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Public Preferences for Silvicultural Attributes of European Forests

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ABSTRACT

This report explores the relationship and contribution of 12 key silvicultural attributes to the recreational value of forests in Europe. While the majority of research in this field has focused on individual case studies, this study is one of the few to provide a pan-European synthesis through a combination of a literature review and primary research. A Delphi survey was carried out with panels of experts in each of four contrasting European regions: Great Britain, the Nordic Region, Central Europe, and Iberia. For each attribute, participants were asked to state what they believed to be the nature of the relationship, and relative contribution, of each attribute to the overall recreational value of forests. The findings indicate that 'size of trees' is universally considered one of the most important attributes, along with attributes that reflect level of intervention such as 'size of clear-cuts', 'residue from thinning and harvesting', and 'visual penetration'. The results also suggest that, on average, the public prefer a degree of intervention to 'tidy up' the forest, creating a situation of 'managed naturalness'. Other key findings include the relative unimportance of 'number of tree species'. There are also some striking variations in the ranking of certain attributes across regions. 'Residue' is considered of very little importance in Central Europe whereas it scores highly elsewhere. Similarly, in Great Britain, the highest importance is attached to 'variation in tree size', although this attribute scores low elsewhere. The low importance given to 'variation between stands' in Great Britain contrasts with the Nordic Region and Central Europe, where, arguably, similar kinds of forest may extend across large areas and may be seen to be monotonous.

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CONTENTS

1. INTRODUCTION

As part of the EU-funded Integrated Project EFORWOOD, a computer-based *ex ante* sustainability impact assessment tool ('ToSIA') was developed for the European forestry wood chain. During the project, a set of some 24 indicators was identified through an iterative process with stakeholders, covering as far as possible the three pillars of sustainability: nine indicators under the 'economic' pillar, seven under 'social', and eight under 'environmental'. As part of Work Package 2.3 'Social and Cultural Values', an effort was made to develop the indicator 'recreational value of forests' to reflect the considerable public benefits derived from visits to forests, and to incorporate this within the impact assessment tool. This work was seen as important because, otherwise, the project would only have focused on employment-related social indicators, sending out the message that these represent the only important aspects of social value derived from forests.

The resulting 'recreational value' indicator consisted of a score, on a scale from 1-10, assigned to each of 240 forest stand types across Europe that differed according to tree species composition, stand age, forest management alternative, and region. A conceptual framework and methodology was developed to obtain the scores using a pan-European Delphi survey with 46 experts located in four contrasting European regions: Great Britain, Nordic Region, Central Europe, and Iberia, and then to combine the scores with outputs from EFISCEN, a forest resource projection model, to assess the long term impacts of changes in forest management to the recreational value of forests (Schelhaas et al., 2010).

The use of a Delphi survey presented an opportunity to ask additional questions that would provide further insights into the impacts of forest management on recreational value of forests in Europe. A literature review was carried out, which helped the authors to identify 12 key silvicultural attributes with a significant impact on recreational value of forests. For each attribute, Delphi survey participants were asked to state what they believed to be the nature of the relationship, and relative contribution, of each attribute to the overall recreational value. It was apparent from the literature review that the majority of research in this field involves case studies and few attempts have been made to synthesise the results across large geographical areas. For the first time, this study offers an indicative quantification of the nature and relative contribution of each attribute to recreational value at a pan-European level.

The geographical focus of the literature review and the Delphi survey was Europe, but the review was extended to include key studies and reviews that were produced in the USA, where the information appears to support the European findings or fills in gaps in understanding about preferences for European forests.

In the next section, an account of the literature review and the Delphi survey methodology is given, along with a description of the methods commonly used in forest preference research. Section 3 presents the findings of both the survey and the literature review. Section 4 uses additional material from the literature review to explore the extent to which generalisations can be made about public preferences across different geographical regions, social groups and recreational activities. The conclusions highlight key findings and issues raised by the study.

2. METHODS

THE LITERATURE REVIEW

The literature review presented in this report drew upon the combined knowledge of the WP2.3 team comprising social scientists from UK, Denmark, Austria France, Germany and Spain. First, the available English language material was assembled by the UK representatives, and then partners from the other countries supplemented this by searching additional references, including those written in other languages, which they summarised in English using a template. All relevant peer-reviewed work was included so that the findings were based primarily on evidence shown to be robust. However, other sources were used where this appeared to make a significant contribution (see Bibliography).

The references were assembled initially through the prior knowledge of individual team members and their colleagues and supplemented with database and internet searches. Search engines that were used included Google Scholar, Web of Knowledge, CAB and AGRIS. To ensure consistency, the following keywords were used by all team members: a) Europe, b) forest, c) National Parks (secondary key term), d) protected areas (secondary key term). These terms were then combined with each of the following: preference, perceptions, silviculture, attitudes, scenic beauty, management alternatives, valuation methods, landscape, recreational benefits, recreational values, zoning, forest design, and forest infrastructure. To avoid repeating the work of others, existing literature reviews were utilised, including those by Ribe (1989) for North America and Europe, and Gundersen and Frivold (2008) for Fennoscandia.

Several points need to be made about the scope of the review, and possible limitations. First, no search can be wholly comprehensive and some articles (e.g. grey literature and work in progress) may not be included. Secondly, the substantial literature on the economic value of non-market benefits of forests contains occasional studies that could be used indirectly to determine relative aesthetic preferences for different types of forest, for example contingent valuation studies that estimate willingness to pay for visits to different types of forest, and hedonic pricing methods to calculate the impact of different types of forest on property prices. Although some of these studies were located, it is likely that others remain undiscovered. Thirdly, it is clear from the results presented here that the coverage of Europe is patchy, with many case studies reported from Scandinavia and fewer studies from Southern and Eastern Europe. To some extent the Delphi survey addresses this uneven coverage in the existing research.

ASSESSING RECREATIONAL VALUE

A continuum of landscape assessment methodologies can be described, from those which emphasise the physical attributes of the setting to those which focus on the subjective meanings attached by individuals who encounter the landscape (Lee (2001: 3). Thus, Lee proposed the following four tiered model, drawing on Zube et al. (1982: 8), Daniel and Vining (1983), Kaplan and Kaplan (1989) and others (cf. Jensen and Koch, 1998: 48ff; Sheppard and Harshaw, 2001).

1. The expert or formal aesthetic model

This method is based upon the view that aesthetic quality is determined by the physical elements of the landscape. There is no emphasis on perception, and the human response is taken as constant (Lee 2001: 3, citing Daniel and Vining, 1983) Lee (2001: 3) writes: “The properties which determine environmental quality are believed to transcend different landscapes and landscape types.” These are assessed by skilled and trained observers and typically include the forms, lines, colour and texture of landscape features, while the relationships between these may be assessed in terms of their diversity, harmony, unity and contrast. There are conflicting views on the extent to which the judgements of experts reflect those of the general public (ibid.)

2. The phenomenological or existential model

At the other end of the spectrum are approaches which seek to evaluate the meanings which people attach to the landscape. The approach goes well beyond the visual realm, with the landscape seen as a source of "tactile, olfactory and auditory experiences in addition to actions, affordances and intentions". Similarly, in addition to current subjective feelings, the approach incorporates "the observer's history of experiences, associations, interpretations and expectations". All of these aspects of individual experience cannot be separated and need to be included in the assessment (Lee 2001: 4). The approach uses in-depth interview or analysis of literary sources, producing rich qualitative data on a very small number of samples, but this cannot provide generalisable knowledge of preferences for physical attributes of the landscape (Lee, 2001: 5, cf. Scott et al., 2009).

3. The psychological model

In this approach individuals are asked to select from a checklist of adjectives that describe the landscape. Lee (2001: 5) writes: "A high quality landscape is one that evinces many positive feelings, warmth, security, relaxation, freedom or happiness. A low quality one evinces expressions of claustrophobia, insecurity, gloom, anxiety and so on." The relevance of these feelings is then assessed by relating them to scores for overall scenic quality derived by independent groups of subjects. The approach has identified the importance of the notion of 'mystery', 'complexity', 'coherence' and a 'sense of spatiousness' to landscape quality (Lee, 2001: 5, citing Kaplan and Kaplan, 1989).

4. The psychophysical model

This approach seeks to relate individual physical attributes of the landscape with overall measures of scenic quality, again derived by independent groups of subjects. Lee (2001: 5) argues that the psychophysical approach provides the greatest prospect for incorporating public preferences into planning and design guidelines.

The majority of the information presented in the literature review has been drawn from preference studies that use the psychophysical model, using visual (pictures or computer images) and sometimes verbal or field stimuli to elicit preferences for landscapes that differ according to specific attributes. Koch and Jensen (1988: 55) list a number of advantages of using pictures, including the ability to transmit a large quantity of information to the viewer but disadvantages include the fact that a picture is only a static representation of reality with the possibility that key preference-determining factors are missing. There are issues regarding the extent to which visual preferences derived in this way can act as a proxy for recreational value, and also the scope for generalisation about preferences for forest types across different social groups (see Section 4).

On the relative validity of visual, verbal and field stimuli, Gundersen and Frivold (2008: 243) write: "Tahvanainen et al. (2001) found big differences between opinions based on verbal questions and opinions based on photos for grading, and recommended using visual stimuli for assessing people's visual preferences. […] Koch and Jensen (1988) and Karjalainen (2006) summarized methodological studies testing the validity of using photos instead of on-site field presentation, and concluded that photos can constitute a valid basis for preference studies of forests and landscapes, regardless of being greyscale or in colour, provided that they are selected carefully." Gundersen and Frivold (2008: 246) continue: "Tyrvainen and Tahvanainen (1999) compared differences in viewer response to 28mm panoramic photographs representing a series of rural landscapes and to computer graphic drawings representing the same landscapes, and found that the presentation format had little effect on the ratings."

The most established approach to assessing and modelling recreational values on the basis of visual representations of a forest is to develop regression models which fit recreational scores (or more precisely visual quality scores) with silvicultural variables derived from inventory data. This work was developed in the USA in the 1970s and 1980s using established psychophysical techniques and referred to as the Scenic Beauty Estimation (SBE) method. It sought to predict the SBE for the forests in a given region on the basis of its silvicultural attributes. Brown and Daniel (1984) describe its history, methods and application with reference to pioneering studies by Shafer et al. (1969), Daniel

and Boster (1976) and Arthur (1977). They summarise their approach as a "method of measuring scenic beauty, standard forest inventory techniques for measuring landscape characteristics, and statistical models to relate the two" (Brown and Daniel, 1984: 3).

Typically, the SBE method involves systematic photography of randomly located views within forested areas. The photographs are then presented to a sample of observers who individually rate the scenic beauty of the image on a ten point scale. The ratings are then adjusted to allow for differences in how individuals used the rating scale to derive unbiased scores for public perception of scenic beauty. The silvicultural attributes of each photographed scene are then measured using standard inventory methods, including ground vegetation, tree height, number of stems, and basal area. A number of regression models are then developed by selecting the optimum number of variables (for which data were available to forest managers) with the most impact on the SBE score. The coefficient for each independent variable in the model reflects its contribution to the overall SBE. Brown and Daniel were able to explain a large proportion of the variance in perceived scenic beauty for the relatively simple ponderosa pine (*Pinus ponderosa*) ecosystem in Arizona where they worked (ibid: 3-9, 28).

Since their study was conducted, the method has been applied extensively, in particular in Scandinavia, possibly aided by the relatively simple composition of the Scandinavian forest landscape. A variation on the method, which has been applied in Catalonia (Blasco et al., 2009), is to take photographs of the target tree species and develop computer images of individual trees, which can then be assembled into images representing near views of forest stands with known combinations of variables such as height, density, and level of ground cover. Tyrvainen et al. (2005: 90, citing Karjalainen and Tyrvainen, 2002) write: "Today digital image editing… and in the future virtual landscape simulators offer the most sophisticated means of visualization for landscape research".

SELECTING SILVICULTURAL ATTRIBUTES

The results presented in this report are organised around 12 key silvicultural attributes. These were selected through an iterative process alongside: a) the review of forest preference literature, b) the development of a conceptual framework within Module 2 of EFORWOOD for modelling the impacts of scenarios on sustainability indicators (Edwards et al., in press), c) presentation and discussion of ideas with researchers within and beyond the project, including participants at a workshop organised by WP2.3 at the MMV4 conference in Tuscany in October 2008 on monitoring and management of visitor flows to protected areas, and d) piloting of the Delphi survey questionnaire.

The attributes that were chosen are given in Table 1, listed in the random order that was used throughout the study. Most of the published articles on forest preferences produce their own variation on this typology. Typically the attributes become parameters in one or more regression models. Another typology of attributes with a similar scope and purpose to those given here is provided by Lee (2001) using terms commonly used by UK Forestry Commission landscape architects (see Box 1 below). The typology developed for our study differs to that of Lee's in several ways, including its distinction between stand and landscape level, and its focus on the stand level which provides more scope for modelling. Most importantly, our study uses attributes which have been studied repeatedly in landscape preference research. The aim was to select attributes that support the task of deriving recreational scores for different forest stand types as part of the Delphi survey. As far as possible the attributes were chosen because they were separable and additive (cf. Garrod, 2002: 10).

Table 1. Silvicultural attributes covered by the study

1. Size of trees within stand • Stand age: from establishment to maturity • Canopy height: from low to high
2. Variation in tree size within stand • Variation in tree size: from uniform to diverse • Number of canopy layers: from one to many
3. Variation in tree spacing within stand • Variation in tree spacing: from regular to different sized groups of trees and openings
4. Extent of tree cover within stand • Tree cover: from sparse (i.e. retention and seed trees) to moderate (e.g. shelterwood and selection systems) to full (i.e. closed canopy)
5. Visual penetration through stand • Distance visible: from short to long • Understorey and shrub layer: from dense to absent
6. Density of ground vegetation cover up to 50 cm height within stand • Ground cover: from absent to dense
7. Number of tree species within stand • Number of species: from one to many
8. Size of clear-cuts • Size of clear-cuts: from small to large
9. Residue from harvesting and thinning • Volume of tree stumps, branches and other visible woody residue: from low to high
10. Amount of natural deadwood (standing and fallen) • Volume of deadwood: from low to high
11. Variation *between* stands along a 5 km trail through forest • Number of forest stand types* encountered: from one to many
12. 'Naturalness' of forest edges • Proportion of 'natural' looking (i.e. not straight) edges: from low to high

Box 1. A typology of forest landscape attributes (Source: Lee 2001: 134)

1. **Scale** (whether the size of a woodland, the proportions of woodland and open ground, and the proportions of different component areas of the woodland reflect the scale of the landscape)
2. **Shape** (whether the shape of the woodland – external edge shape – and the shape of internal components of the woodland is organic or geometric)
3. **Broadleaved/conifer**
4. **Overall diversity**
5. **Species diversity**
6. **Age diversity**
7. **Colour diversity** (diversity is the number and degree of different features in the landscape)
8. **Spacing/density** (in distant views, the impression of close planting, closed canopy and an absence of open space contribute to a low score. In internal views, the impression of openness, whether between trees or groups of trees, or through the trees gives a high score)
9. **Human intrusion** (the extent to which an impression is gained of the hand of man having been present. Thus, discordant man-made features indicate greater intrusion than features which blend, even though they may be equally man-made)
10. **Genius loci** (the spirit of a place or its strength of character. That which gives the landscape its unique character)

Confusion can arise regarding the distinction between silvicultural 'attributes' and 'interventions'. Many of the studies reported here examine both silvicultural attributes, i.e. measurable features of the forest landscape, and the immediate or longer term effects of interventions, such as different thinning and harvesting regimes. The list of attributes compiled here was restricted to features that can (at least in theory) be measured in any forest stand, regardless of its forest management alternative or phase of development, so that the conclusions can be used to support the process of deriving recreational scores for all stands. As far as possible, evidence of the effects of each type of intervention on public preferences were assigned to the most appropriate silvicultural attribute. The effects of thinning, selection and shelterwood systems are considered mainly under 'visual penetration through stand'. The effects of clear-cuts and related measures which are, at least in part, carried out for aesthetic reasons such as use of retention trees and seed trees are covered under 'extent of tree cover within stand'.

THE DELPHI SURVEY

Once the attributes were selected, and the literature review was carried out, the Delphi survey was implemented. The steps in the survey process are summarised in Table 2, and are based upon the protocol for the Delphi method developed by Novakowski and Wellar (2008). The method is described in detail in Edwards et al. (in press).

Delphi is a social research technique that seeks to provide a reliable group opinion on how to solve a complex problem through the use of expert judgement (Landeta, 2006: 468; cf. Linstone and Turoff, 1975: 3). Typically, a panel of experts is invited to participate anonymously in a questionnaire survey. Questions are structured in a way that allows participants to rank, or select from, a continuum of possible answers, thereby allowing the group statistical response to be analysed. After the first round of responses has been received, the results are summarised by the survey monitor, and the survey is redistributed to each panel member who is given the opportunity to revise their original answers in the light of the full set of anonymous responses. The process undergoes one or more iterations until stability in the responses is reached. Often, but not always, the responses converge towards a position of consensus (Gordon, 1994: 3).

Table 2. Steps for obtaining recreational scores using the Delphi method

Preparation for the survey
1. Identify and address knowledge gaps
2. Ensure Delphi is the most appropriate research instrument
Survey design
3. Preparation of draft background report and survey
4. Establish criteria for recruitment of participants
5. Select and contact participants
6. Trial run
7. Final revision of background report and survey
Survey implementation
8. Round 1: distribution of report and survey
9. Incorporation of feedback from round 1
10. Round 2: redistribution of survey
11. Incorporation of feedback from previous round [Return to step 10 until stability is reached]
Analysis of results
12. Final tabulation of responses
13. Analysis of final results
Dissemination to participants
14. Anonymous post-Delphi survey
15. Dissemination of research results

Source: Adapted from 'Flowchart for a normative Delphi' (Novakowski and Wellar, 2008: 1488).

Survey design

To apply the survey across Europe, four panels were assembled, one for each of four case study regions: a) Great Britain (i.e. upland areas of Scotland, England and Wales), b) Nordic Region (i.e. boreal areas of Norway, Sweden and Finland), c) Central Europe (i.e. southern Germany, Austria and Switzerland) and d) Iberia (i.e. Mediterranean areas of Spain and Portugal). These were selected to reflect the diversity of biogeographical and socio-cultural contexts in Europe (cf. Pröbstl *et al*., 2009). The survey was carried out between September 2009 and January 2010 in parallel in each of the four regions. Overall, 46 experts participated in the survey: 10 in each of the Great Britain and Iberia panels, 12 in the Nordic panel, and 14 in the Central Europe panel. Two rounds were required before stability in responses was reached.

The survey questionnaire presented the 12 attributes and asked participants the following three questions:

> (a) For each attribute listed in the table [see Table 1 above], please indicate whether its relationship to the recreational value of the forests in your region is best described as: positive, negative, bell-shaped, U-shaped, or even [see Fig 1 below]. For example, for 'attribute 1', if you think recreational value increases when 'stand age' increases from establishment to maturity, please write 'P' for 'positive'.
>
> (b) For each attribute, please assign a weighting, on a scale from 1 (low) to 10 (high), to indicate its relative contribution to the overall recreational value of the forests in your region. Use the same weighting for different attributes if appropriate.
>
> (c) For each attribute, indicate your level of confidence in your answers for 'a' and 'b' (low, medium, or high).
>
> Please provide any comments and explanations for your answers in the box provided.

Fig 1. Relationships between silvicultural attributes and recreational values

	**Positive** Recreational value increases when the level of the attribute increases from low to high
	**Negative** Recreational value decreases when the level of the attribute increases from low to high
	**Bell-shaped** Recreational value is enhanced by the attribute, except when the level of the attribute is very low or very high
	**U-shaped** Recreational value is reduced by the attribute, except when the level of the attribute is very low or very high
	**Even** Recreational value is not affected by the level of the attribute

It was explained to participants that: "The 'recreational value' of a forest is defined here in terms of the preferences of people who regularly use forests as sites for recreation (i.e. 'forest visitors'). Their preferences for a given forest are likely to be influenced by many factors, but this survey is concerned only with silvicultural attributes (tree size, stand density, species composition, etc). For most visitors, these are important because they affect the visual attractiveness of the forest. However, some visitors may also value the same attributes for non-aesthetic reasons, e.g. because they provide better habitats

for hunting, bird-watching, or collection of mushrooms and berries. When completing the questions, try to take these differences into account, and answer on behalf of the 'average' visitor."

At the end of Round 1 the scores and comments were collated and provisional analysis carried out. Questionnaires for Round 2 were prepared and circulated. These were tailored for each individual: a table was provided which gave the results from the first round of everyone in their panel. Also, on a separate page, alongside a new score-sheet, their personal scores from Round 1 were provided. Participants were invited to reconsider their previous answers in the light of the aggregated group's response, and to revise them (or comment upon them) if they felt this was appropriate. Once all responses to Round 2 had been received, the results were analysed and, since it was clear that stability in responses had been reached, participants were informed that the survey was completed and asked whether they were willing to have their names identified (see Acknowledgements).

3. RESULTS AND DISCUSSION

This section starts by presenting and discussing the scores and comments generated by the Delphi survey for all attributes in all regions. Each attribute is then considered in turn: the Delphi survey scores and comments for that attribute are highlighted and then compared with the relevant findings of the literature review. A final sub-section discusses findings relating to 'naturalness', a concept which encompasses several of the attributes included in the survey, drawing from the survey comments and the literature review.

RESULTS OF THE DELPHI SURVEY

All 46 participants completed the two rounds of the Delphi survey that were required before stability in the responses was reached, although some participants made no changes to their Round 1 responses. The number of changes made to individual responses during Round 2 for each region is shown in Table 3. If 'relationship', 'contribution' and 'confidence rating' for each of the 12 attributes in a given region are all considered as separate 'responses', then, overall, around 10% of responses were changed in Round 2, which is less than the rule of thumb proposed by Nelson that stability is reached when fewer than 20% of individual participants' responses have changed (Nelson, 1978: 45, cited in Novakowski and Wellar, 2008: 1494).

Table 3. Changes to responses made during Round 2, by region

	Great Britain	Nordic Region	Central Europe	Iberia	Average (weighted)
Percentage of participants who changed at least one response	70	67	86	60	72
Percentage of responses that were changed	9.7	6.5	14.5	8.6	10.1

The average results for 'relationship', 'relative contribution' and 'confidence rating' for each attribute in each region are given below.

Relationship

The data on the relationship of each attribute to the recreational value of forests for each respondent are given in the Appendix. The most commonly identified relationship for each region is given in Table 4, plus the results of the Exact Test for each attribute.

A Pearson Exact Chi-Square Test was used to test the allocation of distribution types across all four regions. This was done separately for each attribute. The Exact Test is used because the data is on a nominal scale: there is no relationship between the five distribution types. The test analyses how extreme the values for each attribute are compared to how they could have been. When the P value is greater than 0.05 it can be assumed with at least 95% certainty that there is no difference between regions. The analysis suggests that the allocation of distribution types for each attribute can be regarded as similar across the four regions, with the exception of attributes 4, 5 and 6. Table 4 shows that there was less agreement between regions for these attributes (see also Appendix). Attribute 4 (extent of tree cover) was similar in Great Britain, Central Europe and Iberia, but in Nordic Region the results were equally for positive and bell-shaped. For Attribute 5 (visual penetration) the most common distribution type was bell-shaped, except in Iberia where it was positive. For Attribute 6 (density of ground vegetation) the most common distribution type was bell-shaped except in Iberia where it was negative. Also in Nordic region, although most respondents chose bell-shaped, the scores were split between three distribution types.

Table 4. Most frequently identified relationship to recreational value, and Exact text results, by region

Attribute	Relationship to recreational value					Exact test (P)
	Great Britain	Nordic Region	Central Europe	Iberia	All regions (% of total counts)	
1. Size of trees	P	P	P	P	P (91)	0.35
2. Variation in tree size	P	B	P	P	P (63)	0.43
3. Variation in tree spacing	P	P	P	B	P (59)	0.06
4. Extent of tree cover	B	P/B	B	B	B (74)	0.03
5. Visual penetration	B	B	B	P	B (54)	0.02
6. Density of ground vegetation	B	B	B	N	B (59)	0.02
7. Number of tree species	P	P	B	P	P (52)	0.49
8. Size of clear-cuts	N	N	N	N	N (93)	0.43
9. Residue	N	N	N	N	N (69)	0.84
10. Amount of natural deadwood	B	N	B	B	B (59)	0.10
11. Variation between stands	P	B	P	P	P (59)	0.09
12. 'Naturalness' of forest edges	P	P	P	P	P (93)	0.06

NB: N=46 for all attributes except Attribute 12 where it was 45.

Relative contribution

The data for relative contribution of each attribute to the overall recreational value of forests for each respondent are also given in the Appendix. The mean scores for each attribute for each region are summarised in Table 5.

Table 5. Mean contribution to recreational value, by region

Attribute	Mean contribution			
	Great Britain	Nordic Region	Central Europe	Iberia
1. Size of trees	7.8	9.7	7.5	7.9
2. Variation in tree size	8.0	5.7	6.2	5.1
3. Variation in tree spacing	6.8	6.1	6.8	5.0
4. Extent of tree cover	6.3	7.0	6.3	7.0
5. Visual penetration	5.9	7.8	5.9	8.2
6. Density of ground vegetation	4.0	5.6	5.0	6.1
7. Number of tree species	5.9	6.4	4.8	7.2
8. Size of clear-cuts	7.1	9.1	7.3	7.8
9. Residue	6.5	9.5	4.4	8.1
10. Amount of natural deadwood	4.2	7.2	5.1	5.9
11. Variation between stands	4.8	8.7	7.5	6.1
12. 'Naturalness' of forest edges	6.1	6.0	7.1	6.0
Mean	6.1	7.4	6.2	6.7

A J-T test was carried out to determine whether there were significant differences between the four regions in the distribution or 'shape' of the weightings for each attribute. This test showed that there was a significant difference for all attributes except Attribute 2, 3 6, 11 and 12. However, the differences could also be because respondents for a given region tended to use the ten point scale in a different way: the shape of the distribution may be the same but shifted up or down the scale. In Table 5 we see that the mean contribution for all attributes was different between regions suggesting that there was a difference between regions in how the average individual used the ten point scale.

To resolve this problem of the scale being used differently, and to allow the scores for each region to be compared, the ratings were converted into rankings. The ranked scores were then analysed for each individual respondent to test whether they had ranked the attributes similarly or differently. The test used was Kendall's Coefficient of Concordance. This is to assess whether individuals agree or differ in their scoring of the relative contribution of the 12 attributes, i.e. whether they are in the same order (and therefore whether they can be combined and represented as an average for each attribute). The test showed that, within each of the four regions, there was strong agreement between individuals in the ranking of the contribution of the attributes ($P < 0.001$).

A similar analysis was then carried out across all four regions. There was also general agreement ($P = 0.06$) suggesting that it could be stated with 94% confidence that the rankings for all four regions were in the same order. Attributes 1, 4, and 8 showed the highest agreement in the order of importance across the four regions, and Attributes 2, 3, 9 and 11 showed the lowest agreement.

The overall ranking for each region is also given in Table 6. Using this information, in Table 7, the attributes have been reordered according to their relative contribution to the recreational value of forests in Europe as follows (from highest to lowest).

Table 6. Ranked mean contribution to recreational value, by region (12=highest; 1=lowest)

Attribute	Ranked mean contribution				Overall ranking
	Great Britain	Nordic Region	Central Europe	Iberia	
1. Size of trees	11	12	11.5	10	12
2. Variation in tree size	12	2	6	2	5
3. Variation in tree spacing	9	4	8	1	5
4. Extent of tree cover	7	6	7	7	7
5. Visual penetration	4.5	8	5	12	9
6. Density of ground vegetation	1	1	3	5.5	1
7. Number of tree species	4.5	5	2	8	3
8. Size of clear-cuts	10	10	10	9	11
9. Residue	8	11	1	11	10
10. Amount of natural deadwood	2	7	4	3	2
11. Variation between stands	3	9	11.5	5.5	8
12. 'Naturalness' of forest edges	6	3	9	4	5

Table 7. Ranked mean contribution to recreational value, by region, in descending order (12=highest; 1=lowest)

Attribute	Ranked mean contribution				Overall ranking
	Great Britain	Nordic Region	Central Europe	Iberia	
1. Size of trees	11	12	11.5	10	12
8. Size of clear-cuts	10	10	10	9	11
9. Residue	8	11	1	11	10
5. Visual penetration	4.5	8	5	12	9
11. Variation between stands	3	9	11.5	5.5	8
4. Extent of tree cover	7	6	7	7	7
12. 'Naturalness' of forest edges	6	3	9	4	5
3. Variation in tree spacing	9	4	8	1	5
2. Variation in tree size	12	2	6	2	5
7. Number of tree species	4.5	5	2	8	3
10. Amount of natural deadwood	2	7	4	3	2
6. Density of ground vegetation	1	1	3	5.5	1

Confidence ratings

The Appendix shows the count of confidence ratings for 'relationship' and 'relative contribution' assigned to each attribute in each region. These data are used in Table 8 to calculate a median confidence rating, by giving a score of 1 for low, 2 for medium, and 3 for high level of confidence. The medians suggest that respondents had medium or high confidence in the information they provided for 'relationship' and 'relative contribution' for all attributes with the exception of Attribute 6 in Nordic Region where the level of confidence was between low and medium. Overall, confidence in participants' responses was highest in Central Europe and lowest in Iberia, although the pattern across the four regions appears to be quite consistent (see also Appendix).

Table 8. Median confidence rating for 'relationship' and 'contribution', by region

Attribute	Great Britain (n=10)	Nordic Region (n=12)	Central Europe (n=14)	Iberia (n=10*)
1. Size of trees	3	3	3	3
2. Variation in tree size	3	2	3	2
3. Variation in tree spacing	3	2	3	2
4. Extent of tree cover	2	2	2	2
5. Visual penetration	2	3	3	2.5
6. Density of ground vegetation	2	1.5	3	2
7. Number of tree species	2	2	2	2
8. Size of clear-cuts	2.5	3	3	2.5
9. Residue	2	3	2	3
10. Amount of natural deadwood	2	2	2	2
11. Varitaion between stands	2	3	3	2
12. 'Naturalness' of forest edges	2	2	3	2
Median	**2**	**2**	**3**	**2**

*N=9 for attribute 12 in Iberia.

DELPHI SURVEY PARTICIPANTS' COMMENTS

Overall, 48 comments were made by survey participants, in both rounds for all regions. Some of the comments made more than one point: in total around 87 points were raised (a 'point' was defined loosely according to whether it warranted a separate line in the analysis).

Examination of each point revealed that the majority related to individual attributes, providing an explanation for the respondent's ranking or stating the assumptions that were made. A few indicated why they had adjusted or corrected particular scores given in Round 1 on further reflection or after examining other respondents' scores. Several points related to the relative importance of 'variation' or 'naturalness' for recreational value, and referred (explicitly or implicitly) to attributes 2, 3, 7 and 11 in particular. Additional points, including some criticisms, were made on the conceptual framework that was used to derive the scores.

The numbers of points raised are given in Table 9, by type and region. Comments relating to individual attributes are given under the relevant heading in the next section. General points on variation and naturalness are discussed under 'Public perceptions of naturalness' at the end of this section. Points relating to the conceptual framework are given below.

Table 9. Indicative number of points raised by participants, by type and region

Type of point raised	GB (n=10)	Nordic (n=12)	Central (n=14)	Iberia (n=10)	Total
Points on individual attributes:					
1. Size of trees within stand	1		2		3
2. Variation in tree size within stand	1	2	1		4
3. Variation in tree spacing within stand		1			1
4. Extent of tree cover within stand		1	2	1	4
5. Visual penetration through stand	1	2	2		5
6. Density of ground vegetation cover		2	3		5
7. Number of tree species within stand	3		5		8
8. Size of clear-cuts	3			1	4
9. Residue from harvesting and thinning			5		5
10. Amount of natural deadwood	1	3	6		10
11. Variation between stands along 5km trail		3	1	1	5
12. 'Naturalness' of forest edges	2	2	3		7
General points on variation / naturalness	2	1	2	1	6
Points on the conceptual framework	10	2	2	6	20
Total	24	19	34	10	87

Points on the conceptual framework

Members of the Great Britain panel raised the following diverse points regarding the conceptual framework used in the Delphi survey. One respondent questioned the suitability of the five relationship graphs that were given in the questionnaire: "I have based my answers on what I assume to be your idea of the forest but I am not sure about how well some of the graph types really fit the attribute." Another suggested that "forest size and presence/absence of harvesting/thinning activity may also be important attributes." Another participant noted the influence of contextual factors on the relative contribution of some of the attributes, in particular 'visual penetration' and 'number of tree species': "An even-aged birchwood can be v attractive for recreation- so can an uneven aged wood of the same species. It is more a matter of personal preferences than aggregate preferences I would have thought." Likewise, another wrote: "Relative contribution is a difficult one to score! You will note that low confidence ratings correlate with low relative attribute scores!"

Similarly, another participant from Great Britain implied that it may be difficult to provide a single score for an attribute when there may be significant differences in contribution for different types of forest: "First, it is worth noting that there are differences between Sitka spruce and birch woodlands in terms of their recreation value. Generally, birch is likely to have a much higher recreation value than Sitka. Further, there are differences in the public's general expectations of these two forest types: Sitka is generally considered to be grown for commercial timber and therefore is often thought of as being grown in dense, regimented stances. Birch, on the other hand, tends to be considered as much more open woodland with natural planting. Thus, my responses above are based on two generally considerations: (i) how one could improve the recreation value of Sitka to try to make it look more natural, and (ii) how to retain the natural character of a natural birch woodland."

One respondent was critical of the reductionist approach used in the study: "In most work I have done people rarely separate out the individual elements in this way. i.e. the whole is greater that the sum of the parts and the interplay between these indicators is infact what I see as key." The same participant also noted the lack of coverage of non-silvicultural factors: "There should have been mention of specific management of stands for recreational or conservation value. One key aspect in Scotland is the erection of tree fences which actually decreases recreational value. This is a key issue and should be included."

One participant from Central Europe regretted having to participate after the survey design had been finalised, and hence was unable to address perceived weaknesses in the methodology: "I find it rather

difficult to be involved in such a project only at this very stage of weighting, not knowing enough about the structure of the whole evaluation scheme; many important aspects of forest recreation are not listed in the criteria; the special scale of the process is not documented." Another respondent from Central Europe stressed the difficulties of scoring the attributes due to the variation between tree species, and types of visitor, in particular between rural and urban populations, and also due to seasonal effects.

In Iberia, comments reflected difficulties in generalising across different types of forest and visitor. One participant wrote: "Relative contribution of each attribute is very difficult to assess. It would be easy with combinations." Another expanded on the difficulties of generalising across different tree species: "Pinus spp and Quercus spp are grouping lots of species that are part of numerous different ecosystems in the south of Europe. Two major climates might be distinguished in the area: Oceanic and Mediterranean climates. From broadleaved evergreen forests and Mediterranean coniferous forest (EU forest types 9 and 10) to cultivated forest (EU forest type 14, e.g. pine plantations in the south-west of France and in the north-west of Spain), the variety of oak and pine forests is large and recreation as well. The impact of stand attributes on the recreational function of forests in this part might differ depending on the original type of forest that is (/was) present in the area." Similarly, another participant wrote: "Mental images of pine forests are easy to conjure for me. Regarding oak forest, though, I find difficulties visualizing just one type. Most Mediterranean oak forest is nowadays a dehesa or a coppice. Some downy oak forests are closed, humid, far more mixed and completely different in physiognomy. "Oak forest" includes a very wide range of conditions in just one class. I also find difficult to rate the attributes knowing they all are important." Finally, one respondent noted the difficulty responding on behalf of the average visitor: "My confidence rating was "Low" in all cases because I find it very hard to answer on behalf of the average visitor. Although I tried not to do it I am probably giving more my personal opinion."

PREFERENCES FOR SILVICULTURAL ATTRIBUTES

This section presents the individual scores and comments generated by the Delphi survey on the relationship and contribution of each attribute to recreational value, and compares this with the findings of the literature review.

1. SIZE OF TREES WITHIN STAND

This attribute was ranked in the top three in all four regions in terms of its relative contribution to the overall recreational value of forests. Overall it ranked highest across all regions (see Table 10).

Table 10. Ranked mean contribution of 'size of trees within stand', by region

Region	Ranked mean contribution to recreational value
Great Britain	11
Nordic Region	12
Central Europe	11.5
Iberia	10
Overall ranking	**12**

The relationship to recreational value was consistently seen as positive across the four regions. Thus, as stand age increases from establishment to maturity, or as canopy height increases from low to high, the recreational value increases (see Table 11).

Table 11. Relationship to recreational value of 'size of trees within stand', by region

Region	Relationship to recreational value					Modal class
	Positive	Negative	Bell-shaped	U-shaped	Even	
Great Britain (n=10)	8		1	1		Positive
Nordic Region (n=12)	12					Positive
Central Europe (n=14)	13		1			Positive
Iberia (n=10)	9				1	Positive

Delphi survey comments on this attribute noted the positive contribution of older trees and stands to recreational value. One respondent from Great Britain noted the 'wow' factor associated with very large trees. Another respondent, from Central Europe, pointed out the dangers that can be associated with older trees due to falling branches.

Overall, the scores obtained from the Delphi survey were universally supported by the literature review. 'Size of trees', 'maturity of stand', or by implication 'canopy height', appears to be the attribute with the most important and generalisable link to recreational value, with larger trees being preferred. For example, in a review article of preference studies from USA and Europe, Ribe (1989: 62) writes: "An element of visual forest condition also prevalently given aesthetic merit is the presence or dominance of large trees. This intuitive aesthetic sensibility is confirmed by preference research, as mature and old-growth forests and trees of all kinds do enjoy aesthetic affection (Brown and Daniel 1984, 1986, Brush 1978, 1979, Kellomaki 1975, Klukas and Duncan 1967, Schroeder and Daniel 1981, Schweitzer and others 1976, Herzog 1984)."

Similarly, in a more recent review of studies in Fennoscandia, Gundersen and Frivold (2008: 248) write: "Numerous surveys with different methodologies showed that preference increases with increasing tree age, or, more exactly, with tree size, and with advancing stage of stand development (Haakenstad 1972, 1975; Lind et al. 1974; Kellomäki 1975; Saastamoinen 1982; Hultman 1983; Korhonen 1983; Kellomäki and Savolainen 1984; Pukkala et al. 1988; Kardell 1990; Hallikainen 1998; Karjalainen, 2000; Lindhagen and Hörnsten 2000; Silvennoinen et al., 2001; Tyrväinen et al. 2001)."

Reviewing similar literature to Ribe, Silvennoinen et al. (2001: 12) write: "People prefer stands of tall trees, especially pines and birches (Savolainen and Kellomaki, 1981; Schroeder and Daniel, 1981; Brown and Daniel, 1986; Hull and Buhyoff, 1986; Brown, 1987; Hull et al, 1987; Rudis et al., 1988; Axelsson-Lindgren, 1990; Ribe, 1990; Mattson and Li, 1994; Hallikainen, 1998; Liao and Nogami, 1999)."

The positive effect of tree size applies whether trees are measured by height, standing volume or diameter, as highlighted by Ribe (1989: 62): "This positive affect applies to big trees identified by height (Savolainen and Kellomaki 1981, Klukas and Duncan 1967) or by more conventional measures like standing volume or diameter (Arthur 1977, Brown and Daniel 1984, Daniel and Boster 1976, Daniel and Schroeder 1979, Schroeder and Daniel 1981, Vodak and others 1985)."

Similarly, diameter is shown to be correlated with scenic beauty in Catalonia. Blasco et al. (2009: 76) write: "…the larger the diameter, the higher scenic beauty is. Large number of small trees and pines decreased the scenic beauty." They continue (2009: 77): "Our models indicate that an enlargement in the mean diameter of trees increases the scenic beauty, which corresponds to previous studies (Arthur 1977; Brush 1979: Benson and Ullrich 1981; Buhyoff et al. 1986; Rudis et al 1988)."

There is some evidence that the positive contribution of large trees is increased in stands with lower density. Ribe (1989: 62) adds: "Large trees are even more important in stands with fewer trees per acre (Hull and Buhyoff 1986)." However he also adds (1989:62): "Results clearly comparing the aesthetic gains achievable from different numbers of large trees per acre in different forest types have not been reported."

Mature stands may have reinforcing attributes, in particular lower tree density (and hence the possibility of greater visual penetration – see below). Ribe (1989: 62) adds: "In general, forest stands that include noticeable evidence of large trees have been found to be more attractive. Such mature forests may also tend to exhibit reinforcing scenic attributes, such as lower tree densities and understories, although this is not always explicitly tested or noted in reporting the value of large trees."

There are some exceptions to the general pattern. In a study conducted in Denmark, the link between stand age and public preference was stronger for broadleaves than for conifers. Jensen (1997: 143) writes: "According to the mean assessment of the population in 1977 and 1994 surveys, the popularity of deciduous forest increases as the age of the stand increases – for winter and summer alike. Concerning the popularity of coniferous forest, it was not possible to detect any relationship to age of stand in the results of the 1977 survey. This was, however, the case in 1994, where the pattern gets close to that found for deciduous forest."

Likewise, in Norway a substantial proportion of respondents to a national survey didn't know or were neutral about their preference for old growth versus young growth forest. Gundersen and Frivold (2008: 248) continue: "In a national survey of Norway's population (Hoen and Winther 1993), respondents were asked if they preferred to visit "old growth forest" rather than "young growth forest". Forty-eight per cent of the respondents agreed and only 8% disagreed, but as many as 44% selected the neutral or don't know options."

Recovery over time

Some studies have highlighted that recreational value is influenced by the time that has elapsed since silvicultural treatments were carried out. For example, the recreational value of stands in establishment phase may be particularly low after clearfelling, but it may increase gradually over time due to a decline in visible woody residue, disturbed soil, and other evidence of intervention, rather than due to an increase in tree size over the same period of time.

Silvennoinen et al. (2002: 263) write: "The length of time since the treatment has been found to correlate positively with the stand's visual quality (Hultman 1983, Brown and Daniel 1984, Hull and Buhyoff 1986, Kardell and Mard 1989, Ribe 1989, Kardell 1990, Palmer 1990, Lindhagen 1996). However the development of dense undergrowth after the treatment may have an opposite influence on the visual quality (Schroeder and Daniel 1981, Brown and Daniel 1984, Hull et al. 1987)." Similarly, Gundersen and Frivold (2008: 250) write: "Visual amenity value increases with the development of the new tree generation. After removal of the seed trees, the amenity value of a naturally regenerated stand is equal to that of a clear-cut stand at the same development stage." The temporal effect is summarised in Fig 2 below (see also 'Residue from harvesting and thinning').

One possibility that was rarely raised in the literature and the Delphi survey is that a young stand may contribute to the recreational value of a forest visit because it allows visitors to see beyond the stand itself. Occasionally this effect may be negative, for example if it reveals the recently cut edge of a neighbouring mature stand, although often it facilitates attractive views over distant stands, hills or mountains, or simply provides a welcome relief to the monotony of the closed-canopy forest. This would suggest a U-shaped distribution, a possibility raised by one respondent from the Great Britain Delphi panel.

Another point is that the results suggest that a mature stand of uniformly large trees is preferable to a mature stand with a diversity of tree ages. As noted under 'variation in tree size', this may not always be the case, for example as suggested by the high importance attached to variation in tree size by the Great Britain panel.

Fig 2. Average temporal development of the scenic beauty score (Source: Silvennoinen et al. 2002: 269)

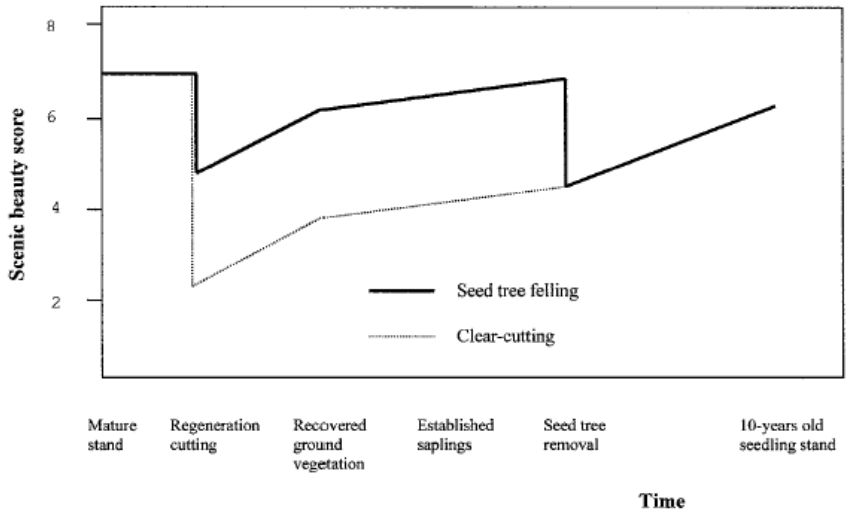

Fig. 3. Average temporal development of the scenic beauty score (range 1–10) of a Scots pine stand, as evaluated from photographs, in clear-felling and natural regeneration.

2. VARIATION IN TREE SIZE WITHIN STAND

Overall, this attribute was ranked 5 out of 12 across the four regions in terms of its overall contribution to the recreational value of forests. It was the highest ranking attribute in Great Britain, yet for the other three regions it was seen as relatively unimportant. The variation between regions was very high (see Table 12).

Table 12. Ranked mean contribution of 'variation in tree size within stand', by region

Region	Ranked mean contribution to recreational value
Great Britain	12
Nordic Region	2
Central Europe	6
Iberia	2
Overall ranking	**5**

The relationship of this attribute to recreational value was seen as positive by most respondents in each region except the Nordic Region where slightly more respondents considered the relationship to be bell-shaped (see Table 13). Thus, for Great Britain, Central Europe and Iberia, as variation in tree size within stand increases, from uniform to diverse, or as the number of canopy layers increases from one layer to many, the recreational value increases. Some respondents, especially in the Nordic Region, felt that very low or very high variation caused its contribution to be negative.

Table 13. Relationship to recreational value of 'variation in tree size within stand', by region

Region	Relationship to recreational value					Modal class
	Positive	Negative	Bell-shaped	U-shaped	Even	
Great Britain (n=10)	8		2			Positive
Nordic Region (n=12)	5		6		1	Bell-shaped
Central Europe (n=14)	10		4			Positive
Iberia (n=10)	6		4			Positive

A respondent from the Nordic Region commented that this attribute has been included in many Nordic studies, "but very few concluded that this is an important factor". Another from Nordic Region felt that this was "very hard to answer" for this attribute and that he didn't think that "any of the suggested

relationships fits". In contrast, in Central Europe one respondent reflected a more widely held view that: "The recreational value exists when there is a big number of different trees in the forest. This means high diversity and high diversity means high vitality. The recreation effect will be very good."

The literature review confirmed that the positive contribution of variation in vertical stand structure is highlighted by several studies. In their review of Fennoscandian studies, Gundersen and Frivold (2008: 248) write, under 'stratification or vertical structure': "Several surveys with different methodologies indicated that the public tends to give high scores to irregular stands with a mixture of trees of different sizes, as long as they are not disturbed by obvious traces from cutting operations (Lind et al., 1974; Hultman, 1983; Kellomäki and Savolainen, 1984; Kardell 1990, 2001; Lindhagen and Hörnsten, 2000)." Elsewhere, Gundersen and Frivold (2005:10) write on 'intermediate cuttings' how thinning from below appears to be more appreciated than thinning from above, but add: "On the other hand, a survey by Savolainen and Kellomaki (1981) stressed the importance of keeping some stratification, by leaving a maximum of 1000 – 1500 evenly scattered small trees per hectare after thinning."

Similarly, the earlier review of USA and European studies by Ribe (1989: 60) gives a mixed perspective on the impact of vertical diversity. Referring to USA studies, he writes: "Two reported findings relate to scenic beauty explicitly to forests' age structure. In one, mature even-aged ponderosa pine stands were preferred to uneven-aged stands, which were preferred to young even-aged stands (Brown and Daniel 1984). Later Ribe (1989: 60) continues: "The scenic effect of vertical forest structure is not so clear [compared to density and glades and visual penetration]. Brown and Daniel (1984) found vertical diversity, or the number of canopy layers, unrelated to SBEs. Similarly, Yarrow (1966) found that some respondents preferred mixed crown heights while others preferred single canopy layered forests. The scenic value of the low structural element of an understory of seedlings and/or shrubs has more frequently been investigated…" The study by Yarrow was carried out in Great Britain.

The positive impact of vertical diversity is confirmed in the Nordic Region by Silvennoinen et al. (2001: 18) who write: "A new predictor in our models, compared to earlier ones, is the skewness of the height distribution of trees, which increases the priority. Skewness is high in stands where tall trees overtop an under-storey of small trees, such as a regeneration area with standing seed trees and successful regeneration or a sparsely populated mature stand with naturally emerged spruce under-storey. The effect of skewness in our models corresponds to the result of Savolainen and Kellomaki (1981) who found that a conifer under-storey increases priority. Other studies indicate that bushes and lower vegetation make the view more pleasing (Schroeder and Daniel, 1981; Ribe 1990). Seed tree stands are experienced as rather pleasant visual environment (Mattsson and Li, 1994; Karjalainen, 1996; Lindhagen, 1996; Karjalainen and Komulainen, 1999)."

A review of Nordic literature by Tyrvainen et al. (2005: 91-92) concludes that: "In general, old and mature forest stands are preferred over young and small trees, but small trees, if they form the lower canopy layer of a two-storey stand, are considered to improve the aesthetic value of the stand." This last point was supported by Silvennoinen et al. (2001: 12) who write: "Stands of small trees are not appreciated, but small trees may be considered to look good if they form the lower canopy layer of a two-storey stand (Savolainen and Kellomaki, 1981; Schroeder and Daniel, 1981; Ribe, 1990)."

Elsewhere in Europe, Hekhuis and Wieman (1999:342) demonstrate that age variation can be an important factor influencing recreational value of forests in The Netherlands. They identify variation in age classes or development phases within tree stands as a key criterion for consideration. In a study of the ecological and social benefits of forests in Lorraine, France, Després and Normandin (1998) also found that there was a high preference for uneven-aged forests (77% of responding households preferred them).

While the literature presents evidence of the value of vertical diversity, the Delphi survey strongly suggests that this attribute is much more important in Great Britain than elsewhere in Europe. The

high importance attached to vertical diversity in the Great Britain Delphi panel is also supported by a study by Garrod (2002: 10) who reported the following public preferences for structural (height) diversity in UK forests: trees of various heights, 74.8%; trees that are all similar heights, 9.9%; equal preference, 14.7%; neither, 0.7%. In Great Britain, it is possible that, in the public imagination, even aged stands of conifers are regarded as particularly unattractive, not necessarily because they are even aged but because they tend to be dense stands of Sitka spruce that are rarely permitted to grow to maturity, are rarely thinned, and are often designed insensitively with geometric edges that fit poorly in the landscape.

3. VARIATION IN TREE SPACING WITHIN STAND

Overall, this attribute was ranked 5 out of 12 across the four regions in terms of its overall contribution to the recreational value of forests (see Table 14). It was ranked relatively highly in Great Britain (linked perhaps to the high importance attached in Great Britain to variation in tree size) and Central Europe, but was seen as relatively unimportant in the Nordic Region and especially in Iberia. The variation between regions was very high.

Table 14. Ranked mean contribution of 'variation in tree spacing within stand', by region

Region	Ranked mean contribution to recreational value
Great Britain	9
Nordic Region	4
Central Europe	8
Iberia	1
Overall ranking	**5**

The relationship of this attribute to recreational value was seen as positive by most respondents, and by fewer respondents as bell-shaped (see Table 15) In Iberia most respondents considered the relationship to be bell-shaped. Thus, for Great Britain, the Nordic Region and Central Europe, as variation in tree spacing within stand increases from regular to different sized groups of trees and openings, the recreational value increases. Some respondents, especially in Iberia, felt that very low or very high variation caused its contribution to be negative.

Table 15. Relationship to recreational value of 'variation in tree spacing within stand', by region

Region	Relationship to recreational value					Modal class
	Positive	Negative	Bell-shaped	U-shaped	Even	
Great Britain (n=10)	8		2			Positive
Nordic Region (n=12)	6		5		1	Positive
Central Europe (n=14)	11		3			Positive
Iberia (n=10)	2		7		1	Bell-shaped

During the Delphi survey, one comment on this attribute, from Nordic Region, noted that: "like visual penetration, small openings and variation in space seems to be an important factor, but lacking evidence in research."

Spacing

The literature review presents evidence of the positive impact of variation in tree spacing. In Great Britain, Garrod (2002: 10) reported the following public preferences for tree spacing in UK forests: regularly spaced trees, 10.1%; randomly spaced trees, 77.4%, equal preference, 11.8%; neither, 0.7%. Garrod's study used 33 photographs of forest landscapes from across UK, and more than 400 respondents in a series of choice experiments. "Of all the preferences investigated, the strongest were for plantings that mixed trees and open space and where spacing of trees was random rather than regular". Similarly, Lee (2001: 21) found a preference for more natural woodland that was not planted in straight lines. See also Willis et al. (2003) on spacing pattern.

Clumping and natural openings

In UK, Garrod (2002; 10) concludes that there is a preference for forest stands with openings. Referring mainly to studies in USA, Ribe (1989: 60) shows a mixed response to horizontal structural diversity. He writes: "The spatial distribution of tree density may also matter in scenic preferences, but this is not yet clear. Clumping of dense trees in ponderosa pine stands showed some evidence of being slightly preferred (Arthur 1977), but alternatively of being less so in the same kind of forest (Brown and Daniel 1984, 1986). The weakness of these relations, or factors correlated with clumping in the scene samples, might account for the discrepancy. In the latter case, clumping distributions, which create well-bounded and therefore visually defined meadow openings, may improve scenic beauty, especially if large enough (Brush 1978, 1979)." Ribe continues, noting the link between this attribute and visual penetration (1989: 60): "In any case, the positive aesthetic affect of forest openings, like that of less dense forests, likely has to do with the distance one can see into such landscapes, and measures of such visual penetration have been found to be correlated with scenic beauty (Echelberger 1979, Kardell 1979, Kellomaki and Savolainen 1984)."

Later Ribe (1989: 61-2) discusses the effect of canopy openings: "The presence of canopy openings in eastern US forests has been found to have a weak but positive influence upon scenic preferences (Brush 1979, Radar 1971). Such findings have been attributed to the visual desirability of resulting increases in ground vegetation cover in western US forests (Brown and Daniel 1984, 1986) and to lighting contrasts which contribute to crown prominence in ponderosa pine (Arthur 1977). However, in some other forest types, canopy openings can produce increased sapling densities over time, which may then account for lower perceived beauty, although this effect may not always be attributed to an open canopy in research reports."

Referring to the pattern of clear cuts, Ribe (1989: 65-6) writes: "Difference attributable to the spatial type of clear-cut pattern, as observed from within a forest, can be detected and make a scenic difference (Boster and Daniel 1972). Patch clear-cuts are preferred to larger ones, but are less attractive than shelterwood cuts (Schweitzer and others 1976). Patch cuts have also been found slightly preferable to strip-cuts and again less attractive than partial cuts (Echelberger 1979)." Regarding thinning in rows, Jensen (1993: 87) writes: "The experts' perception agrees with the preferences of the population – selective thinning ranks higher in preference than thinning in rows."

Gobster (1999: 56) writes: "But while forest ecologists have shown that fragmentation due to forest harvesting and other activities can be reduced by making fewer but larger openings and by minimising edge/area rations (i.e. round instead of linear), visual preference research shows that people generally prefer smaller openings over large ones, and opening that are scattered over those that are concentrated."

Structural diversity within stands is a part of what many people consider to be 'naturalness' or 'wildness', which is often valued highly. However, structural diversity within stands also reduces visual penetration, which may also be valued highly. To some extent, the two effects may cancel each other out. The logical conclusion is that, overall, people prefer size diversity within stands so long as there is still visual penetration. Irregular spacing patterns are preferred to straight lines, and hence the effect of line thinning is undesirable. Clumping of trees, for example due to patchy regeneration or selective felling, may be preferred because it gives the impression of naturalness, but it is hard to generalise.

4. EXTENT OF TREE COVER WITHIN STAND

Overall, this attribute was ranked 7 out of 12 across the four regions in terms of its overall contribution to the recreational value of forests (see Table 16). It was ranked consistently at around this level of importance, with very little variation between regions.

Table 16. Ranked mean contribution of 'extent of tree cover within stand', by region

Region	Ranked mean contribution to recreational value
Great Britain	7
Nordic Region	6
Central Europe	7
Iberia	7
Overall ranking	**7**

The relationship of this attribute to recreational value was seen as bell-shaped by most respondents, with the exception of the Nordic Region where it was equally judged to be bell-shaped and positive (see Table 17). Thus, in general, as extent of tree cover increases from sparse (i.e. retention and see trees) to moderate (e.g. shelterwood and selection systems) to full (i.e. closed canopy), the recreational value increases and then decreases. Very low or very high tree cover was considered less valuable than a moderate level of tree cover.

Table 17. Relationship to recreational value of 'extent of tree cover within stand', by region

Region	Relationship to recreational value					Modal class
	Positive	Negative	Bell-shaped	U-shaped	Even	
Great Britain (n=10)	1		9			Bell-shaped
Nordic Region (n=12)	6		6			Positive/Bell
Central Europe (n=14)	1	2	10		1	Bell-shaped
Iberia (n=10)	1		9			Bell-shaped

The Delphi survey comments on this attribute tended to indicate that the precise context can have a significant impact on its relative contribution, making it difficult to score with confidence. One respondent from Central Europe noted that it depends upon the "structure of the ground". The contribution would be negative "if the low cover is obviously caused by forestry (former clearcut with some seed trees)" or positive "if the low cover is perceived as natural or semi-natural (e.g. mountain pastures with a low tree cover due to grazing) and attractive". The importance of context is implicit in the comment of another Central European respondent who wrote that "glades and areas where the forest is less dense provide views, diversity in light and shadow [which can] enhance the recreational experience". Similarly, from Iberia, one respondent wrote: "Question 4 is a bit complicated to me, because I think that people like variety of tree covers, and it is not easy to me to compare different levels of tree covers. But finally, I think that BS is the shape that describes better the relationship."

Retention, seed and shelter trees

A number of studies suggest that a very sparse tree cover, comprising retention, seed and/or shelter trees retained after clearfelling, improves recreational value. For example, Lindhagen (1996: 386) notes that keeping seed trees may be a method of achieving acceptance for the cuttings and to make the regeneration as smooth as possible for the visitors.

In their review of Fennoscandian studies, Gundersen and Frivold (2008: 249-50) write: "Leaving seed trees or other single trees on a clear-cut area generally improves people's impression of it, likewise provision of a view (Kardell et al., 1977; Hultman, 1983; Kardell and Mård, 1989; Kardell, 1990; Mattsson and Li, 1994)." Later, Gundersen and Frivold (2008: 250) write of retention trees: "Tönnes et al. (2004) studied the scenic impact of retention trees. Retention trees are left on clear-cut areas mainly for the benefit of biological diversity. For that reason it is recommended to leave them in groups rather than as solitary trees. However, grading of photos showed that solitary retention trees provide a higher aesthetic value than a similar number of retention trees in groups. Leaving fewer retention trees than corresponding to a volume of $3m^3ha^{-1}$ does not significantly improve the scenic value of a clear-cut area." This contrasts with Gundersen and Frivold (2008: 250) citing a study of long-distance views carried out by Karjalainen and Komulainen (1999) which showed that: "seed trees improved the scenic appearance of cutting sites, but solitary retention trees did not significantly enhance the visual quality of the scene."

Silvennoinen et al. (2002: 263) write: "Natural regeneration with seed and shelter trees has often been found to be visually more acceptable than clear-felling and planting (Haakenstad 1972, Hultman 1979, Kardell 1990, Pings 1993, Mattson and Li 1994, Lindhagen 1996, Mäntymaa 1998). However, some studies indicate that there is not a great difference between the visual acceptability of clear-cutting and seed tree felling (Brunson and Reiter 1996)."

Silvennoinen et al. (2002: 271) add to this, with their own results: "Natural regeneration with seed trees seems to be a way to avoid the very negative effect of a clear-felling, especially in the case of Scots pine stands. This is because both the seed tree stand and an established regeneration of pines are regarded as much more attractive than an open area. A seed tree stand with an established regeneration of pines was regarded as almost as beautiful as a mature stand, and clearly better than a young seedling or sapling stand without seed trees. This indicates that keeping part of the seed trees on the regeneration area for a long time is another way to lessen the negative visual impacts of regeneration (Haakenstad 1972, Hultman 1979, Karhu and Kellomaki 1980, Kardell 1990, Pings 1993, Mattsson & Li 1994, Lindhagen 1996, Karjalainen 1996, Karjalainen and Komulainen 1999). This conclusion is not in agreement with some of the earlier studies (Brunson and Shelby 1992, Johnson et al. 1994, Brunson and Reiter 1996)."

Silvennoinen et al. (2002: 271) continue: "Regeneration of more fertile sites occupied by spruce and birch is more problematic: the seed tree method is seldom successful with spruce and a dense cover of hardwood seedlings and saplings, which soon appear on a fertile regeneration area, is not appreciated. A too sparse seed tree stand may give an impression of a deserted landscape (Kardell 1978, Lucas 1991). A birch seed tree stand is typically very sparse and the trees are not particularly attractive as isolated trees. Only a dense enough seed tree stand is thought to be clearly better than an open area (Lindhagen 1996, Karjalainen and Komulainen 1999)."

Landscape composition

Studies of landscape composition which consider preferences for the proportion of trees in the landscape tend to confirm the bell-shaped distribution identified during the Delphi survey. Tyrväinen et al. (2005: 92) write: "Variation is greatly appreciated, not only due to mixtures with other types of trees, but also combination of trees with fields, meadows and, in particular, water elements (Schmithüsen et al. 1997)." Willis (2003: 4.1.1), citing Garrod and Willis (1992) concludes that a patchwork of woods rather than 100% forest cover appears to be preferred.

The study in UK by Garrod (2002: 10) reported the following public preferences for size of forest in UK: large forests, 22.4%; small woodlands. 57.2%; equal preference, 19.2%; neither, 1.2%. This again suggests preference for moderate tree cover. The same study reported the following public preferences for proportions of trees and space in UK forested landscapes: a mix of trees and open spaces, 83.4%; just trees, 5.3%; equal preference, 10.8%; neither, 0.5%. Garrod writes: "Of all the preferences investigated, the strongest were for plantings that mixed trees and open space and where spacing of trees was random rather than regular". Roth and Krämer (2000) also identify a preference for forest/field mixtures within the landscape.

Similarly, Gundersen and Frivold (2008: 248) write: "Various investigations have pointed out that forests with possibilities for views over the surroundings are preferred (Haakenstad 1972, 1975; Lind et al. 1974; Kellomäki and Savolainen 1984)." Later (2008: 249) they write: "In two Norwegian landscape studies, photos showing pastoral fields and woodlands with broadleaved trees got the highest scores of all nature types presented (Strumse 1994; 2002a, b)."

Gundersen and Frivold (2008: 251) write: "Non-managed, overgrown fields and afforestation of such abandoned fields were considered the most disturbing factors in the local cultural landscape for land-owners, landscape planners, and people participating in the planning process in several rural landscapes and villages in Finland (Komulainen, 1998). Karjalainen and Komulainen (1998) showed manipulated slides of various options for afforestation of abandoned farmland to a mixed group of

voluntary survey participants in North Finland. All options were perceived as disturbing despite the afforested area in each option being 'small'. The situation of the afforested area was more important for the scenic beauty than the tree species used. Afforestation near the edge of an adjacent forest was preferred to location in the middle of the field. Using a similar method with respondents from East Finland, Tahvanainen et al. (1996) found that moderate afforestation (1/3 of the original farmland area) could have positive effects on scenic beauty, but that afforestation was little appreciated if it was applied to originally attractive cultural landscapes (cf. Strumse, 1996). A survey in Sweden (Kardell, 1990) showed very heterogeneous opinions among respondents when asked about their impression of a field afforested with *P. abies*."

Hunziker and Kienast (1999: 163-164) studied landscape preferences for spontaneous forest regeneration of abandoned agricultural land, and showed a preference for medium levels of reforestation. They write: "…we generated a series of 'reforestation images' by subjecting one single, real photograph of a landscape to computer-aided photo editing. […] Five images were compared: 1) cleared, 2) not reforested, 3) slightly reforested, 4) mostly forested, 5) completely forested." Scenario 1 resembled intensive agriculture; scenario 2 resembled the 'traditional' condition of the land in the 1950s, and scenarios 3-5 showed the 'current' condition. Hunziker and Kienast (1999: 166-8) continue with their results: "…the curves representing preference values given for increasing degrees of reforestation are similar to a bell, with a peak at the level of partial reforestation. [3 is most preferred, followed by 4, then 2, then 5, then 1]. A landscape with a medium level of reforestation seems to be the type of landscape people find most attractive. This result, therefore, substantiates the assumption arising from existing theories and prior research (Hunziker 1995)."

Hunziker et al. (2008: 144-5) compared preferences for four landscape scenarios in Switzerland: 1) 'status quo', 2) 'intensification', 3) restoring tradition' and 4) 'reforestation': "The results… show that the general Swiss public assesses all scenarios of cultural landscape change positively." [Preferences were in order: 1, 2, 4, 3.] Regarding the positive assessment for 'spontaneous reforestation' they write: "This result is rather surprising because previous studies have found that extensive and homogenous spontaneous reforestation tends to be viewed negatively (Volk 1985; Hunziker 1995; Tahvanainen et al. 1996; Hunziker and Kienast 1999). However… other recent studies in Switzerland and the Netherlands have also found rather positive attitudes towards rewilding (e.g. Bauer 2005; Van den Berg and Koole 2006)."

Garrod (2002: 13-14) reports on preferences for different "generic forest landscapes" compared to non-forested alternatives in UK. The landscapes under study were: 1) plateau conifer, 2) mountain conifer, 3) hilly/rolling conifer, 4) mountain broadleaves, 5) hilly/rolling broadleaves, and 6) urban fringe broadleaves. He writes: "Clear preferences for forested landscapes compared with the non-forested alternatives are only found for broad-leaved woodland in a peri-urban setting". […] The lack of significant willingness to pay values associated with certain landscape contexts is a cause for concern. [This is partly due to the small sample size] …Willingness to pay values were based on a maximum of 160 choices from 40 individuals. […] The negative coefficients associated with views of broad-leaved woodlands in mountain areas are also observed in both samples. The results may therefore reflect indifference among the population regarding certain forested landscapes or dissonance in preferences across the population." Note that the added benefit of the forest views representing recreational opportunities was elicited separately and subtracted from the landscape benefit.

To conclude, it is hard to generalise from the literature about the preferred percentage of forest cover because much depends upon what is between the forests, and the overall layout and context. We can conclude that presence of a significant proportion of open space is positive, and that the bell-shaped distribution suggested by the results of the Delphi survey may be tentatively supported.

5. VISUAL PENETRATION THROUGH STAND

Overall, this attribute was ranked 9 out of 12 across the four regions in terms of its overall contribution to the recreational value of forests (see Table 18). However, there was high variation between regions, with the Iberian panel ranking it highest, and Great Britain and Central Europe ranking it as relatively unimportant.

Table 18. Ranked mean contribution of 'visual penetration through stand', by region

Region	Ranked mean contribution to recreational value
Great Britain	4.5
Nordic Region	8
Central Europe	5
Iberia	12
Overall ranking	**9**

The relationship of this attribute to recreational value was seen as bell-shaped by most respondents, again with the exception of Iberia where it was considered to be positive (see Table 19). Thus, in general, very low and very high levels of visual penetration through a stand were considered to be negative compared to moderate levels. Likewise, moderate understorey and shrub layers were considered more positive to absent, or very dense, understorey and shrub layers.

Table 19. Relationship to recreational value of 'visual penetration through stand', by region

Region	Relationship to recreational value					Modal class
	Positive	Negative	Bell-shaped	U-shaped	Even	
Great Britain (n=10)	1		6	1	2	Bell-shaped
Nordic Region (n=12)	4		8			Bell-shaped
Central Europe (n=14)	4		9		1	Bell-shaped
Iberia (n=10)	8		2			Positive

A survey respondent from the Nordic Region saw the potentially high relevance of this attribute, although it could be seen to overlap with other attributes in the list: "'Visual penetration through stand' seems to be a key question regarding recreational value, but very few studies have this as main topic. Visual penetration depends strongly on several of the other factors mentioned in the scheme, e.g. Size of trees within stand, Variation in tree size within stand, Variation in tree spacing within stand, Extent of tree cover within stand. Savolainen & Kellomäki (1984) identify a Bell-shaped curve regarding distance visual penetration." Another Nordic respondent suggested that there was: "normally a positive effect, but in very frequented areas it might be negative." A respondent from Central Europe commented that "gender differentiation is important, for many women the subject feeling of security is very important. Many women are scared (alone) in a forest!" Another noted that "the feeling of being in a forest is lost" in a more open forest, but that such forests, which may also have cattle grazing [e.g. wood pasture], may have a high recreational value.

These conclusions appear to be supported by the literature. Kaplan (1985: 173) suggests that in the USA open forests receive higher preference ratings because they increase visual access or because less groundcover supports easier access. She states that: "Information that facilitates comprehension about what might be going on is valued; thus smoother textures, suggestions of paths, and sufficient openness to permit at least a sense of visual access is appreciated."

Gundersen and Frivold (2008: 248) write: "People tend to appreciate visibility in the forest (Haakenstad 1972, 1975; Hultman 1983), at least to some extent. In a small study with visual stimuli, Kellomaki and Savolainen (1984) concluded that the scenic value culminated when visibility passed 40-50 m."

Rydberg and Falck (2000: 13) explored fear of dense woodland (as well as attitudes towards edges): "…people tend to prefer more open woodlands and forests of the pillared-hall type (Parsons 1995). The sense of 'enclosure', which is a fundamental physical feature of forests, often causes people to feel fear and anxiety (Burgess 1995); nevertheless the sense of enclosure is also the main reason people appreciate woodlands."

Herzog and Kirk (2005: 621) studied path curvature, danger and visibility in forests in USA. It is relevant to understanding preferences for visual access: "Mystery refers to the promise that more could be seen if one entered more deeply into a setting. In general, mystery enhances preference, as documented by 30 years of research (for review see Kaplan, Kaplan and Ryan 1998), although not everyone is convinced (Stamps 2004)." [...] Herzog and Kirk continue (2005: 623): "On theoretical ground, one might expect that visibility, the ability to see unhindered into a setting, generally would be a desirable property in a forest setting. Blocked views make it difficult to comprehend any setting and discourage exploration. Thus, they have been associated both theoretically (s. Kaplan 1979) and empirically (e.g. Herzog 1992) with depressed preference. [...] Conversely, visual access has been associated with positive reactions to forest settings [refs]. […] Likewise the burgeoning literature on fear of crime highlights the fact that blocked views afford concealment for criminals and thus are associated with danger reactions... […] Two recent studies of preference and danger in natural settings (Herzog & Kropscott 2004, Herzog & Kutzli 2002) have included a predictor variable called visual access, defined as the ability to see all parts of a setting without having one's views blocked or interfered with."

Tyrväinen et al. (2005: 92) write: "In a study in Helsinki, Finland, the majority of residents preferred managed forests probably because of security and cultural reasons (Tyrväinen et al 2003). The most disliked stands were unmanaged forest vistas where young coppice limited sight and accessibility." Tyrväinen et al. (2005: 92) continue: "In a study conducted in Redditch, UK (Coles and Bussey 2000), open structure woodlands were found to be preferred over woods with a dense canopy cover, in particular because of security concerns but also as open woodland offers a more varied environment".

Stand density

The literature on stand density and understorey density is relevant to understanding this attribute. The link between stand density and stand age is often highlighted. Gundersen and Frivold (2008: 248) write: "Young, dense stands got a relatively low score in a slideshow survey by Pukkala et al. (1988), regardless of tree species (birch, pine or spruce). Walking in open, young stands is preferred above walking in dense, young stands (Haakenstad 1972; Hultman 1983), probably because open stands are easier to penetrate. Children and young people might have other opinions (Rydberg, 1988a) as they may visit such stands for other reasons." Gundersen and Frivold (2005: 5) expand on this exception: "Rydberg (1998a), in a study limited to young stands of various densities, found that dense stands were preferred; a substantial part of his respondents were children and teenagers."

The bell-shaped distribution of the attribute is clear from Ribe (1989: 60) who writes: "The low beauty of young forests is best explained by their high density, for this clearly detracts from scenic beauty in a variety of forest types (Brush 1978, 1979, Daniel and Boster 1976, Hull and Buhyoff 1986) and more so among very young dense stands of saplings and young poles… (Brown and Daniel 1984, Schroeder and Daniel 1981, Hull and others 1987)." Ribe (1989: 60) continues: "Density may also become too low and begin then to reduce scenic preferences (Savolainen and Kellomaki 1981). For example, Buhyoff and others (1986) found a scenically optimal number of 1- to 5-in. stems per acre to be about 1150, with more or fewer reducing perceived scenic beauty. This optimal value seems higher than that suggested by other studies. It grows slightly with stand age or average tree diameter, as respondents evidently were more tolerant of many saplings if the affect of large trees served to offset the density affect. [cf. Arthur 1977 …]"

Likewise, Silvennoinen et al. (2001: 12) write: "The within-forest visibility should be reasonably good, i.e. the stand should not be very dense (Savolainen and Kellomaki, 1981; Schroeder and Daniel, 1981; Hultman, 1983; Hull and Buhyoff, 1986; Brown 1987; Hull et al., 1987; Rudis et al, 1988; Ribe,

1990; Jensen, 1993; Bostedt and Mattson, 1995; Liao and Nogami, 1999)." Silvennoinen *et al.* (2002) also argues that dense young stands have a negative influence. Caparrós Gass and Campos Palacín (2002) referring to pine forest in Spain also show that dense young stands have a negative influence. González et al. (2001) referring to Galicia in Northwest Spain, conclude that low density of pines is preferred.

In contrast, Blasco et al. (2009: 76) write: "According to the models… the high densities of trees or bushes increase the scenic beauty." Later they conclude (2009: 77): "The present study reflects increasing scenic beauty in denser stands, which disagrees with other studies (Silvennoinen et al. 2001)."

Understorey density

Regarding understorey density, the bell-shaped distribution suggested by the Delphi survey is supported by Tahvanainen et al. (2001: 67), who found that removal of undergrowth had a negative impact on scenic beauty but that undergrowth should not become too dense as it may reduce visibility which is an important factor for recreation. This implies that there is an optimum density.

However, other sources present a contradictory picture. Regarding understorey density, Gundersen and Frivold (2008: 248) write: "Using visual stimuli to a modest number of respondents, Kellomaki and Savolainen (1984) found that in a regular, rural forest stand the presence of some undergrowth would increase the scenic value. In the Helsinki city forests, using a sample of citizens concerned about the management of those forests, Tyrvainen et al. (2003) came to the opposite conclusion. The most disliked stand type was dense and closed forest vistas with abundant undergrowth, where young coppices limit sight and visibility. Respondents of Kardell (1990) gave a high score for a stratified stand, but when the study was repeated after removal of all small and medium sized trees, creating an open pine stand with a view towards a lake, the stand got a still higher score."

Similarly a range of relationships was identified by Ribe (1989: 60-61): "The scenic value of the low structural element of an understory of seedlings and/or shrubs has more frequently been investigated [than vertical structure]. It would be expected to be negative in reducing visual penetration, as reported by Brush (1978). However, an understorey contributed to scenic beauty in western US forests (Schroeder and Daniel 1981) and also did so when it was diverse, as Brush (1979) reported that a varied understory in a red pine stand contributed to aesthetic liking. These results are contrary to the open parklike ideal forest image. However, a lower density or interesting character seen in an understory may influence the direction of its aesthetic value. Savolainen and Kellomaki (1981) found that a relatively sparse understory of visually defined coniferous saplings more clearly contributed to beauty perceptions tn did other denser stories. This relationship remains uncertain because understory density variables, as opposed to sapling counts, have been infrequently tested in empirical scenic studies, which favour other more routine timber cruise measurements in predicting beauty. One exception is founding Patey and Evans (1979) among preferences reported in the field. There, forests with less shrubbery were preferred, except among wildlife interest groups. Another comes from Hull and others (1987), who could not identify a significant relation between understory density and SBE in their photo response generated model."

Other studies tend to show a simple negative relationship between understorey density and recreational value. Tyrväinen et al. (2003) concluded that the most disliked stand type in the Helsinki city forests was dense and closed forest vistas with abundant undergrowth, where young coppices limit sight and visibility. Similarly, Karjalainen (1996) notes that dense shrub growth can negatively affect scenic beauty. The effect is negative if the undergrowth begins to resemble a thicket stage plantation. Jensen (1997: 142) carried out: "a comparison of the same 149-year-old beech stand without understorey and with natural regeneration." He concluded that: "the latter type of forest is preferred – mature deciduous forest undergoing regular natural regeneration. […] However… this difference can only be ascertained with significance in the 1977 survey." Blasco et al. (2009: 77) write: "The presence of bushes represents in our study an increment in the perceived scenic beauty, which agrees with previous studies (Shroeder and Daniel 1981; Ribe 1990). Small trees on the contrary seem to

have a negative effect on the stand scenic beauty perception, an effect previously reported by Brown and Daniel (1984) and Silvennoinen et al. (2001)."

Thinning

The substantial literature on the impacts of thinning is probably of most relevance to this attribute. Ribe (1989: 63) writes: "Thinnings… have generally been found to increase perceived beauty, with qualifications. In the eastern US, thinned stands have been found to be preferred to unthinned stands if allowed to recover and with attendant pruning (Brush 1978, 1979, Radar 1971); in western US if resulting slash is removed from the stands (Kenner and McCool 1985). Vodak and others (1985) found that light thinnings in eastern US hardwoods are preferred to heavy ones by a variety of groups and suggest thinning of eastern hardwoods to 17 square meters of basal area per hectare (75 square feet per acre) as aesthetically optimal. Such an optimal basal area is also reported by Hull and others (1987) for southern US pine forests. They found that this optimum grows with stand age as trees become larger, suggesting that tree numbers are more important than basal area. And the optimal basal area they report grew over time to a much higher level than that of Vodak and others (1985), namely 40 square metres of basal area per hectare (10 square feet per acre) at age 30. […] The existence of aesthetically optimal tree densities suggests that overthinning is possible, and this is somewhat supported by Daniel and Boster's (1976) study where a heavily thinned ponderosa pine stand was decisively least preferred, although this stand also contained slash, obscuring the singular affect of thinning."

In conclusion, Ribe (1989: 63-4) notes that, in general, thinning of small trees is preferable: "The weight of this evidence from southern US pine stands suggests that the density of small stems adversely effects scenic perceptions more than that of large stems, although a very low density of small stems can still be seen as relatively ugly (Hull and others 1987). This suggests a general rule for the aesthetic effects of alternative thinnings: Those that leave larger trees are beneficial. Still, it might be possible to have too many large trees… (Hull and others 1987). […] In sum, the aesthetic effect of thinnings is a problem contingent upon treatment design, stand situation, and time frame."

A similar conclusion is made by Gundersen and Frivold (2005: 10) who write regarding 'intermediate cuttings': "Few studies included the visual impact [of thinning] of young stands. Kardell (1990) identified a clear positive response on thinning in both pre-commercial and commercial thinning stands. […] Tyrväinen et al. (2003) found that moderate thinnings, including some visible stumps, were well accepted. Thinning from below, that is removal of the smallest trees, appears to be more appreciated than thinning from above, or removal of the largest trees (Haakenstad 1972; Kellomäki 1975; Kardell 1990)." Elsewhere, Gundersen and Frivold (2008: 250) write: "In a rural area of Finland, Silvennoinen et al. (2002) found that leaving the strongest and most attractive individual trees in tending of young, dense stands increased the perceived beauty to a greater extent than thinning in middle-aged and older stands."

An overview is also given by Silvennoinen et al. (2002: 263) who write: "All thinning treatments increase visibility in the forest, which is usually considered positive (Savolainen and Kellomaki 1981, Schroeder and Daniel 1981, Hultman 1983, Hull and Buhyoff 1986, Brown 1987, Hull et al. 1987, Rudis et al. 1988, Ribe 1990, Jensen 1993, Bostedt and Mattsson 1995, Liao and Nogami 1999. […] Thinning treatments affect the stand's scenic beauty less than regenerative fellings (Pings 1993, Brunson and Reiter (1996). Although only a few studies are available on the visual effects of tending and thinning treatments of young stands, both positive (Patey and Evans 1979, Schroeder and Daniel 1981, McCool et al. 1986, Hull et al. 1987, Palmer 1990, Sievänen 1993, Mäntymaa 1998) and negative (Vodak et al. 1985, Pings 1993) impacts have been reported. In general, the emergence of a very dense young stand has been experienced to be visually undesirable (Hultman 1983, Kardell and Mård 1989, Ribe 1989, Kardell 1990, Lindhagen 1996)."

From their own research, Silvennoinen et al. 2002: 271 add to this: "The analysis of photographs indicated that thinning treatments have quite a small immediate effect on the scenic beauty score. This means that the positive effects (improved visibility) and negative effects (cutting residues) are small or largely cancel each other out. Thinnings increased the mean scenic beauty score most in young and

dense stands. Young stand improvement had the greatest positive visual effect. The reason for this is most probably that stands treated with this method are very dense, approaching the self-thinning limit. Removing a great number of dominated, weak and slender stems reveals the strongest and most attractive individuals and increases the visibility within the stand. The positive effect was greatest in hardwood stands and conifer stands with a mixture of hardwoods. Some other studies indicate that thinnings in hardwood stands may not always yield visual benefits (Vodak et al. 1985, Pings 1993)." Later, Silvennoinen et al. (2002: 271) note that: "Extraction roads needed in mechanized thinning treatments were never shown in the photographs used in this study, which may have led to a slightly too positive view on the visual effects of thinning."

Other perspectives include those of Jensen (1993: 87) who writes: "The population prefers very heavy thinning to light thinning of Norway spruce. All expert groups share this perception of the population's preferences…" [See also: Jensen (1997: 147) which states that this was the case in 1977 and 1994.] Tahvanainen *et al*. (2001:60) write of their study in oak and pine forests in the southwest of Finland that thinning (and removal of undergrowth) had a negative effect on 'natural' scenic beauty although such treatments were evaluated positively for recreation. Tyrväinen *et al.* (2003: 142) found, in urban forests around Helsinki, that thinning in spruce stands negatively affected scenic beauty although it was considered to be less unsightly in other forest types. Yet, overall, the study showed that thinning improves scenic beauty compared to no management.

Shelterwood and selection systems

The literature on shelterwood and selection systems indirectly reveal preferences for difference levels of visual penetration. Gundersen and Frivold (2008: 250) write: "The uniform shelterwood system has been suggested as an alternative to clear cutting in urban forests, because tree generations in the uniform system partially overlap and not all trees are removed at once (Rydberg 1998b and others). Not many Fennoscandian preference surveys included this alternative. It should be kept in mind that when the last shelter trees are removed upon completion of regeneration, the stand becomes a uniform young stand similar to the one regenerated by clear cutting. Recreationists in North Finland do not give shelterwood stands a particularly high score, according to a slide-based study by Saastamoinen (1982). Unfortunately the development stage of the stands was not specified in his report."

Gundersen and Frivold (2008: 250) continue: "A photo of a stand that could be either a dense seed-tree stand or a shelterwood stand, with *P. sylvestris* as shelter trees and a dense regeneration of *P. sylvestris* and *Betula* spp., got a high score among the respondents of Hultman (1983) and Lindhagen and Hörnsten (2000). A set of mail surveys in North Sweden (Mattsson and Li, 1994; Mattsson et al., 1995; Holgén et al., 2000) included ranking of photo series from four different silvicultural systems: clear-cut with planting, clear-cut with regeneration from seed-trees, the uniform shelterwood system, and the selection system. Photo series from mixed pine-spruce stands in various phases of shelterwood regeneration, including completed regeneration with no shelter trees, got the highest recreational value." Later Gundersen and Frivold (2008: 250) note that: "True selection forestry with complete all-size stratification is and has always been rare in managed Fennoscandian forests (Andreassen, personal communication)."

Ribe (1989: 64) writes: "Among even-aged harvests, near views of shelterwoods are preferred to those of clear-cuts among western US forests irrespective of other site treatments such as slash removal (Benson and Ullrich 1981). Scenes from recently harvested shelterwood cuts in the same forests are still disliked compared to scenes from most other preharvest forest conditions (Daniel and Boster 1976, Schweitzer and others 1976). Seed-tree cuts have not been clearly tested." Other perspectives are given by: McCool et al. (1986), Hultman (1983) and Bradley and Kearney (2007: 49).

In conclusion, it appears that moderate density is generally preferred to low or high density, largely because it allows visual accessibility but also perhaps because it gives the impression of healthiness and good management. The results of thinning operations are generally positive (especially after any evidence of intervention has gone). In normal silvicultural practice, stands are probably more likely to be too dense than too sparse because dense planting encourages straight stems, and because thinning is

often uneconomic. Stands that are considered aesthetically too sparse often result from inadequate levels of natural regeneration. Low density stands of some broadleaves (especially birch) may be considered less attractive than conifers at the same age and density.

6. DENSITY OF GROUND VEGETATION COVER UP TO 50cm HEIGHT WITHIN STAND

Overall, this attribute was ranked lowest across the four regions in terms of its overall contribution to the recreational value of forests (see Table 20). However, there was some variation between regions, with the Iberian panel giving it a moderate ranking.

Table 20. Ranked mean contribution of 'density of ground vegetation cover', by region

Region	Ranked mean contribution to recreational value
Great Britain	1
Nordic Region	1
Central Europe	3
Iberia	5.5
Overall ranking	**1**

The relationship of this attribute to recreational value was seen as bell-shaped by most respondents, again with the exception of Iberia where it was considered to be negative (see Table 21). Thus, in general, very low and very high levels of ground vegetation were considered to be negative compared to moderate levels.

Table 21. Relationship to recreational value of 'density of ground vegetation cover', by region

Region	Relationship to recreational value					Modal class
	Positive	Negative	Bell-shaped	U-shaped	Even	
Great Britain (n=10)	1		8		1	Bell-shaped
Nordic Region (n=12)	3	4	5			Bell-shaped
Central Europe (n=14)	2	1	11			Bell-shaped
Iberia (n=10)	1	6	3			Negative

The Delphi survey comments suggested that the contribution of this attribute is dependent upon the precise nature of the ground cover. One respondent from Nordic Region noted that the contribution of ground vegetation of a height of 50 cm is "totally different than the height of 20 cm." Another from the same region commented that this attribute was "difficult to estimate". In Central Europe, two different comments were offered: one respondent noting that the relationship was "generally positive, but [that] some spots with bare ground, rocks or herbaceous plants also enhance recreational value". Another respondent gave a high score and a negative relationship: **"**From my experience, forest visitors clearly prefer little undergrowth, especially little and not too dense ground cover for various reasons (such as comfortable walking, seeing where you are walking, no hidden spiders, snakes, getting wet etc) – hence I feel that there is a negative correlation with increasing ground density (up to 50 cm). Since this might be a decisive factor whether to enter a forest or not, I ranked it rather high (8) in the importance and relative contribution with a high confidence rating of my opinion! However, I changed the correlation form to bell shaped since some flowers on the forest ground might make the forest more attractive!" Another comment from Central Europe noted that: "we might consider the role of ticks" which may deter people from leaving the path if there is substantial ground vegetation.

From the literature review it was apparent that this attribute has not been the focus of much preference research. Ribe (1989: 63) concludes from a small number of studies, mainly in USA, that it generally makes a positive contribution: "The vegetative ground coverage of forest floors, as opposed to a shrub and sapling understory, whether of grasses, ferns, forbs, or seedlings, is positive in affect (Arthur 1977, Radar 1971). This relation appears to be reinforced when scenic preferences are compared between forests with ground covered with vegetation versus those with bare or disturbed soil (Brush

1978, 1979, Echelberger 1979, Schroeder and Daniel 1981). Brown and Daniel (1984, 1986) and Daniel and Schroeder (1979) have found vegetative ground cover to be a primary positive factor in their SBE prediction models. A forest managed specifically for range, as an open parklike stand with a grass ground cover, was considered of above average scenic beauty by all sampled observer groups except environmentalists (Daniel and Boster 1976). […] This preference for lower ground vegetation cover is also confirmed in stands where taller shrubbery was controlled by grazing and other methods (Patey and Evans 1979). This effect may be limited to such treatments that do not excessively impact vegetation, as would overgrazing and scarification."

Other researchers present a mixed picture. Tahvanainen et al. (2001:60), in a study carried out in coastal southwest Finland, used visual and verbal stimuli to elicit preference responses and discovered through verbal questioning that there were differences of opinion concerning ground cover based on gender and age. No general conclusion appears to be given. Karjalainen (1996:168) suggests that shrubs and grass can mitigate against the negative scenic effects of clearcutting. Gundersen and Frivold (2008: 249) write: "Very few Fennoscandian surveys included specific questions about the field layer in forests. Verbal surveys by Lind et al. (1974) and Aasetre (1993) showed that a majority enjoys "walking on a green mat of forest mosses", but the mental image "forest mosses" is not clearly stated."

To conclude, low ground vegetation is preferred in general to bare ground but it depends upon the kind of vegetation. Bare ground may be expected in some contexts (e.g. under a closed canopy of mature conifers), and hence acceptable or preferred by some groups. Preferences for different types of vegetation are difficult to generalise. A covering of spring flowers under a mature stand of broadleaves is highly valued and expected in some contexts. Less attractive vegetation (e.g. bramble in UK) may add little value, or be valued negatively, for some visitors who see the vegetation as a barrier to physical access even if there is still very good visual access.

7. NUMBER OF TREE SPECIES WITHIN STAND

Overall, this attribute was ranked 3 out of 12 across the four regions in terms of its overall contribution to the recreational value of forests (see Table 22). There was some variation between regions, with the Iberian panel giving it a moderate ranking.

Table 22. Ranked mean contribution of 'number of tree species within stand', by region

Region	Ranked mean contribution to recreational value
Great Britain	4.5
Nordic Region	5
Central Europe	2
Iberia	8
Overall ranking	**3**

The relationship of this attribute to recreational value was seen as positive by most respondents, with the exception of Central Europe where it was considered to be bell-shaped (see Table 23). Thus, in general, as number of species within the stand increases from one to many, the recreational value increases.

Table 23. Relationship to recreational value of 'number of tree species within stand', by region

Region	Relationship to recreational value					Modal class
	Positive	Negative	Bell-shaped	U-shaped	Even	
Great Britain (n=10)	5		4		1	Positive
Nordic Region (n=12)	6		5		1	Positive
Central Europe (n=14)	6		8			Bell-shaped
Iberia (n=10)	7		2	1		Positive

This attribute prompted diverse comments during the Delphi survey, especially from Central Europe. One respondent from Great Britain suggested that we might assume the public prefer tree species diversity, but that this may not be the case: "I think it is very easy to be seduced into thinking that people like more species. I think many people think a single spp beechwood is extremely beautiful, and with almost no ground flora or lower storey (relevant to other questions here). Similarly some of the most awe inspiring forest I've seen recently involved a huge stand of Douglas fir in Wales – one species, one age. So I do think it depends on (a) species and (b) cultural perceptions of what is acceptable." During Round 2, the same respondent added that its relative contribution was too dependent on other factors to be scored with confidence: "again, a single species forest can be very beautiful (native Scots pine) or not (Sitka spruce) – other factors interact too strongly with this one to make it scorable."

One respondent from Central Europe echoed this point, by noting that the relationship would be "negative if the forest is too dense without [a] view." Another argued that: "none of the relationships fits" for this attribute: "I guess something hyperbolical (high increase in the beginning, less in the middle, asymptotically none in the end)". In Round 2, the respondent added: "I still think that this relation is best described as hyperbolical (or better: positive with a diminishing slope) i.e. 2 species are valued higher than 1 species, but 5 species are not valued higher than 3 species, simply because most folks are not able to distinguish different tree species. However, I do not want to leave you without answer, and I take "positive" as a linear approximation to "positive with a diminishing slope". A further respondent from Central Europe concluded that the relationship was best described as positive: "I disagree with the mainstream opinion: I stick to P and ranking 8. I think, the number of tree species is very important, the more species in a stand, the better the stand is suited for recreation e.g. for children collecting leaves in autumn, mix of colours during seasons." A final respondent from this region suggested that the value attached by many experts to this attribute was associated with its biodiversity value, and that this factor was likely to be appreciated less by the average visitor.

Species type (broadleaves, conifers and mixed)

The literature appears to support the conclusion of the Delphi survey that species type is relatively unimportant. Regarding species composition, Ribe (1989: 62) highlights the significance of context, and suggests that there is a slight overall preference for species diversity. He writes: "The species composition of forests can influence scenic preferences. Certain species may be preferred as more fitting or expected in different settings. For example, British respondents preferred mainly coniferous stands in mountain areas and mainly deciduous stands in agricultural settings (Yarrow 1966). In a given setting, a mix of species can increase scenic beauty (Cook 1972, Kellomaki 1975), although general agreement on this relation may be weak, as Karhu and Kellomaki (1980) found that two thirds of their subjects preferred mixed stands and one third monocultures. The inclusion of aspens among ponderosa pine has a beneficial scenic affect, while oaks, junipers, and firs do likewise to a lesser extent (Schroeder and Daniel 1981). The same affect is observed where similarly white-barked birches are mixed into coniferous stands (Kellomaki and Savolainen 1984), where at least 10% of other species are mixed into a ponderosa pine forest (Daniel and Schroeder 1979), or where a little Gambel oak is mixed among ponderosa pine (Brown and Daniel 1984). […] Among monoculture or near-monoculture forests, a study of Europeans showed a preference for mature birch to Norway spruce or Scots pine (Karhu and Kellomaki 1980, Kellomaki 1975, Savolainen and Kellomaki 1981). Among Minnesota residents, mature red pine was preferred to white pine, which was preferred to paper birch (Klukas and Duncan 1967)."

Ribe (1989: 62) concludes: "All these results seem rather anecdotal. Species preferences appear to be partly influenced by cultural, regional, contextual, and subjective expectations. The structural attributes of the forests, rather than the corresponding species used in the tests, may well have played a critical role, as in the Massachusetts and Minnesota findings, and these considerations may be more important than explicit species choices. The overall results do suggest aesthetic merit in forests with a variety of species when they create visual diversity, as has often been suggested by landscape architects."

The overall picture assembled by Gundersen and Frivold (2008: 248) is also unclear: "Elements of deciduous trees in coniferous forests are generally considered positive, according to surveys by Haakenstad (1972), Lind et al. (1974) and Hultman (1983). Regarding people's attitudes to mixed stands and pure spruce, pine and birch stands, the various surveys including such questions provided a rather messy picture. Haakenstad (1972) and Andreassen (1982) found that respondents preferred mixed deciduous-coniferous stands to pure stands, at least when asked verbally, while Korhonen (1983) and Tyrväinen et al. (2003) came to the opposite conclusion using verbal and visual stimulation, respectively. Some authors found that pure birch stands were preferred above pure coniferous stands (Karhu and Kellomäki, 1980; Hultman, 1983; Kellomäki and Savolainen, 1984), others found that pure pine stands were about equally attractive as pure birch stands (Kellomäki, 1975; Pukkala et al., 1988; Tyrväinen et al., 2003) or even more attractive (Korhonen, 1983). In two different conifer-dominated urban forests, respondents of Haakenstad (1972) and Andreassen (1982) preferred coniferous stands more than deciduous stands for walking. Our overall conclusion is that people's preferences for tree species and species compositions strongly depend on the context of other factors like openness and visibility, the amount of light in the stand, and stratification, as well as what kind of forest people are used to."

An overview by Axelsson Lindgren (1995: 282) suggested that: "In spruce stands, the mixture of other species constantly increased the beauty and recreation evaluations. The effect of the tree species depended on the age and size of the trees [citing Pukkala et al. 1988; Savolainen & Kellomaki, 1981]. […] Rather different results are given in a study by Koch and Jensen (1988), where the photos to a large extent show broadleaved deciduous forest common in Denmark. Studies conducted in other Nordic countries have very few photos of broadleaved deciduous forest. The Danish subjects like deciduous forest better than coniferous forest, especially in the summertime. Beech forest is most preferred. High preferences for beech forest are also found in Sweden (Hultman 1983). Deciduous forest gets more popular with increasing age of the trees (Koch and Jensen, 1988). […] In wintertime, young stands of spruce are just as much liked as young beech stands."

Jensen (1993: 85) reports, on 'the choice of tree species', that: "All segments of the expert group have a very clear perception that the population prefers broadleaved forests to coniferous forests – which is true. […] A topic which has been discussed for many years in Danish forestry is beech versus Norway spruce… According to the mean assessment of the population, old stands of beech rank higher in preference than old stands of Norway spruce in the summer… When the photos are taken in the wintertime there is no significant difference between the population's mean assessment of a stand of young beech and Norway spruce… And if the Norway spruce had a light cover of snow, then it would presumably have been ranked highest." [See also Jensen 1997: 143. This was similar in 1977 and 1994].

Other perspectives include that of Schraml and Volz (2009: 248, citing Schriewer, 1998), who provide a list of adjectives to show perceptions of coniferous and broadleaved forests in Germany, based on 50 interviews:

Table 24. Perception of coniferous and broadleaved forests in Germany (n=50) (Schraml and Volz 2009: 248, citing Schriewer 1998)

Conifer forests	Broadleaved forests
Artificial, man-made	Native, natural
Darkness, black	Light, diverse colours
Impermeable, repelling	Permeable, inviting
Uniform, military	Individual
Monotony	Diversity
Young trees	Old trees
Mushrooms	Flowers
-	Cathedrals
'Waldsterben'	-

In a study by Garrod (2002: 10) the following public preferences for tree species type in UK forests were estimated: coniferous trees 13.7%; broadleaved trees 54.6%; equal preference 30.8%; neither 1.0%. A preference for mixed stands in UK was also shown by Entec and EERG (1997: 3-4) who describe their contingent valuation survey which involved 638 respondents. "The sample contained a mix of non-users and users (with varying frequencies of use) of forests…" The following results were obtained regarding species composition:

Table 25: WTP bids: pooled data across 1st, 2nd and 3rd preferences (Entec and EERG 1997: 6)

Design		Mean	95% ci
Autumn	Evergreen only	7.53	0.71 – 14.35
	Evergreen + broadleaved	12.49	5.80 – 19.18
	Evergreen + broadleaved + Larch	17.86	13.14 – 22.58
Spring	Evergreen only	13.54	3.24 – 23.85
	Evergreen + broadleaved	10.39	3.70 – 17.08
	Evergreen + broadleaved + Larch	17.00	12.39 – 21.61
Winter	Evergreen only	31.69	16.29 – 47.09
	Evergreen + broadleaved	10.90	3.97 – 17.83
	Evergreen + broadleaved + Larch	13.22	9.85 – 16.59

Entec and EERG (1997: 3-4) conclude overall from their study that: "The WTP [willingness to pay] values confirm a preference for 'natural-looking' forests with positive net values being expressed for such enhancements. One exception was for winter, where Evergreens only was found to have a higher WTP than mixed species – possibly due to the so-called 'Christmas Card' effect."

Again, a preference for broadleaves in UK was shown by Lee (2001: 70) who write: when people in the household survey said that they would like to see more forests, they were asked what kind of trees should be planted. 37% said any kind of trees; 33% said a mixture of the two (broadleaved/conifers); 21% preferred broadleaved, and 5% said conifers; 4% said they don't know. […] Social class differences were considerable, as discussed in Section 4. Elsewhere, Lee (2001: 21) revealed that participants felt that conifers were acceptable in an appropriate landscape (i.e. one sparsely populated by people) while broadleaf species were more popular at a local level. Lee (2001: 154-56) writes, on the results of his landscape preference study, that the distinction between broadleaved and conifer trees had a very low but positive correlation with 'best picture', i.e. in favour of broadleaved trees. Also, the inclusion of a proportion of broadleaved trees was significantly more important to close views than distant views.

Likewise, in a forest complex in Flanders, Roover *et al* (2002: 136) found that pure coniferous stands were not popular amongst user groups such as walkers and that again mixed forests had the highest preference rating.

Two studies were found which examined public preferences for tree shapes, which could indirectly reveal preferences for species type. In urban greenspaces in northwest Turkey, Müderrisoğlu et al. (2006) found from their sample of 268 people that pyramid shaped trees were most preferred and that a mixture of round and pyramid shapes were considered more scenic and created a relaxing atmosphere (ibid: 799). If pyramidal shaped trees represent conifers and irregular shaped trees represent broadleaves, the results suggests a preference for mixed stands in this specific urban context. Parsons and Daniel (2002:49, citing Sommer and Summit 1996, and Summit and Sommer 1999), note that in the USA, and cross-culturally, people prefer "spreading and globular, acacia-like tree shapes" associated with productive habitats. They went on to suggest evolutionary explanations for these visual preferences.

Importantly, at least for a UK context, the planting design and the management regime need to be separated out to understand the impact of tree species per se. A related point is made by Price (2003: 127, citing Price 1995) who writes: "Sitka spruce more than 50 years old must have been planted at least 50 years previously – at a time when little design input to plantations was attempted. Hence adverse aesthetic effect may be due not to physiological age as such, but to a correlated attribute – lack of design input – of which the normative implications are quite different."

Other perspectives are provided by: Bernasconi and Schroff (2003); Maresca (2001) for preferences for broadleaves, conifers and mixed in peri-urban Paris, and Despres and Normandin (1998) for a study in Lorraine, France, where mixed forests were considered the most popular, followed by broadleaved forests, and finally by conifers. However, in this latter study, most people were indifferent. Willis (2003: 411), citing Willis and Garrod (1992), concluded that broadleaves can enhance, while conifers can reduce, property values.

Exotic tree species

Differential preferences for exotic tree species are dependent upon the extent to which the public are able to distinguish them from native species. In Spain González *et al.* (2001) found that in a study of 200 Galician citizens people preferred the traditional forests (i.e. oak, chestnut and broadleaves) over conifers or eucalyptus plantations. Gundersen and Frivold (2008: 251) write: "Almost 60% of the respondents in the verbal mail survey of Haakenstad (1972) did not want areas with exotic tree species in the forests around Oslo. Only 13% answered that they would like such areas. In these forests practically all tree species are indigenous. In some parts of the municipal forests of Trondheim, however, afforestation with foreign conifer species has a long tradition (Aaeng 1923). Here, forest visitors were more positive to the presence of such species than Haakenstad found for residents of Oslo. […] (Andreassen, 1982)" Some large forest holdings in North Sweden planted the American pine species *Pinus contorta* over large areas… Kardell and Wallsten (1989) invited volunteers from a small town for a forest walk in the neighbourhood to test their preferences regarding two *P. contorta* stands and three stands with indigenous tree species (pure *P. sylvestris*, pure *Picea abies* and a mixed *P. abies* and *Betula* spp. Stand). All stands were middle aged and structurally similar. The authors concluded that the two *P. contorta* stands were perceived as slightly lighter and less natural than the other stands, but no less suitable for outdoor recreation. Ordinary people among the respondents turned out to be rather indifferent both about forestry in general and about the use of *P. contorta* in particular. Far from all forest visitors are able to recognise differences between foreign and domestic tree species at all (Kardell and Wallsten, 1989), so questions about exotic species can be difficult to formulate and answers difficult to interpret (cf. Haakenstad 1972)."

8. SIZE OF CLEAR-CUTS

Overall, this attribute was ranked 11 out of 12 across the four regions in terms of its overall contribution to the recreational value of forests (see Table 26). There was very little variation between regions.

Table 26. Ranked mean contribution of 'size of clear-cuts', by region

Region	Ranked mean contribution to recreational value
Great Britain	10
Nordic Region	10
Central Europe	10
Iberia	9
Overall ranking	**11**

The relationship of this attribute to recreational value was seen as negative by almost all respondents (see Table 27). Thus, in general, as size of clear-cuts increases from small to large, the recreational value decreases.

Table 27. Relationship to recreational value of 'size of clear-cuts', by region

Region	Relationship to recreational value					Modal class
	Positive	Negative	Bell-shaped	U-shaped	Even	
Great Britain (n=10)		8	1	1		Negative
Nordic Region (n=12)		12				Negative
Central Europe (n=14)		13	1			Negative
Iberia (n=10)		10				Negative

During the Delphi survey, one participant from Great Britain commented that the relationship of this attribute to recreational value was dependent upon the scale of the landscape: "although I appreciate the specific nature of the question the relative size of clear cuts has a distinct relationship to the scale of the landscape and elevation of the forest area. Both these attributes will influence the relative scale and design of the clear cut shape. Meaning that in a large scale rolling landscape, a relatively large scale clear cut may be appropriate on hilltops; its success from a forest user's perspective will depend on its internal shape, specifically the margin, relationship to landform and features, any retentions and edge detail." A related point from another Great Britain participant suggested that a bell-shaped relationship was most appropriate: "For Q8, I suspect my B rather than N Relationship score reflects a cultural acceptance of clear cuts as a primary forest management tool in Scottish forests. Further, with many of those forests in visible upland hill areas visual scale of clear cuts is an issue; both too small and too large scale can be a visual issue that has a potential impact on the recreational experience in these forest landscapes." Similarly, a participant from Iberia suggested that very small clear cuts may be regarded as positive: "Concerning question 8, I think that people could assess positively some clear cuts if they are very very small (because in that way we would be getting a kind of variety in the landscape and I think that people like that). However, I have to remark that I refer to very small clear cuts. However I see the point of the majority and I have changed my vote."

From the literature, the overall effect of this attribute is summarised by Gundersen and Frivold (2008: 250) who write: "Silvicultural measures that have been discretely performed, without striking traces from harvesting, leave an impression of caring for the natural environment. This is believed to have an influence on the registered visual effect (Lind et al. 1974; Kardell and Lindhagen 1998)." Silvennoinen et al. (2002: 268) indicates how the scenic beauty score changes on a continuum from clear-cutting (very negative impact) through to young stand improvement (positive impact) (see Fig 3).

Several other studies provide further evidence of the negative impact of intrusive interventions, including clear-cuts. Ribe (1989: 64) writes: "Considerable research has attended to perceptions of the results of timber harvest methods, due to their obvious aesthetic impacts. […] Not surprisingly, the most essential and obvious finding regarding harvest perceptions is that the greater the proportion of trees removed, the lower the scenic value of the result (Vodak and others 1985). Echelberger (1979) also reports this relationship and, in searching for emotive causes, found that when viewing harvested areas his respondents favoured adjectives like, 'violent,' 'rough,' or 'rugged' in forming negative impressions and 'gentleness' or 'delicacy' for positive ones. This supports the importance of perceived

damage in the negative perception of harvested sites." Later Ribe (1989: 64) adds: "The low scenic value of clear-cuts is empirically supported for in-stand eastern US hardwood views (Vodak and others 1985) and for mid-ground western US vista views (McCool and others 1986). More often, the ugliness of clear-cuts is simply assumed, with visual mitigation measures the object of research."

Fig 3. Mean change in the scenic beauty score (range 1-10) in different cutting types (Source: Silvennoinen et al. 2002: 268)

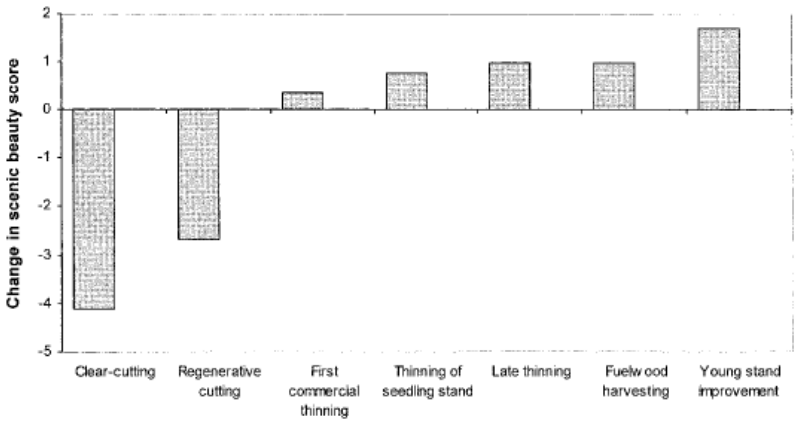

Fig. 2. Mean change in the scenic beauty score (range 1–10) in different cutting types. The *y*-axis is the difference in the scenic beauty score after cutting and just before the treatment. The after-cutting score is the mean of a fresh cutting area and a situation 1–3 yrs later.

Gundersen and Frivold (2008: 249) write: "Different earlier surveys (Haakenstad 1972; Lind et al. 1974; Kardell, 1978; Hultman 1983; Korhonen, 1983) indicated that large, fresh clear-cuts were considered negative by a majority of forest visitors. The proportion of respondents with a negative attitude to clear-cuts tends to increase with the size of the clear-cuts (Kardell 1978; Hultman, 1983; Korhonen, 1983; Kangas and Niemeläinen, 1996), with poor adaptation of the clear-cuts to landscape forms (Kardell, 1978; Karjalainen and Komulainen, 1999), with the amount of stumps and wooden debris (Kardell et al. 1977; Aasetre, 1993, 1994), and with closeness to the city (Jaatinen, 1976). Haakenstad (1972) showed clear-cuts of various sizes to passing forest visitor near Oslo, Norway. A majority responded that the largest clear-cut (6 ha) was too large, while the size of the smallest (2 ha) was suitable." Later Gundersen and Frivold (2008: 250) write: "A recent study from Finland (Silvennoinen et al., 2002), where volunteers were asked to grade photos and fill in a questionnaire, confirmed that clear cutting reduces the amenity value of a stand significantly more than regeneration with seed trees."

Regarding long distance views, Gundersen and Frivold (2008: 250) note that: "The surveys cited above dealt with near-distance visual effects of regeneration cuttings. Karjalainen and Komulainen (1999) made use of manipulated photos depicting long-distance views of some clear-cutting options on a sample of forest experts, tourists and the general population. Their main findings were that the zero option (no cutting) was preferred to visible clear-cut areas."

Similarly, Silvennoinen et al. (2002: 263) write: "Earlier studies [also] indicate that people do not find clear-felling areas visually attractive (Benson & Ullrich 1981, Daniel & Boster 1976, Vodak et al. 1985, Mattsson & Li 1994, Kangas and Niemelä 1995, Brunson & Reiter 1996, Komulainen 1998, Mäntymaa 1998)." From their own research, Silvennoinen et al. (2002: 271) report that: "Natural regeneration with seed trees seems to be a way to avoid the very negative effect of a clear-felling, especially in the case of Scots pine stands. This is because both the seed tree stand and an established regeneration of pines are regarded as much more attractive than an open area." In another study which included preferences for different sized clear-cuts, Karjalainen (1996: 164) notes that: "felling areas that got highest [preference] ranks could hardly be recognised as having been clear-felled. They were small and had an abundance of shrubbery, big solitary trees, or big trees in the foreground of the felling area." Finally, Entec and EERG (1997: 6) report that their contingent valuation survey of 638

respondents in UK produced the following willingness to pay values: large clearfell areas, £8.33; small clearfell areas, £13.18.

9. RESIDUE FROM HARVESTING AND THINNING

Overall, this attribute was ranked 10 out of 12 across the four regions in terms of its overall contribution to the recreational value of forests (see Table 28). It was given high importance in all regions except Central Europe where it was given the lowest importance.

Table 28. Ranked mean contribution of 'residue from harvesting and thinning', by region

Region	Ranked mean contribution to recreational value
Great Britain	8
Nordic Region	11
Central Europe	1
Iberia	11
Overall ranking	**10**

The relationship of this attribute to recreational value was seen as negative by almost all respondents (see Table 29). Thus, in general, as volume of tree stumps, branches and other visible woody residue increases from low to high, the recreational value decreases.

Table 29. Relationship to recreational value of 'residue from harvesting and thinning', by region

Region	Relationship to recreational value					Modal class
	Positive	Negative	Bell-shaped	U-shaped	Even	
Great Britain (n=10)		10				Negative
Nordic Region (n=12)		12				Negative
Central Europe (n=14)		13	1			Negative
Iberia (n=10)		9	1			Negative

During the Delphi survey all the points relating to this attribute were made from Central European participants, whose comments often also referred to 'deadwood' (attribute 10). One respondent wrote that the attribute "Depends strongly on the character of the treatment and the special structure (z.B. nach Reihendurchforstung mit Havester oder gegenüber traditioneller Durchforstung z.B. unregelmäßige Entnahme und Materiallagerung einzelstammweise) [and] the age of the forest." Its contribution was judged to be "negative in younger stands, more acceptable in older ones" and "overall negative."

Another participant asserted the view that there was high variation in preferences between individuals which cancelled each other out: "The individual perception of woody residue and deadwood is very dissimilar or are mutually contradictory and depends highly on a person's nature related values: What one perceives as perfection is for another undesirable. For this reason there can't be identified a simple relationship between residue/deadwood and recreational value. Best fitting is in my opinion the even-shaped solution, because the individual differences cancel each other."

A third view was that the contribution of residue was "slightly negative; depends on forest type and ground cover". A fourth participant referred to both residue and deadwood, and argued that its contribution was important: "I disagree with the mainstream opinion: Forest residues from harvesting or deadwood is one of the more important features in the forests that affect visual qualities."

A fifth view highlights again the broad range of opinions within the Central European panel: "I changed my assessment in the most substantial way in terms of residues from harvesting and thinning. I still think that a certain amount of tree stumps can be attractive, especially if they are old; but other

residues of harvesting may be perceived as disturbing. Therefore I changed my assessment of the impact of the attribute from bell-shaped to negative."

From the literature on slash and residue, Ribe (1989: 66) writes: "The most effective scenic mitigation of timber harvests in relatively arid western US forests is to reduce evidence of slash, as it is universally disliked (Brush 1979, Daniel and Boster 1976, Daniel and Schroeder 1979, Radar 1971, Schroeder and Daniel 1981, Brown and Daniel 1986, Schweitzer and others 1976). Stumps can also be disliked (Daniel and Boster 1976, Radar 1971), as can bare soil in regenerating stands (Willhite and Sise 1974). […] Arthur (1977) found volume of slash to be the principal determinant of low SBEs, and more so when piled. […] …Vodak and others (1985) found slash to be viewed negatively, but particularly so when it stood more than 18 in. above the ground and could be seen above ground vegetation. They still suggest slash removal as the single most effective immediate scenic mitigation of harvests in eastern US hardwoods. […] Brown and Daniel (1984, 1986) also found slash volume a major negative determinant of ponderosa pine SBEs, particularly when inventoried at more than 1/4 – in. in diameter, and they support slash removal as scenic mitigation. However, a further investigation of alternative scenic mitigation measures suggests that chipping and spreading of slash is nearly as effective as removal and that either of these methods produce results one year after harvest that are preferred to piling and burning (Benson 1974, Benson and Ullrich 1981). […] These results regarding slash, and burned slash over time, suggest that the regrowth of ground vegetation is an effective postharvest site treatment for scenic purposes (Schweitzer and others 1976). In partially harvested stands, Radar (1971) found that forest floor seedlings and plantings aided scenic mitigation roughly as much as slash removal… As for the perception of harvested sites with reduced ground vegetation, open sites prepared for tree plantings with herbicides, plowing, and drainage are disliked, mainly by nonforesters (Karhu and Kellomaki 1980, Yeiser and Shilling 1978). More natural ground treatments are less negatively viewed (Boster and Daniel 1972). Benson and Ullrich (1981) found shrubbery removal after harvest, as opposed to ground vegetation treatments, to be a modestly effective postharvest preparation in increasing beauty, especially when combined with slash removal."

Ribe (1989: 63) writes elsewhere that a preference for thinned stands was found "in western US if resulting slash is removed from the stands (Kenner and McCool 1985)." Similarly, when suggesting that overthinning is possible, he writes that: "this is somewhat supported by Daniel and Boster's (1976) study where a heavily thinned ponderosa pine stand was decisively least preferred, although this stand also contained slash, obscuring the singular affect of thinning."

Studies of the impact of recovery time on slash and residue have been reviewed by Ribe (1989: 69) who writes: "Time also affects the visual condition of forests, and managers may often need to know about the relative scenic beauty of a forest over the long term under alternative managements. […] The first time-flow scenic study to be reported comes from Hull and Buhyoff (1986), who successfully developed this approach using an SBE prediction model with forest simulations, and named it the scenic beauty temporal distribution (SBTD) […] It compared the total scenic output of several alternative management programmes for loblolly pine in the southern US over a 50 year period, as opposed to the immediate scenic effect of single management choices. It yielded some interesting time-related findings. Not surprisingly, longer rotation periods yielded greater scenic flows over time, due to their lesser frequency of harvest impacts. […] In addition, the scenic enhancing effects of thinning over the long-term outweighed the short-term reduction in beauty attributable to increased slash from the thinning operation."

Similarly, referring to the recovery period, Silvennoinen et al. (2002: 271) add: "It seems that the visual recovery of a stand [to any kind of cutting] is fast: only a few years after the cutting the stand is regarded as much more pleasant than immediately after the cutting. This result is most probably related to visible cutting residues which quite soon disintegrate or are covered and hidden by ground vegetation (Hultman 1983, Kardell & Mård 1989, Ribe 1989, Kardell 1990, Lindhagen 1996." See also Brown and Daniel 1984, Hull and Buhyoff 1986, Palmer 1990 (ibid: 264).

As reported under 'visual penetration', Gundersen and Frivold (2008: 250) write: "Surveys with very different scopes and methodologies showed that selection cuttings, like the group selection and single tree selection systems, do not cause negative reactions to any large extent (Haakenstad, 1972; Kardell and Lindhagen, 1998; Holgén et al., 2000; Kardell, 2001). However, fresh group selection cuttings with debris are much less appreciated than old group cuttings under regeneration where debris is no longer visible (Hultman, 1983; Lindhagen and Hörnsten, 2000)." Elsewhere, Gundersen and Frivold (2008: 250) write how debris can lower the aesthetic impact of thinning (see also 'visual penetration'): "…the amount of wooden debris after tending or thinning seemed to be a key factor for people's appreciation of stands treated with intermediate cuttings (Hultman, 1983; Karjalainen, 2000; Silvennoinen et al., 2002). The nation-wide photo survey by Hultman (1983) showed that freshly tended young stands (pre-commercial thinning) with visible debris are little appreciated by the public, while similar stands with a path through them or with completely decayed debris got a higher score." These results are also supported by Danish surveys (Koch and Jensen 1988, Jensen 1999, Jensen and Skovsgaard 2009). Earlier, Gundersen and Frivold (2008: 248) write, under 'stratification or vertical structure': "Several surveys with different methodologies indicated that the public tends to give high scores to irregular stands with a mixture of trees of different sizes, as long as they are not disturbed by obvious traces from cutting operations (Lind et al., 1974; Hultman, 1983; Kellomäki and Savolainen, 1984; Kardell 1990, 2001; Lindhagen and Hörnsten, 2000)."

Similar findings include those reported by Silvennoinen et al. (2002: 263) who write: "Cutting residues are visible for many years after the treatment, which is an example of scenically negative impacts (Arthur 1977, Schroeder and Daniel 1981, Benson 1982, Vodak et al. 1985, Brown and Daniel 1986, Jensen 1993, Brunson and Reiter 1996, Karjalainen 1996, Hallikainen 1998, Karjalainen and Komulainen 1999)." From their own research, Silvennoinen et al. (2002: 271) report: "The analysis of photographs indicated that thinning treatments have quite a small immediate effect on the scenic beauty score. This means that the positive effects (improved visibility) and negative effects (cutting residues) are small or largely cancel each other out."

Likewise, Axelsson Lindgren (1995: 282) writes: "Twigs are irritating and disturbing in all kinds of forests, according to a number of studies (Haakenstad 1972, Lind et al, 1974, Hultman 1983, Koch & Jensen 1988, Savolainen and Kellomaki 1981). The more twigs on clearcuttings, the more negative they are perceived to be."Karjalainen (1996: 164, citing Heino 1974 and others) note that large clearfelled areas with soil preparation and lop and top received the lowest rankings. Wood harvesting residue was disliked. Jensen (1997: 148) writes: "…the population preferred the [beech] forest floor to be cleared of logs and branches in the 1977 and 1994 surveys. These results agree with what has been found in several surveys (e.g. Haakenstad, 1975, pp 128ff; Hultman, 1983, pp. 41ff; Kardell and Holmer, 1985, pp 64ff). …the results do not support the myth which asserts that 'the public prefers to see forestry at work'." See also Jensen (1993: 87).

Soil preparation

The similarly negative public perception of soil preparation is also relevant here. Gundersen and Frivold (2008: 251) write: "that ploughing and other kinds of strong soil preparation for natural regeneration were not appreciated by the general population (e.g. Korhonen, 1983; Kardell and Mård, 1989; Sievänen, 1993) is hardly surprising. Soil disturbance in small patches for enhancing natural regeneration in partial cuttings seems not to have been included in the surveys." See also Font and Tribe (2000: 3) who refer to logging waste and soil preparation.

10. AMOUNT OF NATURAL DEADWOOD (STANDING AND FALLEN)

Overall, this attribute was ranked a low 2 out of 12 across the four regions in terms of its overall contribution to the recreational value of forests (see Table 30). It was given a relatively low importance in all regions except the Nordic Region where it was given a moderate importance.

Table 30. Ranked mean contribution of 'amount of natural deadwood', by region

Region	Ranked mean contribution to recreational value
Great Britain	2
Nordic Region	7
Central Europe	4
Iberia	3
Overall ranking	**2**

The relationship of this attribute to recreational value was seen as bell-shaped by most respondents, although also as negative, in particular in the Nordic Region (see Table 31). Thus, in general, a very low and very high volume of deadwood is seen as negative compared to a moderate amount.

Table 31. Relationship to recreational value of 'amount of natural deadwood', by region

Region	Relationship to recreational value					Modal class
	Positive	Negative	Bell-shaped	U-shaped	Even	
Great Britain (n=10)		1	8			Bell-shaped
Nordic Region (n=12)	1	7	3	1		Negative
Central Europe (n=14)		2	10		2	Bell-shaped
Iberia (n=10)		3	6		1	Bell-shaped

During the Delphi survey a participant from Great Britain saw the amount of deadwood as a good example of an attribute with a bell shaped distribution: "if you go overboard with that attribute then it might deteriorate the recreation value."

In the Nordic Region and Central Europe the issue was seen to be highly dependent upon the visitor's understanding of the biodiversity value of deadwood, and the extent to which this influenced his or her perception of the stand's recreational value. One Nordic participant wrote: "'Amount of natural deadwood' seems to be a key aspect, but not well studied. Here also knowledge about biodiversity is an additional factor." A second Nordic participant wrote: "Information about the importance for biodiversity of natural coarse woody debris makes the average forest visitor somewhat less negative to such elements in the forest." Similarly, a third wrote: "[The] dead wood issue is controversial. There is a growing group of people who understand the ecological value of dead wood and thus also appreciate dead wood even in the recreational setting. Then the 'general public' like dead wood less but do not necessarily dislike them either."

Likewise, in Central Europe, one participant wrote: "Depends on people perceiving it: People knowing about it, having some information, younger or well educated persons perceive it explicitly positive according to a study I carried out in a National Park. I would judge on this for amounts up to 20-30 m3/ha for sure, to portions with 150 m3 with some limitations due to my chosen research design. Persons not so familiar with forest ecosystems or older, less educated persons perceive deadwood being a very negative feature." Similarly, another wrote that the relationship was "Negative, but depending on education and motives" for example visits to protected areas perhaps for wildlife viewing. Again, another respondent wrote: "I also lowered my assessment on the impact of dead wood, because a majority of visitors might not perceive its value for natural diversity."

A different view from Central Europe was that the relationship of the attribute "depends on age" and that the respondent "cannot answer independently" of this factor. Finally, one respondent highlighted the possible association between deadwood and a perceived lack of management and risk to the visitor: "…I am of the opinion that if there is too much natural deadwood, it is not attractive for a visitor to enter the forest (not everybody is a biodiversity experts and knows about the value of dead wood in a forest) – from most of the visitors dead wood might be perceived as a not well managed forest (if not clearly walking in a virgin forest) and it might be considered rather as a danger than an invitation to visit the forest – hence I think that the relative contribution whether a forests provides a high recreational value depends a lot from this factor!"

Much of the literature on this attribute highlights differences according to educational background and profession. Tyrväinen et al. (2005: 92) write: "In general, residents also disliked dead or decayed trees left in the forest. However, younger, higher educated residents and active urban forest users preferred more ecologically-oriented management compared to older, less-educated residents and less active users" (see Section 4).

Gundersen and Frivold (2008: 249) write: "Dead trees and snags in a forest are generally disliked both by tourists in rural areas and by urban forest visitors, according to Finnish surveys (Karjalainen, 2000; Tyrvainen et al., 2001, 2003); the former using verbal questions, the two latter using visual stimuli. A possible exception is pine forest (Karjalainen, 2000)." The study showed that men are more tolerant of dead and decaying ground wood as are younger people and those with higher education levels (Karjalainen 2000: 143).

There were few studies of this attribute at the time of writing reported by Ribe (1989; 63) who writes: "Natural downed wood, not resulting from harvest and thinning activities, and therefore distinguishable from slash, has not often been separately considered as such in scenic preference research. Where this distinction has been explored, some evidence suggests that natural downed wood is more acceptable than slash (Schroeder and Daniel 1981), but it is still of negative affect (Benson and Ullrich 1981)." It is possible that attitudes towards deadwood have improved over time since Ribe's review, with increase in public understanding of its contribution to biodiversity.

A negative relationship to recreational value is also suggested by Tahvanainen *et al.* (2001: 67) who write that dead and downed wood have a negative effect. Their research, plus Shroeder and Daniel (1981), Brown and Daniel (1986), and Hull and Bukyoff (1986), provide evidence. Axelsson Lindgren (1995: 283) writes: "The great amount of fallen trees make virgin forest unsuitable for outdoor recreation (Hultman 1983, Savolainen & Kellomaki 1981). Danes prefer beech forests without dead logs (Koch & Jensen 1988)." Later Axelsson Lindgren (1995: 283) also highlights differences between social groups: "Environmental protectionists and biologically educated people are positive to dead and fallen trees, while other people want such elements to be removed (Kardell 1990, see also Savolainen and Kellomaki 1981)."

Changes in public attitudes to this attribute over time are also considered by Jensen (1997: 148) who writes: "According to the mean assessment of the population, beech forest without dead trees is preferred. […] It can also be postulated that the population's understanding of the biological processes were greater at the time of the 1994 survey than when data was collected in 1977. It is not possible to confirm this hypothesis in the above comparison." Elsewhere Jensen (1993: 87) highlights differences between social groups: "The population gave preference to the beech forest without the dead trunk. The experts differed greatly on this question… The politicians and even more so the biologists [n=11], have the misperception that the population prefers the forest with the dead tree." Jensen (1993: 90) adds: "All the expert groups had the 'wrong' perception that there was a preference… for the gnarled oak stand."

A more positive conclusion was made by Nielsen et al (2007:63-68) who report that a few standing or fallen dead trees will be tolerated in Denmark as they represent more 'natural' forests (mixture of different species, ages and sizes). This study also provides several references for different types of people, and shows that deadwood is positive if people are knowledgeable. Similarly, a more positive relationship was found in Belgium, a survey of public preferences (4540 individuals) in Brussels revealed that 80% felt that deadwood was an integral part of the forest landscape and should be kept (Vanwijnsberghe and van de Leemput 2002).

Herrmann et al. (2002: 17) revealed a diverse range of attitudes towards deadwood, which may help interpret the Delphi findings. Typical forests of the National Park with standing and lying deadwood pleased 68% of interviewees (41% to a very large extent, 27% to a large extent). A total of 32% didn't like deadwood lying around, for the following reasons: a) Some believed deadwood was a result of air

pollution and hence considered it an ecological damage; b) Others were able to differentiate between natural conditions and ecological damage due to information in the media. Some of them thought deadwood was the result of an infestation by pests, c) Some disliked the appearance of the forest even though they knew it is part of the natural life cycle, d) Older people remembered the wood shortage during WWII and people from countries with low growing stock considered it a waste not to collect the deadwood, e) Italian visitors in particular expected the National Park to be a 'classic park' or at least 'traditionally cultivated land', and in their eyes the park was untidy.

Wind felled trees

The case of wind-felled trees needs to be considered separately because aesthetically they can often have a particularly negative impact. Gundersen and Frivold (2008: 249) write: "The least appreciated of 28 photos in a nation-wide Swedish survey conducted in 1977 by Hultman (1983) and repeated in 1997 by Lindhagen and Hörnsten (2000), was a photo of a mixed pine-spruce stand with an abundance of recent wind-felled trees. A photo of a virgin spruce forest with gap disturbance and wind-felled trees in several decay classes did not do very much better, ranging as no. 23 of 28 in 1977 and no. 21 of 28 in 1997." Gundersen and Frivold (2008: 249) continue: "Kardell (1990) asked a group of volunteers consisting of town residents and forestry students to evaluate some stands with dead and wind-felled trees in 1978, 1980 and again in 1988. In 1978 and 1980, a majority of the respondents suggested removing the wind-felled trees, while in 1988 a majority suggested leaving them in the forest."

Negative views also prevail for fire damaged forest, although this was rarely the focus of preference research. Gundersen and Frivold (2008: 248) write: "Attitudes to openings caused by large-scale disturbances like forest fires seem not to have been measured in Fennoscandia; however, the preferences for controlled burning in regeneration areas are low (Karjalainen, 2000).

In conclusion, studies suggest that less deadwood is regarded as positive for the aesthetic value of a forest, but there is strong evidence that a modest level of deadwood is acceptable or preferred by people with better understanding of conservation issues, and tentative evidence that there is a gradual trend towards greater acceptability and preference for a modest level of deadwood perhaps due to an increasingly informed public. Excessive deadwood in any forest may rightly be perceived as evidence of a dying forest (e.g. after a pest invasion or fire). Preferences regarding deadwood also depends upon context and expectations. Some deadwood may be accepted or preferred in naturally managed stands where it is more likely to occur. For some social groups, deadwood in production forests may be regarded as an indication of poor management.

11. VARIATION BETWEEN STANDS ALONG A 5km TRAIL THROUGH FOREST

Overall, this attribute was ranked 8 out of 12 across the four regions in terms of its overall contribution to the recreational value of forests (see Table 32). Its importance varied greatly between regions, with high importance attached in the Nordic Region and Central Europe.

Table 32. Ranked mean contribution of 'variation between stands', by region

Region	Ranked mean contribution to recreational value
Great Britain	3
Nordic Region	9
Central Europe	11.5
Iberia	5.5
Overall ranking	**8**

The relationship of this attribute to recreational value was seen as positive by most respondents, and secondly as bell-shaped (see Table 33). Thus, in general, as the number of forest stand types

encountered increases from one to many, recreational value increases, although a significant proportion of respondents saw very high or very low variation as negative.

Table 33. Relationship to recreational value of 'variation between stands', by region

Region	Relationship to recreational value					Modal class
	Positive	Negative	Bell-shaped	U-shaped	Even	
Great Britain (n=10)	5		3	1	1	Positive
Nordic Region (n=12)	5		7			Bell-shaped
Central Europe (n=14)	10		4			Positive
Iberia (n=10)	7		1		2	Positive

During the Delphi survey, three participants from the Nordic Region noted the relative lack of literature on the contribution of this attribute. One participant mentioned the study by Axelsson-Lindgren (1990). Another mentioned: "In Finland, we know least about the preferences of variation between stands and naturalness of forest edges; if we knew better maybe my scores would be higher." A third wrote: "I was a bit surprised over the groups rating on this question, because it is very few studies that have tested this at a Nordic scale. Variation in forest is, however often concluded to be an important factor in many studies using verbal stimuli, but in this studies scale is rarely defined. Is it variation within the stand or between stands?"

A participant from Central Europe suggested a bell shaped distribution, since diversity is likely to be appreciated but too much may appear messy: "In my opinion, a certain amount of variability of stands along a trail stands for a vital forest which consequently might stand for a higher recreational value for the visitor. On the other hand – if this variability is becoming too high, the visitor might get the impression (not knowing about forestry at all) that this forest is not very well maintained and the impression might be messy and not provide the impression of an 'endlessly' big forest which can be 'full of nature'... therefore I think that the correlation needs to be bell-shaped – at medium relative contribution!" In Iberia, one participant noted that people tend to like variety, including diversity between stands.

The most relevant published work on the significance of this attribute is probably the pilot study by Axelsson-Lindgren and Sorte (1987). Thus, in his review article, Ribe (1989: 69) writes: "…the scenic dynamic of forests along roads and trails can be critical in achieving aesthetic goals. Managers may, for example, gain more in recreational-aesthetic value from a varied set of stands than if all stands were uniformly maximized in their singular perceived beauty. […] Axelsson-Lindgren and Sorte (1987) compared hikers characterizations of experiences from a diverse forest trail versus a more monotonous one. The hikers using the trail through a greater variety of forest stands reported more pleasant experiences, perceived more variability, engaged in a wider range of activities, and had more accurate time perceptions. They also took a bit more time, consistent with the findings of Gustke and Hodgson (1980)."

Axelsson-Lindgren and Sorte (1987: 212) write: "Our study, which was carried out in Järavallen forest in southern Sweden, is based on the view that the possibility of a visitor experiencing visual variation depends to a great extent on the environmental aspect we have called the Forest Visual Opportunity Spectrum (FVOS). [cf. "Brown and Stankey (1981) in their description of the Recreation Opportunity Spectrum (ROS)."] Our basic hypothesis is that a forest area can be divided into visually distinguishable forest stands, a visual forest stand being defined as an area of vegetation visually different in character from the adjacent vegetation. The number of visual forest stands, their size, and the degrees of difference between them, are factors determining the pattern of Forest Visual Opportunity Spectra."

Axelsson-Lindgren and Sorte (1987: 213) continue: "In this preliminary study… […] Two hiking trails, each 2.5 km long, were laid out in the forest, one trail passing through eight different visual forest stands; the other trail through only three. The experimental subjects, 16 students [were divided into two groups, which walked the two trails in different orders and then given a questionnaire] The

questions dealt with the variation, pleasantness and originality of the trail, and whether the trail was conducive to engaging in different recreational activities such as strolling alone, picnicking or jogging. The respondents also assessed the time spent on the trail in minutes and the length of the trail in metres."

Axelsson-Lindgren and Sorte (1987: 214-5) continue: "The varied trail was looked upon as the more pleasant… but whether this preference is valid for all sorts of visual variation between forest stands remains an open question, as too marked a visual variation between forest stands might even evoke negative responses. […] The trail through many visual forest stands was considered conducive to the practice of a wider variety of open-air activities than the trail through few visual forest stands… while the trail through few visual forest stands was considered better suited to jogging… […] The respondents made more errors in time and length assessments of the trail through few visual forest stands than in those of the trail through many visual forest stands… The ability to orientate oneself in time and space thus seems to be dependent upon the degree of visual variation between forest stands. In many environments it is decidedly an advantage to be able to get one's bearings, while in other environments, such as in a setting with contemplative qualities, the opposite may be true."

Axelsson-Lindgren and Sorte (1987: 215) continue: "The FVOS of Järavallen embraces a total of 28 visual forest stands, each with its own distinctive character in relation to its surroundings. The largest visual forest stand is about 40 ha (100 acres) and the smallest is about 1 ha (2.5 acres)."

Later, Axelsson Lindgren (1995: 283) writes (of 'combinations of forest stands'): "Physical characteristics of importance to visual variation seem to be tree species and ages and to what extent they are mixed, as well as the density and structure of the stands (Axelsson Lindgren 1990, see also Haakenstad 1972, Aasetre 1992, Savolainen and Kellomaki 1981). The study by Koch and Jensen (1988) indicates that Danes prefer forest areas with both deciduous and coniferous stands, especially if the majority of the area is covered by deciduous trees. Few Norwegians prefer pure deciduous forests (Haakenstad 1972, see also Aasetre 1992). Just as in the Danish study, a great majority of visitors to Oslomarka do wish, however, to see birch, rowan and other deciduous trees as components of the forest landscape (Lind et al. 1974). In Finland, Mikola (1982) states that broadleaves provide lots of lightness in a coniferous forest landscape, and Prunus and Sorbus add more colour."

Axelsson Lindgren (1995: 283-4) continues: "So far, perception of forest interiors of single stands has been discussed the most. As Hultman (1983) suggests, variation between forest stands may well be just as important to the recreation experience. According to Kellomaki (1973), mixed forests are liked the most, as the richness in colours and shapes relaxes and gives new inspiration. Variability of forest stands may give more aesthetic and recreational experiences, as the attraction depends on the sequence of stands (Pukkala et al. 1988), and on the manner in which they are arranged. Diversity of forest landscapes is appreciated, as for example changes between mixed forests and monocultures variation in age, height and density, and variation in the degree of cultivation of forests (Loven 1973, Kellomaki 1975, Mikola 1982). High diversity in forest stands may, however, be perceived as monotonous when spread over large forest areas (Kellomaki 1973, Koch and Jensen 1988). Less appreciated forest types, such as clearcuttings and young tree cultivations, may contribute in a positive way to the variation if they are present in small amounts (Kellomaki 1975). Small clearcuttings may, in a positive way, open the closed canopy and the views (Pukkala et al. 1988…). Diverse structure of age classes may thus be positive, as every age class may contribute with its kind of recreational value. Proportion and location of tree species are also important to perceived differences between forest stands."

Axelsson Lindgren (1995: 284) continues: "A study on what people perceive as similarities and differences between forest stands (Axelsson Lindgren 1990) resulted in five similarity groups: young deciduous stands; forest with mixed density and mixes of species and age; old, parklike deciduous forest; coniferous forest with high stems; young, very dense coniferous stands. […] The study found extraordinary correspondence between expert and layman evaluations. […] Field studies of strolls along forest trails show that an increased number of visual forest types along a trail increases the desire to practice different open-air activities (Axelsson Lindgren 1990…). Evaluations of the length

of the trails and the time required to walk them were more accurate as the number of visual forest types increased."

Similar findings are reported in Gundersen and Frivold (2008: 248) who write: "A majority of residents in Oslo, capital city of Norway, responded that they preferred taking a walk in "a mixture of old and young forest" to taking a walk in "old forest" (Haakenstad 1972, pp. 51 and 75). Whether the respondents associated "a mixture of old and young forest" with a mixture of even-aged stands in different stages or with an uneven aged stand is not known."

The importance of diversity in the landscape is also suggested by the household survey by Lee (2001: 97-98), where twenty landscape photos were shown, and respondents were asked to rank their favoured views and then provide reasons for their choices. Lee writes: "They are less informative than might have been hoped. Looking first at why the favoured pictures are preferred…, the presence of water (including 'reflections') accounts for almost a third (31%). A further 31% of respondents include some general reference to the scenic quality and the remainder is a wide range of more specific reasons with a maximum of 9%, shared by 'colours' and 'scenic variety'. It can be argued that the public shares the landscape architects' valuation of high diversity, which appears in 'scenic variety', 'colours', and 'like the mix of trees', which together account for 23%. Turning to the least preferred landscapes… the dominant categories are some variation on the theme of bland, uninteresting, boring, flat and dull – a total of 52%. These are the converse of the 'generally scenic' and high 'diversity' assessments of the preferred landscapes."

Other observations by Lee relate to the significance of 'genius loci' or 'spirit of place'. Lee (2001: 154) adds, regarding distant landscapes: "Genius loci is the most obvious example of an attribute that is heavily laden with the aesthetic and accordingly producing some quite high correlations… especially with Best picture, the most obviously aesthetic measure provided by the public… […] There is virtually zero correlation… between Genius loci and the public's assessment of landscape suitability for timber production. […] colour diversity is highly correlated with the best picture…"

Other perspectives supporting a preference for diversity include that of Broadhurst and Harrop (2000:193), who add that people are attracted to a varied landscape and diversity of tree species and ages as well as the presence of water. Schraml and Volz (2009: 235) write: "The observed complexity appears to be a crucial element in forests that are positively evaluated. Diverse habitats with many amenities offer stable ecosystems, relative safety and better living conditions for man. Thus, a preference for landscapes with a high level of complexity is adaptive in an evolutionary sense (Kaplan 1992)." See also the study in UK by Garrod (2002: 10).

A relationship between complexity and scenic beauty is shown by Hunziker and Kienast (1999: 174-5) who write: "The way the pattern indices estimate landscape complexity obviously yields a linear relationship between complexity of the formal content [i.e. of landscape elements: trees shrubs and open land] and scenic beauty. This is principally in accordance with the theoretical model of Kaplan et al. (1972, 1989), which also claims a linear relationship between landscape preference and complexity. In that respect we confirmed this part of their theory but with the application of a quantitative measure of complexity independent of the respondents." Hekhuis and Wieman's (1999: 342-3) study in the Netherlands reveals that variation is an important criterion for recreation value, but they were unable to evaluate at which scale (e.g. stand level or forest level) variation is most appreciated. They considered diversity in tree age, species, and in terms of open spaces. Jensen (undated: 31) asks whether landscape relief influences preferences for a diverse forest: "Is it perhaps the case that large unit forestry is only perceived as truly monotonous in a flat landscape? – and visitors have probably found that, even there, monotony can have its aesthetic/experiential value, as can be found in e.g. the Danish heath plantations."

The positive effect of increasing diversity of the forest through provision of glades suggested by Rydberg and Falck (2000: 13) who write: "The presence of forest glades with benches is, therefore, of great importance [especially for senior citizens]. […] The glades are the places where stop and take a

rest, enjoy the solitude of the forests, and feel comfortable in the peacefulness and silence of the soothing forest. […] Glades are also meeting places for adults and playrooms for children. Creation of dynamic glades (ca 0.5ha) has been suggested as a method to enhance habitat diversity in relatively uniform areas and to increase the amenity value of forests (Gilbert 1989). Small areas of clear-felling, cleaned from slash, could temporarily act as glades in forests." Similarly, Gundersen and Frivold (2008: 247-8) write: "Semi-open forests give a better view and sense of safety than dense forests, and openings in a forest provide perceptible space and visual access to more distant areas (Kaplan et al., 1988). Several surveys showed that natural openings in a forest (e.g. non-productive forest land, bogs, and lakes) were considered more positive among respondents than openings resulting from clearcuts (Lind et al., 1974; Haakenstad, 1975; Aasetre, 1994; Hallikainen, 1998), although it should be noted that only verbal stimuli were used here. Both verbal and visual stimuli resulted in positive judgements of openings originating from traditional agriculture, pastureland or abandoned farmland – particularly those with a historical component in them (Lind et al, 1974; Hallikainen, 1998; Komulainen, 1998; Kaltenborn and Bjerke, 2002)."

It is worth noting that size of stand can act as a proxy for diversity between stands. Axelsson Lindgren (1995: 288) writes: "The length of border zones in the landscape has been used as a way to measure the degree of variation in landscapes (Skärbäck 1980)." See also Garrod (2002: 10) which suggests that small stands are preferred to large stands in their UK study.

In conclusion, diversity between stands is generally regarded as a positive attribute, especially if the internal boundaries appear organic when seen from a distance. It has been suggested that high levels of diversity can look too 'busy' in a 'large scale' landscape, where diversity between forest blocks (groups of stands) may be preferable, a view which supports the 'bell-shaped relationship suggested by many Delphi survey participants. Also, in some contexts people may expect uniformity, e.g. where mature pine forests are regarded as part of the local natural heritage. Small stand size effectively increases the diversity within a forest area, which can be seen as having a positive effect. It also helps greatly to ameliorate the negative impact of clearfelling. At its extreme (e.g. group selection) the forest takes on an increasingly natural appearance which may be preferred. Small regenerating stands can then resemble natural glades.

12. 'NATURALNESS' OF FOREST EDGES

Overall, this attribute was ranked 5 out of 12 across the four regions in terms of its overall contribution to the recreational value of forests, with moderate deviation between regions (see Table 34). Most importance was attached to this attribute by the Central Europe panel, and least in the Nordic Region panel.

Table 34. Ranked mean contribution of 'naturalness of forest edges', by region

Region	Ranked mean contribution to recreational value
Great Britain	6
Nordic Region	3
Central Europe	9
Iberia	4
Overall ranking	**5**

The relationship of this attribute to recreational value was seen as positive by almost all respondents (see Table 35). Thus, in general, as the proportion of 'natural' looking (i.e. not straight) edges increases from low to high, the recreational value increases.

Table 35. Relationship to recreational value of 'naturalness of forest edges', by region

Region	Relationship to recreational value					Modal class
	Positive	Negative	Bell-shaped	U-shaped	Even	
Great Britain (n=10)	10					Positive
Nordic Region (n=12)	12					Positive
Central Europe (n=14)	11		3			Positive
Iberia (n=10)	9					Positive

During the Delphi survey, one participant from Great Britain noted the link between this attribute and 'size of clear cuts': "For Q12, my relatively high Relative Contribution score is related to Q8; forest edge is not only the relationship with the landscape outside the forest but also includes internal edges created by clear cuts." In the Nordic Region, one respondent noted that the attribute was "not well studied". Another wrote that it was: "More important in hilly than in flat landscapes and more important towards cuttings than towards agricultural land."

In Central Europe, one respondent explained during Round 2: "We conducted two surveys (master theses) several years ago about perception and visitor assessment of forest edges. Natural edges were rated worse than 'traditional' ones due to the reduced 'edge feeling' (sitting (with barbecue, fire place) under trees with sight over the fields). This might have changed a bit towards better assessment of naturalness. Thus, I change from even (or negative...) to bell shaped." Similarly, a bell shaped relationship was proposed by another Central European participant: "The forest edge is usually what the visitor sees first when coming to a forest – so to say the first impression. Again, a certain amount of "natural looking" might be a good first impression. However, a "too much" of natural look might easily turn into a "not well managed", or "not well taken care of" forest – which consequently is little inviting to the one who seeks recreation for body and mind... Therefore a bell-shaped correlation at relatively high importance ('first impression')."

Regarding the literature on stand edges and shapes, Tahvanainen et al. (2001: 54) highlight the importance of considering the structure and design of a forest edge for landscape aesthetics and the overall visual experience. They advocate a well-designed edge that "consists of a mixture of bush and tree species which have great ecological and aesthetic importance." Gundersen and Frivold (2008: 250) cite Karjalainen and Komulainen (1999): "Irregular and horizontal orientations of clear-cuts on a hillside are preferred to regular and vertical orientations." Axelsson Lindgren (1995: 288) writes: "The shapes of border zones are especially important for the experience of forests in open landscapes." Entec and EERG (1997: 6) report that their contingent valuation survey of 638 respondents in UK produced the following results for willingness to pay for different shaped forests: straight shape, £10.46; contoured shape, £17.39. See also Fuller et al. (1995).

Rydberg and Falck (2000: 12) explored attitudes to forest edges, glades and a fear of dense vegetation in Sweden. They wrote that: "The urban green areas are characterised by fragmentation, which has resulted in many small forests in close connection to houses and a high proportion of forest edges. Since it is of great importance for human aesthetic and visual perception, the forest edge should be a delightful sight, acting as a welcoming entrance into the forest and forming the 'walls' of the forest room (Gustavsson and Fransson 1991, Sarlöv Herlin 1994). Well designed forest edges are structurally complex and consist of a mixture of bush and tree species. Structurally complex forest edges have essential biological values as habitats for many plants and animal species, and together with high structural diversity of the accompanying forests, the urban biological diversity could be supported."

Screening and leave strips

Of relevance to stand edges, the potential to conceal unattractive stands or clear-cuts through the use of leave strips is discussed by Ribe (1989: 65-6) who writes: "Leave-strips have value as scenic mitigation. Leave-strips left in large clear-cuts can serve to increase their scenic acceptability compared to open cuts (Schweitzer and others 1976). A stand containing re-vegetated strip clear-cuts between thinned leave-strips was found to be of average SBE value compared to the low value expected for a clear-cut (Daniel and Boster 1976)." Similarly, Gundersen and Frivold (2008: 250),

citing Karjalainen and Komulainen (1999) write: “leaving an edge along the shoreline improves the visual quality of the felling area.”

Bell (2001: 202) provides a critique of the ‘screening and hiding’ approach, a precursor to forest landscape design, which he describes as ‘scenery’ or ‘visual’ resource management. He describes how screening or hiding of forestry activities was pioneered by the US Forest Service and was linked to attempts to preserve the appearance the landscape. However, this fell out of favour by the 1990s and there were gradual moves towards the ‘positive design’ approach where forest activities were designed to limit negative impacts on the scenery rather than hiding them from view. Indeed, writing about aesthetic considerations in British forestry Lucus warns that, “decisions to ignore visual impact in less prominent areas are invariably regretted either because new roads open up new views or because the visual impacts is wrongly assessed in the first place” (Lucas 1997: 348).

PREFERENCES FOR ‘NATURALNESS’

This final sub-section offers a more ‘holistic’ view of how the silvicultural attributes combine in reality to produce forested landscapes of different kinds with different levels of public preference. The extent to which the forest appears to be ‘natural’ is one of the most important single factors that influence perceptions. However, it is difficult to define and quantify. According to de Groot and Ramakrishnan (2005: 467-8) there is an overall preference for park-like landscapes (e.g. Kellert 1993), and individual differences can “nearly always be interpreted in terms of differences in the preferred degree of ‘wildness’ in natural landscapes” (e.g. Kaplan and Kaplan 1989).

Insights from the Delphi survey

The degree of ‘naturalness’ can be seen to be influenced by many, if not all, of the 12 attributes discussed above. Several points were made during the Delphi survey about the contribution of ‘variation’ or ‘variety’ to the recreational value of forests, which relates in particular to the attributes ‘variation in tree size’, ‘variation in tree spacing’, ‘number of tree species’, and ‘variation between stands’, and to the overall level of ‘naturalness’ of the stand.

One participant from Great Britain wrote: “Key attributes that contribute to the recreation value of forest [include] variation within that forest; whether this variation is type of tree species, tree size, spacing etc. The greater the variation over a range of attributes will lead to increased recreation value.” Another wrote: “I share an earlier observer’s comment about variety… A Scots pine forest with a few juniper is not in my view short of variety nor a Chiltern beech wood, nor an East Anglian oak with hazel coppice.”

The generally positive assessment of ‘variation’ was also shared by a participant from Nordic Region who wrote: “variation in tree spaces and between stands increases positive impact in landscape, with high confidence”. A preference for ‘managed naturalness’ was implied by another participant: “From my questionnaires in the Black Forest it turned out that most people don`t like even-aged forests, monocultures and less close-to-nature forests but also not wilderness. Many prefer variation and naturalness but also views, paths and infrastructure which they associate with forest (management) signalling some human activities.”

A detailed analysis of several attributes, focusing on ‘diversity’, was offered by another Central Europe participant: “According to our findings, there are two main factors influencing the recreation value: natural diversity and diversity in terms of the perspective (change of sheltered parts and sunny place with a good view. Recreation value, however, also depends on the recreation need. More sheltered areas (high density, a certain monotony) is probably more suited for mental recovery and self-reflection, whereas more openness might be better for emotional regulation and a sense of freedom. As most people visit forests with a variety of recreation motives, a medium level of most characteristics is probably most adequate. Therefore, most of the attributes have a bell-shaped characteristic in terms of its contribution to recreation quality. In terms of residues and density of

ground vegetation, the contribution is not very clear. Experimental research suggests that 'clean' forests have a better effect on psychological recovery. Low values also allow people to leave the paths. On the other hand, natural diversity is a dominant factor of attractiveness."

In Iberia, a contrasting perspective was given by one participant, on account of the different forest structure to central and northern parts of Europe: "Naturalness is a term difficult to evaluate. If we understand naturalness in a Mediterranean context as: a high density of shrubs (e.g. *Buxus sempervirens*, *Rosmarinus officinalis*, *Erica arborea*, *Erica multiflora*, *Ramnus alaternus*, *R. lycioides*, mainly) and of young and thin trees, the proliferation of prickly plants (e.g. *Genista scorpius*, *Ulex parviflora*, etc.), and the existence of lianas (e.g. *Lonicera implexa*, *Smilax aspera*, *Rubus ulmif*olius, *Rubia* spp., etc) make entering forests more difficult; then, natural sites are not well valuated for recreational purposes."

Recreational scores

'Naturalness' was also one of the focuses of EFORWOOD D2.3.6 (Edwards et al. 2010) which analysed preferences for five different forest management alternatives using data derived from the second part of the Delphi survey. As described in D2.3.6, Delphi survey respondents were asked to provide a score, on a ten point scale, for each of 60 'forest stand types' that may be present in their respective region. Each score was chosen to indicate how they believe potential visitors would value a forest stand of that type as a location for recreational use. The 60 forest stand types represented each of the different possible combinations of five forest management alternatives (FMAs), four phases of development (establishment, young, medium, adult), and three tree species types (conifer, broadleaved, mixed conifer and broadleaved). The five FMAs were selected because they fall on a continuum from non-intervention to intensive production forest management, as follows: 1) forest nature reserve, 2) close-to-nature forestry, 3) combined objective forestry, 4) intensive even-aged forestry, and 5) wood biomass production. This continuum also reflects degree of naturalness.

The main purpose of this exercise was to generate data that could then be combined with the forest resource projection model, EFISCEN, to assess impacts of changes in forest management on the recreational value of forests at pan-European level. However, through the use of conjoint analysis, the scores were valuable in their own right, by allowing us to measure the relative importance of each of the three variables (i.e. FMA, phase of development, and tree species type). Across Europe, tree species type was shown to be relatively unimportant compared to phase of development and to a lesser extent FMA (Edwards et al. 2010).

Of more relevance to the present study, however, the conjoint analysis also provided a measure of the relative importance for each of the five FMAs. The mean utility or 'importance value' for each component is given in Table 36 (cf. Edwards et al. 2010: Fig 1). A positive value indicates a positive contribution to the recreational value of a given forest stand. For Great Britain, the highest contributions are provided by FMA1 (forest nature reserves) and FMA2 (close-to-nature forestry). For Nordic Region the highest contribution is provided by FMA3 (combined objective forestry) and to a lesser extent FMA2, while FMA1 makes a small negative contribution. For Central Europe, the highest contribution is provided by FMA1, while in Iberia it is provided by FMA2. The data suggests there are significant differences between regions, although on balance it is clear that it would be incorrect to assume that the public simply prefer forests with the lowest level of intervention, and hence the highest degree of 'naturalness'. With the exception of Central Europe, close-to-nature forestry or combined objective forestry are preferred more, or equally, to forest nature reserves.

Table 36. Mean importance weightings of five forest management alternatives, by region

Region	Forest nature reserves (FMA1)	Close-to-nature forestry (FMA2)	Combined objective forestry (FMA3)	Intensive even-aged forestry (FMA4)	Wood biomass production (FMA5)
Great Britain	1.14	1.13	0.69	-1.31	-1.65
Nordic Region	-0.14	0.67	0.86	-0.10	-1.30
Central Europe	1.37	1.25	0.53	-1.27	-1.86
Iberia	0.80	1.20	0.77	-0.93	-1.84

'Managed naturalness'

The insight that the visiting public tend to prefer a degree of intervention to 'tidy up' the forest, partly for aesthetic reasons but also perhaps to make them appear safer and more accessible, is strongly supported by the literature. The resulting effect might be termed 'managed naturalness'. It is possible that many people may state a preference for naturalness, but may not realise that their preferred natural looking forests are in fact quite intensively managed. In so far as 'natural forest' exists in Europe, it might often be judged as relatively unattractive both aesthetically and as a site for recreation.

On naturalness, Ribe (1989: 59) writes: "A basic forest condition preference often researched is whether people find managed forests more attractive than unmanaged ones. For example, Yarrow (1966) found a preference for 'natural' forests among his British respondents in a mail survey. Such preferences varied among French social groups… (Brun-Chaize 1976)" [cf. Savolainen and Kellomaki 1981 for Finland] Drawing from these studies and also Boster and Daniel (1972), Daniel and Boster (1976), Benson and Ullrich (1981), Schweitzer and others (1976), Williamson and Chalmers (1982), Vodak and others (1985)." Ribe (1989: 60) concludes: "All these findings together suggest that there is no clear and simple aesthetic dichotomy between managed and unmanaged forests, except when management creates heavy disturbances."

Regarding the case of tree plantations, Ribe (1989: 62-63) concludes that the level of domestication largely determines preferences: "Tree plantations represent a stand condition of problematic aesthetic value compared to less regimented more natural appearing stands, but this problem has received relatively little research attention. […] In Britain, Yarrow (1966) found that plantations not planted in straight rows were preferred, that mixed species plantations were preferred to monocultures, and then that mixing by groups was preferred to those mixed by row. […] In general, all these findings suggest that plantations are generally aesthetically acceptable to public observers, but more so if less obviously domesticated."

The ways in which several of the attributes discussed in this report combine to provide a 'diverse', 'organic' and 'natural' forest is highlighted by Garrod (2002: 10-11), who used 33 photographs of forest landscapes across the UK and more than 400 respondents in a series of choice experiments. He found the following preferences for different attributes of forests: "Respondents were asked about their preferences for the types of forest that they would like to see in a view. […] Preferences across the seven choices… suggest that a 'typical' respondent prefers small woodlands comprising of stands of randomly spaced broad-leaves of varying heights, interspersed with areas of open space. […] Of all the preferences investigated, the strongest were for plantings that mixed trees and open space and where spacing of trees was random rather than regular. If these preferences were translated to the factors that determined the forest configurations used in the choice experiment, it might be expected that respondents would prefer shape to be 'more organic' rather than 'basic'; scale to be 'small' rather than 'large'; structural variety to be 'high' rather than 'low'; and species variety to be 'high' rather than 'low'."

Tyrväinen et al. (2005: 92) write: "An increasingly important question is whether people find managed forests more attractive than unmanaged ones. Previous forest preference studies conducted mainly during the 1980s suggest that residents prefer managed forests if traces of human activity are not

visible. Although both types of results exist, many studies suggest that areas that are thought to be in natural condition are perceived to be more beautiful than if traces of human activity are visible (e.g. Axelsson-Lindgren 1995). Furthermore, logging residues, dead snags and decayed wood left in the forests are not appreciated."

Gundersen and Frivold (2008: 249) write: "In North Finland, Saastamoinen (1982) observed a positive preference for natural forest stands, although this category of forest also got the largest standard deviation. He explained this preference with the idea of a natural stand being a part of a larger wilderness area (*Urho Kekkonen* National Park), in which people neither expect to find permanent constructions like forest roads nor temporary traces from harvesting."

Lee (2001: 75) reports that his household survey respondents in UK were asked: "how do you think forests should appear in the landscape?" They were invited to assess nine attributes, using a five point scale. In addition, they were asked "How do you think that trees in the forests should be managed?" The data were combined for the purposes of analysis. There were high percentages of agreement or strong agreement with (in ranked order of agreement): 1) look natural, 2) be colourful or beautiful, 3) look inviting, 4) blend into landscape, 5) have a lot of variety, 6) be casual, irregularly-shaped, 7) be allowed to grow wild.

Other perspectives include that of Rametsteiner and Kraxner (2003:12) who highlight that the majority of respondents in a pan-European study felt "that a slightly tended forest may fulfil its functions better than a strongly tended forest or one that is left on its own". The public here defined 'slightly tended' as tidy, litter free with mixed tree species in a natural state. Bernasconi and Schroff (2003) in a study on seven forests in the Bern region, Switzerland reported that when asked whether they preferred wild, unmanaged or clean managed/cultivated forests, 75% of respondents chose the former. In Italy, Scrinzi and Floris (2000: 179-180) identified public preference for what they call 'pseudo-natural' forests. It did not matter whether forests were made up of conifers or broadleaves but a certain range of features were seen as desirable including forest stands that were "relatively open, not intricate, with good visibility on the ground, low density of stand, and even vertical stems of intermediate or large size".

Hekhuis and Wieman (1999: 343) argue that, at the stand level, close-to-nature forestry at a small scale is preferred over large-scale clear-cutting forest management (Hekhuis and Wieman 1999: 343). Key silvicultural attributes of small-scale, close-to-nature forestry include small regeneration units, mixed species and age classes, natural regeneration, long rotation periods and elements of nature protection like deadwood (ibid: 338). Roth and Krämer (2000) also identify a preference for close-to-nature forests. Schraml and Volz (2009: 244) write: "It is widely believed that in recent years the recreational and ecological discourse has met and found common goals. Furthermore, close-to-nature forestry is considered optimal for forest recreation. Silvicultural experts postulate that 'a forest that is managed close to nature widely fulfils the recreational demands of the people' (Leibundgut 1993)."

In conclusion, the consensus appears to be that naturalness is preferred to intensively managed forest, but that a degree of intervention is preferred to 'tidy up' the forest landscape, even if many recreational users may not be fully aware that the forests they prefer are not entirely natural. This issue of the level of knowledge of forest mangement practices and how it shapes perceptions and preferences is the focus of the next section.

4. VARIATIONS IN PUBLIC PREFERENCES

The results of the Delphi survey and literature review have been presented in a way that highlights similarities across social groups in order to provide a synthesis of preferences for each attribute at the European level. This section focuses on the differences in preference and asks to what extent can we make generalisations for each attribute given that the conclusions drawn from published studies are typically site-specific (cf. Ribe, 1989: 70). The level of variation likely to be obtained in public preferences for each attribute is considered here across four types of variation: a) different geographical regions, b) social groups, c) recreational activities, and d) other contextual factors.

GEOGRAPHICAL VARIATIONS

Geographical differences and similarities are highlighted by the Delphi survey results for each of the four regions covered by the study. Comparison of the literature for case studies in different parts of Europe may also suggest geographical differences, although few studies explicitly compare preferences across different parts of Europe. Jensen and Koch (1998: 43) note that: "preferences of visitors can vary considerably, even over shorter distances, from one cultural area to another and even between different segments of the population".

Possible explanations for variation in preferences across geographical regions are discussed by Schraml and Volz (2009). First, they suggest that (ibid: 246-7): "People in regions where broadleaves are already numerous tend to show a preference for broadleaf trees. This correlation, which has been described on the basis of individual examples from various regions in Europe (Vanderlinden and Lust 1988, Ott 1980, Degener 1963), was most recently examined systematically in Germany (Schraml and Volz 2004). A comparison of the preferences of people from states with a high percentage of broadleaves with those from regions with fewer broadleaves reveals obvious differences. People from broadleaf-rich regions show a higher preference for broadleaves than those from broadleaf-poor areas." Likewise, Schraml and Volz (2009: 245) assert, citing Rozsnyay (1979): "In Ireland, people who live in traditional forestry areas show a more positive disposition toward coniferous forests than those in areas with lower forest cover and a high level of afforestation activity."

Secondly, Schraml and Volz (2009: 235) suggest: "The preferences of those who were able to gain particular experiences in the surroundings in which they grew up are thought to be modified according to local landscape conditions. Some authors who use evolutionary theories postulate a learning process in individuals who recognise their parents' habitat as optimal for raising their own offspring (Balling and Falk 1982). Thirdly, and related to where people grew up, Schraml and Volz (2009: 236) note that: "On the subject of appreciation of tree species distribution, it was postulated as early as the early 1970s that the indifference of the population toward the mixture of tree species increases the less the species composition deviates from the composition of the forests which people visit for recreation (Heeg 1971)." Finally, Schraml and Volz (2009: 236) refer to the phenomenon of 'adaptive preference', a term: suggested by Elster (1983) as a means to supplement Rational-Choice approaches in economic theory: "He metaphorically explained this adaptation process with the legendary reaction of the fox who rejected the grapes as sour once he realised they were unavailable. Thus the term 'adaptive preference' describes the phenomenon of individuals adapting their preferences to their circumstances, especially in view of perceived constraints. People prefer certain goods because alternatives are not available and dislike others that are not available."

SOCIAL GROUPS

General observations

Individuals within different social categories such as age, gender, ethnicity, socio-economic group, level of education, residential location, and profession, may have different perceptions of recreational value of the same forest stand. In a broad sense, there are similarities in preferences across social groups. According to de Groot and Ramakrishnan, research by Kaplan and Kaplan (1989) shows "the overwhelming similarity in aesthetic preferences between people from different subgroups and with different backgrounds" although the majority of the studies they draw upon were from industrialised countries (de Groot and Ramakrishnan 2005: 467-8).

This view contrasts with Lee (2001: 2) who writes: "If public perception prevails, it will be partly due to an increasing awareness that the absolute basis for aesthetics is at best skeletal and that most of the flesh is added by personal associations and experience, filtered through cultural norms. If landscape appreciation is in the eye of the beholder (and there is sufficient evidence for this from cross-cultural studies and even from the very recently emerging studies in Britain) there are very strong reasons for taking public preferences into account in the planning process." Later, Lee (2001: 120) writes: "… it is often argued that there is not one 'public' but many. This is, of course, a reduction ad absurdum, but we should at least attempt to assess the differences between some of the main parts that comprise the whole. A beginning has been made by comparing identifiable groups that are likely to have different preferences for leisure activity and aesthetic enjoyment, that is the old and young, the male and female, and the educated and less well educated."

Soliva and Hunziker (2009: 284) explored 'ideal landscapes' and noted how aesthetics is just one of the factors that influence individuals' assessments of landscape: "In fact an ideal landscape is not only an optimum combination of aesthetically relevant (visual) landscape elements, but it also has to give an optimum satisfaction of other interests. Thus, when people assess a landscape, they are influenced not only by their aesthetic perceptions, but also by their values, assumptions, knowledge-bases, personal interests and life situations." Soliva and Hunziker (2009: 292) conclude that: "It is an important result of this study that the socio-economic and cultural aspects of landscape changes under the different scenarios take priority over visual aspects."

Numerous other authors have highlighted differences between social groups on the basis of case study research (e.g. Bradley and Kierney, 2007; Gundersen and Frivold, 2005: 12; Jensen, 1993; Lee, 2001: 71; Nielsen *et al*., 2007: 64; Rametsteiner and Kraxner, 2003). The extent to which many of these conclusions about specific social groups can be generalised at national level is likely to be limited. Hunziker et al (2008: 140) write: "Specific results on differences between social groups regarding landscape preferences have been published by Yu (1995), Van den Berg et al. (1998), Stamps (1999), Kaltenborn and Bjerke (2002), and Van den Berg and Koole (2006). Of particular interest are the articles by Stamps (1999), who conducted a meta-analysis of socio-demographic differences in landscape preferences…"

Silvennoinen et al. (2002: 271) write, of their own findings: "The age, gender, education, dwelling area and profession of the respondent, and ownership of forest sometimes correlated with preferences significantly. […] Earlier studies also indicate that a respondent's background may be a significant factor on their attitudes (Brush 1976, Knopf 1987, Brunson and Reiter 1996, Lindhagen 1996, Hallikainen 1998, Van den Berg et al. 1998, Tahvanainen et al. 2001). Blasco et al. (2009: 73) write: "When the background of the judges (gender, country or occupation) was included into the model as additional predictors, no significant improvements are achieved." However, later they acknowledge "…the use of a quite homogeneous population of judges" (ibid: 77).

Regarding preferences for 'naturalness' Tyrvainen et al. (2005: 92, citing Tyrvainen et al. 2003) note that: "In a study in Helsinki, Finland… younger, higher educated residents and active urban forest users preferred more ecologically-oriented management compared to older, less-educated residents and less active users." Similarly, Silvennoinen et al. (2002: 271) write, of their own findings: "In the

present study, women, young urban people and those who do not own forest or have work related to forestry tended to experience thinnings less positively and saw regenerative cuttings as more harmful than the others did. These results are reasonably well in line with earlier findings (Karhu and Kellomaki 1980, Kangas and Niemela 1995, Karjalainen 1996, Mantymaa 1998). However, significant differences were less common and less systematic when the analysis was based on photographs [as opposed to replies received from the direct questions on the attitudes towards different cutting methods]."

Age

Few studies have been carried out on preferences of children. Gundersen and Frivold (2008: 247) write of their review: "Almost all respondents were adult; only one survey (Rydberg, 1998a) included children and young adolescents. […] All in all, children, young adolescents, immigrants, and elderly or handicapped people were under-represented in the material." Elsewhere, Gundersen and Frivold (2005: 13) write: "In a preference study about density in young stands, Rydberg (1998a) found a significant difference between forestry students on the one hand and other young people plus a group of nine-year old children on the other hand. Forestry students preferred the less dense stands."

Tyrvainen et al. (2005: 90) write: "In preference research aesthetic values are thought to be linked to the evaluation context as well as respondents' characteristics such as education, recreational activity, nature relationship, age and gender. Preference studies mainly from North America have shown that attitudes towards the wooded environments differ between children, teens and adults (Kaplan and Kaplan 1989). Youths appreciate the wild, dense, and hidden forest more than cultivated and open forest. […] For children, structurally diverse natural places have been stressed as being more inspiring and imaginative, even compared to a well-organized playground (Kaplan and Kaplan 1989…)."

Gender

Regarding gender, Gundersen and Frivold (2005: 13) write: "Kardell (2001) found a striking difference between the attitudes of male and female forestry students, female students being less positive to clear-felled areas than male students. However, the number of respondents was small and the differences were not tested statistically." Also, in a study carried out in coastal southwest Finland, Tahvanainen *et al.* (2001: 63-64?) used visual and verbal stimuli to elicit preference responses and discovered through verbal questioning that there were differences of opinion concerning ground cover based on gender and age. Women felt that removal of undergrowth had a negative effect on scenic beauty while men thought it was quite positive (although men also believed undergrowth removal increased recreational value). Moreover, older persons (over the age of 59 years) were more positive about the scenic beauty impacts of undergrowth removal than were middle-aged (35-59 years) respondents. In Catalonia, Spain, three separate studies revealed statistically significant differences in peoples' preferences regarding forestry policies and programmes, especially between older women and older men, and older and younger women. However, there was no overall difference in preferences attributable to gender (Farreras et al. 2005).

Profession

One possible generalisation that may hold across Europe concerns differences in attitudes of people with different levels of knowledge about forestry practice. Foresters tend to be more accepting of intrusive silvicultural interventions such as clear-felling and thinning operations in the short term before the site has regenerated or recovered (e.g. Bliss 2000: 7).

Ribe (1989: 71) writes: "…different types of people, and people with different experiential expectations, can perceive forests in differing ways. In some cases, these findings seem easy to explain. For example, professional bias occurs in instances where one would expect certain attributes to be liked. Cattlemen like open grassy forests, foresters favour tall straight trees, wildlife experts favour habitat shrubbery, and landscape architects apply higher aesthetic standards to scenery."

Gundersen and Frivold (2008: 252) write: "Several preference studies included statistical analyses of differences in preferences between *respondents with some sort of a background in forestry* and other

respondents. Of these, only two studies (Hultman, 1983; Pukkala et al., 1988) found no significant difference. Not surprisingly, trained foresters showed a greater appreciation for scenes that have been formed in ways they had been accustomed to in their education than other people, like seed-tree regeneration, whole-tree harvesting and young forests (Hultman, 1981), clear felling (Kardell, 1978; Hultman, 1981; Karjalainen, 1996), felling with seed trees (Lindhagen, 1996) and clear felling with retention trees (Tonnes et al., 2004), and a less positive attitude to photos of a virgin forest (Hultman, 1981) and a young stand with spruce damaged by frost (Lindhagen, 1996). […] Hultman (1983) reported a highly significant correlation between the attitudes of the 79 respondents who had experience with forest-related work and the 540 without such experience in his representative sample of Swedish residents ($r=0.95$, $p=0.001$)."

In a study of preferences for four landscape scenarios with different amounts of forest in Switzerland, Hunziker et al. (2008: 145) write "… one traditionally relevant driver of landscape preferences was confirmed, i.e. the type of profession. This confirms reports by Dearden (1984), Strumse (1996) and Van den Berg et al (1998), as well as findings from mountain areas outside Europe, e.g. in New Zealand (Foran and Wardle 1995). These authors found that landscape experts and decision-makers assess landscape developments consistently differently than lay people. In our case, the experts rated return to the traditional cultural landscape much higher, and both reforestation and intensification much lower than the general Swiss public."

In his questionnaire survey of preferences in UK, Lee (2001: 67) writes: "The majority believe timber production to be the least important use of forests. This is a stark measure of the difference between the attitudes of the public and those of forestry managers. Nature conservation is considered by the public to be by far the most important use, followed by scenic attraction and, thirdly, recreation" (See also Lee 2001: 68, Table 52. Later, Lee 2001: 147-9 elaborates on the divergence between individual landscape architects in assessing landscapes using their own criteria.)

Clear-cuts

The views of professional land managers differ from those of the wider public on the acceptability of clear-cuts and other intrusive interventions. Several studies have concluded that clear-cuts are more acceptable to foresters than non-foresters. Gundersen and Frivold (2005: 13) write: "In Finland, Pukkala et al. (1988) did not find any significant differences between foresters, biology students and urban citizens in their rating of slides of various types of forest stands. Karjalainen (1996), in a study of scenic preferences solely using photos of different clear-felled areas, found that forestry personnel had a much more positive attitude to clear felling than both ordinary citizens and environmentalists. Ninety-eight percent of the forestry personnel participating in her survey thought that clear-felling was a suitable felling method, while only 12% of the environmentalists and 5% of the lay residents felt the same. However, all three respondent groups rank-ordered the photographs of clear-felled areas in a similar way. Tönnes et al. (2004) came to a similar result when showing their respondents slides of different clear-felled areas with retention trees. Respondents with a forestry education found most of the images to be significantly more attractive than people who had no education in forestry."

Gundersen and Frivold (2005: 13) continue: "In a pilot study, Kardell (1978) compared scenic preferences of forestry students with students of other professions. Respondents were asked to evaluate ten photos with an Osgood scale. The student groups had rather similar opinions, except about a photo of a clear-felled area that was praised by forestry students and rejected by the other students. Lindhagen (1996) notes that forestry students ranked a clear-felled area with a lot of seed trees significantly lower than other groups in his survey."

Regarding other intrusive interventions, Silvennoinen et al. (2002: 270-1) note that urban informants are more critical of thinning. Differences in profession and level of education affected opinions. See also Ribe (2002).

Regarding attitudes to clear-cuts and level of knowledge or education, Becker (1983: 173) carried out a study of perceptions of clear cuts in USA study. Analysis of summer visitors indicated that there was

a positive, significant association between visitor education levels and a knowledge of clear-cuts [in relation to recognising a clear-cut]. The closer the visitors lived to the State forest, the more likely they were to recognise the clear-cuts. The final significant association was between opinions about clear-cutting and recognition of a clear-cut. Specifically, those visitors who recognised the cuts were less antagonistic towards clear-cutting as a management tool, than visitors who did not recognise the cut areas they had encountered. Finally, there was no significant association between recognition of the clear-cut areas and the enjoyment reported by the visitors, from their forest recreation. Only 8% of visitors who recognised the cuts and 7% of visitors who did not recognise the cuts did not enjoy their visit.

Bliss (2000) argues that public opposition to clear-cutting is based on social issues relating to perceptions, values and trust (Bliss 2000: 4). He divides people into two parties: the 'disinterested' public made up of casual forest visitors who object to clear-cutting on visual grounds, and the 'interested public' made up of citizens who evaluate the relationship between forest practices and other values they consider important (Bliss 2000: 6). Amongst interested citizens, clear-cuts are associated with a range of negative practices such as deforestation, plantation forestry (seen as the industrialisation of the natural landscape), environmental degradation and exploitation (ibid). While Bliss recognises that some of these associations are unfounded, he suggests that the public dislike clear-cutting because the practice symbolises a model of industrial-style forestry from the past, "before foresters understood that trees were more than wood, and forests were more than trees" (Bliss 2000: 7). They associate clearcutting with deforestation. Bliss refers to his own work in the mid-south and Oregon and also to Shindler et al. (1993).

Tree species type

Social class differences were clear among preferences for different tree species types according to Lee (2001: 70) who reports: when people in the household survey said that they would like to see more forests, they were asked what kind of trees should be planted. 37% said any kind of trees; 33% said a mixture of the two (broadleaved/conifers); 21% preferred broadleaved, and 5% said conifers; 4% said they don't know. Lee (2001: 71-72) continues: "Social class differences are considerable, with AB (professional and managerial) strongly favouring the broadleaved form with a progressive reduction in this preference through to DE (manual). A preference for broadleaved forests is closely reflected in the membership of environmental groups (Table 60). It is well known that environmentalism is related to social class and is strongest in the AB grouping, so it is therefore difficult to identify which is the main cause. […] [Also] AB are the most frequent users in percentage terms, though not in absolute terms. […] there is a very strong preference for broadleaved species among existing frequent visitors."

Schraml and Volz (2009: 246) considered influence of social class on public preference for 'broadleaves', 'conifers', 'mixed' or 'no opinion': "A remarkable number of people have no opinion on this issue, i.e. the subject is of no interest to them. In most of the German studies of the 1960s and 1970s in which the category 'no opinion' was offered, between 20% and 50% of the interviewees chose this answer. Today the number of undecided people appears to be smaller. In this regard the results are similar all over Europe. […] Attempts to characterise the group of people that show a clear preference for broadleaf trees demonstrate repeatedly that age, education and origin (rural versus urban areas) are factors of high relevance with regard to existing preferences (Lee 2001, Braun 2000, Wöbse 1972). Overall it can be said that members of the well-educated classes with a higher social status tend to prefer broadleaf trees. This appears to hold true for urban areas as well. There are also indications that people who frequently visit the forest tend to prefer broadleaf trees. Finally, as can be expected, members of environmental organisations also show a marked preference for broadleaves."

Schraml and Volz (2009: 245) comment on the low level of knowledge of tree species in Ireland: "Feelings of resentment toward conifers are correlated with a lower level of knowledge regarding the differences between broadleaved and coniferous trees in the less forested areas. In those areas, between one fifth and one quarter of the respondents were unable to classify certain tree species (oak, spruce, ash, pine and beech) as either broadleaves or conifers when the species names were mentioned in the interview or when the subjects were shown pictures of the trees (O'Leary et al., 2000). In

regions with a long-standing forestry tradition, the results of methodologically similar surveys differ greatly. Here a clear majority of the interviewees will recognise at least the main tree species of their region. […] (Rozsnyay 1979)." Schraml and Volz (2009: 247) add: "In Germany 33% of the population has never heard about the efforts to increase the percentage of broadleaf trees in the forest (Schraml and Volz 2004). […] The 'forestry revolution' toward a close-to-nature forestry occurs largely unnoticed by the public (Schriewer 1998)."

In conclusion, Schraml and Volz (2009: 250) write: "The issue of tree species, while crucial to the experts, is only of very limited interest to the general public. In many other cases it is questionable whether the interviewees actually have a clear concept of the forest types on which they are asked to comment."

Regarding forest owners and species type, Schraml and Volz (2009: 247) note: "A comparison of the results of the MultifoRD study from several European countries reveals that forest owners clearly demonstrate a higher sensitivity to the significance of forest types with regard to forest quality than is shown by other groups. Similar results can be found in several national studies. Forest owners in Germany, for example, more frequently profess a preference for coniferous forests than do other people (Schraml and Volz 2004)."

RECREATIONAL ACTIVITIES

The classic approaches to landscape preference research outlined in Section 2 above are based on individual perceptions of near-view 'scenic beauty', 'aesthetic value, or 'visual quality' of the forest stand depicted in photographs or computer images. To what extent can it be claimed that visual quality scores obtained through this method reflect preferences to visit that site for recreational use? Is it necessary to disaggregate between different types of recreational user such as walkers (for whom aesthetic and recreational values may be very similar) and hunters (for whom aesthetic and recreational preferences may differ)? Few published preference studies appear to have differentiated between aesthetic and recreational values to show how preferences differ according to how the forest is used.

It is argued in this study that the majority of people would prefer to visit forests with higher aesthetic value, and hence visit those sites more frequently, regardless of the particular recreational activity being pursued. Evidence to support the view that scenery is the main motivation behind visits to forests is provided by Lee (2001). Lee (2001: 35) writes regarding his household survey involving 200 interviews in four distinctive areas of UK: "the total sample is sufficiently similar to the UK distribution of age and sex to allow cautious generalisation." Later, Lee (2001: 58) states how he explored: "the users' perceptions of the relative importance of the different attributes forests have to offer, and the particular attributes that motivate them to visit forests." He asked "What is the importance to you of the following statements concerning what forests may offer people?" Eleven attributes were pre-selected, and 'beautiful scenery' scored the highest mean score for importance, with 34% saying this was important, and 55% saying that this was very important. However, elsewhere Lee (2001: 120) asserts that his study "marks a departure from previous studies in its attempt to address the fact that no landscape can be 'all things to all men'; preferences should be assessed against some well defined purpose."

Brown and Daniel suggest that interactions between visitors and the forest environment can be located on a continuum between an emphasis on the recreational activity itself (such as white water kayaking) and emphasis on the aesthetic experience (such as hiking, and driving for pleasure), with activities such as hunting and fishing located somewhere between the two. Furthermore the emphasis may shift from moment to moment for any one individual (Brown and Daniel 1984: 2). An individual's aesthetic preferences may also change over time due to a sense of familiarity and attachment to a site or a type of site that is used habitually for a particular recreational activity. This could be the case for some users of popular mountain biking sites in Scotland within areas of intensive even aged forest generally

regarded to be of relatively low aesthetic value. In the face of this variation, Brown and Daniel conclude that: "the scenic beauty of the forest environment probably always makes some contribution to visitor satisfaction, and in many cases is the predominant component" (ibid). In doing so they support their methodology as a means to help mangers reach trade-offs between the competing needs of timber production and recreational use of forest land.

In several regions, the most important forest based recreational activities in terms of visit numbers are probably walking, dog-walking, cycling and jogging. This is the case for urban and peri-urban forests near Vienna (Arnberger, 2006) and for the whole of Scotland (Edwards et al., 2009). These four activities can be considered mutually exclusive in that a trip involving one of them is unlikely to involve any of the others. Together they account for 98% of all visits to Scottish forests (ibid). It may be hypothesised that they represent the end of Brown and Daniel's continuum where aesthetic values are most important. Hence, for Scotland, scores which measure visual quality may be a close proxy for recreational value. In other countries the list is more diverse, for example a Swedish study indicated high levels of participation in walking, berry picking, cycling, hunting, fishing, bathing and skiing (Hörnsten, 2000: 8). Following Brown and Daniel, it may be necessary to assume that scores for visual quality of a stand act as a proxy for preferences for all major types of recreational use. To reduce confusion, the Delphi survey questionnaire asked participants to provide 'recreational scores' rather than 'aesthetic' or 'scenic beauty' scores.

Of the few studies that distinguished recreational from aesthetic value, Axelsson Lindgren (1995: 281-2) writes: "In a Finnish study (Pukkala et al. 1988), a pure, old and rather sparsely stocked birch stand got the highest preference for beauty, while pure and old pine stands were the most preferred for recreation (see also Loven 1973, Kellomaki 1973, Savolainen & Kellomaki 1981)." Similarly, Lindhagen (1996: 381) studied two sites in Sweden (Hammarskog, 11 km south-southwest of Uppsala, and Fjällnora, 16km east of the town). The respondents generally liked old coniferous stands better than clear-cut areas and young dense coniferous stands. Two of the mature stands at Fjällnora were, however, considered as less suitable for outdoor recreation than some of the younger stands and clear-cut areas.

Other perspectives include that of Rametsteiner and Kraxner (2003:41) who state that most people included in the study highlighted recreation as the main reason for visiting a forest. Rollins and Robinson (2002, cited in Harshaw et al. 2007: 233) assert that a consequence of the diversity of outdoor recreation activities that are available, and of the differing motivations that people hold for participating in these activities, is that there is not an average outdoor recreation participant upon whom management may focus; the management of outdoor recreation means managing for diversity. Gundersen and Frivold (2008: 247) write of their review of 53 Fennoscandian studies: "All of the surveys were related to traditional outdoor life in the three countries. We found no studies that covered possible preferences regarding forest structures in relation to alpine skiing, off-road biking, horseback riding, or other outdoor activities that have recently gained popularity, particularly among young people (Odden, 2004)."

Clear-cuts and other interventions

As well as the differing views of clear-cuts between foresters and non-foresters, Ribe (1989: 71) writes: "Also understandable are instances where forests with recreational or wild-use labels are perceived with some positive bias, or where recreationists, whose activities make use of clear-cuts, perceive them less negatively. Other observed intersubjective differences seem more arbitrary." Elsewhere, Ribe (1989) writes: "However, Becker (1983) found that recreationists who had recognized a clear-cut during their activity did not tend to report lower quality experiences and that many hunters actually liked clear-cuts in as much as they promoted better hunting. Levine and Langenau (1979) also found that negative views toward clear-cuts are not absolute, but are softened among 'diversive recreationists' who can make use of clear-cuts for things like hunting and berry picking, and that men can be more accepting of clear-cuts. These findings indicate that the perception of clear-cuts can be mitigated by circumstantial and subjective factors, but do not override the more general aesthetic dislike of clear-cuts."

A study by Brunson and Shelby (1992) in the Pacific northwest of USA explored the relationship between scenic and recreational value of forests at stand level and landscape level. Comparative judgements of recreational and scenic quality were obtained by surveying 95 persons who visited old-growth Douglas-fir stand and five nearby stands that had been harvested within the previous two years. Two of the latter had been harvested using traditional practices, and three used alternative methods that can be considered New Forestry. Next, they judged each stand's acceptability as a scenic landscape, as a place to hike and as a place to camp. The results suggest commonalities between these uses. Brunson and Shelby (1992: 39) showed that old-growth stands were judged most attractive, the traditional clear-cut was least acceptable, and partial-cutting methods fell somewhere in between. Among the partial-cutting methods, the patch cut – which left the most standing volume – was the most acceptable. The two-story stand, with its residual of 100-year-old-trees, was more acceptable than the thinned 30 to40 year old stand."

CONTEXTUAL FACTORS

In addition to the factors discussed above, the context in which the value judgement is made can be significant. Tyrvainen et al. (2005: 90) note that: "In preference research aesthetic values are thought to be linked to the evaluation context as well as respondents' characteristics such as education, recreational activity, nature relationship, age and gender." Similarly, Jensen and Koch (1998: 40) note that many factors can influence an individual's assessment of the quality of a forest for recreational activities including weather conditions, time of day, coincidences (e.g. seeing a roe deer). They also raise concerns over the difficulties of representing accurately people's preferences, which are dynamic and often changeable, adding "…there is considerable risk of generalisation, idealisation and strategic responses" (ibid: 68). Ward Thompson (1998: 8) points out: "what a person has seen in the landscape immediately before influences the response to what is seen next… so views of the same scene at the start and the end of the journey may evoke different responses."

Also preferences may appear to be different according to the methodology used to elicit them. If a researcher asks for judgements of a photo, taken out of context, this may elicit a different response than if the researcher takes the informant to the site itself and then asks for their value judgement, since their perception may be altered by their experiences of the landscape leading up to the site, as well as other sensory perceptions such as smell, the wind, rainfall or sunshine, etc. Of course, this is precisely why landscape preference studies use photos or other visual simulations, taken out of context, to control for such context-specific variables, and allow easier comparison between forest views. But the point needs to be made that values elicited in this way may differ from the actual experience of the site by a recreational user. A full definition of aesthetic value would extend beyond visual experience alone. According to Brown and Daniel (1984:2), aesthetic experience is made up of a mixture of sensory experiences (e.g. smells, sounds, touches and sights) and expectations but they add that visual aspects make a major contribution to aesthetic experiences.

Attachment and familiarity

Another context-specific factor that may impact on the value that is attached to the forest is the familiarity with the site that may be built up over numerous visits. People who make regular visits to local woodland may begin to value that particular site as highly as other woodlands, widely judged to have a higher aesthetic value, through their psychological, spiritual or emotional attachment to the particular site.

The study of 'attachment to place' by Hunziker *et al* (2008) highlights this effect. "The results revealed that strong feelings existed regarding all kinds of 'unspectacular' landscape features, e.g. a certain spot where one used to go for a walk or a tree from childhood. These landscape elements play a crucial role when it comes to judging landscape change, because people attach a special meaning to them and notice even slight changes" (ibid: 143). […] "Some landscape elements are characterized by changing valuation through time: some are considered as disturbing at the beginning, but later they

become a symbol of the community. Hay (1998) found the same trend and concluded that time is the most important factor in the genesis of place attachment. Nevertheless, there is a certain demand to retain elements from the past, as already mentioned by Hoffenberg (2001), who stressed the relevance of historical elements for the valuation of a landscape" (ibid: 144). […] "…historical aspects of landscapes are important factors in the formation and stabilization of identity" (ibid 145).

Of relevance here, Præstholm et al. (2002) looked at two case study sites in Denmark and found that positive preferences for forest attributes were closely linked to the distance travelled to get to the forest. They suggest that individuals and groups are most likely to participate in recreational activities that are in forests close to their home, and that regular visits contribute to their increasing attachment (and its associated values) to the local forest (Præstholm 2002: 102). Likewise, Rametsteiner and Kraxner 2003: 31 concluded from a review of European literature that individuals may have different expectations, requirements and demands in terms of what they want from forests depending upon whether they visit forests for a day or whether they make short visits to local forests.

Englin and Mendelsohn (1991: 286) drew some counter intuitive conclusions regarding how familiarity affects preferences. "The more people visit a site, the more they seem to choose sites with Douglas fir, spruce, alpine fir, rock and ice, and views. In contrast, people who visit sites often are less likely to choose hemlock forests and old-growth forests. This last result is particularly interesting, for it suggests that old-growth is desired for an occasional trip but not for a 'favourite' (often visited) site."

On the importance of familiarity and attachment, Gundersen and Frivold (2008) suggest that: "There is, however, a risk that a management practice based solely on general rules for enhancing recreational values excludes the uniqueness and the identity of each forest, which in many cases are the most important elements for recreational users and tourism. Forest landscapes are diverse and can be repositories of history, rituals, cultural and spiritual meanings, social and personal identities, and emotional memories; values that are not measured directly in quantitative surveys of forest preferences. Such surveys alone can hardly capture people's true attachment to a particular place in a forest landscape."

Changes over time

It is often asserted in the context of landscape preferences that people don't like change: people want what they expect or what they have grown up with. Bell (2001:201) notes that forestry involves managing a dynamic and changing forest landscape but public attitudes towards landscape change can be conservative with the "persistent belief still held by many people that forests grow to a climax type and naturally stay that way for ever" (ibid: 206). Bell argues that people may have preconceived ideas about how forests should appear that can conflict with current understandings of dynamic landscapes.

Regarding changes over time, Gundersen and Frivold (2008: 253) write: "Lindhagen and Hornsten (2000) found small differences in ranking and mean scores of 28 photos among representative samples of residents of Sweden asked in 1977 and 1997. Six of the photos got a slightly higher score in 1997: the largest difference was found for a photo of a virgin forest (see section on "Dead standing trees and windfalls" above). A reason for the increased appreciation of that particular photo could be that the importance of decaying windfallen logs for biodiversity had become a part of public consciousness during the period. Nevertheless, a large majority of the respondents still considered the virgin forest on the photo unsuitable for recreation. […] Five photos got a slightly lower mean score in 1997 than in 1977…" Other references were given but the evidence was less strong.

Stability over time is suggested by Silvennoinen et al. (2001: 18) who write: "The predictors of our models and their regression coefficients correspond to earlier results (Savolainen and Kellomaki, 1981; Pukkala et al., 1988). It seems that Finns' scenic beauty preferences have not changed notably in the recent past…"

Similarly, Jensen (1997: 160) writes: "It has not been possible to detect major changes in the preferences of the general Danish population over a period of more than 15 years. No complete alteration in preferences has been found in the topics surveyed." This conclusion is supported by the few other studies that have looked at trends over time. Possibly no other study has looked at changes over time for the general population. Jensen (1997: 160) continues: "Cole et al. (1995) state in their research summary: […] 'Little evidence supports the idea that the visitors of today or the trips they take are substantially different from those of a decade or two ago'. Also Palmer (1997) conclude in this direction: 'that the citizens of a town have a relatively stable understanding and scenic preference for the landscape within which they live, at least within the time frame of a decade.' […] Also Lucas (1985), in general, found very few obvious changes in the visitors' preferences between 1970 and 1982. The few noticeable changes ascertained can be ascribed to changes in the character of the area studied, and to its recreational utilisation. […] Minor changes in the Danes preferences from 1977 to 1994 have been found in relation to a few topics…" Jensen (1997: 162) concludes: "When comparing the relatively few studies of trends in forest preferences the overall conclusion (so far) is that the preferences studied in general are quite stable over time – at least during a decade or two. This conclusion can be supported by Smith (1994) whose paper 'Is there real opinion change?' elaborate the statement that: 'Most opinion change is slow and steady'."

Concluding remarks

Overall, it could be argued that a significant level of generalisation is possible for each of the attributes between geographical regions, social groups, and those pursuing the main recreational activities allowing some conclusions to be made about public preferences that apply across Europe. Possibly there are wider variations in preferences for non-silvicultural features such as trails, interpretation and facilities, although this falls outside the scope of the study. This conclusion is supported by the relatively consistent weightings and relationships proposed for individual attributes by participants in the Delphi survey. One acknowledged exception is the difference in preferences between professionals or 'experts' and the rest of the population.

A final point concerns differences between what experts think the public prefer, and what the public actually say they prefer. ('Experts' in this context means professional foresters and other land managers rather than experts in forest preference research who participated in the Delphi survey: see Section 2.) This topic was researched by Jensen (1997: 130) who writes: "Several surveys have shown that forest managers and landscape managers' own preferences – or their perception of visitors' preferences – do not always agree with the visitors' preferences (e.g. Hendee and Harris, 1970; Willhite and Sise, 1974; Hultman, 1981; Jensen, 1993)." However, elsewhere, Jensen (1993: 91-92) elaborates that the differences are modest: "This study of experts' perception of the forest and landscape preferences of the Danish population shows that there are more similarities than differences between the experts' perceptions and the preferences of the population. But, not all issues are assessed in the same way: in about one third of the issues investigated, the experts' perceptions differ from the preferences of the population. Where do they go wrong? The experts believe that the population prefers the more natural/unmanaged forest – for example, with a broken tree trunk and gnarled oaks. The reason for this bias in the experts' perception could be due to the influence of the more articulate nature conservation groups in society. […] The experts also believe that a general development of recreation facilities in the forest has stronger support in the population than is actually the case. […] It might be expected that the politicians, 'standing aloof from the world', would be further than the other 'experts' from a perception which agreed with the preferences of the population But, actually a close resemblance is found."

5. CONCLUSIONS

The research reported here has sought to present a synthesis of public preferences for different silvicultural attributes for the whole of Europe. The study began with a comprehensive review of the literature on forest preferences in Europe and to a lesser extent USA involving compilation of a bibliography of over 300 references. The next step was to develop a robust typology of measurable silvicultural attributes at stand level that could be used to inform assessments of the impacts of changes in forest management on recreational use. The typology of attributes was then included in the pan-European Delphi survey, which indicated the relationship of each attribute to recreational value of forests, weighted its relative importance, and explored the extent to which these findings could be generalised across the four contrasting case study regions. The survey results and participants' comments for each attribute were then presented and discussed alongside relevant findings generated from the literature review.

The findings of the survey and review broadly support the conclusions reported in existing review articles such as Ribe (1989) and Gundersen and Frivold (2008). For example, Ribe (1989: 70) writes in conclusion to his article: "A number of findings are reconfirmed in different studies and are evidently quite general. They serve to demonstrate the scenic value in certain forest characteristics against the view that aesthetic forest products are largely subjective and capricious. However, these scenic characteristics are also relatively intuitive and therefore not particularly new. They include findings that big trees are attractive, moderately stocked more open stands are preferred, ground slash and other evidence of harvests are disliked, ground vegetation enhances forest scenes, evidence of fire detracts from beauty, and species variety can enhance the same."

The main contribution made by this study has been to supplement these descriptive conclusions with quantitative estimates of the relationship and relative importance of each attribute to the recreational value of forests in Europe, as well as the variation between geographical regions. This report appears to be the first attempt to do so. The use of a Delphi survey, as opposed to a full psychophysical survey using a representative sample of the visiting public, was considered necessary due to the ambitious nature of the goal. While there is evidence of the reliability of the Delphi method in similar contexts (e.g. Landeta 2006), the data presented in this report needs to be seen as indicative, due to compromises inherent in the study design. One of the main criteria for selection of experts was whether they were familiar with forest preference research, and hence more able to take into account potential differences between their own preferences and those of the general public. It is also worth reiterating that the self-reported confidence levels of respondents were medium or high for all attributes in nearly all regions, and this is reflected also in the comments provided by respondents in their questionnaires (see Section 3). Nevertheless, the extent to which experts were able to represent the views of the general public remains uncertain.

The findings indicate clearly that 'size of trees' is universally considered one of the most important attributes, along with attributes that reflect level of intervention such as 'size of clear-cuts', 'residue from thinning and harvesting', and 'visual penetration' which is partly a consequence of management intensity. The results highlight the relationship between several of the important attributes and the degree of 'naturalness', and suggest that, on average, the public in most of Europe prefer a degree of intervention to 'tidy up' the forest, creating a situation of 'managed naturalness'. Other key findings include the relative unimportance of 'number of tree species', which supports the conclusions of the second part of the Delphi survey reported in Edwards et al. (2010) that 'tree species type' is seen to have a relatively small impact compared to the structural properties of the stand, especially tree size and structural diversity.

One of the strengths of the study is the opportunity it provides to compare results across regions. This reveals some striking variations in the ranking of certain attributes. 'Residue' is considered of very little importance in Central Europe whereas it scores highly elsewhere. This may be a consequence of differences in silvicultural practice, although further investigation would be required to determine how

this may be the case. Similarly, in Great Britain, the highest importance is attached to 'variation in tree size', although this attribute scores low elsewhere. Arguably this reflects the prevailing negative perception of intensive even-aged plantations of Sitka spruce (*Picea sitchensis*) the dominant silvicultural regime in upland areas of Great Britain. Few stands of conifers show significant variation in tree height in Great Britain, and those that do may consequently be regarded as unusually attractive for recreation. The current policy of conversion to Continuous Cover Forestry in parts of Great Britain, which is characterised by uneven-aged stands, is driven in part by its perceived benefits to landscape and recreation. The low importance attached to 'variation between stands' in Great Britain contrasts with the evidence presented in Axelsson-Lindgren and Sorte (1987) for Sweden, and unsurprisingly perhaps this attribute scored higher in Nordic Region. Possibly the importance attached to this attribute reflects the scale of forestry in each region. In Great Britain, forestry is a relatively small scale operation, which perhaps already shows high variation between stands and a greater proportion of non-forest cover than other parts of Europe where similar kinds of forest may extend across considerable areas and may be seen to be monotonous.

It is hoped that this research will provide a useful resource for researchers, managers and policymakers, who wish to gain an overview of the contribution of key silvicultural attributes on recreational value of forests, and also prompt further work that goes beyond the scope of specific case studies, and overcomes the methodological limitations of a Delphi survey, to develop further pan-European perspectives on public preferences for forest attributes and types.

APPENDIX: INDIVIDUAL RESPONSES TO THE DELPHI SURVEY

RELATIONSHIP

The data on 'relationship' of each attribute to the recreational value of forests for each respondent are given below.

Table A1. Count of relationship types for each attribute: Great Britain (n=10)

Attribute	Relationship to recreational value				
	Positive	Negative	Bell-shaped	U-shaped	Even
1	8		1	1	
2	8		2		
3	8		2		
4	1		9		
5	1		6	1	2
6	1		8		1
7	5		4		1
8		8	1	1	
9		10			
10		1	8		1
11	5		3	1	1
12	10				
Grand Total	47	19	44	4	6

Table A2. Count of relationship types for each attribute: Nordic Region (n=12)

Attribute	Relationship to recreational value				
	Positive	Negative	Bell-shaped	U-shaped	Even
1	12				
2	5		6		1
3	6		5		1
4	6		6		
5	4		8		
6	3	4	5		
7	6		5		1
8		12			
9		12			
10	1	7	3	1	
11	5		7		
12	12				
Grand Total	60	35	45	1	3

Table A3. Count of relationship types for each attribute: Central Europe

Attribute	Relationship to recreational value				
	Positive	Negative	Bell-shaped	U-shaped	Even
1	13		1		
2	10		4		
3	11		3		
4	1	2	10		1
5	4		9		1
6	2	1	11		
7	6		8		
8		13	1		
9		13	1		
10		2	10		2
11	10		4		
12	11		3		
Grand Total	68	31	65	0	4

Table A4. Count of relationship types for each attribute: Iberia (n=10)*

Attribute	Relationship to recreational value				
	Positive	Negative	Bell-shaped	U-shaped	Even
1	9				1
2	6		4		
3	2		7		1
4	1		9		
5	8		2		
6	1	6	3		
7	7		2	1	
8		10			
9		9	1		
10		3	6		1
11	7		1		2
12	9				
Grand Total	50	28	35	1	5

*n=9 for Attribute 12.

RELATIVE CONTRIBUTION

The data for relative contribution of each attribute to the overall recreational value of forests for each respondent are given below.

Table A5. Individual respondents' scores for relative contribution: Great Britain

Attribute	Individual ID										Mean contribution
	1	2	3	4	5	6	7	8	9	10	
1	8	5	8	10	10	10	4	8	5	10	7.8
2	8	8	10	5	9	6	10	7	7	10	8.0
3	8	5	8	8	8	6	9	7	2	7	6.8
4	6	4	7	7	10	4	6	6	7	6	6.3
5	7	5	6	9	7	3	9	6	2	5	5.9
6	7	4	2	3	2	1	8	4	6	3	4.0
7	6	8	8	6	5	1	10	6	3	6	5.9
8	9	7	5	8	7	10	7	4	8	6	7.1
9	10	4	5	9	6	9	3	8	7	4	6.5
10	6	4	3	1	4	2	8	4	5	5	4.2
11	6	4	6	2	4	6	2	6	7	5	4.8
12	5	5	5	4	5	9	10	8	5	5	6.1
Mean											6.1

Table A6. Individual respondents' scores for relative contribution: Nordic Region

Attribute	Individual ID												Mean contribution
	1	2	3	4	5	6	7	8	9	10	11	12	
1	10	10	10	10	10	9	8	9	10	10	10	10	9.7
2	5	6	5	5	5	7	2	3	8	8	7	7	5.7
3	5	6	8	7	5	8	5	2	4	9	6	8	6.1
4	8	8	7	6	9	8	2	8	5	8	8	7	7.0
5	10	8	10	8	10	9	6	7	1	8	9	8	7.8
6	8	6	5	7	5	7	5	1	3	5	7	8	5.6
7	10	6	5	7	5	8	3	5	6	6	9	7	6.4
8	10	9	10	10	10	9	7	10	9	8	7	10	9.1
9	10	10	10	10	10	9	10	8	9	9	9	10	9.5
10	7	10	8	10	8	7	8	8	5	6	3	6	7.2
11	10	10	6	9	9	9	6	9	10	10	7	9	8.7
12	6	5	6	7	5	8	6	4	6	7	7	5	6.0
Mean													7.4

Table A7. Individual respondents' scores for relative contribution: Central Europe

Attribute	Individual ID														Mean contribution
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
1	7	8	8	6	9	9	5	8	9	8	5	10	3	10	7.5
2	5	6	7	6	7	5	5	6	6	6	4	10	5	9	6.2
3	5	6	8	5	8	5	6	5	7	8	8	8	8	8	6.8
4	3	7	8	5	7	8	6	6	6	7	7	7	6	5	6.3
5	4	7	7	3	9	6	5	7	6	7	4	7	7	4	5.9
6	2	4	6	3	9	8	7	8	4	4	3	3	6	3	5.0
7	3	5	5	2	8	4	4	6	8	4	4	7	4	3	4.8
8	10	10	8	3	8	6	7	8	7	7	8	10	3	7	7.3
9	2	5	4	5	8	3	3	7	7	4	3	4	5	2	4.4
10	3	6	6	3	8	4	4	7	7	4	4	4	6	6	5.1
11	8	6	9	10	8	3	6	5	10	8	9	8	10	5	7.5
12	3	8	8	8	9	4	4	7	9	8	6	9	8	8	7.1
Mean															6.2

Table A8. Individual respondents' scores for relative contribution: Iberia

Attribute	Individual ID										Mean contribution
	1	2	3	4	5	6	7	8	9	10	
1	7	2	8	10	9	6	8	9	10	10	7.9
2	6	6	8	5	3	2	4	5	7	5	5.1
3	8	3	8	4	4	4	5	4	5	5	5.0
4	7	5	8	8	6	6	7	8	7	8	7.0
5	10	7	7	10	10	7	7	10	5	9	8.2
6	7	7	3	10	7	8	7	5	3	4	6.1
7	7	7	9	8	8	6	6	7	7	7	7.2
8	10	7	10	10	7	7	6	7	7	7	7.8
9	9	7	8	8	8	9	8	8	7	9	8.1
10	6	5	9	5	6	6	7	5	5	5	5.9
11	8	6	8	5	6	6	5	7	7	3	6.1
12	8	4	8		7	5	4	4	10	4	6.0
Mean											6.7

CONFIDENCE RATINGS

The count of confidence ratings assigned to the responses provided for 'relationship' and 'relative contribution' for each attribute in each region are given below.

Table A9. Count of confidence ratings by region (1=high; 2=medium; 3=low)

Attribute	Great Britain (n=10)			Nordic Region (n=12)			Central Europe (n=14)			Iberia (n=10*)		
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
1		2	8			12		6	8	1	3	6
2		2	8	2	9	1	2	4	8	3	5	2
3	1	2	7	3	4	5	2	4	8	3	6	1
4	1	9			10	2	1	8	5	1	7	2
5	4	4	2		4	8	3	3	8	1	4	5
6	3	5	2	6	4	2	2	4	8	1	7	2
7	2	5	3	3	7	2	3	7	4	1	5	4
8	2	3	5			12		3	11	1	4	5
9	2	4	4			12	2	6	6	1	2	7
10		9	1	3	4	5	3	6	5	2	5	3
11	3	6	1		4	8	1	4	9	4	5	1
12		6	4	3	8	1		5	9	2	4	3
Total	**18**	**57**	**45**	**20**	**54**	**70**	**19**	**60**	**89**	**21**	**57**	**41**

*n=9 for attribute 12 in Iberia.

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