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The ecological impact assessment of a proposed road development (the Slovak approach)

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ABSTRACT

The construction of roads is one of the most widespread forms of natural landscape modification. Over the last 20 years, dozens of road constructions have been assessed in Slovakia, which makes it possible to talk about methodological positives and negatives. A special feature of Slovakia is that many planned or renovated roads are located in protected areas or are in contact with them (including Natura 2000 sites). Therefore, it is important to understand the scope of the roads' ecological impacts and find ways for their appropriate evaluation and incorporation into the Environmental Impact Assessment process. For this reason, the Ecological Impact Assessment methodology can be used as a basis for our research, which consists of three stages. In the first stage (scoping), a buffer circumventing the proposed road is created to determine the area for impact prediction and evaluation. Subsequently, the landscape structure and baseline landscape conditions are discussed, a map of current landscape structure is created and the current ecological status of the affected area is calculated. In the second stage (the evaluation of ecological resources), important ecological parts of the landscape are delineated. This step is based on the importance of previous information and its vulnerability, and leads to the mapping of the road ecological impact zone. In the third stage (impact assessment), important ecological parts are spatially correlated with the proposed road construction. Finally, the significance of ecological impacts of the activity is evaluated by applying specific criteria (duration, reversibility, magnitude, size and road ecological impact zone significance). A scale is proposed for each criterion to evaluate the total significance of impacts. In this way, detailed significant ecological impacts can be found which will help lead to proposed correct mitigation measures and a post-project analysis.

1. Introduction

The determination of environmental impact has to be focused on the following factors: population, human health, biodiversity (with particular attention being paid to species and habitats protected under Council Directive 92/43/EEC and Directive 2009/147/EC), land, soil, water, air, climate change, material assets, cultural heritage and the landscape, and the interaction between these factors (CEU, 2014, 2011). Over the last decade, environmental issues such as sustainability, biodiversity protection, climate change and the risk of accidents and disasters have also become more important. The measurements have been taken to avoid, prevent and reduce significant impacts on species, habitats and Natura 2000 sites (CEU, 2014).

An Environmental Impact Assessment (EIA) is a systematic process that analyses environmental impacts of development actions beforehand (Glasson et al., 2013). In accordance with Article 3, Directive 2011/92/EU, amended by 2014/52/EU, an EIA has to identify, describe and evaluate the direct and indirect effects of a project in an appropriate way. All possible impacts of the environment should be taken into regard when choosing the final project, locality, and planning and technical proposals. An EIA tries to find ways to improve a project mainly from an environmental and ecological point of view (Pavlickova et al., 2009).

Ecological problems have been a serious component of EIAs since they were established by EIA Directive 85/337/EEC in 1985 (CEC, 1985). The International Association for Impact Assessment (IAIA, 1999) claimed that one of the main objectives of an EIA is to preserve the productivity and the capacity of nature, especially its systems and ecological processes for maintaining the sustainability of its functions.

An ecological impact denotes an impact on a habitat or species due to direct or indirect effects on the environment caused by a project. An Ecological Impact Assessment (EcIA) is a process of identifying, quantifying and evaluating the potential impacts of projects on ecosystems and their components. If the implementation of an EcIA is clear, it serves as a scientifically strong approach for the management of ecosystems (Treweek, 1999).

At the national level, many countries have developed assessment methodologies where biodiversity is taken into consideration (Jones-

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Walters and Mulder, 2009). The demand for the conservation of biodiversity and its consideration in the process of planning and decision making has been underlined in legal frameworks (e.g. the EIA Directive) and in some policy documents such as the Convention on Biological Diversity (Article 14) (SGUN, 1993). The European Landscape Convention (2004) is also relevant when dealing with ecological impacts; the importance of unprotected areas is emphasized in Article 2 (SGCE, 2004).

Particular guidelines for the assessment of impacts on biodiversity and the ecological impacts of an infrastructure have been prepared by the Department of Transport (DoT, 1993), the United States Environmental Protection Agency (EPA, 1994), the Swedish National Road Administration (SNRA, 1996), the Institute of Ecology and Environmental Management in the United Kingdom (IEEM, 2006), the National Road Authority of Ireland (NRA, 2009), and other organizations around the world. The infrastructure has a large-scale effect on ecological processes, which results in various ecological impacts (Karlson and Mörtberg, 2015).

An EcIA can be a part of a formal EIA or a basis for other forms of environmental assessment or evaluation. An EcIA should include the following stages (IEEM, 2006):

1. Scoping — involving consultation to ensure the widest possible input for determining the scope of EcIA
2. An identification of the expected zone of influence
3. A determination and evaluation of ecological resources
4. A description of expected biophysical changes which could affect valuable ecological resources
5. An assessment of those changes if they are able to cause a significant ecological impact
6. The development of ecological improvement and mitigation measures for avoiding any negative impacts
7. An assessment of ecological impacts and their significance
8. The summing up of consequences for decision making
9. The monitoring and implementation of mitigation measures and ecological outcomes

An EcIA is also an essential instrument for precise impact prediction and evaluation within the EIA. The expanding of a transport infrastructure usually causes important adverse impacts, particularly the fragmentation of natural habitats, on the affected landscape (Opdam and Wiens, 2002). An EIA is therefore an essential instrument to assess the impacts of a planned infrastructure. When assessing road projects within an EIA, an EcIA should include the following stages (NRA, 2009):

1. Scoping — the set of information which is needed for the EIA of a road project is developed. In addition, the understanding of the road project, the prediction of impacts, the designation of a zone of influence and the identification of ecological resources have to be integrated at this stage.
2. The evaluation of ecological resources — identified ecological resources are evaluated in terms of geographical features, nature conservation and any other related attributes.
3. Impact assessment — impacts are characterized and the value of the impacts' significance is determined.
4. Mitigation measures are proposed.

In the planning process, the spatial scale of ecological impacts is very important and must be stressed (Karlson et al., 2014). Therefore, the incorporation of species- and habitat-specific data is necessary for the improvement of the ecological impact assessment of a project (McHugh and Thompson, 2011). In the context of this research, "ecological receptors" refer to sites, habitats and species that occur near the project where impacts are possible.

A geographic information system (GIS) is a recommended technical tool for the accurate evaluation of potential impacts of road constructions. GISs are tools to collect, store, search for, transform and display spatial and attributive data for a particular set of purposes; they can support all desirable requirements (Pauditsova, 2002; Burrough and McDonnell, 1998; Antunes et al., 1996). The benefits from the usage of GISs in the EIAs of road projects are important for decision makers and scientists because they allow for the assessment of various management strategies before their implementation. They can also be used within EcIAs.

The impacts of road constructions are truly differentiated in terms of their geographical scope or effects. For a better understanding of the effects of potential impacts, a road-effect zone should be created. This tool enables a definite spatial detection of the scope of possible ecological effects for a more precise consecutive evaluation. A road-effect zone allows for the spatial detection of the scope of potential ecological effects and asymmetrically expands both sides of the road while the zone boundaries are varying. The creation of a road-effect zone depends on local species, the exact location and the type of disturbance (NRC, 2005). A zone is drawn to incorporate the various land uses, habitats and resources on each side of the proposed road that may potentially be affected by a road effect. According to this concept, the "zone of influence" of a road project can also be detected as a place where all the potential impacts are expected.

The landscape elements identified within a road-effect zone can be used for the basic assessment of the landscape affected by a road project. When evaluating the ecological impacts, one of the most important landscape attributes is ecological stability. A landscape's ecological stability is the ability of any ecological system to survive, even under the influence of disturbing factors, and reproduce its substantial characteristics in terms of outside interferences (Michal, 1994). The evaluation of a landscape's ecological stability is considered to be the basis for assessing all conditions and assumptions of actual land use and forms an important part of land-use planning documents in Slovakia, such as the Territorial System of Landscape Stability (the Slovak equivalent of an ecological network) or EIA documentation. A lot of methodological tools have been created to describe the level of ecological stability of a specific area. The majority of these tools is based on a calculation of a coefficient of ecological stability (CES) (e.g. Rehackova and Pauditsova, 2007). The calculated value of this coefficient expresses the environmental quality of the landscape and the ecological importance of its components (Pavlickova and Vyskupova, 2015).

The impact assessment in an EIA involves the evaluation of the negative and positive significance of an impact. The "concept of significance" is key in this process (Briggs and Hudson, 2012; Lawrence, 2007). It determines the scarcity, rarity, diversity and originality of the site as well as the naturalness, degree of perturbation and connectivity between ecosystems (Hrasko, 1997). The majority of EIA experts recommend the determination of significance during the screening stage or during the impact prediction. However, significance can also be presented in other stages (Wood, 2008; Weston, 2000; Sadler, 1996). Additionally, it seems very appropriate to include the criterion of ecological significance into the proposed methodology with respect to the actual EIA experience.

During the Slovak EIA process, the evaluation of environmental impacts has to be done to include impacts on biota and protected areas of the environment. According to the Slovak EIA Act (Act. No. 24/2006 Coll. on EIA), there is no special requirement for ecological impact evaluation. EIA practise is usually oriented on the evaluation of basic impacts on biota in proximity to the project. However, the concept of ecological significance is absent. The proposed method tries to incorporate this into the EIA process for protected areas and all landscape elements. In light of the above, the aim of this paper is to propose a method for the incorporation of ecological impact assessment methodology into the EIA process of road construction and test it on a model project in Slovakia.