EFORWOOD

Sustainability Impact Assessment of the Forestry - Wood Chain

Project no. 518128

EFORWOOD

Tools for Sustainability Impact Assessment

Instrument: IP

Thematic Priority: 6.3 Global Change and Ecosystems

# Deliverable D2.3.6
# Assessment of the Recreational Value of European Forest Management Alternatives

Due date of deliverable: 31.01.2010
Actual submission date: 07.04.2010

Start date of project: 011105
Duration: 4 years

Organisation name of lead contractor for this deliverable: Forest Research (FR)

Version: FINAL

| **Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)** | | |
|---|---|---|
| **Dissemination Level** | | |
| **PU** | Public | X |
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# Assessment of the Recreational Value of European Forest Management Alternatives

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**April 2010**

## ABSTRACT

This report describes research carried out to derive scores for the recreational value of 240 forest stand types across Europe. The scores were obtained through a Delphi survey involving 46 European experts organised into 4 regional panels: Great Britain, Nordic Region, Central Europe, and Iberia. In each region, 60 forest stand types were defined according to three tree species types (conifer, broadleaved, and mixed), four phases of development (i.e. stand ages: establishment, young, medium and adult), and five forest management alternatives (FMAs) on a continuum from low to high levels of management intensity (forest nature reserves, close-to-nature forests, combined-objective forestry, intensive even-aged forestry, and wood biomass production).

The resulting scores were applied in two ways. First, they were combined with outputs from the European forest resource projection model, EFISCEN, to estimate current and future recreational values under different policy scenarios. This is reported in EFORWOOD D2.3.7. Secondly, which is the focus of this report, conjoint analysis was used to determine, in each European region, the relative importance of the three variables that defined the forest stand types: type of tree species, phase of development (i.e. stand age), and FMA. The research complements EFORWOOD D2.3.3 which used other data derived from the same Delphi survey to assess the nature, and relative importance, of the relationship between 12 key silvicultural attributes and the recreational value of forests in each of the four regions.

The findings suggest that, across Europe, tree species composition was of relatively minor importance in explaining the overall variation in scores. In UK and Central Europe, comparably high importance was attached to FMA and phase of development, while in the Nordic Region and Iberia, phase of development was considered more important than FMA. The relative importance attached to each FMA suggests that most visitors prefer close-to-nature or combined-objective forestry to unmanaged forest nature reserves. The low importance attached to tree species suggest that criticism directed towards non-native conifers, and perceived preferences for broadleaves across Europe, may not be due to the choice of tree species per se, but the use of conifers in intensive management regimes characterized by dense even-aged monocultures and short rotation lengths. It is acknowledged that such a finding may hide substantial variation in preferences between individuals and social groups, between people pursuing different recreational activities, and between geographical regions with their contrasting cultural landscapes.

**ACKNOWLEDGEMENTS**

The authors would like to thank the 46 members of the four Delphi panels who generously gave their time to participate in the Delphi survey that formed the findings presented in this report:

- **Great Britain panel:** Simon Bell, Mike Christie, Guy Garrod, Max Hislop, Iona Hyde, Anna Lawrence, Alister Scott, Nicholas Shepherd, Bill Slee and Ken Willis.

- **Nordic panel**: Mattias Boman, Lars Helge Frivold, Vegard Gundersen, Sven-G Hultman, Eeva Karjalainen, Minna Komulainen, Anders Lindhagen, Irja Löfström, Eija Pouta, Dan Rydberg, Tuija Sievänen and Per Wallsten.

- **Central Europe panel:** Arne Arnberger, Andreas Bernasconi, Matthias Buchecker, Peter Elsasser, Erwin Frohmann, Ralf Hansmann, Marcel Hunziker, Florian Kraxner, Gerd Lupp, Carsten Mann, Andreas Muhar, Ulrike Pröbstl, Stephan Wild-Eck and Veronika Wirth.

- **Iberia panel:** José G. Borges, Raul Brey, Alejandro Caparrós Gass, Gloria Domínguez Torres, François Lefevre, Livia Madureira, Robert Mavsar, Nicolas Robert, Eduardo Rojas Briales, Cristina Vega García.

We also thank Jean-Michel Carnus, Jeoffrey Dehez, Bill Mason, Jose Manuel Gonzalez, Stefania Pizzirani, Mart-Jan Schelhaas, Mike Smith, Phillip Taylor, and other members of the EFORWOOD Module 2 team.

**CONTENTS**

# 1. INTRODUCTION

The EU-funded Integrated Project EFORWOOD has developed a computer-based *ex ante* sustainability impact assessment tool ('ToSIA') 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.

In a previous EFORWOOD deliverable (PD2.3.4 – Edwards et al. 2008) two approaches to modelling impacts of forest management on recreational value were presented (see also Edwards et al. in press). The first approach required development of regression models that estimate recreational value on the basis of national inventory data for a given region. The second was a simpler assessment framework, arguably with greater potential to be applied at larger spatial scales. This alternative approach makes use of a typology of European silvicultural regimes developed in EFORWOOD as a means to break down the silvicultural variation across Europe into a manageable matrix of 'forest stand types'. The matrix comprises five Forest Management Alternatives (FMAs) which lie on a continuum from non-intervention to intensive production forest management, as follows: forest nature reserve, close-to-nature forestry, combined objective forestry, intensive even-aged forestry, and wood biomass production. Each FMA can be broken down into four processes, or 'phases of development': establishment, young, medium, and adult (Duncker *et al*., 2007). Thus, the five FMAs and four phases give a total of 20 possible forest stand types. A recreational score is then derived on a ten-point scale for each stand type for each of the major tree species in a given region. The most robust way to derive these scores would be to use psychophysical methods with computer images that accurately represent each forest stand type. Instead, a less resource intensive approach was employed involving expert judgement formalised through the use of a Delphi survey.

Once the scores are obtained for each stand type, they can be combined with outputs from the forest resource projection model, EFISCEN, to weight them by the total area currently occupied by that stand type in the region. The mean of all 20 weighted scores represents the current recreational value of all forests of a given species in the region, again expressed on a ten-point scale. To assess how this value may change in response to a given scenario, EFISCEN is used to forecast changes in the area of each of the 20 stand types. These projected area data are then used to recalculate the total recreational value for the future reference year. The approach is demonstrated in D2.3.7 (Schelhaas et al. 2010), and Schelhaas et al. (in prep.) for different levels of implementation of the Natura 2000 policy at a pan-European level between 2005 and 2050, and in Pizzirani et al. (in prep.) for assessing impacts of scenarios in a case study of the Cairngorms National Park, Scotland.

This report describes the methodology used to derive the recreational scores for four contrasting European regions, and presents the final scores for each region that were used to model impacts of Natura 2000. Apart from their application in impact assessment, the recreational scores also have an intrinsic research interest because they can be used to infer the relative contribution of different silvicultural attributes to the overall recreational value of forests. The report goes on to apply conjoint analysis to the scores to determine the relative importance of each FMA, phase of development, and tree species type in explaining the differences in recreational scores between regions and across Europe as a whole. The discussion draws on comments provided by the survey participants and related literature to interpret variations in scores and utilities between the variables under study, and to explore the strengths and weaknesses of the Delphi approach and the conjoint analysis. The wider application and significance of the research and possible future directions are also outlined.

## 2. METHODS

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).

The steps in the Delphi survey process used to derive recreational scores are summarised in Table 1, based upon the protocol for the Delphi method developed by Novakowski and Wellar (2008). The method is described in detail in PD2.3.5 (Edwards et al. 2009) and Edwards et al. (in press).

**Table 1. 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).

To apply the survey across Europe, four Delphi panels were assembled, one for each of four case study regions: a) Great Britain (i.e. upland areas of Scotland, England and Wales), b) the 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 bio-geographical 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.

Examples of the questionnaires used for Round 1 and Round 2 of the survey are given in Appendices 1 and 2. The questionnaire comprised two main questions. Question 1 asked participants to provide assessments of the relationship and relative contribution of 12 key silvicultural attributes to the recreational value of forests in their respective region. The methodology and results of this question

are reported in D2.3.3 (Edwards et al. 2010). Question 2 generated the recreational scores discussed in this report. Although Questions 1 and 2 have been written up separately, they covered related topics. Question 1 supported Question 2 by giving participants a chance to 'warm up' and think about public perceptions of recreational value and its relationship with silvicultural attributes. All of the attributes in Question 1 were explicitly or implicitly included in Question 2. Similar two-part questionnaire designs have been employed by other studies using conjoint analysis (Alriksson and Oberg 2008: 248).

The questionnaire included a score-sheet comprising three matrices: one matrix for the most common conifer species in that region, one for the most common broadleaved species, and one for mixed stands of the most common conifer and broadleaved species. The tree species used in each region are given below:

- **Great Britain:** Sitka spruce (*Picea sitchensis*) and birch (*Betula* spp.)
- **Nordic Region:** Scots pine (*Pinus sylvestris*) and birch (*Betula* spp.)
- **Central Europe:** Norway spruce (*Picea abies*) and beech (*Fagus sylvatica*)
- **Iberia:** Pine (*Pinus* spp.) and oak (*Quercus* spp.)

Each matrix had 20 cells representing the five FMAs and four phases of development. Such an experimental design generates a total of 240 scores in 12 matrices for the four European case studies. (NB: In response to feedback during Round 1 of the survey, it was decided that one forest stand type – Adult FMA5 – could not exist according to the definitions provided, and it was removed from the questionnaire for Round 2, thereby reducing the total number of scores to 19 per species, or 228 overall.)

The delineation of the regional boundaries, and the selection of tree species to represent conifer and broadleaved trees in each region, represented a trade off between a narrow definition (reducing the variation in how participants interpreted each forest stand type) and a broad definition (increasing the scope for generalisation of the results to cover other parts of Europe). In order to generate a complete dataset for Europe for the purposes of modelling the impacts of EU policies, the results were transferred to other European countries by selecting the most similar case study region. Thus, the results for Great Britain were judged to be most suitable for transferring to Northern Ireland, Republic of Ireland and The Netherlands; those for the Nordic Region were applied to Estonia, Finland, Latvia, Lithuania, Norway and Sweden; those for Central Europe were applied to Austria, Belgium, Bulgaria, Czech Republic, Denmark, France, Germany, Hungary, Luxemburg, Poland, Romania, Slovenia, Slovakia and Switzerland, and those for Iberia were transferred to Croatia, Greece, Italy, Portugal and Spain (see Schelhaas et al. 2010, Schelhaas et al. in prep).

Participating experts were asked to fill in each cell with a score on a ten-point scale to indicate how they believed potential visitors would value a forest stand of that type as a location for recreational use. They were also asked to provide comments or explanatory notes on the decisions that they made. Participants were requested to use the full range of scores from 1 to 10 across the whole score sheet. However, it was stressed that each matrix could have a different range of scores (e.g. 1-10, 2-8, 4-10) if they thought that forests of different species have different overall values. A tip was suggested whereby participants first identify the stand(s) with '1' and the stand(s) with '10' across the whole score sheet. Then they identify the remaining highest and lowest stands within each matrix. Then they fill in all the other scores. They were asked to use full numbers (i.e. no decimals or fractions), and to use the same score for different forest stand types if they felt they are of equal recreational value. They should assume that there is suitable physical access into, alongside, or in close proximity to the stand from which a visitor could judge its recreational value. Scores were to be based on bio-physical features only, ignoring paths and other recreational infrastructure that may be present in such a forest type. Participants were also asked to provide a score for every cell, even though in practice some may be extremely rare, e.g. 'adult FMA5' or 'establishment FMA1', and to try and provide average scores across all seasons of the year to allow for differences in appearance of deciduous trees and due to snowfall, etc. When scoring 'establishment phase' stands, they were asked to bear in mind that

neighbouring stands may also be visible and to assume that these were of the same FMA. Finally it was suggested that they allow their scores to be informed by the relationships and weightings they provided for the 12 attributes in Question 1 of the their questionnaire (see D2.3.3 – Edwards et al., 2010), and to the pan-European definitions of each FMA given in the appendix of the questionnaire (see Appendix 1).

At the end of Round 1 the scores and comments were collated and provisional analysis was carried out. Questionnaires for Round 2 were prepared and circulated (see Appendix 2). These were tailored for each individual: a table was provided which gave the results from the first round of everyone in their panel, including all of the comments. 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.

## 3. RESULTS

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 scores during Round 2 for each region is shown in Table 2. Overall around 14% of scores were changed, 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 2. Changes to scores made during Round 2, by region**

| | Great Britain | Nordic Region | Central Europe | Iberia | Average (weighted) |
|---|---|---|---|---|---|
| Percentage of participants who changed at least one score | 70 | 42 | 36 | 20 | 41 |
| Percentage of scores that were changed | 5.2 | 9.6 | 13.0 | 3.2 | 13.8 |

The median values from Round 2 for each forest stand type and region represent the final recreational scores used for modelling impacts of forest management on recreational value. These are given in Table 3 below. Scores for individual participants are given in Appendix 3. The table shows a broad pattern in the data, whereby the scores tend to increase from FMA5 to FMA1 or 2 (or sometimes 3), and from Establishment to Adult, for any given species type in each region, indicating that recreational value increases with both the age and 'naturalness' of the stand. While adult stands always have the highest score, in some cases FMA2 or FMA3, rather than FMA1, has the highest score. As discussed in Section 4, this general pattern is consistent with the results of the comprehensive literature review carried out by the authors in D2.3.3 which suggests a universal preference for large old trees, but that visitors often prefer forests that are not too wild, and show some low level of intervention to 'tidy them up' and create what might be called 'managed naturalness' (Edwards et al. 2010).

Examination of the table also shows that tree species type appears to have a relatively small impact on the variation in recreational scores. Overall there appears to be a slight preference for broadleaved and mixed stands compared to conifer stands. Again, as discussed in Section 4, this is broadly consistent with the literature, which suggests that preferences for species type are context-specific and often dependent upon what the public expect to see in the locality (Edwards et al. 2010, cf. Schraml and Volz 2009).

**Table 3. Recreational scores by phase of development, FMA, species type, and region**

| Region | FMA | Conifer | | | | | Broadleaved | | | | | Mixed | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Phase | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Great Britain | Est | 3 | 3 | 3 | 1 | 1 | 4 | 3.5 | 3.5 | 2.5 | 2 | 4 | 4 | 3.5 | 2.5 | 2 |
| | Young | 3.5 | 3 | 3 | 2 | 1.5 | 6 | 6 | 5 | 3.5 | 2.5 | 5 | 5 | 5 | 4 | 2.5 |
| | Med | 5 | 5 | 6 | 3 | 2.5 | 8.5 | 8 | 7.5 | 5 | 3.5 | 8 | 8 | 6.5 | 5 | 3.5 |
| | Adult | 6.5 | 7 | 6.5 | 4.5 | - | 10 | 10 | 8 | 6 | - | 8 | 9 | 8.5 | 6 | - |
| Nordic Region | Est | 2 | 2 | 2.5 | 1 | 1 | 2 | 2 | 2.5 | 1.5 | 1 | 2 | 2 | 2.5 | 2 | 1 |
| | Young | 2.5 | 3 | 3.5 | 2.5 | 2 | 3 | 3.5 | 4 | 3 | 2 | 3 | 3.5 | 4 | 3 | 2 |
| | Med | 5.5 | 7 | 7 | 5.5 | 3 | 6 | 8 | 7 | 7 | 4 | 5.5 | 7.5 | 7 | 6 | 4.5 |
| | Adult | 8 | 9 | 9 | 8 | - | 8 | 10 | 9 | 8 | - | 8 | 9 | 10 | 9 | - |
| Central Europe | Est | 4 | 4 | 3 | 1 | 1 | 4 | 4 | 3.5 | 2 | 1 | 5 | 4 | 4 | 2 | 2 |
| | Young | 4.5 | 4 | 3 | 2 | 1 | 5.5 | 5 | 4 | 3 | 2 | 5.5 | 5.5 | 4.5 | 3 | 2 |
| | Med | 6 | 6 | 5 | 3 | 2 | 7 | 7 | 6 | 5 | 3 | 7 | 8 | 7 | 5 | 3 |
| | Adult | 8 | 7.5 | 7 | 4 | - | 8.5 | 9 | 8 | 6 | - | 10 | 9 | 8 | 6 | - |
| Iberia | Est | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 | 1.5 | 3.5 | 3 | 3 | 2 | 2 |
| | Young | 3.5 | 3.5 | 3.5 | 1.5 | 1 | 4 | 5 | 4.5 | 3 | 1.5 | 5 | 6 | 5 | 3.5 | 2 |
| | Med | 7 | 6.5 | 6 | 4 | 2 | 7 | 7 | 7.5 | 5 | 3 | 8.5 | 9 | 7.5 | 6 | 3 |
| | Adult | 6.5 | 8 | 8 | 5 | - | 8 | 8.5 | 8 | 6 | - | 9.5 | 10 | 9 | 6.5 | - |

Key to Forest Management Alternatives (FMAs): 1 Forest nature reserves, 2 Close-to-nature forests, 3 Combined objective forestry, 4 Intensive even aged forestry, 5 Wood biomass production.

The data was explored with conjoint analysis, a decompositional stated preference method that can be used to estimate the preference each respondent has for each attribute of a situation (or product). Respondents are presented with a number of situations that vary according to the levels of each attribute, and are then asked to evaluate each one, typically by ranking or rating. Their responses are then 'decomposed' to calculate the importance weightings (or utility factors, or part worth's) for each attribute (Alriksson and Oberg 2008: 244-6, Green and Srinivasan 1978). Conjoint analysis was used here to show: a) the relative importance of the three attributes (i.e. FMA, phase of development, and species type) and b) the relative importance of the different components of each attribute (i.e. the five FMAs, four phases of development, and three species types).

**Relative importance of attributes**

The mean importance of each variable in each region calculated by conjoint analysis is given in Table 4 below, which also shows the same results as ratios of importance. The mean importance for FMA, phase of development and species type are expressed as percentages, and together they add up to 100. The results suggest that, in all four regions, phase of development is the most important, and species type is the least important, of the three factors in explaining the recreational value of forests. For Great Britain, the importance of phase of development is around twice that of species type, while FMA is of slightly lower importance than phase of development. For the Nordic region, phase of development is seen as eight times as important as species type and more than twice that of FMA. The results of the Central Europe panel resemble those of Great Britain, although species type is of relatively lower importance than for Great Britain. For the Iberia panel, phase of development is around three times as important as species type, while FMA lies approximately half way in importance between phase of development and of species type.

The ratios shown in Table 4 highlight how the relative importance of the three factors in Nordic Region is most different from that of the other regions. A multivariate analysis of variance (MANOVA) was carried out on the utilities for each region to test whether there were differences in importance between FMA, phase of development and species type between the four regions. The analysis showed that there was a significant difference between the regions ($P<0.01$). However, if Nordic Region were taken out of the analysis, then the MANOVA test would show no significant difference between the three remaining regions.

**Table 4. Mean and ratio of importance of FMA, phase of development and species type, by region**

| Region | Importance of attribute (mean) | | | Importance of attribute (ratio) | | |
|---|---|---|---|---|---|---|
| | FMA | Phase of devt | Species type | FMA | Phase of devt | Species type |
| Great Britain (n=10) | 37 | 41 | 23 | 1.6 | 1.8 | 1 |
| Nordic Region (n=12) | 28 | 65 | 8 | 3.5 | 8.1 | 1 |
| Central Europe (n=13) | 38 | 45 | 17 | 2.2 | 2.6 | 1 |
| Iberia (n=10) | 35 | 50 | 15 | 2.3 | 3.3 | 1 |

It is possible that Nordic Region (and to a lesser extent Iberia) shows such a different (lower) relative importance of species type because the two species that were allocated to the Nordic participants, i.e. Scots pine and birch, happened to be more similar in terms of their contribution to recreational value than the species that were allocated to the other regions. If this were the case, Nordic Region is different to the other regions also because phase of development is relatively more important than FMA compared to other regions. This is seen more clearly in Table 5, which omits the results for species type, and shows how the ratio of FMA to phase of development for Nordic Region is higher than for other regions, and similarly to a lesser extent for Iberia.

**Table 5. Ratio of importance of FMA and phase of development, by region**

| Region | Importance of attribute (ratio) | |
|---|---|---|
| | FMA | Phase of devt |
| Great Britain | 1 | 1.1 |
| Nordic Region | 1 | 2.3 |
| Central Europe | 1 | 1.8 |
| Iberia | 1 | 1.4 |

**Relative importance of the components of each attribute**

Figs 1 to 3 show the mean relative contribution to the recreational score of forests in each region, respectively for each FMA, phase of development and tree species type. The full set of utility values are given in Appendix 3.

Regarding the relative contribution of each FMA (Fig 1), in Great Britain and Central Europe there is a stepwise increase in contribution from FMA5 to FMA1, although in Great Britain there is almost no difference between FMA1 and FMA2. In both the Nordic Region and Iberia, FMA1 also contributes less. However, in Nordic Region, FMA3 is considered the most valuable closely followed by FMA2 and then FMA1, while in Iberia, FMA2 is most valuable, with FMA1 and FMA3 contributing slightly less. Taken together, these results support the literature by suggesting that the public prefer forests that have a degree of unobtrusive intervention to 'tidy them up' (see Section 4).

Regarding the relative contribution of each phase of development (Fig 2), there is a consistent pattern across the four regions: without exception there is a stepwise increase in contribution from Establishment to Adult phase. The relative importance of phase of development in each region, compared to the other two attributes, is also apparent here, with Nordic Region and to a lesser extent Iberia showing a greater spread in values for each component (and hence greater importance for this attribute) than for Great Britain and Central Europe.

Regarding the relative contribution of each tree species type (Fig 3), there appears to be a consistent pattern across three of the four regions, with broadleaves preferred to conifers, which are preferred to mixed stands of conifer and broadleaves. The exception is Great Britain, where conifers are particularly unpopular, even in mixed stands, so that broadleaves are the preferred option. The spread in values indicates again that this attribute is of relatively minor importance compared to the other two

attributes (FMA and phase of development), especially for the Nordic Region where the contributions of each species type are very similar.

**Fig 1. Contribution of each FMA to recreational score, by region**

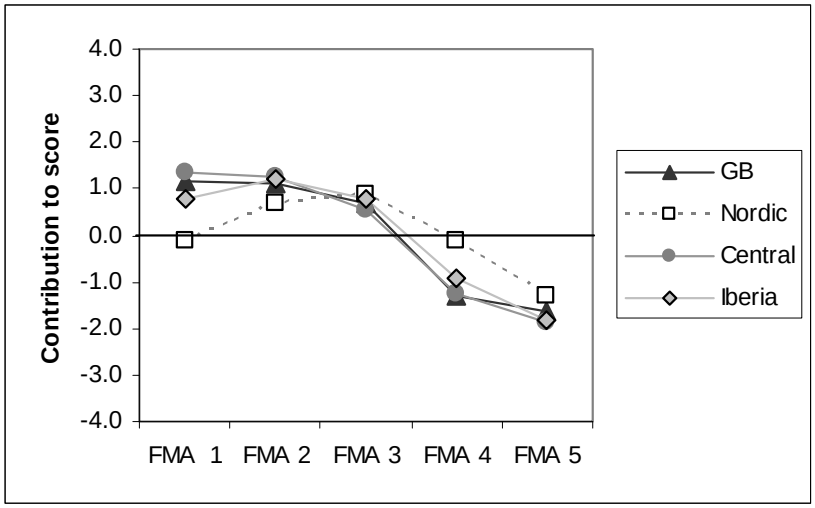



**Fig 2. Contribution of each phase of development to recreational score, by region**

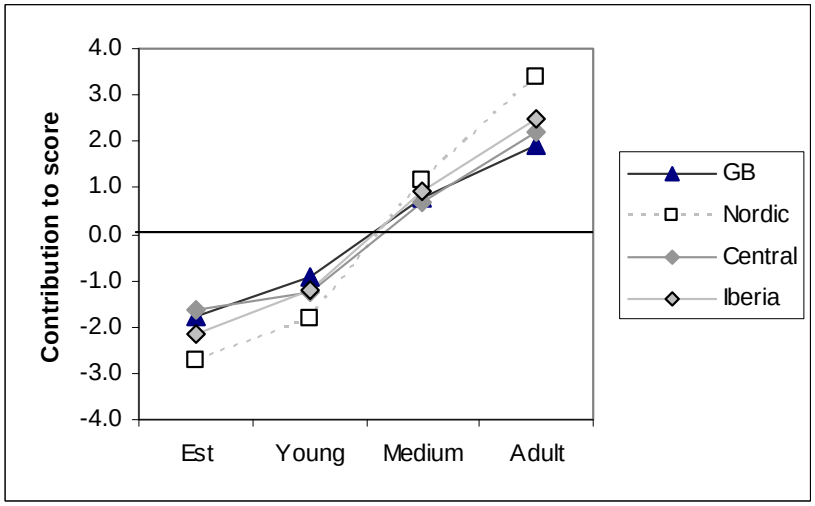
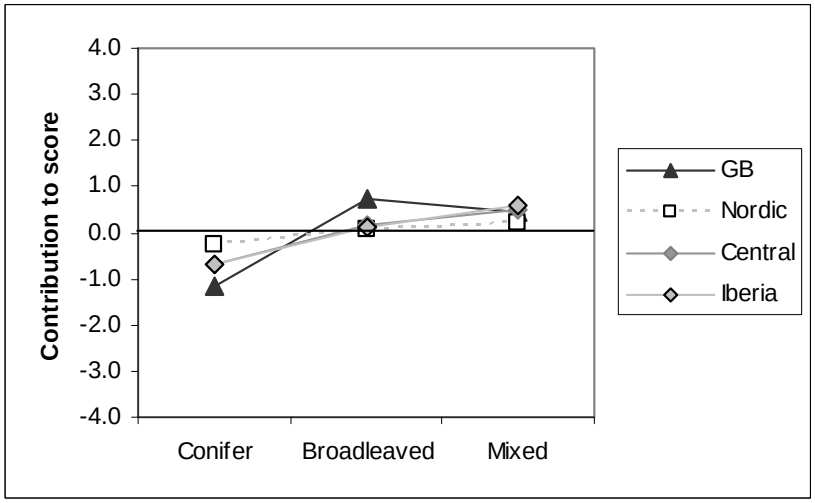



**Fig 3. Contribution of each tree species type to recreational score, by region**



These results are discussed further below, drawing from the comments made by participants in their questionnaire responses, and the literature on related research.

## 4. DISCUSSION

Both the Delphi approach and conjoint analysis have recognised strengths and weaknesses as a means to derive recreational scores and importance weightings for each attribute. Delphi surveys are dependent upon the selection of experts, although if the method is followed thoroughly it can generate reliable data at much lower cost than standard questionnaire surveys using larger samples of subjects (Landeta et al. 2006: 476). The utility values derived through conjoint analysis are dependent upon the precise elicitation format employed, including the selection of attributes, and levels of attributes, for each hypothetical situation constructed by the researcher for evaluation (Freeman 2003, Spash 2007, Urama 2006, cited in Alriksson and Oberg 2008: 250). Additional design issues are discussed below, followed by a comprehensive analysis of the points raised by participants in their questionnaire comments regarding methodological issues and individual explanations for their scores. The final section draws on literature on related research to help with further interpretation of the results.

### Methodological issues

Two alternative designs were piloted: the full profile design that was employed in the survey whereby all 60 forest stand types were presented in three matrices, and a reduced design whereby respondents were asked to score 16 forest stand types selected to represent sufficient combinations of attributes so that all other combinations could be calculated using conjoint analysis. Typically a researcher seeks to reduce the combinations of attributes, and levels of attributes, to optimise the number of evaluation situations presented to the respondent so that they are not overburdened (Poortinga et al. 2003, cited in Alriksson and Oberg 2008: 246). On the other hand, some authors argue that a full design may give a more realistic choice situation allowing researchers to model actual choices (Herrmann et al. 2003, cited in Alriksson and Oberg 2008: 247).

In practice, it became clear during the pilot phase that respondents found the reduced design very difficult to complete. Completion of the full design was still difficult, but made manageable because respondents could take into account the position of each cell in relation to the axis of management intensity, from FMA1 to 5, and the axis of stand age, from establishment to adult. With each cell that was scored, respondents could make iterative adjustments to their scores in neighbouring cells until they were satisfied that the patterns found along each row and column fitted their understanding of the contribution of the two variables. Likewise, as scores were filled in for one tree species type, respondents could adjust the equivalent scores for the other tree species types so that the overall pattern between the tree matrices fitted their understanding of the contribution of each species type. Hence, the full profile design proved to be simpler than the partial design because of the contextual information inherent in the design of the score-sheet.

During the design phase of the study, the researchers were concerned that the importance of tree species type was measured across three separate grids whereas the importance of FMA and phase of development were measured within each grid. This imbalance may have distorted how participants adjusted their scores to fit their understanding of the contribution of each attribute, although no participant mentioned in their comments that this had been an issue for them.

In the guidance notes, it was stated that respondents should use the full ten-point scale so that there was a ‘1’ and a ‘10’ somewhere on their score-sheet, although not necessarily within any one of the three species type matrices. This was done to eliminate the variation between participants in their use of the ten point scale whereby some individuals mark generously, using the top end of the scale, and vice versa. This was necessary to allow each individual to compare their scores with the median scores for all other members of their panel during Round 2 and to give them the opportunity to refine their Round 1 scores in the light of this information. If a Delphi method had not been used, this procedure would not have been required since the results could have been adjusted afterwards to put everyone’s

scores on the same scale. The requirement was not immediately clear to everyone and some results were adjusted following communications with the Delphi panel coordinator.

Use of the Delphi approach, and hence the opportunity for participants to revise their scores, probably added slightly to the accuracy of the results. As mentioned in Section 3, only 14% of scores were changed during Round 2. These changes led to very few changes in median scores for each of the 240 forest stand types. Similarly, relatively few new points were raised in the Round 2 comments. In retrospect, given the extra work required by the researchers and participants, the survey may have been carried out more efficiently as a simple questionnaire rather than as a Delphi survey with multiple rounds, although this would have incurred a small loss in accuracy of the results and in the range of feedback from participants.

**Delphi survey participants' comments**

Overall, 56 comments were made, in both rounds for all regions. Some of the comments made more than one point: in total around 93 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 they could be categorised into five types: a) explanations for individual respondent's scores, b) problems with the conceptual framework of forest stand types, c) difficulties in answering the question, d) problems with the focus on individual stands taken out of context, and e) problems with the notion of the 'average visitor'. The numbers of points raised are given in Table 6, by type and region. Each category is then examined in turn below.

**Table 6. 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 |
|---|---|---|---|---|---|
| a) Explanations for scores | 8 | 16 | 12 | 11 | 47 |
| b) Conceptual framework | 6 | 7 | 7 | 2 | 22 |
| c) Difficulties answering question | 2 | 7 | 1 | 2 | 12 |
| d) Stands taken out of context | 1 | 3 | 1 | 2 | 7 |
| e) Problems with 'average visitor' | 0 | 2 | 2 | 1 | 5 |
| Total | 17 | 35 | 23 | 18 | 93 |

**a) Explanations for individual respondent's scores**

Individual explanations for their scores allow further interpretation of the results, overall and for each region, in particular regarding the relative preferences for 'naturalness' implicit within the continuum of five FMAs.

Great Britain

For the Great Britain panel, scores for phase of development increased consistently from Establishment to Adult. One respondent appeared to reflect the groups' scores when commenting that: *"I have generally scored establishment as low, since land disturbance is often very visible at this stage; particularly in the more commercial stances. I have generally scored adult as high, reflecting the fact that people often like to see mature trees. However, with the more commercial stances, clear felling of large areas would reduce recreation appeal."*

Scores for FMAs tended to increase from FMA5 to FMA1 and FMA2, although no respondent from the Great Britain panel provided explanations for this trend in their comments.

Regarding tree species type, the following comment appeared to reflect the group's view: *"Generally, the highest recreation values would be found in birch, then mixed then sitka."* They went on to explain: *"Although in [question] 1 above I have suggested that variation is important for recreation value, I feel that a mix of stika and birch would reduce the recreation value compared to birch; one might consider this an 'invasion' of the birch forest with sitka. However, you could look at it from another view point and considered that planting of birch on the edge of sitka would enhance the*

*recreation value of sitka."* This comment suggests that the choice of Sitka spruce, a species that is disliked by many people knowledgeable about land use in Great Britain, and that occurs infrequently in mixed stands with birch, may have reduced the value of mixed stands compared to pure broadleaved stands.

Nordic Region

As with other regions, preferences increased consistently from Establishment to Adult phase of development. Thus, one respondent stated that *"clear cut areas and young stands are least preferred."* Another noted that establishment of pine in the region often involved fire, reducing further the recreational value of such sites: "*Establishment of Scots pine in FMA1 and FMA2 have got lower score since I believe the natural regeneration of Scots pine would have been after forest fires. Burned areas are often disliked by the broader public.*" Similarly, another respondent wrote: *"The production of lingonberries in Scots pine forests explains the higher score for establishment phase of Scots pine than for birch. The natural disturbance regime of Scots pine is mainly forest fire. So forest fire should be part of establishment phase of for FMA1 and FMA2. However when scoring I have not considered forest fire as apart from the establishment phase."*

One respondent queried the panel's consensus regarding phase of development: *"I am much in doubt about the recreational values of the Establishment phases because people do appreciate views, particularly in agricultural landscapes, and with short rotation forestry views would be more frequent."* However, the respondent finally opted to give low scores for Establishment: *"On the other hand, the question regards the phase as 'a location for recreation'. Few adult forest visitors appreciate staying in dense young forest stands, which is why I have put up low values."* Nevertheless the point is relevant across all four regions that, depending upon the precise context, Establishment phase stands may provide attractive views or welcome relief from a dense forest environment, and also may be more attractive than thicket stage plantations. (See the indicative scores proposed by Edwards et al., in press, prior to carrying out the Delphi survey.)

Regarding relative preferences for the five FMAs, Nordic Region was most different from the other regions, with the greatest preference shown for FMA3. The low preference for forest nature reserves compared to in other regions was noted by two respondents. One commented: *"…we know that Finnish people in general do not like dead trees, and that the unmanaged forest is in most cases too dense…"* Another stated that *"Sometimes forest nature reserves have been perceived as confused sceneries among recreationists due to the dead woods and fallen trees."* A third respondent commented on FMA5: *"My reason for giving the FMA5 (wood biomass production) low scores for recreational value throughout, is the assumed high density and low penetrability of such stands provided that they are managed with no thinnings. Lacking large trees and open spaces, I think they are unattractive for the common forest visitor."*

There was very little difference in preferences for each tree species type expressed by the Nordic panel. As noted above, it may have happened that the species chosen to represent the region, i.e. Scots pine and birch, are regarded as being similar in recreational value in the region. One respondent highlighted the high amenity value attached to birch, noting that he or she had scored it even higher than other participants: *"Birch is highly valued in Finland. Seems that I have given better scores than others for young birch stands particularly because of the general understanding of how important birch is in the visual landscape, not assuming that one walks in a young birch stand."*

Central Europe

Comments supporting the stepwise increase in preferences for phases of development in Central Europe included the following: *"Generally I think old forest stands are liked, and that (the liked) naturalness is more visible in old stand. So rating increase from top to down in particular for the less intensive use scenarios."* Similarly: *"people prefer old stands to younger stands that offer less diversity of forms and structures… My level of confidence might be a bit reduced in the younger phase. Here, the influence of the season might be particularly strong. In autumn and in particular in situations of snow cover, young stand can become very attractive due to the eye-level of colours and*

*forms. To a lesser extent this might also apply to the phase of establishment.*" Another commented that: "*Older beech stands in FMA 4&5 might have a clearly higher recreational value than at the establishment or at young ages – with similar recreational value than FMA3…"* Also, one respondent wrote: "*Lowest values for 'young stands': these are commonly very dense, and visually not penetrable, which is probably least preferred by visitors."*

In contrast to the overall trend, one respondent noted the positive impact of views in establishment phase stands: *"In general, I tend to see young stands less positive than the other experts and I see these type of stands more negative than the establishment phase. When looking at visual qualities, young stands do not provide views since they are very dense. Also there is very little ground vegetation. Both are provided in the phase of establishment. Visual quality improves, when age increases and the stems loose branches at the lower end and stands therefore get less dense."*

Many comments were made to explain relative preferences for the FMAs. There were divergent views on the whether the public would prefer FMA3, 2 or 1. On balance there was a slight preference for FMA1, but the comments provide insights into the factors that shape public preferences for naturalness/disorder versus management/order. One respondent wrote: *"Naturalness and no intervention could please visitors on average, but there are some liking cleaned up, managed forests, as long as they are not exploited. So ratings decrease from left to right slowly, but than more strongly when it comes to the two extensive use-variants on the right."*

Another made a similar point, and also stressed the influence of the context: *"A typical recreation seeking person (in Switzerland) likes diversity, nature and the personal feeling of security, dislikes disorder and visible human interventions in a forest, and may in different moments or situations be mutually contradictory in its perceptions of different FMAs."*

Likewise a similar point was made in the following comment: *"Forest reserves with dead trees and high diversities of stands are – if they do not look too scaring – perceived as more attractive and more natural than tended forests. Even-aged forestry can be attractive if the stands are old as the single trees might have attractive shapes, and sunlight might partly penetrate the canopy layer offering a nice pattern of sunny and shady places. Stands structured for wood biomass production are of poor attractivity even in the adult phase as the regularity of the tree pattern spoils the sense of naturalness."*

Again, the following point was made: *"[For conifers] My scores are consequently higher than the average (after first round) because I am of the opinion that still many people visiting forests for their recreation are not experts in any field of ecology or similar. Hence, a tidy forest (which is only provided in the cases of combined objective forestry or intensive even-aged forestry) comes closest to the picture. Also there might be the visitor's impression that this is a real forest he is allowed to touch and to walk in or do sports etc. Whereas a forest nature reserve is something to look at but 'not to use'… In beech stands, especially the adult development phases might give at least the same recreational value in FMA3&4 to the visitor than FMA1&2 do. Since the forests with higher 'production orientation' might be 'cleaner' in the view of the visitor, it is easier to walk around and enjoy – also there might be slightly more light in the stands than in the 'hall structures' of a close-to-climax natural beech stand."*

Similarly, another comment was: *"…I rate forest nature reserves in a medium or adult stage less positive than the average score for all experts. I argue, that such forests are characterized by certain critical qualities, in particular the distance of visibility may be a problem for many people (women!). Such forests may even discourage a segment of the population from visiting a forest. …I rate a combined objective forestry in comparison to the other experts more positively. If such a forest gives the general public good opportunities for recreation activities and the intervention in the forest seem for a layman soft, than the forest management alternative 'combined objective forestry' may become as conforming to the general public's notion as the more positively rated alternative 'close-to-nature forests'. To bring it to the point: As long as forestry management doesn't interfere with the general*

*public's illusion of forest as pure nature, forestry can do everything. But to do so, the persons in charge must have an extensive knowledge about layman's perceptions of forests!"*

Finally, a respondent explained that they had given: *"Lower values for FMA1 than for FMA2 and 3: nature reserves may contain dangers for visitors (falling branches etc) they appear less 'tidy' (which is especially important for older people according to my experience), and 'natural disturbance regimes' can lead to visually very disappointing situations for visitors (example: national park Bavarian Forest after insect disease). […] Lower values for FMA4&5 than FMA2 and 3: Any visible sign of technical inputs is probably generally disliked by visitors. I assume this effect is stronger (=more visible) in younger stands; in adult stands, FMA3 and FMA4 may look, very much alike for an average visitor."*

Regarding tree species type, the slightly higher preference for mixed stands and slightly lower preference for conifers was supported by the comments. One respondent wrote: *"Well I think diverse forests are liked most, but not very much more than either spruce or beech forests. Lower values for beech reflect influence of winter, where leaves are missing in solely beech forests."* Another wrote: *"Based on the results of our empirical studies we know that people prefer mixed forests to monocultures, and deciduous forests to coniferous forests."* A third respondent suggested: *"Relation spruce-beech-mixed: a preference of beech over spruce probably exists in my region, but I guess it is restricted to the summer aspect; in wintertime probably the preference changes, so in sum over the whole year there may not be very big differences. However, mixed forests are probably preferred even in wintertime (they show the aesthetical advantages of both conifers and deciduous trees)."*

Iberia

No comments were made that singled out the preference for older phases of development, although this preference was implicit in other comments. Regarding relative preferences for the five FMAs, similar points were made to those in other regions concerning possible low preference for unmanaged forest nature reserves, although on average FMA1 was only slightly less preferable to FMA2. One commented that: *"For nature reserves, the small decrease of the score for adult forests is due to the increasing amount of dead wood that might be disturbing to a part of the visitors (e.g. giving a less maintained impression, more difficult moving. […] Intense managed even aged forests might be less attractive in younger stages, but in latter stages they can become very similar to the less intense managed forests. In particular, with regards to the density and visibility they might have a 'plus' when compared to other forest types (less understorey)."* Similarly, another respondent wrote: *"The presence of old trees is also important for people who might be in favor of close to nature management or nature reserves in the advanced stages (over-mature). However, in the case of forests used as nature reserves, the visual penetration is limited and the physical entrance in the stand is rarely possible. This limits the recreation value of these stands."*

**b) The conceptual framework of forest stand types**

Several concerns were raised about the framework for conceptualising the 20 forest stand types in a given region.

Great Britain

The main concern was the choice of Sitka spruce, since it is an introduced species, and hence would not normally be found in FMA1 or 2. Part of the problem here lay with individual respondents' interpretations of the generic definitions of each FMA provided in the questionnaire (see Appendix 1). In line with all tree species used in the study, Sitka was selected because it is by far the commonest conifer species in upland areas of Great Britain. Hence, it was important that the survey derived scores for this species (in particular for FMA3 and 4) to provide data for the modelling of policy impacts described in D2.3.7 (Schelhaas et al. 2010; Schelhaas et al. in prep.). Sitka exists in a few old growth stands that structurally resemble forest nature reserves, and this was considered sufficient for its inclusion in the framework. Some respondents questioned use of Sitka in close-to-nature forestry, although this is in fact increasingly common with the current policy to promote continuous cover forestry using Sitka in parts of UK. Similarly, Sitka and birch may not be found growing together as

frequently as pine and birch. Thus, one respondent wrote: *"I find it difficult to envisage SS in nature reserves or close to nature management in GB – but have seen it in CCF systems in Wales so answered accordingly… Also find it relatively hard to envisage birch/SS mixes…"* Another participant made a similar point also in relation to FMA5: *"Some of the options just seem non-feasible, so I feel I am answering a silly question – close to nature implies native for me and therefore close to nature sitka is out. And likewise for old SRC! But I guess you cover yourself in the background notes."* Likewise, another wrote: *"I do though – as others have expressed – take issue with Sitka spruce being established as a component of FMA1 and 2. This was why my original scores were so low. It would be interesting to know why Sitka spruce was selected rather than, say, Scots pine."*

The above comments revealed that the unlikelihood of finding Sitka in FMA1 or FMA5 had caused some respondents to give lower scores, although the rarity of such stand types has no bearing on their recreational score. In contrast, another respondent made a similar point about the choice of Sitka, but also accepted that it was not a significant issue given the goals of the study: *"…for all parts of this question and regards the forest nature reserves and close-to-nature forestry FMA, my reading of the appendix definitions would imply that as an introduced species Sitka spruce does not have a place in either system. However, since the question relates to the average visitor and the value they would place on a stand I am recognising that for some this aspect of 'naturalness' would neither be apparent nor an issue. But this explains my low scores."* A further comment suggested that the poor judgements of Sitka by other participants in the panel might have been more critical than those of the general public: *"I do wonder whether some people demonise Sitka because of the way it is grown. I have seen quite attractive uneven aged stands of sitka in western Ireland. I suspect it is the association rather than the actuality which is the problem sometimes."* Together these latter comments raise the possibility that the low value attached to Sitka may not have been reflected so strongly if the survey had not involved experts who are so aware of the negative environmental impacts of the species in Great Britain.

<u>Nordic Region</u>

Ironically, the species combination for Great Britain may have been a more suitable choice for in the Nordic Region. Regarding FMA5, one respondent wrote: *"Scots pine is not a good alternative for wood biomass production. Spruce has been a more interesting alternative both in wood biomass production perspective and in combination with birch."* And regarding FMA1 and 2, another participant wrote: *"As you know close-to-nature forestry promote shade tolerant species such as spruce and beech. Pure birch or Scots pine forests are therefore seldom developed in FMA1 and FMA2."* Also, a specific problem with mixed stands of FMA4 was raised: *"In intensive even-aged forestry with mixed birch and pine, birch is removed at an early stage, at least here in Norway. Otherwise it would not be intensive even-aged forestry."*

Most points raised concerned the rarity of particular forest stand types. One respondent highlighted the rarity of single species stands in their particular locality: *"The single-species stands are to me somewhat "exotic" – pure spruce forests exist only in parts of southernmost Sweden (and spruce was not included in this study anyway) – pure pine forests in the north and on very poor soils – also not very common – pure birch are very unusual generally, or consist of rather small stands. I suppose you had to choose your set of stand to find something that is at least somewhat common to all the respondents. But if other respondents had the same problem as I do, the answers will not be very reliable."*

Other respondents reflected concerns, also raised in other regions, about the existence of particular combinations of phase of development and FMA. Regarding establishment FMA1, one wrote: *"By definition, the short rotation (5-25 years) excludes the Adult phases in pine and birch under Nordic climatic conditions."* In addition adult FMA5 was questioned: *"Young stands in forest nature reserves are very rare and mainly possible after forest fires. Stands established for wood biomass production are also very rare, and people do not have images of these in their minds."* As mentioned above, Adult FMA5 was removed from the score-sheets in Round 2 of the survey although all other forest stand types were retained.

Another perspective raises questions about the consistency of classes used for phases of development across the four case studies: *"For me as a Swede, the Phases of development also appeared a bit "young", e.g. I think "on average" that a 50 year old stand is medium aged, whereas adult stand would be somewhere around 80+ years. So I had to rescale my thinking there. And then you run into inconsistencies (as you mention), i.e. it's hard to imagine an establishment phase for a forest nature reserve or an adult phase for wood biomass production. I think you should simply block out the alternatives that are unrealistic from the score sheet."*

Central Europe

Four comments from the Central Europe panel reflected similar concerns about the rarity or impossibility of certain combinations of attributes, again typically adult FMA5 and establishment FMA1. Regarding adult FMA5, one asked: *"Do these stand types really exist according to the rotation periods mentioned?"* Another wrote: *"Establishment is an unrealistic phase for a Forest Nature Reserve, unless establishment also includes natural rejuvenation after catastrophes. Extreme biomass production is limited to short cycles, therefore adult biomass is not realistic. I am not familiar with empirical studies on the impact of such forms."* Similarly, another participant wrote: *"Some combinations (cells) are not only in practice rare, but even all but impossible."* And finally: *"Biomass production and beech, does this work? […] Adult phase not existent for biomass production."*

Iberia

Related concerns about particular combinations of attributes were raised in Iberia. For example: *"I never heard of oak or mixed biomass production forests. Usually, in the Iberian peninsula, are this types of forests composed of exotic species (e.g. Pinus radiata, Eucalyptus spp.) and are not considered as very aesthetic by the public."* And finally: *"Oak intensive plantations are nonsense, as well as mixed oak forests. Are you meaning deciduous oaks or evergreens? Broadleaves species are very different, e.g. Eucalyptus can not be valuated as an oak."* Many such comments across the four regions raise legitimate concerns. They reflect the compromises inherent in the need to define a workable conceptual framework that holds across Europe.

**c) Difficulties in answering the question**

Comments were explicitly invited regarding the level of confidence participants had in their responses and these were often provided as well as comments highlighting the difficulties some had in answering the question. When the questionnaire was being piloted it was clear that the exercise was difficult, but not impossible, and one of the reasons for using a Delphi survey was that experts could be selected that could imagine each stand type, and understand the question. The research design that was employed was seen as the easiest way to derive the recreational scores without the use of greater resources as part of a thorough psychophysical survey with a representative sample of the population in each region. In particular the pilot also tested another survey design involving scoring of a small number of stands, but it was seen as too difficult because each stand was taken out of the context provided by the three matrices. Although not piloted, it was felt that a similar problem would have arisen with the use of pairwise comparisons, a design that was suggested by two participants in their comments.

Great Britain

Two comments made the point that the question was difficult to answer. One stated that: *"This is a very difficult question to answer because it states nothing about the management quality."* Another noted that: *"My degree of confidence is generally medium to low in this section."*

Nordic Region

Comments on confidence levels were as follows. One wrote: *"In general, my confidence rate is not very high. It was quite difficult to answer."* In contrast another wrote: *"Confidence level is medium throughout… in style with the oracle of Delphi."*

Comments from the Nordic panel on conceptual difficulties were as follows: *"There are too many variables that you should compare at the same time. It is 7-10 items that human capacity can process at the same time. Maybe pairwise comparisons would be better way to do this."* Likewise another wrote: *"Difficult question to answer. It was hard to retain a consistency in rankings between A, B and C [i.e. conifer, broadleaved and mixed stands], between FMAs and Phases of development."* Another stated that: *"I find it extremely difficult to answer this question. The situations are in most cases so theoretical and unlikely that I have trouble relating to them."*

Central Europe
Just one comment revealed difficulties in answering the question: *"I find this not an easy task, specifically the level of abstraction is demanding."*

Iberia
Similarly, in Iberia, one comment on confidence levels was made: *"My confidence in all the scores given is very low."*

**d) The focus on individual stands**
A number of points were raised that noted the problems associated with identifying a typical stand of a given type, and then providing an objective evaluation of a stand when taken out of context. The guidance notes in the questionnaire sought to clarify and reduce the variables associated with context by highlighting that establishment and young stands may allow views beyond the stand itself that may influence recreational value and that it should be assumed that those views would be of stands of the same FMA and species type, although of different phases of development. Nevertheless, inevitably, there were other aspects of context that could not be made explicit in this way.

Great Britain
One respondent in Great Britain raised this issue, referring to the lack of reference to the information available to a recreational user that may influence preferences: *"It is also clear that quality of information and interpretation provided is key to maximising the recreational experience. […] The lack of option for this was disappointing."*

Nordic Region
The influence of neighbouring forest stand types, and the size of the stand, were both highlighted in this region as important factors that were not included in the study design. One respondent wrote: *"The context of the stand in the surrounding landscape is of high importance for peoples evaluation, e.g. a nature reserve stand in an intensive even-aged forestry landscape is a rarity and may be appreciated for that and vice versa."* Another noted that: *"For the Establishment phase, the size of the stand has a very large influence on the judgement. A very small stand (opening) might very well be judged as a positive experience, whereas a large one would be judged as negative. I find it difficult to make judgement of the stand type, independently of the stand size. This problem is most obvious in the low age stands."* Also, it was noted that: *"Openings in the forest without dense tree regeneration and without visible forest debris are highly valued by visitors, but such openings are not an option in this matrix."*

Central Europe
One comment was made in this region regarding geographical variation in attitudes to Norway spruce: *"The most relevant changes I made concern my assessment of adult Norway spruce stands. In Switzerland, they are only appreciated in locations of higher altitude, where they are considered as natural. There, however, they are very welcome. And in other countries of Europe, Norway spruce might be more popular, because they are less dominant than in Swiss forests."*

Iberia
The point regarding size of stand, and the kind of forest in surrounding stands, was well expressed by one respondent in Iberia: *"During a regeneration phase, natural regeneration is mainly preferred to a plantation. This phase is a bit difficult to note, because it also depends on the context. A small stand in*

*the establishment phase surrounded by many older forests offers the opportunity to have an open area to look at other stands Its recreation value might be higher in this case than the value of the young stand (in dense forests). However, if the establishment area is large (what I assumed in answering the previous table), this development stage might rather turn down people"*. The same respondent went on to mention that: "*One important factor is the diversity of stand development stage and forest types at the landscape level which is not assessed in this survey."*

**e) The notion of the 'average visitor'**

The guidance notes in the questionnaire asked respondents to answer on behalf of the 'average visitor'. Several case studies in the literature highlight differences in preferences for silvicultural attributes and forest stand types according to categories such as gender, age, ethnicity and type of recreational activity being pursued (Edwards et al. 2010: 499ff). Such differences are often specific to the particular case study, and it is difficult to make claims at regional level about differences in preference between men and women for example. One generalisation that appears to hold is the greater acceptance of intrusive silvicultural interventions among people who have knowledge of land use issues including professional foresters (Bliss 2000). For this reason, one of the criteria for selecting experts for the Delphi panels was whether they were familiar with forest preference research and hence were able to take into account this effect when answering on behalf of the average visitor. Similarly, individuals pursuing specialist recreational activities such as hunting, berry picking or mountain biking may be shown to have different preferences to other visitors, and respondents were asked to try to take this into account. In theory this would involve weighting scores according the proportion of each type of recreational activity. In practice such differences may make little impact on the scores since it appears that, across Europe, the majority of recreational users of forests are non-specialist walkers. During the research design phase it was concluded that, while there may be significant variation in preferences between individual members of the public, the notion of the average visitor was meaningful.

<u>Great Britain</u>

No comments were made by the Great Britain panel about the notion of the average visitor.

<u>Nordic Region</u>

An interesting point was raised by one respondent in Nordic Region that the types of people visiting each FMA may have different preferences: *"FMA1: I have thought about the average forest visitor who happens to stumble across such areas, not about those who have special interests in wilderness or biology. However, most visitors in forest nature reserves do have special interests in wilderness or biology and would have given FMA1 much higher scores."* The same respondent also pointed out that *"Children probably have other opinions than adults"*, although, as noted above, it appears that their different preferences are not sufficient clear or consistent to be able to adjust the scores accordingly, or to ask for different scores for adults and children.

<u>Central Europe</u>

The following comment also highlights difficulties with the 'average visitor' but, again, does not suggest how the scores might differ for different social groups: *"From several studies significant differences between different user and/or age groups… are known. There is not one recreational value for all, there is no average visitor?! […] The required process to exclude knowledge and studies in that field and create a so called average visitor is questionable and might influence the rating."* A similar comment accepted that, despite variation between individuals, it was possible to answer on behalf of the average visitor: *"…forestry can be from one to another person very different or even contradictory. But nevertheless there is in many ways something like a 'common sense'. My answers reflect exactly that, what I see as this 'common sense'."*

<u>Iberia</u>

Again a similar point was raised by one participant in the Iberia panel, who wrote: *"The needs for recreation depend on the age of the population, its educational level and knowledge of the forest. We have to keep in mind that the average need might correspond to none of the real needs…"* The idea

that there may be 'real needs' that differ from those of the average is likely to be of importance at the operational level, e.g. in the design of specialist facilities for a minority group of users, rather than at the larger spatial scales covered by this study where use of the notion of the average visitor was considered the only pragmatic way to score preferences.

**Insights from related preference research**

As mentioned above, Question 1 of the same Delphi survey asked respondents to indicate the relationship and relative contribution of 12 silvicultural attributes to the overall recreational value of forests in their region. This work was reported in EFORWOOD D2.3.3 (Edwards et al. 2010) along with the results of a comprehensive literature review structured around the same attributes. All 12 attributes from Question 1 relate in some way to the three attributes examined in this report, in particular, 'size of trees within stand' clearly relates directly to 'phase of development', and 'number of tree species' relates to 'tree species type'. Although 'naturalness' was not one of the 12 attributes selected for Question 1 (because it was seen to combine too many attributes that had already been selected), additional literature was reported in D2.3.3 that referred to preferences for 'naturalness' in forest landscapes. This material relates directly to preferences for FMAs reported here. Insights from these sections of D2.3.3 are summarised below as a way to help interpret the results reported above.

**a) Forest Management Alternatives**

The finding from the Delphi survey scores and comments that the visiting public in some regions 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 also 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. Another point raised by one participant is that the visitor profiles for particular FMAs, most obviously forest nature reserves, may be different from the average.

A review by Ribe (1989) of forest preference research in USA and to a lesser extent Europe was unable to see a clear relationship between naturalness and preference. He notes (Ribe 1989: 59) that: *"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."*

A preference for 'managed naturalness' is apparent from a review of Nordic literature by Tyrväinen et al. (2005: 92) who 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."*

A household survey of forest preferences in Great Britain by Lee (2001) suggests a preference for FMA1 and 2, rather than stands with more significant levels of intervention such as FMA3. Lee (2001: 75) concluded that: *"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."* This conclusion is in line with the Delphi survey findings for the Great Britain panel. Similarly, 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. This study presented two contrasted options to their respondents, which perhaps hides distinctions between unmanaged nature reserves of FMA1 and the 'managed naturalness' of FMA2 or 3.

One of the very few pan-European studies of attitudes to forests (Rametsteiner and Kraxner 2003) highlighted that the majority of respondents felt *"that a slightly tended forest may fulfil its functions better than a strongly tended forest or one that is left on its own"* (Rametsteiner and Kraxner 2003: 12) in other words FMA2 or 3. The public here defined 'slightly tended' as tidy, litter free with mixed tree species in a natural state. 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"*.

A preference for close-to-nature forests was explicitly mentioned by several authors, although it is possible that the use of the term 'close-to-nature' may not be seen by these authors as separate from 'forest nature reserves'. 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)."*

Overall, 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. The literature does not allow clear differentiation between European regions, although some evidence can be found to support the regional differences suggested by the Delphi survey, for example the preference in Great Britain for FMA1 and 2, and the preference for FMA2 and 3 in the Nordic Region (where most research has been carried out). The scarcity of studies from Central Europe and Iberia meant that the preference in Central Europe for FMA1, and the preference in Iberia for FMA2, was not clearly supported by the literature although these findings were broadly supported by participants' comments.

**b) Phase of development**

The attribute 'size of trees within stand' was ranked highest across all regions in Question 1 of the Delphi survey, and in the top three in each of the four regions, in terms of its contribution to recreational value. Also, its relationship to recreational value was consistently seen as positive across the four regions with very few exceptions. Thus, as stand age increases from establishment to maturity, or as canopy height increases from low to high, the recreational value increases (Edwards 2010: 16). These findings fully support those reported here regarding the highest importance attached to 'phase of development' in all regions, and the positive relationship between increasing stand age and recreational value.

The findings are also universally supported by the literature review. 'Size of trees', 'maturity of stand', or by implication 'canopy height', appear to be the qualities with the most important and generalisable link to recreational value, with larger trees being preferred. For example, 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 their 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)."*

The positive effect of tree size applies regardless of how size is measured, 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)."* Diameter is shown to be correlated with scenic beauty in Catalonia. Blasco et al. (2008: 9) write: *"…the larger the diameter, the higher scenic beauty is. Large number of small trees and pines decreased the scenic beauty." They continue (2008:10-11): "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)."*

Ribe notes that mature stands may have reinforcing attributes, in particular lower tree density, and hence the possibility of greater visual penetration. 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 footnotes to the general pattern. In a study conducted in Denmark, the link between stand age and public preference may be 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 phases of development. Gundersen and Frivold (2008: 248) write: *"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."*

**c) Tree species type**

While 'tree species type' was not included in Question 1 of the Delphi survey (because it consists of nominal categories), the related attribute 'number of tree species within stand' was included (which consists of ordinal categories), and ranked a low 3 out of 12 across the four regions in terms of its overall contribution to the recreational value of forests. There was some variation between regions, with the Iberian panel giving it a moderate ranking (8 out of 12). 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. Thus, in general, as number of species within the stand increases from one to many, the recreational value increases (Edwards et al. 2010: 31). This suggests a slight preference for mixed stands over monocultures, which is supported by the findings reported

above (see Fig 3) with the partial exception of the species selected for Great Britain where pure birch stands were preferred slightly to mixed stands of Sitka spruce and birch.

The literature on public preferences appears to support the conclusion that species type is relatively unimportant, although the picture regarding relative preference of type is rather unclear.

Regarding mixed stands versus monocultures, Ribe (1989: 62) suggests a slight preference for mixed stands: *"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)."* Regarding preferences for pure conifer and broadleaved stands, Ribe (1989: 62) supports the conclusion that broadleaves are preferred: "*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).*

Ribe (1989: 62) highlights the significance of context, reflecting the comments made by one Central European participant cited above: *"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)."*

His conclusion confirms the relative unimportance of species type, and gives an unclear picture of relative preferences for each type (Ribe 1989: 62): *"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."*

Similarly, the overall picture assembled by Gundersen and Frivold (2008: 248) for Fennoscandia is complex: *"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 of the Nordic literature (Axelsson Lindgren 1996: 282, citing Pukkala et al. 1998 and Savolainen and Kellomaki 1981) concluded 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."*

Elsewhere in Europe a slight overall preference for broadleaves and/or mixed stands may be more apparent in the literature. In Denmark, preferences for beech and spruce are summarised by Jensen (1993: 85): *"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."*

In Germany, Schraml and Volz (2009: 248, citing Schriewer, 1998) provide a list of adjectives to show perceptions of coniferous and broadleaved forests in Germany, based on 50 interviews. The conifer forests are described in terms such as 'artificial', 'man-made', 'darkness', 'impermeable', 'repelling', 'uniform', 'monotony', 'young trees' and 'mushrooms', while the broadleaved forests are described as 'native', 'natural', 'light, diverse colours', 'permeable', 'inviting', 'individual', 'diversity', 'old trees' and 'flowers'. Evidently this suggests broadleaved stands are preferred to coniferous stands, which supports the findings for Central Europe shown in Fig 3.

Similar findings to the German study might apply to Great Britain, where research indicates a preference for broadleaves and/or mixed stands. Garrod (2002: 10) estimated the following public preferences for tree species type in Great Britain's forests: coniferous trees 13.7%; broadleaved trees 54.6%; equal preference 30.8%; neither 1.0%. A preference for mixed stands over pure conifer stands in Great Britain was shown by Entec and EERG (1997: 3-4) using a contingent valuation survey of both users and non-users of forests. The exception was in winter, which they suggested was a consequence of the 'Christmas Card' effect. A household survey in Great Britain conducted by Lee (2001: 70) asked participants, who had said they would like to see more forests, what kind of trees should be planted. 37% said any kind of trees; 33% said a mixture of broadleaved and conifers; 21% preferred broadleaved, and 5% said conifers; 4% said they don't know. Lee (2001: 71) stressed that social class difference were very significant, with more wealthy educated respondents preferring broadleaves and also being more likely to visit forests regularly. Willis (2003: 411), citing Willis and Garrod (1992), concluded that broadleaves in Great Britain can enhance, while conifers can reduce, property values. 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. And in Lorraine, France, Despres and Normandin (1998) showed that mixed forests were considered the most popular, followed by broadleaved forests, and finally by conifers. However, in this latter study, most people were indifferent.

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."* This point was raised also by one of the Great Britain panellists.

## 5. CONCLUSIONS

The study reported here is one of the few to attempt to assess public preferences for a broad range of forest types at a pan-European scale. The original motivation was to derive recreational scores for each forest type that could then be used for modelling impacts of forest-related policies, and this work is reported in Schelhaas et al. (2010) and Shelhaas et al. (in prep). However, the scores have proven valuable in their own right as a means to calculate the relative preference of the three attributes used to define forest stand types (FMA, phase of development, and tree species type).

Perhaps the most striking finding is that, across Europe, tree species composition was of little importance in explaining the overall variation in scores. This finding suggests that criticism directed towards non-native conifers, and perceived preferences for broadleaves across Europe, may not be due to the choice of tree species per se, but the use of conifers in intensive management regimes characterized by dense even-aged monocultures and short rotation lengths. Overall, phase of development (or stand age) was the most important of the three attributes. These headline findings are fully supported by the literature on previous forest preference studies, although it is acknowledged that they may hide substantial variation in preferences between individuals and social groups, between people pursuing different recreational activities, and between geographical regions with their contrasting cultural landscapes.

There were also regional differences. In UK and Central Europe, comparably high importance was attached to FMA and phase of development, while in the Nordic Region and Iberia, phase of development was considered more important than FMA. The relative importance attached to each FMA suggests that most visitors prefer close-to-nature or combined objective forests to unmanaged forest nature reserves. The exception was Central Europe where forest nature reserves were preferred. Some support can be found in the literature to support these findings, although, with the exception of the Nordic Region, it is hard to make generalisations at regional level from existing literature. The patchy coverage of Europe by previous researchers highlights the value of the study reported here with its common evaluation framework applied to four contrasting European regions.

It is important to stress that the results are indicative. The use of a Delphi approach was necessary to carry out a survey on such an ambitious scale with limited resources, but there are weaknesses in the approach. It could be improved upon through use of a psychophysical survey that used images instead of descriptions for each forest stand type, and a larger representative sample of the public who visit forests. As it stands, the results offer interesting conclusions about the relative importance of different attributes across Europe as a basis for further research, as well as providing for the first time a data-set for modelling impacts of policies on recreational value of forests in Europe.

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## APPENDIX 1: SAMPLE QUESTIONNAIRE (ROUND 1)

# A Delphi survey to assess the recreational value of forests in upland areas of Great Britain

**Your Name:** Example

This survey aims to quantify the recreational value of different forest types that may be found in upland areas of Great Britain. It is one of four surveys being carried out in four regions located across Europe. The surveys focus on the most common conifer and broadleaved tree species growing in each region. For Great Britain, these are Sitka spruce (*Picea sitchensis*) and birch (*Betula* spp.).

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.

## QUESTION 1: SILVICULTURAL ATTRIBUTES

**(a) For each attribute listed in the table below, 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 graphs 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' in the first column.**

**(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. IMPORTANT: Use the full range of weightings from 1-10. 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 on the following page.**

**Relationships between silvicultural attributes and recreational values**

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

**Please fill in each column (a, b and c) as described above:**

| Silvicultural attribute | (a) **Relationship** Select from: '**P**ositive', '**N**egative', '**B**ell-shaped', '**U**-shaped' or '**E**ven' | (b) **Relative contribution** Select from: **1** (=lowest) to **10** (=highest) | (c) **Confidence rating** Select from: '**L**ow', '**M**edium' or '**H**igh' |
|---|---|---|---|
| **1. Size of trees within stand**<br>• Stand age: from establishment to maturity<br>• Canopy height: from low to high | | | |
| **2. Variation in tree size within stand**<br>• Variation in tree size: from uniform to diverse<br>• Number of canopy layers: from one to many | | | |
| **3. Variation in tree spacing within stand**<br>• Variation in tree spacing: from regular to different sized groups of trees and openings | | | |
| **4. Extent of tree cover within stand**<br>• 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**<br>• Distance visible: from short to long<br>• Understorey and shrub layer: from dense to absent | | | |
| **6. Density of ground vegetation cover up to 50 cm height within stand**<br>• Ground cover: from absent to dense | | | |
| **7. Number of tree species within stand**<br>• Number of species: from one to many | | | |
| **8. Size of clear-cuts**<br>• Size of clear-cuts: from small to large | | | |
| **9. Residue from harvesting and thinning**<br>• Volume of tree stumps, branches and other visible woody residue: from low to high | | | |
| **10. Amount of natural deadwood (standing and fallen)**<br>• Volume of deadwood: from low to high | | | |
| **11. Variation *between* stands along a 5 km trail through forest**<br>• Number of forest stand types* encountered: from one to many | | | |
| **12. 'Naturalness' of forest edges**<br>• Proportion of 'natural' looking (i.e. not straight) edges: from low to high | | | |

* 'Forest stand types' differ according to stand age, management regime, and/or tree species composition.

**Comments on Question 1:**

## QUESTION 2: FOREST STAND TYPES

The scoring sheet below consists of three matrices representing forest stands with three different tree species compositions: a) Sitka spruce, b) birch, and c) mixed (i.e. Sitka spruce and birch). Each matrix has 20 cells representing five forest management alternatives (FMAs) and four phases of development (establishment, young, medium and adult).

The five FMAs lie on a continuum from non-intervention to intensive production, as follows. They have common definitions across Europe (see appendix).

1. Forest nature reserves
2. Close-to nature forestry
3. Combined objective forestry
4. Intensive even-aged forestry
5. Wood biomass production

The four phases of development are defined as follows:

1. **Establishment:** 0–5 years: less than 2 metres in height.
2. **Young:** 5–15 years: between 2 metres, and up to 7 cm breast height diameter (DBH).
3. **Medium:** 15–50 years: up to when most height growth has been reached.
4. **Adult:** 50+ years: after the time when most height growth has been reached.

**Using the score sheet below, please fill in each cell with a score, on a scale from 1 (lowest) to 10 (highest), to indicate how you believe the average visitor would value a forest stand of that type as a location for recreation in your region. Please provide comments or explanations for your answers in the box provided on the following page.**

**PLEASE READ CAREFULLY!**

- **Important:** Use the full range of scores from 1 to 10 across the whole score sheet. However, each matrix may have a different range of scores (e.g. 1-10, 2-8, 4-10) if you think that forests of different species have different overall values.

- **Tip:** First identify the stand(s) with '1' and the stand(s) with '10' across the whole score sheet. Then identify the remaining highest and lowest stands within each matrix. Then fill in all the other scores.

- Use full numbers (i.e. no decimals or fractions). Use the same score for different forest stand types if you feel they are of equal recreational value.

- Assume that there is suitable physical access into, alongside, or in close proximity to the stand from which a visitor could judge its recreational value.

- Base your scores on bio-physical features only: ignore paths and other recreational infrastructure that may be present in such a forest type.

- Please provide a score for every cell, even though in practice some may be extremely rare, e.g. 'adult FMA5' or 'establishment FMA1'.

- Try to provide average scores across all seasons of the year to allow for differences in appearance of deciduous trees and due to snowfall, etc.

- When scoring 'establishment phase' stands, remember that neighbouring stands may also be visible. Assume that these are of the same FMA.

- It may help to refer to your weightings for the attributes in the table above (question 1), and to the descriptions of FMAs in the appendix.

## Score sheet: Great Britain

### A) SITKA SPRUCE

| Phase of development | Forest management alternative (FMA) | | | | |
|---|---|---|---|---|---|
| | 1. Forest nature reserves | 2. Close-to-nature forests | 3. Combined objective forestry | 4. Intensive even-aged forestry | 5. Wood biomass production |
| 1. Establishment | | | | | |
| 2. Young | | | | | |
| 3. Medium | | | | | |
| 4. Adult | | | | | |

### B) BIRCH

| Phase of development | Forest management alternative (FMA) | | | | |
|---|---|---|---|---|---|
| | 1. Forest nature reserves | 2. Close-to-nature forests | 3. Combined objective forestry | 4. Intensive even-aged forestry | 5. Wood biomass production |
| 1. Establishment | | | | | |
| 2. Young | | | | | |
| 3. Medium | | | | | |
| 4. Adult | | | | | |

### C) MIXED (SITKA SPRUCE AND BIRCH)

| Phase of development | Forest management alternative (FMA) | | | | |
|---|---|---|---|---|---|
| | 1. Forest nature reserves | 2. Close-to-nature forests | 3. Combined objective forestry | 4. Intensive even-aged forestry | 5. Wood biomass production |
| 1. Establishment | | | | | |
| 2. Young | | | | | |
| 3. Medium | | | | | |
| 4. Adult | | | | | |

**Comments on Question 2** (if relevant, also indicate your level of confidence in particular scores):

**Please email your completed questionnaire, and any queries you may have, to:**
David Edwards, Social and Economic Research Group, Forest Research, Northern Research Station, Roslin, Scotland EH25 9SY. Tel: +44 (0)131 445 8495. **david.edwards@forestry.gsi.gov.uk**

**Thank you for participating in the survey.**

If you would like a copy of the final report, please type 'YES' in the textbox:

## APPENDIX
## Descriptions of Forest Management Alternatives (FMAs)

### 1. Forest nature reserve
The main objective of forest nature reserves is to allow natural processes and natural disturbance regimes to develop to create natural ecologically valuable habitats. They are typically protected by an ordinance or forest act. No operations are allowed that might change the nature of the area. Possible operations may include construction of visitor trails, and limited measures to protect against external factors such as fire.

### 2. Close-to-nature forestry
The main objective is to manage each stand with the emulation of natural processes as a guiding principle. Financial return is important, but management interventions must enhance or conserve the ecological functions of the forest. Timber can be harvested and extracted, but some standing and fallen dead wood is left, which may reduce productivity. Only native or site adapted tree species are chosen. Natural regeneration is preferred. The rotation length is generally much longer than the age of maximum mean annual volume increment (MMAI) and harvesting uses small scale removals resulting in the development of an irregular and intimately mixed stand structure.

### 3. Combined objective forestry
Management pursues a combination of economic (timber production) and non-market objectives. Mixtures of tree species are often promoted, comprising both native and introduced species suitable for the site. Natural regeneration is preferred, but planting or direct seeding may also be used. Site cultivation and/or fertilization may be carried out. The rotation length is either similar to (in conifers) or longer than (broadleaves) the age of MMAI and the harvesting system is generally designed around small scale clear felling with groups of trees retained for longer periods to meet landscape and biodiversity objectives. This management alternative is also referred to as ‘multiple-use forestry’.

### 4. Intensive even-aged forestry
The main objective is to produce timber, although landscape and biodiversity may feature as secondary objectives. Typical stands tend to be even-aged, and composed of one or very few species. Any species can be suitable provided it is site-adapted and non-invasive. Planting, seeding or natural regeneration are all possible depending upon which option is most economic. Intensive site management including cultivation and weed control is used to ensure rapid establishment. Genetically improved material is often planted where available. The rotation length is often less than or similar to the age of MMAI. Clear felling is normal practice or in some countries a combination of shelterwood and clear-cut is applied if natural regeneration is more economic. Whole tree harvesting may occur but residues are normally left on site.

### 5. Wood biomass production
The main objective is to produce the highest amount of small dimension wood biomass or fibre. Tree species selection depends mainly on the economic return, as long as the species is not invasive. Pure stands of single species are generally favoured. Intensive site management may occur to ensure rapid canopy closure. The rotation period is short: typically from 5-25 years depending on species characteristics and the economic return. The intensity of harvesting is at its maximum compared to the other alternatives. The final felling is a clear-cut with removal of all woody residue, and even the stumps if there is a suitable market. Management can resemble traditional coppicing.

## APPENDIX 2: SAMPLE QUESTIONNAIRE (ROUND 2)

- **A Delphi survey to assess the recreational value of forests**
- **in upland areas of Great Britain**

### ROUND 2:
### QUESTIONNAIRE AND FEEDBACK FROM ROUND 1

**Your Name:** Example

**This questionnaire is for Round 2 of the survey. It gives the results from the first round of everyone in your panel, including the comments. You are invited to reconsider your previous answers in the light of this information, and to revise them (or comment upon them) if you feel this is appropriate in the spaces provided below.**

**For reference, your previous answers are reproduced below, along with the original questions and appendix. New instructions for Round 2 have been highlighted in blue.**

### QUESTION 1: SILVICULTURAL ATTRIBUTES

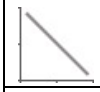
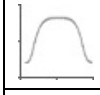
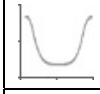
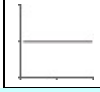
**(a) For each attribute listed in the table below, please indicate whether its relationship to the recreational value of the forests in your region is best described as: positive, negative, bell-shaped, U-shaped, or even (see graphs below). For example, for 'attribute 1', if you think recreational value increases when 'stand age' increases from establishment to maturity, please write 'P' for 'positive' in the first column.**

**(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. IMPORTANT: Use the full range of weightings from 1-10.* 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 on the following page.**

**Relationships between silvicultural attributes and recreational values**

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

*It is not essential that you use a '1' and a '10' in this question (see accompanying email).

## QUESTION 1: RESULTS FROM THE 'GREAT BRITAIN' PANEL – ROUND 1 (N=10)

**The results from Round 1 for the entire 'Great Britain' panel are summarised below.**

| Silvicultural attribute | (a) Relationship<br>**Commonest response** (& frequency) | (b) Relative contribution<br>**Median score** (and full set of scores in ascending order) | (c) Confidence rating<br>**Commonest response** (& frequency) |
|---|---|---|---|
| **1. Size of trees within stand**<br>• Stand age: from establishment to maturity<br>• Canopy height: from low to high | **Positive**<br>P(6), B(2), U(1), E(1) | **8**<br>(2,4,5,8,8,8,10,10,10,10) | **High**<br>L(1), M(2), H(7) |
| **2. Variation in tree size within stand**<br>• Variation in tree size: from uniform to diverse<br>• Number of canopy layers: from one to many | **Positive**<br>P(8), B(2) | **8**<br>(5,6,6,6,8,8,9,10,10,10) | **High**<br>M(3), H(7) |
| **3. Variation in tree spacing within stand**<br>• Variation in tree spacing: from regular to different sized groups of trees and openings | **Positive**<br>P(8), B(2) | **7.5**<br>(2,5,6,6,7,8,8,8,8,9) | **High**<br>L(1), M(3), H(6) |
| **4. Extent of tree cover within stand**<br>• Tree cover: from sparse (i.e. retention and seed trees) to moderate (e.g. shelterwood and selection systems) to full (i.e. closed canopy) | **Bell-shaped**<br>P(1), B(9) | **6**<br>(4,4,6,6,6,6,7,7,7,10) | **Medium**<br>L(1), M(8), H(1) |
| **5. Visual penetration through stand**<br>• Distance visible: from short to long<br>• Understorey and shrub layer: from dense to absent | **Bell-shaped**<br>P(1), N(1), B(6), U(1), E(1) | **6**<br>(2,4,5,5,6,6,7,7,9,9) | **Low or Med**<br>L(4), M(4), H(2) |
| **6. Density of ground vegetation cover up to 50 cm height within stand**<br>• Ground cover: from absent to dense | **Bell-shaped**<br>P(2), N(1), B(6), E(1) | **3.5**<br>(1,2,2,3,3,4,5,6,7,8) | **Medium**<br>L(3), M(5), H(2) |
| **7. Number of tree species within stand**<br>• Number of species: from one to many | **Positive**<br>P(5), B(4), E(1) | **6**<br>(1,3,5,6,6,6,8,8,9,10) | **Medium**<br>L(2), M(5), H(3) |
| **8. Size of clear-cuts**<br>• Size of clear-cuts: from small to large | **Negative**<br>N(7), B(2), U(1) | **7**<br>(4,5,5,7,7,7,8,8,9,10) | **High**<br>L(2), M(3), H(5) |
| **9. Residue from harvesting and thinning**<br>• Volume of tree stumps, branches and other visible woody residue: from low to high | **Negative**<br>N(10) | **6.5**<br>(1,3,4,4,6,7,8,9,9,10) | **Med**<br>L(1), M(5), H(4) |
| **10. Amount of natural deadwood (standing and fallen)**<br>• Volume of deadwood: from low to high | **Bell-shaped**<br>N(1), B(7), E(2) | **4**<br>(1,1,2,3,4,4,5,5,6,8) | **Medium**<br>L(2), M(7), H(1) |
| **11. Variation *between* stands along a 5 km trail through forest**<br>• Number of forest stand types* encountered: from one to many | **Positive**<br>P(5), B(3), U(1), E(1) | **5**<br>(2,2,2,4,4,6,6,6,6,7) | **Medium**<br>L(3), M(6), H(1) |
| **12. 'Naturalness' of forest edges**<br>• Proportion of 'natural' looking (i.e. not straight) edges: from low to high | **Positive**<br>P(10) | **5**<br>(3,4,4,5,5,5,5,8,9,10) | **Med or High**<br>L(2), M(4), H(4) |

* 'Forest stand types' differ according to stand age, management regime, and/or tree species composition.

**QUESTION 1: Your personal answers from Round 1 are shown below. If you would like to revise any of them, please write your new answers in the columns for 'Round 2'. Otherwise, leave the columns blank. Please write any new comments you may wish to make in the box on page 7.**

| Silvicultural attribute | (a) Relationship<br>Select from: '**P**ositive', '**N**egative', '**B**ell-shaped', '**U**-shaped' or '**E**ven' | | (b) Relative contribution<br>Select from: **1** (=lowest) to **10** (=highest) | | (c) Confidence rating<br>Select from: '**L**ow', '**M**edium' or '**H**igh' | |
|---|---|---|---|---|---|---|
| | **Round 1** | **Round 2** | **Round 1** | **Round 2** | **Round 1** | **Round 2** |
| **1. Size of trees within stand**<br>• Stand age: from establishment to maturity<br>• Canopy height: from low to high | **P** | | **8** | | **M** | |
| **2. Variation in tree size within stand**<br>• Variation in tree size: from uniform to diverse<br>• Number of canopy layers: from one to many | **P** | | **10** | | **M** | |
| **3. Variation in tree spacing within stand**<br>• Variation in tree spacing: from regular to different sized groups of trees and openings | **P** | | **8** | | **M** | |
| **4. Extent of tree cover within stand**<br>• Tree cover: from sparse (i.e. retention and seed trees) to moderate (e.g. shelterwood and selection systems) to full (i.e. closed canopy) | **B** | | **7** | | **M** | |
| **5. Visual penetration through stand**<br>• Distance visible: from short to long<br>• Understorey and shrub layer: from dense to absent | **B** | | **6** | | **L** | |
| **6. Density of ground vegetation cover up to 50 cm height within stand**<br>• Ground cover: from absent to dense | **N** | | **2** | | **M** | |
| **7. Number of tree species within stand**<br>• Number of species: from one to many | **B** | | **9** | | **M** | |
| **8. Size of clear-cuts**<br>• Size of clear-cuts: from small to large | **B** | | **5** | | **L** | |
| **9. Residue from harvesting and thinning**<br>• Volume of tree stumps, branches and other visible woody residue: from low to high | **N** | | **1** | | **M** | |
| **10. Amount of natural deadwood (standing and fallen)**<br>• Volume of deadwood: from low to high | **E** | | **3** | | **L** | |
| **11. Variation *between* stands along a 5 km trail through forest**<br>• Number of forest stand types* encountered: from one to many | **B** | | **6** | | **M** | |
| **12. 'Naturalness' of forest edges**<br>• Proportion of 'natural' looking (i.e. not straight) edges: from low to high | **P** | | **4** | | **L** | |

* 'Forest stand types' differ according to stand age, management regime, and/or tree species composition.

## QUESTION 2: FOREST STAND TYPES

The scoring sheet below consists of three matrices representing forest stands with three different tree species compositions: a) Sitka spruce, b) birch, and c) mixed (i.e. Sitka spruce and birch). Each matrix has 20 cells representing five forest management alternatives (FMAs) and four phases of development (establishment, young, medium and adult).

The five FMAs lie on a continuum from non-intervention to intensive production, as follows. They have common definitions across Europe (see appendix).

6. Forest nature reserves
7. Close-to nature forestry
8. Combined objective forestry
9. Intensive even-aged forestry
10. Wood biomass production

The four phases of development are defined as follows:

5. **Establishment:** 0–5 years: less than 2 metres in height.
6. **Young:** 5–15 years: between 2 metres, and up to 7 cm breast height diameter (DBH).
7. **Medium:** 15–50 years: up to when most height growth has been reached.
8. **Adult:** 50+ years: after the time when most height growth has been reached.

**Using the score sheet below, please fill in each cell with a score, on a scale from 1 (lowest) to 10 (highest), to indicate how you believe the average visitor would value a forest stand of that type as a location for recreation in your region. Please provide comments or explanations for your answers in the box provided on the following page.**

**PLEASE READ CAREFULLY!**

- **Important:** Use the full range of scores from 1 to 10 across the whole score sheet. However, each matrix may have a different range of scores (e.g. 1-10, 2-8, 4-10) if you think that forests of different species have different overall values.

- **Tip:** First identify the stand(s) with '1' and the stand(s) with '10' across the whole score sheet. Then identify the remaining highest and lowest stands within each matrix. Then fill in all the other scores.

- Use full numbers (i.e. no decimals or fractions). Use the same score for different forest stand types if you feel they are of equal recreational value.

- Assume that there is suitable physical access into, alongside, or in close proximity to the stand from which a visitor could judge its recreational value.

- Base your scores on bio-physical features only: ignore paths and other recreational infrastructure that may be present in such a forest type.

- Please provide a score for every cell, even though in practice some may be extremely rare, e.g. 'adult FMA5' or 'establishment FMA1'.

- Try to provide average scores across all seasons of the year to allow for differences in appearance of deciduous trees and due to snowfall, etc.

- When scoring 'establishment phase' stands, remember that neighbouring stands may also be visible. Assume that these are of the same FMA.

- It may help to refer to your weightings for the attributes in the table above (question 1), and to the descriptions of FMAs in the appendix.

## QUESTION 2: RESULTS FROM THE 'GREAT BRITAIN' PANEL – ROUND 1 (N=10)
## Median scores (plus full sets of scores in ascending order)

### A) SITKA SPRUCE

| Phase of devt. | Forest management alternative (FMA) | | | | |
|---|---|---|---|---|---|
| | 1. Forest nature reserves | 2. Close-to-nature forests | 3. Combined objective forestry | 4. Intensive even-aged forestry | 5. Wood biomass production |
| Estab. | **3** (1,1,2,3,3,3,4,4,4,6) | **3** (1,2,2,2,3,3,3,3,4,5) | **3** (1,1,2,2,3,3,3,4,5,7) | **1** (1,1,1,1,1,1,1,1,2,4) | **1** (1,1,1,1,1,1,1,1,2,2,5) |
| Young | **3.5** (1,1,2,2,3,4,4,5,5,6) | **3** (2,2,2,2,3,3,3,5,7,7) | **3** (2,2,2,2,3,3,4,5,7,7) | **2** (1,1,1,2,2,2,2,2,3,3) | **1.5** (1,1,1,1,1,2,2,2,2,5) |
| Medium | **5** (1,2,4,5,5,5,7,7,8,10) | **5** (2,3,4,4,5,5,6,7,7,9) | **6** (3,5,5,5,6,6,6,6,7,8) | **3** (1,1,2,3,3,3,3,4,4,4) | **2.5** (1,1,2,2,2,3,3,3,3,5) |
| Adult | **6.5** (1,3,3,5,6,7,8,8,9,10) | **7** (2,4,5,5,7,7,8,8,9,10) | **6.5** (4,5,5,6,6,7,7,8,8,8) | **4.5** (1,1,2,3,4,5,5,6,6,7) | **3** (1,2,2,2,3,3,4,4,5,5) |

### B) BIRCH

| Phase of devt. | Forest management alternative (FMA) | | | | |
|---|---|---|---|---|---|
| | 1. Forest nature reserves | 2. Close-to-nature forests | 3. Combined objective forestry | 4. Intensive even-aged forestry | 5. Wood biomass production |
| Estab. | **4** (3,3,3,4,4,4,5,6,6,9) | **4** (3,3,3,3,4,4,5,6,6,9) | **3.5** (2,2,3,3,3,4,4,4,7,8) | **2.5** (1,2,2,2,2,3,3,3,4,7) | **2** (1,1,1,2,2,2,2,2,3,8) |
| Young | **6** (4,4,5,5,6,6,6,6,7,10) | **6** (4,4,5,5,6,6,6,6,6,10) | **5** (3,4,4,4,5,5,6,6,8,8) | **3.5** (1,2,2,3,3,4,4,4,5,7) | **2.5** (1,1,2,2,2,3,3,3,3,8) |
| Medium | **8.5** (4,7,8,8,8,9,9,9,10,10) | **8** (5,7,8,8,8,8,9,9,9,10) | **7.5** (6,6,6,7,7,8,8,8,8,9) | **5** (1,3,5,5,5,5,6,6,6,7) | **3.5** (2,2,2,3,3,4,4,5,6,8) |
| Adult | **10** (8,8,9,9,10,10,10,10,10,10) | **10** (7,8,9,10,10,10,10,10,10,10) | **8** (7,7,8,8,8,8,9,10,10,10) | **6** (1,4,4,6,6,6,7,7,8,8) | **3.5** (2,2,2,2,3,4,5,6,7,8) |

### C) MIXED (SITKA SPRUCE AND BIRCH)

| Phase of devt. | Forest management alternative (FMA) | | | | |
|---|---|---|---|---|---|
| | 1. Forest nature reserves | 2. Close-to-nature forests | 3. Combined objective forestry | 4. Intensive even-aged forestry | 5. Wood biomass production |
| Estab. | **4** (1,3,3,3,4,4,5,5,6,7) | **4** (2,3,3,4,4,4,5,5,6,7) | **3.5** (2,2,2,3,3,4,4,5,5,6) | **2.5** (1,1,2,2,2,3,3,4,4,4) | **2** (1,1,1,2,2,2,2,3,4,6) |
| Young | **5** (2,4,4,5,5,5,6,8,8,8) | **4** (3,4,4,4,5,5,7,7,8,8) | **5** (3,3,4,5,5,5,5,5,6,8) | **4** (1,2,3,3,4,4,4,4,4,6) | **2.5** (1,2,2,2,2,3,3,3,4,5) |
| Medium | **8** (4,6,7,8,8,8,8,9,9,10) | **8** (5,5,7,7,8,8,8,9,10,10) | **6.5** (5,6,6,6,6,7,7,8,10,10) | **5** (1,4,4,4,5,5,6,6,6,8) | **3** (3,3,3,3,3,4,4,4,6,8) |
| Adult | **8** (5,7,7,8,8,8,9,10,10,10) | **9** (6,7,8,9,9,9,10,10,10,10) | **8.5** (6,6,7,8,8,9,9,10,10,10) | **6** (1,3,5,5,6,6,7,8,8,8) | **4.5** (2,3,3,4,4,5,5,6,8,8) |

**QUESTION 2: Your personal scores from Round 1 are shown below on the left-hand side. If you would like to revise any of these, please write them in the tables for 'Round 2' on the right-hand side. Otherwise, leave the cells blank. Please write new comments in the box on the following page.** (Note: In response to feedback from Round 1, 'Adult FMA5' has been removed from the score-sheet in this round, because it does not exist according to the definitions given in the appendix.)

## A) SITKA SPRUCE

| ROUND 1 | | | | | |
|---|---|---|---|---|---|
| Phase of development | Forest management alternative (FMA) | | | | |
| | FMA1 | FMA2 | FMA3 | FMA4 | FMA5 |
| 1. Estab. | 2 | 2 | 1 | 1 | 1 |
| 2. Young | 3 | 3 | 2 | 2 | 2 |
| 3. Med. | 5 | 4 | 3 | 3 | 3 |
| 4. Adult | 6 | 5 | 4 | 4 | 4 |

| ROUND 2 | | | | | |
|---|---|---|---|---|---|
| Phase of development | Forest management alternative (FMA) | | | | |
| | FMA1 | FMA2 | FMA3 | FMA4 | FMA5 |
| 1. Estab. | | | | | |
| 2. Young | | | | | |
| 3. Med. | | | | | |
| 4. Adult | | | | | |

## B) BIRCH

| ROUND 1 | | | | | |
|---|---|---|---|---|---|
| Phase of development | Forest management alternative (FMA) | | | | |
| | FMA1 | FMA2 | FMA3 | FMA4 | FMA5 |
| 1. Estab. | 4 | 3 | 3 | 3 | 2 |
| 2. Young | 6 | 5 | 4 | 4 | 3 |
| 3. Med. | 8 | 7 | 6 | 5 | 4 |
| 4. Adult | 10 | 8 | 7 | 6 | 5 |

| ROUND 2 | | | | | |
|---|---|---|---|---|---|
| Phase of development | Forest management alternative (FMA) | | | | |
| | FMA1 | FMA2 | FMA3 | FMA4 | FMA5 |
| 1. Estab. | | | | | |
| 2. Young | | | | | |
| 3. Med. | | | | | |
| 4. Adult | | | | | |

## C) MIXED (SITKA SPRUCE AND BIRCH)

| ROUND 1 | | | | | |
|---|---|---|---|---|---|
| Phase of development | Forest management alternative (FMA) | | | | |
| | FMA1 | FMA2 | FMA3 | FMA4 | FMA5 |
| 1. Estab. | 3 | 3 | 2 | 2 | 2 |
| 2. Young | 4 | 4 | 3 | 3 | 3 |
| 3. Med. | 6 | 5 | 5 | 4 | 4 |
| 4. Adult | 7 | 6 | 6 | 5 | 5 |

| ROUND 2 | | | | | |
|---|---|---|---|---|---|
| Phase of development | Forest management alternative (FMA) | | | | |
| | FMA1 | FMA2 | FMA3 | FMA4 | FMA5 |
| 1. Estab. | | | | | |
| 2. Young | | | | | |
| 3. Med. | | | | | |
| 4. Adult | | | | | |

**Please write any new comments you may have on Questions 1 and 2 in the relevant box below.** For reference, all comments received from all participants in the 'Great Britain' panel in Round 1 are shown on the following pages.

**Question 1:**

**Question 2:**

## QUESTION 1: Comments received from the 'Great Britain' panel (Round 1)

**Comment 1:** 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. The importance I have rated highly for all but I am not sure as to how important the average visitor might consider some, in which case I have lowered the confidence limit. The size of coupes question I assume to mean coupes seen from within and not on another hillside, which is why I have put it negative.

**Comment 2:** I've assumed that the 'average' visitor will be accessing the forest (on foot) via existing tracks/paths/forest roads unimpeded rather than finding their own route through the forest – if not, I would have to revise my scores as attributes such as amount of natural deadwood, amount of residue from thinning/harvesting, density of ground vegetation are likely to be of greater importance to such as visitor than visual penetration of stand etc.

Relative contribution is a difficult one to score! You will note that low confidence ratings correlate with low relative attribute scores!

Forest size and presence/absence of harvesting/thinning activity may also be important attributes.

**Comment 3:** Not clear about q. 12 – are you saying proportion of natural to straight edges, or proportion of natural edges to non-edges? My answer is as if the latter. If the former, change to P, 9, H.

Q 7: 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.

**Comment 4:** 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.

There is also the added problem of the increased opportunities for recreation in forests and whilst most people walk people are generally interested I seeing wildlife, or even other recreational activities.

Their should have be 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.

**Comment 5:** 8. Size of clear cuts: 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.

**Comment 6:** 5 and 7 can have many answers. 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

**Comment 7:** 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.

Key attributes that contribute to the recreation value of forest is 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.

**Comment 8:** Some of the other attributes, which I have classed as bell shaped, will add to the recreation value of forest if present; but if you go overboard with that attribute then it might deteriorate the recreation value. For example, the amount of deadwood.

**QUESTION 2: Comments received from the 'Great Britain' panel (Round 1)**

**Comment 1:** I have assumed that establishment phase for all forest types is not very interesting and that closed stands of young forest in both types are also rather dull. However the mature biomass production will probably be a bit similar to the intensive types – it might be difficult to tell them apart, assuming they ever actually reach that stage.

**Comment 2:** Somewhat unsure of how to answer (b) – am assuming marking at high levels – i.e. high canopy height, high volume woody residue, dense ground cover, etc.

**Comment 3:** I find it difficult to envisage SS in nature reserves or close to nature management in GB – but have seen it in CCF systems in Wales so answered accordingly – i.e. based on natural regen in small openings, actually quite attractive.

Also find it relatively hard to envisage birch / SS mixes but had an imaginative afternoon.

**Comment 4:** This is a very difficult question to answer because it states nothing about the management quality. N Scotland many landowners may well have such woods but the differences in such management are immense.

I have waked through such forests and feel in my view the recreational experience is enhanced through the Caledonian pine forests and it is waking through tat almost primeval forest that is key to that experience. It is also clear tat the quality of information and interpretation provided is key to maximising the recreational experience. I have published on this aspect. The lack of option for this was disappointing.

My degree of confidence is generally medium to low in this section.

**Comment 5:** For all parts of this question and regards the wood biomass production FMA, I have given the same score for Medium and Adult because I have assumed that wood biomass would be cropped before reaching the Adult stage.

Also for all parts of this question and regards the forest nature reserves and close-to-nature forestry FMA, my reading of the appendix definitions would imply that as an introduced species Sitka spruce does not have a place in either system. However, since the question relates to the average visitor and the value they would place on a stand I am recognising that for some this aspect of 'naturalness' would neither be apparent nor an issue. But this explains my low scores.

**Comment 6:** Some of the options just seem non-feasible, so I feel I am answering a silly question- close to nature implies native for me and therefore close to nature sitka is out. And likewise old SRC!

But I guess you cover yourself in the background notes.

In haste I am on leave and will slide of the screen if I do not do it now.

**Comment 7:** Generally, the highest recreation values would be found in birch, then mixed then sitka. Although in 1 above I have suggested that variation is important for recreation value, I feel that a mix of sitka and birch would reduce the recreation value compared to birch; one might consider this an 'invasion' of the birch forest with sitka. However, you could look at it from another view point and considered that planting of birch on the edge of sitka would enhance the recreation value of sitka.

I have generally scored establishment as low, since land disturbance is often very visible at this stage; particularly in the more commercial stances.

I have scored adult as high, reflecting the fact that people often like to see mature trees. However, with the more commercial stances, clear felling of large areas would reduce recreation appeal.

**Please email your completed questionnaire, and any queries you may have, to:**
David Edwards, Forest Research, Scotland, United Kingdom. Tel: +44 (0)131 445 8495.
**david.edwards@forestry.gsi.gov.uk**

**Thank you for participating in the survey.**

## APPENDIX 3: UTILITIES FROM CONJOINT ANALYSIS

The importance values for each factor, by participant, in each region are given in Tables A1 to A4.

**Table A1. Importance values for each factor, by participant: Great Britain**

| Participant ID | FMA | Phase | Type |
|---|---|---|---|
| 1 | 30.0 | 60.0 | 10.0 |
| 2 | 54.7 | 10.5 | 34.8 |
| 3 | 24.5 | 47.2 | 28.3 |
| 4 | 53.4 | 33.8 | 12.8 |
| 5 | 33.3 | 48.0 | 18.7 |
| 6 | 29.2 | 50.0 | 20.8 |
| 7 | 30.6 | 19.2 | 50.2 |
| 8 | 25.1 | 49.1 | 25.8 |
| 9 | 22.1 | 55.0 | 22.9 |
| 10 | 66.0 | 32.3 | 1.7 |

**Table A2. Importance values for each factor, by participant: Nordic Region**

| Participant ID | FMA | Phase | Type |
|---|---|---|---|
| 1 | 44.0 | 55.6 | 0.4 |
| 2 | 35.1 | 58.6 | 6.2 |
| 3 | 23.1 | 73.3 | 3.6 |
| 4 | 17.9 | 73.9 | 8.1 |
| 5 | 28.2 | 66.2 | 5.5 |
| 6 | 27.2 | 56.2 | 16.6 |
| 7 | 30.9 | 65.5 | 3.5 |
| 8 | 27.7 | 67.2 | 5.1 |
| 9 | 20.2 | 70.3 | 9.4 |
| 10 | 28.0 | 63.6 | 8.3 |
| 11 | 26.8 | 54.6 | 18.6 |
| 12 | 22.3 | 69.1 | 8.5 |

**Table A3. Importance values for each factor, by participant: Central Europe**

| Participant ID | FMA | Phase | Type |
|---|---|---|---|
| 1 | 42.4 | 36.8 | 20.7 |
| 2 | 41.9 | 46.8 | 11.8 |
| 3 | 40.6 | 43.7 | 15.6 |
| 4 | 34.7 | 48.1 | 17.2 |
| 5 | 60.5 | 24.3 | 15.2 |
| 6 | 38.8 | 47.5 | 13.7 |
| 7 | 31.5 | 49.3 | 19.1 |
| 8 | 37.3 | 51.3 | 11.3 |
| 9 | 33.1 | 47.6 | 19.3 |
| 10 | 36.3 | 48.5 | 15.2 |
| 11 | 18.4 | 73.8 | 7.8 |
| 12 | 32.8 | 36.4 | 30.8 |
| 13 | 47.8 | 27.7 | 24.5 |

**Table A4. Importance values for each factor, by participant: Iberia**

| Participant ID | FMA | Phase | Type |
|---|---|---|---|
| 1 | 29.6 | 51.4 | 19.0 |
| 2 | 31.8 | 35.3 | 32.9 |
| 3 | 47.2 | 46.1 | 6.7 |
| 4 | 29.6 | 55.8 | 14.7 |
| 5 | 35.8 | 49.5 | 14.7 |
| 6 | 42.1 | 44.0 | 13.9 |
| 7 | 33.2 | 58.2 | 8.5 |
| 8 | 36.8 | 50.9 | 12.3 |
| 9 | 14.0 | 79.2 | 6.8 |
| 10 | 48.2 | 31.1 | 20.7 |

The average importance for each factor is given for each region in Tables A5 to A8.

**Table A5. Average importance of each factor: Great Britain**

| Variable | N | Mean | Std Dev | Minimum | Maximum |
|---|---|---|---|---|---|
| FMA | 10 | 36.9 | 15.3 | 22.1 | 66.0 |
| Phase of development | 10 | 40.5 | 16.1 | 10.5 | 60.0 |
| Type | 10 | 22.6 | 13.6 | 1.7 | 50.2 |

**Table A6. Average importance of each factor: Nordic Region**

| Variable | N | Mean | Std Dev | Minimum | Maximum |
|---|---|---|---|---|---|
| FMA | 12 | 27.6 | 7.0 | 17.9 | 44.0 |
| Phase of development | 12 | 64.5 | 6.8 | 54.6 | 73.9 |
| Type | 12 | 7.8 | 5.2 | 0.4 | 18.6 |

**Table A7. Average importance of each factor: Central Europe**

| Variable | N | Mean | Std Dev | Minimum | Maximum |
|---|---|---|---|---|---|
| FMA | 13 | 38.2 | 9.7 | 18.4 | 60.5 |
| Phase of development | 13 | 44.7 | 12.2 | 24.3 | 73.8 |
| Type | 13 | 17.1 | 6.0 | 7.8 | 30.8 |

**Table A8. Average importance of each factor: Iberia**

| Variable | N | Mean | Std Dev | Minimum | Maximum |
|---|---|---|---|---|---|
| FMA | 10 | 34.8 | 9.9 | 14.0 | 48.2 |
| Phase of development | 10 | 50.1 | 13.3 | 31.1 | 79.2 |
| Type | 10 | 15.0 | 7.9 | 6.7 | 33.0 |

The utilities for each of the 12 attribute levels (i.e. five types of FMA + four phases of development + three species types) are given in Tables A9 to A12.

**Table A9. Utilities: Great Britain**

| ID | Inter-cept | FMA | | | | | Phase of development | | | | Species type | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | Estab | Young | Med | Adult | Con | B/L | Mix |
| 1 | 5.00 | 1.50 | 1.00 | -0.00 | -0.83 | -1.67 | -3.00 | -1.67 | 1.33 | 3.33 | -0.49 | 0.56 | -0.07 |
| 2 | 5.36 | 2.14 | 2.14 | 0.72 | -1.94 | -3.07 | -0.69 | 0.31 | 0.17 | 0.21 | -1.72 | 1.60 | 0.12 |
| 3 | 4.15 | 1.18 | 0.51 | -0.23 | -0.65 | -0.82 | -1.88 | -0.75 | 0.65 | 1.98 | -1.14 | 1.17 | -0.03 |
| 4 | 5.50 | 1.58 | 1.75 | 1.75 | -2.00 | -3.09 | -1.50 | -0.76 | 0.70 | 1.56 | -0.32 | -0.42 | 0.74 |
| 5 | 4.53 | 0.55 | 1.13 | 0.88 | -0.61 | -1.96 | -2.06 | -1.53 | 1.20 | 2.40 | -1.09 | 0.44 | 0.65 |
| 6 | 4.84 | 1.07 | 0.91 | 0.82 | -0.84 | -1.96 | -2.18 | -1.31 | 0.49 | 3.00 | -1.42 | 0.68 | 0.74 |
| 7 | 6.06 | -0.47 | -0.31 | 1.44 | -1.22 | 0.56 | -0.86 | -0.46 | 0.81 | 0.50 | -2.89 | 1.47 | 1.42 |
| 8 | 4.54 | 0.71 | 0.80 | 0.46 | -0.62 | -1.36 | -2.00 | -0.87 | 0.66 | 2.21 | -1.12 | 1.09 | 0.03 |
| 9 | 5.36 | 0.89 | 0.56 | 0.39 | -0.94 | -0.91 | -1.89 | -1.69 | 0.91 | 2.67 | -1.21 | 0.53 | 0.68 |
| 10 | 4.46 | 2.20 | 2.78 | 0.70 | -3.46 | -2.22 | -1.66 | -0.66 | 0.93 | 1.40 | -0.09 | 0.07 | 0.02 |
| **Av** | **4.98** | **1.14** | **1.13** | **0.69** | **-1.31** | **-1.65** | **-1.77** | **-0.94** | **0.79** | **1.93** | **-1.15** | **0.72** | **0.43** |

## Table A10. Utilities: Nordic Region

| ID | Inter-cept | FMA | | | | | Phase of development | | | | Species type | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | Estab | Young | Med | Adult | Con | B/L | Mix |
| 1 | 5.54 | -0.20 | 2.46 | 0.55 | -0.72 | -2.09 | -2.73 | -1.34 | 1.06 | 3.01 | -0.01 | -0.01 | 0.03 |
| 2 | 4.51 | -0.42 | 1.66 | 1.24 | -0.49 | -1.98 | -2.04 | -2.51 | 0.98 | 3.57 | -0.00 | -0.32 | 0.32 |
| 3 | 4.55 | -0.89 | -0.22 | 0.94 | 0.14 | 0.02 | -2.42 | -1.22 | 0.25 | 3.39 | -0.06 | -0.11 | 0.17 |
| 4 | 3.66 | -0.74 | -0.41 | 0.84 | 0.23 | 0.08 | -2.66 | -2.59 | 1.38 | 3.87 | -0.40 | 0.08 | 0.32 |
| 5 | 5.07 | 0.18 | 0.43 | 1.18 | -0.01 | -1.78 | -3.40 | -2.14 | 2.00 | 3.54 | -0.29 | 0.29 | 0.01 |
| 6 | 5.93 | 0.49 | 1.07 | 0.65 | -0.10 | -2.11 | -3.46 | -1.80 | 2.14 | 3.12 | -0.93 | -0.09 | 1.02 |
| 7 | 4.08 | -1.08 | -0.50 | 1.67 | 1.00 | -1.08 | -1.48 | -2.48 | 0.62 | 3.34 | -0.12 | 0.19 | -0.07 |
| 8 | 4.98 | -0.23 | 1.35 | 0.68 | -0.50 | -1.29 | -2.98 | -1.32 | 0.89 | 3.41 | 0.02 | 0.23 | -0.25 |
| 9 | 4.89 | -0.06 | 0.78 | 0.28 | 0.04 | -1.03 | -3.09 | -1.49 | 1.35 | 3.23 | -0.51 | 0.17 | 0.34 |
| 10 | 4.12 | -0.12 | -0.04 | 1.38 | 0.27 | -1.48 | -2.59 | -2.12 | 0.80 | 3.91 | 0.48 | -0.10 | -0.38 |
| 11 | 4.86 | 0.31 | 0.47 | 0.97 | 0.00 | -1.76 | -2.59 | -1.19 | 0.81 | 2.97 | -1.16 | 0.73 | 0.43 |
| 12 | 4.44 | 1.14 | 0.97 | -0.03 | -1.03 | -1.06 | -3.31 | -1.78 | 1.59 | 3.49 | -0.21 | -0.31 | 0.52 |
| **Av** | **4.72** | **-0.14** | **0.67** | **0.86** | **-0.10** | **-1.30** | **-2.73** | **-1.83** | **1.16** | **3.40** | **-0.27** | **0.06** | **0.21** |

## Table A11. Utilities: Central Europe

| ID | Inter-cept | FMA | | | | | Phase of development | | | | Species type | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | Estab | Young | Med | Adult | Con | B/L | Mix |
| 1 | 5.19 | 1.80 | 1.64 | 0.31 | -1.61 | -2.14 | -1.73 | -0.59 | 0.63 | 1.69 | -1.06 | 0.86 | 0.20 |
| 2 | 4.89 | 1.86 | 1.94 | 0.02 | -1.64 | -2.18 | -2.16 | -0.96 | 0.72 | 2.40 | -0.35 | -0.41 | 0.76 |
| 3 | 4.78 | 1.97 | 1.22 | -0.03 | -1.28 | -1.90 | -1.91 | -1.11 | 0.77 | 2.25 | -0.92 | 0.35 | 0.57 |
| 4 | 4.42 | 0.75 | 1.25 | 1.00 | -0.92 | -2.09 | -0.08 | -2.82 | 1.09 | 1.81 | -0.69 | -0.26 | 0.98 |
| 5 | 5.31 | 2.77 | 1.85 | 0.93 | -2.06 | -3.49 | -1.11 | -0.65 | 0.37 | 1.40 | -0.85 | 0.73 | 0.12 |
| 6 | 4.30 | 1.45 | 0.62 | 0.45 | -1.13 | -1.39 | -1.37 | -0.83 | 0.09 | 2.10 | 0.11 | -0.55 | 0.45 |
| 7 | 4.92 | 1.49 | 0.66 | -0.01 | -1.01 | -1.14 | -2.26 | -0.59 | 0.97 | 1.87 | -0.88 | 0.16 | 0.72 |
| 8 | 5.50 | 0.25 | 0.42 | 1.42 | -0.41 | -1.68 | -1.76 | -1.56 | 0.83 | 2.5 | 0.44 | 0.06 | -0.50 |
| 9 | 4.09 | 1.41 | 1.08 | 0.08 | -1.09 | -1.48 | -1.29 | -1.69 | 0.52 | 2.46 | -0.88 | 0.08 | 0.80 |
| 10 | 5.02 | 1.31 | 1.41 | 0.47 | -1.19 | -1.73 | -1.69 | -1.22 | 0.54 | 2.37 | -0.83 | 0.39 | 0.44 |
| 11 | 4.59 | 0.08 | 0.91 | 0.83 | -0.92 | -0.90 | -3.19 | -2.59 | 1.59 | 4.19 | -0.04 | -0.37 | 0.41 |
| 12 | 4.86 | 0.23 | 1.39 | 1.39 | -1.52 | -1.49 | -1.39 | -0.79 | 0.33 | 1.85 | -1.36 | -0.01 | 1.38 |
| 13 | 5.37 | 2.46 | 1.80 | 0.05 | -1.70 | -2.60 | -1.37 | -0.77 | 0.58 | 1.56 | -1.53 | 1.07 | 0.46 |
| **Av** | **4.86** | **1.37** | **1.25** | **0.53** | **-1.27** | **-1.86** | **-1.64** | **-1.24** | **0.69** | **2.19** | **-0.68** | **0.16** | **0.52** |

## Table A12. Utilities: Iberia

| ID | Inter-cept | FMA | | | | | Phase of development | | | | Species type | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | Estab | Young | Med | Adult | Con | B/L | Mix |
| 1 | 4.17 | -0.67 | 1.16 | 1.57 | -0.92 | -1.13 | -1.91 | -1.37 | 0.49 | 2.79 | -0.88 | 0.86 | 0.02 |
| 2 | 4.36 | 1.39 | 0.89 | -0.11 | -0.77 | -1.40 | -1.56 | -0.82 | 0.84 | 1.54 | -1.35 | -0.19 | 1.54 |
| 3 | 4.60 | 2.40 | 1.99 | 0.24 | -1.85 | -2.78 | -2.60 | -0.73 | 0.87 | 2.46 | -0.25 | -0.25 | 0.49 |
| 4 | 6.77 | 0.90 | 0.90 | 0.90 | -1.43 | -1.27 | -2.23 | -0.63 | 0.70 | 2.17 | -0.77 | 0.39 | 0.39 |
| 5 | 6.77 | 1.40 | 1.40 | 0.90 | -1.35 | -2.33 | -2.50 | -2.04 | 1.90 | 2.65 | -0.75 | -0.02 | 0.77 |
| 6 | 4.22 | -0.64 | 0.28 | 1.94 | 0.78 | -2.36 | -2.56 | -0.02 | 0.64 | 1.94 | -0.72 | 0.70 | 0.02 |
| 7 | 4.36 | 0.72 | 1.05 | 1.22 | -0.95 | -2.04 | -2.76 | -1.96 | 1.77 | 2.96 | -0.32 | -0.21 | 0.53 |
| 8 | 4.66 | 0.26 | 1.34 | 1.17 | -0.66 | -2.11 | -2.46 | -0.99 | 1.14 | 2.31 | -0.54 | -0.07 | 0.61 |
| 9 | 3.13 | -0.05 | 0.62 | 0.37 | -0.47 | -0.47 | -2.13 | -2.13 | 0.27 | 4.00 | -0.2 | -0.10 | 0.32 |
| 10 | 6.12 | 2.29 | 2.38 | -0.46 | -1.71 | -2.51 | -0.86 | -1.32 | 0.34 | 1.83 | -1.00 | -0.10 | 1.10 |
| **Av** | **4.92** | **0.80** | **1.20** | **0.77** | **-0.93** | **-1.84** | **-2.16** | **-1.20** | **0.90** | **2.47** | **-0.68** | **0.10** | **0.58** |