

GUIDELINES

on How to Use Spatial Planning Tools in
Integrative Management of Ecological Corridors

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Guidelines on How to Use Spatial Planning Tools in Integrative Management of Ecological Corridors

Output 3.2

ConnectGREEN Project “Restoring and managing ecological corridors in mountains as the green infrastructure in the Danube basin”

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List of abbreviations

» AKK	Alpine Carpathian Corridor
» CCA	Connectivity Conservation Area
» CCIBIS	The Carpathian Countries Integrated Biodiversity Information System
» COP6	Sixth Conference of the Parties
» EIA	Environmental Impact Assessment
» EU	The European Union
» EUSDR	The EU Strategy for the Danube Region
» IUCN	International Union for Conservation of Nature
» SEA	Strategic Environmental Assessment
» TEN-G	Trans-European Network for Green Infrastructure
» TEN-T	Trans-European Transport Network
» WCPA	World Commission on Protected Areas

Foreword

The elimination of social and economic disparities in Europe is only possible via balanced social, economic and environmental development, while respecting the need of protection and sustainable development of European cultural and natural heritage.

Carpathian Mountains as an ecological backbone of the Danube Region with their valuable ecosystems and cultural landscape are inherent part of this heritage, representing important part of Europe's green infrastructure and providing the whole spectrum of ecosystem services that in the context of climate change challenge appear crucial for the development of sustainable economies and welfare of inhabitants. The Carpathian Convention creating legal framework for joint transnational approach to the safeguarding and sustainable development of the Carpathian microregion needs to be implemented by multiple coordinated and integrated activities, harmonizing diverse interests in the landscape with the common denominator of protection and sustainable use of outstanding natural capital of Carpathian ecosystems that is composed of fragile ecosystems including very rich diversity of fauna and flora many times confronted with the pressure of rush economic and social development.

Development of settled areas, urban sprawl, construction of the transport and other technical infrastructure, expansion of leisure time activities into the open landscape and other human activities contribute to the fragmentation of valuable landscape ecosystems, destruction of natural habitats of wild animals, and creation of barriers for their migration. Recently, it has become a much more complex problem requiring comprehensive, holistic but at the same time very pragmatic and action-oriented approaches aimed to harmonize the links between protection of wildlife and sustainable use of ecosystems and rush economic and technology development for satisfaction of growing human needs. The fact that the ecosystem services dependent on biodiversity, adaptability and

robustness of natural ecosystems and bring benefits for both the nature and the society needs to be the core of integrated landscape management in all territories, not only in protected areas.

This management needs to integrate the management of natural capital with the management of human development activities, using the whole spectrum of methods and tools, starting with nature based solutions and ending with high technologies in one interlinked system. This publication, as one of important ConnectGREEN Project outputs implemented within the Interreg Danube Transnational Programme, aims to contribute to the outline of such system following the logic Avoidance – Mitigation – Compensation, while underlying the hierarchy from strategic comprehensive planning and decision-making, via designing up to the construction, use and maintenance, not forgetting the phase of up-grading and re-development as important parts of life-cycle of settlement and infrastructural elements.

The academic knowledge here is combined with practical examples of proper methods and tools to address broad spectrum of relevant problems and relevant stakeholders in the process of integrated landscape management and create interlinks between them. The accessibility of the publication in virtual environment allows its interactive use and interlinks it with other relevant sources of information, including the outputs of the above mentioned ConnectGREEN Project and other projects completed by the consortium in previous years.

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Director General

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Introduction



The concept of landscape connectivity is usually interpreted at two conceptual levels: structural and functional. Structural connectivity or landscape connectivity is expressed by properties of spatial landscape structure independently of attributes of organisms and it is explored while applying the Forman's patch-corridor-matrix model. Functional connectivity leans on the concept of metapopulation ecology assuming behavioural response of organisms to varied landscape elements (patches and boundaries).

The maintenance of the landscape connectivity is not real without its acceptance in the spatial planning documents (Valachovič, 2018) and other spatial development management tools, framed by national legislation related to spatial planning. The quality and acceptance of the results derived from

the Methodology for Identification of Ecological Corridors in the Carpathian Countries by Using Large Carnivores as Umbrella Species (ConnectGREEN Project Output 3.1) is crucial to sustain the landscape connectivity and for further development in the management of wildlife/migration corridors in the Carpathians.

The objective of these "Guidelines on how to Use Spatial Planning Tools in Integrative Management of Ecological Corridors", hereafter the "Guidelines", is to **clarify how and where the aspects of the ecosystems' inter-connectivity and wildlife can be supported in the management process of comprehensive spatial/land-use development in ecological corridors.**

IUCN WCPA with other partners introduced a concept of an ecological network for conservation

as a common standard for global monitoring and database management of ecological networks and ecological corridors (Okániková et al., 2021). Hilty et al. (2020) defined the ecological network for conservation as “a system of core habitats (protected areas, other effective area-based conservation measures (OECMs) and other intact natural areas), connected by ecological corridors, which is established, restored as needed and maintained to conserve biological diversity in systems that have been fragmented”.

The Preamble of the Framework Convention on the Protection and Sustainable Development of the Carpathians (Carpathian Convention) demands inter alia ecological coherence, too: “Being aware of the fact that efforts to protect, maintain and sustainably manage the natural resources of the Carpathians cannot be achieved by one country alone and require regional cooperation, and of the added value of transboundary cooperation in achieving ecological coherence”. Another important document in this field is the UNEP Carpathians Environment Outlook (Balteanu et al., 2007). This Outlook brings the comprehensive information about the state and development of the environment in the Carpathian region encompassing seven countries of the Central and South-Eastern Europe (Czech Republic, Slovakia, Poland, Hungary, Ukraine, Romania and Serbia). Apart from an occasion that the project and the resulting materials brought about so far isolated comprehensive and topical information about the state of the environment in the Carpathian region, they represent one of the first steps in implementing the International Carpathian Framework Convention adopted at the 5th Pan-European Conference of the Ministers of the Environment in Kiev in 2003. The material is based on the analysis of the background situation and continues by analysing the socio-economic driving forces of the social development and environmental changes.

These Guidelines aim to contribute to strengthening the capacity of integrative and sectoral planning and designing for safeguarding and supporting the biodiversity of ecosystems, especially ecological connectivity between natural habitats in the Carpathians. The role of spatial planning system, including land-use planning as a dominant integrative planning system in the majority of national states within the Carpathian macro-region, includes legally defined tasks to safeguard the sustainability of spatial development, as it is shown in the analyses of national legal systems in Annex 2.

The planning systems in all countries include crucial responsibilities and instruments for fulfilling this task, including effective protection of biodiversity via optimising the land-use management and preventing the conflicts between different demands on land and nature protection. Efficient use of these instruments and transferability of innovative approaches and instruments seem to be limited by the absence of awareness about them and by the dominance of sectoral policies. This is because the Guidelines try to underline the role of instruments to safeguard the biodiversity and connectivity between natural habitats at strategic and planning level as a crucial point to avoid potential conflicts and manage the existing ones, and secondly to bring the overview of particular technical solutions, which have been broadly covered by the publication “Wildlife and Traffic in the Carpathians - Guidelines to minimize the impact of transport infrastructure development on nature in the Carpathian countries” (Hlaváč et al., 2019) issued as the output of the TRANSGREEN project. Those technical solutions are understood as the tools predominantly linked to eliminating or mitigating negative effects of existing or residual conflicts, it means conflicts which cannot be avoided in the planning phase.

In addition, there is an absence of clearly formulated societal demand and priorities in spatial development, in which a low position of societal interest in biodiversity protection is reflected. This in many cases results in only formal fulfilment of the spatial planning tasks in safeguarding the development sustainability. We need to realise that political decision is what results from the professional planning processes in the end, since the Guidelines operate in synergy with the strategic documents and proposals for political documents/decisions as described in the Chapter 2, 3, and 4.

Chapter 1

HOW TO USE THESE GUIDELINES



The Guidelines aim **(1) to show how to identify the existing or potential conflicts** between the public interests to safeguard and strengthen biodiversity and growing demands on land-use for social and economic development; and **(2) to show how it is possible to use the spatial planning tools** to avoid, minimize or compensate those conflicts within the landscape.

The Guidelines are linked to the Output 3.1. 'Methodology for Identification of Ecological Corridors in the Carpathian Countries by Using Large Carnivores as Umbrella Species' as the ecological corridors create inputs to the Guidelines. The Guidelines, together with the Methodology, are inputs for formulating the International Action Plan on Conservation of Large Carnivores and Ensuring Ecological Connectivity in the Carpathians (ConnectGREEN Project Output 5.1) and the Action Plans for Mitigating Threats to Corridors (ConnectGREEN Project Output 4.2). At the same

time, the Guidelines include spatial planning tools which can be used in the Action Plans.

The Guidelines show possibilities to resolve the conflicts on three levels (avoidance, mitigation, compensation) and they offer a large number of tools listed in order to be implemented in the formulation of the Action Plans.

[Relation to other ConnectGREEN Project deliverables \(see also Figure 1 below\)](#)

These Guidelines, prepared as one of the outputs from the ConnectGREEN project, are interconnected to other deliverables building up on the know-how included in them as some of them provide more detailed information on particular aspects covered by the Guidelines contextually. The Guidelines, representing Output 3.2 of the ConnectGREEN Project were jointly developed by conservationists and spatial planners to find and promote ways to harmonize the interests between nature conservation and different land-use types.

The nature of potential conflicts in the eco-corridor areas is assessed and tackled by the Guidelines. Among other projects' outputs the most important for the Guidelines are as follows:

Output 3.1 Methodology for Identification of Ecological Corridors in the Carpathian Countries by Using Large Carnivores as Umbrella Species

Important output for the Guidelines is the Methodology for Identification of Ecological Corridors in the Carpathian Countries by Using Large Carnivores as Umbrella Species. The Methodology is developed for its use in the macro-region of Carpathians and can be adapted to specific needs of each particular country at local, regional and national level. It has been tested in the pilot sites. The general methodology will be embedded as part of the Strategy into the frame of the Carpathian Convention through its parties.

Output 3.3 Ecological Corridors Database within CCIBIS

An important base for implementing the Guidelines is created by the GIS database related to the identified ecological corridors at pilot sites' as well as national and Carpathian levels. It is going to be incorporated into the existing CCIBIS. This database together with the spatial planning toolkit developed under WP4 is accessible to all stakeholders dealing with ecological corridors' management or spatial planning.

Output 4.1 Ecological Corridors Database for each Pilot Area

The database related to ecological corridors in the pilot areas has been developed additionally to the identification of ecological corridors for the whole Carpathians' area, based on the elaborated Methodology (Output 3.1). The map of identified corridors for each pilot area, integrated

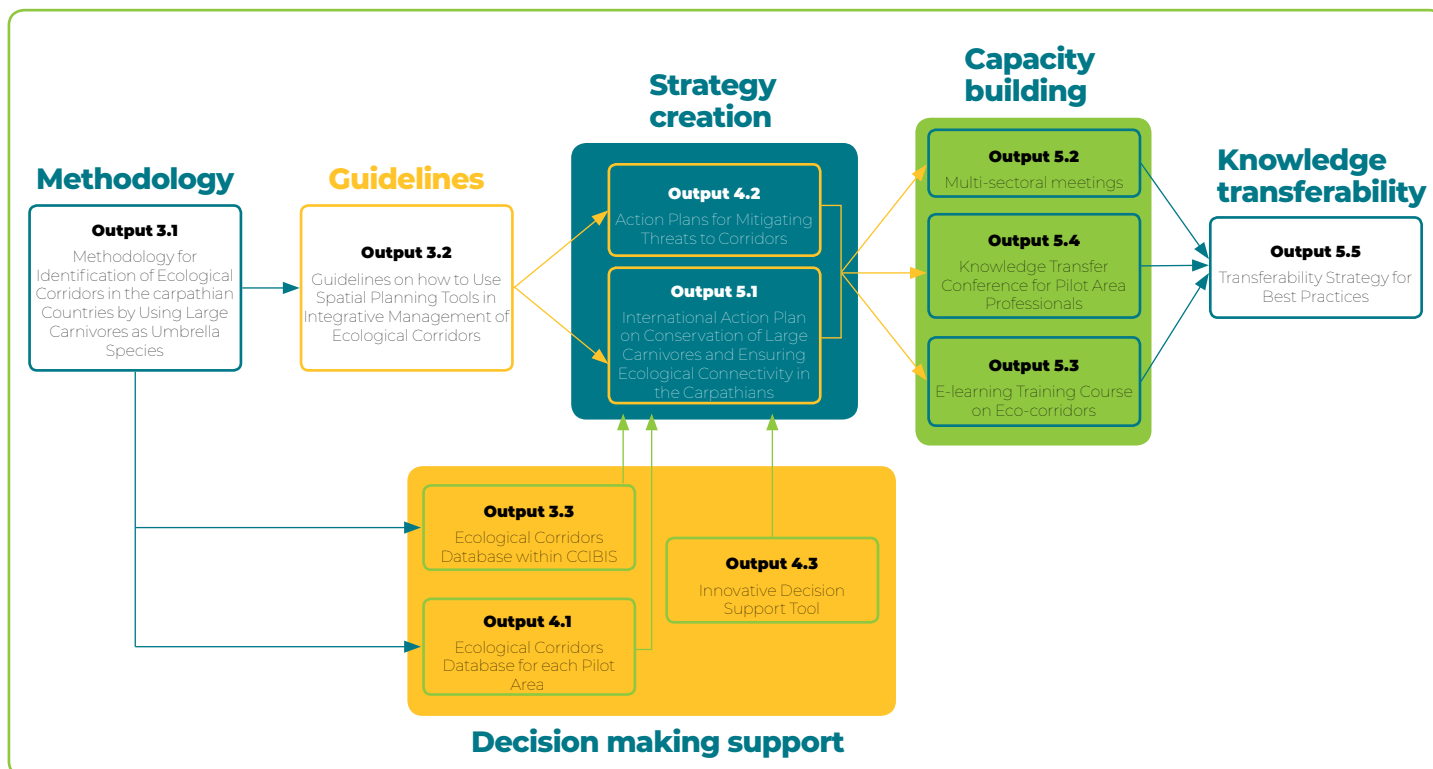


Figure 1: Relation of the material to other ConnectGREEN Project Outputs

into the CCIBIS and related database can serve as a model example for the development of the database and maps in respective countries in the area of Carpathians and used as a source of data in the processes as described in these Guidelines.

Output 4.2 Action Plans for Mitigating Threats to Corridors

Management and restoration measures, defined in a participatory way with the key stakeholders after knowing the location of the corridors, the barriers and threats to them in each pilot area represent a model action plan that can be implemented in order to strengthen the eco-connectivity as a part of planning processes in line with these Guidelines.

Output 4.3 Innovative Decision Support Tool

A Decision Support Tool, developed as a part of ConnectGREEN project, helps the planners and decision makers to ensure that the most appropriate solutions will be taken to safeguard the ecological corridors and solve different conflicts between nature conservation and intended or existing economic development in a systematic way.

Output 5.1 International Action Plan on Conservation of Large Carnivores and Ensuring Ecological Connectivity in the Carpathians

The International Action Plan on Conservation of Large Carnivores and Ensuring Ecological Connectivity in the Carpathians builds upon the results from previous work, on the Carpathian Convention Biodiversity Protocol, its Strategic Action Plan, earlier projects (e.g. BioREGIO, AKK) and the EUSDR, and will provide the strategic guidance document for maintaining and restoring ecological corridors in the Carpathians based on national consultations with professionals and decision makers, which was adopted by the 6th Conference of the Parties to the Carpathian Convention in autumn 2020. This document represents a tool for harmonizing different interests on land-use with biodiversity protection at the national level.

Output 5.3 E-learning Training Course on Eco-corridors

The E-learning training course has been developed for both target groups – spatial planners, nature conservationists and related professionals. The course is focused on identification, management, monitoring of eco-corridors for conservationists and protected areas staff; the other course on integration of eco-corridors in spatial plans dedicated to spatial planners and related professional groups, including authorities. The e-learning course can be used as a supporting tool for planning processes as advised by the Guidelines.

Output 5.5 Transferability Strategy for Best Practices

A strategy for transfer of project results into wider Danube/EU processes includes an action plan to implement common future activities in ecological connectivity, which is important for broader acceptance of the Guidelines. This strategy also involves analysis of new scientific data to support implementation of the EU's TEN-G Initiative with a focus on eco-connectivity between Natura 2000 sites and ecosystem services of corridors.

Chapter 2

MAIN CONFLICTS IN ECOLOGICAL CORRIDORS



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A series of human activities, such as land-use development around the world, are constantly changing the original earth surface, resulting in the loss or occupation of a large number of animal and plant habitats, the fragmentation of natural landscape, and the poor connectivity of patches, which has increased the ecosystem degradation (Gao et al., 2017; Harris, 1984; Zhang et al., 2014; Vasconcelos et al., 2020; Starr et al., 2016). Landscapes in the Carpathians

and across the globe are increasingly human-dominated (Ghoddousi et al., 2020; Tilman et al., 2017). Fragmentation of landscape is a threat to all species (incl. smaller animals), but for large carnivores this is particularly problematic as they are wide-ranging species and require large tracts of suitable and well-connected habitat (Crooks et al., 2011; Ripple et al., 2014). This is worrisome given that large carnivores play a key role in ecosystems (Ripple et al., 2014). Many protected areas create

rather isolated territories, not large enough to host viable carnivore populations, driving large carnivores to seek habitat and dispersal corridors in surrounding landscapes (Crooks et al., 2011; Di Minin et al., 2016). A central approach in this regard is to maintain connectivity between protected areas and habitat patches, commonly through retaining and establishing corridors (Tischendorf and Fahrig, 2000; Kramer-Schadt et al., 2011).

Corridor identification typically focuses on landscape features, such as roads, high elevation, or the inhospitable matrix surrounding habitat patches, which affect structural connectivity (Tischendorf and Fahrig, 2000; Kramer-Schadt et al., 2011) and species occurrence data (Okaníková et al., 2021). However, ecological factors such as predation, competition, and prey availability (Cushman et al., 2010), as well as species' intrinsic characteristics, such as avoidance of unsafe landscapes (Ciuti et al., 2012; LaPoint et al., 2013; Gehr et al., 2017), affect behavioural responses of organisms to landscape structure and thus functional connectivity (Vasudev et al., 2015). Ignoring such ecological and behavioural constraints to dispersal might thus overestimate corridor functionality and undermine conservation efforts (Chetkiewicz et al., 2006; Scharf et al., 2018).

For large carnivores, there are a number of reasons for human-caused mortality, including wildlife-vehicle collisions or poaching (Ripple et al., 2014). During the last decades, the rural areas have rapidly changed in appearance, i.e. depopulation of villages, disappearance of traditional land-use, abandonment of extensively-used agricultural areas, and increased tourism, mining activities and increased occurrence of fences as a new trend appearing in rural areas in particular. All this has had a significant impact on the landscape and its biodiversity, and clever planning is required to avoid, reduce or mitigate the negative impacts, while allowing for desirable development of the rural economies (Zingstra et al., 2009).

The development of ecological networks is primarily based on the Theory of Island Biogeography by McArthur and Wilson (1967) which demonstrated that wildlife populations cannot survive in smaller, fragmented (unconnected) patches and that biodiversity depends on the size, shape and connectivity of the habitats available. The larger, more connected and more robust the habitats are, the more likely it is

for species populations to survive. Hence, it was thanks to this science that designing connected networks of habitats became a new basis for conservation planning.

For Europe, the Carpathians do not only form an important reservoir of large carnivores, but they also play a role in connecting wildlife areas in Eastern, Western and Southern Europe. Over the last century, significant changes occurred in the Carpathians regarding land-use and land cover. In the constantly changing landscape in Carpathians, while farmlands are being abandoned and pastures are encroached by forests in small and local scale, drastic changes in a large scale are taking place influencing ecological connectivity in a non-reversible way (Deodatus et al., 2013):

- » **Privatisation and fragmentation of land (e.g. large scale fencing);**
- » **Developing road infrastructure and urbanisation;**
- » **Unsustainable development of tourism and recreational facilities.**

As a result, the Carpathians tend to turn into a fragmented landscape of isolated forest blocks with little possibilities for animals to move from one to another. In the meantime, many Carpathian countries have established a framework for the development of ecological network, including legislation, spatial planning and policy targets, which led to the consolidation of protected area systems, primarily established in marginal areas with a low human population density. However, since complexes of protected areas are usually separated by zones with high human influence, such as agriculture, settlements and infrastructure, the connectivity between these protected areas has hardly been improved. In many cases, fragmentation continues due to expanding traffic infrastructure, tourism facilities, settlements and other development (Deodatus et al., 2013).

Moreover, the Carpathian Convention in the Art. 8 demands that the protection of migration routes be taken inter alia into consideration: "1. The Parties shall pursue policies of sustainable transport and infrastructure planning and development, which consider the specificities

of the mountain environment, by taking into consideration the protection of sensitive areas, in particular biodiversity-rich areas, migration routes or areas of international importance, the protection of biodiversity and landscapes, and of areas of particular importance to tourism”.

The project 'LIFE Connect Carpathians' has defined the following key threats to biodiversity in the Carpathian region (LIFE Connect Carpathians, 2019):

- » **Fragmentation of landscape;**
- » **Human-wildlife conflicts;**
- » **Conflicting strategies, plans and policies;**
- » **Capacity for landscape scale conservation (human resources, funding);**
- » **Poaching;**
- » **Socio-economic decline;**
- » **Lack of awareness of landscape and values.**

Focusing on the effects of infrastructure and by its development-derived land-use impact on nature, they are typically divided into two groups: primary (directly bound to the construction and further operation of a given piece of infrastructure) and secondary (effects that do not directly fall into the transport sector but are likely induced by it). The basic categories and descriptions are described here, for more information see Luell et al. (2003) and Hlaváč et al. (2019).

There are five main primary ecological effects of infrastructure and land-use change on nature. These include loss of wildlife habitat, habitat fragmentation and barrier effects, fauna traffic mortality, disturbance and pollution. An important fact is that these effects very often interact with one another and the resulting synergistic effects may then have an even stronger negative impact. Additionally, the overall complex of effects is much more cumulative in case of pairing or bundling of infrastructure and land-use change when roads, railways or canals and waterways lie close to each other in a parallel way (Helldin and Jaeger, 2016; Deshaies, 2016; Godart et al., 2016). Therefore, such synergies should always be considered.

Secondary ecological effects of infrastructure on wildlife are represented by changes in land-use, human settlement or industrial development and logistics that originate as a result of new road and railway construction activities. Another important factor is an increased degree of human access and disturbance associated with denser transport infrastructure. As these secondary effects fall under the responsibility of many different sectors, not just the transport one, they should always be carefully considered in SEAs and EIAs. Especially careful planning is then needed in case of sensitive habitats or so far undisturbed wildlife areas, because limiting access of people to valuable wildlife habitats may prove very complicated once infrastructure is built there.

Chapter 3

IMPLEMENTING THE INTERNATIONAL ACTION PLAN **on Conservation of Large Carnivores and Ensuring Ecological Connectivity in the Carpathians and the Action Plan for Mitigating Threats to Corridors**



The Guidelines show possibilities to resolve the conflicts on three levels (avoidance, mitigation, compensation) and they offer a large number of tools listed in order to be implemented in the formulation of action plans.

Summary of International Action Plan on Conservation of Large Carnivores and Ensuring Ecological Connectivity in the Carpathians

The International Action Plan on Conservation of Large Carnivores and Ensuring Ecological Connectivity in the Carpathians provides strategic guidance document for maintaining and restoring ecological corridors in the Carpathians based on national consultations with professionals and decision makers. It represents a tool to harmonize different interests on land-use with biodiversity protection at the national level.

The International Action Plan was adopted at the

Sixth Meeting of the Conference of the Parties to the Framework Convention on the Protection and Sustainable Development of the Carpathians (COP6) in November 2020.

Carpathian Convention in the Art. 4/6 demands inter alia: "The Parties shall take appropriate measures to integrate the objective of conservation and sustainable use of biological and landscape diversity into sectoral policies, such as mountain agriculture, mountain forestry, river basin management, tourism, transport and energy, industry and mining activities".

The engagement of all interested parties is crucial for the success of the International Action Plan, for the successful development, conservation and protection of ecological corridors in the Carpathians, as well as for the reconciliation of spatial planning and nature protection objectives across the Carpathian countries. Therefore, it will be embedded

into the frame of the Carpathian Convention through its parties, setting the basis for the long-term conservation of ecological corridors in the Carpathians and fauna and flora that they harbour.

The Action Plan implementation will be supported by and further contribute to the Carpathian Countries Integrated Biodiversity Information System (CCIBIS), an online platform for collecting and sharing scientific information and data generated in projects within the Carpathian Convention Community. In addition, undertaking activities of the Action Plan might contribute to the further development of CCIBIS by providing additional/updated data and relevant information. At the end of the implementation period, every six years since the adoption of the Action Plan, a report on the goals achieved and actions completed shall be prepared by the Secretariat of the Carpathian Convention, with inputs provided by the Carpathian Convention Working Group on Biodiversity.

Aiming at the maintenance of the long-term viability of large carnivores' populations in the Carpathians, while ensuring their favourable conservation status in the individual countries through transparent national processes, cross-border cooperation and a transdisciplinary approach, the Parties and relevant actors shall undertake the actions grouped under 7 strategic objectives:

Strategic Objective 1: Standardize monitoring procedures of large carnivores in the Carpathians;

Strategic Objective 2: Prevent habitat fragmentation and ensure ecological connectivity in the Carpathians;

Strategic Objective 3: Improve coexistence of humans with large carnivores

Strategic Objective 4: Improve law enforcement with respect to illegal killing of large carnivores;

Strategic Objective 5: Improve communication and cooperation between all relevant stakeholders;

Strategic Objective 6: Strengthen institutional capacity-building; and

Strategic Objective 7: Decrease impacts of climate change on large carnivores and their habitats.

The full text of the International Action Plan can be found on ConnectGREEN project website in the Library section.

Action plans for Mitigating Threats to Corridors

Action plans have been prepared for all four pilot areas of the ConnectGREEN project. They define restoration measures in a participatory way and include location of corridors in each pilot area as well as barriers and threats to them. The objective of the action plans is to strengthen the eco-connectivity in the pilot areas.

Action plans consist of:

1. General descriptive part

- » Landscape fragmentation as a threat for large carnivores;
- » Target species and their situation in the pilot area;
- » Description of main barriers in the pilot area;
- » Methodology of delineation of ecological network for large carnivores;
- » Critical zones – importance for connectivity in the area;
- » Description of the Card of critical zone

2. Cards of critical zones

- » Landscape characteristics;
- » Overall rating of permeability for large mammals;
- » Overall rating of permeability for other mammals;
- » Dispersal barriers;
- » Landscape features important for animal migration;
- » Land-use plans;
- » Field report – animal tracks;

3. Suggested improvement measures

Chapter 4

THE IMPORTANCE OF SPATIAL PLANNING AND LAND-USE MANAGEMENT



The process of spatial development is a permanent process driven by different forces with different intensity, dynamics and extent. It includes natural processes and societal processes in their mutual interactions and synergies. The complexity of these processes is a big challenge for spatial planning and spatial development management.

Natural ecosystems are exposed to multiple stresses, resulting from past and ongoing human activities and their side effects, natural processes of changes as well as continual development of human society closely linked with land-use

changes. The interactions between natural ecosystems and human activities represent a broad scale of direct and indirect influences. These Guidelines are focused on those linked to land-use and its spatial effects.

The most efficient way to avoid or minimize the conflicts and negative effects of human activities on nature and wildlife is to reflect the needs to protect the biodiversity, wildlife and the life preconditions for natural ecosystems, including their connectivity in a proactive approach in each step of spatial/land-use development management, but especially in the planning phase.

The effects of the spatial/land-use development on eco-connectivity and potentials for their minimizing differ depending on:

Spatial organisation, modes, forms and intensity of land-use and linked infrastructure (transport infrastructure, water, energy, waste management infrastructure etc.):

- » Functional use of the land (function, intensity/capacity, functional ties, functional area);
- » Land cover/build-up structures linked to functional use (type, volumes, functional areas, barrier effects);
- » Infrastructural systems serving the area;
- » Functional ties and externalities/external impacts of functional use of particular areas (material and immaterial flows, emissions, etc.).

Landscape contexts:

- » Types and resilience (incl. health conditions) of ecosystems;
- » Species presence;
- » Landscape features, land cover, modes of land-use.

The lists and description of the whole scale of approaches, methods and instruments in these Guidelines are linked to the spatial/land-use development process, including:

- » Mapping the existing and potential mutual interactions, cumulative effects and synergies between different functions and ecosystems in the landscape.
- » Overlapping the 'ecosystems/green infrastructure map' with the 'spatial development/land-use map' which is of special importance to the strategy we have to follow and to see and acknowledge general cumulative and synergic impacts on nature-environment-wildlife, and
- » Decision on the priorities in the hierarchy: Avoidance – Mitigation – Compensation.

At the same time, embedding the approaches, methods and instruments in the phases of the spatial development/land-use management, we can clearly see the necessity of a multidisciplinary

approach and working together, right from the beginning of the planning phase, among politicians, technicians, engineers, planners, economists, landscape designers, geographers, social scientists, environmentalists etc. It also shows clearly the need of active involvement of stakeholders in each phase.

The **spatial development/land-use management process is a permanent process in which the managerial body, using different kinds of interventions into the development processes, running to certain extent independently, tries to optimise the development effects based on:**

- » Reflection to the state of art of the territory;
- » Needs/demands on the land-use and spatial organization;
- » Defined goals and value systems.

Carpathian Convention offers a special Art. 5. to the Spatial planning:

"1. Parties shall pursue policies of spatial planning aimed at the protection and sustainable development of the Carpathians, which shall take into account the specific ecological and socio-economic conditions in the Carpathians and their mountain ecosystems, and provide benefits to the local people. 2. The Parties shall aim at coordinating spatial planning in bordering areas, through developing transboundary and/or regional spatial planning policies and programmes, enhancing and supporting the co-operation between relevant regional and local institutions. 3. In developing spatial planning policies and programmes, particular attention should, inter alia, be paid to: (a) transboundary transport, energy and telecommunications infrastructure and services, (b) conservation and sustainable use of natural resources, (c) coherent town and country planning in border areas, (d) preventing the cross-border impact of pollution, (e) integrated land-use planning, and environmental impact assessments."

Chapter 5

THE ECOSYSTEMS SUSTAINABILITY MANAGEMENT AS A PART OF THE PROCESS OF SPATIAL PLANNING, DEVELOPMENT, LAND-USE AND INFRASTRUCTURE OPERATION

In the context of these Guidelines it can be differentiated between the **two types of demands on managerial interventions:**

- » Demands resulting from the needs to improve the existing situation of natural ecosystems, including improvement of biodiversity (in the context of changes influencing their resilience, current state influenced by the past development and contemporary human activities), and
- » Demands on new land-use and/or spatial organization and connected infrastructure in reflection to social and economic development needs.

In both cases (independently from modifications) the processes of spatial development/land-use management follow common logic of the steps starting with the scoping, via planning, designing and phase of development, operational management and monitoring (Figure 2).

The content of the respective phases has a common base which varies to a certain extent depending on demands motivating managerial intervention.

In respective phases, different tools are used for harmonising different interests on land-use and spatial development with the development and protection of natural ecosystems (biodiversity, ecosystem services, resilience etc.). They are represented by specific planning and decision-making procedures (including processes of public participation), institutional instruments (including legal instruments), analytical and planning work and documentation, technical and environmental solutions. These are described in the other chapters of the Guidelines.

The above mentioned general scheme describing the main phases of the spatial development planning relevant for ecosystem sustainability management contains several important steps/actions/operations, especially relevant to safeguard efficient management of ecosystem sustainability with special focus on ecosystem connectivity as displayed in the overview in the following Figure 3.

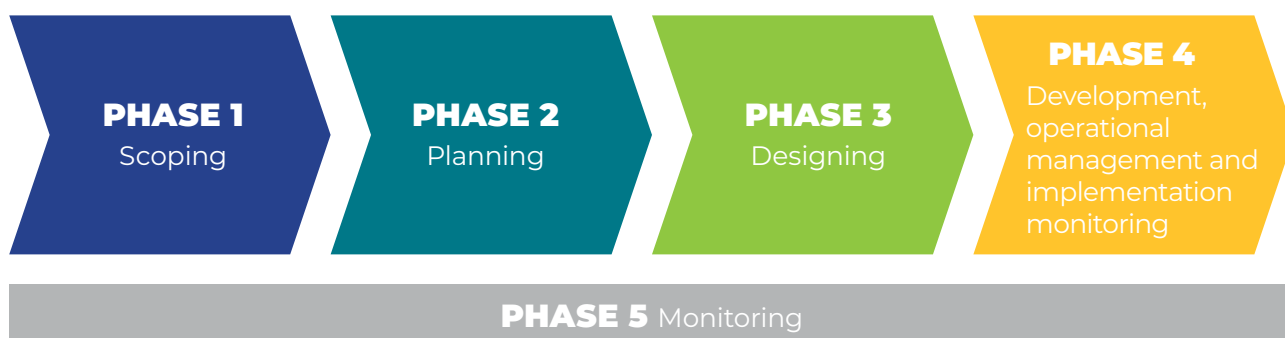


Figure 2: Main phases of the spatial development planning relevant to ecosystem sustainability management

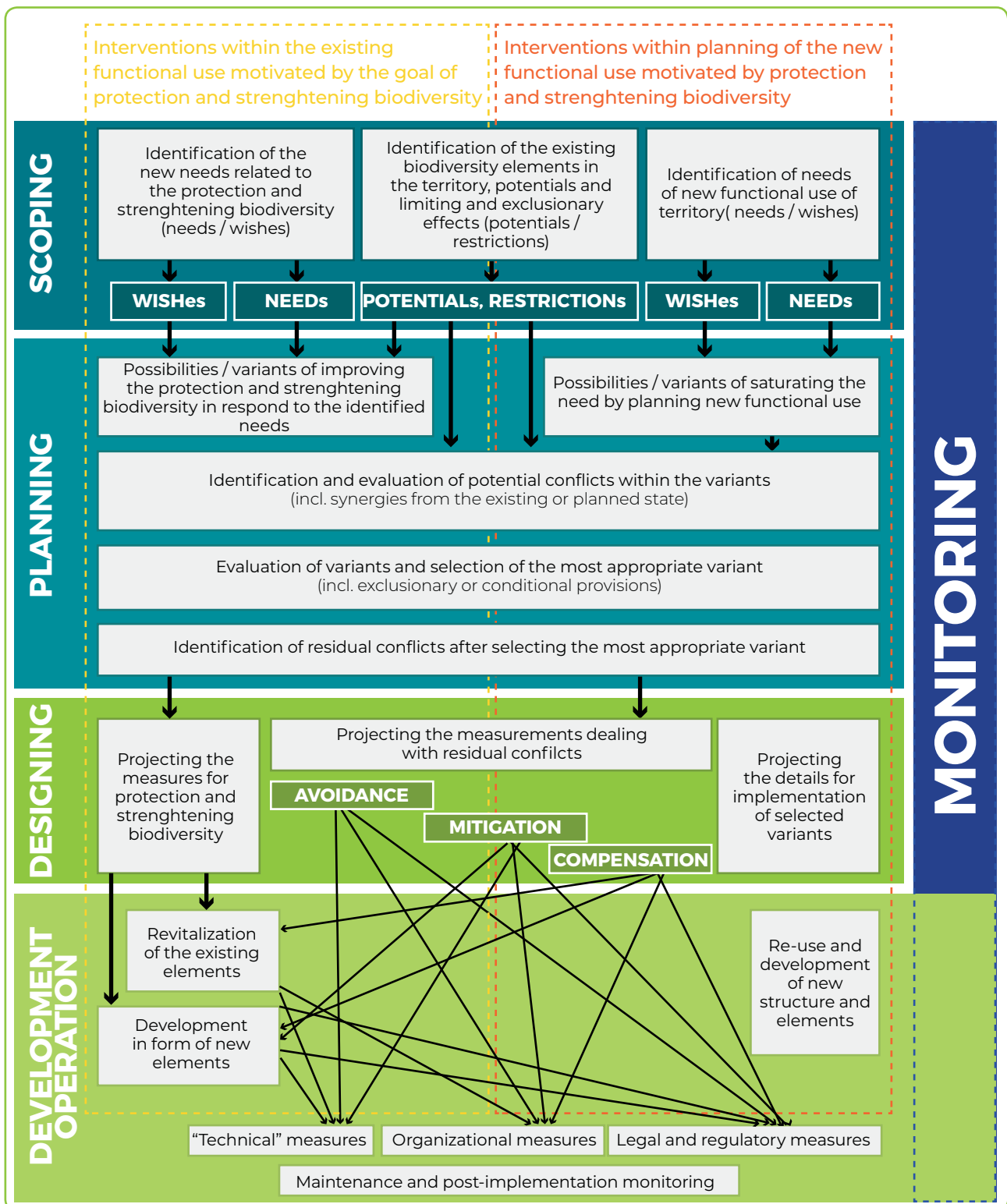


Figure 3: Detailed content of the main phases of the spatial development planning relevant to ecosystem sustainability management

Each step/phase is characterised by:

- » The content of the steps/phase;
- » The problems/challenges to be solved in relation to the wildlife protection in respective phase/step, and
- » Advised approaches to be used in reflection of identified problems/challenges.

Chapter 6

SPATIAL PLANNING PROCESSES
AND TOOLS IN INTEGRATIVE
MANAGEMENT OF ECOLOGICAL
CORRIDORS IN PARTICULAR
PHASES OF SPATIAL PLANNING,
DEVELOPMENT AND LAND-USE



The detailed scheme describing the main phases of the spatial development planning relevant to ecosystem sustainability management and their important steps/actions/operations, especially relevant to safeguard efficient management of ecosystem sustainability

with special focus on ecosystem connectivity, is described in details and interlinks in this chapter divided into the sub-chapters focused on particular phases. The phase of monitoring is going across all phases, although numbering as phase 5.

PHASE 1 Scoping

The content of the scoping phase

This sub-chapter brings an overall description of the scoping phase content and its specifics for the development, in reflection to two different types of demands on managerial interventions (Figure 4).

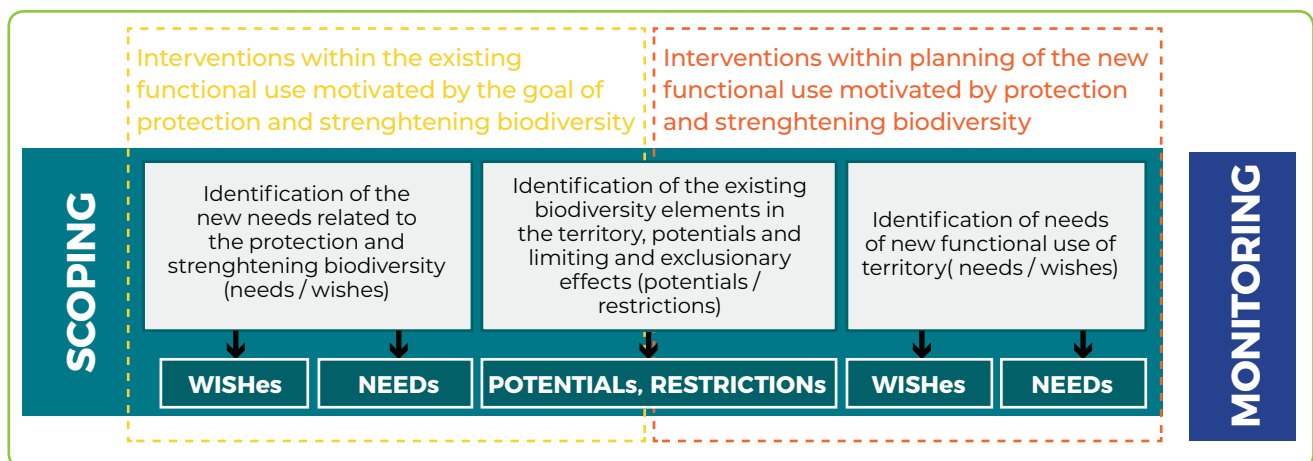


Figure 4. A detailed scheme of the scoping phase

The phase of scoping focuses on answering the questions as follow:

What?

- » What are the needs for improvement and challenges for future development/evolution of natural ecosystems under current land-use/spatial arrangement of the territory?
- » What are the demands on new land-use/spatial organisation resulting from the current and expected social and economic development?
- » What are the potentials, limitations, and restrictions for covering the demands?

Where?

- » Where in the territory are the needs for improvement interventions identified and where are the potentials to cover the demands?

How?

- » How is it possible to cover the demands in the most efficient and sustainable way? (best practice)

The phase of scoping, in the context of above described two types of demands on managerial interventions as described at the beginning of Chapter 6., is focused on:

Identification of existing ecosystems in the territory, their elements, potentials and limitations for their sustainable development

- » Mapping the presence and quality of ecosystems and their elements in the territory;
- » Classification of ecosystems and their quality elements in the territory from the viewpoint of their resilience/vulnerability, performance of ecosystem services, importance/values, based on defined indicators;
- » Identification of the challenges for the development of ecosystems resulting from climate change and other external factors.

The identification of the needs to improve the existing situation of natural ecosystems

- » Identification of the needs to improve ecological status of existing land-use/development (derived from what nature needs) including the increase in biodiversity, strengthening resilience of ecosystems, improvement of bio-connectivity (defragmentation);
- » Identification of the conflicts between the existing land-use/spatial arrangement and sustainability of ecosystems in the territory;
- » Identification of the needs to protect existing ecosystems facing new challenges by new legal, technologic, technical and other measures, and
- » Identification of the potentials for sustainable use of ecosystem services in the territory reflecting the identified demands of society.

The identification of new qualitative and quantitative demands on spatial organization/land-use and related infrastructure in reflection of current or expected needs resulting from social and economic development

- » Realistic identification of current and estimation of future qualitative and quantitative demand on land-use and/or spatial organisation and related infrastructure, mirroring the development in the society and its economy;
- » Assessment of the potential to cover the identified demand by existing capacities of land-use, spatial structures and related infrastructure, including the assessment of the preconditions for their efficient use, identification of the potentials/limitations for sustainable use of ecosystem services in the territory in reflection to identified needs to saturate new demands of society;
- » Threats and conflicts between existing land-use and other interests in the territory, including nature and wildlife conservation and sustainable development;
- » Identification of the potentials/alternatives to cover new demand by new spatial organisation/land-use.

Problems/challenges to be solved in the scoping phase

Description of the key problems/challenges to be solved in the scoping phase in reflection to new demands on land-use and/or spatial organization, motivated by social and economic development needs.

In case of clearly formulated new demands on land-use/spatial organisation and related infrastructure, the scoping phase is crucial to efficiency (economic and societal) and effectiveness of decisions on how to cover these demands. The risks relate to the demand underestimation and the need for additional solutions in the near future.

Description of the key problems/challenges to be solved in the scoping phase in reflection to demands resulting from the needs to improve the existing situation in natural ecosystems

In the scoping phase, the following challenges/problems in relation to the ecosystems' sustainability can be specifically addressed:

- » Resolving conflicts between (existing, demanded) functional land-use or mode of land-use/spatial organisation and ecosystems' sustainability protection;
- » Identification of crucial elements for ecosystems sustainability;
- » Overstepping the carrying capacity of the territory resulting in ecosystem degradation/devastation;
- » Ecosystem degradation or resilience lowering due external factors (e.g. climate change);
- » Functional radiation into surrounding area with ecosystems (e.g. housing activities are radiating from the functional areas with housing into the surrounding areas of urban green or into the landscape creating the so called contact zones)
- » Existing/potential landscape fragmentation;
- » Revitalisation of ecosystems or their parts;
- » Strengthening the resilience of natural ecosystems;

- » Restoring the territorial systems of ecological stability;
- » Land take (transformation of open landscape into build-up areas, including areas of roads and other infrastructure);
- » Drought/floods/water in the landscape with special focus on climate change context of them;
- » Eco-system protection/restoration needs.

To achieve and to protect the balance between different interests in the territory, social, economic and environmental dimensions of sustainability are some of the key tasks of land-use/spatial development management. Requests on managerial interventions can result from the development of each from interlinked subsystems – social, economic as well as environmental. In many cases, the efficiency of interventions focused on the development and protection of natural ecosystems is much higher if they are embedded in the system of land-use/spatial development management or if they have the nature of land-use/spatial development management interventions as a part of a comprehensive management system. In this context, the phase of scoping needs to identify not only the demands resulting from the needs to improve the existing situation of natural ecosystems, but, at the same time, interdependences of possible interventions and a potential of different instruments to safeguard balanced effects of the interventions with regards to environmental, social and economic sustainability.

Advised approaches to be used in the scoping phase

In optimal case, the scoping phase should be an integrated part of permanent monitoring of spatial development (including the ecosystem monitoring) and analytical part of the comprehensive land-use/spatial development management at the transnational, national, regional and local levels. Unlike the past, spatial planning in the 21st century is not a sequential but continual activity based on permanent monitoring, planning and decision making placed on updated information continually

collected by smart monitoring systems and analysed in smart data maintenance and analysis systems. Such systems have to be developed in a comprehensive way and used for all sectors and environmental supervision of the development. This integration allows to follow the development in each particular subsystem (e.g. natural ecosystems), as well as synergy with other subsystems (e.g. social, economic) and ahead of time signalise expectable problems, imbalance or challenges for the development. Such an approach not only allows for contextual monitoring but smart system of in-time warning in case of appearing disturbances, including the identification of the reasons of their appearance.

Moreover, it can activate the potential of comprehensive and specific instruments of land-use/spatial development management (e.g. modelling future demands, extrapolation and other prognostic methods) in combination with specific instruments of nature conservation (e.g. environmental assessment methods, biotope mapping) increasing the efficacy of interventions targeted on improving the sustainability of natural ecosystems in the territory.

In relation to the problems addressed by the scoping phase regarding the ecosystems sustainability, following instruments need to be specifically stated as followed (Table 1).

Challenge / problem	Scoping approaches / methods / instruments
Conflicts between (existing, demanded) functional land-use or mode of land-use/spatial organisation and ecosystem sustainability protection	<ul style="list-style-type: none"> » Mapping/maps » Operational measures in spatial demanding sectors (e.g. speed limits, visibility improvement in transport)
Identification of crucial elements for ecosystem sustainability in the territory	<ul style="list-style-type: none"> » Methodology for identification of ecological corridors in the Carpathian countries using large carnivores as umbrella species » Upgrading the existing critical elements of ecosystems » Mapping/maps » Protected landscape sub-systems and their elements » Eco-connectivity concept (habitat, landscape, ecological) » Concepts of genetic isolation, Habitat fragmentation and land degradation, Ecological and landscape connectivity, Green and Grey Infrastructure » Classification of eco-corridors – identification of ecological migration potential (MPE)
Ecosystem degradation/devastation by overstepping the territory carrying capacity	Assessment and evaluation (incl. methods)
Ecosystem degradation or resilience lowering due to external factors (climate change, exposure to imissions e.g. noise, pollutions etc.)	Assessment and evaluation (incl. methods)
(existing, potential) Functional radiation into surrounding area with ecosystems (existing, potential)	Institute of preserved/protected areas

Landscape connectivity/ fragmentation (existing, potential)	<ul style="list-style-type: none"> » Methodology for identification of ecological corridors in the Carpathian countries using large carnivores as umbrella species » Migration study » Technical barriers (protective barriers to avoid threats) » Classification of critical zones » Mapping/maps » Concept of ecological corridors (wildlife corridors, migration corridors, movement corridors) » Eco-connectivity concept (habitat, landscape, ecological) » Concepts of genetic isolation, Habitat fragmentation and land degradation, Ecological and landscape connectivity, Green and Grey Infrastructure » Assessment and evaluation (incl. Methods) » Classification of roads and motorways by their permeability » Classification of railways by their permeability » Classification of watercourses and other water bodies by their permeability » Classification of non-forest areas by their permeability
Revitalisation of ecosystems or their parts affected negatively by the past development of the territory; strengthening the resilience of natural ecosystems	<ul style="list-style-type: none"> » Green and Grey Infrastructure » Assessment and evaluation (incl. Methods) » Classification of watercourses and other water bodies by their permeability » Classification of non-forest areas by their permeability
Restoring the territorial system of ecological stability negatively affected by the development in surrounding areas	<ul style="list-style-type: none"> » Green and Grey Infrastructure » Assessment and evaluation (incl. Methods) » Classification of watercourses and other water bodies by their permeability » Classification of non-forest areas by their permeability
Land take	Land cover management (e.g. assessment of Earth observation data (such as Copernicus HRL Imperviousness or CLC urban layers), based on comparison of periodic mapping outputs)
Draught/floods/water in the landscape, especially in the context of climate change	Land cover management (e.g. assessment of Earth observation data (such as Copernicus HRL Water and wetness), based on comparison of periodic mapping outputs)

Table 1. Challenges/problems and related approaches/methods/instruments in the scoping phase

There are monitoring and assessment tools of special importance in addition to the approaches and tools addressed traditionally. They provide relevant information about current land-use/spatial development, trends, existing or expectable side effects, including environmental effects, and can be valuable sources in identifying critical points and limits for current land-use and/or spatial organisation and their future changes.

In parallel with the comprehensive monitoring and assessment of land-use/spatial development,

specific attention should be paid to monitoring and assessment of biodiversity elements as the measures targeting the improvement in territory ecosystem sustainability. They have to be neatened/adapted to specific needs of existing biodiversity elements in a given natural environment.

Transfer of best practice solutions and know-how has a special position in the scoping phase, allowing to propose, design and implement efficient interventions.

PHASE 2 Planning

This phase is crucial, aimed at studying potential responses to identified needs, planning alternatives, but most importantly preparing and taking strategic decisions. The logic of the main steps in the planning phase is displayed in Figure 5:

- » Intervention within the existing functional use motivated by the goal of protection and strengthening biodiversity;
- » Intervention within planning of the new functional use motivated by protection and strengthening biodiversity.

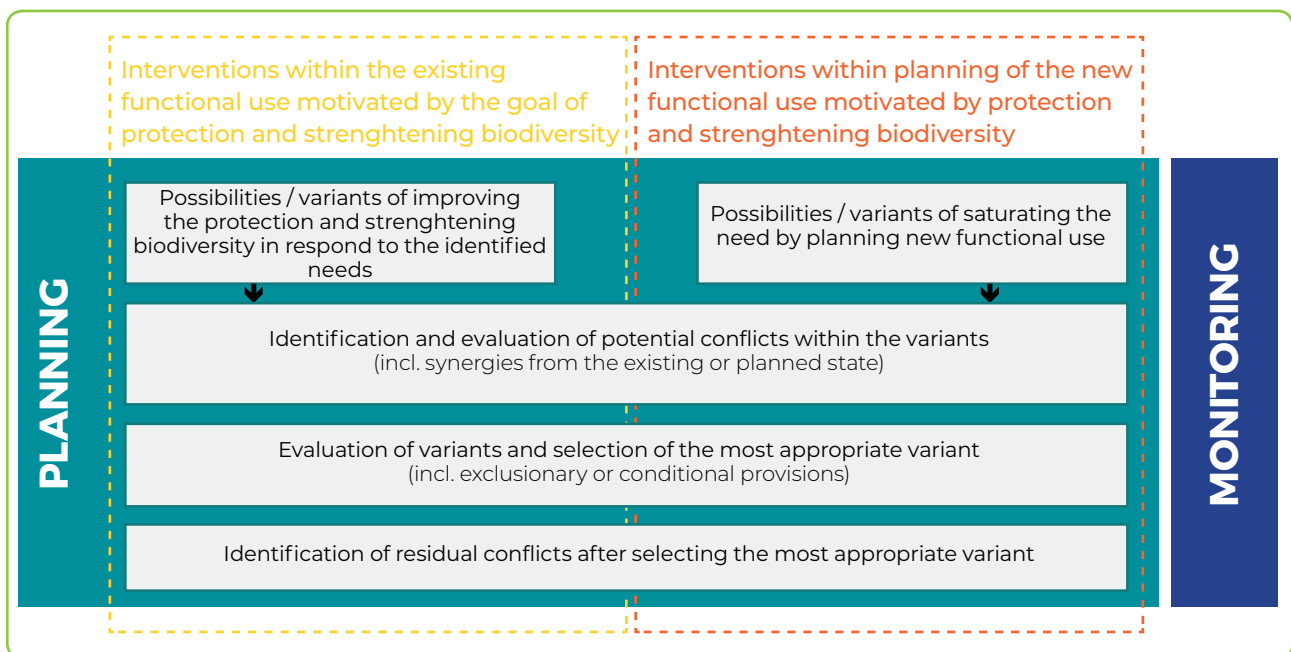


Figure 5: A detailed scheme of the planning phase

The phase of strategic planning is a crucial decision-making phase for the outputs of the following decisions:

What?

- » What are the alternatives/variants of responses to identified demands in the territory?
- » What are the expected conflicts linked to particular alternatives/variants with a special focus on conflicts in land-use/spatial organisation and sustainability of ecosystem?

How?

- » How is it possible to cover the identified demand in the most efficient and sustainable way with minimum conflicts?/ how to avoid conflicts? (which alternative/variant under which conditions)?
- » How to mitigate and compensate for residual conflicts?

Where?

- » Where to locate interventions?
- » Where to locate the mitigation/compensation measures?

Answering these questions, the phase of planning is the most important phase of the whole land-use/spatial development management, especially regarding the ecosystem' development and preservation.

The phase of Planning can be divided into Strategic and Detailed planning as follows:

» **Strategic planning** sets the main goals, principles, parameters for the formulation of alternatives/variants, their assessment and decision on choice from them.

Strategic planning includes:

Strategic sectorial planning (e.g. transport planning, environmental planning)

Although our focus is on comprehensive land-use/spatial development planning, the integration and harmonisation of different sectorial interest and approaches (as the main feature of this planning) builds upon a clear definition of strategic interests, limits and goals of particular sectors expressed in their strategic sectorial planning documents. They deal with the development of specific functional systems at the level of the EU, national states, regions or municipalities, bringing the development perspective from their specific view.

The strategic sectorial planning documents are elaborated as:

- » The bases for land-use/spatial development planning coordinating and harmonising them in the territory (e.g. document on territorial system of ecological stability), or
- » A part of one of the phases after land-use/spatial development planning focused on deepening specific content of its documents (e.g. general plan of green infrastructure).

Strategic comprehensive planning

The main goal of strategic comprehensive planning is the cross-sectorial coordination and harmonisation of different interests in respective territory including the interest in protection and sustainable development of ecosystems. The dominant scale levels for strategic land-use/spatial development planning is municipal (scale approx. 1:5 000/1:10,000) and regional (scale approx. 1:25 000/1:50 000) level

with the links to national and supranational or to the local (district) level (the local level in some countries is the object of building codes. The supranational level is represented in the EU countries by the documents based on shared responsibility of the EU and national states – see Annex 2).

Political support at every territorial level is essential to ensure the connectivity and biodiversity conservation. The experience of stakeholders and business community and their best practices are also important, as they are key stakeholders in many government decisions and can dramatically influence biodiversity conservation practices at multiple levels of governance. Also, the scale at which spatial planning and management is performed is a key factor in assessing the best connectivity.

Strategic comprehensive planning is the platform for coordinating sectorial strategic documents as well. Typical feature of this level of planning is the development of comprehensive strategies and critical decision-making working with alternatives. The comparison of different alternatives based on scoping outputs allows for better understanding of possibilities, limitations and optimal solutions for harmonising different interests. The decision making has a form of adopting the planning documentation (e.g. land-use plan) by territorial governance body (government, regional self-government, and municipal council), framing complex development including new transport corridors. It is like this because it is usually binding for all stakeholders in the Central European planning culture and is of special importance to harmonise nature and wildlife with transport infrastructure development.

Inherent part of the strategic planning (of both sectorial and comprehensive) and strategic decision-making process is a strategic environmental assessment (SEA) of planning documentation, although the outputs of this process is not binding for a decision-making body.

Detailed planning includes the elaboration of detailed structural plans at the level of districts (or local government units, municipalities, cities, part of the cities depending on the planning system in each country) or specialised plans focused on particular development problem or functional subsystem (e.g. revitalisation of urban ecosystems, transport network planning). The scale of detailed planning (approx. 1:2 000) allows to go into detailed planning

with the structure of the plots and include detailed regulations not only for functional use of plots but of physical structures, spaces and buildings, fences and greenery as well.

This represents an important tool to safeguard natural ecosystem sustainability by setting the parameters for the decision about the placement of the investment (e.g. territorial decision) including the definition of exact place of the construction and binding precondition for projecting and construction design. This phase follows the frames defined at the level of strategic planning.

The detailed planning creates the basis for designing, followed by the final decision usually in the form of a building permit. The basis for the building permit process is the documentation for building permit and the binding statements of all relevant representatives of public interest – state bodies, organisations responsible for public infrastructure management, nature conservation, etc.

Problems/challenges to be solved in the planning phase

This phase is the most important for avoiding the conflicts between different interests on land-use/spatial development and, at the same time, for setting the frames to mitigate and compensate for threats and negative effects of the development of a particular functional subsystem in the territory on other subsystems (e.g. of housing or transport on ecosystem and vice-versa).

In this phase, there are two parts of confronted elements for the process of harmonisation defined:

A.

- » The intervention – Change of land-use (quantitative/qualitative)/spatial organisation or construction of the infrastructure in the territory with defined parameters deriving the effects on ecosystems;
- » The ecosystem of the territory which is going to be affected by the intervention with its specific features including its resilience (e.g. by localisation/definition of the corridor of the road or railway).

B.

- » The intervention – strengthening/ development of sustainability of ecosystems in the territory (e.g. revitalisation of wetlands);
- » Functional subsystem in the territory which is going to be affected by the intervention (e.g. a residential area exposed to a high level of mosquito attacks and others).

Typical feature of the strategy development phase and strategic decision-making is the work with alternatives. The comparison of the alternatives allows for better understanding of possibilities, limitations and optimal solutions.

The main challenge for this phase in relation to the improvements of ecosystems sustainability represents the synergies between the improvement measures implemented directly in the territory of ecosystems and organisational, technical and ecological measures in the broader territory interacting with the addressed ecosystems. They can act independently and in synergies influencing the efficiency of the improvement interventions.

In the phase of planning, the following challenges/problems in relation to the ecosystems' sustainability can be especially addressed:

- » Conflicts between (existing, demanded) functional land-use or mode of land-use/spatial organisation and ecosystem sustainability protection;
- » Assessment/comparison of benefits resulting from respective land-use/spatial organisation for particular beneficiaries and their values for society, identification of public interest and cost/benefit balance in relation to particular stakeholders;
- » Ecosystems degradation/devastation by overstepping the carrying capacity of the territory;
- » Ecosystem degradation or resilience lowering due to external factors (climate change, explosion to imissions e.g. noise, pollutions etc.);
- » Functional (existing, potential) radiation into surrounding area with ecosystems;
- » Landscape fragmentation (existing, potential);
- » Revitalisation of ecosystems or their parts affected negatively by the past development of the territory;

- » Restoring the territorial system of ecological stability negatively affected by the development in surrounding areas;
- » Land take;
- » Draught/floods/water in the landscape.

Advised approaches to be used in reflection to identified problems/challenges in the planning phase

The land-use/spatial development is the object of strategic comprehensive planning at the state, regional as well as municipal levels, such as strategic socio-economic plans and programs (e.g. national development strategies, regional development plans) and land-use plans or similar strategic planning

documentation. Especially the land-use/spatial development plans with their supporting documents and parts (e.g. landscape plans, plans of territorial system of ecological stability... see differences among countries in Annex 2) are usually the tools for the crucial harmonisation of different interests in the territory, including the protection and development of ecosystems. The land-use/spatial development plans create a platform for territorial integration of different specialised planning documents, including specific documentation on nature conservation. Ignoring this fact leads to lower authority and efficiency of measures in ecosystem protection being confronted with competitive social and economic priorities.

In relation to the problems addressed by the planning phase regarding the ecosystem's sustainability, the following instruments need to be stated (Table 2):

Challenge / problem	Planning approaches / methods / instruments
Conflicts between (existing, demanded) functional land-use or mode of land-use/spatial organisation and ecosystems' sustainability protection	<p><u>Planning instruments:</u></p> <ul style="list-style-type: none"> » Organisational principles of land-use » Land-use plan (1:5 000 – 1: 10 000) » Spatial development plan (1:50 000) » Landscape plan » Land-use/structural (3D) organisation <p><u>Conservation methods & approaches:</u></p> <ul style="list-style-type: none"> » Legal processes supporting protection » Specific nature protection documentation » Preserved/protected areas » Migration study » Concept of ecosystem services » Areas with land-use limitations
Assessment/comparison of benefits resulting from respective land-use/spatial organisation for particular beneficiaries and their values for society, identification of public interest and cost/benefit balance in relation to particular stakeholders	<ul style="list-style-type: none"> » Assessment and evaluation (incl. methods e.g. the SWOT analysis) » Legal processes supporting protection » Subsidies, payments for owners' limitation due to public interest
Ecosystems degradation/ devastation by overstepping carrying capacity of the territory	<ul style="list-style-type: none"> » Areas with the land-use limitations » Restrictions/penalties

<p>Ecosystem degradation or resilience lowering due externalities (climate change, explosion to the imissions e.g. noise, pollutions etc.)</p>	<ul style="list-style-type: none"> » Areas with the land-use limitations » Change in land-use » Land-use plan (1:5 000 – 1:10 000) » Spatial development plan (1:50 000) » Landscape plan » Eco-barriers » Landscape vegetation adjustments » Change of the mode of agricultural land-use » Splitting large plots of arable land by planting lanes of vegetation » Noise/Visual/Light barriers (e.g. walls, embankments) » Upgrading existing critical elements of ecosystems
<p>(Existing, potential) functional radiation into surrounding area with ecosystems</p>	<ul style="list-style-type: none"> » Land-use plan (1:5 000 – 1:10 000) » Spatial development plan (1:50 000) » Areas with the land-use limitations » Change in land-use » Eco-barriers
<p>Landscape connectivity/fragmentation (existing, potential)</p>	<ul style="list-style-type: none"> » Land-use plan (1:5 000 – 1:10 000) » Landscape plan » Eco-connectivity concept (habitat, landscape, ecological) » Bridges, tunnels, underpasses » Fauna Passages » Placement of a spare/replacement habitat » Removing of fences and other barriers » Protected landscape sub-systems and their elements » Areas with the land-use limitations » Change in land-use » Landscape vegetation adjustments » Upgrading existing critical elements of ecosystems » Landscape water regime management
<p>Restoring the territorial system of ecological stability negatively affected by the development in surrounding areas</p>	<ul style="list-style-type: none"> » Land-use plan (1:5 000 – 1:10 000) » Spatial development plan (1:50 000) » Landscape plan » Eco-connectivity concept (habitat, landscape, ecological) » Green infrastructure plan
<p>Land take</p>	<ul style="list-style-type: none"> » Land-use plan (1:5 000 – 1:10 000) » Spatial development plan (1:50 000) » Brownfields re-use, » Compact city concepts, green city concepts, eco-city concepts » Organisational principles of land-use » Restrictive financial land-use instruments

Draught/floods/water in the landscape, with special focus on climate change contexts	<ul style="list-style-type: none"> » Organisational principles of land-use » Catchment area plans » Land cover management » Areas with the land-use limitations » Landscape water regime management » Water course management » Fences and barriers, dykes (e.g. for amphibians)
Eco-system protection need	<ul style="list-style-type: none"> » Preserved/protected area » Land-use/spatial planning law act » Nature conservation law acts

Table 2. Challenges/problems and related approaches/methods/instruments in the planning phase

While executing one of the main tasks of land-use/spatial development planning (harmonisation of different interests of different stakeholders and decision on most efficient, sustainable and conflict-less land-use), there appears the problem of comparison of different kinds of benefits linked to different land-use. The use of the **concept of ecosystem services** can be advised as a response to this problem, including the **methods for ecosystem services assessment**.

Based on the EU directive these strategic development documents are the objects of strategic environmental assessment (SEA) on strategic documents. The main outputs from the SEA process, which includes the first phase of public participation in the decision-making process, these areas follow:

- » Transparent identification of expected positive and negative effects, threats, conflicts, risks, benefits, beneficiaries and users in the context of the proposed development activities or land-use changes;
- » Advice/decision about acceptability of the activities, changes, choice of alternatives of the activities (obligation to assess alternatives in SEA process), and

- » Definition of the preconditions to accept the activities under a chosen alternative, e.g. required parameters or changes of the parameters of the land-use, spatial organisation and related infrastructure and technologies and algorithm to implement the plans (incl. timing, location, measures for avoidance, mitigation and compensation of negative effects of the construction and operation of the road as well as monitoring, incl. indicators) framing strategic decision.

The output of the SEA process has the form of the final statement of the SEA authority orienting the developer and responsible body for approval of proposed planning documentation and subsequently issuing the territorial and building permit in the process of detailed projecting and decision-making. Definition of the parameters reflecting the needs to protect and develop ecosystem sustainability already in this phase is crucial. They should be important inputs for the phase of projecting.

Monitoring included in the SEA using specific indicators for environmental supervising of impacts on biodiversity, ecological connectivity and green infrastructure has to be implemented in the practice.

PHASE 3 Designing

The content of the projecting phase

The line between planning and designing phases is fuzzy. The phase of designing is a continual extension of the planning phase focused on detailed elaboration of interventions after deciding upon the choice of optimal alternative/variant on how to respond to the demands/needs identified in the scoping phase. The detailed designs/projects are elaborated especially with regards to:

- » Particular measures for protection and strengthening sustainability of ecosystems under the given land-use/spatial organisation arrangements;
- » Particular measures for protection and strengthening sustainability of ecosystems implemented as a part of new land-use/spatial organisation arrangements fixed in new land-use/spatial planning documentations and especially those required in the outputs from the SEA process;
- » Particular solutions for avoidance, mitigation or compensation of residual conflicts after deciding on the choice of optimal alternative/variant of new land-use/spatial development fixed in new land-use/spatial planning documentations and especially those, required in the outputs from the SEA process.

The detailed structure of particular steps/operations included in the phase of designing brings following Figure 6.

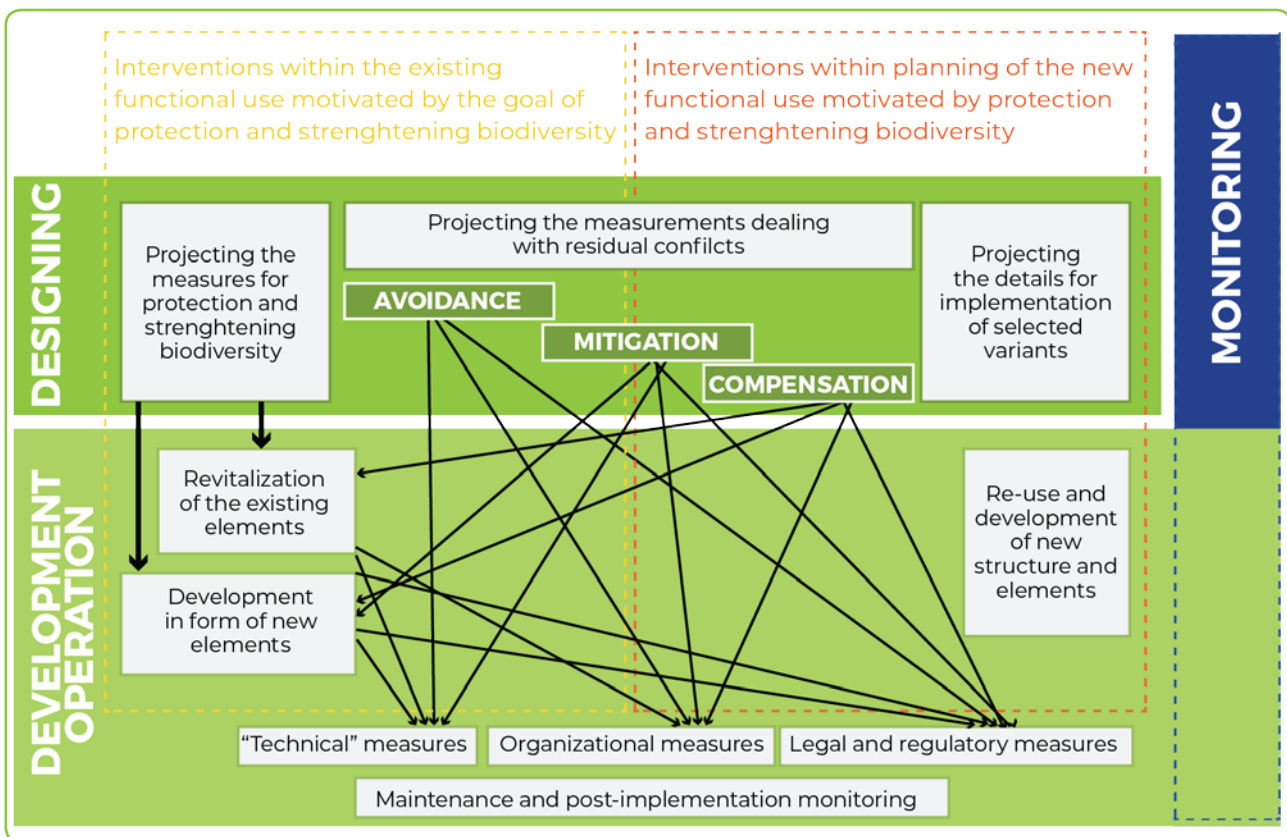


Figure 6: Detailed scheme of the designing phase

The phase of designing focuses on answering the questions as follows:

What?

- » What particular interventions are needed to avoid/mitigate/compensate for residual conflicts linked with the implementation of the chosen alternative/variant of the response to identified demands/needs?
- » What resources are necessary to be activated in order to implement the proposed interventions?

How?

- » How should the proposed interventions, their timing, extend, content, technologies, preconditions be implemented?
- » How should the proposed interventions be combined so as to achieve the expected effects and their synergy?

Who?

- » Who will be responsible, collaborating, affected by the implementation of the proposed particular interventions?
- » Who will coordinate the implementation process?

Where?

- » Where should the proposed interventions be implemented?

This phase builds on

- » Previous planning phase including the analytical work;
- » Strategic environmental assessment (SEA);
- » Basic requirements resulting from the strategic phase of decision-making;
- » Detailed data on the technologies and resources available; and
- » Detailed data on environment of implementation;
- » Detailed data on habitats, species presence with habitats use and ecological corridors

Based on the defined and in-detail identified problems, threats and challenges, the proper solutions at the level of projecting and construction design are proposed and elaborated. The output of this phase is detailed documentation on particular interventions, which is the basis for their permission and realisation/implementation.

Vital data from the monitoring before the procurement phase are necessary to evaluate in order to avoid additional changes in the contract, following the need to minimize the environmental impacts and the ecological connectivity and to determine the design details of the mitigation measures in space and size.

Inherent part of the projecting and construction design phase is a process of the environmental impact assessment (EIA). The EIA process is usually linked to the previous strategic environmental assessment (SEA) process in which the preferred approach concerning the ecological aspects is AVOIDANCE at strategic level¹. The assessed variants are compared in a cost-benefit-analysis evaluating technical, environmental and financial aspects. The result is a decision for the overall best option.

The main objective in choosing between multiple variants is to avoid the maximum amount of obstacles between development and interest of ecosystems protection at the level of detailed design.

The EIA process includes the second phase of public participation. The challenge of public participation is increased by multiple addressing of the public on the one hand, regarding the same topic in different permission and assessment processes that are improperly harmonised, and by the problems of objectivity and justice on the other hand.

The output of the EIA process has the form of the final statement of the EIA authority. This statement focuses on setting the preconditions for following designing, construction, in-use setting and operation and maintenance. In the countries where the EIA process and permission process in accordance with the Building code are not integrated like in Austria, Slovakia or Czech Republic, the final statement of the EIA authority is binding for the developer and responsible body for issuing the permit. Concerning the ecological aspects, the most emphasis is on AVOIDANCE and MITIGATION.

1 - In General, Avoidance is the basic choice in SEA and mitigation in the main already choice for EIA. In the strategic level (SEA) it is large scale Avoidance (to not touch a N2000) but also in the optimization of the final alignment (EIA) small scale avoidance is possible and necessary. In the EIA it is then mitigation and compensation.

SEA and EIA processes include as inherent part the public participation processes using different methods and tools.

The phase of projecting and construction design ends with the process of permission mouting into the issuing the permit (e.g. building permit) document by a responsible authority. In accordance with the building code, a similar law, or a specific law (e.g. on railways) it includes detailed preconditions for the construction of the infrastructure and it has to unify the statements of all responsible sectoral bodies including the nature protection, water protection and management etc.

Problems/challenges to be solved in the phase of designing

The phase of projecting is crucial in identifying the optimal solutions to the problems which could not be solved or identified at the strategic level of planning. The existence of strategic decision already made actually limits the scale of available instruments of interventions and/or dominant measures focused on avoiding, mitigating and compensating negative effects of new land-use/spatial organisation arrangement and related infrastructure.

In the phase of designing/projecting, the following challenges/problems can be especially addressed regarding the ecosystem sustainability:

- » Cuttings and embankments;
- » Climate change, draught/floods/water in the landscape;
- » Constructional devastations;
- » Residual functional conflicts, (conflicts still present in the landscape after/in spite of introducing the measures proposed in the phase of planning);
- » Habitat deterioration;
- » Minimizing the impacts of natural ecosystems on land-use and vice-versa;
- » Improvement of ecosystem resilience and strengthening the robustness and adaptability of ecosystems.

Enhancement of habitat improvements/completion of territorial system of ecological stability.

The coherence of the implemented land-use/spatial organisation arrangements and designs of proposed interventions with the preconditions defined in the strategic phase including the statement of the SEA authority needs to be assessed in the designing phase, including the compliance with the current legal requirements, technical requirements and other requirements of the relevant public body and public interests. The final phase of projecting has to react to the conditions established by the EIA.

The relevance of SEA is based on:

- » The extent and character of the intervention focused on protection and strengthening the sustainability of ecosystems and
- » The given land-use/spatial organisation arrangements.

In case the SEA is not introduced, the dominant instrument for safeguarding the environmental dimension in the decision-making is the process of environmental impact assessment (EIA) linked to the phase of designing. It is necessary to stress that the EIA process has to deal with the detailed assessment of the proposed changes and interventions into the ecosystems.

The challenge for the designing phase represents the required synergy among technical, organisational and managerial measures implemented within the territory and its surrounding area, especially in the context of safeguarding/revitalising eco-connectivity in the landscape.

Advised approaches to be used in reflection to identified problems/challenges

The character of the designing phase determines the need to combine integrative approaches focused on synergy effects with specific targeted approaches focused on the development of specific solutions in response to specific problems. Above all the potentially merged planning and projecting phases in case of ecosystem sustainability improvement under the existing land-use/spatial development arrangements require broader

integrative approach in designing – it means the shift from particular measures and tools towards their systems, taking into account the road line itself as well as broader landscape.

Integrative approach should be leading in assessing available tools and adapting them to the specific conditions of respective environment of the territory. They have to be effective as well as efficient, not only economically, but from the viewpoint of the objective – better protection and sustainability of ecosystems. This cannot be achieved without targeting synergies between particular tools and measures. The transfer of best practice seems to be the preferred efficient approach, but the innovative unique solutions need

to be implemented, especially in response to new challenges and specific situations. The nature closed solutions are in many cases much more efficient than the technical and technological solutions.

It is important to stress the participative approaches framing the involvement of broad scale of stakeholders, starting with the professionals, via citizens up to the representatives of decision-making bodies and entrepreneurs.

In relation to the problems addressed by the designing phase regarding the ecosystem sustainability, the following instruments need to be stated (Table 3):

Challenge / problem	Designing approaches / methods / instruments
Climate change, draught/ floods/water in the landscape	<ul style="list-style-type: none"> » Water courses management » Landscape water regime management » Green roofs, green walls » Organisational principles of land-use
Constructional devastations	Construction design, proper selection of construction materials and technologies
Residual functional conflicts	<ul style="list-style-type: none"> » Fauna passages » Fences and barriers, dykes (e.g. for amphibians) » Noise/Visual/Light barriers (e.g. walls, embankments) » Urban vegetation adjustments » Operational measures in the transport (e.g. speed limits, visibility improvement) » Areas with land-use limitations » Migration study » Project of protective measures
Habitat deterioration	<ul style="list-style-type: none"> » Enhancement of the habitat quality (such as reducing grazing pressure, raising the water table, reduction of dust, noise, etc.) » Upgrading existing critical elements of ecosystems Removing of fences and other barriers » Renaturation of the stream (meanders), green boundaries » Upgrading existing critical elements of ecosystems » Ensuring open dumping sites and material ditches
Lowering the impacts of natural ecosystems on land-use and vice-versa	<ul style="list-style-type: none"> » Stabilization of slopes to prevent sliding » protection of soil on slopes from water erosion

Improvement of ecosystem resilience and strengthening the robustness and adaptability of ecosystems (incl. habitat enhancement Improvements/ completion of territorial system of ecological stability)

- » Landscape vegetation adjustments
- » Noise/Visual/Light barriers (e.g. walls, embankments)
- » Protected landscape sub-systems and their elements
- » Upgrading existing critical elements of ecosystems
- » Placement of a spare/replacement habitat
- » Areas with the land-use limitations
- » Legal processes supporting protection
- » Change of the mode of agricultural land-use
- » Splitting large plots of arable land by planting lanes of vegetation
- » New natural guiding vegetation for the planned eco-duct
- » Fauna Passages
- » Operational measures in the transport (e.g. speed limits, visibility improvement)

Table 3. Challenges/problems and related approaches/methods/instruments in the designing phase

PHASE 4 Development, operational management and implementation monitoring

The content of the development, operational management and implementation monitoring phase.

The phase of development, operational management and monitoring represents the process in which the approved land-use/spatial development planning documents are implemented via technical, legal, organisational measures, projects and construction and similar works, including the revitalisation of existing or realisation of new elements of ecosystems. The implementation follows the documentation elaborated in the phase of planning and designing including the avoiding, mitigating and/or compensating measures as defined in the permissions. For the development realised by the construction and similar works defined temporal measures adequate to the connected environmental risks should be followed in the implementation phase.

Important part of this phase is the ecological site surveillance - monitoring of the construction and similar work and its effects including environmental effects and adjustment of the construction in harmony of the outputs from the monitoring. If the development has got the form of construction work, in-use taking decision is needed before taking the built work into operation. Inherent part of operational management is monitoring of the effects, assessment of efficacy and efficiency of implemented land-use/spatial development plan and/or improvement measures towards protection and strengthening sustainability of ecosystems during operational phase and of direct and indirect side effects.

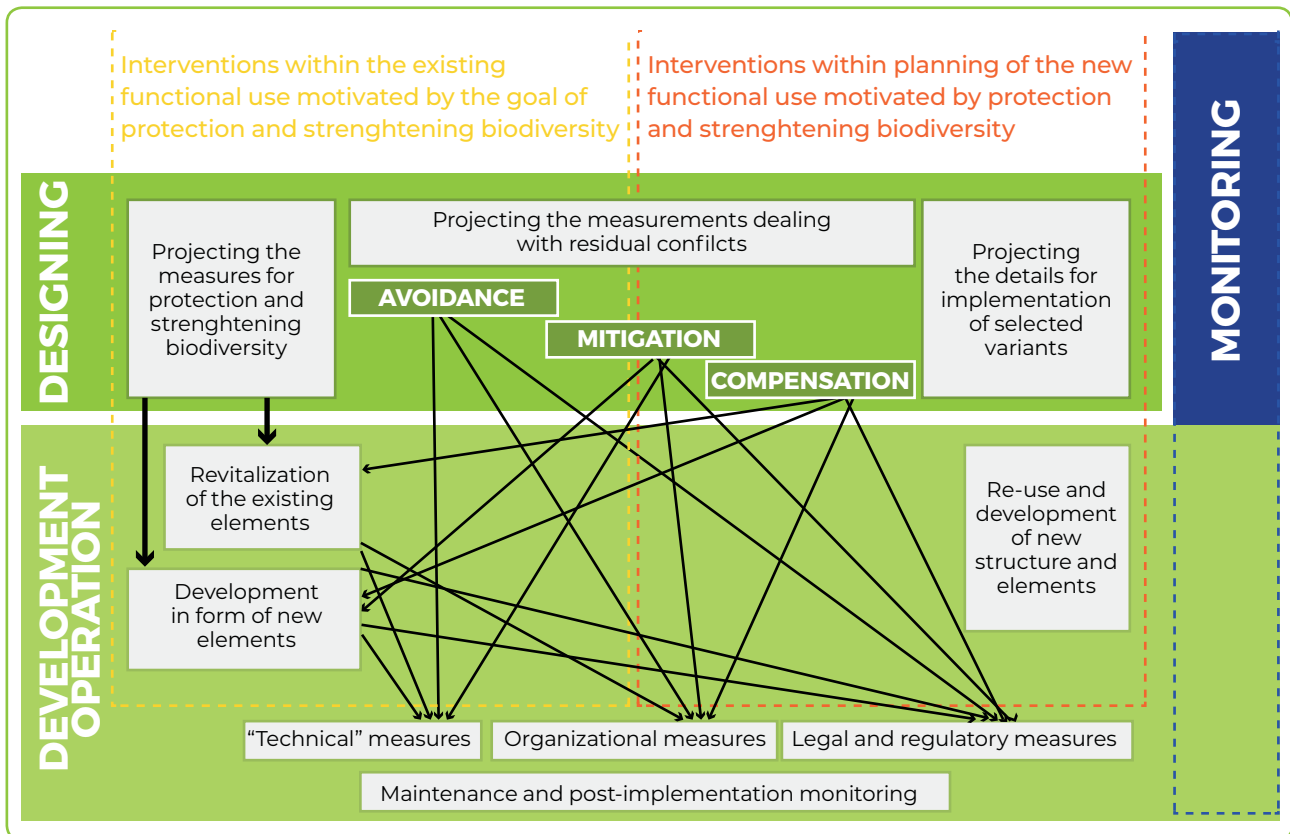


Figure 7: A detailed scheme of the development and operation phase

This phase includes operation, maintenance and accompanied operational monitoring, but important part of this phase represents proposal and implementation of proper measures in reaction to the operational monitoring outputs. Absence of proper maintenance negatively influences the operation and sustainability of the land-use/spatial organisation and related infrastructure as well as technical tools improving environmental standards (Figure 7).

The phase of development, operational management and monitoring focuses on answering the questions as follows:

What?

- » What are the achieved effects of the development and to which extent they meet the expectation?
- » What are the side effects of the development?

How?

- » How is it necessary to react to the monitoring outputs by corrective interventions of operational management?
- » How is it necessary to react to the monitoring outputs by modification of land-use/spatial development plans?

Where?

- » Where should be the proposed corrective interventions implemented?

The problems/challenges to be solved in the phase of development, operational management and monitoring

Implementation of the land-use/spatial development plan, as well as measures targeted at protection and strengthening sustainability of ecosystems, can affect a much broader area than the area of implementation itself. During the implementation, unexpected features of the environment can be discovered requiring the modification of the technologies used, and even the changes in the location of interventions or in the land-use/spatial organisation, requiring the permission process be re-opened. This is because

the monitoring is an important part of this phase. The changes in the land-use/spatial organisation and realisation of the interventions for protection and strengthening sustainability of ecosystems are, in many cases, connected with the restrictions in the operation of the territory, limitations of the implementation processes in time, space and used technologies. It can bring additional threats to the existing ecosystems in the territory as well. Temporal interventions connected with the phase of implementation/construction (e.g. demolition of the fences, penetration of the movement barriers) can cause lowering of environmental standards in the territory and this fact has to be mirrored in the careful definition of adequate temporal measures during the implementation/development/construction processes.

The specifics of the phase of operation, maintenance and monitoring of the interventions to protect and strengthen the sustainability of ecosystems fall under the fact that there exists a good reference basis for comparing the effects of these interventions in the form of the data from the territory before their implementation. That occurs because the monitoring is understood as a permanent activity joining all phases of the spatial development planning and implementation. This allows for very efficient assessment of expected and real effects and proposal of efficient corrections or new measures based on the outputs from monitoring which in this case consists of 3 parts as follows:

- » The first part is focused on the monitoring as the part of scoping, planning and designing. It provides the data for the decisions about realisation of interventions for protection and strengthening sustainability of ecosystems and for planning, projecting and designing of particular interventions;
- » The second part is focused on the phase of implementation/development/construction parallel with the continual operation of the territory. It mainly provides the data on operational decision immediately reacting to new situation and the appeared problems during implementation/development/construction;

- » The third part represents typical post-implementation monitoring.

Although the focus of monitoring should be on crucial critical aspects, comprehensive monitoring and assessment is the precondition to objective assessment of the effects, including unpredictable effects and flexible reaction to these effects by proposing and implementing proper measures, the question of monitoring efficiency is often discussed. The involvement of broad public and decision makers who can contribute to its improvement is obligatory and crucial.

It is important to 'capitalise' the monitoring outputs not only in relation to the assessment as the input for optimisation of given land-use/spatial organisation arrangement or protection and strengthening sustainability of ecosystems, but as a source of knowledge and experience for future planning, projecting and designing as well, facing similar problems and challenges (learning process).

Advised approaches to be used in reflection of identified problems/challenges in the phase of development, operational management and implementation monitoring

The implementation phase, by its content and approaches, is determined by the planning and especially projecting phase defining not only parameters of final land-use/spatial organisation of the territory or implementation of interventions for protection and strengthening sustainability of ecosystems, but for the implementation/development/construction phase as well. It is important to safeguard proper in-time reflection to the monitoring of the implementation processes in the form of the measures and adaptation changes of parameters, technologies, technical and other solutions, while avoiding the negative effects of the implementation/development/construction and further land-use/spatial organisation of the territory.

Crucial approaches and tools in this phase are linked to permanent data collection, maintenance and evaluation of the implementation and operation of the land-use/spatial organisation in the territory. In relation to the ecosystem sustainability, this would primarily mean:

- » Monitoring of the eco-connectivity including monitoring of conflicts in the territory;
- » Monitoring of distribution and movement of animals in the area, incl. mortality;
- » Monitoring of resilience and health of ecosystems;
- » Monitoring of effectiveness of implemented measures;
- » Innovative technical, organisational and other solutions in the land-use and related infrastructure;
- » Changes in the land-use on the territory and in surrounding area;
- » Changes in the parameters of related infrastructure.

Monitoring key indicators in order to preserve connectivity will provide important feedback on both sudden and gradual changes in ecosystem dynamics and human use of landscapes. Some connectivity monitoring indicators include:

1. Trends of the population of key species.
2. The movement of species according to new interconnections
 - » Fragmentation indices for natural areas (for example, in forest areas);
 - » Fragmentation indices of rivers (for example, dams on various rivers);
 - » Fragmentation indices of air migration routes and local movements for birds and bats (for example, wind farms)
3. Fragmentation indices for natural areas (for example, in forest areas);
4. Fragmentation of rivers (for example, dams on various rivers).

Different methods of **environmental supervision** can be used in monitoring the development of land-use and spatial organisation in parallel with the development of the ecosystems' status at all phases

of the projects from implementation via full operation up to operational management and correctional interventions.

Monitoring as inherent part of the development and operational management phase should consist of regularly repeated measurements of relevant variables. Monitoring needs to fulfil the following requirements (for more information see Luell et al., 2003):

- » The monitoring should be purpose-oriented and planned – with clear objectives and efficiency, determining the chosen methods, standards, scale and criteria for the evaluation;

- » The variables selected needs to identify the quality of ecological processes and/or land-use/ spatial organisation properties;

- » Measurements are regular and standardised;

- » The scale (both in time and space) of measurement is appropriate for the detection of change and for operational management and for planning/designing;

- » The outputs from monitoring need to be directly linked to the operational management and planning in order to meet adequate decisions based on them.

PHASE 5 Monitoring

In order to reach sustainable development in integrated spatial/land-use development management in the Carpathians, it is necessary to know the real effects of transportation and land-use change on biota. Monitoring the effects of transportation and land-use change on biota is an important part of the process of planning, construction, operation and maintenance of infrastructure. It provides information about the negative impacts of transportation and land-use change on nature and feedback on the effectiveness of the applied solutions. This way it significantly contributes to optimisation of construction processes and to effective prevention, reduction or compensation of negative impacts on nature (Hlaváč et al., 2019).

The need for monitoring and its objectives

Objective information about populations of individual species in the surroundings of a development projects and transport infrastructure and information about their changes caused by transportation is necessary to be able to successfully limit negative effects of changes in land-use and transportation on wildlife. Such information can be gained solely by a correctly designed monitoring. The following can only be found out by means of monitoring:

- » How many animals actually die on roads and what is the effect of this mortality on the populations of respective species;
- » How the barrier effect of a linear transport infrastructure becomes evident in populations; and
- » The disturbing effect of traffic manifested in populations of target species.

Monitoring is also a mechanism that allows spatial planners to check the effectiveness of measures which have been applied in order to reduce the impact of development on the habitat fragmentation. Monitoring of effectiveness provides an important feedback and allows to:

- » Avoid repeating mistakes;
- » Provide new information to improve the design of mitigation measures;
- » Identify the measures with an optimal relationship between cost and benefit; and
- » Save money for future projects.

It is therefore clear that monitoring is a basic tool that helps effectively protect wildlife from negative impacts of land-use change and transportation. Properly designed monitoring is also a tool that

ensures maximum effectiveness of funds spent on mitigation measures. For these reasons, it should be of general interest to include monitoring into the process of planning in integrated spatial/land-use development management (Hlaváč et al., 2019).

Definition of monitoring

In general, monitoring should consist of regularly repeated measurements of selected variables. An activity can only be called monitoring if the following requirements are met:

- » Measurements are standardised;
- » The selected variables indicate ecological processes of interest or properties that need to be detected; and
- » The scale (both in time and space) of measurement is appropriate for the detection of change.

Without clear objectives for monitoring, these requirements cannot be fulfilled. The establishment of these objectives and the selection of methods, standards, scale and criteria for the evaluation of the effectiveness of measures require basic ecological knowledge of the systems affected. Therefore, the involvement of ecologists or wildlife biologists in the design of monitoring schemes is fundamental (Luell et al., 2003).

Basic monitoring framework must be part of preparation of each infrastructure construction or modernization process and must be taking place in each phase of the planning process. Monitoring programme should be part of the EIA process and should always include:

- » Monitoring the state of biota in the defined territory, performed as three phase monitoring:

- » before construction;
- » during construction;
- » after putting the infrastructure into operation;

The monitoring programme needs to include the entire process from analysis of input materials and setting the goal of monitoring through the description of monitoring processes and methods to setting the form of outputs and recipients of the outputs (Hlaváč et al., 2019).

Standards and responsibility for monitoring

As mentioned earlier, monitoring is an essential tool in improving the functionality of measures designed to protect fauna and increase the effectiveness of funds spent on these measures. It is therefore necessary that monitoring become a mandatory part of the decision-making processes and authorizing constructions and reconstructions (modernizations) of infrastructure. At the same time, there need to be standards set for a minimum extent of monitoring to always be ensured. There are many decision-making processes related to land-use change and infrastructure development. They are not always about authorizing new constructions, even modernizations (upgrading) of the existing infrastructure have significant impacts on nature. However, often only individual measures, such as fencing of the existing road, noise-protection walls, equipping with crash barriers, vegetation adjustments, etc., are the subject of authorization. Also, additionally built measures on current infrastructure (fauna passages, etc.) are implemented more and more frequently. Moreover, even measures relating to the traffic itself can impact fauna – for example changes in speed limits, etc. (Hlaváč et al., 2019).

In case only partial adjustments are being decided or there is a combination of more decision-making processes, it is necessary to prepare the monitoring programme individually.

Based on the specific needs and financial possibilities, the environmental, planning and transportation authorities can assign other studies and monitoring activities as well, which do not directly continue the decision-making about new constructions – this is so-called ‘above-standard monitoring’. It is represented for example by:

- » Scientifically demanding monitoring that exceeds the standard monitoring frame (for example monitoring of the long-term effects of

a motorway on genetic structure of populations on both sides of the motorway, using methods of satellite telemetry, etc.);

- » Effects of disturbance by traffic on wildlife during operation on existing roads;
- » Identification of places with increased fauna traffic mortality on existing roads.

A fundamental requirement in organizing monitoring is the need for cooperation of transportation, planning and nature conservation authorities (and other involved organizations in these sectors) on its preparation, implementation and using its results. If the monitoring was ensured by one side only, it is very likely that the results would not be reliable for the other side. Unfortunately, even cases when each of these sides organizes and finances its own monitoring are known from practice. Such a system is not effective, needless duplicities in work arise and as a final consequence this way does not lead to needed cooperation (Hlaváč et al., 2019).

The following principles apply to new constructions and reconstructions where minimal extent of monitoring is set:

- » Monitoring is financially ensured by investor of the construction;
- » Preparation of the monitoring programme must be based on knowledge about ecological conditions in a given area, therefore the preparation is to a large extent a task for nature conservation authority – it discusses and approves the proposed plan with the investor;
- » Contractor (implementor) of monitoring is usually selected based on competitive tendering that belongs to the responsibility of investor. Investor invites nature conservation authority to participate in the competitive tendering;
- » Partial monitoring results are presented to both the investor and nature conservation authority; and

Final report is handed over to both the investor and nature conservation authority, and they together decide about its release.

The extent and means of the above-standard monitoring will always depend on its contracting authority. However, even in these cases, the exchange of information among the transportation, planning and environmental sectors is very much needed.

Chapter 7

EPILOGUE

EPILOGUE

These Guidelines on how to Use Spatial Planning Tools in Integrative Management of Ecological Corridors have got ambition to address in an overview different aspect of the ecosystems' inter-connectivity and wildlife as the objects of the management process of comprehensive spatial/land-use development. These Guidelines introduce integrated spatial/land-use development management as important tool for safeguarding sustainable development and protecting natural ecosystems and their connectivity, while allowing consequent implementation of the hierarchy Avoidance – Mitigation - Compensation in its complexity and complementarity. It is displayed as a proper environment for the integration of sectoral approaches and tools across different hierarchic scale levels (transnational, national, regional, local), across different phases (scoping, planning, designing, implementing, operating) as well as different actors and decision makers (governance bodies, professionals, developers, public etc.).

Interconnecting and embedding the approaches, methods and instruments in the phases of the spatial development/land-use management allows minimizing the conflicts and negative effects of the human activities on the nature and wildlife in a proactive approach. The precondition is a consequent multidisciplinary approach and working together among all stakeholders right from the beginning of the planning phase. The coordination and mediation position of spatial planners based on the awareness of their role as

displayed in these Guidelines needs to be balanced with mutual respect among all participating professions and subjects, especially those bringing deep understanding of ecosystems and wildlife protection in the planning and decision-making processes.

In the context of the comprehensiveness of this topic and diversity of planning system across the national states in the Carpathian macro-region, the Guidelines cannot cover in detail all approaches, methods and instruments varying from problem to problem and from country to country. This is because the handbook is based on internationally agreed logic of the process of spatial/land-use development management process as common denominator for different national or regional approaches fixed by specific national legal framework.

The complexity of the spatial/land-use development processes and its dynamics is a big challenge for spatial development management not only at international level, and requires very flexible supportive tools, such as these Guidelines. In addition, the whole scale of useful information can be found in the outputs from other Interreg projects e.g. TRANSGREEN, SaveGREEN and others publicly available. These facts were decision-making for the architecture of this handbook based on open structure allowing its permanent innovation, completion as well as adaptation to each country's specifics.

Glossary (based on Hlaváč et al., 2019)

-
- » **Barrier effect** A combination of different factors (technical structures and their parameters, disturbances, fauna mortality) that together decrease the probability and success rate of crossing linear features or surfaces by wildlife.
-
- » **Biodiversity / biological diversity** The richness among living organisms including terrestrial, marine and freshwater ecosystems and the ecological complexes that they belong to. It includes diversity within and between species and within and between ecosystems as well as the processes that link ecosystems and species.
-
- » **Connectivity** The state of structural landscape features being connected, enabling the access between places via a continuous route of passage. The physical connections between landscape elements.
-
- » **Corridor** A tract of land or water connecting two or more areas of habitat that aid animal movement across the landscape.
-
- » **Ecological connectivity** The binding or interconnection of eco-landscape elements (semi-natural, natural habitats or buffer zones) and biological corridors between them from the viewpoint of an individual, a species, a population or an association of these entities, for the whole or part of their developmental stage, at a given time or for a period given to improve the accessibility of the fields and resources for fauna and flora.
-
- » **Ecological / wildlife corridor** Landscape structures of various size, shape and vegetation cover that mutually interconnect core areas and allow migration of species between them. They are defined to maintain, establish or enhance ecological connectivity in man-influenced landscapes.
- Wildlife corridors - allow the movement of a wide range of organisms between areas of high natural value
- Migration corridors - allow animal movement (both regular and irregular) between areas of their permanent distribution (core areas)
- Movement corridors - allow animal movement within core areas (including daily movements in search of food, etc.).
-
- » **Ecological network** A coherent system of natural and/or semi-natural landscape elements configured and managed with the objective to maintain or restore ecological functions as a means to preserve biodiversity while also providing relevant opportunities for the sustainable use of natural resources (Bennett and Mulongov, 2006). Ecological network consists of core areas, corridors and buffer zones.
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- » **Ecosystem services** The Millennium Ecosystem Assessment (2005) defined Ecosystem Services as "the benefits that people derive from ecosystems". Besides provisioning services or goods like food, wood and other raw materials, plants, animals, fungi and micro-organisms provide essential regulating services such as pollination of crops, prevention of soil erosion and water purification, and a vast array of cultural services, like recreation and a sense of place.
-

» Fauna passage	A measure installed to enable animals to cross over or under a road, railway or canal without coming into contact with traffic.
» Fragmentation	(of landscape, habitats, populations) – A process where continuous landscape is further divided into smaller and smaller units that are mutually isolated, or reduced in the area. Such units then gradually lose their potential for fulfilling their original functions. Transformation of large habitat patches into smaller, more isolated fragments of habitat (Jaeger et al., 2011).
» Green infrastructure	A strategically planned network of high quality natural and semi-natural areas with other environmental features, which is designed and managed to deliver a wide range of ecosystem services and to protect biodiversity in both rural and urban settings.
» Habitat	The type of site (vegetation, soils, etc.) consisting of biotopes, where an organism or population naturally occurs - including a mosaic of components required for the survival of a species. Assemblage of all biotic and abiotic factors that create the environment of a specific species, population, and community.
» Land-use / spatial planning	An activity aimed at predetermining the future spatial usage of land and water by the society. A process of spatial planning with aim to use the landscape resources in a sustainable way, balancing socio-economic and environmental needs and conditions.
» Migration	Regular movement of animals outside of their original home ranges. For the purpose of ConnectGREEN project, the term migration also applies to other types of animal movement (within home ranges, food searching, dispersal of young etc.).
» Migration barrier	Natural and anthropogenic structures in the landscape which restrain the free movement of animals.

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Annex 1: List of tools integrated in spatial planning and management processes

Group of tools	Tools	Sub-tools
Active protective-supportive interventions into the hydric system	Active protective-supportive interventions into the hydric system	Artificial floods
		Co-watering
		Preserving constant water level in the course
	Landscape water regime management	Flood polders
		Measures to increase landscape water accumulation capacities
		Development of evaporation areas and water areas
Active protective and supportive interventions towards upgrading existing ecosystems	Landscape vegetation adjustments	Optimisation of the volume of biologically active matter, changes in microclimatic conditions (increase in humidity, limiting climatic extremes)
		Creation of living space for natural succession of xerothermic vegetation
		Substitution of non-original tree species in mixed forests by original species and change of monotonic pine tree forests into mixed tree species consisting of original tree species
		Designing/planting shrubs and trees that are attractive to animals
		Specific adaptive changes of ecosystems to climate change and other externalities incl. vegetation adjustments
	Urban vegetation adjustments	Change of urban ecosystem composition (in reaction to the problems of allergens or occurrence of invasive arts)
	Enhancement of the habitat quality (such as reducing grazing pressure, raising the water table, reduction of dust, noise, etc.)	
	Upgrading existing critical elements of ecosystems	Habitat/ecosystems suitability patches incl. creating new/improvement of the existing breakings, alleys and other vegetation of non-forest wood vegetation
		Clearing of overgrown fallow lands (re-cultivation of left-out land, meadows, pastures and vineyards)
		Creating landscape structures, meadows, new habitats, revitalization of grasslands
Active protective-supportive interventions towards ecosystems improving their eco-connectivity	Splitting large plots of arable land by planting lanes of vegetation	Revitalization of grasslands
New river crossing places for fauna	New river crossing places for fauna	
New natural guiding vegetation for the planned eco-duct	New natural guiding vegetation for the planned eco-duct	

Annex 1

Group of tools	Tools	Sub-tools	
Active protective-supportive interventions into the hydric system	Bridges, tunnels, underpasses	Passages (underpasses, overpasses / tunnels, culvert, eco-bridges) Breakings in break-winds	
	Fauna Passages	Fauna terrestrial passages Fish passages at the dams	
	Placement of a spare/replacement habitat		
	Green roofs, green walls		
	Removing of fences and other barriers		
Protective technical or nature close elements for eco-connectivity	Eco-barriers		
	Technical barriers (protective barriers to avoid threats)		
	Fences and barriers, dykes (e.g. for amphibians)		
	Noise/Visual/Light barriers (e.g. walls, embankments)	Planting vegetation near stalls	
	Operational measures in the transport (e.g. speed limits, visibility improvement)		Escape ramps (e.g. from motorway areas)
			Detection systems
			Artificial deterrents
Stabilization of slopes to prevent sliding; protection of soil on slopes from water erosion			
Ensuring open dumping sites and material ditches			
Land-use management restrictive regulation tools	Areas with the land-use limitations	Building closure area	
		Creating a quiet zone in at least 400-meter distance from an ecoduct in each direction	
		Areas with functional and structural limits (e.g. in tourism, agriculture)	
		Areas with defined modes of functional use in agriculture	
		Areas with limits for land-use and construction in flood risk areas	
		Areas with limits for fences, barriers, linear infrastructure elements	
	Organisational principles of land-use		Horizontal segregation (distances between intensively used land and ecosystem elements)
			Land take limitation via land protection
			Soil sealing limits

Annex 1

Group of tools	Tools	Sub-tools
Land-use management restrictive regulation tools	Restrictive financial land-use instruments	Marketable land take limits
		Payments for land take
		Payments for non-used available infrastructure
		Payments for non-used plots in built-up area
	Land-use/structural (3D) organisation	Land-use/structural (3D) organisation change in land-use plan Change of land-use status of a plot
Sectorial planning/ designing documents	Catchment area plans	
	Project of protective measures	
	Specific nature protection documentation	
	Migration study	Coordination migration study Detailed migration study Framework migration study
	Infrastructural plans incl. transport	
Integrative planning documents	Landscape plan	
	Spatial development plan (1:50 000)	
	Structural plan (1:2 000 - 1:5 000)	
	Land-use plan (1:5 000-1:10 000)	
	Local and regional socioeconomic development plans	
	Green infrastructure plan	
Instruments of active land-use change (implementation of regulations - physical change)	Change in land-use	Change in land-use from 'forest area' into 'meadows and pastures'/eco land'
		Change in land-use into 'biotope' or 'lane of vegetation'
		Change in land-use of the area into 'empty land' with an objective to preserve the core area - no construction in this area
		Change in land-use of the area into 'meadows and pastures'
		Change in land-use of the area with a small lake and channel into 'water areas'
	Change of the mode of agricultural land-use	Extensive gardening measures Creating fallow lands or break-winds (incentivising farmers to continue to produce fodder and preserve xerophytic pastures)
	Spatial reorganisation and structural change of land-use	
	Brownfields` re-use	

Annex 1

Group of tools	Tools	Sub-tools
Classification and typologisation of eco-corridors	Classification of critical zones	
	Classification of eco-corridors – identification of ecological migration potential (MPE)	
Classification and typologisation of barriers	Classification of non-forest areas by their permeability	
	Classification of watercourses and other water bodies by their permeability	
	Classification of railways by their permeability	
	Classification of roads and motorways by their permeability	
Conceptual instruments in planning	Concept of ecological corridors (wildlife corridors, migration corridors, movement corridors)	Green infrastructure network development
	Compact city concepts, green city concepts, eco-city concepts	
	Concepts of genetic isolation, habitat fragmentation and land degradation, ecological and landscape connectivity, green and grey infrastructure	
	Eco-connectivity concept (habitat, landscape, ecological)	
	Concept of ecosystem services	
Methodological instruments in planning	Methodology for identification of ecological corridors in the Carpathian countries using large carnivores as umbrella species	
Construction design instruments	Construction design, proper selection of construction materials and technologies	
Legal protective instruments	Preserved/protected areas	Preserved buffer zones
		Conserved Areas - OECMs [Other effective area-based conservation measures]
		Regional zone of greenery
	Protected landscape sub-systems and their elements	Protected ecological corridors (wildlife corridors, migration corridors, movement corridors)
		Ecological network of the landscape
		Preserved natural paths (roads)
		Preserved river crossing places and other places for fauna crossing across rivers and brooks
Restrictions/penalties		

Annex 1

Group of tools	Tools	Sub-tools
Legal protective instruments	Legal processes supporting protection	Expropriation
		Land-use permissions
		Nature conservation
		Legal definition of public interest
Measurements, inventarisation, analytical work	Mapping/maps	Mapping/maps of occurrence of the target species
		Mapping/maps of elements limiting migrations
		Mapping/maps of migration supportive elements
		Mapping/maps of green landscape structures
		Ecological network mapping/maps
		Land-use and land-cover mapping/maps
		Ecosystem service mapping
		Ecosystem service assessment
	Assessment and evaluation (incl. methods)	Evaluation of the permeability
		SEA methodology
Managerial and legal systems	Land cover management	EIA methodology
		Biological activity value account in spatial planning
		Land-use/spatial planning law act
		Nature conservation law acts
		Sectorial planning law acts
Financial, incentive, compensation measures	SEA, EIA law act	
Financial, incentive, compensation measures	Subsidies, payments for owners` limitation due public interest	

Annex 2: Overview of national spatial planning systems

**this is a summary based on the report 'Ecological corridors in the spatial planning system in the countries of the Carpathians' (Deliverables 3.3.1 and 3.3.2. of the ConnectGREEN Project)*

1. Responsible institutions at all territorial levels related to spatial planning

National level

Spatial planning represents a complex, multi-sectoral approach; therefore responsibilities are very often shared at national level between ministries, which even happens to be the case in the analysed countries as well. In the case of Hungary, the national level is extremely fragmented due to the shift of competencies over the last years: land-use planning and all the planning activities related to EU co-financing are delegated to the Cabinet Office of the Prime Minister but several other tasks such as strategic spatial planning or spatial development or rural development based on Hungarian funds belong to other ministries. In Slovakia, the responsibilities are also shared: the Ministry of Investments, Regional Development and Informatisation of the Slovak Republic responsible for spatial planning, the Ministry of Transport and Construction responsible for land-use planning; the Ministry of Environment responsible for landscape planning, and the Ministry of Agriculture and Rural Development responsible for rural development (Table 4).

CZECH REPUBLIC	HUNGARY	SERBIA	SLOVAKIA	ROMANIA
Ministry of Regional Development	Cabinet Office of the Prime Minister (use of EU-funds, rural development, land-use planning), Ministry of National Development, (spatial development), Ministry of National Economy (strategic spatial planning) Ministry of Agriculture (rural development)	The Ministry of Construction Transport and Infrastructure - MCTI	The Ministry of Construction Transport and Infrastructure - MCTI	The Ministry of Regional Development and Public Administration, Ministry of Culture and National Patrimony; The Ministry of the Environment and Climate Change

Table 4: Actors at national level

Regions, special areas

The regional level mostly represents NUTS3 regions in the analysed countries. In Hungary, the NUTS2 regions ceased to have competencies in spatial planning and development during a reform in 2011 and the major regional competencies are delegated to the counties (NUTS3). In Romania, for the NUTS2 regions, Regional Development Strategies and Regional Spatial Plans are elaborated by the central government. The county councils (NUTS3) in co-operation with the Ministry of Regional Development elaborate the County territorial development strategies and land-use plans. In Slovakia, the 8 NUTS3 self-governmental regions have the right to elaborate regional spatial plans. In the Czech Republic, the NUTS3 regions have competencies in spatial planning. In Serbia, the regions NUTS2 do not have competencies; just the region of Vojvodina has a stronger autonomy, with the right of elaboration of a spatial plan (Table 5).

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	SERBIA	SLOVAKIA	CZECH REPUBLIC	ROMANIA	HUNGARY
NUTS2	Ministry of Construction, Transport and Infrastructure			Sectoral Ministries and Regional Development Agencies	
	Regional Spatial Plans, Province and Belgrade Metropolitan Area Spatial Plans for Special Purpose Areas			Regional development strategies and Regional Spatial Plan	
NUTS3	Authorities of the Vojvodina Province	Self-governmental Region (for land-use plans and programs) Ministry of Transport and Construction (only for land-use plans)	Regional council	Ministry of Regional Development, and Public Administration and County Councils	County Self-governments
	Regional Spatial Plan for Vojvodina Province Special Purpose Areas	Program of Social and Economic Development of the Self-Governmental Region, Land-use Plan of Self-governmental Region; Landscape-Ecological plan	Regional Development Strategy, Development Principles	County territorial development strategies Inter County Plan; Inter-urban or Inter-communal Zone Plan; Border Zonal Plan; Metropolitan, peri-urban plan of major cities and municipalities	County Spatial Development Strategy, Land-use plan
Special regions	Regional Spatial Plan of the Belgrade Metropolitan Area	Regional Land- use Plans of the National Parks TANAP and NAPANT Landscape- ecological plan		Spatial Plan of the Bucharest-Ilfov Region	Land-use plan of Budapest Agglomeration Land-use plan of Balaton Recreational Region

Table 5: Spatial plans and decision-making institutions at regional level

Local level

It has the strongest authority in land-use planning in all countries. The local level is responsible for the lowest level of state government (local level plans, zonal plans, building permits). Aside from the general local plan, in some countries, specific and more detailed plans are elaborated for certain areas of the settlement (Table 6).

In Romania, for protected areas (World Heritage, tourism areas of national interest, Historical Monuments etc.) at a local level, special zonal plans are elaborated by the local government and central bodies (responsible ministry).

Responsible bodies for spatial planning		
Czech Republic	Responsible institution	Competence
National	Ministry of regional Development	<p>The Ministry is the central administrative authority in cases of town and country planning and</p> <ul style="list-style-type: none"> a) executes the state supervision in the cases of town and country planning, b) procures the spatial development policy and the planning materials necessary to that, c) keeps records of the planning activity, d) performs other activities pursuant to this Act. <p>The Ministry ensures methodical support for the implementation of contemporary knowledge of town and country planning, urban planning, architecture and constructional and technical knowledge, as well as of public priorities in building development and building industry, especially within protection of life and health, in care of the environment and in preservation of cultural, archaeological and natural heritage.</p> <p>The Ministry establishes the structural component of the state to solve conceptual questions of theory and practice in the sphere of town and country planning, urban planning and architecture. Ministry may delegate with this activity the already existing structural component of the state.</p>
Regional	Regional Office of administrative region	<ul style="list-style-type: none"> a) procures the development principles and, in the cases stipulated by the law, the regulatory plan for the areas and corridors of the supra local importance, b) procures the non-statutory planning materials, c) is the respective authority within the planning permission proceedings and within the proceedings pursuant to special regulations, within which it is decided on changes in the territories, which refer to more administrative units of the municipalities with extended competencies, d) is the respective authority within the planning permission proceedings on the programs, which require the environmental impact assessment) issues the planning permission in cases stipulated under the law, e) determinates the building office relevant to the planning permission in cases stipulated under the law, f) enters the data into the register planning activity for its administrative unit, g) performs other activities pursuant to this Act.

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Czech Republic	Responsible institution	Competence
Local	Municipal authority	<ul style="list-style-type: none"> a) procures the plan and the regulatory plan of the municipal territory, b) procures the planning materials, c) at the request of the municipality it procures the plan, regulatory plan and the planning study within its administrative district, d) at the request of the municipality it procures the restriction of the developed area within its administrative district, e) it is the respective authority within the planning permission proceedings in terms of application of town and country programmes, if it does not issue the planning permission, f) it is the respective authority within the proceedings pursuant to special regulation, within which it is decided on the changes in the area, g) submits the motion to enter the data into the register of the planning activity, h) performs other activities pursuant to this Act.
Hungary	Responsible institution	Competence
National	Cabinet Office of the Prime Minister Ministry of National Economy	Elaborates the Partnership Agreement, coordinates the use of EU-funds, rural development, Elaborates National Land-Use Framework Plan, spatial development Elaborates National Development Strategy Land-use plans of priority regions
Regional	County Self-government	Elaborates County Land-Use Framework Plan County Development Strategy Coordinates rural development activities
Local	Local Self-government	Elaborates the master plan of the settlement and Building Code
Serbia	Responsible institution	Competence
National	The Ministry of Construction, Transport and Infrastructure - MCTI	<ul style="list-style-type: none"> · The elaboration of the National Spatial Plan · The elaboration of the Regional Spatial Plans, with exception of regional plans for Vojvodina Province and Belgrade Metropolitan Area · The elaboration of the Spatial Plans for Special Purpose Areas, with exception of spatial plans for Vojvodina Province territory · The elaboration of the National Strategy for Integrated and Sustainable Urban Development (1st elaborated 2018) · Issues the location and building permit for constructions of national and regional importance

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Serbia	Responsible institution	Competence
Regional	Authorities of the Vojvodina Province	<ul style="list-style-type: none"> • The elaboration of the Regional Spatial Plan for Vojvodina Province in accordance with the National Spatial Plan • The elaboration of the Spatial Plans for Special Purpose Areas at the Vojvodina Province territory
Local	Authorities of the Local Municipality	<ul style="list-style-type: none"> • The elaboration of the Spatial Plan for Municipality Territory • The elaboration of the General Urban Plan for urban area • The elaboration of detailed regulation plans • Issues the location and building permit for constructions of local importance • Implementation of all adopted local plans – spatial and urban plans, sectoral plans, programs and projects
Slovakia	Responsible institution	Competence
National	<p>Government of the Slovak Republic</p> <p>Ministry of Investments, Regional Development and Informati-sation of the Slovak Republic (socio-economic development planning of territorial units)</p> <p>Ministry of Transport and Construction (land-use planning)</p> <p>Ministry of Environment (landscape planning)</p> <p>Ministry of Agriculture and Rural Development (rural development)</p>	<p>Vision and Strategy of the Procurement and approval of the planning documents:</p> <p>Development of Slovakia 2030 (National Strategy of Regional development) (approved by the state Government)</p> <p>Spatial Development Perspective (KURS) (approved by the state Government)</p> <p>Territorial System of Ecological Stability</p> <p>Procurement of the Land-use Planning Materials at national level</p> <p>Strategy of territorial development of Slovakia</p> <p>Land Technical Materials, specifically focused and systematically compiled and updated sets of data characterising the state and conditions prevailing in an area, are produced for the whole territory of the Slovak Republic and for selected territorial units;</p> <p>Other materials used for the production of the land-use planning documentation and are produced particularly for the creation and protection of the living environment, the protection of nature and the creation of the landscape, the protection of cultural and historical heritage and technical and transport infrastructure.</p> <p>Issues the location and building permit for constructions of specific buildings and infrastructural constructions</p>

Slovakia	Responsible institution	Competence
Regional	8 Self-governmental regions	<p>Procurement and approval of the planning documents:</p> <p>Program of Social and Economic Development of the Self-Governmental Region (integrated territorial strategy)</p> <p>Program of Social and Economic Development of a Group of Municipalities</p> <p>Land-use Plan of the Region (Land-use Plan of Self-governmental Region or other regional units e.g. national parks)</p> <p>Landscape – ecological Plan at the Regional level</p> <p>Land-use Plan of a Group of Municipalities</p> <p>Procurement of the Land-use Planning Materials</p> <p>A land-use planning study at the regional level, covering partial problems in the area in question. It is produced in preparation of land-use plan as a proposal of concept of spatial arrangement and functional use of land or for making the land plan more detailed or verification of land plan and in case of amendment of land plan or for solution of some specific land technical, landscape-ecological, environmental or architectonic problems in land as a basis for land-use decision-making, or if it is stipulated otherwise in special regulation;</p> <p>A land-use general plan at the regional level addresses the possibilities of long-term spatial arrangement and functional use of land. It is elaborated on the basis of analysis and evaluation of land-technical conditions, environmental conditions and social conditions of land, as well as on the basis of analysis and evaluation of land system of ecological stability, tendencies of land development and environmental care;</p> <p>Other materials used for the production of the land-use planning documentation are produced particularly to create and protect the living environment, protect nature, create the landscape, and protect the cultural and historical heritage and technical and transport infrastructure.</p>
Local	Local self-government	<p>Procurement and approval of the planning documents:</p> <p>Program of Social and Economic Development of a Municipality</p> <p>Land-use Plan of a Municipality</p> <p>Landscape-Ecology plan at the Municipal level</p> <p>Procurement of the Land-use Planning Materials</p> <p>An urban study at the local level, covering partial problems in the area in question. It is produced in preparation of land-use plan as a proposal of concept of spatial arrangement and functional use of land or for making the land plan more detailed or verification of land plan and in case of amendment of land plan or for solution of some specific land technical, landscape-ecological, environmental or architectonic problems in land as the basis for land-use decision-making or if it is stipulated otherwise in special regulation;</p>

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Slovakia	Responsible institution	Competence
Local	Local self-government	<p>A land-use general plan at the local level addresses the possibilities of long-term spatial arrangement and functional use of land. It is elaborated on the basis of analysis and evaluation of land-technical conditions, environmental conditions and social conditions of land as well as on the basis of analysis and evaluation of land system of ecological stability, tendencies of land development and environmental care;</p> <p>Other materials at the local level used for the production of the land-use planning documentation and are particularly produced to create and protect the living environment, protect nature, create the landscape, and protect the cultural and historical heritage and technical and transport infrastructure.</p> <p>Issues the location and building permit for constructions (transferred competence from the state)</p>
Romania	Responsible institution	Competence
National	The Ministry of Regional Development and Public Administration	<ul style="list-style-type: none"> a) The elaboration, under the Prime Minister's coordination, of the Territorial Development Strategy of Romania and of the public policies according to its objectives; b) Elaboration of sections of the National Spatial Plan; c) Elaboration of the Regional Spatial Plan, structured in sections for each development region, which substantiate the regional development plans.
Regional	Authorities of the county public administration (County Council)	<ul style="list-style-type: none"> a) Taking over the provisions of the national, regional and zonal spatial planning plans, as well as the priority investments of national, regional or county interest, within the spatial and urban planning documentation for the administrative territories of the county localities; b) The elaboration of the County Spatial Plan and of the spatial zonal plans of county interest; c) Endorsement of the urban and spatial planning documents belonging to the administrative-territorial units of the county.
Local	Local government authorities and the mayor	<ul style="list-style-type: none"> a) The local council coordinates and responds to the entire urbanization activity carried out on the territory of the administrative-territorial unit and ensures the observance of the provisions included in the approved territorial planning and urbanization documentation for the realization of the urban development program of the commune or city constituencies;

Table 6. Main actors and competence in spatial planning

2. System of spatial planning in countries

Spatial planning instruments		
Czech Republic	Socio-economic development planning instruments	Land-use planning documents
National	Strategic framework of Sustainable development in CZ	Spatial Development Policy of the Czech Republic
Regional	Regional Development Strategy	Development Principles
Local	Strategic Development Plan	Plan Regulatory plan
Hungary	Socio-economic development planning instruments	Land-use planning documents
National		National Urban Development Strategy National Spatial Plan
Regional		Regional Spatial Plan
Local		Municipality Spatial Plan General Urban Plan Plan of General Regulation Plan of Detailed Regulation Design Project
Slovakia	Socio-economic development planning instruments	Land-use planning documents
National	National regional development strategy (Vision and strategy of the development of Slovakia 2030)	Land-use Planning Documentation Spatial Development Perspective Territorial System of Ecological Stability Planning materials: Strategy of territorial development of Slovakia Land Technical Materials Other materials

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Slovakia	Socio-economic development planning instruments	Land-use planning documents
Regional	<p>Program of social and economic development of the self-governmental region</p> <p>Program of social and economic development of a group of municipalities</p>	<p>Land-use Planning Documentation</p> <p>Land-use plan of the region</p> <p>Land-use plan of self-governmental region</p> <p>Landscape-ecology plan at the regional level</p> <p>Land-use plan of a group of municipalities</p> <p>Planning materials:</p> <p>Land Technical Materials at the regional level</p> <p>An land-use planning study</p> <p>A land-use general plan at regional level</p> <p>Other materials at regional level</p>
Local	<p>Program of social and economic development of a municipality</p>	<p>Land-use Planning Documentation</p> <p>Land-use plan of a municipality</p> <p>Landscape-ecology plan at the municipal level</p> <p>Planning materials:</p> <p>Land Technical Materials at the regional level</p> <p>An land-use planning study</p> <p>A land-use general plan at local level</p> <p>Other materials at local level</p>
Romania	Socio-economic development planning instruments	Land-use planning documents
National	<p>Spatial Development Strategy of Romania</p>	<p>National Spatial Plan</p>
Regional	<p>Regional development strategies</p> <p>County territorial development strategies</p>	<p>Regional Spatial Plans</p> <p>Inter County Plan;</p> <p>Inter-urban or Inter-communal Zone Plan;</p> <p>Border Zonal Plan;</p> <p>Metropolitan, peri</p>
Local	<p>Development Strategy of the Town / Commune</p>	<p>General Urban Plan of the Town / Commune</p>

Table 7: Spatial planning instruments in respective countries

Annex 2

Spatial planning in all countries has a highly hierarchical system. Higher level of planning is binding for the lower level. Generally higher level plans are not so detailed and mostly establish the spatial framework for development defining principles and guidelines (national, regional). They usually do not include details related to issues in the competency of local level (Table 7).

Spatial planning mostly covers two types of planning: social-economic, strategic approach and land-use planning. In Hungary, the two approaches occur parallel at all territorial levels. We can see a strong regulatory approach at the national level as well: The National Land-use Framework Plan contains a structural plan and regulation zones. Following the structural plan of the country the settlements have to designate at least 71% of the land-use form, for example agricultural areas in their local plan. In Hungary, according to the present regulation, forests have a significant role in spatial planning a special zone of forests is defined in the national plan where the settlements at least 95% of the zone area have to be designated as forests.

At the regional level, strategic plans and land-use plans are mostly parallel elaborated with the exception of Serbia where a spatial plan is elaborated.

In Serbia, Romania and Hungary, there are regions with special conditions, mostly the capital region or recreational areas of national importance for which specific regional plans are elaborated and adopted by the state.

Regional level land-use planning mostly focuses on the functional organisation of the space, determining the basic elements of the settlement structure and interrelations between them and highlights areas and corridors of supra local importance, determines the requirements for their utilization, and coordinates the planning activities of municipalities.

In Serbia, there is actually no such division of planning as development and land-use planning; a spatial plan is elaborated for the regions just in case in areas of national importance: the Spatial Plan for Special Purpose Area is a more detailed plan elaborated with regulation for designed zones

of special purpose's development. In most of the countries there are special areas, at least to mention the metropolitan area of the capital region which requires special attention.

The elaboration of strategies and land-use plans is based on detailed analysis of social, economic, environmental and landscape conditions, but in most of the countries landscape planning does not occur as an independent planning activity as it does in Slovakia. Next to strategic and land-use plans in Slovakia, the Landscape ecological plan is the document elaborated as a part of the procurement of land-use plans at regional and municipal level with the focus on landscape ecological analysis, assessment and optimisation of functional use in the harmony with landscape ecologic potentials and limits for the development.

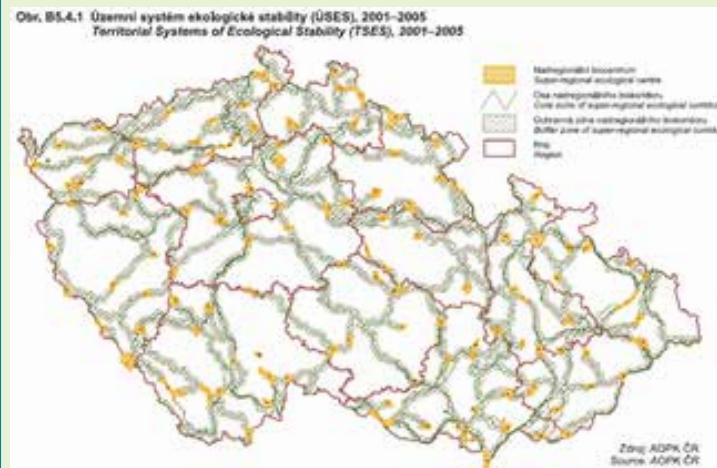
In all countries, a regional level can influence a local level, but mostly the local level/the municipality is the strongest actor in physical planning. Aside from the general local plan, specifically in some countries, more detailed plans are elaborated for certain areas of the settlement.

Integrating spatial planning and ecological networks

Spatial plans with ecological networks

Integration of ecological networks into the spatial planning

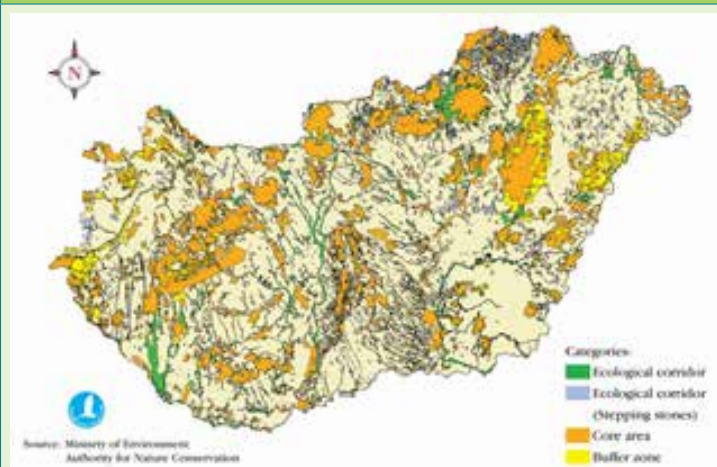
Czech Republic



Territorial system of Ecological Stability in Czech Republic (<http://www.ceeweb.org/work-areas/priority-areas/green-infrastructure/maps/>)

The Territorial System of Ecological Stability of the Landscape (TSES) is the only nature conservation tool constituting an ecological network in the landscape in the Czech Republic. The nature conservation tool is integrated in the spatial planning system. Act No. 114/1992 Gaz., as amended later, defines the TSES as an interconnected system of both natural and altered but still semi-natural ecosystems. The TSES consists of three basic elements – biocentres, biocorridors and interactive elements. A biocentre (existing and planned) is a habitat or a system of habitats which makes possible the permanent existence of a natural or semi-natural ecosystem. Biocorridor (biotic dispersal & migration corridors) is an area which makes possible the migration and/or dispersal between biocentres: thus, it makes a real interconnected network from isolated biocentres. The third components of TSES are interactive elements, small areas/patches/plots (often spatially isolated).

Hungary



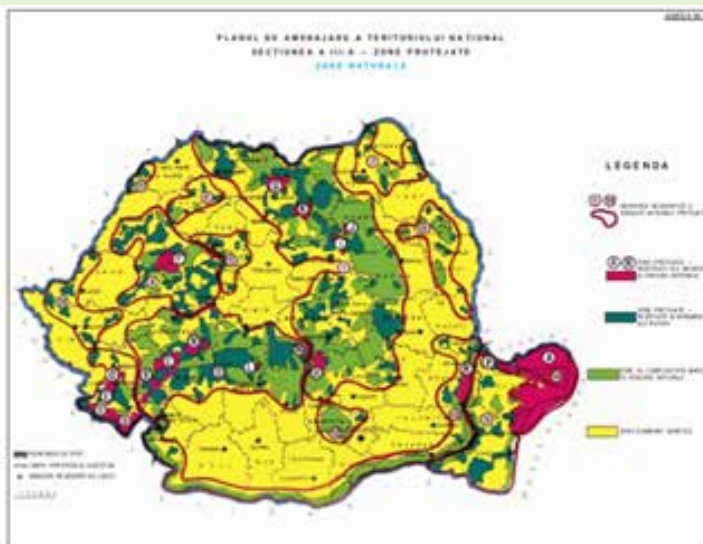
In Hungary the ecological network is integrated into the spatial plans. The national ecological network zone includes the core areas, the buffer zones and the ecological corridors as well. In the zone of core areas and ecological corridors the rules restrict the designation of areas for development, the placement of transport infrastructure and new surface mines, as well as the prescription that the utility lines fit into the landscape.

Integrating spatial planning and ecological networks

Spatial plans with ecological networks

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Romania



Nature protection areas in Romania national Spatial Plan

https://www.siu-grc-cjph.ro/c/document_library/get_file?uuid=2175fc9d-e8de-4f50-bf15-92fe80187ee8&groupId=10157

In Romania, Law 350/2001 on Spatial and Urban Planning specifies that territorial management aims, among others, to ensure the protection of natural and built landscapes, biodiversity conservation and the creation of ecological continuity. The basic purpose of spatial planning is to harmonize the economic, social, ecological and cultural policies at national and local level and among its objectives is that of a sustainable management of the landscape, which is a basic component of the natural and cultural heritage and natural resources.

The National Plan indicates core areas of international and national importance and corridors and includes international nature conservation priorities: Natura 2000, Emerald, PEEN.

The County/Regional plans determine core areas (10-100 Kmp) and connecting corridors between these areas (e.g. natural river valleys, semi-natural recreation areas for local settlements). The Comprehensive Urban Plans determine the function of small habitats, woodlots, wetlands, grassland, patches, ponds (<10 Kmp) and connecting corridors (stream banks, hedgerows, field verges and ditches).

Serbia



Ecologic Network of Voivodina

(<http://www.pzzp.rs/rs/sr/zastita-prirode/ekoloska-mreza.html>)

In Serbia, the Nature Protection Act (2009, 2010, 2016) the protection and management of the ecological corridors is not clearly defined, it is treated as a part of ecological network without specified obligations or restrictions. Legislation for the spatial planning and construction sector does not provide provisions relating to ecological corridors. Ecological corridors are indirectly covered by the provisions relating to the protection of nature and landscape. In spatial planning practice ecological corridors have been formally developed in spatial plans at different levels of planning.

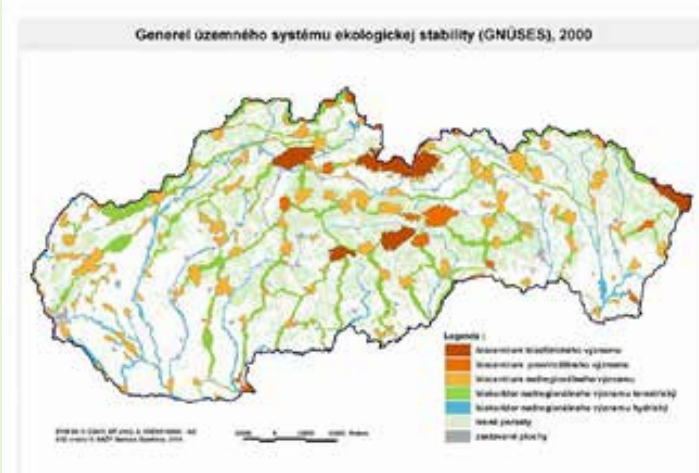
Integrating spatial planning and ecological networks	
Spatial plans with ecological networks	Integration of ecological networks into the spatial planning
Slovakia	
 <p>The General of the Super-regional (national level) Territorial System of Ecological Stability of the Slovak Republic (Source: SEA SR)</p>	<p>In Slovak landscape, there exists an ecology plan at the regional and municipal level. Landscape ecologic plan is the document elaborated as a part of the procurement of land-use plans at regional and municipal level with the focus on landscape ecologic analyses, assessment and optimisation of functional use in the harmony with landscape ecologic potentials and limits for the development. The plans of the Territorial Systems of Ecological Stability are in accordance with the Law on land-use planning supportive documents. As defined in the Act Nr. 543/2002 on Nature and Landscape protection: The Territorial System of Ecological Stability is such a spatial structure of interconnected ecosystems, their constituents and elements, which provides the diversity of conditions and forms of life in the landscape. This system consists of biocenters, biocorridors and interacting elements of supra-regional, regional or local importance.</p>

Table 8. Short overview of Ecological networks from the partner countries

As table 8 demonstrates above the ecological networks in **all of the analysed countries were integrated** into the spatial planning system, although **in different ways and levels**. At territorial levels there are **special maps/GIS layers** about the ecological networks **in the spatial plans** of all of the countries **except Serbia**. In Serbia the ecological networks have been formally stated in spatial plans; however, they are most often mentioned in generalized formulations about the necessity of their identification, valorisation and protection, without clear spatial delimitation on maps. However, also in Serbia, good examples can be found (e.g. AP Vojvodina), where spatial delimitation and protection measures are defined in the Regional Spatial Plan for Vojvodina Province.

At **local levels, gaps were identified in more countries**. In **Serbia**, the problem is the same than at territorial level (the ecological networks are formally treated; however, they are mentioned in generalized formulations). In the **Czech Republic**, the information on the area, lengths and coverage is only available on a part of the Czech Republic territory and rarely in a digital format. In **Hungary**, the most important problem is the inconsistency of the spatial plans at different levels from the ecological networks perspective. It means that the designation of ecological network at a local level is based on estate records, and it is hardly comparable with the national ecological network.

ConnectGREEN DTP2-072-2.3

Restoring and managing ecological corridors in mountains as the green infrastructure in the Danube basin

Project partners:

Romania: WWF Romania (Lead Partner) · National Institute for Research and Development in Constructions, Urban Planning and Sustainable Spatial Development · Piatra Craiului National Park Administration

Austria: WWF Central and Eastern Europe

Czech Republic: Nature Conservation Agency of the Czech Republic · Silva Tarouca Research Institute for Landscape and Ornamental Gardening

Hungary: CEEweb for Biodiversity · Hungarian University for Agriculture and Life Sciences (formerly Szent Istvan University)

Slovakia: Slovak Environment Agency · The State Nature Conservancy of the Slovak Republic · Slovak University of Technology in Bratislava – SPECTRA Centre of Excellence of EU

Serbia: Institute of Architecture and Urban & Spatial Planning of Serbia · National Park Djerdap

Associated Strategic Partners

Czech Republic: Ministry of the Environment · Ministry of Regional Development of the Czech Republic

Hungary: Bükk National Park Directorate

Romania: Ministry of Environment of Romania

Serbia: Ministry of Environmental Protection of the Republic of Serbia

Slovakia: Ministry of Transport and Construction of the Slovak Republic

Ukraine: Ministry of Ecology and Natural Resource of Ukraine

Austria: Danubeparks – Danube River Network of Protected Areas

France: Alpine Network of Protected Areas – ALPARC

Montenegro: Parks Dinarides – Network of Protected Areas of Dinarides

Pilot Areas

1. Piatra Craiului National Park – Bucegi Nature Park (Romania)
2. Apuseni-SW Carpathians (Romania) / National Park Djerdap (Serbia)
3. Western Carpathians (Czech Republic – Slovakia)
4. Bükk National Park (Hungary) / Cerová vrchovina Protected Landscape Area (Slovakia)

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