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Sustainable Forest Management Preferences of Interest Groups in Three Regions with Different Levels of Industrial Forestry: An Exploratory Attribute-Based Choice Experiment

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Abstract The challenge of sustainable forest management is to integrate diverse and sometimes conflicting management objectives. In order to achieve this goal, we need a better understanding of the aspects influencing the preferences of diverse groups and how these groups make trade-offs between different attributes of SFM. We compare the SFM preferences of interest groups in regions with different forest use histories based on the reasoning that the condition of the forest reflects the forest use history of the area. The condition of the forest also shapes an individual's forest values and attitudes. These held values and attitudes are thought to influence SFM preferences. We tested whether the SFM preferences vary amongst the different interest groups within and across regions. We collected data from 252 persons using a choice experiment approach, where participants chose multiple times among different options described by a combination of attributes that are assigned different levels. The novelty of our approach was the use of choice experiments in the assessment of regional preference differences. Given the complexity of inter-regional comparison and the small sample size, this was an exploratory study based on a purposive rather than random sample. Nevertheless, our results suggest that the aggregation of preferences of all individuals within a region does not reveal all information necessary for forest management planning since opposing viewpoints could cancel each other out and lead to an interpretation that does not reflect possibly polarised views. Although based on a small sample size, the preferences of interest groups within a region are generally statistically significantly different from each other; however preferences of interest groups across regions are also significantly different. This illustrates the potential importance of assessing heterogeneity by region and by group.

Keywords Sustainable forest management · Environmental economics · Preference elicitation · Stated preference · Trade offs · Heterogeneity of preferences

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Introduction

The notion of Sustainable Forest Management (SFM) has evolved historically from sustainable timber production to managing the forests for various ecological, economic and social values (Messier and Kneeshaw 1999; McDonald and Lane 2002; Wang 2004). In trying to implement sustainable forest management (SFM), forest managers face the challenge of integrating diverse management objectives into their management plans (Margerum 1995; Ananda and Herath 2003). The task is not simple, since a balance is needed between different objectives such as conservation, recreational use and timber production which are valued differently by different groups of people. The task becomes even more challenging in regions with a high proportion of private forest ownership where regional objectives are desired (Leskinen and others 2004).

Sophisticated planning and decision making tools have been developed to help in combining the various objectives (Seely and others 2004; Kangas and others 2005; Sturtevant and others 2007). Participatory processes have

been used to identify the management preferences of interested parties (Tanz and Howard 1991; Kangas and others 2001; Tyrväinen and others 2003). Research is needed, however, in order to better understand which aspects influence the preferences of diverse groups and how they make trade-offs between different attributes describing the characteristics of SFM, for example jobs and conservation areas.

We used a choice experiment approach that has proven useful in studying trade-offs in resource management settings (Horne and others 2005). Choice experiments on forest use have been carried out mainly related to the recreational use of the forest (Boxall and others 1996; Adamowicz and others 1997, 1998a; Boxall and Macnab 2000; Horne and others 2005) and nature conservation (Li and others 2004; Horne 2006; Lehtonen and others 2006). Some choice experiments related to SFM have also been conducted (Shapansky and others 2008; Xu and others 2003), but studies that compare different groups are rare.

Our study compares the preferences of various interest groups in each study region and similar groups across regions. Group membership is an important component of social identity (Turner and Oakes 1989). Individuals may belong to various social groups simultaneously and their social identity is a combination of these group identities (Harshaw and Tindall 2005). Interest or user groups are thought to create subcultures based on their shared forest experiences, which would lead to group-specific preferences related to forest management (Berninger and others 2009). For example foresters, representing the forest industry, have been shown to have a greater preference for use of the forest to produce market products compared to environmental and aboriginal groups (Kant and Lee 2004; Kumar and Kant 2007).

All above mentioned research focuses on one study area at a time. Thus the influence of place-related factors on SFM preferences is unexplored. Earlier research indicates that forest use history and importance of commercial forestry in the region has an effect on rankings of SFM indicators and forest value orientations (Berninger and others 2009; Berninger and Kneeshaw 2009). Theoretically, it has been stated that forest values are influenced by current and historical forest use through changing forest conditions and through forest experiences that modify cultural models about forests (Berninger and others 2009). These held values[1] are then thought to have an influence on preferences which can be defined as favoured options (Adamowicz and others 1998b). Empirically, forest values and attitudes are shown to moderately predict respondent preferences for forest use or management alternatives (Brown and Reed 2000; Horne and others 2004). This gives us reason to believe that forest use history and importance of commercial forestry has an effect on SFM preferences as well.

Our research questions are the following: Do SFM preferences differ across regions and can these differences be explained by differing current and historical forest use? How do the SFM preferences differ in the different interest groups within and across regions? Do inter-group differences in SFM preferences increase as the importance of commercial forestry increases in a region?

Methods

The Choice Experiment Method

In order to evaluate SFM preferences we used choice experiments where participants are given multiple choice tasks and for each task they are asked to choose their preferred alternative of two or more alternatives. The alternatives are described by various levels of a set of attributes. The attributes and their levels are designed to reveal individual preferences for SFM attributes and different management strategies. This method can be used to study both use and non-use values of natural resources (Grafton and others 2004, p. 264).

The choice experiment method is based on random utility theory and provides information on trade-offs between the attributes in question (Adamowicz and others 1997, 1998a). Individuals are assumed to choose the alternative that maximizes their utility or as described by Hensher and others (2005, p. 707) the level of happiness that an alternative provides them.

According to random utility theory the utility (U) of alternative i is the sum of systematic (V_i) and error (ε_i) components. The systematic component (V) contains specific and observable attributes that in the case of a stated preference method are defined by the researcher and presented to the individual in the form of choice sets. The presence of an error component ε means that the overall utility is random and only the probability of choice of one alternative over another can be analyzed:

$$P(i) = P(V_i + \varepsilon_i > V_j + \varepsilon_j) \quad \forall j \neq i, \quad i,j \in C_n$$

where C_n is the choice set of individual n (Adamowicz and others 1997).

The Survey Instrument

The attributes were designed to represent each of the three dimensions of sustainable forest management: ecological, economic and social (Table 1). The attributes were based on a preliminary study conducted in 2005 where 4–10

[1] Held values can be described as "emotionally charged beliefs about what is desirable, right and appropriate" (Tindall 2003).

Table 1 Components of sustainable forest management (SFM), related attributes and their levels in the three study regions

Component of SFM and attribute	Levels (current situation in bold)	Coding
Ecological		
Conservation area % forest land	*Southeastern Finland:* **2**, 3, 5, 8 *The Mauricie:* **2**, 5, 8, 12 *Central Labrador:* **50**, 40, 53, 56	Change from current in % units
Ecological, economic and social		
Average size of clear cuts, ha	*Southeastern Finland*: **2**, selective cutting, 1 (50%), 4 (200%) *The Mauricie:* **25**, selective cutting, 12.5 (50%), 50 (200%) *Central Labrador:* **10**, selective cutting, 5 (50%), 20 (200%)	0 = selective cutting 1 = current situation 0.5 = half the current 2 = double the current
Ecological and social		
Wildlife species the forest supports	1. The forest supports common species 2. The forest supports common species and also some spectacular large mammals and birds 3. The forest supports common sp., some spectacular species and some rare species 4. The forest supports common sp., some spectacular sp., some rare sp. and some endangered species	Categories, dummy coding
Social and economic		
Forest sector jobs at the local and regional level	*Southeastern Finland:* **15950**, 12760 (−20%), 14355 (−10%), 17545 (+10%) *The Mauricie:* **8300**, 6640 (−20%), 7470 (−10%), 9130 (+10%) *Central Labrador:* **60**, 54 (−10%), 66 (+10%), 72 (+20%)	% change from current situation
Economic		
Increase/decrease in taxes, prices of goods and costs of services will cause an increase/decrease of your annual personal expenses, change $/€ per year per household	*Southeastern Finland*: **0**, 30 €, 100 €, 300 € *The Mauricie:* **0**, 42 $, 140 $, 420 $ *Central Labrador:* **0**, −140 $, 140 $ 420 $	Money, 1€ = CAD 1.4[a]

Since the current level was different in each study region, the attributes were coded as a change from the current situation except for the wildlife categorical attribute and the change in annual expenses attribute

[a] Purchasing power parity conversion factor for Finland 1.1, for Canada 1

persons from each interest group were asked to list and rank sustainable forest management indicators (Berninger 2006; Berninger and others 2009). The *proportion of forest land set aside for conservation* is an ecological variable. The attribute *wildlife species* that *the forest supports* combines ecological aspects of biodiversity maintenance with social aspects of the multiple use of the forest: Hunters want favourable conditions for game species, recreational users like to see charismatic species and nature observation enthusiasts seek rare species. The attribute *average size of clear cuts* is an ecological variable that was included because many people in the preliminary study were against big clear cuts and preferred selection cutting. It is also a social variable since opposition to clear cuts is partially based on landscape effects for recreational users of the forest. It can also be considered an economic variable, since it affects logging costs. *Forest sector jobs* describe the socioeconomic role of forestry in the region and *the decrease or increase in annual household expenses* describes the costs of possible additional conservation areas or the gains in reducing conservation areas for the personal economy of the respondent.

The five attributes described above were used in the study and each attribute was assigned four levels, one of which represents the current situation (Table 1). Since the current level was different in each study region, as described in the study area section, most of the attributes were coded as a change from the current situation. Thus we are comparing preferences for changes (percent changes in most cases) in attribute levels across regions. We are assuming that within the range of attributes of our experiment, preferences for changes are not affected by the initial level of the attribute. In a typical case diminishing marginal utility would suggest that preferences for

percentage changes in attributes would depend on the initial level of the attribute. In order to compare across regions with very different base conditions, we are required to make this assumption. Changes in annual household expenses that were measured in euros were converted into Canadian dollars. Central Labrador is the only area where this attribute included a negative level referring to a situation of decreasing taxes (Table 1). The wildlife attribute was dummy-coded, since it is a categorical variable, not continuous like the other attributes.

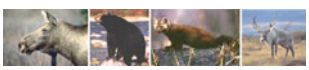
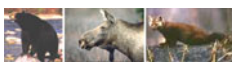
The questionnaire started by asking background information of the participants and questions related to forest values and attitudes that were used to introduce the participants to the topic. The results of the value and attitude section are presented in Berninger (2007a, b, c) and Berninger and Kneeshaw (2009). In the choice experiment section, each participant was presented eight different choice tasks, where an individual compares the current situation with two possible future scenarios. The study included all together 16 different choice tasks. Thus two different versions of the questionnaire were used and were distributed alternately to the respondents. An example of a choice task is presented in Table 2. The combinations of the levels of different attributes used in the choice tasks were determined using orthogonal tables that are developed for choice experiments (Sloane 2006). The questionnaires were first written in English and then translated into Finnish and French. Thus each region had a different language version of the questionnaire. The explanation of the attributes was adjusted to the specific situation in each region. Before application, the questionnaires were tested by a small group of people in each region and adjusted to improve comprehension.

The Study Areas and Interest Groups

Our study areas were Southeastern Finland, the Mauricie in Central Quebec and Central Labrador (Berninger and Kneeshaw 2009). They all have an extensive cover of boreal forest and forest use is important for the local people. They form a gradient of importance of commercial forestry, an index described by the forest sector's share of the labour force and total economic production as well as the amount of logging per forest area; Southeastern Finland being the most intensive, the Mauricie next and Central Labrador the least intensive (Berninger and others 2009). Also the length of time forests have been commercially managed varies across regions, the longest history being in Southeastern Finland where industrial forestry began in the 1870's (Tasanen 2004, p. 421) and the shortest in Central Labrador where commercial logging started in the 1970's and is still marginal (Forsyth and others 2003).

The forest management strategy in each study region also differs due in part to the different forest use history and partly due to differing land ownership patterns. In Southeastern Finland, 80% of the forest land is owned by families, the mean size of the holdings is about 20 ha and there are about 7,000 small holdings of less than 4 ha (Finnish statistical yearbook of forestry 2006). This has led to management by small cut blocks, the average size being under 2 ha. Due to intensive forest management over a long time period, the forests in Southeastern Finland are

Table 2 An example of a choice set from the Central Labrador study area

Please select one of these three options by checking the box below your preferred option			
Attributes	Option 1 Current situation	Option 2	Option 3
Conservation area % forest land	50%	50%	40% (Current situation less 10%)
Average size of clear cuts	10 ha	Selective cutting	5 ha (Current situation/2)
Wildlife species the forest supports	Species favored by or neutral to forestry, charismatic species, some species of late successional forests and some endangered sp.	Species favored by or neutral to forestry only	Species favored by or neutral to forestry, charismatic species and some species of late successional forests
			
Forest sector jobs	60	66 (+10%)	54 (−10%)
Increase in your annual expenses, $ per household	$ 0	$ −140	$ 140
Preferred option: (Check one box)	1☐	2☐	3☐

dominated by even age stands and there is very little old forest in the area. About 3.4% of the forest land is over 120 years old and only 0.9% of the forest land is over 140 years old (Kaakkois-Suomen metsäkeskus 2005b). Less than 2% of the forest land in Southeastern Finland is legally protected (Kaakkois-Suomen metsäkeskus 2005a) and there is little potential of increasing it through conventional methods.

In the Mauricie, where most of the forests are owned by the province of Quebec, very large cut blocks have been used for industrial forestry (Fall and others 2004). At the moment the mean size of cut blocks is 25 ha. In the Mauricie only 2% of the forest land is legally protected, but potential for increasing protected area coverage still exists in the region.

In Central Labrador almost all of the forest is provincially owned. The average cut block size is 10 ha as calculated for logging carried out between 1975 and 2005. In Central Labrador there are no legally protected areas. The proportion of conservation area used in this study is based on the current management plan for District 19 A (Forsyth and others 2003). Under the current plan no logging is carried out in areas dedicated for conservation of natural and cultural values (50% of forest land), but the plan is revised periodically. Logging has been marginal in the area and there are few fires. Thus most of the forests can be considered old (Forsyth and others 2003).

In Southeastern Finland and in the Mauricie the number of forest sector jobs is decreasing, whereas given the low level of forest sector employment there is a potential for an increase in Central Labrador (Kaakkois-Suomen metsäkeskus 2005a; Halifax Global 2006; Government of Quebec 2008).

This study included the following groups in each area: (1) local or regional environmental groups; (2) multiple users of the forest; and (3) forestry professionals. In Southeastern Finland forest owners and in Central Labrador the indigenous groups of Innu and Metis were also included since they are important actors in forest policy in these regions. The multiple users group included hunters, berry and mushroom pickers, hikers and other recreational users of the forest. The forestry professionals group included representatives of the government forest planning officers and the forest industry.

The Recruitment of Participants and Meetings

The study consisted of separate meetings with a sample of each interest group in order to obtain information about their forestry preferences. We invited the participants to come to a central facility, to give them an opportunity to reflect thoroughly on the issues and questions at hand. The use of separate meetings for each group has proven to be effective, especially in conflict-prone settings (Sheppard and Meitner 2005). The meetings with the different interest groups were organized in 2006: in Kouvola and Lappeenranta, Southeastern Finland from January 17th to January 26th, in La Tuque and Trois Rivières, Mauricie from July 4th to July 9th, in Goose Bay and Sheshatshiu, Central Labrador from September 19th to September 22nd and on November 30th. Each meeting lasted about 2 h.

The recruitment techniques used were adapted to the local conditions of each region and special characteristics of each group. The participants were invited using email, whenever possible, but also by traditional letters, telephone calls, a newspaper advertisement and posters distributed in the Innu community of Sheshatsiu in Central Labrador. The contact information was obtained through local forest planning networks in each region (for example the Regional Forest Council in Southeastern Finland, the TRIAD project in the Mauricie Quebec, and Forest Management Committee of District 19A in Goose Bay Labrador). We did not aim for a random sample, but instead tried to reach as many potential participants for each interest group as possible. For example, the base population of environmentalists or forestry professionals in Central Labrador was about 20 persons (Berninger 2007c). Random sampling was only used to choose 200 forest owners to be invited from the forest owners register in Southeastern Finland since these were abundant (Berninger 2007a). 28 forest owners came to the meetings, the response rate thus being 14%. More details on recruitment in each region are available in Berninger (2007a, b, c, c).

In each meeting the participants were explained the objectives of the study and the contents of the questionnaire. Each attribute was described in detail and the idea of a choice experiment was explained. The questionnaire was distributed and participants had an opportunity to ask questions prior to its completion. In the meeting for the Innu in Sheshatsiu, questions presented in English were translated to innu-aimun when needed. Assistance was also provided in understanding and filling in the questionnaires. At the end of each meeting a de-briefing session was held. The discussion was focused mainly on the participant's impressions of the survey and the approaches they used in making choices and trade-offs, but the task also inspired discussion on important local issues related to forests and their use.

The Participants

A total of 252 persons participated in the study (Table 3). The region with the most participants was Southeastern Finland, which is also the region with the largest population. Mean age and the percentage of women participants in the forestry professionals group were very similar in all three regions and also consistent with McFarlane and Boxall's (2000) study. About half of the environmentalists

were women both in Southeastern Finland and Central Labrador, but only one third of the environmentalists were women in the Mauricie, Central Quebec (Table 3). The mean age of the environmentalists in Central Labrador was higher than in the other regions due to a limited number of persons under 40 years among the active members of environmental organizations in the area. The multiple users group in Central Labrador had more women than men participants, while only one fifth of the multiple users group in the other regions were women (Table 3). There was a considerable difference in the mean age of the multiple user groups in the different regions with the oldest participants being in Southeastern Finland and the youngest in the Mauricie, Central Quebec.

Data Analysis

The choice experiment data were analyzed using a conditional logit model with the MDC procedure of the SAS statistical package (SAS institute 2001) as well as the NLOGIT procedure with the statistical package Limdep (Greene 2007).[2] Joint models for each region and separate models for each interest group were estimated. An alternative-specific constant (ASC) was estimated to measure the tendency to select options representing the current situation (Adamowicz and others 1998a). Both linear and quadratic models were estimated for each data set and models with a best fit to the data are presented in the results. Pairwise likelihood ratio tests were conducted with SAS to test whether the estimated model parameters for interest groups within and across regions differed significantly (Hensher and others 2005, pp. 335–337). In order to have more detailed information on the attributes contributing to the differences between groups, we estimated a joint model for all participants in the three regions including the interactions of regions and groups with the attributes conservation area, cut block size, wildlife category 4, money and ASC for the current situation. The base region used was the Mauricie (Québec, Canada) and the base group was multiple users. Marginal values of attribute change were calculated by region and by group. For the wildlife categorical variable marginal values were calculated for the change from one category to another. The marginal value is the dollar amount an individual would be willing to trade for a change in an attribute and still maintain the same utility level. Marginal values are used to standardize attributes to the same units (dollars) in order to enable comparisons across models. As mentioned above, we are comparing preferences for change in attributes and not accounting for the fact that each region has a different base level of attributes or set of initial conditions. If these differences in base levels affect the preferences for attribute changes, then the regional differences in preferences we examine are confounded with the differences in the base level of attributes. However, we hope that for the range of attributes we examine the base level has relatively little effect. Nevertheless one should interpret the inter-regional comparisons with this in mind—results stated as preference differences across regions could be a result of the different initial conditions or could be actual preference differences.

[2] We also estimated mixed logit models by group (that account for the replication of choices by individuals—panel data) and compared them with the conditional logit models. The results show that although there is some heterogeneity within the groups, the mixed logit results are qualitatively similar to conditional logit in terms of our research questions. Thus the mixed logit results are not reported here, but are available from the authors upon request.

Results

Differences Within Regions

In Southeastern Finland, the parameter estimates for conservation area, cut block size and the alternative-specific constant (ASC) for the current situation contrast between the different groups (Table 4). Some groups have positive and significant parameter estimates which means that they prefer a situation with more of that attribute, when all else is held constant. In contrast, other groups have negative and significant parameter estimates for the same attributes demonstrating a preference for less of that attribute. The joint model (column 'All' in Table 4) does not reflect this polarized setting (Table 4). According to pairwise likelihood ratio tests, the model estimated for environmentalists in Southeastern Finland is significantly ($P < 0.0001$) different from those of other groups in the region (Table 5). The model estimated for forestry professionals differs significantly from the model estimated for multiple users (pairwise likelihood ratio test, $P = 0.025$, Table 5).

In the Mauricie, the models estimated for each group are significantly different from each other (pairwise likelihood ratio test, $P < 0.001$, Table 5), but there are no significant opposite parameter estimates like in Southeastern Finland (Table 4). In Central Labrador, none of the groups had a significant parameter estimate for conservation area (Table 4). According to the pairwise likelihood ratio test significant differences ($P < 0.05$) were detected between most groups, but not between the multiple users and the Metis or environmentalists and forestry professionals (Table 5).

Comparison of Groups Across Regions

When the models estimated for the same groups in different regions are compared, some similarities and

Table 3 The number of participants, percentage of women and mean age in each region and each group

	Environmentalists	Forestry professionals	Multiple users	Forest owners	Metis	Innu	Total
Southeastern Finland							
No of participants	41	24	22	28	–	–	115
% of women	49	13	18	18			28
Mean age	45	43	58	50			49
The Mauricie							
No of participants	13	20	18	–	–	–	51
% of women	31	11	20				20
Mean age	47	43	46				45
Central Labrador							
No of participants	15	15	15	–	18	23	86
% of women	53	13	53		39	32	38
Mean age	52	45	50		52	40	47

differences are detected. Models estimated for environmentalists in Southeastern Finland and the Mauricie are similar in many aspects, for example in parameter estimates for conservation area and cut block size (Table 4), and they both differ significantly from the model estimated for the environmentalists in Central Labrador (pairwise likelihood ratio test, $P < 0.001$, Table 6). The models estimated for forestry professionals and multiple users are significantly different in Southeastern Finland in comparison to both other regions (pairwise likelihood ratio test, $P < 0.001$, Table 6). The biggest differences are found in the parameter estimates for the ASC for the current situation and cut block size (Table 4).

At least one level of the wildlife attribute was significant for all groups and generally the categories with more wildlife were preferred with the exception of multiple users in the Mauricie and the Innu in Central Labrador. The models for these groups showed preference of level 3 (forest conditions supporting common species, some spectacular species and some rare species) over level 4 (which also includes endangered species, Table 4).

Our study areas are designed to form a gradient from lesser to greater importance of commercial forestry (for more information, see section on study areas) when moving from Central Labrador through the Mauricie to Southeastern Finland. When marginal values of attribute change for the same groups across regions are examined, some regional trends along the gradient can be detected. The marginal value of cut block size for environmentalists decreases from Central Labrador to Southeastern Finland, while the trend increases for multiple users (Fig. 1). This means that environmentalists in Southeastern Finland are willing to pay more for decreasing cut block size than the environmentalists from other regions, even if the current cut block size is already the smallest among the three regions (mean cut block size 2 ha in contrast to 25 ha in the Mauricie and 10 ha in Central Labrador).

For jobs, both forestry professionals and multiple users show a decreasing trend of marginal values from Central Labrador to Southeastern Finland (Fig. 1). These positive marginal values indicate that people are willing to pay for additional jobs or to avoid losing jobs from the area. This trend may reflect differences in the way forest use generates employment and in the general economic opportunities in the region.

For wildlife, marginal values for moving from level 1 to level 3 show an increasing trend from Central Labrador to Southeastern Finland for environmentalists and a decreasing trend for forestry professionals (Fig. 1). This means that environmentalists in Southeastern Finland are willing to pay more for moving from a situation with less wildlife species to a situation with more wildlife species than environmentalists in Central Labrador. The reverse is true for forestry professionals.

The tendency of selecting the status quo alternative was measured by the alternative-specific constant (ASC). The difference between groups in ASC parameter estimates within a region grows from Central Labrador through the Maurice to Southeastern Finland (Table 4, Fig. 2). In Central Labrador the environmentalists favoured the status quo alternative all else held constant, while the ASC was not significant for other groups in the region. In the Mauricie the multiple users group had a tendency to select alternatives with changes in relation to status quo, all else

Table 4 Parameter estimates (and standard errors) for models estimated for each group and joint models estimated for all participants in each region (column 'All')

Attribute	Southeastern Finland					The Mauricie			
	Env. $n = 41$	Prof. $n = 24$	Mult. $n = 22$	Owners $n = 28$	All $n = 115$	Env. $n = 13$	Prof. $n = 20$	Mult. $n = 18$	All $n = 51$
Cons.	0.107** (0.0392)	−0.118 (0.0810)	−0.0139 (0.0624)	−0.123* (0.0592)	0.00234 (0.0240)	0.204*** (0.0526)	0.0271 (0.0383)	−0.0126 (0.0361)	0.0559** (0.0216)
Cut block size	−0.855*** (0.164)	0.680** (0.233)	−0.0499 (0.198)	0.0463 (0.181)	−0.145** (0.0790)	−0.470* (0.254)	−0.0680 (0.199)	−0.809*** (0.228)	−0.405*** (0.120)
Wildlife1[a]	−1.084*** (0.237)	−0.440 (0.318)	−0.601* (0.263)	−0.169 (0.226)	−0.585*** (0.110)	−0.878 (0.559)	−0.010 (0.456)	−0.613 (0.440)	−0.405 (0.261)
Wildlife3[a]	1.119*** (0.329)	1.334** (0.428)	0.742* (0.361)	0.755* (0.337)	0.881*** (0.148)	0.868 (0.571)	0.879* (0.456)	1.391** (0.438)	0.941*** (0.258)
Wildlife4[a]	1.904*** (0.267)	1.939*** (0.417)	1.143** (0.329)	1.154*** (0.306)	1.314*** (0.130)	1.867*** (0.475)	1.040* (0.409)	1.0381** (0.379)	1.179*** (0.224)
Jobs	0.00422 (0.00950)	0.0404* (0.0167)	0.0325* (0.0128)	0.0170 (0.0118)	0.0155** (0.00506)	0.0279* (0.0167)	0.0207 (0.0128)	0.0357** (0.0132)	0.0273*** (0.00747)
Money[b]	−0.132* (0.0610)	−0.465*** (0.1351)	−0.231* (0.0925)	−0.386*** (0.097)	−0.163*** (0.0345)	−0.120 (0.114)	−0.221* (0.0920)	−0.235** (0.0872)	−0.1766*** (0.0513)
ASC for the current situation	−0.830** (0.292)	1.507*** (0.411)	1.195*** (0.312)	0.800** (0.2754)	0.857** (0.124)	−0.212 (0.543)	0.134 (0.355)	−1.259*** (0.374)	−0.347 (0.219)
Log-likelihood	−194.73	−131.18	−152.87	−184.76	−874.72	−72.13	−138.66	−136.26	−381.47

Attribute	Central Labr.					
	Env. $n = 15$	Prof. $n = 15$	Mult. $n = 15$	Metis $n = 18$	Innu $n = 23$	All $n = 86$
Cons.	0.0277 (0.0309)	−0.0181 (0.0281)	0.015 (0.026)	−0.0256 (0.0222)	0.00350 (0.0179)	−0.00218 (0.0102)
Cut block size	−0.329 (0.269)	0.283 (0.232)	−0.850*** (0.246)	−0.648** (0.218)	0.0564 (0.153)	−0.240** (0.0895)
Wildlife1[a]	0.0891 (0.6444)	−2.059* (1.0765)	−1.101* (0.568)	−0.158 (0.4462)	0.700* (0.354)	−0.0773 (0.209)
Wildlife3[a]	0.700 (0.587)	0.478 (0.493)	0.461 (0.478)	0.337 (0.446)	1.025** (0.349)	0.614** (0.192)
Wildlife4[a]	1.587** (0.517)	1.492*** (0.4342)	0.947* (0.401)	0.947* (0.371)	0.816** (0.305)	1.014*** (0.167)
Jobs	0.0259 (0.0159)	0.0244* (0.0147)	0.0303* (0.0132)	0.00966 (0.0113)	0.00516 (0.00852)	0.0134** (0.00506)
Money[b]	−0.211* (0.0923)	−0.111 (0.0866)	−0.149* (0.0777)	0.0340 (0.0663)	−0.0198 (0.0515)	−0.0567* (0.0298)
ASC for the current situation	0.519* (0.303)	−0.0582 (0.294)	−0.0699 (0.0699)	0.215 (0.273)	−0.235 (0.238)	0.0804 (0.120)
Log-likelihood	−95.43	−98.18	−111.39	−138.60	−196.70	−688.12

Linear models were a better fit to the data than quadratic models. Thus all the results presented here are based on linear models

Cons. conservation area, *Env.* environmentalists, *Prof.* forestry professionals, *Mult.* multiple users, *ASC* alternative-specific constant for the current situation

[a] This variable was dummy coded., the levels of the attribute are presented in Table 1

[b] One unit is equivalent of 100 Canadian dollars

*** Significant at $P \leq 0.001$; ** significant at $P \leq 0.01$; * significant at $P \leq 0.1$

Table 5 Results of the pairwise likelihood ratio test between groups in each region

	Likelihood ratio	Degrees of freedom	*P*
Southeastern Finland			
Env–Prof	301.56	7	<0.0001
Env–Own	263.78	7	<0.0001
Env–Mult	197.46	7	<0.0001
Prof–Mult	16.00	7	0.0251
Prof–Own	12.32	7	0.0905
Mult–Own	6.16	7	0.5212
Mauricie			
Env–Prof	52.24	7	<0.0001
Env–Mult	43.88	7	<0.0001
Prof–Mult	25.42	7	0.0006
Central Labrador			
Env–Innu	43.80	7	<0.0001
Prof–Innu	40.02	7	<0.0001
Mult–Innu	25.78	7	0.0006
Prof–Metis	22.64	7	0.002
Prof–Mult	21.80	7	0.0028
Metis–Innu	19.57	7	0.0066
Env–Metis	17.54	7	0.0142
Env–Mult	16.70	7	0.0195
Env–Prof	13.89	7	0.0532
Metis–Mult	7.85	7	0.3456

Table 6 Results of the pairwise likelihood ratio test between the same groups across regions

	Likelihood ratio	Degrees of freedom	*P*
Environmentalists			
Finland-Labrador	37.95	7	<0.0001
Mauricie-Labrador	23.14	7	0.0016
Finland-Mauricie	5.59	7	0.5889
Professionals			
Finland-Mauricie	46.99	7	<0.0001
Finland-Labrador	40.75	7	<0.0001
Mauricie-Labrador	12.98	7	0.0725
Multiple users			
Finland-Mauricie	50.84	7	<0.0001
Finland-Labrador	28.17	7	0.0002
Mauricie-Labrador	9.97	7	0.19

held constant. For other groups in the region the parameter estimate for ASC was not significant. In Southeastern Finland forestry professionals, multiple users and forest owners had a tendency to choose the status quo alternative, while the environmentalists had a tendency to choose alternatives different from the current situation when all else was held constant.

We also studied the monetary impact of increasing conservation area by 3 and 6 percentage units for different regions and groups (Fig. 3). This analysis illustrates the polarization of groups in Southeastern Finland, the importance of increasing conservation area for the environmentalists in the Mauricie in contrast to other groups, and the lack of importance of increasing conservation area in Central Labrador.

Interactions

An alternative approach to identify differences between groups is to pool the data and model the interactions of the regions and groups with the attributes. This gives more detailed information on the attributes which contribute to the differences between groups. When compared to the base category of multiple users and the base region Mauricie, environmentalists in Finland and in the Mauricie place a higher weight on conservation, whereas Finnish forestry professionals, multiple users and forest owners as well as the Metis and forestry professionals from Central Labrador place a lower weight on conservation (Table 7). Finnish environmentalists prefer smaller cut blocks, and Finnish forestry professionals prefer larger cut blocks than the multiple users in the Mauricie (Table 7). The Finnish environmentalists also put more weight on wildlife category 4 with endangered species and less weight on cost than the multiple users in the Mauricie. Also the Metis from Central Labrador place little weight on cost. Forest owners from Finland place more weight on cost than the multiple users in the Mauricie (Table 7).

Is the Difference Between Groups Greater than the Difference Across Regions?

We used marginal values for attribute changes for conservation area, cut block size, jobs and wildlife attributes to see if the difference between groups is greater than the difference between regions. For each attribute, the groups in each region were ordered according to the resulting marginal value (Fig. 1). We then analyzed visually which marginal values were similar.

For conservation area the marginal values cluster by group with the environmentalists being on one end and professionals on the other and multiple users in the middle (Fig. 1). For cut block size the marginal values also cluster by group, but here multiple users and environmentalists are similar. For jobs, the marginal values seem to be clustered more by region than by group (Fig. 1). For wildlife there is no clear pattern although there is some clustering for environmentalists and multiple users (Fig. 1).

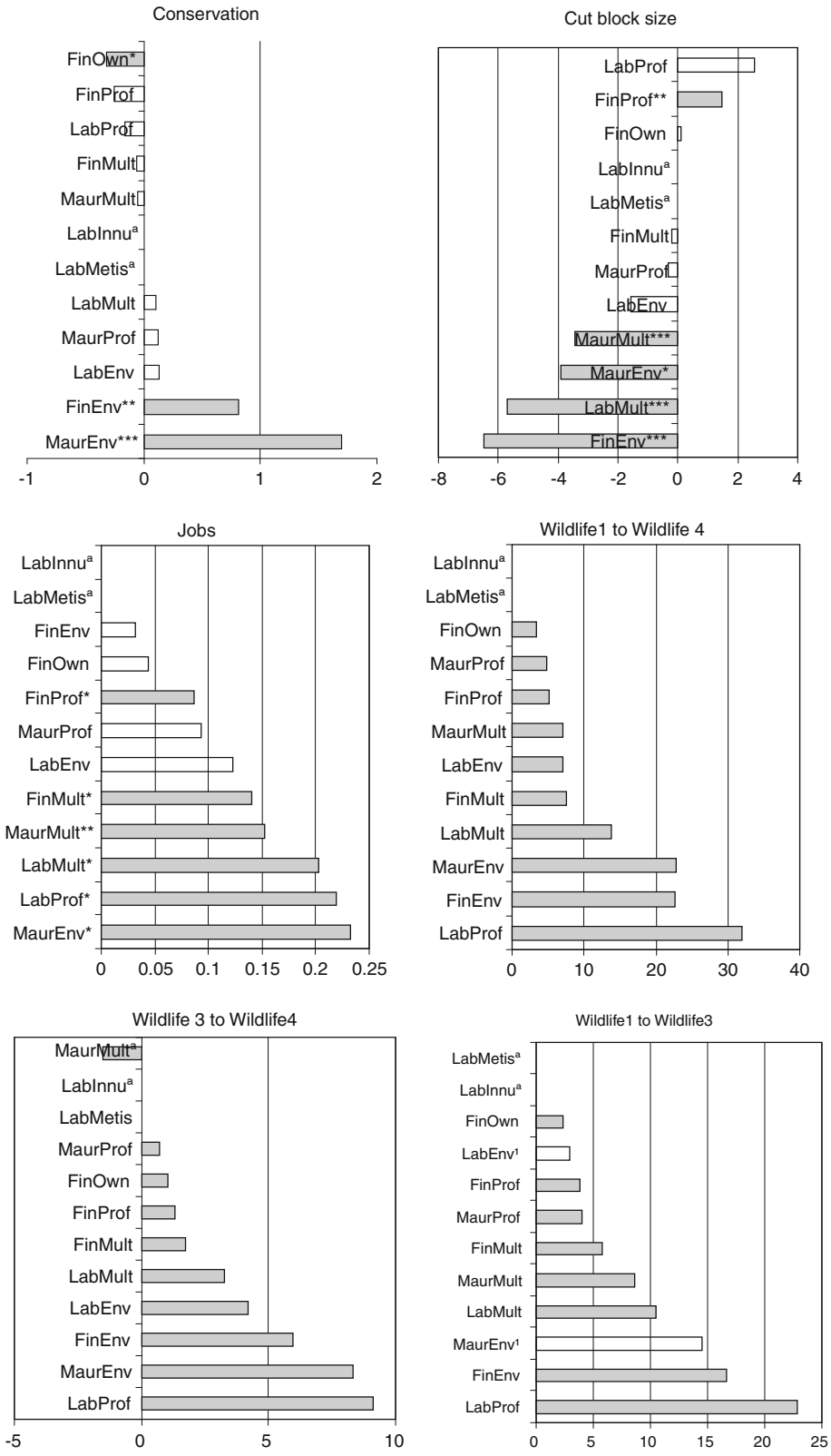


Fig. 1 The marginal values (in CAD 100) of attribute change for conservation, cut block size, wildlife and jobs by region and by group. Those marginal values calculated using significant parameter estimates are marked with a *grey fill*. For the wildlife attribute, no significance levels are marked, since attribute change is calculated as difference between two categories which may have different significance levels. Each category is explained in Table 4. *Fin* Southeastern Finland, *Maur* the Mauricie, *Lab* Central Labrador, *Env* environmentalists, *Mult* multiple users, *Prof* forestry professionals, *Own* forest owners. *** Significant at $P \leq 0.001$; ** significant at $P \leq 0.01$; * significant at $P \leq 0.1$. [a] The parameter estimate for annual household costs was very small and not significant. It was thus treated as 0. Marginal values were not calculated. [1] None of the attribute levels was significant

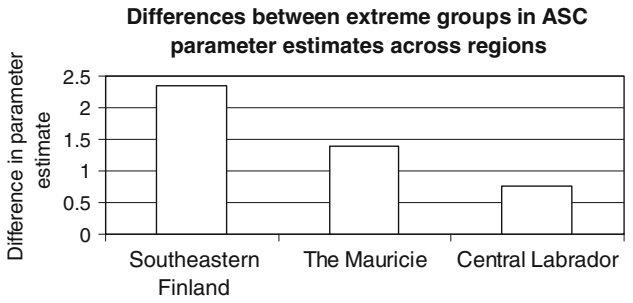


Fig. 2 Differences between extreme groups in alternative-specific constant (ASC) parameter estimates across regions. *Fin* Southeastern Finland, *Maur* the Mauricie, *Lab* Central Labrador

Discussion

Preference Differences Within and Across Regions

Regional comparison is not easy, since several factors affect the results simultaneously and only some of them can be considered in any given study. We tried to eliminate some factors by choosing only boreal regions and areas where forest is abundant and its non-timber use important for local people. We also chose areas to form a gradient in the importance of commercial forestry as described in the methods. Although this index includes various factors related to forestry, other factors like demographic patterns are not covered here. Thus the inter-regional comparison should be interpreted with caution.

Our first research question asked whether SFM preferences differ across regions and whether the differences can be explained by differing current and historical forest use. Our results indicate that SFM preferences differ across regions: The same interest groups across regions were statistically different. In addition, we detected regional trends in marginal values of attribute change that seem to reflect regional differences in current and historical forest use. These results are in line with earlier research in which we reported trends in the differences between extreme groups in biocentric and anthropocentric value orientations (Berninger and Kneeshaw 2009) and in the weightings of environmental and economic components of sustainability (Berninger and others 2009) along the same gradient. In its incorporation of historical and cultural differences between regions, the above mentioned results suggest that the gradient of importance of commercial forestry represents an important factor in the variation across regions. The connection between the importance of commercial forestry and people's perceptions may be explained by the historical and current forest management that shapes individual and group forest experiences through local forest conditions (Hallikainen 1998; Berninger and others 2009). These forest experiences, in turn, modify cultural models about forests.

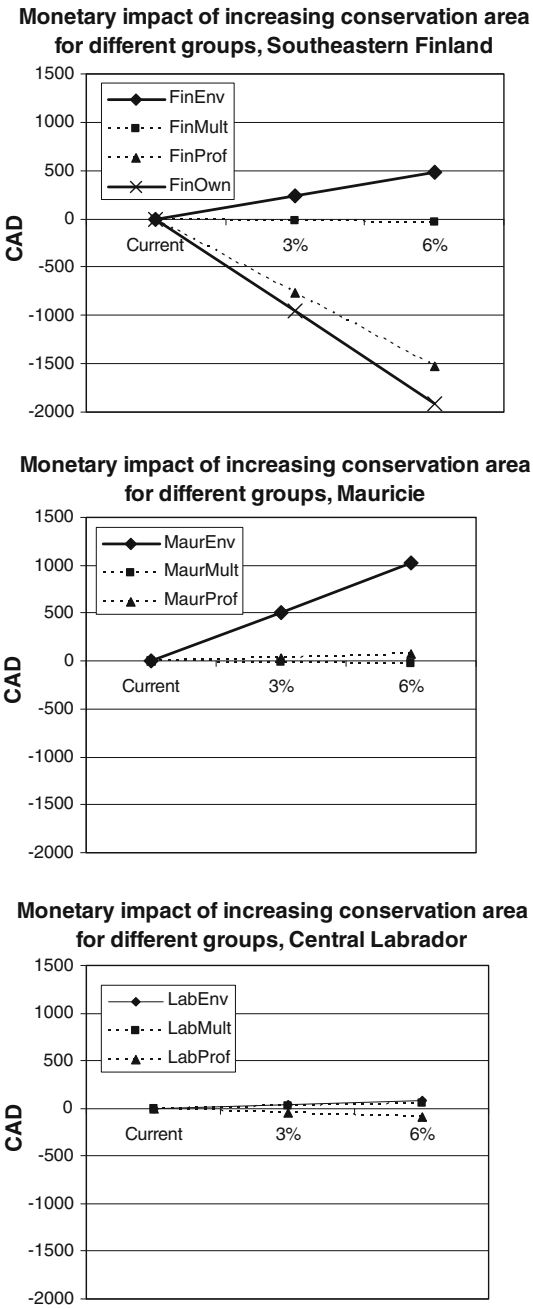


Fig. 3 Monetary impact of increasing conservation area from the current situation by 3 and 6% units for different groups in the three research areas. The *solid lines* mean that the parameter estimates were significant, the *dashed lines* mean that they were not significant and the figure should be interpreted with caution

Thus regional preference differences are a result of a complex interaction of culture, forest use and physical conditions of the forest.

Our second research question asked how the SFM preferences differ over interest groups within and across regions. The statistical analysis of our sample groups suggests that the preferences of interest groups within a region are generally significantly different from each other;

Table 7 Parameter estimates (and standard errors) for joint models estimated for all participants in the three regions including the interactions of the regions and groups with some of the attributes

Attribute	
Conservation area	0.0723 (0.0355)*
Cut block size	−0.2841 (0.1967)
Wildlife1[a]	−0.4249 (0.1007)***
Wildlife3[a]	0.7839 (0.1100)***
Wildlife4[a]	1.1314 (0.2502)***
Jobs	0.0164 (0.003519)***
Money[b]	−0.1916 (0.0848)*
ASC	0.0177 (0.1575)
Finland × Environmentalists × Conservation area	0.0848 (0.0493)*
Finland × Professionals × Conservation area	−0.2972 (0.0812)***
Finland × Multiple users × Conservation area	−0.1384 (0.0728)*
Finland × Owners × Conservation area	−0.2039 (0.0691)**
Mauricie × Environmentalists × Conservation area	0.1366 (0.0507)**
Mauricie × Professionals × Conservation area	−0.0454 (0.0549)
Labrador × Environmentalists × Conservation area	−0.0255 (0.3509)
Labrador × Professionals × Conservation area	−0.0943 (0.0437)*
Labrador × Multiple users × Conservation area	−0.0684 (0.0438)
Labrador × Metis × Conservation area	−0.1018 (0.0419)*
Labrador × Innu × Conservation area	−0.0632 (0.0398)
Finland × Environmentalists × Cut block size	−0.5574 (0.2399)*
Finland × Professionals × Cut block size	0.8223 (0.3143)**
Finland × Multiple users × Cut block size	0.2460 (0.2812)
Finland × Owners × Cut block size	0.3334 (0.2697)
Mauricie × Environmentalists × Cut block size	−0.2070 (0.3186)
Mauricie × Professionals × Cut block size	0.1719 (0.3027)
Labrador × Environmentalists × Cut block size	−0.000442 (0.3268)
Labrador × Professionals × Cut block size	0.4464 (0.2949)
Labrador × Multiple users × Cut block size	−0.4354 (0.3120)
Labrador × Metis × Cut block size	−0.4060 (0.2999)
Labrador × Innu × Cut block size	0.2138 (0.2443)
Finland × Environmentalists × Wildlife4[a]	1.0040 (0.3132)**
Finland × Professionals × Wildlife4[a]	0.0837 (0.3954)
Finland × Multiple users × Wildlife4[a]	0.0611 (0.3747)
Finland × Owners × Wildlife4[a]	−0.0255 (0.3509)
Mauricie × Environmentalists × Wildlife4[a]	0.4817 (0.4239)
Mauricie × Professionals × Wildlife4[a]	−0.0274 (0.3730)
Labrador × Environmentalists × Wildlife4[a]	0.5898 (0.3781)
Labrador × Professionals × Wildlife4[a]	0.4319 (0.3974)
Labrador × Multiple users × Wildlife4[a]	0.0246 (0.3718)
Labrador × Metis × Wildlife4	0.0930 (0.3581)
Labrador × Innu × Wildlife4	−0.5268 (0.3341)
Finland × Environmentalists × Money[b]	0.1677 (0.0990)*
Finland × Professionals × Money[b]	−0.2006 (0.1319)
Finland × Multiple users × Money[b]	−0.0616 (0.1298)
Finland × Owners × Money[b]	−0.2190 (0.1245)*
Mauricie × Environmentalists × Money[b]	0.1250 (0.1378)
Mauricie × Professionals × Money[b]	−0.0563 (0.1296)
Labrador × Environmentalists × Money[b]	−0.0738 (0.1196)
Labrador × Professionals × Money[b]	0.1381 (0.1172)

Table 7 continued

Attribute	
Labrador × Multiple users × Money[b]	0.0585 (0.1155)
Labrador × Metis × Money	0.2131 (0.1073)*
Labrador × Innu × Money	0.1386 (0.0998)
Finland × Environmentalists × ASC	0.7461 (0.2729)**
Finland × Professionals × ASC	0.8356 (0.3428)*
Finland × Multiple users × ASC	0.8832 (0.3011)**
Finland × Owners × ASC	–
Mauricie × Environmentalists × ASC	–
Mauricie × Professionals × ASC	0.0871 (0.3322)
Labrador × Environmentalists × ASC	–
Labrador × Professionals × ASC	0.2157 (0.3255)
Labrador × Multiple users × ASC	−0.1970 (0.3537)
Labrador × Metis × ASC	0.1032 (0.3239)
Labrador × Innu × ASC	−0.4498 (0.2835)
Log-likelihood	−1704

The base region is Mauricie and the base group is multiple users

*** Significant at $P \leq 0.001$;
** significant at $P \leq 0.01$;
* significant at $P \leq 0.1$

[a] This variable was dummy coded., the levels of the attribute are presented in Table 1

[b] One unit is equivalent of 100 Canadian dollars

–, Could not be estimated due to collinearity

however preferences of interest groups across regions are also significantly different. This illustrates the importance of assessing preferences by region and by group.

The aggregation of preferences of all individuals within a region does not reveal all of the information necessary for forest management planning since opposing viewpoints can cancel each other out, as demonstrated by results in Southeastern Finland, and lead to an interpretation that may not reflect possibly polarised views.

The detected preference differences across groups may be seen as interplay between local and interest group identities (Harshaw and Tindall 2005). For some attributes like jobs local identity seems to play a stronger role than group identity, whereas for other issues like conservation and cut block size group identities are, to some extent, shared across regions. This may reflect the global agenda of environmental groups which includes protection of old growth forests and elimination of clear cutting (Humphreys 2004). Also a general negative attitude of forest users towards clear cuts has been reported for example by Pâquet and Bélanger (1997) and Ribe (2006). An exception is Southeastern Finland, where the multiple users were neutral towards cut block size which could be due to the large number of forest owners within the multiple users group (Berninger 2007a; Tahvanainen and others 2001). An interesting topic for further research would be to study whether the opposition to clear cuts is due to ecological reasons in contrast to social reasons like their landscape effects, and also whether forest owners who are also multiple users of the forest have different views on clear cuts in their different roles concerning the forest.

Another interesting line of future research would be to further develop the idea of industrial forestry considering the life-cycle impacts of the goods it produces. For example, the type and amount of energy used and the durability of the products (like furniture) may be important variables affecting how individuals value products from forest industry.

The third research question asked whether inter-group differences in SFM preferences increase as the importance of commercial forestry increases in the region. Inter-group differences, as reflected in the difference in the parameter estimates for ASC, conservation area and money[3] across groups, increase as one moves from Central Labrador to the Mauricie and finally to Southeastern Finland.

Preferences Possibly Reflecting Indigenous and Multiple Use Values

The very low and/or insignificant parameter estimate for household costs for the Metis and Innu imply that for these groups, in contrast to the other groups, money was not an important factor in their choice of preferred alternatives. This can be interpreted as reflecting cultural differences between indigenous and non-indigenous peoples. It has been suggested that indigenous cultures have common features like indifference to ownership and the value of sharing (Adamowicz and others 1998b). Specifically, the Innu culture does not encourage accumulating property; money is used quickly, often for going out to the land (Mailhot 1997, p. 69; Samson 2003, p. 154).

The multiple users in the Mauricie and the Innu in Central Labrador showed a preference for a lower over a higher wildlife level. It seems confusing that a situation

[3] The parameter estimates for household costs for the Metis and Innu groups form an exception explained in the next section and are not included in the comparison.

with less wildlife is preferred. The highest level in the wildlife attribute, however, adds endangered species to the picture, and this could be viewed as a threat to hunting, a very popular activity for these two groups.

Tendencies to Select or to Avoid the Status Quo Alternative

It is common that participants exposed to a choice situation have a tendency to prefer the status quo alternative, holding all attributes constant. This observation is often explained as status quo bias, which means reluctance to move away from the current situation in order to avoid making choices; it is frequently reported as a common characteristic of difficult choice situations (Samuelson and Zeckhauser 1988). However, the tendency for selecting the status quo alternative may also mean that participants genuinely prefer the current management regime over the alternatives presented (Horne and others 2005). They may have their own interests embedded in the current system, for example income from logging or a job in the forest industry.

The tendency to favour the status quo has also been interpreted as a possible mistrust of the managing institution, or as a belief that resource managers would not be capable of carrying out the programs suggested (Adamowicz and others 1998a). This interpretation, however, refers to a situation where a new project is carried out with the status quo alternative being the non-implementation alternative comparable to the zero alternative in the Environmental Impact Assessment (EIA, Pölönen 2006). This interpretation may be valid in Central Labrador, where industrial forest management is new, and environmentalists favoured the status quo alternative. In the case of suggesting alternatives to management that has been applied in the present form for decades, as is the case in Southeastern Finland and the Mauricie, the above mentioned interpretation may not be valid. The tendency of forestry professionals, multiple users and forest owners in Southeastern Finland to favour the current situation may in this case be interpreted more as a trust of the resource managers: they are doing a good job in managing the forests and no change is needed. Conversely, the environmentalists in Southeastern Finland and the multiple users in the Mauricie systematically searched for change to the current situation, which could be interpreted as a mistrust of resource managers to meaningfully incorporate suggested alternatives for managing the forest.

Sampling Issues

This was an exploratory study with a relatively small sample size based on a purposive rather than random sample. Sampling was challenging since we wanted to reach the interest groups that formed the target group for this study. At a population level the groups studied here are not evenly distributed, but multiple users groups are the largest group in each region. In forest management planning forest users have not always been well represented (except for hunting organizations) since they are weakly organized. In future studies focused specifically on multiple users, a random sample of a general population in the area with specific questions on the use of the forests may be the most feasible. However, the use of our sampling strategy permitted us to reach groups that would have been almost absent in sampling of the general population, for example environmentalists in Central Labrador.

Aspects Possibly Influencing Preferences or Preference Differences

Adoption of a consumer or citizen role when answering the questions may have an effect on preferences (Nyborg 2000; van Rensburg and others 2002; Ovaskainen and Kniivilä 2005). In our study, a part of the attributes represent broad social issues while another part reflects more private issues with both roles being partially present at the same time. Another aspect possibly influencing our results is the use of both positive and negative attribute levels. It has been shown in the economic literature that preferences depend on a reference point and that people tend to value avoiding loss more than securing an equal sized gain (for example Tversky and Kahneman 1991). Also the fact that the meetings in different regions were held in different seasons may have an impact on the results as shown by Lindhjem (2007) in a valuation study of non-timber benefits. We assume that trade-offs among different components of sustainable forest management are not as sensitive to seasonal variation. More research is needed to explore these issues.

Preference differences (as exhibited by different coefficients or partworths) may arise from differences in error variances across the groups or regions (Swait and Louviere 1993). This is a potential source of error in our interpretation.

Forest ownership structure is one of the factors influencing regional differences. People may have different preferences for private and public land. The choice experiment conducted here focused more on regional objectives than on individual forest owners. In future research, it would be interesting to compare responses of the same subjects to separate questions for public and private forest areas.

Conclusions

We studied regional and group differences in SFM preferences in three boreal regions. Our results show that

preferences differ between the different interest groups within and across regions. We interpret the differences across regions as being partially due to differing current and historical forest use. Our results indicate that the preference structure of each group is influenced by both the local forest conditions and forest use, which is reflected in the gradient of importance of commercial forestry, forest culture and group identities that are partially shared with similar groups in other regions.

A higher level of importance of commercial forestry in the region seems to increase the nature orientation of environmentalists and the economic orientation of forestry professionals. This along with the trends detected in supporting or rejecting the status quo alternative suggests that there is an increasing trend in inter-group differences in SFM preferences from the little managed area to the intensively managed region. This may, among other factors, reflect the influence of the current and historical forest use in shaping SFM preferences and the differences across groups.

Our results show that the aggregation of preferences of all individuals within a region does not reveal all of the information necessary for forest management planning since opposing viewpoints can cancel each other out and lead to an interpretation that does not reflect possibly polarised views. Instead, preferences should be assessed separately for all relevant user groups.

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References

Adamowicz WL, Swait J, Boxall PC, Louviere J, Williams M (1997) Perceptions versus objective measures of environmental quality in combined revealed and stated preference models of environmental valuation. Journal of Environmental Economics and Management 32:65–84

Adamowicz WL, Boxall P, Williams M, Louviere M (1998a) Stated preference approaches for measuring passive use values: choice experiments and contingent valuation. American Journal of Agricultural Economics 80(1):64–75

Adamowicz W, Beckley T, MacDonald DH, Just L, Luckert M, Murray E, Phillips W (1998b) In search of forest resource values of indigenous peoples. Society and Natural Resources 11:51–66

Ananda J, Herath G (2003) Incorporating stakeholder values into regional forest planning: a value function approach. Ecological Economics 45(1):75–90

Berninger K (2006) Millaisia teemoja ja painotuksia sisältyy kaakkoissuomalaisten mielestä kestävään metsätalouteen? Neljän intressiryhmän ajatuksia. Metsätieteen aikakauskirja 3:399–410 (Which themes and rankings do forest users in Southeastern Finland include in SFM? Thoughts of four interest groups, in Finnish)

Berninger K (2007a) Neljän intressiryhmän näkemyksiä Kaakkois-Suomen metsien hoidosta. Alue ja ympäristö 36(1):45–50 (Views of four interest groups on forest management in Southeastern Finland, in Finnish)

Berninger K (2007b) Attitudes des trois groupes d'intérêt sur les forêts et la foresterie en Mauricie. Rapport pour le projet TRIADE. http://www.projettriade.ca/recherche_doc.php. Accessed November 27, 2008

Berninger K (2007c) Attitudes towards forests and forestry of five interest groups in Central Labrador. Report for the Labrador Forest Management Model Integration Project. http://www.lfmi.uqam.ca/report/report/Forest_attitudes_and_preferences.pdf . Accessed August 13, 2007

Berninger K, Kneeshaw D (2009) Forest value orientations and attitudes towards forestry of interest groups in three regions varying in importance of commercial forestry. International Journal of Sustainable Society 1(4):391–408

Berninger K, Kneeshaw D, Messier C (2009) The role of cultural models in local perceptions of SFM—differences and similarities of interest groups from three boreal regions. Journal of Environmental Management 90:740–751

Boxall PC, Macnab B (2000) Exploring the preferences of wildlife recreationists for features of boreal forest management: a choice experiment approach. Canadian Journal of Forest Research 30:1931–1941

Boxall PC, Adamowicz WL, Swait J, Williams M, Louviere JJ (1996) A comparison of stated preference methods for environmental valuation. Ecological Economics 18:243–253

Brown G, Reed P (2000) Validation of a forest values typology for use in national forest planning. Forest Science 46:240–247

Fall A, Fortin M-J, Kneeshaw D, Yamasaki S, Messier C, Bouthillier L, Smyth S (2004) Consequences of various landscape-scale ecosystem management strategies and fire cycles on age-class structure and harvest in boreal forests. Canadian Journal of Forest Research 34:310–322

Finnish statistical yearbook of forestry (2006) SVT agriculture, forestry and fishery 2006. Finnish Forest Research Institute, Helsinki

Forsyth J, Innes L, Deering K, Moores L (2003) Forest ecosystem strategy plan for forest management district 19 Labrador/Nitassinan. Innu Nation and Newfoundland and Labrador Department of Forest Resources and Agrifoods, Northwest River

Government of Quebec (2008) Forests: building a future for Québec, green paper. Ministère des Ressources naturelles et de la Faune (MRNF), Quebec City

Grafton RQ, Adamowicz W, Dupont D, Nelson H, Hill RJ, Renzetti S (2004) The economics of the environment and natural resources. Blackwell Publishing, Malden

Greene W (2007) LIMDEP 9.0 reference guide. Econometric Software Inc, Plainview

Halifax Global (2006) Strategic plan to develop Labrador secondary manufacturing and value added wood products industry. http://www.nr.gov.nl.ca/forestry/publications/labrador_wood_products_report_1.pdf. Accessed May 29, 2006

Hallikainen V (1998) The Finnish wilderness experience. Finnish Forest Research Institute, Research Papers 711, Rovaniemi

Harshaw HW, Tindall DB (2005) Social structure, identities, and values: a network approach to understanding people's relationship to forests. Journal of Leisure Research 37(4):426–449

Hensher DA, Rose J-M, Greene WH (2005) Applied choice analysis: a primer. Cambridge University Press, Cambridge

Horne P (2006) Forest owners' acceptance of incentive based policy instruments in forest biodiversity conservation—a choice experiment based approach. Silva Fennica 40:169–178

Horne P, Karppinen H, Ylinen E (2004) Kansalaisten mielipiteet metsien monimuotoisuuden turvaamisesta. In: Horne P, Koskela T, Ovaskainen V (eds) Metsänomistajien ja kansalaisten näkemykset metsäluonnon monimuotoisuuden turvaamisesta. Metsäntutkimuslaitoksen tiedonantoja 933, pp 25–46 (in Finnish)

Horne P, Boxall PC, Adamowicz WL (2005) Multiple-use management of forest recreation sites: a spatially explicit choice experiment. Forest Ecology and Management 207:189–199

Humphreys D (2004) Redefining the issues: NGO influence on international forest negotiations. Global Environmental Politics 4:51–74

Kaakkois-Suomen metsäkeskus (2005a) Metsäohjelma 2006–2010. Kouvola, 37 pp

Kaakkois-Suomen metsäkeskus (2005b) Metsä- ja ympäristökertomus 2005. Kouvola, 36 pp

Kangas J, Kangas A, Leskinen P, Pykäläinen J (2001) MCDM methods in strategic planning of forestry on state-owned lands in Finland: applications and experiences. Journal of Multi-Criteria Decision Analysis 10:257–271

Kangas J, Store R, Kangas A (2005) Socioecological landscape planning approach and multicriteria acceptability analysis in multiple-purpose forest management. Forest Policy and Economics 7:603–614

Kant S, Lee S (2004) A social choice approach to sustainable forest management. Forest Policy and Economics 6:215–227

Kumar S, Kant S (2007) Exploded logit modeling of stakeholders' preferences for multiple forest values. Forest Policy and Economics 9:516–526

Lehtonen E, Kuuluvainen J, Pouta E, Rekola M, Li C-Z (2006) Non-market benefits of forest conservation in southern Finland. Environmental Science & Policy 6:195–204

Leskinen P, Leskinen L, Tikkanen J (2004) Assessing objectives of regional forest policy in northern Finland. Scandinavian Journal of Forest Research 19:180–190

Li C-Z, Kuuluvainen J, Pouta E, Rekola M, Tahvonen O (2004) Using choice experiments to value the Natura 2000 nature conservation programs in Finland. Environmental & Resource Economics 29:361–374

Lindhjem H (2007) 20 Years of stated preference valuation of non-timber benefits from Fennoscandian forests: a meta-analysis. Journal of Forest Economics 12:251–277

Mailhot J (1997) The people of Sheshatshit: in the land of the Innu. Institute of Social and economic Research, Memorial University, St. John's

Margerum RD (1995) Integrated environmental management: moving from theory to practice. Journal of Environmental Planning and Management 38:371–392

McDonald GT, Lane MB (2002) Forest management systems evaluation: using ISO14000. Journal of Environmental Planning and Management 45:633–652

McFarlane B, Boxall P (2000) Forest values and attitudes of the public, environmentalists, professional foresters, and members of public advisory groups in Alberta. Canadian Forest Service, Northern Forest Centre, Information Report NOR-X-374

Messier C, Kneeshaw D (1999) Thinking and acting differently for sustainable management of the boreal forest. Forestry Chronicle 75(6):929–938

Nyborg K (2000) *Homo economicus* and *Homo politicus*: interpretation and aggregation of environmental value. Journal of Economic Behaviour & Organization 42(3):305–322

Ovaskainen V, Kniivilä M (2005) Consumer versus citizen preferences in contingent valuation: evidence on the role of question framing. The Australian Journal of Agricultural and Resource Economics 49:379–394

Pâquet J, Bélanger L (1997) Public acceptability thresholds of clearcutting to maintain visual quality of boreal balsam fir landscapes. Forest Science 43:46–55

Pölönen I (2006) Quality control and the substitutive influence of environmental impact assessment in Finland. Environmental Impact Assessment Review 26:481–491

Ribe RG (2006) Perceptions of forestry alternatives in the US Pacific Northwest: information effects and acceptability distribution analysis. Journal of Environmental Psychology 26:100–115

Samson C (2003) A way of life that does not exist, Canada and the extinguishment of the Innu. Social and economic studies 67. Institute of Social and Economic Research, Memorial University, St. John's

Samuelson W, Zeckhauser R (1988) Status quo bias in decision making. Journal of Risk and Uncertainty 1:7–59

SAS Institute (2001) Documentation for the 8.2 release of the MDC procedure. http://support.sas.com/rnd/app/doc.html. Accessed May 11, 2007

Seely B, Nelson J, Wells R, Peter B, Meitner M, Anderson A, Harshaw H, Sheppard S, Bunnell RL, Kimmins H, Harrison D (2004) The application of a hierarchical, decision-support system to evaluate multi-objective forest management strategies: a case study in northeastern British Columbia, Canada. Forest Ecology and Management 199:283–305

Shapansky B, Adamowicz WL, Boxall P (2008) Assessing information provision and respondent involvement effects on preferences. Ecological Economics 65:626–635

Sheppard S, Meitner M (2005) Using multi-criteria analysis and visualisation for sustainable forest management planning with stakeholder groups. Forest Ecology and Management 207:171–187

Sloane NJA (2006) Www pages. A library of orthogonal arrays. http://www.research.att.com/~njas/oadir/. Accessed April 18, 2006

Sturtevant B, Fall A, Kneeshaw D, Simon N, Papaik M, Berninger K, Doyon F, Morgan D, Messier C (2007) A toolkit modeling approach for sustainable forest management planning: achieving balance between science and local needs. Ecology and Society 12(2):7. http://www.ecologyandsociety.org/vol12/iss2/art7/

Swait J, Louviere J (1993) The role of the scale parameter in the estimation and comparison of multinomial logit models. Journal of Marketing Research 30(3):305–314

Tahvanainen L, Tyrväinen L, Ihalainen M, Vuorela N, Kolehmainen O (2001) Forest management and public perceptions—visual versus verbal information. Landscape and Urban Planning 53:53–70

Tanz JS, Howard AF (1991) Meaningful public participation in the planning and management of publicly owned forests. Forestry Chronicle 67(2):125–130

Tasanen T (2004) Läksi puut ylenemähän. Metsien hoidon historia Suomessa keskiajalta metsäteollisuuden läpimurtoon 1870–luvulla [Summary: The history of silviculture in Finland from the Medieval to the breakthrough of forest industry in 1870s]. Finnish Forest Research Institute Report 920, Vammala

Tindall DB (2003) Social values and the contingent nature of public opinion and attitudes about forests. Forestry Chronicle 79:692–705

Turner JC, Oakes PJ (1989) Self-categorization theory and social influence. In: Paulus SB (ed) Psychology of group influence. Erlbaum, Hillsdale, pp 233–275

Tversky A, Kahneman D (1991) Loss aversion in riskless choice: a reference dependent model. Quarterly Journal of Economics 106:1039–1061

Tyrväinen L, Silvennoinen H, Kolehmainen O (2003) Ecological and aesthetic values in urban forest management. Urban Forestry and Urban Greening 1:135–149

Van Rensburg T, Mill G, Common M, Lovett J (2002) Preferences and multiple use forest management. Ecological Economics 43(2–3):231–244

Wang S (2004) One hundred faces of sustainable forest management. Forest Policy and Economics 6:205–213

Xu W, Lippke BR, Perez-Garcia J (2003) Valuing biodiversity, aesthetics, and job losses associated with ecosystem management using stated preferences. Forest Science 49:247–257