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研究论文

GIS支持下的中国西部公路建设生态影响区划

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摘要 根据公路的线形景观结构及其对生态系统影响特征，构建了公路建设对生物多样性潜在影响指数（*B*），以及反映区域生态系统对公路建设扰动的抵抗能力和生态恢复难易程度的生态脆弱性指数（*EV*），运用GIS技术，以25km×25km的像元分别计算该两个指数的数值。以计算结果为依据，结合公路建设中造成的边坡侵蚀类型，完成了中国西部公路建设生态影响区划。该区划包括3个公路边坡侵蚀影响大区，10个生物多样性潜在影响区和32个生态易损性小区。西部公路建设生态影响区划的研究结果表明，西部地区今后公路建设中生态保护的重点内容具有明显区域差异，因而不同区域应采取的保护措施也应不尽相同。

关键词 公路；生态影响；区划；中国西部

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GIS-based regionalization of the ecological impact relating to highway construction in west China

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Abstract

The aims of this study are to distinguish the spatial difference of the ecological impacts relating to highway systems and characterize this difference in West China, through a regionalization in terms of potential soil erosion and biodiversity loss in the future along with highway construction, as well as the local ecosystem vulnerability against the highway construction disturbance.
For evaluating the highway construction impacts on local ecosystems and analyzing the difference of those impacts over West China, the following indexes have been developed in order to take into account the impacts based on each pixel of 25×25 km^2 with GIS support.
① Biodiversity impact index (*B*)The index *B* has been applied to evaluating the intensity of potential impacts of highway construction on local biodiversity. The hypothesis for the evaluation is that the potential impacts of highway construction on local biodiversity will grow notably with the increases of vegetation diversity, the amount of high rank nature reserves, the richness of endemic elements of taxonomy and the fragmentation of landscape. *B* has been therefore defined as:

$B=D+S+I$

where D is the diversity index of vegetation type described by Shannon-Weaver Index; S is the richness class of total endemic plant genera in each province; and I is the segregation grade of fauna and flora, which is constructed on the basis of landscape ecology theory and calculated by the following formula:

$$I=1/M\sum i=1a_iL_i+\sum 4j=1b_jS_j$$

where I is the segregation grade of fauna and flora for a mesh in highway network; M is the area of a mesh; L_i is the total length of highway class i within a mesh; S_j the number of nature reserves at rank j within a mesh; and a_i and b_j the weight shares for highway class i and nature reserves rank j respectively.

② Ecological vulnerability index (EV)

The index EV has been used to revealing the vulnerability of local ecosystem to the disturbance resulted from highway construction. EV consists of four parameters:

$$EV=A+R+H+X$$

where A, R and H represent aridity, erodible grade of the surface materials and the relative altitudinal difference, respectively; X represents the intensity of the erosion agent, which is the number of days per year with strong wind in wind erosion region or the number of days per year with heavy rains in water erosion region. In the region where strong frozen erosion happens far and wide, X represents the temperature class, which can be an index reflecting the sensibility of the frost. The regionalization is conducted by top-down dividing strategy at the first level, and then by bottom-up merging strategy at the second and the third levels. According to the main erosion type on the disturbed sites resulted from highway construction, the West China has been first divided into three domains, namely, water erosion domain, wind erosion domain and frozen erosion domain. Based on the distribution pattern of the biodiversity impact index B, each domain has been in turn divided into several different regions, and totally 10 regions have been distinguished in West China. Finally, the ecological vulnerability index EV, calculated for each domain separately, has been used to divide the regions further into 32 different sub-regions by merging similar meshes and pixels.

The result of the regionalization presented here suggests that: 1) the southwest mountainous area, partly located at the margin of Qinghai-Tibetan Plateau, has not only high diversity of vegetation types but also high richness of endemic plants. For the sake of the highway management at present and the highway design and construction in future, a special attention must be paid to biodiversity conservation and biological invasion prevention; 2) the Sichuan Province and the east Yunnan Province bear a heavy fragmentation caused by highway network. The connecting corridors for animals among different patches embedded in highway network should be built, and the further fragmentation should be prohibited as strictly as possible in the future highway construction; 3) In sub-regions with high vulnerability the strong measures of preventing land from soil erosion at the highway construction sites must be taken before, during and after the construction in various aspects.

Key words highway _ ecological impacts _ regionalization _ west China

DOI

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