DECREASE OF NEGATIVE IMPACT OF TRANSPORT INFRASTRUCTURE INVESTMENTS ON NATURAL MIGRATION OF THE WILD ANIMALS

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Abstract

Fast growth of roads and traffic has very important impact on wildlife. General information about the harmful effect of transportation investments connected with migration of the animals is presented. A classification of typical passages for animals together with descriptions is included.

Practical examples of different applications of corrugated steel structures to construct animal passings prove that such structures can be used to create aesthetic and environmental friendly crossings.

Key words: corrugated steel, testing stand, steel structures, tests results, animal crossing

1. INTRODUCTION

According to the basic principle of sustainable development, mutual relation between activity of a human and function of ecosystem remain in homeostasis. Close relationship and equivalency of economic development, environment and social development determine among other things, keeping of stability of ecological processes and ecosystems, and preservation of genetic diversity. It is of great importance also from a viewpoint of protection of animal ecosystems.

Technical solutions which, according to above mentioned principle, can decrease negative impact of construction on a possibility of comfortable migration of animals are described. Nature conservation does not mean resignation from an investment. Use of suitable technical solutions, which let animals migrate safely, means to be in an agreement with road and railway development.
International Scientific Technical Conference “Influence of Transport Infrastructure on Nature” which took place on September 13-15th, 2006, in Poznan was devoted to this topic [1].

2. PROBLEM ORIGIN

Construction of a route is serious interference in nature space, which is occupied by a number of different kinds of ecosystems created in the environment an integrated, dynamic system. The interference mostly manifests itself in increase of terrain fragmentation by barrier effect which leads to decrease an area of animal existence and to discontinue their migration routes. It results in finding of partners for reproduction, decreasing of genetic changeability in population or even its death [2], [3].

![Figure 1. Direct and indirect impact of road and traffic on wild animals life [8]](image)

Besides of above mentioned barrier effect, very substantial consequence of transport infrastructure development is intense animal mortality. It depends on traffic intensity and speed, width of the route and area where this route is running. On Polish roads amphibians, medium forest animals and mammals and also big mammals perish the most often. On West European roads and railway lines, the biggest mortality were noticed among deers, hares, foxes, badgers and
wild boars. First and foremost it results from a large number of these species. Many research concerning influence of road traffic on collision and fatalities (so-called roadkill) show that place of their occurrence (so-called hot spots) is not accidental. [4], [5], [6].

Both Polish and European experience show that nature results of infrastructure influence on environment are very serious [7], [8], [9], [10] and one has to take them into consideration while designing new routes to respect animal needs and ensure them safe function.

The most substantial consequences (direct and indirect) of interference of human in nature space related with realization of communication investment are showed in Figure 1.

3. CLASSIFICATION OF ANIMAL CROSSINGS AND COMMENTS REGARDING ECONOMICAL JUSTIFICATION OF THEIR CONSTRUCTION

Animal passings are effective solutions of above stated problem. They are links between two, divided by route, pieces of land, allowing for free migration and stable function within population. Figure 2 shows classification of animal crossings and their short description is presented below [2], [11].

• **Small underpasses**
  Small underpasses are mainly designed for amphibians, and constructed of round or rectangular shaped profile situated crosswise road, finished with holes adjacent to longitudinal road fence. Dimensions of such passings are: width more than 2 m, height more than 1,5 m.
  These types of underpasses are designed for amphibians and reptiles, mainly frogs, but they can be used by other small animals such as: badgers, foxes, martens, weasels, otters, polecats, hedgehogs and rodents.

• **Medium underpasses**
  Medium underpasses are designed as tunnels with round or rectangular shape with internal dimensions which ensure sufficient visibility of light and vegetation on the opposite side of passing i.e. more than 6 m wide and more than 2,5 m high.
  Such underpasses are used for medium size mammals: deers, wild boars, foxes. With suitable development they can be used by lynxes, wolves and even red deers.

• **Big underpasses**
  Big underpass has a form of tunnel situated under road with a shape of rectangle or arch, constructed of concrete or steel elements, blended into the environment by suitable plants. Minimum parameters are 15 m in width and 3,5 m in height.
Big underpasses are built for big mammals: elks, bears, red deers, wolves, lynxes, bison.

- **Medium and big overpasses**
  Medium and big overpasses are designed in particular when road runs in trench and top surface of the overpass is situated at the level of surrounding terrain. They can be constructed as tunnels running the roads or grade separations over road. Shapes, dimensions and a way of development of the overpass should ensure the best visibility of plants on the opposite side of road. Extreme strips should be planted with vegetation. Opaque fences with a height of 1.5 - 2.5 m should be installed to protect from noise and car light. Height of fences depends on species of animals which are using the overpass. Fences alongside the road

Figure 2. Classification of animal passings [3]
and suitable bushy vegetation should be an extension of the fences on the overpass. Fertile soil 30-70 cm thick on which grass and plants attracting animals, is significant element of development of overpass.

Medium overpasses are designed for small and medium mammals and can be also used by reptiles, amphibians and big mammals. Big overpasses are constructed for big mammals, especially for hoofed animals and can be also used by reptiles, amphibians and medium mammals what make them universal.

It is possible to construct combined (multifunctional) passings which can conduct unsurfaced, forest or serve as technological roads.

Diversity of materials and technology are used for construction of animal passings such as concrete, steel, plastics. Selection of the material is very often connected with size of passing (small, medium, big). Types of technologies and materials are described in [12], [13], [14], [15], [16]. Algorithm for economical analysis of results of action which prevents road-kills was worked out in the USA [4]. Based on evidence of collisions cost, tables which allows for financial estimation of probable collisions and their confrontation with prevention costs were prepared. Using the algorithm [4], [13], [14] it is easy to find limit of capital expenditure for which planned ecological investment is financially justified.

On the basis on American tests from Virginia [6], evaluation of financial benefits caused by building of animal underpasses were made. Graph from Figure 3 confirms that together with limitation of potential number of deer-vehicle collisions during a year, savings in expenditures caused by collisions are increasing.

Figure 3. Reduction of expenditures caused by limitation of deer-vehicle collisions [5]
4. ANIMAL CROSSINGS MADE OF FLEXIBLE STRUCTURES

From the middle of 20th century the use of flexible structures for construction of animal crossings have become more and more popular. HDPE pipes, helically corrugated steel pipes and pipe-arches and corrugated steel plate structures are used. The variety of shapes lets them to fit into existing conditions and environment. Short construction time and slight negative influence of flexible structures on environment are very important advantages.

With the use of flexible structures both underpasses and overpasses can be constructed. Underpasses can be design as culverts equipped with shelves. Depending on the parameters of culverts and shelves this kind of underpasses can be used by amphibians and small mammals. Shelves can be constructed of steel or HDPE plates fixed to pipe wall and cover with geotextile and aggregate (Figure 4) or made of gabions (Figure 5). Shelves can be also made of stones, gravel, or geotextile filled with aggregate (Figure 6).
Animal crossings with the use of large span corrugated steel plate structures can be built over roads. Leading countries in building those are Canada, USA and South Korea. One of the biggest flexible structures to serve as animal overpass was built in South Korea. It has a span of 20 m and is located on Namwon Road (Figure 7). The biggest flexible structure built so far in Europe that served as an animal crossing was constructed in Poland over A2 motorway [12], [13], [16]. This overpass consists of two arches with span of 17.7 m located over motorway lines and two closed profile structures 9.4 m in span designed for technological roads (Figure 8). The same arch structure was used to built animal passing over National Road no. 5 near Poznań in Poland (Figure 9). Other example comes from the Netherlands and is located between Arnhem and Apeldoorn in Woeste Hoeve (Figure 10). It is a twin tunnel with spans of 16.13 m and rise of 8.15 m.

5. CONCLUSIONS

Presented issue of construction of animal passings in the context of decreasing of negative influence of roads and traffic on wildlife confirms the necessity of
obeying the principle of sustainable development. Construction of animal crossings becomes a major task in environmental areas with developed road network. There’s a methodology to quantify and qualify the costs of construction of crossings versus economical and environmental benefit. Flexible pipes and structures are successfully used for building of animal crossings over the world. Short realization time, low construction cost, aesthetics of these structures as well as their ecological virtues make this kind of structures very interesting ecological bridges.

6. REFERENCES

Decrese of negative impact of transport infrastructure investments…

Protected Metropolitan Greenspace. The Case of the Barcelona Region, Spain, International Scientific Technical Conference, Influence of Transport Infrastructure on Nature, Poznan


ZMIEJESZZNIE NEGATYWNEGO WPŁYWU INFARSTRUKTURY TRANSPORTOWEJ NA MIGRACJĘ DZIKICH ZWIERZĄT

Streszczenie

Szybkie powstawanie dróg oraz rosnący ruch samochodowy wywierają duży wpływ na przyrodę. W referacie przedstawione zostały informacje ogólne dotyczące szkodliwego wpływu inwestycji związanych z transportem, które kolidują z szlakami migracji zwierząt. Referat zawiera klasyfikację i opis typowych przejść dla zwierząt. Praktyczne przykłady różnych zastosowań karbowanych konstrukcji stalowych do budowy przejść dla zwierząt udowadniają, że tego typu konstrukcje mogą być używane do stworzenia przejść estetycznych i przyjaznych środowisku.

Słowa kluczowe: blacha karbowana, konstrukcja stalowa, wyniki badań, przejście dla zwierząt