moose. In many protected areas of Europe, large carnivore species including the bear, the wolf, and the lynx are often absent or present in smaller population numbers. When exclusively focusing on predators, it might be possible to overlook some important and suitable areas for some large mammals in general and therefore protection measures might not be suggested for them. Especially red deer is known that its presence can suggest a potential suitability of particular habitats potentially relevant for future re-colonization by large carnivore species. Further, both the red deer and the moose do undertake a "typical migration" which is defined by a periodic movement away from and subsequently return to a similar location"[65] which is not the case in the European large carnivores. Especially in countries with scarce occurrence of predators, the red deer and the moose where present can serve as reliable umbrella species.

Poland also focussed on scientific methods to identify their country-wide network of ecological corridors. As target species for animal movement, wolf and lynx was chosen. The map of ecological corridors is interactive and available on the web which enables people to quickly control and search for corridors or protected areas.

Romania highly focused on the brown bear occurrence which is known to be very sensitive to habitat fragmentation among large carnivore species. Studies from the North America even suggest that the wolf and the lynx are able to use small underpasses and/or culvert whereas bears are often repelled by traffic volume and avoid risky crossings through dark small culverts[66]. By having several projects on connectivity, Romania tried to develop an agreed methodology for the identification and designation of ecological corridors which is an important step in maintaining its high level of biodiversity and could be inspiring for other countries as well. And yet, the methodology has not been adopted.

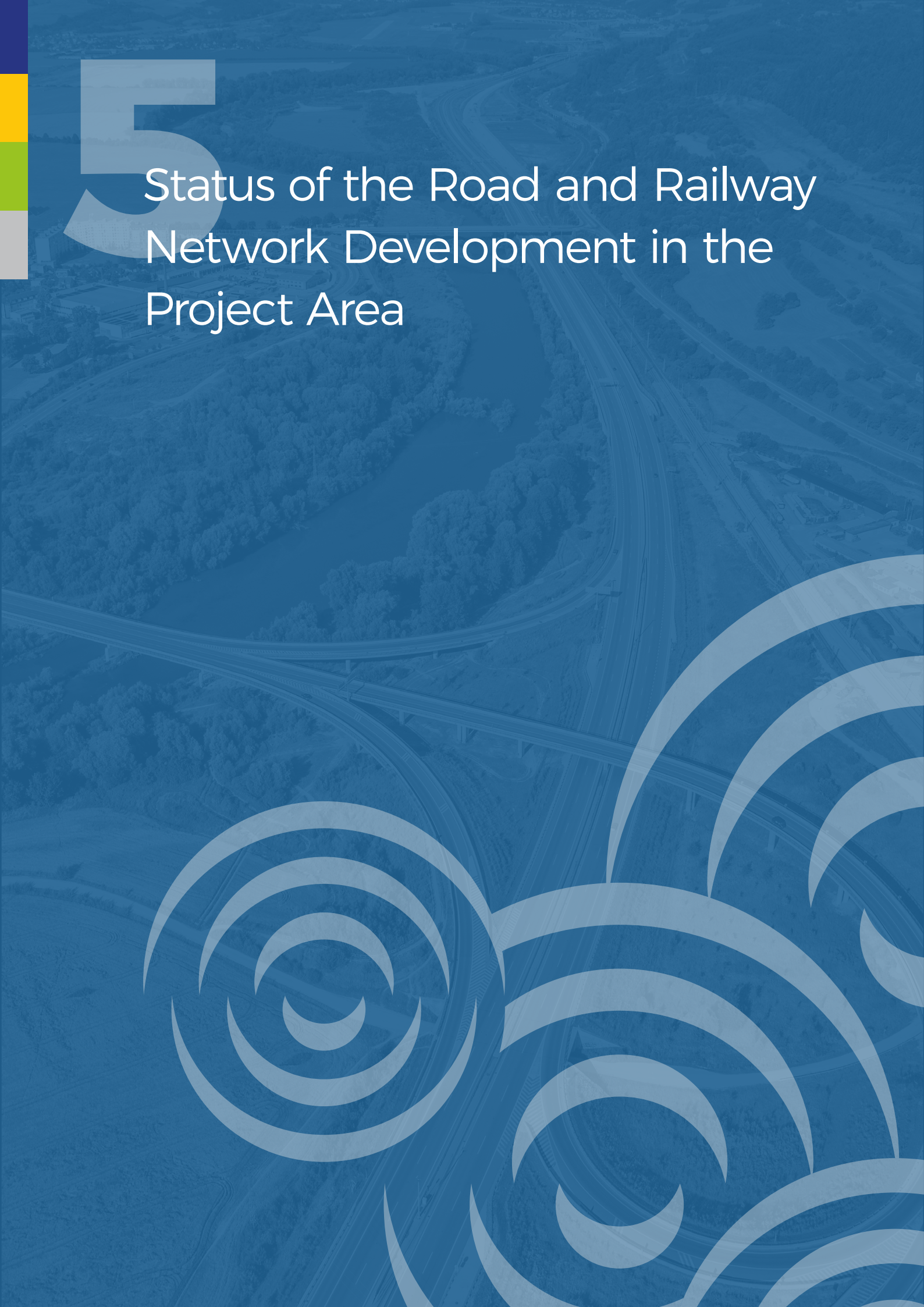
The map of Hungary was prepared in cooperation with the IUCN and is available as a book. The system of creation was very scientifically based, compiled various databases and included extensive fieldwork. Further, Hungary attempts to implement the map into landscape planning processes. It would be necessary to update this map with updated field research results and occurrence of just recently re-settled carnivore species.

As described above, the map of ecological stability of Slovakia is not very reliable, but frequently used. It can be stated that the map is quite widely accepted. Therefore it is a pity that the map is not updated and does not include large mammal species. It would be very important to finally update the map and to include large mammal species like the red deer, the wolf, the bear, and the lynx. This approach would enable the map to reliably point out important areas and corridor sites.

The identification of ecological corridors is in different statuses in the involved countries. However, one important obstacle is the management of corridors and their subsequent protection into legislative concerning landscape planning processes. If the protection of ecological corridors is compulsory, we have a real chance to reduce the resistance of landscapes for animal movements and to keep sensitive areas permeable for wildlife. It is worth to mention that the management of a network of ecological corridors will always be a dynamic process and can be influenced by various factors. Changing of former untouched areas into agricultural or other land use types, or re-occupation of former habitats by large carnivore species[67] are just two factors influencing the location and functionality of corridors. It should be a must to validate in the field any potential network of ecological corridors and constantly monitor it later on.

65 Nicholson et al, 2016
66 Proctor et al, 2012
67 Chapron et al, 2014

5 Status of the Road and Railway Network Development in the Project Area



5.1 Introduction

Ancient trade routes have crossed Europe since times immemorial. The Carpathian region is located at the crossroads of East–West (from South-Eastern Europe/Asia towards Western Europe) and North–South ("Amber road" Baltic-Adriatic). Therefore the role of transport has always played a crucial role in the economic life of the Carpathian region. Complicated orography of the region predetermined the best routes for transport networks. Their directions followed the deep narrow valleys of main rivers embedded in mountain ranges. Other human activities were also concentrated in these favourable locations and formed barriers, which are hardly or not at all permeable for the wildlife.

The 19th century laid the foundations of transport networks. The major part of the region was under the rule of the Kingdom of Hungary in those times. The modern age concept of the transport network development was created and made official within the Act XXX of 1848. Besides improving the conditions for the most important inland waterways (Danube, Tisza, Dráva rivers), it contained also the fundamental directives for the radial road and railway network[68].

The rail network has reached its peak at the beginning of WWI. New post-WWI states faced the problem of a lack of infrastructure that was not designed to meet their needs, as the new geopolitical structure of Europe radically changed flows of trade and people in the region. A privileged position of railways began to slowly decline in favour of the emerging road transport, which took over the role of the main transport system during the 1960s. Its rising importance meant a significant increase in motorisation and traffic intensities, which were difficult to be absorbed by the existing road system, especially in the hinterlands of the main cities. The plans for the construction of motorway networks have been developed, for example Czechoslovakia adopted it through the government resolution Nr. 286 in 1963[69]. However, the construction of the motorways in the Carpathian countries continued very slowly. There were only 1,118 kilometres of the discontinuous motorway network in operation around 1990 (see Tab. 2). Socio-economic changes after 1989 have brought an extremely rapid growth in traffic, which has spurred increased construction efforts, thus the overall length of motorways in these countries quintupled in 25 years. Further expansion is expected in the upcoming years.

68 Oszter, 2017
69 Lídl et al, 2009

5.2 Status of the road network and railway development

One of the crucial problems in the Carpathian countries is the long-term unfavourable development of the modal split, with rising road transport, with individual automobile transport in particular. The underdeveloped transport networks in the Danube-Carpathian region is not designed to meet all rising mobility needs. Mobility challenges at stake consist of multimodality improvement, better interconnections amongst the modes, and modernisation and extension of infrastructure networks. In this respect, the opportunities rely on the potential to improve the TEN-T Core Network Corridors crossing the region[70]. These corridors are displayed in Fig. 16.

In addition to the TEN-T core network, the notable project of strategic importance is the Via Carpathia transport corridor. It is a planned international route, leading from the Baltic port of Klajpeda (Lithuania), passing Southern Poland, Slovakia, Hungary, Romania, Bulgaria to Greece with some branches including connection between Lviv and Odessa through Western Ukraine. It reaches both the Black Sea and the Aegean Sea. This corridor partially overlaps with the existing TEN-T corridors.

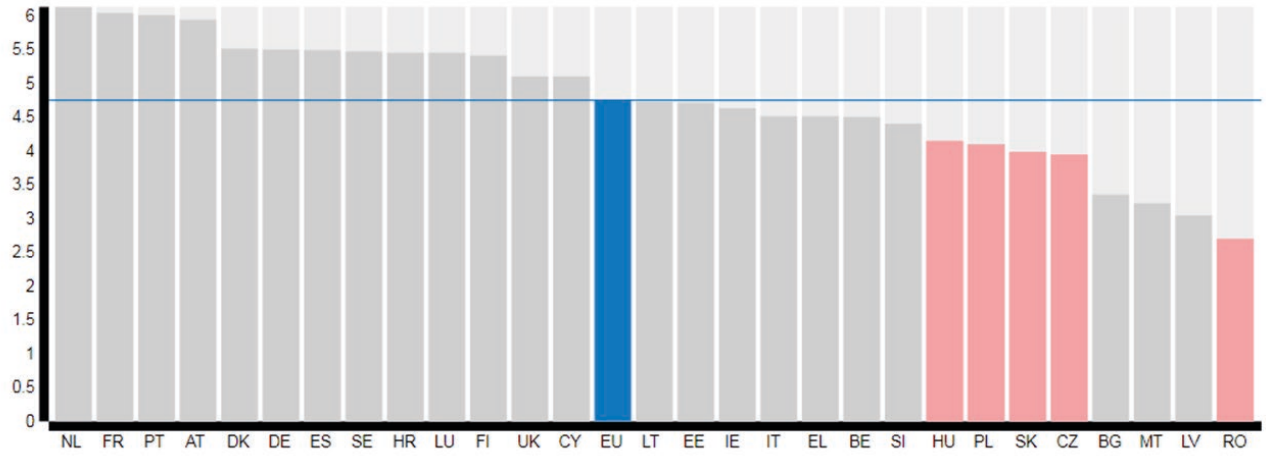


Fig. 16 Quality of road in EU countries, score 2016-2017 [71,72].

70 Maffi & Brambilla, 2017
71 https://ec.europa.eu/transport/facts-fundings/scoreboard_en
72 Schwab, 2017

Fig. 17 Scheme of TEN-T transport corridors in the Carpathian area.

The completion of the core transport network is important to fulfil the goals of the European transport policy (EC, 2011), which includes (among other) to shift 30% of road freight over a distance of 300 km to other modes such as rail or waterborne transport; to complete a European high-speed rail network by 2050; to reach the majority of rail for medium-distance passenger transport by 2050 and to complete a functional and EU-wide multimodal TEN-T 'core network' by 2030.

The major transportation bottlenecks were identified by TEN-T Core Network Corridors' studies (EC, 2014a-f) where the infrastructure does not meet technical standards and requires rehabilitation, upgrading or widening measures. The lack of capacity may also occur in a specific time period for high utilisation and nearby urban agglomerations, where traffic is mixed (i.e. long distance, regional and urban).

All five EU-members from the Carpathian countries belong to the states with worst quality of roads far behind EU average. It will be necessary to increase the volume of reconstruction of the existing roads, which is also an opportunity to improve conditions for decreasing the degree of fragmentation and for improving the road permeability for wildlife.

The completion of the TEN-T road network continues at a fair speed in Hungary and Poland. Also, Romania has made relatively good progress over the last years. On the other hand, in the Czech Republic and Slovakia, this process is very slow (Fig. 18).

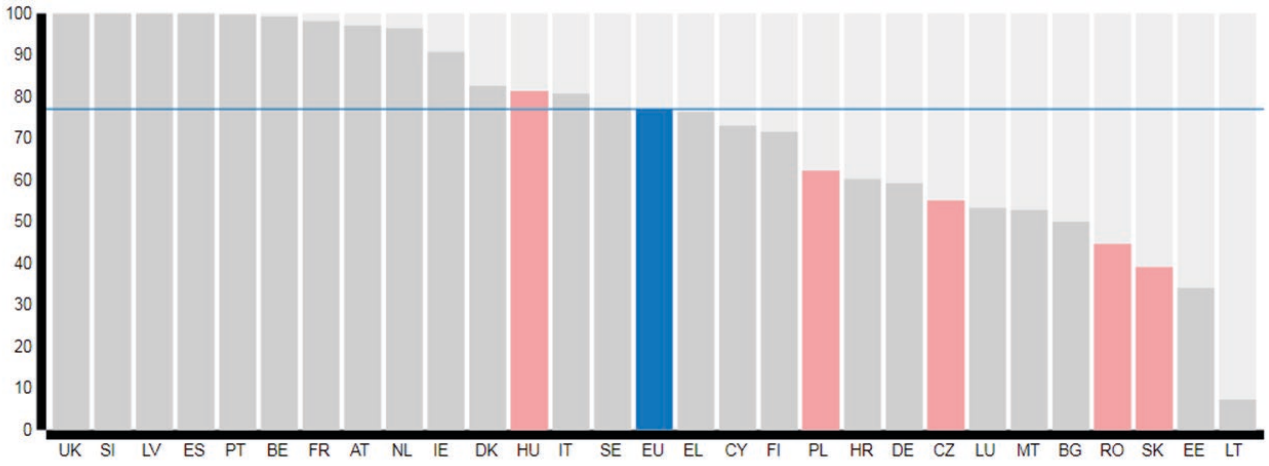


Fig. 18 Completion of TEN-T Core Road Network in %, 2015 [73].

73 https://ec.europa.eu/transport/facts-fundings/scoreboard_en

Table 2

Length of motorway and road network in the Carpathian countries as of January 2016[74,75,76,77,78].

	CZ	SK*	HU	PL	RO	UA	RS
Motorways 1990 [km]	326[1]	1,921	361	220	113	0	n/a
Motorways [km]	12,232	463	1,481	1,559	747	177	782*
Motorway density [km per 1,000 sqkm]	15.51	9.50	15.91	4.99	3.13	0.29	8.85
Expressways [km]	- [2]	274	443	1,292	16,859	± 9,000	n/a
National roads [km]	5,807	3,306	30,061	16,442			4,487*
Secondary roads [km]	14,593	3,611	174,599	29,109	35,316	± 7,000	11,392
Tertiary class roads [km]	34,135	10,363		125,092	33,158	± 147,000	29,374
Road network total [km]	55,757	18,031	206,584	173,494	84,333	± 163,000	45,410
Road network density [km per 1,000 sqkm]	707.0	367.7	2210.6	554.9	353.8	± 270.0	513.9

Notes:

CZ-Czech Rep.; SK-Slovakia; HU-Hungary; PL-Poland; RO-Romania; UA-Ukraine; RS-Republic of Serbia

[1] In 1990 Czech and Slovak Republics were Czechoslovakia.

[2] The Czech Republic included 459 km of expressways into motorway network from January 1st, 2016

* all data as of January 1st, 2017 unless noted

Table 3

Comparison of road categories in the Carpathian countries

EN	CZ	SK	HU	PL	RO	UA	RS
motorway	dálnice	Diaľnica	autópálya	autostrada	autostradă	автомагістраль	ауто-пут
expressway	silnice pro motorová vozidla	rýchlostná cesta	autóút + gyorsút	droga ekspresowa	drum expres	автошлях	Брзи пут
national road	silnice I. třídy	cesta I. triedy	elsődrendő főút	droga krajowa	drum național	національна дорога	државни путеви IБ реда
secondary road	silnice II. třídy	cesta II. Triedy	másodrendű főút	droga wojewódzka	drum județean	регіональна дорога + територіальна дорога	државни путеви IIA реда
tertiary road	sIlnice III. třídy	cesta III. Triedy	helyi út	droga powiatowa	drum comunal	обласна дорога + районна дорога	државни путеви IIБ реда
local road	místní komunikace	miestne komunikácie		droga gminna	drum de interes local	місцева дорога	општински путеви

74 MD ČR, 2017a
75 SSC, 2017
76 GUS, 2017
77 Verner, 2017
78 SORS, 2017

The core railway network is defined by the TEN-T Directive, which set up the Trans-European high-speed rail (HSR) network and the Trans-European conventional rail network. The majority of railways in the Carpathian countries are underdeveloped, technologically forgotten in the past. The main lines (mostly these included in the TEN-T network) have been upgraded to increase travel speed up to 160 km/h in the recent years (and probably with an expected increase up to 200 km/h in certain sections). Especially the Czech Republic has advanced in this respect and has already completed the rehabilitation of nearly two-thirds of the network of European importance. On the other hand, Romania has just started and has only completed about 5% of the network by 2015. These railways are being upgraded but still not real HSR lines with speeds exceeding 220 km/h. These are, however, important for the competitiveness of the railway sector in passenger transport for long-medium distances from 300 to 800 km[79]. The Carpathian countries only started to think about construction of HSRs. While Hungary recently announced plans to build new connections between Vienna and Budapest, Budapest and București via Cluj[80], the Czech Republic published a policy document[81] to open the discussions on the future of HSR. In the cargo sector the most serious problems are related to the capacity of the major railways; that is, limitations in the transit of the main railway hubs and insufficient interoperability due to individual national technical requirements for rolling stock which are not compliant with the common European standards.

Table 4

Length of railway network in the Carpathian countries as of 2016 (compiled from MD ČR, 2017b; ŽSR, 2017; INS (2017); Verner, 2017 and Eurostat)

	CZ	SK	HU	PL	RO	UA	RS
Railways [km]	9,564	3,206	7,811	19,132	10,774	± 21,000	3,739
of this electrified [km]	3,236	1,587	3,018	11,874	4,030	± 10,000	1,247
of this double tracked [km]	1,965	1,016	1,250	8,731	2,917	n/a	n/a
Rail network density [km per 1,000 sqkm]	121.3	65.4	84.0	61.2	45.2	± 34.8	42.3

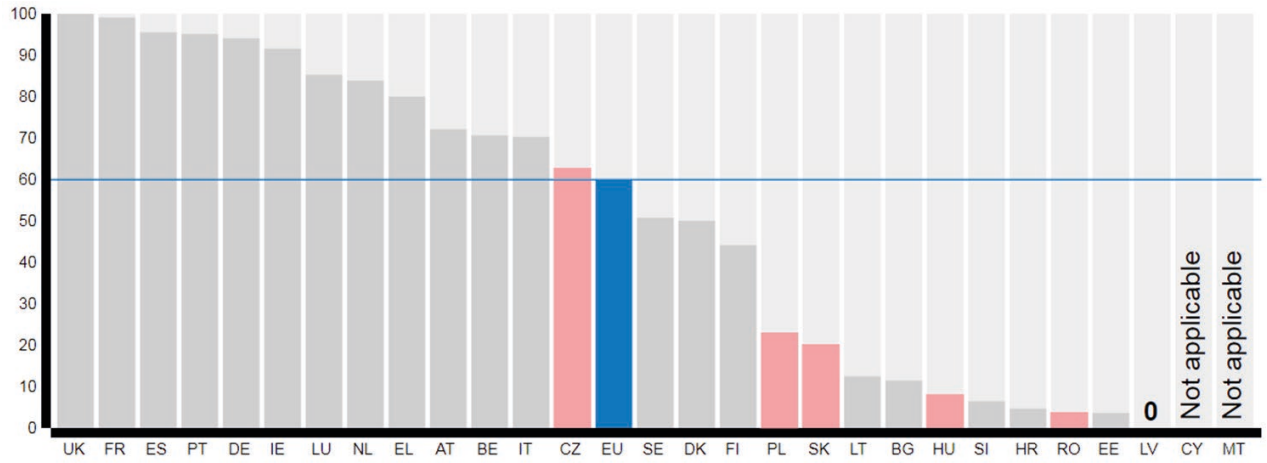


Fig. 19 Completion of TEN-T Core Rail Network in %, 2015 [82]

79 CMC, 2013
80 http://www.business-review.eu/news/romania-and-hungary-aim-to-build-a-high-speed-railway-between-cluj-and-budapest-157236
81 https://www.mdcr.cz/getattachment/Media/Media-a-tiskove-zpravy/Ministr-Tok-Vysokorychlostni-trate-potrebuji-novy/MD_Program-rozvoje-rychlych-spojeni-v-CR.pdf.aspx>
82 https://ec.europa.eu/transport/facts-fundings/scoreboard_en

5.3 Country specific information

5.3.1 Romania

Road:

Compared to other European countries, Romania has a small road transport network despite the size of the country and the high demand coming from the busy and growing traffic. Romania ranks the last out of all Member States as for the road quality (see Fig. 17), registering little improvement in road safety and remaining in the penultimate place at European level from the number of deaths viewpoint. Romania has the lowest provision of motorway-standard road in the EU per head of population. Only 50% of national roads are in good condition, and approximately 65% of the national network is beyond its service life and the level of service provided by the road network is generally poor.

The first motorway in Romania connecting București and Pitești (96 km) was put into operation in 1972. It had been the only Romanian motorway for many years. The only other route of this type opened in the 20th century and was the short (18 km) section near Cernavodă in 1987. The construction activity was revived after 2000. Fast growth of motorways between 2004 and 2014 was incited by European funds and the total length achieved a sixfold increase in just ten years. The pace of construction has slowed down in recent years.

The State's road management company "Compania Națională de Administrare a Infrastructurii Rutiere" (CNAIR) is responsible for managing and maintaining of national roads and motorways. Lower class roads are under the management of regions, or possibly municipalities or communes.

Railway:

The missing adequate investments in the railway network after the fall of the Communist regime caused the loss of competitiveness of the railway sector in Romania. According to the Master Plan[83], the Romanian Railways are in a crisis situation. Since 1990, passenger kilometres have fallen by 90%, and freight kilometres by 70%, although the position with rail freight has stabilised. Average speeds for passenger trains have fallen to 45 km/h in 2012 from 60 km/h in 1990, and the average speed of freight trains is a mere 23 km/h. According to the same document, between 60-80 % of the track-related assets are life expired; there were 1,800 temporary speed restrictions in 2012, and there is an estimation that the current speeds are 20-30% below the design speed of the track. The World Bank Report[84] also stated that the railway network managed by Compania Națională de Căi Ferate "CFR" SA is heavily indebted and subsidized as a result of inefficient operations.

There is currently no high speed rail network in Romania but there are projects developing TEN-T conventional railway infrastructure for medium speed trains (160 km/h), such as the main backbone heavily invested and upgraded Constanța – București – Brașov – Sighișoara – Deva –Arad, the part of the Rhine-Danube corridor. Consideration on HSR between Budapest, Cluj and București is still only at the level of political debates.

83 MOT RO, 2016
84 https://www.worldbank.org/content/dam/Worldbank/document/eca/Romania-Snapshot.pdf

5.3.2 Slovakia

Road:

The first motorway in Slovakia was D2 finished in 1980 and connecting Bratislava with Brno and Prague. Only 192 km of motorways were completed before 1990: next to D2 also D61 between Bratislava and Piešťany and isolated sections of D1 near Liptovský Mikuláš and a link between Prešov and Košice. Since then, the progress of motorway construction has been slow, also due to difficult orographic conditions. So Slovakia belongs to the states with the lowest density of motorways in EU. The land covered by transport infrastructure represents 8% of the total area of Slovakia[85].

In general, the network of roads of the 1st, 2nd and 3rd class is already completed (some bypasses are missing), but the major problem is that many of these roads do not meet the current capacity needs or safety standards. Due to long-term overloading and insufficient maintenance, the qualitative parameters declined[86]. Some roads also need to be upgraded because of increasing traffic intensity and the quality of maintenance needs to be improved too, especially on lower-class roads.

The motorways are owned (with the exception of concessions) by the National Motorway Company (joint-stock company fully owned by the state), while the owner of state roads and concession motorways is the state (these are managed by Slovak Road Administration, which is state budgetary organization). Owner of the 2nd class and 3rd class roads is a self-governing region, and local roads are owned by municipalities.

The priority for the next years is to construct a new superior road infrastructure and to finish and improve the quality of TEN-T motorways and expressways as well as to improve accessibility of less developed regions through their connection to the TEN-T network. With respect to the current average speed of constructing motorways and expressways, the time necessary for completing the TEN-T core network (scheduled to 2030) will exceed the time limit by several years[87].

Railway:

The backbone route of the railway network in Slovakia is the corridor Bratislava - Žilina – Košice, which is gradually upgraded to a speed of up to 160 km/h although some sections will not be able to definitely achieve such speed due to difficult geographic conditions. The owner of the railway infrastructure is the state and the administrator is the Railways of the Slovak Republic. The Bratislava railway junction is the main (or one of the main) hubs of the entire Slovak railway system and its adequate functioning is a prerequisite for economic growth and sustainable transport development in general. Nowadays, its technical design and capacity of routes does not meet the needs of regular passenger transport (incl. commuting in the metropolitan area) and neither the needs of freight transport including technical limitations or even access bans for modern rolling stock.

The advantage of current railways in Slovakia is the high density of lines and stations. The capacity of lines is high and there is a good connection to railway networks of neighbouring countries. On the other hand, the technology is outdated and the technical status of infrastructure is not sufficient, while the efficiency of railway roads depends on the status of railway infrastructure[69].

85 http://enviroportal.sk/uploads/report/6961.pdf
86 OPII, 2017
87 MDVR, 2016

5.3.3 The Czech Republic

Road:

Although the construction of the motorway network started in former Czechoslovakia well before the WWII[88], it was not until 1971 that the first section was opened to traffic due to the long interruption in construction between 1942 and 1966. The motorway network was originally supposed to be completed in 2010 but the Ministry of Transport (MoT) has delayed this goal several times, and it is now set to 2050. However, the current speed of construction is too slow to achieve even this goal. Especially the preparation process is unnecessarily long and drawn out. According to the MoT, the average time from obtaining the consent for the environmental impact assessment (EIA) until issuing the building permit is 13 years. Legislative changes are under discussion to accelerate the construction process based on the experience from Germany and other countries.

From 1971 to 1990, only 389 km of motorways were opened. During the next 25 years, the length of the network almost doubled. The original expressways were incorporated into the motorway network in 2016 by administrative decision as the speed limit and most of construction parameters of these two categories were similar. The length of the motorway network rocketed to 1,225 km. The term expressway is newly used for four-lane first class roads with separate carriageways where the speed limit is 110 km/h. On the other hand, the network of first class roads is decreasing – from approximately 6,900 km in 1950 to the current length of 5,800 km. This is the result of upgrades to the motorways and also the conversion of less-favoured routes into the second class roads.

Road infrastructure is owned by the state (motorways, 1st class roads) and operated by the Roads and Motorways Directorate, regional authorities (2nd class roads, 3rd class roads), municipalities (local roads) or private subjects/physical persons (purpose-built roads often without public access).

Railway:

The railway network in CZ is one of the densest in the world. Its basics were developed as early as during the 19th century; after WWI only a few notable lines were constructed. These included a new line between Havlíčkův Brod and Brno put into operation in 1953 and two connections to Slovakia finished in 1930s. The spatial distribution of railways has not changed much since then, but the efforts aimed at technical upgrades of existing lines, doubling to expand the capacity, electrification and speeding up of traffic. Since the early 1990s, the concept of four transit railway corridors has come into effect, meaning extensive construction works on the main lines to achieve higher speeds (up to 160 km/h), increasing safety and traffic efficiency. Local reallocations are made in problematic areas to get more favourable parameters of routes (larger curves, less climb), often requiring the construction of new tunnels. Most of the railway network is maintained by the Railway Infrastructure Administration with the exception of a few regional railways under the management of other subjects.

There has been a broad discussion on high-speed railways (HSR) nowadays in CZ. The conceptual basis document was produced by MoT (2017) for the government's decision on whether and under what conditions the Czech Republic should go towards the planning, construction and operation of a comprehensive high-speed rail system. The concept of this system (in Czech called "Rychlá spojení" = "Fast Connections") is based on linking the operation on the newly constructed high-speed lines and the modernized conventional rail infrastructure.

There are five connections proposed to be part of HSR in CZ: (i) Prague – Brno – Ostrava - Katowice; (ii) Brno – Břeclav - Vienna/Bratislava; (iii) Prague – Plzeň – Domažlice – Munich; (iv) Prague – Ústí nad Labem – Dresden; (v) Praha – Wroclaw. The inclusion of the fifth connection into the concept is under consideration due to doubts about its economic efficiency[89,90,91].

88 Lídl & Janda, 2006
89 MD ČR, 2017b
90 MD ČR, 2017a
91 ŘSD, 2016

5.3.4 Hungary

The fan-shaped arrangement of the road and railway network refers to the historical need of the Kingdom of Hungary at which time the networks were formed.

Road:

The way to modern motorway network was very similar to other Eastern-block countries. Although the first short stretch of motorway was opened as early as in 1964, the construction progressed very slowly and there were only 361 kilometres in 1990. After 2000, the speed of construction emerged and Hungary has the densest motorway network in the region nowadays. The Magyar Közút Nonprofit Zrt. is in charge of operation and maintenance of national roads while the Nemzeti Infrastruktúra Fejlesztő Zrt. is responsible for the development of large-scale projects such as motorways and expressways.

The current existing network mainly consists of radial connections with its centre in Budapest. This part of network has almost been completed. Tangential links are only in the planning phase.

Regarding the other road network, the main bottlenecks are due to non-adequate design standards (i.e., single carriageway without level-free junctions), degraded surface and congested sections close to urban nodes[92].

Railway:

The major railway links are upgraded to meet the current interoperability standards and to increase travel speed up to 160 km/h. There are no high-speed lines in Hungary yet but in the future, the speed increase up to 200 km/h is planned for the link between Vienna and Budapest. There are two infrastructure managers in Hungary, the MÁV Hungarian State Railways (MÁV Co.) and GySEV. The major part (7251 km) of the network is managed by MÁV Co.

Another project prepared to increase travel speed to 200 km/h is the new modern Budapest – Belgrade line. An important project is also the Budapest-Miskolc-Ukrainian border rail upgrading, which could receive funding from the "Connecting Europe Facility" (CEF). The plans are available, but presumably there will be no implementation until 2020[93,94,95].

92 Maffi & Brambilla, 2017 MD ČR, 2017b
93 MoND HU, 2014
94 Korm. Határozat 1371/2016 (VII. 15.)
95 Korm. határozat 1656/2017 (IX. 13.)

5.3.5 Ukraine

Ukraine is one of the largest European countries. Its regions are diverse; the following text only deals with the westernmost part of country – Zakarpatya and neighbouring regions.

Road:

Directions of the roads in Zakarpatya are following natural conditions especially mountain ridges. Main traffic intensities are concentrated at the following roads: Kiev – Chop (I and II category, international), Rogatyn – Mukacheve (II category, national), Sambir – Uzhgorod (II category, national). There are few interregional roads (Dolyna, Bogorodchany), regional (such as Vynogradiv – Beregove) and local roads. A wide system of forestry roads is available mainly in the mountain part of the region.

Due to lack of funds for road infrastructure Ukraine is limited in developing new infrastructures. The plans for Zakarpatya region are following:

1. Mukacheve – Beregove – Luzhanka (border crossing between Ukraine and Hungary). According to the actual plans of the State Road Service of Ukraine, the reconstruction consists of two parts: (a) reconstruction (to repair, renew and upgrade parameters of existing II category road) between Mukacheve and Beregove and (b) construction of Beregove bypass of a total length of 14,8 km - new road to be constructed on the arable land area.

2. Lviv – Mukacheve. There are plans to construct a new motorway between Lviv and Mukachevo as the existing M-06 road passes through mountains with difficult road construction conditions and lack of possibilities to upgrade the existing road. A motorway through the Carpathians is announced without specifying its location. Currently, a pre-feasibility study is being conducted. The project is under question due to serious lack of funds even for the rehabilitation and maintenance of the existing road network.

Railway:

The main railroads in Zakarpatya are important international connections between Lviv and Chop (via Mukacheve and Volovets) and Lviv and Uzhgorod (via Sianki). The Ivano-Frankivsk – Yasinia – Rakhiv - Dilove line lost its international importance after the dismissal of connection to Romanian Valea Vișeului. There are also some regional lines such as Batevo – Khust – Solotvino and narrow gauge system connecting Beregove, Irshava and Vynogradiv. All lines are managed by Lviv railway, which is part of state-owned Ukrzalyaznitsa.

Rail traffic intensity is correspondently low with maximum index at Lviv – Chop (potential capacity is 100 trains/day, actual – 5 times less). Local railroads are used for passenger traffic only. Maximum train speed on the railroads is 70 km/hour (Lviv – Uzhgorod, Lviv – Chop) and lower on the rest of the railroads. The speed limit is caused by difficult natural conditions in the mountains and bad technical state of local railroads. In the Carpathians the railroads pass through numerous tunnels and bridges which provide good opportunities for ecological connectivity. There are no plans to construct new railroads in Zakarpatya region for the upcoming years[96].

96 Verner, 2017

5.3.6 Poland

There are two Core TEN-T Network Corridors crossing Poland: the Baltic-Adriatic Corridor extending from the Polish ports Gdańsk and Gdynia and from Szczecin and Świnoujścievia to the Czech Republic or Slovakia further to the south; and the North Sea-Baltic Corridor connecting North Sea ports through Germany and central Poland to the eastern EU border and to the Baltic countries. Another significant corridor is Via Carpatia.

Because of its size, this country spreads from the Baltic coast to the ridges of Carpathians and from Nisa and Odra rivers to Bug. The following text focuses only on the Carpathian area and its hinterland, which is forming the south-eastern part of the country.

Road:

Polish Carpathians and its foothills are accessible by the A4 motorway, which ensures the important connection between Germany and Ukraine. The beginning of its construction can be traced back to the time of the Nazi-Germany with first section near Wroclaw (Breslau) already opened in 1937, which was by far the only Polish motorway. Four years after the proposed schedule, the entire length of the A4 was completed in 2016, so A4 became the second complete motorway in Poland. Another important road for this region is the expressway S1 from Katowice via Bialsko-Biala to the Slovak border near Zwardoń, out of which 70% is completed, whereas two sections (including Przybędza – Milówka in the southern mountainous part) are still under construction.

For a long time Poland suffered from the lack of appropriate main road network but the construction of motorways emerged after 2000 giving rapid improvement of the situation and Poland became the current leader in highway construction in region.

Motorways, expressways and national roads are part of the national road network and operated by General Directorate for National Roads and Motorways (GDDKiA) or private concessors. Voivodeship roads are administered by the governments of the respective regions and powiat roads are managed by the respective county.

Railway:

The principal infrastructure manager of railway network is PKP Polskie Linie Kolejowe. It provides licensed rail operators with the access to infrastructure.. Among others, the largest railway modernization program in Polish history is being implemented in order to achieve an appropriate level of safety and improve travel speeds. The main Polish railway in the Carpathians and their foothills is the double-track electrified line Kraków – Tarnów – Rzesów – Przemysl, part of the Core TEN-T conventional railway network. The individual valleys are served by branch lines from this line such as Bielsko-Biala – Zwardon (- Skalité in Slovakia); Kraków – Chabówka – Zakopane; Tarnów – Nowy Sacz – Muszyna (- Plaveč in Slovakia) and Rzeszów – Jaslo – Zagórz – Lupków (- Medzilaborce in Slovakia). There are no high-speed railways planned in the Polish Carpathians[97,98,99].

97 GUS, 2017
98 Opoczynski, 2016
99 PKP, 2016

5.3.7 Serbia

Thanks to its position Serbia provides transport corridors for passengers and cargo flows linking Europe with the Black Sea countries, Near East and Asia. Two European corridors, namely VII – the Rhine-Danube and X (Salzburg - Ljubljana - Zagreb - Belgrade - Niš - Skopje - Thessaloniki) – the international highway and railroad, intersect on the Serbian territory, providing excellent connections with Western Europe and the Middle East. However, due to a serious lack of funding for new developments and general maintenance during the last 25 years, existing transport infrastructure is far behind its current and future exceptional potential. The priority for the next period is the development of multimodal transportation and transition from road to railway and river transportation.

Road:

The construction of motorways in former Yugoslavia started as early as in 1970s. Far before, in post-WW2 years, a two-lane road known as "Brotherhood and Unity Motorway" was completed, which later became part of A1 motorway. The construction of only half-profile motorway encompassing two traffic lanes with land acquisition and major structures such as overpasses carried out for full-profile motorway was common in these times. The extension to the standard 2x2 highways was done much later.

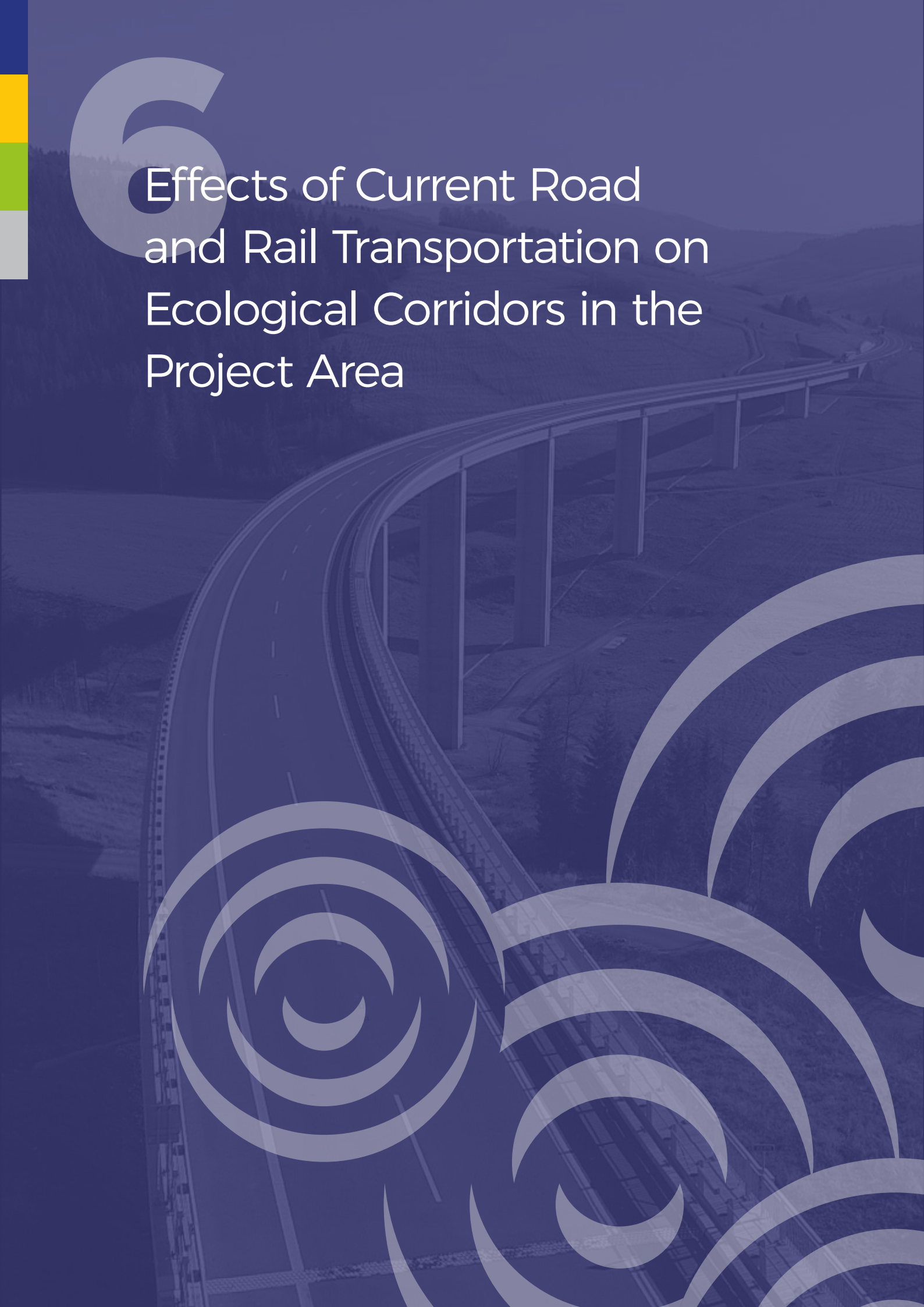
The main backbone of the Serbian road network is motorway A1 (Hungarian border – Novi Sad – Belgrade – Niš – Macedonian border) along with A3 (Belgrade – Croatian border). Several sections in the South Morava valley and the last part of Belgrade bypass are still missing. In addition, most of the A4 from Niš to Bulgarian border is finished. The priority for Serbia's road infrastructure development is the construction of Belgrade - Bar (Montenegro) motorway. The Serbian government has just signed a contract for two stretches of that motorway. The construction of another motorway between Niš and Priština (Kosovo) should begin in 2018.

Railway:

The railway network in Serbia lacked investments in previous years, but serious efforts have been made by the Government of Serbia in order to restructure and modernize the railway network and the rolling stock. Serbia has signed contracts with 43 international forwarding companies to increase the number of container trains using infrastructure maintained by Infrastructure of Serbian Railways JSC. The notable project in passenger transport is the upgrade of the Belgrade-Budapest railroad for the speed up to 200 km/h. Several other projects are under consideration to improve the network and its capacity[100,101].

100 RS-MOE, 2010
101 SORS, 2017

6 Effects of Current Road and Rail Transportation on Ecological Corridors in the Project Area



6.1 Effects of current road and rail transportation on ecological corridors in the Czech Republic – overlaps between transport infrastructures and ecological corridors, barrier effect

The most up-to-date results were analysed during the project Complex Approach to the Protection of Fauna of Terrestrial Ecosystems from Landscape Fragmentation in the Czech Republic (2015-2017). The assessment was made for all problematic barrier sites in the layer of biotope of selected specially protected species of large mammals (see chapter 4). There were identified 251 problematic sites with some barrier effects in total (barriers included all possible types e.g. highways, roads, railways, settlements, lakes/dams, vast agricultural fields, fenced areas etc.). The category highway was present in 51 cases, the category road was present in 199 cases and railway in 100 cases out of all problematic barrier sites.

More detailed analysis of crossing points of the biotope layer with transport infrastructure only revealed 182 most problematic sites throughout the Czech Republic. The analysis was done for all spatial conflicts between the layer of biotope and the set of highways, first class roads and other roads on which the annual average daily traffic intensity was calculated to be at least 10,000 vehicles per 24 hours (data from year 2015). Moreover, in 44 problematic sites out of 182, there can be expected a high degree of risk for interruption of the coherence of the whole ecological network. The highest priority should be preferably given to these places when analysing the necessity of construction of mitigation measures in the sense of Technical Conditions 180 (TP180), for example in the preparation of infrastructure reconstruction, especially in the case of sites with a direct link to the core area defined in the biotope layer. As expected, most of the sites were identified on the older highways (e.g. D1, D5, D10) where the problems of landscape fragmentation and migration of wildlife have not been taken into account during the construction and have not yet been reconstructed or upgraded. The only locality with occurrence of serious conflicts on a motorway which was built after year 2005 is the conflict point on D48 located east of Rychaltice. The second group of critical points are those located on the first-class roads. The permeability for wildlife is often worsened due to the occurrence of cumulative effects of the presence of multiple barriers (road with high traffic intensity, railway) and usually located in the tight and often steep river valleys (the Vsetín Bečva valley, the Elbe river valley).

From the above-mentioned summary of the existing problematic sites, it is obvious that the effect of linear infrastructure on ecological network is very significant even now. Therefore it is necessary to think of the landscape fragmentation from the very beginning, when planning a new road/railway or upgrading the existing one in the future.

The main types of measures which should be taken into account

In principle, the measures can be divided into three basic groups:

4) Measures to support the migration/ movement of animals – migration objects. These are building objects on the road (bridges, tunnels) that allow overcoming of communication by animals. These objects are mostly implemented for communication for reasons other than animal migration (transfer of field depressions, valleys, watercourses, lower class roads, field and forest roads, etc.) and allow animals to migrate/ move as a side effect. In addition to these objects, special migratory objects with the primary function of animal migration can be implemented in justified cases. At present, this is the key measure to allow the safe movement of animals in the fragmented landscape.

5) Measures to prevent animals from entering the communication – mechanical barriers (fences, noise barriers), other barriers (e.g. sound, odour repellents, light reflectors).

6) Measures for the driver – these measures affect the safety of traffic on the roads in relation to the animals. These are special measures to modify the speed of traffic and to warn the driver of the occurrence of animals (traffic signs) and to increase communication visibility.

The overall efficiency of each individual measure is determined by a number of environmental and technical factors. For migration objects, there are four basic sets of factors:

a) Basic solution concept – based on the category of communication, height and surrounding topology of the terrain. The basic types of migration objects are overpasses and underpasses.

b) Dimensions of migration objects (length, width, height). The demands of animal taxons differ significantly. The large mammal group has the highest demands for the dimensions of objects.

c) Incorporation of objects into the surrounding landscape. Important is the type of surface on or below the object, field and vegetation treatments, guidance elements, etc.

d) Protection against disturbance (artificial lighting, noise, visual contact) on communication made by traffic flow (e.g. noise barriers etc.)

6.2 Effects of the current roads and rail transportation on ecological corridors in Hungary – overlaps between transport infrastructures and ecological corridors, barrier effect

In the pilot area and road construction planning, the Borsod-Abaúj Zemplén County is the most concerned (alongside the Slovakian border), and the Szabolcs-Szatmár Bereg County (alongside the Ukrainian border). In the Spatial Planning of Miskolc (2008), the ecological network is included as well as the ecological corridor is mentioned - "On the area of ecological corridors designation of new area for construction and new buildings are prohibited".

The Land Use Plan of Borsod-Abaúj-Zemplén County (2009) does include regulations for the ecological corridors. All settlements are listed that have ecological corridors in their area. The Regional Development Plan of Borsod-Abaúj-Zemplén County (2013) does not include developing of ecological corridors. However, it mentions that during the developments protection of biodiversity needs to be taken into account, natural areas and natural resources have to be preserved, and also the sustainable development criteria have to be taken into account.

39.5% of Borsod-Abauj-Zemplen County is Natura 2000 area, 9 SPAs, 47 conservation areas. This is the county where the M30 motorway will lead through.

In the pilot area are also concerned:

Bükk National Part, Aggtelek National Park, Zempléni Protected Landscape Area, Tokaj-Bodrogzug Protected Landscape Area, Kesznyéteni Protected Landscape Area, Szatmár-Bereg Protected Landscape Area, and several Natura 2000 sites. In the area of Aggtelek National Park and Bükk National Park the conservation areas have approved management plans. In Hungary, management plans are mostly written for conservation areas (smaller scale than the PLA), the approved management plans cover almost the whole pilot area. The approved management plans of the conservation areas on Aggteleki NP don't include measures to secure or re-establish corridors.

Ecological corridors were mostly designated in stream and river valleys in the area of Bükk National Park. Bükk NP has the densest ecological corridors, between the Láz-bérci PLA, Tarnavidéki PLA and Mátra PLA, and in the forests of Western-Bükk and East-Mátra. The corridors run from Zemplén PLA, Tarnavidéki PLA and Karancs-Medves PLA, as well as from the Ipolytarnóc fossils conservation area connecting with Slovakia.

In Hungary, 79.6% of Hungary's land is agricultural land (7.4 million ha). 20.4% is abandoned areas (1.9 million ha). Agricultural (arable) land is usually in private ownership. Three thirds of the arable land are in natural persons ownership (73.1%), one quarter of the arable land is in the ownership of the state (22.7%).

6.3 Effects of current road and rail transportation on ecological corridors in Poland – overlaps between transport infrastructures and ecological corridors, barrier effect

Road network

The road network in Poland mainly consists of roads with a 1-way structure, as a rule it is devoid of protective fences and typical animal crossings. The above conditions make it possible for animals to move along the surface of the road (the so-called passage on the road surface) across the majority of national roads. This is the basic method of maintaining ecological communication in areas crossed by roads without fences, and its effectiveness depends on the intensity of vehicle traffic and the presence of additional physical barriers hindering the migration of animals (e.g. deep ditches, energy-intensive barriers).

The most effective barrier effect concerns roads with a traffic volume as of > 10 thousand / day, where there is a high risk of collisions with animals, moreover, a large proportion of individuals are deterred as a result of strong noise and other road contamination – thus avoiding the surroundings of roads and attempts to cross them.

The huge spatial scale of collisions and their location in important natural areas cause one of the priority threats to the protection of biodiversity in Poland and Central Europe.

The preservation of ecological communication requires a thorough and precise assessment of the barrier effect and the design of effective minimization of measures in the case of conducting any investment projects.

Railway network

A detailed analysis of the collisions of the most important sections of the railway network with the network of ecological corridors and fauna habitats of pan-European and domestic importance shows that 13 sections of railway lines intersect key areas for maintaining ecological connectivity of around 912 km. The huge scale of the collision and their large spatial spread cause one of the most important threats to the protection of biodiversity in Poland. In order to avoid the fragmentation of the natural space by railway lines, a thorough and precise assessment of their barrier effect and planning activities that effectively minimize the effects of any investment projects is needed.

Currently, studies are underway on the construction of a new high-speed railway system, allowing trains to travel at speeds of >250 km/h. For reasons of passenger safety, it is assumed that protective fencing, protecting against accidents/collisions involving people and animals will be introduced. Fenced lines will cause environmental fragmentation by creating a full ecological barrier for all terrestrial animal species. The preservation of ecological communication will be possible only through the introduction of minimizing measures in the form of ecological bridges and animal crossings – according to the standards used in the case of expressways.

6.4 Effects of current road and rail transportation on ecological corridors in Romania – overlaps between transport infrastructures and ecological corridors, barrier effect

Due to the lack of official designation and recognition of ecological corridors in Romania, the effect of road and rail transportation on wildlife corridors has not been properly addressed and studied and there is no methodology defined to perform such an assessment. There are some isolated cases when this type of effect has been addressed, especially by the NGOs; however, the approaches differ in the absence of a methodology or guidelines at the national level.

In addition, there is no database at the national level (or at county levels) with the road and railway kills which should be the basis for analysing the effects of transportation on wildlife and identifying mitigation measures and solutions.

However, as the first step, an analysis of the impact and effects of road and rail network on the intersected Natura 2000 sites and other protected area categories should be performed in cooperation with the protected area managers and custodians.

The road network is probably having a greater impact on protected areas considering the actual context which was also presented in the previous chapters. The current road network is intersecting several Natura 2000 sites. The first "green bridge" ever to facilitate the crossings of a highway (Lugoj-Deva) by wildlife was recently built (2018). Two other similar structures are in construction on the same highway to allow the movement of large carnivores between Apuseni and SW Carpathians and vice-versa. This is a shy start in maintaining the functionality of ecological corridors, intersected by highways, for large carnivores and ideally for others, planned highways ecological connectivity will be considered more seriously.

6.5 Effects of current road and rail transportation on ecological corridors in Serbia – overlaps between transport infrastructures and ecological corridors, barrier effect

Ecological corridors have not been comprehensively defined in Serbia. The situation is better in Vojvodina Province (where a more or less comprehensive ecological network has been implemented in physical planning) while for the rest of Serbia it is not the case.

Mitigation measures (wildlife crosses) have not been implemented on the majority of constructed highways and rails. Some measures have been implemented on the E75 between Novi Sad and Subotica.

Integral assessment of transport infrastructure on wildlife has not been made in Serbia. However, the impact is expected to be higher in mountainous areas in central Serbia where larger natural and semi-natural areas (forested areas) are intersected by transport infrastructure (Corridor 10, N-S direction). The highway E75 mainly runs along Velika Morava valley and separates natural and semi-natural ecosystems in eastern Serbia (Carpathian part – with major protected areas like NP Đjerdap and future Nature Park Kučaj) and western Serbia. The highway and the railway along Corridor 10 have no structures particularly built for wildlife migration. There are some underpasses built for other purposes (local transport, bridges etc.) and it can be assumed that they are used by some animal species (certainly not large carnivores). It has to be considered that eastern and western mountain areas of Serbia are naturally divided by Morava valley but there are some natural corridors which could enable migration (i.e. Ražanj locality which connects the Carpathian part with the central and western Serbia). However, this is now prevented by the E75 highway.

The planned A2 highway (Belgrade – South Adriatic) is of high potential risk for wildlife and nature conservation. The highway route is very close to several important protected areas like Nature reserve Uvac, Nature park Golija, Nature reserve Peštersko polje. The constructed section of the highway (Ljig/ Preljina) does not include any specifically constructed wildlife crosses, only passes constructed for other purposes. The EIA for this section has not indicated that specific wildlife crosses are necessary, without comprehensive justification. Hopefully, planning documents and assessments for the rest of the highway, which is far more problematic from the aspect of nature conservation, will include better analysis of nature conservation aspects and will propose better mitigation measures.

6.6 Effects of current road and rail transportation on ecological corridors in Slovakia – overlaps between transport infrastructures and ecological corridors, barrier effect

Since Slovakia joined the European Union in 2004, the network of road infrastructure seriously increased its length. Further, the traffic volume expanded significantly. Due to its geographical range in the centre of Europe, Slovakia is often functioning as a connection between Western and Eastern international trade and travel. The country has not been prepared for this. Till now, Slovakia constantly enlarges infrastructure or improves the existing roads, respectively. Under this strong economic pressure, mitigation measures were just rarely planned alongside new roads. Further, the absence of science based research of ecological corridors in the country is worsening the situation.

Thousands of wildlife species are killed in traffic accidents every year (Hunting Statistics of the Slovak Republic). However, detailed evidence of traffic-related mortality is often missing. Various institutions deal with traffic related mortality of wildlife resulting in the fact that data are additionally scattered in various places. Nevertheless, few studies dealing with specific species could already successfully demonstrate that habitat fragmentation in Slovakia is seriously enhanced. Traditional movement corridors of large mammal species including big game and large predators are heavily threatened and often not working properly.

In case of the brown bear, the population is split in the Central and the Eastern bear population. The habitat suitability model[102] showed that suitable habitats would indeed exist between these two sub-populations, but that most important drivers for the ongoing fragmentation are road infrastructure and human disturbance. A genetic study on brown bears even pointed out that these two sub-populations show genetic differences already[103]. Brown bears are often used as umbrella species and can be used as an indicator for habitat suitability.

Detailed studies on bear behaviour in relation to roads additionally confirmed that (wildlife) movements between northern and southern parts of the bear range are under threat. Traffic volumes reach up to more than 27,000 vehicles on one-lane roads. Even, secondary roads pose serious movement/dispersal barriers if the traffic volume reaches more than 5,000 vehicles/ 24 hrs[104].

These results can clearly draw attention to the complex topic of wildlife and traffic. Much more research would be necessary including other predators and large mammal species to have a better insight in traffic related mortality, movement and traditional dispersal routes.

102 Koreň et al, 2011
103 Straka et al, 2012
104 Skuban et al, 2017

Train related mortality is hardly documented. However, half of bear mortality happened on railways. Interviews with the Slovak Railway Association confirmed that many different wildlife species are hit by trains every year. This data evaluated minimally. It does not serve as a basis for making conclusions.

The project TRANSGREEN can help the country get a better understanding of the difficult thematic wildlife – traffic mortality – disruption of ecological corridors. Many different institutions including the Traffic police, the Institute for Traffic, the Road building association, the Slovak Railway association, the State Nature Conservancy, etc. are either involved in the project or offered their cooperation.

As already mentioned, the effect of current road and rail transportation on movement corridors of large mammals is especially negative in the pilot area Malá Fatra (see also 3.4, 4 and 10.3). Even without any highway, the high traffic volume on secondary roads impedes movement of many large mammal species including predators.

In the Slovenský kras project area, there is lower traffic compared to Malá Fatra. The TRANSGREEN project will help to better identify ecological corridors and to find out the impact of current road and rail transportation on migratory/movement routes of large mammals.

Kysuce area is situated near the Czech and Polish border. Thus, the neighbouring countries will profit from new results, too. Some of the roads have negative impacts on landscape permeability. The second reason might also be the increased traffic volume in the border region since Slovakia and Czech Republic split and later entered the EU.

6.7 Effects of current road and rail transportation on ecological corridors in Ukraine – overlaps between transport infrastructures and ecological corridors, barrier effect

As of today, there have been no studies done on barrier effects, habitat fragmentation and disturbance caused by road and rail transportation in Zakarpattya region. TRANSGREEN brief studies of critical points and animal migration on the road Mukacheve – Beregoce were the first attempts to get some preliminary data.

Most of the studies related to the impact of road infrastructure on the environment focus on air pollution, soil pollution, and changes in the geosphere. It can be partly explained by the fact that traditional evaluation of ecological impacts of road infrastructure and traffic did not focus on biodiversity and ecosystems continuity. Absence of plans to construct new roads, when all works (including construction and reconstruction) are carried out on the roads which have existed at least for decades or even more than a century (especially railroads). Also, any lack of interest to study the impact of road infrastructure on the ecological corridors can be explained by the fact that ecologic corridors were not identified until the last years. The other reasons include: rare occurrence of traffic accidents with serious consequences and impact on men and property, low density of big animals in the areas surrounding roads, especially motorways, abundance of

road structures permeable for animal migration (bridges over Latorytsya river) on the main road of Zakarpattya (Kiev - Chop) in the mountainous part of the region, correspondently low traffic speed in the numerous sections of roads in the mountains due to difficult natural conditions. (Anatoliy Pavelko)

The map of the ecological network, which was elaborated by the State Department of the Nature Protection of the Transcarpathian region, does not cover all the known ecological corridors in the region. These corridors connect core areas, which are mainly situated in the nature protection areas. Generally, some corridors in the Transcarparhian region are fragmented by different structures like large and medium agricultural areas, road and rail infrastructure, as well as settlements. It applies especially to the plain part of the region, where the road net is relatively dense.

There are some parts of ecological corridors overlapping with roads and their associated infrastructures, which create disturbance or represent barriers for animal's migrations/ movements.

Generally there is no rail infrastructure in the pilot area in the Transcarpathian region of Ukraine.

In the part of the pilot area "Dyjda", where the road is planned, there is no disturbance, barriers or other impact on the ecological corridor. It seems that the real ecological corridor is situated in the forest patches, which are located along the state border. In the case of building a high intensity road, the negative factors will appear and the situation will need additional analysis and mitigation measures.

The existing road between Berehove and Mukacheve towns is characterized by relatively high traffic density.

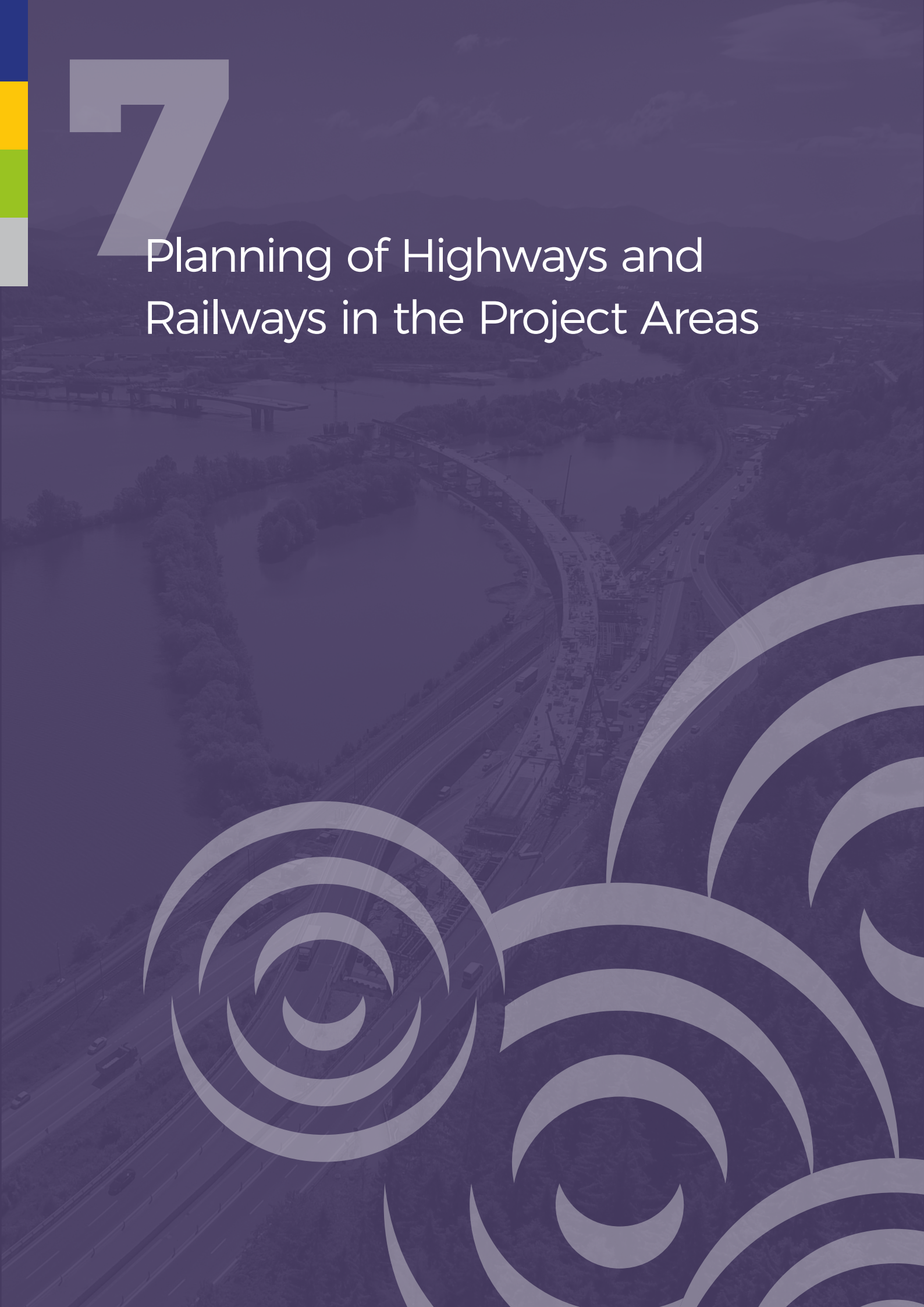
Traffic collisions with the wild animals known here are very rare, possibly because of low occurence density of these animals. Some road crosses of different animal species have been registered based on snow and mud tracking and mapped during the survey in 2017-2018. There are no barriers for animal movements at the moment. However, large mammals usually avoid crossing this road. Supposedly, the noise from the traffic may pose some disturbance to the animals.

Generally, the road and rail infrastructure in the area do not represent a major obstacle/barrier for animals. However, some places are critical for the movement of different mammal species. This is noticeable, in particular, by the death of animals in different parts of the region. Majority of collisions happened in the plain part of the Transcarpathian region, close to large rivers and their tributaries: Tysa, Borzhava, Latorytsia and others.

Over the last two decades, the collisions with large mammals on the rail have been unknown. Obviously, transport infrastructure has a great influence on the movement of animals, as evidenced by mammals avoiding crossing high-traffic roads.

7

Planning of Highways and Railways in the Project Areas



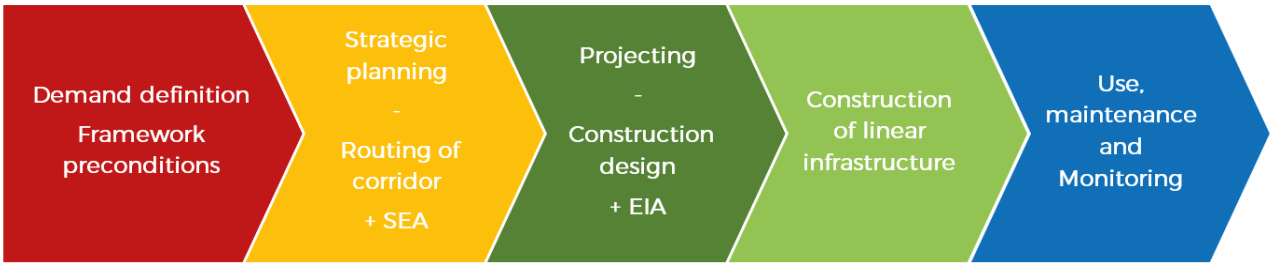
7.1 Minimizing fragmentation through appropriate planning

The upcoming transport infrastructure development is a necessary prerequisite to fulfilling goals of the European transport policy, especially in terms of completion of the TEN-T network by 2030, which is essential for each EU country. This is especially relevant for the countries whose transport networks are in bad condition such as the countries of Central and South-Eastern Europe. However, such massive development brings enormous pressure to the other components of the landscape. The challenge is ecosystem conservation, threatened by landscape fragmentation.

Detailed description of principles and recommendations for efficient planning of motorways and railways with minimal impact and reducing fragmentation of terrestrial ecosystems is described in the Wildlife and Transportation in the Carpathian Countries Guidelines, which is another major output of TRANSGREEN project. The general process for the development of the roads and railway lines includes the logic of five steps starting with the scoping, continuing with planning, designing, construction and use/maintenance and monitoring.

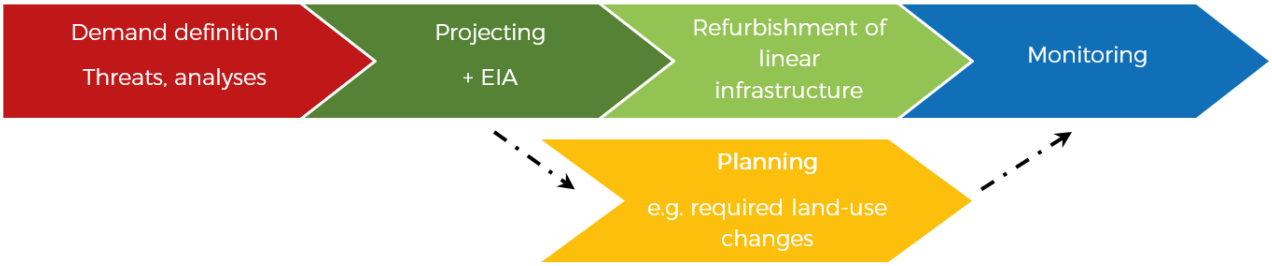
However, these phases can show differences in various cases depending on what the goal is:

- **development of new road /railway or their sections**
  The overall flow of logically interlinked steps is represented by the phases shown in the following diagram:



- **upgrade of existing road/railway** (modernising, extension in former corridors, increase of capacities, speed, etc.)
  When upgrading existing infrastructure, the logic scheme of the process might be:

- **improving ecological status of existing routes and railways**
  The development of the linear transport infrastructure by improving its ecological status of the existing roads and railways is a specific case of upgrading the infrastructure. As in some cases, the efficiency of the particular technical interventions implemented on the road/railway line depends on supportive interventions in a broader area, the process has to include the planning and implementation of ecologic, managerial and organisational intervention in broader areas.



For all three presented cases, the engagement of the whole spectrum of stakeholders is crucial within the strategic planning and design phases starting with the local communities and their representatives from the government, owners, entrepreneurs, NGOs, professionals, relevant public sector representatives and other bodies. The process of participation is framed by the SEA and EIA. The limit for participation of non-experts is in many cases their capacity to understand the technical data and the danger of preferences of subjective motivations and personal interest against the public interests.

In general, it is important to emphasize that each new transport infrastructure development contributes to the increase of the degree of fragmentation. A key issue is the involvement of regional/spatial planning to ensure as much as possible the maintenance of connectivity of the green elements in the landscape. Especially in a situation when infrastructure affects vulnerable areas (such as Natura2000 sites) the sequence avoidance – mitigation – compensation should be applied to preserve protected areas and to minimise the impact.

It is necessary to design defragmentation measures when upgrading or renewing existing infrastructures as a large part of it was not planned and built to tackle fragmentation issues.

Maintaining the permeability of the linear infrastructures like roads and railways is just one piece of the puzzle. It is equally important to ensure the continuity of the entire migration/movement corridors despite the various potential conflicting interests. These conflicts may escalade,particularly in spatially limited areas (due to orography, nature conservation, etc.) especially in the valleys of the Carpathian Mountains.

7.2 Planning of highways and railways in individual countries – practices including environmental assessments, stakeholder consultation and involvement processes, decision making

7.2.1 Romania

The major planning document in terms of transport infrastructure is General Transport Master Plan[105] which is a mid- to long-term strategy for developing transport infrastructure in the next 15 years. The plan proposes the development of approximately 6,770 km of roads, out of which about ½ represent the existing roads, which need to be upgraded. As for the railway network development in Romania, a total of 3,323 km are going to be rehabilitated.

The planning process in the country does not work well due to lack of credible scientific data. The ecological corridors are not identified and designated, so it is difficult to respect them in the planning process. This leads to an increase in habitat fragmentation. In the absence of ecological corridors many mitigation measures are not properly designed and not implemented in proper places. Another reason for rising fragmentation is lack of harmonization of cross-sectoral policies and strategies.

The national specifics are two separate levels of discussion:

a) national level – the strategic master plan on transport with a very brief analysis on the impact, although it contains references to green infrastructure;

b) project level – there is not enough time allocated to analyse the alternatives or to properly assess the impact on the environment. A short period of time and scarce resources are often allocated to biodiversity assessments, and this is why later some problems arise; the intervention of the environmental authority appears later in the planning, during EA and EIA. This is a problem because in many cases it does not allow the inclusion of all the criteria and costs of the green infrastructure for instance in terms of references and public acquisition process – data availability.

Thus, there is a great breakthrough between national planning and planning at project level. There is a general lack of data, for instance the dataset on species and habitats that are part of the Natura 2000 network is incomplete and there is no official recognition of ecological corridors at the moment. So the cumulative impact cannot be considered in most of the cases, or, it is not properly calculated.

The main organizations involved in the planning process are: the Ministry of Transport, the Ministry of the Environment with the National Agency for Environmental Protection (ANPM), The Romanian Waters National Administration (ANAR), the Ministry of Waters and Forests, the National Agency of Natural Protected Areas (ANANP), beneficiaries (National Company for Road Infrastructure Administration – CNAIR, Romanian Railways – CFR).

105 MOT RO, 2016

7.2.2 Slovakia

Transport infrastructure development in Slovakia is framed by the following strategic documents:

1) Strategic Plan of Transport Infrastructure Development in Slovakia up to 2020, Phase I[106].

2) Strategic Plan of Transport Infrastructure Development in Slovakia up to 2030, Phase II[107].

3) Strategic Plan for the Development and Maintenance of the 2nd and 3rd class roads[108].

The problem of habitat fragmentation due to transport infrastructure was underestimated in Slovakia for long time. Therefore, there are just few studies existing aiming at identification of core areas and ecological corridors. There is indeed an EIA analysis carried out during a landscape planning process, but it is rather a theoretical analysis lacking in reliable field data and validation. One reason for that might be that for resolving the final judgement in the landscape planning processes, responsible people of the EIA have a maximum time of 10 days. Further, the majority of judgements are based on the map of the so-called "Supra-regional Territorial System of Ecological Stability for Slovakia" which is neither actual (updated in the 1990s), nor taking large mammal species into account. At last we must unfortunately state that people involved in the EIA process are not necessarily biologists and/or involved in the thematic of large mammals' movements.

The common planning practise for new motorways and expressways is that the National Motorway Company will address the State Nature Conservancy in order to find an agreement for the suggested road section, than the State Nature Conservancy will address the regional responsible nature conservation unit (e.g. national parks, landscape protected areas etc.) for a consultation. Unfortunately it must be stated that many regional responsible nature conservation units are understaffed and do not have capacities to carry out special studies on animal movement behaviour. Thus, main tasks carried out refer to mapping of protected species and sometimes monitoring of target wildlife. If the particular nature conservation unit do have a good overview, there is a good chance to suggest correct places for implementation of mitigation measures. Otherwise we must expect such unhappy situations like in the case of the landscape protected area Poľana and the expressway R2. The entire road section was placed on an embankment completely impeding any wildlife movement. At last, road building companies do have a duty by themselves to ensure some monitoring of the area, however, the final decision will be made by the EIA department.

The following institutions are involved in landscape planning processes: the State Nature Conversancy, municipalities, road and railway building organisations, public (in form of meetings with the local people including hunters, foresters, and conservationists), sometimes private organizations and NGOs but with a rather advisory role.

106 MTCRD SK, 2014
107 MTCRD SK, 2016
108 MTCRD SK, 2015

7.2.3 The Czech Republic

The key document of the Ministry of Transport defining the priorities and objectives in the field of transport and transport infrastructure development on both medium (2020) and long term (up to 2050) is the Transport Sectoral Strategy, 2nd Phase[109]. This document is based on the transport policy priorities defined by the Transport Policy of the Czech Republic approved by Government Resolution No. 449 of June 12, 2013, which is an umbrella strategic document for the Ministry of Transport. The Transport Policy of the Czech Republic presupposes the elaboration of separate follow-up strategies for individual sub-areas, which need to be dealt with in greater detail.

Based on the previous experience in the construction of linear structures, especially motorways, the biggest problems are seen in assessing the impact of the transport corridor on sustainable land development (SEA process as part of land-use planning documentation) and environmental impact assessment (EIA) in subsequent procedures. A key problem that is addressed is the impact of the new infrastructure on the environment, in particular the elimination of health impacts (noise and vibrations, air pollution), the location of the linear construction in the landscape and the solution to the issue of fragmentation, the interruption of ecological corridors/migration routes of wildlife. The existing environmental legislation is often used in an abusive way by different interest groups who are against any new construction, which significantly prolongs the deadlines set by the Building Act for the preparation of the construction. The processing time is more than twice the standards in other European countries and often takes even 15 years.

While new constructions are at least generally in line with the minimal nature conservation requirements, the unresolved conflict point is the permeability of older motorways (and expressways) which were put into operation before the SEA/EIA law. The restoration/improvementof permeability requires the construction of additional measures to improve the ecological status of the road, which has not yet been solved.

Basic stakeholders groups that is relevant to the process of transport infrastructure development in the Czech Republic:

- Ministries: the Ministry of Transport; the Ministry of Environment; the Ministry of Regional Development
- Regional authorities: regions, municipalities with extended powers
- Transport Infrastructure operators: Roads and motorways directorate (motorways, 1st class roads); Regional road administrations (2nd and 3rd class roads); Railway Infrastructure Administration (all railways)
- Conservation agencies: Nature Conservation Agency
- Planners and consultation companies incl. EIA/SEA experts
- Associations of transport companies and other infrastructure users
- Owners & land users including hunter associations
- Ecological NGOs and interest groups

109 SUDOP, 2013

7.2.4 Hungary

The fundamental document of road and railway developments is the National Transport Strategy (issued in October 2013). The document determines the transport strategy until 2030 with an outlook until 2050 and with the first phase until 2020. The newest regulations related to the road infrastructure development are two Government Resolutions setting up the future short- and medium-term priorities in road transport and plan for their implementation until 2022 (1371/2016; 1656/2017).

The current Hungarian policies are generally in line with the recommendations described in the regional Wildlife and Transportation in the Carpathian Countries Guidelines developed within the TRANSGREEN. The stakeholder engagement is referred to as the public consultation round wherein the national parks and public are invited to discuss the assessment as well as to give suggestions.

In the planning process there is a difference in the approach with respect to whether the infrastructure is already existing or planned. With respect to the already existing linear infrastructure, according to the environmental regulations, this should be adapted through effective mitigation measures to reduce the environmental damage. Although the regulation states that in order to understand the environmental effects of an activity and for suitably controlling the environmental impacts, an environmental audit is to be made. The competent authority can encourage the responsible authorities to conduct an environmental audit but this is not done in most of the cases. The most efficient way to regulate or decrease the impacts related to habitat fragmentation at the planning stage is to choose the routing/alignment through the least number of most sensitive areas. The new motorway M30 from Vásárosnamény follows this example wherein the National Infrastructure Developing (NID) Ltd. is assessing the impact of 3 different road scenarios in order to reduce the impact of the motorway construction on the environment. This is a step in the right direction for the future infrastructure development plans in Hungary.

The main difficulty with regards to the implementation of the nature conservation laws is that the assessment of the plans is defined for all types of spatial plans at all different levels of the government, thus making it difficult to clearly differentiate the requirements as well as the scope of these assessments and plans at different stages. Some other weaknesses are represented by the administrative capacity and the knowledge of SEA in regards to ecological issues. Another important difficulty in the implementation of the nature conservation rules is that related to the lack of awareness and the society not being pro-active in influencing the decision making process. The area of nature conservation is primarily influenced and tackled by a few NGOs, researches and nature conservationists. There is a need for more discourses within the society for the change in attitude towards nature conservation.

7.2.5 Ukraine

Ukrainian planning and construction legislation does not address the issue of fragmentation of ecosystems. It is not addressed directly even by ecological legislation, such as Law of Ukraine "On Protection of the Environment", Law of Ukraine "On Ecological Network of Ukraine", Law of Ukraine "On Natural Protected Areas of Ukraine". The only legal act, which refers to fragmentation of ecosystems, is the Protocol on Sustainable Transport to the Framework Convention on the Protection and Sustainable Development of the Carpathians. (P. 2 Art. 2 – cooperation of the Parties, Art. 3 – definitions, Art. 9, Art. 10, Art. 11) ratified by Ukraine in 2016. However, regardless of the obligation taken by Ukraine by signing the Protocol, there has been no improvement so far in the national legislation towards addressing habitat fragmentation as an important ecological problem.

There are provisions in the Branch Construction Norms (GBN B.2.3-218-007:2012). "Ecologic Requirements to Motorways", which contain recommendations to construct passages and fences on the roads with traffic intensity of over 10,000 vehicles/day as well as to prevent any changes of watercourse and to support water flow speed favourable for migration of fish and other water animals. The provision is a recommendation, not obligation. Taking into account that the Norms were adopted in 2012 and there have been no new roads constructed since then, it is not clear whether the recommendation will be implemented into practice. The Ministry of Infrastructure of Ukraine announced in 2017 that wildlife passages will be constructed on the new roads (in particular Lviv North by-pass), which intersect protected areas, migration routes of animals and large forests.

The procedure for planning of highways and railways in Ukraine is in line with the European approach and include the following stages:

1) Strategic planning of transport infrastructure (national and regional level) subject to SEA

2) Projecting – construction design – subject to EIA

3) Construction works

4) Use, maintenance and monitoring (post-project monitoring is carried out in case if prescribed by EIA Conclusion)

5) Additional measures to be taken to prevent, avoid, mitigate, eliminate of adverse impact on the environment (in case if recorded by post-project monitoring).

In practice the efficiency of the approach cannot be assessed taking into account that EIA and SEA legislation was only approved in 2017 and came into force in 2017 – 2018. Since then, there have been no new roads constructed. The Cabinet of Ministers approved two important documents defining the future development of the road network. The first document was State Specific Economic Programme of Development of Motor Roads of State Importance for 2018 – 2022[110]. The programme includes the construction of 325 km of new roads. In May 2018, the National Transport Strategy of Ukraine – 2030[111] was approved. This document includes, inter alia, provisions on wildlife passages (construction of passages and fences at wildlife migration/movement routes; reforestation, protection and use of motor- and railroad protective forest as part of the ecological network). On the other hand, neither the Strategy nor the Programme include lists and characteristics of the planned individual road projects, so it is not possible to assess how many roads/kilometres will be subject to the EIA procedure.

110 UKRAVTODOR, 2018
111 UKRAINE Cabinet of Ministers, 2018

Major stakeholders involved in planning of transport infrastructure are:

- National authorities and agencies – the Ministry of Infrastructure of Ukraine; the Ministry of Regional Development, Construction, Housing and Public Utilities; the Ministry of Environmental Protection of Ukraine; the State Forestry Agency of Ukraine; the State Agency of Water Resources of Ukraine; the State Motor Road Service of Ukraine; "Ukrazaliznytsya" – state operator of railways in Ukraine
- Rregional authorities and agencies (example from Zakarpattya region): Motor Road Service in Zakarpattya region; "Zakarpattya Oblavtodor" – operator of roads in Zakarpattya region; Regional State Administration of Zakarpattya; Department of Ecology and Natural Resources of Zakarpattya Regional Administration
- Administrations of protected areas
- Local self-governance authorities
- Public participation – local and national NGOs active in environmental protection, tourism development, hunting, fishing in the region

7.2.6 Poland

The development of transport infrastructure is based on government strategic and programming documents and is implemented according to the plans of transport infrastructure managers. At the national level, the long-term strategy (by 2030) is provided by the Concept of Spatial Development of the country, while the mid-term strategy is based on The Strategy for Responsible Development. There are also spatial development plans at the level of provinces that include green and blue infrastructure - both existing and planned. The fundamental documents of road and railway developments are the Transport Development Strategy until 2020 (derived from the perspective until 2030) and the Program of Construction of National Roads for the years 2014 - 2023 (with a prospect until 2025). The process of developing strategies and legislation in all sectors (including transport) is made in a collaborative way and takes place with the participation of representatives of stakeholders representing both governmental and self-governmental administration as well as social administration (also in the form of consultation). For this purpose, inter-ministerial working groups are formed within which options are analysed and discussed, then consulted and submitted to decision-makers.

National implementation programs and plans, including investment programs based on strategic documents, are developed by competent administrative authorities (e.g. Ministers) in cooperation with sectoral bodies and entities. In the case of transport plans, the responsible development body is the Minister responsible for transport (currently Minister of Infrastructure) with the cooperation of national transport infrastructure managers (General Director for National Roads and Motorways, PKP Polskie Linie Kolejowe S.A. – Polish rail lines company etc.) and transport operators. The development of strategic and planning documents in the field of transport is subject of the process of public consultations. Comments and proposals submitted during the consultation process are considered by bodies preparing drafts of strategic documents. Consultations are open – each institution, organization or citizen has the right to express their opinion and to submit comments and postulates. As part of these consultations, cycles of regional consultation meetings are organized, in which representatives of regional self-governments take part. The element of the public consultation is a public debate enabling participants to express their opinion on the presented documents.

However, low social awareness in the area of spatial planning and environmental protection can be observed. The present regulations ensuring consultation of acts concerning land use in the process of environmental impact assessment do not encourage sufficiently the municipalities to make decisions on the partnership level and do not expose benefits for the inhabitants from taking active and conscious part in shaping local spatial policy. Another identified problem is insufficient coverage of binding local spatial planning acts of key areas relevant for nature conservation although the key elements of Green Infrastructure in Poland are 'preserved natural wealth' and 'ecological corridors and networks'. The absence of a well-defined binding framework means there are no uniform rules to determine corridors, and no consistent network of corridors. The degree of implementation of ecological corridors therefore varies in local plans, and the concept of green infrastructure is not fully incorporated in other policies such as climate adaptation, water management, management of floods, recreation and tourism or food security[112].

112 DG ENVI, 2017

7.2.7 Serbia

The major document defining directions in the transport infrastructure sector is the Spatial Plan of the Republic of Serbia from 2010 to 2021[113]. The transportation projects for completion are selected according to the Methodology for Selection and Prioritization of Infrastructure Projects, which is part of the National priorities for international assistance (NAD) 2014-2017 with projections until 2020, adopted by the Government of the Republic of Serbia in November 2013.

Serbia is lacking appropriate planning with respect to the fragmentation issues. Two main causes can be identified: low awareness and weakened enforcement of environmental laws and lack of hard, approved, systematized data on corridors and relevant habitats. Serbia is currently having a state model for development, where the state is leading main development and infrastructure projects with highly centralized decision making. In order to make the development of infrastructure faster, the government is simplifying procedures, especially those related to the environment (i.e. new Law on construction and planning is highly "offensive" in providing welcoming environment for investors and developers). Institutions responsible for environmental aspects are either avoided in decisions making process or pushed to issue acceptable solutions which are not harming fast implementation of development projects. In addition, capacities of environmental institutions are low. Serbia has got a separate ministry responsible for environment only in 2017. There are no comprehensive habitat/species distribution maps which could provide a basis for integrative planning of transport infrastructure. The situation is slightly better in Vojvodina province where work on ecological network is in a more advanced stage and the so far identified significant ecological areas and corridors are integrated into planning documents (regional and municipal spatial plans). The ecological corridors and connectivity aspects can be integrated into the planning process when the so-called "conditions for nature protection" are issued by state institutes for nature conservation (there are two of them: the Institute for Nature Conservation of Serbia and the Institute for Nature Conservation of Vojvodina province). Planners are obliged to integrate and obey the conditions (conservation measures) defined by the institutes. However, these conditions are often vague and not specific (not referring to exact geographical areas) allowing planners to avoid conservation measures in many cases.

Serbia is in the EU accession process. A significant part of the EU environmental provisions is transposed into the national legislation but effective enforcement mechanisms are missing (i.e. Decree on appropriate assessment is still not adopted). This situation is creating confusions in Serbia, since the national government is still allowed not to fully comply with the EU regulations, and at the same time the EC is not having a firm position towards Serbia on dealing with environmental issues according to the EU nature directives (environment is not among the priority topics in the negotiation).

The major stakeholders involved in the planning process are:

- Ministry of Environment – recently formed and still not adequately engaged in the issues of connectivity and transport infrastructure planning
- Institutes for nature conservation – relevant, but missing capacities and (inter-sectoral) governmental support.
- Public enterprise for state roads (JP Putevi Srbije) – maintenance, modernisation, planning and construction of roads in Serbia
- Public enterprise for railways (JP Železnice Srbije) – maintenance and development of railway network
- Public institutions for planning and construction (several of them- CIP/Institute for transport, Institute for roads)
- Institute for Architecture and Urbanism of Serbia – involved in the development of many spatial plans.

113 RS-MoE, 2010

8

Avoidance, Mitigation and Compensation

8.1 Avoidance of habitat loss and fragmentation

Transport has significant impacts on biodiversity through ecosystem alteration and fragmentation, thereby negatively impacting ecosystem services and biodiversity in general. Avoiding or mitigating the fragmentation impacts of transport infrastructure on nature is a well-established Green Infrastructure strategy in the transport sector.

Fragmentation of habitats and nature in general may be minimised by choosing specific technical and designed solutions, e.g., tunnels, or viaducts which minimise land-take or by allowing watercourses, including natural banks, to exist under the structure. A large expertise in the transport sector exists on the implementation of green bridges and eco-tunnels to mitigate the barrier effects for wildlife movement.

Developing Green Infrastructure adjacent to infrastructure has the potential to keep and continue the delivery of many ecosystem services. Road and railway verges and canal banks form important wildlife corridors and can play a key part in the tourism appeal of the landscape for many recreational activities. They can be an important food source for wild pollinators. Moreover, vegetation reduces noise levels by hampering or modifying the propagation of sound. Green Infrastructure solutions can also sustainably mitigate carbon emissions, using the potential of new or restored peat lands and forests for carbon uptake and storage. Furthermore, transport infrastructure is vulnerable to extreme weather conditions and natural disasters, such as floods, landslides and avalanches, which cost lives and are the cause of billions of EUR of damage each year in the EU. Green Infrastructure solutions that boost disaster resilience of infrastructure form an integral part of EU policy on disaster risk management.

Costs & benefits of Green Infrastructure in relation to Transport

There are obviously some costs related the development of Green Infrastructure in relation to transport. A proper estimation of these costs needs to be done in the earliest stages of planning the development of transport infrastructures. A realistic budgeting will ensure a smooth implementation of Green Infrastructure later on.

Costs vary according to the scale of the project, location, etc. There are two main types of costs associated to Green Infrastructure development:

- One-off costs, which include capital costs of activities to plan, define, research, designate, purchase, protect, restore or create Green Infrastructure that need to be completed only once;
- Ongoing costs, which include recurrent costs of activities to protect, manage and monitor green infrastructure that need to be undertaken on a regular basis over time[114].

EU Member States can support Green Infrastructure through programs integrated into their development strategies. There are various co-financing opportunities currently available, e.g. the Structural Funds (European Regional Development Fund), LIFE+, the European Fund for Strategic Investment, etc. Investing in green infrastructure does not just protect natural capital. It is a big step towards the smart, sustainable and inclusive growth which is one of the EU's priority objectives[115].

114 Naumann et al, 2011
115 http://ec.europa.eu/environment/nature/ecosystems/investing/index_en.htm

The benefits of green transport corridors go beyond just biodiversity (e.g. preservation of the quality of habitats and functionality of ecological corridors, ecosystems); they create benefits for regional economies, employment, tourism and recreation, public health, water management and sustainability of energy and transport systems (climate change mitigation and adaptation). Environmental benefits are derived from: the long-term conservation of nature and biodiversity; reducing the carbon footprint of the transport sector; maintaining ecological coherence in the landscape; and from avoiding traffic accidents caused by wildlife.

Green Infrastructure can often provide more benefits at lower costs than single-purpose grey infrastructure. In the transport sector, integration of transport and Green Infrastructure may enhance scenic value and connectivity resulting in increased benefits from leisure and tourism. Combining Green Infrastructure with permeable pavements may further reduce storm management costs and environmental pollution.

Green walls or green embankments along infrastructure function as noise barriers, reduce air pollution through particulate filtering, mitigate water run-off as well as reduce storm-water flows as part of a sustainable drainage system. Elements of Green Infrastructure that can be integrated into road construction include vegetated drainage in combination with porous materials, permeable pavers, into streets or parking lots. These measures increase on-site neighbourhood storm water capacity.

Good practices in Transport & Green Infrastructure

The good practices in this field are almost missing currently in the Carpathian Eco-region. However, there is one well-known good practice example related to the mitigation of the negative effect of transport and other sectors on ecological connectivity. It is in fact about the Alpine-Carpathian Corridor, implemented between Austria and Slovakia.

The project aimed to construct and preserve a coherent 120 km ecological corridor from the Alps to the Carpathians in response to the increasing fragmentation caused by expanding transport infrastructure, agriculture intensification, and the rapid expansion of built-up areas. The main objectives were to safeguard the key habitats and enable the migration/movement and genetic exchange between wild animal populations. Between 2009-2012, several measures were implemented within the framework of this cross-border and cross-sectorial project, such as improving the traffic network by building 'green bridges' over highways at key points / bottlenecks as well as the creation of suitable habitat patches or stepping stones within the corridor. Public awareness campaigns and environmental education for schools within the region were also part of the project. The project budget was EUR 4.8 million, whilst the project delivered several additional benefits, such as recreation and ecotourism[116].

116 http://ec.europa.eu/environment/nature/ecosystems/pdf/Green%20Infrastructure/GI_transport.pdf

Legal and Political Support

The fragmentation of natural habitats by transportation infrastructure is a problem that cannot be solved without an acknowledgement of the topic at policy level and without specific strategies and plans.

The principles of avoidance, mitigation and compensation are embedded in the European and in some national administrative policies and legal frameworks.

Currently, the most important instruments at the European level are:

- the EC Directive on Environmental Impact Assessment (EIA) ;
- the EC Strategic Environmental Assessment (SEA) Directive;
- the Habitats and Birds Directives (which together form the Natura 2000 ecological network);
- the Convention on Environmental Impact Assessment in a Transboundary Context and the Pan-European Biological and Landscape Diversity Strategy (PEBLDS); and
- White Paper on European Transport Policy.

Carrying out SEAs and EIAs ensures that environmental issues including fragmentation are considered at an early stage of a programme, plan, or project development.

Another aim of the SEA and EIA is to ensure public debates at the early stages. Before a programme, plan or project is adopted and before any construction work is initiated, all relevant authorities, stakeholders, NGO's and members of the general public should be involved in a public inquiry to inform the final decision on whether the development should proceed.

The Pan-European Biological and Landscape Diversity Strategy (PEBLDS) promotes the concept of 'ecological networks' (i.e. connections between habitats via ecological corridors). This has been specifically identified as an effective strategy for addressing habitat fragmentation as it promotes the integration of biodiversity conservation into land-use planning procedures. Consideration of these 'ecological networks' in the planning of roads, railways and waterways may help avoid critical bottlenecks in habitat connectivity and identify where mitigation measures are required.

The EC White Paper on the European Transport Policy for 2010 highlights the importance of sustainable development principles within the transport sector and strives to make the transport more environmentally friendly. It gives priority to air quality, climate change and noise pollution problems; however, it is useful to mention biodiversity or habitat fragmentation as issues of concern. In some European countries, nevertheless, the problem has been recognised with such importance that it receives a special mention in their national transport policies.

8.2 Existing mitigation measures

Mitigation measures such as fauna crossings (underpasses and overpasses) have a proven record of success. However, mitigation should not only focus on the more prestigious passages for large animals. A lot can also be done, at relatively low cost, to increase the permeability of the existing and future transportation infrastructure by adapting the design of engineering structures to wildlife. Many existing wildlife barriers could be lifted by adapting local road and rail overpasses and underpasses to allow for infrequent use by animals. Ecological expertise is necessary from the early beginning of each plan for an infrastructure project. Engineering structure design processes and standards should be reviewed by ecologists to assess these possibilities.

Mitigation is also important for existing infrastructure, much of which was built at a time when the effects of habitat fragmentation were not yet understood. It is often possible to mitigate the existing impacts with appropriate retrofit measures.

Valuable lessons for mitigation and compensation can be learnt from densely populated and intensively developed countries in Western Europe, where the problem of habitat fragmentation has long been recognised. From less populated countries in the Nordic area we can learn what undisturbed areas can be. Many other European countries have already developed national research programmes into the effects of infrastructure on biodiversity, the findings of which will be used to inform the planning and design of new infrastructure.

One good example of mitigation has been presented at the previous point, 8.1 (the Alpine Carpathian Corridor).

8.3 Evaluation and monitoring of the efficiency of the mitigation measures

There is no comprehensive evaluation and monitoring of the efficiency of the mitigation measures in the Carpathian countries, where they exist at all.

The only countries that are paying more attention to this aspect are Slovakia and the Czech Republic.

In Slovakia, the 250 m wide green bridge near Mengusovce was monitored by the National Motorway Company by using camera traps. The bridge is currently frequently used by wildlife species. Several times, fighting red deer stags during the mating season could be filmed. Greatest success was the evidence of a bear resting during the day in a shrubbery on the green bridge. This successful example clearly demonstrates that we still have a good chance to keep a human-dominated landscape permeable for large mammal species provided that we implement mitigation measures in correctly identified places.

In the Czech Republic, there have been several research projects conducted mainly within bachelor/master theses in order to evaluate actual utilization of mitigation structures by different species, but without using a harmonised approach.

As a response to the lack of a clear and harmonised methodology for monitoring existing mitigation structures, the TRANSGREEN project developed a methodology in this respect, which is part of the Wildlife and Transportation in the Carpathian Countries Guidelines.

8.4 Existing compensation measures

In situations where infrastructure dissects especially vulnerable areas or where mitigation measures are inadequate or impossible to construct, certain compensation measures may be necessary. Ecological compensation may be defined as creating, restoring or enhancing ecosystems in order to counter-balance ecological damage caused by infrastructure development. For example, specified natural habitats and their ecological functions, such as wetlands or old-growth forests, should be developed elsewhere to compensate for the negative effects of a project.

When compensation is implemented, the measures should balance the ecological damage, aiming for a 'no-net-loss' situation that benefits both habitats and their associated species.

Ecological compensation is a 'last resort' solution – it should only be used when planning or when mitigation measures were unable to prevent damage. However, it should be noted that the biological value of newly engineered habitats is often not as high as old and established natural and semi-natural habitats, for example, in terms of biodiversity.

There is no real compensation measure system implemented in the Carpathian countries. Even if it is requested to implement some compensation measures by the environmental authorities, they are not put in practice in the end. For instance, in the Czech Republic, compensation measures were imposed along the stream Žabník in Moravská gate east of the village Milenov, because of the construction of the new highway D48. The measures should have consisted in land purchase by National Road Directorate, followed by planting of trees in the vicinity of the stream Žabník to support migration/movement along the stream in the north-south direction. However, the measures as such were not finally implemented.

9

9.1 The Czech Republic

Practice CZ1: Optimization of the railway between CZ-SK national border – Mosty u Jablunkova and Bystřice n. Olší (TRANSGREEN CZ-SK pilot area)

The project of railway reconstruction took place in the eastern part of the Czech Republic in the area of Mosty u Jablunkova city. This area was identified to be important for large carnivore´s migration/movement from Slovakia and Poland, facilitated by the Site of Community Importance CZ0724089 Beskydy, which was designated for the wolf, the bear and the lynx protection. Two last migration/movement corridors were identified in the area, which allow free animal movement in east-west direction. Beskydy Protected Landscape Area Administration proposed the construction of two underpasses located in the migration/movement corridors during the preparatory phase of the railway reconstruction (see Fig. 20). Finally, these two mitigation structures were already constructed. Both underpasses meet the requirements to allow large mammals' movement. Thus the permeability of the railway sections for large mammals has been improved, which has been successfully confirmed by sand belt monitoring and snow tracking of animals passing through the underpasses.

Fig. 20 Underpass constructed on the railway in the Mosty u Jablunkova city area close to the national border. GPS: 49°32'29.3"N 18°44'50.7"E-

9.2 Hungary

Practice HU1: M85 Motorway

The track of M85 motorway in West-Hungary divided a Natura 2000 area (HUFH20013), but a wildlife overpass was built to re-connect it. Moreover, underpasses for middle-sized animals have been built as well as noise and bird protection walls. This reduces the probability of collisions with birds and bats. Light-pollution is also reduced with the existing wall, thus animals sensitive to noise won't be disturbed too much by the road. Thus, it can be concluded that the road occupies less habitat. The cooperation between NID Ltd. and the planner company was good, the fauna and flora has been assessed in a proper way.

Fig. 21 Road M85 in Hungary. A wildlife overpass and underpass was built, as well as noise and bird protection walls. (Blue: ready, green: planned).

Practice HU2: Reflectors on odometers alongside roads

In 2013, the Szigetköz Hunting Community applied a new, less-widespread system in Hungary: they installed retro reflector devices on odometers alongside Main Road 1. It was a great success as wildlife collisions have extensively reduced. The number of collisions can be reduced by 80% by applying this method[117].

Fig. 22 Blue retro reflectors installed on odometers on Main Road 1 in Hungary, successfully reducing wildlife collisions. Area surrounding GPS: 47°50'59.4"N 17°27'00.1"E

117 www.infomovar.hu, 2013

9.3 Poland

Currently, along the motorways in Poland, there are already several green bridge-type passes to allow wildlife movement (16 facilities). Moreover, bridges over watercourses are adapted to the migration/movement of animals (18 objects along the motorways). On the motorways there are also structures for medium sized animals, such as underpasses (9 facilities) or culverts for smaller animals (27 facilities, 16 of which are under construction).

Practice PL1: Green bridge over the śląskich expressway – A1 motorway

The largest green bridge (fig. 23) built over the śląskich expressway – A1 motorway, section Gliwice-Rybnik, initially had a number of design flaws. In the end they all have been corrected and currently the wildlife passage is fully functional and very well managed.

Practice PL 2: Over passes over the E20 railway line, section: Rzepin-Kunowice

In 2007, two overpasses were created over the E20 railway line, section: Rzepin-Kunowice (fig. 24). The facilities are very well designed and integrated into the environment and their functionality is high – they are a benchmark for railway solutions in Europe.

Practice PL3: Wildlife passages along the A2 motorway, section: Nowy Tomyśl-Świecko

The best wildlife passages have been built up to now along the A2 motorway, section: Nowy Tomyśl-Świecko – 12 in total, in 2011. They were built using corrugated constructions. The passages are placed in appropriate locations and can be considered as good examples in terms of wisely using geometry and surface management (fig. 25).

Practice PL4: Largest wildlife passages over the A4 motorway, section Kraków-Tarnów and the E30 railway line

The largest wildlife crossings in Poland were built over the A4 motorway, section Kraków-Tarnów and the E30 railway line. The passages with a width of at least 80 m are in Poland considered to be really effective in minimizing the barrier impact of the motorways on the ecological corridors of national importance.

Fig. 23 The largest upper crossing at the śląskich expressway - A1 motorway, section: Gliwice-Rybnik in Poland[118]

Fig. 24 In 2007, two upper transitions were created over the E20 railway line in Poland, section: Rzepin-Kunowice[119]

Fig. 25 The best top passages have been built up to now on the A2 motorway, section: Nowy Tomyśl-Świecko[120]

118 http://korytarze.pl
119 http://korytarze.pl
120 http://korytarze.pl

9.4 Romania

Practice RO1: Wildlife passages along the Lugoj-Deva motorway

The first major transport infrastructure project in Romania that incorporated mitigation measures for ensuring connectivity within the landscape is the Lugoj-Deva highway, part of TEN-T corridor V. In the critical sector where the highway intersects a Natura 2000 site designated to ensure the corridor-role for large carnivores at regional level, the original technical project has been improved and includes a system of solutions for allowing the movement and dispersion of these species – tunnels, viaducts, green-bridges (Fig. 26). Three green bridges are being built, 2 tunnels and 3 viaducts are expected to be realised according to the environmental permit. This is the first time in Romania when mitigation measures are considered in the case of transport infrastructure development. All these Green Infrastructure elements are essential for maintaining the ecological connectivity between the Apuseni Mountains and SW Carpathians in Romania.

Fig. 26 The first green bridge ever built in Romania - Lugoj-Deva highway, close to Branișca village © Cristian-Remus Papp

9.5 Serbia

There are no notable best practice examples in Serbia at the moment.

9.6 Slovakia

Beside some prolonged viaducts in the case of some road sections, there are two green bridges existing in Slovakia. The first is near Mengusovce connecting the High and the Low Tatras Mountains. The second one is the so-called ACC (Alps-Carpathians Corridors) near Bratislava which should enhance wildlife movement between Slovakia and the neighbouring country Austria.

Practice SK1: Mengusovce (green bridge)

The building of this green bridge was finalised in 2008. The bridge was accurately planned and realized by the National Motorway Company NDS. The width is 250 m, which enables wildlife to move on it without feeling too much disturbed by the traffic under the construction. According to the legislation, such a wide bridge is already defined as a tunnel and needs special security systems including emergency exit and ventilation. The green bridge was planted with vegetation including with bushes and trees. Nowadays, it looks like a small overgrown opening surrounded by forests. Despite the fact that wildlife did hardly use the construction during the first year, it is nowadays accepted as being fully functional and an important part for the ecological connectivity in the area. The NDS filmed various animal species including big game and large carnivores' species using this bridge. Most impressive images involved daily resting of bears in the thickets and fighting of red deer males during the mating season. This properly functioning green bridge could be a very good example of not only a well working mitigation measure, but also of a successful cooperation of various (sometimes conflicting) institutions.

Fig. 27 Green bridge Mengusovce in Slovakia. GPS: 49.043605, 20.391450 © Google maps, 2018

Practice SK2: ACC (Alpine-Carpathian Corridor)

This project was mainly initiated by WWF Austria and carried out in cooperation with various institutions from Austria and Slovakia (fig. 28). List of project partners included the Slovak University of Technology in Bratislava – SPECTRA Centre of Excellence EU, University of Applied Soil Science, Vienna, National Motorway Company from Slovakia (NDS) and Austrian Road Financing public limited company (ASFINAG), State Nature Conservancy of the Slovak Republic – Záhorie PLA, National Park Donau-Auen (AT), and several NGOs. As one of the results of the project, the green bridge over D2 motorway between Kúty and Malacky was finally finalised in 2016. The vegetation is still not fully grown; however, animal movement was already documented but to a lesser extent. Once the vegetation cover will be more pronounced, wildlife movements will most probably be intensified on the green bridge. This project is definitely a good example showing that even the existing home range barriers can be overcome. Furthermore, this example also shows that animal species which had movement limitations and options in the past will need some time to "re-learn" and use to a greater extent the movement possibilities across the landscape. Slovakia has the interest to keep wildlife habitat permeable as many highways are still in the planning process.

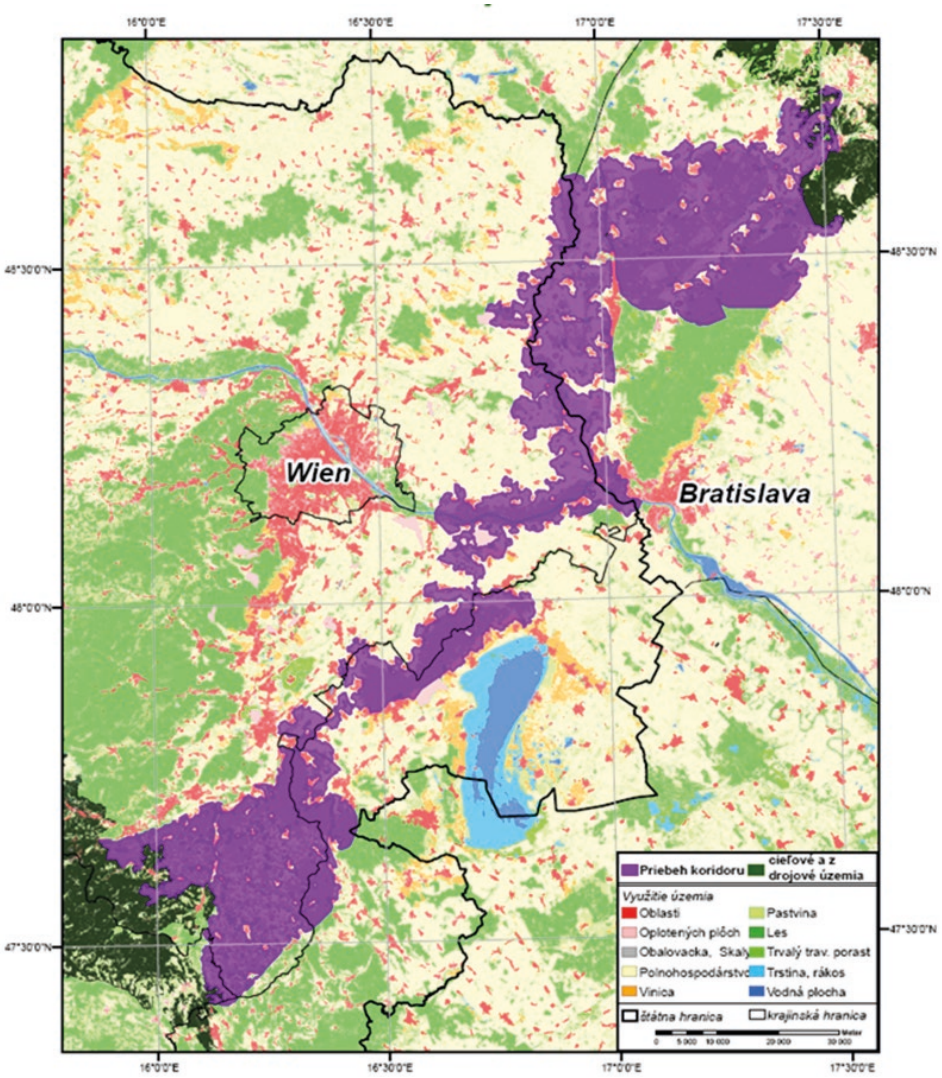


Fig. 28 Routing of Alpine-Carpathian Corridor in the border area of Austria and Slovakia[121].

121 BOKU, 2012

9.7 Ukraine

As of today, there are no particular examples of intentional sustainable transport development in Ukraine. Up to now, some decisions from the past can be considered as being sustainable taking into account that they create conditions for permeability of motorways and railroads. They are related to:

- Bridges over Latorytsya river in the Carpathians (Kiev - Chop) (12 large and medium bridges on the section of approximately 30 km);
- Beskydskiy tunnel and other tunnels in the Carpathians (characteristics, location);
- Numerous culverts and bridges, especially under railroads;
- Narrow-gauge railroads

9.8 Austria

Since Austria is also a participating country in the TRANSGREEN projects, we are providing two good practice examples from this country towards the development of sustainable transport infrastructure.

Practice AT1: Austria's Defragmentation Programme

Austria has a total of about 2,000 km of motorways. Since 1986, it is obligatory to fence them on both sides for traffic safety reasons. Since then, Austrian motorways have formed an impermeable barrier to most of the terrestrial fauna species.

After elaborating studies to localise the main conflict points between green and grey infrastructure (existing motorways) the Ministry for Transport, Innovation and Technology released the Directive "Habitat connectivity" in 2006, which obliged the Motorway company, ASFINAG, to create 20 wildlife crossing structures along the existing motorways in the next 20 years. The locations of these crossing structures have been investigated through several studies and represent the most important crossing points between the motorway and internationally important wildlife corridors.

So far 4 bridges have been built, 5 more will be constructed in the near future. However, about half of the necessary locations face big difficulties either caused by the lack of legal protection of the corridors in spatial plans or by other linear transportation infrastructures very close to the motorways.

Some good practices can be identified in Lower Austria. A main wildlife corridor connecting the Alps with the Czech Republic is intersected – among others – by the A1 West Highway (Fig. 29).

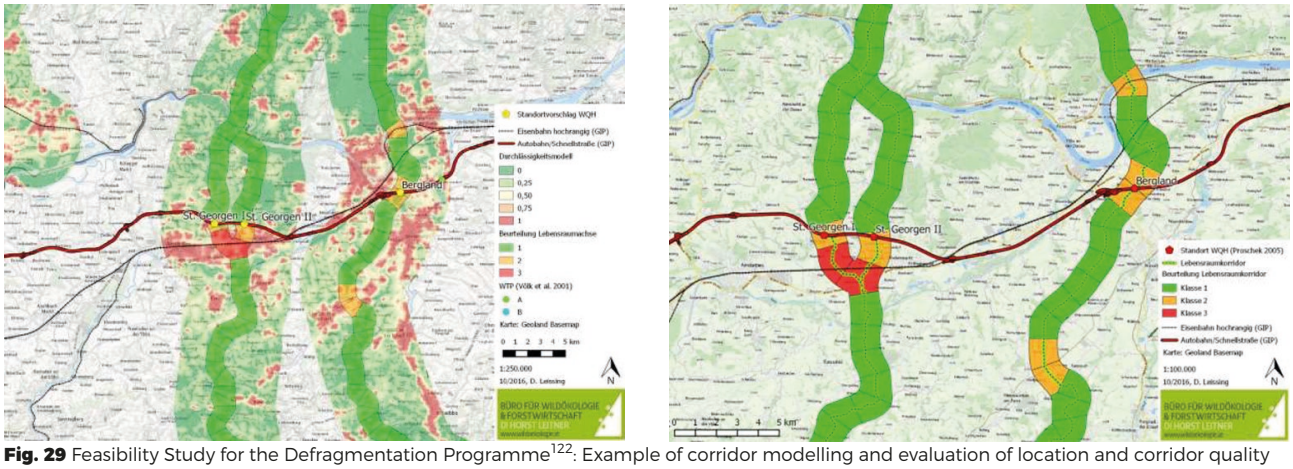


Fig. 29 Feasibility Study for the Defragmentation Programme[122]: Example of corridor modelling and evaluation of location and corridor quality

9

The eastern location shows one example of successful retrofitting of a wildlife crossing over the existing motorway, the green bridge "Bergland" (Fig. 30). It was constructed in 2015 with a width of 60 m and connects two parts of a forest, which was fragmented by the motorway. Unfortunately the corridor has not been protected by spatial planning yet.

Fig. 30 The Greenbridge Bergland. © Fritz Völk

122 Leitner et al, 2016

Practice AT2: Spatial Planning – the crucial tool

The Austrian experience shows that the protection of wildlife corridors by spatial planning is one of the most important and crucial steps. Without the protection of wildlife corridors in spatial or land-use plans, the investments for crossing structures fail their effectiveness in a long term perspective.

In Austria, Spatial Planning is within the competence of the nine counties/provinces, which makes it difficult to set a common standard in the whole country. Some counties have already incorporated wildlife corridors in their regional spatial programs, like Styria or parts of Salzburg (Pinzgau) (Fig. 31). These regional plans are legally binding to all local plans, settlement development and infrastructure planning.

Another tool that starts to incorporate the wildlife corridors now is the so-called Forest Development Plan. These plans show the functions (protection, recreation, social and economic services) and importance of forest areas. Styria has already incorporated the wildlife corridors in their Forest Development Plans (Fig. 32); in the future, hopefully, other counties will continue. It is not legally binding to incorporate them in any planning processes, but nevertheless, they are at least shown and available.

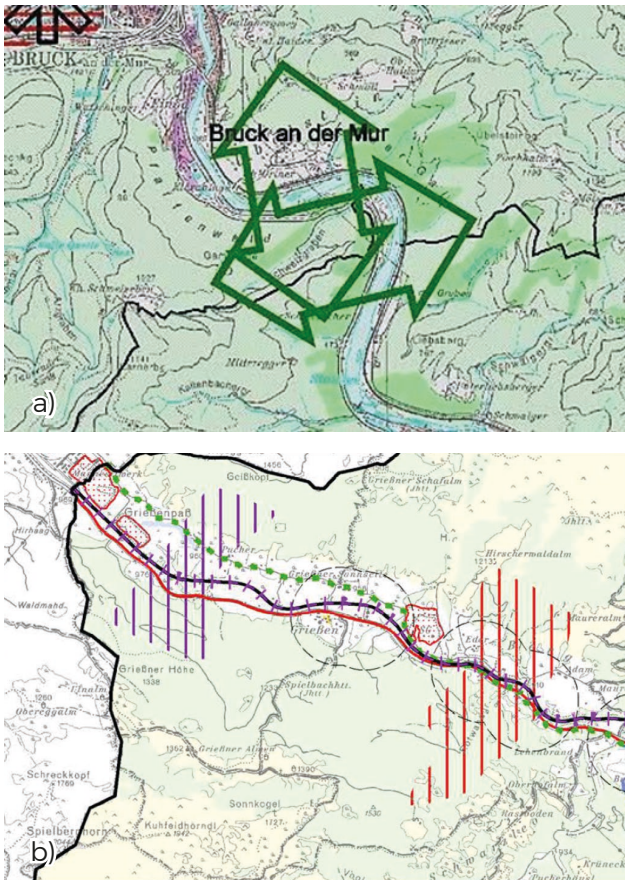


Fig. 31 a). Regional Spatial Programme for the Valley of the Mur, Styria: the green arrows indicate the wildlife corridors; b) Regional Spatial Programme for Pinzgau, Salzburg: red stripes indicate supraregional green-corridors and lilac stripes regional green corridors.

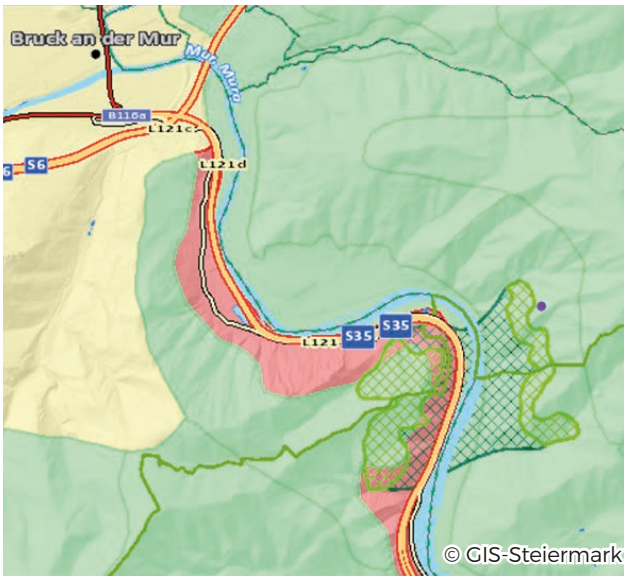
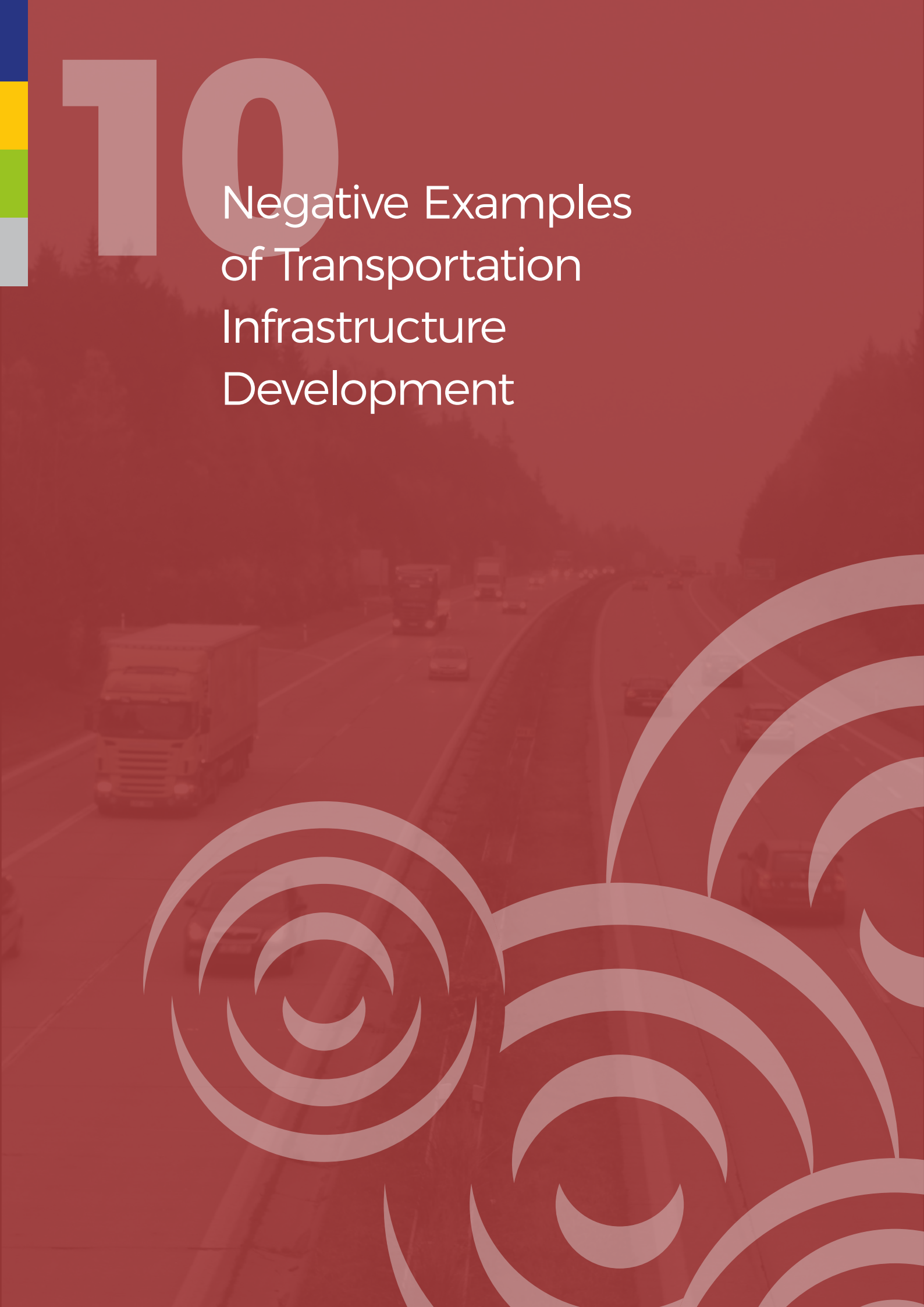


Fig. 32 Forest Development Plan of Styria, Bruck an der Mur: red indicates protection as the main functional priority of the forest, yellow recreation and green no special functional priority; dark and light green cross hatch shows the wildlife corridor (also represented in Fig. 31 a)).

10

Negative Examples of Transportation Infrastructure Development



There are obviously many negative examples concerning the infrastructure development in the Carpathian region and in Europe in general, even if they are not highlighted or properly documented.

10.1 The Czech Republic

Practice CZ1: Ecoducts constructed on road circuit in the city of Prague

Very questionable is the construction of four ecoducts in the newly built southern road circuit (Fig. 33) and two ecoducts that were built on the northern road circuit of Prague (Fig. 34). It is a suburban, very intensively used area with high building activity. No endangered species can be expected to inhabit the area, nor can be expected to migrate or disperse through the road. We can suppose that the adjacent vicinity will be under high pressure from developers and other investors. Extensive camera trapping monitoring has been done on some of the ecoducts that confirmed very low frequency or even absent usage by animals . Thus the efficiency of the invested funds is very low.

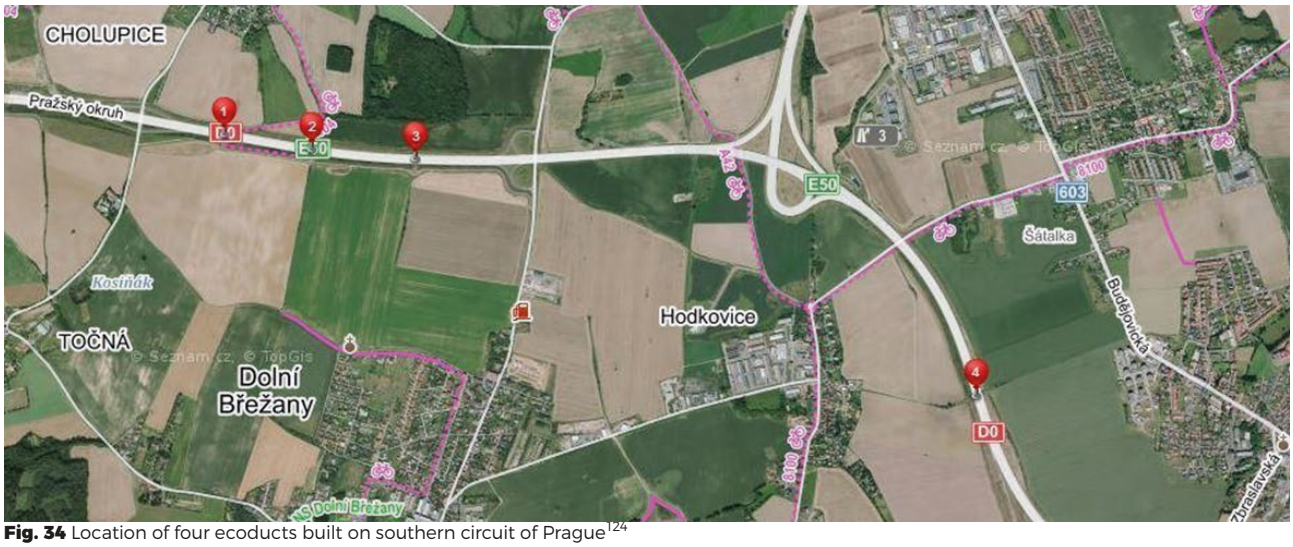


Fig. 34 Location of four ecoducts built on southern circuit of Prague[124]

Fig. 35 Location of two ecoducts built on the northern circuit of Prague[125]

124 www.mapy.cz
125 www.mapy.cz

10.2 Hungary

Hungary has a relatively low number of wildlife passages (40 in total as of 2010) and these passages are not evenly distributed with regards to the main wildlife corridors, which results in unused opportunities[126]. A frequent problem is the maintenance of amphibian underpasses – there is a lack of maintenance. After a heavy rainfall for example, they can be clogged hindering the animals to pass. This is the case for example of Road number 2 near Parassapuszta (Eastern-Hungary at Slovak boarder). Due to poorly designed leading paths, animals tend to avoid overpasses built for mitigating human impact on wildlife in Hungary. Unnatural appearance of these passes often seem repulsive to wildlife. Consequently, overpasses remain idle despite large investments. Another overall problem in Hungary is that during the planning of a new road/motorway, the collected information in some cases is not sufficient to assess the consequences of the project. This is why the TRANSGREEN project is a main support and projects like this can serve as good examples and if implemented well in advance, can give a real hand in planning of motorways for the sake of protecting our natural values.

Practice HU1: Expansion of R67 Road without wildlife overpass

R67 road is a 2x1 lane road. It will be expanded in the near future to a 2x2 lane road. The existing road divides a good quality oak forest. At the current state animals could move between the two forest fragments, although resulting in some road-kills. The future road is going to have a shoulder, a dividing fence in the middle as well as fences, thus there will be no chance for animals to cross (except for the birds). Although there were discussions about it, no wildlife mitigation measures/GI elements will be built. This is due to a lack of fauna assessment and the not so harmonised cooperation with the planner company. Thus, it couldn't be decided what kind of animals move between the two habitats, and what type of wildlife overpass would be needed. Area surrounding GPS: 46°35'16.0"N 17°49'12.3"E.

Practice HU2: Wildlife pass built, but not functioning

Hungary's biggest viaduct is at Kőröshegy on the M7 motorway to the south of Lake Balaton. The necessity of this large viaduct was a topic of many debates, at the end the constructions finished in 2007. It is more than 1,800 meters long and 88 meters high[127]. In the proximity of the viaduct a badly implemented wildlife overpass has been built (Fig. 35). The overpass itself is built on a correct location (leading out from a forest and connecting in a dirt road); nevertheless it is not functioning due to some mistakes/details that were overlooked. Ditches, a double guardrail and some sections are covered in asphalt[128]. Wildlife traces made it visible how the deer turned around.

In another case along the same M7 motorway, an underpass was ended up being too low for most medium-large sized mammals (Fig. 36).

Fig. 35 Poorly implemented wildlife crossing with concrete on M7 Motorway at Kőröshegy in Hungary. GPS: 46°48'58.7"N 17°54'10.1"E [128]

Fig. 36 Poorly implemented, too low wildlife underpass in Hungary[128].

126 http://vadgazdalkodas.emk.nyme.hu/oktatasi_segedletek/Nagyvad/vadatjarok_kialakitasa.pdf
127 http://nol.hu/archivum/archiv-459158-262810
128 http://www.origo.hu/tudomany/20090722-autopalya-monitoring-interju-farkas-janossal-a-vadatjarokrol.html

10.3 Poland

Practice PL1: Poor designing and implementation of GI elements in Poland.

The number, density and parameters of animal crossings differ in many cases from the optimal ones, also in protected areas where the highest protection status can be found, with many priority habitats and species. The functionality of most passages (fig. 37, 38. 39) for large and medium sized animals is significantly limited by their poor management or use of the surrounding area by humans – as a result, GI elements with appropriate locations and sizes are used sometimes only by individual species and do not fulfil landscape functions.

Fig. 38 Underpass for small animals permanently flooded by water [129]

Fig. 37 S-3 expressway Międzyrzecz – Świebodzin. Viaduct for large animals close to Nietoperek in Poland, where the height is limiting the possibilities of the animals to move from one way to another.

Fig. 39 Totally fenced passage in Poland [130]

129 http://korytarze.pl
130 http://korytarze.pl

10.4 Romania

Practice RO1: Poorly planned green bridge over the Lugoj-Deva highway

The lack of an integrated approach in the case of Lugoj-Deva highway where the solution of a green bridge built in Branișca area over the highway does not mitigate the negative effects of the adjacent existing county road 706A (the green-bridge ends in the county road instead of passing it and leading the animals in the existing forest patch that borders the road) (Fig. 40).

Practice RO2: Modernisation of European road E79 between Oradea and Brad

The modernisation of the European road E79 has been done without environmental impact assessment studies; as a result, many permeable sectors within an important ecological connectivity area have been significantly affected. Large carnivores can cross the road in this ecologically important area in a very limited number of locations.

Practice RO3: Highway sector between Sebeș and Sibiu without proper mitigation measures intersecting an ecological corridor for large carnivores

On the motorway A1 in the sector between Sebeș and Sibiu there were 3 bears killed in the autumn of 2018. There were no mitigation measures planned and constructed in the area for large carnivores. The initial studies performed in the area and the environmental impact assessment were poorly performed and they did not identify any ecological corridor for carnivores. As a result, the conflicts between transport and wildlife started to appear (fig. 41). Even though ă the need for defragmentation in the area was recognized, there has been no particular measure taken so far.

Fig. 40 The green bridge near Brănișca which ends in a county road
© Cristian-Remus Papp

Fig. 41 A bear killed on A1 motorway between Sebeș and Sibiu[131]
© Agerpres

10.5 Serbia

There was no information available on negative examples in Serbia.

131 http://www.stiridinvest.ro/urs-lovit-de-o-camioneta-pe-autostrada-sibiu-orastie/

10.6 Slovakia

Practice SK1: Dual-carriageway section R2: Zvolen – Pstruša – Kriváň: 18.23 km

The section Zvolen – Kriváň was step-by-step realized and finalised in 2017. The total budget for the express-road was 315 Mio Euro (Zvolen – Pstruša: 137 Mio Euro; Pstruša – Kriváň: 178 Mio Euro). The section has dramatic negative impacts on the movement of wildlife because of its construction and absence of useful wildlife crossing structures. In general, it can be said that express roads can have a more negative impact on wildlife migration/movement. Roads of this type are allowed to cover the design of the landscape more than a highway. Consequently, fewer viaducts need to be planned for dual carriageways (express roads) than on highways. In case of the mentioned R2 section, the construction is even worse. Nearly the entire section is located on an embankment which creates a complete barrier for the movement of any wildlife species (Fig. 42). Not a single mitigation measure is implemented. The road section isolates the valuable Poľana Mountain range from the south of the country and further from Hungary. Poľana is home to many wildlife species including large ungulates and the three large carnivore species the brown bear, the European wolf, and the European lynx, which all are well represented in terms of numbers. Large carnivores originating in Poľana Mts. used to have the possibility to disperse further to the south of Slovakia and even to Hungary, but nowadays this is no longer possible. Vice versa, genetic exchange between Hungarian and Poľana sub-populations is now blocked alongside this section. Sadly, even if there were attempts to re-connect the area again, the embankment makes the construction of a green-bridge nearly impossible. It is worth to mention that the NGO Carpathian Wildlife Society conducted a 2 year study concerning migration routes of large mammals alongside the 50 km section Zvolen – Pstruša – Kriváň – Lučenec. One output of this study was the English brochure Brown Bear Corridors in Slovakia, 2007[132]. The brochure includes several detailed maps of the section Zvolen – Lučenec with the identified wildlife crossings. Moreover, the results were delivered to the National Motorway Company NDS. However, NGO´s in Slovakia do not have the power to influence decisions and can participate in road planning processes only in the form of consultation. Thus, the results were ignored in the end and the embankment realized. There were wildlife corridors identified alongside the section Zvolen – Kriváň based on 8 involved target species (large ungulates, wild cat, and large predators.). After the building plan of the section R2 with the embankment was published, the National Forest Centre Zvolen under the leadership of Dr. Slavomír Finďo even wrote a petition against the construction to the Ministry of Transport in Bratislava. Unfortunately, the Ministry did not even care to react, indicating a reduced interest in keeping the landscape permeable for wildlife in the future. As a resume, we would seriously insist on implementing mitigation measures for wildlife in the planned section Kriváň – Lučenec. After Kriváň, it is the junction to Bzová which is the last remaining possibility for wildlife of the Poľana Mts. to move to the south and vice versa. We would strongly recommend keeping this place permeable for future wildlife movement by realizing either a long and high (> 7 m) viaduct, or a properly planned green bridge.

Fig. 42 Dual carriage way R2 from the village Pstruša onward. The road is over many kilometres located on an embankment without any mitigation measures for wildlife. Thus, the important mountain range Poľana on the left of the picture is completely isolated from the south of Slovakia (and Hungary). GPS: 48°32'57.9"N 19°19'32.2"E

132 Finďo et al, 2007

Practice SK2: Dual carriageway R4 section Kapušany – State border SK/PL

The planned dual carriageway R4, section Kapušany – State border SK/PL has a very high potential to seriously impede movement/dispersal of brown bears between central and eastern Slovakia (and further to Ukraine). Genetic differences among the two sub-populations have already been proved[133].

Without the implementation of proper mitigation measures on identified bear movement/dispersal routes, the re-connecting of the two sub-populations in Slovakia is nearly impossible (Fig. 43). We strongly recommend intensive wildlife monitoring be started in the field and to have a good cooperation between the National Motorway Company and environmental authorities. The entire section should have a length of 55.1 km[134].

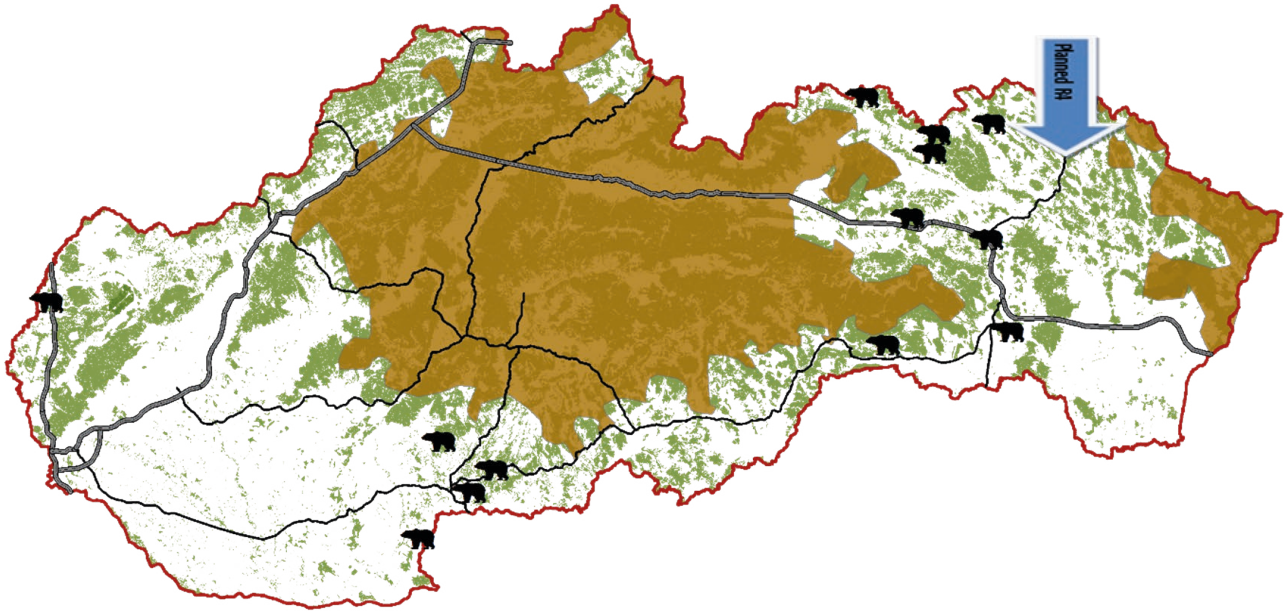


Fig. 43 Brown bear range including single individuals. The planned dual carriageway R4 could seriously hinder genetic exchange between the Eastern and the Central sub-populations[135]

133 Straka et al. 2012
134 www.cesty-ineko.sk
135 Finďo et al. 2014

10.7 Ukraine

Practice UA1: Roads in the detriment of railroads

In the project area, the transport infrastructure development, as of today, is focused on the maintenance and reconstruction of existing road and railroad network. Traffic capacity of main motorways in Zakarpattya is almost exhausted while traffic capacity of railroads for both passenger and freight transportation is underused and can be increased without any serious impact on the environment. Also, it does not require the construction of new railroads, just maintenance and improvement of existing infrastructure and modernization of rail traffic schemes. Narrow-gauge railways played an important role in the passenger traffic in the south and central part of the region. Ukrainian Railways, referring to losses caused by exploitation of narrow-gauge railway network, closed several lines and the last existing line is under the risk of complete closure. At that, the losses are caused by bad management of these railroads, lack of investments into maintenance and modernization of infrastructure, inconvenient passenger traffic schedule, which doesn't allow narrow-gauge railways to compete with buses. An essential part of the profit could be generated by tourists, who expressed huge interest in travelling by narrow-gauge railways, but according to reports from tourism associations, they face serious difficulties even to arrange case-by-case travels, and the railway administration ignores the importance of the establishment of the regular connection.

10.8 Austria

Since Austria is also a participating country in the TRANSGREEN projects, we are providing two negative examples of transport infrastructure development from this country as well.

Practice AT1 Cumulative impact effect of transport infrastructures on wildlife corridors

In the western part of the corridor connecting the Alps with the Czech Republic two crossings, St. Georgen I and II, should be built. But south of the motorway A1 the new high-speed railway line intersects the corridor as well (Fig. 44). The noise protection walls of the railway form an impermeable barrier for wildlife. In this case, the construction of a green-bridge over the highway would only effectively defragment the corridor if the railway company would as well construct measures to make their infrastructure permeable for wildlife again. Strong cooperation from both stakeholders is needed in such cases!

Fig. 44 a) Motorway A1 crossing the wildlife corridor in St. Georgen, OÖ; b) noise protection panels along the high-speed railway in St. Georgen, OÖ[136]

136 Leitner et al, 2016

Practice AT2 – Spatial planning can be badly implemented

A). Especially in mountainous regions the protection of wildlife corridors are crucial, as all infrastructure and settlements gather along the valleys and thereby intersect the mountain habitats and potential wildlife corridors. The Rhein-Valley in Vorarlberg in the western-most part of Austria shows what happens without proper strategic spatial planning. The valley is very densely populated and developed and by now there is no possibility left to connect the Natura 2000 area "Lauteracher Ried" with the hill slopes on the other side of the valley any more (fig. 45). All possibilities for wildlife to cross the valley have been lost.

B). Apart from regional spatial plans – or especially if those do not incorporate wildlife corridors – local spatial plans need to take wildlife corridors into account, especially if mitigation measures have been realised already. An an example of a municipality in Salzburg shows what happens if it is not. A green-bridge was built there over a major road but later the settlement development did not take into account to keep the wildlife corridor and even the bridge itself free from the settlement development (Fig. 46). So by now, the settlement expanded even onto the green-bridge. Houses there have the addresses "Greenbridge No. 1 to 11".

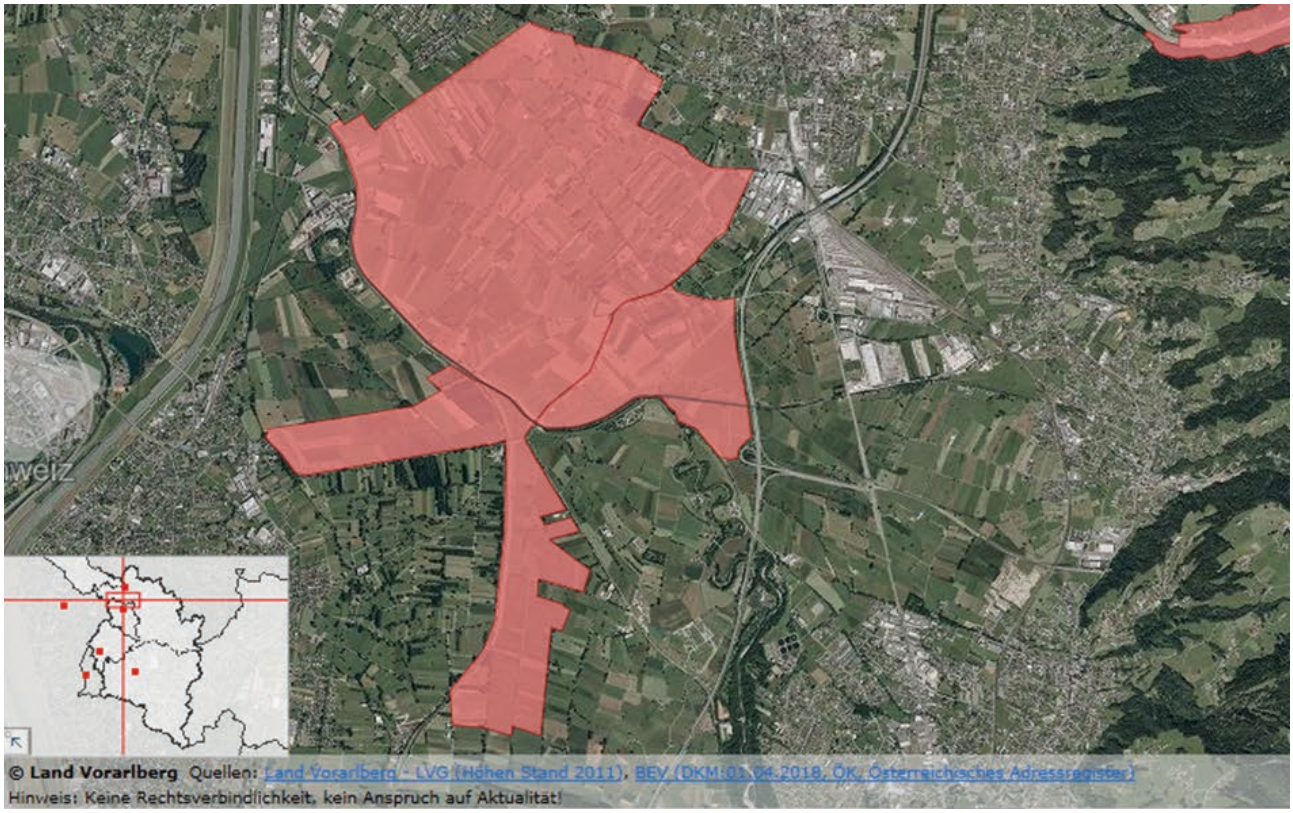


Fig. 45 Vorarlberg, Rheintal: the Natura 2000 site Lauteracher Ried and the hills of the valleys, completely separated by settlements

Fig. 46 Salzburg, Göming: the settlement expanded on the green-bridge

11

Gaps of Available Knowledge, Accessibility and Availability of Biodiversity and Transport Data

Several gaps have been identified during the project implementation, the most important ones being related to:

- There are huge gaps in terms of knowledge availability, but also expertise and experience in properly dealing with the mitigation of negative effects of transport infrastructure projects. This is partly because in some countries at least (e.g. RO) there were no projects before dealing or considering such issues.
- There are gaps in terms of understanding the effects and impacts of linear infrastructure projects. In addition, the calculation and evaluation of cumulative effects is generally done in a very superficial way.
- General Biodiversity related data is available at the EU level through different databases developed by the EC and the European Environmental Agency. However, there are big differences between the national databases. In some countries data is generally scarce, especially in RO and UA. In RO for instance, there is no national biodiversity database publicly available, which might help in identifying potential conflicts with transport infrastructure development in biodiversity rich areas like in protected areas.
- There is a lack of cooperation and open dialogue between many actors involved in the development of grey and green infrastructures. This is a great barrier which should be overcome for the benefit and safety of both humans and animals.
- There is no standard monitoring of the effectiveness of the implemented mitigation measures and already built objects. This leads to the fact that the passage for the animals is realized and no one will evaluate whether it fulfils its purpose. Monitoring of the effectiveness of the implemented measures is standard in many countries and is perceived as a necessary step towards increasing the efficiency of funds spent to ensure the permeability of linear transport infrastructure for animals.
- There is a lack of studies on migration/movement behaviour of wildlife in the Carpathian eco-region. There are no harmonised methodologies to perform large carnivores monitoring, sometimes not even at national levels (e.g. in RO & UA).
- The issue of landscape fragmentation has been underestimated in most of the Carpathian countries for several years. Some studies were performed especially in protected areas; however, that is not enough to avoid landscape fragmentation for mammals with large home ranges.
- Open information on spatial distribution of roads and railways and their categories is generally available from infrastructure managers for all countries, but not necessarily in shape format. However, there is lack of official open spatial data. A good alternative is the Open Street Map project, which of course does not provide detailed or technical information like e.g. GI elements.
- Traffic intensities on roads are usually collected once in five years through detailed traffic census to the level of regional roads. Full data in spatial form are not freely available on-line in any country. Some countries present them in a map form in their respective view application or as exported raster maps (CZ, SK, PL, HU). For RO detailed data are available from CESTRIN[137] only as a paid service.
- Another source of traffic intensities is UNECE's e-Roads census, which only covers major roads included in the European Agreement on Main International Traffic Arteries "AGR" (all countries but UA). There is no intensity data for road traffic in UA at all.
- Regarding traffic intensities on railways there are no open data available anywhere with comprehensive information covering the whole network. Information can only be obtained from infrastructure managers. Intensity for major railways (included in AGC agreement) should be obtained from UNECE's e-Rail census. Data from some European countries are freely available (including SK and HU for 2015 and SK, RS and UA for 2010).

137 https://www.cestrin.ro

- No data were collected within the TRANSGREEN project regarding the level of disturbances from traffic. Information on these effects is generally missing; however, partial information on noise pollution can be obtained from the mapping done by the EU member states to assess exposure to noise from key transport and industrial sources, and made available through two initial reporting phases, 2007 and 2012. This was required by the Environmental Noise Directive (END; 2002/49/EC). This mapping should also cover (besides the other sources) roads with annual traffic exceeding 3 million vehicles and major railway lines with intensity higher than 30,000 trains per year. In some countries, such data is available as raster in internet based viewer applications and not as shape file.

- Information about wildlife mortality on roads is quite well collected in CZ from various sources such as NCA, police accident database, hunters; a common database is available for viewing at www.srazenazver.cz. Partial data collected by the conservation agency are available for certain sections of roads and/or certain species such as brown bear. Other countries (UA, PL) collect road-kills through police but UA data cannot be analysed properly due to the fact that the registration includes both domestic and wild animals. Causalities on railways are also collected by infrastructure managers – CZ, PL. For HU and RO, there is currently no systematic process of road-kill data collecting. However, RO started to test and implement a similar road kill application tool as the one from CZ. For RS this information is not available.

12

Recommendations to Fill in the Gaps

Some of the key recommendations that should be considered are:

- Cooperation among key stakeholders should be widely promoted at national levels. National platforms should be established with key experts from all important fields in order to analyse each transport project and to come up with specific and targeted recommendations and solutions to minimise the impacts of linear infrastructure on biodiversity.
- Proper biodiversity assessments should be included in the very early stages of transport infrastructure planning. Planning is a critical stage which defines the vision, considers strategic options, identifies available resources and sets timetables for implementation. A rigorous planning provides important opportunities to identify potential environmental conflicts and to formulate appropriate measures to avoid their occurrence.
- The problem of habitat fragmentation and movement corridors of wildlife should be more seriously taken into account. The EIA & SEA processes should be carried out in a transparent and systematic way. Proper field assessments should be performed in order to identify all relevant wildlife corridors to avoid future conflicts and potential accidents. The ecological corridors should also be integrated into spatial planning processes.
- There is a need for up to date databases on wildlife, ecological corridors and the mortality caused by road and rail traffic. A standardized methodology of data collection would help in better identification of wildlife movement and identification of ecological corridors. Along with this, availability of GIS data would enable better mapping of temporal and spatial wandering of the animals which could be especially helpful in transboundary development programs. The monitoring data related to wildlife and ecological corridors may be out of date, this is why it is important to have web-based libraries continuously updated with information. CCIBIS can play a key role in this.
- When planning for a project, the selection of alternatives (location and technical solutions) should be a carefully performed and should precede the development and approval of the Feasibility study. The best alternative should be selected through a multi-criteria analysis[138].
- The environmental authorities must ensure high transparency in the decision-making process and should publish all relevant documents associated with the project on its website: presentation memorandums, field investigation reports, reports on environmental impact, appropriate assessment studies, opinions submitted by various stakeholders (managers/custodians of protected natural areas, NGOs, etc.) and experts, regulation drafts and other decisions and final regulations, monitoring reports.
- To increase the involvement of stakeholders, and to benefit from their opinion, it is recommended that the project beneficiary, supported by technical teams (engineers, environmental experts, etc.) create and moderate online platforms that can enable the access to documents and maps, as well as expressing opinions, recommendations, etc.
- Capacity building should be organised for all stakeholders involved in both grey and green infrastructure development. This is key for achieving sustainable infrastructure development.
- It is crucial to have a good cooperation between environmental protection authorities and transport development authorities. Without a close cooperation between these key players it is almost impossible to develop sustainable transportation projects.
- Monitoring of the effectiveness of GI elements is important for improving planning processes and wise use of funds.
- Building trust should also be considered and for this the multi-stakeholder platform mentioned above might be a starting point. The platform should be organised on a regular basis and should also include updates from the members. The GreenWeb Platform[139] for instance can also be a good way to move forward and improve knowledge, share experiences and expertise, seek for common solutions, etc.
- Coordinated cooperation is needed – projects like TRANSGREEN should be developed and implemented and their results should be integrated into spatial planning process, decision making, policy work, etc.

138 Nistorescu et. al, 2016
139 http://green-web.eu/

13 Conclusions

- The Carpathians are home to many large mammal species including the three large carnivore species: the brown bear, the grey wolf, and the Eurasian lynx. The road and railway network is not fully developed in the area, which gives us the chance to implement proper mitigation measures in adequate places to allow wildlife movement across the landscape.
- The issue of wildlife movement and transport has been generally underestimated in the Carpathian region so far. Only a few studies on the impact of traffic on wildlife movement and behaviour have been carried out.
- Landscape fragmentation and the limitation of transport infrastructures' permeability is one of the most serious threats to mammals' movement and dispersal, affecting their genetic viability on long-term.
- The harmonisation of grey and green infrastructure is a long-term and complex process but essential for all well-being. Cooperation between all parties involved in the process is a prerequisite for success.
- There is an urgent need to develop national databases where they are absent, with road and rail kills, but also with biodiversity data in order to be more efficient in the identification of conflicts with wildlife and the selection of proper mitigation measures and locations where they should be implemented.
- Monitoring of both wildlife and transport is important for data collection and understanding and justifying the measures that are required for a sustainable transport network in the Carpathians.
- The lack of officially designated/ recognised ecological corridors is affecting the development and consolidation of the GI network in the Carpathian eco-region.
- A pool of experts and professionals should be developed in all sustainable transport-related fields.
- It is crucial to improve communication, knowledge and data sharing between Environmental, Transport and Spatial planning sectors.
- The TRANSGREEN project gives a very good frame to harmonise grey and grey infrastructure in the Carpathian eco-region and should be continued and replicated in other regions as well.

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Hungary – CEEweb for Biodiversity
Romania – Association "Milvus Group", WWF Romania
Slovakia – National Motorway Company, State Nature Conservancy of the Slovak Republic, SPECTRA – Centre of Excellence of EU – Slovak University of Technology in Bratislava

Associated Strategic Partners

Austria – Ministry for Transport, Innovation and Technology
Czech Republic – Ministry of the Environment
Hungary – National Infrastructure Developing Private Company Ltd.
Poland – Ministry of Infrastructure and Construction
Romania – Ministry of the Environment, Ministry of Transport
Slovenia – Ministry of Infrastructure
Ukraine – Ministry of Ecology and Natural Resources, Transcarpathian Regional State Administration – Department of Ecology and Natural Resources