

Investigating public preferences for forest recreation attributes: combined scenic beauty and discrete choice model

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Introduction

The main purpose of this study is to derive forest recreation demand in Jizerske Mountains Protected Landscape Area and to disentangle aesthetic factors that are responsible for changes in recreation utility of visitors. We estimate visitors' preferences for alternative forest sites as a function of site characteristics using choice experiment technique. As forest scenic beauty may represent a crucial factor in decisions of visitors in terms of which recreation area to visit, specific emphasis is put on the aesthetical perception of forest stands.

We analyse the individuals' aesthetical perceptions of the appearance of mountain forest stands in Jizerske Mountains using scenic beauty estimation (SBE) method. Aesthetic indicators of forest stands, represented by scenic beauty estimates, are used to measure the individuals' aesthetic values of various types of mountain forest, and they are further employed to improve the properties of welfare measurements derived by the choice experiment exercise.

Methods

This study combines several key methods: scenic beauty estimation introduced by Daniel and Boster (1976) and choice experiment technique based on Mcfadden's random utility theory.

Scenic beauty estimation method enables to achieve continuous quantitative measures of aesthetic preferences for alternative forest management systems. SBE is based on the perceptual aesthetic judgments of observer panels and is designed to overcome several sources of bias of raw data on observers' evaluation of forest stands. SBE estimation has been applied to assess the impacts on scenic beauty of various timber harvest and silvicultural forest management procedures in many countries (Ribe, 2009; Fanariotu and Skuras, 2004). However, there have been only few attempts so far to use SBE estimates in further welfare analysis and only one of them was based on choice experiment model (Beardmore, 2005).

Choice experiment technique is designed to disentangle visitors' preferences on several visual and recreational forest stand characteristics, both of which enter the main model. Using random utility theory, we derive the demand for the forest stands, explaining the choice of specific forest stand with use of its environmental (visual and recreational) characteristics and the characteristics of the visitor that is making the choice among alternative forest stands.

The data for the research have been collected through a questionnaire survey, on-site in several locations in the central part of Jizerske Mountains. The survey focused on participants of summer

recreational activities such as hiking and mountain biking, and resulted in a total of 722 completed questionnaires.

Results

Scenic beauty analysis reveals that visitors assign the lowest aesthetic values to dead and damaged forest stands compared to immature, high spruce and broad-leaved forests. The same results are obtained from choice experiment model: broad-leave and immature trees have positive effect on utility; the opposite effect has dead forest stands.

We find that higher scenic beauty is connected with more open forest stands with younger and smaller trees, which is consistent with the findings of previous studies (Brown and Daniel, 1984; Ribe, 1989). Broadleaf forests are the most aesthetically valued type of vegetation cover in Jizerske Mountains, mainly due to the fact that they consist of less dense vegetation with open treetop. Immature forests are also evaluated more positively than baseline spruce forests. Here, the whole effect is caused by the lack of high-grown trees in the view. As expected, the least aesthetically appealing type of vegetation is dead tree forest stands. With any evidence of disturbance in the quality of forests, the aesthetic value shrinks sharply, similarly to the results of Ribe (2009). Steeper terrain and occurrence of shrubs and herbage contributes to visual attractiveness of the forest stand.

The same types of forest stands that were evaluated under the scenic beauty estimation procedure were included in the choice experiment study. To estimate the regression parameters for each attribute's level under investigation, we use a conditional (fixed-effects) logistic regression. We then precise the model with estimated scenic beauty standardized measures. The following table depicts the results of the full model including SBE measures.

Number of observation = 10 412		Log likelihood = -3 085				
LR chi2(15) = 1047.24		Pseudo R2 = 0.1451				
choice	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
price	-0.004	0.00	-11.05	0.00	0.00	0.00
not crowded	0.60	0.08	7.89	0.00	0.45	0.74
very crowded	-1.04	0.07	-16.01	0.00	-1.17	-0.92
trail_panel	-0.26	0.11	-2.48	0.01	-0.47	-0.06
trail_stabilized	0.30	0.07	4.56	0.00	0.17	0.43
trail_forest	0.10	0.08	1.20	0.23	-0.06	0.27
trees_dead	-0.57	0.08	-7.36	0.00	-0.73	-0.42
trees_beech	0.23	0.07	3.34	0.00	0.10	0.37
trees_immature	0.24	0.06	4.27	0.00	0.13	0.36
sbe_beech_notcrowded	0.34	0.07	4.62	0.00	0.19	0.48
sbe_imm_notcrowded	0.47	0.07	6.77	0.00	0.33	0.61
sbe_imm_verycrowded	-0.38	0.09	-4.47	0.00	-0.55	-0.21
sbe_dead_notcrowded	0.38	0.05	7.59	0.00	0.28	0.47
sbe_dead_verycrowded	-0.36	0.10	-3.66	0.00	-0.55	-0.16
sbe_dead_stabilized	0.41	0.09	4.55	0.00	0.23	0.58

Table 1: Conditional logistic regression (full model)

The site characteristics that may increase a recreationist's utility associated with a visit to a forest stand are the low crowdedness of the recreation site (not crowded), sandy stabilized or natural forest trails (trail stabilized, trail forest), broad-leaved or immature forest stand type (trees beech, trees immature). The utility declines with high crowdedness of the area (very crowded), panel trails in the

area (trail panel) and dead forest stand type of the forest (trees dead). The results also prove that all variables depicting the forest type have higher coefficients in the composite model than in the base model, which has noticeable effects on the magnitude of utility estimates.

Conclusion

There definitely is a clear link between forest management practices applied in protected landscape area Jizerske Mountains and the visual experience of visitors of the area. The utility of recreationists in Jizerske Mountains is greater when choosing a broadleaf or immature forest stand type, compared to coniferous forest. However, the sensitivity of the recreational utility is almost four times higher when a recreationist chooses a locality with a presence of dead trees.

These results may provide a support for the forestry management practices in the area, which nowadays concentrate on afforestation of the central part which had been extensively damaged by air pollution and insect infestation in 1970's, and also on the changes in tree composition (from spruce to broad-leaved trees more natural to the site).

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