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Abstract

Forests are a major element of the Estonian landscape and are visited by many people for recreational purposes. This article explores the Estonian natural forest environment from an aesthetic point of view. Previous studies have shown that natural landscapes are preferred over artificial, man-altered landscapes, yet little is known about preferences within natural settings in Estonia, where the forest forms an important aspect of the culture. The study reported here aimed to test the preferences for different natural forest stand structures using photographs shown to 97 participants. The evaluation was based on the environmental preference matrix of coherence, complexity and mystery formulated by Kaplan and Kaplan (1982, 1989), the photos being assessed for these factors by experts before the preference survey took place. Other elements were also evaluated to see which respondents found most attractive or unattractive and which might affect preference. The results were analysed to see which factors best explained preferences. Similarities between expert-group and lay-person assessments of predictor variables were also examined. Mystery proved to be statistically the strongest predictors of preference followed by coherence, as expressed by the test subjects, although the most preferred scenes were rated by experts as having high levels of coherence, showing some differences between experts and non-experts. The elements which most negatively affected preference were signs of death and decay as well as natural untidiness. This suggests that features inherent to natural landscapes and natural processes are not well understood or appreciated by the test population and that more information could be provided explaining why these are necessary parts of the natural landscape.

Key words: visual landscape perception, human-landscape interaction, environmental preference, natural forest views, naturalness of environment

Introduction

Forests make up a significant proportion of the Estonian landscape – some 51% of the land is covered by them (Estonian Environment Information Centre 2012) – and they are a constant part of almost every scene or vista. Being a relatively flat country with few hills (Arold 2005) the forest landscape is experienced as either a series of edges viewed across open fields or from within, when driving along roads or using the many forest trails for recreational purposes. Outdoor recreation is an important leisure activity for Estonians both in winter and in summer, 89% of Estonians visit forests at least once a year and around 30% at least once a month (Estonian Society of Forests 2008). The reasons most people give for visiting forests is to be close to nature, to get away from stressful daily lives and to undertake physical exercise (Kaplan and Kaplan 1989, Han 2003). Having distinct seasons, with a long snowy winter and a short but warm summer, very different activities are undertaken in each season. Skiing dominates the winter while hiking, camping and picking berries and mushrooms are popular in summer. According to some research in so-called "forest culture" and outdoor recreation patterns at an European level, Estonians have a close relationship to the forest as part of an identifiable "northern European culture", although affected by the history of being in the Soviet Union (Bell et al. 2005, Proebstl et al. 2010) and this influences the kind of activities and preferences for forests due to their dominance in the landscape.

Estonian forests have a mixed ownership, 40% being state owned and managed, the rest being privately owned or subject to privatization (Estonian Environment Information Centre 2012) but there is a right of access to all forests by everyone. The forests are an important source of timber and so are managed for its production, usually by small-scale clear cutting which results in a patchy pattern across the landscape with many areas being a mix of stands of different ages and composition. In addition the stand types vary according to soil types so that there may be quite a fine-scale variation on a particular territory. The RMK,

the state forest management organisation provides recreational facilities in many areas with lakes and other special attractions, where people can enjoy the forest. Many protected landscapes, of which Estonia has a relatively high proportion (25% of forests) (Ibid.) contain forests which are less-intensively managed or are unmanaged and these are also important and popular places for Estonians to find "real" nature, where the forest contains dead and dying trees, trees blown over by the wind and so on, offering a different experience from the managed forests so prevalent elsewhere. The question arises – what kind of natural forest landscape do people prefer? Which types of forest do they like to visit and should recreational forests in particular be managed for their aesthetic appeal? How do they view the elements of death and decay inherent to natural ecosystems?

Landscape preference studies have a history going back to the "Scenic Beauty Estimation Method" (Daniels and Boster 1976) where different scenes have been shown to respondents from different ages and backgrounds in many countries. These have been used to try to identify characteristic elements that should be included in the design and management of forests in order to make them attractive to people. In general, most studies suggest that people are most attracted to scenes of a natural character or landscapes with no dominant visible human impact (Kaplan and Kaplan 1989, Kaplan 1995, Gobster 1996, Simonič 2003, Rosenblad and Niit 2005). It has also been identified that access to nature has a positive psychological impact especially for urbanized people (Kaplan and Kaplan 1989, Ward Thompson 2002, Ward Thompson et al. 2010) and that visiting "nature" can help to reduce stress. Using green areas, especially forests, for their physical and mental health-promoting qualities is becoming a more significant element of public policy in many countries (Nilsson et al. 2010).

Based on Berleant's (1992) aesthetic theory, *environment* means nature, culture and ourselves (people) in an interconnected system. In this paper the term environment is narrowed down and interpreted through the notion of *landscape*, which is the field of our present actions – it is the part of environment that we can engage with at a given time (Bell 2012). In the words of the European Landscape Convention, landscape is "...an area of land as perceived by people..." (Council of Europe 2000); therefore, that through perception an aesthetic appreciation is an important benefit to be gained from the landscape. In the context of the Estonian landscape as noted above, with the focus on the internal setting as opposed to external vistas, Berleant's (1992) definition of *participatory landscape* is relevant. Participatory landscape, as opposed to panoramic landscape, develops a spatial and experiential continuity with a person. Here, space reaches out to encompass the viewer as a participant. Herein, the notion of natural environment has been equated with the notion of participatory natural forest landscape.

The field of ecological aesthetics pioneered by Leopold (1949) has been developing (Gobster 1995; Bell 2012) in which the aesthetic qualities of nature are deemed to include features associated with natural processes such as death and decay, exemplified in a forest by dead or wind-blown trees, insect attacks, fires and other features which tend to be managed out of most forests. This work suggests that people prefer not to see such signs in a landscape and that this affects the aesthetic response.

Preference for the landscape/environment is a result of a complex process which involves the perception of objects and spaces and a person's reaction to them, also taking into account their potential usefulness and support, what are known as "affordances" (Gibson 1979). Perception is also active – we seek out areas in a landscape with certain properties. Thus, aesthetics, at least to some extent, includes the functional suitability of spaces and objects with the needs of the perceiver, as well as their sensory qualities which may evoke beauty, for example (Bell 2012). Theories of landscape perception and aesthetics suggest that both the content and spatial organisation of landscape elements may affect landscape preferences and be a basis for a predictive framework.

The Kaplans' environmental preference theory (Kaplan and Kaplan 1982, Kaplan and Kaplan 1989) refers to two important purposes that concern people throughout their waking hours – making sense of and involvement with their surroundings. It is suggested that these two purposes probably had an important effect on the long-term survival potential of individuals and populations during the early evolutionary phases of the human species. Environments that support these purposes should therefore tend to be preferred. The Kaplan model is based on cognitive aspects of the landscape – not the physical characteristics *per se* but the informational content of the landscape as perceived.

Making sense and involvement are thus associated in the Kaplan model with four informational factors which form a preference matrix, these being *coherence*, *complexity*, *legibility* and *mystery*. All four factors are considered as positive characteristics, variables or predictors of preference. The matrix is divided into two parts, one describing the present, immediate two-dimensional environment (coherence and complexity), and the other describing the predicted, promised future three-dimensional environment (legibility and mystery). *Coherence* refers to being able to organize what one sees

into relatively few identifiable units, or informational chunks. Normally, natural landscapes are internally very coherent, since what can be seen is associated with and derives from natural processes. *Complexity* concerns whether there is enough present in the scene to keep one occupied or interested. Complexity is defined in terms of the number of different visual elements in a scene. *Mystery* is hidden in a scene, which gives the impression that one could acquire new information if one were to wander deeper into the landscape. Mystery is often associated with the notion of *surprise*. A critical difference between mystery and surprise is that in a surprise the new information is present and it is sudden. In the case of mystery the new information is not present, it is only suggested or implied; new information is continuous with what is already available. Herzog and Bryce (2007) have suggested (that there is some confusion with the standard definition of mystery using the notion of surprise. *Legibility* is a characteristic of an environment that looks as if one could explore it extensively without getting lost. Environments high in legibility are those that look as if they would be easy to make sense of as one wanders farther and farther into them. However, it is difficult to use in small-scale internal landscape scenes as there is often insufficient information visible to tell whether it extends for any distance and it is now considered to be the least important predictor of preference (Simonič 2003). Coherence, complexity and mystery have also been associated with the three so-called objectives of visual design or composition, namely unity (equated to coherence) diversity (equated to complexity) and *Genius loci* (equated to mystery) (Bell 2012) which allow them to be linked to activities such as landscape design and management and which are used in forest landscape design (Bell and Apostol 2008).

Behaviour settings are the landscapes or places within which activities such as recreation take place (Barker 1968, Schoggen 1989) and it is the interface between the patterns of behaviour and the environment in which the behaviour takes place so that the environment in some sense "matches" the "behaviour". Thus, if preferences for landscape or scenes as settings for behaviour such as outdoor recreation can be understood it potentially provides possibilities to guide managers of those landscapes as how best to protect or manage them so as to ensure positive settings, especially in natural landscapes where dead trees and naturally damaged or disturbed areas have to be taken into account.

Aims of the study

A lot of attention has been paid to investigating attitudes and preferences toward natural versus built environments, and different types of recreational landscapes, as noted above. Some research considering different aspects of environmental preference for forests has been carried out in the past but these focus mainly on the impact of broad categories of elements (Lee 1991) or different forest management approaches (Ribe 1991, Herzog and Barnes 1999). Less focus however, has been given to investigation of preferences within different natural landscape types or to the perceptual qualities of different natural vegetation types and elements.

The point of departure for the present study was visual preference for Estonian forest scenes of different visual composition in terms of the three main components of the Kaplan preference matrix. Previous studies have shown that people's reactions and assessments to the environment on the basis of photo views compared to being in the environment itself are rather similar, hence the results of a survey based on photo views can be considered credible. In order to discover preferences, pictures have become the substitutes of the real world (Shafer and Richards 1974, Daniel and Boster 1976, Hull and Stewart 1992, Ode et al. 2009).

The aim of the study was therefore to test preferences for Estonian natural forest landscapes for the first time using the Kaplan model as the theoretical basis and the three aspects of coherence, complexity and mystery as the dimensions for developing a predictive model. The research questions are:

Does the Kaplan model enable landscape preferences to be predicted in relation to the specific forest stand structures and their combinations found in natural Estonian forests?

Are there differences in the evaluation of the predictor variable between experts and non-experts?

Are the preferences affected by the presence of particular elements or features indicative of ecological processes and objectively measured "naturalness"?

Materials and methods

Panagopoulos (2009) has generalised the following three main techniques for direct aesthetic evaluation of forest landscapes: 1. the design expert approach, where landscape is evaluated and inspected by an expert, usually a landscape architect, with respect to a combination of abstract design parameters and relationships among these elements to classify each area in terms of complex formal characteristics that are considered relevant to landscape; this approach has been used extensively for design purposes (see Bell and Apostol 2008); 2. The ecological expert approach, where landscape is characterised in terms of species, ecological zones, succession stage or other indicators of ecolog-

ical processes; and 3. Psychophysical preference modelling, this is a quantitative, holistic technique of landscape evaluation objectively estimating public perception of aesthetic quality. Psychophysics is the study of measurement that attempts to relate environmental stimuli to human sensations, perceptions and judgments. In the psychophysical approach, biophysical and human-perception components are even-handed. These are typified in the approaches mentioned above such as those of Lee, Ribe, Daniel etc.

The method used here involves an ecological expert approach in selecting scenes that are considered by such an expert to represent "naturalness" in the content, structure and presence of elements; the design expert approach for assessing the degree of coherence, complexity and mystery of each scene and the psychophysical approach in the use of the questionnaire survey of preferences.

Selection of landscape views and expert assessments

Based on the Kaplan matrix of psychological environmental preference, a sample of pictures of 27 Estonian natural forest views was compiled from a pool of about 2000 photos held in an archive of nature photographs belonging to an environmental expert with an ecological background. The photographs were considered by the expert who selected them as being natural in the sense that there were only elements present which had arisen through natural processes and no direct management or human intervention had taken place. The photos were natural, original examples with no subsequent retouching work being carried out on them. The photos were selected to represent the "green" season, ie late spring to early autumn so as to keep the study to one main recreational season in Estonia and to contain a range of different stand structures typical of Estonian forests. The final selection of photos fully covered the previously described Kaplan's theoretical environmental preference matrix of coherence, complexity and mystery on the scale of low, medium and high occurrence. The qualities describing the informational content – *coherence*, *complexity* and *mystery* – were assessed for each view by four experts (landscape architects familiar with the Kaplans' theory) into low, medium and high occurrence. The variable of *legibility* was omitted in this survey for reasons already noted above. These assessments followed the general guidelines as shown in Table 1. In addition, the *occurrence of big trees*, *the occurrence of crooked trees*, the degree of the *visibility of the sky, the variability of relief* and *the degree of visibility into the stand* were also assessed by the experts (rating scale: low; medium; high) in order to gain information that may help to account for some of the preferences as suggested by earlier studies (Ribe 1991, Herzog and Kutzli 2002, Herzog and Kropscott 2004, Herzog and Bryce 2007, Herzog in Nasar 1988). Since these features are not equally distributed across all the views they have to be regarded as supportive aspects. The criteria in Table 2 were also applied to the choice of pictures in order to verify their comparability and naturalness.

Table 1. Categories of expert assessments of coherence, complexity and mystery

Coherence
Low: there are over five distinguishable elements or groups of elements in the view and / or objects do not fit together well.
Medium: there are up to five distinguishable elements or groups of elements in the view, of which some do not fit together well.
High: there are up to five distinguishable elements or groups of elements in the view, which fit together well.
Complexity
Low: there are up to three distinguishable elements or groups of elements in the view.
Medium: there are four to five distinguishable elements or groups of elements in the view.
High: there are over five distinguishable elements or groups of elements in the view.
Mystery
Low: view is open or closed; there is no hidden information.
Medium: view is mostly closed or mostly open; hidden information can be presumed.
High: view is half-open; hidden information is perceptible.

Table 2. Criteria for view comparability

It is a view of a participatory environment, not a panoramic view;
Views reflect forest landscape in the "green" period, from late spring to early autumn;
Views are taken horizontally from eye-level;
There are no visible human impacts (e.g. roads, technical facilities, forest management, etc);
There are no water elements which predictably strongly raise the assessments of preference;
There are no eye-catching objects that seem to be foreign bodies in the environment (e.g. people, animals, big rocks, significant variability of the relief, etc).

Test subjects

The experimental procedure consisted of a comparison between expert and non-expert subjects. The expert group consisted of four members with previous knowledge of the presented environmental preference theory and with an educational background in environmental sciences and landscape architecture. They assessed the pictures on the Kaplans' matrix as described above so these ratings could be compared to those of the test subjects. Students of environmental and technological specialities were used as the test group. Students are, in general, regarded as a suitable representative group of society or the common population for research on such areas as environmental

perception and landscape assessment, whose assessments can be regarded as a reflection of other groups of society (Han 2003, Hill and Daniel 2008, Herzog and Kropscott 2004). Students were chosen as the test group in order to get a quick and a reliable result. It is easier to organise a sufficient number of students at one time and in the same place (an auditorium), situation and condition for survey compared with members of the general public. Of course this may involve some bias in the results but only if the aim of the study is to find an answer to a question of general applicability to the wider population. In this case such a bias is not a major problem, especially if the students are either not studying the subject under investigation or are sufficiently early in their studies that they have not been exposed to the theories under investigation. For this study the test group consisted of a total of 97 18-28-year-old individuals (average age 20.3 years, women 68%) of whom 41 studied at the Estonian University of Life Sciences – 9 being students of landscape architecture and 32 of landscape protection and conservation and 56 participants studied at the Tartu College of the Tallinn University of Technology – 42 students of landscape architecture, 10 of building restoration, and 4 of product development and production technology. 89% of the test subjects were 1st or 2nd year students and 11% were attending 1st year of the master programme. So the majority of the test subjects did not have previous knowledge and practice in visual landscape assessment. The question of bias will be considered further in the discussion section.

Questionnaire and test procedure

The forest view preferences were assessed using means of a questionnaire (see Table 3 for a summary of questions) which was developed using typical examples of questions from previous studies, so as to enable the results to be evaluated in the context of other studies. All the answers were given on a 5-point Likert scale ranging from 1 (not at all) to 5 (very much). The key question of preference was how much the test subject liked the view (question 1), the notion of "liking" being equated with "preferring". Questions 3, 4, and 5 were formulated according to the descriptions of coherence, complexity and mystery, in order to understand the respondents' notion of the structure of the view and its impact on preference. As previous researches have claimed that the perceptible naturalness and familiarity of the environment also impact the preference (Kaplan and Kaplan 1982, Ribe 1991, Simonič 2003, Ode et al. 2009), questions about the perception of these qualities were asked to test such standpoints – respectively questions 2 and 6. The aim of questions 7 and 8 was to determine which landscape elements were considered the most attractive and least attractive; they were asked to name one element they liked the most and one which they liked the least in each view. Discovering such preferences and assessing familiarity is assumed to bring out opinions that may result from the cultural background and previous knowledge of the respondents.

The test was carried out on the sample population in five different sub-groups reflecting the availability of classes. The 27 landscape views were shown to the respondents by being projected onto a large screen in the auditorium. Each respondent was given a copy of the questionnaire to complete. The questionnaire and how it should be filled in was introduced in a five-minute presentation before the session commenced. The questionnaires had previously been labelled with numbers which corresponded to the numbers of the projected views. The views were presented in a random but predetermined order, the only condition being that two pictures with similar qualities would not appear in succession. In each sub-group, the views were presented in a different order to decrease the possible impact of assessments being affected by the order of the presentation of the views. Each view was shown until all respondents had signalled that they had filled in the relevant section of the questionnaire. The average duration of the survey was about 40 minutes.

Table 3. Questions used corresponding to variables (originally presented in Estonian language)

Preference – How much do You like the view?
Naturalness – How natural is the environment depicted in the view in Your opinion?
Coherence – Do objects in the view fit together in Your opinion?
Complexity – How complex is the environment depicted in the view in Your opinion?
Mystery – Does the environment depicted in the view seem so interesting to You that You would like to move about in it and find out more about it?
Familiarity – Does the environment seen in the view seem familiar to You?
The most liked object – Name one object You like the most in the view.
The least liked object – Name one object You like the least in the view.

The data were entered picture by picture into MS Excel spreadsheets. The data was statistically analysed in SPSS 16.0 and MS Excel statistics programs. The tests and the results are described in the next section.

Results

Reliability test

The statistical reliability analysis conducted in SPSS supported the reliability of the gathered data

filled in by test persons. The reliability measure (Cronbach's alpha) across the results of the whole questionnaire was 0.78, which is generally considered a good result. The reliability of the assessments of each questioned variable ranged from 0.83 to 0.91 (average 0.88). It can be concluded that the questionnaire was well understood and the respondents provided reliable results.

Preference order

The mean results of assessments of the test group and experts in test group preference order are shown in Table 4.

Table 4. Average results of the assessments given by the test group, experts and author in the order of preference returned by the test group

	Test persons						Expert group							
No of the view	Preference	Naturalness	Coherence	Complexity	Mystery	Familiarity	Complexity	Coherence	Mystery	Dominance of big trees	Visibility of the sky	Occurrence of slanted trees	Visual penetrability	Variability of relief
18	4.85	4.04	4.61	3.18	4.59	3.1	3	5	5	5	1	3	3	1
8	4.49	4.03	4.67	2.22	3.77	4.1	1	5	3	3	3	1	5	1
6	4.46	4.41	4.61	2.86	4.11	4.0	1	3	5	3	1	1	3	1
23	4.41	4.58	4.37	3.96	4.21	3.1	5	3	3	3	1	3	3	3
12	4.37	3.55	3.79	3.38	4.06	2.5	3	1	5	3	5	1	3	1
5	4.14	4.00	4.01	2.73	3.53	3.1	1	3	3	1	1	3	3	3
17	4.01	4.28	4.10	2.98	3.44	3.4	3	5	3	1	1	1	5	1
9	3.99	4.07	4.15	2.78	3.56	3.5	1	5	5	3	1	1	3	1
26	3.85	4.42	4.04	3.70	3.44	3.0	5	5	3	1	1	3	3	1
7	3.80	4.01	4.35	2.56	3.18	3.3	1	5	1	1	1	3	1	1
25	3.80	3.82	3.66	2.79	3.43	3.0	5	5	5	1	5	3	5	1
16	3.76	3.91	3.73	3.34	3.44	2.2	3	5	1	1	1	1	1	1
13	3.75	4.16	3.48	3.33	3.27	3.0	3	3	1	3	3	1	1	1
15	3.72	3.88	3.77	2.93	3.45	3.4	3	3	5	5	1	1	3	1
27	3.69	4.45	3.90	4.14	3.23	3.3	5	5	1	3	1	1	1	1
11	3.64	4.08	3.64	3.31	3.25	3.2	3	1	3	3	1	5	3	3
22	3.56	4.42	3.86	3.41	3.40	3.2	5	3	1	3	3	3	3	1
14	3.46	4.33	3.71	3.11	3.07	2.9	3	3	3	1	3	1	3	1
21	3.41	4.03	3.40	3.25	3.10	3.0	5	1	5	5	1	3	3	1
20	3.37	3.86	3.40	3.34	3.12	3.0	5	1	3	1	3	5	3	1
1	3.27	3.41	3.65	3.01	2.96	2.5	1	1	1	1	5	3	5	1
10	3.08	3.90	3.57	2.89	2.75	3.7	3	1	1	1	1	5	3	1
24	2.91	3.82	3.06	3.25	2.69	3.0	5	3	5	3	3	3	3	1
3	2.90	2.87	3.10	2.89	2.75	2.8	1	1	5	1	5	3	3	1
4	2.80	4.09	3.40	3.21	2.41	3.4	1	3	1	1	1	1	1	1
19	2.62	4.22	2.93	4.20	2.38	3.2	5	1	1	1	1	5	1	1
2	2.41	2.96	3.22	2.30	2.33	2.6	1	1	3	1	5	1	5	1

Prediction of preference

A regression analysis was performed to test the predictability of the independent variables of coherence, complexity and mystery on the dependent variable of preference using linear regression test in SPSS. The combined effectiveness of a series of predictors in describing preference is summarized in a statistical expression as R^2. The regression analysis was conducted in two parts as follows:

1. Assessments of preference of the test group. This was analyzed separately for the variables of each view and also for the average of all views (see Table 5).

2. Comparison of preference of the test group with the assessments of the expert group (see Table 6). Since the expert results were given as a consensus from the four experts together, only a regression analysis with average results was possible.

In the case of almost all views (except two) assessed by the test group the most significant predictor of preference (Table 5) was mystery. Coherence was the next most significant predictor followed by naturalness and complexity which were less important. The importance of familiarity in predicting preference was almost non-existent. From the results given by the expert group (Table 6) the most important variable predicting the test persons' preference of a view was coherence. Occurrence of big trees was also relevant.

Table 5. Prediction of preference by variables assessed by the test group. Significant coefficients ($p < 0.05$) are bold

		β-coefficients for each variable				
No of the view	R^2	Naturalness	Coherence	Complexity	Mystery	Familiarity
1	0.63	**0.16**	**0.27**	**0.16**	**0.45**	0.03
2	0.61	**0.36**	0.09	0.01	**0.52**	0.01
3	0.57	0.13	**0.31**	0.12	**0.40**	**-0.17**
4	0.54	0.04	**0.39**	-0.04	**0.44**	-0.04
5	0.52	0.15	0.10	0.13	**0.51**	0.13
6	0.63	**0.22**	**0.29**	-0.02	**0.48**	-0.02
7	0.53	-0.07	**0.24**	-0.05	**0.60**	0.05
8	0.31	-0.01	**0.27**	**0.23**	**0.36**	-0.04
9	0.52	**0.23**	**0.22**	-0.13	**0.46**	0.00
10	0.50	0.13	**0.31**	0.09	**0.44**	-0.11
11	0.45	0.13	**0.35**	-0.04	**0.38**	-0.06
12	0.50	**0.27**	**0.26**	-0.07	**0.35**	0.01
13	0.43	0.06	0.08	0.04	**0.62**	-0.10
14	0.50	0.11	**0.28**	**0.19**	**0.45**	-0.11
15	0.60	0.13	**0.26**	0.08	**0.59**	**-0.15**
16	0.57	0.06	**0.26**	0.05	**0.55**	0.12
17	0.59	0.12	0.08	**0.23**	**0.57**	-0.03
18	0.30	0.05	0.10	0.04	**0.46**	-0.11
19	0.55	0.16	**0.28**	0.01	**0.46**	0.03
20	0.67	**0.16**	**0.23**	-0.01	**0.63**	-0.05
21	0.50	0.16	**0.30**	0.02	**0.54**	-0.29
22	0.56	0.10	**0.22**	0.02	**0.54**	0.14
23	0.56	0.01	**0.43**	-0.11	**0.42**	-0.10
24	0.59	-0.02	**0.33**	-0.03	**0.52**	0.07
25	0.45	**0.19**	0.06	-0.02	**0.52**	0.10
26	0.59	-0.04	**0.50**	**-0.15**	**0.42**	0.01
27	0.44	0.16	**0.22**	-0.07	**0.42**	0.00
With mean values	0.97	0.13	0.14	-0.10	**0.81**	-0.02

Table 6. Prediction of preference by variables assessed by the expert group. Significant coefficients ($p < 0.05$) are bold

R^2	Coherence	Complexity	Mystery	Occurrence of big trees	Visibility of the sky	Occurrence of crooked trees	Visual penetrability	Variability of relief
0.61	**0.62**	-0.13	0.08	**0.40**	0.07	0.05	0.09	0.32

Comparison of the assessments of the test group and experts

In order to evaluate the similarity of the assessments of the test group and experts on the basis of the variables of coherence, complexity and mystery, a Z-test in MS Excel was conducted. This enabled the set of the test group's assessments to be compared to a

constant expert assessment value for each variable of each view. In Table 7 *p*-values <0.05 (marked bold) show where expert and test group assessments were significantly different. According to the Z-test about half of the assessments coincided and half did not. The values were most different for coherence and mystery.

Table 7. *p*-values of Z-test

No of the view	Coherence *p*-value	Complexity *p*-value	Mystery *p*-value
1	**0.00**	**0.00**	**0.00**
2	**0.00**	**0.00**	1.00
3	**0.00**	**0.00**	1.00
4	**0.00**	**0.00**	**0.00**
5	**0.00**	**0.00**	**0.00**
6	**0.00**	**0.00**	1.00
7	1.00	**0.00**	**0.00**
8	1.00	**0.00**	**0.00**
9	1.00	**0.00**	1.00
10	**0.00**	0.89	**0.00**
11	**0.00**	**0.00**	**0.02**
12	**0.00**	**0.00**	1.00
13	**0.00**	**0.00**	**0.00**
14	**0.00**	0.13	0.27
15	**0.00**	0.76	1.00
16	1.00	**0.00**	**0.00**
17	1.00	0.58	**0.00**
18	**0.00**	0.053	**0.00**
19	**0.00**	1.00	**0.00**
20	**0.00**	1.00	0.18
21	**0.00**	1.00	1.00
22	**0.00**	1.00	**0.00**
23	**0.00**	1.00	**0.00**
24	0.31	1.00	1.00
25	1.00	1.00	1.00
26	1.00	1.00	**0.00**
27	1.00	1.00	**0.00**

Secondly, the tendencies of the results of the test subjects and experts in regard to coherence, complexity, and mystery were compared. This was to overcome the fact that because the test subjects tended not to give very low average values overall, nevertheless the relative tendencies in variability might be similar between the two groups. The average results are compared in Table 8. The mean divergences and correlation coefficients for expert and test group assessments were also calculated for each variable. The correlation coefficient (0.72) is the highest and divergence (1.12) the lowest in the case of complexity. The correlation coefficient of coherence (0.63) is also moderately high while the correlation of mystery (0.39) is relatively low. Thus, the assessments of coherence and complexity were rather similar but assessments of mystery differed somewhat more between the experts and the test population.

In the assessment of *coherence*, the range of average assessments given by test group respondents ranged from 2.93 (view 19) to 4.67 (view 8). The greatest difference between the assessments of the test group and experts was 2.79 (view 12). The results show

Table 8. Comparison of the assessment of coherence, complexity and mystery of test group respondents and experts. Divergence of assessments less than 1 are marked in bold

Coherence				Complexity				Mystery			
No of the view	Test group's mean results	Experts' results	Divergence of results	No of the view	Test group's mean results	Experts' results	Divergence of results	No of the view	Test group's mean results	Experts' results	Divergence of results
8	4.67	5	**0.33**	*19*	4.2	5	**0.8**	*18*	4.59	5	**0.41**
6	4.61	3	1.61	*27*	4.14	5	**0.86**	*23*	4.21	3	1.21
18	4.61	5	**0.39**	*23*	3.96	5	1.04	*6*	4.11	5	**0.89**
23	4.37	3	1.37	*26*	3.7	5	1.3	*12*	4.06	5	**0.94**
7	4.35	5	**0.65**	*22*	3.41	5	1.59	*8*	3.77	3	**0.77**
9	4.15	5	**0.85**	*12*	3.38	3	**0.38**	*9*	3.56	5	1.44
17	4.1	5	**0.90**	*20*	3.34	5	1.66	*5*	3.53	3	**0.53**
26	4.04	5	**0.96**	*16*	3.34	3	**0.34**	*15*	3.45	5	1.55
5	4.01	3	1.01	*13*	3.33	3	**0.33**	*16*	3.44	1	2.44
27	3.9	5	1.10	*11*	3.31	3	**0.31**	*17*	3.44	3	**0.44**
22	3.86	3	**0.86**	*21*	3.25	5	1.75	*26*	3.44	3	**0.44**
12	3.79	1	2.79	*24*	3.25	5	1.75	*25*	3.43	5	1.57
15	3.77	3	**0.77**	*4*	3.21	1	2.21	*22*	3.4	1	2.4
16	3.73	5	1.27	*18*	3.18	3	**0.18**	*13*	3.27	1	2.27
14	3.71	3	**0.71**	*14*	3.11	3	**0.11**	*11*	3.25	3	**0.25**
25	3.66	5	1.34	*1*	3.01	1	2.01	*27*	3.23	1	2.23
1	3.65	1	2.65	*17*	2.98	3	**0.02**	*7*	3.18	1	2.18
11	3.64	1	2.64	*15*	2.93	3	**0.07**	*20*	3.12	3	**0.12**
10	3.57	1	2.57	*3*	2.89	1	1.89	*21*	3.1	5	1.9
13	3.48	3	**0.48**	*10*	2.89	3	**0.11**	*14*	3.07	3	**0.07**
20	3.4	1	2.4	*6*	2.86	1	1.86	*1*	2.96	1	1.96
21	3.4	1	2.4	*25*	2.79	5	2.21	*3*	2.75	5	2.25
4	3.4	3	**0.4**	*9*	2.78	1	1.78	*10*	2.75	1	1.75
2	3.22	1	2.22	*5*	2.73	1	1.73	*24*	2.69	5	2.31
3	3.1	1	2.1	*7*	2.56	1	1.56	*4*	2.41	1	1.41
24	3.06	3	**0.06**	*2*	2.3	1	1.3	*19*	2.38	1	1.38
19	2.93	1	1.93	*8*	2.22	1	1.22	*2*	2.33	3	**0.67**
Mean divergence			***1.36***				***1.12***				***1.33***
Correlation coefficient			***0.63***				***0.72***				***0.39***

that the assessments of test persons and experts were quite similar; higher and lower rates remain on the same side of the table; views No. 12 and 25 have to be regarded as exceptions. View 12 received the twelfth highest coherence rating (3.79) from the test group and the highest rating from experts. View 25 received the sixteenth highest assessment of coherence (3.66) from the test group and the fifth highest from experts.

In the assessment of *complexity*, the range of average assessments given by the test group was from 2.22 (view 8) to 4.20 (view 19). Here, it can also be seen that the assessments of the test group and experts are rather similar. Views 4 and 25 are exceptional here. View 4 received the thirteenth highest assessment of complexity (3.21) from the test group and also the highest rating from the experts. View 25, however received the twenty second highest assessment of complexity (2.79) from the test group and the fifth highest rating from experts.

In the assessment of *mystery*, the range of average assessments given by the test group was from 2.33

(view 2) to 4.59 (view 18). The assessments of the test group and experts differed somewhat more than in the case of coherence and complexity. The assessments of the eight highest ranking views can be considered to be rather similar, but there are more differences between the assessments in the lower part of the table. The greatest differences were observed for views 16, 22, 24 and 3. Views 16 and 22 have received considerably higher scores for mystery from the test group (respectively 3.44 and 3.40) than from experts (1). Views 24 and 3, however, have received considerably lower scores for mystery from the test group (respectively 2.69 and 2.75) than from experts (5).

Attractive and unattractive elements

In the survey, respondents were asked to name one element they liked the most and one object they liked the least in each view, in order to receive additional information which might help account for view preferences (see Tables 9 and 10). Elements that were named at least five times, meaning, by at least 5% of respondents, for a particular view were used in the results. Elements that were named by less than 5% of the respondents were abandoned; these results are marginal to make conclusions. Similar elements named differently by test respondents were grouped under one term. Answers that were unintelligible or had no clear connection with the view were excluded. The tables also present the number of views in which the respective element was named, and the relationship between the number of times the element was named and its representation in the views. This data should be considered as information supporting the results of the research, since the general representation of the elements in the views was not part of the view selection procedure. The elements regarded as most attractive were mostly those that apparently indicated that environment was in a "good condition" according to common understanding (although the opinions of environmental experts may differ) (Kolb et al 1995), such as healthy, vital elements or ones with an interesting or peculiar appearance. Respondents from the test group tended to prefer high and lush and also soft, mossy and low undergrowth. Young, vital trees and big, thick-stemmed and tall trees were important attractive elements. Unattractive elements were mainly those that might visually indicate the poor condition of the environment, eg dead or dying and decaying objects. Thus, bare, dry, crooked, broken, fallen trees and branches, weak young shaded trees, shabby or old naturally well pruned trees, and high undergrowth were considered unattractive.

Table 9. Pleasant objects named at least 100 times

Named object	Number of mentions	Number of views where mentioned	Quotient of mentions and views
high. lush underbrush or	354	12	29.5
low underbrush. moss	325	10	32.5
young conifers	286	10	28.6
birch. birch stem	226	10	22.6
big. thick. high tree	206	9	22.9
tilted. crooked tree	103	7	14.7

Table 10. Unpleasant objects named at least 100 times

Named object	Number of mentions	Number of views where mentioned	Quotient of mentions and views
dried trees and	334	15	22.3
fallen trees and	252	11	22.9
small peaky	161	11	14.6
thicket. very dense	124	10	12.4
broken tree	123	3	41
high underbrush.	117	10	11.7

The most and the least preferred forest views

Rather than present in detail the assessments of all the views, it may be more useful to identify the main features of the two most and two least preferred views as representing the extremes of the range and from this inferring some broad characteristics of these.

The test group assessed view 18 (see Figure 1) as the most preferred view (average rating of preference 4.85). Average assessment scores of the view are shown in Figures 2 and 3. This is also very coherent and mysterious, moderately complex and familiar, and perceived as natural. Regression analysis showed that mystery is statistically the most important variable in the prediction of preference. The values of the additional variables for this view were as follows: high

Figure 1. The most preferred view (Author of the photo Anneli Palo)

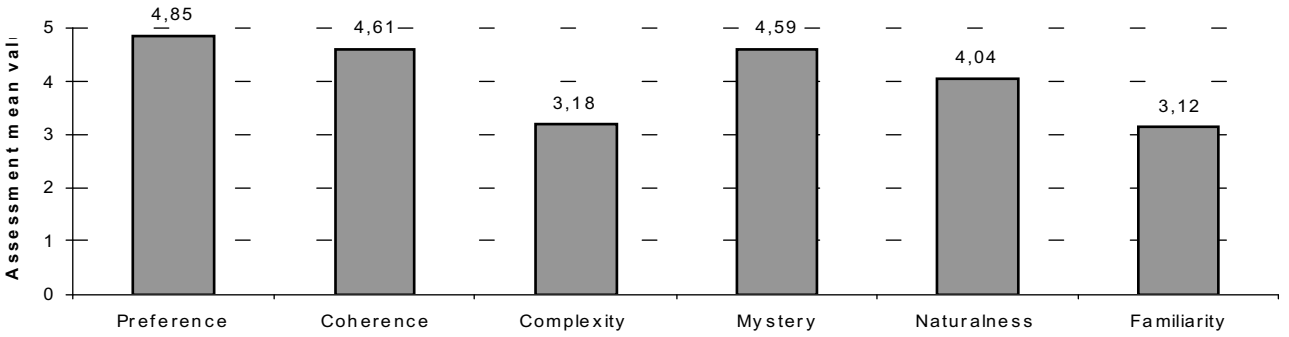


Figure 2. Average test group assessments of the variables of the most preferred view

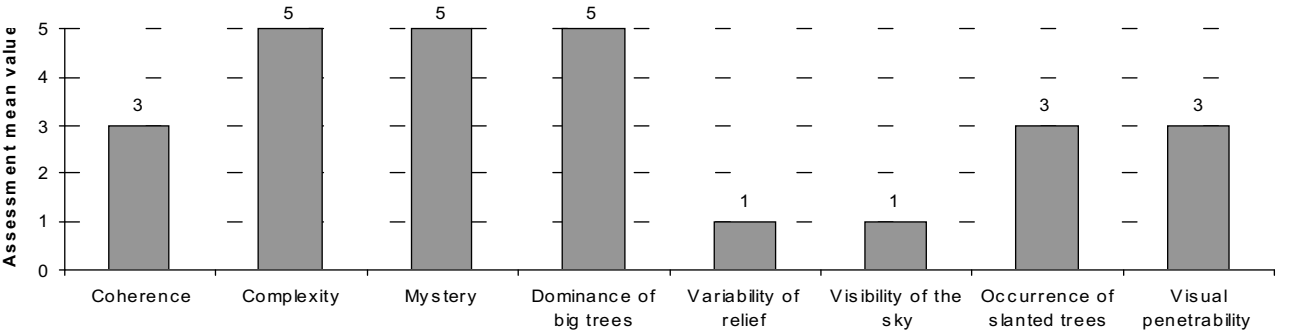


Figure 3. Expert group assessments of the variables of the most preferred view

occurrence of big trees, low variability of relief, low visibility of the sky, medium occurrence of leaning trees, and medium visual penetrability. Respondents from the test group named the following as the most attractive elements: crooked forked great pine-tree (45 respondents), big and thick pine-trees (24), low soft underbrush (12), tree-root (6), small white blossoms (5). The following elements were named as un attractive: dry branches (16), fallen branch (10), broadleaved trees in the distance (9), small fir-trees (9).

The second view in terms of preference was No. 8 (see Figure 4) (rating of preference 4.49). The average assessments of the picture are shown in Figures 5 and 6. According to the assessments of the test group the second view is very coherent, not complex, rather mysterious, very familiar and perceived as rather natural in terms of preference. The regression analysis showed that in the case of this view, mystery and coherence were statistically important variables in the prediction of preference. Assessments of the variables of the this view were as follows: medium occurrence of big trees; medium visibility of the sky; low occurrence of leaning trees; high visual penetrability. The test group respondents named the following as the most attractive elements or phenomena: high straight pines (34), underbrush, moss (33), neatness, order (11) coherence, spaciousness, view (6), wholeness (5). The following elements or phenomena were named as unattractive: branches on the ground (21), straight stem in the foreground (12), excessive order of trees (8). The most pleasant objects were straight, vital pines and soft, low underbrush. Dead objects like fallen branches proved to be unattractive, likewise, excessive simplicity and order was also sometimes perceived as unattractive.

Figure 4. The second most preferred view (Author of the photo Anneli Palo)

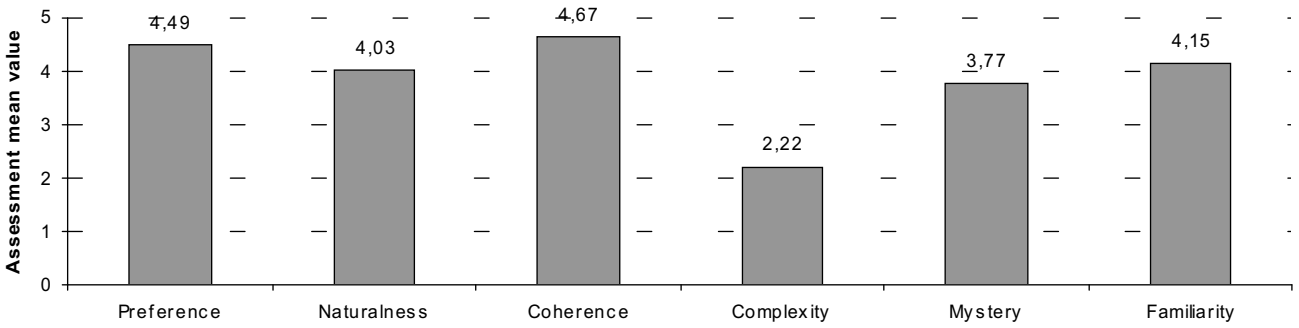


Figure 5. Average test group assessments of the variables of the second most preferred view

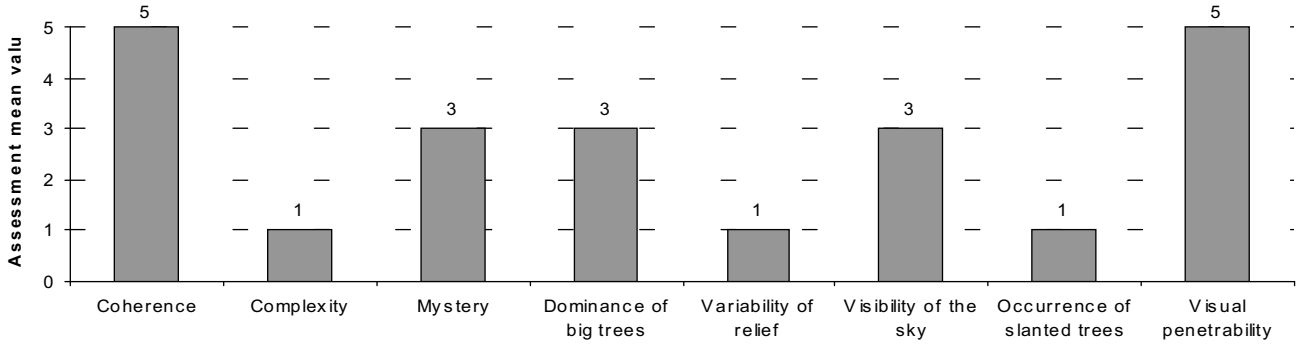


Figure 6. Expert group assessments of the variables of the second most preferred view

The least preferred view was No. 2 (see Figure 7) (rating of preference 2.41). The average assessments of the view are shown in Figures 8 and 9. According to the assessments of the test group the least preferred view is not very coherent, complex, mysterious, familiar, or natural. According to regression analysis, the most important predictors of preference of the view were mystery and naturalness. The assessment of the expert group was as follows: low coherence; low complexity; medium mystery. The values of the additional variables were: low occurrence of big trees, low variability of relief, high visibility of the sky, low occurrence of leaning trees, high visual penetrability. The test group respondents named the following as the most attractive elements: higher pines in the background (37), moss and green underbrush (17), heather (12), young trees (5). The following elements were named as the most unattractive ones: dry, bare trees (44), sky (7), tree with a broken stem (6), bigger trees in the background (6), burnt forest (5), and young thickset trees (5). Bigger and more vital and living trees and plants are seen as more attractive. Dry, bare and broken trees that refer to decay are perceived as unpleasant.

Figure 7. The least preferred view (Author of the photo Anneli Palo)

The test group assessed view 19 (see figure 10) (rating of preference 2.62) as the second least preferred view. The average assessments of the view are shown in Figures 11 and 12. According to the assessments of the test group the view is not very coherent or mysterious, was very complex, moderately familiar and rather natural. According to regression analysis, the most important predictors of preference were mystery and coherence. The assessment of the expert group was as follows: low coherence, high complexity, low mystery. The values of the additional variables were: low occurrence of big trees, low variability of relief, low visibility of the sky, high occurrence of leaning

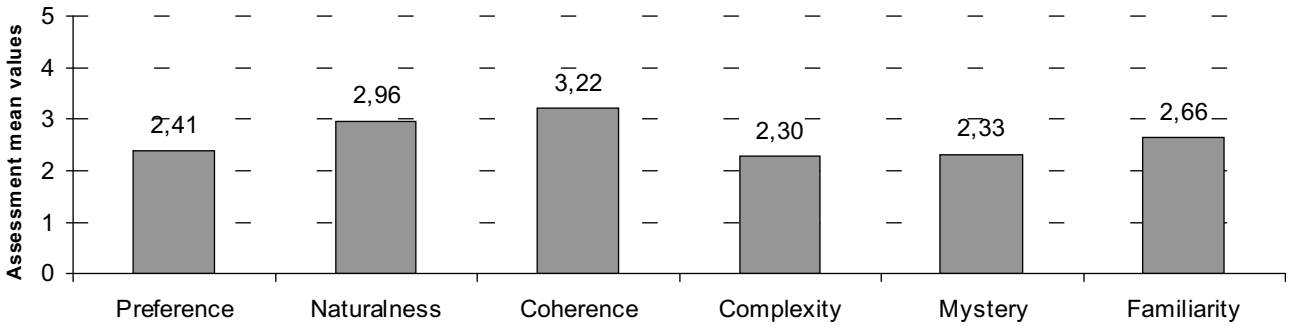


Figure 8. Average test group assessments of the variables of the least preferred view

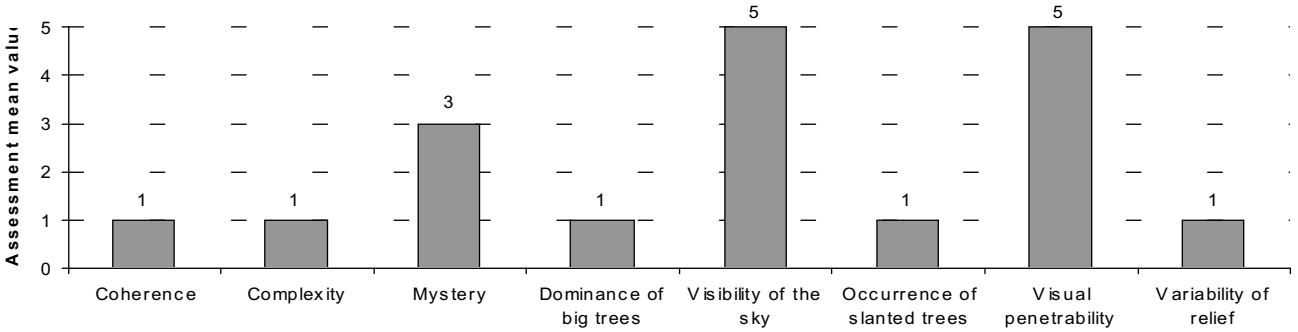


Figure 9. Expert group assessments of the variables of the least preferred view

trees, low visual penetrability. Test group respondents named the following as the most attractive elements: small fir-trees (27), root-stump, tree-stub (24), ferns (16), broken, fallen tree (7). The following elements or phenomena were named as the most unattractive: root-stump, tree-stub (23), brushwood, thicket (14) disorder, negligence (11), underbrush, high grass (10), broken, fallen tree (10), birch, white birch stem (6), small fir (6). Unattractive were mostly dead or decaying objects; likewise, excessive density of the stand, closeness of trees and mess was generally perceived as unattractive.

Figure 10. The second least preferred view (Author of the photo Anneli Palo)

Discussion

In the present study, all of the three techniques identified by Panagopolous (2009) have been linked in order to gain a consistent result. At the first stage, the ecological expert approach was implemented in choosing relevant natural forest photo views that could be differentiated from human-influenced landscapes. At the second stage the design expert approach was used in combining the collection of 27 views to cover the variable matrix of coherence, complexity, and mystery in terms of low, medium and high occurrence. At the third stage the psychophysical approach was applied in the design of the preference survey. Application of these three approaches in the study permits us to make the following observations: 1. the views were representative of the Estonian natural forest environment but were limited when it came to the managed forest environment which covers the majority of forests in Estonia; 2. the views contain a full range of the environmental preference matrix; and 3. expert and non-expert assessments could be compared.

The main findings about view preferences were that the most significant variable to emerge from the

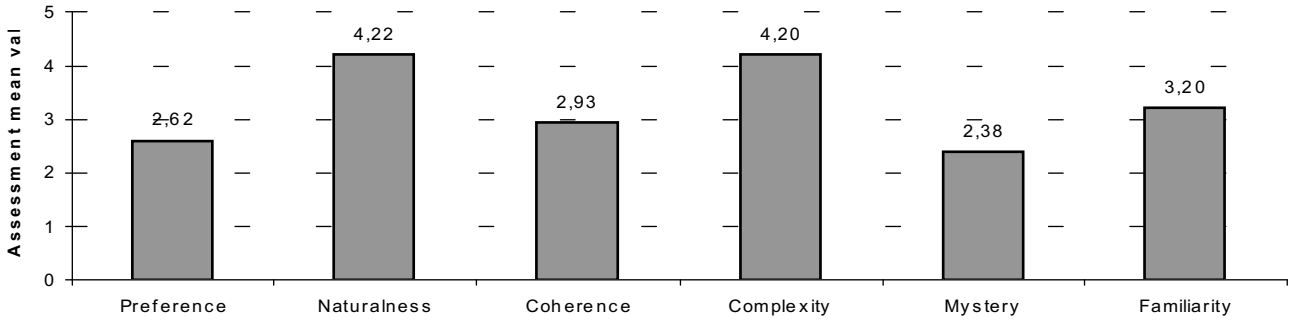


Figure 11. Average test group assessments of the variables of the second least preferred view

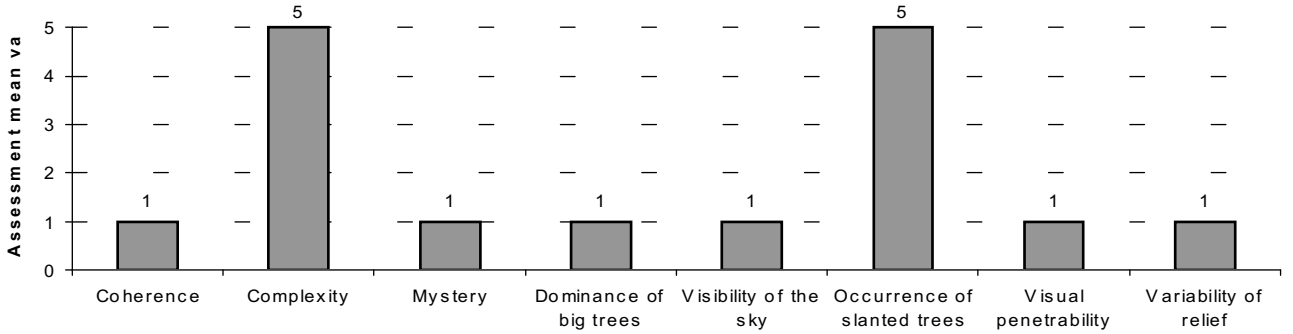


Figure 12. Expert group assessments of the variables of the second least preferred view

test group as the predictor of preference was mystery, while coherence was second followed by complexity. However, according to the expert group pre-evaluation assessments the most preferred scenes were ranked as being higher at the level of coherence than of complexity and mystery. Thus, experts see more coherence in the scene than the non-experts and mystery is more significant for non-experts. Contrary to predictions based on earlier studies (Kaplan and Kaplan 1989, Purcell and Lamb 1998, Ulrich 1986) naturalness was less significant in our case. However, this can probably be easily accounted for because all of the views had been selected especially for their natural character so there was no evidence of non-naturalness in the sample and none was identified by the viewers who saw them as being unnatural. Complexity was of low significance in our results. The role of complexity has been of variable importance in previous studies, too. This may be because in the discussions on the role of diversity in landscapes it has been asserted (e.g. Bell 2004) that low diversity (or complexity) is boring while too much is confusing so that there is a non-linear relationship. Therefore the lower significance may reflect the confusing effect of too much complexity in some scenes. The importance of familiarity in predicting preference was almost non-existent.

While the results generally coincide with and support those of previous research (e.g. Anderson in Kaplan 1989, Ribe 1991, Herzog and Barnes 1999, Simonič 2003), there are some differences in the relevance of variables in the prediction of preferences. In the present study, the most important variables predicting preferences were mystery and then coherence. This is rather different from the results of studies such as that of Simonič (2003) who studied a variety of different landscapes including a set of views ranging from forest wilderness to geometric anthropogenic settings. That study found coherence to be the most important variable predicting preference while mystery and complexity did not have much influence. Likewise, Herzog and Leverich (2003) found complexity to be a marginal predictor for preference. Anderson (in Kaplan 1989) found that coherence, mystery and also, contrary to our results, complexity influenced preferences most clearly. Views of spacious and varying landscapes received the highest preference rates. Complexity also seemed to predict preference to a reasonable level in a study by Kaplan et al (1972). Similar to the current study, however, Herzog and Barnes (1999) found mystery and coherence to be important positive predictors of preference in the case of field/forest environments. In contrast, there are recent findings that in the case of low-access forest environments mystery is uncorrelated with preference ratings unless the defi-

nition of mystery is expanded and introduced thoroughly to test subjects (Herzog and Bryce 2007). In the present study, although accessibility was not separately explored, mystery was a positive predictor of preference in case of all of the views even though some presumably low-access views were presented (views no 22, 27).

Our study has revealed additional predictors for view preferences in terms of elements that the test group respondents found attractive or unattractive the most. The most attractive elements were those that visually indicated the good condition of the environment: healthy, vital trees or elements with an interesting or peculiar appearance. Test group respondents liked high and lush, but also soft, mossy and low undergrowth. The elements they liked the least visually indicated the apparently poor condition of the environment: dead or dying, decaying objects. Thus, bare, dry, crooked, broken, fallen trees and branches, weak young shaded trees, untidy or old naturally well-pruned trees, and high undergrowth were not preferred. In general terms our results support the observations of Ribe (1991), that forest stands of an old-growth condition are visually preferred, and single veteran trees also add visual value to the forest landscape. Likewise Matsuoka and Kaplan (2008) have reported that, in general, the public prefers lush vegetation covering the forest floor. We have not studied man-altered forest stands such as clear-cuts or replanted stands, which gave the lowest preferences in Ribe's study. However, the least preferred forest pictures in our case resembled low-productivity young stands to some extent. This also corresponds to the fact that young, especially shaded trees or trees with a shabby appearance were often named as unattractive elements.

It may be possible to generalise the main findings in terms of the relationship between mystery, the attractive elements noted by test subjects and the design objective of Genius loci as noted in the introduction. This could be that the higher mystery levels when accompanied by interesting big old trees and other characterful elements together yield a greater sense of Genius loci. This is something that may be worth exploring further.

The evaluation of the similarity of the assessments of the test group and experts on the basis of coherence, complexity and mystery variables has shown that the assessment scores were slightly different in case of coherence and most dissimilar in the case of mystery. It can be explained by the innately different assessment contexts of the two groups. While test group respondents perceived natural forest views to be high in coherence and mystery in comparison to their previous experience of landscapes in general (including artificial and other disturbed landscapes with which they were familiar), then the experts were focused on finding different organizational views in the context of those specific natural forest environments contained within the images used in the test, not in landscapes generally. The experts also had a greater appreciation of the meanings of the terms coherence, complexity and mystery while the test subjects were confronted with the words and short, simple descriptions and may not have been able to articulate exactly what they meant in the landscape. This could mean that another way of evaluating the results would have been merely to test for preference and then to correlate the preference scores to the expert evaluation of the three variables. This would not have been so rewarding and would not have shown up the differences in either understanding or in context as shown by the two groups taking part.

The explanation of the phenomenon that natural forest landscapes did not receive very low values for any of these variables from test subjects could also be that natural landscapes are inherently perceived as coherent, are generally more complex by nature and less visually organized than artificial landscapes, and are generally perceived as more mysterious than everyday urban landscapes. Since expert assessments were focused on finding different organizational content within forest landscapes, not in landscapes generally low values had to be given to some views. This illustrates the need for studying different landscape types separately, as it gives a more thorough overview of preference factors within a specific landscape type than when comparing different landscape types in general.

If we look for more reasons for the greater divergence in the assessments of mystery, it might be explained, in the case of the test group, by unfamiliarity with the definition presented in the theory as already noted above, and an imperfect understanding of the question asked about mystery in the questionnaire, which was: "Does the environment depicted in the view seem so interesting to you that you would like to move on in it and find out more about it?". Respondents in the test group might have paid more attention to the first half of the question – "does the environment seem interesting?" – and, without taking into account the three-dimensional space and the existence of hidden information so relevant in the assessment of mystery, may have given assessments on the basis of other, two-dimensional, interesting features in the view. Therefore, the possibilities of rephrasing the questions should be considered in the future. The more precise rephrasing of the definition of mystery has been given as an option by Herzog and Bryce

(2007), in the same paper where the distinction between mystery and surprise was discussed. It was found that a longer explanation of the meaning of mystery is needed in very low levels of visual access, where mystery is confused with surprise, in which case new information is suddenly revealed, not promised as in the case of mystery.

The findings in relation to attractive or unattractive elements are also interesting. The focus on healthy trees and thriving undergrowth as being attractive and dead or decaying elements as being unattractive implies that death and decay is an unattractive aspect of nature. The developing field of ecological aesthetics (as noted in the introduction) suggests that since these elements are a natural and unavoidable part of life in its fullest expression then we should learn to appreciate them as part of the ecosystem, especially in natural landscapes. It is clear that this concept has yet to take root in Estonia among the test subjects at least.

We should also take into account some limitations when considering the results. First, the selection of photos that was used for visual stimuli had only one representative for each visual-informational composition. For better demonstration multiple views for each category could be used. However, in the present study, multiple samples were not used to prevent mental fatigue of the test subjects. Second, the test group was dominated by young and female students, which might not generalize to other age and gender groups (Herzog and Bryce 2007; Balling and Falk 1982; Herzog et al. 2000, Zube, Pitt and Evans 1983), although similar test groups have been accepted in similar studies before (Herzog and Bryce 2007, Han 2003, Han 2010, Herzog and Leverich 2003, Herzog and Kropscott 2004, Hill and Daniel 2008, Sevenant and Antrop 2009, Anderson 1981).

The use of photographs, which as has been discussed in the introduction, have been accepted for a long time as suitable surrogates for real landscapes, may work better in more open or panoramic scenes which we might be able to venture farther into if we were confronted with the real equivalent. However, in internal scenes two dimensional photos do not allow for adequate perception of depth and in Berleant's theory of the Aesthetic of Engagement (1992) and also affordance theory (Gibson 1979), movement through a landscape is necessary to appreciate it fully. This implies using different techniques for presenting images to viewers or conducting research in the field rather than the laboratory. Two non-field methods could be possible – the use of short videos to give a deeper image of the landscape and the use of virtual reality to enable test subjects to feel that they are in the landscape.

Conclusions

The aim of the study was to test preferences for Estonian natural forest landscapes for the first time using the Kaplans' model as the theoretical basis and the three aspects of coherence, complexity and mystery as the dimensions for developing a predictive model. The research questions were:

Can different specific Estonian natural forest landscape preferences be identified? From the results it can be concluded that there are a range of preferences for different types of natural forest landscapes in Estonia. Those containing high degrees of mystery and coherence, in that order, were judged to be most preferred. The elements which were most attractive besides the general landscape composition and structure were those which enhanced mystery and gave them character and an overall strong sense of Genius loci. These could be the types of landscape already chosen for protection but where such places occur elsewhere they could be identified and marked for special treatment so that the positive feelings evoked by the qualities could be safeguarded for the future. The findings that dead, decaying and untidy landscape elements are found to be unattractive is also noteworthy. While no one can be forced to like dead trees, the importance of dead wood and natural processes in the environment and ecosystem could be communicated to the general public so that forests in general are not over-managed in order to make them too tidy.

Does the Kaplan model enable landscape preferences to be predicted in relation to the specific forest stand structures and their combinations found in natural Estonian forests? It seems that the results demonstrate that under the limited conditions of this experiment there are some clear correlations between factors and preferences, with mystery emerging as the most significant, followed by coherence and then by complexity. Planners of recreation al areas, designers of trails and managers of natural or managed forests could use this understanding to ensure that the mystery in the landscape is enhanced.

Are there differences in the evaluation of the predictor variable between experts and non-experts? The evaluation of the degree of similarity of the assessments between the test group and experts for coherence, complexity and mystery has shown that the scores were most similar for complexity, slightly different for coherence and most dissimilar for mystery. Test group respondents perceived the natural forest views to be high in coherence and mystery when compared to their previous experience of landscapes in general, so very low values were not given. The experts focused on finding different visual organizational

patterns in the context of specific natural forest environments, not in landscapes generally, so the full range of values was represented and differences with test group assessment scores emerged.

Are the preferences affected by the presence of particular elements or features indicative of ecological processes and objectively measured "naturalness"? It seems that the test subjects see the presence of elements representing death and decay or some kind of lack of "ecosystem health" or vitality as visually unappealing. This suggests that the role of some natural processes in natural ecosystems is not clearly understood or, if it is understood, is not seen as aesthetically meaningful. Nature protection organisations could consider increasing the awareness of this in their educational or interpretative materials.

Appendix 1. Views chosen by the expert group with assessed variables
Author of the photos Anneli Palo, except No. 25 by Peeter Vassiljev

1. low complexity
low coherence
low mystery

2. low complexity
low coherence
medium mystery

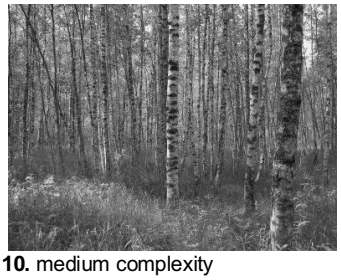
3. low complexity
low coherence
high mystery

4. low complexity
medium coherence
low mystery

5. low complexity
medium coherence
medium mystery

6. low complexity
medium coherence
high mystery

7. low complexity
high coherence
low mystery



8. low complexity
high coherence
medium mystery

9. low complexity
high coherence
high mystery

10. medium complexity
low coherence
low mystery

11. medium complexity
low coherence
medium mystery

12. medium complexity
low coherence
high mystery

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References

Anderson, L.M. 1981. Land use designations affect perception of scenic beauty in forest landscapes. *Forest Science* 27 (2): 343-400.

Balling, J.D. and Falk, J.H. 1982. Development of visual preference for natural environments. *Environment & Behavior* 14 (1): 5-28.

Barker, R.G. 1968. Ecological Psychology: Concepts and methods for studying the environment of human behaviour. Stanford University Press, Palo Alto, CA, 242 pp.

Bell, S. 2004. Elements of visual design in the landscape (2nd Edition). E & FN Spon, London, 196 pp.

Bell, S. 2012. Landscape: Pattern, Perception and Process (2nd Edition). Routledge, London, 350 pp.

Bell, S. and Apostol, D. 2008. Designing sustainable forest landscapes. Taylor and Francis, London, 356 pp.

Bell, S., Blom, D., Rautamaki, M., Castel-Branco, C, Simson, S. and Olsen, E.A. 2005. Design of urban forests. In: C. Konijnendijk, K. Nilsson, T.B. Ranmdrup and J. Schipperijn (Editors), Urban forests and trees. Springer Verlag, Berlin, p. 149-186.

Berleant, A. 1988. Aesthetic perception in environmental design. In: J. L. Nasar (Editor), Environmental aesthetics: Theory, research and applications. Cambridge: Cambridge University press, p. 84-97.

Berleant, A. 1992. The aesthetics of environment. Temple University Press, Philadelphia, 256 pp.

Council of Europe. 2000. European landscape convention. CoE, Brussels.

Daniel, T.C. and Boster, R. 1976. Measuring landscape aesthetics: the SBE method. Res. Pap. RM-167. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain and Range Experiment Station.

Estonian Environment Information Centre. 2012. Yearbook Forest 2010. Tartu, 226 pp.

Gibson, J. J. 1979. The ecological approach to visual perception. Houghton Mifflin, Boston, 332 pp.

Estonian Society of Forests. 2008. Mets on puhkamiseks, mitte raiumiseks [Forest is for recreation not for cutting]. www.metsainfo.ee/index.php?option=com_content&view=article&id=180%3Amets-on-puhkamiseks-mitte-raiumiseks&Itemid=156.

Gobster, P. H. 1995. Aldo Leopold's ecological aesthetic: integrating aesthetic and biodiversity values. *Journal of Forestry* 93 (2): 6-10.

Gobster, P.H. 1996. Forest aesthetics, biodiversity, and the perceived appropriateness of ecosystem management practices. In: M.W. Brunson, L.E. Kruger, C.B. Tyler, S.A. Schroeder (tech. eds). Defining social acceptability in ecosystem management: a workshop proceedings; 1992 June 23-25, Kelso, WA. Gen. Tech. Rep. PNW-GTR-369. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, p. 77-97.

Han, K.-T. 2003**.** A reliable and valid self-rating measure of the restorative quality of natural environments. *Landscape and Urban Planning* 64: 209-232.

Han, K.-T. 2010. An Exploration of Relationships Among the Responses to Natural Scenes: Scenic Beauty, Preference, and Restoration. *Environment and Behavior* 42: 243-270.

Herzog, T.R. 1988. A cognitive analysis of preference for field-and-forest environments. In: J. L. Nasar (Editor), Environmental aesthetics: Theory, research and applications. Cambridge: Cambridge University press, p. 343-356.

Herzog, T.R. and Barnes, G.J. 1999. Tranquility and Preference Revisited. *Journal of Environmental Psychology* 19 (2): 171-181.

Herzog, T.R. and Bryce, A.G. 2007. Mystery and preference in within-forest settings. *Environment and Behavior* 39 (6): 779-796.

Herzog, T. R., Herbert, E. J., Kaplan, R., & Crooks, C. L. 2000. Cultural and developmental comparisons of landscape perceptions and preferences. *Environment and Behavior* 32: 323-346.

Herzog, T.R. and Kropscott, L.S. 2004. Legibility, Mystery, and Visual Access as Predictors of Preference and Perceived Danger in Forest Settings without Pathways. *Environment and Behavior* 36: 659-677.

Herzog, T.R. and Kutzli, G.E. 2002. Preference and perceived danger in field/forest settings. *Environment and Behavior* 34: 819-835.

Herzog, T.R. and Leverich, O.L. 2003. Searching for Legibility. *Environment and Behavior* 35: 459-477.

Hill, D. and Daniel, T.C. 2008. Foundations for an ecological aesthetic: Can information alter landscape preferences? *Society and Natural Resources* 21: 34-49.

Hull, R.B. and Stewart, W.P. 1992. Validity of photo-based scenic beauty judgements. *Journal of Environmental Psychology* 12: 101-114.

Kaplan, S. and Kaplan, R. 1982. Cognition and Environment: Functioning in an uncertain world. New York: Praeger, 287 pp.

Kaplan, R. and Kaplan, S. 1989. The experience of nature: A psychological perspective. New York: Cambridge University Press, 340 pp.

Kaplan, S. 1995. The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology* 15: 169-182.

Kaplan, S., Kaplan, R. and Wendt, J.S. 1972. Rated preference and complexity for natural and urban visual material. *Perception And Psychophysics* 12 (4): 354-356.

Kolb, T.E., Wagner, M.R. and Covington, W.W. 1995. Forest Health From Different Perspectives. Details: In: L.G. Eskew (Editor), Forest health through silviculture: Proceedings of the 1995 National Silviculture Workshop; 1995 May 8-11; Mescalero, New Mexico. Gen. Tech. Rep. RM-GTR-267. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 5-13.

Lee, T.R. 2001. Perceptions, attitudes and preferences in forests and woodlands. Technical Paper 18, Forestry Commission, 166 pp.

Leopold, A. 1981 (first published 1949). A Sand County almanac. Oxford University Press, New York, 240 pp.

Matsuoka, R.H. and Kaplan, R. 2008. People needs in the urban landscape: Analysis of Landscape and Urban Planning contributions. *Landscape and Urban Planning* 84: 7-19.

Nilsson, K., Sangster, M., Gallis, C., Hartig, T. de Vries, S., Seeland, K. and Schipperijn, J. (Editors). 2011. Forests, Trees and Human Health. Springer, Berlin, 452 pp.

Ode, Å., Fry, G., Tveit, M.S., Messager, P., Miller, D. 2009. Indicators of perceived naturalness as drivers of landscape

preference. *Journal of Environmental Management* 90: 375-383.

Panagopoulos, T. 2009. Linking forestry, sustainability and aesthetics. *Ecological Economics* 68: 2485–2489

Proebstl, U., Wirth, V., Elands, B. and Bell, S. (Editors) 2010. Management of recreation and nature-based tourism in European **forests**. Springer-Verlag, Heidelberg, 336 pp.

Purcell, A.T. and Lamb, R.J. 1998. Preference and naturalness: An ecological approach. *Landscape and Urban Planning* 42: 57-66

Ribe, R.G. 1991. The scenic impact of key forest attributes and long-term management alternatives for hardwood forests. In: McCormick, Larry H.; Gottschalk, Kurt W., eds. Proceedings, 8th Central Hardwood Forest Conference; 1991 March 4-6; University Park, PA. Gen. Tech. Rep. NE-148. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 34-54.

Rosenblad, Y. and Niit, T. (supervisor). 2005. Eesti maastikud kui vaimseks taastumiseks sobivad paigad: magistritöö [Estonian Landscapes as Restorative Places: masters thesis]. Tallinna Ülikool, sotsiaalteaduskond, psühholoogia osakond. (in Estonian with English abstract)

Sevenant, M. and Antrop, M. 2009. Cognitive attributes and aesthetic preferences in assessment and differentiation of landscapes. *Journal of Environmental Management* 90: 2889–2899.

Schoggen, P. 1989.Behavior Settings: A revision and extension of Roger G. Barker's Excological Psychology, Stanford University Press, Stanford, CA

Shafer, E.L. Jr and Richards, T.A. 1974. A Comparison of Viewer Reactions to Outdoor Scenes and Photographs of those Scenes. USDA Forest Service Research Paper NE-302. Upper Darby, PA.

Simonič, T. 2003. Preference and perceived naturalness in visual perception of naturalistic landscapes. *Zbornik Biotehniške fakultete Univerze v Ljubljani. Kmetijstvo* 81 (2): 369-387.

Ulrich, R.S. 1986. Human responses to vegetation and landscapes. *Landscape Urban Planning* 13: 29-44.

Ward Thompson, C. 2002. Urban Open Space in the 21st Century. *Landscape and Urban Planning* 60 (2): 59-72.

Ward Thompson, C., Aspinall, P. and Bell, S. (Editors). 2010. Innovative approaches to researching landscape and health. Routledge, London and New York, 290 pp.

Zube, E.H., Pitt, D.G. and Evans, G.W. 1983. A lifespan developmental study of landscape assessment. *Journal of Environmental Psychology* 3: 115-128.

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ПРЕДВАРИТЕЛЬНАЯ ОЦЕНКА ПРЕДПОЧТЕНИЙ ОТНОСИТЕЛЬНО ВИДОВ ЕСТЕСТВЕННЫХ ЛЕСОВ ЭСТОНИИ

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Резюме

Леса являются главным элементом ландшафта Эстонии, используемым большим количеством людей в рекреационных целях. Эта статья впервые изучает среду естественных лесов Эстонии с эстетической точки зрения. Предыдущие исследования показали, что предпочтение отдается природным ландшафтам по сравнению с антропогенными. Несмотря на это, о предпочтениях среди разнообразия природных ландшафтов Эстонии, где лес формирует важный аспект культуры, известно очень мало. Целью данной работы было проанализировать предпочтения разных естественных типов леса, используя для этого демонстрацию фотографий 97 участникам. Оценка основывалась на матрице факторов согласованности, сложности и таинственности, сформулированной в работе Каплан и Каплан (1982, 1989) для определения предпочтений в окружающей среде. Перед проведением исследования предпочтений, фотографии были оценены экспертами по вышеупомянутым факторам. Оценивались также и другие элементы для выяснения, что респонденты считали наиболее или наименее привлекательным, и что влияло на их предпочтения. Результаты были проанализированы для нахождения факторов, наилучшим образом предсказывающих предпочтения. Сходства в оценках между группой экспертов и группой неопытных лиц также были провеерены. Как показали тесты неопытных лиц, фактор таинственности оказался статистически наиболее достоверным предсказателем предпочтения, с последующим фактором согласованности. Эксперты же, отдали наибольшее предпочтение видам с высокой степенью согласованности, показав некоторые различия в оценках экспертов и не экспертов. Самое отрицательное влияние на предпочтения оказывали признаки гибели и разложения, а также беспорядочность в природе. Предполагается, что неотъемлемые свойства ландшафтов и естественных процессов еще не так хорошо понятны и приемлемы для опрошенной популяции, и что необходимо давать больше информации, объясняющей, почему эти признаки присущи природным ландшафтам.

Ключевые слова: Визуальное восприятие ландшафта, взаимодействие человека и ландшафта, предпочтения окружающей среды, виды естественных лесов, естественность окружающей среды