Dissertationes Forestales 31

The visual preferences for forest regeneration and field afforestation – four case studies in Finland

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Academic dissertation

To be presented, with the permission of the Faculty of Biosciences of University of Helsinki, for public criticism in Walter Hall, Agnes Sjöbergin katu 2, Helsinki, on December 8th 2006, at 12 o'clock

Title: The visual preferences for forest regeneration and field afforestation - four case studies in Finland

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ISSN 1795-7389
ISBN-13: 978-951-651-150-7 (PDF)
ISBN-10: 951-651-150-3 (PDF)

(2006)

Publishers:
The Finnish Society of Forest Science
Finnish Forest Research Institute
Faculty of Agriculture and Forestry of the University of Helsinki
Faculty of Forestry of the University of Joensuu

Editorial Office:
The Finnish Society of Forest Science
Unioninkatu 40A, 00170 Helsinki, Finland
http://www.metla.fi/dissertationes

Karjalainen, Eeva. 2006. The visual preferences for forest regeneration and field afforestation - four case studies in Finland. University of Helsinki, Faculty of Biosciences, Department of Biological and Environmental Sciences.

ABSTRACT

The overall aim of this dissertation was to study the public's preferences for forest regeneration fellings and field afforestations, as well as to find out the relations of these preferences to landscape management instructions, to ecological healthiness, and to the contemporary theories for predicting landscape preferences. This dissertation includes four case studies in Finland, each based on the visualization of management options and surveys.

Guidelines for improving the visual quality of forest regeneration and field afforestation are given based on the case studies. The results show that forest regeneration can be connected to positive images and memories when the regeneration area is small and some time has passed since the felling. Preferences may not depend only on the management alternative itself but also on the viewing distance, viewing point, and the scene in which the management options are implemented.

The current Finnish forest landscape management guidelines as well as the ecological healthiness of the studied options are to a large extent compatible with the public's preferences. However, there are some discrepancies. For example, the landscape management instructions as well as ecological hypotheses suggest that the retention trees need to be left in groups, whereas people usually prefer individually located retention trees to those trees in groups. Information and psycho-evolutionary theories provide some possible explanations for people's preferences for forest regeneration and field afforestation, but the results cannot be consistently explained by these theories.

The preferences of the different stakeholder groups were very similar. However, the preference ratings of the groups that make their living from forest – forest owners and forest professionals – slightly differed from those of the others. These results provide support for the assumptions that preferences are largely consistent at least within one nation, but that knowledge and a reference group may also influence preferences.

Keywords: landscape, perception, visualization, scenic

ACKNOWLEDGEMENTS

When I was hired as researcher at the Finnish Forest Research Institute at the beginning of 1990s, I did not have any aspirations to complete a doctoral degree. However, now after several years, phases and events, the dissertation is almost completed.

At first, I would like to thank Dr. Aarne Reunala, who initiated Case Study I and convinced me to step into the world of research. I would like to express my thanks to Dr. Eija Pouta, Dr. Ashley Selby, M.Sc. Tuija Sievänen, Prof. Heimo Karppinen and Dr. Jari Varjo for their helpful comments on the manuscript and M.Sc. Juha Siitonen for giving ecological insights into the manuscript. I am grateful to my co-authors, Lic.Tech. Minna Komulainen, M.Sc. Susan Tönnes, Lic.Sc. Irja Löfström, and M.Sc. Marjo Neuvonen, for their ideas, diligence, overall views, and statistical expertise. I extend special thanks to the pre-examiners, Prof. Timo Pukkala and Prof. Liisa Tyrväinen, for their constructive comments that helped to improve the manuscript.

Without the financial support of the Finnish Forest Research Institute, the Ministry of Agriculture and Forestry, and the Metsämiesten Säätiö, this study would not have been possible. I wish to acknowledge the many people who assisted in conducting the studies: Mr. Tuomo Härkönen, Mr. Pertti Ruuska, Mrs. Raija Lahtinen, Mr. Erkki Oksanen, Mr. Jarmo Palokallio, Mr. Aaro Huusko, among others, as well as all the people who helped in organizing the survey panels and the people who were willing to participate in the studies. I also extend my thanks to the personnel of Metla library.

My parents provided me a beautiful living environment on an island of Lake Saimaa where I learned to appreciate the beauty of nature. I am grateful to my sisters, Liisa and Kaisa, and to their families, and especially to my favorite boy, Eero, for giving me a lot of joy and excuses to play. I would like to thank all my friends and their families, especially Leena, Eija, Anne and Sanni, for sharing moments of their lives with me. Finally, the dearest thanks are to Juha for his warmth, encouragement, and patience, as well as for the long discussions on my dissertation.

LIST OF ORIGINAL ARTICLES

This dissertation consists of the summary and the following case studies, which are referred to in the text by their Roman numerals. These papers are reproduced with the permission of the journals in question.

I **Karjalainen, E.** 1996. The scenic preferences concerning clear-fell areas in Finland. Landscape Research 21(2): 159–173.

II **Karjalainen, E.** & Komulainen, M. 1998. Field afforestation preferences: A case study in northeastern Finland. Landscape and Urban Planning 43(1–3): 79–90.

III **Karjalainen, E.** & Komulainen, M. 1999. The visual effect of felling on small- and medium-scale landscapes in north-eastern Finland. Journal of Environmental Management 55(3): 167–181.

IV Tönnes, S., **Karjalainen, E.**, Löfström, I. & Neuvonen, M. 2004. Scenic impacts of retention trees in clear-cutting areas. Scandinavian Journal of Forest Research 19(4): 348–357.

Studies II and III. Eeva Karjalainen has been responsible for planning the evaluation methods of the images, the questionnaire, and sampling of the respondents. She has supervised the preparation of the images and implemented the surveys in practice. She has also been responsible for analyzing the data and has been the main author of the articles.

Study IV. Eeva Karjalainen has been responsible for planning the study and the research methods. This includes designing the retention tree alternatives, choosing the visualization methods and study areas, and planning the sampling of the respondents. She has supervised the preparation of the images at the first stages. In addition, she has participated in interpreting the results and writing the article.

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PART I: BACKGROUND, THEORY AND PREVIOUS STUDIES

1 BACKGROUND, AIMS AND STRUCTURE OF THE DISSERTATION

1.1 Background of the dissertation

In Finland, forests cover about 70% of the total area and are thus a significant element in the landscape. It is typical for a Finnish landscape to have a relatively small variation in topography, except for the northern and some parts of eastern Finland. The open areas in the forested landscape are provided by lakes (10% of the total area), fields (8%), and treeless mires (5%). The most common tree species is Scots pine, 65% of the forest land having it as a dominant tree species. The corresponding figures for Norway spruce and deciduous trees are 24% and 10%. Roughly 60% of the forest land in Finland is covered by mixed stands or stands having at least some species mix. (Finnish Statistical Yearbook... 2005)

Timber production is important for the Finnish economy, the export of forest industry being one-fourth of the total exports of Finnish goods. Forestry is practiced to some extent in most of the forest area, except the 7.2% of the forest and scrub land that is strictly protected. In addition to this, 5% of the forest and scrub land is under restricted forestry use. (Finnish Statistical Yearbook... 2005) Despite intensive timber production, Finnish forests are typically multi-functional forests. Thus the same forest area can be used for timber production, nature or biodiversity protection, tourism, and outdoor recreation. Based on the every-man's right, there is public access to almost all forest areas, i.e. there exists a right to walk, pick berries and mushrooms and camp nearly everywhere.

Finnish forests are actively used for outdoor recreation. For example, 68% of Finns walk in forests and parks, 56% pick berries, 56% spend time at summer cottage, 48% observe nature and enjoy scenery, and 38% pick mushrooms. Almost all Finns go into nature at least once a year. Two-thirds participate in outdoor recreation at least once a week on average. It is estimated that roughly a half of these forest visits occur in timber production forests based on the everyman's right. (Pouta and Sievänen 2001) The wide use of forests for recreation requires that special emphasis is put on the visual quality of forest landscapes. Since forests are at the same time under intensive timber production, this poses challenges for forest management.

The scenic values of the forests and other rural areas of Finland are important for several reasons. First, scenic beauty is an attraction for outdoor recreation and nature-based tourism and may have growing importance in timber marketing as well. Furthermore, scenic beauty helps to achieve the restorative and other well-being effects of nature. Also, the importance of scenic values is emphasized in Finnish legislation and political strategies. Finally, for some forest owners, scenic values may be the main motivation for forest ownership. For these reasons, natural resource management should pay attention to the visual quality of rural areas. One problem, however, is the limited scientific knowledge base for landscape management.

Beauty has been regarded by philosophers as one of the three ultimate values (truth, goodness and beauty) (Lothian 1999). Several studies show that the scenic beauty of the forest is an important quality for Finnish outdoor visitors. In the study by Paronen (2001), Finns most often mentioned the following well-being effects of recreation: refreshing and

mood enhancing, calming and relaxing, getting close to nature, and enjoying scenery. When visitors were asked about the forest management in recreation areas, they stated that scenic beauty was more important to them than species diversity, variation in landscape, or passability (Horne 2002). Also, the visitors of Koli National Park reported that the most important motive for visiting this national park was its scenery (Sievänen 1993). These findings concerning the importance of the beauty of the natural environments has also been supported by foreign studies. For example, Schroeder (2002) found that beauty was one of the most often mentioned qualities of special places in outdoor environments.

Nature and trees affect people's well-being and might be a crucial factor in people's recovery from stress and attentional fatigue. The restoration refers to a person's mental, physiological and functional recovery from stress (a challenging or threatening situation) or attentional fatigue that has been caused by long-lasting concentration on tasks (Aura et al. 1997). Natural environments are preferred to urban environments (e.g. van den Berg et al. 2003, Staats et al. 2003), and many studies clearly show that natural environments elicit stronger restorative effects than do built environments. These studies report that compared to urban environments, natural environments improve human mood states, concentration or performance, and likewise produce positive changes in physiological measures after stressful or attention-demanding situation (Ulrich 1981, Ulrich et al. 1991, Hartig et al. 1991, Herzog et al. 1997, Laumann et al. 2001, Herzog et al. 2003, Laumann et al. 2003, Hartig et al. 2003, van den Berg et al. 2003). In addition, Korpela et al. (2001) found that natural settings were over-represented among the favorite places and under-represented among the unpleasant ones. Restoration was particularly typical for the natural favorite places. However, the potential for people to recover from stress in nature is clearly not fully tapped in our society. Consequently, this recovery potential is not paid enough attention either in urban planning or forest management planning.

Besides the recreational use of forests, the demands for harmonious rural landscapes are set by the growing promise of nature-based tourism. Beautiful landscape is an important attraction for nature-based tourism and thus knowledge of the visual management of forests and other rural landscapes is urgently needed. Tourism is supposed to be the most rapidly growing means of livelihood in the world, and nature-based tourism is predicted to be the most fast increasing part of tourism (Silvennoinen et al. 1997, Koivula et al. 2005). For example, it has been estimated that from 2000 to 2003, the Finns took 10% more nature-based trips including accommodation. Koivula et al. (2005) propose that nature-based tourism might even become the most important form of use of forests in the most attractive areas. Moreover, the visual quality of forest management may get more emphasis in timber marketing as well because social sustainability of forestry is important asset in timber sales promotion, in addition to ecological sustainability.

More than a half of Finnish forest land is owned by private forest owners (Finnish Statistical Yearbook... 2005) and thus their decisions are crucial to the visual forest landscape. At least part of the private forest owners pays more attention to other values than timber production, such as scenic values. Of the private forest owners that were included in the studies of Kuuluvainen et al. (1996) and Karppinen (1998a, 1998b), 18–31% were classified as recreationists who emphasized the non-timber and amenity aspects, such as the aesthetic values of their forest ownership. In addition, Selby et al. (2005) showed that 19% of the forest owners placed their priorities of forest owning on non-wood benefits from their forests as well as on nature conservation and nature values. More knowledge on the visual forest management would be needed in order to achieve the forest owners' objective to preserve scenic values.

The different types of forest areas may be used by various groups of people and it is possible that the needs and desires of these groups are not compatible. This is why the managers of the areas need to know the profile of the users of the area as well as the preferences of the divergent groups. In addition, the managers' views and preferences may differ from those of the visitors of the areas, and if these indeed differ, the managers should become conscious of those dissimilarities. Likewise the forestry personnel who give advice to forest owners should be aware of the possible discrepancies in their own preferences and those of the forest owners. Therefore, knowledge of the preferences of the different user groups, as well as the preferences of the forest owners and forestry professionals need to be established.

The sustainable use of forests includes economic, ecological and social sustainability. However, in recent years, Finnish forest policy has focused mostly on timber production and the ecological values of the forests while social values have received much less emphasis. The central components of social sustainability are amenity values and the well-being effects of forests. Of these, the scenic values are very important. However, in public debate and in conflicts about forest use, as well as in political discussions, the scenic quality of forests has not played a prominent role. For example, minor weight on the scenic values can be seen in that even though the pan-European criteria for the sustainable forestry contain issues directly involving the visual effects of forestry, none of the Finnish criteria and indicators considers visual quality of forest management (Suomen kestävän metsätalouden... 1997, Suomen metsätalouden tila... 2000).

Nevertheless, due to the international development in the 1990s, Finnish political programs and legislation started to pay attention to landscape management in forestry and rural areas (e.g. Metsätalous ja ympäristö 1994, Nature Conservation Act 1996, Metsälaki 1996, Finland's National Forest... 1999). Correspondingly, the importance of open agricultural lands has been emphasized in the political papers and strategies (e.g. Uusiutuvien luonnonvarojen kestävä... 1995, Maa- ja metsätalousministeriön luonnonvarastrategia 2001), partly because agricultural land is a scarce resource in Finland and the field afforestation poses a threat to traditional rural landscapes, especially in eastern and northern Finland. The previously mentioned programs and legislation require that natural resource management needs to pay attention to the landscape. Moreover, Finland has ratified the European Landscape Convention (2006) that obligates the authorities to preserve landscape values.

However, scenic values may not be important in all areas. Landscape management should be emphasized in places that have special scenic values and in places that are most often used. In Finland, the scenic quality of forests should be stressed at least in those places that are in active recreational or nature tourism use, as well as in other places that are often seen. Examples of these are forests nearby settlements and fields, forests nearby water bodies and long-distance views, forests along heavily operated roads, and forests in the vicinity of nature protection areas (Metsähallituksen metsien... 1990, Finland's National Forest Programme 2010 1999, Maa- ja metsätalousministeriön luonnonvarastrategia 2001).

The two most important organizations giving forest management guidelines in Finland are the Forestry Development Centre Tapio (serves forestry organizations in the private sector) and Metsähallitus (Finnish Forest and Park Service, takes care of the state owned forests). The forest management instructions given by these organizations (e.g. Luonnonläheinen metsänhoito 1994, Metsätalouden ympäristöopas 1997, 2004, Hyvän metsänhoidon suositukset 2001, 2006) have given minor attention to the visual landscape management issues and visual design guidelines have been on very general level, the special forest landscape management guidelines of Tapio (Metsämaiseman hoito 1997) and the latest environmental

guide of Metsähallitus (Metsätalouden ympäristöopas 2004) being somewhat more detailed than the other guidelines.

These Finnish visual management guidelines are based on landscape design principles (e.g. Lucas 1991, Bell 1993), previous experiences, and common sense. Results of preference studies may also be utilized to a degree. However, it is not clearly stated to which extent the landscape management guidelines are based on aesthetic concerns and to which extent they rest on ecological and economic matters. Nevertheless, as little research on people's preferences for forest management has been conducted the visual landscape management guidelines have not had very good opportunities to utilize the public preferences. Furthermore, whereas ecological concerns have been highly emphasized in Finnish forestry, little is known about the compatibility of ecological alternatives and public preferences.

Although many studies in the United States have concentrated on the people's visual preferences for forest landscapes, the studies focusing on the preferences for forest management options have been rarer. Moreover, the results of other countries cannot be directly applied to Finland. Only few Finnish studies have been undertaken on the people's preferences for forest regeneration (Tahvanainen et al. 2001, Silvennoinen et al. 2002, Tyrväinen et al. 2003). The Finnish studies on the public preferences for field afforestation are likewise scarce (Tahvanainen et al. 1996, Nousiainen et al. 1998). Correspondingly, the visual landscape management guidelines for field afforestation in Finland are almost non-existent (Pellonmetsittäjän opas 1996). Thus the knowledge base for landscape management is narrow, and especially limited is the knowledge of people's perceptions and preferences towards forest regeneration and field afforestation.

Science-based landscape management could be promoted by integrating public landscape preferences appropriately in rural landscape design and in forest management planning. In addition, the understanding of public preferences provides information for participatory planning. If this knowledge of public preferences is used in the management of rural landscapes, the scenic and restorative qualities of these landscapes can be enhanced.

1.2 Aims, structure and approach of the dissertation

1.2.1 Aims of the dissertation

The overall aim of this dissertation is to study the public's preferences for forest regeneration fellings and field afforestation, as well as to find out the relations of these preferences to landscape management instructions, to ecological healthiness, and to the contemporary theories for predicting landscape preferences.

The aims of this dissertation can be summarized as follows:

1) To find the visually most acceptable ways to implement forest regeneration and field afforestation
2) To study the effect of the stakeholder group on the preferences for forest regeneration and field afforestation
3) To study the possible contradictions between the preferences for forest regeneration and field afforestation, ecological recommendations, and landscape management guidelines
4) To evaluate whether the theories for predicting landscape preferences are appropriate in so far as preferences for forest regeneration and field afforestation are concerned
5) To study people's responses to forest regeneration fellings

In addition, this dissertation assesses the various approaches to studying landscape quality, compares and evaluates the theories for predicting landscape preferences, describes and evaluates the methods used in landscape preference research, and provides an overview of the empirical studies on rural landscape preferences.

This dissertation does not take into consideration landscape design or forest management planning (see e.g. Antikainen 1993, Komulainen 1998). Instead, it produces inputs for the Finnish landscape design and forest management planning systems, and can therefore enhance the science base of the planning methods. The results of this dissertation can be used to improve the visual quality of forest regenerations and field afforestation, and thus to maintain the recreative and restorative qualities of these areas in which the management actions are implemented.

The case studies of this dissertation focus on timber production forests and agricultural lands. However, the results can be utilized to manage recreation areas as well even though the recreation areas are usually managed in a lighter way than timber production forests.

1.2.2 Structure of the dissertation

Part I of this dissertation explains the background for this dissertation, discusses the theoretical frameworks for the studies on landscape preferences, describes the research methods, and reviews the previous studies on landscape preferences. First, the framework of this dissertation is presented, and concepts of landscape and preference are then defined. Next, a classification of the landscape quality studies is presented and the approach of this dissertation is located in the classification. A discussion is presented of the roles of emotional and cognitive processes as well as the positions of genetic and cultural origins in the formation of landscape preferences. The most important contemporary theories for predicting the landscape preferences are described and evaluated, and the relationships between them are examined. The next section of this dissertation focuses on the methods and results of previous landscape preference studies. The visualization as well as the evaluation methods are discussed and the main results of previous rural landscape preference studies are reviewed.

Part II of this dissertation provides a summary of the four empirical case studies. The background, material and methods of the case studies are described. The results are then summarized, the validity and reliability of the studies is discussed, and the results are analyzed in relation to the theories for predicting landscape preferences. In addition, an examination is made of the connections and contradictions between the results of the case studies, visual landscape management guidelines, and ecological recommendations. Finally, future visions are presented.

Table 1 illustrates the objectives of this dissertation, the case studies in which the objective is studied, the basis and background for studying the objective (the relevant chapter in Part I of this dissertation), and the approach to study the objective. Objective 1 is the main research objective of this dissertation. This objective is studied in all the case studies by the psychophysical research tradition that is described in the chapter entitled “Classification of landscape assessments studies”. The research approach used is rating and ranking the management alternatives created by visualization. These methods are discussed in the chapter entitled “Methods to measure preferences”. Objective 1 is based on an assumption that preferences are to a large extent genetically determined which is discussed in the chapter entitled “Formation of landscape preferences”. The results of the previous studies on rural

Table 1. The objectives of this dissertation, the case studies in which the objective is studied, the background for studying the objective (the relevant chapter in Part I of this dissertation), and the approach to study the objective.

Objective	Case study	Background for studying the objective (relevant chapter in Part I of this dissertation)	Approach
1) To find the visually most acceptable ways to implement forest regeneration and field afforestation	I, II, III, IV	Classification of landscape assessments studies	Psychophysical approach
		Methods to measure preferences	Visualization, rating and ranking the alternatives
		Rural landscape preferences	Rural landscape preferences as a basis for the preferences for forest regeneration and field afforestation
		Formation of landscape preferences	At least partly innate preferences
2) To study the effect of the stakeholder group on the preferences for forest regeneration and field afforestation	I, II, III, IV	Classification of landscape assessments studies	Psychophysical approach
		Methods to measure preferences	Visualization, rating and ranking the alternatives
		Effects of the respondents' backgrounds on preferences	Comparison of the results of the case studies to previous studies
		Formation of landscape preferences	Preferences at least partly dependent on the knowledge and stakeholder group
3) To study the possible contradictions between preferences, ecological recommendations, and landscape management guidelines	I, II, III, IV		Comparison of the results of the case studies with the landscape management guidelines and with the principles of ecological healthiness
4) To evaluate if the theories for predicting landscape preferences are appropriate when preferences for forest regeneration and field afforestation are concerned	I, II, III, IV	Theories for predicting preferences	Comparison of the variables of the information and psycho-evolutionary theories with the results of the case studies
5) To study people's responses to forest regeneration fellings	I	Classification of landscape assessments studies	Qualitative approach, content analysis
		Methods to measure landscape preferences	Visualization, open-ended questions

landscape preferences are used as a background when studying this objective, while the previous research on preferences for field afforestation and forest regeneration is scarce.

Similarly, Objective 2 is studied in all the case studies with previously mentioned methods (psychophysical approach, visualization, ranking and rating). This objective is based on the assumption that preferences are partly dependent on the knowledge and stakeholder group of the respondent. These cultural and cognitive influences on preferences are described in the chapters "Formation of landscape preferences" and "Effects of respondents' backgrounds on preferences". Further, the results concerning Objective 2 are compared to the results of previous studies that are described in the last-mentioned chapter.

Objective 3 is studied by comparing the results of all the case studies to the landscape management guidelines as well as to the principles of ecological healthiness. Correspondingly, Objective 4 is explored by comparing the results of the case studies to the variables of information model and psycho-evolutionary theory which are presented in the chapter "Theories for predicting landscape preferences". Objective 5 is studied in Case Study I through visualization and by adopting a qualitative approach that uses open-ended questions and content-analysis.

1.2.3 Framework of the dissertation

Figure 1 illustrates the framework of this dissertation. The perceptions of and preferences for landscapes are formed based on affective and cognitive processing which can occur both consciously and unconsciously. This dissertation presumes that the prevailing processes in the formation of preferences are rapid and unconscious. Further, this dissertation is mainly based on a post-positivist approach (Guba and Lincoln 1994) believing that certain basic rules can be found in the ways people perceive landscape and evaluate its pleasantness throughout different cultures, stakeholder groups, and natural environments.

Despite these genetic grounds for preferences, the local environments and cultures also affect preferences to some extent. Furthermore, there are individual differences depending on the personal background of the individual – such as previous experiences, knowledge, expectations, purposes, values, and needs – and the moment of the evaluation, for example the emotional states, mood, and fatigue of the individual. Despite the possible individual differences, this dissertation supposes that the group means are reliable measures of landscape

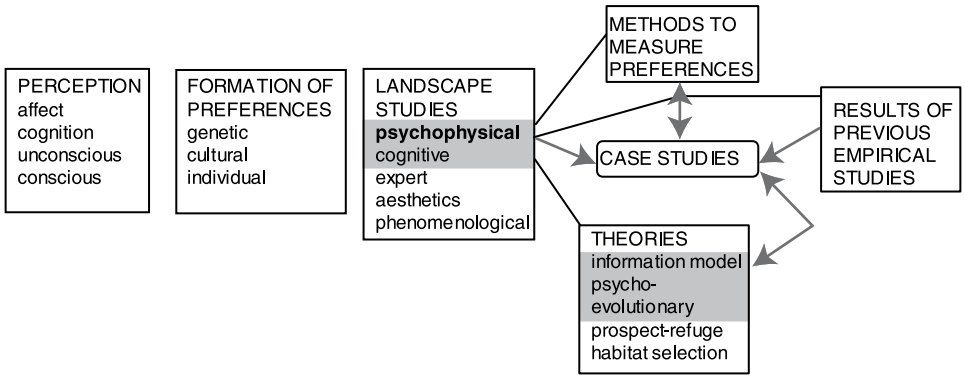

Figure 1. Framework of the dissertation.

preferences. In short, this dissertation is based on the assumptions that general features that improve the visual quality of forest regeneration and field afforestation areas can be found, but that differences between the stakeholder groups and individuals may however exist.

The considerations of the roles of affect, cognition and consciousness in the formation of landscape preferences as well as the genetic and cultural origins of preferences create a basic understanding for the landscape preferences. This dissertation produces information on the roles of genetic, cultural and individual factors – as well as on the role of knowledge – in the preferences by including the different stakeholder groups in the case studies and producing knowledge on the differences and similarities in their perceptions and preferences.

This dissertation presents various approaches to study landscape quality, but the focus is on the psychophysical and cognitive research traditions. The classification of landscape assessment studies helps create a more comprehensive picture of the diverse research field and to place the case studies in a larger framework of research traditions. This dissertation is based on the psychophysical and cognitive research traditions and the case studies included in it in particular on the psychophysical approach. The case studies adopt research methods that are used in the psychophysical tradition, and the results of the case studies are compared to the results obtained by psychophysical and cognitive approaches.

The most important theories predicting landscape preferences can be seen as belonging to the psychophysical and cognitive traditions. They are based on evolutionary perspective supposing that there are universally preferred environmental configurations, but most of them also regard the cultural influences as being important. These theories consider the first responses to environment as being quick and unconscious, and affective reactions as having a central role in perceptions and preferences.

Most studies on landscape preferences do not have a strong connection between theory and empirical research. The theories for predicting preferences have been empirically tested to some extent, but clear conclusions concerning the appropriateness of these theories cannot be drawn based on these empirical tests. Partly owing to the lack of appropriate theories, many of the empirical preference studies are not based on any specific theory; instead, they are grounded on the practical needs of natural resource management. Reflecting on the latter practice, the case studies in this dissertation are based on practical needs. However, the connections between the results of the case studies and the variables of information and psycho-evolutionary theories are sought here to be able to draw conclusions about the appropriateness of the theories in relation to forest regeneration and field afforestation.

This dissertation deals predominantly with visual landscape, and the sense of sight is assumed to be a central means of perceiving landscapes (Ulrich 1983, Jubenville et al. 1987, Hietala-Koivu et al. 2006). Further, it is presumed that visualization can capture the important landscape configurations of regeneration and afforestation areas.

1.3 Defining concepts

1.3.1 Concepts of landscape

The term landscape is used in many research fields. However, the different paradigms or theories have different understandings of landscape, different definitions for landscape, and different methods to study people's perceptions of landscape.

For instance, in some research fields, the term landscape is expanded to cover almost every aspect of our surroundings and human environmental experience, while in other disciplines,

this term has a more restricted definition. For example, landscape ecology uses the term landscape to include nearly all elements of the environment or ecosystem; landscape includes biological and ecological processes as well as the human influence on the landscape (Forman and Godron 1986). Similarly in the human sciences, landscape perception has been enlarged to cover all features of the human environmental experience, recollection and imagination (memories, symbolic meanings, historical, cultural social significances, spiritual values) (Daniel 2001a).

In other research fields or paradigms a landscape has more specified dimensions. In landscape architecture, a landscape can be defined as "a part of environment that we can engage with a given time" (Bell 2001). In geography, a landscape has been defined as "a perceived segment of the earth surface" and as "a way of seeing" (Terkenli 2001). In the social sciences, a landscape often implies the meaning that is given to a certain landscape. For example, in constructivism, a landscape would be a construction of the human mind that can differ from person to person. The psychological concept of a landscape emphasizes how a human being experiences a landscape (Hietala-Koivu et al. 2006).

Attempts to combine all these different landscape concepts into one have been made for example by Tress and Tress (2001). They define an interdisciplinary landscape concept as the "complex dynamic system made up of interrelated subsystems known as the geo-, bio- and noo-sphere (the mental sphere in which humans function)". According to Tress and Tress (2001), a landscape is thus the concrete nexus of nature and culture, and a spatial and mental entity. However, expanding the concept of landscape in this way is not necessarily useful in studying the specific questions connected to landscapes such as the visual quality of a landscape (Daniel 2001a). Rather, every specific study needs to define the concept of landscape and that largely depends on the research objectives.

1.3.2 Concepts of landscape and preference in this dissertation

Figure 2 illustrates the relations of the concepts interlinked with landscape as understood in this dissertation. The definitions of concepts are summarized in Table 2.

In this dissertation, environment is defined as including everything surrounding us and containing ourselves as well. The environment also consists of elements that cannot be seen or sensed with our senses, for example, the biological processes. It includes both urban and rural environments as well as natural and cultural environments. This dissertation deals with rural environments and both natural and cultural environments, especially timber production forests and agricultural lands.

Landscape is defined here as "the experiential environment that can be perceived by sensory – sight, taste, smell, hearing, touch – , affective, and cognitive processes". Based on these processes, mental images are formed. The scenery or scene is "the part of the landscape that can be perceived with the sense of sight", i.e. it is the visual landscape. The difference between scenery and scene is that scenery usually contains natural features and is considered to be beautiful. Visual is a neutral adjective meaning something related to sight while scenic implies beautiful views and natural features like its parent word, scenery.

View (vista, prospect, lookout) is "the part of the visual landscape (scene) that can be seen at one glance, from one view point". In the Finnish language, only one word describes the landscape, scene and scenery, namely "maisema". "Näköala" or "näkymä" are the Finnish counterparts to view, prospect and vista. This dissertation deals mostly with visual landscapes and in particular, views into these scenes.

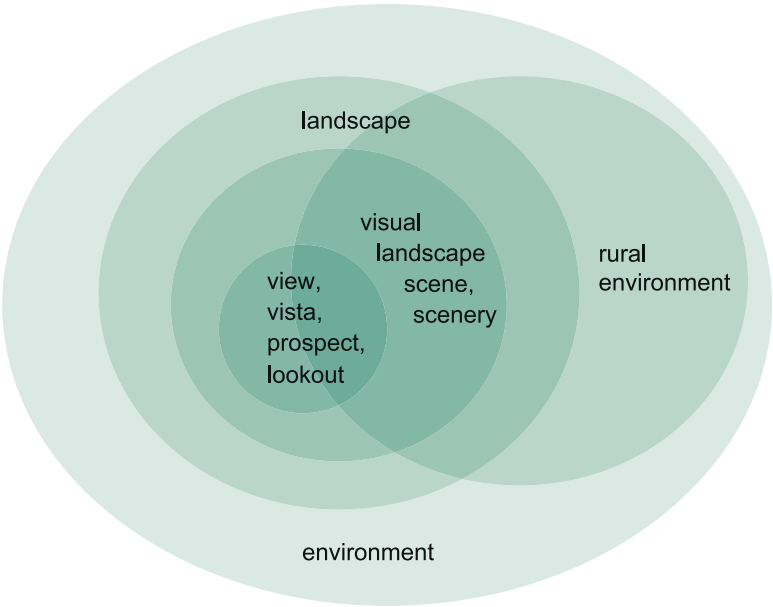

Figure 2. Connections between the terms related to landscape.

Table 2. Definition of the concepts of this dissertation.

Concept in English	**Concept in Finnish**	**Definition of concept**
Landscape	Maisema	The experiential environment that can be perceived by sensory (sight, taste, smell, hearing, touch), affective, and cognitive processes
Visual landscape, scene, scenery	Maisema	The part of the landscape that can be perceived with the sense of sight
View, vista, prospect, lookout	Näköala, näkymä	The part of the visual landscape (scene) that can be seen at one glance, from one view point
Near-distance view, middle-distance view, long-distance view	Lähimaisema, kaukomaisema	0-100 m, 100-200 m, more than 200 m
Preference	Preferenssi, pitäminen, mieltymys, arvostus	A liking for something

This dissertation uses the terms long-distance, middle-distance and near-distance views in connection with Finnish rural landscapes. Exact distances for the near-, middle- and long-distance views cannot be determined. The near-distance view is an area which covers the three-dimensional vision of humans. In the near-distance, separate objects, their relations, colors and forms can be distinguished (Iisakkila 1977). The limit of the near-distance view is around 20–100 meters depending on the environmental conditions such as weather (Maisematoimikunnan mietintö 1980). In Finnish landscapes, a long-distance view is usually considered to start at 100–200 meters from the viewer (Antikainen 1993). As this dissertation concerns Finnish rural landscapes, a long-distance view is regarded as beginning around 200 meters from the viewer, and the middle-distance view is considered to locate between 100 and 200 meters from the viewer.

Preference is also a concept that is used in many disciplines. Preference is often used in economics when it can be defined in the following way: When an individual reports that "A is preferred to B", it is taken to mean that all things considered, he or she feels better off under situation A than under situation B (Nicholson 2002).

The term preference in landscape studies usually means liking or appreciating. This dissertation refers to preference as "a liking for something". The term preference implicitly contains an assumption that something is favored over something else. Nevertheless, this concept does not necessarily imply a direct comparison of objects. The result of landscape preference studies often is a rank-order of the presented objects, i.e. certain landscapes are preferred to other landscapes. However, an individual respondent does not necessarily rank-order or compare the different landscapes but the final preference order can be a result of means or medians of ratings. Thus, preference implies that opinions of people have been inquired and that it is a relative measure.

2 THEORETICAL CONSIDERATIONS CONCERNING LANDSCAPE PREFERENCES

2.1 Classification of landscape assessment studies

2.1.1 Approaches to study landscape quality

The visual perceptions of and preferences for landscapes are studied under various kinds of paradigms and by many disciplines such as aesthetics, landscape architecture, psychology, geography, the social sciences, forest sciences, etc. Research methods and practices are diverse and vary according to the disciplines and research questions. Efforts to classify and categorize these various approaches are useful because they help to analyze and structure the rich spectrum of different frameworks as well as to place the individual studies in the field of landscape assessment studies.

Zube et al. (1982) and Daniel and Vining (1983) have presented classifications that are often used in literature reviews. Zube et al. (1982) have divided the approaches used to study landscape perceptions into four categories; expert, psychophysical, cognitive, and experiental paradigms. Daniel and Vining (1983) use a similar kind of classification. They have defined the methods of assessing landscape quality as approaches that are ecological, formal aesthetic, psychophysical, psychological, and phenomenological. The ecological and formal aesthetic models correspond to the expert paradigm, the psychological model to

the cognitive paradigm and the phenomenological model to the experiental paradigm in the classification of Zube et al. (1982).

Terkenli (2001) categorizes landscape aspects as being visual (forms), cognitive (meanings) and experiential (functions). The main difference to the classifications of Zube et al. (1982) as well as Daniel and Vining (1983) is that here the biophysical and ecological analysis have been placed in the same category labeled ”experiental” as human experiences.

Lothian (1999) divides the paradigms of landscape quality assessments into subjectivist and objectivist paradigms. The objectivist approach believes that the aesthetic quality is inherent in the physical landscape, and subjectivist regards the landscape quality as a product of the mind. Both of these paradigms have prevailed in the philosophy of aesthetics but in the history of philosophy, a shift has occurred from regarding beauty as being inherent in the object to considering it as being in the eyes of the beholder. The objectivist approach is similar to the expert, ecological and formal aesthetic approaches in the classifications of Zube et al. (1982) and Daniel and Vining (1983), while the subjectivist is parallel to the perception-based approaches (psychophysical, psychological, cognitive, and phenomenological).

Hietala-Koivu et al. (2006) add a representational approach to the objective and subjective approaches of observing landscape. According to them, the objective approach observes the physical landscape, the subjective examines the landscape experienced by an individual, and the representational view considers the different ways to describe the landscape and the cultural meanings given to landscapes. The representational view thus covers the aesthetic and parts of the cognitive and phenomenological approaches.

A modification of these classifications is presented in Figure 3. This review excludes the ecological approaches, and includes only the approaches concerning landscape as defined in this dissertation (i.e. experiential environment). The quality of the landscape is always determined by human appraisal, either by the public or by an expert. Landscape assessment studies fall into two main categories; the views of experts, and the perceptions, preferences, and experiences of the public. The environmental aesthetics approach is in between these two categories and can be a useful link between them. The research on public perceptions can be further divided into three categories: the psychophysical, cognitive, and phenomenological approaches. The psychophysical and cognitive approaches can be named as preference studies.

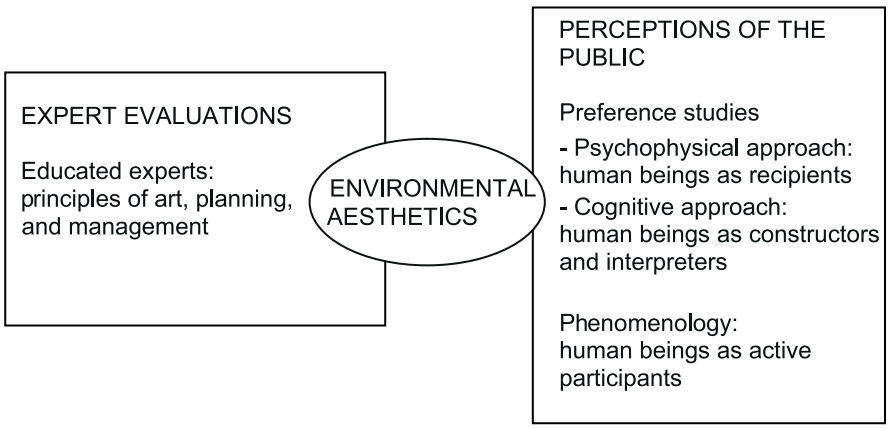

Figure 3. Approaches to assess landscape quality.

In the *expert approach,* skilled and trained experts study and evaluate landscape quality according to the principles of art, design, or management. Various visual landscape design methods have been developed to analyze the visual features of the landscapes and the impacts of landscape change, for example, the Scenery Management System of the US Forest Service, the Visual Resource Management of the US Bureau of Land Management, and the Visual Resource Management of British Columbia, and the Forest Landscape Design Guidelines of British Forestry Commission (Forest Landscape Design... 1994, Landscape aesthetics 1995, Visual Resource Management 2006). In Finland, methods for forest landscape planning have been developed by Komulainen (Antikainen 1993, Komulainen 1998).

These methods usually include the following steps: determining the objectives, inventory, analysis, synthesis or design, and follow-up. For example, in the process of the forest landscape design of the British Forestry Commission (Forest Landscape Design... 1994), physical information such as the contours, soils, ecology, archaeology, and recreation are surveyed. In addition, the visibility, sensitivity and character of the site are mapped. An analysis is made of the constraints and opportunities, visual patterns (shapes, visual forces, scale, elements of diversity, unifying factors, and the spirit of the place) and aesthetic problems. The design synthesis brings together the objectives, survey and analysis. The Scenery Management System of the US Forest Service (Landscape aesthetics 1995) is used to identifying landscapes that are important and to prioritizing their scenic values. In the inventory steps, the expert describes the landscape character and maps the visibility and scenic classes and integrity levels. Finally, alternative development options are designed, evaluated and selected.

These kinds of expert approaches are useful for landscape planning but they are not always scientifically well-defined (Zube 1984). The individual expert assessments are not established to be consistent (Daniel 2001a). Moreover, expert approaches often lack the input of public perceptions. Daniel (2001a) states that in the practical landscape management in the United States, the expert- and perception-based approaches have begun to merge into an approach that addresses the interdependency of landscape features and human perceptual processes. In Great Britain, the landscape design principles are tested by inquiring about the public perceptions of them (Bell 1998). In Finland, Komulainen (1998) has incorporated participatory planning in the rural landscape planning method.

Environmental aesthetics can be situated somewhere between the expert approach and the perceptions of the public. Aesthetics is the philosophical and critical study of beauty, examining whether beauty has certain principles and on which grounds the term beauty and other aesthetic terms are used. For aesthetics, the objects of study can be descriptions of the environment, for example, in literature and the visual arts. The normative branch of environmental aesthetics presents what is good, beautiful and valuable. This type of aesthetician is the judge of taste, and values are considered to be general. Conversely, descriptive environmental aesthetics describes the different taste and value systems. The criteria used in descriptive aesthetics are agreed upon, and one society can harbor different value systems. (Sepänmaa 1981, 1987) Environmental aesthetics can clarify the discussion concerning the environment, give terms, require accuracy, increase the knowledge about the values behind the choices, and create a basis for applied research. In order to be useful in natural resource management, environmental aesthetics should be able to offer theories for the applied research to test and apply.

Recently, a concept of *ecological aesthetics* has been discussed extensively because it offers one possibility to combine ecological and aesthetic needs in natural resources management. The basis for the norms of ecological aesthetics is ecological healthiness and sustainability. Ecological aesthetics allows different kinds of systems that have been agreed upon because

different kinds of alternatives are also possible in nature. According to Sepänmaa (1987), ecological aesthetics should be able to take a stand in the superiority of the different kinds of systems; the criteria for aesthetical acceptability are needed. Nevertheless, the evaluation criteria can be used only when the human contribution to the change of nature is evaluated because an ecologically sound environment is always beautiful, as is everything in its natural state (Kinnunen 1981).

According to ecological aesthetics, aesthetic appreciation should be based on ecological knowledge i.e. what is ecologically good also looks good to us. Ecological knowledge can broaden people's vision to recognize the dynamic nature of healthy ecosystems, and to accept landscape change (Daniel 2001a). However, we do not yet fully understand the forest ecosystem dynamics and the spatial principles of ecology and it is therefore questionable whether we can determine what naturalness and ecological healthy actually are (Daniel 2001a, Sheppard 2001). Furthermore, it seems ethically problematic to direct people to prefer certain kinds of landscapes. On the contrary, Sheppard (2001) introduces a concept of visible stewardship that assumes that we find aesthetic those things that clearly show people's care for a particular landscape, and their attachment to it.

Ecological aesthetics is linked closely to the discussion of the science-based and non-science based approaches of environmental aesthetics. The science-based view is parallel to ecological aesthetics. According to this view, the more science-based knowledge of nature a person has, the deeper aesthetic experience he or she achieves. On the contrary, the non-science-based approach states that if a person does not perceive nature based on knowledge but on an experiential level, he or she is part of nature. In this case the border between the experiencer and nature merges and the aesthetic experience is strong. (e.g. Eaton 2003)

Psychophysical models measure the visual elements of the landscape either from a picture or in the field, for example, the amount of logging residue, the diameter of the stands, and the basal area. The respondents are then asked to evaluate the quality of the landscape, usually by providing a single psychological response on such factors as landscape preference, scenic beauty, or scenic quality. As a result, the connections are sought between the features measured and the preferences observed by means of statistical analyses. Many studies do not specify any psychophysical functions but describe the characteristics of preferred and less-preferred landscapes in general terms (Daniel and Vining 1983).

Psychophysical models can produce concrete knowledge for planning and management purposes but nevertheless they lack theoretical content (Ruddell et al. 1989). For example, psychophysical models do not explain why people like or dislike certain landscape features. In addition, a landscape is perceived and experienced as a space or structure where several variables operate in combination but these models concentrate on single elements in the landscape. Also, psychophysical models are not necessarily applicable in other areas or in different kinds of forest stands other than those for which they are developed. For example, Brown and Daniel (1984) observed that their scenic-beauty models developed for the Ponderosa pine stand in one region cannot be applied to similar stands elsewhere without substantial loss in predictive power.

When the landscapes elements are measured on site and the preference ratings are given based on photos, it should be made certain that the measured elements are visible in the photos, because otherwise the appropriateness of the variables is questionable. Moreover, it is not entirely definite if the chosen variables really are relevant for landscape preferences, and it is not known what people actually give attention in the images or in the real landscape. Along with the development of the visualization methods, this problem has decreased. Since visualization allows changing only one aspect of the landscape at a time, it can be

more accurately deduced which elements in the landscape have affected the perceived preferences.

The *cognitive (or psychological) approach* involves a search for human meaning and information that are associated with landscapes. The cognitive approach emphasizes how the viewers organize, process and interpret the informational content of the environment (Ruddel et al. 1989). Cognitive research is interested in human reactions, and the aesthetic quality is only one of the several dimensions of the human response (Daniel and Vining 1983).

Cognitive research is often based on the presentation of the landscape studied. The respondent may be asked to evaluate the landscape through such perceptual, cognitive, and affective concepts as mystery, unity, coherence, and complexity. These variables are not separate features in the landscape but they describe the landscape as a whole. The relationships between variables and preference are subsequently examined in order to ascertain the psychological basis of landscape preferences. In addition, the analyses can encompass the interviews, texts, drawings or cognitive maps produced by humans. The cognitive and psychophysical approaches can be referred to as preference studies.

Cognitive studies can help us understand the reasons for landscape preferences. Even so, the content of the variable may differ depending on the individual who is assessing the landscape. Another complication is that it is not clear how preference differs from the other qualities that are measured in order to predict preferences. In addition, the landscape variables established in cognitive studies are often difficult to make concrete for practical landscape planning and management.

Phenomenological, humanistic and experiential landscape research is here categorized under the same title, *phenomenological approach*. Zube et al. (1982) have also placed aesthetics and geography in this category. Other scholars would not place phenomenological studies under the headings landscape quality research or landscape assessment studies because phenomenological studies rather concentrate on the experiences of people than on the quality of the landscape.

Phenomenological research considers human beings as active participants. It focuses more on the relationship between landscape and a person than on the comparative assessment of different landscapes. This orientation deals with the phenomenology of landscape experience. The phenomenological approach seeks to understand the total experience of the individual when he or she interacts with the landscape (Herzog 1985). These studies may also aim at exploring what is the meaning and significance of the different landscape configurations to a certain individual.

Phenomenological studies thus focus on human representations, interpretations, and experiences of nature. Consequently, research objects can be items that have been created in the interaction between man and environment, as for example, the landscape descriptions in the literature and historical documents. Humanists have often studied historical trends in landscape appreciation and have concentrated on the landscape descriptions of the social elite and the exceptional features of the landscape. In addition, interviews and surveys can be used as research methods. (Porteous 1982, Daniel and Vining 1983, Herzog 1985)

The phenomenological and humanistic approaches provide qualitative knowledge and they can explain the meanings of a landscape for certain individuals and offer explanations for their preferences. These approaches can also be useful in natural resource management. A phenomenological study concerning a certain specific place may provide useful information for the management of this place. The drawbacks of these methods are that they are often laborious and they seldom have generalizability beyond the particular place studied.

2.1.2 Concluding remarks of the approaches to study landscape quality

Visual landscape assessment has a long tradition in the United States. There the visual qualities of landscapes have been given attention in environmental resource management for more than a half a century (expert approach). The public's landscape preferences have also been studied in the U.S. for several decades mainly by applying psychophysical and psychological methods (public perceptions). Most of the empirical research on landscape quality in the United States has originated from The National Environmental Policy Act in 1969 that required aesthetics to be considered in federally funded projects (Brush et al. 2000). Nowadays, a shift has occurred from psychophysical research to studies concentrating on places (the concepts of place and space, meaning of place, place attachment, and favorite places).

In Europe, aesthetic, geographical and ecological approaches have been more common than visual landscape assessments or public perception studies. Nevertheless, visual landscape design principles have also been developed, especially in Great Britain (e.g. Lucas 1991, Bell 1993, Forest Landscape Design... 1994, Gustavsson and Ingelög 1994, Komulainen 1998). Landscape preference studies have been somewhat more frequent in Finland than in other European countries (e.g. Kellomäki 1975, Savolainen and Kellomäki 1981, Saastamoinen 1982, Pukkala et al. 1988, Tahvanainen et al. 1996, Hallikainen 1998, Silvennonen et al. 2001, Tahvanainen et al. 2001, Silvennoinen et al. 2002, Tyrväinen et al. 2003). In recent years, ecological aesthetics has been discussed both in North America and Europe. Daniel (2001a) also sees a contrasting paradigm emerging; the socio-cultural paradigm that emphasizes negotiation and consensus building and in which the environment is viewed as a social construction and individual preferences only as indications of cultural background.

All the previously described approaches are useful in studying the landscape quality or in natural resource management, and all of them have their drawbacks as well. Even though an expert approach provides tools for visual landscape planning, expert assessments are not always reliable. By comparison, environmental aesthetics could create a basis for applied research. Yet environmental aesthetics has not so far produced applications – such as theories or criteria for aesthetic acceptability – that could be useful in applied research or natural research management.

Psychophysical models provide answers to practical problems in natural resource management but they would need a stronger theoretical and conceptual basis. For example Ribe (1990) states that the theory required to formulate and unify in-forest beauty prediction models does not yet exist, i.e. the psychophysical models developed for one type of forest may not apply in other kinds of situations. In turn, cognitive and phenomenological studies can help understand the meaning of landscape and reasons for landscape preferences. However, the psychological landscape variables of cognitive studies are to large extent dependent on the interpreter of the landscape, and the phenomenological studies are often too time-consuming to perform and their results cannot usually be generalized beyond the particular place studied.

In the practical landscape design and forest management planning, the integration of perception-based studies and the expert approach is needed. For example, Bishop and Hull (1991) as well as Bishop and Hulse (1994) have suggested a model to match public- and expert-based (including GIS) landscape assessments for visual resource management. Daniel (2001a) observes that this kind of merging is already happening in the practical landscape management in the United States. As for Finland, Komulainen (1998) has developed a planning method in which the local inhabitants participate in the planning process. By

comparison, in Great Britain, landscape design principles have been tested and calibrated by preference research (e.g. Bell 1998).

Public preferences can be silent knowledge that influences the mind of the planner or decision maker, but a more systematic approach would nevertheless be needed. For instance, scenic beauty indices based on preference research could be included within the parameters used in numerical forest management planning systems (Nousiainen et al. 1999, Pukkala 2004). According to the model of Pukkala et al. (1995), management objectives i.e. criterion variables (e.g. timber production, scenic beauty, and ecological values) and their relative importance are specified by a decision analysis. Scores for each criterion variable are computed in order to simulate alternative forest management plans. The results of landscape preference studies can be utilized in calculating the scenic beauty scores.

At the moment, the results of different perception-based studies (psychophysical, cognitive, phenomenological) are difficult to compare and combine owing to the diverse assumptions as well as different research and analyses methods. To produce comparable knowledge, interdisciplinarity and combination of different approaches as well as standardization of research methods is needed. One possibility for the integration would be that the more theoretical approaches could generate theories and the more applied research could be based on these theories as well as test them. For instance, Zube (1984) and Hartig (1993) have suggested that the psychophysical, cognitive and phenomenological approaches should be combined into one theoretical framework for landscape perception studies, because none of them can alone explain the interaction between a landscape and a human being.

Nevertheless, the use of only one theory would not be appropriate. Landscape perceptions and preferences are complex and multidimensional phenomena, and we do not accurately know the exact ways and processes how perceptions and preferences are formed. For this reason, these phenomena should not be studied only in an interdisciplinary way that is based on common theories but also by different disciplines, methods and assumptions in order to gather different kinds of knowledge. Different research goals may require different research methods, different theories and assumptions behind the research. However, the same research objective can also be studied through applying various approaches. Yet the integration of all the knowledge produced by diverse approaches is essential to gain a more thorough comprehension of landscape preferences and perceptions.

This dissertation belongs to the psychophysical and cognitive research traditions. The empirical case studies included in this dissertation are closest to the psychophysical approach even though the case studies do not measure elements of the actual landscape or images but describe the differences between the scenes. The psychophysical method was considered to be the most appropriate approach for the case studies aiming at producing practical knowledge for natural resource management as psychophysical approach uses concrete landscape elements that can be applied in practical planning situations.

2.2 Formation of landscape preferences

2.2.1 Roles of affect, cognition and consciousness in landscape preferences

The nature of cognitive-emotional interactions is one of the most debated topics in the psychology of emotion (LeDoux 1995). In addition, the roles of affective and cognitive processes in the formation of preferences have been discussed extensively in the landscape perception and preference literature (Lazarus 1982, Ulrich 1986, Bourassa 1990, Kaplan

1995, Zajonc 2000, Daniel 2001b). There seems not to be unanimity among scholars as to the meanings, ways of functioning, and importance of these processes in landscape preferences.

The cognitive and emotional processes seem to be interconnected. Paul et al. (2005) state that cognitive processes – appraisals of stimuli, events and situations – play an important role in the generation of emotional states, and vice versa, emotional states influence cognitive functioning by inducing attention, memory, and judgment biases. For example, the study by Gray et al. (2002) demonstrated that emotion and higher cognition can be truly integrated. In other words, at some point of processing, the functional processing is lost, and emotion and cognition conjointly and equally contribute to the control of thought and behavior. Furthermore, Lazarus (1982) states that cognitive processes are important in the formation of emotions, and some emotions are more dependent on cognition than others. Cognitions and emotions can be simultaneous, and emotions can influence the cognitive processes at any stage of the cognitive processes and vice versa (Lazarus 1982).

On the other hand, it is possible that logical/rational processes and emotional processes may be carried out in separate brain systems that are significantly insulated – or at least partially independent – from each other (Zajonc 1980, Daniel 2001b). This means that emotional responses might also occur in the absence of inputs from the cognitive system (Zajonc 1980, LeDoux 1995, Zajonc 2000). Correspondingly, a person could connect an object with an affective meaning or preference before knowing what the object or event is (Zajonc 1980). In fact, several researchers state that the first reactions towards an objective are emotional (Zajonc 1980, Ulrich 1986, Bourassa 1990). This initial affective reaction would then influence an ensuing process of the cognitive evaluation of the scene (Zajonc 1980, Ulrich 1983).

Both emotions and cognitions that influence preferences can be genuinely unconscious (Kaplan 1995). The processes of perception, learning and cognition can occur independent of any conscious awareness of them. Similarly, psychological processes that are implicit and affective may sometimes take place in the mind and brain independent of conscious feelings (Berridge 2003). Despite the absence of subjective feelings in such cases, affective reactions still influence people's preference judgments (Winkielman and Berridge 2004). Similarly, these unconscious emotional responses can manifest themselves in observable affective reactions (Berridge 2003).

In short, we still do not know all the factors involved in the process of preference formation. For instance, it is not still clear what kind of perceptions, cognitions, and emotions are relevant in aesthetic quality (Daniel 2001a). As described earlier, landscape preferences are probably influenced both by affective and cognitive processes. However, we do not yet know which are the actual mechanisms at work in the emotional and cognitive processes, whether they are separate or interconnected, nor do we know order in which they occur and which ones are more important. Further, it is not yet known to what extent these processes (the selection of information, perception, affective and cognitive processing) are unconscious and to what extent they are conscious. The roles played by the unconscious and conscious as well as by the affective and cognitive processes may depend both on the environment that is perceived and on the individual qualities of the perceiver.

It seems probable that at least the first reactions in preference formation are affective and automatic. For example, Korpela et al. (2002) provide support for people's rapid and automatic affective evaluations of environmental scenes. It is possible that some of the people's rapid reactions – e.g. mood states, decisions or approach/avoidance behavior – might be based on these initial states of processing. For instance, Daniel (2001b) states that it is likely that environmental preferences may depend more on people's specialized affective reactions than

on any knowledge-based logical operations. However, the initial automatic reactions may alter in the later stages of processing that include more cognitive processing.

2.2.2 Genetic and cultural formation of landscape preferences

The origin of landscape preferences involves two main approaches and explanations. First one states that landscape preferences are to a large extent genetically predetermined, and the second position argues that preferences are learned and dependent on the culture, time period, and the individual. It seems most probable that preferences are influenced both by inherited and learned properties, and that individual differences also exist within the same culture.

The genetic or evolutionary approach argues that people's preferences are to a great extent innate and that they were basically formed already in the early stages of human evolution. So preferences are explained in terms of human survival (Appleton 1975, Ulrich et al. 1991, Orians and Heerwagen 1992). The genetic approach is supported by the clear observation that humans prefer natural settings to urban settings (van den Berg et al. 2003, Staats et al. 2003), and that nature enhances the restoration from stress and attentional fatigue (Ulrich 1981, Hartig et al. 1991, Ulrich et al. 1991, Hartig et al. 2003, Herzog et al. 2003, Laumann et al. 2003, van den Berg et al. 2003).

Ulrich et al. (1991) argue that because humans evolved over a long period in natural environments, they have an unlearned predisposition to respond positively to natural content and to configurations that were favorable for survival or the ongoing well-being during evolution. Furthermore, it seems that the fundamental human perceptual and cognitive processes do not vary between cultures and that culture does not alter human nature as being a highly visual information-seeking animal (Ulrich 1977). These similarities in information-processing capabilities of humans may lead to similarities in the use and interpretation of environmental information and hence to similarities in people's scenic evaluations of landscapes (Hull and Revell 1989b).

Nevertheless, a biological basis cannot totally explain environmental preferences. Even though there are repeated findings of intra- and inter-cultural similarities in aesthetic preferences (Shafer and Tooby 1973, Buhyoff et al. 1983, Tips and Savasdisara 1986, Yang and Kaplan 1990, Purcell et al. 1994), differences between cultures and within one culture have also been reported (Zube and Pitt 1981, Abello and Bernaldez 1986, Kaplan and Herbert 1987, Kaplan and Talbot 1988, Hull and Revell 1989b) (See also chapter 3.3). Further, people's comprehensions of nature (see Knopf 1987) as well as their idea of what is beautiful have changed over time. Moreover, some heavily altered landscapes are interpreted as being beautiful (Botkin 2001). For example, Nohl (2001) states that new aesthetic orientations occur when significant landscape changes take place and when a population group has strong but not necessarily aesthetic interests in that new landscape.

Nevertheless, some empirical studies show that people's landscape preferences are rather stable within a time frame of ten or twenty years. Lindhagen and Hörnsten (2000) showed that the forest landscape preferences of Swedes had changed only slightly in two decades (see details in chapter 3.3). Another study by Palmer (1997) analyzed the perceptions and preferences of the citizens of Cape Cod over a ten-year period. Despite the high degree of changes in land-use, the citizens' understanding and visual preference for the landscape were relatively stable within a ten-year time frame.

Based on these observations, it can be assumed that humans have an innate genetic aesthetical sensitivity that is developed into diverse cultural and individual forms (Kogan

1994). Bourassa (1990) introduces a categorization of the sources that affect landscape preferences: biological, cultural and individual. These sources can be described by aesthetic laws, rules and strategies. The aesthetic laws are genetically inherited, the rules are dependent on the culture, and the strategies are individual.

Aesthetic laws refer to the landscape properties that people innately like, i.e. certain environmental features and configurations are favored all over the world. As an illustration, people prefer natural environments and natural non-artificial forms, such as bent forms and edges and gradual changes in shapes and colors (Kaplan and Herbert 1987, Knopf 1987, Kaplan and Kaplan 1989, Yu 1995). The cultural rules can either be different or identical between different cultures. For instance, the preferences of Chinese and Western people differed only in those landscapes that had special cultural meanings (Yu 1995). Landscape preferences are also to some extent dependent upon individual factors, such as a person's past experiences, current purposes and goals, knowledge, expectations, needs, values, attitudes, emotional states, etc. (e.g. Hull and Revell 1989b). As such, preferences may be guided by personal hopes and expectations as to what kind of effect the environment would have on the individual's own well-being or the particular purpose in mind (Hartig 1993).

As mentioned, it is probable that some landscape properties, configurations and landscape types are preferred in the same way all over the world or at least in one cultural region. When studying landscape preferences, it would be important to know which landscape elements and arrangements of these features are universally (genetically inherited) appreciated and which of the preferences are dependent on culture, time period, or on individual factors. This kind of knowledge does not exist yet and it poses a great challenge for future research.

2.3 Theories for predicting landscape preferences

The most important theories aiming at explaining the reasons for preferences and at predicting preferences are information processing or knowledge acquisition theory (Kaplan and Kaplan 1989, 1998), psycho-evolutionary or affective theory (Ulrich 1983, 1986), prospect-refuge theory (Appleton 1975), and habitat selection theory (Orians and Heerwagen 1992). All these theories are based on the assumption that the landscapes preferred by humans enhance survival. The next chapter describes these theories as well as compares and evaluates them.

The case studies of this dissertation are not based on any of these theories. Instead, the relationships between the results of the case studies and the variables of the information and psycho-evolutionary theories were examined to determine if these theories could explain the preferences for regeneration and afforestation areas.

2.3.1 Information model or knowledge acquisition theory

The theory most often cited for predicting landscape preferences is the information or knowledge acquisition model proposed by Rachel and Steven Kaplan (Kaplan 1987, Kaplan and Kaplan 1989, Kaplan et al. 1998). This theory is based on a large number of empirical preference studies. According to this information model, landscape preferences are based on the need to function efficiently in the environment. People's preferences are therefore affected by the chances the environment offers for people to explore and the restrictions it sets for activities. Correspondingly, functioning depends on two basic human needs: understanding and exploration. Understanding means that a person can make sense of what is going on. It

is a process in which a person structures the environment so that he or she can experience the environment as understandable and clear and can move there without getting lost. Exploring implies that the environment stimulates and maintains a person's interest and offers a lot of information.

The information theory asserts the following four cognitive aspects of landscape that are crucial in the appreciation of landscape: coherence, legibility, complexity, and mystery (Table 3). Coherence and legibility are important in understanding the scene while they provide information that can help people make sense of the environment. People more easily understand environments that are well-organized and distinctive. In turn, complexity and mystery provide opportunities for people to explore. Complexity and mystery suggest the potential for exploration either because of the variety of the elements or because of the cues that imply there may be more to be seen. Thus the preferred environments contain ample information but in a legible and coherent form. (Kaplan and Kaplan 1989, Kaplan et al. 1998)

Coherence means that the different parts of the landscape fit together. Coherence thus provides a sense of order and helps in directing attention. This means that a coherent landscape is easy to organize and structure. Coherent settings have a few distinct regions or areas that can be discerned and these make it easier for people to make sense of the place. Coherence can be increased by having some repeating themes and unifying textures or a limited number of contrasting textures. A coherent environment can either be clear and simple or it can be rich and structured. In other words, a scene can be high in complexity and coherence at the same time. (Kaplan and Kaplan 1989, Kaplan et al. 1998)

A *legible* environment is easy to understand and to remember. It is a well-structured place with distinctive elements (landmarks) and identifiable objects. A legible scene has some memorable components that help people orientate to it. In a legible space, it is easy for people to figure out where they are at any given moment and to find their way back. (Kaplan and Kaplan 1989, Kaplan et al. 1998)

The perceived *mysteriousness* makes the environment attractive. Mystery is a promise that as you go deeper into the landscape, there is more to be seen than that is immediately perceivable. The setting seems to invite you to enter more deeply into it and thereby to learn more. Mystery can be enhanced for example by vegetation that partially obscures what lies behind it or by making the road wind through the forest. *Complexity* is the internal variation of the scene. A complex landscape includes a wealth of information and offers different

Table 3. The preference matrix according to Kaplan and Kaplan (1989).

Goal of the activity / **Availability of the information**	Understanding	Exploration
Immediate, 2D	COHERENCE	COMPLEXITY
Inferred, predicted, 3D	LEGIBILITY	MYSTERY

kinds of visual elements as well as possibilities for different kinds of activities. Complexity reflects how much there is going on in the scene and how much there is to look at. (Kaplan and Kaplan 1989, Kaplan et al. 1998)

The information model states that both the content of the landscape and the cognitive processes taking place in people's minds influence preferences. A human requires both immediate information and information that can be inferred. Whereas coherence and complexity provide information and exploration immediately, legibility and mystery are inferred and predicted. Coherence and complexity are based on a two-dimensional plane that represents the surface of the picture. At this primary level, perception involves a very rapid assessment of the patterns of light and dark. Elements and textures in the scene, including their grouping and location are extracted from this primary information. (Kaplan and Kaplan 1989, Kaplan et al. 1998)

The three-dimensional aspect involves the inference of what is deeper in the scene. The inference of the third dimension occurs rapidly and unconsciously, although it may take a few milliseconds longer than the very rapid processing of the two-dimensional aspects. The third dimension is provided by depth that is important in both understanding and exploration. In order to be legible and mysterious, the scene requires the inference of the third dimension. (Kaplan and Kaplan 1989, Kaplan et al. 1998)

Many studies have empirically tested the information theory. These empirical studies provide evidence that both understanding and exploration – as well as both immediate and inferred information – are essential to forming landscape preferences. Of the four variables, mystery has been confirmed to be the most powerful predictor (Ulrich 1977, Herzog 1984, 1985, 1987, 1989, 1992, Kaplan et al. 1989, Herzog and Bosley 1992, Kent 1993, Strumse 1994, Hagerhall 2000). In addition, several studies show that coherence explains human preferences (Herzog 1984, 1985, 1989, 1992, Herzog and Bosley 1992, Kent 1993, Strumse 1994). However, in the studies by Herzog's (1987), Gimblett (1990) and Kaplan et al. (1989) coherence was not important. Thus coherence appears not be as strong predictor of preference as does mystery.

Complexity occupies a somewhat vague position in predicting preference. In some studies complexity explained preferences (Herzog 1985, 1992, Gimblett 1990, Kent 1993, Strumse 1994), while in others, it did not (Herzog 1984, 1989, Kaplan et al. 1989). Legibility has not been a very good predictor of preference (Herzog 1989, Kaplan et al. 1989, Gimblett 1990, Kent 1993). It can be strongly (Herzog 1989, 1992) correlated with coherence. Even so, a later study by Herzog and Kropscott (2004) found that legibility and coherence were independent predictors of preference.

In short, mystery seems to be the most consistent of the four predictors of preferences but coherence is also important. Complexity does not necessarily serve as an adequate means to explain preferences and legibility seems to not be a strong predictor. It is likely that coherence and legibility measure more or less the same things. It can also be hypothesized that when understanding landscape, the immediate information (coherence) is more important than the information that can be inferred (legibility). On the contrary, when exploring the environment, the inferred/predicted information (mystery) might be more significant than the immediate (complexity).

Even though individual studies have established correlations between preferences and the information variables, the meta-analysis of Stamps (2004) showed that the correlations between the preference and information variables have not been reproducible and that computing collective correlations would be therefore misleading. Stamps (2004) concludes that the information theory has not generated reproducible results.

To conclude, empirical studies indicate that the information model does not work as such, i.e. all the variables seem not to be important predictors of preference. However, the theory has not been modified and developed further. Cultural and sub-cultural differences are not integrated in the information theory, even though Kaplan and Kaplan (1989) point out that the perceptions and preferences for natural environments are not universal, but that some differences arise due to familiarity, formal knowledge, expertise, and variation that is cultural, ethnic or sub-cultural. Kaplan and Kaplan omit these dissimilarities by arguing that despite differences in background knowledge, the need to understand and explore is quite general, and certain environmental attributes play a strong role in making likely comprehension and the possibilities for exploration (Kaplan and Kaplan 1989).

The theoretical basis of the information theory is solid and offers good grounds for the chosen variables. However, the variables of the information theory remain on a general level and are not easily understood and applied. Different people may interpret these variables in varying ways, and the content of each variable may differ depending on the landscape type and observation distance. Most of the empirical studies have included the variables as such, i.e. the studies have not tried to operationalize them into more concrete landscape features. Kaplan et al. (1989) explain the general level of the predictors by stating that the information model is concerned with the organization of the space rather than focusing on specific elements in the physical setting. They also point out that the variables of the theory apply to a large variety of environments and situations (Kaplan 1987). If more detailed content were given to the variables, the theory might then lose some of its universality.

However, the variables of the information theory do not cover all the configurations that probably influence preferences (Kaplan and Kaplan 1989). Examples of such features are visual access, familiarity, smooth ground, a sense of depth, openings, paths and signs, views and vistas, a sense of enclosure, and water (Kaplan et al. 1998). These elements should be incorporated into the theory so as to provide more complete explanations for preferences.

2.3.2 Psycho-evolutionary or affective theory

The psycho-evolutionary or affective theory for predicting landscape preferences has been developed by Roger Ulrich (1977, 1983, 1986). Ulrich considers preference to be an important affect but only one of a broad range of emotions (such as fear, interest, anger and sadness) that are central in responding to the environment. According to Ulrich (1983), many affects are precognitive and based on little information. Immediate, unconsciously triggered emotional responses play a central role in the initial level of responding to nature. Certain landscape properties cause a human to like or dislike the environment. Responding in the initial state should be adaptive in the sense that it is appropriate to the situation and motivates approach-avoidance behaviors that foster the ongoing well-being or survival.

After the initial affective reaction, a cognitive evaluation of the setting occurs in terms of its significance for well-being. According to Ulrich (1983), affects are universal but the conscious experience of the individuals might vary considerably owing to their differences in cognition. The cognitive process entails recognition, identification and a more extensive processing of the information. Evaluation may be accompanied by memories and associations which, along with emerging emotions, add to the complexity of the observer's conscious experience. As a result, there is an ongoing interplay of feelings and thoughts. Adaptive responses can range from stress and avoidance behavior to restoration and approach behavior. (Ulrich 1983, Ulrich et al. 1991)

According to the psycho-evolutionary theory, the emotional well-being of a human being is elicited by a secure, resource-rich environment (Ulrich 1986). Ulrich (1983) postulates seven landscape properties that influence preferences: structural properties (especially focality), complexity, depth, ground surface texture, deflective vistas, threat, and water. Although developed for the natural environment, many notions in this framework would also apply to urban visual settings (Ulrich 1983).

The information in the landscape should be *structured* or patterned. This is because of aesthetic reactions can occur largely on the basis of the configuration in a visual array as opposed to individual features. Focality, which is a more specific term than unity, coherence or order, is an important aspect of structuring. Focality refers to the degree to which a scene contains a focal point or an area that attracts the observer's attention. Focality is produced when lines, textures and landform contours and other patterns direct the viewer's attention to a specific part of the scene. It is important that pattern properties provide continuity among the separated or dissimilar elements. Focality also results when a single, prominent feature or grouping of features create a scene of dominance that attracts the viewer's eye. (Ulrich 1977, 1983)

Complexity is defined as the number of independently perceived elements in a scene. Low preference is associated with the extreme ends of complexity, while high preference is linked with moderate complexity. However, highly complex scenes can also be appreciated if they are structured. (Ulrich 1983) An important variable for defining the relationships between the elements of a scene is visual *depth*. The sense of depth can be established by such means as textural gradients and overlapping land forms (Shafer and Brush 1977). Furthermore, depth can be increased by landmarks or by having definable bands across the landscape. These horizontal regions can help define layers in the scene. (Kaplan et al. 1998)

Ground surface texture influences both the impression of the depth or space in a setting and the ease of comprehending element relationships in three dimensions. Uniform even-length ground textures and areas of textural homogeneity should be preferred. (Ulrich 1977, 1983) In *deflective vistas*, the line of sight is deflected or curved, signaling that new landscape information is just beyond the visual bounds defined by the observer's position. Settings characterized by *threat or risk* elicit dislike and often fear. *Water* features usually are accorded especially high levels of preference. Water is also a focal element and can increase the sense of depth. (Ulrich 1983)

In short, according to the psycho-evolutionary theory, a preferred environment is visually diverse but has order or patterning and has elements that help viewers to focus their gazes. In other words, complexity should have structural properties that establish focal point, and other order and patterning should be present as well. Furthermore, in an appreciated setting the view has moderate to high level of depth, a deflected vista is present i.e. new landscape is immediately behind the perceived landscape, there is nothing threatening in the landscape, and the ground surface texture is even, smooth, homogenous and passable. (Ulrich 1983, 1986)

There are many similarities between the information and psycho-evolutionary theories (Table 5). A deflective vista corresponds to the information model's mystery and structural properties to coherence. However focality may also have correspondence in legibility. As mentioned earlier, empirical studies show that mystery and coherence have been good predictors of preferences (Herzog 1984, 1985, 1989, 1992, Herzog and Bosley 1992, Kent 1993, Strumse 1994), and focal point has also predicted preferences (Ulrich 1977, Herzog and Barnes 1999). Complexity has also explained preferences to some extent (Herzog 1985, 1992, Gimblett 1990, Kent 1993, Strumse 1994).

In addition, empirical evidence supports other elements in Ulrich's model. For instance, danger and preference have been negatively related (Herzog and Smith 1988, Herzog and Miller 1998, Herzog and Kropscott 2004), and feelings of safety and preference have been connected (Hagerhall 2000). Moreover, water is appreciated and is an important predictor of preferences (Shafer and Brush 1977, Eskelinen 1979, Koch and Jensen 1988, Herzog and Bosley 1992, Hammitt et al. 1994, Herzog and Barnes 1999).

Texture (smoothness of ground texture) has often predicted preferences (Ulrich 1977, Herzog 1985, Kaplan et al. 1989, Kent 1993, Strumse 1994) but, however, in some studies it has not been important (Herzog 1984, 1987). Similarly, ease of movement was positively related to preferences in Strumse's (1994) study, while in other studies, ease of movement was not connected with preferences (Kaplan et al. 1989, Kent 1993). It is possible that ease of movement is correlated with texture (Kaplan et al. 1989).

Little attention has focused on depth but other variables that refer to depth have been studied more extensively. These kinds of variables are openness, spaciousness, viewing distance, visual penetration, visual access, and visibility. Nevertheless, the theoretical content of these variables is different and therefore direct comparison of the results of these studies is problematic. Depth is correspondent to structured spaciousness or openness where one can get a sense of distance. Spaciousness can be defined, for example, as "spaciousness that the scene conveys, how much room there is to wander in" (Herzog 1984, 1985, 1987). Visual access or visual penetration imply that the vegetative foreground exists, while openness and viewing distance can refer either to near-views or vistas in which the vegetative foregrounds are absent (Ruddell et al. 1989).

Good predictors of preferences have been visual penetration (Ruddell et al. 1989), distance (Hull and Buhyoff 1983), visibility (Herzog and Kutzli 2002), and depth (Ulrich 1977). Ulrich (1977) observed that subjects favored medium to high levels of depth. Especially in forest landscapes, visibility is one of the most important predictors of preferences (e.g. Hultman 1979, Brown and Daniel 1986, Hull et al. 1987, Pukkala et al. 1988, Rudis et al. 1988, Ruddell et al. 1989, Haider 1994, Lindhagen and Hörnsten 2000, Silvennoinen et al. 2001). Hammitt et al. (1994) suggest that a visually impenetrable foreground may produce feelings of danger.

Spaciousness or openness has often been a strong predictor of preferences (Herzog 1984, 1985, Kaplan et al. 1989, Strumse 1994, Herzog and Barnes 1999). Yet some studies indicate that spaciousness is not connected to preferences (Herzog 1987, 1989, 1992, Herzog and Bosley 1992, Kent 1993). Probably the significance of spaciousness or openness depends on the landscape type, and it might be that openness or spaciousness is more important in forest environments (e.g. Kent 1993) than in other landscape types.

In short, most of the variables proposed in the psycho-evolutionary theory have been supported by empirical research. Based on empirical studies, good predictors of preferences seem to be structural properties (including focality), depth, threat, deflective vistas and water, while complexity and ground surface texture have a contradictory position. Nevertheless, the different studies are difficult to compare because a variable by the same name may have different definitions depending on the study.

The psycho-evolutionary theory lacks a theoretical explanation as to why these variables are adopted into the theory. The selection seems to be more or less subjective and there might be other variables that are as important or even more important for preferences. The variables of psycho-evolutionary theory are on very different levels, i.e. they are not commensurate. Water is the only concrete element and threat is the most abstract variable in the model, while the others are somewhere in between. Similarly to the information theory, the more detailed

content of the abstract variables would be useful in empirical research or in landscape planning. However, Ulrich (1983) states that preferences can occur largely on the basis of the configuration in a visual array, as opposed to individual features.

Ulrich (1983) points out that an ideal or complete preference theory should include culture as a component. He states that culture can produce wide variations in cognitive appraisals of natural settings subsequent to initial affective reactions. He does not, however, incorporate cultural effects in any more details in this theory.

2.3.3 Prospect-refuge theory

Appleton's (1975) prospect-refuge theory is based on the assumption that in the early states of human evolution, it was crucial to people's survival to be able to hide (seek refuge) as well as to be able to see a large area (prospect). In other words, a human has the desire to see without being seen. According to Appleton's theory, people still prefer environments with prospect-refuge qualities because preferring this kind of settings has had an adaptive advantage in the course of evolution.

Prospect refers to having an overview of the landscape, the opportunity to have an unhindered view to see into the distance. Refuge is the extent to which the environment provides places where one could hide. Prospect-refuge is a place from where one can see without being seen. Appleton (1975) has divided prospects to direct and indirect prospects. Direct prospects are good views; panoramas and vistas that provide views directly observed. Indirect prospects offer potential for further views such that prospect is only suggested and not directly experienced from where the observer currently stands.

Refuges can be categorized by their functions (hides, shelters), origins (natural, artificial), substance (earth, vegetation, nebulous), accessibility, and efficacy. Hiding place implies a creature escaping something or someone, while shelter provides escape from an inanimate hazard such as the wind, rain and sun. This theory also implies the existence of some hazard which may be humans, animals, meteorological, instability, aquatic, fire, or locomotion hazards. (Appleton 1975)

The environment's potential to offer aesthetic pleasure i.e. prospect-refuge components depends on various factors: a) the objects that symbolize prospects and refuges, b) the manner and intensity in which the objects symbolize them, c) the spatial arrangements of the symbols, d) the equilibrium of the prospect and refuge symbols (balance), e) and the physical media by which such an arrangement is communicated to the observer (light is especially important in observing prospect). (Appleton 1975)

Landscapes can be either prospect-dominant or refuge-dominant or well balanced in both these aspects. A weakness in prospect or in refuge may be compensated by a strength in the other. The strength of prospect or refuge can be enhanced by magnets that serve as dominant figures or focal points that attract attention. Other important factors in experiencing prospect-refuge-hazard symbols are the surfaces, scale, locomotion, light and darkness and the human involvement. (Appleton 1975)

For example, Woodcock (1982, cited by Kaplan 1987) and Herzog (1989, 1992) have studied the prospect-refuge theory empirically. Woodcock (1982, cited by Kaplan 1987) divided both prospect and refuge into primary and secondary versions of each. Only the primary prospect (a good view) was a strong predictor, but the other ones did not explain preference adequately. Similarly, refuge has not been a significant predictor of preference in urban environments (Herzog 1989, 1992).

The elements of the prospect-refuge theory have also been analyzed empirically by studies that have not aimed to study this theory per se. Indirect prospect corresponds to mystery, which is a strong predictor of preferences (e.g. Kaplan et al. 1989, Herzog 1992, Herzog and Bosley 1992, Kent 1993, Strumse 1994, Hagerhall 2000). Direct prospect refers to openness, depth and visual access which are shown to explain preferences (e.g. Ulrich 1977, Ruddell et al. 1989, Strumse 1994, Herzog and Kutzli 2002). One part of refuge may include the safety or absence of danger and these variables have been good predictors of preference (e.g. Herzog and Miller 1998, Hagerhall 2000, Herzog and Kropscott 2004). After first publishing his theory, Appleton (1984) has stated that his theory is misunderstood in the way the prospect and refuge should be present in the same environment. Instead, he proposes that it is more likely that people prefer environments where prospect and refuge alternate, i.e. there are wide-open views and then wooded areas.

Some empirical studies have observed that people prefer environments that have prospect-refuge qualities, and that they can even prefer savannah-like environments, something that resembles the original home of human beings. For example, Ulrich (1977) observed that people preferred park-like scenes with scattered trees or small groupings of trees, as well as even or fine ground texture. Moreover, the preferred forest environments have prospect-refuge qualities; there is good visibility, large trees and some undergrowth and thus it is possible to hide among the trees and undergrowth while maintaining a view of a large area (e.g. Balling and Falk 1982, Zube 1984, Ulrich 1986, Ribe 1989).

The prospect-refuge theory is too general to provide a basis for the applications of practical landscape design. Moreover, the theory itself is not very clearly structured, and the other variables besides prospect and refuge are presented incoherently and vaguely. Furthermore, empirical studies have not provided clear support for the variables prospect and refuge. However, when these variables have been operationalized to a more concrete level, they have predicted preferences to some extent (indirect and direct prospect, feeling of safety or absence of danger). The literature and empirical studies on the prospect-refuge theory have concentrated solely on the variables prospect and refuge and have largely omitted the other aspects incorporated in the theory such as spatial arrangement and the balance of the symbols, surfaces, scale, locomotion, etc. This is perhaps partly due to the undefined and vague presentation of these variables in the theory. However, other empirical studies demonstrate that some of these variables, including the focal point, surface and locomotion, predict preferences to some extent (e.g. Ulrich 1977, Kent 1993, Strumse 1994, Herzog and Barnes 1999).

2.3.4 Habitat selection theory

Orians and Heerwagen (1992) offer a comprehensive model of the habitat selection theory, although this theory has also been discussed earlier, for example by Appleton (1975). The habitat selection theory asserts that the relationship between the human observer and the perceived environment is basically the same as the relationship of a creature to its habitat. An aesthetic response arises from a reaction to that environment as a habitat, a place that affords the opportunity for achieving biological needs (Appleton 1975). The habitat selection theory assumes that preferences are based on the evaluation of benefits and risks that the environment offers.

According to the habitat selection theory, individuals deal with both the spatial and temporal scales of assessments. Orians and Heerwagen (1992) divide the spatial frame into

three stages: rapid evaluation, information gathering, and the decision to stay or leave. During the first stage, the individual makes a rapid decision to either explore the landscape further or to avoid it and to move on to another area. Responses at this stage are highly affective and may be unconscious. If the responses at the rapid evaluation stage are positive, the individual may enter the information-gathering stage at which cognitive processes are important. The environmental features that are significant at the information-gathering stage can be divided into those that enhance exploration and those that aid orientation. The last spatial stage concerns the decision to stay in the environment to carry out a certain set of activities there. A suitable habitat must contain a mixture of patches that provides opportunities for all the activities required. Furthermore, the proximity of habitats providing the different components may influence settling decisions. (Orians and Heerwagen 1992)

The temporal frame of assessment also includes three stages: changes that demand immediate attention, evaluation and quick response; changes that occur more slowly when there is time for reflection and evaluation; and permanent features. Transitory environmental cues – light, weather, fire, and large mammals – must be responded to quickly. Examples of changes that occur more slowly are seasonal changes which are highly predictable. Environmental cues influencing long-term behavior are geomorphological (mountains, hills, valleys, rivers, and lakes) and vegetative features. (Orians and Heerwagen 1992)

Besides concentrating on the spatial and temporal scales of assessment, the habitat selection theory also offers environmental features that are essential at each stage of evaluation. For rapid evaluation, important factors are spatial configurations (e.g. openness), gross depth cues (the assessment of distances), ease of movement, and certain classes of context such as water and trees. At the cognitive stage, central features are complexity, degree of surprise, novelty, incongruity, mystery, patterns, changes in elevation, lookouts, landmarks, pathways, borders or edges, and features connected with risk assessment (concealments, high visual access, multiple escape routes). (Orians and Heerwagen 1992)

Empirical studies show that most of the variables listed in the habitat selection theory are important in the formation of preferences. The empirical studies mentioned earlier show that complexity, spatial configurations, visual access, mystery, perceived danger, and water all predict preferences (Ruddell et al. 1989, Herzog 1992, Herzog and Bosley 1992, Herzog and Barnes 1999, Herzog and Kropscott 2004). Both topographic variation (Eskelinen 1979, Herzog 1985, Tahvanainen and Tyrväinen 1998) and trees (Jensen 1993, Kaltenborn and Bjerke 2002) are also positively related to preferences.

The main attainment of the habitat selection theory is to discuss the spatial and temporal scales of assessments, while the variables that are important in the evaluation receive much less attention. The purpose of this theory is not to provide the most important landscape configurations for predicting preferences, but the variables are listed as examples and this list is not meant to be comprehensive. As its name indicates, the habitat selection theory is based on the process of the selection of a place to live. However, the preferences for places to visit may differ from this.

2.3.5 Comparison and conclusions of the four theories

All four theories have common features. They are based on an evolutionary perspective supposing that people prefer survival-enhancing environments. All of them postulate that certain environmental configurations are universally essential in environmental preferences. In addition, human involvement is a central part of all four theories. Both the information

Table 4. The stages of perceiving the landscape variables according to the information, psycho-evolutionary and habitat selection theories. The prospect-refuge theory does not consider the different phases of perceiving.

Theory / Stages of perceiving	Information model	Psycho-evolutionary theory	Habitat selection theory
Immediate / affective/ rapid affective evaluation	Coherence, complexity	Complexity, structural properties, visual depth, threat, water	Spatial configuration, depth, ease of movement, context (trees, water)
Inferred or predicted / cognitive / cognitive information gathering	Legibility, mystery	Ground surface texture, deflected vistas	Complexity, degree of surprise, novelty, incongruity, mystery, patterns, changes in elevation, lookouts, landmarks, pathways, borders, concealments, high visual access

model and the habitat selection theory include exploration and understanding or orientating aspects.

The information, psycho-evolutionary and habitat selection theories regard affective and cognitive processing as being integrated, complementary aspects that lead to aesthetic experiences (Parsons and Daniel 2002). The psycho-evolutionary and habitat selection theories assert that people's initial reactions to landscape are quick, unconscious, affective evaluations, and that people make a more thorough, cognitive evaluation later on. These models differentiate which landscape variables are important at the affective stage and which at the cognitive stage (Table 4).

According to the information model, unconscious type of cognition may also precede the affective judgments (Kaplan 1987). However, parallel to the two previously mentioned theories, the information model distinguishes which variables can be perceived immediately and which are predicted or inferred (Table 4). The information, psycho-evolutionary and habitat selection theories place the corresponding variables – except complexity – mainly in the same phases of perceiving. By comparison, the prospect-refuge theory does not consider the different stages of perceiving.

The variables presented in each theory have similar counterparts in other theories (Table 5). Again, these theories are interconnected so that all of them could "produce" similar kinds of preferred landscapes. For example, according to Zube (1984), an environment that provides prospect and refuge, and a landscape that is coherent, complex, legible, and mysterious are often similar kinds of landscapes. For instance, these can be park-like landscapes that include interspersed openings and wooded areas (Zube 1984).

Mystery is a component integrated in all the four theories. Mystery (information model, habitat selection theory), deflected vista (psycho-evolutionary theory) and indirect prospect

Table 5. Connections between the variables of the four theories for predicting landscape preferences.

Information model	Psycho-evolutionary theory	Prospect-refuge theory	Habitat selection theory
Mystery	Deflective vistas	Indirect prospect	Mystery, novelty, degree of surprise, incongruity
Coherence	Structural properties: especially focality	Focal point, balance, spatial arrangement, scale	Patterns, spatial configurations
Complexity	Complexity		Complexity
Legibility	(Depth, complexity, focality, ground surface texture)	(Direct prospect, focal point, locomotion)	Landmarks, pathways, visual access, changes in elevation, edges
	Depth	Direct prospect	Depth, visual access
	Threat	Hazard, refuge	Risk assessment (=concealments, multiple escape routes, changes in elevation, visual access)
	Ground surface texture	Surfaces, locomotion	Ease of movement
	Content: water		Content: water, trees
		Light and darkness	Temporal changes: light, weather, season

(prospect-refuge theory) illustrate more or less the same thing. The mystery of the information model corresponds to the deflected vista (new landscape immediately behind) of the psycho-evolutionary theory, as well as to the Appleton's concept of an indirect prospect that refers to a prospect that is only suggested and not directly experienced from where the observer currently stands. The habitat selection theory adds degree of surprise, novelty and incongruity to the concept of mystery.

The term *coherence* used in the information model is also present in some form in the other theories. The psycho-evolutionary theory emphasizes the importance of structural properties, especially focality. The prospect-refuge theory contains features such as focal point, balance, spatial arrangement, and scale which largely correspond to the term the Kaplans propose, coherence. Moreover, the habitat selection theory discusses patterns and spatial configurations which can also be seen as being components of coherence.

Complexity i.e. visual diversity is a component of all the theories except the prospect-refuge theory. The variable *legibility* of the information model is not as such included in the

other theories. Yet the psycho-evolutionary theory argues that depth, complexity, focality and ground surface texture are all elements of legibility (Ulrich 1977). Similarly, the habitat selection theory states that changes in elevation, lookouts, landmarks, pathways, and edges enhance way-finding (Orians and Heerwagen 1992), which in turn plays a central role in legibility.

Depth or visual access is integrated in all four theories. Depth as such is part of the psycho-evolutionary and habitat selection theories. Furthermore, depth has many similarities with direct prospect (a good view) of the prospect-refuge theory. Depth per se does not belong to the variables of the information model, but depth is the third dimension of the model because legibility and mystery require the inference of depth.

All the theories, except the information model, add *threat or hazard* as a complementing aspect of mystery, because mysterious environments may also contain threats. The prospect-refuge theory includes hazard as such, as well as a hiding place from the hazard (refuge). The habitat selection theory contains features that enhance the prevention of or escape from a hazard; concealments, changes in elevation, and multiple escape routes. All these theories include good visual access or depth, which is central in the observation of a hazard.

Whereas the psycho-evolutionary model emphasizes the importance of *ground surface texture*, the habitat selection theory pays attention to ease of movement, and the prospect-refuge theory includes both of these. The psycho-evolutionary and habitat selection theories also pay attention to the *content of landscape*, and assert that especially water and vegetation are important for preferences. Both the prospect-refuge and habitat selection theories consider the *temporal changes* caused for example by light, weather, and season.

Variables of the theories are interconnected; for example, visual access or depth seems to be a precondition for legibility, coherence, mystery, and complexity (Ruddell et al. 1989, Kaplan et al. 1998, Herzog and Leverich 2003, Herzog and Kropscott 2004). In turn, sense of depth can be created by topographic variation, landmarks and other distinctive elements (Kaplan et al. 1998). In addition, other possible elements of legibility are depth, visual access, complexity, focality, ground surface texture, landmarks, pathways, changes in elevation, and edges (Ulrich 1977, Orians and Heerwagen 1992). Threat may be present in mysterious environments and visual access may be the precondition of perceiving a threat.

Of the four theories, the information model has been empirically studied to the largest extent. The other theories have not been tested as such but rather individual variables included in them have been examined. However, the results of these empirical studies are difficult to compare. First, the definitions of the variables may be different, i.e. they are understood and defined in different ways depending on the study. Second, the images that are representing these variables are diverse, ranging from the close-ups of forest views to urban spaces and panoramic vistas. The range of a variable may also differ in the different studies.

Nevertheless, empirical studies show that most of the variables of the information and psycho-evolutionary theories predict preferences quite well. Similarly, many variables of the habitat selection theory also seem to be related to preferences. Instead, the prospect-refuge theory does not seem to work very well empirically, while refuge has not been connected with preferences in the empirical studies. Instead, the other variables incorporated in the theory do predict preferences to some extent.

Based on empirical studies, it seems that the following variables of the four theories are related to landscape preferences; mystery (deflective vistas), coherence (focal point and other structural properties), depth or visual access, and absence of threat. Other variables related to landscape preferences to some extent are smoothness of ground texture, ease of movement, and complexity. The more concrete contents of the environment provided by

psycho-evolutionary and habitat selection theories, such as water, changes in elevation, and trees, also predict preferences.

In conclusion, the information and psycho-evolutionary theories seem the most promising theories for prediction of landscape preferences. Both of them have variables with clear definitions, and most of the variables have been supported by empirical research. The theory having the most solid and appropriate theoretical basis of the four theories is the information model.

All four presented theories for predicting landscape preferences have their limitations and deficiencies. None of these theories has tried to incorporate cultural and individual differences in the theory, even though at least the information and psycho-evolutionary theories assert that these are important factors in preference formation. Within the psycho-evolutionary and habitat selection theories, the selection of variables seems to be somewhat arbitrary and random and thus lack sound theoretical grounds. Similarly, in the prospect-refuge theory, variables other than prospect-refuge-hazard lack theoretical grounds. As for the prospect-refuge theory, it lacks clear definitions and structure. In addition, the habitat selection theory is more concentrated on spatial and temporal scales of assessments than on the landscape variables that affect preferences.

Not all the variables of the theories for predicting landscape preferences have been confirmed to be strong predictors of preference, whereas all important predictors are probably not included in these theories. These theories should be further developed so that the predictors that are not shown to be central should be given less attention, and the still missing but essential configurations that predict preferences should be integrated into the theories. These elements could be added as separate variables that directly predict preferences, or alternatively, they could provide more detailed content to the variables already included in the theories. Furthermore, some predictors may vary in their effectiveness depending on the environment, and some predictors may be more robust than others across different settings (Kaplan et al. 1989). It would be important to determine such environmental differences and find the most robust predictors.

The variables of each theory are on a quite general level. However, the psycho-evolutionary and habitat selection theories include somewhat more detailed and concrete variables than the information theory and prospect-refuge theory, as for example, water, uniform ground texture, trees, changes in elevation, pathways, and borders. The broad definition of the variables provides possibilities to apply the theory to different types of landscapes and views, and supports the universality of the theory. Yet the practical landscape planning situations as well as the empirical research would benefit from more detailed variables that would have unambiguous definitions and that would not be greatly dependent on the interpreter of the variable. One possibility to provide more accurate predictors would be that each variable would have a different kind of operationalization depending on the type of environment and observation distance. For example, mystery might have a different content in near-distance forest views than in large-scale agricultural landscapes. Ulrich (1983) suggests that variables such as the amount of downed wood, slash, and species diversity could be surrogates for complexity in the forested environment.

In short, all the theories for predicting preferences should be developed based on empirical studies, and these theories should incorporate cultural factors. In addition, the variables of these theories should be operationalized on a more concrete level and/or the theories should incorporate other features that as well are important in landscape preferences.

The majority of the empirical studies on landscape preferences have emerged from solving practical problems in landscape and natural resource management that require

prompt answers. These studies are not usually based on the theories for predicting landscape preferences, partly because the theories are not able to give much input for solving practical problems studied.

Correspondingly, the case studies of this dissertation are not based on any of these theories predicting preferences. These theories were not considered to be appropriate for the research designs aiming at producing hands-on knowledge for the forest and landscape management, i.e. ascertaining the visually most acceptable forest regeneration and field afforestation alternatives. The general and broad variables of these theories would have been problematic to operationalize for the purposes of a practical case study. These kinds of studies would benefit most from theories developed one step further, i.e. from an application built for a specific setting and which would also provide variables that are essential in this particular setting.

The main contribution that these theories could have offered the case studies would have been to provide possible explanations for the observed preferences. Nevertheless, because these theories are not established to be valid, the application of these theories to the case studies would have still been more theory testing and developing than finding the actual reasons for preferences. In this case, the practical part of the studies would have remained weak. Instead, in Chapter 5.5 the variables of the two most promising theories for predicting landscape preferences (information model and psycho-evolutionary theory) are reflected to the results of the case studies in order to find out if these theories could provide explanations for the preferences for forest regeneration and field afforestation.

3 PREVIOUS EMPIRICAL STUDIES

3.1 Methods to measure landscape preferences

The next chapter discusses the methods used to measure landscape preferences and thus provides the background and grounds for the methods that were chosen for the case studies. This chapter can help in placing the methods of the case studies within the commonly used methodologies in landscape preference studies.

3.1.1 Visualization of the landscape

A usual practice in landscape preference studies is that the studied landscapes are either visited on-site or visualized. An often used means of visualizations are photographs as well as images created by digital image editing or computer simulators. Digital photo editing or image capture technology uses computer software for the manipulation of digital images. Computer simulators or virtual landscape simulators are based on the use of map information, a digital elevation model (DEM), compartment data of the target area, and visual objects. The pictures or objects can be produced, for example, by three-dimensional computer graphics or by wire frames coated by digitized objects.

The visualizations or on-site visits are necessary in preference studies because people's preconceptions of the landscape or landscape management methods do not often correspond to the actual landscape or actual management measures. For instance, Tahvanainen et al. (2001) showed that the preconceptions concerning the different silvicultural measures did not

consistently correspond to perceptions based on visual images. However, when respondents were familiar with forestry, direct questions gave results quite similar to the evaluations of photographs showing silvicultural treatments (Silvennoinen et al. 2002).

Most of the landscape preference studies rely solely on photographs or other images because they are more cost-effective than site visits. When evaluating images, more judges can be used and more scenes can be evaluated than in field observations. In image evaluations the conditions are more controlled and many factors affecting site visits can be eliminated, such as weather conditions. Furthermore, digital image editing or computer simulators offer possibilities to study the temporal and spatial changes in the actual landscape which might be difficult or impossible to provide in real scenes (Stewart et al. 1984, Karjalainen and Tyrväinen 2002).

Nevertheless, there are many questions concerning the external validity of the visualizations i.e. how well the results can be applied to real world conditions. It is clear that visualizations are not able to represent the whole richness of real nature; they are less complex, less multidimensional and offer less interaction with the landscapes than the real scenes (Karjalainen and Tyrväinen 2002). Daniel and Meitner (2001) conclude that visualizations may not be valid surrogates for studying actual environmental experiences but are valid for landscape quality assessments.

Many studies have compared the preferences for actual on-site scenes and the preferences for photographs representing these scenes. These studies have concluded that photographs are acceptable substitutes for on-site visits if they include most of the visual elements of the landscapes (Shafer and Richards 1974, Daniel and Boster 1976, Shuttleworth 1980, Savolainen and Kellomäki 1981, Stewart et al. 1984). A meta-analysis of 11 studies received a correlation of 0.86 ($p<0.001$) between the photographic and on-site evaluations (Stamps 1990), which strongly supports the validity of image-based evaluations. Palmer and Hoffman (2001) extended Stamps's meta-analysis to 19 studies and received a correlation of 0.80 which further supports the reasonableness of using photographic representation for the evaluation of visual landscapes.

Yet some studies show that photographic representations may not always be valid (Brown et al. 1988, Hull and Stewart 1992). When campers were interviewed on-site, they consistently preferred the forest around them to the same forest area represented by color photos (Brown et al. 1988). Hull and Stewart (1992) showed that even though there were differences between the on-site and photographic evaluations of individuals, the average on-site ratings were similar to the average photo-based assessments. Hull and Stewart assumed that these differences may be caused by the context of a strenuous day's hike in the case of on-site evaluations. Further, the different evaluations may be dependent on the differences in meaning, novelty and mood between the on-site and photo-based contexts. According to Scott and Canter (1997), people can evaluate differently the picture as such and the place that the picture is representing.

Landscape preference studies often use *digital image editing* that edits the original photos. The quality of pictures produced by the digital image editing corresponds to the original photos. The main advantage of digital image editing as compared to photographs is that it is possible to study the effect of a particular change in the landscape and to control other variables. Yet detailed changes in the original images are time-consuming and costly to make and the method cannot be easily automated. Furthermore, the pictures produced are, to a certain extent, open to inaccuracy and perspective distortion due to the subjective evaluations present in the modification of the original pictures. Since it is difficult to estimate the effect of change in the landscape on the basis of a photograph and without the help of

spatial data, the visualizations are mere approximations of the effects of change. (Karjalainen and Tyrväinen 2002)

Specific changes in the images are often easier to make with *computer simulators* than by digital image editing. For example, the simulation of changes caused by forest management is easy if the system is made compatible with the available forest inventory and satellite data. In that case, the accurate effect of the change can also be calculated. Computer simulators can illustrate the effects of the summer and winter seasons as well as the atmospheric effects. Furthermore, simulators allow choose the viewpoint flexibly and they may also allow flexible real-time movement in virtual landscapes. (Karjalainen and Tyrväinen 2002)

At least some of the current landscape simulators can be regarded as first-generation virtual environment tools (Orland and Uusitalo 2001). However, the immersion into a virtual world provided by these simulators is not yet very good. It is still difficult to use existing software packages to simulate viewer's movement in a photorealistic forest environment. In addition, the images produced by the simulators do not yet correspond to the real forest environments – that include many details and nuances – very well even though the simulations would use digitized tree and other objects.

The representational validity of computer simulation depends on the aim of the study, on the accuracy and the level of realism of the chosen computer graphics, and on the level of details in the studied landscapes. Most landscape preference research purposes seem to require a higher level of photo-realism that can be offered by current computer simulators. The correspondence between the illustration and the details of the real landscape is important when the aim of a study is to explore people's perceptions of a particular area, especially if the area includes many details and unique features, or when studying preferences for close-ups with their special features. Furthermore, if respondents are familiar with the study area, realistic images are needed. (Karjalainen and Tyrväinen 2002)

Daniel and Meitner (2001) showed that only if images achieve a high level of photo-realism, they can provide valid indications of the perceived scenic beauty of forest landscapes. Visualizations that rely on lower levels of graphic realism may produce consistent responses from observers but these responses may not correspond to real environments. Furthermore, the results of Bishop and Rohrmann (2003) showed that even detailed computer simulations do not necessarily generate the same responses as the corresponding real environment. They concluded that particular environmental features – such as vegetation and color – may require a more realistic presentation than computer simulations.

Nevertheless, current computer simulators may be adequate for some purposes, such as studying long-distance views when the details merge easily (Nousiainen et al. 1998, Tyrväinen and Tahvanainen 1999), sometimes in psychophysical research when the explaining variables involve separate physical features found in the environment (Karjalainen and Tyrväinen 2002), and in situations when it can be supposed that the respondents can imagine the real environment based on the somewhat rough illustrations. Daniel and Meitner (2001) suggest that the affective processes that are important to environmental perceptions and preferences may require very realistic representations, while more abstract visualizations may be sufficient for responses that are based on more cognitive processes such as way finding or cognitive maps.

Computer graphics and the realism of the objects and illustrations are developing at a fast speed. Future computer simulators will provide digital three-dimensional objects more easily and more realistically. In the future, landscape simulators will also provide better immersion and interactivity when the environment responds the user's acts through such means as head-mounted devices and data gloves, etc. The developments in computer simulators open

up new opportunities for landscape preference research. Examples of these are movement in a photo-realistic forest environment, production of photo-realistic illustrations fast and effortlessly from the different viewpoints, a simulation of change photo-realistically and easily, and connection of photo-realistic images to spatial data.

Some studies indicate that the assessments of static *still imagery* do not parallel those of dynamic displays (Hetherington et al. 1993, Heft and Nasar 2000, Bishop et al. 2001). Hetherington et al. (1993) suggested that those landscapes including strong dynamic features such as waterfalls may not be adequately represented by still imagery. Another study by Bishop et al. (2001) showed that movement through a virtual environment can produce different choices than the exposure to still images only. When studying the preferences of people who move in the landscapes or when studying the preferences for landscapes that include dynamic features, dynamic displays are needed. However, when studying landscapes that are mainly experienced from one spot and do not include dynamic elements, static images may represent the actual landscape adequately enough.

The *sampling of landscapes* is dependent both on the aims of a particular study and the contents of the landscapes. In any case, the sampling should reflect how people view the landscapes. For example, Hull and Revell (1989a) suggest that sampling should be based on people's behavior in the landscape, such as the intensity and location of use. When a specific landscape is studied, it is necessary to decide how many images are needed to adequately illustrate the studied landscape and how to locate the viewing points. Sometimes only one image may sufficiently represent the scene. As an illustration, Daniel and Boster (1976) and Savolainen and Kellomäki (1981) showed that relatively homogenous near-distance landscapes can be adequately represented only by one image. In the case of long-distance scenes, the landscape may frequently be viewed from one main point only and then one visualization point may be enough. However, if the studied environment is heterogeneous and diverse, one image cannot capture the whole richness of the landscape. In any case, the studies need to include all the important viewing points. The effect of the location of the viewing point is illustrated, for example, by Pings and Hollenhorst (1993) who demonstrated that preference ratings were higher when people felt they were within the forest stand rather than viewing forest from just outside the stand.

The *context* in which the pictures are shown may influence the results of preference studies. Context refers to the other images shown in the evaluation, the order of showing the pictures, as well as the context of the evaluation situation. As ratings are always relative measures, a certain image could be assessed in different ways depending on the context of other pictures shown in the evaluation. Furthermore, when a landscape is evaluated in the context of one group of landscapes, this is not necessarily comparable to another landscape that is assessed in the framework of other scenes (Hull 1989). Brown and Daniel (1987) demonstrated that the ratings of forest scenes are influenced by the nature of the previously viewed and rated scenes. When the same forest scenes were assessed in a different context, the scenic beauty ratings were different. Yet the studies of Daniel and Boster (1976) and Karjalainen (2000) reported that the context in which the images were presented did not affect the evaluations.

An example of the influence of the evaluation situation is given by Palmer (1990), who observed that visual evaluations were affected not only by the season represented in the scene but also by the season when the evaluation was conducted. He concludes that scenes should be evaluated during the season that they represent. Correspondingly, Brown and Daniel (1987) suggest that the assessment context should be made to match the real world context to which the results are to be applied.

The most part of landscape perception occurs through the sense of sight (Ulrich 1983, Jubenville et al. 1987) even though *other senses* are important as well. In particular, the sight is the most central sense when being distant from the landscape. Even so, inside the landscape, for example inside a forest, all the human senses become important in perceiving. Therefore, when studying experiences and preferences within the landscape, senses other than sight should also be included in the studies.

3.1.2 Evaluation methods

Evaluation methods. Visual preference studies involve people evaluating certain attributes in the scenes by selected evaluation methods of the images. Evaluation methods that are often used include numerical rating scales (e.g. 0–10), rank-ordering of the pictures, pair-wise comparisons of the images, and semantic differential scales (evaluating different elements of the landscape). For the numeric rating scales, acceptability measures are also applied (e.g. -4 – +4). Instead of numerical scales, graphic scales can be employed here as well. Rating scales are also applied in paired comparisons if the respondents are asked to indicate how much more they prefer one image to another. The different kinds of versions of rank-ordering are, for instance, the Q-sort method and the magnitude estimation method. In the Q-sort method, the images are put to a certain number of piles according to the evaluation criterion, for example, according to scenic beauty. Each pile is then connected to a numerical value and the Q-sort method is thus close to numerical rating. In the magnitude estimation method, people put the photos on the table in an order of preference. The distances between photos then reflect the different preferences for the photos.

The numeric rating scales are fast and easy to use, but using them often means confronting certain problems as well. At first, the individual scales can change during the evaluation process. Second, respondents can use the scale in a different way. Examples of this are that one can use the scale widely and another narrowly, or the ratings can concentrate on the other end of the scale. These kinds of individual differences can, however, be eliminated by the mathematical standardizations of the individual scales. Third, the evaluation of each picture has to be made without seeing the image in relation to other images. If a person ascribes the best score to one image it is not possible for him or her to give a better score if encountering more beautiful picture later on. Attempts to eliminate this problem have been made by showing a set of slides before the actual rating so that the respondents can adjust their individual scales. Moreover, respondents are often allowed to go beyond the scale.

The pair-wise comparisons and the rank-ordering of the images are based on the assumption that people are rather good at making comparisons but bad in making absolute judgments. The paired comparisons and ranking may allow finer discriminations between the images than the rating (Hull et al. 1984) and some drawbacks of the rating can be avoided by using the paired comparison or ranking. However, the paired comparisons and ranking are often time-consuming. If rating scales (how much more a respondent prefers one image to another) are used in the pair-wise comparisons, the same problem as in the rating is faced: keeping the scale constant during the evaluation. Another factor is that when using conventional techniques of paired comparisons or ranking, the number of images is restricted to 10–15 slides (Buhyoff et al. 1980, Daniel and Vining 1983). In ranking, this can be solved by using the Q-sort method in which the images are sorted into a certain number of piles and each pile can be assigned several images.

In paired comparison, one possibility to deal with more images is to divide the pictures into sub-sets which can be made commensurable by including one scaling image into each set. This kind of approach is used in some versions of the Analytic Hierarchy Process (AHP) (Kangas et al. 1993). If, for instance, 21 images are included in a study and they are evaluated in 5 sets consisting of 5 pictures, this makes a total of 50 comparisons. That amount of comparisons is on the upper limit of people's endurance, and the number of pictures is still limited. Furthermore, when each photo set contains a scaling image, even a small difference in the evaluation of the scaling image may greatly affect the results of all the alternatives (Tahvanainen et al. 1996).

The regression approach of the AHP allows somewhat a larger number of images to be studied than the earlier versions of the AHP. In the regression version, the minimum number of pair-wise comparisons is m-1, with m being the number of the entities, for example, images (Alho et al. 2001). However, with the minimum number of comparisons, the quality of the estimates would be expected to be poor. For this reason scholars such as Tahvanainen et al. (2001), Silvennoinen et al. (2001) and Tyrväinen et al. (2003) have adopted (m-1) + (m-2) comparisons. For example, in the study of Tahvanainen et al. (2001), 28 images were examined which then required 53 comparisons. In addition, the AHP produces ratio scale measures based on a general theory of ratio scale estimation. Reason for this is that in the AHP, judges estimate which of the two images is more beautiful and how much more beautiful (Saaty 1977).

Several studies show that the response format does not affect the results of the study. Those studies report that pair-wise comparisons and rating methods have produced consistent results (Daniel and Boster 1976, Buhyoff et al. 1982, Tahvanainen et al. 1996). Additionally, paired comparisons and rank-ordering have produced similar kinds of outcomes (Buhyoff et al. 1980, Hull et al. 1984, Nousiainen et al. 1998). Moreover, Buhyoff et al. (1981) demonstrated that the magnitude estimation method generated identical results to the pair-wise comparison. Lindhagen (1996) also found that the keywords used by the respondents to describe the sites were consistent with the numeric answers.

Transformations. The rating scales (rank-ordering, pair-wise comparison, numerical rating) usually produce ordinal scale measures. One exception of this is, for instance, the Analytical Hierarchy Process, AHP (see above). In psychology, as well as in the visual assessment studies, the ordinal scale measures are traditionally used in the parametric statistical methods, even though they do violate the assumptions of the parametric methods. This tradition is based on the lack of appropriate non-parametric methods (Golbeck 1986). Some landscape researchers state that ordinal scale measures can be used for parametric statistical tests if the number of respondents is at least 20 and the group is homogenous (Daniel and Vining 1983), or if the preferences for the landscapes differ significantly (Benson and Ulrich 1981). According to Lindhagen (1996), ordinal data can be treated as interval data if the number of categories is more than four and if the number of observations is high. In other fields, for example, in the food sciences (in the organoleptic assessment of food) the rating scale measures are treated as interval scale measures (Hellemann 1993). The study of Silvennoinen et al. (2002) revealed that parametric and non-parametric tests produced very similar results, which means that the statistical inferences would be the same whether the evaluation scales are treated as ordinal or as interval scales.

In some landscape preference studies, the ordinal scale ratings are scaled to interval scale values by using mathematical transformations (e.g. the Law of Comparative Judgment LCJ, the Scenic Beauty Estimation Method SBE) in order to use parametric statistical methods that require at least interval scale values. Assumptions within the scaling methods is that an

interval-level perceptual continuum underlies people's responses to the environment and that rating scale responses are derived from the underlying continuum by means of a judgment process (Schroeder 1984).

Another purpose for using mathematical transformations – besides scaling the ordinal scales to the interval ones – is to standardize the differences of the individual scales. The different raters can use the scale in different ways (large scale, narrow scale, the ratings are on the other end of the scale) and transformations are used to scale the individual scales to be commensurable.

Nevertheless, the appropriateness of transformations and standardization is controversial. According to Golbeck (1986), no feasible method is available for deriving interval data from ordinal scale data. Further, it is difficult to say what the resulting estimates of scenic beauty really mean in the SBE-method (Golbeck 1986). Schroeder (1984) states that sophisticated scaling methods, although theoretically superior to simple mean ratings, do little to change the reliability or the interval properties of the ratings in practice.

According to many studies, simple means and different scaling methods produce similar results. For instance Benson and Ulrich (1981) showed that the SBEs and the means were almost identical in the homogenous respondent groups. A simple mean ratings generated results similar to the more complicated scaling methods (a true-score model, law of categorical judgment, signal detection theory), both with respect to scale values assigned to environments and with respect to the inter-group reliability of the scale values (Schroeder 1984). The simple magnitude estimation method produced equal values to the metric obtained from law of comparative judgment (Buhyoff et al. 1981).

Attributes evaluated. In landscape preference studies, respondents are asked to evaluate different kinds of qualities of landscapes such as scenic beauty, visual quality, landscape quality, like or dislike, recreational value, the acceptability of the measure seen in the photo, and the suitability for a specific outdoor recreation activity, etc. Results may be affected by the kind of attributes the judges are enquired to assess in the images. Hull and Revell (1989b) argue that when people are asked to evaluate landscapes with general terms like preference or quality – without any more specific definition – people will apply different constructs depending on their background, for instance preference for recreation, for tourism, for residential purposes, or for income.

Brunson and Shelby (1992) found that ratings for scenic quality, hiking quality and camping quality did differ to some extent. Tahvanainen et al. (2001) noticed that scenic beauty and recreational preferences differed significantly from each others. Purcell et al. (1994) likewise observed slight differences in the overall preference, preference for living and working environment, and preference for a place to visit. By contrast, Hull et al. (1984) found that whether people were asked to evaluate scenic beauty or their preference for the landscape did not have any significant influence on the results. In the same vein, Karjalainen (2000) found no differences between the evaluations of the suitability for recreation and preference.

Connections between preferences and landscape variables. Landscape preference studies usually aim at explaining why the landscapes differ in visual quality. The differences are typically explained by the landscape features and not by the features of the judges. Psychophysical and cognitive preference studies often aim at exploring relationships among variables or building prediction models. The connections between the landscape preferences and landscape variables are usually studied by statistical analysis such as by computing correlations and regression analyses.

In cognitive models, landscape variables are also psychological constructions that are rated by judges. In this orientation, the psychological concept preference is explained by other psychological measures but it is not clear how clearly these variables differ from preference. In the psychophysical models, landscape features are measured on field or in images. In some cases, the researcher describes the liked or disliked features of the landscapes. Sometimes, the respondents are also asked which features influence their evaluations (e.g. Brush 1979, Anderson 1981). When the features are measured in the field, they are not necessarily seen in the photos, and for this reason the validity of these kinds of variables is questionable. For example, Hull and Revell (1989a) stress that all the measured features and their whole range should be clearly seen in the photos.

In all approaches it remains unclear if the chosen predictive variables are important in the formation of landscape preferences. However, the appropriateness of especially the descriptive method is increased by the use of digital image editing and computer simulations, when only one aspect in the image can be changed at a time and thus the features affecting the preferences can be deduced more accurately.

3.1.3 Reliability and validity of the evaluations

Individual ratings are never perfectly consistent. The evaluations might vary from one day to another, depending on factors such as the mood and degree of fatigue of the respondent. In addition, the evaluation scales and criteria can change during the evaluation process. Another factor is that raters differ in reliability; one might be highly reliable, and another one very inconsistent. For this reason some scaling methods give greater weight to the more reliable individuals (Schroeder 1984).

Even though the individual ratings are not always consistent, the group average preference seems to be an appropriate measure for most of the studies on landscape preferences. For instance, Daniel and Meitner (2001) suggested that if group internal reliability or homogeneity is reasonable, the group means will the best basis for predicting group as well as individual behavior and for measuring the similarities and differences in the assessed landscapes.

The general practice for assessing the reliability of visual landscape assessments is to calculate the correlation between the mean ratings of the different groups, or the reliability of a group's mean rating (Palmer and Hoffman 2001). Several studies show that group-to-group reliabilities (Brown and Daniel 1984, Rudis et al. 1988, Hetherington et al. 1993), intra-class reliabilities (Brown and Daniel 1987, Rudis et al. 1988), inter-rater reliabilities (Gobster and Chenoweth 1989), and split-half reliabilities (Herzog 1985, Herzog and Bosley 1992) of rating judgments are high.

Nevertheless, for example Palmer and Hoffman (2001) as well as Hull and Stewart (1992) state that the group average is not the best method to analyze the reliability of ratings. Palmer and Hoffman (2001) argue that the analysis of the reliability of the ratings should begin with individual rather than group data because the reliability of the individual and group ratings may differ significantly. Palmer and Hoffman (2001) also suggest that the validity of representations must be evaluated at the site level, and not for an aggregation of sites. Hull and Stewart (1992) point out that although group averages may be suitable for management decision-making, at least the validity tests of landscape simulations should focus on the individual.

For instance, the study of Tyrväinen and Tahvanainen (1999) showed that even though the average results were consistent of the photographs and computer vector illustrations,

there was large variety between the different individuals in understanding those images. Nevertheless, Stewart et al. (1984) demonstrated that the photographic judgments correlated well with the field judgments, whether the field and photographic judgments of the individual observes, or the means of several observers' judgments were analyzed. Moreover, Kangas et al. (1993) observed that individual landscape preferences are usually well in line with general preferences and with those of other individuals.

Landscape preference studies often use relatively small groups of respondents, especially in testing hypotheses or building models. In these cases, groups are often drawn from quite homogenous populations such as university students. For instance, Schroeder (1984) and Daniel (2001a) conclude that visual assessment studies have consistently achieved acceptable inter-group reliabilities with small to moderate size of groups (5–30).

The generalizability of a specific landscape preference study is often limited. The results might not be applicable to other kinds of environments or respondent groups. Furthermore, the preference indices are always relative and they can be interpreted only in the context of the other images shown at the same time. Even so, when a large number of similar kinds of results accumulate from different kinds of landscapes and respondent groups, it can be assumed that these findings are applicable to a larger range of environments and people, or are even universally applicable. Nevertheless, comparing the results of the different studies is often difficult, because the research methods are not compatible.

When interpreting and combining the results of visual preference studies, for example for the use of practical forest management, it is important to know the contents of the original images. As an illustration, the result that undergrowth improves the visual quality of a forest is not useful if the type of undergrowth is not specified (species, height, quality, and density). Unfortunately research articles do not always present the images used.

3.2 Rural landscape preferences

This section reviews the studies on visual preferences for forest and agricultural landscapes, the focus being on forest landscapes. Furthermore, this section seeks for explanations for forest landscape preferences by reflecting the results of the empirical studies to the theories for predicting landscape preferences. Previous studies that would concentrate on the actual focus of the case studies, forest regeneration and field afforestation, are scarce. For this reason, knowledge of forest and agricultural landscape preferences in general may provide some background for the case studies and to help understand the preferences for forest regeneration and field afforestation.

Several studies show that natural environments are preferred to urban environments (e.g. van den Berg et al. 2003, Staats et al. 2003). When people experience higher stress or a state of attentional fatigue, the preferences for nature over urban settings are even more distinct (van den Berg et al. 2003, Staats et al. 2003). Furthermore, Nordic people tend to prefer forests or wildlands to other rural environments (Jensen 1993, Kaltenborn and Bjerke 2002).

North America, especially the United States, has the longest traditions – more than 30 years – and the widest research on forest landscape preferences. Yet, it can be assumed that the research results obtained in other cultures cannot be directly applied in Finland owing to the cultural and environmental differences. The Finns' relationship towards nature is presumably different from that of other cultures. The Finns' association to the forest is probably still based on the tradition of obtaining their livelihood from the forests, and the forests may be experienced more in a functional way (as and environment for work and leisure activities)

than as an object of aesthetic appreciation. Furthermore, forests cover 86% of the land area of Finland and thus Finns are very familiar with forests.

Nevertheless, both Finnish and foreign preference research has produced similar kinds of results. Moreover, the different research approaches have produced coherent results. These results indicate, to summarize, that people generally like forests that have large trees, good visibility, sparse undergrowth, a green and uniform ground floor, and not much logging residue or downed wood (e.g. Balling and Falk 1982, Zube 1984, Ulrich 1986, Ribe 1989).

The Finnish studies of visual forest landscape preferences have concluded that Finns prefer spacious forest stands that consist of tall trees and that have a good visibility but also have abundant greenery and nuances (Kellomäki 1975, Savolainen and Kellomäki 1981, Pukkala et al. 1988, Silvennoinen et al. 2001). In addition, Kellomäki (1975) found the following features to be visually important: the impression of the natural state i.e. no human traces to be observed, multi-colorness, and a variability in the environment. These results can be explained in light of the theories for predicting preferences; this type of forest offers visual access, visual diversity, coherence, ease of movement, lack of threatening factors, and may also provide mystery as well as prospect-refuge qualities.

The studies by Kellomäki (1975) and Savolainen and Kellomäki (1981) established that the forest structure (how it structures to the landscape space or to the forest view) is more important than the separate elements in the landscape. Ulrich (1977) likewise states that the attractiveness of a scene is affected by several variables operating in combination. The study by Tyrväinen et al. (2003) implies that the effect of understorey management, thinning or the removal of dead snags and decayed ground wood is dependent on the composition of the forest stand and tree species. These observations are consistent with the theories predicting landscape preferences. These theories do not concentrate on the specific, separate elements of the landscape but instead emphasize the qualities connected to the wholeness of the scene, for example, spatial arrangement, complexity, mystery, legibility, etc.

A large body of research clearly shows that people appreciate *old forests and large trees* (Schroeder and Daniel 1981, Saastamoinen 1982, Brown and Daniel 1984, 1986, Herzog 1984, Buhyoff et al. 1986, Hull and Buhyoff 1986, Hull et al. 1987, Pukkala et al. 1988, Rudis et al. 1988, Ruddell et al. 1989, Ribe 1990, Kardell et al. 1993, Pings and Hollenhorst 1993, Haider 1994, Kardell and Lindhagen 1998, Liao and Nogami 1999, Lindhagen and Hörnsten 2000, Silvennoinen et al. 2001). Furthermore, Karjalainen (2000) demonstrated that the age of a forest stand influenced people's preferences more than the tree species or the way of management. Nevertheless, very old forests are not always the most preferred ones (Benson and Ulrich 1981, Karjalainen 2000). Old forests – at least if they are managed – are often spacious, and it is possible that spaciousness affect preferences more than the age of the forests per se. One reason for liking large trees may be that they may serve as landmarks and thus increase the legibility and sense of depth in the forest stands. Large trees can also structure the scene and offer focal points.

Spacious forests, in which *visibility* is good, are generally preferred to dense forests (Haakenstad 1972, Brush 1979, Hultman 1979, Brown and Daniel 1986, Hull and Buhyoff 1986, Hull et al. 1987, Pukkala et al. 1988, Rudis et al. 1988, Ruddell et al. 1989, Aasetre 1993, Kardell et al. 1993, Haider 1994, Kardell and Lindhagen 1998, Lindhagen and Hörnsten 2000, Silvennoinen et al. 2001). However, very wide visibility is not liked, because the forest should include enough green biomass (Savolainen and Kellomäki 1981). Yet according to the results by Pings and Hollenhorst (1993), visual penetration and screening did not affect preferences. There may be an optimal level of density, and this optimal density may vary with the type of forest viewed, for example, urban parks versus natural forests (e.g. Ribe 1990).

The theories for predicting landscape preferences provide possible reasons for liking spaciousness. Depth as such predicts preferences. Visibility and spaciousness offer focal points and make the forest more coherent and legible i.e. easier to make sense of, structure and understand. In addition, visibility offers possibilities to see the environment in more detail and may thus provide complexity. Spaciousness may also create deflective vistas and increase the sense of mystery. A spacious forest offers more room for people to move, and also a perceived threat may be smaller than in dense forests. However, spacious forests may not provide as good refuges as dense ones do.

In Finland, the Scots pine and Silver birch are usually preferred to the Norway spruce (Pukkala et al. 1988, Silvennoinen et al. 2001, Tyrväinen et al. 2003). One reason for this low preference for the Norway spruce may be that spruce forests are often denser and darker than pine or birch forests. A forest harboring many *species* is frequently liked and mixed forests (several tree species) are generally appreciated more than forests consisting of one tree species (Haakenstad 1972, Kellomäki 1975, Karhu and Kellomäki 1980, Savolainen and Kellomäki 1981, Schroeder and Daniel 1981, Kardell and Lindhagen 1998). Haider (1994) and Bostedt and Mattsson (1995) demonstrated that in the predominantly coniferous forests, the hardwoods contributed to the scenic beauty. Correspondingly, Schroeder and Daniel (1981) and Ribe (1990) showed that the presence of non-dominant tree types increased the perceived scenic beauty of forests.

By comparison, Tyrväinen et al. (2003) observed that forests consisting of one tree species were either preferred to or equally preferred to mixed forests. Pukkala et al. (1988) found that the mixed stands were not evaluated higher than the pure birch or pine stands, but in the spruce stand, a mixture of other species increased the scenic beauty. This result is probably due to the low preferences for spruce. One reason for the frequently observed preferences for mixed stands may be that several tree species in the forest stand increase the visual diversity and complexity and thus offer more possibilities for exploration. Also, non-dominant trees may serve as landmarks in a forest stand and thus increase the legibility and sense of depth.

Dead and downed wood has a strong detracting impact on visual preference (Brown and Daniel 1984, 1986, Vodak et al. 1985, Ribe 1990, Jensen 1993, Haider 1994). Unfortunately, studies do not usually differentiate between the logging residue and naturally downed wood. While *logging residue* is always disliked (Arthur 1977, Heino 1974, Benson and Ulrich 1981, Schroeder and Daniel 1981, Brown and Daniel 1984, Vodak et al. 1985, Aasetre 1993, Kardell et al. 1993, Liao and Nogami 1999, Kardell and Lindhagen 1998, Lindhagen and Hörnsten 2000), it is possible that natural downed wood is more acceptable than slash (Schroeder and Daniel 1981). However, both slash and fallen wood decreased the scenic beauty of the Hinoki forests (Liao and Nogami 1999), and people did not like the dead snags and decaying ground wood in urban forests (Tyrväinen et al. 2003). By comparison, Rudis et al. (1988) found that a limited amount of downed wood was positively associated with scenic beauty. The different types and forms of dead material (e.g. snags and chicots, overall size and age, free standing, leaning, lying on the ground) might influence people's judgments of the scenic beauty differently, or simply their degree of visibility differs in the images (Haider 1994). Ribe (1990) suggests that large quantities of downed wood, dead trees and slash may create a perception contrary to the desired sense of a healthy and thriving forest.

The theories predicting landscape preferences provide possible explanations for these findings. The dead standing or downed wood may increase the complexity and sense of mystery. Yet they may also hinder the visibility and ease of movement, make the ground surface less smooth, decrease the spatial arrangement of the forest stand, and make the environment more threatening. The dead standing or downed wood can both increase and

decrease the legibility of the scene. Individual dead trees may serve as landmarks, but large numbers of them may hinder people finding their way. Correspondingly, logging residue disturbs the ease of movement and negatively affects the ground surface texture. Thus the logging residue may increase the perceived threat by making the escape from threat more difficult. The slash may also decrease the coherence and complexity of the scene and the sense of depth as well as hinder way-finding.

Low undervegetation, i.e. green ground cover (herbage, grass, forbs) is appreciated (Schroeder and Daniel 1981, Schroeder and Brown 1983, Brown and Daniel 1984, Brown and Daniel 1986, Ribe 1990, Pings and Hollenhorst 1993, Liao and Nogami 1999). Green ground cover enhances visual diversity, vividness, ease of movement, the smoothness of ground texture, and the impression of depth. Green ground cover may also enhance coherence by creating unifying textures.

Undergrowth (small trees, sapling, shrubs) is liked as well (Brush 1979, Koch and Jensen 1988, Silvennoinen et al. 2001, Tahvanainen et al. 2001), unless it is not too dense (Rudis et al. 1988, Ruddell et al. 1989) and does not hinder the visibility. Savolainen and Kellomäki (1981) observed that while conifer undergrowth was perceived positively, deciduous undergrowth was experienced negatively. They also stated that shrub layer may be important in structuring the forest view (Savolainen and Kellomäki 1981). Haider (1994) found that respondents differentiated the scenes along a continuum of the presence or absence of ground cover and brush, although this dimension was independent of scenic beauty. Optimally structured undergrowth may enhance the depth and spatial arrangement of the scene as well as increase the sense of mystery and complexity. This type of undergrowth may also provide hiding places. If the undergrowth is spacious enough, it may also provide a feeling that there is nothing threatening in the surroundings. Dense undergrowth not only decreases the depth and visual access but also detracts locomotion and the smoothness of the ground cover.

According to some studies, people prefer forests consisting of *uneven-sized trees* to those having even-sized trees (Yarrow 1966, Cook 1972, Buhyoff et al.1986, Koch and Jensen 1988). Un-even sized trees may offer more complexity and a sense of mystery. They may also enhance the sense of depth by defining layers in the scene.

Many studies report that *managed forests* are preferred to forests in their *natural state* (Daniel and Boster 1976, Hultman 1979, Savolainen and Kellomäki 1981) or unmanaged forests (Brush 1979, Tyrväinen et al. 2003). On contrary, some studies have shown that forests in their natural state are preferred to or liked as much as the managed forests (Vodak et al. 1985, Hull and Buhyoff 1986). Preferences for the managed-unmanaged continuum of forests are probably influenced by the intensity of forest management actions, i.e. how much human influence is visible, for example, as evidenced by the amount of slash and other downed wood. Other contributing factors are people's values and environmental attitudes and these may affect people's preferences if they can distinguish between a forest that is managed and one that is in its natural state.

Whether or not people appreciate forests in their natural state is likely to be dependent on how much the forest provides visual access, ease of locomotion, smoothness of ground surface texture as well as coherence. Hultman (1979) found that unmanaged forests that were difficult to pass through were appreciated if they had a trail. Karjalainen (2000) observed that forest visitors liked the old Scots pine forests in their natural state as much as the managed old Scots pine forests, but in the case of the Norway spruce forests, the managed ones were preferred to those in their natural state. The reason for this may be that the spruce forests in their natural state were darker, more closed and included more dead material than did the pine forests. In short, the spruce forests may have offered less visual access, less coherence, and

less smooth ground texture than the pine forests. In addition, forests in their natural state may be perceived as threatening, but they can also provide complexity and a sense of mystery.

The preference studies have concentrated on the forest stand level. However, if a certain kind of forest stand is appreciated, this does not mean that people would prefer only this kind of stand in a larger forest area. Instead, the *variation* between the different kinds of stands – for example, the variation in densities, tree sizes, tree species, etc. – is probably important for visual preferences. Especially in Finland, where people typically experience the forest by hiking, skiing or otherwise moving in the forest, it can be assumed that the variation between the landscape types is important. Unfortunately, very little research has been conducted concerning the meaning of the variety of the landscape types or the optimal variation.

Axelsson-Lindgren and Sorte (1984) showed that variation in forests is important for the sense of time and place as well as for the activity of people. The respondent stated that the path having more landscape types was more comfortable, more variable and stimulating for more activities – and they evaluated the time they used walking through it more exactly – than the path having less landscape types. Likewise, Karjalainen (2000) observed that forest visitors preferred a recreation area consisting of different types of forest stands even though some of the stands were the less preferred ones. Moreover, Lindhagen (1996) found that the perception of the whole forest area is not the same as the sum of the stands within it.

Gustke and Hodgson (1980) observed that the rate of travel along a trail reduced when people entered a different kind of environment, i.e. when they left an open meadow and entered a forest. Researchers interpreted this result by concluding that aesthetic pleasure is strengthened when the environment offers distinctive discontinuity. They concluded that the effect of discontinuity may depend on the frequency with which discontinuities occur along a trail, i.e. there might be an optimum frequency of discontinuity. Another study by Heft and Nasar (2000) reported that the highest ratings came from the turn segments of the route where the greatest amount of new information was revealed.

Variation between the different types of landscapes and forest stands may enhance way-finding, complexity and the mystery of the environment. Since the preferences of the different groups of people may vary, the variable environment can also satisfy many types of needs. Also, if one landscape type does not have a certain preferred quality, another type may have it, as in the variation between prospect and refuge qualities.

Most of the variables of the information, psycho-evolutionary, prospect-refuge and habitat selection theories do fit to the results of the empirical studies on preferences for forest landscapes. Explanations for people's forest landscape preferences can be found in complexity, coherence (focal point, structure, and order), depth and visual access, mystery, legibility, ground surface texture and ease of locomotion, and threat. In addition, preferred forest landscapes include prospect-refuge elements. These are environments in which one can both hide and have the possibility to see far into the distance.

As mentioned previously, studies on *preferences for agricultural lands* are much rarer than the research examining the preferences for forest landscapes. Even so, it can be concluded that traditional agricultural landscapes are usually preferred to their modern counterparts (Willis and Garrod 1992, Strumse 1996, Kaltenborn and Bjerke 2002). Moreover, a Finnish study reported that the highest scenic values were given to agricultural landscapes with a variation in topography and vegetation, while large, open and flat field areas were judged as being the most unattractive landscapes (Tahvanainen et al. 1996).

Kaltenborn and Bjerke (2002) showed that Norwegians expressed their strongest preferences for wildland scenes containing water as a dominating element. Next in preferences were cultural landscapes and traditional farm environments. The least preferred

category of pictures was the landscapes showing the effects of modern agricultural practices. Correspondingly, Strumse (1996), who studied visual preferences for agrarian landscapes in western Norway, found high preferences for traditional agrarian landscapes and a relative dislike for a dominating human influence as well as many of the effects of modern farming practices. In addition, Willis and Garrod (1992) discovered that current agricultural landscapes as well as the conserved landscapes were appreciated highest while the least preferred alternatives were the semi-intensive and intensive agricultural landscapes.

The studies on the preferences for forest regeneration and field afforestation are reported in Chapter 5.1 in connection with the discussion on the results of the case studies.

3.3 Effects of the respondents' backgrounds on preferences

This dissertation assumes that besides innate genetic factors, cultural and individual issues, such as values, attitudes, education, etc., may also affect preferences. The following chapter explores differences in the perceptions of the different cultures and subcultures. This review provides a background for the case studies which, among other things, analyzed the possible discrepancies between the preferences of the various stakeholder groups.

The landscape preference studies have concentrated on examining the differences between the various landscapes, and much less attention has been paid to the effect of the respondents' personal background for the preferences. In other words, landscape preferences have usually been tried to be explained by landscape properties rather than by the respondents' cultural or sub-cultural background. This is partly due to the prevailing paradigms in landscape preference research that suppose preferences being to large extent innate. For example Brush et al. (2000) point out that the research approaches used in landscape perception research have been adopted mainly from the field of environmental psychology with little input from the sociologists and demographers. They state that more attention should be given to the demographic representation of participants.

As described in Chapter 2.2.2, it seems probable that both cultural (=learned) and genetic factors contribute to the perceptions of and the preferences for landscapes (Hull and Revell 1989b, Purcell and Lamb 1998, Bourassa 1990, Hartig 1993). There are large similarities in the preferences of people from different cultures as well as between individuals. However, despite these parallels, there also are discrepancies, especially when the preferences are explored in more details. Yang and Kaplan (1990) point out that the landscape perceptions may differ even though the preference ratings would be highly correlated, i.e. even if the relative preferences are highly similar, the patterns among the ratings may be distinct. Moreover, Hull and Revell (1989b) suggest that the limited between-person variation reported may be due to research designs which limit examination of the potential between-person differences.

The comparison of the different studies on the effect of personal background on preferences is problematic because the content of the pictures shown, the research designs, attributes evaluated as well as the statistical analyses used vary from one study to another. Observed similarities and differences are largely dependent on the content of the studied landscapes. The statistical analyses used may also affect the results obtained, for example whether the correlations or the differences in the levels of ratings are studied. A typical situation is that the rank order of the landscapes is similar among the various groups but there are some differences in the levels of ratings given to the individual pictures (e.g. Hultman 1983). Especially when studying the differences in rating levels of several images and several

respondent groups, there are so many comparisons that some differences are inevitably found even if they are not actual.

Even though landscape preferences seem to be rather stable (Palmer 1997, Lindhagen and Hörnsten 2000, Tyrväinen et al. 2003), forest landscape preferences may also slightly change over time. Lindhagen and Hörnsten (2000) demonstrated that albeit the ranking of forest photos had changed only slightly in twenty years, some differences emerged in the perceptions. In 1997, photos showing trees lying on the ground, logging residues or dead standing trees, and a virgin forest were considered to be more suitable for forest recreation than twenty years earlier. Kardell (1990) reported that in the year 1978, only 17% of the respondents thought that a wind-fell spruce could be left in the forest while ten years later, 47% of the respondents thought so. These changes might be due to the growing ecological awareness.

The following paragraphs contain a review of the research conducted on the effect of some variables related to the respondents' background on landscape preferences. These variables include the culture and geographical area, familiarity of the landscape, childhood experience, place of residence, land ownership, occupation, education connected with landscape design or forest management, environmental activity, type of outdoor activity, frequency of outdoor visits, level of education, information given on the photos, age, gender, and personality type.

The preference studies have found both similarities and differences in the landscape perceptions of people coming from *different cultures and geographical areas*. According to Zube (1984), the similarities in landscape preferences tend to be greater among similar cultures and environments and less so among dissimilar ones. However, several studies show that there are more similarities than differences between cultures and regions even if the cultural and/or environmental situations differ significantly.

Korean and western groups had strong similarities in perceiving landscapes (Yang and Kaplan 1990). In addition, the Balinese and the tourists visiting Bali agreed substantially in their visual evaluations. In fact, the tourists coming from the different western cultures were more in agreement with one another than were the Balinese themselves (Hull and Revell 1989b). The preferences of Swedes, Danes, Dutch, and Americans were very similar to each other (Buhyoff et al. 1983), as were the preferences of Scots and North-Americans (Shafer and Tooby 1973). Italians and Australians evaluated the same types of scenes in parallel ways (Purcell et al. 1994) and people living in the different Asian countries had similar kinds of preferences (Tips and Savasdisara 1986). The similarity of the Swedes and the Americans was impressive although some minor differences were found; Americans gave higher ratings to scenes having neat manicured qualities (mowed ground surface) than Swedes (Ulrich 1977). Further, people living in Arizona and those living elsewhere in the United States had very similar preferences to each other (Balling and Falk 1982).

Conversely, some differences in the preferences of Eskimos and non-Eskimos (Sonnenfeld 1967, cited by Zube and Pitt 1981), blacks and whites (Zube and Pitt 1981, Kaplan and Talbot 1988) and Australian and North-American students (Kaplan and Herbert 1987) have been reported. Yu (1995) observed that the preferences of the Chinese and Western people differed only in those landscapes that had special cultural meanings. Nevertheless, although the Westerns' landscape preferences did correlate well with those of the well-educated urban Chinese, they did not correlate with those of the less well-educated rural Chinese. In addition, some differences may also emerge in perceiving the functions of a landscape. For example, the Japanese tended to view trees as commodities (functional view, oriented towards human

work), whereas the Germans tended to associate forests with mystery and romance (Kohsaka and Flitner 2004).

Familiarity of landscape clearly influences preferences. Several studies show that people usually prefer familiar environments (Hammit 1979, Penning-Rowsell 1982, Lyons 1983, Dearden 1984, Kaplan and Herbert 1987). Balling and Falk (1982) provide hints that the time people spend in nature during childhood may affect preferences. Contrary to this finding, Brush et al. (2000) found that *childhood experience* did not account for much of the variation in the enjoyability of driving through rural landscapes. Tips and Savasdisara (1986) also observed that the childhood perception of the different macro-geographic environments did not imply differing landscape rankings at later ages. As well, Kellomäki (1975) observed that where people lived during childhood had no effect on their evaluation of the forest stands.

Correspondingly to familiarity, the *place of residence* may affect preferences (Tips and Savasidara 1986, Yu 1995). The respondents who lived in low-density natural housing environments expressed a higher appreciation of the natural scenes than did urban residents and vice versa (Dearden 1984). Furthermore, the non-urban respondents (Silvennoinen et al. 2002) and local inhabitants (Nousiainen et al. 1998) displayed different preferences for the landscape management options as did the urban respondents and tourists. These results may, however, rather reflect the effect of familiarity on people's preferences than the effect of their living in rural or urban areas. Moreover, people probably choose living environments that they prefer.

The people who live closely connected to the natural landscape and who earn their living from nature might significantly differ in their preferences from other population groups (Yu 1995). Yu (1995) found that Chinese farmers, compared to other subjects, gave higher ratings to those scenes with agricultural fields and rated lower those landscapes that included bad and foggy weather. Finnish and Swedish studies showed that the preferences of *landowners* for landscape management operations differed to some extent from those of non-owners (Kardell and Wallsten 1989, Tahvanainen and Tyrväinen 1988, Silvennoinen et al. 2001, Silvennoinen et al. 2002). However, studies conducted in the United States reported that students agreed closely with landowners in their ratings of forest stand attractiveness (Brush 1979, Vodak et al. 1985).

Occupation per se does not usually affect landscape preferences (Dearden 1984, Brunson and Shelby 1992, Brush et al. 2000, Silvennoinen et al. 2002) if it is not *connected to landscape design, or forest and nature management*. Some studies have shown that the landscape architects' preferences differed from those of other groups (Daniel and Boster 1976, Buhyoff et al. 1978). On the contrary, some studies have demonstrated that training in landscape design or land-use planning did not affect preferences (Zube 1974, Dearden 1984, Yu 1995).

In some North-American studies, forestry occupation did not affect preferences for forest pictures (Daniel and Boster 1976, Buhyoff and Leuschner 1978), while in other studies, the foresters and resource managers evaluated the images representing different biomes and forest stands differently from the other groups (Balling and Falk 1982, Haider 1994). According to Finnish studies, forestry personnel have a more positive attitude towards the visual effects of forest management than does the general public (e.g. Karhu ja Kellomäki 1980, Silvennoinen et al. 2002). Similarly, Swedish studies have found discrepancies between forestry students and other groups in the ratings of forest stands (Kardell et al. 1993, Lindhagen 1996, Rydberg 1998).

The preferences of *environmental groups* often differ from the preferences of other groups (e.g. McCool et al. 1986). For instance, Dearden (1984) found that individuals motivated to join an environmental lobby group had a higher appreciation of wilderness landscapes

than had the planners or members of the public. Furthermore, Swedish nature protectionists appreciated the mature forests and ecological management options more than did the other groups (Kardell 1990) and were also more critical towards a foreign tree species than were the other groups (Kardell and Wallsten 1989). Likewise, the Australian respondents with botanic and nature conservation interests favored the native species more than did Australian students (Kaplan and Herbert 1987). These results may reflect the environmentalists' concern over the preservation of species. People with environmental values may also have higher standards for visual quality and they may also be more sensitive to changes in natural landscapes. However, some studies show a high agreement in preferences of the environmental groups and the other public groups (Daniel and Boster 1976, Kardell et al. 1993, Haider 1994).

Brush (1979) noticed that the respondent's preferred mode of travel through woodlands may influence their perceptions of the attractiveness of the forest stands. By comparison, Haider (1994) found that different *types of outdoor activities* actively pursued did not affect scenic preferences for the white and red pine forests. The *frequency of outdoor visits* may also affect preferences. The respondents with higher wilderness contact time had higher appreciation of wilderness landscapes (Dearden 1984). Similarly, Swedes who often visited the forest had a more positive opinion of the forest sites' suitability for their outdoor recreation purposes than those who visited forest less frequently (Kardell et al. 1993, Lindhagen 1996). Moreover, Tyrväinen et al. (2003) noticed that active nature observers and outdoor visitors had slightly different preferences from the less active ones. These results may as well reflect the importance of familiarity in preference formation.

Level of education did not affect the visual preferences for rural, wilderness and urban fringe landscapes (Dearden 1984), forest management operations (Silvennoinen et al. 2002), forest stands (Kellomäki 1975) or white and red pine forests (Haider 1994). However, Tyrväinen et al. (2003) observed that the highly educated appreciated the ecological management options in the urban forests more than did those who had a lower level of education. Yu (1995) likewise found that education level combined with living environment affected the preferences for rural landscapes.

The *information* given concerning the images to be evaluated does, in some cases, affect people's preferences (Buhyoff and Leuschner 1978, Anderson 1981) and in some other cases it does not (Wellman and Buhyoff 1980, Vodak et al. 1985). This depends on the type of information given and the content of the photos showed. Brunson and Reiter (1996) found that the respondents who had heard the ecosystem management information did not give higher ratings to the ecosystem management stands than those who had not heard the info. However, the office workers who had heard the information rated the ecosystem management options higher than those office workers who had not heard the info. Concerning university students, the situation was the opposite: the informed respondents rated the ecosystem management images lower than did the uninformed respondents (Brunson and Reiter 1996). By comparison, Brush et al. (2000) reported that the knowledge regarding land management and land use practices affected the landscape preferences.

Children and adults may have different preferences. Water enhanced the children's landscape preferences more than the adults' preferences and furthermore, physical complexity was not important for the children (Zube et al. 1983). In addition, young children preferred the savannah to the forests, while there were no differences in the other age groups (Balling and Falk 1982). In Lyons' study (1983) on vegetational biomes, the children showed higher preference scores than did the other age groups. On the contrary, for example, Jackson et al. (1978) as well as Ward and Porter (1980) did not find any differences between children

and adults. It seems possible that children might appreciate simpler and less complex environments than adults do.

In some studies, the differences between adults belonging to the *different age groups* have been observed. For instance, younger people liked images showing high naturalism and great compatibility (Zube et al. 1983), a virgin forest (Lindhagen and Hörnsten 2000) or ecological management options (Tyrväinen et al. 2003) more than the older ones liked these types of images. Furthermore, the older respondents generally tend to give lower scores to images than the younger people (Balling and Falk 1982, Lyons 1983). Conversely, other studies show that age does not affect preferences (Kellomäki 1975, Dearden 1984, Haider 1994, Brush et al. 2000, Silvennoinen et al. 2002).

According to many studies, *gender* does not affect environmental preferences (Kellomäki 1975, Jackson et al. 1978, Balling and Falk 1982, Penning-Rowsell 1982, Dearden 1984, Kardell et al. 1993, Yu 1995, Brush et al. 2000, Silvennoinen et al. 2002). However, some differences in preferences between the genders have been reported (e.g. Macia 1979, Lyons 1983). Yu (1995) observed differences between men and women for some special environments. Tyrväinen et al. (2003) found that the men liked ecological management options in the urban forests more than did the women. In a Swedish study, the women assessed most of the forest sites to be more suitable for their outdoor recreation than did the men (Lindhagen 1996). Kardell and Wallsten (1989) likewise found that the women had more positive perceptions of a foreign tree species than did the men.

The *type of the personality* may also affect the visual preferences (Macia 1979). For example, emotionally unstable personalities liked the landscapes showing repeating patterns and structural rhythm (Abello and Bernaldez 1986). These kinds of personalities may try to compensate for the lack of stability in their emotional lives by seeking regular and predictable environments.

The different studies have reported contradictory results concerning most of the variables examined in this chapter; some studies show that a variable influences preferences and some other studies show that it does not. As mentioned previously, these contradictions might be due to the differences in research designs, statistical analyses, and contents of the pictures shown. Nevertheless, based on the reviewed studies, it can be concluded that people tend to prefer familiar environments and do not like visual changes taking place in their home environments. Furthermore, people who frequently visit nature often give higher preference scores for natural environments than do the less active ones. Also, people usually prefer the environments in which they live. While occupation as such does not affect preferences, training in forestry seems to have some influence on the ratings of forest scenes. However, these results concerning the frequency of nature visits, place of residence, and occupation in forestry may rather reflect the effect of familiarity than any other separate variable. In addition, people may at first prefer natural environments and as a consequence, seek to live, visit, or work in these kinds of environments.

Environmental values tend to affect preferences so that environmental groups usually appreciate naturalism more than other groups. Moreover, land ownership and knowledge about the assessed landscapes may affect preferences. In some special cases, variables such as age, gender, and level of education might influence preferences as in, for example, ecological management options.

Based on these findings, the case studies hypothesized that an occupation or training in forestry, land ownership, local residency, as well as environmental attitude could all affect the preferences for forest regeneration and field afforestation.

PART II: THE FOUR CASE STUDIES

4 BACKGROUND, MATERIAL AND METHODS OF THE CASE STUDIES

4.1 Background and aims of the case studies

All the case studies included in this dissertation aimed at finding out public preferences for forest regeneration or afforestation of agricultural land, and at studying the possible differences between the different stakeholder groups' preferences. All the case studies were based on practical needs to produce knowledge on which to base the guidelines for the forest visual landscape management. These case studies also aimed at examining the possible contradictions between the visual preferences and ecological recommendations as well as the landscape management guidelines.

Case Study I (1992–1995). Case Study I was initiated by the growing criticism of the general public as well as the environmentalists towards clear fellings. The Forest 2000 -program established in 1985 (Metsä 2000 ohjelman... 1985) represented a different era from the previous financing programs of forestry, which have promoted the profitability of Finnish forestry (Metsätalouden rahoitusohjelmat). Even though the aim of the Forest 2000 -program was to increase timber production, this program also considered the multiple-use of forests and other values besides timber production, such as the recreational use of forests and landscape management. This program even suggested detailed instructions for visual landscape management. In addition, the international development in the 1990s (e.g. Rio Conference 1992 and Ministerial Conferences on the Protection of Forests in Europe) began to pay attention to the social sustainability of forest management.

The landscape management guidelines of Metsähallitus (Forest and Park Service) and the Forestry Development Center Tapio, which were valid at the time Case Study I was designed, asserted that the most important aspects of landscape management are the size and shapes of the regeneration area (Metsähallituksen metsien... 1990, Metsien hoito: Etelä-Suomi 1990, Metsien hoito: Pohjanmaa-Kainuu 1990, Metsien hoito: Lappi 1991, Metsänhoitosuositukset 1989). The Tapio instructions also emphasized the positive visual effects of clear fellings, stating that clear fellings make the landscape more spacious and when properly located, they can even be beneficial for the scene. According to these instructions, small clear felling areas bring variation while large ones are monotonous, and moreover, in visually important places, large clear fellings should be avoided. (Metsänhoitosuositukset 1989) Furthermore, both the Tapio and Metsähallitus guidelines stated that untreated patches, tree groups or solitary trees should be left in the regeneration areas, and large and old special trees and snags should be preserved (Metsänhoitosuositukset 1989, Metsähallituksen metsien... 1990). These guidelines also suggested that heavy soil preparation should be avoided in visible places, such as roadsides and viewpoints (Metsänhoitosuositukset 1989, Metsien hoito: Etelä-Suomi 1990, Metsien hoito: Pohjanmaa-Kainuu 1990, Metsien hoito: Lappi 1991).

The motivation for Case Study I was the public criticism towards clear felling areas, the introduction of landscape issues in political programs, as well as the emergence of landscape management instructions in the guidelines for forest management. Case Study I was one of the first Finnish studies on the public's preferences towards forest management operations based on the visualization of these actions. This case study aimed at studying the attitudes of the general public towards clear felling, as well as the possible differences in the perceptions

of environmentalists, forestry professionals and the general public. Another objective of this study was to find features that are important in perceiving clear felling areas and to determine if there are differences in perceiving the different types of clear felling areas. Case Study I also tested to some extent the relevance of the landscape elements included in the landscape management guidelines.

Case Study II (1994–1997). The area of agricultural land has decreased steadily in Finland. The field area diminished by 16% from the 1950s to the 1960s. A further 15% reduction in field area occurred between the 1960s and 1990s. (Finnish Statistical Yearbook... 2005) Diminishing the agricultural land poses a threat to the traditional, open cultural landscape in the Finnish rural areas, in particular because agricultural land is a scarce resource in Finland, covering only 8% of the land area.

When Finland joined the European Union in 1995, the EU's Common Agricultural Policy (CAP) started to guide Finnish agricultural land use. Finland had to implement the EEC 2080/92 council regulation that instituted a community aid scheme for forestry measures in agriculture. The program composed by the Finnish Ministry of Agriculture and Forestry aimed at reducing agricultural land in Finland by 88,000 hectares in the years 1995–1999. Consequently, the farmers received subsidies for afforestation. In 1997, the aim was reduced to 45,000 hectares, which would have been 2% of the agricultural land of Finland, and the subsidy was decreased (Paajanen 1999). However, the final afforestation area was only 27,600 hectares. Nevertheless, in northern and eastern Finland, the afforestation of the farm fields that are abandoning agricultural production is changing the cultivation landscape to forest landscape (Maa- ja metsätalousministeriön luonnonvarastrategia 2001).

In the beginning of the 1990s, the Finnish political programs started to emphasize the importance of agricultural and rural landscapes. In 1992, the Ministry of Environment listed 56 nationally valuable landscape areas to be taken into consideration in land use planning, with a total area of 730,000 hectares. Besides those national areas, 171 regionally valuable landscape areas were listed. (Maisema-aluetyöryhmän mietintö 1992) The main parts of these areas are situated in cultivated lands. Furthermore, according to the Ministry of Environment working group on landscape areas (Maisema-aluetyöryhmän mietintö 1992), landscape management should be urgently researched more. In the same vein, the working group for the rural landscape of the Ministry of Agriculture and Forestry (Maatalous maaseudun monimuotoisuuden... 1995) stated that the agricultural landscapes have scenic value and that in field afforestation, the preservation of the scenic field areas should undertaken.

Case Study II was motivated by the political considerations of the scenic importance of agricultural lands and by the concern for the increasing amount of afforestation. At the time when the Case Study II was planned, studies on public preferences for field afforestation and the visual instructions to implement afforestation were almost non-existent. This case study was based on the need to develop guidelines for adjusting the afforestations to the Finnish cultural landscape based on the visual preferences for the afforestation options. Case Study II also aimed at studying the possible differences in the field afforestations preferences of the local people, tourists of the area, and of the forestry professionals. In addition, there was a requisite to test some of the existing landscape design principles from the point of view of the general public.

Case Study III (1994–1997). The Environmental Program for Forestry (Metsätalous ja ympäristö 1994) published in 1994 was designed to adapt Finnish forestry to the changing international environmental demands and was the basis for restructuring the Finnish forest policy. This program concentrated on the ecological sustainability but also shortly mentioned the multiple-use of forests, such as landscape management, and suggested that landscape

planning and management should be developed based on Finnish landscape, forest aesthetics and forest management. This program also provided some detailed instructions for visual management of forests.

In the beginning of the 1990s, the first Finnish publications started to emerge on forest landscape design and management (e.g. Rautamäki 1990, Antikainen 1991, 1993). These were based on the principles of landscape design, mainly adopted in the Great Britain (e.g. Lucas 1991, Lowland landscape... 1992, Forest Landscape Design...1994). In 1993, Metsähallitus (Forest and Park Service) introduced its first Environmental Guide for Forestry that also included instructions for visual landscape management (Metsätalouden ympäristöopas 1993). During the next year, the Forestry Development Centre Tapio published new forest management guidelines with some instructions on landscape management (Luonnonläheinen metsänhoito 1994).

These guidelines set by Metsähallitus and Tapio stated that felling areas should repeat the forms, lines and scale of the surrounding landscape, and that the borders of regeneration areas should be irregular (Metsätalouden ympäristöopas 1993, Luonnonläheinen metsänhoito 1994). The Tapio instructions asserted that the vertical shape of the felling area does not fit into the horizontal shapes of the landscape, and that the linear borders can be softened by leaving tree groups in the felling area (Luonnonläheinen metsänhoito 1994). According to the Metsähallitus guidelines, it is visually better to leave seed trees in groups than individually and evenly in the felling area (Metsätalouden ympäristöopas 1993). Seed or shelter trees – or sharply outlined clear felling strips – should not be left against the horizon line (Metsätalouden ympäristöopas 1993, Luonnonläheinen metsänhoito 1994). The guidelines also stipulated that forest stands on the lakeshore are to be left untouched. However, small openings can be made up to the lakeshore in order to open up the landscape (Metsätalouden ympäristöopas 1993), and a dense shelterbelt on the lakeshore is better than a thinned strip (Luonnonläheinen metsänhoito 1994).

The grounds for Case Study III were the restructuring of Finnish forest policy that began to pay attention to landscape management, and also to the lack of knowledge concerning the public preferences for forest regeneration. This case study was motivated by a concern whether the visual landscape management instructions developed by the experts were valid from the point of the Finnish forest users. Also, it was questioned whether these principles that were developed in other countries were suitable for the Finnish landscape. Like Case Study II, Case Study III aimed at studying the possible differences in the preferences of the local people, tourists of the study area, and of the forestry professionals.

Case Study IV (1999–2003). In the second half of the 1990s, the management of visual forest landscape started to be emphasized more although it was still a minor issue in political discussions and decisions. The new Forest and Nature Conservation Acts were adopted in 1997. According to the Forest Act (Metsälaki 1996), scenically valuable areas can be treated according to the special character of the site. One aim of the Nature Conservation Act (1996) was to preserve the beauty of nature and landscape values. Further, for example, Finland's National Forest Programme 2010 (1999) approved by the Finnish government states that landscape and cultural values, outdoor recreation, tourism, as well as other multiple use functions, will be taken into account and advanced within forest management and protection.

In 1997, Metsähallitus published a new version of its Environmental Guide for Forestry (Metsätalouden ympäristöopas 1997) that had visual landscape management instructions that were very similar to the previous ones. These instructions stated, for example, that it is visually better to leave seed trees in groups than individually and evenly in the felling

area. In the same year, Tapio introduced a special guide for forest landscape management (Metsämaiseman hoito 1997). This guide states, for instance, that evenly, individually located retention trees do not improve the near-distance view but suggests that the retention trees should be preferably left in groups, and the retained trees should have impressive trunks and broad crowns.

The political discussions and decisions in the second half of the 1990s called for more knowledge on the visual impacts of forest regeneration. The forest regeneration practices had been changed in the 1990s in response to a demand to pay attention to biodiversity and ecological issues. However, it has been unclear if the forest regeneration that ensures biodiversity values is also visually satisfactory. In particular, the visual impacts of the retention trees had been heavily criticized because the retention trees left in the felling areas were often small, damaged or otherwise in poor condition. Furthermore, the previous research on the public preferences for the retention trees in clear felling areas was contradictory and scarce. As in Case Study III, it was questioned if the current Finnish landscape management instructions were appropriate form the point of public perceptions. The starting point for Case Study IV was therefore the lack of knowledge of the visual impacts of the retention trees and the need for visual guidelines concerning retention trees, which would be valid from the forest users' point of view. This case study also aimed at studying the possible discrepancies in the preferences of the forest owners and tourists in the study area.

4.2 Material and methods of the case studies

Material and methods of the four case studies are summarized in Table 6.

Visualization. All the case studies used visual material to present the forest regeneration or field afforestation alternatives. Case Study I used original photographs, while in Case Studies II and III, digital image editing of the original photographs was applied in order to change only one aspect in a photo at a time. Case Study IV also utilized digital image editing. The basic landscape was created by a forest landscape simulator (FORSI) and then it was improved to be more natural and realistic through digital image editing. The images used in Case Studies II, III and IV were quite photo-realistic, because the objects that were shifted to the original images were transferred from digitized photos.

Forest regeneration and field afforestation options. Case Studies I and IV examined the preferences for clear felling areas in the near-distance views, while Case Studies II and III concerned medium- and long-distance views. In Case Study I, the visual preferences for the typical clear felling areas that are seen along the roadsides were studied while in the other three studies, the forest regeneration and afforestation treatments were designed and then created in the images.

In Case Study I, all the clear-cut areas along two frequently used highways were photographed. The photographs including man-made structures and wide long-distance views were eliminated. The remaining photos were grouped into different categories according to their visual appearance. Altogether 16 categories were created. One or two photos from each group were then selected for the study. In addition, Case Study I compared different treatments, but because the original photographs were used, other features besides those in the focus of interest varied to some extent as well. However, similar kinds of landscapes that were differing mainly only in one aspect were selected. The parameters studied were the size of the felling area, soil preparation, logging residue, undergrowth, solitary trees, background forest, long-distance view, and the openings in the background forest.

Table 6. Material and methods of the four case studies.

Case study	Viewing distance	Visualization	Evaluation method	Images	Respondents	Treatment	Level of treatment	Repetitions
I	Near-distance	Photographs	Rank ordering, checklist, verbal assessments	31	152 (72 residents of Helsinki region, 36 environmentalists, 44 forestry professionals)	Size of felling area	Small, large	1
						Soil preparation	None, some, plenty	1
						Logging residue	None, some	1
						Undergrowth	None, small bushes, conifer saplings	1
						Solitary trees	None, small deciduous trees, big Scots pines	1
							Small birches, big Norway spruces	1
							Birches, Scots pines	1
							None, one small birch, group of small birches	1
						Background forest	Coniferous forest, mixed forest	1
						Long-distance view	None, visible	1
						Openings in the background forest	None, openings without view, openings with view	1
II	Middle- and long-distance	Digital image editing	Graphic rating scale (0–100), rank ordering	11	190 (33 local residents, 99 tourists, 58 forestry professionals)	Shape of afforestation	Oblong irregular, oblong geometrical, quadratic	2
						Location of afforestation	At the forest edge, in the middle of field, shuts off the long-distance view	2
						Tree species in afforestation	Silver birch, Norway spruce	1
III	Middle- and long-distance	Digital image editing	Graphic rating scale (0–100), rank ordering	23	190 (33 local residents, 99 tourists, 58 forestry professionals)	Felling in summit forest	Unbroken skyline, clear felling, seed tree felling	2
						Shape of felling area	Irregular, geometrical horizontal, geometrical vertical	2
						Felling along lakeshore	Dense shelterbelt, thinned shelterbelt, no shelterbelt	2
						Solitary tree groups in felling area	None, groups close to edges, groups in the middle	1
						Solitary trees in felling area	None, dead trees, close to edges, group in the middle, individually in the middle	1
IV	Near-distance	Landscape simulator and digital image editing	Numerical rating scale (1–7)	40	373 (112 visitors, 261 forest owners)	Volume of retention trees	1 m^3/ha, 3 m^3/ha, 6.5 m^3/ha, 11 m^3/ha	3
						Condition of retention trees	Poor, moderate, good	3
						Size of retention trees	Undergrowth, young and mature, young and mature with some large trees	3
						Location of retention trees	1 group, 2 groups, 3 groups, solitary trees	3
						Viewpoint	Three points	1

In Case Studies II, III and IV, the forest regeneration and field afforestation options were implemented by using digital image editing and/or a landscape simulator. Various treatments (e.g. logging on the lakeshore) were studied and the different levels of each treatment were created in the images (e.g. dense strip, thinned strip, no strip at all). Case Studies II and III had the treatments and their different levels implemented in two basic landscapes that were quite similar to each other. Both basic scenes of Case Study II showed a vast hayfield in the foreground and a forest edge with buildings and/or lake in the distance. The basic scenes of Case Study III displayed a lake in the foreground and a forested slope in the background, the other scene showing a long-distance, and the other one a middle-distance view. Case Study IV used three basic scenes and in addition, the effect of the viewpoint was analyzed. All the three basic scenes represented clear felling areas in near-distance view differing mainly only in topography.

In Case Studies II and III, a priori hypotheses about the preferred management options were created, mainly based on the principles of landscape design. Case Study II examined the preferences for the shape and location of the field afforestation areas as well as for tree species used in afforestation. Case Study III studied people's preferences for the different regeneration options in lake shore forest and in summit forest. In addition, preferences for the shape of the felling area and for the solitary trees in felling area were examined. Case Study IV concentrated on the effect of the retention trees in the felling area. The influence of the number, size, and location of the retention trees were studied.

Study areas. The study areas in all the case studies were visually significant districts: roadsides, nationally valuable landscape areas, and the vicinities of important nature-based tourism and recreation areas. In Case Study I, all the clear-cut areas along two frequently used highways were photographed. The original photos of Case Studies II and III were taken in Kainuu, and the study areas of Case Study IV were situated in Northern Karelia. In Kainuu and Nothern Karelia, forestry is an important means of livelihood, and nature tourism is also increasing. In addition, the study areas in Kainuu (Vuokatti, Melalahti, Naapurivaara) are classified as nationally valuable landscape areas in Finland and this increases the value of these areas for current and future tourism. Yet to attain results that are generalizable, the original scenes were chosen so that they did not include any distinct landscape features of the study areas.

Respondents. Various stakeholder groups were included in all the studies: environmentalists, general public, tourists, forestry professionals, and forest owners. In Case Study I, 152 respondents evaluated 31 photographs. The respondents consisted of residents of the Helsinki region (72 people), environmentalists (36 people), and forestry personnel (44 people).

Case Studies II and III utilized the same 190 respondents. The respondents consisted of 33 residents of the study areas (Melalahti and Naapurivaara), 99 tourists of the area (Vuokatti), and 58 forestry professionals. The respondents were shown a total of 34 slides: 11 of which concerned Case Study II and 23 of which were related to Case Study III.

In Case Study IV, 373 respondents evaluated 40 images. These respondents consisted of 112 visitors of Koli National Park in Northern Karelia and 261 forest owners who live in Northern Karelia.

Evaluation methods. In Case Study I, the respondents rank-ordered the 31 photographs by using a modification of the Q-sort method in which the respondents at first sorted the photos into five piles according to the beauty or ugliness of the scene and after that, rank-ordered the photos within each pile. In addition, the respondents evaluated 8 of the photos separately. For each of these 8 photos, the respondents evaluated the aesthetic effect (disfiguring/beautifying) of 19 visual features on a five-point scale and answered two open-ended questions.

In Case Studies II and III, graphic rating scale was used and this was compared to the rank-ordering of some of the images. The attribute evaluated was how much the respondent liked the image. In Case Study II, 6 out of the 11 images, and in Case Study III, 17 out of the 23 images were rank-ordered in addition to the rating. In Case Study IV, respondents evaluated how much they liked each image using a seven-point numerical rating scale.

Statistical analyses. In Case Study I, a rank-ordering of the photos produced ordinal scale data that were analyzed by non-parametric statistical methods. To test the differences between the ranks of the photographs, a Friedman two-way analysis of variance and its paired tests were used (all the photos were included in the Friedman test, and the paired tests were applied within the predetermined photo groups or photo pairs). The unanimity of all the respondents and the unanimity between and within respondent groups were tested by the Kendall's coefficient of concordance. The Kruskall-Wallis one-way analysis of variance was used to test the differences between the ranks of respondent groups in each photo separately. The differences between the respondent groups' evaluations of the features of the photos were tested by a χ^2 test arranged by slide and feature. In addition, the results of the Kruskall-Wallis one-way analysis of variance were compared to the outcomes of the parametric one-way analysis of variance and Tukey's studentized range method. The data from open-ended questions were analyzed by content analysis.

In Case Studies II and III, the assessments were made using a graphic scale which was assumed to be an interval scale and for this reason parametric statistical analyses were used. The differences between the ratings of the slides were tested by the two-way analysis of variance and by the Tukey's studentized range method. Field images and forest images were included in the separate analyses of variance. The preference ratings of each respondent group were also analyzed separately by the two-way analysis of variance and by the Tukey's studentized range method. In addition, the differences between the respondent groups were tested by the one-way analysis of variance and the Student-Newman-Keuls multiple range test which were applied to each photo separately. The consistency of the evaluation of the slides that were shown twice was tested by the paired t-test. The congruity of the two evaluation methods (rank-ordering and rating) was tested using Spearman's rank correlation co-efficient.

In Case Study IV, the effect of treatment and topography and the effect of their interaction on the preferences were studied using the two-way analyses of variance in a randomized block design. Each treatment (total volume, condition, size, location) was tested within separate analyses (i.e. four different models were constructed). The ratings of one respondent formed a block within these analyses. Multiple comparisons between the preferences for the different levels of each treatment were tested with a Tukey HSD test for three clear-cutting areas. The differences in the ratings for the images representing different viewpoints were analysed by the Friedman and Wilcoxon tests. The differences in the preferences between the three respondent groups were also studied for each treatment separately using two-way analyses of variance in a randomized block design. The ratings of one respondent group constituted a block within these analyses. In addition, the ratings of the respondent groups for the lowest treatment levels (1 m^3, in poor condition, undergrowth) were analyzed, each image separately, by applying the Kruskall-Wallis one-way analysis of variance. The effect of the other socio-demographic background variables on the preferences was tested for the hilly clear-cutting area only in each image separately by the Kruskall-Wallis one-way analysis of variance and the Mann-Whitney U-test.

5 SUMMARY AND DISCUSSION OF THE RESULTS OF THE CASE STUDIES

5.1 Visual implementation of forest regeneration and field afforestation

5.1.1 Changes in the landscape

The case studies suggest that people do not like visual changes in their natural and rural environments. Case Study III revealed that respondents clearly preferred untouched forest to regeneration fellings. Correspondingly, previous studies show that people do not usually like felling areas (e.g. Lovén 1973, Savolainen and Kellomäki 1981, Vodak et al. 1985, Brunson and Shelby 1992, Aasetre 1993, Pings and Hollenhorst 1993, Palmer et al. 1995, Pâquet and Bélanger 1997). However, we do not know how much other factors besides the visual landscape affect the low appreciation for clear fellings. One reason for this dislike may be that logging residue and soil preparation hinder locomotion and passability. In addition, the objection to clear fellings might be partly due to the fact that the human impact is so clearly visible, or due to the respondents' ecological concerns.

Case Study II concluded that the respondents preferred the original agricultural landscapes to the scenes displaying small field afforestation sites. Correspondingly to forest regeneration, the respondents' negative perceptions of the afforestation areas might not be caused only by visual impacts but also by, for example, the threats that afforestation may pose to the traditional landscape, means of livelihood, and food production. Similarly to Case Study II, Komulainen (1998) also reported that the residents of rural villages considered the attractiveness of the village environment to be decreased most by field afforestation and abandoned fields.

Nousiainen et al. (1998) discovered that local inhabitants did not accept afforestation, but potential tourists, however, preferred the alternatives that contained the wide areas of afforestation. Tahvanainen et al. (1996) demonstrated that the scenic beauty of agricultural landscape decreased with the increasing intensity of afforestation. Yet small-scale afforestation, when only a minor part of the visible open area was afforested, proved not to be visually very important, and moderate afforestation could even have a positive effect on the scenic beauty in some landscapes. Correspondingly, Cook and Cable (1995) found that shelterbelts improved the scenic beauty of the plains landscape. These results suggest that at least in large monotonous agricultural areas, afforestation may have a positive effect. A Swiss study also reported that a partial ingrowth of forest into an agricultural landscape was assessed as being an improvement in the visual quality of the landscape (Hunziker 1995).

Tahvanainen et al. (1996) also found that the more attractive the original landscape was, the greater the negative effect of afforestation. Similarly, the clearly negative effect of afforestation in Case Study II may be partly due to the villages having special scenic values while they belong to the nationally valuable landscape areas listed by the Ministry of the Environment. The Finnish studies (Case Study II, Tahvanainen et al. 1996, Nousiainen et al. 1998) concerned the landscapes in Eastern Finland, where the fields are small and afforestation poses the greatest threat for the traditional rural landscape. However, the results could be different in Western Finland, an area that has larger, uniform agricultural lands.

5.1.2 Perceptions of the clear felling areas

Case Study I demonstrated that people can perceive a regeneration area both as one entirety and as through separate constituents of the visual landscape. The most common grounds for rank-ordering the photographs were trees, shrubs and undergrowth, the size of felling area, and soil preparation. However, many respondents did not mention detailed features but answered that they rank-ordered the photos according to beauty, image, or general impression. Similarly, some studies suggest that the attractiveness of a scene is affected by several variables operating in combination rather than by separate landscape elements (Kellomäki 1975, Ulrich 1977, Savolainen and Kellomäki 1981).

According to Case Study I, people paid attention to at least some of the elements that are emphasized in the landscape management instructions (shape of felling area, solitary trees). The respondents most often paid attention to features that can be altered by forest management, i.e. background forest, size of the felling area, solitary trees, soil preparation, view from the area, and the shape of the felling areas. Most seldom they paid attention to aspects that are usually more difficult to affect: sky, rocks, bush belt in the background forest, sunshine, and red willowherbs.

Case Study I gave reason to assume that clear fellings may be experienced in an emotional way as the respondents portrayed the felling areas with words that had emotional content. The respondents described the most disliked felling areas with negative adjectives such as disgusting, dead, raped, depressing, gloomy, and terrible. By contrast, for their preferred fellings, they used positive adjectives such as beautiful and harmonious to describe them. These kinds of felling areas reminded the respondents of meadows and they attracted the respondents for a walk. The respondent stated that these clear felling areas evoked images of summer, the sun, the singing of birds, and berry-picking places.

5.1.3 Temporal effects of forest regeneration

Although the temporal effect of forest regeneration was not the focus of the case studies, Case Study I showed that the time passed from felling is decisive in the perception of the felling areas. So if the felling area was small and already had some vegetation, it could be perceived positively. Correspondingly, other studies show that temporal influences are important for the perception of forest management actions as well as for preferences for these actions (e.g. Benson and Ulrich 1981, Palmer 1990, Pâquet and Bélanger 1997, Silvennoinen et al. 2002, Shelby et al. 2003).

Hultman (1983) discovered that felling areas already having visible renewal are preferred to felling areas without any seedlings or saplings. Similarly, Silvennoinen et al. (2002) noticed that after a few years of felling, the stand is already regarded as being clearly more pleasant than immediately after that felling. Pâquet and Bélanger (1997) likewise found that the acceptability of the regeneration area increased with a growth of vegetation. However, the positive effect of growing vegetation may reduce when the vegetation becomes so big and abundant that it hinders visibility. Palmer (1990) observed that in the northern hardwood forests of the United States, the scenic value was low after harvest (1 to 3 years) but increased while the view remained open and the slash degraded (4 to 6 years) and then slowly decreased as the young growth became dense enough to obstruct the view (8 to 13 years).

5.1.4 Size of the felling area

Case Study I indicates that small clear felling areas are preferred to big ones in the near-distance views. Furthermore, the respondents felt that the large size was one of the most disfiguring features of the felling areas. Similarly, other Nordic studies show that in the near-distance views, the small felling areas are preferred to large ones (e.g. Haakenstad 1972, Hultman 1979, Hultman 1983). Palmer et al. (1995) as well as Pâquet and Bélanger (1997) found that increasing the amount of forest cut led to an increase in the negative visual effects in the middle- and long-distance views as well. In addition, Bostedt and Mattsson (1995) concluded that making clear fellings smaller, even if there were more of them, increased the non-market value of the forests for tourism in Sweden.

Some scholars claim that one, uniform, large felling area is more pleasant than several small ones in the long-distance views (e.g. Kardell 1978). Palmer et al. (1995) found that in the long-distance views, the felling units that were between 4–5.6 hectares were preferred to the smaller (1.6–2 ha) or larger (8–12 ha) felling units when the total amount of felling remained the same. However, Pâquet and Bélanger (1997) observed that in the middle-distance views, the small clear felling areas were preferred to one large area. When clear fellings were in the form of a single patch, a level of harvesting 25% of the visible landscape was accepted, while in the dispersed patch strategy, harvesting 50% was accepted. This means that it is possible to decrease the visual impact of a clear felling by dispersing the felling surface into smaller areas.

Case Study I showed that small clear fellings can also be experienced in a positive way depending on their implementation and the time passed from felling. It is possible that small felling areas can bring variation and thus affect the landscape experience positively when people are moving within the forest. Nevertheless, for example Pâquet and Bélanger (1997) have shown that even a small clear felling created a negative visual impact. The different visual elements of a felling area probably operate in combination, and thus the effect of the size of a felling area on respondents' visual preferences might also depend on the other implementation of the regeneration area.

5.1.5 Soil preparation and logging residue

Case Study I clearly demonstrated that soil preparation and logging residue have a negative effect on the visual quality of the regeneration areas. The large clear felling areas with logging residue and soil preparation were ranked the lowest. When the photo pairs were compared, the photos displaying soil preparation and logging residue were ranked lower than the photos not showing slash and soil preparation. Moreover, the respondents indicated that the most disfiguring features of the felling areas were soil preparation, logging residue, and the large size of the area. Correspondingly, other studies show that logging residue decreases the visual quality of the forests or felling areas (Arthur 1977, Heino 1974, Benson and Ulrich 1981, Schroeder and Daniel 1981, Brown and Daniel 1984, Vodak et al. 1985, Aasetre 1993, Kardell et al. 1993, Liao and Nogami 1999, Kardell and Lindhagen 1998, Lindhagen and Hörnsten 2000). By comparison, few previous studies have been conducted on the visual effects of soil preparation.

The soil preparation displayed in the photos of Case Study I was relatively heavy and the current lighter soil preparation methods might have a smaller negative visual effect. Furthermore, the effect of soil preparation and logging residue reduces as time passes and

when there is enough green up to hide the soil disturbances and woody debris. Like the other responses to the felling areas, the dislike of logging residue and soil preparation may also be partly affected by other factors besides visual quality, such as passability.

5.1.6 Number of retention trees and the amount of other vegetation in the regeneration area

All the case studies concerning forest regeneration (I, III, IV) suggested that if retention trees are meant to enhance the appreciation of felling areas, there has to a sufficient number of retention trees and they have to be sufficiently close to the viewer.

Case Study I showed that the most preferred felling areas were small and had a lot of shrubbery, big solitary trees, or trees in the foreground of the felling area. As well, the comparison of photo groups showed that clear fellings with solitary trees or undergrowth were preferred to those felling areas without any trees or undergrowth (three photo groups). Additionally, the most beautifying features of felling areas were associated with vegetation: background forest, solitary trees, conifer saplings, bushes, and grass.

Case Study III concluded that retention trees enhanced the appreciation of a regeneration area only if they were clearly visible and distinguishable. Case Study IV, which concentrated solely on the effect of the residual solitary trees, found that the more retention trees there were in the felling area, the more the image was appreciated. Only a few trees (<1m³/ha) in a regeneration area did not affect the preferences.

Correspondingly, other studies show that silvicultural methods that leave retention trees, seed trees or shelter trees in the felling areas are usually preferred to the clear fellings, at least when a near-distance view is concerned (Haakenstad 1972, Hultman 1979, Karhu and Kellomäki 1980, Hultman 1983, Brunson and Shelby 1992, Kardell et al. 1993, Pings and Hollenhorst 1993, Lindhagen 1996, Silvennoinen et al. 2002). Furthermore, studies conducted on the economic valuation reveal that shelterwood and seed-tree regenerations have the highest recreational value in Sweden (Mattsson and Li 1994, Holgén et al. 2000).

Silvennoinen et al. (2002) observed that natural regeneration with seed trees had a smaller negative visual effect than did the clear felling, especially in the pine stands. Lindhagen (1996) likewise showed that group selection method was preferable to clear felling in the Norway spruce stands. Pings and Hollenhorst (1993) demonstrated that while clear felling had the lowest visual value, the deferment treatment in which up to 30% of the residual trees were left had the second lowest value, and the most preferred felling methods were those in which the stocking was not reduced under 50%. Brunson and Shelby (1992) found that people preferred the felling areas in which either living trees or snags were left to the traditional clear felling areas. Moreover, Ribe (2005) observed that an increased number of retention trees improved substantially the perceived scenic beauty of the felling areas in the long-distance views as well.

However, the amount of time passed may affect significantly the visual importance of the retention or seed/shelter trees. Shelby et al. (2003) showed that initially, a clear felling without any remaining trees was perceived as the most unattractive treatment but ten years later, little difference was perceived between the treatments (clear felling, snag retention, thinning, two storey, and patch cut). Nevertheless, seed or shelter trees should be kept for a sufficiently long time in a regeneration area in order to improve the visual quality of the area (e.g. Silvennoinen et al. 2002).

5.1.7 Quality of the retention trees

Based on Case Studies III and IV, the quality of retention trees left in the felling areas seems to be visually important. Case Study IV showed that the better the condition of the retention trees and the larger the retention trees, the more the image was liked. Furthermore, retention trees in poor condition did not enhance the appreciation of the felling area at all. In addition, undergrowth improved only slightly the visual quality of regeneration as compared to the effect of mature trees. In Case Study III, dead trees left on the felling area did not affect the preferences. However, the trees in Case Study III were situated further from the viewer (a middle-distance view), and it is possible that they were not clearly seen.

Conversely, Case Study I suggested that all kinds of retention trees improved the visual quality of a clear felling area (two photo groups: no trees, small deciduous trees, big pines; no trees, one small birch, a group of small birches). Even a clear felling with a crooked, small birch was preferred to a clear felling without any trees at all. These photos displayed soil preparation which is considered disturbing, and it can be hypothesized that if the felling area is perceived to be especially unattractive, even trees in poor condition can improve the visual quality. Furthermore, Case Study I used the original photos and other factors besides the solitary trees may also have affected the evaluations. Conversely, the answers from the checklist of Case Study I showed that solitary trees may have a disfiguring effect. These seemingly contradictory results of Case Study I may be due to the sensitivity of the inquiry methods. When people are asked if the trees disfigure or beautify, they might think that the trees in poor condition do indeed disfigure the scene but when ranking the photos, even trees in poor condition may affect the ranking result positively.

In Case Study I, the quality and species of undergrowth (one photo pair: small bushes and conifer saplings) did not make a difference in the preferences. However, the answers according to the checklist indicated that some of the respondents thought the shrubs and grass to be disfiguring.

Nelson et al. (2001) discovered that strong canopies of deciduous trees elicited a more favorable perception of beauty both in the summer and winter states than did the weaker ones. Schroeder and Daniel (1981) as well as Jensen (1993) found that standing dead trees in the forest produced negative visual effects. On the contrary, Pings and Hollenhorst (1993) concluded that dead logs increased the scenic beauty of the hardwood felling areas. Visual effects of standing dead trees are probably dependent on the context in which they are seen. For instance, in a felling area that is often perceived as ugly, even dead logs and trees in poor-condition can improve the visual quality, while in forests which are usually perceived as being pleasant and thriving, dead trees might have a disfiguring effect.

5.1.8 Location of the retention trees in the felling area

Based on Case Studies III and IV, it can be assumed that individually located solitary trees are preferred to the trees in groups both in the near-distance and middle- and long-distance views. When trees are located individually, they fill the empty space of a felling area and make the felling area look more like a forest. These results are consistent with the study by Ribe (2005), which reported that the retention trees dispersed throughout the harvested area were preferred to those trees aggregated in clumps in the long-distance views.

Case Study III showed that in the middle- and long-distance views, the solitary tree groups in no way affected the preferences for felling areas. However, it is possible that people did

not distinguish the trees in the long-distance view. Instead, Case Study IV found that in the near-distance views, solitary tree groups enhanced the appreciation of the regeneration areas but less than individual residual trees did. It did not matter if the trees were in one, two or three groups, as all these options were equally preferred.

5.1.9 Location of the afforestation

Based on Case Study II, it seems that the visually best location for a field afforestation slot is at the edge of the existing forest, where it blends in with the forest. The least preferred location of afforestation was in the middle of the field, probably because the afforestation is more distinguishable in the middle of the field than at the edges. The afforestations blocking the long-distance view were preferred to, or equally preferred to, those at the edge of the forest. Correspondingly, Case Study I concerning clear fellings showed that openings in a background forest or a long-distance view from the felling area did not affect people's preferences.

Visual depth and distance have been good predictors of preferences (e.g. Ulrich 1977, Hull and Buhyoff 1983) but in Case Study II, blocking of a long-distance view was not a decisive factor. The blocking afforestations were further in the background and thus not especially visible, and the long-distance views blocked were not very striking. Moreover, despite afforestation, the landscapes probably preserved enough visual depth.

5.1.10 Shapes of the afforestation and regeneration areas

Case Study II showed that the preferred shapes of afforestation site are those that reflect the shapes of the surrounding environment. In Melalahti, the shapes of the original landscape were irregular and round. Correspondingly, the irregular afforestation shapes were preferred to the geometrical ones, and a distinction in preferences was made according to the irregular-geometric aspect. In Naapurivaara, where the original landscape had oblong geometrical shapes, the oblong afforestation shapes were preferred to the quadratic ones. In addition, the differences in preferences were found between the oblong and the quadratic shapes (not irregular and geometric).

Case Study III explored among other things the preferences for the different shapes of felling areas seen in middle- and long-distance views. The vertical geometrical shape was the most disliked alternative in both of the basic scenes. In the long-distance view (Vuokatti), the irregular shape of a felling area was preferred to a geometric horizontal shape, while in the middle-distance view (Melalahti), the irregular and horizontal shapes were equally preferred. In Melalahti, the irregularly shaped regeneration might have looked larger than the horizontally shaped. Also, in the middle-distance view (Melalahti), when the felling area was closer the viewer, the shape might not have been so easily seen than in the long-distance view (Vuokatti). Nevertheless, the irregular-geometric aspect might not be as important as assumed in the landscape management instructions (Pellonmetsittäjän opas 1996, Metsämaiseman hoito 1997, Metsätalouden ympäristöopas 2004).

Similarly, Ribe's study (2005) suggests that abrupt edges of the felling areas produce negative visual affects whether these edges are geometric or irregular. Ribe found that irregularly shaped area improved the scenic beauty only slightly when compared to the geometric shapes and only at very low retention tree levels. However, a Swedish study

reported that the square or rectangular clear fellings were regarded negatively while small deviations from a geometric pattern led to more positive judgments (Kardell 1978).

5.1.11 Regenerations in the summit and lakeshore forests

Case Study III suggests that the preservation of the uniform hill silhouette is important. For the middle- and long-distance views, a seed-tree felling and a totally unbroken skyline (logging situated lower on the slope) of a summit forest were equally preferred. In the middle-distance view, a clear felling that broke the skyline was the least preferred alternative, whereas in a long-distance view, a clear felling breaking the uniform horizon and seed-tree felling were equally preferred. In the middle-distance view, the individual trees might have been more easily distinguishable than in the long-distance views and this might have caused the more positive evaluations.

In addition, Case Study III showed that the protection of lakeshore forests is scenically important. Leaving a shelterbelt between a lake and a felling area was preferred to a clear felling reaching until the lake. Furthermore, a dense strip of trees was preferred to a thinned shelterbelt. These results suggest that the edge of the felling area is important to people's perceptions of and preferences for felling areas at least when the felling area borders a lake or a skyline. This is expected because people usually pay attention to edges (Shafer and Brush 1977). For example, Ribe (2005) found that the abrupt edges of the felling areas produced negative visual affects.

5.1.12 Topography of the landscape

Case Study IV demonstrated that the felling area having the most variation in topography was the most appreciated of the three felling areas, and the one having the least variation was the most disliked. Similarly, the previous studies have found that variation in topography predicts preferences (Eskelinen 1979, Herzog 1985, Tahvanainen and Tyrväinen 1998). For example, Tahvanainen and Tyrväinen (1998) showed that the highest scenic values were given to the landscapes with variation in topography and vegetation.

5.2 Effects of the basic scene, viewing distance and viewpoint on preferences

Case Studies II and III suggest that the same management alternative can be perceived in different ways depending on the *basic scene* in which it is implemented. In other words, an implementation of the same management option might look different in different kinds of landscapes. In Case Study III, no statistically significant difference was detected between the preferences for the two original basic scenes. Nevertheless, the preference scores for the same management alternative differed in these two scenes (in 5 cases out of 10). Yet the other basic scene represented a long-distance and the other one a middle-distance view, and the differences between the two scenes may also be due to the viewing distance.

In Case Study II, the respondents appreciated three afforestation options out of four in the Naapurivaara scene more than in the Melalahti scene. On the contrary, the original landscape of Melalahti was slightly preferred to the original landscape of Naapurivaara. However, this difference was not statistically significant. The Naapurivaara scene was presumably

perceived to be less attractive because it was more flat and monotonous than the Melalahti scene. This suggests that afforestation might be more readily accepted in the monotonous and less beautiful environments. This is consistent with the study of Tahvanainen and Tyrväinen (1998) suggesting that afforestation appears to have the most negative effect on the relatively attractive original scenes and a lesser effect on the relatively unattractive original scenes.

Case Studies II and IV suggested that the way of implementing the management actions might be more important in the attractive environments than in the less beautiful ones. Case Study II showed that in Melalahti (the more attractive scene), there were more differences in the respondents' preferences for the alternative afforestation options than in Naapurivaara (the less attractive scene). Correspondingly, Case Study IV found fewer differences between the alternative options in the flat felling area – that was the least preferred area – than in the undulating and in the hilly areas. In the flat felling area, the preferences for moderate- and well-conditioned trees did not differ while they differed in the two other areas. Also, adding a few large trees in a tree group did not improve the visual quality of the flat felling area, while it enhanced the appreciation of the other two regeneration areas. However, the least differences for the different number of tree groups were found in the hilly area. It can be concluded that in the flat area, which was least liked, the condition and size of the retention trees was less important than in the hilly and undulating areas.

Yet the effect of the basic scene seems not be decisive because Case Studies II, III and IV reveal that the preference orders of the alternative management options were almost the same in the different basic scenes. However, some small differences were found. The differences concerning Case Study IV were reported in the previous paragraph. As for Case Study II, the afforestation in the background was preferred to other afforestation options in Melalahti while in Naapurivaara it was equally preferred to the options situated at the forest edge.

Concerning Case Study III, the observed differences in preference orders in the two basic scenes may be due to the *viewing distance* as well. Some landscape features, for example retention trees, may not be easily distinguishable in the long-distance views, while other features – such as shapes – may not be clearly discernible when they are close to the viewer. In Case Study III, the seed-tree felling and clear felling without any trees were equally preferred when they were seen from a long-distance (Vuokatti), while the seed-tree felling was preferred to the clear felling when the options were presented in the middle-distance view (Melalahti). Moreover, the dense shelterbelt and a shelterbelt with an opening to a lake were equally preferred in the long-distance view (Vuokatti), while in the middle-distance view, the dense shelterbelt was preferred to thinned one (Melalahti). Conversely, some features may not be so easily distinguished when viewed from a middle- or near-distance. Irregular shapes of felling area were preferred to horizontal shapes from a long-distance (Vuokatti), while those viewed from a middle-distance were equally preferred (Melalahti).

Case Studies I and IV demonstrated that the *viewing point* from which the regeneration area is looked at affects preferences. Case Study IV visualized the same retention tree option from three different viewpoints, and the preference scores between the images differed statistically significantly. In Case Study I (as reported in Karjalainen, 1995), the ratings were significantly different for the different photographs representing the same felling area. However, Daniel and Boster (1976) as well as Savolainen and Kellomäki (1981) have concluded that relatively homogenous forest scene can be represented by one image only.

The effect of the viewpoint on people's preferences likely depends on the heterogeneity and variability of the landscape, i.e. in a variable landscape, the effect is probably greater than in the more monotonous environment. As for the regeneration areas, decisive factors concerning the influence of the viewpoint on people's preferences are at least the topography

and the shape of a felling area, the variability of the edge of a forest, and the location of the retention trees and other vegetation. If retention trees are close to the viewer, this probably increases the beauty scores more as compared to the viewpoint from which the trees are further away. Correspondingly, if there are large variations in the topography of the felling area or the shape is very winding, the different viewing points might display visually different parts of the regeneration area.

5.3 Differences between the respondent groups

The preference ratings are affected, besides by the images shown, by the respondents' personal backgrounds. The different respondent groups were therefore included in all the case studies. The respondents in Case Study I consisted of Helsinki residents, environmentalists, and forestry professionals, while in Case Studies II and III the respondent groups were local residents and tourists of the study areas as well as forestry professionals. The respondents of Case Study IV were the tourists of the study area and the forest owners who lived in the area.

In all the case studies, the different respondent groups provided surprisingly similar preference orders of the images. However, training in forestry, forest ownership, a personal relationship to the assessed landscape and an environmental attitude all affected people's evaluations of the management options to some extent. Forestry professionals appreciated the images representing regeneration areas more than did the other groups. Forestry professionals also tended to make more distinctions between the alternative options for forest management than did the others. In addition, forest owners rated the pictures showing the regeneration areas higher than the tourists rated them. Furthermore, the residents of Melalahti village gave much lower scores to the images representing field afforestation in their own village than did the other groups (tourists and forestry professionals), and local residents also made more distinctions between regeneration options than did the tourists. Environmentalists' preferences were to a large extent similar to the general public but some differences were observed.

Evidence from Case Study I revealed that *forestry professionals* had a more positive attitude towards clear fellings than had the other groups. The forestry personnel was disturbed by the unmanaged appearance (shrubs, grass, and small, crooked trees) of the felling area and liked the felling areas that seemed to be managed (seed trees, conifer saplings) more than did the other respondents. Similarly, the forestry professionals paid attention to the slash and soil preparation less often than did the other groups. They also considered the felling areas to be smaller than did the other respondents. Case Study III found that forestry professionals assigned higher ranks to the felling options than did the other respondents. These forestry personnel also detected more differences between the alternative regeneration options than did the other groups. Case Study IV noted that people having a forestry education (most of them were forest owners) found majority of the images representing the regeneration areas more attractive than those who did not have a forestry education. These results show that the preferences that the forestry professionals express may differ from those of the forest visitors. In fact, forestry professionals should be aware of these discrepancies when planning forest management, especially in the areas used for recreation or for nature tourism.

Similarly, other Finnish studies indicate that forestry personnel has more positive attitude towards the visual effects of forest management than does the general public (Karhu ja Kellomäki 1980) and that forestry professionals consider the neglect of forest management to

be visually disturbing (Lovén 1973). Silvennoinen et al. (2002) found that foresters regarded a thinning of a young stand as an improvement in visual quality more often than did the other respondents. Correspondingly, Swedish forestry students ranked the stand damaged by frost lower than did the other groups, and these students also rated the clear felling area with seed trees higher than did the other respondents (Lindhagen 1996). Another study by Kardell et al. (1993) demonstrated that Swedish forestry students also considered clear felling areas and small openings more suitable for their recreation than did the other groups. Similarly, forestry students appreciated the open forests more than did children and teenagers (Rydberg 1998).

North-American studies likewise report that the foresters evaluated slides representing the different biomes differently from other groups (Balling and Falk 1982) and that the preferences of the resource managers differed from those of public groups for the white and red pine forests (Haider 1994). However, an occupation in forestry did not affect the preferences for the forest pictures including insect damage or forest management actions (Daniel and Boster 1976, Buhyoff and Leuschner 1978). In addition, Pukkala et al. (1988) revealed that foresters, biology students and urban residents had almost the same preferences for forest the stands that covered the whole range of variation in age, density and tree species composition.

Case Study IV showed that the *forest owners* rated the images representing the regeneration areas higher than did the tourists. Furthermore, the active forest owners found most of the images to be more attractive than did the passive forest owners. This suggests that people who earn at least part of their income from forestry may have a more positive attitude towards the regeneration areas and may also consider them to be more beautiful than do the other people. Yu (1995) suggests that groups that are closely connected to the natural landscape and make their living from nature might differ in their preferences from other population groups. Also, many Finnish studies show that landowners' preferences for landscape management operations differ to some extent from those of non-owners (Tahvanainen and Tyrväinen 1998, Silvennoinen et al. 2001, Silvennoinen et al. 2002). According to Silvennoinen et al. (2002), forest owners appreciated thinnings more than did non-owners, but the evaluations of the clear fellings and seed-tree fellings were similar. Tahvanainen and Tyrväinen (1988) likewise demonstrated that land owners' attitudes towards field afforestation were more positive than those of other groups. Similarly, a Swedish study found that forest owners had more negative attitude towards a non-native tree species (Pinus contorta) than had the other respondents (Kardell and Wallsten 1989). By contrast, studies conducted in the United States reported that students agreed closely with landowners in rating the attractiveness of forest stands (Brush 1979, Vodak et al. 1985).

Case Study II suggests that *local residents* are sensitive to field afforestation, and that familiarity with the landscape may be important when responding to changes in the environment. The residents of Melalahti village gave lower scores to the afforestation options implemented in their own village than did the other groups, whereas the residents of Naapurivaara did not consider the afforestation in their village to be any more disturbing than did the other groups. The reason for this might be that only one-third of the Naapurivaara residents recognized that the photo represented their village, while all the Melalahti residents identified the photo taken from their village (Karjalainen and Komulainen 1997). Moreover, the Melalahti residents had received information on the landscape values in connection with the landscape project implemented in their village. Correspondingly, Melalahti residents gave lower scores to some of the afforestation alternatives of the Naapurivaara village than did the other respondents.

Even though the Melalahti residents liked the field afforestation less than did the other groups, Case Study III showed that the preference ratings for forest regeneration did not differ between the groups. As for Case Study IV, the forest owners, who lived in the study area and thus were also local residents, ranked the regeneration areas even higher than did the tourists. It is probable that the respondents in Case Studies III and IV did not recognize that the forest scenes represented local areas. In addition, the changes near the immediate vicinity of a person's own home might be more important than in the forest, and agricultural landscapes may be connected with other kinds of values as forests. Field areas may have stayed open for centuries while forest landscapes are more dynamic and experience changes more often. Moreover, income received from forestlands may also have affected the respondents' evaluations.

Nousiainen et al. (1998) stated that local inhabitants did not like afforestation areas, whereas potential tourists preferred the alternatives that contained wide areas of afforestation. Komulainen (1998) reported that local residents regarded afforestation or the abandonment of fields as being the most disfiguring actions of the rural villages. Correspondingly, Johnson et al. (1994) suggest that visual impacts are more important in specific, valued settings, such as one's own home. Based on these findings, it can be assumed that the visual quality of the everyday environment is important and the changes in it may cause negative reactions.

Case Study IV revealed that *people living in the countryside* (most of them were also forest owners and local inhabitants) liked the images depicting regeneration areas more than did the city dwellers. This result is consistent with previous studies. For instance, Silvennoinen et al. (2002) discovered that non-urban respondents gave higher scores to forest thinnings than did urban respondents. Becker (1982) noticed that the nearer the forest the respondent lived, the more probably he or she recognized a clear felling and the less he or she was against clear fellings. Furthermore, several studies indicate that people usually prefer familiar environments (Hammit 1979, Penning-Rowsell 1982, Lyons 1983, Dearden 1984, Kaplan and Herbert 1987). It is possible that people who are accustomed to seeing regeneration areas accept them more readily and do not consider them as being as unattractive as people who are not used to looking at them.

Case Study I found that the *environmentalists'* preferences were very similar to the preferences of the other groups. However, some differences were observed. The environmentalists paid attention to the size of the felling area more often and considered the fellings (4 slides out of 8) as being larger than did the Helsinki residents or forestry personnel. The environmentalists also described the felling areas with positive adjectives less often than did the other groups.

Other studies have found both differences and similarities in the preferences of the environmental activists and other groups. For instance, Kardell et al. (1993) found that membership in a nature protection group did not affect the evaluation of different forest areas, including felling areas. Haider (1994) likewise indicated a high agreement for scenic beauty between the environmental groups and other public groups for the white and red pine forests. Similarly, Daniel and Boster (1976) stated that the environmentalists were in agreement with other groups about the scenic beauty of the different areas, including pictures representing forest management actions.

On contrary, many studies show that the environmental groups' preferences often differ from the preferences of other groups (Dearden 1984, McCool et al. 1986, Kaplan and Herbert 1987, Kardell and Wallsten 1989, Kardell 1990). For example, the environmental groups regarded timber harvesting as being much more negative than did the other groups (McCool et al. 1986). Furthermore, Swedish nature protectionists gave higher ranks to the mature

forests and lower ranks to the plantings than did the other groups. The nature protectionists also wanted the dead, dried trees to be left in the forest more often than did the other respondents (Kardell 1990). Environmentalists may also have more negative attitude towards foreign species than other people (Kaplan and Herbert 1987, Kardell and Wallsten 1989). It is possible that people with environmental values may not have only ecological concerns, but may also have a closer relationship to nature and this can affect their evaluations as well.

Case Study IV also examined the effect of *gender, level of education, age and frequency of participation in outdoor activities* on people's preferences. None of these variables seemed to influence the respondents' preferences for the regeneration areas. Correspondingly, according to many studies, gender (Kellomäki 1975, Jackson et al. 1978, Balling and Falk 1982, Penning-Rowsell 1982, Dearden 1984, Kardell et al. 1993, Brush et al. 2000, Silvennoinen et al. 2002), level of education (Kellomäki 1975, Dearden 1984, Haider 1994, Silvennoinen et al. 2002), or age (Kellomäki 1975, Dearden 1984, Kardell et al. 1993, Haider 1994, Brush et al. 2000, Silvennoinen et al. 2002) do not have any effect on landscape preferences. For example, Silvennoinen et al. (2002) found that women and men as well as people having different levels of education evaluated the different forest management operations similarly.

On contrary, some studies have found discrepancies between genders in the perceptions of forests (Kardell and Wallsten 1989, Lindhagen 1996, Tyrvväinen et al. 2003). Tyrväinen et al. (2003) observed that men and the highly educated appreciated the ecological management options in the urban forests more than did women and those who had a lower level of education. Furthermore, some studies have found that young people tend to like images showing naturalistic options, such as virgin forests and ecological management, more than older people do (Zube et al. 1983, Lindhagen and Hörnsten 2000, Tyrväinen et al. 2003).

Some studies suggest that the frequency of outdoor visits may affect forest landscape preferences (Dearden 1984, Kardell et al. 1993, Lindhagen 1996, Tyrväinen et al. 2003). For instance, active outdoor visitors appreciated closed forest vistas more and found thinned and cleared woodlands less appealing than did the passive forest visitors (Tyrväinen et al. 2003). Nevertheless, when comparing the results of previous studies to the results of case study IV, it has to be noted that the images in Case Study IV represented regeneration areas, most of them showing retention trees. The possible differences between the respondents might have become more apparent if the content of the images varied more.

Based on the case studies, it can be concluded that forest professionals and forest owners may perceive regeneration areas to be visually more acceptable than do the other groups of people. If the preferences of forest owners and managers differ from those of the forest visitors, the contradictions may be caused in some areas, especially those actively used for recreation and nature tourism, as well as for areas nearby residences. Further, the afforestation of agricultural land may be considered to be especially disturbing by the local residents.

5.4 Validity and reliability of the results

5.4.1 Statistical validity

The data received in Case Studies I and IV was on an ordinal scale, and the parametric statistical methods are not strictly applicable to the ordinal data. This may induce problems in statistical validity concerning Case Study IV, in which the parametric tests were applied to ordinal scale data (received from a 7-point numerical scale). The graphical scale used in

Case Studies II and III was assumed to be an interval scale and the data were analyzed by parametric statistical methods.

However, in landscape research and the social sciences, parametric methods are often used to analyze ordinal scale data. Furthermore, several landscape researchers state that ordinal scale measures can be used in parametric statistical tests under the following conditions; if the number of respondents is at least 20 and the group is homogenous (Daniel and Vining 1983), if the preferences for landscapes differ significantly (Benson and Ulrich 1981), or if the number of categories is more than four and if the number of observations is high (Lindhagen 1996). All these conditions were fulfilled in all the case studies.

Furthermore, parametric and non-parametric methods often produce similar results. The data of Case Study I were analyzed by using non-parametric methods and in addition, some parametric tests were used and the results were compared. The differences in the medians of the photographs between the respondent groups were tested by the Kruskal-Wallis one-way analysis of variance and were compared to the results of the parametric one-way analysis of variance and to Tukey's studentized range method. Both analyses produced similar results. In addition, the medians and means of the photos produced almost the same rank-ordering result. As confirmation of this finding, Silvennoinen et al. (2002) demonstrated that parametric and non-parametric tests gave very similar results, which means that the statistical inferences would be the same whether the evaluation scales are treated as ordinal or interval scales.

Problems in statistical validity may also arise when large numbers of relationships are examined, looking a posteriori for the significant ones, without using a priori hypotheses. This means that when a large number of tests are applied, differences emerge even though they would not be real. Overall, all the case studies tested mainly a limited number of a priori hypotheses, which does not cause any statistical validity problems. However, while testing the effect of a respondent group or any other background variables, a posteriori tests were applied (i.e. all possible relationships were tested). In Case Studies I and IV, this caused quite large number of tests and observed differences. Nevertheless, this should not cause statistical validity problems, because these studies focused on analyzing only the trends in the evaluations of each respondent group or background variable group, and no separate test or an individual observed difference was given any emphasis.

5.4.2 Reliability

Case Studies I, II and III showed that the different evaluation methods of the images gave consistent results, which increases the reliability of the results. Respondents in Case Study I were asked to rank-order the photos, to evaluate certain features of some photographs, and to answer open-ended questions. All these methods gave similar results.

Case studies II and III showed that the means or medians of the ratings seem to be consistent across the different evaluation methods (rank-ordering and rating). However, individual respondents may be inconsistent. In Case Study III, 43 of the 190 respondents rank-ordered some of the photos that all the respondents had evaluated on a graphic rating scale: 10 photos of the Vuokatti forest scene and 7 options of the Melalahti forest scene. Correspondingly, in Case Study II, 36 of the respondents rank-ordered 6 field scenes from Naapurivaara. Preference orders in all three series were the same by using a graphical rating scale and rank-ordering. However, the Spearmann's rank correlation coefficients were relatively low in each case (0.515 for the Vuokatti forest scene, 0.484 for the Melalahti forest scene, 0.275 for the Naapurivaara field scene). This indicates that the individual evaluations were quite

inconsistent depending on the evaluation method. The low correlation coefficient might also be due to narrow scales that the respondents used in the graphic scale evaluations.

The reliability of the results of case studies II and III was examined by showing four slides twice. The data for both studies were collected at the same time. The respondents were shown altogether 34 slides, and four of these slides were shown twice. Three of these four slides received similar ratings each time (paired t-test, $p<0.05$), one's ratings differed.

As for Case Study I, the unanimity of all the respondents and the unanimity within and between respondent groups were tested by the Kendall's coefficient of concordance. These tests revealed that there were high degrees of concordance between all respondents, within respondent groups, and between the groups.

5.4.3 Internal validity

The respondents were asked to evaluate the scenic beauty (Case Study I) or how much they liked the image (Case Studies II, III, IV). Yet we do not know the actual basis for their assessments, such as how much the evaluations are based on aesthetics and how much these assessments are based on other factors, such as ecology, means of livelihood, etc. Nevertheless, the respondents' preferences are manifested in a visual form and can thus be described based on the visual appearance of the felling and afforestation areas. Moreover, Case Study I showed that the most common grounds for rank-ordering the photographs were the trees, shrubs and undergrowth, the size of felling area, and soil preparation, and these are at least visual expressions of the respondents' preferences.

Other variables besides the studied landscape and personal background variables may have affected the evaluations as well. For instance, the evaluations may have been influenced by the respondent's mood or mental agility. Also other factors in the images, besides those that the case studies focused on, may have affected the preferences. This is true especially in Case Study I but less probable in the other studies in which the digital image editing (only one aspect in the image changed at a time) was used. Case Study I dealt with this issue by asking the respondents open-ended questions in which they described what they paid attention to in the photos and their grounds for rank-ordering the photos. The answers indicated that the things the respondents most often paid attention to were the same as was assumed by the researcher. Moreover, the results of Case Study I were very similar to the other case studies that used digital image editing. However, it might not be so clear what people are actually seeing in the photos, while in Case Study I, the respondents sometimes gave ratings to some environmental features that were not apparent in the photos.

It is improbable that the researcher's expectations would have affected the results, or that the respondents would have provided answers that make themselves look good, because it has not been clear what the expectations of the researcher or the "correct" answers would have been. Exceptions to this are the forestry professionals who may have tried to assign ratings that would be in line with their possible education in landscape design. However, it is not evident how many of these forestry professionals had received training in landscape issues at that time.

The evaluation method in each case study was simple and it is assumed that all respondents understood it. In addition, the respondents were able to ask the researcher if they did not comprehend the task, because the respondents conducted the evaluation face-to-face to the researcher. Moreover, the number of the evaluated images was limited (31–40 images) and it can be assumed that the respondents did not get tired with the task. Even so, the assessed

images displayed quite small differences, especially in Case Study IV in which all the images represented retention tree alternatives, and some respondents may have been frustrated by this. In Case Study I, some of the respondents probably got somewhat exhausted with the detailed evaluation of the eight slides, because their response rates dropped towards the end of the evaluation.

5.4.4 External validity

The selection of respondents was not random, but specific respondent groups were used. If more time and funding were available, the use of a random sample of respondents instead of panels would have increased the generalizability of the results. However, the use of panels is the usual approach adopted in landscape preference studies. For instance, several studies show that the group-to-group reliabilities (Brown and Daniel 1984, Rudis et al. 1988, Hetherington et al. 1993), intra-class reliabilities (Brown and Daniel 1987, Rudis et al. 1988), inter-rater reliabilities (Gobster and Chenoweth 1989), and split-half reliabilities (Herzog 1985, Herzog and Bosley 1992) of the rating judgments are high when convenient samples are used. This indicates that other samples drawn from the same population would also have produced similar results. Furthermore, it would have been expensive to send color images to a large random sample at the time the data of the case studies was collected. In addition, in the panel evaluation, the conditions for evaluation can be controlled and the respondents can be instructed and motivated personally.

Rigorously, the results can be generalized only to similar kinds of population groups that the respondent panels represented (Case Study I the residents of the Helsinki region, forestry professionals and environmentalists; Case Studies II and III residents and tourists of Kainuu area as well as forestry professionals; Case Study IV forest owners and tourists of Northern Karelia). However, the different respondent groups ended up to very similar preference orders for the images and no significant differences based on background variables were observed, even though the groups were representing very different kinds of interest groups such as the environmentalists versus forestry professionals. It might therefore be correct to generalize the results beyond the respondent groups.

Based on the previous studies, it can be assumed that the images used in the case studies are comparable to actual visits in the corresponding landscapes (see the discussion in Chapter 3.1.1). It is also assumed that the results apply to southern and eastern Finland and to those kinds of landscapes, views and viewing distances that were apparent in the images (Case Studies I and IV, clear fellings from a near-distance view; Case Study II, field afforestation areas from near- and middle-distance views; Case Study III, regeneration areas on the hill slopes from middle- and long-distance views).

If more repetitions (i.e. basic scenes or viewpoints) were included in Case Studies II, III and IV, the results would have been more valid and easier to generalize for the different conditions. However, the number of repetitions is restricted by the fact that only a limited number of images can be shown to the respondents. Moreover, in all the case studies, the respondents were also inquired other things besides merely rating or ranking the images. In Case Study I, the respondents completed a detailed evaluation of eight photographs, and in Case Studies II and III, they answered open-ended questions and a battery of statements about different values connected with forests. In Case Study IV, respondents completed a set of statements concerning the effect of information on the preferences.

5.5 Comparison of the results with the theories predicting landscape preferences

The following chapter examines the results of the case studies in relation to the existing theories for landscape preferences. Table 7 illustrates how the results of the case studies can be explained and interpreted in the light of the information model and psycho-evolutionary theory (Ulrich 1977, 1983, 1986, Kaplan 1987, Kaplan and Kaplan 1989, Kaplan et al. 1998). These theories were chosen for the comparison because they seem to be the most promising theories for predicting preferences (see Chapter 2.3).

Case Study III showed that the respondents *did not like clear fellings* when compared to untouched forests. One reason for this may be that fellings may reduce the overall coherence because clear fellings do not blend in with the surrounding forest environment. Furthermore, clear fellings do not invite the viewer to explore the area. As such, clear fellings may detract the sense of mystery and diminish complexity of the environment by decreasing the amount of visual elements. In felling operations, the soil is broken and logging residue is generated and thus the smoothness of the ground texture and passability are reduced.

Nevertheless, the dislike for felling areas cannot be totally explained by the information and psycho-evolutionary theories. It is also possible that small clear fellings could provide coherence, mystery, complexity, and legibility in a larger forest area. A small clear felling can increase the complexity of the forest area by providing an opening in the forested environment or by offering new species of plants and animals. The diversity of the environment reduces rapidly when implementing clear fellings, but after a few years when the new vegetation has emerged, the complexity increases. A clear felling can sometimes provide a sense of mystery when it is bordered in a way that it offers a new landscape immediately behind the perceived landscape. A small clear felling may help direct the viewer's attention and offer a distinct region that might make it easier for the viewer to make sense of the larger forest environment. Furthermore, a small clear felling in a larger context can serve as a landmark that supports a person's orientation and way-finding and thus enhances the legibility of the environment.

Case Study I demonstrated that *small clear fellings* are preferred to large ones. Small felling areas fit better in the scale of the forested landscape than large ones. A large felling area offers little to focus on and provides few elements that help structure the space. The small size of regeneration area is preferable for the ground surface texture, while a small felling area breaks the smoothness and passability of the ground surface in a smaller section than a large one. On the one hand, large clear felling areas may be perceived as being threatening because they break the harmony of nature. On the other hand, clear fellings can also diminish the perceived threat by opening up views.

The case studies revealed that people appreciate *retention trees* in the regeneration areas. Retention trees may support the coherence of a regeneration area in several ways: retention trees help the felling area fit better in the forested environment, they provide a clear focus, they may organize the felling area to a few distinct regions when it is easier to make sense of the place, and they may provide some re-occurring themes and a contrasting texture to the clear felling area. Furthermore, retention trees increase the complexity of an otherwise monotonous felling area and can enhance the perceived mystery by providing vegetation that partially obscures what lies behind it. Moreover, trees in the felling area can serve as landmarks and thus help increase the legibility of the felling area. If the retention trees provide different layers in the landscape, they can enhance the sense of depth. The retention trees may also preserve the ground surface texture in the immediate vicinity of the trees.

Case Study IV showed that the more trees there are on a felling area, the more the regeneration area is liked. A large number of trees helps the regeneration area to blend in

Table 7. Connections between the information and psycho-evolutionary theories for landscape preferences and the results of the case studies.

Information model	Psycho-evolutionary theory	Results of the case studies: the preferred clear fellings	Results of the case study: the preferred field afforestation
Coherence	Structural properties (order and patterns, one can focus gaze)	Retention trees, large number of retention trees, good condition of trees, individually located trees, preservation of hill silhouette, shelterbelt on lakeshore, no vertical shapes, no soil preparation, no logging residue, small size of the felling area	Forms that imitate the surroundings, afforestation at the forest edge, no afforestation
Complexity	Complexity	Retention trees, large number of retention trees, individually located trees, variation in topography, small size of the felling area	No afforestation
Mystery	Deflective vistas	Retention trees, large number of retention trees, variation in topography, shelterbelt on lakeshore, small size of the felling area	No afforestation
Legibility		Retention trees, variation in topography, small size of the felling area	No afforestation, afforestation at the forest edge
	Surface smooth and passable	No soil preparation, no logging residue, no felling, small size of the felling area, retention trees, large number of retention trees	No afforestation
	Depth	Retention trees, preservation of hill silhouette, shelter belt on lakeshore, variation in topography	No afforestation
	Nothing threatening		No afforestation

better with the neighboring forest landscape and may help divide the felling area into small, distinct regions. A large number of trees may also provide more complexity. Furthermore, the more trees, the more clues available that there might be more to be seen behind the trees. Also, a large number of trees preserves the texture of the ground surface more than a smaller number of trees.

Case Study IV demonstrated that trees that were in poor condition did not improve the visual quality of the felling area, while moderate- and good-conditioned trees did. In other words, the better the condition of the trees, the more the regeneration area was liked. The good condition of the trees may improve the coherence of the felling area by helping the regeneration area to better hang together with the thriving neighboring forest. Nevertheless, both poor- and good-conditioned trees could enhance complexity, serve as distinct elements, and offer mystery by suggesting that new information might be available behind the trees.

The case studies found that individually located trees were preferred to the trees in groups. This may be because the individually located trees may "hide" the actual felling and thus the felling goes better together with the surrounding environment than the felling area with tree groups. Also, when trees are situated individually, the regeneration area may be more complex than when the trees are in groups. However, the preferences for individually located trees cannot be completely explained by the information and psycho-evolutionary theories. Locating the retained trees in groups could also enhance coherence, complexity, mystery and legibility of the scenes. Tree groups might serve as focal points that attract the viewer's eye and provide a few, distinct regions that make it easier to make sense of the place. Both individually located trees and tree groups can support mystery by offering vegetation that to a degree conceals what lies behind them, and serve as distinctive elements that help in orientation.

According to Case Study I, *logging residue and soil preparation* are visually disturbing. They diminish the smoothness and passability of the ground texture. In addition, they reduce the coherence of the landscape by decreasing the sense of order and harmonization with the neighboring forest. Case Study III found that the vertical regeneration *shapes* are not liked. The reason for this might be that vertical shapes do not usually blend in with the shapes of the surrounding landscape.

Case Study III showed that the *preservation of the hill silhouette and leaving a shelterbelt in lakeshore fellings* are visually important in the middle- and long-distance views. A uniform skyline as well as a shelterbelt on the lakeshore may help the felling area to harmonize better with its environment. A shelterbelt provides a border between a felling area and a lake and thus makes it easier to define areas. Similarly, a uniform hill silhouette creates a clearly defined felling area. An unbroken skyline in the summit forest felling and shelterbelt on the lakeshore felling may also offer definable "bands" or horizontal regions in the landscape and can thus enhance depth. Furthermore, a shelterbelt on lakeshore may create deflective vistas that signal that new information is available beyond the shelterbelt.

Case Study IV established that felling areas that have a *variation in topography* were preferred to flat regeneration areas. Variation in topography may enhance the complexity of the environment and may also make the environment more distinct and thus help orientation within the area. This variation in topography may also partly obscure what lies behind it and thus support a sense of mystery. Overlapping landforms may also enhance the sense of depth.

According to Case Study II, *original agricultural landscapes* were preferred to the afforested landscapes even though the afforestation sites were small. Even small afforestation areas may not fit in the surrounding environment. Afforestation patches diminish the

smoothness and passability of the ground surface. They may also reduce the legibility by decreasing the distinctiveness of the landscape. Furthermore, the afforestation sites may decrease the sense of depth, complexity and mysteriousness of the landscape by blocking views. Yet another point is that afforestation might be perceived as something threatening that reduces the viewer's feeling of security while, for example, it diminishes the land area used for food production.

However, the information and psycho-evolutionary theories do not provide a complete explanation for the dislike for afforestation areas. Case Study II focused on small field areas whereas in large and monotonous agricultural lands the results could be the opposite: properly located afforestation sites could increase the complexity, coherence, legibility and mystery of the large agricultural lands, as well as enhance the sense of depth.

Case Study II suggested that the shapes of field afforestation areas that *imitate the forms of the surrounding environment* were preferred. This makes the whole environment more balanced and easier to comprehend. Case Study II showed that the respondents preferred locating a field *afforestation area at the edge of an existing forest* to locating it in the middle of the field area. One reason for this might be that location at the forest edge may help to maintain the coherence and legibility of the landscape. When afforestation is a continuation of the existing forest, it blends in with the forest and the landscape might be easier to make sense of and it might also be easier to orientate in the environment.

In short, the information and psycho-evolutionary theories may provide some possible explanations for the preferences for the forest regeneration and field afforestation options included in the case studies. Coherence seems to explain the preferred features of the regeneration and afforestation areas to the largest extent. Other variables that seem to explain the preferences for the regeneration areas to some extent are complexity, mystery, legibility, depth, and ground surface texture while threat seems not to be important. The reason for the insignificance of threat might be that the studied landscapes were open and a threat was not apparent.

According to the direct empirical tests of the variables of the information theory, mystery has been the most consistent predictor of preferences, whereas when interpreting the results of the case studies, coherence seems to be the strongest predictor. Of the predictors, it might be easier to provide elements that enhance the coherence of the regeneration area rather than the features that could support mystery, complexity or legibility.

However, the results of the case studies cannot be explained unambiguously by the information and psycho-evolutionary theories. In many instances, these theories could have also provided the opposite explanations to those that the results showed. For example, both poor- and good-conditioned trees could enhance the complexity, legibility and mystery in a regeneration area. Both individually located trees and tree groups could support the legibility, mystery and coherence of a felling area. Moreover, both clear fellings and untouched forests can provide coherence, mystery, and complexity. Correspondingly, agricultural landscapes both with and without afforestation patches can include complexity, coherence, a sense of depth, mystery, and legibility.

The coherence of the regeneration areas can be supported by making small felling areas, by leaving large numbers of retention trees in good condition, and by locating them individually, by preserving the uniform hill silhouette, by leaving shelterbelts on lakeshore fellings, and by avoiding vertical shapes, soil preparation and logging residue. Complexity can be improved by retaining a large number of trees and locating them individually throughout the felling area. Mystery can be enhanced by preserving a shelterbelt on lakeshore fellings and by large number of retention trees if they are located so that they partially conceal what lies

behind and thereby invite the viewer to explore the area. The legibility of the felling area can be increased by leaving distinctive retention trees. A small felling area can enhance the legibility, mysteriousness and complexity of a larger forest area. In addition, the variation in topography may support complexity, mystery and legibility.

The smoothness of the ground texture and the passability can be preserved by avoiding soil preparation and logging residue. Also, small size of felling area and large number of retention trees decrease the amount of broken ground texture. A sense of depth can be enhanced by the retention trees which serve as layers of vegetation. Distinctive elements, such as individual trees, can also increase a sense of depth. In addition, preserving the skyline of the summit forest and leaving shelterbelts while regenerating lakeshore forests both are ways to offer definable horizontal layers that may support depth. A sense of depth is also enhanced by variation in the topography which may provide overlapping landforms.

Concerning afforestation, the coherence and legibility of the landscape can be maintained by locating afforestation at the edge of the existing forest. Coherence can be further supported by reflecting the shapes of the surrounding environment.

5.6 Comparison of the results with the landscape management guidelines and ecological healthiness

Table 8 compares the current Finnish forest landscape management guidelines, hypotheses and results of the case studies concerning the visual preferences for the forest regeneration and field afforestation options as well as the ecological healthiness of these options. There are large similarities between the visual preferences, landscape management guidelines, and the ecological principles, with the latter two being most identical. However, some differences also exist, especially between visual preferences and landscape management guidelines, as well as between visual preferences and ecological hypotheses.

5.6.1 Visual preferences vs. landscape management guidelines

The current forest landscape management guidelines by the Forestry Development Centre Tapio and Metsähallitus (Forest and Park Service) (Metsämaiseman hoito 1997, Metsätalouden ympäristöopas 2004, Hyvän metsänhoidon suositukset 2006) are to a large extent compatible with the results of the case studies. The landscape management instructions do emphasize some of the elements that people pay attention to in the regeneration areas, for instance, the shape of the felling area and retention trees. Both the results of the case studies and the landscape management guidelines suggest that the forms and shapes of the surrounding landscape should be reflected, the visually most disturbing shape of felling area is a vertical shape, and a uniform skyline should not be broken. Moreover, they suggest that the retention trees should be large and impressive, the shelterbelt should be left on lakeshore fellings and the dense shelter belt is better than a thinned strip.

Nevertheless, there are also discrepancies between the landscape management guidelines and the results of the case studies. Moreover, the instructions largely omit some configurations that are central for people forming preferences for felling areas, such as size of the felling area, soil preparation, and logging residue.

The main difference between the preferences and the guidelines concerns the location of the retention trees. The landscape management guidelines of Tapio and Metsähallitus

(Metsämaiseman hoito 1997, Metsätalouden ympäristöopas 2004) suggest that the retention trees should preferably be left in groups. Furthermore, the Tapio instructions (Metsämaiseman hoito 1997) state that evenly, individually located retention trees do not improve the visual quality of a regeneration area in the near-distance view. However, Case Studies III and IV indicated opposite results, i.e. individually located trees were preferred to tree groups. Another point is that the guidelines of Tapio (Metsämaiseman hoito 1997) assert that retention trees should be left close to the forest edges, which was also not confirmed by the case studies.

The landscape management guidelines of Tapio (Metsämaiseman hoito 1997) state that long, horizontal boundaries and angular shapes are poorly suited for the Finnish forest landscape; instead, irregular shapes are more suitable. Similarly, the environmental guide of Metsähallitus (Metsätalouden ympäristöopas 2004) states that shapes should be organic, not geometric. Even so, the results of Case Study III suggested that the irregular and horizontal shapes of the felling areas can at least in some cases be equally preferred. Moreover, according to the guidelines for field afforestation by Tapio (Pellonmetsittäjän opas 1996), gentle and round forms should be favored in field afforestation, whereas Case Study II established that geometric oblong shapes can be equally preferred to irregular shapes.

The Tapio guidelines (Metsämaiseman hoito 1997) suggest that often more important than the size of felling area is the irregular shape and that the boundaries are drawn in an angle to the contour lines, whereas Case Study I showed that small clear felling areas are preferred to large ones. The earlier versions of the landscape management guidelines state that removing logging residue is beneficial for the landscape and that visually sensitive places can be treated by lighter soil preparation (Hyvän metsänhoidon suositukset 2001, Metsätalouden ympäristöopas 1997). By contrast, the current guidelines state only that the traces of forest management should be minor in the recreation forests (Metsätalouden ympäristöopas 2004). However, Case Study I showed that soil preparation and logging residue are perceived as being disturbing.

The a priori hypotheses that were used in Case Studies II and III were based partly on the same landscape design principles as the landscape management guidelines applied by the Forestry Development Centre Tapio and Metsähallitus. For this reason, their suggestions are for the most part rather similar. Correspondingly, the results of the case studies confirmed the following a priori hypotheses of the studies: a vertical shape is visually the most disturbing shape of a felling area, the shelterbelt should be left when regenerating lakeshore forests, a dense shelterbelt is better than a thinned one, afforestation areas should be located at a forest edge, and the shapes of the afforestation sites should reflect the shapes of the surrounding environment.

The differences between the a priori hypotheses and the results of the case studies concern the shapes and location of the afforestation and regeneration areas, the retention trees, and the regeneration options in the summit forests. Some of these discrepancies are already described above. In addition, the a priori hypotheses of Case Study II suggested that the afforestation that closes the long-distance view would be the worst afforestation option, whereas the results demonstrated that the worst option was the afforestation in the middle of the field. Furthermore, according to the a priori hypotheses of Case Study III, the seed-tree felling would be the worst regeneration option in a summit forest, whereas the results showed that a seed-tree felling and a totally unbroken skyline were equally preferred.

From these above described discrepancies it can be concluded that the landscape design principles are not always in line with public preferences.

Table 8. Contradictions and similarities between the hypotheses used in Case Studies II and III, landscape management guidelines*, the results of the case studies, and ecological healthiness. Within one row, the statements having similar content have the same color.

Treatment	Hypotheses (based on landscape design principles) used in Case Studies II and III	Finnish forest landscape management guidelines	Preferences according to Case Studies I, II, III and IV	Ecological principles
Regeneration felling in a summit forest	A continuous, unbroken skyline when the felling is located lower on the slope is the best option. A clear felling that breaks the skyline is the second-best alternative, while seed-tree felling against the skyline is the worst option. (III)	Holes in the horizon should be avoided. On skylines, seed trees should be situated more densely than normally so that separately stuck out trees and canopies cannot be seen against the horizon.[3] The breaking of a uniform skyline should be avoided.[1, 2] Seed trees or retention tree groups can soften the change caused by a felling. A summit forest can be regenerated in zones[2].	Unbroken skyline and seed-tree felling were equally preferred while clear felling was the worst option. (III)	n.s.
Shape of the felling area	On hillside forest, an irregular diagonal shape is the best option while a horizontal geometric shape is the second best. A vertical geometric shape is the worst option. (III)	Shapes should be organic and natural, not geometric, rather horizontal than vertical[3]. Long, horizontal or vertical shapes do not suit the Finnish landscape, instead irregular shapes fit well[2]. On hillsides, the felling should be situated diagonally against the slope.[1, 2] Shapes of felling areas should follow the forms of the terrain.[1, 3]	Irregular and horizontal shapes can be equally preferred while the vertical shape was the most disliked one. (III) The forms and shapes imitating the original landscape were preferred. (II)	An irregular shape is better than geometric.
Felling in a lakeshore forest	On lakeshore fellings, leaving a dense shelterbelt is the best option and an evenly spaced thinned strip is the second-best. Leaving no shelterbelt at all is the worst alternative. (III)	A shelterbelt on lake shore should be varying, rhythmic[1,3]. A shelterbelt should be left. A thinned shelter strip is artificial, natural shelterbelt having varying width blends in with the landscape[2].	A dense shelterbelt was the preferred option, while a clear felling without a shelter belt was the most disliked alternative. (III)	On lakeshores, a shelterbelt of 5-30 m should be left.[3] The shelterbelt should be rather dense than thinned.

Treatment	Hypotheses (based on landscape design principles) used in Case Studies II and III	Finnish forest landscape management guidelines	Preferences according to Case Studies I, II, III and IV	Ecological principles
Location of felling area	The best location for a felling area is on a hillside forest and the second-best in a summit forest. A lakeshore is the most sensitive place for fellings. (III)		A felling was most disturbing in a summit forest and least disturbing on a lakeshore (III).	Fellings should be located rather in a summit or hillside forest than directly on the lakeshore.
Location of retention trees in the felling areas	It is better to leave retention tree groups close to the edges of a felling area than in the middle. The best option to locate the individual solitary trees is close to the edges of felling area, the second-best option is to leave them individually in the middle. The third-best option is to retain trees in a group in the middle. The dead solitary trees are the worst option. (III)	The best alternative is to locate trees or tree groups close to the edges.[2] Important places for trees: roadside, narrowest parts, close to forest, etc.[3] Retention trees should be preferably left in groups.[2,3] Evenly, individually located retention trees do not improve the near- distance view.[2]	No difference in the location of the tree groups. (III) In the case of individually located trees, the trees retained individually in the middle became the preferred option, no distinction between the other alternatives. (III) Individually located trees were preferred to the tree groups. (IV)	Trees should be left in groups[3] and close to edges.
Number of retention trees	Not hypothesized		The more retention trees, the more the felling area was liked. (IV)	The more retention trees, the better.
Condition of retention trees	Not hypothesized	Individual trees should be large and imposing.[3] Retention trees should have impressive trunks or broad crowns.[2]	The better the condition of the retention trees the more the felling area was liked. (IV) Dead logs (III) and trees in poor condition (IV) had no impact.	Large and decaying trees are ecologically the best ones. Small trees have no impact.
Size of felling area	Not hypothesized	More important than the size of felling area is an irregular shape and boundaries drawn in an angle to contour lines.[2]	Small clear fellings were preferred to large ones. (I)	Both small and large felling areas.

Treatment	Hypotheses (based on landscape design principles) used in Case Studies II and III	Finnish forest landscape management guidelines	Preferences according to Case Studies I, II, III and IV	Ecological principles
Soil preparation and logging residue	Not hypothesized	In recreation forests, the traces of forest management should be minor.[3]	Soil preparation and logging residue disturbed (I).	Not possible to compare.
Shape of afforestation	The shapes of the afforestation area should reflect the shapes of the surrounding environment. An oblong irregular shape is the best option. An oblong geometrical shape is the second-best option and quadratic shape is the worst option. (II)	Gentle and round forms are favoured.[4]	Afforestation areas reflecting the shapes of the surrounding landscape were preferred. Geometric oblong shapes can be equally preferred to irregular shapes. Also, a geometric oblong shape can be equally preferred to a quadratic shape. (II)	n.s.
Location of afforestation	Afforestation at a forest edge is the best alternative. The second-best option is afforestation in the middle of the fields. Afforestation that closes the long-distance view is the worst option. (II)	Fields that are bordered by forests are visually suitable for afforestation.[2]	The afforestations located close to the forest edge were preferred. The worst option was the afforestation in the middle of the field. (II)	n.s.

* [1] Hyvän metsänhoidon suositukset. 2006. Metsätalouden kehittämiskeskus Tapio. 100 p.

[2] Metsämaiseman hoito.1997. Metsätalouden kehittämiskeskus Tapio ja Metsäteho Oy. 25 p.

[3] Metsätalouden ympäristöopas. 2004. Metsähallitus. 159 p.

[4] Pellonmetsittäjän opas. 1996. Käytännön Maamies ja Tapio. 19 p.

5.6.2 The results of each case study vs. the effective landscape management guidelines

This chapter compares the results of each case study to the landscape management instructions that were effective when the case study was implemented. This chapter examines which statements of the landscape management guidelines of that time the case study confirmed and which it opposed.

Case Study I confirmed some part of the landscape management guidelines of the Forestry Development Center Tapio and Metsähallitus that were effective when the study was designed. Case Study I proved to be similar to the guidelines in demonstrating that small felling areas are preferred to large ones, that the trees in the felling areas create a positive visual impact, that soil preparation should be avoided, that the shape of the felling area is important, and that felling areas can be also experienced in positive way (Metsänhoitosuositukset 1989, Metsien hoito: Etelä-Suomi 1990, Metsien hoito: Pohjanmaa-Kainuu 1990, Metsien hoito: Lappi 1991).

The results of *Case Study III* are to some extent contradictory to the landscape management guidelines used at the time the study was planned. These guidelines stated that the seed or shelter trees should not be left against the horizon line but, instead, it is sometimes better to regenerate the summit forest by a clear felling (Metsätalouden ympäristöopas 1993, Luonnonläheinen metsänhoito 1994), whereas Case Study III found that both the seed-tree felling and totally unbroken skyline were equally preferred while the clear felling was the most disturbing option. The current version of the environmental guide of Metsähallitus (Metsätalouden ympäristöopas 2004) is more in line with the results of Case Study III. This guide states that the seed trees on skylines should be situated more densely than normally so that trees that stick out separately cannot be seen against the horizon, and that holes in the skyline should be avoided. Furthermore, the landscape management guide of Tapio (Metsämaiseman hoito 1997) states that seed trees or retention tree groups can soften the change caused by the felling in the summit forests.

Moreover, the instructions of that time as well as the current guidelines state that it is better to leave trees in groups than individually in the felling area (Metsätalouden ympäristöopas 1993, 1997, Metsämaiseman hoito 1997, Metsätalouden ympäristöopas 2004), while the results of Case Study III showed the opposite. However, Case Study III confirmed some statements of the landscape management guidelines that were effective at that time: vertical shapes and hollows in the summit forests are disturbing, the forest stands on the lakeshore should be left untouched and a dense shelterbelt is better than a thinned strip (Metsätalouden ympäristöopas 1993, Luonnonläheinen metsänhoito 1994).

The results of *Case Study IV* somewhat contradicted both the landscape management instructions that were effective when the study was designed and the current landscape management guidelines. These guidelines state that retention trees should be left in groups and that individually left trees do not improve visual quality (Metsämaiseman hoito 1997, Metsätalouden ympäristöopas 1997, Metsätalouden ympäristöopas 2004). The results of Case Study IV showed the opposite: individually left trees were preferred to tree groups. Instead, Case Study IV confirmed the statement of the guidelines that retained trees should have impressive trunks and broad crowns (Metsämaiseman hoito 1997, Metsätalouden ympäristöopas 2004).

5.6.3 Visual preferences vs. ecological healthiness

The ecologically best alternatives are not completely known but the ecological statements presented in Table 8 are based on general ecological rules and reasoning, as well as on a dispersed and diverse amount of research. For this reason, the prediction of the ecological significance and the impacts of different treatments is not unambiguous.

The visual landscape management guidelines of the Forestry Development Center Tapio and Metsähallitus (Metsämaiseman hoito 1997, Hyvän metsänhoidon suositukset 2006, Metsätalouden ympäristöopas 2004) are to a large extent consistent with ecological hypotheses. The reason for this is that Finnish landscape design implicitly pays attention to ecological and biodiversity issues. Both landscape management guidelines and ecological hypotheses suggest that retention trees should be left in groups and close to the edges of the felling area, and that retention trees should be large and have impressive trunks. Furthermore, both assert that the irregular shapes of the felling areas are better than the geometrical shapes, and that the size of the felling area is not a decisive factor. A shelterbelt on the lakeshore fellings should be left, and a dense strip is better than a thinned one.

Correspondingly, there also are strong similarities between visual preferences and ecological healthiness. The results of the case studies as well as the ecological principles suggest that the more retention trees there are left in the felling area, the better, and that large retention trees are the best alternative, while small trees do not have much impact. Increasing the number of retained trees enhances the living conditions of many declined forest species (Hyvärinen et al. 2005). For example, a great majority of the beetles associated with aspens can tolerate a clear felling provided that a sufficient number of suitable host trees is retained (Martikainen 2001). Furthermore, old, large trees are necessary for many forest species (Saaristo and Lehesvirta 2004), and the more variable the tree species and size composition, the better it is for biodiversity.

Moreover, both visual preferences and ecological hypotheses assert that a dense shelterbelt along the lakeshore is better than a thinned strip, while no shelterbelt at all is the worst option. A shelterbelt is important for biodiversity and water quality. The ecotones between the two different ecosystems usually have abundant species diversity, and a shelterbelt also prevents the leaching of nutrients and organic matter. (Saaristo and Lehesvirta 2004) A shelterbelt with varying width is ecologically the most beneficial option.

Nevertheless, some discrepancies emerge between the ecologically healthy options and the visual preferences. The greatest difference is that it seems to be ecologically sound to leave retention trees in groups, while people usually prefer individually located trees. Within a tree group, the species (e.g. epiphyte lichen or moss) can disperse more easily, and the local populations will be preserved better than in individual trees. Also, within a tree group, the environmental conditions are variable, as for example both shade and exposure to sun, while around an individually located tree the conditions are rather similar. Nonetheless, if there are individual valuable trees in the forest stand, it might be better to retain them – even though they would be scattered – than to leave less valuable trees in groups. Especially the large deciduous trees should be retained even if they are located separately (Saaristo and Lehesvirta 2004). The ecologically ideal option could be a combination of the individual valuable trees and the trees in groups.

Furthermore, irregular shapes of the felling areas are ecologically better than the geometric shapes, while the irregular and horizontally shaped regeneration areas can in some cases be equally preferred. The irregular shape of the felling area is ecologically beneficial because

the borderline is longer and thus provides more variable environments and circumstances than the geometric borders.

In many cases there is no clear ecological divergence between the management options, whereas visual preferences may differ. For example, concerning the regeneration felling in the summit forest, a seed-tree felling was preferred to a clear felling that broke the skyline, whereas there is no ecological distinction between the options. All kinds of variation are advantageous for biodiversity, and for this reason, in a large forest area, it is beneficial to regenerate the forest both by clear fellings and seed-tree fellings. Clear felling areas often have diverse species composition, and the species that are adapted to the early stages of the succession benefit from the clear felling (Saaristo and Lehesvirta 2004). On the other hand, seed trees help to preserve the mychorizza and detritus in the area. If the seed trees were left permanently, it would be a more ecologically sound option than the clear felling.

Small clear fellings are preferred to big ones, while from an ecological point of view, the variation of the commercial forests would be enhanced by having different sizes of felling areas (Saaristo and Lehesvirta 2004). Soil preparation and logging residue are visually disturbing, whereas they are not ecologically unambiguous issues. If logging residue is removed, the amount of decaying wood diminishes. However, leaving logging residue in a felling area is not a natural alternative because in natural forests, the needles and woody debris burn every now and then. Furthermore, logging residue has different consequences for different kinds of species groups. If logging residue is left, the plants favoring nitrogen will increase and the plants suffering shadowing will decrease, and vice versa.

Soil preparation gives variety to the soil structure, may open seed banks and provides possibilities to plant species that cannot grow if the surface layer of the forest soil is not broken (Saaristo and Lehesvirta 2004). However, heavy soil preparation is not ecologically beneficial as it alters the soil structure and may also change the composition of the ground vegetation. For example, the average cover of Vaccinium Myrtillus in Finland has diminished from 18% to 8% in forty years, mainly due soil preparation (Hotanen et al. 2000). Soil preparation also increases the leaching of nutrients and organic matter.

5.7 Summary of the results

This dissertation aimed at answering questions raised from practical forest management issues. It produced new knowledge on many topics which have not been empirically studied much so far: namely preferences for quality, location and the number of retention trees, the shapes of the regeneration areas, soil preparation, regeneration in the summit forests and lake shore forests, and the preferences for locating afforestation patches. This dissertation also generated qualitative knowledge on people's perceptions of the felling areas and produced information on the elements that people pay attention to in the felling areas. This work also produced knowledge on the compatibility of the visual preferences and landscape management guidelines, as well as the compatibility of visual preferences and ecological recommendations.

Despite the practical focus of this dissertation, it also contributed information regarding some theoretical questions posed in landscape preference research. This work tested the evaluation methods used in landscape preference research (ranking vs. rating) as well as the suitability of the parametric statistical tests in the ordinal scale data. Furthermore, it developed a new implication of the Q-sort method in which the images are initially sorted into a certain number of piles and then rank-ordered within piles. This allows finer discrimination between

the images than the original method. In addition, this dissertation combined qualitative and quantitative research methods.

This work compared and evaluated the theories for predicting landscape preferences. It indirectly tested the information and psycho-evolutionary theories by comparing the predicting variables of the theories to the results of the case studies. In addition, this dissertation provided thorough insight into the current state of the art in landscape preference research. It assessed the various approaches to study landscape preferences, reviewed comprehensively the results of previous studies on forest landscape preferences, and evaluated the methods used in them.

This dissertation demonstrated that the way in which the forest regeneration and afforestation of agricultural land is performed is visually important. Paying attention to even minor factors in the planning and implementation of the management operations can improve the visual quality of the timber fellings and afforestation. Furthermore, Case Study I showed that a clear felling can evoke even positive feelings, thoughts and memories depending on the time passed from the felling, the implementation of the felling, and the viewing point to the felling area.

Table 9 presents the guidelines for the visual implementation of forest regeneration and field afforestation that can be given based on the case studies. These guidelines can be applied only to similar environmental and cultural conditions that were prevailing in the case studies.

Fellings and afforestations should not be eye-catching in the landscape. A regeneration area can be made well-matched with its environment by maintaining the small size, by avoiding soil preparation and logging residue if possible, by leaving mature good-conditioned trees individually throughout the felling area, by preserving uniform skylines, by leaving shelterbelts in the lakeshore fellings, and by avoiding vertical shapes. Afforestation can be made to blend in with the landscape by situating the afforestation sites close to the forest edges and by reflecting the shapes of the environment.

The current forest landscape management guidelines put forth by the Forestry Development Center Tapio and Metsähallitus (Forest and Park Service) are to a large extent compatible with the results of the case studies of this dissertation. Correspondingly, the visual preferences for the management options studied and the ecological healthiness of those options are, in general, similar. All of them suggest, for example, that retention trees should be large and that a dense shelterbelt in the lakeshore fellings is better than a thinned strip. Nonetheless, some discrepancies do arise between people's visual preferences and the landscape management instructions, as well as between the visual preferences and the ecologically sound options. The major difference is that the landscape management instructions suggest leaving the retention trees in groups and that this also seems to be ecologically sound. However, according to the case studies, people preferred the individually located retention trees to the trees in groups. Furthermore, the size of felling area, the soil preparation and logging residue all affected the respondents' preferences but these are not focused on in the current landscape management guidelines.

The results showed that preferences may not depend only on the management alternative itself, but also on the viewing distance, viewing point and the scene in which the management options are implemented. In attractive and variable environments, the way of implementing the management actions might be more important than in the less attractive environments. Furthermore, the changes caused by the forest regeneration and field afforestation may be more readily accepted in the less attractive landscapes.

Similarly, the viewing distance may affect preferences because some landscape elements may not be distinguishable in the long-distance views (e.g. retention trees), while some large-

Table 9. The preferred implementations of forest regeneration and field afforestation according to the case studies.

Management	Preferred implementation according to the case studies
Forest regeneration	
Number of trees and amount of other vegetation	The more trees and greenery in a regeneration area, the more it was liked; only a few trees (< 1 m^3/ha) did not enhance the visual quality of a regeneration area.
	Seed tree fellings were preferred to clear fellings.
Location of retention trees	Individually located residual trees were preferred to tree groups.
Condition of retention trees	The better the condition of the retention trees, the more the regeneration area was appreciated.
Size	Small clear fellings were preferred to large ones.
Soil preparation and logging residue	Soil preparation and logging residue disturbed.
Fellings in summit forest	Preservation of the hill silhouette (uniform skyline) was important.
Fellings in lakeshore forest	Leaving a shelterbelt in the lakeshore fellings was appreciated.
Shapes	Vertical shapes were not liked in the long-distance views.
Field afforestation	
Shapes	Shapes reflecting the surrounding landscape were appreciated.
Location	Afforestations located at the edge of an existing forest were preferred.

scale features may not be clearly seen in the near-distances (e.g. shapes). The influence of the viewing point from which the area is looked at on the preferences likely depends on the heterogeneity and variability of the landscape. In other words, in a diverse landscape, the effect of the vantage point is probably greater than in the more homogenous and monotonous environments.

Generally, the different stakeholder groups ended up offering surprisingly similar preference orders for the images, and their ratings were to a large extent parallel as well. However, the local inhabitants may be more sensitive towards the landscape changes than others because some of them gave lower scores to the afforestation options than did the other groups. In addition, the preferences of the groups that earn at least some part of their living from the forest may differ from those of others. For instance, forest owners and forestry professionals did not consider the regeneration areas as being as disturbing as did the other groups. The forestry professionals also detected more differences between the alternative

regeneration options than did the other groups. This means that the forestry professionals' and landowners' preferences do not always correspond to the preferences of the recreationists and the forest visitors. And finally, the environmentalists expressed more negative attitudes to the clear fellings than did the other groups.

The results concerning the stakeholder groups reflect that knowledge and the reference group have some importance in the formation of preferences. Even so, these differences were minor, and the unanimity of the stakeholder groups in their preference orders gives support to the assumption that preferences are largely consistent at least within one nation. Furthermore, Case Study I gave reason to assume that the emotions affect the perceptions of the clear felling areas.

Furthermore, this dissertation showed that different evaluation methods (rating and ranking) produced compatible results and that parametric and non-parametric tests in the ordinal scale data produced similar results. In addition, the results gave support to the complementarity of the qualitative and quantitative approaches.

The interpretation of the results of the case studies in the light of information and psycho-evolutionary theories indicated that these theories offer some possible explanations for people's preferences for forest regeneration and for field afforestation, even though all the results could not be consistently explained by these theories. Based on the case studies, it seems that coherence best explains the preferences for the regeneration and afforestation areas, while most other variables of these theories could also be interpreted to explain preferences to some extent. Furthermore, when comparing the variables of the theories to the previous studies conducted on forest landscape preferences, it seemed that most of the variables of the information and psycho-evolutionary theories could explain the forest landscape preferences to a degree. However, the theories should be developed further in order to be useful in practical, empirical studies.

6 FUTURE VISIONS

6.1 Challenges for future research

The field of the landscape perception studies is heterogeneous and dispersed. Landscape perceptions are studied by many disciplines based on their own premises. To a degree, the different approaches are complementary; other approaches produce practical information, whereas others may help to understand the reasons for preferences or the meanings of landscape to individuals. When preferences are studied by various methods and assumptions the knowledge that cumulates is rich, many-sided, and multi-dimensional.

However, the heterogeneity of the research field also means the fragmentation of knowledge. Besides, the results are difficult to compare – even within one research tradition – while the research methods used are not compatible. A standardization of the research methods could produce more comparable results. Furthermore, the scattered knowledge could be combined into a one, or several comprehensive frameworks that would consider landscape values from many angles and that could generate comparable knowledge. Nevertheless, not all research can be done within one framework, or by standardized methods, or by prevailing research traditions, but various methodologies and completely new approaches are needed as well. Truly interdisciplinary research could generate completely novel insights. A combination of qualitative and quantitative approaches could be beneficial, because qualitative research

could provide entirely new perspectives to many research problems while a quantitative approach could bring more generalizability.

The objectives of landscape preference studies are often practical; they aim at producing knowledge that can be utilized in natural resource planning and management. These practical visual preference studies would need stronger theoretical bases and concepts. However, the existing theories for predicting landscape preferences (e.g. the information and psycho-evolutionary models) are not verified and are not easily applied to the practical studies nor are they operationalized for them. These theories should be developed further and their soundness should be confirmed so that they could be better utilized in empirical research. For example, the information model could be more easily applied in the forest landscape preference studies if forest landscape configurations that contribute to each variable of the information theory could be determined. In addition, the theories should incorporate the cultural and sub-cultural influences in the prediction of preferences. The field would also welcome new theories for predicting the landscape preferences that would be applicable to the different kinds of environments and practical planning situations.

Landscape preferences seem to be dependent on three sources: genes, culture, and the traits of an individual. A great challenge for the future research is to differentiate the landscape elements and their configurations that are universally liked and those for which the preferences are dependent on culture, time period, or on the individual characters. For example, in some cases, the knowledge produced in other countries cannot be applied to Finnish landscapes and to Finns, whereas some part of this knowledge may be universal.

Despite the tendency to see cultural factors as affecting preferences, the landscape preferences have usually been tried to explain by the features of the landscape, while the effect of the culture and subculture on preferences has been studied far less. A greater understanding is needed regarding the influence of the respondent's background on their preferences. Even though the discrepancies between the various groups have been studied to some extent, the results are difficult to compare due to the different methods used. Furthermore, research on the individual differences is scarce. An essential question is whether the landscape quality is more important to some groups or to some individuals than to others. Certain types of personalities might be more sensitive to their environment than others. For example, the influence of the surrounding environment on mental well-being might be stronger for some persons than others.

A more in-depth understanding is needed of the reasons for people liking certain kinds of environments and configurations. Furthermore, more knowledge is called for regarding the well-being effects of preferred environments. It seems that environmental preferences are related to the environment's potential to provide restoration from stress and attentional fatigue (van den Berg et al. 2003, Staats et al. 2003). Yet the pattern of the effective predictors is not necessarily the same for restorativeness and preference. In addition, the landscape configurations that enhance the restorative effects have not yet been identified. For instance, different kinds of forests may differ in their restorative quality (Herzog et al. 2003). More comprehension is needed of which forest elements support the restorative effects and what the relationship is between the preferences and restorativeness.

Even though most of the environmental perception happens through the sense of sight (Ulrich 1983, Jubenville et al. 1987), other senses are also important in perceiving a landscape. Yet most of the preference studies have concentrated on visual landscapes while little is known about the effect of sounds, noise, smells, taste and touch on preferences. Especially when inside a landscape, for example, within a forest, all the senses become central in the sensation and perception of that landscape. Therefore, when studying experiences, preferences and

restorativeness within a landscape, other senses besides the sense of sight should also be included in the studies.

A more comprehensive understanding is needed of the role of spatial and temporal variation in environmental experience. When forest visitors move within a forest, as is the typical case in Finland, variation within a larger forest area is likely an essential factor in their experience. For this reason, further research is needed, for instance, on perceptions for clear felling areas in a larger context, such as when people move around in a forest. In addition, more research is called for on the effects of the temporal factors on landscape preferences. For example, people's preferences for the forest management options change in the course of the growth and succession of the forest. Also, a person's preferences might alter over his or her individual lifespan due to the changes in society and culture. Even though some studies indicate that landscape preferences are rather stable (Palmer 1997, Lindhagen and Hörnsten 2000), they can also to some extent vary over time. As a consequence, the importance of continuous studies and follow-up cannot be overemphasized.

The Finnish rural landscape is being changed most rapidly and strongest by the forest regeneration fellings and field afforestation; therefore these operations should be implemented in a way that fits in as well as possible to the surrounding environment and by means that can soften the abrupt change. Further research is needed on the preferences for forest regeneration and field afforestation. This research could, for example, focus on the shapes of the regeneration areas, acceptable sizes of regeneration and field afforestation areas, and role of variation. Moreover, the interactions between the separate variables as well as their relative importance for preferences should be studied. For instance, it seems probable that as for the regeneration areas, the size of felling area is more important than many other factors.

Knowledge of the economic costs and incomes of landscape management would be useful in practical landscape management. The incomes are often indirect, received from sources such as nature-based tourism or through the well-being effects caused by improved visual quality. Additionally, more research is needed on optimization and decision-making analysis in forest management that would take into account the various values of the forests. These models could help to find the most efficient forest management methods (see e.g. Pukkala 2006). In addition, more research on landscape preferences is needed for the bases of the scenic beauty indices that are used in the numerical forest planning.

More knowledge is called for regarding the suitability, reliability and appropriateness of the different research methods used in landscape perception and preference studies. The development of visualization methods, such as the rapid advances in computer graphics and realism of the illustrations, opens up new possibilities for preference research. Nonetheless, the new methods need to be appropriately tested and evaluated. In addition, more attention needs to be given to the sampling of respondents, the generalizability of the results, and reliability of research.

6.2 Finnish rural landscape management issues in the future

In the future, the conflicts between the different goals in the management of the Finnish rural areas will probably continue and also cover other issues besides the currently important timber production, ecological values, and local livelihood. The nature-based tourism and the meaning of outdoor recreation are increasing, and other forms of forest use besides traditional timber production may get more emphasis in the future (Koivula et al. 2005, Hetemäki et al. 2006). Furthermore, the restorative potential of nature might get more attention in urban and

rural planning as well as in forest management planning, if there is a growth in knowledge and awareness of the mental well-being effects, such as restoration, that the natural environments provide. Scenic beauty is a central element in these probably increasing forms of the use of forests (nature-based tourism, recreation, restoration).

There are several possibilities to work out the contradictions between the different management aims. For example, ecological aesthetics offers possibilities to integrate the scenic and ecological concerns. Ecological aesthetics states that aesthetic appreciation should be informed by ecological knowledge i.e. what is ecologically good also looks good to us. In Finnish forestry, some type of ecological aesthetics approach has been implicitly practiced since the 1990s – even though not explicitly stated – while scenic beauty has been subordinate to ecological concerns. On the contrary, the socio-cultural paradigm, that emphasizes negotiation and consensus building, provides more multi-faceted answers for the disagreements between the competing management objectives. In Finland, participatory planning has already been implemented to some extent on the publicly owned lands. However, the negotiation-based approaches might receive more emphasis in future forestry. The balance between the different management aims (timber production, biodiversity protection, landscape values, etc.) can also be sought by decision-making methods such as the Analytical Hierarchy Process (AHP).

One solution to reduce the inconsistencies between the amenity values and other management objectives is to incorporate the results of the preference studies systematically in the planning methods. This would also enhance science-based landscape management and planning. In landscape design, the results of preference studies could be one input in the planning process, and in the forest management planning, the research-based scenic values could be integrated in the planning systems. Preference studies could be utilized in the participatory planning processes as well. Furthermore, completely new approaches could be developed and applied, such as the planning frameworks or methods that would be based on the theories for predicting landscape preferences.

The starting points for individual management decisions are the aims and functions of the particular land area in concern, and in the case of private ownership, the goals of the land owner. For some land owners, the scenic beauty might be the main objective for owning forest land (see Kuuluvainen et al. 1996, Karppinen 1998a, 1998b). When the management objectives of the land owner and other interest groups are contradictory, a compensation system might be introduced. On publicly owned land, emphasis on scenic values has to be put most in those places that are most frequently used and seen such as urban forests, areas nearby settlements, areas used for recreation and nature-based tourism, as well as areas along frequently used roads. Sometimes scenic values might be emphasized at the cost of other values, such as timber production or ecology. In some specific places, the main goal of forest management could be the production of well-being effects, such as restoration and scenic beauty.

Finnish forest policy has traditionally paid attention to the economic value of forests, especially timber production. From the 1990s on, the ecological sustainability of forestry has been strongly emphasized in practical forest management. Instead, the social sustainability of forestry has not received much attention thus far and considerations of social sustainability have mainly included the rights and livelihood of the local people as well as employment, whereas scenic beauty issues have been largely omitted. However, it is probable that the next era of Finnish forest policy will stress the importance of the social sustainability of forestry, and in particularly, the well-being effects of the forests, including scenic beauty.

REFERENCES

Aasetre, J. 1993. Miljöpreferanser i Nordmarka. Resultater fra en åpen intervjuundersökelse. Nina-Oppdragsmelding 205. Norsk Institutt for Naturforskning. 46 p.

Abello, R.P. & Bernaldez, F.G. 1986. Landscape preference and personality. Landscape and Urban Planning 13: 19–28.

Anderson, L.M. 1981. Land use designations affect perception of scenic beauty in forest landscapes. Forest Science 27(2): 392–400.

Antikainen, M. 1991. Ruissalon metsäsuunnitelma 1991–2000. Turun kaupunki, ympäristönsuojelutoimiston julkaisu 7/1991.

— 1993. Metsämaiseman suunnittelu Kolin kansallispuistossa. Metsäntutkimuslaitoksen tiedonantoja 456. 88 p.

Alho, J.M., Kolehmainen, O. & Leskinen, P. 2001. Regression methods for pairwise comparison data. In: Schmoldt, D.L., Kangas, J, Mendoza, G.A. & Pesonen, M. (eds.). The Analytic Hierarchy Process in Natural Resource and Environmental Decision Making. p. 235–251.

Appleton, J. 1975. The experience of landscape. John Wiley & Sons. 293 p.

— 1984. Prospects and refuges re-visited. Landscape Journal 3(2): 91–103.

Arthur, L.M. 1977. Predicting scenic beauty of forest environments: some empirical tests. Forest Science 23(2): 151–160.

Aura, S., Horelli, L. & Korpela, K. 1997. Ympäristöpsykologian perusteet. WSOY. 197 p.

Axelsson Lindgren, C. & Sorte, G.J. 1984. Visuellt urskiljbara vegetationskaraktärer som planunderlag: exemplet Järavallsskogen. Sveriges lantbruksuniversitet, Institutionen för landskapsplanering. Stencil 84:3. Alnarp.

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

Becker, R.H. 1982. Opinions about clear-cutting and recognition of clear-cuts by forest recreation visitors. Journal of Environmental Management 17: 171–177.

Bell, S. 1993. Elements of visual design in the landscape. E & FN Spon. 212 p.

— 1998. The landscape value of farm woodlands. Forestry Commission. Information Note. November 1998. 8 p.

— 2001. Can a fresh look at the psychology of perception and the philosophy of aesthetics help contribute to the better management of forested landscapes? In: Sheppard, S.R.J. & Harshaw H.W. (eds.). Forests and Landscapes: Linking Ecology, Sustainability and Aesthetics. IUFRO Research Series 6. CABI Publishing. p. 125–148.

Benson, R.E. & Ulrich, J.R. 1981. Visual impact of forest management activities: findings on public preferences. USDA Forest Service. Research Paper INT-262. 14 p.

Berridge, K.C. 2003. Pleasures of the brain. Brain and Cognition 52(1): 106–128.

Bishop, I.D. & Hull, R.B. 1991. Integrating technologies for visual resource management. Journal of Environmental Management 32: 295–312.

— & Hulse, D.W. 1994. Prediction of scenic beauty using mapped data and geographic information systems. Landscape and Urban Planning 30: 59–70.

— & Rohrmann, B. 2003. Subjective responses to simulated and real environments. Landscape and Urban Planning 65: 261–277.

— , Wherrett, J.R., & Nukker, D.R. 2001. Assessment of path choices on a country walk using a virtual environment. Landscape and Urban Planning 52: 225–237.

Bostedt, G. & Mattsson, L. 1995. The value of forests for tourism in Sweden. Annals of Tourism Research 22(3): 671–680.

Botkin, D.B. 2001. An ecologist's ideas about landscape beauty: beauty in art and scenery influenced by science and ideology. In: Sheppard, S.R.J. & Harshaw H.W. (eds.). Forests and Landscapes: Linking Ecology, Sustainability and Aesthetics. IUFRO Research Series 6. CABI Publishing. p. 111–123.

Bourassa, S.C. 1990. A paradigm for landscape aesthetics. Environment and Behavior 22(6): 787–812.

Brown, T.C. & Daniel, T.C. 1984. Modeling forest scenic beauty: concepts and application to Ponderosa pine. USDA Forest Service Research Paper RM-256.

— & Daniel, T.C. 1986. Predicting scenic beauty of timber stands. Forest Science 32(2): 471–487.

— & Daniel, T.C. 1987. Context effect in perceived environmental quality assessments: scene selection and landscape quality ratings. Journal of Environmental Psychology 7: 233–250.

— , Daniel, T.C., Richards, M.T. & King, D.A. 1988. Recreation participation and the validity of photo-based judgments. Journal of Leisure Research 20(4): 40–60.

Brunson, M.W. & Reiter, D.K. 1996. Effects of ecological information on judgments about scenic impacts of timber harvest. Journal of Environmental Management 46: 31–41.

— & Shelby, B. 1992. Assessing recreational and scenic quality. How does new forestry rate? Journal of forestry 90(7): 37–41.

Brush, R. 1979. The attractiveness of woodlands: perceptions of forest landowners in Massachusetts. Forest Science 25(3): 495–506.

— , Chenoweth, R.E. & Barman, T. 2000. Group differences in the enjoyability of driving through rural landscapes. Landscape and Urban Planning 47: 39–45.

Buhyoff, G.J. & Leuschner, W.A. 1978. Estimating psychological disutility from damaged forest stands. Forest Science 24 (3): 424–432.

— , Wellman, J.D., Harvey, H. & Fraser, R.S. 1978. Landscape architects' interpretations of people's landscape preferences. Journal of Environmental Management 6: 255–262.

— , Leuschner, W.A. & Arndt, L.K. 1980. Replication of a scenic preference function. Forest Science 26(4): 227–230.

— , Arndt L.K. & Propst, D.B. 1981. Interval scaling of landscape preference by direct and indirect measurement methods. Landscape Planning 8: 257–267.

— , Wellman, J.D. & Daniel, T.C. 1982. Predicting scenic quality for mountain pine beetle and western spruce budworm damaged forest vistas. Forest Science 28(4): 827–838.

— , Wellman, J.D., Koch, N.E., Gauthier, L. & Hultman, S. 1983. Landscape preference metrics: an international comparison. Journal of Environmental Management 16:181–190.

— , Hull, R.B., Lien, J.N. & Cordell, H.K. 1986. Prediction of scenic quality for southern pine stands. Forest Science 32(3): 769–778.

Cook, W.L. 1972. An evaluation of the aesthetic quality of forest trees. Journal of Leisure Research 4(4): 293–302.

— & Cable, T.T. 1995. The scenic beauty of shelterbelts on the Great Plains. Landscape and Urban Planning 32: 63–69.

Daniel, T.C. 2001a. Whither scenic beauty? Visual landscape quality assessment in the 21st century. Landscape and Urban Planning 54: 267–281.

— 2001b. Aesthetic preference and ecological sustainability. In: Sheppard, S.R.J. & Harshaw H.W. (eds.). Forests and Landscapes: Linking Ecology, Sustainability and Aesthetics. IUFRO Research Series 6. CABI Publishing. p. 15–29.

— & Boster, R.S. 1976. Measuring landscape aesthetics: the scenic beauty estimation method. USDA Forest Service, Research Paper RM-167. 66 p.
— & Meitner, M.M. 2001. Representational validity of landscape visualizations: the effects of graphical realism on perceived scenic beauty of forest vistas. Journal of Environmental Psychology 21(1): 61–72.
— & Vining, J. 1983. Methodological issues in the assessment of landscape quality. In: Altman, I. & Wohlwill, J.F. (eds.). Behavior and the Natural Environment. p. 39–84.
Dearden, P. 1984. Factors influencing landscape preferences: an empirical investigation. Landscape Planning 11: 293–306.
Eaton, M.M. 2003. Fakta ja fiktio luonnon esteettisessä ymmärtämisessä. In: Sepänmaa, Y., Heikkilä-Palo, L. & Kaukio, V. (eds.). Metsään mieleni. Maanhenki Oy. p. 90–100.
Eskelinen, O. 1979. Pyynikin ulkoilualue; tutkimus erään metsäisen ulkoilualueen luonnonympäristön hyvinvointitekijöistä. Silva Fennica 13(2): 146–151.
European Landscape Convention. 2006. [Internet site]. Finland's Ministry of Environment. Available from: http://www.ymparisto.fi/. [Cited 10 May 2006].
Finland's National Forest Programme 2010. 1999. Ministry of Agriculture and Forestry. Publications 2/1999. 40 p.
Finnish Statistical Yearbook of Forestry. 2005. Metsätilastollinen vuosikirja. SVT Maa-, metsä- ja kalatalous 2005: 45. Metsäntutkimuslaitos. 424 p.
Forest Landscape Design Guidelines. 1994. Forestry Commission. HMSO. 28 p.
Forman, R.T.T. & Godron, M. 1986. Landscape ecology. 619 p.
Gimblett, H.R. 1990. Environmental cognition: The prediction of preference in rural Indiana. Journal of Architectural and Planning Research 7(3): 222–324.
Gobster, P.H. & Chenoweth, R.E. 1989. The dimensions of aesthetic preference: a quantitative analysis. Journal of Environmental Management 29(1): 47–72.
Golbeck, A.L. 1986. Evaluating statistical validity of research reports: a guide for managers, planners and researchers. USDA Forest Service, General Technical Report PSW-87. 22 p.
Gray, J.R., Braver, T.C. & Raichle, M.E. 2002. Integration of emotion and cognition in the lateral prefrontal cortex. Proceedings of the National Academy of Sciences of the United States of America 99(6): 4115–4120.
Guba, E.G. & Lincoln, Y.S. 1994. Competing paradigms in qualitative research. In: Denzin, N.K. & Lincoln, Y.S. (eds.). Handbook of Qualitative Research. Sage Publications. p. 105–117.
Gustavsson, R. & Ingelög, T. 1994. Det nya landskapet. Skogsstyrelsen. 360 p.
Gustke, L.K. & Hodgson, R.W. 1980. Rate of travel along an interpretive trail. The effect of an environmental discontinuity. Environment and Behavior 12(1): 53–63.
Haakenstad, H. 1972. Skogbehandling i et utfartsområde, En opinionsundersokelse om Oslomarka. Meldinger fra Norges landbrukshogskole (51)16.
Hagerhall, C.M. 2000. Clustering predictors of landscape preference in the traditional Swedish cultural landscape: prospect-refuge, mystery, age and management. Journal of Environmental Psychology 20: 83–90.
Haider, W. 1994. The aesthetics of white pine and red pine forests. The Forestry Chronicle 70(4): 402–410.
Hallikainen, V. 1998. The Finnish Wilderness Experience. Finnish Forest Research Institute. Research Papers 711. 288 p.

Hammit, R.E. 1979. Measuring familiarity for natural environment through visual images. Proceedings of Our National Landscape Conference. USDA Forest Service, General Technical Report PSW-35. p. 217–226.
Hammit, W.E., Patterson, M.E. & Noe, F.P. 1994. Identifying and predicting visual preference of southern Appalachian forest recreation vistas. Landscape and Urban Planning 29: 171–183.
Hartig, T. 1993. Nature experience in transactional perspective. Landscape and Urban Planning 25: 17–36.
— , Mang, M. & Evans, G.W. 1991. Restorative effects of natural environment experiences. Environment and Behavior 23(1): 3–26.
— , Evans, G.W., Jamner, L.D., Davis, D.S. & Gärling, T. 2003. Tracking restoration in natural and urban field settings. Journal of Environmental Psychology 23: 109–123.
Heft, H. & Nasar, J.L. 2000. Evaluating environmental scenes using dynamic versus static displays. Environment and Behavior 32(3): 301–322.
Heino, J. 1974. Finlands stadsägda skogar betraktade speciellt ur friluftssynvinkel. Folia Forestalia 223.
Hellemann, U. 1993. Asteikot ja niiden soveltaminen. In: Tuorila, H. & Hellemann, U. (eds.). Elintarvikkeet aistien puntarissa. p. 32–42.
Herzog, T.R. 1984. A cognitive analysis of preference for field-and-forest environments. Landscape Research 9(1): 10–16.
— 1985. A cognitive analysis of preference for waterscapes. Journal of Environmental Psychology 5: 225–241.
— 1987. A cognitive analysis of preference for natural environments: mountains, canyons, and deserts. Landscape Journal 6: 140–152.
— 1989. A cognitive analysis of preference for urban nature. Journal of Environmental Psychology 9: 27–43.
— 1992. A cognitive analysis of preference for urban spaces. Journal of Environmental Psychology 12: 237–248.
— & Barnes, G.J. 1999. Tranquility and preference revisited. Journal of Environmental Psychology 19: 171–181.
— & Bosley, P.J. 1992. Tranquility and preference as affective qualities of natural environments. Journal of Environmental Psychology 12: 115–127.
— & Kropscott, L.S. 2004. Legibility, mystery, and visual access as predictors of preference and perceived danger in forest settings without pathways. Environment and Behavior 36(5): 659–677.
— & Kutzli, G.E. 2002. Preference and perceived danger in field/forest settings. Environment and Behavior 34(6): 819–835.
— & Leverich, O.L. 2003. Searching for legibility. Environment and Behavior 35(4): 459–477.
— & Miller, E.J. 1998. The role of mystery in perceived danger and environmental preference. Environment and Behavior 30(4): 429–449.
— & Smith, G.A. 1988. Danger, mystery and environmental preference. Environment and Behavior 20(3): 320–344.
— , Black, A.M., Fountaine, K.A. & Knotts, D.J. 1997. Reflection and attentional recovery as distinctive benefits of restorative environments. Journal of Environmental Psychology 17: 165–170.
— , Maguire, C.P. & Nebel, M.B. 2003. Assessing the restorative components of environments. Journal of Environmental Psychology 23: 159–170.

Hetemäki, L., Harstela, P., Hynynen, J., Ilvesniemi, H. & Uusivuori, J. (eds.). 2006. Suomen metsiin perustuva hyvinvointi 2015. Katsaus Suomen metsäalan kehitykseen ja tulevaisuuden vaihtoehtoihin. Metlan työraportteja/Working Papers of the Finnish Forest Research Institute 26. 250 p. [Online publication]. Available from: http://www.metla.fi/julkaisut/workingpapers/2006/mwp026.htm.

Hetherington, J., Daniel, T.C. & Brown, T.C. 1993. Is motion more important than it sounds? The medium of presentation in environment perception research. Journal of Environmental Psychology 13: 283–291.

Hietala-Koivu, R., Joutsalmi, S. & Tyrväinen, L. 2006. Valtakunnallisesti arvokkaiden maisema-alueiden muutoksen arvioiminen. Ympäristöministeriö. Suomen ympäristö 6. 131 p. [Online publication]. Available from: http://www.ymparisto.fi/julkaisut.

Holgén, P., Mattsson L. & Li, C.-Z. 2000. Recreation values of boreal forest stand types and landscapes resulting from different silvicultural systems: An economic analysis. Journal of Environmental Management 60: 173–180.

Horne, P. 2002. Ulkoilijoille tärkeät metsäluonnon ominaisuudet. Metsäntutkimuslaitoksen tiedonantoja 846: 31–38.

Hotanen, J.P., Korpela, L., Mikkola K., Mäkipää, R., Nousiainen, H., Reinikainen, A., Salemaa, M., Silfverberg, K., Tamminen, M., Tonteri, T. & Vanha-Majamaa, I. 2000. Metsä- ja suokasvien yleisyys ja runsaus 1951–95. In: Reinikainen, A., Mäkipää, R., Vanha-Majamaa, I. & Hotanen, J.P. (eds). Kasvit muuttuvassa metsäluonnossa. Tammi. p. 84–301.

Hull, R.B. 1989. Interpreting scenic beauty estimates. Landscape Journal 8: 24–27.

— & Buhyoff, G.J. 1983. Distance and scenic beauty. A nonmonotonic relationship. Environment and Behavior 1983(1): 77–91.

— & Buhyoff, G.J. 1986. The scenic beauty temporal distribution method: an attempt to make scenic beauty assessments compatible with forest planning efforts. Forest Science 32(2): 271–286.

— & Revell, G.R.B. 1989a. Issues in sampling landscapes for visual quality assessments. Landscape and Urban Planning 17: 323–330.

— & Revell, G.R.B. 1989b. Cross-cultural comparison of landscape scenic beauty evaluations: a case study in Bali. Journal of Environmental Psychology 9: 177–191.

— & Stewart, W.P. 1992. Validity of photo-based scenic beauty judgments. Journal of Environmental Psychology 12: 101–114.

— , Buhyoff, G.J. & Daniel, T.C. 1984. Measurement of scenic beauty: the law of comparative judgement and scenic beauty estimation procedures. Forest Science 30(4): 1084–1096.

— , Buhyoff, G.J. & Cordell, H.K. 1987. Psychophysical model: an example with scenic beauty perceptions of roadside pine forests. Landscape Journal 6:113–122.

Hultman, S. 1979. Friluftsskogen i folkets ögon. Sveriges Skogsförbunds Tidskrift 1:32–49.

— 1983. Allmänhets bedömning av skogsmiljöers lämplighet för friluftsliv. 2. En rikstäckande enkät. Sveriges lantbruksuniversitet, Avdelningen för landskapsvård, Rapport 28. 91 p.

Hunziker, M. 1995. The spontaneous reafforestation in abandoned agricultural lands: perception and aesthetic assessment by locals and tourists. Landscape and Urban Planning 31: 399–410.

Hyvän metsänhoidon suositukset. 2001. Metsätalouden kehittämiskeskus Tapio. 95 p.

Hyvän metsänhoidon suositukset. 2006. Metsätalouden kehittämiskeskus Tapio. 100 p.

Hyvärinen, E., Kouki, J., Martikainen, P. & Lappalainen. H. 2005. Short term effects of controlled burning and green tree retention on beetle (Coleoptera) assemblages in managed boreal forests. Forest Ecology and Management 212: 315–332.

Iisakkila, L. 1977. Perustietoa maisemaan vaikuttavista luonnontekijöistä. Otakustantamo. 287 p.
Jackson, R.H., Hudman, L.E. & England, J.L. 1978. Assessment of the environmental impact of high voltage power transmission lines. Journal of Environmental Management 6: 153–170.
Jensen, F.S. 1993. Landscape managers' and politicians' perception of the forest and landscape preferences of the population. Forest & Landscape Research 1993 1(1): 79–93.
Johnson, R.L, Brunson, M.W. & Kimura, T. 1994. Using image capture technology to assess scenic value at the urban/forest interface: A case study. Journal of Environmental Management 13(1): 55–75.
Jubenville, A., Twight, B.W. & Becker, R.H. 1987. Outdoor recreation management, theory and application. Venture Publishing Inc. 219 p.
Kaltenborn, B.P. & Bjerke, T. 2002. Associations between environmental value orientations and landscape preferences. Landsape and Urban Planning 59: 1–11.
Kangas, J., Laasonen, L. & Pukkala, T. 1993. A method for estimating forest landowners' landscape preferences. Scandinavian Journal of Forest Research 8: 408–417.
Kaplan, R. & Herbert, E.J. 1987. Cultural and sub-cultural comparisons in preferences for natural settings. Landscape and Urban Planning 14: 281–293.
— & Kaplan, S. 1989. The experience of nature. a psychological perspective. Cambridge University Press. 339 p.
— & Talbot, J.F. 1988. Ethnicity and preference for natural settings: a review and recent findings. Landscape and Urban Planning 15: 107–117.
— , Kaplan, S. & Brown, T. 1989. Environmental preference: A comparison of four domains of predictors. Environment and Behavior 21(5): 509–530.
— , Kaplan, S. & Ryan, R.L. 1998. With people in mind. Design and management of everyday nature. Island Press. 225 p.
Kaplan, S. 1987. Aesthetics, affect and cognition; environmental preference from an evolutionary perspective. Environment and Behavior 19: 3–22.
— 1995. The restorative benefits of nature: toward an integrative framework. Journal of Environmental Psychology 15: 169–182.
Kardell, L. 1978. Kan hyggen vara annat än fula? Sveriges Skogsförbunds Tidskrift 76(5): 385–433.
— 1990. Talltorpsmon i Åtvidaberg. 1. Förändingar i upplevelsen av skogen mellan 1978 och 1989. Sveriges lantbruksuniversitet. Rapport 46. 103 p.
— & Lindhagen A. 1998. Ett försök med stamvis blädning på Ekenäs. Skogstillstånd, markvegetation samt attityder. The Swedish University of Agricultural Sciences. Department of Environmental Forestry. Report 77. 72 p.
— & Wallsten, P. 1989. Några gruppers attityder till Pinus contorta. The Swedish University of Agricultural Sciences. Department of Environmental Forestry. Report 40. 55 p.
— , Eriksson, L. & Lindhagen, A. 1993. Luckblädningsförsök i Uppsalatrakten 1976–1990. Föryngringsresultat och upplevelsevärden. The Swedish University of Agricultural Sciences. Department of Environmental Forestry. Report 54. 120 p.
Karhu, I. & Kellomäki, S. 1980. Väestön mielipiteet metsänhoidon vaikutuksesta maisemakuvaan Puolangan kunnassa. Silva Fennica 14(4): 409–428.
Karjalainen, E. 1995. Avohakkuumaiseman visuaalinen laatu. Folia Forestalia 3: 211–232.
— 2000. Metsänhoitovaihtoehtojen arvostus ulkoilualueilla. Metsäntutkimuslaitoksen tiedonantoja 776: 123–136.

— & Komulainen, M. 1997. Pellonmetsityksen vaikutus maisema-arvostuksiin. Maaseudun uusi aika 1: 96–104.
— & Tyrväinen, L. 2002. Visualization in forest landscape preference research: A Finnish perspective. Landscape and Urban Planning 59: 13–28.
Karppinen, H. 1998a. Objectives of non-industrial private forest owners: Differences and future trends in southern and northern Finland. Journal of Forest Economics 4(2): 147–173.
— 1998b. Values and objectives of non-industrial private forest owners in Finland. Silva Fennica 32(1): 43–59.
Kellomäki, S. 1975. Forest stand preferences of recreationists. Acta Forestalia Fennica 146. 36 p.
Kent, R.L. 1993. Determining scenic quality along highways: a cognitive approach. Landscape and Urban Planning 27: 29–45.
Kinnunen, A. 1981. Luonnonestetiikka. In: Kinnunen, A. & Sepänmaa, Y. (eds.). Ympäristöestetiikka. Suomen estetiikan seuran vuosikirja. p. 35–56.
Knopf, R.C. 1987. Human Behavior, Cognition, and Affect in the Natural Environment. In: Stokols, D. & Altman, I. (eds.). Handbook of environmental psychology. Volume 1. John Wiley & Sons. p. 783–826.
Koch, N.E. & Jensen, F.S. 1988. Skovens friluftsfunktion i Danmark. IV del. Befolkningens ønsker til skovens og det åbne lands udformning. Saertryk af Det forstlige Forsøgsvaesen i Danmark. 516 p.
Kogan, N. 1994. On aesthetics and its origins: some psychological and evolutionary considerations. Social Research 61(1): 139–165.
Kohsaka, R. & Flitner, M. 2004. Exploring forest aesthetics using forestry photo contests: case studies examining Japanese and German public preferences. Forest Policy and Economics 6: 289–299.
Koivula, E., Saastamoinen, O., Hentinen, L., Loikkanen, T., Määttä, M., Peltonen, A., Saarinen, J. & Tyrväinen, L. 2005. Metsät ja luontomatkailu; nykytila ja kehittämistarpeita. In: Koivula, E. & Saastamoinen, O. (eds). Näkökulmia luontomatkailuun ja sen tulevaisuuteen. Joensuun yliopisto, metsätieteellinen tiedekunta. Tiedonantoja 165. p. 7–61.
Komulainen, M. 1998. Kylämaisema eläväksi! – Asukaskeskeinen suunnittelu maaseudun kehittäjänä. Metsäntutkimuslaitoksen tiedonantoja 682. 128 p.
Korpela, K.M., Hartig, T., Kaiser, F.G. & Fuhrer, U. 2001. Restorative experience and self-regulation in favorite places. Environment and Behavior 33(4): 572–589.
— , Klemettilä, T. & Hietanen, K. 2002. Evidence for rapid affective evaluation of environmental scenes. Environment and Behavior 34(5): 634–650.
Kuuluvainen, J., Karppinen, H. & Ovaskainen, V. 1996. Landowner objectives and non-industrial private timber supply. Forest Science 42(3): 300–309.
Landscape aesthetics – A handbook for scenery management. 1995. U.S. Dept. of Agriculture, Forest Service. Agricultural Handbook Number 701. 34 p.
Laumann, K. Gärling, T. & Stormark, K.M. 2001. Rating scale measures of restorative components of environments. Journal of Environmental Psychology 21: 31–44.
— , Gärling, T. & Stormark, K.M. 2003. Selective attention and heart rate responses to natural and urban environments. Journal of Environmental Psychology 23: 125–134.
Lazarus, R.S. 1982. Thoughts on the relations between emotion and cognition. American Psychologist 37: 1019–1024.
LeDoux, J.E. 1995. Emotions: clues from the brain. Annual Review of Psychology 46: 209–235

Liao, W. & Nogami, K. 1999. Prediction of near-view scenic beauty in artificial stands of Hinoki. Journal of Forest Research 4: 93–98.
Lindhagen. A. 1996. An approach to clarifying public preferences about silvicultural systems: a case study concerning group selection and clear-cutting. Scandinavian Journal of Forest Research 11: 375–387.
— & Hörnsten, L. 2000. Forest Recreation in 1977 and 1997 in Sweden: changes in public preferences and behaviour. Forestry 73(2): 143–153.
Lothian, A. 1999. Landscape and the philosophy of aesthetics: is landscape quality inherent in the landscape or in the eye of beholder? Landscape and Urban Planning 44: 177–198.
Lovén, L. 1973. Metsäammattimiesten metsänhoidolliset arvostukset. Silva Fennica 7(1): 8–22.
Lowland landscape design guidelines. 1992. Forestry Commission. HMSO.
Lucas, O.W.R. 1991. The design of forest landscapes. Forestry Commission. Oxford University Press. 381 p.
Luonnonläheinen metsänhoito. Metsänhoitosuositukset. 1994. Metsäkeskus Tapion julkaisuja 6/1994. 72 p.
Lyons, E. 1983. Demographic correlates of landscape preference. Environment and Behavior 15(4): 487–511.
Maa- ja metsätalousministeriön luonnonvarastrategia. 2001. Uusiutuvien luonnonvarojen kestävä käyttö. Maa- ja metsätalousministeriö. MMM:n julkaisuja 8/2001. 112 p.
Macia, A. 1979. Visual perception of landscape: Sex and personality differences. Proceedings of Our National Landscape Conference. USDA Forest Service, General Technical Report PSW-35. p. 279–295.
Maisema-aluetyöryhmän mietintö I. 1992. Maisemanhoito. Ympäristöministeriö, Raportti 66.
Maisematoimikunnan mietintö. 1980. Komiteamietintö 1980:44. 198 p.
Martikainen, P. 2001. Conservation of threatened saproxylic beetles: significance of retained aspen Populus tremula on clearcut areas. Ecological Bulletin 49: 205–218.
Mattsson, L. & Li, C.-H. 1994. How do different forest management practices affect the non-timber value of forests? – An economic analysis. Journal of Environmental Management 41 (1): 79–88.
McCool, S.F., Benson, R.E. & Ashor, J.L. 1986. How the public perceives the visual effects of timber harvesting: an evaluation of interest group preferences. Environmental Management 10(3): 385–391.
Metsien hoito: Etelä-Suomi. 1990. Metsähallitus. 90 p.
Metsien hoito: Lappi. 1991 Metsähallitus. 90 p.
Metsien hoito: Pohjanmaa-Kainuu 1990. Metsähallitus. 90 p.
Metsä 2000-ohjelman pääraportti. 1985. Talousneuvosto. Metsä 2000 ohjelmajaosto. 189 p.
Metsähallituksen metsien hoidon strategiat ja keskeiset periaatteet. 1990. Metsähallitus. 12 p.
Metsälaki. 1996. 1093/1996. [Internet site]. Finlex ®. Valtion säädöstietopankki. Available from: http://www.finlex.fi/fi/laki/alkup/1996/19961093. [Cited 9 May 2006].
Metsämaiseman hoito. 1997. Metsätalouden kehittämiskeskus Tapio ja Metsäteho Oy. 25 p.
Metsänhoitosuositukset. 1989. Keskusmetsälautakunta Tapio. 55 p.
Metsätalouden ympäristöopas. 1993. Metsähallitus. 112 p.
Metsätalouden ympäristöopas. 1997. Metsähallitus. 130 p.
Metsätalouden ympäristöopas. 2004. Metsähallitus. 159 p.

Metsätalous ja ympäristö. 1994. Osa I: Nykytilanteen kuvaus. Osa II: Ehdotus metsätalouden ympäristöohjelmaksi. Metsätalouden ympäristöohjelmatyöryhmän mietintö 1994:3. Maa- ja metsätalousministeriö. 100 p.

Nature Conservation Act. 1996. 1096/1996. [Internet site]. Finlex ®. Valtion säädöstietopankki. Available from: http://www.finlex.fi/fi/laki/kaannokset/1996/en19961096.pdf. [Cited 9 May 2006].

Nelson, T., Johnson, T., Strong, M. & Rudakewich, G. 2001. Perception of tree canopy. Journal of Environmental Psychology 21: 315–324.

Nicholson, W. 2002. Microeconomic theory. Basic principles and extensions. Eight edition. Thomson Learning. 748 p.

Nohl, W. 2001. Sustainable landscape use and aesthetic perception – preliminary reflections on future landscape aesthetics. Landscape and Urban Planning 54: 223–237.

Nousiainen, I., Tahvanainen, L. & Tyrväinen, L. 1998. Landscape in farm-scale land-use planning. Scandinavian Journal of Forest Research 13: 477–487.

— , Tahvanainen, L. & Tyrväinen, L. 1999. Visuaalinen maisema monitavoitteisessa metsäsuunnittelussa. Metsätieteen aikakauskirja 3: 505–522.

Orians, G.H. & Heerwagen, J.H. 1992. Evolved response to landscapes. In: Barkow, J.H., Cosmides, L. & Tooby, J. (eds.). The Adapted mind: evolutionary psychology and the generation of culture. Oxford University Press. p. 555–579.

Orland, B. & Uusitalo, J. 2001. Immersion in a virtual forest – some implications. In: Sheppard, S.R.J. & Harshaw H.W. (eds.). Forests and Landscapes: Linking Ecology, Sustainability and Aesthetics. IUFRO Research Series 6. CABI Publishing. p. 205–224.

Paajanen, V. 1999. EU:n metsätoimenpideohjelman toimeenpano. ETY 2080/92 – asetuksen mukainen pellonmetsitys Suomessa. Valtion tilintarkastusvirasto. Tarkastuskertomus 15/99. 51 p.

Palmer, J.F. 1990. Aesthetics of the north-eastern forest: the influence of season and time since harvest. Proceedings of the 1990 North-Eastern Recreation Research Symposium. USDA Forest Service, General Technical Report NE-145. p. 185–190.

— 1997. Stability of landscape perceptions in the face of landscape change. Landscape and Urban Planning 37: 109–113.

— & Hoffman, R.E. 2001. Rating reliability and representation validity in scenic landscape assessments. Landscape and Urban Planning 54: 149–161.

— , Shannon, S., Harrilchak, M.A, Gobster, P.H. & Kokx, T. 1995. Aesthetics of clearcutting – alternatives in the White Mountain National Forest. Journal of Forestry 93(5): 37–42.

Pâquet, J. & Bélanger. L. 1997. Public acceptability thresholds of clearcutting to maintain visual quality of boreal Balsam fir landscapes. Forest Science 43(1): 46–55.

Paronen, O. 2001. Ulkoilun hyvinvointikokemukset ja esteet. In: Sievänen, T. (ed.). Luonnon virkistyskäyttö 2000. Metsäntutkimuslaitoksen tiedonantoja 802. p. 95–111.

Parsons, R. & Daniel, T.C. 2002. Good looking: in defense of scenic landscape aesthetics. Landscape and Urban Planning 60: 43–56.

Paul, E.S., Harding, E.J. & Mendl, M. 2005. Measuring emotional processes in animals: the utility of a cognitive approach. Neuroscience & Biobehavioral Reviews 29(3): 469–491.

Pellonmetsittäjän opas. 1996. Käytännön maamies ja Tapio. 19 p.

Penning-Rowsell, E.C. 1982. A public preference evaluation of landscape quality. Regional Studies 16: 97–112.

Pings, P. & Hollenhorst, S. 1993. Managing eastern hardwood forest for visual quality. Proceedings of the 1993 North-Eastern Recreation Research Symposium. USDA Forest Service, General Technical Report NE-185. p. 89–93.

Porteous, D. 1982. Approaches to environmental aesthetics. Journal of Environmental Psychology 2: 53–66.

Pouta, E. & Sievänen, T. 2001. Luonnon virkistyskäytön kysyntätutkimuksen tulokset – Kuinka suomalaiset ulkoilevat? In: Sievänen, T. (ed.). Luonnon virkistyskäyttö 2000. Metsäntutkimuslaitoksen tiedonantoja 802. p. 32–76.

Pukkala, T. 2004. Monsu, metsäsuunnitteluohjelma. Versio 4. Ohjelmiston toiminta ja käyttö. Joensuun yliopisto. 75 p.

— 2006. Optimising the semi-continuous cover forestry of Finland. Allgemeine Forst- und Jagd-Zeitung 177(8/9): 141–149.

— , Kellomäki, S. & Mustonen, E. 1988. Prediction of the amenity of a tree stand. Scandinavian Journal of Forest Research 3: 533–544.

— , Nuutinen, T. & Kangas, J. 1995. Integrating scenic and recreational amenities into numerical forest planning. Landscape and Urban Planning 32: 185–195.

Purcell, A.T. & Lamb, R.J. 1998. Preference and naturalness: an ecological approach. Landscape and Urban Planning 42: 57–66.

— , Lamb, R.J., Mainardi Peron, E. & Falchero, S. 1994. Preference or preferences for landscape? Journal of Environmental Psychology 14: 195–209.

Rautamäki, M. 1990. Maakunnallinen maisemaselvitys. Varsinais-Suomi. Varsinais-Suomen seutukaavaliitto. Ympäristöministeriö.

Ribe, R.G. 1989. The aesthetics of forestry: what has empirical preference research taught us? Environmental Management 13(1): 55–74.

— 1990. A general model for understanding the perception of scenic beauty in Northern hardwood forests. Landscape Journal 9: 86–101.

— 2005. Aesthetic perceptions of green-tree retention harvests in vista views. The interaction of cut level, retention pattern and harvest shape. Landscape and Urban Planning 73: 277–293.

Ruddell, E.J., Gramann, J.H, Rudis, V.A. & Westphal, J.M. 1989. The psychological utility of visual penetration in near view forest scenic-beauty models. Environment and Behavior 21(4): 393–412.

Rudis, V.A., Gramann, J.H., Ruddell, E.J. & Westphal, J.M. 1988. Forest inventory and management-based visual preference models of southern pine stands. Forest Science 34(4): 846–863.

Rydberg, D. 1998. Urban forestry in Sweden: silvicultural aspects focusing on young forests. Doctoral thesis. Swedish University of Agricultural Sciences, Umeå. Acta Universitatis Agriculturae Sueciae. Silvestria 73. 25 p and four articles.

Saaristo, L. & Lehesvirta, T. 2004. Luonnonhoidon ekologiset perustelut. Metsätalouden kehittämiskeskus Tapio. Julkaisu 17/2004. 31 p.

Saastamoinen, O. 1982. Economics of multiple-use forestry in the Saariselkä forest and fell area. Communicationes Insituti Forestalis Fenniae 104. 102 p.

Saaty, T.L. 1977. A scaling method for priorities in hierarchial structures. Journal of Mathematical Psychology 15: 234–281.

Savolainen, R. & Kellomäki, S. 1981. Metsän maisemallinen arvostus. Acta Forestalia Fennica 170. 75 p.

Schroeder, H. 1984. Environmental perception rating scales. A case for simple methods of analysis. Environment and Behavior 16(5): 573–598.

— 2002. Experiencing nature in special places. Surveys in the North-Central Region. Journal of Forestry, July/August 2002: 8–14.

— & Brown, T.C. 1983. Alternative functional forms for an inventory-based landscape perception model. Journal of Leisure Research 15(2): 156–163.
— & Daniel, T.C. 1981. Progress in Predicting the Perceived Scenic Beauty of Forest Landscapes. Forest Science 27(1): 71–80.
Scott, M.J. & Canter, D.V. 1997. Picture or place? A multiple sorting study of landscape. Journal of Environmental Psychology 17: 263–281.
Selby, A., Petäjistö, L. & Koskela, T. 2005. Forests and Afforestation in a Rural Development Context: a Comparative Study of three Regions in Finland. Working Papers of the Finnish Forest Research Institute 14. 92 p. [Online publication]. Available from: http://www.metla.fi/julkaisut/workingpapers/2005/mwp014.htm.
Sepänmaa, Y. 1981. Tarkoituksenmukaisuus ympäristön kauneuden kriteerinä. In: Kinnunen, A. & Sepänmaa, Y. (eds.). Ympäristöestetiikka. Suomen estetiikan seuran vuosikirja. p. 199–232.
— 1987. Metsäestetiikka ja metsän estetiikka. Silva Fennica (21)4: 374–385.
Shafer, E.L. & Brush, R.O. 1977. How to measure preferences of natural landscapes. Landscape Planning 4(3): 237–256.
— & Richards, T.A. 1974. A comparison of viewer reactions to outdoor scenes and photographs of those scenes. USDA Forest Service, Research Paper NE-302.
— & Tooby, M. 1973. Landscape preference: an international replication. Journal of Leisure Research 5: 60–65.
Shelby, B., Thompson, J., Brunson, M. & Johnson, R. 2003. Changes in scenic quality after harvest. a decade of ratings for six silvicultural treatments. Journal of Forestry, March 2003: 30–35.
Sheppard, S.R.J. 2001. Beyond visual resource management: emerging theories of an ecological aesthetic and visible stewardship. In: Sheppard, S.R.J. & Harshaw H.W.(eds.). Forests and Landscapes: Linking Ecology, Sustainability and Aesthetics. IUFRO Research Series 6. CABI Publishing. p. 149–172.
Shuttleworth, S. 1980. The use of photographs as an environment presentation medium in landscape studies. Journal of Environmental Management 11: 61–76.
Sievänen, T. 1993. Kolin kansallispuiston kävijät. Metsäntutkimuslaitoksen tiedonantoja 465. 56 p.
Silvennoinen, H., Tahvanainen, L. & Tyrväinen, L. 1997. Matkailu, maaseutu ja ympäristö: matkailun nykytila ja tulevaisuuden näkymät Suomessa ja Pohjois-Karjalassa. Joensuun yliopisto, metsätieteellinen tiedekunta. Tiedonantoja 57.
— , Alho, J., Kolehmainen, O. & Pukkala, T. 2001. Prediction models of landscape preferences at the forest stand level. Landscape and Urban Planning 56: 11–20.
— , Pukkala, T. & Tahvanainen, L. 2002. Effects of cutting on the scenic beauty of a tree stand. Scandinavian Journal of Forest Research 17: 263–273.
Staats, H., Kieviet, A. & Hartig, T. 2003. Where to recover from attentional fatigue: an expectancy-value analysis of environmental preference. Journal of Environmental Psychology 23: 147–157.
Stamps, A.E. 1990. Use of photographs to simulate environments: A meta-analysis. Perceptual and Motor Skills 71: 907–913.
— 2004. Mystery, complexity, legibility and coherence: A meta-analysis. Journal of Environmental Psychology 24: 1–16.
Stewart, T.R., Middleton, P., Downton, M. & Ely, D. 1984. Judgments of photographs vs. field observations in studies of perception and judgment of the visual environment. Journal of Environmental Psychology 4(4): 283–302.

Strumse, E. 1994. Environmental attributes and the prediction of visual preferences for agrarian landscapes in Western Norway. Journal of Environmental Psychology 14: 293–303.

— 1996. Demographic differences in the visual preferences for agrarian landscapes in Western Norway. Journal of Environmental Psychology 16: 17–31.

Suomen kestävän metsätalouden kriteerit ja indikaattorit metsätalouden tilan kuvaajina. 1997. Maa- ja metsätalousministeriö. 72 p.

Suomen metsätalouden tila 2000. Kestävän metsätalouden kriteerit ja indikaattorit. 2000. Maa- ja metsätalousministeriö. Julkaisuja 5/2000. 104 p.

Tahvanainen, L. & Tyrväinen, L. 1998. Model for predicting the scenic value of rural landscape – a preliminary study of landscape preferences in North Carelia. Scandinavian Journal of Forest Research 13: 379– 385.

— , Tyrväinen, L. & Nousiainen, I. 1996. Effect of afforestation on the scenic value of rural landscape. Scandinavian Journal of Forest Research 11(4): 397–405.

— , 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.

Terkenli, T.S. 2001. Towards a theory of the landscape: the Aegean landscape as a cultural image. Landscape and Urban Planning 57: 197–208.

Tips, W.E.J. & Savasdisara, T. 1986. The influence of the environmental background of subjects on their landscape preference evaluation. Landscape and Urban Planning 13: 125–133.

Tress, B. & Tress, G. 2001. Capitalising on multiplicity: a transdicplinary systems approach to landscape research. Landscape and Urban Planning 57: 143–157.

Tyrväinen, L. & Tahvanainen, L. 1999. Using computer graphics for assessing the aesthetic value of large scale rural landscapes. Scandinavien Journal of Forest Research 14: 282–288.

— , Silvennoinen, H. & Kolehmainen O. 2003. Ecological and aesthetic values in urban forest management. Urban Forestry & Urban Greening 1: 135–149.

Ulrich, R.S. 1977. Visual landscape preference: a model and application. Man-Environment Systems 7(5): 279–293.

— 1981. Natural versus urban scenes. Some psychophysiological effects. Environment and Behavior 13(5): 523–556.

— 1983. Aesthetic and affective response to natural environment. In: Altman, I. & Wohlwill, J.F. (eds.). Behavior and the Natural Environment. Vol 6. Plenum Press. p. 85–125.

— 1986. Human responses to vegetation and landscapes. Landscape and Urban Planning 13: 29–44.

— , Simons, R.F., Losito, B.D., Fiorito, E., Miles, M.A. & Zelson, M. 1991. Stress recovery during exposure to natural and urban environments. Journal of Environmental Psychology 11: 201–230.

Uusiutuvien luonnonvarojen kestävä käyttö. 1995. Katsaus maa- ja metsätalousministeriön luonnonvarapolitiikkaan. MMM:n julkaisuja 4/1995. 132 p.

Van den Berg, A. E., Koole, S.L. & Wulp, N.Y. 2003. Environmental preference and restoration: (How) are they related? Journal of Environmental Psychology 23: 135–146.

Ward, L. M. & Porter. C.A. 1980. Age-group differences in cognition of the molar physical environment: a multi-dimensional scaling approach. Can. J. Behav. Sci. 12: 329–346.

Wellman, J.D. & Buhyoff, G.J. 1980. Effects of regional familiarity on landscape preferences. Journal of Environmental Management 11: 105–110.

Willis, K.G. & Garrod, G.D. 1992. Assessing the value of future landscapes. Landscape and Urban Planning 23: 17–32.
Winkielman, B. & Berridge, K.C. 2004. Unconscious emotion. Current Directions in Psychological Science 13(3): 120–123.
Visual Resource Management. 2006. [Internet site]. US Department of the Interior. Bureau of Land Management. Available from: http://www.blm.gov/nstc/VRM/. [Cited 16 May 2006].
Vodak, M.C., Roberts, P.L., Wellman, J.D. & Buhyoff, G.J. 1985. Scenic impacts of eastern hardwood management. Forest Science 31(2): 289–301.
Yang, B. & Kaplan R. 1990. The perception of landscape style: A cross-cultural comparison. Landscape and Urban Planning 19: 251–162.
Yarrow, C. 1966. A preliminary survey of the public's concepts of amenity in British forestry. Forestry 39(1): 59–67.
Yu, K. 1995. Cultural variations in landscape preference: comparisons among Chinese sub-groups and Western design experts. Landscape and Urban Planning 32: 107–126.
Zajonc, R.B. 1980. Feeling and thinking: Preferences need no inferences. American Psychologist 35: 151–175.
— 2000. Feeling and Thinking: Closing the debate over the independence of affect. Studies in Emotion and Social Interaction, Second Series. p. 31–58.
Zube, E.H. 1974. Cross-disciplinary and intermode agreement on the description and evaluation of landscape resources. Environment and Behavior 6: 69–89.
— 1984. Themes in landscape assessment theory. Landscape Journal 3: 104–110.
— & Pitt, D.G. 1981. Cross-cultural perceptions of scenic and heritage landscapes. Landscape Planning 8: 69–87.
— , Sell, J.L. & Taylor J.G. 1982. Landscape Perception: Research, application and theory. Landscape Planning 9: 1–33.
— , Pitt, D.G. & Evans, G.W. 1983. A lifespan development study of landscape assessment. Journal of Environmental Psychology 3: 115–128.