

# Mitigation measures in Germany

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**Abstract.** Germany has made much effort to mitigate habitat fragmentation caused by transportation infrastructure. Examples are wildlife underpasses, overpasses, river crossings and tunnels at road and railway systems. More than 50 overpasses have been built during the last 20 years. Most of them mitigate fragmentation effects of new roads or highways, respectively. River passes have been upgraded with top soil and vegetation to connect biotopes. In order to prove the invested efforts, three large and several minor investigation projects have been carried out. The main results found their way into a German guideline: Construction of Fauna Passages at roads. It outlines not only the demands of red deer, roe deer, wild boar, badger, European otter and other animals with large and small habitats. But it distinguishes between passes for single species and those to connect habitats with all their inventory.

**Key words:** road infrastructure, mitigation measures, green bridge, underpasse, viaduct, Germany, handbook

In the process of road planning and construction an Environmental Impact Assessment [EIA] is necessary. Sequence of works for an Environmental Impact Study for a road construction project:

- Delimitation of survey area based on project and landscape/physiographic parameters
- Survey, description and assessment of the protected resources
- Depiction of area with different conflict densities with regard to protected resources
- Planning of route variants with reference to the areas where relatively few conflicts arise
- Determination and assessment of the impacts arising, and comparison of variants with reference to the individual protected resources
- Summary of the results and professional recommendations.

The EIA shows the main conflicts between the project and natural environment. Based on it an *Landscape conservation implementation plan* is worked out. This includes mitigation measures which are necessary to connect biotopes and individuals of affected animal populations.

There are different kinds of mitigation measures:

- 2 types of Green Bridges
  - Green Bridges for biotopes/landscape
  - Green Bridges or fauna overpasses for target species
- Large and high viaducts across deep valleys
- Green underpasses
- Ecological upgraded river crossings
- Underpasses for large and medium-sized animals
- Underpasses for small animals (incl. amphibians).

There is an uncounted number of underpasses for amphibians and other small animals in Germany. I estimate the number at several hundreds. They are wide-spread throughout the country.

Most of them are located at country- and district-roads, but on federal roads as well. This type was object of the first guideline about animal passes in the 1980ies, which was updated in 2000 (MAMs 2000 – Merkblatt für den Amphibienschutz an Straßen). This guideline says a lot about where and how to help Amphibians in the neighbourhood of roads, and determines exact dimensions for crossing tunnels in relation to their lengths. As well, lengths, height and quality of fences is determined. Last investigation projects pointed out, that only a minor number of animals heading to such a tunnel, is actual crossing it. Presently an investigation project tries to find out, why this is the case. In a presumption it might be the quality of the tunnels ground. We now test its acidity, humidity and microclimate conditions, which might contribute to a drying process of the crossing individuals.

There is evidence that other small animals like mice, snails, bugs etc. and even squirrels make use of these tunnels, but the pleasant effects on their populations have not been studied yet.

For all larger types of passages a new handbook has been written. It is called “Merkblatt zur Anlage von Querungshilfen für Tiere an Straßen” [Guideline for the construction of fauna passages at roads]. Its main characteristic is the differentiation whether a whole biotope or just a special target species gets help to overcome the road. It contains tables for dimensions of underpasses, river crossings and overpasses dependent on the structure of the biotope or the species, respectively (see for example table 1).

**Table 1.** A sample fragment of the handbook of „Merkblatt zur Anlage von Querungshilfen für Tiere an Straßen“

Minimum dimensions for a frame culvert (rectangular outline)	
length in meters	inside width and height in mm
< 20	1000/750
< 30	1500/1000
< 40	1750/1250
< 50	2000/1500
Minimum dimensions for a pipe culvert (circular outline)	
length in meters	width of bore in mm
< 20	1000
< 30	1400
< 40	1600
< 50	2000

Underpasses constructed just for Deers, wild boars and similar species don't need vegetation, but sandy ground, black coloured bottoms of walls and heavy stones at the entrances to avoid abuse by off-road vehicles. The need of sound-absorbing materials is plausible, but not yet proved. The number of this type of underpasses have not yet been counted. To make a rough estimate, it may be about 100.

For the purpose of getting more species underneath the road, especially those ones that need shelter by structure or vegetation, a wider type of underpass is necessary. If this one is not located at a valley and its purpose is just to connect biotopes, we call it “Green Underpass”. It is of distinct height and wideness to allow growth of vegetation. The first one of this new type of underpass for habitats is constructed in Rheinland-Pfalz, western part of Germany.

Rather than achieving acceptance for Green Underpasses it is much easier to open river crossings not only for the highest water level, but for biological purposes as well. Based on a research project about these buildings, we determined the opening of at least 10 m plus waterbody in the case of runnels or creeks, and banks of at least 2½ times of the water body at each bank in case of rivers. This is for better growth of vegetation. The investigation showed the necessity of vegetation

for smaller animals. In 2002 we started an inquiry in how many cases river crossings have been upgraded for ecological purposes. We got a large number of announcements and were very happy about progressiveness of the German road administration. But by proving those announcements we considered most of them as conventional river crossings, without any ecological attributes. This pointed out the shortfalls in understanding about what makes a crossing usable for animals. In particular, water is needed under the building and has to be supplied by various devices.

Large viaducts, especially if more than 15 m in height, give good conditions for the connection of biotopes. Top soil is needed to allow vegetation. Water from rainfalls and light are assumed to be sufficient. Sensitive areas have to be protected during construction for not being destroyed by construction site equipment. In many cases the vegetation of the valley can be continued under the building. Animals do not even notice that they are crossing an obstacle which they can't overcome at other places.

Green bridges are the best solutions for the connection of biotopes. As they are overpasses, microclimate conditions do not change as they do in case of underpasses. With them, nearly all aspects of the habitats beside the road can be connected. These are namely vegetation, i.e. soil, plant species and structure. With this, we hope to have the building equipped for the demands of the animal species which live in the fragmented biotopes. These are not only Wild Boars and Red Deers, but all the smaller species as well which live on or within the soil or the vegetation. These are species like mice, bugs, butterflies, birds or even bats.

We differentiate between green bridges built to connect the whole equipment of the fragmented biotopes and those bridges which work as wildlife overpasses for selected species. The former are at least 50 m wide, but should have a width of 130 m for natural or semi-natural old-growth forests. The width of the latter bridges might be only 30 m, which is sufficient for species like hare, wild boar and deer. Compared with underpasses for these species the "extra width" serves as shelter from the traffic.

In 2002, an inquiry showed that in Germany 36 Green Bridges were constructed, 8 were in construction and other 33 were planned. Without a new, current inquiry we can estimate, that there are at least 50, even more, constructed Green Bridges in Germany. I do not know any other country in the world that have a similar number. Most of these bridges are built in connection of the expansion of the road networks due to the openings and connections to eastern countries during the last decade.

Much has been done in construction and research, but many more is to do in future. A first conference focussing traffic routes and German habitat corridor network was held in March 2006 in Hannover. For connection of countries we do not only need connecting technical structures, but nature structures as well. The tasks are clear: avoidance of new barriers and removal of the old once.