



# Catalogue of Measures

## **Arad - Deva Pilot Area**



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## **Arad-Deva Pilot Area (Romania)**

Part of Output 4.1

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

Danube Transnational Programme, DTP1-187-3.1

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## Authors

Radu Moț  
(Association Zarand, Romania, initiator of GreenWEB – Connecting people within connected landscapes)  
Adrian Juravlea  
(Association Zarand)  
Alexandru Drăgoiu  
(Association Zarand)  
Florina Ciubuc  
(Association Zarand)

## Layout and graphic design

Alex Spineanu (Graphic designer, Romania) & Marián Špacír (SPECTRA) with support of Catalina Murariu (WWF Romania)

## Photo credits

Zarand Association.  
Authors and contributors, specific credits with other contributors are mentioned in the legend.

## English proofreading

Private Language School BS SCHOOL, Ondrej Straka, BSBA

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## About TRANSGREEN

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

## Output 4.1 Catalogues of measures available for:

Kysuce-Beskydy cross-border pilot area (the Czech Republic, Slovakia)  
Miskolc-Košice-Uzhgorod trilateral pilot area (Hungary, Slovakia, Ukraine)  
Arad-Deva pilot area (Romania)  
Tîrgu Mureș - Iași pilot area (Romania)

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# 1. Introduction

Several large transport infrastructure projects are under construction or being planned along the Carpathian Mountains. The Carpathian region is the largest mountain region in Europe and is shared among seven Central and Eastern European countries, namely the Czech Republic, the Slovak Republic, Hungary, Poland, Ukraine, Romania and the Republic of Serbia. The TRANSGREEN project aims to contribute to safer and environmentally friendly road and rail network development.

Major issues with new infrastructure in biodiversity rich areas are those of habitat fragmentation, biodiversity loss, disruption of migration routes and mortality caused by collisions. There is also an issue of noise pollution, emissions from vehicles and visual disruptions.

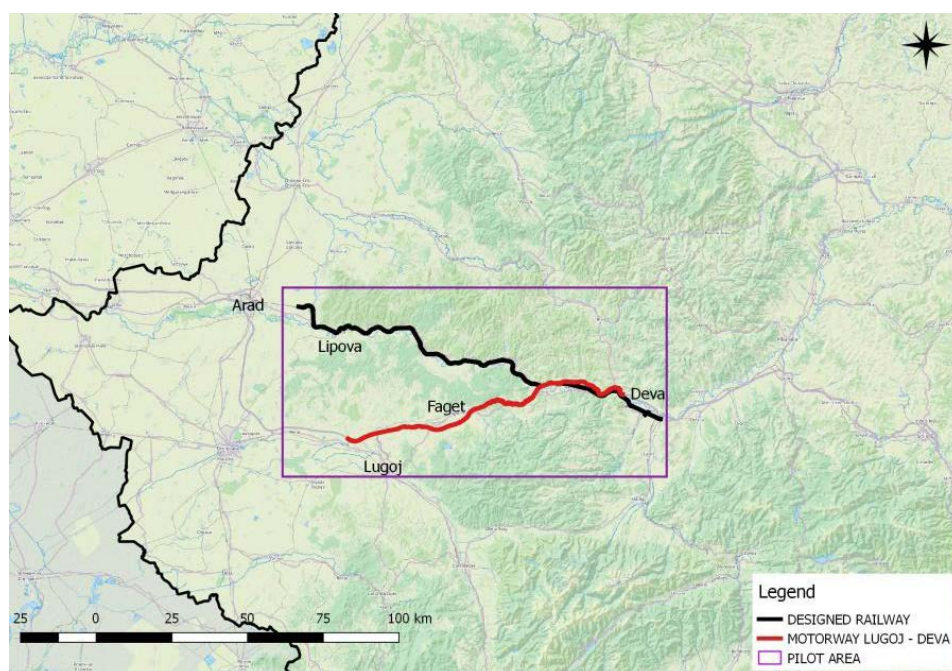


Fig. 1: The Arad - Deva TRANS-GREEN pilot area and the two major infrastructure projects being under construction in the area: the Lugoj-Deva Motorway and the upgrade of Curtici-Simeria railway sector.

The Mureș floodplain is a typical linkage area, a broader region of connectivity, important to facilitate the movement of multiple species and maintain ecological processes within the Northern and Southern forested neighbouring areas but along the river valley as well, and were delineating clear movement corridors for species is difficult due to its relative high degree of permeability. Mureș River itself is a central corridor and the floodplain is actually a network of dynamic (in time and space) movement routes/corridors.

The dynamic of landscape permeability and favourability for different species is complex here due to the multitude of natural and anthropogenic processes and activities; therefore, the theme of fragmentation due to transport infrastructure needs to be addressed at landscape level, as part of a multi-sectoral action plan.

The linkage area is important for local species (most of the floodplain and surrounding forested areas are included in Natura 2000 sites) but also for regional connectivity of large carnivore populations.

Therefore, the Catalogue of Measures presented here is an extract from an operationalized action plan for the linkage area, of interest to be implemented through the Bear and Wolf Regional Action Plans, through the Natura 2000 management plans and through cross-sectoral harmonization projects.

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## Aim of the study



**T**he **aim** of the study was to assess the Curtici - Simeria railway upgrade project potential impact on connectivity for large mammals/ carnivores (and other species as secondary topic) within the linkage area represented by Mureş floodplain and to integrate specific railway-related measures into a landscape-level action plan.

The **approach** used was to collect, collate and analyse the relevant data from an integrated, landscape approach. As discussed, the Mureş lower floodplain being a complex and dynamic landscape it acts as a linkage area and although rough prioritization can be made, it is not possible to define clear corridors. Therefore, the set aim was to address key fragmentation spots and to ensure overall permeability of the landscape with measures addressed to different sectors.

The list of main **activities** conducted within TRANSGREEN project is presented below:

- » Mapping barriers represented by existing linear features (transport infrastructure – roads, railway; the Mureş river);
- » Mapping terrain permeability;
- » Collecting and recording species presence;
- » Assessing permeability of the railway upgrade project;
- » Assessing potential impact of railway upgrade project;
- » Identifying and assessing critical points on the railway upgrade project based on impacts;
- » Proposing enhancement solutions for the railway upgrade project, if necessary;
- » Correlating the measures with outputs from other projects/initiatives and integrating experts' inputs;
- » Integrating solutions into a Catalogue of Measures at landscape level for TRANSGREEN Arad-Deva pilot area;
- » Discussing technical details with responsible stakeholders;
- » Communicating and disseminating the results.

The structure of the proposed **Catalogues of Measures** was designed to fit within a connectivity focused action plan for the linkage area represented by the Mureş lower floodplain.

Whenever possible, the measures have been illustrated with examples and high priority or the critical points have been extracted as the GIS shapefiles available for the CCIBIS platform.

The main focus of the TRANSGREEN project in the Arad - Deva pilot area was the upgrading of the Curtici-Simeria railway and, in subsidiary, the Lugoj-Deva motorway. As these major infrastructure projects are in different stages of construction, not all the information was available, therefore the Catalogue of Measures/action plan should be considered as a working document still to be completed.

The Catalogue of Measures is connected with and contains the results of other projects implemented by the Zarand Association in the area and could be considered as an Annex to the Bear and Wolf Regional Action Plans developed by LIFE Connect Carpathians for the area between the Apuseni Mountains and the Southern Carpathians, and could be implemented through the management plans of Natura 2000 sites or through sectoral plans.

The structure of the document is based on the identified threats, proposed solutions to these threats and actions necessary to carry out these solutions.

The threats identified could be grouped into 3 main categories:

- » First one associated with structural barriers caused by linear features (existing and new transport infrastructure, power lines and water courses) and wildlife mortalities associated with linear infrastructures;
- » Second one associated with structural and functional permeability being reduced by changes in land cover, land use and by anthropogenic activities;
- » Third one associated with the lack of coherent approach and lack of capacity to address permeability-related issues in collaboration with all stakeholders, including the lack of efficient communication.

As presented, the TRANSGREEN focus is on the potential impact of the railway and motorway projects, therefore within this document we are presenting objectives and measures for the first category of threats.

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# Measures proposed and identified critical points





Table 1: The correspondence between threats and objectives.

Cat.	Threat	Objectives
I	1. Increasing the barrier effect through the implementation of new infrastructure projects	<ol style="list-style-type: none"> <li>1. Ensure functionality of underpasses</li> <li>2. Ensure functionality of overpasses</li> <li>3. Increase permeability of railway embankments</li> </ol>
	2. Increasing the barrier effect of the existing linear features caused by structural interventions	<ol style="list-style-type: none"> <li>1. Maintain permeability of existing transport infrastructure</li> <li>2. Maintain the permeability of the Mureş River banks at current level</li> <li>3. Maintain/increase longitudinal permeability of the Mureş River and its tributaries</li> </ol>
	3. Wildlife mortalities associated with linear infrastructures (including electric power lines)	<ol style="list-style-type: none"> <li>1. Implement an adequate fencing system on motorways, including escape gates</li> <li>2. Direct animals towards functional underpasses for non-fenced infrastructure</li> <li>3. Warn drivers in road-kill/accident-danger areas</li> <li>4. Warn train conductors in road-kill/accident-danger areas</li> <li>5. Prevent accidents caused by mammals blocked in tunnels or on large bridges</li> <li>6. Increase visibility on roads/railways</li> <li>7. Special measures for birds</li> <li>8. Special measures for bats</li> <li>9. Special measures for amphibians/reptiles</li> <li>10. Collect and assess data to understand critical points/sectors</li> <li>11. Use integrated database as decision-supporting tools (to take/adjust measures to prevent traffic-kills/damages /human casualties)</li> <li>12. Develop specialized teams to deal with wildlife-related incidents on transport infrastructure, including emergency interventions</li> </ol>
II	4. Reduced landscape permeability caused by changes in land-use	<ol style="list-style-type: none"> <li>1. Inforce legislation on changes of land-use to less permeable categories</li> <li>2. Facilitate/support changes of land-use to high permeable categories</li> </ol>
	5a. Reduced landscape permeability caused by land management - fencing	<ol style="list-style-type: none"> <li>1. Fencing regulations and promoting non-fenced areas</li> <li>2. Build guidelines and impose fencing-related conditions linked with subsidies programmes</li> </ol>
	5b. Reduced landscape permeability caused by land management - crops/vegetation	<ol style="list-style-type: none"> <li>1. Prevent large-scale monocultures/facilitate/support mosaic cultivation</li> <li>2. Support adequate management of natural features/marginal habitats</li> <li>3. Support and promote development of good-practice examples of connectivity-sensible agriculture and forestry practices</li> </ol>
	5c. Reduced landscape permeability caused by land management - degradation of natural habitats	<ol style="list-style-type: none"> <li>1. Prevent/control spreading invasive plant species and restoration of invaded lands</li> <li>2. Prevent/enforce legislation on fires</li> <li>3. Prevent alteration of water bodies, restore hydric system and support restoration of wetlands</li> </ol>
	6a. Reduced landscape permeability caused by other anthropogenic activities - game management	<ol style="list-style-type: none"> <li>1. Develop coherent game management plans and apply EIA/AA procedures</li> <li>2. Facilitate data-collection on key-species</li> <li>3. Harmonize game management with Natura 2000 and connectivity-related objectives</li> <li>4. Poaching prevention and control</li> </ol>
	6b. Reduced landscape permeability caused by other anthropogenic activities - human-wildlife conflicts	<ol style="list-style-type: none"> <li>1. Facilitate the implementation of legislation on damage compensations</li> <li>2. Facilitate implementation of traditional shepherding</li> <li>3. Facilitate implementation of modern methods for prevention</li> <li>4. Facilitate increased subventions based on large carnivores conservation</li> <li>5. Regulate other anthropogenic activities which favour conflicts</li> <li>6. Facilitate rapid intervention in special situation related with wild animals</li> </ol>
III	7. Lack of coherent monitoring and adaptation	<ol style="list-style-type: none"> <li>1. Develop an integrated monitoring programme - procedures, database, indicators, assessment</li> </ol>
	8. Reduced support by stakeholders at landscape level for an integrated ecosystem approach	<ol style="list-style-type: none"> <li>1. Facilitate networking and develop a common platform and database</li> <li>2. Facilitate information, awareness, education, communication</li> <li>3. Support research and studies; inter-sectoral capacity building and facilitate development of new labour opportunities</li> <li>4. Develop a regional identity and promote the area - nature, culture, services</li> <li>5. Facilitate development &amp; alignment of local sustainable development strategies into regional sectoral strategy</li> <li>6. Facilitate/support sustainable development initiatives</li> </ol>

# 1 Threat 1

## INCREASING THE BARRIER EFFECT THROUGH IMPLEMENTATION OF NEW INFRASTRUCTURE PROJECTS

### Description:

The Mureş lower floodplain is an important transport corridor, new major transport infrastructure projects being implemented in the area are the Lugoj-Deva motorway and the Curtici-Simeria railway. Both projects are in construction phase and have environmental permits.

### Objectives:

» The first measure to address the permeability of new transport infrastructure is to maximize the defragmentation-role of objects (underpasses & overpasses) design for construction reasons. With this purpose, these objects should be assigned with environmental role and any specification modification should be subject to a revised environmental permit, as a decrease in permeability of these objects may require extra special solutions for wildlife. A special consideration during

designing should be given to adaptation to extreme phenomenon (flooding) due to climate changes.

» As the upgrade railway line will not be fenced, it is expected that animals (both domestic and wild species) will cross the railway embankment anyway. The most suitable sectors need to be adapted for rapid passing, in conjunction with proper measures to prevent traffic accidents.

### Objectives set to address the threats are:

**1.1. Ensure the functionality of underpasses**

**1.2. Ensure the functionality of overpasses**

**1.3. Increase the permeability of railway embankments**

Measures proposed per objectives are described below with the list of required/proposed actions:

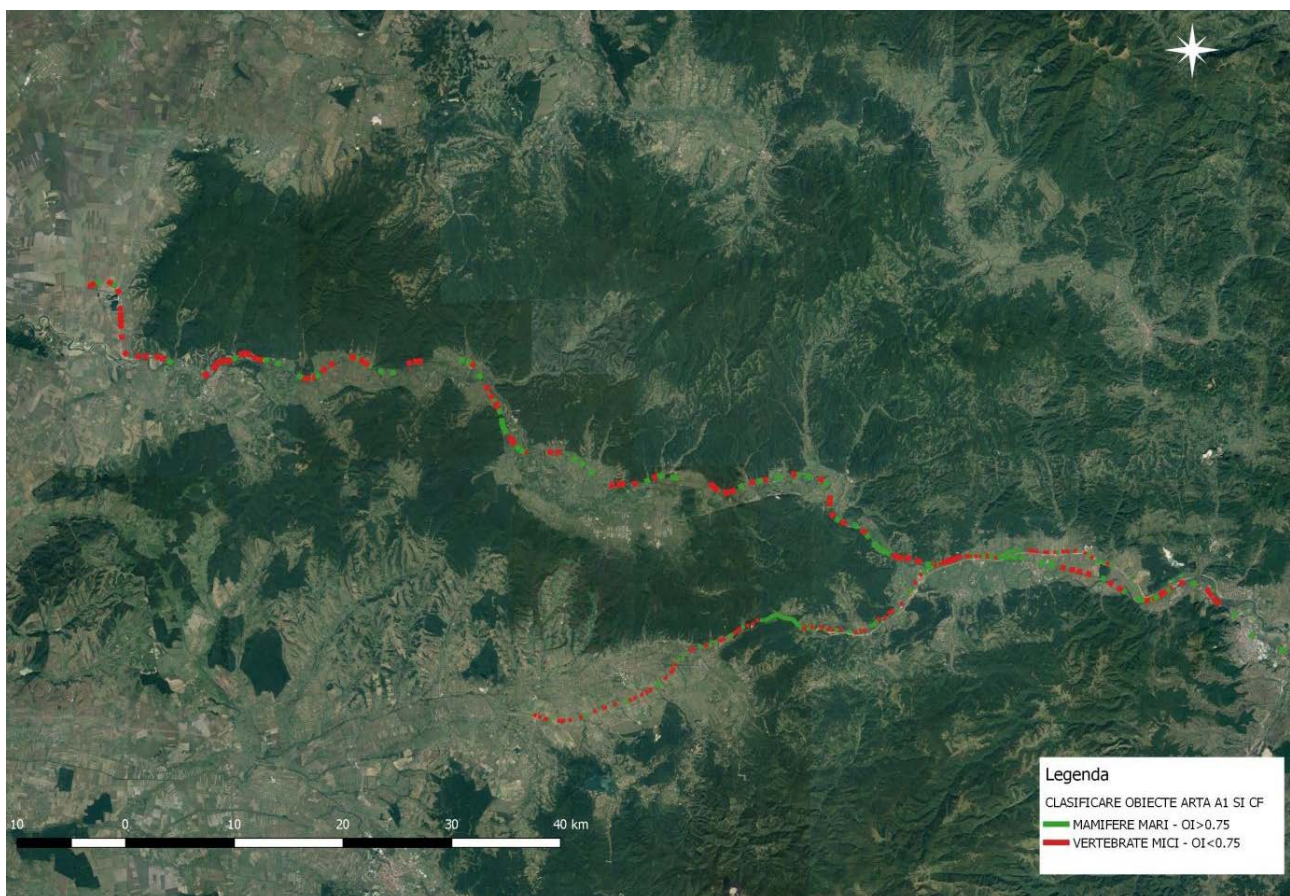


Fig. 2: Objects on railway and motorway have been mapped and could be classified by OI (Openness Index) in order to assess their functionality for different groups of species. Example of OI classification: green = OI > 0.75, red = OI < 0.75 (background Google Maps).

# Objective 1.1.

## Ensure functionality of underpasses

### 1.1.1. Comply with technical specification of underpasses from a design study and include the functional ones in the environment permits as wildlife structures (a. - railway; b. - motorway)

#### Examples of identified problems:

Since the motorway construction has been assigned in a build & design approach, the constructors have often modified the specification of objects to reduce the sizes/costs. It is not clear if the modifications have been agreed in the new EIA permits. In some sectors of the section IV of the motorway, special structures for wildlife have not been requested since the objects included in the feasibility study would have ensured the overall permeability. In this case the alteration of the original specification may have a significant impact. Likewise, in section III, it seems that the length of the bridge over the Mureş River has been significantly reduced.

As the railway is currently under construction, this issue needs to be clarified.

#### Existing resources (within TRANSGREEN and related projects):

The specifications of underpasses for Curtici-Simeria railway and Lugoj-Deva motorway within the study area have been collected from the project sketches and the GIS database has been created with Openess Index (OI) calculated for each object.

A classification on 12 classes of OIs relevant

for different groups of species has been produced based on the existing literature (TRANSGREEN).

Wildlife and Traffic in the Carpathians - Guidelines how to minimize the impact of transport infrastructure development on nature in the Carpathian countries and the Romanian version of it specify that all suitable underpasses need to be included in the environmental permits.

#### Priority areas:

Underpasses with higher chances to have important role for large carnivores (classes 8 – 12) have been highlighted separately for both the railway and motorway.

#### Actions required:

- Abandon build & design approach in favour of producing detailed final technical plans that will be followed by contractors and monitored by environmental authorities;
- Include all relevant objects into the environmental permits;
- Specify this requirement within the EIA/AA procedures;
- Compare the differences between specifications from the technical project with the constructive details of the build infrastructure, and the overall impact on permeability due to changes – as a case study;
- Design and develop an overall monitoring programme (*standards, protocols, guidelines, responsibilities, tasks, infrastructure, budgets, database, reports*) for infrastructure which will include object-based monitoring protocols; include the measure within the Natura 2000 management plans of ROSCI370 Râu Mureş între Lipova și Păulis, ROSCI0407 Zarandul de Vest, ROSCI0355 Podișul Lipovei-Poiana Rusca, ROSCI0064 Defileul Mureșului, ROSCI0373 Raul Mureş între Branisca și Ilia.



Fig. 3: A large rectangular passage included in the initial technical plan was changed into a semi-circular, reduced in size object, diminishing drastically its potential use for wildlife.

### 1.1.2. Enhance technical specification to increase OI in critical points (if the case)/avoid barriers for aquatic/semi-aquatic species

#### Examples of identified problems:

At this point of assessment, there are no evident occurrences in which underpasses would need to be enlarged; however, there are examples in which the constructive details of walls outside the underpasses are reducing the OI. From the drawings, it is unclear if the bottom of underpasses will be adjusted to allow for the movement of aquatic species.

#### Existing resources (within TRANSGREEN and related projects):

The specifications of underpasses for Curtici-Simeria railway within the study area have been collected from the project sketches, the GIS database has been created and the OIs have been calculated for each object in two ways – one without considering the adjacent walls and the other one with these elements counted in. In some instances, the difference is significant as additional walls are increasing the tunnel effect for underpasses. The objects (culverts, bridges) on permanent water courses can be selected in the database.

#### Priority areas:

A list of underpasses with significant differences induced by adjacent walls is available for the railway project. It is not clear if the walls are part of the pre-fabricated structures; however, this topic will be discussed with the railway company.

Objects for which OI decreased due to adjacent walls are available in database. Objects on permanent water courses could be selected in the GIS database.

#### Actions required:

- Specify the topic of adjacent structures and water barriers within the EIA/EA procedures;
- Develop an intervention programme (linked with the monitoring programme) aiming to maintain the functionality of underpasses; include the measure within the Natura 2000 management plans of ROSCI370 Râul Mureş între Lipova și Păuliș, ROSCI0407 Zarandul de Vest, ROSCI0355 Podișul Lipovei-Poiana Rusca, ROSCI0064 Defileul Mureșului;
- Document the impact as part of the object-based monitoring, included in the overall infrastructure monitoring programme.

### 1.1.3. Landscaping of underpasses (a - railway; b - motorway)

#### Examples of identified problems:

There is little experience in Romania in **adjusting constructive details of objects and in their integration in landscape** in order to make them functional/increase their functionality for wildlife.

Although this is a matter of case-by-case approach, there is a need for guidelines, trainings and experience exchanges on how to maximize the functionality of underpasses through design, construction and sensitive land management. As the functionality of the object is dependent on the surrounding terrain, and therefore beyond the jurisdiction/responsibility of the infrastructure administrators, landscaping/integration into the landscape should also be considered as part of the compensatory measures. These aspects should be included into the EIA/AA procedures.

In practice, the only reference made to the objects' role for functional permeability is in environmental permits, but only for objects specially designed as mitigation solutions for wildlife.

As objects functional for wildlife passage are critical points of the Green Infrastructure, there is a need for a focused and integrated approach in this matter.

#### Existing resources (within TRANSGREEN and related projects):

TRANSGREEN - Wildlife and Traffic in the Carpathians - Guidelines how to minimize the impact of transport infrastructure development on nature in the Carpathian countries and the Romanian adaptation thereof.

#### Priority areas:

Underpasses with higher chances to have an important role for large-carnivores (classes 8 – 12) have been highlighted separately for both the railway and motorway. The objects located within natural vegetation type of land-use, including water courses, have a higher chance to be used by wildlife/including aquatic species as the landscape features favour movement of animals towards/through the objects. On the other hand, objects located within less permeable terrain (i.e. crop fields) may be of higher local significance, therefore potential functionality of all objects should be maximized through landscaping.

#### Actions required:

- Develop guidelines on landscaping and build capacity through know-how exchange;
- Include landscaping into EIA/AA procedures and environmental permits, inclusively as compensatory measures;
- Include the measure within the Natura 2000 management plans of ROSCI370 Raul Mureş între Lipova și Păuliș, ROSCI0407 Zarandul de Vest, ROSCI0355 Podișul Lipovei-Poiana Rusca, ROSCI0064 Defileul Mureșului;
- Develop pilot projects focusing on concrete management/restoration of Green Infrastructure to maximize the functionality of underpasses on the Curtici-Simeria railway, Lugoj-Deva motorway and other infrastructure projects through landscaping.

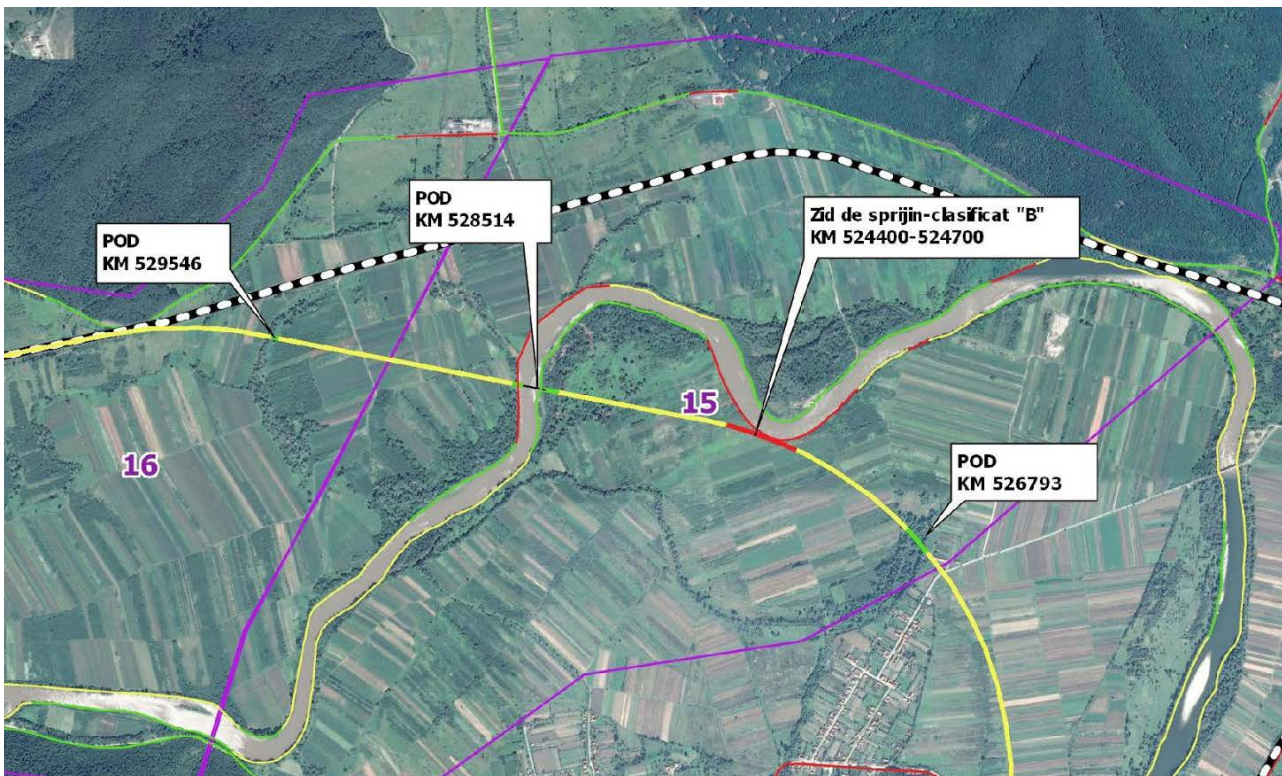


Fig. 4: Large bridges over the river Mureș should function as important underpasses on the upgrade railway, therefore proper landscaping is required in order to maximize their function. Example of permeability assessment: green = highly permeable, yellow = medium permeable, red = barrier for large mammals; purple = priority study areas; (background Google Maps).

#### 1.1.4. Adjust constructive details to mitigate noise and artificial lighting impacts (if the case) (a - railway; b - motorway)

##### Examples of identified problems:

To minimize disturbance effects, light and noise associated with traffic needs to be mitigated at least for objects important for wildlife passing.

**a - railway.** For the railway as the traffic is less constant, the impact of noise might be less relevant. There is no data on whether the bridges will be lightened. Even if the entrances of tunnels will be lightened, we expect the impact to be insignificant in the areas where the top of tunnels will be mostly forested. In open areas, the impact needs to be checked and addressed if the case (with special attention paid to mammals, including bats).

One option will be to exchange the fencing on top of underpasses for noise barriers – see measure 3.2.1 – to be discussed with the responsible railway experts.

**b - motorway.** Light and noise mitigation solutions have been included into the environmental permit of Lugoj-Deva motorway, but proper implementation of the measures needs to be observed.

##### Existing resources (within TRANSGREEN and related projects):

Best practices: Austrian Railway Company, EGNATIA Motorway Company.

##### Priority areas:

Long bridges on railway and motorway, viaducts, large underpasses on motorway.

##### Actions required:

- Develop guidelines on noise/light mitigation and build capacity through know-how exchange;
- Include noise/light mitigation related with important objects within the EIA/AA procedures and environmental permits;
- Include noise/light mitigation related with important objects as a measure within the Natura 2000 management plans of ROSCI370 Raul Mureș între Lipova și Păuliș, ROSCI0407 Zrandul de Vest, ROSCI0355 Podișul Lipovei-Poiana Rusca, ROSCI0064 Defileul Mureșului, ROSPA0029 Defileul Mureșului Inferior-Dealurile Lipovei;
- Develop pilot projects focusing on noise/light mitigation to maximize the functionality of objects on the Curtici-Simeria railway, Lugoj-Deva motorway and other infrastructure projects.

## Objective 1.2. Ensure the functionality of overpasses

### 1.2.1. Comply with the technical specification and technologies (bored tunnels) (a - railway; b - motorway)

#### Examples of identified problems:

**a - railway.** The tunnels were designed on the railway due to building requirements to achieve constant high speeds. The implied technology is bored tunnels. As this technology is the most environmentally friendly, the implementation needs to be observed, as the construction is assigned in a build & design approach and builders have often modified the specification and technologies after contracting. Therefore, respecting the bored-technologies needs to be discussed with the responsible staff of the railways.

**b - motorway.** The bored tunnels on the Lugoj-Deva motorway were requested as a mitigation measure for the most important sector for large carnivores' connectivity (and part of the system of solutions). Later, constructor companies opinioned that the solution should be extended as it will avoid potential landslides experienced in similar situations where the adopted solution meant massive excavations. The "tunnel section" was excluded from the contracted project and is yet to be opened for a tender. In the meantime, discussions continue about modifying the environmental permit in order to change back the solution to excavations instead of tunnels, arguing that bears are not present on the motorway alignment.

#### Existing resources (within TRANSGREEN and related projects):

TRANSGREEN Guidelines emphasizing on system of solutions for large carnivores outside permanent range.

TRANSGREEN Guidelines emphasizing the prioritization of the bored tunnels as a desirable technology.

#### Priority areas:

Tunnel areas have been made available as the GIS layers based on the technical project specifications.

#### Actions required:

- Implement the current environmental permit specifications related to bored tunnels solutions and include the technology specification in the tender documents for the Lugoj-Deva motorway.
- Highlight the benefits of tunnels as mitigation measures in the national guidelines;

c. Facilitate joint/integrated funding from the Green Infrastructure - a related funding line for costly mitigation measures (tunnels, green bridges, ...);

d. Monitor the implementation of tunnel solutions.

### 1.2.2. Maintain the permeability of the terrain on top of tunnels during their construction (a - railway; b - motorway)

#### Examples of identified problems:

There exists no extensive experience in Romania on building and maintaining the tunnel tops permeable on purpose during the construction.

The measure is addressing the land under the jurisdiction of CFR/CNAIR and is complementary with landscaping (integration of objects into adjacent landscape) and sectoral measures addressing the landscape elements.

#### Existing resources (within TRANSGREEN and related projects):

Assess the cases of already build railway tunnels (i.e. Hunedoara, Danes sections) and learn from these examples.

Priority areas:

The land under the jurisdiction of Motorway and Railway companies, respectively.

#### Actions required:

- Develop guidelines on maintaining the permeability of tunnel tops during construction and build the expert capacity through know-how exchange;
- Include specific requests (based on guidelines) concerning the permeability of tunnel tops into the EIA/AA procedures and environmental permits;
- Include the permeability of tunnel tops as a measure within the Natura 2000 management plans of ROSCI0064 Defileul Mureşului, ROSCI0355 Podişul Lipovei-Poiana Rusca Natura 2000 sites;
- Include the monitoring of facilitating-features as part of the tunnel tops management;

### 1.2.3. Manage green bridges (including tunnel-tops) surface in order to maximize their functionality for wildlife (a - railway, b - motorway)

#### Examples of identified problems:

There is no practical experience in Romania in adapting constructive details of green bridges and management of the area on top of green bridges

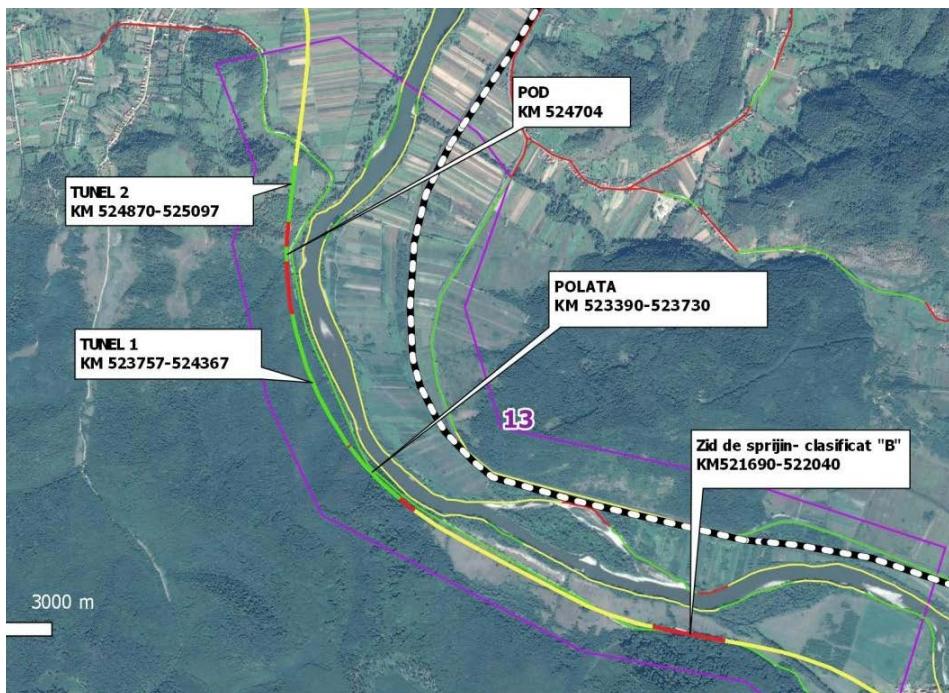


Fig. 5. Pojoga section is one of the two sectors where bored tunnels were projected on the Păuliș -Deva upgraded railway. It is important that specified technology be respected and the permeability on the top of tunnels be ensured during and after construction. Example of permeability assessment:  
green = highly permeable,  
yellow = medium permeable,  
red = barrier for large

in order to increase their functionality for wildlife. This measure only addresses the surfaces of the green bridges themselves, as their integration into landscape is the object of measure 1.2.4.

Although this is a matter of case-by-case approach, there is a need for guidelines, trainings and experience exchanges on how to maximize the functionality of green bridges through design, construction and specific land management on the tops of green bridges.

In practice, the technical details refer to constructive elements as fencing, noise/light barriers but not to landscape elements – soil, water, vegetation, micro-habitats, elements like stones, wood etc. – important to enhance the functionality for the wildlife and to deter from unwanted usage (vehicle use etc.).

Moreover, there is no experience on whom, how and with what resources will coherent management and maintenance works be implemented.

Another important topic related to the surface management is to properly incorporate monitoring tools/equipment/features and who and how the human access to the green bridges will be regulated and enforced.

As tunnels and green bridges represent critical wildlife passages, they are also very important elements of the Green Infrastructure, therefore there is a need for a focused and integrated approach to their management.

#### Existing resources (within TRANSGREEN and related projects):

The TRANSGREEN's Guidelines on Wildlife and Traffic in the Carpathian Countries and the Romanian national guidelines.

#### Priority areas:

Land under the jurisdiction of Motorway and Railway companies, respectively.

#### Actions required:

- Develop guidelines on maintaining the permeability of tunnel tops during construction and build the expert capacity through know-how exchange;
- Include the green bridges top-area management into the EIA/AA procedures and environmental permits;
- Include the green bridges top-area management and monitoring as a measure within the Natura 2000 management plans of ROSCI0064 Defileul Mureșului, ROSCI0355 Podisul Lipovei-Poiana Rusca, ROSCI0373 Raul Mureș între Branisca si Ilia Natura 2000 sites;
- Develop procedures/legislation related to the human access to the green bridges and enforce regulations, inclusively as the Natura 2000 regulations in ROSCI0064 Defileul Mureșului, ROSCI0355 Podisul Lipovei-Poiana Rusca, ROSCI0373 Raul Mureș între Branisca si Ilia Natura 2000 sites;
- Develop pilot projects focusing on concrete management/maintenance and monitoring on green bridges and tunnels of the Lugoj-Deva motorway and Arad-Curtici railway as very important elements of the Green Infrastructure, in order to maximize their functionality and to expand local experience.



Fig. 6: The land-use on top of the Pojoga tunnels of the Păuliș –Deva upgraded railway is complex, therefore adequate management regulations are mandatory in order to ensure functional connectivity.

#### 1.2.4. Landscaping of motorway green bridges

##### Examples of identified problems:

There is no experience in Romania as for the integration of green bridges into landscape in order to increase their functionality for the wildlife.

Although this is a matter of case-by-case approach, there is a need for guidelines, trainings and experience exchanges on how to maximize the functionality of green bridges through sensitive management of the adjacent land, which is not under the jurisdiction of the Motorway Company. As the functionality of the object is dependent on the surrounding terrain, and therefore beyond the jurisdiction/responsibility of the infrastructure administrators, landscaping/integration into landscape should be considered also as part of the compensatory measures. These aspects should be included into the EIA/AA procedures.

As green bridges represent critical wildlife passages, they are also very important elements of the Green Infrastructure, therefore there is a need for a focused and integrated approach to their management.

##### Existing resources (within TRANSGREEN and related projects):

TRANSGREEN - Wildlife and Traffic in the Carpathians - Guidelines how to minimize the impact of transport infrastructure development on nature in the Carpathian countries and the Romanian adaptation thereof.

##### Priority areas:

The area adjacent to green bridges.

##### Actions required:

- a. Develop guidelines on landscaping and build the expert capacity through know-how exchange;
- b. Include landscaping into EIA/AA procedures and environmental permits, inclusively as compensatory measures;
- c. Include landscaping as a measure within Natura 2000 management plans of ROSCI0064 Defileul Mureșului, ROSCI0355 Podișul Lipovei-Poiana Rusca, ROSCI0373 Râul Mureș între Branisca și Ilia Natura 2000 sites;
- d. Develop pilot projects focusing on concrete management/restoration of Green Infrastructure to maximize functionality of green bridges on Lu-goj-Deva motorway through landscaping, including long-term lease/acquiring land for conservation.





Fig. 7: Green bridges being built on the section 3 of the Lugoj-Deva motorway needs to be integrated into landscape through a local management plan aiming to ensure the functionality of these critical passage points.

### 1.2.5. Implement a solution for the Branisca motorway green bridge to mitigate DJ 706A county road

#### Examples of identified problems:

The Branisca green bridge is the first green bridge build in Romania, on the section IV of the Lugoj-Deva motorway. It was reduced in size from the original specifications due to its sub-optimal position for large carnivores. However, the monitoring process during the non-operational phase of the motorway shows it was used by a variety of mammal species, including the wild boar, the roe and the red deer, the wolf and the bear. Due to its location near sheepfolds, it is used regularly by sheep as well.

Due to jurisdiction issues with the adjacent land (county road and forest), the design solution didn't include mitigation of the nearby county road DJ 706A, therefore the Sothern end of the green

bridge leads precisely into the road. Although the traffic here is insignificant, the existing solution is suboptimal and needs to be adapted after the completion of the green bridge over the motorway.

#### Priority areas:

Branisca green bridge area including adjacent road and forested slope.

#### Actions required:

- Develop a design solution to complement the existing construction, based on the potential know-how;
- Solve the jurisdiction, land-property and permits for the extension;
- Develop a project to implement the solution, including the management and monitoring of the green bridge.



Fig. 8: In order to ensure its functionality, an extension of the Branisca green bridge needs to mitigate the adjacent county road and to lead the animals to/ from the forested area.



Fig. 9. County road DJ 707A will be used as a technical road during tunnel construction and will be most likely upgraded during the process. Already having steep slopes, any increase in the barrier effect during the upgrade will make the tunnel area dysfunctional.

### 1.2.6. Maintain/restore permeability of adjacent roads DJ 707A and 63 after building the railway tunnels

#### Examples of identified problems:

The railway upgrade project includes two tunnel sections in the hill areas in the vicinity of Bata and Tisa villages. The adjacent roads already have high slope embankments making the tunnel areas sub-optimal for medium-large size mammals. The adjacent roads will be used as access roads during the tunnel construction and some road platform enlargement activity is to be expected/is happening already, leading to an increase in physical barriers for wildlife movement. In order to maximize the functionality of tunnel areas, it is critical that the permeability of the roads be restored/enhanced after construction through intervention on adjacent slopes and on adaptation of the traffic safety elements for DJ 707A.

#### Priority areas:

Road DJ 707A and 63 sections adjacent to railway tunnels.

#### Actions required:

- a. Develop an intervention plan with a railway company and railway constructors;
- b. Develop an intervention plan with road companies;
- c. Develop a pilot project to support adaptations/restoration work.

### 1.2.7. Decommissioning of the Cosevita motorway junction after completion of tunnel sector (TBD)

#### Examples of identified problems:

Since the motorway section with tunnels is not open yet for a tender and it is expected to be the last section finished, the builder of motorway section III constructed a junction in order to allow a connection of the finished motorway sectors with the European road E673/68A. The junction was not originally part of the project and is unclear if the environmental permit has been modified to address this new element. Therefore, it is undefined if the junction will be decommissioned after the completion of the tunnel sectors, by whom, how and from what resources.

#### Priority areas:

The Cosevita motorway junction.

#### Actions required:

- a. Agree on a plan to address the junction after the motorway completion;
- b. Develop a pilot project to support potential decommissioning, restoration work.

# Objective 1.3.

## Assign legal status and develop coherent regulations for wildlife passages

### 1.3.1. Include important passing structures (tunnels, green bridges, bridges, viaducts, other large underpasses) in cadastre plans

#### Examples of identified problems:

Green Infrastructure elements are not included into the cadastre plans; therefore, there are no restrictions on land use/anthropic activities which can impact their functionality.

#### Existing resources (within TRANSGREEN and related projects):

Apuseni-Meridionali corridor is a pilot-area within ConnectGREEN DTP project dealing with harmonization of the Green infrastructure with land-use plans.

#### Priority areas:

Objects suitable for different groups of mammals are available as a GIS database.

#### Actions required:

- Map Green Infrastructure elements and assess them in relation with land-use categories;
- Implement demonstrative harmonization of Green Infrastructure with land-use plans in the ConnectGREEN DTP project;

- Develop guidelines based on the ConnectGREEN DTP project experience;
- Implement other projects aiming at harmonization of Green Infrastructure with land-use plans.

### 1.3.2. Include important passing structures (tunnels, green bridges, bridges, viaducts, other large underpasses) and important permeable sectors of linear features into the Natura 2000 management plans with assigned measures for the land management, usage regulations and monitoring

#### Examples of identified problems:

Coherence of the Natura 2000 network is not reflected in measures addressing the permeability of the landscape/Green Infrastructure. Important passage objects or sectors are not addressed in the Natura 2000 sites management plans; therefore, there are no restrictions on land use/anthropic activities which can impact their functionality, or specific management/conservation/monitoring measures.

#### Existing Resources (within TRANSGREEN and related projects):

TRANSGREEN Guidelines – EIA, monitoring TRANSGREEN & LIFE LCC permeability maps and methodologies.

#### Priority areas:

The GIS data base of objects and permeable sectors correlated with the Natura 2000 sites limits. Natura 2000 sites – please refer to map.

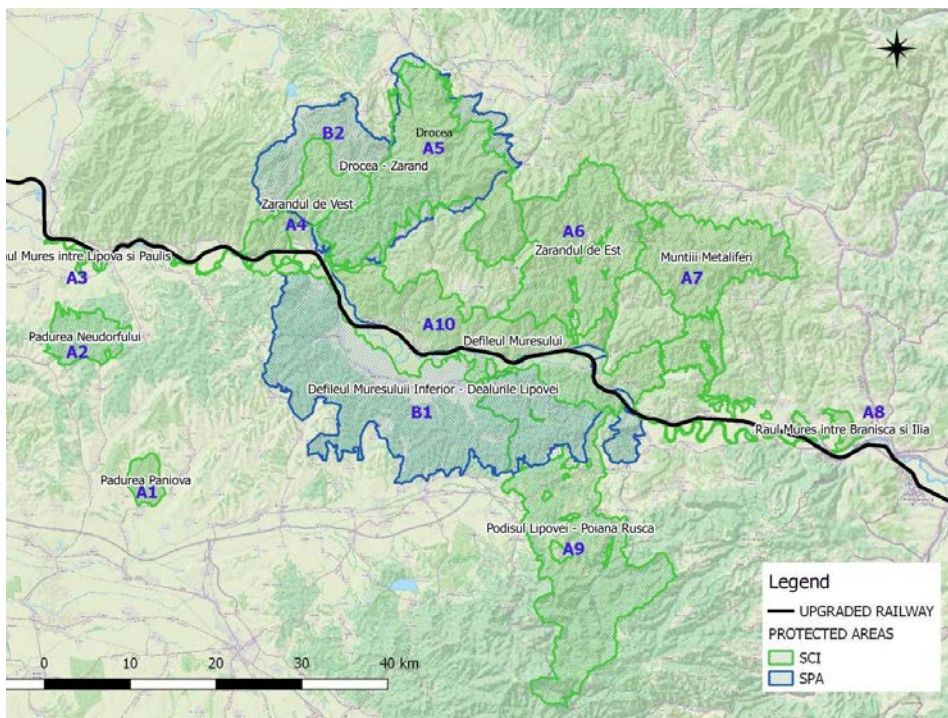


Fig. 10: The Natura 2000 sites in the pilot area (map source: Open Street Maps, The Romanian Ministry of Environment).

Table 2. Natura 2000 sites within pilot area

NAME and CODE of protected area	Type	Code on Map
ROSCI0338 Padurea Paniova	SCI	A1
ROSCI0337 Padurea Neudorfului	SCI	A2
ROSCI370 Raul Mureş între Lipova și Păuliș	SCI	A3
ROSCI0407 Zarandul de Vest	SCI	A4
ROSCI0070 Drocea	SCI	A5
ROSCI0406 Zarandul de Est	SCI	A6
ROSCI0325 Muntii Metaliferi	SCI	A7
ROSCI0373 Raul Mureş între Branisca și Ilia	SCI	A8
ROSCI0355 Podisul Lipovei-Poiana Rusca	SCI	A9
ROSCI0064 Defileul Mureşului	SCI	A10
ROSPA0029 Defileul Mureşului Inferior-Dealurile Lipovei	SPA	B1
ROSPA117 Drocea-Zarand	SPA	B2

#### Actions required:

- Develop guidelines and implement the Natura 2000 sites specific conservation measures and regulations in order to maintain/enhance functionality;
- Integrate conservation measures and regulations into the updated Natura 2000 management plans;
- Integrate conservation measures, regulations and monitoring into coherent operational plans for regional action plans (i.e. the the Bear and Wolf Regional Action Plans of LIFE LCC);
- Develop projects to implement measures, regulations and monitoring in the Natura 2000 sites;
- Produce the EIA/AA set of procedures and measures for Natura 2000 sites related with permeability.

## Objective 1.4. Increase the permeability of railway embankments

### 1.4.1. Facilitate restoration with natural/ indigenous grass vegetation of embankment sections (if the case)

#### Examples of identified problems:

Although the first aim is to ensure the functionality of underpasses and overpasses as safe passages for wildlife, since the railway will not be fenced, it is expected for mammals to cross the railway embankments.

The environmental permit asks for adaptation of the rock-bed embankments for ungulates, by grass instalment. At this point it is unclear if and what kind of interventions are necessary, as the railway is not yet built, but if the sectors will be adapted for ungulate use, respective sectors should be selected

where accidents are more easily avoided/mitigated (sectors with high visibility); complementary solutions should be implemented – signalling, detectors etc.

#### Existing resources (within TRANSGREEN and related projects):

Austrian Railway Company (ÖBB) best practice.

#### Priority areas:

Potential sectors not overlapping with danger zones have been included into the GIS database.

#### Actions required:

- Identify existing case studies and technological solutions;
- Delineate and monitor potential sectors after railway construction has been completed;
- Implement embankment restoration solution if this is the case, in conjunction with accident-avoidance measures and monitoring procedures;
- Develop best-practice guidelines.

## INCREASING BARRIER EFFECT OF EXISTING LINEAR FEATURES CAUSED BY STRUCTURAL INTERVENTIONS

### Description:

The Mureş floodplain represents a transport corridor, European/national road and railway following the river course and secondary (county/communal and local) roads accessing them. The ecological linkage role of the Mureş floodplain is important for both transversal connectivity between adjacent forested areas in the North and South for which the Mureş tributaries and their riparian vegetation are important, but also for *longitudinal connectivity* ensured by the Mureş River and its riparian vegetation.

Existing infrastructure is already causing barriers for the wildlife. The Mureş River has a serpentine course with banks being constantly eroded, which led to diverse and dynamic transversal permeability.

At present the connectivity role is not fully acknowledged and not considered during structural interventions with the existing infrastructure (modernization /upgrades) or with water courses (flood-prevention works), environmental procedures not addressing the connectivity topic.

The role of tributaries is extremely important for aquatic species both as reproduction sites and refuges, but the longitudinal permeability of the Mureş River and its tributaries is already affected by a series of engineering works which increase the impact of climate change-related phenomenon (drought).

### Objectives:

- » Maintain the current level of transversal permeability, prioritizing permeable sectors which allow for safe crossings for the wildlife between the northern and southern forested areas.
- » Maintain/increase the longitudinal permeability of the Mureş River and of its tributaries and mitigate existing barriers.

### Objectives set to address the threats are:

2.1. Maintain permeability of the existing transport infrastructure

2.2. Maintain the permeability of the Mureş River banks at current level

2.3. Maintain/increase longitudinal permeability of the Mureş River and its tributaries

Measures proposed per objectives are described below with the list of required/proposed actions:

## Objective 2.1. Maintain permeability of existing transport infrastructure

### 2.1.1. Inform the road/rail and environmental authorities on important (permeable) sectors

Examples of identified problems:

Road and environmental authorities do not have access to a database/map of important (permeable) road sectors and objects.

#### Existing resources (within TRANSGREEN and related projects):

A methodology (AZ 2017) has been developed to classify important structural characteristics of roads and to model permeability for different groups of species. GIS maps showing 3 permeability classes for large carnivores are available for most of road infrastructure.

#### Priority areas:

Road (European, national, county level) and rail network.

#### Actions required:

- a. Continue mapping of infrastructure, including sectors under construction;
- b. Develop classification formulas for other species groups and ground-proofing of results;
- c. Include the infrastructure permeability maps in the GreenWeb GIS database;
- d. Align GIS maps with road authority database;
- e. Facilitate authorities' usage of GreenWeb database and platform;
- f. Implement periodic mapping of infrastructure (with higher frequency in critical points), assess changes and inform responsible authorities (*as part of an integrated monitoring programme*).

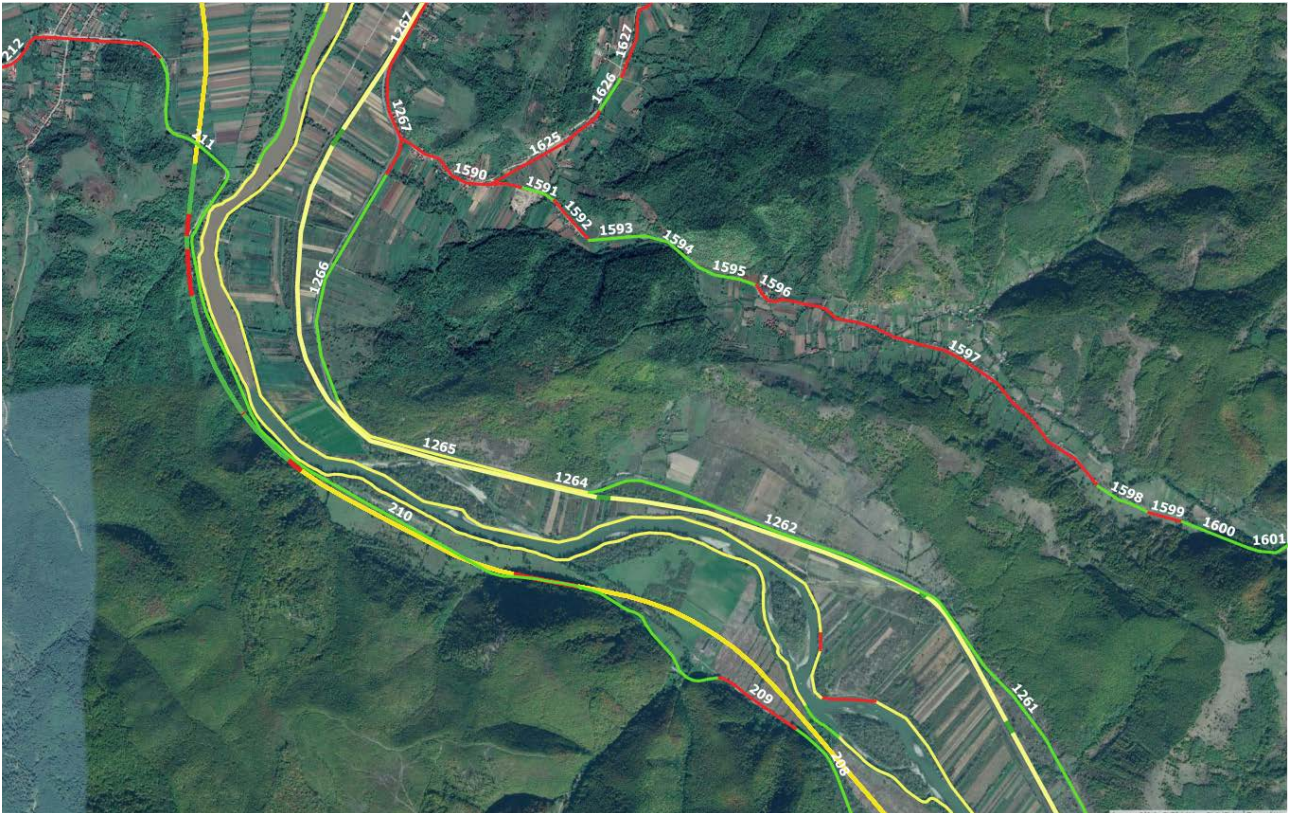


Fig. 11: Example of permeability assessment of linear features for large carnivores being mapped: green = highly permeable, yellow = medium permeable, red = barrier; (background Google Maps).

### 2.1.2. Inform responsible environment and road/rail authorities (including designers and constructors) on technical criteria for maintaining permeability

#### Examples of identified problems:

Road and environmental authorities do not have access to guidelines on design and building technical solutions to maintain or to increase permeability of existing infrastructure during upgrading/maintenance interventions.

#### Existing resources (within TRANSGREEN and related projects):

European defragmentation programs.

#### Priority areas:

Preserving/increasing the existing permeability for large carnivore species is critical in the current permeable sectors (class F and R/green and yellow) and potential restoration in the current barriers (class B/red sectors).

#### Actions required:

- a. Develop guidelines on maintaining the permeability of tunnel tops during construction and build the expert capacity through know-how exchange.

### 2.1.3. Structural interventions (upgrading/modernization etc.) should be subject of EIA/AA procedures

#### Examples of identified problems:

There are examples when the upgrading/modernizations of transport infrastructure projects were not subject of the EIA/AA procedures and, as a result, the fragmentation impact was significant.

Regarding the upgraded rail line, it should be discussed if/how/when the existing sectors will be decommissioned.

#### Priority areas:

Preserving/increasing the existing permeability for large carnivore species is critical within the current permeable sectors (class F and R/green and yellow) and potential restoration in the current barriers (class B/red sectors).

#### Actions required:

- a. Include technical solutions into the EIA/AA procedures and environmental permits, inclusively as compensatory measures to restore the permeability of existing barriers when new barriers could not be avoided;

- b. Include technical solutions linked with measures within the Natura 2000 management plans of ROSCI370 Raul Mureş între Lipova si Păuliş, ROSCI0407 Zarandul de Vest, ROSCI0355 Podisul Lipovei-Poiana Rusca, ROSCI0064 Defileul Mureşului, ROSCI0373 Raul Mureş între Branisca si Ilia.

**2.1.4. Periodic management of road/rail objects included in a maintenance programme, implement interventions to avoid barriers for aquatic/semi-aquatic species**

**Examples of identified problems:**

A series of underpasses of existing roads are blocked by alluvial material, dense vegetation or anthropogenic debris/waste. In some cases, the water courses have eroded under the culvert beds and therefore the connectivity for aquatic species is (quasi-)permanently affected.

**Priority areas:**

All objects over the permanent tributaries of the Mureş are included in the GIS database.

**Actions required:**

- a. Include connectivity-focused periodic maintenance of road/rail object;
- b. Develop pilot projects focusing on concrete maintenance of the existing infrastructure in order to maintain or increase the permeability and to produce best-practices/procedures /standards in collaboration with road, rail, water and environmental staff responsible;
- a. Develop a permanent monitoring programme linked with object-database (*as part of an integrated monitoring programme*).



Fig 12. Example of blocked small bridge/culvert on the existing railway - Km 566+100



Fig. 13: Sector on the river Mureş with highly permeable (class F) natural banks.

## Objective 2.2. Maintain the permeability of the Mureş river banks at current level

### 2.2.1. Inform the water and environmental authorities on the Mureş banks permeable sectors

#### Examples of identified problems:

Water and environmental authorities do not have access to a database/map of the important Mureş banks (permeable) sectors and objects.

#### Existing resources (within TRANSGREEN and related projects):

A methodology (AZ 2017) has been developed to classify and model the permeability of river banks for different groups of species. GIS maps of showing 3 permeability classes for large carnivores are available for the Mureş River.

#### Priority areas:

Mureş River.

#### Actions required:

- b. Develop classification formulas for other species groups and ground-proofing of results;
- c. Include the river permeability maps in the GreenWeb GIS database;
- d. Align GIS maps with water authority database;
- e. Facilitate authorities' usage of GreenWeb database and platform;
- f. Implement periodic mapping of river banks (with higher frequency on critical points), assess changes and inform responsible authorities (as part of an integrated monitoring programme).

### 2.2.2. Inform responsible environment and water authorities (including designers and constructors) about technical solutions for maintaining permeability while implementing flood-preventing structural interventions & prioritization for new "green" alternative (non-structural approach)

#### Examples of identified problems:

Water and environmental authorities have limited good-practice experience at designing and implementing close-to-nature flood-preventing solutions.

#### Existing resources (within TRANSGREEN and related projects):

The Netherlands, Germany – river restoration program.

#### Priority areas:

The Mureş and its tributaries.

Preserving/increasing existing permeability for large carnivore species is critical in current permeable sectors (class F and R/green and yellow) and potential restoration in current barriers (class B/red sectors).

#### Actions required:

- a. Map the permeability of tributaries;
- b. Develop guidelines on maintaining the permeability of tunnel tops during construction and build the expert capacity through know-how exchange;
- c. Include technical solutions linked with measures within the Natura 2000 management plans of ROSCI370 Raul Mureş între Lipova si Păuliş, ROSCI0407 Zarandul de Vest, ROSCI0355 Podisul Lipovei-Poiana Rusca, ROSCI0064 Defileul Mureşului, ROSCI0373 Raul Mureş între Branisca si Ilia.
- d. Develop pilot projects to implement solutions as case-studies/good-practice experiences.



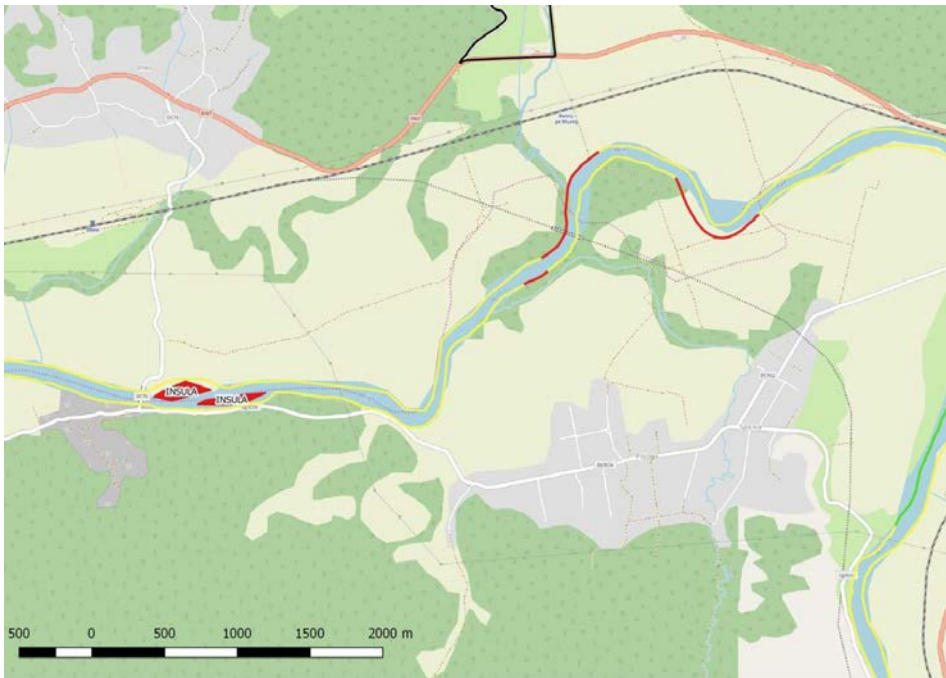


Fig 14: Example of permeability classification for the Mureș River banks for large carnivores: green = highly permeable, yellow = medium permeable, red = barrier.

### 2.2.3. Structural interventions on river banks should be the subject of the EIA/AA procedures

#### Examples of identified problems:

Transversal connectivity is not a topic addressed by the EIA/AA procedures and structural interventions are usually linked with flooding prevention and considered as overriding biodiversity objectives.

Another type of interventions is related to the stabilization of banks within the immediate vicinity of a transport infrastructure. In the case of railway upgrade, the length of these structural interventions is limited and with an overall insignificant impact; however, in other cases the modernization of infrastructure has been done in conjunction with water course regulation in significant lengths (as European road E79) leading to a major decrease in transversal connectivity.

#### Existing Resources (project):

Current measure is linked with measures 2.2.2.

#### Priority areas:

Preserving/increasing the existing permeability for large carnivore species is critical in the current permeable sectors (class F and R/green and yellow) and potential restoration in the current barriers (class B/red sectors).

#### Actions required:

- Include technical solutions in the EIA/AA procedures and environmental permits, inclusively as compensatory measures;

- Include technical solutions linked with measures within the Natura 2000 management plans of ROSCI370 Raul Mureș între Lipova și Păuliș, ROSCI0407 Zarandul de Vest, ROSCI0355 Podisul Lipovei-Poiana Rusca, ROSCI0064 Defileul Mureșului, ROSCI0373 Raul Mureș între Branisca și Ilia.

## Objective 2.3. Maintain/increase longitudinal permeability of the Mureș River and of its tributaries

### 2.3.1. Identify all barriers and develop an intervention/defragmentation programme (inclusive for the Mintia dam)

#### Examples of identified problems:

Longitudinal permeability is becoming more critical in the context of climate-change effects – droughts and flooding –; therefore, the impact of potential barriers (dams, undersized culverts, bridges) needs to be assessed and an intervention/defragmentation programme needs to be designed. The Mintia dam is blocking the migration of fish on the Mures River and a mitigation solution needs to be implemented.

**Existing resources** (within TRANSGREEN and related projects):

The Netherlands, Germany – river restoration program.

**Priority areas:**

Mintia dam on the Mureş River.

**Actions required:**

a. Map, document and prioritize intervention points;

- b. Develop guidelines on maintaining the permeability of tunnel tops during construction and build the expert capacity through know-how exchange;
- c. Develop pilot projects to implement solutions as case-studies/good-practice experiences;
- d. Monitor the impacts of implemented solutions.

## 3 Threat 3

### WILDLIFE MORTALITIES ASSOCIATED WITH LINEAR INFRASTRUCTURES (INCLUDING ELECTRIC POWER LINES)

**Description:**

As new major infrastructure is developing and high traffic is swapping from the National roads towards motorways and trains will achieve significantly higher speeds, wildlife-traffic dynamic is expected to change as well (number of incidents, locations, frequencies, severity – damages and potential human casualties).

Wildlife mortalities associated with linear infrastructures is considered as one of the major anthropogenic impacts, but in Romania it is not studied too much. However, the implications do not only concern biodiversity but are related with traffic safety, damages and even human casualties, therefore proper mitigation should be taken seriously.

We also included here the impact of electric lines (power lines and railway electric lines) on birds, which seems high in Romania compared with other countries since this impact is not mitigated either.

**Objectives:**

- » The first objective will be to prevent wildlife from entering the motorway by implementing an adequate fencing system including escape gates for animals that accidentally enter motorways. For unfenced infrastructure, the objective is to implement traffic safety measures, direct the wildlife towards safe passages and to prevent animals from being trapped inside tunnels or on large bridges where accidents are difficult to avoid.
- » Special objectives should address bats, birds and amphibians which are impacted by light, noise and water management related to infrastructure. For birds, the mitigation of electric lines is very important.

- » A specialized intervention team should be created to respond to wildlife-related situations on motorways, especially as large mammals can be trapped in hazardous incidents when crossing the infrastructure.
- » A system of collecting data and assessment of situations is mandatory as a decision-making tool.

**Objectives set to address the threats are:**

- 3.1. Implement an adequate fencing system on motorways, including escape gates
- 3.2. Direct animals towards functional underpasses for non-fenced infrastructure
- 3.3. Warn drivers in road-kill/accident-danger areas
- 3.4. Warn train conductors in road-kill/accident-danger areas
- 3.5. Prevent accidents caused by mammals blocked in tunnels or on large bridges
- 3.6. Increase visibility on roads/railways
- 3.7. Special measures for birds
- 3.8. Special measures for bats
- 3.9. Special measures for amphibians/reptiles
- 3.10. Collect and assess data to understand critical points/sectors
- 3.11. Use integrated database as decision-supporting tools (to take/adjust measures to prevent traffic-kills/damages /human casualties)
- 3.12. Develop specialized teams to deal with wildlife-related incidents on transport infrastructure, including emergency interventions

Measures proposed per objectives are described below with the list of required/proposed actions:

## Objective 3.1. Implement an adequate fencing system on motorways, including escape gates/ramps

### 3.1.1. Implement an adequate fencing system on motorways, including escape gates

#### Examples of identified problems:

For some sections of the Lugoj-Deva motorway, the environmental permit requested special bear-proof fence; however, as the bear incidents on motorways became more frequent, there is a need to assess the necessity for a potential extension of the bear-proof fencing. Also, it is important to add escape gates for mammals which entered the motorways.

#### Existing resources (within TRANSGREEN and related projects):

Specifications of bear-proof fence within Environmental permit for the Lugoj-Deva;

EGNATIA highway experience on expanding bear-proof fencing;

TRANSGREEN guidelines;

#### Priority areas:

Lugoj-Deva between Nemesesti and Soimus;

Extend to A1 within bear range;

#### Actions required:

- Implement bear-proof fence solutions requested by environmental permit for the Lugoj-Deva;
- Assess other risk-areas and implement bear-proof fence solutions;
- Develop pilot projects to improve the fencing system on A1, implement escape-gates solutions.



Fig. 15: Incidents with bears on A1 motorway are becoming more frequent. Assessment of situation, implementing adequate fencing and ensuring permeability in critical areas are important not only for connectivity but for traffic safety as well (photos from press - [www.oradesibiu.ro](http://www.oradesibiu.ro))



### 3.1.2. Implement a programme of fencing assessment and repairing/upgrading when necessary

#### Examples of identified problems:

Due to degradation of existing regular fences there are a lot of incidents with wildlife and domestic animals entering the motorways.

Other high-risk areas are the junction areas where animals can enter the motorways; therefore, the extension of proper fencing and escape-gates should be implemented here as well.

#### Existing resources (within TRANSGREEN and related projects):

EGNATIA Motorway Company, Greece.

#### Priority areas:

All motorway sections and junction areas – Şoimuş, Gothatea, Coşevita, Margina.

#### Actions required:

- Collect data and make use of the database of accident/incidents /high risk-sectors;
- Implement a fencing assessment programme which will inform of regular repairing/upgrading/extension of fences;
- Assess other risk-areas and implement proper fencing solutions on national roads in junction areas;
- Develop pilot projects to mitigate junction areas and affected fences.

## Objective 3.2. Direct animals towards functional underpasses

### 3.2.1. Fence areas above the functional underpasses for medium/large mammals (a - on railway; b - on European roads, if necessary)

#### Examples of identified problems:

For non-fenced infrastructure (national roads, railways), the possibility for wildlife to cross over embankments is still present. As discussed, the priority would be to make so many functional underpasses that the collision risk would be minimized. The fencing sectors where functional underpasses are located will increase the chance for medium/large-sized mammals to use those underpasses.

The measure is important on the new railway as the collision risks would be higher compared with the actual situation when trains are circulating with low speed and at low frequencies.

For national roads, the traffic is expected to reduce significantly after the motorway will be completely functional, thus the opportunity of the measure should be assessed after the completion of motorway.

#### Existing resources (within TRANSGREEN and related projects):

Location of underpasses on the railway is available as the GIS database.

#### Priority areas:

Underpasses with OI > 4.

#### Actions required:

- Design solutions and specifications for fencing, based on expertise exchange;
- Develop pilot project to implement solutions on the railway;
- Map underpasses and assess traffic/wildlife incidents on roads after motorway completion;
- Develop pilot project to implement solutions on the national roads, if necessary.

### 3.2.2a. Install special walls to direct amphibians, reptiles towards underpasses and adapt embankments - on railway

### 3.2.2b. Install special walls to direct amphibians, reptiles, small mammals into underpasses - on roads

### 3.2.2c. Enhance structures specified in the environmental permit with special walls to direct amphibians, reptiles, small mammals into underpasses - on motorway

#### Examples of identified problems:

For non-fenced infrastructure (national roads, railways) the possibility for wildlife to cross over the embankments is still present. As discussed, the priority would be to make so many functional underpasses that the wildlife kills would be minimized. One solution is to install special plastic walls in order to direct amphibians/reptiles/other small-size species into the functional underpasses.

For railway, a complementary measure is to install special small tunnels on embankments/beneath the rails.

#### Existing resources (within TRANSGREEN and related projects):

Locations of underpasses necessary for amphibians were requested by the environmental permit for the Lugoj-Deva motorway.

Location of underpasses on the railway is available as the GIS database.

Recommendations available in TRANSGREEN guidelines.

### Priority areas:

Underpasses for amphibians requested through the environmental permit for the Lugoj-Deva motorway.

Important areas for amphibians/reptiles identified through studies related with railway upgrade.

### Actions required:

- Implement solutions requested by environmental permits;
- Map traffic kill sectors significant for amphibians;
- Develop pilot project to identify important areas for amphibians/reptiles/small-size animals and to implement solutions on the railway, roads and motorway.

## Objective 3.3. Warning drivers on road-kill/accident-danger areas

### 3.3.1. Install warning signs in accident-prone areas on roads/motorways

#### Examples of identified problems:

One solution to prevent roadkills /accidents/ incidents related to the wildlife in traffic is to signal high-risk areas for the drivers. These high-risk areas should be identified based on robust data collection (see Objective 10 and 11). The completion of motorway will affect traffic in the area and may

affect the location of the road-kill/accident-prone sectors.

#### Existing resources (within TRANSGREEN and related projects):

High-risk areas have been identified based on road-kill records collected and are available in the GIS database. Locations of traffic signs have been proposed.

Recommendations available in TRANSGREEN Guidelines.

#### Priority areas:

High-risk areas where traffic signs no longer exist.

#### Actions required:

- Extend data collection and identification of high-risk areas on roads;
- Develop pilot project to implement traffic signs;
- Monitor the reaction of drivers to the classic traffic warning signs.

### 3.3.2. Test & implement new type of warning devices, including automatic animal-detectors on roads

#### Examples of identified problems:

The classic warning signs may not trigger the expected reaction from drivers as they get used to them in time. In this respect, new type of signs (luminous etc.) may work at making drivers more alert.

Other potential solutions are to implement automatic animal-detectors (either detecting the animals' presence and alerting drivers, or alerting animals about approaching cars). The efficiency of



Fig. 16: Existing data can inform authorities on high-risk areas on roads.

these solutions is still debatable and depends on the local context.

**Existing resources** (*within TRANSGREEN and related projects*):

High-risk areas have been identified based on road-kill records collected and are available in the GIS database. Locations of traffic signs have been proposed.

A LIFE project will test the implementation of the automatic warning solution in Romania.

**Priority areas:**

High-risk areas.

**Actions required:**

- a. Monitor the efficiency of classic and alternative traffic signs;
- b. Develop pilot project to implement alternative traffic signs.

## Objective 3.4. Warning train conductors on road-kill/accident-danger areas

### 3.4.1. Install warning signs for conductors (physical/visual or automatic signals) in accident-prone sectors

**Examples of identified problems:**

The measure is important on the new railway as the collision risks with both wildlife and domestic animals would be higher compared with the actual situation when trains are circulating at low speed and low frequencies. The potential high-risk sectors are on curves, at entrances/exits of tunnels and long bridges and in the vicinity of dense vegetation. Therefore, the measures under this objective correlate with the complementary ones addressing visibility etc.

The signals may be classic (physical signs along the railway) or may be automatic warning signals inside the locomotive when approaching high-risk sectors.

**Priority areas:**

Potential high-risk areas have been identified based on the alignment and habitat favourability for medium-large-sized mammals.

**Actions required:**

- a. Develop pilot project to collect data, implement warning signs based on expertise-exchange and monitor the impact of measures.

### 3.4.2. Test & implement new type of warning devices - automatic animal detectors

**Examples of identified problems:**

The measure is important on a new railway as the collision risks with both wildlife and domestic animals would be higher compared with the actual situation when trains are circulating at low speed and low frequencies. Although the potential high-risk sectors are on curves, at entrances/exits of tunnels and long bridges and in the vicinity of dense vegetation, as the railway will not be fenced, the risk of collision with medium-/large-sized animals is present along the entire alignment.

The warning devices should detect medium-/large-sized animals on or in the vicinity of the rail and to signal their presence to train conductors and/or to deter animals using acoustic signals.

**Existing resources** (*within TRANSGREEN and related projects*):

**Priority areas:**

Potential high-risk areas have been identified based on the alignment and habitat favourability for medium-large-sized mammals.

**Actions required:**

- a. Develop pilot project to collect data, implement warning signs based on expertise-exchange and monitor the impact of measures.

## Objective 3.5. Prevent accidents caused by mammals blocked in railway tunnels or on long bridges

### 3.5.1. Fence sectors at entrance/exit of tunnels/bridges for medium - large mammals, with escape gates

**Examples of identified problems:**

Large/medium-sized animals and even people entering the railway tunnels or bridges on the Mureş River represent a very high-risk situation, which can lead to traffic accidents. To prevent this, fences with escape gates should be installed at entrances/exits of tunnels and bridges.

The technical specification of fences should be discussed as it may not be necessary to install the full-specification bear-proof ones (with underground and top reinforced parts) if the animals still have the option to pass through the laterals. The solution

should be implemented in conjunction with measure 3.5.2, as fencing does not ensure 100% prevention.

**Existing resources** (*within TRANSGREEN and related projects*):

Austrian Railway Company.

**Priority areas:**

Tunnel areas and the Mureş bridges.

**Actions required:**

- a. Design solutions and specifications for fencing, based on expertise exchange;
- b. Develop pilot project to implement solutions on the railway.

**3.5.2. Automatic sound/light warning signals when trains approach tunnels or bridges; Detectors/signals for medium - large mammals & humans entering tunnels/crossing on long bridges;**

**Examples of identified problems:**

Large/medium-sized animals and even people entering the railway tunnels or bridges on the Mureş River represent a potentially high-risk situation for accidents to occur. As fencing (measure 3.5.1.) does not ensure 100% prevention, complementary solutions are necessary to alert either animals/people of approaching trains, or the train conductors of animals/people being inside tunnels or on bridges.

**Existing resources** (*within TRANSGREEN and related projects*):

Austrian Railway Company.

**Priority areas:**

Tunnel areas and the Mureş bridges.

**Actions required:**

- a. Design detectors/ automatic sound/light warning signals based on the expertise exchange;
- b. Develop pilot project to implement solutions on the railway.

## Objective 3.6. Increase visibility on roads/railways

**3.6.1. Adequate management of verges (a - of roads, b - of railway)**

**Examples of identified problems:**

The role of the verges is important, complex and their functionality depends on the structure, type

and frequency of interventions. Therefore, clear and coherent management measures should be designed and implemented.

The management should aim to develop structures adequate for harmonizing the different roles of verges – prevent traffic accidents, ensure noise and light filter, prevent fire from spreading, barriers for snow, prevent invasive species from spreading and take into consideration their habitat role.

The standards/recommendations for verge management should also take into account the land use – infrastructure, forest, pasture, agricultural, wetlands/riparian, afforestation etc. – and to align with sectoral management.

The type (mechanical, chemical) of interventions and their frequency are important for the local species.

**Existing resources** (*within TRANSGREEN and related projects*):

TRANSGREEN Guidelines.

**Priority areas:**

All major infrastructure.

**Actions required:**

- a. Develop guidelines and norms for verge management based on exchange of expertise;
- b. Include guidelines and norms in the sectoral policies, norms and practices (transport, agriculture, forestry, water, conservation);
- c. Develop pilot project to implement verge management.

## Objective 3.7. Special measures to avoid birds' mortalities

**3.7.1.a. Implement protection solutions for power lines**

**3.7.1.b. Implement protection solutions for railway electric lines**

**Examples of identified problems:**

Powerlines represent a risk for bird mortalities, but the impact is not mitigated in Romania. Railway electric lines are considered to have a lesser impact; however, mitigation measures are implemented in different countries.

**Existing resources** (*within TRANSGREEN and related projects*):

The Czech Republic best practices.

Austrian Railway Company.

### Priority areas:

Powerlines in the Mureş Valley.

Upgraded railway.

### Actions required:

- Develop guidelines and norms for powerlines mitigation solutions;
- Include powerline-related bird mortality in regular monitoring;
- Develop pilot project to implement powerlines mitigation solutions.

### 3.7.2. Implement adequate solutions for preventing collisions with motorway acoustic panels

#### Examples of identified problems:

Suboptimal implementation of noise-barriers on motorways may lead to bird mortalities due to collision with transparent walls.

#### Existing resources (within TRANSGREEN and related projects):

TRANSGREEN Guidelines.

#### Priority areas:

Sectors where noise-barriers will be built on the Lugoj-Deva motorway are included into environmental permit as well as technical specification.

#### Actions required:

- Follow/enhance (if needed) the technical specification for noise-barriers in order to minimize bird collisions on the Lugoj-Deva motorway based on the expertise-exchange;
- Include noise-barriers bird mortality in regular monitoring;
- Develop pilot project to implement noise-barriers mitigation solutions.

## Objective 3.8. Special measures to avoid bats' mortalities

### 3.8.1. Implement adequate solutions for lighting on motorway

#### Examples of identified problems:

Certain bat species have adapted to hunt insects around artificial lights, and this may increase the risk of collisions on motorways. In Romania the impact was not studied. Several studies proposed changes in light spectrums as mitigation measures.

#### Existing resources (within TRANSGREEN and related projects):

TRANSGREEN Guidelines.

#### Priority areas:

Favourable habitats of target-species intersected by the Lugoj-Deva motorway.

#### Actions required:

- Identify critical areas on the Lugoj-Deva motorway and the technical specifications for bat-safe lighting;
- Include lighting-related bats mortality in regular monitoring;
- Develop pilot project to implement lighting mitigation solutions and to develop good-practices.

## Objective 3.9. Special measures to avoid amphibians & reptiles' mortalities

### 3.9.1. Implement sensitive water/gutter management

#### Examples of identified problems:

Temporary water ponds associated with infrastructure gutter systems are attractive for some amphibians and reptile species but may become mortality traps as water is quickly drying, it is polluted or when gutters are cleaned during maintenance works.

To avoid mortality, the gutters should be built in a way that water does not stay, and they should be cleaned outside reproduction periods or during dry periods. The measure needs to be correlated with verge management and implementation of tunnels for amphibians in important areas.

#### Existing resources (within TRANSGREEN and related projects):

Measures developed for ROSCI0406 Natura 2000 site.

#### Priority areas:

All infrastructure, including secondary roads.

#### Actions required:

- Develop and implement norms/standards for gutter construction and maintenance;
- Include gutter monitoring into the regular monitoring programme;
- Harmonize maintenance with species conservation/Natura 2000 management – in



terms of resources allocated and solutions (safe ponds for relocation etc.);

- d. Develop pilot project to implement sensitive water/gutter management solutions and to develop good-practices.

## Objective 3.10. Collect and process data to understand incidents/accidents critical sectors

### 3.10.1. Collect data and inform dedicated database with records on incidents (a. - rail; b. - motorway)

#### Examples of identified problems:

Currently, there are no coherent procedures of collecting traffic-kill data on railways and motorways and, thus, there is no assessment of black-spots and investigation of causes in order to prevent further incidents. In other countries, train conductors need to report every incident related with wildlife collisions. In Romania, there is permanent guarding patrolling on motorways which may present an opportunity for data collection. Standardized and easy electronic data collection and reporting needs to be set in place. The data should be linked with an integrated platform in order to be able to support informed decisions. GreenWeb platform was initiated to support such initiatives in SE Europe and the first data base and application is being built and tested as part of the TRANSGREEN.

#### Existing resources (within TRANSGREEN and related projects):

TRANSGREEN - Carpathian Countries Integrated Biodiversity Information System (CCIBIS, [www.ccibis.org](http://www.ccibis.org))

GreenWeb platform

CDV Czech Republic

#### Priority areas:

All railways, motorways.

#### Actions required:

- a. Develop methodologies, a mobile app and a support database for data collection and assessment based on the exchange of expertise;
- b. Develop pilot projects to implement data collection and to develop best practices;
- c. Support building a data-base and produce assessment results;
- d. Develop country/regional/European scale projects with a coherent data input.

### 3.10.2. Develop a traffic-kill mobile application for citizen-science linked with a managed database

#### Examples of identified problems:

Currently, there are a number of project-based data reporting cases which are open to general public, but there is no operational open mobile-application aiming to collect data related with road-kills.

Within the TRANSGREEN, an application and a database are adapted from the Czech Republic by CDV and AZ/GreenWeb and data has been collected during the TRANSGREEN and older data has been uploaded. The application is in a development phase and could be expended country wide.

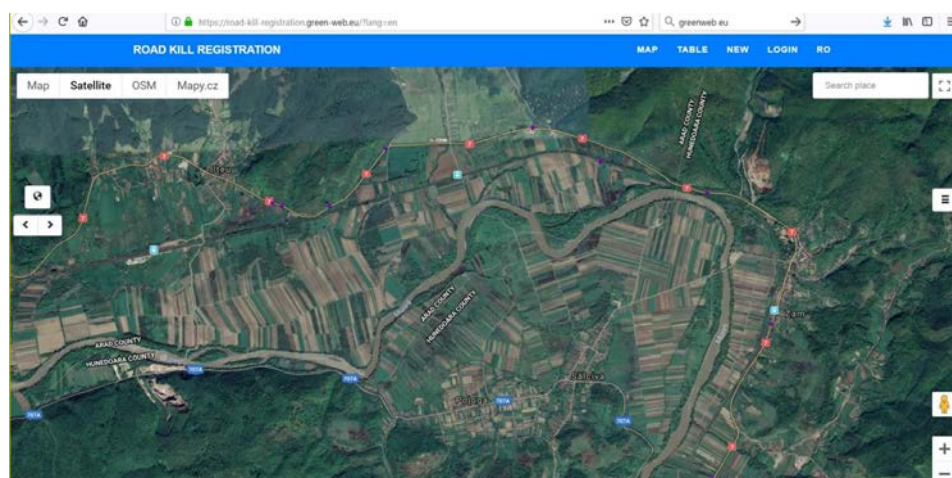


Fig. 17: Print screen from the GreenWeb road kill registration app, a testing phase. <https://road-kill-registration.green-web.eu/?lang=en>, as part of the TRANSGREEN activity.

Management and data validation will be needed to link the data with the GreenWeb integrated platform in order to be able to support informed decisions.

**Existing resources** (*within TRANSGREEN and related projects*):

TRANSGREEN

GreenWeb platform

CDV Czech Republic

**Priority areas:**

All roads, motorways.

**Actions required:**

- a. Develop a mobile app and support database for data collection and assessment based on the exchange of expertise;
- b. Develop pilot projects to test and implement data collection and to develop best practices;
- c. Promote the mobile app to drivers;
- d. Support building a database and produce assessment results;
- e. Develop country/regional/European scale projects with a coherent data input.

**3.10.3. Develop/promote a standardized mobile app for professional monitoring**

**Examples of identified problems:**

A lot of data was collected by professionals of different expertise (species, habitats) in different contexts (research, university, protected area management, impact studies etc.), but the data is not collated and available in a form that would benefit the professional community.

With the advances in mobile phones (GPS, camera, storage capacity, and usage of online and customized maps), there is an opportunity to create mobile forms that can be used in the field and uploaded into a managed database. The data should be linked with an integrated platform in order to be able to support informed decisions. GreenWeb platform was initiated to support such initiatives in SE Europe.

**Existing resources** (*within TRANSGREEN and related projects*):

Species and habitats monitoring forms have been harmonized for grid-based data collection for ROSCI0406 Natura 2000 sites.

**Priority areas:**

Natura 2000 sites

**Actions required:**

- a. Develop a mobile app and support database for data collection and assessment based on the exchange of expertise;

- b. Develop pilot projects to test and implement data collection and to develop best practices;
- c. Promote the mobile app and database to professionals;
- d. Support building a database and produce assessment results;
- e. Develop country/regional/European scale projects with a coherent data input.

**3.10.4. Collect data from police & insurance companies and other authorities (game managers, agencies, ...)**

**Examples of identified problems:**

Currently, there are no coherent procedures of collecting traffic-kill data from accidents reported to the police or insurance companies or from other authorities such as protected area managers, agencies, and game managers. Standardized and easy electronic data collection and reporting needs to be set in place. The data should be linked with an integrated platform in order to be able to support the informed decisions. GreenWeb platform was initiated to support such initiatives in SE Europe.

**Existing Resources (project):**

CDV Czech Republic

**Priority areas:**

Country wide.

**Actions required:**

- a. Develop methodologies, a mobile app and a support database for professional data collection;
- b. Develop pilot projects to implement data collection and to develop best practices;
- c. Support building a database and produce assessment results;
- d. Develop country/regional/European scale projects with a coherent data input.

**Objective 3.11. Create/train specialized teams to deal with wildlife-related incidents on motorways, including emergency interventions**

**3.11.1. Develop procedures and adjust legislation to make teams operational**

**3.11.2. Train and equip specialized personnel**

**3.11.3. Develop operationalized collaboration protocols with other authorities/responsible**

**Examples of identified problems:**

Large (and medium-size – i.e. the wild boar) mammals entering the motorway may lead to

accident-prone situations and needs rapid and specialized interventions in order to stop the traffic, drive the animal towards an exit, tranquilize and relocate or even kill the animal in order to prevent human casualties.

While rapid intervention teams have been tested and operated without clear legal support, this specific scenarios are new to Romania and need a legislation update, clarification on jurisdiction (i.e. use of tranquilizing substances and fire arms on motorways), relocation procedures for protected species (i.e. the bear) and inter-organizational procedures and standards.

**Existing resources** (*within TRANSGREEN and related projects*):

Croatia Motorway Company

LIFE Projects in Romania supporting intervention teams

**Priority areas:**

Motorways

**Actions required:**

- a. Create a working group with motorway company and stakeholders in order to identify working scenarios;
- b. Draft integrated standard procedures and identify needs;
- c. Expertise exchange with other countries;
- d. Develop and implement pilot projects to create best-practices;
- e. Address legislation updating.

**Objective 3.12. Develop and use an integrated database as a decision-supporting tool to address traffic incidents (to implement/adjust measures to prevent wildlife traffic-kills, damages, human casualties)**

**3.12.1. Collect and input all relevant data into an integrated database**

**3.12.2. Identify, monitor and assess causes favouring black-sectors**

**3.12.3. Assess the impact of adjusted/new measures being implemented to prevent traffic-kills**

**Examples of identified problems:**

This objective is addressing the lack of integrated data collection and integrated assessment to identify, understand the causes, the favouring factors and to adjust existing measures or to implement new ones in order to reduce traffic-related incidents.

**Priority areas:**

Country/regional/European scale.

**Actions required:**

- a. Develop and support an integrated database, data-collection and validation protocols;
- b. Support studies to understand the dynamic of traffic-related incidents;
- c. Develop pilot projects to assess the impact of adjusted/new measures being implemented to prevent traffic-kills.

4

# **Annex:**

## In-depth Analysis

### **ARAD - DEVA PILOT AREA**



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# 1. Introduction

**T**he Arad-Deva area was selected as a pilot area within TRANSGREEN project as rehabilitation of the railway between Arad and Deva is located in one of the most sensitive areas in terms of connectivity: the river Mureş valley, a critical linkage zone within one of the most important European ecological corridors (the one between Apuseni Mountains and Southern Carpathians) for large carnivores (bear, wolf, lynx). The area is already affected by the existing and new infrastructure (as the Lugoj- Deva A1 motorway).

Large carnivores (bear, wolf, lynx) are key species at regional scale, but other animal species (mammals, birds, reptiles, amphibians, fish, invertebrates) could be affected by transport infrastructure as their local habitats might be fragmented. Transport routes are mostly situated in Mureş valley, following one of the largest river of Romania, where, together with changes in the land-use, might create a significant migration barrier for a range of species.

In the Arad-Deva pilot area, the main road infrastructure is represented by European roads where no mitigation measures for animal migration are present and by the A1 motorway which is under construction and where the first eco-ducts are being built. However, the most critical mitigation measures requested by the environmental permit (viaducts and bored tunnels) are still under debate and not built yet.

The Arad-Deva area is one of the four pilot areas of the TRANSGREEN project, funded by the Danube Transnational Programme. The aim of the project is to contribute to development of safer and environmentally-friendly road and rail networks that already exist or are being developed in the area of the Czech Republic, Hungary, Romania, Slovakia and Ukraine.

The object of the TRANSGREEN project in Arad-Deva pilot area is the upgrade of the railway project as part of the Pan-European Corridor IV, which links Romania with 7 countries (Germany, the Czech Republic, Slovakia, Hungary, Romania, Bulgaria, Greece and Turkey). Within Romania, the railway crosses the country from West to South-East, linking some major cities as Arad – Deva – Brasov – Ploiesti – Bucharest – Constanta.

Within the TRANSGREEN project, the activity is focused on identifying the potential impact of the planned railway up-grade on the functionality of the critical connectivity areas (micro-corridors/potential movements for large & medium-size mammal species) within the linkage zone represented by the Mureş River valley. If the impact is significant, we will propose the implementation of necessary mitigation measures. The railway project includes objects that could be effective as mitigation measures for animal migration (tunnels, bridges, culverts) and do not includes protective fencing along the route.

This document provides an overview of major policies influencing the construction of railway infrastructure in the pilot area along with an overview of stakeholders influencing the process of infrastructure development. Furthermore, a detailed description of ecological corridors in the area is included. The aim of the document is to clearly identify the issue of landscape connectivity in the area and to create a basis for decision-making. The document should help the authorities, officers, planners of construction projects and other stakeholders to make a decision which will benefit both people and nature.

There is a lot of experience already in Europe on how to minimize the negative environmental impacts of transport infrastructure. We have a unique opportunity to use this experience to avoid the mistakes that have been made and develop the transportation infrastructure in a sustainable way.

The main drivers of biodiversity change are land-use and land-cover change, climate change, pollution, fragmentation and infrastructure development<sup>1</sup>.

The ubiquity of transport networks and the growing body of evidence of the negative impacts that roads and other linear infrastructure bodies have on wildlife and ecosystems suggest that infrastructure represents a major driving factor of biodiversity loss<sup>2</sup>. The most commonly reported impacts from roads and utility corridors include habitat loss, intrusion of edge effects in natural areas, isolation of populations, barrier effects, road mortality and increased human access<sup>3</sup>. Road construction leads to habitat destruction and creates open spaces in otherwise closed forests<sup>4</sup>. The open spaces may fragment populations (barrier effect), attract light demanding species and may be avoided by others (edge effect)<sup>5</sup>. Additionally, the use of infrastructure by cars or trains increases the risk of collisions with wildlife and the stress on (breeding) individuals (due to noise and visual stimuli), both of these risks affecting animal populations<sup>6</sup>. According to Trombulak & Frissell (2000), roads of all kinds affect ecosystems in seven general ways: (1) increased mortality from road construction, (2) increased mortality from collision with vehicles, (3) modification of animal behaviour, (4) alteration of the physical environment, (5) alteration of the chemical environment, (6) spread of exotic species, and (7) increased alteration and use of habitats by humans. These general effects overlap somewhat. Road construction kills sessile and slow-moving organisms, injures organisms adjacent to a road, and alters physical conditions beneath a road. Vehicle collisions affect the demography of many species, both vertebrates and invertebrates. Roads alter animal behavior by causing changes in home ranges, movement, reproductive success, escape response, foraging behaviour and physiological state. Roads change soil density, temperature, soil water content, light levels, dust, surface waters, patterns of runoff and sedimentation, as well as adding heavy metals, salts, organic molecules, ozone, and nutrients to roadside environments. Roads promote the dispersal of exotic species by altering habitats, stressing native species, and providing movement opportunities and corridors. Roads also promote increased hunting, fishing, passive harassment of animals, and landscape modifications. Not all species and ecosystems are equally affected by roads, but overall, the presence of roads is highly correlated with changes in species composition, population sizes, and hydrologic and geomorphic processes that shape the aquatic and riparian systems (Trombulak & Frissell, 2000).

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1 Sala et al., 2000; Sanderson et al., 2002; Alkemade et al., 2009

2 Benítez-López et al., 2010

3 Forman & Alexander, 1998

4 Santos & Tabarelli, 2002

5 Ortega & Capen, 1999

6 Parris and Schneider, 2009

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## Geographical description of the area

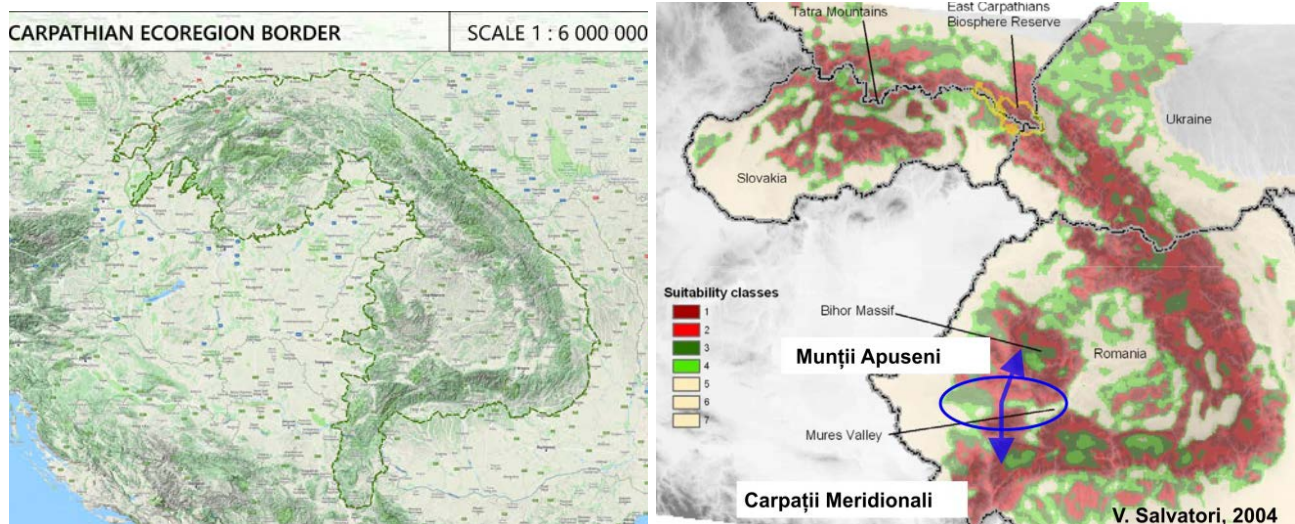




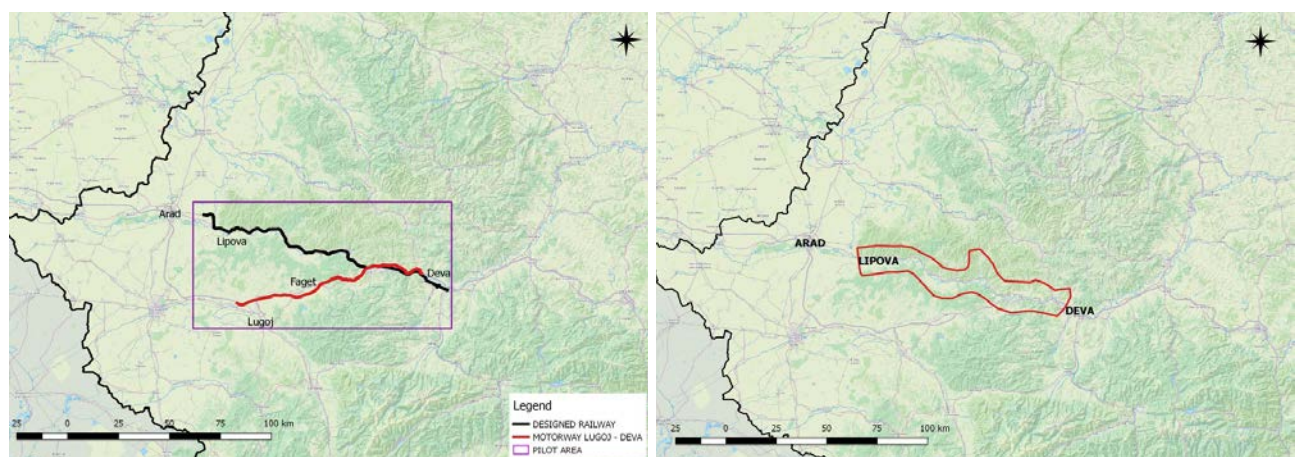


The Arad-Deva pilot area is located in Western part of Romania and, based on the railway alignment in relation with the regional ecological corridor, TRANSGREEN project focuses on the sector of the railway between Lipova (Păuliș) and Deva.

The railway alignment is located in the Mureș river valley, following the course of the river, having the Zarand and Metaliferi Mountains on the North, Dealurile, Podisul Lipovei and Poiana Rusca Mountains on the South. The size of the study area, which encompasses the Mureș valley and adjacent forested slopes, is about 151,500 ha, with elevations varying from 175 m to 690 m above the sea level.



Map 1. Left: General location of the Arad-Deva area in the Carpathians range and Right: within the regional ecological corridor between Apuseni Mountains and Southern Carpathians in Romania (right map source Salvatori, 2004).



Map 2. Left: General location of the Arad-Deva railway (the black line, in connection with the A1 Lugoj-Deva motorway - the red line); Right: TRANSGREEN pilot-area (map source: Open Street Maps).



Photo 1. View of the Mureş valley from the top of the future tunnel for new railway, showing existing infrastructure (old railway line, European Road), natural and cultivated land, Mureş River and the forested hills of Zarand and Metaliferi Mountains (Radu Mot).

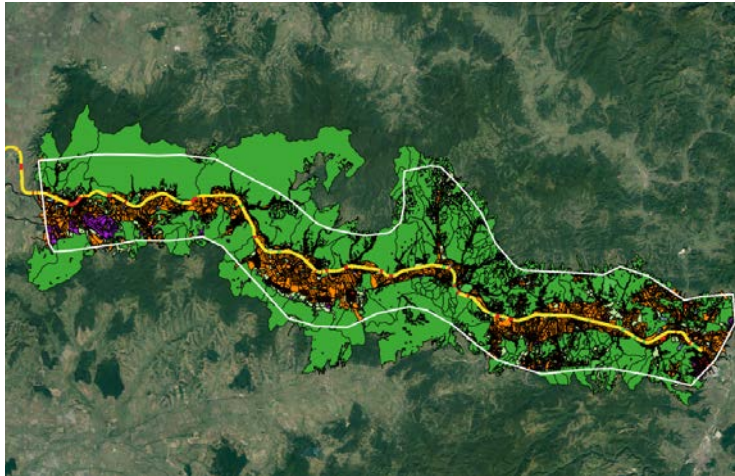
Most of the Mureş Valley within the project area is included in an SCI, the ROSCI0064 Defileul Mureşului, a significantly large Natura 2000 site (34,149.10 ha) which has assigned a corridor role for all three species of large carnivores (bear, lynx, wolf), with the bear using the area during seasonal migrations and the lynx and the wolf also as resident species. Apart from large carnivores, in the standard form of SCI Defileul Mureşului there are 6 mammal species, 5 amphibian and reptile species, 11 fish species, 4 invertebrate species and one plant species, 3 forest habitats and 1 grassland habitat.

The SCI Defileul Mureşului is overlapping with a large (55,943.90 ha) SPA, the ROSPA0029 Defileul Mureşului Inferior-Dealurile Lipovei which has listed 34 bird species on its standard form.

Within the pilot area, the Mureş River has a meandering course which created a typical flooded plain, with water bodies and marsh areas. During the '60s-70s, the plain was drained, and land used for intensive agriculture, until the '90s when land was restituted in small parcels to local farmers. At present, most of the land is abandoned (small scale agriculture not being profitable also because of massive damage caused by wild boars) and is experiencing natural succession to wetland/natural riparian vegetation or is invaded by exotic species as *Amorpha fruticosa*. Some small parcels are still being cultivated by local farmers and there are several situations where investors have bought more-or-less compact large areas of land.

At present, the land general aspect is mosaicked with patches of forests (natural mixed deciduous species – the oak, the beech, the hornbeam, the linden, and the alluvial), forested grasslands, grasslands, wetlands, watercourses, agricultural landscape – both extensive crop fields and meadows and intensive crop fields, urbanized and industrial/extraction sites. As a result, the Mureş valley is used by a wide variety of species as quasi-permanent habitat (including large species as the wolf, the lynx, the jackal, the red deer, and the wild boar), offering refuge and foraging/food resources. It is worth mentioning that in one occasion we documented lynx mating on the river banks. For several fish species, Mureş tributaries intersected by transport infrastructure function as reproduction sites but also as refuges when conditions on the main river are becoming inadequate.

In terms of permeability, the existing European E67 road has a significant barrier effect due to constructive details and intensive traffic, also in conjecture with localities, quarries and adjacent railway and river. In some cases, large agricultural land is being intensively managed and even fenced. The river banks are steep in many sectors, but the river is not affected by massive regulation works and is permeable, with many islands acting like stepping stones for wildlife. In general, at present, we would qualify the Mureş valley as being rather permeable for terrestrial wildlife.



**Land use category**

<b>PA</b>	Forested areas	<b>TA</b>	Crop land
<b>HN</b>	Marsh areas	<b>CP</b>	Permanent crops
<b>HR</b>	Water courses	<b>DR</b>	Transport infrastr.
<b>PP</b>	Permanent pastures	<b>CC</b>	Built areas

Map 3. Left: The study area with the railway alignment and land-use categories; Right: Detail within the study area - vegetation type (up) and land-use categories (below) (Source: APIA, Google Earth)

However, the Mureş valley is a critical linkage area and landscape permeability for animal species should be taken into account when planning a new and/or upgrading existing transport infrastructure or changing the land usage. Nowadays it is widely recognized that infrastructure represents a major driving factor of biodiversity loss and, as a result, it is required to assess, monitor and avoid/mitigate/compensate the impact of infrastructure projects on environment.

It is crucial to understand the associated effects of infrastructure development on different phases (construction, operation phase), levels (in relation with other sectors - development, land-use) and

scales (cumulative impacts of other projects). By not having an integrated approach at landscape level, the danger is that either the impact of a particular project is not properly acknowledged and addressed, or that state-of-the-art solutions implemented for a given project might become useless since their functionality is impacted by other adjacent factors. Therefore, it is important to understand the project area in its dynamic (both from ecosystem, land-use and anthropogenic development aspects) and to establish, monitor and adapt a system of measures for landscape permeability (transferred to each particular sector and project) that is resilient to changing factors (including the climate).

3

# Legislative context



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

### 3.1. National law on nature conservation that applies to pilot area

- » Law no. 5/2000 regarding the planning of the national territorial (section III is dealing with protected areas).
- » Emergency Government Ordinance no. 195/2005 for environmental protection with subsequent amendments and completions, approved through Law no 245/2006 with subsequent amendments and completions
- » Emergency Government Ordinance no. 57/2007 regarding the regime of protected areas, conservation of natural habitats and of wild flora and fauna with subsequent amendments and completions, approved through Law no. 41/ 20011 with modifications and completions.
- » Ministerial Order no. 19/2010 for approving the methodological guidelines on the appropriate assessment of the potential effects of plans and projects on protected areas of community interest.
- » Ministerial Order no. 135/2010 for approving the methodology for environmental impact assessments for public and private projects.
- » Law no. 137/2010 for ratifying the Protocol on the conservation and sustainable use of biological and landscape diversity, adopted and signed in Bucharest on June 19, 2008, at the Framework Convention on the protection and sustainable development of the Carpathians, adopted in Kiev on May 22, 2003.
- » Water Law no. 107/1996 with modifications and completions.
- » Law no. 46/2008 – Forest Code, republished, as subsequently amended and supplemented.
- » Law no. 407/2006 hunting and hunting protection, with subsequent amendments and completions.

### 3.2. National law on transport infrastructure that applies to pilot area

Regarding Transportation, the Master Plan for Transport in Romania 2030 mentions the need to respect conservation measures in future projects including integrating non-structural and Green Infrastructure measures, and avoiding negative impacts on protected areas, forested areas and unprotected areas where species of community interest are identified by reconsidering planning of routes.

The Territorial Development Strategy of Romania 2035 clearly refers to Green Infrastructure as an efficient way to adapt to climate change and to diminish natural risks compared to physical or grey infrastructure. Specific measures include protecting the natural habitats (by ensuring diversity of and interconnectivity between natural areas, particularly in the context of Natural 2000 management) and developing green spaces in urban areas and green belts around major cities.

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

### 3.3. National law on landscape development and construction that applies to the pilot area

Law No. 350/2001 regarding the territory arrangement and urban planning, with subsequent completions and modifications. Ministerial Order no. 19/2010 for approving the methodological guidelines on the appropriate assessment of the potential effects of plans and projects on protected areas of community interest.

The Territorial Development Strategy of Romania 2035 clearly refers to Green Infrastructure as an efficient way to adapt to climate change and to diminish natural risks compared to physical or grey infrastructure. Specific measures include protecting natural habitats (by ensuring diversity of and interconnectivity between natural areas, particularly in the context of Natura 2000 management) and developing green spaces in urban areas and green belts around major cities.

### 3.4. European Directives and strategies, relevant conventions

#### 3.4.1. EU Nature Directives (FFH, BD) and the Biodiversity Strategy

At the EU level, nature and biodiversity are protected through several directives. The EU has been committed to the protection of nature since the adoption of the **Birds Directive 79/409/EEC** in April 1979. It provides a comprehensive protection to all wild bird species naturally occurring in the Union.

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

Often the migratory wild bird species can only be protected by cooperating across borders. Urban sprawl and transport networks have fragmented and reduced their habitats, intensive agriculture, forestry, fisheries and the use of pesticides have diminished their food supplies, and hunting needed to be regulated in order not to damage populations. Concerned with their decline, Member States

unanimously adopted the Directive. It is the oldest piece of EU legislation on the environment and one of its cornerstones. Amended in 2009, it became the Directive 2009/147/EC.

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

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

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

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

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

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

Certain articles of the Habitats Directive (Art. 6, 12, 16 and 17) require Member States to report on

the conservation status of habitats and species, on compensation measures taken for projects having a negative impact on Natura 2000 sites or on derogations they may have applied to the strict protection measures.

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

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

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

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

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

### 3.4.2. Directives related to transport (road and rail)

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

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

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

- » The Comprehensive Network: Covering all European regions;

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

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

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

Oversight of the Corridors and the implementation of the two Horizontal Priorities lies with European Coordinators; high-level personalities with long standing experience in transport, financing and European politics, nominated by the European Commission.

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

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

#### Relevant EU regulations concerning transportation:

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

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

### **The EU Strategy on Green Infrastructure**

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

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

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

The Green Infrastructure Strategy proposed by the European Commission, promotes the development of Green Infrastructure across the EU delivering economic, social and ecological benefits and contributing to sustainable growth. It guides the implementation of Green Infrastructure at EU, regional, national and local levels. A main feature of the Green Infrastructure Strategy is its integration into relevant policies through: ecosystem-based adaptation into climate change policies; nature based solutions into research and innovation policies; natural water retention measures into water policies; and through its focus on delivering multiple ecosystem services and their underlying factor – rich biodiversity – into nature policies. The Natura 2000 network in particular plays a major role in protecting many of the core areas with healthy ecosystems. The Green Infrastructure approach is also reflected in regional

and cohesion policies, disaster prevention and the greening of the Common Agriculture Policy. As Green Infrastructure can make a significant contribution to many sectors and EU policy objectives, Green Infrastructure is being integrated into many funding streams including Structural Funds (the European Regional Development Fund (ERDF); European Social Fund (ESF)), the Cohesion Fund (CF), the European Maritime and Fisheries Fund (EMFF), the European Agricultural Fund for Rural Development (EAFRD), LIFE+ and Horizon 2020 project funds and the Natural Capital Financing Facility (NCFF) of the European Investment Bank (EIB).

### **Green Infrastructure and the Biodiversity Strategy**

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

### **Policy setting & ongoing implementation**

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



## 3.5. Environmental procedures (SEA, EIA, AA) – short description of the status of these processes in the area, if applicable for the pilot area

### 3.5.1. SEA

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

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

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

appropriate, they shall be subject to public debate, together with the plan/programme draft.

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

### 3.5.2. EIA

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

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

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

### 3.5.3. AA

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

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

4

# Stakeholder Analysis



Successful implementation of the TRANSGREEN project requires strong cooperation with and between different stakeholders. Key stakeholders who are playing a crucial role in the decision-making process and thus having the decisive influence on the project implementation have been identified and analysed. Other stakeholders play a supportive role or can benefit from project outcomes, therefore their detailed analysis helped to identify the means of how different stakeholder groups should be approached and involved in the project:

- » **Key stakeholders** (who could have a determinant role and need to be actively engaged with) are Transport Companies (SNCFR SA), EIA/SEA experts, entrepreneurs/construction companies, custodians of Natura 2000 sites, administrative bodies – agencies, ministries.
- » **Other stakeholders** (who could play a supportive role and need to be informed) are academic and research institutions, professional cross-sectoral platforms/networks, landowners & land users, media, the general public.



Photo 2. Discussions with stakeholders - Lipova, November 2017

## 4.1. Organizations, institutions and state administration bodies involved in nature conservation and their competencies in the pilot site

- » WWF Romania - TRANSGREEN partner
- » Ministry of Environment - TRANSGREEN Associated Strategic Partner, associated partner partner in LIFE Connect Carpathians
- » National Agency for Protected Areas - management of protected areas/Natura 2000 site
- » National Agency for Environment Protection - environment regulation
- » Romanian Academy - scientific & academic body
- » National Institute for Forest Research and Development - research and management in game and forestry
- » Arad County Environmental Protection Agency - environment regulation
- » Hunedoara County Environmental Protection Agency - environment regulation
- » Arad County Environmental Guard - control and enforcement of environment regulation
- » Hunedoara County Environmental Guard - control and enforcement of environment regulation

- » EPC BUCURESTI Ltd. – environment consultants
- » WILDLIFE MANAGEMENT CONSULTING Ltd. – environment consultants
- » Zarand Association – TRANSGREEN responsible for pilot area/custodian of ROSCI0406 Zarandul de Est, associated partner in LIFE Connect Carpathians
- » Fauna&Flora International – Beneficiary partner in LIFE Connect Carpathians
- » Arad Forest Administration – custodian of ROSCI0407 Zarandul de Vest and ROSCI0070 Drocea
- » Excelsior Association – custodian of ROSCI0337 Padurea Neudorfului
- » Mureş Water Administration – water management
- » Arad & Hunedoara County Agencies for Payments and Intervention for Agriculture - agricultural and grassland land management
- » Hunting areas administrators – game management
- » Green Web Network, IENE – network of transport & ecology experts

## 4.2. Organizations, institutions and state administration bodies involved in transport infrastructure development, management and their competencies in the pilot site

- » Ministry of Transport – TRANSGREEN Associated Strategic Partner
- » Romanian Railway Company “SNCFR SA” – related to the Ministry of Transport
- » Association: ASTALDI SpA& FCC-& SALCEF& THALES – construction companies
- » Association: Biocentrum Kft. Hungary & Green Line Energetik SRL Bucuresti & CP MED LABORATORY Ltd. Bucuresti & Pro Air Clean Ecologic SA Timisoara – construction companies
- » Association: Arex Pegaso& Sistema – construction companies

- » GEOSTUD Ltd. – construction companies
- » ProInfrastructura – transport-focused NGO

## 4.3. Organizations, institutions and state administration bodies involved in spatial planning and their competencies in the pilot site

- » Arad and Hunedoara County Councils – Planning
- » Local administrations – Planning

## 4.4. Other stakeholders

- » Farmers, landowners
- » Media – national, regional, local, international
- » General public – local, national



# Status of the road and railway network development in the pilot area

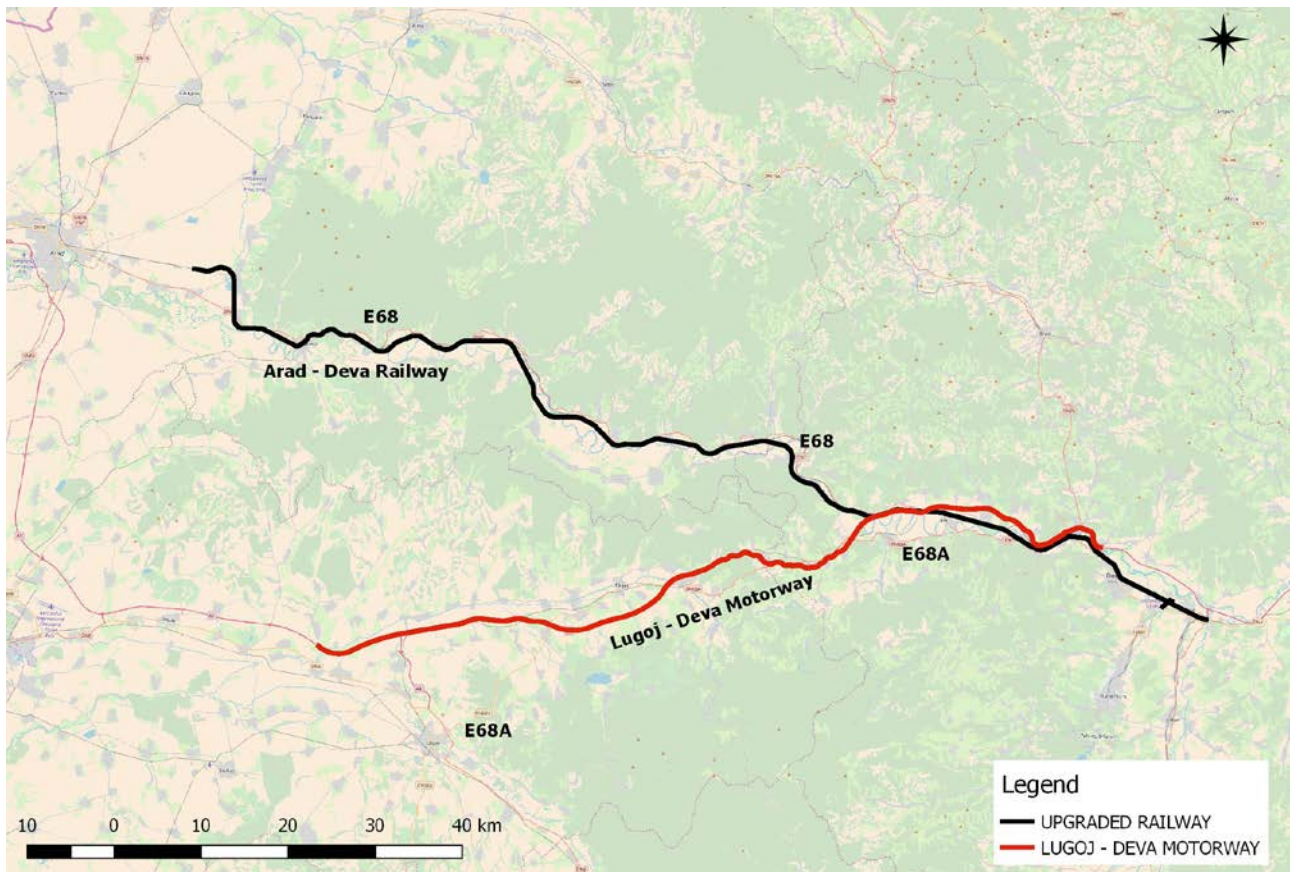


## 5.1. Existing transport infrastructure

The project area is intersected by a number of major infrastructure elements (part of European TENT-T4 and national network) but also by a multitude of county and local roads.

The major transport infrastructure is represented by:

- » The A1 Lugoj-Deva Motorway - under construction;
- » The European road E68 (DN7) which makes the connection between Western border and major cities: Arad-Deva-Sibiu;
- » The European road E68A which makes the connection between major cities: Timisoara-Lugoj-Deva;
- » The Arad-Deva railway.



Map 4. Transport infrastructure within the pilot-area (map source: Open Street Maps).

Within the pilot area, the biggest cities linked by the railway are Arad and Deva, capital cities of Arad and Hunedoara counties, respectively. Both counties are part of West development region of Romania.

At present, the density of public roads in the West Region of Romania is slightly below country

figures, with Arad County below region's and with Hunedoara County above both region and country figures. The density of railways in the West Region of Romania is slightly below country figures, with Arad County above both region and country figures and with Hunedoara county above region's and below country figure (Table 2).

<b>Table 2a. Public roads data</b>			
	<b>Area</b>	<b>Total length of public roads (km)</b>	<b>Density of public roads (km/100 km<sup>2</sup>)</b>
<i>Density of public roads in Arad and Hunedoara Counties</i>	Arad County	2,240	28.9
	Hunedoara County	3,206	45.4
	West Region RO	1,092	32.1
	<b>Romania</b>	<b>79,904</b>	<b>33.5</b>

(Source: Western development region – demographic and geographic characteristics)

	<b>Area</b>	<b>Total length of railways (km)</b>	<b>Density of railways (km/100 km<sup>2</sup>)</b>
<i>Density of railways in Arad and Hunedoara Counties</i>	Arad County	470	6.1
	Hunedoara County	291	4.1
	West Region RO	1,094	3.4
	<b>Romania</b>	<b>10,948</b>	<b>4.6</b>

(Source: Western development region – demographic and geographic characteristics)

**Table 3. Predicted traffic growth rates for passengers and cargo**

<b>Railway Section</b>	<b>Growth rate for 2046 comp. to 2010 for -</b>	
	<b>- Passengers, no.</b>	<b>- Cargo</b>
Arad – Radna	x 1.28	x 1.60
Radna – Ilia	x 1.97	x 1.59
Ilia – Deva	x 1.27	x 1.62
Deva – Simeria	x 1.26	x 1.76

(Source: Feasibility study, 2011, SNCFR SA)

For the upgrade railway, the Romanian Railway Company predicted for year 2046 a traffic growth rate between 126 – 197% for public and between 1.59 – 1.76% for cargo.

## 5.2. Planned transport infrastructure

By **upgrading the railway line** from the Romanian border with Hungary to Simeria (185 km), the infrastructure project aims to accommodate higher speeds, to promote high-quality traffic along Pan-European Corridor IV, to increase transport safety and protection of the environment, and also to ensure interoperability in line with the EU standards.

The target speed levels are 160 km/hr. for passenger trains and 120 km/hr. for cargo. Although a significant upgrade from current figures (70 km/hr. for passenger trains and 60 km/hr. for cargo), the upgraded railway will not have the status of a *high-speed railway*.

The new **Lugoj-Deva A1 motorway** sector, part of the same Pan-European Corridor IV, will increase the traffic speed, comfort and security for drivers, and is expected to decrease the traffic on the existing parallel infrastructure – E68 and E68A.

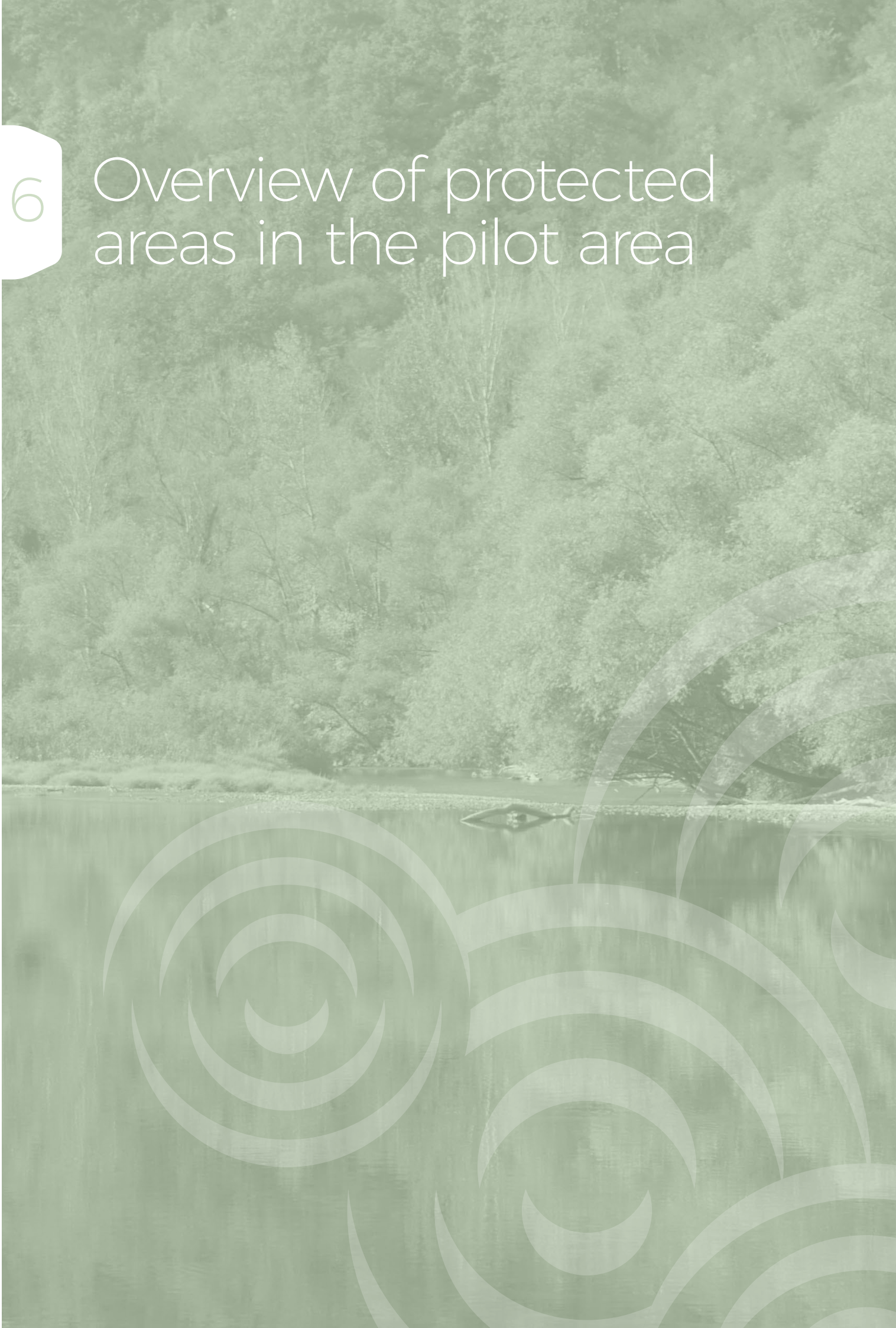
Both infrastructure projects are very important from regional, national and international perspective. For both projects the EIA/SEA procedure has been completed.





6

# Overview of protected areas in the pilot area

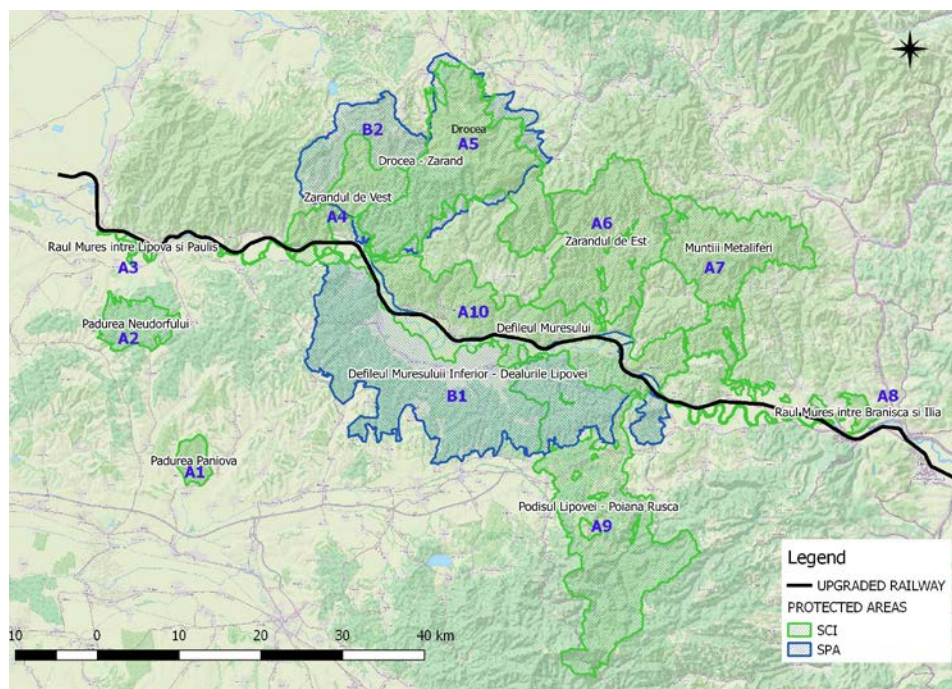


## 6.1. Overview of protected areas in the pilot area

Between Păuliș and Deva, the railway intersects three Natura 2000 sites: ROSCI0064 Defileul Mureșului Inferior, ROSCI0407 Zarandul de Vest, ROSPA0029 Defileul Mureșului Inferior-Dealurile Lipovei, and is adjacent or in close vicinity of several other SCIs and

SPAs: ROSCI0338 Padurea Paniova, ROSCI0337 Padurea Neudorfului, ROSCI370 Raul Mureș între Lipova și Păuliș, ROSCI0070 Drocea, ROSCI0406 Zarandul de Est, ROSCI0325 Muntii Metaliferi, ROSCI0373 Raul Mureș între Branisca și Ilia, ROSCI0355 Podisul Lipovei-Poiana Rusca, ROSPA117 Drocea-Zarand.

Other protected areas of national or local importance in vicinity of the railway alignment are Padurea Pojoga, Balta Soimos.



Map 5. The Natura 2000 sites in the pilot area (map source: Open Street Maps, Romanian Ministry of Environment).

Table 4. The Natura 2000 sites in the pilot area

NAME and CODE of protected area	Type	Code on Map 5
ROSCI0338 Padurea Paniova	SCI	A1
ROSCI0337 Padurea Neudorfului	SCI	A2
ROSCI370 Raul Mureș între Lipova și Păuliș	SCI	A3
ROSCI0407 Zarandul de Vest	SCI	A4
ROSCI0070 Drocea	SCI	A5
ROSCI0406 Zarandul de Est	SCI	A6
ROSCI0325 Muntii Metaliferi	SCI	A7
ROSCI0373 Raul Mureș între Branisca și Ilia	SCI	A8
ROSCI0355 Podisul Lipovei-Poiana Rusca	SCI	A9
ROSCI0064 Defileul Mureșului	SCI	A10
ROSPA0029 Defileul Mureșului Inferior-Dealurile Lipovei	SPA	B1
ROSPA117 Drocea-Zarand	SPA	B2
Padurea Pojoga	National	-
Balta Soimos	National	-

## 6.2. Biodiversity of the pilot area

Animal species which could be affected by transport infrastructure are either local species specific to ecosystems/habitats intersected by transport infrastructure, species that migrate from/to neighbouring habitats for food, water or shelter, individuals in dispersal which are using the linkage area represented by the Mureş valley to move from one habitat to another, indigenous or allochthone species which use the transport infrastructure as forage habitat or dispersal corridor. For fish species, Mureş tributaries function as reproduction sites but also as refuges when conditions on the main river are inadequate.

Within terrestrial mammal species, large carnivore species have the highest spatial demands – they use large home-ranges and especially young animals naturally disperse from parent’s territories for long distances. During their migrations they have to face several obstacles in the human dominated landscape such as highways, roads, railways, urban build-up areas, fenced enclosures etc. The wolf being more adaptable, the bear and the lynx being stronger related with forested areas are considered good indicator species for good/bad permeability of transport infrastructure for other forest species e.g. ungulates: the red deer, the wild boar.

Typical species which could be affected by transport infrastructure in the Arad-Deva pilot area are presented in the table below.

**Table 5. Typical species which could be affected by transport infrastructure in the Arad-Deva pilot-area**

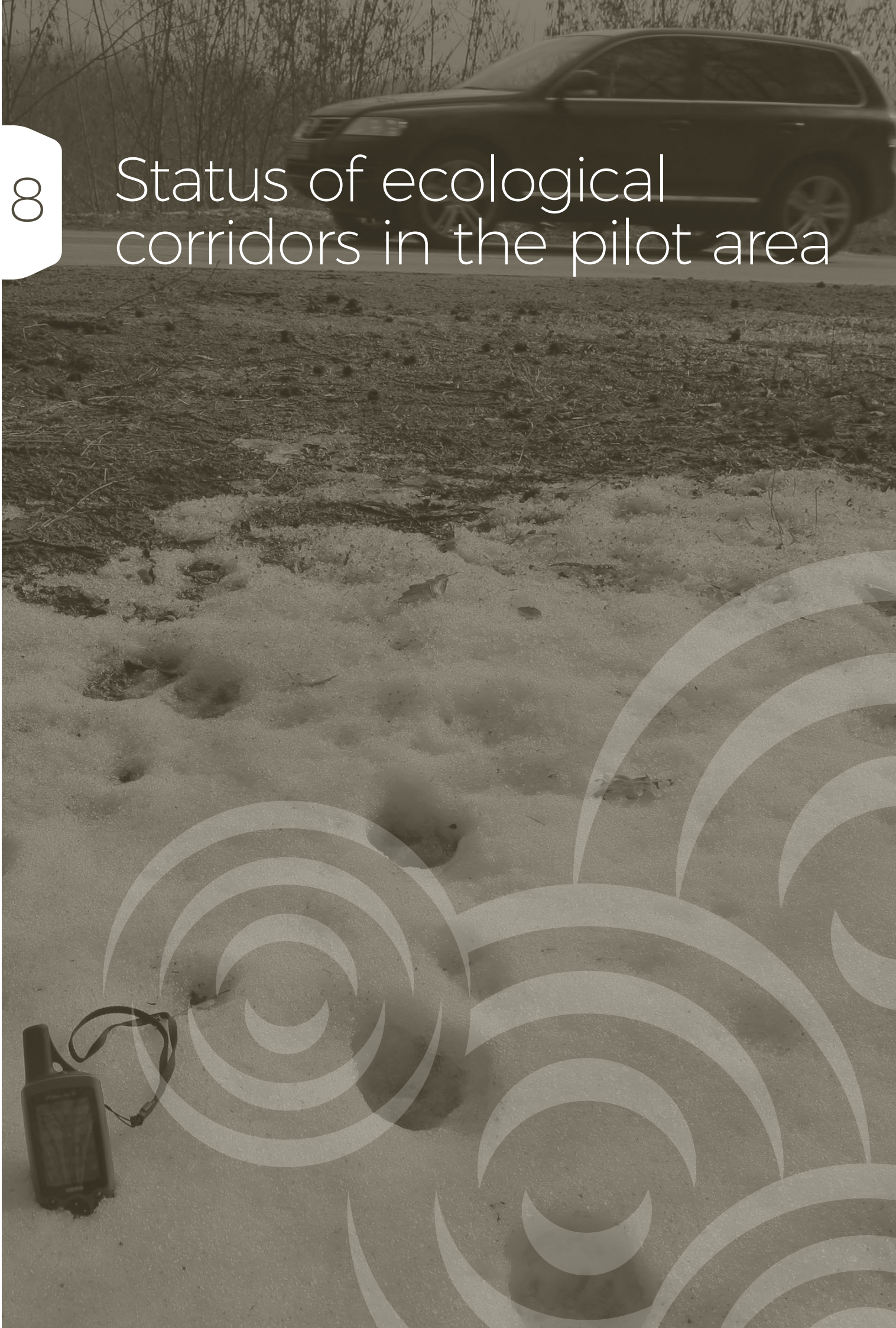
Group/type of species	Species
Large carnivores	Brown bear ( <i>Ursus arctos</i> ), grey wolf ( <i>Canis lupus</i> ), Eurasian lynx ( <i>Lynx lynx</i> ), golden jackal ( <i>Canis aureus</i> )
Large herbivores	Red deer ( <i>Cervus elaphus</i> ), Wild boar ( <i>Sus scrofa</i> )
Medium-size mammals	Roe deer ( <i>Capreolus capreolus</i> ), Red fox ( <i>Vulpes vulpes</i> ), European otter ( <i>Lutra lutra</i> ), Eurasian beaver ( <i>Castor fiber</i> ), European badger ( <i>Meles meles</i> ), European wildcat ( <i>Felis silvestris</i> ), European hare ( <i>Lepus europaeus</i> ), beech marten ( <i>Martes foina</i> ), European pine marten ( <i>Martes martes</i> )
Small size mammals	Red squirrel, polecat, hedgehog, stoat, least weasel, dormice, common vole
Bats	Greater mouse-eared bat ( <i>Myotis myotis</i> ), lesser horseshoe bat ( <i>Rhinolophus hipposideros</i> ), barbastelle ( <i>Barbastella barbastellus</i> )
Birds	Northern goshawk ( <i>Accipiter gentilis</i> ), common kingfisher ( <i>Alcedo atthis</i> ), lesser spotted eagle ( <i>Aquila pomarina</i> ), Eurasian eagle-owl ( <i>Bubo bubo</i> ), common buzzard ( <i>Buteo buteo</i> ), European nightjar ( <i>Caprimulgus europaeus</i> ), white stork ( <i>Ciconia ciconia</i> ), black stork ( <i>Ciconia nigra</i> ), short-toed snake eagle ( <i>Circaetus gallicus</i> ), Western marsh harrier ( <i>Circus aeruginosus</i> ), hen harrier ( <i>Circus cyaneus</i> ), corncrake ( <i>Crex crex</i> ), white-backed woodpecker ( <i>Dendrocopos leucotos</i> ), middle spotted woodpecker ( <i>Dendrocopos medius</i> ), Syrian woodpecker ( <i>Dendrocopos syriacus</i> ), black woodpecker ( <i>Dryocopus martius</i> ), merlin ( <i>Falco columbarius</i> ), collared flycatcher ( <i>Ficedula albicollis</i> ), red-breasted flycatcher ( <i>Ficedula parva</i> ), booted eagle ( <i>Hieraaetus pennatus</i> ), common little bittern ( <i>Ixobrychus minutus</i> ), red-backed shrike ( <i>Lanius collurio</i> ), lesser grey shrike ( <i>Lanius minor</i> ), wood lark ( <i>Lullula arborea</i> ), European honey buzzard ( <i>Pernis apivorus</i> ), grey-headed woodpecker ( <i>Picus canus</i> ), Ural owl ( <i>Strix uralensis</i> ), barred warbler ( <i>Sylvia nisoria</i> ), wood sandpiper ( <i>Tringa glareola</i> ), Eurasian hoopoe ( <i>Upupa epops</i> ).
Reptiles and Amphibians	Great crested newt ( <i>Triturus cristatus</i> ), smooth newt ( <i>Lissotriton vulgaris ampelensis</i> ), yellow-bellied toad ( <i>Bombina variegata</i> ), red-bellied toad ( <i>Bombina bombina</i> ), European pond turtle ( <i>Emys orbicularis</i> ), fire Salamander ( <i>Salamandra salamandra</i> ), European grass frog ( <i>Rana temporaria</i> ), common toad ( <i>Bufo bufo</i> ), green toad ( <i>Bufo viridis</i> ), common spadefoot ( <i>Pelobates fuscus</i> ), European tree frog ( <i>Hyla arborea</i> ), common frog ( <i>Rana temporaria</i> ), agile frog ( <i>Rana dalmatina</i> ), marsh frog ( <i>Pelophylax ridibundus</i> ), green lizard ( <i>Lacerta viridis</i> ), sand lizard ( <i>Lacerta agilis</i> ), common lizard ( <i>Zootoca vivipara</i> ), slow-worm ( <i>Anguis colchica</i> ), Aesculapian snake ( <i>Zamenis longissimus</i> ), grass snake ( <i>Natrix natrix</i> ), smooth snake ( <i>Coronella austriaca</i> ), adder ( <i>Vipera berus</i> ).
Fish	Southern barbel ( <i>Barbus meridionalis</i> ), Amur bitterling ( <i>Rhodeus sericeus amarus</i> ), golden spined loach ( <i>Sabanejewia aurata</i> ), spined loach ( <i>Cobitis taenia</i> ), white-finned gudgeon ( <i>Gobio albipinnatus</i> ), Kessler’s gudgeon ( <i>Gobio kessleri</i> ), loach ( <i>Misgurnus fossilis</i> ), streber ( <i>Zingel streber</i> ), common zingel ( <i>Zingel zingel</i> ).
Carabids	<i>Rosalia alpina</i> , <i>Cerambyx cerdo</i> , <i>Lucanus cervus</i> , <i>Morimus funereus</i> , <i>Carabus variolosus</i>
Mollusca	<i>Unio crassus</i>
Invasive species	<i>Amorpha fruticosa</i> etc.

# 7. Existing planning and strategic documents

**T**here are no regional or local land-use plans available; therefore, we used as reference the land-use categories available from the Agency for Agriculture Payments (APIA). Although the actual use of the agricultural land may differ significantly, the APIA land-use information can be used to assess evolution scenarios in as regardless of the existing type of vegetation, the changes towards the registered land use categories could be done without any/much approval.

8

# Status of ecological corridors in the pilot area



Several major projects were focusing in the last years on developing methodologies to identify ecological corridors or to identify critical connectivity areas at different levels (local, regional or national) in Romania.

'Open Borders for Bears between the Romanian and Ukrainian Carpathians' (2012-2014) of WWF Romania was among the first projects to identify a transboundary network of ecological corridors in the Carpathians. Another project, 'South-western Carpathian Wilderness and Sustainable Development Initiatives' (2014-2017) lead by WWF Romania had as

a main result the proposal of a draft methodology for the designation of ecological corridors at national level. In addition to this, the main terrestrial corridors were identified in the south-western Carpathians.

A methodology to classify critical areas for large carnivores crossings over the existing transport infrastructure as part of landscape permeability assessment was developed in 2010 (Mot et al.) and used to support the designation of a regional network of protected areas between Apuseni Mountains and the southern Carpathians in Romania, consisting of 13 new Natura 2000 sites.



Map 6. The network of protected areas between Apuseni and Southern Carpathians, source LIFE Connect Carpathians

'LIFE Connect Carpathians' (2013-2019) project lead by Fauna & Flora International in partnership with Zarand Association, Romanian Ministry of Environment and Romanian Gendarmerie is focusing on implementing demonstrative practical activities to support/enhance connectivity and will develop Regional Action Plans for the Bear and the Wolf with a focus on connectivity between the Apuseni Mountains and the southern Carpathians in Romania.

Two other national level projects were implemented in 2015-2016, with results not yet published:

- » The 'Ecological Corridors for Habitats and Species in Romania - COREHABS' project, led by Transylvania University of Brasov provided some tools for the identification, assessment, monitoring and management of ecological corridors at the national level.
- » The National Environmental Guard's project, 'Development of the Methodology for Establishing Ecological Corridors and Training the Administrators of the Protected Areas for their Better Management' aimed at developing methodologies for establishing ecological corridors for large mammals, migratory birds and migratory fish species and complex software applications in order to contribute to a better management of the Romanian protected areas.

## 8.1. The role and importance of ecological corridors for animal movement and/or dispersal

Wildlife need to move and to access resources, exchange genes, expand their ranges and/or establish new territories, among other needs. Connected landscapes allow the movement of wildlife and facilitate ecological processes. These are common concepts in conservation, and as climate change and other stressors act on the landscape, connectivity becomes even more important in allowing animals to adapt to changing conditions. There are many terms used to describe the facets of connectivity. In some cases, there is a variety of definitions for the same term, which can cause confusion among readers.

Corridors are an important component of functional ecological networks. The primary focus

of corridor conservation is usually on supporting animal movement. Movements crucial to long-term viability of wildlife populations include daily foraging bouts among local resource patches, seasonal migrations between summer and winter ranges, once-in-a-lifetime dispersal events to seek new territories, and multi-generational range shifts in response to climate change. The wildlife use habitat corridors for different purposes, in different patterns, and on different scales, depending on the species. One way to identify a corridor is by the species-specific needs and the movement function they provide; this is considered a fine-filter approach. An alternative coarse-filter approach is to define corridors based on integrity and continuity of landscape features or natural conditions, which requires the assumption that swaths of connected natural areas are likely to support movement of a variety of species. Coarse-filter approaches are useful for providing a high-level overview of areas of potential importance for connectivity. Particularly at finer scales, maintaining different movement processes requires different corridor designs and management. A corridor designed to support a given movement of one species may not support other movement processes of that species or movement of other species without additional management actions. Similarly, the spatial scale of a corridor is determined by the species and process that it is intended to support. These types are not dependent on scale, biome, region, ownership, or governance, although management actions may vary as a function of these attributes.

A corridor is a distinct component of the landscape that provides connectivity. Corridors – in the sense of functional linkages between sites – are essential tools to maintain or restore a degree of coherence in fragmented ecosystems. Wildlife corridors specifically facilitate the movement of animals, while other types of corridors may support connectivity for plants or ecological processes. Although the term is frequently used synonymously with corridor, linkage refers to broader regions of connectivity important to maintain ecological processes and facilitate the movement of multiple species.

Purposes of ecological corridors commonly recognized include to:

- » Assist movement of wide-ranging or migrating animals through developed landscapes;
- » Facilitate dispersal of individual species between otherwise-isolated habitats or populations in order to establish a new home range;
- » Secure regular daily movements in order to search for food, shelter or finding mates;
- » Promote effective continuity and gene flow between populations in two areas by supporting a resident population;



- » Promote the natural continuity of habitats, communities and ecological processes between large areas such as national parks and conservation reserves;
- » Provide the opportunity for populations to shift in response to change and natural catastrophes;
- » Provide habitat and continuity for wildlife in conjunction with other environmental and social benefits (Bennett 2003).

The originally continuous distribution of many animal species is being disintegrated by rapid landscape fragmentation in the recent time. In a human dominated landscape, people continue to fragment natural environments via urbanization, agricultural activities, but also expanding of transport infrastructure. Urbanization is defined as habitat destruction whereas transport infrastructure rather fragments and transects wildlife habitats. Through the identification of ecological corridors, the level of habitat fragmentation can be reduced by implementing the suitable mitigation measures. Thus, development of new human structures is not blocked but its impact on natural wildlife habitat and its permeability should always be taken into account. Therefore, identification of ecological corridors needs to be done as accurately as possible.

Wildlife species often use traditional routes in order to move among patches with a suitable habitat. This knowledge is often transmitted to the offspring. Consequently, if mitigation measures aiming at the improvement of wildlife movement are placed inappropriately, their effect is doubtful. The most affected are groups of species restricted to the well-preserved natural environment, those with great requirements on the size of their home-range/territory, or regularly or occasionally dispersing/migrating species.

The so-called critical barrier sites are defined within the migration corridors, i.e. areas with significant barrier effect which hinder the permeability of a given section for target species. The permeability of the corridor is lowered in these points as a result of:

- » Close proximity of built-up area (the width between settlements is less than 500 meters)
- » Crossing with important transportation infrastructure (highways, 1<sup>st</sup> class roads, two rail railways etc.)
- » Crossing through non-forest agricultural land (wider than 2 km)
- » Combination of several barrier factors of lower intensity (e.g. 2<sup>nd</sup> grade road together with a railway in non-forest land etc.)

## 8.2. Main threats to ecological connectivity

The high biodiversity of the pilot area is represented by the rich list of protected species and the extension of the protected areas in the region. The Mureş Valley, apart from its local biodiversity significance is a major linkage area between neighbouring hill/mountain areas. In this respect, the main threats to structural connectivity in the project area are represented by landscape alteration and fragmentation (related to transport infrastructure, land-use and habitat alteration) and the main threat to functional connectivity are represented by disturbance factors (related to traffic and other human activities) and mortality factors (traffic, hunting, poaching).

Motorways, other roads, and railways may represent an important barrier for natural movement and migration of wildlife species due to their constructive permeability and due to traffic, which deter crossings and pose the risk of an animal-vehicle collision. For that reason, it is absolutely necessary to plan and implement appropriate mitigation measures which allow safe crossing of the road/railway by wildlife during construction or as part of upgrading transport infrastructure.

The motorways and high-speed railways have the most serious consequences for the animal populations as they often create an insurmountable barrier due to the continuous fencing and high intensity of traffic (adapted after Anděl & Gorčicová 2008 in Kutal 2013).

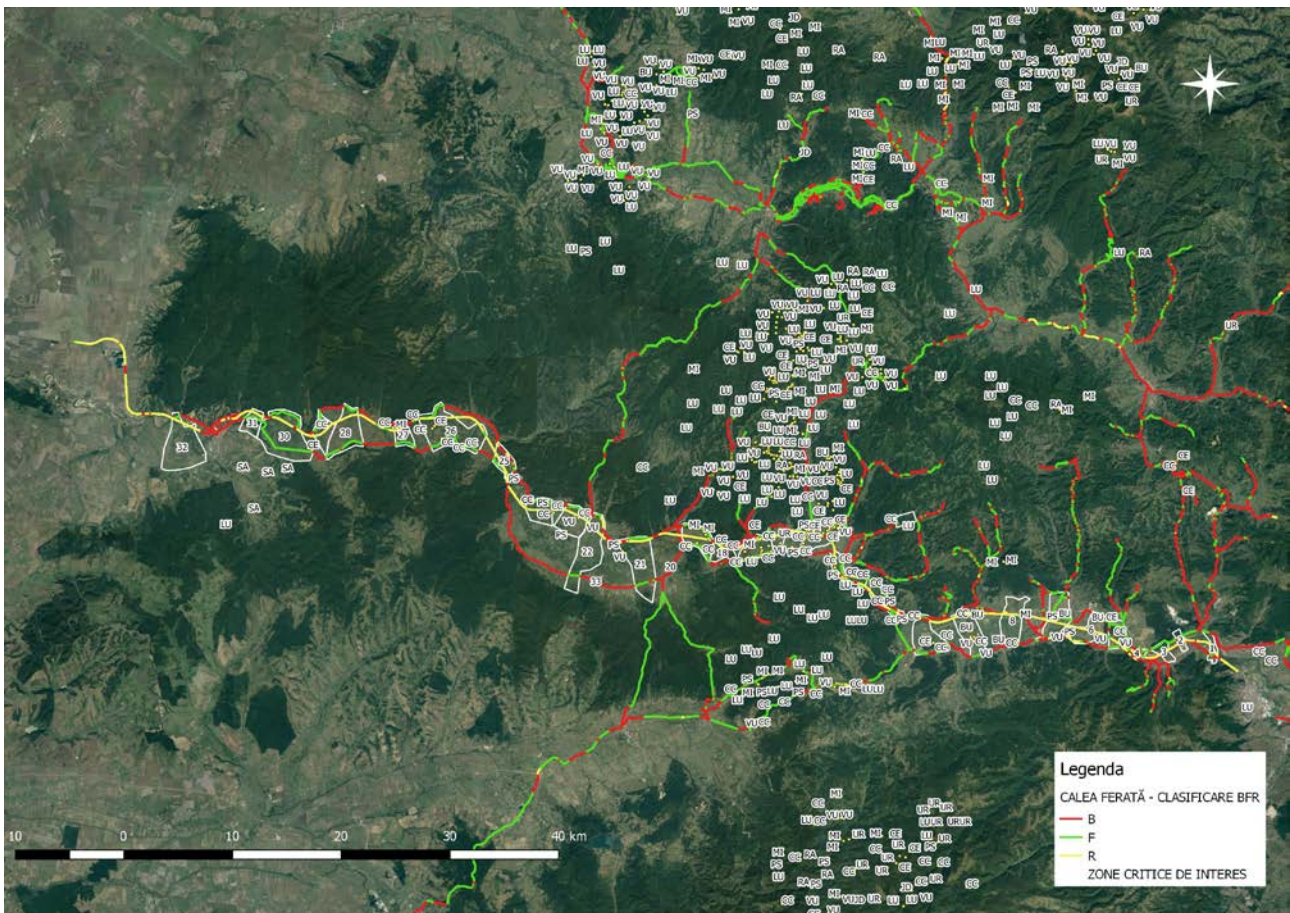
However, lower category of roads with higher traffic intensity also creates an impermeable barrier. For instance, in Slovakia, a substantial part of traffic-related bear mortalities has happened on secondary roads and railways (SNC SR). More intensive traffic leads to increasing number of collisions with animals. The number of animals killed on roads may be so high that they could threaten the survival of some species or their population. Higher traffic volumes are connected with an increased barrier effect. A study in Slovakia (Skuban, Find'o) shows that traffic volume exceeding 5,000 vehicles per day completely restricted the movement of bears. The intensity on the roads during the night or early morning is much important, because animals cross the roads during the night more often (Kutal 2013). The study realized in PLA Beskydy show that permeability of the roads for animals was better when the traffic intensity during the night was lower (Váňa in Kutal, 2012, Dostál (2018) – separate result/output of the TRANSGREEN project).

Roads with lower traffic intensity may also have an important impact on the animal populations, mainly for species living in relatively low population densities and inhabiting large areas, for example large carnivores. Death of even only one individual caused by a collision with a motor vehicle may therefore mean a considerable loss for the small population (Kutal 2013) or for connectivity of (relatively) separate populations.

The barrier effect caused by the constructive specifications even for infrastructure with lower traffic intensity is generally neglected, with much more emphasis being placed on traffic values. However, the structural permeability of the existent transport infrastructure is critical data for decision making process in safeguarding migration/movement routes connecting permeable sectors through the landscape.

**Table 6. Threats and potential approach for conflict management**

<b>Threat</b>	<b>Potential approach for conflict management</b>	
<b>1. Traffic-kills</b>	1.1.	Increase/maintain functionality of all underpasses
	1.2.	Fence entrances in tunnels
	1.3.	Fence sectors above functional underpasses
	1.4.	Light and sound warnings systems at entrance/exits of tunnels
	1.5.	Signal accident-prone sectors on the railway
	1.6.	Warning signs for drivers on mortality spots on roads
	1.7.	Management of vegetation along roads and railways
<b>2. Large-scale monoculture</b>	2.1.	Incentives for specific cultures
	2.2.	Minimal obligatory measures into sectoral policy, adapted for biodiversity AND connectivity
	2.3.	Acquire and manage land for biodiversity AND connectivity
<b>3. Fencing of large areas</b>	3.1.	Building regulation and control/enforcement
	3.2.	Incentives for specific cultures
	3.3.	Minimal obligatory measures into sectoral policy, adapted for biodiversity AND connectivity
<b>4. Fire</b>	4.1.	Awareness and enforcement
<b>5. Inappropriate management of natural vegetation</b>	5.1.	Guidelines, link with CAP and Water Directive, forestry legislation and norms; awareness and control
<b>6. Un-sensitive water management</b>	6.1.	Awareness and avoidance of unnecessary water regulation
	6.2.	"Green" management of water bodies
	6.3.	Strict regulation of sand/gravel extractions
<b>7. Invasive species</b>	7.1.	Control and ecological restoration
<b>8. Poaching</b>	8.1.	Control in sensitive areas
<b>9. Disturbance and predation of stray/shepherd dogs</b>	9.1.	Enforce legislation
	9.2.	Facilitate the use of specialized guarding dogs
<b>10. Increased human-wildlife conflicts</b>	10.1.	Awareness
	10.2.	Facilitate implementation of prevention measures
	10.3.	Compensations
	10.4.	Include corridors as areas eligible for targeted subsidies or management measures



Map 7. Species records, permeability assessment of existing transport infrastructure (Green = high permeability sector, Yellow = average permeability sector; Red = low permeability sector /barrier), species recordings and selected study areas (white polygons) (TRANSGREEN/ LIFE LCC/COREHABS).

## 8.3. Corridors identification

### 8.3.1. Methodology of identification

The area between Apuseni Mountains and Southern Carpathians was identified as significant regional corridor by Salvatori (2004), highlighting the Mureș valley linkage area, in a GIS and expert-opinion study at Carpathian region.

A study (Mot et al., 2010) based on identification of critical points represented by important permeable sectors of existing infrastructure, habitat suitability and land-use supported the designation of new Natura 2000 sites to form a regional ecological network in 2011.

During the TRANSGREEN project a more detailed mapping of permeability of existing linear features (transport infrastructure, rivers) was produced. As project of railway up-grade is on technical solution stage, data extracted from drawings was used to estimate the permeability of the future construction.

The presence of species was collected through a mix of methods – transects, camera-traps, observations and road-kill data. Land use and local disturbance factors were assessed using satellite imagery and field observations.

As a result, 33 study areas are being analysed in detail, in order to identify and assess the functionality of movement routes of mid-sized and large mammal species.

A set of 10 main threats that might impact the structural and functional connectivity has been identified (Table 6) and for each, a list of potential approaches to mitigate the conflict has been proposed. For each study area, important sectors were identified where concrete measures to ensure structural and functional permeability are being proposed and will be discussed with the relevant stakeholders.

### 8.3.2. Support by GIS modelling

Supplementary to TRANSGREEN activities, we started to use various GIS tools to generate the potential movement routes and to assess the probability for these routes to retain their role within different land-use scenarios, and, if feasible, to develop a priority classification system for the movement routes, to support decisions in further stages of the project. A first model of landscape resistance/permeability using the wolf as target-species has been produced and it is currently ground-proofed in order to test and to enhance the GIS model.



Map 8. First result (not-yet-validated) of modelling with Circuitscape – landscape resistance for wolf movement (left) and habitat connectivity for the wolf (right).

## 8.4. Wildlife monitoring in the pilot area

The main object of TRANSGREEN study in the pilot area is large/medium-sized mammals with the emphasis on large carnivores. The presence of species in the pilot area was collected from the recent database of Zarand Association (from a mix of methods – transects, camera-traps, incidental observations, poaching records and road-kill data),

historical records of bear spotting outside official range and TRANSGREEN monitoring.

Based on terrain particularities and resources available within TRANSGREEN project, the monitoring was based on monitoring the river Mureş as a major transect throughout the project area and recording traffic kills on transport infrastructure. For the Mureş area we decided to install camera traps on islands which could act as steppingstones and to monitor river banks on mud/sandy ground. During field monitoring all accidental observations were recorded.



Map 9. Camera traps locations on islands and banks' permeability of river Mureş



Photo 3/4. Red deer poached on one of Mureş islands (left) and accidental observation of a male roe deer climbing a steep bank after swimming across Mureş (right).

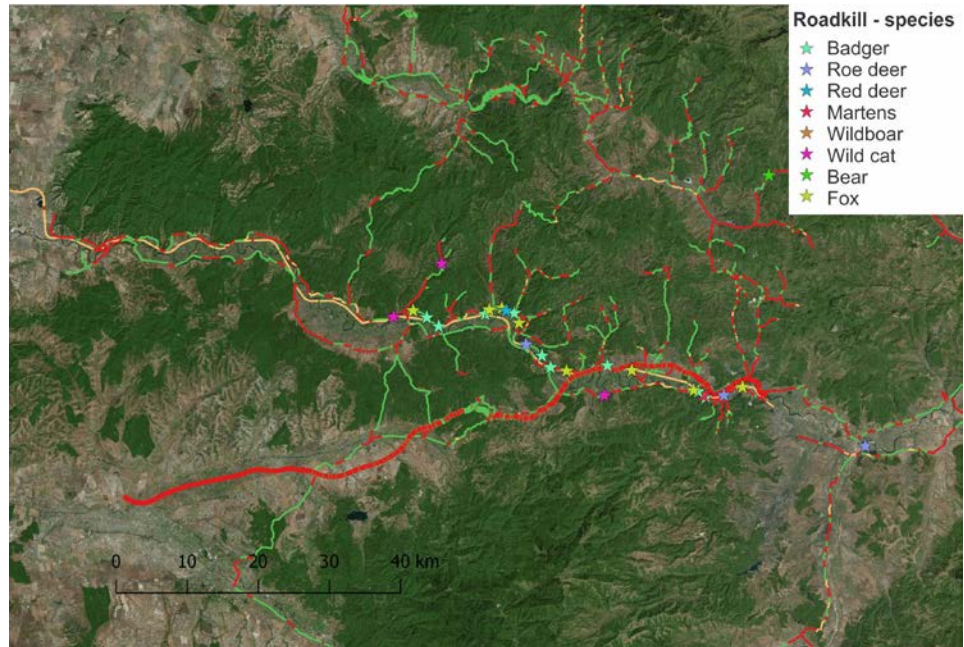
**Table 7. Species and number of individuals captured on cameras during monitoring of islands**

Species Code	No. of individuals	Date	Camera trap	Monitoring session no.
Wild cat	1	24.03.2018	1	1
Dog	1	25.03.2018	1	1
Red squirrel	1	28.03.2018	1	1
Pheasant	1	30.03.2018	1	1
Roe deer	1	14.04.2018	1	1
Roe deer	1	15.04.2018	1	1
Roe deer	1	17.04.2018	1	2
Marten	1	19.04.2018	1	2
Roe deer	1	20.04.2018	1	2
Roe deer	1	22.04.2018	1	2
Roe deer	1	30.04.2018	1	2
Dog	3	30.04.2018	1	2
Dog	1	1.05.2018	1	2
Dog	1	5.05.2018	1	2
Roe deer	1	5.05.2018	1	2
Owl	1	29.03.2018	2	1
Pheasant	1	08.04.2018	2	1
Wild cat	1	12.04.2018	2	1
Red fox	1	14.03.2018	3	1
Wild boar	1	15.03.2018	3	1
Wild boar	1	18.03.2018	3	1
Red fox	1	20.03.2018	3	1
Wild boar	1	22.03.2018	3	1
Roe deer	2	23.03.2018	3	1
Roe deer	1	06.04.2018	3	1
Roe deer	1	06.04.2018	3	1
Red fox	1	09.04.2018	3	1
Roe deer	2	10.04.2018	3	1
Wild boar	2	13.04.2018	3	1
Wild boar	1	16.04.2018	3	2
Red fox	1	30.04.2018	3	2
Wild boar	1	6.05.2018	3	2
Wild boar	5	15.05.2018	3	2
Beaver	1	15.03.2018	5	1
Wild boar	1	19.03.2018	5	1
Roe deer	1	20.03.2018	5	1
Wild cat	1	24.03.2018	5	1
Red fox	1	26.03.2018	5	1
Beaver	1	26.03.2018	5	1
Roe deer	1	31.03.2018	5	1
Wild boar	1	31.03.2018	5	1
Wild cat	1	02.04.2018	5	1
Wild boar	1	05.04.2018	5	1
Dog	1	06.04.2018	5	1
Roe deer	1	19.04.2018	5	2
Red fox	1	26.04.2018	5	2
Wild boar	2	6.05.2018	5	2
Wild boar	1	10.05.2018	5	2
Roe deer	1	14.05.2018	5	2
Roe deer	1	17.03.2018	6	1
Roe deer	1	24.03.2018	6	1
Wild cat	1	26.03.2018	6	1
Roe deer	1	29.03.2018	7	1
Roe deer	1	30.03.2018	7	1
Roe deer	1	01.04.2018	7	1
Roe deer	2	08.04.2018	7	1
Roe deer	1	13.04.2018	7	1
Roe deer	1	19.04.2018	7	2
Roe deer	2	22.04.2018	7	2
Roe deer	1	24.04.2018	7	2
Red fox	1	27.04.2018	7	2
Roe deer	1	22.03.2018	8	1
Roe deer	2	23.03.2018	8	1
Beaver	1	03.04.2018	8	1
Wild boar	2	16.04.2018	8	1
Red fox	1	02.05.2018	8	2
Roe deer	1	04.05.2018	8	2
Red fox	1	11.05.2018	8	2
Red fox	1	13.05.2018	8	2
Roe deer	1	15.05.2018	8	2

## Traffic kill recording

Traffic kills records were collected from database and during TRANSGEEN monitoring. Vast majority of data

was collected on roads as railway casualties are hard to be spotted.



Map 10. Traffic kills records in the project area. (Background map: Bing Satellite).

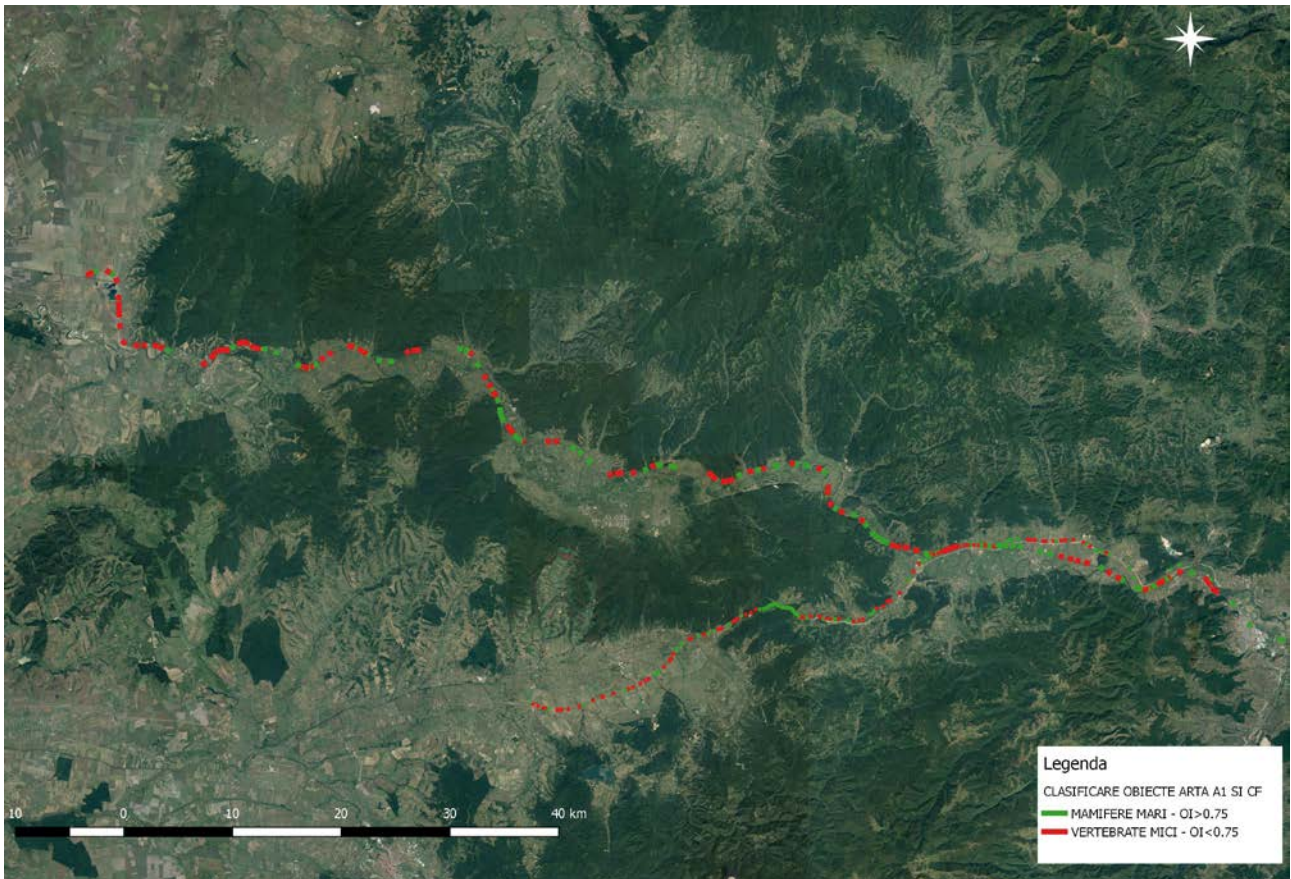


Photo 5/6. A roe deer killed on the European road E68 (left) and a red deer calf killed by train (right) within the pilot area.

## 8.5. Inventory of infrastructure passages

Passages under/over infrastructure are important elements for ensuring safe wildlife crossings. We identified and inventoried existing and design

objects on major infrastructure in the pilot area. Openness-indexes were calculated and classified for permeability effectiveness for different species group, as part of future decision-making process of measures to be implemented to ensure landscape permeability.



Map 11. Location and broad classification of under/over-passages on main transport infrastructure in the project area.



Photo 7/8. Examples of bridges on the existing railway (left) and European road E68 (right) within the pilot area (right).

# 9. Best practices

**T**here is little experience in Romania in terms of mitigating landscape fragmentation and the impact of transport infrastructure; however, several good-practice examples can be highlighted:

- » Specification of connectivity in several sectoral strategic documents.
- » Detailed field data records being used to assess permeability – species occurrence, structural details for infrastructure, land-use.
- » First mitigation solutions included in the environment permit for A1 motorway Lugoj-Deva.
- » Bored tunnels chosen as constructive solution for the upgraded Arad – Deva railway.
- » Acquired land and special management for landscape connectivity (including controlling of invasive species and habitat restoration) as part of the Life Connect Carpathians project.
- » Poaching control in sensitive areas and facilitated implementation of preventive measures), including the use of use of specialized guarding dogs) – Life Connect Carpathians project.
- » Regional action plans targeting to population connectivity – the Life Connect Carpathians project.



# 10. Negative examples

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

The modernization of the European road E79 has been done without any impact assessment studies; as a result, many permeable sectors within an important connectivity area have been significantly affected.



# 11. Gaps of available knowledge, accessibility and availability of biodiversity and transport data

**T**here are huge gaps in terms of knowledge availability, but also expertise and experience in proper dealing with the mitigation of negative effects of transport infrastructure projects. This is partly because there were no projects before dealing or considering such issues.

There are gaps in terms of understanding the effects and impacts of linear infrastructure projects, especially at landscape level. In addition, the calculation and evaluation of cumulative effects is done in a very superficial way.

The road and railway kills are generally not registered and there is no database created at county or national level to start the analysis of gaps in terms of mitigation measures.

There is also a lack of knowledge in terms of genetic sampling for evaluating the population-level benefits of wildlife crossing structures.

Biodiversity-related data is scarce at all levels. There is no national biodiversity database, which might help in identifying potential conflicts with transport infrastructure development in biodiversity-rich areas like in protected areas.

There is also a lack of cooperation and open dialogue between many actors involved in the development of grey and green infrastructures. This is a great barrier which should be overcome for the benefit and safety of both humans and animals.

# 12. Recommendations to fill in the gaps

Cooperation among key stakeholders should be widely promoted. A national platform should be established with key experts from all important fields in order to analyse each transport project and to come up with specific and targeted recommendations and solutions to minimize the impacts of linear infrastructure on biodiversity.

Biodiversity assessments should be included in the very early stages of transport infrastructure planning. Planning is a critical stage which defines the vision, considers strategic options, identifies available resources and sets timetables for implementation. A rigorous planning provides important opportunities to identify potential environmental conflicts and to formulate appropriate measures to avoid their occurrence.

When planning for a project, the selection of alternatives (location and technical solutions) should be carefully performed and should precede the development and approval of the feasibility study. The best alternative should be selected through a multi-criteria analysis.

The environmental authorities must ensure high transparency in the decision-making process and should publish all relevant documents associated with the project on its website: presentation memorandums, field investigation reports, reports on environmental impact, appropriate assessment studies, opinions submitted by various stakeholders (managers/custodians of protected natural areas, NGOs etc.), regulation drafts and other decisions and final regulations, monitoring reports.

To increase the involvement of stakeholders, and to benefit from their opinion, it is recommended that the project beneficiary, supported by technical teams (engineers, environmental experts, etc.) create and moderate online platforms that can enable and facilitate the access to documents and maps, as well as expressing opinions, recommendations, etc.

Capacity building should be organized for all stakeholders involved in both grey and green infrastructure development. This is crucial for achieving sustainable infrastructure development.

Building trust should also be considered and for this purpose, the above-mentioned multi-stakeholder platform might be a starting point. The platform should be organized on a regular basis and should also include updates from the members. The CCIBIS GreenWeb Platform (<http://green-web.eu/>) can also be a good way to move forward and improve cross-sectoral knowledge, share experience and expertise, seek for common solutions etc.

# 13. Conclusions

The harmonization of grey and green infrastructure is a long-term and complex process but essential for all well-being. Cooperation between all parties involved in the process is a prerequisite for success.

There is an urgent need to develop a national database with road and rail kills, but also with biodiversity data in order to be more efficient in the identification of conflicts with wildlife and the selection of proper mitigation measures and locations where they should be implemented.

Monitoring of both wildlife and transport is important for data collection and understanding and justifying the measures that are required for a sustainable transport network in Romania.

The lack of an official methodology for the identification of ecological corridors is affecting the development and consolidation of the Green Infrastructure in Romania.

A pool of experts and professionals should be assembled in all sustainable transport-related fields.

The TRANSGREEN project gives a very good frame to harmonize grey and green infrastructure in the Carpathian eco-region and should be replicated in other regions.

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# 15. Annexes

## Ecological corridors' assessment

**Example: Corridor number: 13 Name of the corridor: "Tuneluri Pojoga"**

### Description of the corridor

The area is linking a major forested area South of Mureş River with a forested hill north of the river, through the Mureş valley which is partly used as agricultural land and partly being abandoned and/or in vegetation succession. There is a forested island on the river where we recorded the presence of various species of mammals, proving that they are crossing the river and showing the role of islands as stepping stones.

### Barriers and threats

*The main barriers* are represented by transport infrastructure (E68 European Road, DJ707A County road, existing railway and the new alignment of the up-graded railway) and the Mureş River.

*The main threats* identified are causalities and disturbance caused by traffic, large scale monocultures, fencing of large areas of land, fire, inappropriate management of natural vegetation, insensitive water management, large-scale invasive alien species, poaching, disturbance and predation of stray/shepherd dogs, increased human-wildlife conflicts.

### Evaluation of the corridor permeability

The permeability of each major linear feature has been mapped and the results are presented below:

**Table 1. Permeability of linear features**

Feature	Sector	Assessment of permeability		Notes: Permeability classes and representation on maps
		Class	Value	
European road E68	1262 part.	F	4	Very good - green
	1263	F	4	Very good - green
	1264	R	2,5	Good - Yellow
	1265	R	2,5	Good - Yellow
	1266	F	4	Very good - green
	1266b			Underpass
County road DJ707A	210	F	4	Very good - green
	211	F	4	Very good - green
Existing railway	31 part.	R		Good - Yellow
	32			Underpass
	33	R		Good - Yellow
	34			Underpass
Mureş bank - South side	65	R		Good - Yellow
	66	R		Good - Yellow
	67	R		Good - Yellow
	68	R		Good - Yellow
	69	R		Good - Yellow
	70	R		Good - Yellow
	702	B		Barrier - Red - "Piatra lui Filip"
	71	F		Very good - green
Mureş bank - North side	200	R		Good - Yellow
	201	B		Barrier - Red
	202	R		Good - Yellow
	203	R		Good - Yellow
	204	R		Good - Yellow
	205	R		Good - Yellow
	206 part	R		Good - Yellow
Island	13-1/202D Insula-3	F		Very good - green

The assessment of permeability for the upgrading railway project is presented in the tables below, per sectors:

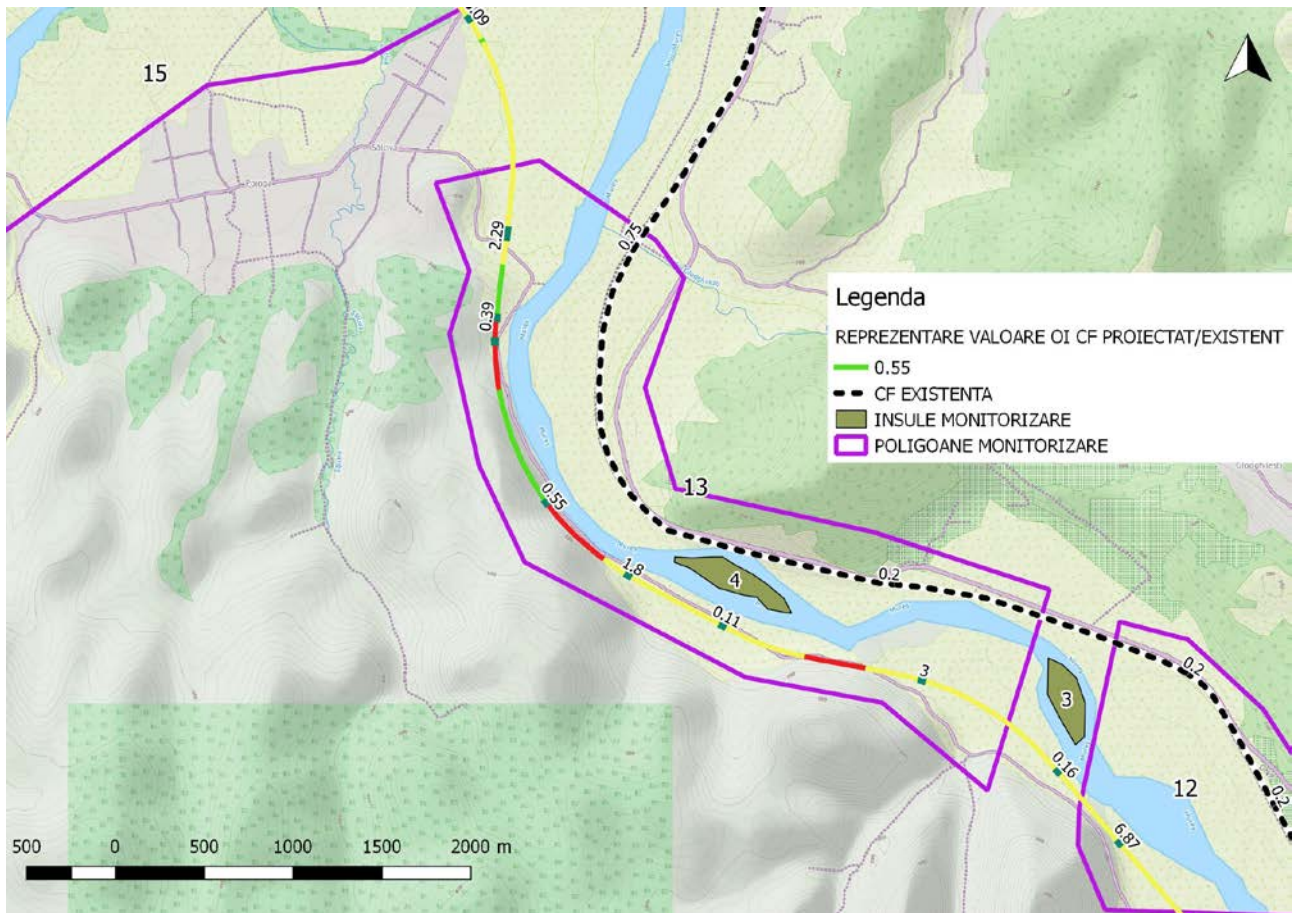
**Table 2a. Permeability of the upgrading railway project - passing over the embankment**

Upgrading railway	ID GIS	KM position	Permeability of embankment - passing over		Drawing	Notes: Permeability classes and representation on maps
			Class	Value		
Transversal profiles	19746	520676-520950	R	3	TS314SI	Good - Yellow
	19756	520951-521325	R	3	TS315SI	Good - Yellow
	19764	521326-521600	R	3	TS316SI	Good - Yellow
	19773	521601-521690	R	3	TS317SI	Good - Yellow
	19784	521691-522040	R	3	TS318SI	Good - Yellow
	19822	522041-522450	R	3	TS319SI	Good - Yellow
	19828	522451-523123	R	3	TS320SI	Good - Yellow
	19833	523124-523300	R	3	TS321SI	Good - Yellow
	19838	523301-523350	R	3	TS322SI-2	Good - Yellow
	19843	523578-523740	B	1	TS323SI-POLATA	Barrier - Red
	19943	523741-524419	F	5	TUNEL-1	Very good - Tunnel
	19848	524420-524670	B	1	TS324SI	Barrier - Red
	19852	524740-524856	B	1	TS325SI	Barrier - Red
	19944	524857-525124	F	5	TUNEL-2	Very good - Tunnel
	19856	525125-525275	R	3	TS326SI	Good - Yellow
19860	525276-526075	R	3	TS327SI	Good - Yellow	

**Table 2b. Permeability of the upgrading railway project - passing through underpasses**

Position	Type	A	H	L	OI_2 with adjacent construction features	Notes
523741	Culvert	11	2	3	0.55	BLOCKED
525295	Bridge	11.4	8	11	2.29	
525331	Culvert	56	2	2	0.07	
522520	Culvert	34	2	2	0.11	
524838	Culvert	23	3	3	0.39	BLOCKED
523121	Bridge	12.3	6	7	1.8	
521350	Passage	20	7.6	14	3	
524704	Bridge	13	9	50	18.75	

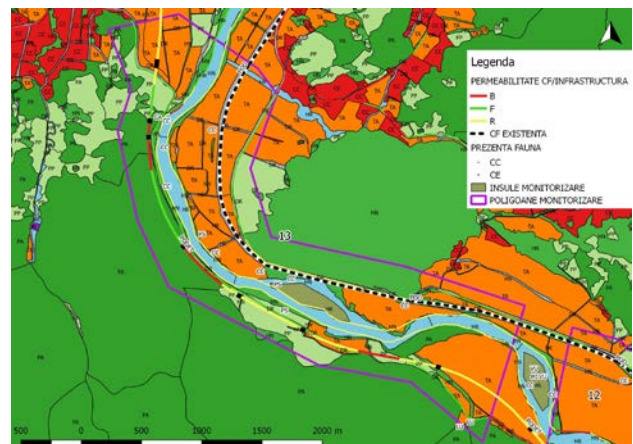
Representation of permeability for the upgrading railway project is presented in the map below, per sectors:



Map 1. Permeability of the upgrading railway in corridor area no. 13: green = highly permeable, yellow = medium permeable, red = barrier for large carnivores.

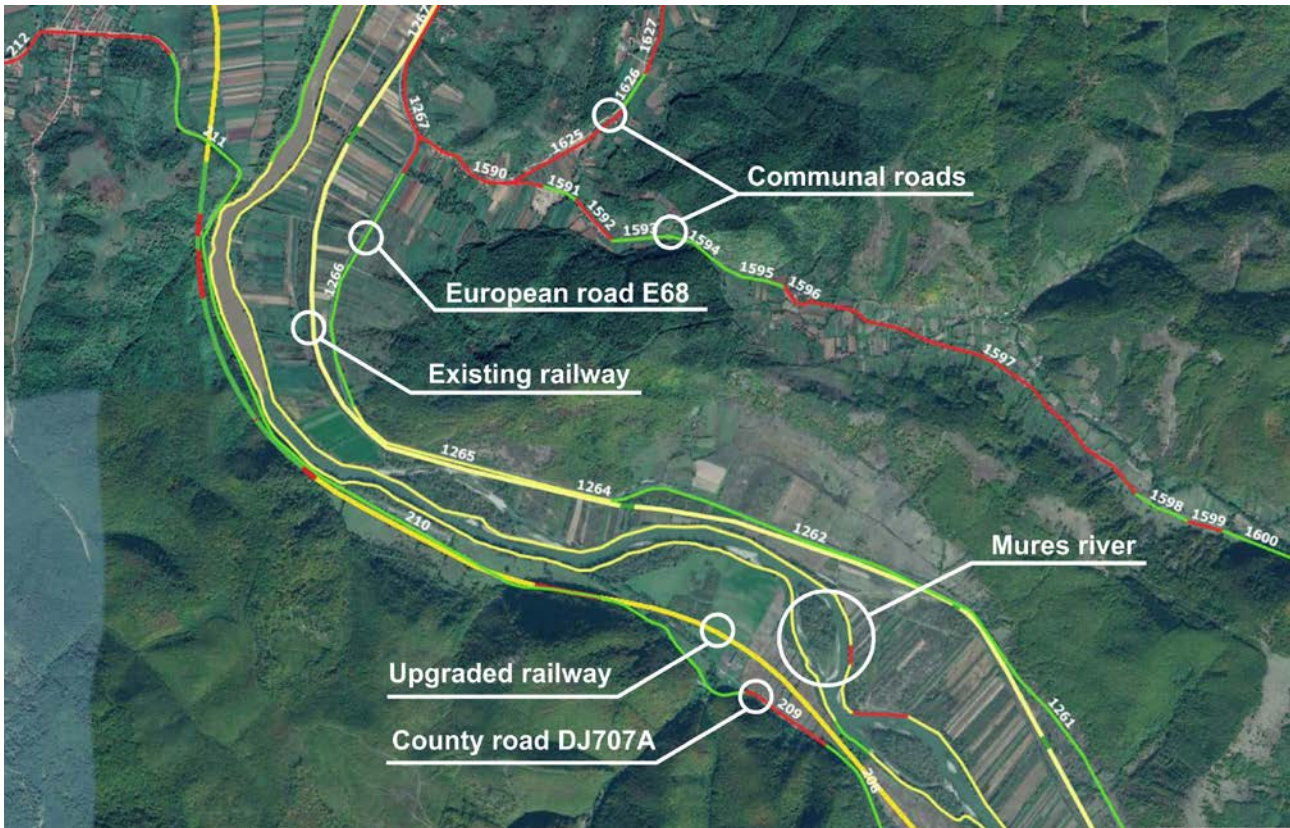
The representation permeability for of all linear features and of the landscape, based on land-use, is presented in the map below, including species records, showing the transitivity of the corridor.

Land use category	
<b>PA</b>	Forested areas
<b>HN</b>	Marsh areas
<b>HR</b>	Water courses
<b>PP</b>	Permanent pastures
<b>TA</b>	Crop land
<b>CP</b>	Permanent crops
<b>DR</b>	Transport infrastr.
<b>CC</b>	Build areas



Map 2. Permeability based on land-use representation for corridor area no. 13.





Map 3. Corridor area no. 13 and the surroundings (in Google Earth) with permeability of linear features: green = highly permeable, yellow = medium permeable, red = barrier for large carnivores.



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### Project Partners

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**Czech Republic** – Friends of the Earth Czech Republic – branch Olomouc, Nature Conservation Agency, Transport Research Centre

**Hungary** – CEEweb for Biodiversity

**Romania** – Association “Milvus Group”, WWF Romania

**Slovakia** – National Motorway Company, State Nature Conservancy of the Slovak Republic, SPECTRA – Centre of Excellence of EU – Slovak University of Technology in Bratislava

### Associated Strategic Partners

**Austria** – Ministry for Transport, Innovation and Technology

**Czech Republic** – Ministry of the Environment

**Hungary** – National Infrastructure Developing Private Company Ltd.

**Poland** – Ministry of Infrastructure and Construction

**Romania** – Ministry of the Environment, Ministry of Transport

**Slovenia** – Ministry of Infrastructure

**Ukraine** – Ministry of Ecology and Natural Resources, Transcarpathian Regional State Administration – Department of Ecology and Natural Resources