OPEN BORDERS FOR WILDLIFE IN THE CARPATHIANS, OBWIC

HARMONIZED MANAGEMENT MEASURES FOR ECOLOGICAL CORRIDORS

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CONTEXT

Present deliverable – Harmonized management measures for ecological corridors was developed in the context of "Open borders for wildlife in the Carpathians"/ OBWIC project. The project is financed by the Hungary-Slovakia-Romania-Ukraine Cross-Border Cooperation Program 2014-2020 on thematic objective 6. Environmental protection, climate change mitigation and adaptation, Priority 6.1. Sustainable use of the environment in the cross-border area.

The OBWIC project contributes to the effective protection of biodiversity in the Carpathian Ecoregion by maintaining and improving ecological connectivity between habitats and maintaining the functions and services of ecosystems, the cornerstone of sustainable development. The target area of the project, approximately 4,000,000 ha, part of the Carpathians, is very valuable in terms of biodiversity, recognized internationally by signing the Convention for the Protection and Sustainable Development of the Carpathians.

The OBWIC project includes activities regarding: the development of strategic documents regarding the identification and designation of cross-border ecological corridors, the effective identification of these ecological corridors but also lobbying and policy activities for their protection. The communication component is a cross-cutting objective and will include awareness-raising and education activities on the importance of ecological corridors and large carnivores (bear, wolf, lynx).

INTRODUCTION

Natural Protected Areas (PAs) are maybe the most important tool for protection and conservation of biodiversity that are largely used over the world. The tool is mainly standardised but new ways of protection and types of protected areas emerged during the last decades. Even so, in Europe, the decline of biodiversity has not been halted and the contribution of protected areas is not enough[1]. New tools are proposed in order to increase the surfaces where management of species operates and biodiversity represent an objective, even if not the main one. In that light, "other effective area-based conservation measures" (OECMs) were proposed as conservation areas that are achieving the effective conservation of biodiversity outside of PAs. Even so, highly populated and so, highly fragmentation of natural landscape, makes very difficult the management of wildlife that are using large territories for maintaining viable populations. Both in-situ conservation tools, PAs and OECMs should be complemented by the existence of landscape connectivity in-between. Connectivity can be achieved through setting up a network of ecological corridors (EC), small parts of landscape with favourable or less favourable habitat designated to allow the free passage of species from one PAs (or OECMs) to another. Basically, in that way, an ecological matrix is set up at the landscape level, a large scale at which the natural processes actually operate.

1. NATURAL PROTECTED AREAS IN THE CONNECTIVITY CONTEXT

From economical perspective, PAs are often seen as a concession that humans made to nature, and for this reason these were designated mainly in places where no conflicts or interactions existed between human development and biodiversity[2]. Based on that, there are numerous cases when PAs were designated regardless the biodiversity richness or covering small fragments of habitats that are insufficient to support ecological processes. These findings are more valuable in the large carnivores' cases, as these species call for large territories to sustain their ecological needs, surfaces well beyond the surface covered by a specific protected area. At a global level, only 9.7% of the protected areas can be considered structurally connected through intact landscapes. "This means that very few PAs have a fully continuous pathway through intact lands, connecting their demarcated edges[3]". At a continental scale, Europe has extremely low levels of PAs connectivity provided by intact lands (0.3%). Thus, approaching connectivity only at the level of protected natural areas may generate erroneous results, in the sense that ecological corridors that would be defined between protected natural areas could be located in core distribution areas for large carnivores. The management measures that would be applied in this situation will focus on partial surfaces compared to the actual distribution areas of large carnivores, and the impact cannot be positive for the conservation status of these species. It is well documented that in Europe all large carnivore species are persisting in human-modified landscapes and largely outside from the

[1] IUCN Guideline 2020, https://portals.iucn.org/library/sites/library/files/documents/PAG-030-En.pdf
[2] Lisette Cantú-Salazar, Kevin J. Gaston, 2010, Very Large Protected Areas and Their Contribution to Terrestrial Biological Conservation, BioScience 60-10
[3] Michelle Ward et al., 2020

protected areas boundaries. Therefore, large carnivores use a large variety of landscapes and not only the PAs, even if the "intuitive forecast could be that large carnivores will persist only in highly managed protected areas[4]".

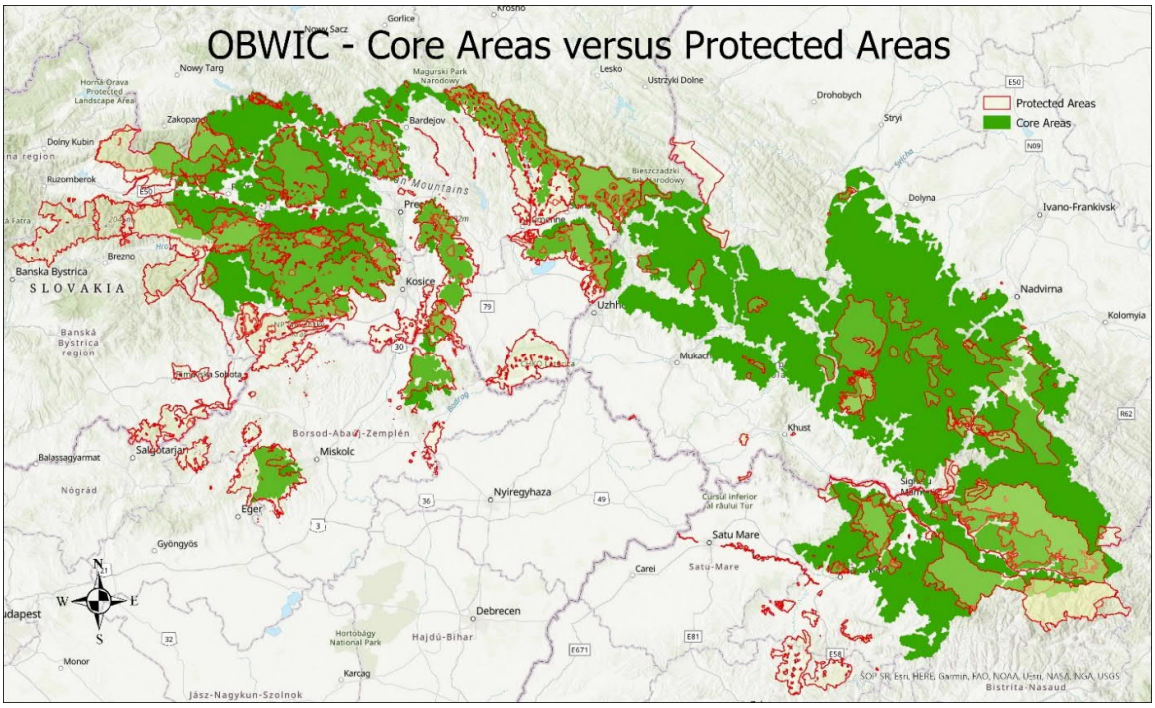

Figure 1. Core area of distribution for large carnivores in the project area overlapped with natural protected areas. It includes national designated and community importance protected areas. There is a large distribution of target species outside of the protected areas.

To cope that spatial gap, Convention for Biological Diversity proposed and defined in 2018 (Decision CBD/COP/DEC/14/8) a new concept (i.e." other effective area-based conservation measures") to reflect an opportunity to provide in situ conservation of biodiversity over the long-term in terrestrial ecosystems beyond PAs limits." Other effective area-based conservation measures (OECMs) have an important role in the conservation of biodiversity and ecosystem functions and services, complementary to protected areas and contributing to the coherence and connectivity of protected area networks, as well as in mainstreaming biodiversity into other uses in land and sea, and across sectors[5]". OECMs are expected to deliver biodiversity outcomes regarding species conservation, habitats and ecosystems. OECMs may be diverse in terms of purpose, design, governance,

[4] Guillaume Chapron et al. 2014
[5] Decision CBD/COP/DEC/14/8

stakeholders and management meaning that is an emerging concept that is trying to encompass a wide range of possible options for implementing conservation measures on areas outside PAs.

As a general approach, conservation efforts need to be allocated at a spatial scale that goes beyond the boundaries of protected natural areas, and connectivity for large carnivores makes more sense as it relates to their actual distribution range.

2. HUNTING MANAGEMENT AND ITS CONTRIBUTION TO CONNECTIVITY

In the four partner countries of the OBWIC project (Hungary, Slovakia, Romania, Ukraine), terrestrial protected natural areas occupy different percentages of the national area, i.e. Romania 23.42%, Slovakia 37.44%, Hungary 22.19%[6], and in Ukraine protected natural areas cover an area of approx. 8.1%[7] (2017 data). On the other hand, hunting grounds cover larger areas, including practically all land use categories except inhabited areas. The territory of each country is divided into hunting management units that are managed by the legally established structures, meaning that there is in place a decision body and also accountability of a wildlife management. On yearly basis, hunting grounds' managers produce the density estimates for wildlife, including large carnivores species.

In the current view, hunters are often seen as users of resources (negative impact) rather than providers of ecosystem services even though they generate systematic data on wildlife species and manage them at the national scale. Of course, there is a wide debate on the monitoring and species inventory techniques carried out by hunters, and therefore the belief that these need to be improved and standardised across countries. Also, the setting of management objectives should be clarified from the perspective of integrating hunting activities into economic activities or it should be considered as a public service contributing to achieving ecological balances.

In the context of ecological connectivity, more attention should be paid to game management, taking into account the fact that hunters manage large carnivores over large areas with a much more precise overlap with the core distribution areas of these species than with natural protected areas. In addition, the management of wildlife also involves the management of the habitat of these species, so the involvement of hunters in the spatial planning process should be considered. Overall, there is a "need for integration of hunting activities and scientific knowledge for future management practices" of large carnivores in parallel with the setting of ecologically sound goals[8].

3. MODELLING CONNECTIVITY NETWORKS

Connectivity has long been a problem addressed as a solution for improving ecological systems, by ensuring the functionality of ecosystem processes through allowing the individuals moving

[6] https://biodiversity.europa.eu/countries
[7] https://eni-seis.eionet.europa.eu/east
[8] Salvatori et al. 2002

between different distribution areas. Therefore, the modelling of connectivity networks is relatively well known and applied, in terms of the steps to be followed when making these networks.

Connectivity modelling begins with the collection of data on the presence of target species (or data collection) and their favourable habitats inventory. From this perspective, continuous monitoring of species and inventories are fundamental to decision-making process, including connectivity decisions. Alongside, data concerning transportation infrastructure, build-up areas and other man-made structures or shall be available.

The modelling process may use different software to produce the map of habitat favourability for target species. Consecutively, after the inventory of the data regarding the anthropic structures, a map of the resistance of the landscape is generated. Particularly, the habitat resistance map should be up to date in respect of barriers that may humper or block the movement of wildlife trough landscape. Habitat favourability map will produce further the core areas for large carnivores' distribution, which combined with resistance map (collection of anthropic barriers) result in a proposal of ecological corridors between different core areas of distribution in terms of most likely routes that can be permeated by large carnivores in the movement between core areas.

This raw model is checked by local experts (wildlife, forest experts, etc) for clear delineation of core areas, but especially for ecological corridors delineation. It is worth saying that some minimal structural thresholds are established for core areas and ecological corridors in order to be representative and functional. In OBWIC project, a minimum size of 300 square kilometres was set up for considering a core area of distribution. For ecological corridors, the rules like:" to be passed in a single discrete event"," as short as possible" or to not exceed as much possible the 2 km width were applied in designing.

4. ECOLOGICAL CORRIDORS GUVERNANCE

Basically, ecological corridors do not fall into the category of natural protected areas. According to the IUCN 'Guidelines for conserving connectivity through ecological networks and corridors' (2020), ecological corridors are" a clearly defined geographical area that is governed and managed over the long term to maintain or restore effective ecological connectivity". The clear conclusions to be drawn from this definition are that ecological corridors have clear boundaries established in the field and that the purpose of these designated areas is to maintain or restore ecological connectivity. Regarding the governance and management of ecological corridors, things are not so tangible. It is important to mention that ecological corridors do not only include favourable habitats for the target species. Ecological corridors can also be established on human modified habitats or highly managed areas, which means that ecological corridors may integrate a large variety of land use and ownership.

In terms of governance, the same range of governance types as for PAs is proposed also for ecological corridors. In any circumstances, an authority over the ecological corridor have to be

identified for decision making process and which is held accountable for reaching connectivity outcomes. In the context of fragmented land use and ownership, an extensive mitigation process shall be put in place to aggregate landowners and/or right holders and/or state agencies to establish the entity that have authority/authorities over ecological corridors and further on to set up the collaborative framework. Moreover, the authority should hold also financial instruments for appropriate implementation of management measures. So far, in the project area of OBWIC project, these circumstances are not met, even if all four countries have (at a different extent) some national policy framework addressing connectivity.

Unfortunately, this is not an isolated situation, when biodiversity targets cannot be reach due to imprecise definition of responsible actors and consequently, lacking of accountability. Even if the theoretical framework is highly developed and global targets are set (or reset), there is a lack of detail on "effective mechanisms to translate global targets into national or local-level action[9]".

Considering all the above aspects, the present proposed harmonized management measures for ecological corridors took into consideration the existent authorities that can be held accountable for measures and also have the effective implementing instruments for these measures.

5. MANAGEMENT MEASURES FOR ECOLOGICAL CORRIDORS AND IMPLEMENTING INSTRUMENTS

First of all, the applicable instruments that have been identified can achieve the implementation of management measures in ecological corridors. Consequently, the owners of the instruments have been identified, so that in the absence of an authority to govern ecological corridors, the measures can be addressed to other existent authorities who currently have responsibilities related to, or impacting the connectivity for large carnivores' species. All the proposed measures are meant to be applied inside of the ecological corridors' boundaries and can ensure the protection of ecological corridors and safeguard the connectivity, based on tools embedded in the current legal framework.

We underline that for implementing any management measure that provide protection and conservation for ecological corridors, associated costs emerge. In present paper we did not make a focused analysis on financial impact or costs that are implicated for managing ecological corridors. Anyway, from every management measure, document is drafting some socio-economic impacts and mitigation measures.

[9] Andrea Perino et al. 2021

Table 1

Management instruments	Accountable authorities
Construction (building) approvals	Local or regional authorities responsible for issuing building approvals
Spatial planning	National authorities responsible with spatial planning development and implementation at different levels (national, regional, local)
Land use categories changings (cadastre)	National authorities responsible with cadastre
Forest Management Plans	Legal Forest Administrations
Hunting Management Plans	Legal Hunting Grounds Managers
Waste Management Plans	National, regional and local authorities responsible for developing and implementing waste management plans
Water Management Plans	National Water Resources Administrations
Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA)	National Environmental Agencies

Connectivity has at least two main components: Structural connectivity and Functional connectivity.

5.1. Structural connectivity

Structural connectivity deals with anthropogenic or natural structures that hamper physically the movement of animals from one core area of distribution to another one. Thus, this is a compulsory requirement for any wildlife corridor, to have no structures (and have none in the future also) that are impermeable for wildlife migration. So, the structural connectivity is a measure of landscape permeability. On that base some general management measures can be suggested to maintain connectivity on long term.

5.1.1. No constructions should be made in ecological corridors (Zona Non Aedificandi). These include all buildings that requires a construction approval or other types of barriers such (fences, impermeable roads, dams, canals, pipelines etc.)

Reason of measure. Building, fences or other man made permanent and temporary structures block wildlife movement.
Socio-economic impact of measure. The measure can affect spatial expanding of built-up areas for certain communities or can generate supplementary costs for infrastructure development.
Mitigation. Change the development strategy for affected communities with scope of development using nature-oriented decision, preservation of traditional land use practices. Conclusion of agreements with landowners where limits for construction of barriers are

fixed. Compensation mechanisms, land swap between public owned land and private land, buy-out of land within ecological corridors to preserve their favorable status.
Implementing instruments. Construction approval procedure

5.1.2. No construction should be planed into Ecological corridors. These include buildings, fences, impermeable roads, dams, canals, pipelines etc.

Reason of measure. Any anthropogenic structure that will be built inside of the ecological corridors will affect the permeability of the corridors, leading to the worsening of the conditions for wildlife passage through.
Socio-economic impact of measure. The measure may impact the local development of the community affected by.
Mitigation. The development strategies should take into consideration that spatial development shall comply the principles of urbanism and avoid uncontrolled expansion of build-up perimeters.
Implementing instruments. Approved Spatial Planning documents.

5.1.3. No changes in land use categories should be operated when proposed land use category conduct to worsening of habitat conditions compared to current state.
Reason of measure. Changing of land use categories, from forest to agricultural land for example, will decrease the habitat favourability of wildlife corridor, decreasing migration activity of wildlife through corridor. On the other hand, when a forested pasture will be categorised as forest, that change is beneficial and will improve on long term the habitat favourability for wildlife.
Socio-economic impact of measure. May affect some agricultural/ animal breeding business development.
Mitigation. The local business model should focus on existing land values and promote activities that can benefit from the presence of natural values in the area. From that perspective, the designation of an ecological corridor in a certain area could represent an important opportunity for local business. Also, in specific financial circumstances, incentives or other financial instruments could be considered.
Implementing instruments. Cadastral Register

5.1.4. Ecological corridors territories are subject to SEA and EIA procedure and plans and activities overlapping its areas require prior environmental assessment.
Reason of measure. Preventing negative impact that can be caused by inadequate planning or activities development and running in the ecological corridor.
Socio-economic impact of measure. Economic impact on the landowners or investors within the migration corridor that might arise from supplementary cost caused by the environmental studies and assessment.
Mitigation. Measure has no immediate impact and do not generate costs directly.
Implementing instruments: Nature protection legislation

5.1.5. Plans and projects of building of linear infrastructure (construction/ essential reconstruction of motor roads, railways, pipelines, electrical transmission lines, dams etc.) are subject to SEA and EIA procedures and the decision on placement of such infrastructure on in ecological corridors must be taken only on basis provided that:

- The option has positive highest integrated ecologic and economic impact;
- Zero option (Refusal from construction) has been considered;
- Mitigation and compensation measures have been considered and included into the development plan if they are expected to have positive
- Compensation measures are considered as the last possible option if other options (mitigation/refusal construction) are not applicable/efficient.

Reason of measure. Linear infrastructure may transform habitats to the extension that they will not serve as ecological corridor for migration of certain / all species. Environmental risks are avoided/ mitigated/compensated. Higher sustainability of linear infrastructure
Socio-economic impact of measure. Increase of costs of planning/construction.
Mitigation. Included in SEA or EIA procedures
Implementing instrument. SEA and EIA procedures.

5.1.6. The banks of rivers and streams shall be preserved so as to avoid a barrier effect; natural riparian vegetation should be preserved.

Reason of measure: The barrier effect of the river increases in case that the river banks are in poor condition, or there is a high slope or inappropriate material (slippery) is used. In case the animals cannot overcome the barrier, they look for the nearest possible crossing, which can often be a road.
Socio-economic impact of measure: Increased care by water management companies and thus increased expenditure.
Mitigation: None
Implementing instruments: Water Management Plans

5.1.7. Fencing of agricultural/forest land should be limited within the migration corridor

Reason of measure: Large-scale fencing of agricultural land and pastures increases the barrier effect.
Socio-economic impact of measure: Problems with insurance of crops may arise. Insurance companies require sufficient security to reimburse damage claims. Current agricultural subsidies support large cultivated areas.
Mitigation: Establishment of unfenced transition strips in the fields and introduction of compensatory measures.

Implementing instruments: Common agricultural policy provisions, compensation schemes, insurance companies documentations.

5.1.8. List of critical points and management measures of migration corridors to be shared with road and rail companies in order to keep corridor permeability at a high level

Reason of measure: Access to this type of information will support the rail / road companies in rail / road management that is in accordance with the protection of migration corridors
Socio-economic impact of measure: Better planning and management
Mitigation: None
Implementing instruments: Technical documentation of rail/ road management companies.

5.1.9. Addition of guidance elements (vegetation adjustments, revitalization of natural elements, additional suitable planting)

Reason of measure. Keeping/ improving the structural connectivity of the corridor.
Socio-economic impact of measure. Increase in the quality of the corridor, supporting its future usage.
Mitigation. Compensation measures.
Implementing instruments. Legislation related to nature protection

5.2. Functional connectivity

Concerning Functional connectivity, it refers to activities that may interfere with wildlife movement trough corridors by generating disturbances and consequently changes in animal behaviour. In those circumstances, even when from structural point of view, the corridor is permeable, wildlife species will avoid to pass through corridor. These management measures may have a local applicability and thus could be considered to have a more specific character – specific management measures.

5.2.1. No litter container should be placed in bottle-neck zones

Reason of measure. Litter/waste may attract wildlife, especially bears and so may compromise the purpose of corridor and produce human-wildlife conflicts.
Socio-economic impact of measure. Some areas may lack to have a proper waste collecting infrastructure
Mitigation. Establish the litter container outside from corridor areas, multiplying the number of litter containers in some areas.
Implementing instruments. Local waste management plan (localisation of litter containers)

5.2.2 Seasonal and time limitation of activities that caused high level of noise and disturbance as sport and entertainment events, military exercises.

Reason of measure. In certain periods of annual cycle, large carnivore individuals are moving at a greater extent. These are the periods when individuals are looking for breeding partners, and for bears also the periods of hyperphagia before the winter season.
Socio-economic impact of measure. May affect the timing of some events.
Mitigation. The authorities that approve events could regulate the timing of events so that impacts on target species are eliminated.
Implementing instruments. Operation permit

5.2.3. Road signs to be installed at places where the road cuts through the corridor (decreased speed limit, beware of animals crossing)

Reason of measure: Correct and proper marking of critical sections with restricting road signs can have a positive effect of reducing collisions with wildlife.
Socio-economic impact of measure: Economic impact - the cost related to the production and installation of road signs.
Mitigation: None
Implementing instruments: Technical documentation of rail/ road management companies.

5.2.4. Preparation of guidelines for structural and functional design of underpasses, overpasses and green bridges (on both the existing and planned infrastructure)

Reason of measure. Concretely and precisely defined specifications of underpasses, overpasses and green bridges will contribute to increased functionality of the corridors (e.g. no cycle route along the corridor that would distract the animals from crossing, acceptable noise and light conditions in road and rail underpasses, specifications related to species requirement, etc.)
Socio-economic impact of measure. Planning, construction and use of underpasses, overpasses and green bridges will become more efficient.
Mitigation. None
Implementing instruments. Specifications for technical documentation

5.2.5. Agricultural waste, biomass, carcasses placed in the migration corridor should be secured from wildlife

Reason of measure. This type of waste attracts wildlife, especially large herbivores and bears. This may compromise the purpose of the corridor and produce human-wildlife conflicts.
Socio-economic impact of measure. Economic impact for farmers due to the need to secure waste.
Mitigation. Financial aid provided by eco- schemes or some kind of compensatory measures
Implementing instruments. Waste management plans

5.2.6. Restriction of growing crops attractive to wildlife in places near to migration corridors (e.g. corn - bear).

Reason of measure. Wildlife can use migration corridors only to migrate to the field just to feed themselves.
Socio-economic impact of measure. Decrease of human wildlife conflict.
Mitigation: Cultivating crops that are not attractive to game.
Implementing instruments: Common agricultural policy provisions, compensation schemes.

5.2.7. Implementation of other preventive measures by farmers in the migration corridors instead of fencing

Reason of measure. Appropriate precautionary measures to protect herds against large carnivores can help reduce the number of barriers in the landscape.
Socio-economic impact of measure. Economic impact on farmers who will need to implement these preventive measures.
Mitigation. Financial schemes
Implementing instruments. Common Agricultural Policy Strategic Plan 2023-2027.

5.2.8. Biodegradable municipal waste (compost) dumping site to be placed outside the migration corridor.

Reason of measure. Municipal compost may attract wildlife, especially large herbivores and bears and so may influence the purpose of the corridor and produce human-wildlife conflicts.
Socio-economic impact of measure: Reduce the human-wildlife conflicts.
Mitigation: Establish municipal compost dumping sites outside the migration corridor or provide composting bins for every household, as well as education about the compost used.
Implementing instruments: Local waste management plan (localisation of litter containers)

5.2.9. Prohibition of building “hunters’ observation seats” in the migration corridor

Reason of measure. Migration corridor should be open for migration without any restrictions, direct or indirect. Hunting affects game indirectly as a stress factor that can stop animals from using the corridor.
Impact of measure. May impact some hunting grounds.
Mitigation. Establish in the ecological corridor no-hunting area rather than in other fragments of hunting grounds.
Implementing instruments. Hunting management plans

5.2.10 Setting the responsibilities for future management of the green bridges in order to safeguard its functionality and its surrounding

Reason of measure. The functionality of the green bridge must be ensured both technically and biologically. The green bridge must be connected to the surrounding environment (e.g. exit to a

field, forest, etc.). Responsibility for the 'biological' maintenance of the bridge and its surroundings (guiding greenery etc.) should be identified during its planning.
Socio-economic impact of measure. Additional cost for management these parcels.
Mitigation. Purchase of land in the immediate vicinity of the green bridge - entrance and exit and wider surroundings, planting of guiding greenery, monitoring of the use of the corridor by wildlife. Compensation for implementation of preventive measures in the absence of land acquisition.
Implementing instruments: Nature protection legislation

5.2.11. Hunting should be restricted within the migration corridor

Reason of measure. Migration corridor should stay permeable and without any disturbance or restriction (direct or indirect). Hunting has an indirect stressful impact on the animals and may cause the corridor to be unused.
Socio-economic impact of measure. Impact on the hunting units.
Mitigation:
Implementing instruments: Establish in the ecological corridor no-hunting area rather than in other fragments of hunting grounds.

5.2.12. Forest management should be done while respecting functionality of migration corridors

Reason of measure. Large-scale intervention into the forest cover may reduce the use of the migration corridor due to decreased habitat suitability for wildlife.
Socio-economic impact of measure. Economic impact on forest management Administrator.
Mitigation. Close-to-nature forest management.
Implementing instruments. Forest management plan

CONCLUSIONS

1. In order to ensure implementation of any conservation or protection measure it is essential to identify a decision and accountable entity that may achieve this goal.

2. Financial instruments should be coherent and predictable in order to maintain connectivity on a long term.

3. Connectivity should address core areas of distribution for large carnivores and not be limited to protected areas.

4. Species monitoring is a very important basic element for species management and connectivity. Therefore, the monitoring and inventory of species must be performed systematically and on an ecosystem scale in order to assess the evolution of trends and make management decisions.

5. Hunters may play an important role in maintaining connectivity, but sound ecologic management objective should be assumed.

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