Interreg
Danube Transnational Programme
SaveGREEN

Local Monitoring Plan Mureş Valley (Târgu Mureş – Târgu Neamţ) Pilot Area

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1. Introduction

When making the methodology of monitoring in the pilot area Târgu Mureş – Târgu Neamţ, first of all it is necessary to consider the PA's specifics. In the following chapters, the structure of the landscape and additional information needed for the methodology are described as well as the chosen monitoring design

1.1. Specifics of the Mureş Valley Târgu Mureş – Târgu Neamţ Pilot Area

The Târgu Mureş – Târgu Neamţ is a large pilot area with a mix of habitats and land uses. It is located in the central part of Romania, linking the historical regions of Transylvania in the west and Moldova in the east. It incorporates a part of the Romanian Eastern Carpathians, as well as mountains' foothills to the west and to the east.

Figure 1 General location of the Târgu Mureş – Târgu Neamţ pilot area in the Carpathian range

One of the wildest and most important areas for biodiversity conservation in the Carpathians, the Târgu Mureş – Târgu Neamţ area harbors a large number of priority large mammal species, such as *Ursus arctos** and *Canis lupus**.

The area is well known as a corridor between the Northern part of the Romanian Carpathians (continuing further in Ukraine) and the higher Southern Carpathians, both very important habitats for large mammals. Ecological corridors have been identified in the area within other project (such as the BioREGIO project, or the ConnectGREEN project).

The level of wilderness and the density of Natura 2000 sites in this area allow for the existence of a high level of biodiversity, including the existence of a large number of bird species. The high density of rivers in the area contributes to the existence of important blue corridors, most very important for such species as the European otter.

The area is currently fragmented by existing roads and railways, as well as additional pressures such as urbanization and the expanding unsustainable tourism industry. The main threat to the biodiversity and the natural character of the area is the proposal of the Târgu Mureş – Târgu Neamţ motorway, envisioned to be constructed within the following decade. The planned development of the motorway, if implemented without adequate impact avoidance and mitigation measures asd without consideration to the other existing pressures in the area, threaten these highly important areas for biodiversity, and could contribute significantly to the interruption of connectivity between different areas of the Carpathians.

1.2. The concept of structural and functional monitoring

Structural and functional connectivity focus on different aspects of landscape: *structural connectivity* indicates the part of the landscape that is actually connected through e.g. corridors. In contrast, *functional connectivity* includes species-specific aspects and their interaction with landscape structures. Thus, functional connectivity is the actual connectivity from species' perspective" (see Scaletool n.d.).

Therefore, in a first step, spatially explicit information from different sources that are suitable to describe the structural endowment of an area are used in a GIS-based model to identify areas that can serve as corridors on the one hand, and to assess these corridors in terms of their structural suitability on the other hand. At sites whose suitability as corridors seems to be limited due to structural features, the functional suitability will be checked by monitoring of both the structures found and the presence of wildlife, and compared with sites whose suitability is not limited by structural features. This procedure should enable an evaluation of the corridor with regard to its functional quality and serve as a basis for proposals for measures that can improve the structural suitability of the corridor.

Note: Additional information is provided in D.T1.1.2. (Grillmayer & Plutzar 2021).

1.3. GIS modelling tool and maps of structural connectivity

The starting point was the consideration to develop a uniform approach for all pilot areas, which is based on homogeneous data sets and identifies the structural corridors with the same methodology. Since there is no distribution data available for most of the pilot areas on order to develop a data-driven bottom-up approach, it was decided, following the meeting of December 7, 2020, to conduct the modelling for structural monitoring using an expert model.

For this purpose, rules for the designation of core areas and for the definition of resistance surfaces – both substantial inputs for the calculation of the corridors – have to be specified for the selected species-groups based on available information and knowledge.

These calculations should use data sets that are largely available in comparable form for all pilot areas. As an added benefit, data that are periodically updated on an ongoing basis will be preferred. In this way, an established set of rules that is transparent and comprehensible can be applied in an analogous manner to future studies. These considerations result in a top-down GIS model based on data available to the EU level and subsequently complemented and improved by regional and local knowledge and field surveys.

Note: Figure 2 *shows the workflow of the GIS-model, using the PA Pöttsching as an example. Additional information is provided in D.T1.1.2. (Grillmayer & Plutzar 2021).*

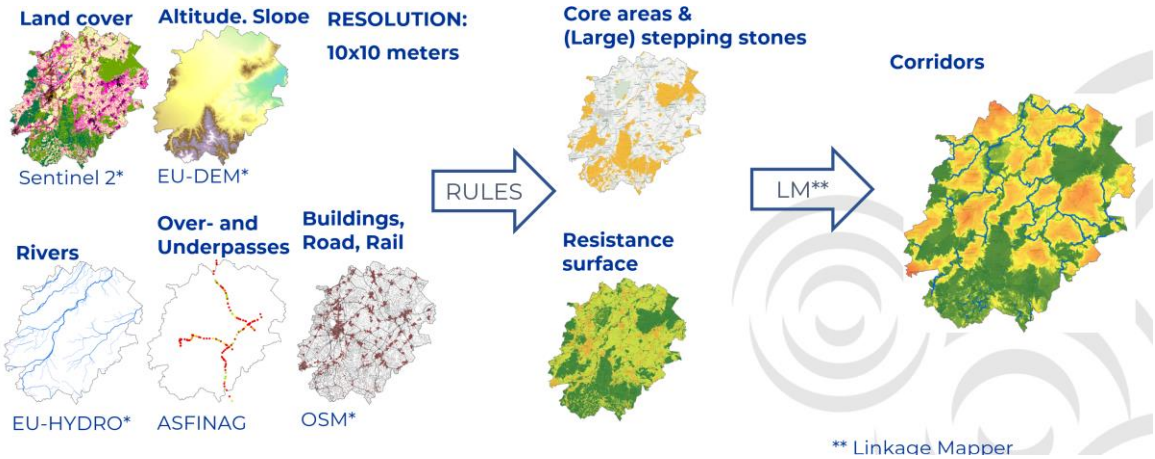

Figure 2 Schematic workflow of the GIS-model to assess the structural connectivity of corridors. * indicates data sets available on EU-level. ** Linkage Mapper is a widely used

modelling framework for the calculation of corridors (see https://circuitscape.org/linkagemapper/linkage-mapper-tools/)

1.4. Local Criteria for prioritization/selection of monitoring sites

The Târgu Mureş – Târgu Neamţ Pilot Area has as its main distinctive feature a current lack of major infrastructure. The motorway proposed in the area is currently at project stage, with a circa 10-year implementation timeframe. Considering this aspect, the monitoring sites proposed in this plan focus on areas which are important from the point of view of structural and functional connectivity, and whose functionality will need to be maintained during the construction and operation of the proposed motorway.

For the prioritisation / selection of monitoring sites in the case of the Târgu Mureş – Târgu Neamţ Pilot Area the following methodology was proposed:

1. Identification of areas of ecological connectivity – structural and functional connectivity. The results of the modelling done in Work Package 1 were used for this step;
2. Identification of areas under pressure from the proposed motorway (e.g. areas where the motorway is not permeable for fauna) and other existing pressures at landscape level (e.g. areas where there is an extension in urbanisation);
3. Identification of areas with important proposed structures, which can ensure ecological connectivity – bridges, viaducts, tunnels, etc.
4. Identification of areas suitable for the proposal of ecoducts on the motorway or on the adjacent infrastructure.

These areas were identified spatially and the monitoring sites were established with the aid of local knowledge of the pilot area, using the input of local experts on the specific fauna.

The minimum requirements established within the SaveGREEN project were also taken into consideration for the monitoring plan. These were the following:

- establishment of at least 10 monitoring sites;
- minimum 1 overpass;
- minimum 1 underpass;
- minimum 3 corridor sites.

1.5. Selection of target species

The target species groups are presented in the table below:

Group	Species	Notes	Type of relevant ecosystems for monitoring of target species
Amphibians & reptiles	*Bombina bombina* (?) *Triturus cristatus* (?)	*After the first field overview*	Riparian areas, forestry roads, agricultural roads, stagnant water.
Medium-sized mammals	*Felis silvestris* *Lutra lutra* (?) *Sus scrofa*	*After the first field overview*	Forest, forested grassland, riparian areas, river banks.
Large-sized mammals	*Ursus arctos (?)* *Canis lupus (?)* *Lynx lynx* *Cervus elaphus* *Capreolus capreolus*	*After the first field overview*	Forest, grassland, forested grassland, riparian habitats, river banks.

Table 1 Groups and species proposed to be monitored in the Târgu Mureş – Târgu Neamţ Pilot Area

1.6. Monitoring methodology, guidelines & tools

After the monitoring sites have been identified, SaveGREEN aims to conduct the monitoring in the eight pilot areas in a consistent way. In order to be able to guarantee this aim, a guideline was developed. This guideline – D.T1.1.3 (Grillmayer, Plutzar & Sedy 2021) – includes the development of standard data forms for the fieldwork as well as a decision matrix to specify which parameters/ measurements have to be carried out for which species and which methods shall be used. The monitoring process will be supported by an electronic application toolbox, which is currently developed for SaveGREEN. The toolbox will support the following project activities:

- Consistent and quality-assured storage of all data created within the framework of the project genesis
- fieldwork and monitoring of functional connectivity within the pilot areas
- Consistent data flows between field workers and IT infrastructure
- Publishing the data and exposing them to general public

Note: Additional information on the toolbox is provided in D.T1.2.1. (Borgwardt, F. & Grillmayer R.).

2. Monitoring actions per site

1.1 Monitoring Site 1 – Tunnel at km 36+060

i. **Description:** the area is located close to the watershed limit between the Nirajul Mic and the Tarnava Mica rivers. It represents core habitat for large (e.g., brown bear, grey wolf, Eurasian lynx [western limit of distribution area], red deer and wild boar), medium-sized (e.g., roe deer) and small mammals (e.g., European wildcat). Simultaneously, it also acts as a vital ecological corridor for seasonal brown bear movements between the mountains in the east (Gurghiu Mountains part of the Romanian Eastern Carpathians) and the further sections of the mountains' western foothills. In this sense, it connects vital feeding grounds located further west in the foothills and vital winter denning areas located in the mountains in the east.

ii. **Monitoring methods** according to draft guideline for standardized monitoring of functional connectivity

Signs (Si) and animal tracks (T) - the planned tunnel is too long to properly monitor via motion-sensor cameras

iii. **Monitoring sessions:**

August 2021 - August 2022 including (13 months)

Figure 3 Area proposed for monitoring in Monitoring Site 1

1.2 Monitoring Site 2 – Viaduct at km 37+000

i. **Description:** same as above, at Monitoring Site 1 - the two planned structures are located right next to each other.

ii. **Monitoring methods** according to draft guideline for standardized monitoring of functional connectivity

Signs (Si) and animal tracks (T) - the planned viaduct is too long to properly monitor via motion-sensor cameras.

iii. **Monitoring sessions:**

August 2021 - August 2022 including (13 months)

Figure 4 Area proposed for monitoring in Monitoring Site 2

1.3 Monitoring Site 3 – Viaduct at km 39+680

i. **Description:** the planned viaduct will arch over the busy DN13A national road, the local railway with low traffic, the Târnava Mică river, as well as several fenced fish ponds. However, the planned development will also intersect a critical ecological corridor currently used by large (e.g., brown bear, grey wolf, red deer, wild boar), medium-sized (e.g., roe deer) and small mammals (e.g., European wildcat, Eurasian otter) for movements from south to north. Moreover, the area represents core habitat for the Eurasian otter. The importance of this specific corridor derives from the fact that the functionality of similar corridors along the DN13A national road is already

threatened by the gradual expansion of human settlements towards each other along the Târnava Mică river. This phenomenon is further aggravated by punctual developments within the still functional corridors.

ii. **Monitoring methods** according to draft guideline for standardized monitoring of functional connectivity

Signs (Si) and animal tracks (T) on the whole length - the planned viaduct is too long to properly monitor via motion-sensor cameras on its entirety.

Additionally, critical sections next to the Tarnava Mica river will also be monitored with motion-sensor cameras (F).

iii. **Monitoring sessions:**

August 2021 - August 2022 including (13 months)

Figure 5 Area proposed for monitoring in Monitoring Site 3

1.4 Monitoring Site 4 – Interchange at km 44+040

i. **Description:** the area represents both a core area and a critical ecological corridor currently used by large (e.g., brown bear, grey wolf, red deer, wild boar), medium-sized (e.g., roe deer) and small mammals (e.g., European wildcat) for movements from the south to the north and back. The importance of this specific corridor derives from the fact that the functionality of similar corridors along the DN13A national road is already

threatened by the gradual expansion of human settlements towards each other along the Tarnava Mica river. This phenomenon is further aggravated by punctual developments within the still functional corridors.

ii. **Monitoring methods** according to draft guideline for standardized monitoring of functional connectivity

Signs (Si) and animal tracks (T) - the planned highway section intersecting the respective area is too long to properly monitor via motion-sensor cameras.

iii. **Monitoring sessions:**

August 2021 - August 2022 including (13 months)

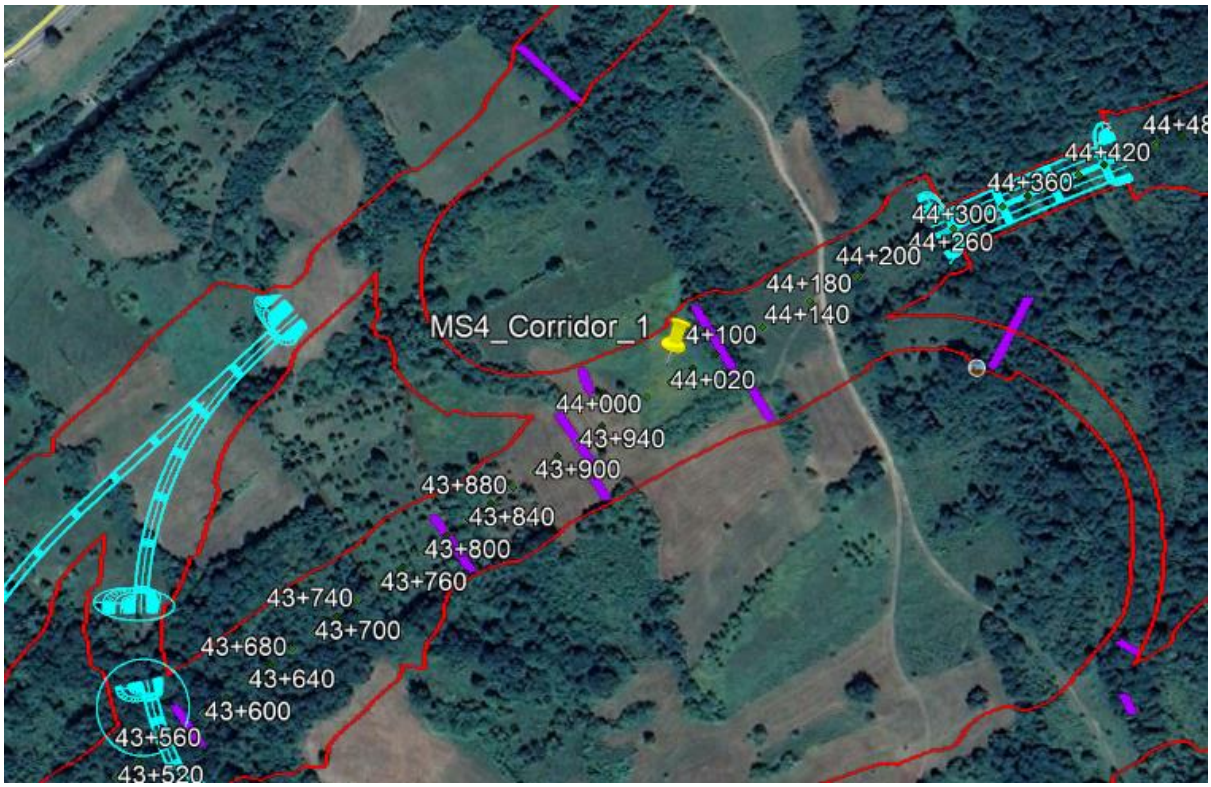

Figure 6 Area proposed for monitoring in Monitoring Site 4

1.5 Monitoring Site 5 – Viaduct at km 49+420

i. **Description:** the area represents core habitat for large (e.g., brown bear, grey wolf, Eurasian lynx, red deer and wild boar), medium-sized (e.g., roe deer) and small mammals (e.g., European wildcat). Simultaneously, it also acts as a vital ecological corridor for seasonal brown bear movements.

ii. **Monitoring methods** according to draft guideline for standardized monitoring of functional connectivity

Signs (Si) and animal tracks (T) on the whole length - the planned viaduct is too long to properly monitor via motion-sensor cameras.

iii. **Monitoring sessions:**

August 2021 - August 2022 including (13 months)

Figure 7 Area proposed for monitoring in Monitoring Site 5

1.6 Monitoring Site 6 – Viaduct at km 58+800

i. **Description:** the area represents core habitat for large (e.g., brown bear, grey wolf, Eurasian lynx, red deer and wild boar), medium-sized (e.g., roe deer) and small mammals (e.g., European wildcat). Simultaneously, it also acts as a vital ecological corridor for seasonal brown bear movements, respectively as a winter denning area for the species.

ii. **Monitoring methods** according to draft guideline for standardized monitoring of functional connectivity

Signs (Si) and animal tracks (T) - the planned viaduct is too long to properly monitor via motion-sensor cameras.

iii. **Monitoring sessions:**

August 2021 - August 2022 including (13 months)

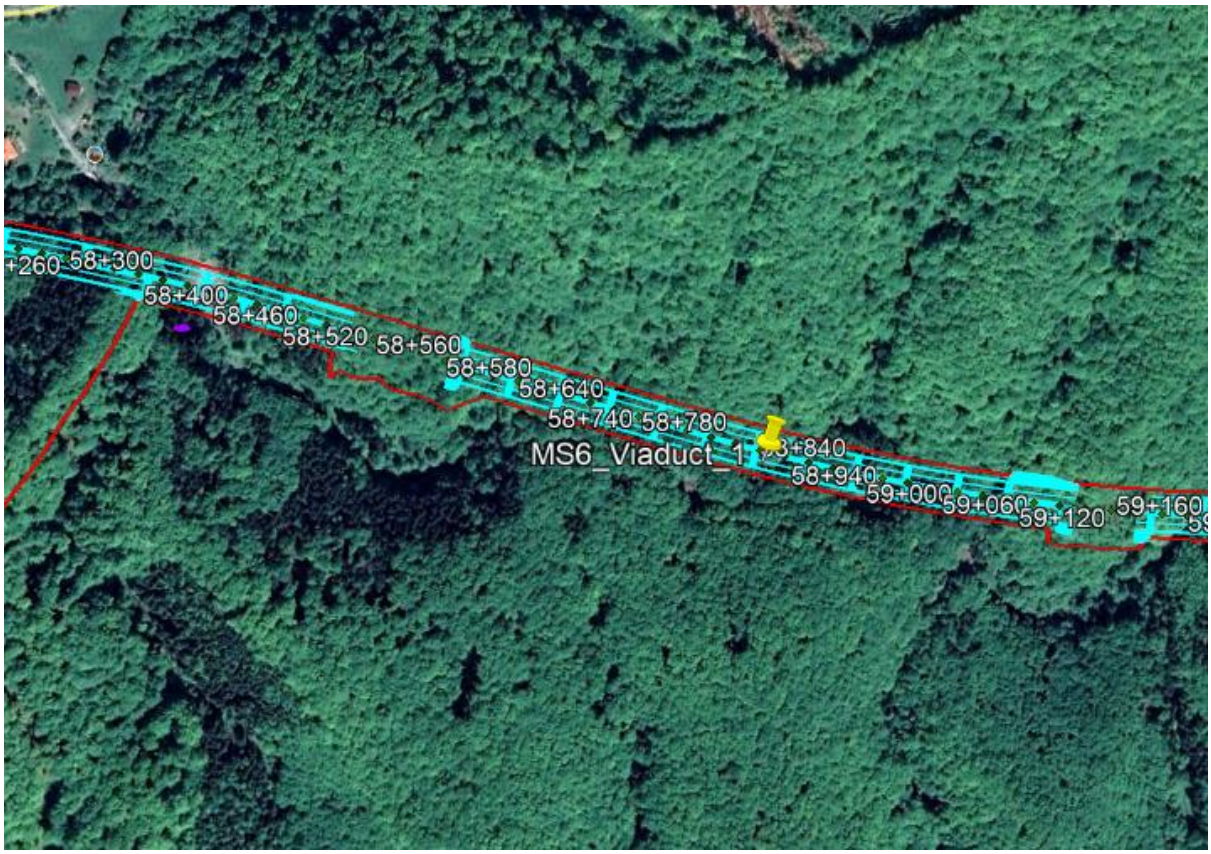

Figure 8 Area proposed for monitoring in Monitoring Site 6

1.7 Monitoring Site 7 – Viaduct at km 63+260

i. **Description:** the area represents core habitat for large (e.g., brown bear, grey wolf, Eurasian lynx, red deer and wild boar), medium-sized (e.g., roe deer) and small mammals (e.g., European wildcat). Simultaneously, it also acts as a vital ecological corridor for seasonal brown bear movements, respectively as a winter denning area for the species.

ii. **Monitoring methods** according to draft guideline for standardized monitoring of functional connectivity

Signs (Si) and animal tracks (T) - the planned viaduct is too long to properly monitor via motion-sensor cameras.

iii. **Monitoring sessions:**

August 2021 - August 2022 including (13 months)

Figure 9 Area proposed for monitoring in Monitoring Site 7

1.8 Monitoring Site 8 – Viaduct at km 71+660

i. **Description:** the area represents core habitat for large (e.g., brown bear, grey wolf, Eurasian lynx, red deer and wild boar), medium-sized (e.g., roe deer) and small mammals (e.g., European wildcat). Simultaneously, it also acts as a vital ecological corridor for seasonal brown bear movements, respectively as a winter denning area for the species.

ii. **Monitoring methods** according to draft guideline for standardized monitoring of functional connectivity

Signs (Si) and animal tracks (T) - the planned viaduct is too long to properly monitor via motion-sensor cameras.

iii. **Monitoring sessions:**

August 2021 - August 2022 including (13 months)

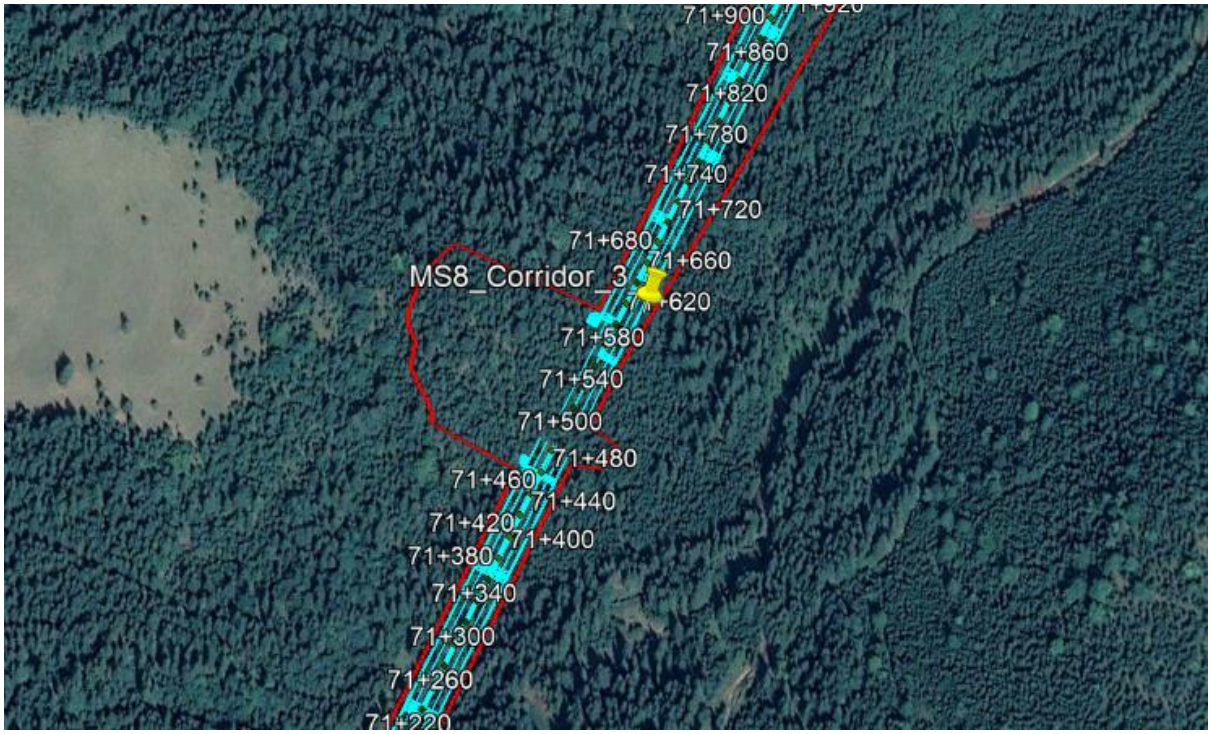

Figure 10 Area proposed for monitoring in Monitoring Site 8

1.9 Monitoring Site 9 – Connectivity area at km 78+800

i. **Description:** the area represents core habitat for large (e.g., brown bear, grey wolf, Eurasian lynx, red deer and wild boar), medium-sized (e.g., roe deer) and small mammals (e.g., European wildcat). Simultaneously, it also acts as a vital ecological corridor for seasonal brown bear and red deer movements from the mountains in the west to the lowlands situated in the east.

ii. **Monitoring methods** according to draft guideline for standardized monitoring of functional connectivity

Signs (Si) and animal tracks (T) - the planned highway section intersecting the respective area is too long to properly monitor via motion-sensor cameras.

iii. **Monitoring sessions:**

August 2021 - August 2022 including (13 months)

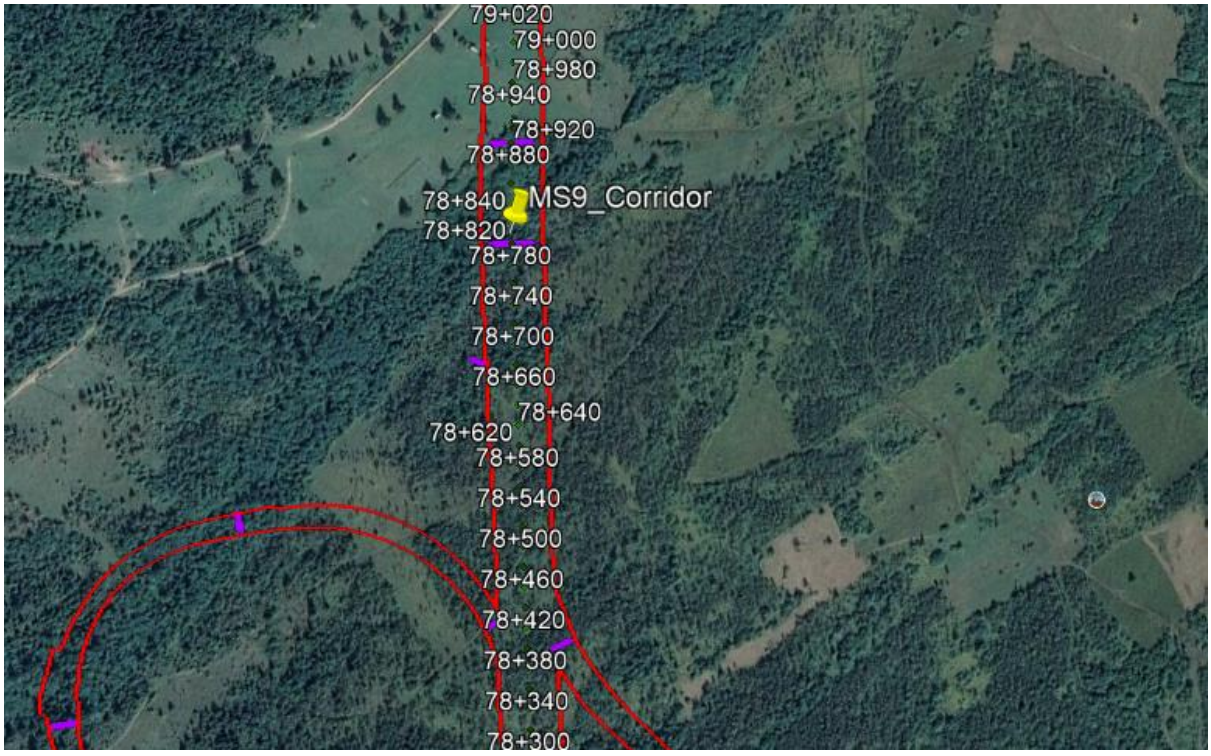

Figure 11 Area proposed for monitoring in Monitoring Site 9

1.10 Monitoring Site 10 – National Road 13A Sovata - Praid

i. **Description:** in between the localities of Sovata and Praid, the National Road 13A intersects an important ecological corridor connecting the mountains in the east to the foothills in the west and used by large (e.g., brown bear, grey wolf, Eurasian lynx, red deer and wild boar), medium-sized (e.g., roe deer) and small mammals (e.g., European wildcat) alike. Collisions between wildlife and vehicles are frequent in the area, often resulting in both traffic kills and material damages. The future functionality of this critical ecological corridor will greatly depend on the permeability of nearby planned structures on the future highway, amongst other things.

ii. **Monitoring methods** ROadkill app (developed during the TransGREEN project)

iii. **Monitoring sessions:**

August 2021 - August 2022 including (13 months)

Figure 12 Area proposed for monitoring in Monitoring Site 10

3. Monitoring plan – the logical framework

The monitoring plan overview is presented in the table below.

Table 2 The monitoring plan overview for the Târgu Mureş – Târgu Neamţ pilot area

Where?		*What?*	*How?*	*When?*	*Who?*	Notes	CSOP - objectives
Code	**Description – role for connectivity, why it was selected?**	**Target species, other factors**	**Methods-codes**	**Calendar**	**Responsible**		
Site 1	• core habitat for large carnivores, ungulates and small carnivores • ecological corridor for brown bears	• Brown bear • Grey wolf • Eurasian lynx • Red deer • Wild boar • Roe deer • European wildcat	Si	August 2021 - August 2022	Milvus Group		1-01 1-2
			T	August 2021 - August 2022	Milvus Group		
Site 2	• core habitat for large carnivores, ungulates and small carnivores • ecological corridor for brown bears	• Brown bear • Grey wolf • Eurasian lynx • Red deer • Wild boar • Roe deer • European wildcat	Si	August 2021 - August 2022	Milvus Group		1-01 1-1
			T	August 2021 - August 2022	Milvus Group		
Site 3	• ecological corridor for large carnivores, ungulates and small carnivores • core habitat for Eurasian otters	• Brown bear • Grey wolf • Eurasian lynx • Red deer • Wild boar	Si	August 2021 - August 2022	Milvus Group		1-01 1-1
			T	August 2021 - August 2022	Milvus Group		

Where?		What?	How?	When?	Who?	Notes	CSOP - objectives
Code	Description – role for connectivity, why it was selected?	Target species, other factors	Methods-codes	Calendar	Responsible		
		• Roe deer • European wildcat • Eurasian otter • Yellow-bellied toad • Great crested newt	F	August 2021 - August 2022	Milvus Group		
Site 4	• core habitat and ecological corridor for large carnivores, ungulates and small carnivores	• Brown bear • Grey wolf • Eurasian lynx • Red deer • Wild boar • Roe deer • European wildcat	Si	August 2021 - August 2022	Milvus Group		1-01 3-10 5b-3
			T	August 2021 - August 2022	Milvus Group		
Site 5	• core habitat for large carnivores, ungulates and small carnivores • ecological corridor for brown bears	• Brown bear • Grey wolf • Eurasian lynx • Red deer • Wild boar • Roe deer • European wildcat	Si	August 2021 - August 2022	Milvus Group		1-01 1-1
			T	August 2021 - August 2022	Milvus Group		
Site 6	• core habitat for large carnivores, ungulates and	• Brown bear • Grey wolf	Si	August 2021 - August 2022	Milvus Group		1-01 1-1

Where?		What?	How?	When?	Who?	Notes	CSOP - objectives
Code	Description – role for connectivity, why it was selected?	Target species, other factors	Methods-codes	Calendar	Responsible		
	small carnivores • ecological corridor for brown bears • winter denning area for brown bears	• Eurasian lynx • Red deer • Wild boar • Roe deer • European wildcat	T	August 2021 - August 2022	Milvus Group		
Site 7	• core habitat for large carnivores, ungulates and small carnivores • ecological corridor for brown bears • winter denning area for brown bears	• Brown bear • Grey wolf • Eurasian lynx • Red deer • Wild boar • Roe deer • European wildcat	Si	August 2021 - August 2022	Milvus Group		1-01 1-1
			T	August 2021 - August 2022	Milvus Group		
Site 8	• core habitat for large carnivores, ungulates and small carnivores • ecological corridor for brown bears • winter denning area for brown bears	• Brown bear • Grey wolf • Eurasian lynx • Red deer • Wild boar • Roe deer • European wildcat	Si	August 2021 - August 2022	Milvus Group		1-01 1-1
			T	August 2021 - August 2022	Milvus Group		
Site 9	• core habitat for large carnivores, ungulates and	• Brown bear • Grey wolf	Si	August 2021 - August 2022	Milvus Group		1-01 5b-2

Where?		What?	How?	When?	Who?	Notes	CSOP - objectives
Code	Description – role for connectivity, why it was selected?	Target species, other factors	Methods-codes	Calendar	Responsible		
	small carnivores • ecological corridor for brown bears and red deer	• Eurasian lynx • Red deer • Wild boar • Roe deer • European wildcat	T	August 2021 - August 2022	Milvus Group		
Site 10	• ecological corridor for large carnivores, ungulates and small carnivores	• Brown bear • Grey wolf • Eurasian lynx • Red deer • Wild boar • Roe deer • European wildcat	Roadkill app	August 2021 - August 2022	Milvus Group		3-10 3-12 5b-3

Legend:

Monitoring methods / codes:

A = personal observation
Ad = acoustic detector
Ba = Barber traps
Bc = Batcorder
D = detector
F = photo trap
Ha = collection by hand
Hn = handling net
Kv = artificial hiding place
Lf = live trap

CSOP objectives – selection:

1-01. Ensure support-data for new infrastructure projects
1-1. Ensure functionality of underpasses
1-2. Ensure functionality of overpasses
3-10. Collect and process data to understand incidents/accidents with wildlife / critical sectors
3-12. Develop and use an integrated database as decision-supporting tool to address traffic incidents (to implement / adjust measures to prevent wildlife traffic-kills, damages, human casualties)
5b-2. Support adequate management of natural features /

N = net
Rk = collecting of road killed individuals
S = track collector
Si = signs
T = animal tracks in snow, mud, sand

marginal habitats
5b-3. Support and promote development of good-practice examples of connectivity-sensible agriculture, water management and forestry practices

4. Monitoring results & feedback, data management

Data and information collected will be implemented in a dedicated database as mentioned in 1.6. This database will be based on the open-source database technology PostgreSQL[1] with the extension PostGIS[2] for the backend to implement a uniform SaveGREEN database schema. The PostGIS extension also enables the storage and analysis of geographic data. This is a proper way to ensure the reuse of the developed tools in other projects without additional licensing costs.

As described in D.T1.2.1. (Borgwardt, F. & Grillmayer R. 2021), the open-source software QField will be used for the first monitoring season. The intension of the first monitoring season is to gather experience and to adjust the monitoring concepts, if necessary, in the second season. Based on the users experience of the first monitoring season, all parameters from the functional monitoring set up, which have great potential for a citizen science monitoring approach, will be implemented on mobile devices which are based on Android. Therefore, the existing mobile application "Roadkill" will be extended with these features.

Hence, all relevant feedback from the first period will be used for further development and refinement of methodology, guidelines and tools.

5. Communicating monitoring

Monitoring results are critical for data-based decisions, therefore will be used to facilitate the engagement of relevant stakeholders for decision-making or of those engaged in different monitoring within the pilot area (ant not only). In this respect, monitoring data are crucial for further development of the local Cross-Sectoral Operational Plans.

Part of data will be relevant for the general public also (a special attention should be given to sensitive data – i.e. rare or protected species important sites: crossings, breeding sites etc. – and should be kept confidential), hence the communication section of the Cross-Sectoral Operational Plans will be further informed by the monitoring results.

1 https://www.postgresql.org/

2 https://postgis.net/

6. References

Borgwardt, F. & Grillmayer R. (2021): Documentation for specifications for the development of the electronic application toolbox - Deliverable D.T1.2.1. Report for the INTERREG-project SaveGREEN. Environment Agency Austria, 44pp.

Grillmayer, R. & Plutzar, C. (2021): Draft Guidelines for standardised monitoring of structural connectivity - Deliverable D.T1.1.2. Report for the INTERREG-project SaveGREEN. Environment Agency Austria, 21pp.

Grillmayer, R., Plutzar, C. & Sedy, K. (2021): Draft Guidelines for standardised monitoring of functional connectivity - Deliverable D.T1.1.3. Report for the INTERREG-project SaveGREEN. Environment Agency Austria, 23pp.

Scaletool (n.d.): Differences between structural and functional connectivity. http://scales.ckff.si/scaletool/?menu=4&submenu=0