

Spatial analysis of road conflicts with NATURA 2000 areas in Poland

Andrzej Łysko*, Robert Cyglicki**, Elżbieta Dusza*, Michał Kupiec*

*Department of Environmental Development and Protection, West Pomeranian University of Technology in Szczecin
Słowackiego 17, 71-434 Szczecin, e-mail: andrzej.lysko@zut.edu.pl

** Polska Zielona Sieć

Abstract: In 2003 the Polish government adopted a Strategy of reconstruction of major national roads for 2003-2013. It was one of the first documents relating to restructuring the Polish expressway and highway network. As a result of accession to the European Union funding became generously available for this purpose. Unfortunately, in the early phase, the inobservance of environmental law, especially in relation to investments in protected areas, has led to numerous environmental conflicts. One of them concerned construction of a bridge over the Rospuda Valley. Incorrect decisions issued between 2004 and 2007 caused not only social problems but also increased the financial costs of the first phase of construction. This document is a summary of analyses carried out between 2004 and 2007, aimed at identifying potential conflicts between construction of motorways and NATURA 2000 sites.

Key words: reconstruction of roads, NATURA 2000, nature conservation, traffic conflicts

Introduction

Poland's accession to the European Union is one of the basic factors affecting the dynamics of development of road infrastructure in our country. From negotiation commitments it results a desire for best profits derived by the development of the internal market and above all from the availability of EU funding. During the negotiations of transitional periods the Polish government committed itself to abide by its own work plan of modernization of the main road network determined in Annex I to the decision of the European Parliament and of the Council of 23 July 1996 (1692/96/WE). The strategy of reconstructing main national roads in Poland in the years 2003-2013 will be carried out by: the construction of motorways, the construction of dual carriageways, the construction of ring roads, the road pavements reconstruction of the TEN-T network and the construction and reconstruction of the remaining network of national roads (Sarna 2004). In practice it means acceleration of constructing motorways: A-1, A-2, A-4/A-18 and fragments of dual carriageways S-1, S-3 and S-8, which constitute the target development of the transport corridors. The process of highways construction as a result of delays and legislative issues prolonged far beyond the planned period. Some acceleration was also a result of preparations for Euro 2012.

According to the data of the General Directorate for National Roads and Motorways in 2000 there were 16590 km of roads of national status in Poland. They are characterised by the highest volume of road traffic. The traffic volume increased nearly twofold in the years 1990-2000. Concentration of such roads in central and southern Poland and their star-like spread into other areas cause that they cross practically all the most important migration routes of large mammals. Moreover, the started modernisation of some of these roads and their adaptation to higher unit pressure (11.5 tons per axle) will result in a further increase in traffic volume and in the deepening of the problem (it concerns about 1700 km of existing roads).

In Poland a programme of development of transport network has been carried out since 2000, the result of which will be some motorways of a total length of 1510 km and several dual carriageways of a length of 1630 km. These roads will gradually, with the progress of realisation of individual investments, take over the role of main elements of the national transport infrastructure. Thus, it is crucial to point out conflict areas in which planning and constructing the roads should in a particular way take into consideration the needs of animal protection. The analysis of migration corridor routes and existing and planned roads showed the location of the most conflicting areas.

Methodology and data sources

The information on driving roads was taken from the Strategy of reconstruction of the main national roads in Poland in the years 2003 – 2013. Whenever possible the data concerning terrain and more detailed technical information on individual fragments of roads were updated. Unfortunately, the limited resources of this kind in the General Directorate for National Roads and Motorways made it impossible to determine the location of conflicts in a more precise way. Particularly troublesome was the determination of the exact routes of some parts of motorways and ring roads around towns. The lack of this information increases the range of uncertainty of this analysis.

The data concerning the areas fulfilling the criteria of the Birds and Habitats directives were taken from the description prepared by the UNEP/GRID commissioned by the Ministry of the Environment. It should be emphasised that not all of the analysed objects were included on the list of mainstays submitted to the European Commission. The reason to this was the fact that we followed judicial decisions of the Court of Justice of the European Union according to which each of these objects must be subjected to the same investment rigors, at least until the ultimate confirmation of the list of areas of the community significance.

The analyses concerning the conflicts between the areas of special protection Natura 2000 and the adjacent areas of the planned for development road network were carried out using a computer programme GIS (QGIS - visualization, basic analyses; PostgreSQL and PostGIS - data structure and spatial analyses). The analyses were based on vector data and on the maps of potential areas Natura 2000 in the scale of 1: 100 000 and 1: 50 000, which, in order to set them cartometric features, were calibrated and reduced to a common system of coordinates PUWG 1992 (State System of Geodesic Coordinates 1992) (EPSG:2180). Then a digital description of the subject matter relating to the borders of areas was worked out and plotted on a map of the planned road infrastructure in the scale of 1: 50 000 and in the case of motorways and dual carriageways in the scale of 1: 100 000, also in the same coordinate system.

Two basic zones of road interaction were determined, referring to the direct and indirect effect of the construction and exploitation of the road infrastructure on environment. The studies and experience of the Birdlife International groups were the basis for the presented assumptions of the size of the interaction zones for the areas of special protection of birds (PLB). Whereas for establishing interaction zones for the areas of special protection of habitats (PLH, PLC) the information relating to the process of construction as well as to the further range of exploitation of road investments in Poland was used to a large extent. For the PLB and PLH areas the borders of which are to a certain extent approximate, we accepted the same assumptions as for the areas of special protection of birds (tab. 1,2,3).

Table 1. Interaction zones of individual road categories for special areas of bird protection (PLB)

Motorways		Dual carriageways				Remaining national roads	
direct	indirect	new		modernised		modernised	
		direct	indirect	Direct	indirect	direct	indirect
1000 m	2000 m	800 m	1600 m	500 m	1000 m	400 m	900 m

Table 2. Interaction zones accepted by Birdlife International in the report on the conflicts between TINA and mainstays of birds

New roads		Modernized roads	
direct	indirect	direct	indirect
1000	2500	500	1000

Table 3. Interaction zones of individual road categories for special areas of habitat protection (PLH)

Motorways		Dual carriageways				Remaining national roads	
direct	indirect	new		modernised		modernised	
		direct	indirect	direct	indirect	direct	indirect
500 m	1000 m	300 m	500 m	250 m	400 m	200 m	350

Determined borders have partially general character, mostly because of developing process of defining them in the country. A real impact of the road on the mentioned mainstays should be analysed every time in the context of precise location studies, detailed data on road parameters, traffic prognoses, sensitivity of a given object and its relations to the Natura 2000 system.

Results

The construction of new roads inevitably influences transformation of natural environment into environment of a high level of disturbances of anthropogenic origin. Motorways can cover more than 10 ha/km of a road. Narrow roads are characterised by a lesser demand for the land, but due to the fact that they are definitely in the majority, they generally have a larger influence on the transformation of a landscape. If we take into account the objects integrated with the surrounding of roads, i.e. shoulders of the road, scarps, steep notches, car parks, petrol stations, pedestrian pavements, the whole area planned for transport demands several times more space as only the surface of the road itself. In most of the European countries the intended use of space for a new infrastructure is an inner problem of landuse planning, which evokes a series of conflicts. Therefore, the location of a road is a subject of a particular interest in assessing the impact on environment in Europe in order to set the basis for activities compensating and soothing the influence of the modern infrastructure (OECD 1994).

The loss of habitats caused by the infrastructure is the most significant in a local scale, whereas in a wider scale it becomes a secondary matter comparable to exploitation of the land in a different way. The complete loss of habitats caused by the infrastructure cannot be assessed only on the basis of physically occupied ground. The effects of barriers isolate spatially individual habitats and make them unavailable to wild animals; the direct effects relating to hydrology and microclimate, pollution caused by chemical substances and an increase in the level of noise change properties of the habitat (Seiler 2001). The effects of disturbances spread on the surrounding areas and cause the general loss and damage of natural habitats to a much larger extent than the road itself.

The cleaning of a road lane on earth scarps results in their drying and increasing the risk of soil erosion (Forman 1999; Jones 2000). Microclimatic conditions are extremely modified. Increasing wind and intensity of light, reduced humidity and temperature are not favourable factors to forest species such as swards or mosses. A direct impact of a road on flora and fauna can even be observed in the area of a few dozen metres off the road (Ellenberg 1986, Mader 1984). Mader (1990) observed changes in the diversity of plants and animals in the forest in a distance up to 30 m. from the edge of the road.

Road noise is another component of disturbance spreading around the surroundings. Despite the fact that

the noise disturbance is more difficult to be measured and less evident than pollution by toxins or suspended particulates, it is regarded as one of the main factors contaminating natural environments in Europe (Mader 1990, Knaaper et al. 1992, Formann, Alexander 1998). Road noise is burdensome to most people. Although there is no direct effect on physical health, staying in the noise for a long time can result in stress and physiological disorder (Watson et al. 2000, Knaapen et al. 1992). Stressogenic character of noise in the case of animals is a disputable matter. However, skittish species can treat road noise as a sign of the presence of a human being and in consequence avoid these areas (Buhlmanan 1995, Knaapen et al. 2000, Guciński et al. 2001). Also artificial light and movement of vehicles can cause disturbances of wild life in the vicinity of roads. For example, street lamplight can affect the growth of plants (Seiler 2001), disturb reproduction and natural development of birds or affect night behaviour of frogs (Buhlmanan 1995). Areas adjacent to the road infrastructure are characterised by large changes in the environment (fig. 1), unfriendly to many forms of wildlife. At the same time they can provide attractive shelters and food, and can influence the spread of specific species along the road corridor. For the sake of safety the shoulders are kept clean and if necessary the grass and plants are mowed and cut, whereas in the surroundings of a road shrubs and trees are planted for esthetic purposes and as natural noise barriers. The search for a compromise between technical solutions and environmental interest poses a challenge to modern projecting and administrating the areas adjacent to roads.

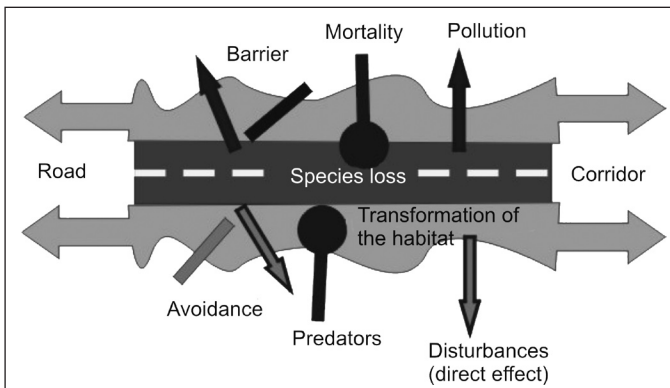


Fig. 1. The scheme of five main ecological effects of existence of the infrastructure: the loss and transformation of the habitat, disturbances caused by pollution, barrier and avoidance, mortality resulted from traffic on roads and changes in the behaviour of predators, the effect of a road or a corridor. The influence of individual factors leads to fragmentation of natural habitats (Seiler 2001).

Another negative effect of new motorways is a considerable mortality rate of animals on roads. For many years this problem has been dealt by biologists who observe an increasing number of accidents along with increasing road traffic and development of the road infrastructure. In their review Forman and Alexander (1988) reported that during the last three decades the roads with cars moving on them have probably exceeded the causes of mortality rate of vertebrates as compared to that resulted from hunting. Collisions with wild animals constitute a growing problem not only for the protection of species and biological balance, but also for the safety of road traffic and related expenses. In most countries the road traffic safety is the main argument for actions reducing mortality of animals on roads. Although the death of a human being is a rare phenomenon in collisions of vehicles with wild animals, the number of injured is high and total economic expenses, including vehicles damages, are significant.

Roads are part of the network functioning in synergy with other links of the infrastructure and this leads to a further loss of habitats and isolation. The process of habitat fragmentation and its influence on wild animals was widely investigated in forest and agricultural areas. Fragmentation means decomposition of adjacent areas into smaller and dispersed fragments. Along with an increase of fragmentation, individual areas can become too small and too much isolated one from another so that they could not fulfil the requirements of habitats. Empirical studies of the fragmentation of habitats caused by forestry, suggest that the loss of more than 80% of habitats in the area result in abrupt extinction of a species. If 60% of habitats vanish from the area, the remains still can be too dispersed to be used. Pollution and direct effects also reduce the number of intact habitats along the road network, but their total loss is absolutely the most important problem.

Potential conflicts with areas of NATURA 2000

Birdlife International report published in 2001, entitled "Assessment of the potential effect of the TINA network on mainstays of birds in the countries that were candidates for the European Union" showed for the first time road conflicts with the bird mainstays of international significance in Poland. 21 areas were then identified within the zones of the effects of roads planned for construction and modernisation in the frame of the TINA9 network. The authors reported scale of the arising problem and recommended quickest implementation of the directive, concerning strategic assessment of the impact of the planned transport corridors on the environment in Central and Eastern Europe prepared at time by the Council and the European Parliament. Unfortunately, in spite of general acceptance of directives for SOOS (Strategic environmental impact assessment), the European Union and the Polish government have not been used so far for harmonizing the needs of natural environment protection with the development of roads.

In 2003 Ministry of the Environment for the first time presented officially proposals of the protected areas planned for the Natura 2000 network. The data about mainstays collected by the experts from the Centre of Information on the Environment UNEP/GRID fulfilled the assumption of the European Union directives and confirmed the immediate need for an approach to planning successive, long term enterprises. Regardless the expectations of non-government organisations and scientific community such activities were not undertaken. The investors were focused rather on efforts to exclude individual objects from the Natura 2000 lists than on constructive solution to potential conflicts. This problem was regarded as a proof of relatively low legal awareness among decision-makers (investors, governmental agencies involved) who seem not to see recommendations issued by the European Commission. The results of spatial analysis (fig. 2) demonstrate the extent of the problems generated by rapid expansion of road network in Poland. It's clear, that numerous environmental conflicts hinder most of the planned road construction. Long process of preparation of road investment in Poland is so tremendous also due to the problems with adjustment to European requirements for environmental impacts, lack of proper social consultations and difficult relations with NGO's and local communities.

Summary

Among all the effects of the road infrastructure, the general fragmentation of the habitats is a most affecting. Infrastructure damages natural processes such as the flow of underground water, the spread of fire, the dispersion of plants and hindrance to migration of animals. The influence of obstacles on wildlife results in the

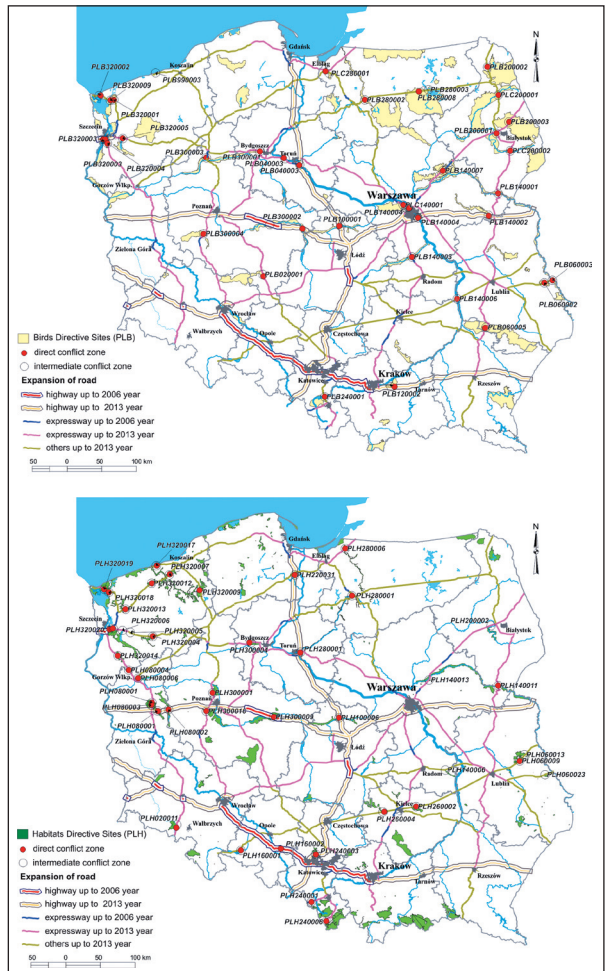


Fig. 2. Potential conflicts with the areas fulfilling the criteria of the Birds and Habitats Directive (authors analysis)

combination of the effect of disturbances and avoidance, physical barriers and mortality on the roads, and all these factors reduce animal migration. Disturbances caused by road noise, road traffic, pollution and a human being's activity can effectively prevent many species from approaching the corridors. Finally, mortality on the roads reduces the number of animals which manage to overcome the obstacle.

The experiments concerning the design and construction of the road infrastructure in Poland confirm the need for permanent monitoring of the way of implementation of decisions of Habitats Directive. The analysis of potential road conflicts with valuable natural mainstays should precede the investment procedures as early as possible - preferably at the stage of the preparation of a technical and economic study of the given road infrastructure. Constant monitoring and prolonged discussion about solutions for road conflict between investors, environmental agencies, NGO's and local government should become a vital part of investment process.

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