研究论文

芦芽山自然保护区旅游开发与植被环境关系——植被景观的类型及其排序

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摘要　　　正确识别旅游活动作用下植被景观的类型及其分布格局，是景区管理者实施生态管理的现实课题。以芦芽山自然保护区为例，利用双向指示种分析（Two-Way Indicator Species Analysis，TWINSPAN）和除趋势对应分析（Detrended Correspondence Analysis，DCA）对此问题进行了研究。结果表明：（1）TWINSPAN将所有样地划分为5个不同等级的植被景观类型区，其结果比较客观地反映出旅游开发与植被景观间的生态关系，指示因子也充分地反映了植被区的人为环境和景观特征。与利用旅游影响系数进行的分类相比，TWINSPAN的结果更为科学合理，明显优于单纯依据一个因子划分的结果。（2）DCA第1轴从左到右旅游影响系数和敏感水平越来越小，信息指数越来越大。DCA第3轴从下而上旅游剔除程度逐渐减小。DCA结果能够识别植被景观类型在空间上分布的规律性，但是这种规律性需要根据生态学知识去加以分析和总结，直观性不强。（3）TWINSPAN结果与DCA结果基本一致，具有良好的可比性

关键词　芦芽山；　植被景观；　双向指示种分析；　除趋势对应分析
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Relationship between tourism development and vegetation environment in Luya Mountain Nature Reserve: vegetation landscape types and ordination

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Abstract The relationship between tourism development and vegetation landscapes is seen from Sensitive Level (*SL*), Landscape Importance Value (*LIV*), information index of biodiversity (*H′*), Shade-tolerant Species Proportion (*SSP*) and Tourism Influencing Index (*TII*). SL is a kind of the degree of tourists paying attention to the selected sample, and shows the scenery of vegetation landscapes. LIV is a kind of the index that shows the important degree of the selected sample in all the vegetation landscapes, and this importance embodies both the quality of ecological environment and the tourism value of plant communities by species　characteristics, biodiversity, community structure, aesthetic factors and so on. H　is an index of biodiversity, and can show the richness and the evenness of species. SSP is the ratio of the coverage of shaded-tolerant species to that of all the species in the selected sample, so it can show the impact of tourism activities on ecological environment. TII is a main standard of evaluating the impact of tourism development on natural environment, including rubbish index, damaging branches index, treading ground index, treading stakes index, woods regeneration index and herb situation index. However, to show the impact of tourism on vegetation in Luya Mountain Nature Reserve clearly, we use Two-Way Indicator Species Analysis (TWINSPAN) and Detrended Correspondence Analysis (DCA), which are the most common ways for vegetation analysis. TWINSPAN can integrate all the factors

information and divide vegetation landscapes into different types, and DCA can range vegetation landscapes in certain sequence in space. In TWINSPAN and DCA, elevation, slope, aspect, road width, distance from tourism road, SL, LIV, H′, SSP and TII constitute a 10×16 matrix with samples.

Based on tourism activities, the rule of vegetation landscape types and spatial pattern is analyzed. It shows that: (1) TWINSPAN gives correct and rapid partition to the classification, and divides all vegetated landscapes into five types. The results produced by TWINSPAN can reflect the ecological relationship between tourism development and vegetation landscapes objectively, and the indicative factors can also embody the humane environment and characteristics of vegetation landscapes. The dividing principle of TWINSPAN is according to the comprehensive information of all factors, so its result is more superior to that only based on one factor obviously. (2) The ordination diagram of DCA can differentiate vegetation landscape districts, and each type has its own area. Seen from their distribution, the first axis of DCA mainly reflects the mutual changing regulation of tourism development and vegetation landscapes, that is, from the left to the right, the distance from tourism road, LIV and H′ increase gradually, while SL and TII decrease. At the same time, the less rubbish is, the lower the height under dead-branch is, the thicker the humus layer is, and the greater the herb coverage is. The third axis of DCA shows the change of tree stumps, that is, from the bottom to the top, the tourism rejecting degree decreases gradually. Therefore, under the impact of tourism activities, the differentiate phenomenon of vegetation landscapes takes place. These results show that DCA can reflect the relationship between tourism development and vegetation landscapes commendably, but this relationship need to be recognized based on ecology knowledge. (3) The DCA ordination could reflect the number-diagram model of vegetation landscapes in simple environmental space. The results of TWINSPAN are identical to those of DCA, both are comparable. This is because that both of them are based on the first axis of RA/CA ordination and have the common grounds in the arithmetic

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