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Abstract

Sustainable forest management (SFM) standards have been criticized for their lack of aesthetic indicators, which some consider to be an important social component of forestry. To provide a basis for the inclusion of aesthetic indicators in SFM frameworks, we used Delphi techniques to survey the beliefs and opinions of SFM and aesthetic experts. The three major reasons provided for the lack of aesthetic indicators were: a lack of aesthetic training amongst those designing criteria and indicators; a bias against aesthetics, which are often considered to be highly subjective; and the general omission of people with knowledge of aesthetics during the development of SFM standards. Based on the responses, we present 10 possible aesthetic indicators appropriate for international SFM standards, including 8 quantitative and 2 qualitative indicators. We also provide 18 other potential aesthetic indicators, which can be applied at various scales of SFM, ranging from local to national. These results should provide guidance to groups developing and revising criteria and indicators of sustainable forest management at various scales, from local to international.

Key words

Sustainable Forest Management, Forest Aesthetics, Indicator Developing, Forest Standard, Delphi Survey

Introduction

All forest services are associated not only with satisfying basic human needs, such as commodity production in forests, but also with higher-level social and cultural necessities (Brown et al. 1987), such as forest aesthetic values. Forest aesthetics are considered important not only for forest management but also for quality of life (Sheppard et al. 2004), as the public has progressively demanded more parks, scenic drives and better housing locations (MEA 2005). As foresters were increasingly required to consider aesthetic values, accordingly many studies of the aesthetics of forestry have been conducted. Ribe (1989), for example, surveyed and analyzed more than 170 research projects, dividing them into 17 topics such as inter-group preference, tree size and aesthetics, management programs and so on. The large number of studies of forest aesthetics might suggest that researchers should have addressed the social conflicts between forest aesthetics and other forest values, especially timber products, and they have certainly provided forest managers with a basis for enhancing scenic beauty in forest management. The social concerns of the public related to scenic beauty have also informed research on visual landscape quality assessment and the methods of systematic scenery management in the late 20th century (Daniel 2001; Eroglu & Acar 2011; Picard & Sheppard 2001a; 2001b; Roth & Grühn 2010).

However, although there has been a surprising amount of research done on forest aesthetics as a result of social concerns, current sustainable forest management (SFM) frameworks have still been criticized for their lack of social and aesthetic criteria and indicators (C&I) (Gough et al. 2008; MCPFE 2002; Meitner et al. 2006; MP 1999; Sheppard et al. 2004). Human activities impact significantly on forests (Rapport et al.

1998; Vitousek et al. 1997), and therefore, SFM should meet both social needs and ecological values (Brown et al. 1987; Costanza and Patten 1995; Norton 1992; Patel et al. 1999; Toman and Ashton 1996). Consequently, social and aesthetic values should be monitored and sustained as a part of SFM, and C&I associated with social and aesthetic values must be included in SFM standards (Bengston 1994; Hunt & Haider 2001; Sheppard et al. 2006).

Since sustainability became an important paradigm in forest management, many SFM standards and C&I schemes have been created. SFM standards can be classified into international, national and local levels based on the spatial scale of their application. National SFM standards have a strong impact on the local standards in their countries (McDonald and Lane 2004), and the national SFM standards, in turn, are usually strongly influenced by international SFM standards (Georgiadis and Cooper 2007). For example, the UK Forestry Standard clearly states that it is linked to the Helsinki Guidelines and Pan-European C&I (Forestry Commission 2004), and in 2003 the Canadian Council of Forest Ministers modified the national C&I for Canada according to the framework of the Montreal Process (Hickey and Innes 2008). Countries participating in the international SFM standards periodically publish their national reports based on the C&I proposed within the international SFM standards. As these national standards are also models for local standards, any problems or omissions in the international standards are likely to be reflected in the national and local standards.

Around 150 countries participate in international SFM processes (Wijewardana 2008). For example, the Montreal Process has 12 member countries, representing approximately 60 % of all the Earth's forests, and there are approximately 40 European

countries in the parallel Pan-European Forest Process (Mayer 2000). Although these international standards have important effects on the definition of SFM in participating countries, they have been criticized for their lack of indicators directly related to social aspects of SFM, especially scenic beauty (Harshaw et al. 2007; Sheppard et al. 2004) and for the dominance of ecological indicators (Gough et al. 2008). These criticisms have arisen because of the widespread acceptance that SFM must include an appropriate balance between ecological, economic and social concerns (Bass 2001; Ferretti 1997). Although some jurisdictions, such as the UK, the USA, and British Columbia in Canada, have developed systematic visual management procedures, these are rarely reflected in SFM standards or their associated C&I. This problem is evident not only in the C&I published by the Montreal Process and the Pan-European Forest Process but also in the SFM standards of the participating countries. For example, there are no or few data related to forest aesthetic values in the recent national SFM reports produced by countries, such as Australia, Canada, New Zealand, Japan, Republic of Korea (Korea), and the United States (See CNR 2016; JFA 2009; KFS 2014; MARF 2009; MPIGA 2008; NZMAF 2014; USDA 2010). This may reflect a widespread belief that there is no proper means to measure and monitor the status of forest scenic beauty within the SFM frameworks already in place. Although Meitner et al. (2006) have developed indicators of scenic beauty for use at a local level, such indicators have not been adopted in any of the international standards. However, without such indicators, claims of having achieved sustainable forest management holistically at a national scale must be interpreted with caution (Hickey and Innes 2005).

In this study, we explored the reasons for the lack of aesthetic indicators and whether or not there is a need for them. Based on this information, we developed specific indicators for forest aesthetic values that could be incorporated into international SFM standards. We used the term 'forest aesthetics' to mean scenic beauty or visual beauty, although aesthetics can be more broadly defined as 'a set of principles concerned with the nature and appreciation of beauty' (Oxforddictionaries 2016), and a wider definition of aesthetics would also contain aesthetic features perceivable by other senses such as sounds and smells, rather than sight alone. In the Delphi survey, we also supplemented the meaning of the term 'forest aesthetics' by using phrases such as 'visually important forests', 'forest managed to protect scenery' and 'visually sensitive areas' in the questionnaire in other to clarify what we meant by the term.

In examining the lack of and need for aesthetic indicators in current international SFM standards, we obtained perspectives from two expert panel groups: the Montreal Process Working Group and a group of experts in forest aesthetics and/or visual resource management. To develop specific forest aesthetic indicators, we conducted Delphi surveys with these two panel groups, consisting of two rounds of questionnaires. We extended the number of potential indicators through expert group consultations, and evaluated the applicability of the indicators to international SFM standards using a five-category rating. We believe that these results should contribute to enhancing the aesthetic indicators in current international SFM standards, and through this should help improve national and local SFM standards.

Materials and methods

1. Delphi survey

A Delphi survey was administered to assess the current status of aesthetic indicators within SFM standards and to develop if necessary new forest aesthetic indicators applicable to SFM standards. The Delphi technique is an iterative multi-stage process, designed to collect knowledge, experiences and opinions of experts, thereby enabling us to make effective decisions about issues such as creating and refining aesthetic indicators, especially when there is an information deficit (Hasson et al. 2000; Miller 2002). The technique is well-established in the field of indicator development. Mendoza and Prabhu (2000) employed this method in assessing various indicators at a local level, and Miller (2002) conducted a two-round Delphi survey on the development of indicators of sustainable tourism. Wolfslehner et al. (2005) employed a national Delphi survey to rate 43 indicators in Austria based on the Pan-European guidelines for SFM. Although Georgiadis and Cooper (2007) did not adopt the Delphi method, they utilized experts' judgements in assessing the indicators that they initially developed for national SFM C&I. These previous studies demonstrate that the knowledge, experiences and judgement of experts can play an important role in the creation and evaluation of indicators, especially at the initial stage of indicator development. Although Mendoza and Prabhu (2000) and Schmidt (1997) reported that the nominal group technique with an atmosphere of open dialogue might be more suitable in terms of consistency and statistical support, we considered that the Delphi technique was the most appropriate method because the expert panels that we selected were drawn from experts worldwide. In addition, the Delphi technique seemed to be suitable for this research in view of the lack of previous research in this area.

In this survey, we first developed an initial set of 12 aesthetic indicators by reviewing current national and international standards and previous studies. This review also enabled the development of a questionnaire that we administered to two expert panels: the Montreal Process Working Group (MPWG) and a group of experts in forest aesthetics (AEG) identified from the published literature. In the first round survey, we asked both groups to rate the initial set of 12 aesthetic indicators. The objective was to analyze the applicability of the indicators to SFM standards. In addition, the experts were invited to suggest any other possible aesthetic indicators. We also asked the expert to suggest reasons why only a few aesthetic indicators had been included in current SFM standards.

Based on the results of the first round survey, a second questionnaire was developed. This questionnaire presented the summary of the first round survey results and required respondents to indicate their opinions on the results of the first round. For newly proposed aesthetic indicators (arising from the suggestions made in the first round), respondents were asked to rate the indicators using the same categories as used in the first round, and to indicate which level(s) of SFM (international, national, regional and forest management unit levels) is(are) appropriate to each indicator. This latter task included both the initial indicator set and those proposed by the first-round participants. Only two rounds were completed due to the low response rate in the second round.

2. Expert panels

We selected two groups of experts to respond to the Delphi survey. The first group consisted of 25 people from the Montreal Process Working Group (MPWG). These are

individuals who have played a major role in developing and improving the C&I used in the Montreal Process. The list of participants was derived from the participant list of the 20th Montreal Process Working Group meeting held in Jeju, Republic of Korea, in 2009. The other group comprised 25 people who had either written on aesthetic indicators or had worked for their governments as specialists or researchers associated with visual resource management. The list of the experts in this group was derived through an internet web search. The two groups were selected to provide a general comparison between individuals involved and not involved in the development of SFM frameworks. We sent initial contact letters by email to the 50 experts to explain the purpose of the survey and to detail our expectations. Then, the questionnaire and consent form were sent by email for the first round survey.

3. Questionnaires

3.1. First round questionnaire

The first-round questionnaire consisted of four parts: (1) rating of an initial aesthetic indicator set, (2) suggestions for other possible aesthetic indicators, (3) suggested reasons for the lack of aesthetic indicators in the present international SFM standards, and (4) information about the respondents. The questionnaire also included an explanation of the terminology used and bibliographic references referred to in the survey.

To develop the initial set of 12 aesthetic indicators (IAI, See Table 1), eight indicators were first drafted based on Meitner et al. (2006) and existing national and international SFM C&I, such as the Montreal Process (1999), the Pan-European Forest Process (MCPFE 2002), the UK Forestry Standard (Forestry Commission 2004) and the

Sustainable Forestry Initiative (SFI 2002). Although the Montreal Process and the Pan-European Forest Process do not include direct aesthetic indicators (Harshaw et al. 2007; Sheppard et al. 2004), two indirect indicators were transformed and included in the initial set of aesthetic indicators (IAI 4 and 12 in Table 1).

We also examined other C&I related to non-timber values. For example, the indicators under Criterion 4, 'Conservation and Maintenance of Soil and Water Resources', in the Montreal Process (1999) were originally aimed at monitoring artificial and natural changes of soil and water, and we considered that such indicators could be applicable to aesthetics. As a result, two further indicators related to human-caused and natural changes of visual qualities were added (IAI 7 and 8 in Table 1). In addition, two indicators (IAI 5 and 6 in Table 1) concerning the area of forest land managed for scenic protection and the area of land converted from non-forest to forest to protect scenic values were added. This resulted in 12 potential indicators being included in the initial set of aesthetic indicators to be rated by the respondents.

To enable the panel to understand easily the features of the aesthetic indicators, they were divided into four categories, as suggested in other attempts to develop social indicators (Harshaw et al. 2007; Sheppard et al. 2004; Sheppard 2003): (1) procedural, (2) direct outcome-based, (3) perceptions or satisfaction and (4) capacity and knowledge indicators. This part of the questionnaire required the panels to rate each aesthetic indicator on a 5-interval scale (low 1 to high 5) according to five rating categories (Harshaw et al. 2007, See Table 2): relevancy, credibility, measurability, cost-effectiveness and connectedness to forestry. The respondents were asked to explain the reasons for their chosen ratings.

Table 1.

Table 2.

In the second part, the questionnaire requested respondents to recommend other aesthetic indicators based on their own experiences, knowledge and studies. As the respondents were the experts in either SFM C&I or forest aesthetics or both, we expected that they would propose additional indicators applicable to SFM standards. In the third section, we suggested four possible reasons, based on Sheppard et al. (2004), for the lack of aesthetic indicators in the current SFM standards. These were: (1) a cultural bias among professionals and scientists that leads to aesthetics being seen as soft or subjective, (2) a lack of training in aesthetics and other social science disciplines amongst scientific advisory groups and government task forces, (3) a general omission from the SFM standards of people with qualifications in aesthetics, and (4) the absence of substantive public input to indicator setting. The respondents were requested to choose all the reasons that they considered were applicable, in addition to suggesting any other reasons. In the final section, we requested general information such as age, occupation, affiliation, and relevant work experience.

3.2. Second-round questionnaire

After the first round of surveys, we developed a second-round questionnaire consisting of five parts. The first section included an introduction to the survey and an explanation of terminology. In the second part, we summarized the newly proposed aesthetic indicators and the reasons for their recommendations by the respondents in the first-round survey.

We listed 28 possible aesthetic indicators, including the 12 initial indicators and 16 new indicators proposed by the respondents. Respondents were asked to provide opinions about each of the possible indicators.

In the third part, we summarized the results of the indicator ratings obtained in round one, using bar graphs to illustrate the mean responses. Respondents were then asked to provide their opinions on these results. In addition, we listed the newly proposed indicators, and asked the respondents to rate these using the same categories as used in the first round. As these new aesthetic indicators could be applied at several scales, we asked respondents to indicate the relevant scale(s) for each of the new indicators. As previously, respondents were asked to explain their ratings

In part four, we summarized the reasons for the lack of aesthetic indicators in current SFM standards, as suggested by the respondents in the first round, and asked respondents to provide their opinions on these results. Finally, we provided space for any further comments about the survey, and we listed the bibliographic references that were used in the questionnaire.

Results

1. Panel characteristics

From the 50 invitations sent out for the first round survey, we obtained 19 responses: eight from the Montreal Process Working Group (MPWG) and 11 from the aesthetic experts group (AEG). In round two, only nine out of 19 respondents from round one replied, two from MPWG and seven from AEG. The average age of respondents was 48.7 years old for the MPWG and 47.6 for the AEG. On average, the respondents had about

15.6 years of work experience for the MPWG and 15.4 years for the AEG. Respondents came from nine different countries (Argentina, Canada, Chile, Japan, Korea, Norway, Russia, UK, and USA). There was a diversity of professional affiliations: nine in government (47.4%), four from universities (21.1%) and six from research institutes (31.6%). All the respondents in the MPWG belonged to public organizations such as government departments or national research institutes.

The majority of respondents in the MPWG were from forestry backgrounds or at least backgrounds related to forestry. For example, their major interests were in natural sciences, such as biology, ecology, and biodiversity, or were associated with social sciences, such as environmental policy or the marketing of forest products. Other major areas of interest included recreation, planning, timber supply modeling, GIS, monitoring land use change and forest assessment. However, none expressed a strong interest in forest aesthetics. In contrast, the major interests of most respondents in the AEG were related to forest aesthetics, such as aesthetics, visual resource management, landscape architecture or environmental perception. Others came from backgrounds in planning related to recreation, public participation, urban forestry and landscape ecology.

Fig. 1.

All respondents in the MPWG had participated in the work of the Montreal Process C&I, and one respondent in this group had worked for another SFM standard, the Forest Steward Council (FSC). Seven respondents had contributed to environmental or ecological indicators, three to economic indicators and three to the social aspects of the Montreal Process C&I (Fig.1.a). The respondents in the AEG had participated in the

development of various levels of SFM standards, including at the international, national, and provincial levels, and the average number of the SFM standards that they had worked on was 1.2. While five respondents in the AEG had contributed to the development of ecological or environmental C&I, nine had worked on social aspects of SFM standards (Fig.1.b).

2. Reasons for the lack of aesthetic indicators

Opinions about the reasons for the lack of aesthetic indicators in current international SFM C&I are shown in Table 3. The two most important reasons were considered to be a bias against indicators seen as being 'soft' or 'imprecise' and a lack of expertise in aesthetic appraisal techniques amongst those developing the standards. In addition to the four reasons provided to the participants by the authors, three respondents suggested that 'scenery management or indicators are not well developed and not applied in many countries', and two respondents thought that 'it would be too expensive and restricting by taking areas out of production or increasing costs'.

The respondents in the MPWG thought that the lack of aesthetic indicators in the current international SFM standards was largely due to two reasons: 'a cultural bias among professionals and scientists' and 'a lack of training in aesthetics and other social science disciplines'. The absence of experts in aesthetics was suggested by one respondent and the lack of public input was suggested by two respondents. Two respondents provided alternative explanations. While 10 of 11 respondents in the AEG agreed that 'a cultural bias among professionals and scientists' and 'a lack of training in

aesthetics and other social science disciplines' were important, the other two proposed reasons in the first round were also considered as important by most .

Table 3.

3. Newly proposed aesthetic indicators

Sixteen new aesthetic indicators (PAI) were proposed by the respondents (Table 4) besides the 12 initial aesthetic indicators (IAI). Two PAI (PAI 3 and 16 in Table 4) were proposed by the respondents in the MPWG. The reason for the recommendation of PAI 16 was that 'aesthetic considerations are usually outside the professionals' scope, except for a few, and should be included in current training of foresters and related professions.' All the other 15 PAI, except PAI 3, were suggested by the respondents in the AEG. Five PAI (PAI 4, 5, 6, 11 and 16 in Table 4) were proposed by two respondents, and the others were recommended by single respondents. Significantly, PAI 16 was proposed by the respondents in both the MPWG and the AEG.

Table 4.

4. Evaluation of the aesthetic indicators

In the first round, the panels rated the initial set of 12 aesthetic indicators (IAI) in terms of relevance, credibility, measurability, cost-effectiveness and connectedness to forestry (Harshaw et al. 2007; See the results of Evaluation with 5 categories from IAI 1 to IAI 12 in Table 5). IAI 8 (Area and/or percent of forest land with significant scenery changes as a result of artificial disturbances, mean response 4.0) and IAI 3 (Area and/or percent of

forest land managed to protect scenery, mean response 3.9) were rated the highest by the MPWG and the AEG.

IAI 7 (Area and/or percent of forest land with significant scenery changes from natural disturbances), IAI 12 (Studies at a sample of sites with special visual values) and IAI 11 (Demonstration of sustainable forest management to the public through enhanced visual treatments and by providing information) were rated the lowest and the mean responses of two groups (MPWG and AEG) were 3.1, 3.2 and 3.4 respectively. Contributing reasons for the low rating of these indicators by the MPWG were low cost-effectiveness (IAI 7 and 12, mean responses 2.6 commonly) and low measurability (IAI 11, mean response 2.8). For the AEG, it was because of the low relevance (IAI 7, mean response 2.3), low credibility (IAI 11, mean response 3.0) and low cost-effectiveness (IAI 12, mean response 3.0). The two greatest differences in mean responses between MPWG and AEG were for IAI 6 (Capacity of the institutional framework to develop and maintain programs to conserve aesthetically valuable forests) and IAI 4 (Capacity of the institutional framework to develop and maintain programs to conserve aesthetically valuable forests), mainly because of the different ratings for relevance and measurability, respectively.

Table 5.

In the second-round survey, we also required that the respondents rate the newly proposed aesthetic indicators. The results are presented in Table 5 (See the results of Evaluation with 5 categories from PAI 1 to PAI 16). The respondents rated PAI 8 (Area and/or percent of logged area within legally established scenic area, mean response 3.8),

PAI 2 (Area and/or percent of forest land with visual landscape inventory data, mean response 3.8) and PAI 4 (Proportion of the institutional framework or program being achieved, mean response 3.6) highest in terms of the five rating categories although the average ratings for PAI were generally lower than those of the IAI. PAI 5 (Cost per ha to apply institutional framework or program to private and public sectors), PAI 3 (Area and/or percent of age-class distribution and species distribution of trees) and PAI 10 (Willingness to pay for view protection) were rated the lowest, and their mean responses were 2.4, 2.6 and 2.6 respectively. The main reason for the low ratings of the PAI 5 and PAI 10 were cited as the low cost-effectiveness (mean responses 1.8, commonly), and PAI 3 was rated low due to the low relevancy to forest aesthetics (mean response 1.9).

5. Applicability of the possible aesthetic indicators

In round two, we required the respondents to rate the appropriateness of the 28 possible indicators (12 IAI and 16 PAI), in response to the question 'at which scale(s) can this indicator be applied to SFM standards?' as some of the PAI were considered to be inappropriate as national or international level indicators. In this question, multiple responses were allowed, and the results are also given in Table 5 (See the results of Appropriateness).

Thirteen indicators (IAI 1, 3, 4, 5, 6, 8, 9, 10, 12, PAI 2, 8, 9, and 16) were rated appropriate for a national or international SFM standard (5 or more responses, selected by more than 50% of respondents). IAI 1 (Existence of aesthetic considerations in harvesting and forests conversions where impacts are a concern), IAI 4 (Capacity of the institutional

framework to develop and maintain programs to conserve aesthetically valuable forests) and PAI 2 (Area and/or percent of forest land with visual landscape inventory data) were rated high (7 or more responses). However, the other fifteen indicators were not rated as potential international or national aesthetic indicators.

At the regional level, eight indicators (IAI 6, PAI 1, 3, 5, 6, 11, 12 and 15) were rated as unsuitable, and twelve indicators (IAI 1, 3, 6, 12, PAI 1, 5, 6, 10, 11, 12, 14 and 16) were rated low (4 or fewer responses) as FMU level aesthetic indicators. Generally, the indicators that were rated high as a national or international aesthetic indicator were rated low as a regional or a FMU level, but seven indicators (IAI 5, 8, 9, 10, PAI 2, 8, and 9) were rated as appropriate aesthetic indicators at all levels.

Discussion

Respondents suggested 11 reasons for the lack of aesthetic indicators in international SFM frameworks. The respondents in the MPWG regarded both (a) a cultural bias among professionals and scientists who viewed aesthetics as soft or subjective, and (b) a lack of training in aesthetics and other social science disciplines amongst those participating in scientific advisory groups and government task forces designing criteria and indicators as major reasons. Such a perspective is consistent with the declared backgrounds of the MPWG participants. Their contributions to the development and revision of SFM C&I had focused on the environmental indicators more than on the social indicators, and most were associated with traditional forestry or related backgrounds. The AEG suggested a much more diverse set of reasons, extending the explanation provided by Sheppard (2003). The results suggest that there is a need for more expertise and training in social

science methods including aesthetics amongst those designing C&I for SFM standards (Beckley et al. 2002). The direct involvement of experts in forest aesthetics in the creation and the revision of C&I seems warranted.

This study suggests that there are ten aesthetic indicators that could be considered for inclusion in international SFM standards (Table 6). The specific criteria that were used to select the final recommended international aesthetic indicators from the IAI and the PAI sets were: (1) five or more responses for a national or an international indicator; (2) 3.5 or higher mean responses over the five rating categories; and (3) 3.0 or higher responses for each rating category. For the first category, national indicators can also be adopted as international indicators without any revision because, for example, the Montreal Process requires member countries to submit periodic reports (every 5 years) on the state of the forests in the countries. The Montreal Process then publishes overview reports based on the country reports. The criterion 'five or more responses' was also used for selecting the final aesthetic indicator set because the number of the participants in this question was nine, so five indicated a majority. The second criterion '3.5 or higher over the five rating category,' was adopted because 3.5 out of 5.0 (full score) represents a rating of more than 70%. The last one '3.0 or higher responses for each rating category' was selected because it would be difficult to use a criterion to monitor the state of forests if the criterion had low relevance, credibility, measurability, cost-effectiveness, or connectedness to forestry.

Table 6.

Given that the current international SFM standards have been criticized for their lack of quantitative indicators (Harshaw et al. 2007; Sheppard et al. 2004), the indicators presented here would enable us to monitor changes in forest aesthetic qualities more precisely and effectively than hitherto with the eight quantitative indicators. In addition, the procedural indicator (1. Existence of aesthetic considerations in harvesting, forests conversions, or planning and forest management process where impacts are a concern) and the perceptions or satisfaction indicator (8. Existence of public surveys of visual impacts in visually sensitive areas) would allow us to detect changes in laws and in public participation and satisfaction.

The response rate for the second round was 47.4% (9 out of 19) based on the 19 responses obtained from the round-one survey, but it was only 18.0% (9 out of 50) based on the 50 invitations sent out for the first-round survey. While only two responses from MPWG members were obtained in the second-round survey, seven experts from AEG responded. The low response rate of the MPWG members may seem to show their lack of interest in forest aesthetics or may reflect their feeling that the survey might not deliver useful insights, or not lead to proposals that could realistically be implemented. However, we assume that it may also reflect this group's reluctance to consider new indicators at a time when many countries within the Montreal Process are failing to report on many of the existing indicators. Because those who participated in the surveys were all experts in the field of SFM or forest aesthetics, and the Delphi survey is not a statistical survey but a qualitative method, the low response rate may not be a major issue (see, for example, Akins et al. 2005). However, the low response rate of the MPWG members may have had an impact on the results by giving them a low reliability, and accordingly, further studies

can be suggested. We were actually quite surprised by the low response rates of the experts, especially given that aesthetics is a known gap in the Montreal Process SFM framework and we are offering a potential remedy for this.

The full set of results from this study is presented in Table 5, as they may be useful when developing aesthetic indicators at a local scale. In addition, as forestry situations differ between countries, regions and management units, the results presented in Table 5 may give some indication of the potential diversity of views about particular indicators.

Conclusions

The current lists of criteria and indicators associated with sustainable forest management are noticeably lacking in indicators related to forest aesthetics. This is an important omission as the general public places considerable value on aesthetics (Lim et al. 2015a). The reasons for the omission are complex, but can be related to a bias against social indicators, which are often seen as being of questionable value by the natural scientists who have traditionally dominated C&I development groups, and to a lack of expertise amongst those individuals in the techniques currently being used to assess forest aesthetics (Lim et al. 2015b).

This work has revealed ten potential aesthetic indicators of sustainable forest management that could be used in future C&I schemes. These have been screened for relevance by both experts in the development of C&I schemes and experts in forest aesthetics. These two groups have not previously been brought together, but the use of Delphi techniques enabled their views to be consolidated into a single set of potential

indicators. A number of other indicators were also identified, but these are either considered to be of lesser importance, or relevant only at the scale of the forest management unit (FMU). Further research might screen sub-national indicators through another Delphi survey involving experts who are in the field of forest management or who utilize local SFM standards. The technique could be also used to develop indicators in other areas that are currently lacking in C&I schemes, most of which relate to social indicators.

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Table 1. Initial set of 12 aesthetic indicators (IAI) for the round-one questionnaire

Initial aesthetic indicators	Source
IAI 1. Existence of aesthetic considerations in harvesting and forests conversions where impacts are a concern (e.g. laws, regulations or public participation processes etc)	Forestry Commission 2004
IAI 2. Existence of historic and/or cultural records on visually important forests	SFI 2002
IAI 3. Area and/or percent of forest land managed to protect scenery [a]	Montreal Process 1999
IAI 4. Capacity of the institutional framework to develop and maintain programs to conserve aesthetically valuable forests (e.g. Visual Quality Objectives)	MCPFE 2002
IAI 5. Area and/or percent of forest land where silviculture is designed to protect scenery (e.g. thinning, prevention, control)	-
IAI 6. Area and/or percent of land conversion from non-forest to forest to protect scenery (e.g. afforestation)	-
IAI 7. Area and/or percent of forest land with significant scenery changes from natural disturbances (e.g. landslides, dieback, insects, fire, wind, snow and rain)	Refer to Montreal Process 1999 (soil and water indicators)
IAI 8. Area and/or percent of forest land with significant scenery changes as a result of artificial disturbances (e.g. conversion for roads, housing)	Refer to Montreal Process 1999 (soil and water indicators)
IAI 9. Area and/or percent of forest land used for timber yield that is protecting scenery by adopting alternative harvesting techniques to clear-cutting (e.g. continuous cover forestry, selective cutting, regeneration before cutting)	SFI 2002
IAI 10. Existence of public acceptance surveys of visual impacts in visually sensitive areas	Meitner et al. 2006
IAI 11. Demonstration of sustainable forest management to the public through enhanced visual treatments and by providing information	Meitner et al. 2006
IAI 12. Studies at a sample of sites with special visual values	MCPFE 2002

[a] The original indicator (Montreal Process 1999) of IAI 3 is 'Extent of area by forest type in protected area categories as defined by IUCN or another classification systems,' and the definition of protected area by IUCN (International Union for Conservation of Nature) includes landscape conservation.

Table 2. Rating categories for the possible aesthetic indicators

Rating categories
Relevancy: Does the indicator tell us something meaningful about social conditions, especially in terms of forest aesthetic values? Is it sensitive to change, and will it show trends over time?
Credibility: Is the indicator reliable (relatively free of factors that introduce "noise") when it comes to interpreting indicator measurements? Is it seen as valid by affected communities and grounded in their cultural worldviews?
Measurability: Is the indicator clearly defined and specific? Is it measurable at an appropriate scale and with sufficient accuracy to be useful? Is data for this indicator available?
Cost-effectiveness: Is the cost of measuring this indicator justified by the value of the information it provides?
Connectedness to forestry: Is the indicator responsive to management actions and practices? Can future indicator levels be forecasted with reasonable accuracy in relation to planned forestry activities?

Table 3. Reasons for the absence of aesthetic indicators in current SFM standards

Reasons [a]	Frequency (%)		
	Total	MPWG [b]	AEG [c]
Reason 1: A cultural bias among professionals and scientists that leads to aesthetics being seen as soft or subjective	28.6	29.4	22.7
Reason 2: A lack of training in aesthetics and other social science disciplines at all levels, from scientific advisory groups and government task forces designing criteria and indicators to forest managers and certification teams	31.7	41.2	22.7
Reason 3: A general omission from the SFM standards of people with qualifications in aesthetics, such as landscape architects, landscape foresters, and other social science professionals	14.3	5.9	18.2
Reason 4: The absence of substantive public input to indicator setting, whereby public concerns for aesthetics, for example, could be actively expressed.	9.5	11.8	13.6
Alternative reasons suggested by respondents	15.9	11.8	22.7
Total	100.0	100.0	100.0

[a] Reasons 1 to 4 were provided in round-one questionnaire, and 7 alternative reasons were suggested by respondents.
[b] n=8, allowing for multiple responses
[c] n=11, allowing for multiple responses

Table 4. Newly proposed aesthetic indicators (PAI) by respondents in round-one survey

Proposed aesthetic indicators	Frequency [a]
PAI 1. Existence of considerations for balance between forest scenery management and other industries or fields (e.g. tourism, recreation, timber production etc.)	1
PAI 2. Area and/or percent of forest land with visual landscape inventory data	1
PAI 3. Area and/or percent of age-class distribution and species distribution of trees	1
PAI 4. Proportion of the institutional framework or program being achieved (e.g. with evaluation or monitoring system)	2
PAI 5. Cost per ha to apply institutional framework or program to private and public sectors	2
PAI 6. General consistency with accepted professional (e.g. perception expert, landscape architect etc.) standards or scenic design guidelines	2
PAI 7. Inclusion of public perception testing in monitoring or establishment of guidelines	1
PAI 8. Area and/or percent of logged area within legally established scenic area	1
PAI 9. Percent of harvested forest in scenic areas compared to amount of regenerated and visually greened up forest	1
PAI 10. Willingness to pay for view protection	1
PAI 11. Number of public / indigenous or residents / stakeholders complaints regarding poor visual management	2
PAI 12. Area and/or percent of scenic forest land where logging is highly acceptable, marginally acceptable, and marginally unacceptable	1
PAI 13. General level of public acceptance of visual outcomes of forest management	1
PAI 14. Number and/or percentage of visitors that rate scenery important to their visit or reason for travel	1
PAI 15. Existence of the use of "Signs of Care" in the visual design or logging activities	1
PAI 16. Training in forest aesthetic values provided to professionals involved in forest management and design (e.g. capacity, university programs, courses, etc.)	2

[a] Number of recommendation by respondents (n=19, allowing for multiple recommendations)

Table 5. Rating results of possible aesthetic indicators by experts

Possible aesthetic indicators [a]	Evaluation with 5 categories [b]						Appropriateness [c]		
	C1	C2	C3	C4	C5	Mean	S1	S2	S3 or S4
IAI 1	4.21	3.32	3.05	3.56	4.21	3.67	4	7	8
IAI 2	3.58	3.58	3.53	3.31	3.58	3.52	7	8	3
IAI 3	3.89	3.61	4.05	4.00	4.05	3.92	4	8	6
IAI 4	4.17	3.59	3.53	3.60	3.83	3.74	5	7	8
IAI 5	3.89	3.32	3.58	3.19	4.42	3.68	6	8	5
IAI 6	3.37	3.39	3.78	3.07	3.56	3.43	4	4	5
IAI 7	2.89	3.00	3.44	2.69	3.11	3.03	5	5	3
IAI 8	4.22	4.00	3.94	3.73	4.06	3.99	6	6	5
IAI 9	3.79	3.53	3.74	3.33	4.53	3.78	6	6	5
IAI 10	3.89	3.63	3.79	3.06	4.05	3.68	5	7	5
IAI 11	3.63	3.16	2.95	3.07	4.03	3.37	5	6	4
IAI 12	3.21	3.07	3.36	2.83	3.64	3.22	3	6	5
PAI 1	2.88	2.38	2.50	2.33	3.63	2.74	4	4	2
PAI 2	3.89	3.78	4.11	3.43	3.89	3.82	7	8	7
PAI 3	1.86	2.29	3.13	2.00	3.50	2.55	6	4	0
PAI 4	4.00	3.88	3.25	3.29	3.50	3.58	5	7	4
PAI 5	2.57	2.14	2.29	1.83	3.14	2.40	3	3	2
PAI 6	3.40	3.00	2.20	3.00	3.40	3.00	4	2	1
PAI 7	3.75	3.25	2.75	2.29	2.88	2.98	5	6	2
PAI 8	3.67	3.56	4.11	3.57	4.22	3.83	6	8	5
PAI 9	3.00	3.20	3.20	2.80	4.00	3.24	5	5	5
PAI 10	2.83	2.67	2.50	1.80	3.00	2.56	3	5	3
PAI 11	2.67	2.00	3.17	3.20	3.33	2.87	3	3	2
PAI 12	3.00	2.00	2.29	3.00	3.71	2.80	4	4	2
PAI 13	3.43	3.29	3.14	2.80	4.14	3.36	5	6	4
PAI 14	3.29	3.29	3.67	3.00	3.43	3.33	4	6	4
PAI 15	3.63	3.13	3.17	2.80	3.88	3.32	8	3	0
PAI 16	3.50	3.38	3.00	3.14	3.50	3.30	2	5	5

[a] See Table 1and 3 for the meaning of each IAI and PAI

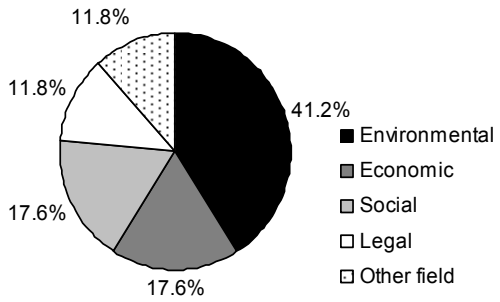
[b] Values are mean responses (1.00 to 5.00); 5 categories were relevance (C1), credibility (C2), measurability (C3), cost-effectiveness (C4) and connection to forestry (C5); Number of panels participating were 19

[c] Values are numbers of respondents (0 to 9); applicability of scale were forest management unit level (S1), regional level (S2), national level (S3) and international level (S4); Number of panels participating were 9 and allowing multiple responses

Table 6. Final recommended aesthetic indicators at an international SFM level and their characteristics

Aesthetic indicators [a]	**Characteristics**	
1. Existence of aesthetic considerations in harvesting, forests conversions, or planning and forest management process where impacts are a concern (e.g. laws, regulations, public participation processes, landscape architect participation etc.)	Procedural	qualitative
2. Area and/or percent of visually sensitive forest land or scenic forest land being protected	direct outcome-based	quantitative
3. Area and/or percent of forest land managed by institutional framework or program to conserve aesthetically valuable forests (e.g. Visual Landscape Design, Visual Resource Management, Scenery Management, Visual Quality Objectives, etc.)	direct outcome-based	quantitative
4. Area and/or percent of forest land where silviculture is designed to protect scenery (e.g. thinning, fire prevention, insect control etc.)	direct outcome-based	quantitative
5. Area and/or percent of land conversion from non-forest to forest to protect scenery (e.g. afforestation etc.)	direct outcome-based	quantitative
6. Area and/or percent of forest land with significant scenery changes as a result of artificial disturbances (e.g. conversion for roads, housing etc.)	direct outcome-based	quantitative
7. Area and/or percent of forest land used for timber yield that is protecting scenery by adopting alternative harvesting techniques to clear-cutting (e.g. continuous cover forestry, selective cutting, regeneration before cutting etc.)	direct outcome-based	quantitative
8. Existence of public surveys of visual impacts in visually sensitive areas	perceptions or satisfaction	qualitative
9. Area and/or percent of forest land with visual landscape inventory data	direct outcome-based	quantitative
10. Area and/or percent of logged area within legally established scenic area	direct outcome-based	quantitative
Total 10 aesthetic indicators	1 procedural 1 perceptions or satisfaction 8 direct outcome-based	2 qualitative 8 quantitative

[a] Some indicators were rephrased based on the opinions of panels and are therefore wording may differ from the IAI and PAI in Table 5.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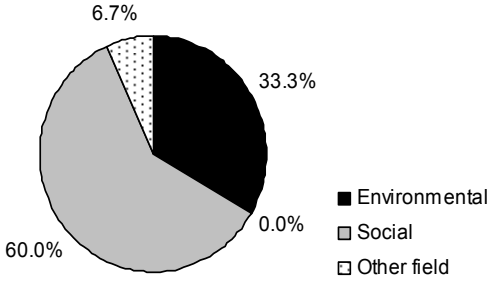
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