TRANSGREEN. Integrated Transport and Green Infrastructure Planning in the Danube-Carpathian Region for the Benefit of People and Nature
January 2017 – June 2019

Biota and ecological connectivity: demands of different groups of fauna on infrastructure permeability
Main types of habitats in the Carpathians with respect to their threat by transport infrastructure

- Carpathians: Biodiversity reservoir for Europe and “green-spine” which facilitates dispersion of species and natural recolonization of some of them

- Fragmentation at the scale of the whole Carpathian range, not just locally

- Linkage areas such as valleys and foothills between mountain areas: critical importance for ensuring the functionality of the Carpathians as a continental corridor

Main valleys: act as barriers for wildlife due to existing settlements, industrial areas, infrastructure, intensive agriculture, mineral extractions etc. – all having a cumulative impact.

New transport infrastructure may be planned in parallel with existing roads and railways (lower costs) → special to the linkage areas in the Carpathians when dealing with the issues of landscape permeability.
- New transport infrastructure threaten different habitats to a different degree → different measures to reduce negative impacts of transportation.

- Each species has different requirements on connectivity and distinct behaviour with respect to transport infrastructure. However, possible to find species with similar requirements on permeability of linear barriers in individual habitats, or to select species that generally represent a wider group with similar requirements = umbrella species → more overall ecosystem or landscape approach.

- Define main types of habitats occupied by groups of species with similar requirements → main habitats from this point of view are: alpine and sub-alpine grasslands, forests, dry grasslands and pastures with shrubs, wetlands, watercourses, agricultural landscapes and urbanized areas.
Alpine and sub-alpine grasslands

All types of alpine forest-free areas, even at altitudes above 1,000 m, which are above altitudinal forest limit or are maintained by sheep or cattle grazing. This type of habitat gradually changes at lower altitudes into forests.
Unique communities with the occurrence of both alpine and forest species

Alpine Marmot (*Marmota marmota*)

Chamois (*Rupicapra rupicapra*)

Golden Eagle (*Aquila chrysaetos*)

Wall Creeper (*Tichodroma muraria*)

Alpine Accentor (*Prunella collaris*)

Apollo Butterfly (*Parnassius apollo*)
European Common Frog (*Rana temporaria*)

Viviparous Lizard (*Zootoca vivipara*)

Common European Viper (*Vipera berus*)

Red Deer (*Cervus elaphus*)
Transit transport infrastructure in alpine conditions: not very common, but intentions to make mountain sport sites and resorts accessible by traffic.

Important to keep in mind: alpine environment is always exceptionally sensitive to any disturbing influences and strong ecological impacts can be expected especially in case of transport constructions.

Attention should be given: ski lifts, related infrastructure and changes in landscape generated by them can have similar negative impacts on wildlife as a new road.

The preferred approach for valuable alpine and sub-alpine grasslands is to be delineated / designated as “roadless” or “low traffic” areas.
- **Forests (mountain coniferous, beech, oak, mixed and alluvial)**

Most common and most species-rich habitats in the Carpathians. Forests are represented at all altitudinal zones, from lowland floodplain forests, through oak and beech forests to mountain spruce forests.

Ecological value influenced by: size, age, species composition, intensity of forest management.
Forests are home to a wide spectrum of species from all groups.

- Rosalia Longicorn (*Rosalia alpina*)
- Fire Salamander (*Salamandra salamandra*)
- Yellow-bellied Toad (*Bombina variegata*)
- Eastern Slow-worm (*Anguis colchica*)
- Western Capercaillie (*Tetrao urogallus*)
- Red Squirrel (*Sciurus vulgaris*)
Edible Dormouse (*Glis glis*)

Forest Dormouse (*Dryomys nitedula*)

Garden Dormouse (*Eliomys quercinus*)

European Wildcat (*Felis silvestris*)

Gray Wolf (*Canis lupus*)

Eurasian Lynx (*Lynx lynx*)
Brown Bear (*Ursus arctos*)

Red Deer (*Cervus elaphus*)

Moose (*Alces alces*)

European Bison (*Bison bonasus*)
From the point of view of transport infrastructure building, forests constitute a habitat where requirements of the widest spectrum of species need to be addressed - from amphibians and small and medium-size mammals, through tree-crown species and bats, to large mammals, which can use forests also as a migration corridor.

The barrier effect of individual road sections will vary depending on habitat value of the given forests, but also according to the significance of their function as migration corridors - from local to regional.
• **Dry grasslands and pastures with shrubs**

Both natural and secondary (man-made and maintained by extensive grazing) grasslands belong to these habitats. This type of habitat used to be more represented, but substantial part of it has been converted to agricultural land. 

On the other hand, areas not suitable for intensive farming often turn into a stage of shrubs and forest as a result of termination of extensive grazing and proceeding succession.
Dry grasslands and grasslands with shrubs and trees are typically characterized by high species diversity of plants, invertebrates, but also reptiles and birds.
Golden Jackal (*Canis aureus*)

European Marbled Polecat (*Vormela peregusna*)

Nightjars (*Caprimulgus europaeus*)
From the point of view of transport infrastructure building, dry grasslands and pastures with shrubs represent habitats where it is necessary to address requirements of specific species occurring in the areas. It may most often mean ensuring connectivity among communities of invertebrates, which are usually closely bound to local vegetation.

Especially grasslands with shrubs and trees can have the function of a migration corridor for large mammals, but also for invertebrates, bats and other species. In such cases it is also necessary to address the requirements of this group of animals on migration permeability.
Wetlands

This type of habitat includes springs, marshes, swamps, peatlands, fens, ponds, lakes and man-made water bodies and also wet meadows in the valleys of river floodplains.

These are very often areas with exceptionally high biodiversity. Wetlands usually have great productivity, therefore substantial part of the original wetlands is now exploited by humans as fisheries or for agriculture.
Fire-bellied Toad (*Bombina bombina*)

European Pond Turtle (*Emys orbicularis*)

Grass Snake (*Natrix natrix*)

Eurasian Otter (*Lutra lutra*)
Planning a new transport infrastructure: consider such variants in which wetlands are not affected at all. In case this is not possible, priority needs to be given to the aquatic animals, but also to the semiaquatic ones, which migrate along both standing and running waters → keep full continuity of the water environment and of the subsequent terrestrial ecosystems.

Another issue to consider is using salt in winter road maintenance = example of secondary effect of transport infrastructure on wildlife, but can have negative impact especially on wetlands, where the run-off consequently ends up and dissolves. Wet meadows are prone to invasive species expansion and building activities can favour this phenomenon.
Watercourses

This type of habitat includes all types of watercourses, from small streams to large rivers such as the Tisza or Danube.

Watercourses have different character – from mountain streams with trout to slow-flowing lowland rivers with carp. The ecological value of the watercourses should be always taken into consideration, irrespective if they are in a natural condition or artificially regulated (canalized).
Danube Salmon (*Hucho hucho*)
Eurasian Minnow (*Phoxinus phoxinus*)
Ukrainian Brook Lamprey (*Eudontomyzon mariae*)

Brown Trout (*Salmo trutta* morpha *fario*)
Dice Snake (*Natrix tessellata*)
Grass Snake (*Natrix natrix*)
European Pond Turtle
(*Emys orbicularis*)

Eurasian Otter
(*Lutra lutra*)

Eurasian Beaver
(*Castor fiber*)
Crossing of transport infrastructure with a watercourse: keep the continuity of the watercourse for fish species and other aquatic organisms, as well as the continuity of banks for semiaquatic animals. Such crossings often create an opportunity to make a passage even for other species, including large mammals.

With watercourse crossings it is also necessary to always consider the movements of birds and bats along the watercourse and when needed plan measures to prevent collisions with vehicles.
Agricultural landscape

1. Landscape mosaic with extensive fields and meadows
Varied mosaic of pastures, meadows and small crop fields, patches of woodland, protective verges, orchards etc = result of traditional small-scale farming in the Carpathian area

High diversity of habitats, high species-richness + relatively good possibilities for the species to move through the different neighbouring habitats

Problem: traditional way of farming has been receding in the last decades and the trend continues. Efforts to maintain as much traditional farming as possible or trying to go back to it are therefore very important.
2. Agricultural landscapes with intensive crop fields and meadows

2nd half of the 20th century: large-scale approaches and intensification of agriculture started to be applied → decrease in biodiversity and ecological value of agricultural landscape. As a result, usually only common and highly adaptable species currently occupy this agricultural landscape.

Most species in this type of landscape: strongly influenced by the crops grown in a given year = occurrence of many species not natural, but rather a consequence of such choices in agriculture.
When planning transport infrastructure, it is usually sufficient to consider the requirements of common species of agricultural landscape. In specific cases, even agricultural landscape can represent a migration corridor for large mammals. This can happen in a situation where a stripe of agricultural land lies between large forested areas. Careful approach is needed in large scale agricultural plains in which the frequency of culverts or other possible passages for fauna is low. This leads to a lack of mitigation measures and low wildlife permeability.

An appropriate system aimed at ensuring effective frequency of mitigation measures is necessary and reconstruction of connectivity at landscape level should be considered as an option here.
- **Urbanized areas**

  Towns in the mountain environment: neighbour with natural or even wilderness areas → animals come to a close contact with urban environment

  Typical for the Carpathians: location of housing development into mountain valleys = creates long, continually built-up areas.

  Biodiversity of urban environment generally quite limited, but is not to be overlooked.
Movement of birds in the city environment, as well as of small mammals in the vicinity of parks

Typical problem of building transport infrastructure in urbanized areas: noise protection walls + barrier effect. **Glass or other transparent walls** mean a danger of collisions for birds and numbers of dead individuals are in some cases very high.

**Solving this problem:** effort to design these walls in such a way that they are registered by the birds early enough.
Lighting: problem for bats and especially on roads/paths near different water bodies

→ lighting attracts a large number of insects and bats catching the insects can be hit by passing cars.

Cycle paths along water streams and marches: dangerous for snakes and amphibians. Especially snakes are heating themselves on tarmac surface during sunny days and thus can easily become victims of cyclists.
Demands of various groups (categories) of animals on permeability of transport infrastructure

Permeability of linear barriers = prerequisite for survival of indigenous species but at the same time result in faster spreading of non-native species

Permeability of a transport infrastructure: influenced by its fencing → to prevent animals from entering the road and improve traffic safety

+ fences increase the barrier effect of the infrastructure: only be built where animals also have the opportunity to cross the highway using a safe fauna passage
1. **Terrestrial invertebrates (especially insects)**

= very diverse group, individual species often have very specific ecology and life cycles. Many species are able to fly as adults, but the ability to overcome longer distances is very different. The further existence of many of these species is currently threatened and fragmentation of populations is a significant issue for them.
Dual approach in relation to transport infrastructure:

- species with high degree of protection (i.e. Apollo Butterfly, Rosalia Longicorn) → solve each situation based on the needs and migration abilities of a particular species

- habitats with high invertebrate species diversity → at the habitat level in a way that ensures full linkage of habitats on both sides of the transport infrastructure
2. Fishes and other aquatic animals

Not only fish species but also other aquatic animals, such as crayfish, dragonflies, freshwater clams, snails and many more.
Fishes that inhabit watercourses often move long distances, some even migrate between freshwater environment and the sea:
✓ anadromous fish: live in the sea and migrate to fresh waters to spawn
✓ catadromous fishes: grow up in fresh waters and then migrate to the sea to spawn
✓ potamodromous fishes: migrate only within freshwaters to spawn)

Free movement through the watercourse in both directions is the condition for existence of most aquatic organisms.
3. Amphibians

Not a very numerous group, includes so called caudal species (newts, salamander) and acaudal species (frogs). Most amphibians belong to threatened and protected species.
Reproduction bound to water: eggs develop and tadpoles live. Adults then leave the water environment, live far away from the places of reproduction.

Migration time: amphibians often have to overcome roads → mass deaths: thousands of individuals killed in a short time-period at one place

High physical activity caused by specific climatic conditions such as night rain after a long period of drought + warmed up road after rain → high amphibian mortality, can lead to extinctions of local populations
4. Reptiles

Includes lizards, snakes and two species of turtle – aquatic European Pond Turtle (*Emys orbicularis*) and terrestrial Hermann's Tortoise (*Testudo hermanni*)
Bound to **warm grasslands with hiding places** (shrubs, fallen wood, rocks or vegetation verges). Common European Viper (*Vipera berus*) = highest altitudes, European Pond Turtle (*Emys orbicularis*) and Dice Snake (*Natrix tessellata*) = lowland rivers and wetlands

Usually use the suitable landscape all-around and they typically move only short distances. Habitat attractive intersected by a road → high mortality as they are attracted by the warm surfaces, often detected also on bicycle trails. Threatened populations: measures to prevent reptiles from entering the road and at the same time to navigate them to safe passages are required.
5. Birds

Very diverse group of species inhabiting all types of environment.
All bird species living in the Carpathians: able to fly and, thus, transport infrastructure does not represent a migration barrier for them.
Many bird species *victims of traffic* + impact of winter maintenance on some species: consumption of salt crystals used in winter road → can be solved by using crystals of minimum size or by using saline solution

Positive aspects: bridges can serve as nesting sites for birds and hiding sites for some bats. Purposeful support of bird nesting on bridges is often problematic and can also be in conflict with regular technical maintenance. Better to solve specific cases by an agreement between road (bridge) management and conservationists.
6. Terrestrial mammals up to the size of fox and badger

Diverse group including small rodents, insectivores, lagomorphs, mustelids, fox and wildcat
Environmental requirements and the ability to overcome barriers vary in different subgroups + differs even in similar species.

The group in general includes mobile animals that frequently crossroads while searching for food. They usually willingly use even small bridges and culverts, but only under the condition that these constructions have a suitable technical design.
7. Otter and other semiaquatic animals

Includes species that live near water environment and often move along watercourses.
Typical representatives are Eurasian Otter and Eurasian Beaver, but many other species move along watercourses as well (European Polecat, Ermine, European Water Vole and others).

Although these species can swim and dive, most of them do not use bridges without existing dry banks. Unsuitable bridges then force the animals migrating along streams to crossroads.
8. Mammals living on trees

Dormouse – all species, Eurasian Red Squirrel, European Pine Marten. These animals can use all passages where connectivity of the forest environment is ensured. In addition, in view of their ability to move in the tops of trees, they can use special overpasses interconnecting tree tops.
9. Bats

Over 40 species of bats in Europe that differ in size but also in their way of life.
All species are able to fly, some of them could overcome long distances high above ground, while others avoid free space and move predominantly in the forest environment.

For such species, busy roads create barriers for their movement → fauna passages should be solved. Lighting along transport infrastructure attracts insects and as a result some bat species become traffic victims in such places.
10. Medium-sized mammals (European Roe Deer, Wild Boar)

These species are widely spread and inhabit both forest and agricultural landscape. While Roe Deer are usually restricted to their permanent home ranges, Wild Boar often moves at long distances. The requirements of these two species are considered as a standard to ensure permeability of roads in common landscape.
11. Large mammals (Red Deer, Moose, European Bison, large carnivores)

3 species of ungulates and 3 species of carnivores: Wolf, lynx and bear belong to endangered and protected species. As top predators, these animals occupy large areas in very low population densities. Wolf is more adaptable but generally lynx and bear are closely linked to forested landscapes.
Connectivity between different parts of their populations at supraregional scale: crucial for their long-term survival

Red Deer is a widespread species in the Carpathians = used as an indicator species, its demands on permeability of landscape are similar to those of large carnivores.

Moose is widespread mainly in northern Europe, only individual migrating animals occasionally visit the Carpathian region. European Bison was reintroduced in some areas and locally became a member of the Carpathian fauna again.

Project co-funded by the European Regional Development Fund (ERDF).

www.interreg-danube.eu/transgreen
Connectivity of different types of habitats

❖ What kind of fauna passages (with what kind of parameters) to build?
There is already enough experience regarding the use of overpasses and underpasses by different animal species in Europe and in other parts of the world.

❖ What should be the density and placement of such fauna passages?
  = how many passages of each category and in a given road section should be built
Safe crossings of wildlife corridors with transport infrastructure: very expensive constructions, but necessary to determine minimum number of passages that still prevents fragmentation of populations → very complicated question from biological point of view

The effectivity of implemented measures in relation to spent funds is therefore always a significant viewpoint: principles of cost-benefit analysis
It is convenient for practical reasons to set general recommendations for prevention of habitat fragmentation that can be implemented for reasonable cost.

Project co-funded by the European Regional Development Fund (ERDF).

www.interreg-danube.eu/transgreen
How should the fauna passages be integrated into the landscape in order to ensure their functionality?

For each new construction plan, a comprehensive analysis of all factors with possible impacts and their cumulative effects in the given area has to be prepared. Most important factors to evaluate: management of surrounding land

Limits given by the specific conditions of the landscape can also be actively influenced by the creation of different types of structures leading the animals to the passages (tree planting, corridor formation, guiding fences, etc.).

Crucial role of spatial planning = take into account reliable information about future development in the area

Reach sufficient permeability of transport infrastructure for animals → verify the possibility of multipurpose use of bridges (culverts) that are originally proposed on the planned route for other uses.

Project co-funded by the European Regional Development Fund (ERDF).

www.interreg-danube.eu/transgreen
Joint use by wildlife and humans brings the risk that sensitive species such as large carnivores will not accept such fauna passage → a crossing point of infrastructure with known migration corridor of large mammals' special overpasses or large underpasses without any human activity are the preferred solutions.

**Structures suitable for multipurpose use:**
- culverts
- bridges over small streams
- motorway bridges over forest paths/roads
- forest paths/roads leading from above over a motorway/road/railway
- large bridges over rivers or entire valleys
- Pier bridges (viaducts) over floodplain areas
Alpine and sub-alpine grasslands

Exceptionally sensitive ecosystems → important transport infrastructure should always be planned in such a way that these habitats are not affected. Demands for maximum transport capacity should in this case be always inferior to environmental requirements. This is true for both technical parameters of the road (width arrangement) and choosing its route. Increased attention: integrating the construction into the surrounding landscape. With respect to permeability, it is necessary to address connectivity of entire ecosystems. Sufficient extent of tunnels is an optimal solution in this type of habitat.
Forests

Habitat where permeability has to be dealt with for the widest spectrum of animals.

The density and placement of fauna passages are in some groups (aquatic fauna, amphibians, otter and others) given by environmental conditions (crossing with watercourse, crossing of a wetland, etc.).

→ crucial to address the question of what is the minimum number of fauna passages that ensures the necessary connectivity and prevents fragmentation of populations.
When multipurpose bridges do not reach the listed recommended densities: necessary to proceed to building special passages of a given category + assess whether the multifunctional objects ensure permeability for species with specific requirements. If not → special measures for these species.

In case a transport infrastructure crosses unique natural forest ecosystems, for example protected natural/old growth/primeval forests, it is essential to ensure complex connectivity of ecosystems on both sides of the planned road. That can be achieved by:

- sufficiently wide overpass/es that will allow for connectivity of tree canopy growths
- tunnel/s
- large bridge/s that overcome(s) an entire valley
Dry grasslands and pastures with shrubs

Significant by diversity of invertebrates, reptiles, birds and small mammals.

Permeability: adjusted culverts and bridges over small streams and channels. Field-road bridges over motorways = very important role but condition for functionality is widening these bridges to get 2-5 m wide strip of grassland vegetation on both sides of the road.

Most steppe invertebrates: bound to specific vegetation types and therefore not able to use culverts or small bridges. Such multipurpose overpasses can be used by a whole range of steppic species, including invertebrates, also some reptiles, European Ground Squirrel, hare and many others.

In some cases special measures preventing animals from entering the road and leading them to suitable passages are necessary.

Transport infrastructure crossed a unique steppe ecosystem with extraordinary diversity or significant protected species \(\rightarrow\) complex connectivity of ecosystems on both sides of the road by a sufficiently wide overpass.
Wetlands

Typical requirement = ensuring permeability for wetland species, especially for amphibians, European Pond Turtle, Dice Snake, from mammals for Eurasian Otter. Main emphasis has to be placed on all bridges where transport infrastructures cross waterbodies or wetlands → proposals need to count with maintaining (or creating) dry banks.

Roads leading on top of pond dams are very dangerous. Amphibians, but often also otters moving along the stream or water body are forced to overcome the dam and frequently become victims of traffic → merge fauna passage for these species with the space assigned for flood flow rate, fencing (barriers) that guides the animals to special underpasses (amphibian passages, otter tunnels, etc.).

+ Risk of aquatic birds' mortality → Special measures: planting suitable vegetation along the road or installing protection to force the birds to fly higher above passing vehicles.
**Watercourses**

Priority requirement: maintaining migration continuity for all aquatic and semiaquatic animal species

Partial widening of a bridge over a watercourse = cheaper solution than building a new special passage

Frequent issue: technical adjustment of the stream bed under the bridge, as it often worsens passability for aquatic and semiaquatic species

Adjustments are sometimes necessary in case of small streams, however, they should always be solved with the use of natural materials. Technical adjustments → maintain minimum jaggedness of the bottom and banks and keep the passability through both the „wet“ and the „dry“ route. Any vertical steps/barriers, sedimentation sumps, stilling basins etc. have to be excluded.
Agricultural landscape

Current agricultural landscape in the Carpathians includes areas with different biodiversity levels.
- Submontane areas with smaller field units and dispersed vegetation: often inhabited by many species
- Intensively used agricultural landscape in lower areas: usually poor in species diversity

Requirements for permeability of roads/railways for fauna: adapted to local conditions → always keep at least basic passability for common species

The guidance greenery in the surroundings of the passage is an important functional element in this type of landscape.
Urbanized area

Very specific type of environment: difficult to define general principles of connectivity/permeability

Specific phenomenon of mountain environment = linear mode of housing development placement, at the bottom of mountain valleys → Important transport infrastructure placed parallel with such developed housing zones

Combination of housing development, fenced fields and transport infrastructure: impassable barrier that separates mountain complexes on both sides of a valley → identification of wildlife corridors and their protection in land-use planning is of fundamental importance

Free passage through linear built-up zone in a mountain valley: crucial to respect this wildlife corridor when building transport infrastructure.
Existence of most species: bound to a specific habitat
+ long migrations of hundreds of kilometres \(\rightarrow\) animals cannot use only their preferred habitat and have to overcome less suitable landscape as well

Free movement through landscape = basic requirement for the long-term existence of these species
Pb: Current landscape unfortunately limits the free movement more and more
Built-up areas, transport infrastructure, recreational and sport resorts and many other human activities = barriers in landscape that block animal movements

Prevent progressive isolation of populations: delimiting migration corridors of large carnivores and ensure proper protection/management through spatial planning
(should be delimited in places of original migration routes).

Project co-funded by the European Regional Development Fund (ERDF).
www.interreg-danube.eu/transgreen
Migration corridors delimitation: ensures interconnection of areas of permanent occurrence, possibly even of potential areas of distribution of the target species.

Distribution ranges of most species are shifting and/or expanding due to climate change or anthropogenic factor: without functional corridors, animals are unable to respond to these changes.

Large mammals representatives of Carpathian nature: migrate over long distances.

Places where a delimited corridor crosses a difficult barrier = “critical spots”: essential for maintaining connectivity, a proposal of special measures to ensure/restore continuity is recommended to be prepared for each critical spot.

Goal = ensuring functionality of migration corridors by protection or restoration of their permeability for large mammals.
Recommended mutual distances of fauna passages in different types of habitats

Setting the recommended mutual distance between fauna passages suitable to provide general recommendations within these guidelines that can be used as a standard in proposing transport infrastructure in the Carpathians.
<table>
<thead>
<tr>
<th>Type of fauna passage</th>
<th>Type of habitat</th>
<th>Large mammals</th>
<th>Roe deer</th>
<th>Fox, badger</th>
<th>Other types</th>
<th>Recommended % of functional fauna passages from the total length of the infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpine and subalpine grasslands</td>
<td>on migration corridors</td>
<td>2-5 km</td>
<td>1-2 km</td>
<td>tunnels, large overpasses and underpasses connecting mountain ecosystems</td>
<td>Alpines and subalpine grasslands</td>
<td>20-30</td>
</tr>
<tr>
<td>Forests</td>
<td>3-5 km</td>
<td>2-5 km</td>
<td>1-2 km</td>
<td>according to local conditions: tree top overpasses, special passages for bats, amphibians and other groups of species</td>
<td>Forests</td>
<td>2-3</td>
</tr>
<tr>
<td>Dry grasslands and pastures with shrubs</td>
<td>on migration corridors</td>
<td>3-8 km</td>
<td>1-2 km</td>
<td>Multifunctional or special overpasses for invertebrates, reptiles, ground squirrel - 3-5 km</td>
<td>Dry grasslands and pastures with shrubs</td>
<td>2-3</td>
</tr>
<tr>
<td>Wetlands</td>
<td>on migration corridors</td>
<td>3-8 km</td>
<td>1-2 km</td>
<td>Measures connecting wetland ecosystems, measures for amphibians, European Pond Turtle, Dice Snake, Eurasian Otter, connecting wetland ecosystems measures preventing collisions with birds and bats</td>
<td>Wetlands</td>
<td>10 depending on the conditions</td>
</tr>
<tr>
<td>Watercourses</td>
<td></td>
<td></td>
<td></td>
<td>permeability for aquatic and semi-aquatic species adaptation for other groups of animals</td>
<td>Watercourses</td>
<td>100</td>
</tr>
<tr>
<td>Agriculture landscape</td>
<td>on migration corridors</td>
<td>5-10 km</td>
<td>1-2 km</td>
<td>measures for particular species in areas with extensive (traditional) agriculture</td>
<td>Agriculture landscape</td>
<td>1</td>
</tr>
<tr>
<td>Urbanised areas</td>
<td>on migration corridors</td>
<td>according to local conditions</td>
<td>1-2 km</td>
<td>measures for particular species – according to local conditions</td>
<td>Urbanised areas</td>
<td>depending on the conditions</td>
</tr>
</tbody>
</table>

1. - areas with permanent occurrence of large mammals  
2. - areas outside the permanent occurrence of large mammals
Thank you!