



Biodiversity Impact Assessment of roads: an approach based on ecosystem rarity

Davide Geneletti*

*Department of Civil and Environmental Engineering (DICA), University of Trento,
Via Mesiano, 77, 38100 Trento, Italy*

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Abstract

Biodiversity has become one of the central environmental issues in the framework of recent policies and international conventions for the promotion of sustainable development. The reduction of habitat worldwide is currently considered as the main threat to biodiversity conservation. Transportation infrastructures, and above all road networks, are blamed for highly contributing to the decrease in both the quantity and the quality of natural habitat. Therefore, a sound Biodiversity Impact Assessment (BIA) in road planning and development needs to be coupled to other commonly considered aspects. This paper presents an approach to contribute to BIA of road projects that focuses on one type of impact: the direct loss of ecosystems. The first step consists in mapping the different ecosystem types, and in evaluating their relevance for biodiversity conservation. This is based on the assessment of ecosystem's rarity. Rarity is a measure of how frequently an ecosystem type is found within a given area. Its relevance is confirmed by the fact that the protection of rare ecosystems is often considered as the single most important function of biodiversity conservation. Subsequently, the impact of a road project can be quantified by spatially computing the expected losses of each ecosystem type. To illustrate the applicability of the methodology, a case study is presented dealing with the assessment of alternative routes for a highway development in northern Italy.

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* Tel.: +39-0461-882685; fax: +39-0461-882672.

E-mail address: davide.geneletti@ing.unitn.it (D. Geneletti).

1. Introduction

The conservation of biological diversity (biodiversity) has recently emerged as one of the major global environmental concerns (Noss and Cooperrider, 1994; George, 1999; Diamantini and Zanon, 2000). Consequently, a thorough treatment of the effects of developments on biodiversity is to be included in the procedure of Environmental Impact Assessment (EIA), as recommended by the Convention on Biological Diversity: "...each Contracting Party shall...introduce appropriate procedures requiring environmental impact assessment of its proposed projects that are likely to have significant adverse impact on biological diversity..." (UNCED, 1992, article 14). Following this recommendation, several governmental agencies have issued guidance on EIA and biodiversity (Canadian Environmental Assessment Agency, 1996; CEQ, 1993) and work is being carried out in this area also by a range of non-governmental bodies, such as the International Association for Impact Assessment (IAIA, 2001) and The World Conservation Union (Byron, 1999). This has led to the establishment of a specific disciplinary field, namely Biodiversity Impact Assessment (BIA), which aims at developing and applying strategies for performing the analysis of the impacts on biodiversity within EIA. However, BIA can still be considered in its infancy, especially for what concerns real applications (Atkinson et al., 2000).

The decline of habitat is globally recognized as the current main threat to the conservation of biodiversity (EPA, 1999). The most severe habitat reduction occurs when a natural ecosystem is converted to an artificial system, as it happens for a road construction. Roads represent one of the most widespread forms of modification of the landscape that occurred during the past century, and particularly after World War II (Trombulak and Frissell, 2000; Smith, 1990). Road developments affect and modify the habitat conditions, which in turn influence the abundance and distribution of plant and animal species, i.e., the biodiversity, of the impacted areas. Reviews on this topic (Byron et al., 2000; Thompson et al., 1997) suggested that road schemes, due to their linear structure, are much more likely to affect natural areas than other developments in general. The dimension of the phenomenon can be pictured by recalling that many industrial nations have given about 1% to 2% of their land to roads and roadsides (Forman, 2000; Seiler and Eriksson, 1995), making the road network a common feature of virtually every landscape.

Roads cause both a direct and an indirect loss of habitat. The direct loss refers to the reduction of the total area of an ecosystem caused by the presence of the road and its verges, i.e., by the conversion of the original land cover (e.g., woodland, grassland, wetland, etc.) into an artificial surface. The indirect loss refers to effects such as the fragmentation (i.e., the portioning of an ecosystem into smaller and more isolated patches) and the degradation of ecosystems (i.e., the biophysical alteration of an ecosystem induced by noise, air and water pollution, artificial light, etc.). These effects cause an indirect loss of habitat in that they reduce the capability of an ecosystem to sustain its original biodiversity.

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