Incommensurability and uncertainty in contingent valuation: willingness to pay for forest and nature conservation policies in Finland

Mika Rekola

Academic dissertation

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To my family

Abstract
This study examines incommensurability and uncertainty in the contingent valuation (CV) of forest and nature conservation. The purpose is to theoretically analyze incommensurability, develop its empirical measurement within CV, and analyze forest amenities under uncertainty. The main contribution of the study is its ability to provide a better understanding of the role of incommensurability in CV and in nonmarket valuation in general.

Incommensurability is examined using the model of lexicographic preferences (L*-ordering). The model of L*-ordering is extended with a many-to-many relationship between wants and goods. The existence and structure of inverse demand functions, willingness to pay (WTP) and willingness to accept (WTA) compensation, are derived from L*-ordering. Inverse demand functions are shown to be a function of three elements, viz. the relationship between wants and goods, the WTA/WTP format and the endowment of the good. In a CV survey concerning the Natura 2000 Network, commitment to private property rights is found to be a new reason for incommensurability. The two instruments used to empirically reveal lexicographic preferences, viz. paired comparisons and attitude statements, are examined in a CV survey considering regeneration cuttings in private forests in Finland. The results show that the methods can produce similar outcomes.

A local CV survey was conducted in the municipality of Loppi in order to measure the value of forest amenities under the uncertainty emerging from regeneration cuttings. Respondents’ risk perceptions are measured using the fractile method, a novel risk communication vehicle in CV. The results indicate that people will be better off if they have information on cuttings beforehand.

Keywords: contingent valuation, incommensurability, uncertainty, lexicographic preferences, paired comparisons, forest conservation, nature conservation
Preface

Environmental economics, and contingent valuation in particular, came to exist for me a decade ago. I can still recall how my thinking was inspired by a Ph.D. course on economic valuation of non-market commodities that I attended in June 1993 at the Agricultural University of Norway in Ås.

In the course of time, several circumstances and people, too many to list here, have contributed to my research. Nevertheless, some of these deserve special mention. To begin with, I sincerely thank the Department of Forest Economics at the University of Helsinki, for providing me with such excellent working conditions. Of all my teachers, I first want to thank Päiviö Riihinen, for without his encouragement I might never have begun to do research. I thank Seppo Vehkamäki for initializing the project and being my first supervisor. I am especially indebted to Jari Kuuluvainen, who has been my main supervisor. His vast professional understanding of research work and his patient and friendly advice have constantly guided my efforts to complete my doctoral research.

I want to express my sincere gratitude to Eija Pouta for making it possible for us to work on these projects in an amicable, innovative and memorable atmosphere.

I was lucky to have Anni Huhtala and Ville Ovaskainen as co-advisors. Their challenging comments have very much improved my research at key stages. In particular, I am indebted to Ville Ovaskainen for careful remarks on my manuscripts throughout the whole research project, starting from the very beginning.

I am also grateful to Richard Bishop, Daniel Bromley, and Joseph Buongiorno for their teaching and the enlightening discussions I had with them during my studies at the University of Wisconsin, Madison, in 1995-1996.

From within the Finnish Forest Research Institute, Olli Tahvonen initialized and provided substantial support for the study on the Natura 2000 nature conservation program. This study also linked my research to work being done by Chuang Zhong Li at the University of Dalarna. I want to thank both for their valuable advice.

I want to extend my thanks to my colleagues affiliated with the Department of Forest Economics: Sami Berghäll, Emmi Lehtonen, Tapio Rantala, Mikko Tervo, and Lauri Valsta, as well as to those working elsewhere: Heimo Karppinen and Jyrki Aakkula.
I also want to acknowledge the participation of the more than 1800 Finns who responded to my mail questionnaires. Without them the study would not have been possible. I owe thanks to research assistants Joel Erkkonen, Janne Nalkki, Jaana Rekikoski, Juha Turkki, and Kyösti Kurikka for handling the large amounts of data.

I want to thank the pre-examiners of this dissertation thesis, Michael Lockwood and Markku Ollikainen. Their extensive and constructive suggestions contributed a great deal to the improvement of the manuscript. Thanks are also due to Henry Fullenwider for his willingness to copyedit some of my manuscripts over the past several years. Naturally, responsibility for any remaining errors lies entirely with me.

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Finally, I want to thank my family. My parents, Leena and Raimo, have always encouraged me, and numerous discussions with Raimo have increased my understanding of forest management practices. I reserve my deepest gratitude to my wife Mira and our children, Markus and Teemu, for their support and understanding. They have kept me in touch with the richness of life outside the walls of academia.

I hope that, in its own way, this thesis will contribute to the improvement of our scientific understanding of important issues related to the successful management of our natural environment.

Helsinki, December 2003

Mika Rekola
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SEPARATE STUDIES I-V
List of Studies

This dissertation includes the following separate studies, which are referred to by Roman numerals in the text as follows:


Author’s contribution

Mika Rekola was the sole author of studies I and IV. In study II Rekola authored those parts of the manuscript that were related to the economic model, willingness to pay measurement and results related to willingness to pay. Pouta provided the theory, measurement and analysis related to variables from social psychology. She analyzed the data and authored manuscript for those parts which were related to these variables. Jari Kuuluvainen, Chuan-Zhong Li and Olli Tahvonen participated in planning the research ideas and data collection, and in revising the manuscript. In study III Rekola provided the idea and the theoretical frame of reference, made the analysis and wrote the manuscript of the study as far as they considered incommensurable preferences. Jari Kuuluvainen, Chuan-Zhong Li, Eija Pouta and Olli Tahvonen participated in planning the research ideas and data collection, and in revising the manuscript. Study V was co-authored with Pouta. Rekola has provided the research ideas, analyzed the data and written the manuscript. The data collection was jointly planned and carried out together with Eija Pouta.
1 INTRODUCTION

1.1 Background

Commercial forestry, especially in the form of clear-cuttings, has caused environmental effects that have been a topic in public discussion in Finland for three decades. At the same time, market agents, landowners and forest industries have gradually promoted voluntary forest conservation in several ways, for example by introducing certification systems. However, as forest environment is essentially a nonmarket good, i.e., a public good, a socially desirable level of forest conservation cannot be reached without public policies. In fact, several forest conservation policies have been initiated recently. These include the conservation of old-growth forests in Northern Finland in 1996, the Finnish implementation of the Natura 2000 program to conserve valuable habitats and species in European Union since 1997, and the conservation of forests in Southern Finland since 1999. A basic question in economic terms with all these projects has been how many resources should be allocated to environmental goods. In particular, would citizens, landowners, or industry be willing to sacrifice their income, profits, or land in order to achieve conservation?

Environmental goods — such as recreational and aesthetic benefits, carbon sequestration, berries, mushrooms and other non-timber goods, and biodiversity benefits from forests — are typically a combination of public and private goods (Freeman 1993, 28-32, Lesser et al. 1997, 8, Lockwood 1997). A pure public good is a nonrival and nonexcludable good. Nonrivalness means that several individuals can consume the same unit of the good. Nonexcludability indicates that preventing others from consuming is impossible or prohibitively costly (Varian 1992, 414). These characteristics can exist in various combinations, as shown in Table 1. The concepts of existence value, nonuse value, and passive use value have been debated, however it seems that they reflect the very idea of public goods (Krutilla 1967, Plourde 1975, McConnel 1983, Randall 1991, Smith 1993, Carson et al. 2001).

1 A pure public good is a theoretical concept that is in practice hard to find. That is why the terms nonrival and/or nonexclusive are, in fact, more informative (Randall 1987). The history of the concept of public goods in economics goes back to Samuelson’s work (1954, 1955, 1958). See Boadway and Bruce (1984) for introduction.
Table 1. Different categories of goods with respect to rivalness and excludability.

<table>
<thead>
<tr>
<th>Good</th>
<th>Properties of goods</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Pure private good</em></td>
<td>excludability</td>
<td>food, paper</td>
</tr>
<tr>
<td></td>
<td>rivalness</td>
<td></td>
</tr>
<tr>
<td><em>Quasi public goods / public services</em></td>
<td>excludability</td>
<td>panorama view point</td>
</tr>
<tr>
<td></td>
<td>nonrivalness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>nonexcludability</td>
<td>crowded recreation area</td>
</tr>
<tr>
<td></td>
<td>rivalness</td>
<td></td>
</tr>
<tr>
<td><em>Pure public goods</em></td>
<td>nonexcludability</td>
<td>carbon sequestration, air quality, biodiversity, national defense</td>
</tr>
<tr>
<td></td>
<td>nonrivalness</td>
<td></td>
</tr>
</tbody>
</table>

Public goods and externalities are closely related. Baumol and Oates (1975, 18-19) defines an externality with two conditions:

“Condition 1. An externality is present whenever some individual’s (say A’s) utility or production relationships include real (that is, nonmonetary) variables, whose values are chosen by others (persons, corporations, governments) without particular attention to the effects on A’s welfare.

Condition 2. The decision maker, whose activity affects others’ utility levels or enters their production functions, does not receive (pay) in compensation for this activity an amount equal in value to the resulting (marginal) benefits or costs to others.“

Externalities are typically discussed when a single party affects, positively or negatively, another party. A classical example of a positive externality is beekeeping, which benefits orchards in the neighborhood, while a good example of a negative externality is a factory that emits soot and creates a nuisance to an adjacent laundry. An externality can be termed as a public good when it is characterized as nonrival and nonexcludable and affects a large number of people. Typical examples are air pollution or biodiversity losses in forests (Johansson 1987, 72, Callan and Thomas 2000, 79).

The basic problem is that the market does not automatically produce enough public goods or they produce too many public bads, and the market solution is inefficient (Boadway and Bruce 1984). ²

The role of nontimber benefits, conventionally labeled as amenity or in situ services, in private forest owners’ harvesting behavior has been studied since the 1970’s (Hartman 1976, Strang 1983, Koskela & Ollikainen 1997, Tahvonen 1999,

² On the concept of economic efficiency see Sen (1982), Silberberg (1990), and Bromley (1994).
Tahvonen and Salo 1999, Koskela & Ollikainen 2001). Most of these amenity services can be classified as public goods. The value of public goods in a specific forest stand depends on the stand characteristics, such as stand age and species composition, as well as the environment, e.g., the adjacent stands. When a forest owner derives utility from amenity services his/her harvesting behavior is changed from the behavior which is based purely on timber values. In extreme cases, it is possible that the owner might leave the stand unharvested.

However, even if the forest owner derives utility from amenity services, his/her cutting behavior is not socially optimum (Koskela and Ollikainen 2001). The more amenity services consist of pure public goods, such as biodiversity or carbon sequestration, the more unlikely is that individual forest owner’s harvesting behavior and the social optimum will coincide. The situation becomes more complicated when amenity services are under uncertainty (Reed 1993, Alvarez and Koskela 2003). Uncertainty in forest owners’ decision making can be related to biological processes, such as damage by forest fires or storm, timber prices, or interest rates. From the citizens’ point of view, the supply of public goods from private forests is often uncertain because of limited information about private owners’ planning and decision-making processes.

Possible solutions to inefficient supply of public goods include the creation of markets, taxation, subsidies, or direct regulation. However, all solutions require information on the demand for the public good, and that information is not directly available from markets. Nonmarket valuation methods are based on consumer theory using economic welfare measures to describe individual’s preferences (demand) for public goods. These measures include willingness to pay (WTP) for an the increase or improvement of a public good and willingness to accept (WTA) compensation for the decrease or loss of a public good.

The contingent valuation method (CVM) is the most widely used nonmarket valuation method (Kriström 1999). Its popularity arises from the fact that it is the only method available to value so-called nonuse values and is easily adapted to assess different levels of public goods, such as those proposed in environmental policy initiatives by NGOs and public authorities (Mitchell and Carson 1989, Braden and Kolstad 1992, Bishop et al. 1995). Economic welfare measures from contingent valuation (CV) can be applied in a cost-benefit analysis (CBA), which is used to assist public policy decision makers (e.g., Hanley and Spash 1993). In addition to CBA, CV can be used to increase citizens’ awareness of environmental issues, to influence policy, to identify decision alternatives, to legitimate decisions, or to estimate environmental damage in litigation (Kuik et al. 1992).
CV employs the survey method. At the heart of CV is a market or referendum scenario that describes a realistic transaction, and the value people place on an environmental good is contingent upon this scenario (Fishhoff and Furby 1988). Any transaction includes three elements 1) a good, b) a payment, and c) a social context. For example, to increase conservation areas in private forests (good) a scenario describes a policy program (social context), e.g., Natura 2000, which includes compensation for the landowners (payment). However, the creation of realistic transactions in CV is not a straightforward task but requires a careful design, including a lot of qualitative research at the outset (Bishop et al. 1995, Kriström 1999).

The method itself has been controversial since the 1980’s, when it became commonly used (Cummings et al. 1986, Kahnemann and Knetsch 1992, Arrow et al. 1993, Hausman 1994, Vatn and Bromley 1994). For instance, it has been proposed that people do not measure all values according to the same standard and that preferences do not indicate exchangeability, i.e. trade-offs, between different goods (Sagoff 1988, O’Neill 1993, Vatn and Bromley 1994). It has also been discussed how welfare changes should be measured if there is uncertainty related to a public good (Weisbrod 1964, Graham 1981, Ready 1995). Especially in CV, the uncertainty of supply plays an essential role (Bishop 1982, Ready 1995).

When trade-offs between goods do not exist, preferences are said to be incommensurables (Chang 1997). Below a certain level some goods, such as food and drink, are essential for subsistence, and they definitely are incommensurable with other goods. Furthermore, people may commit themselves to protect an endangered species no matter what the cost. In a sense, they may attach absolute rights to natural objects (Edwards 1986, Spash and Hanley 1995). People may also be motivated by impure altruism. In this case, utility is derived from doing good, i.e., paying for the project, not from the environmental good itself (Olsen 1965, Andreoni 1989, 1990, Kahnemann and Knetsch 1992). Cognitive inability to make difficult decisions is also a potential reason for incommensurability (Slovic et al. 1988, Opaluch and Segerson 1989).

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4 On the value of nature and the nature of value see Brown (1984), Vatn and Bromley (1994), Sagoff (1998) Lockwood (1997, 1999a). On the definitions of preferences, economic values, and the role of economics in decision making, see e.g., Spash and Hanley 1993. Theory of social exchange has examined people’s willingness to exchange different kinds of resources, such as money, love or information (Foa 1971). There has also been a growing interest among philosophers in incommensurability of values (Chang 1997).
Incommensurability causes a fundamental problem in CV because economic welfare measures assume trade-offs — an individual’s WTP and the increase of environmental good are supposed to provide equivalent utility. A respondent with incommensurable preferences may protest in a CV survey. His/her WTP may also be insensitive to the scope of the environmental good. For example, a respondent’s WTP for preservation of an endangered species might be the same for the preservation of several species.

Incommensurability can be described using the model of lexicographic preferences. In CV surveys paired comparisons and attitude statements have been used to reveal respondents with lexicographic preferences (Edwards 1986, Stevens et al. 1991, Spash and Hanley 1995, Lockwood 1997, 1998, 1999b). However, little has been done to assess the validity of these methods. In fact, no empirical studies have been done to compare these two methods. Furthermore, earlier studies have not paid attention to the conservation of private land, a subject of vital importance in Finland. The conservation of private land may conflict with the acknowledgments of property rights and potentially cause incommensurability.

In addition to incommensurability, uncertainty makes contingent valuation research more complex. Earlier CV literature has considered valuation under uncertainty in a few cases, such as wildlife hunting (Brookshire et al. 1983, Johansson 1990) and air quality (Danielson et al. 1995). However, it seems that no CV studies on uncertain forest amenities have been conducted before. In Finland, where forests are a vital part of the environment and the general public is permitted to use private land for recreational purposes, the question of supply uncertainty emerges. The source of this uncertainty is basically the fact that private forest owners have only a limited duty to take nonmarket goods into account in planning forest management and harvests, and they have no duty to inform the public about their forest operations.

1.2 The objectives of the study

This study examines incommensurability first theoretically using the model of lexicographic preferences, and then empirically in surveys concerning the Natura 2000 nature conservation program and forest regeneration cuttings. Uncertainty concerning regeneration cuttings is investigated in a local case study. The objectives of the study are:

1. to create a more general framework for lexicographic preferences than that used in earlier CV studies and to analyze the existence and the structure of
inverse demand functions. This framework is illustrated using data from previous literature (STUDY I).

2. to explore whether respondent’s commitment to private property rights and commitment to the claim that natural objects have absolute rights are reasons for lexicographic preferences. Using empirical survey data on a specific nature conservation program in Finland, lexicographic preferences are explained and their effect on WTP is analyzed (STUDIES II and III).

3. to analyze the content validity of the two empirical measures of lexicographic preferences: paired comparisons and attitude statements. These measures are tested in an empirical survey concerning decaying and wildlife trees in forest regeneration cuttings (STUDY IV).

4. to analyze peoples’ perceptions of risks and risk attitudes toward future regeneration cuttings in private non-industrial forests, and their WTP for regulating cuttings in a case study from the municipality of Loppi in south-central Finland (STUDY V).

2 A REVIEW OF EARLIER STUDIES

2.1 Lexicographic preferences

2.1.1 Reasons for incommensurability
Several reasons and explanations for incommensurability and scope insensitivity have been proposed. Figure 1 classifies them into four categories: subsistence needs, commitment, altruism, and ambivalence. The arrows in Figure 1 show causal probabilistic relations. In other words, ambivalence, for instance, may only affect incommensurable and scope insensitive preferences in certain circumstances (Opaluch and Segerson 1989). It seems appropriate to assume that the effect is not deterministic because preferences can be seen as constructions depending on the specific context (Fischoff and Furby 1988, Slovic 1995).

The relationship between the various models of lexicographic preferences and incommensurability and scope insensitivity is illustrated with one-to-one and many-to-many utility structures analyzed in Study I. The one-to-one utility structure indicates both scope insensitivity and incommensurability whereas the many-to-many utility structure may indicate only incommensurability.
**COMMITMENT**
- ethical preferences
  - Harsanyi (1955)
  - Olsen (1965)
  - Becker (1974)
    - Sen (1977)
    - Margolis (1982)
    - Edwards (1986)
    - Sagoff (1988)
    - Andreoni (1989, 1990)
  - Stevens et al. (1991)
  - Kahneman and Knetsch (1992)
  - Stevens et al. (1993)
- commitment
- social or group interest
- genuine altruism
- citizens
- intrinsic value
- social interest

**ALTRUISM**
- subjective preferences
  - impure altruism
  - warm glow
  - sympathy
  - self-interest
  - quasi-altruism
  - consumers
  - pure and impure altruism
- moral satisfaction
- social approval

**AMBIVALENCE**
- Simon (1956)
- bounded rationality
- Festinger (1957)
- Akerlof and Dickens (1982)
- Opaluch and Segerson (1989)
- Ready et al. (1995)
- Scott (2002)
- cognitive dissonance
- ambivalence
- conservatism

**INCOMMENSURABILITY**
- e.g., one-to-one relationship
  - Sen (1987)
  - Stevens et al. (1991)
  - Lockwood (1996b)
- e.g., many-to-many relationship

**SCOPE INSENSITIVITY**

**SUBSISTENCE NEEDS**
- minimum standard of living
- minimum level of income
- essential goods

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Figure 1. Reasons for incommensurability and insensitivity to scope.
The issue of scope insensitivity emerged from the so-called embedding problem (Kahneman and Knetsch 1992, Smith 1992, Carson and Mitchell 1995, Carson 1997). Embedding consists of two issues, sequence dependence and scope. The first refers to the observation that the value of a certain good is different depending on the place it has in a set of items to be valued. Hanemann (1995) showed that this sequence effect is consistent with economic theory. Scope insensitivity may also be supported by standard consumer theory (Randall and Hoehn 1996). The reason for this lies in substitution relationships and endowment constraints.

Subsistence needs were first referred to in CV research as a source of incommensurability when Stevens et al. (1991) discussed lexicographic preferences and proposed that individuals may have a minimum level of income below which more income is always preferred to wildlife. Spash and Hanley (1995) proposed that this level of income is a minimum standard of living. In a more general context, Sen (1987) has stressed that a minimum standard of living is a culturally defined concept and it may include in industrial countries owning, for instance, a car. According to Lockwood (1996b) below a certain level of provision some goods become essential to support life and they have no substitutes. It seems relevant to assume that these goods cases produce both incommensurability and scope insensitivity. However, some goods may, indeed, contribute subsistence needs but they have substitutes. In this case, a need for subsistence produces incommensurable preferences which are sensitive to scope. This is described with a many-to-many relationship between wants and goods (See section 2.5).

The idea of commitment entails that an individual behaves according to a norm (ethical, moral or social) that contradicts his/her own welfare. As Sen (1977) wrote:

“One way of defining commitment is in terms of a person choosing an act that he believes will yield a lower level of personal welfare to him than an alternative that is also available to him...One area in which the question of commitment is most important is that of the so-called public goods.”

An individual may not personally consider that a public good, e.g., nature conservation, benefits him/her but feels it is a moral duty to support the provision of the good. Generally speaking, an individual is motivated by, on the one hand, self-interest and, on the other hand, the welfare of society or the state of the natural world. This dichotomy can be described with a dual or multiple utility models, where self and social interests produce irreducibly distinct preferences (Harsanyi, 1955, Sen 1977, Margolis 1982, Edwards 1986, Blamey et al. 1995, Nyborg
Participation in voting or contributions to public goods are examples of socially oriented behavior. Namely, if individuals are motivated purely by self-interest, they would obviously not vote at all (Mueller 1987).

Edwards (1986) was the first to discuss the implications of ethical commitments for welfare analyses of existence values derived from CV. He applied Kennett’s (1980) distinction between quasi-altruism and genuine altruism and proposed that these terms are relevant in explaining explain WTP for existence values. Edwards also referred to Sen’s (1973, 1977, 1979) distinction between the concepts of sympathy and commitment and listed several ethical principles that involve commitment: fiduciary obligations, moral obligations, intergenerational equity and fairness, and perceived rights of animals. Using the model of lexicographic preferences he showed that even if WTA and WTP exist, they are no longer valid economic welfare change measures. Notice that Edwards’ (1986) definition of genuine altruism is different than the pure altruism defined below.

Sagoff’s (1988) addressed the common suspicion that when people are asked to value nonmarket goods, they cannot or do not want to accept trade-offs between goods and money. Bromley and Vatn (1994) discussed the incongruity problem in this same respect:

“If different attributes of a good are incongruous — that is, attached to orthogonal dimensions — one metric (price) will be unable to capture all the relevant information. The moral aspects of environmental choices tends to introduce one important basis for such incongruity.”

Arrow (1997) wrote that typical examples designed to show the absurdity or immorality of assigning a monetary value to activities are based on exceptionally large changes in the amount of good. In most cases only the marginal effects, however, are valid for economic analysis. For example, people working with hazardous activities tend to accept higher wages as compensation for increased

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5 There is no unanimity related to the use of multiple utility frameworks in economics. The assessment of multiple utility frameworks can be done from three perspectives: logical, empirical, and normative (Brennan 1989, Lutz 1993, Brennan 1993). The focus of this study is on empirical assessment even though some material in this section can be classified as normative. The potential usefulness of MU is related to analyses of 1) the possibility of disequilibrium 2) satisfying behaviour, 3) preference changes, 4) the manipulation of preferences, and 5) institutionally relevant information such as trust (Etzioni 1986, Kuran 1990, Lutz 1993). In neoclassical economics, multiple utility models or incommensurable preferences are not usually acknowledged. An illustrative study in this sense is Karni & Safra (2002), where the duality of preferences is first taken as a starting point but later in the paper removed simply by assuming the trade-offs between the distinct preferences.
risk of death. When the risk of death is too high, the trade-off between wages and the possibility of death is no longer accepted.⁶

Referring to Sagoff’s (1988) moral argumentation and the psychological view by Harris et al. (1989), Stevens et al. (1991) argued that decisions on wildlife existence may involve considerations of ethical and moral principles. Stevens et al. (1993) made a hypothesis that in a CV context, people decide to allocate income between themselves and their social interests to do their fair share. Stevens et al. (1993) also made a summary of ethical theories, classifying arguments relevant to understanding existence valuation into four categories: theories of social or group interests, theories of the intrinsic values of nature, impure altruism, and ambivalence.

Nyborg (2000) presented formally the implications of dual preference orderings in the context of environmental valuation. She was able to show that the interpretation of CV responses may differ considerably depending on whether responses are given in a role of a consumer (self-interest) or a citizen (social interest). However, she assumed that individuals take either a self-interest or a social point of view. This is in contrast with the model of lexicographic preferences, which holds that an individual is motivated by both views at the same time.

Pure altruism is connected to the simple desire of an individual to increase the level of public good (Andreoni 1989, 1990).⁷ Impure altruism assumes that individuals derive utility from doing good not from the good itself or from an increase in the goods available to others (Olsen, 1965, Becker, 1974, Andreoni 1989, 1990). This motivation, labeled as warm glow by Becker (1974), provided a rationale for the moral satisfaction argument (Kahneman and Knetsch, 1992, Kahneman et al. 1993, Baron and Greene 1996). Another line of analysis stresses the design and administration of CV surveys as a source of scope insensitivity

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⁶ Arrow (1997) states that when commodities are infinitely divisible and indifference surfaces are convex, the marginal variations in commodity use are commensurable. Most of this reasoning seems acceptable. There is unfortunately some tautology in Arrow’s argument. The existence of surfaces, e.g., in two-commodity cases the existence of indifference curves, itself implicates commensurability. Surfaces are not a causal explanation for the existence of commensurability but a technical description of it.

⁷ The purely nonpaternalistic altruist obtains utility from other’s overall well-being while the purely paternalistic altruist cares about the quantity of goods used by others. The latter would affect benefit cost analysis (McConnell 1997, Johansson 1992). This issue is related to but not the same as the dichotomy of citizen vs. consumer preferences (Sagoff 1988, Blamey et al. 1995, Nyborg 2000). CV responses should be interpreted in a different way in these categories. Consumer preferences count only personal welfare whereas citizen preferences include consideration of the welfare of other people (Nyborg 2000). However, citizen preferences do not derive utility from the act of giving (warm glow). Empirical CV studies reporting on citizen/consumer preferences include Rensburg et al. (2002), Kontogianni et al. (2003), and Mathieu et al. (2003).
(Carson 1997). On the one hand, Carson (1997) provides a review of CV studies since 1984 and the results show that of 35 studies 31 rejected the scope insensitivity hypothesis. On the other hand, Randall and Hoehn (1996) showed that scope insensitivity is standard economic phenomenon induced by substitution relationships and constrained endowments. Regardless, the point in this study is that pure or impure altruism is commensurable with utility from other sources. Even though these definitions of altruism can explain scope insensitivity, they do not assume incommensurability in preferences.

Ambivalence arises when “an individual’s choice involves tradeoffs among characteristics that cannot be easily compared” (Opaluch and Segerson 1989). For example, an individual’s (social) values and his/her individual preferences may conflict. Values can be based on the moral principle stating that all species have a right to exist. However, the principle will need a personal payment, a payoffs, which conflicts with preferences for subsistence. On such occasions, an individual may experience cognitive inability to make decisions that cannot be easily made while balancing the objectives. Two concepts serve as a background for ambivalence: bounded rationality and cognitive dissonance.

Under bounded rationality, as introduced by Simon (1956, 1985), rational information search and processing are limited, and decisions are based on sub-optimal use of noncompensatory strategies. A decision maker seeks a satisfactory solution, if not the best possible. Bounded rationality thus emphasizes the role of perception, cognition, and learning.

The theory of cognitive dissonance was introduced at that time by Festinger (1957). Cognitive dissonance is a psychological phenomenon describing the discomfort an individual feels when observing the difference between earlier knowledge or beliefs and new information.

Akerlof and Dickens (1982) examined the economic consequences of cognitive dissonance. In particular, they analyzed workers who risk their lives at work every day and experience psychological conflict. The study proposed that to resolve the conflict, i.e., cognitive dissonance, people may modify their subjective probabilities concerning the risks of their work. According to Opaluch and Segerson (1989) Akerlof and Dickens (1982) were also first to apply ambivalence in an economic study.

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In the CV context a difficult value conflict, such as nature conservation versus landowners’ property rights, or the complexity of the choice may lead a decision maker into ambivalence (Opaluch and Segerson 1989). If an individual is forced to make a choice, for example in a CV survey, a possible solution to is to use a rule of thumb, such as a lexicographic rule (Slovic et al. 1988, Ready et al. 1995, Scott 2002).

To summarize, subsistence needs, commitment and ambivalence are reasons for both incommensurability and scope insensitivity, whereas altruism is related only to scope insensitivity. Therefore, in order to reveal incommensurability, reasons for scope insensitivity have to be recognized.

2.1.2 Empirical CV approaches to lexicographic preferences

Edwards (1986) was first to present a lexicographic model in CV context. In his model an individual has a minimum income level beyond which he/she is willing to give up all extra money to obtain any increment in wildlife preservation. Edwards noted that typical CV responses cannot reveal incommensurability, and he urged the need to explore empirically whether people’s preferences are based on different ethical systems, such as commitment or sympathy. He proposed qualitative research in general and attitude questions in surveys in particular.

Stevens et al. (1991) was the first attempt to measure lexicographic preferences with the attitude approach in a study involving preservation of wildlife. Their study used several different statements that can be interpreted as measures for lexicographic preferences alone or in combination. These measures were further elaborated in Spash (1998).

Spash and Hanley (1995) further elaborated the model by Stevens et al. (1991) and proposed that the aforementioned income level can represent a culturally determined minimum standard of living. Spash and Hanley (1995) applied a statement and a WTP question as measures of lexicographic preferences concerning the rights of wild animals, plants or ecosystems to be protected. Hanley and Milne (1996) suggested that there could be several categories in which trade-offs are accepted between goods, but no trade-offs are acceptable between different categories of goods.

Lockwood (1996b) discussed the reasons for non-compensatory preference structures and discussed the presented welfare implications of lexicographic preferences. Lockwood (1996b) was also the first to refer directly to the economic lexicographic models by Georgescu-Roegen (1954) and Encarnación (1990) in the CV context.
Spash (1997) examined compensation made by the current generation for the benefit of future generations using several statements. Spash (2000) and Spash et al. (2000) reported results on the valuations of coral reef biodiversity. They used several questions to detect lexicographic preferences applying a three-level response scale.

Lockwood (1997) described an integrated value theory for identifying, measuring and aggregating values that human beings place on natural areas. The study launched the idea of using paired comparisons to measure lexicographic preferences. The method used in that study has its roots in the family of methods called choice experiments, which have been used above all to measure marginal values of attributes (Lancaster 1966, McFadden, 1974, Adamowich et al. 1998, Hanley et al. 1998). Lockwood (1998, 1999b) used paired comparisons to construct a preference map with ranking scores to derive the shape of individual demand curves and to reveal lexicographic preferences for the preservation of Leadbeater’s possum and eucalypt forests in the state of Victoria, Australia.

Sælensminde (1999) applied paired comparisons to elicit valuations of urban traffic air pollution and noise and also analyzed lexicographic preferences in respect to dust/dirt, CO₂ emissions, travel price and time and walking time.

Spash (2000) has provided a comprehensive survey of the literature on noncompensatory preferences in CV. He classifies lexicographic preferences into two categories. In the “naïve” lexicographic procedure, commodities are hierarchically ordered from the most important to the least important and the preference is determined only by the most important commodity. The second category is modified lexicographic preferences, which include thresholds, that is, L*-ordering.

van der Pol and Cairns (2001) used discrete choice experiments to estimate time preferences for health and to reveal what they called “dominant preferences”. That means that respondents have made their choice on the basis of a single attribute, and no trade-offs exist. This is exactly the case of lexicographic preferences. Scott (2002) and McIntosh and Ryan (2002) used paired comparisons to analyze whether attributes of health care could be lexicographically preferred.

To sum up, previous studies have implicitly or explicitly assumed a lexicographic threshold model that can be characterized as having a one-to-one utility structure (Georgescu-Roegen 1954, Hayakawa 1978). The contribution of this study is to introduce a many-to-many utility structure into CV and analyse its welfare implications (Rekola 2003). Earlier studies have emphasized the role of commitment to nature rights as a reason for lexicographic preferences. Pouta et al. (2000) and
Rekola et al. (2000) observed that landowners’ private property rights could also be a source of incommensurability. Finally, earlier CV studies have applied two types of the empirical methods to reveal lexicographic preferences: attitude statements and paired comparisons. Rekola (2002) was the first study to compare these methods.

Figure 2 describes the measurement of lexicographic preferences and the theory of $L^*$-ordering, thus summarizing the contribution of this study. The theory of $L^*$-ordering defines inverse demand functions as a function of three elements: thresholds of wants, the WTA/WTP format, and the relationship between goods and wants.

The measurement of lexicographic preferences in CV can be done with paired comparisons and statements. First of all, a CV survey must define a scenario in terms of good, payment, and context. Paired comparisons are directly based on choices, whereas statements are based instead on attitudes measuring reasons for lexicographic preferences. These reasons are subsistence needs, commitments, and ambivalence. To measure lexicographic preferences with paired comparisons one has to design the levels and magnitudes of attributes. When using statements to measure lexicographic preferences the number of dimensions in response scales has to be determined. One should also bear in mind that instruments designed to measure lexicographic preferences are liable to socially desirable responses (SDR).
Figure 2. Theory of L*-ordering and measurement of lexicographic preferences in CV.
2.2 CV applications under uncertainty

Welfare effects of decisions that concern uncertain nonmarket goods have been widely discussed since Weisbrod’s (1964) proposal on option value (Cicchetti and Freeman 1971, Schmalensee 1972, Graham 1981, Bishop 1982). Option price (OP) has been considered to be the most promising measure (see Ready’s (1995) survey).

Several CV studies have dealt with various environmental risks since the late 1980’s. The monetary value of risks of premature death or disease have been assessed by Smith and Desvousges (1987), McDaniels (1992), Savage (1993), Johannesson et al. (1996), Schwab Christe and Soguel (1996), Beattie et al. (1998), and Hammit and Graham (1999). Valuations of the risks caused by wildlife hunting have been studied by Brookshire et al. (1983) and Johansson (1990); while perceptions of risks to air quality have been considered by Crocker and Shogren (1991) and Danielson et al. (1995).

In addition to assessing valuation, CV studies have also measured respondents’ risk perceptions in several ways, especially using so-called risk indexes. Risk indexes reveal how much personal threat or concern respondents feel when considering an issue under uncertainty (Smith et al. 1990, Savage 1993, Loehman et al. 1994, Danielson et al. 1995). These indexes have been proposed in the risk perception literature by psychologists, social psychologists and decision analysts (Wright 1984, Querner 1994). Viscusi and O’Connor (1984) have argued that as risk indexes may reflect not only individual beliefs about subjective probabilities but also severity of the event, they are not proper measures of probabilities.

There are, however, measurements of risk perception that produces pure probabilities. To assess monetary value of atmospheric visibility Crocker and Shogren (1991) applied a fixed interval method and asked respondents to state the percentage chances that they would see their best and least preferred vistas during their visit. In a study measuring the benefits of groundwater protection, Poe and Bishop (1999) used, in principle, the same method when they asked respondents to state the probability that the nitrate level in their well would exceed government standards. Lee et al. (1997) investigated perceived risk of a need to undergo certain medical operations.

A number of studies have compared objective and subjective risk measures and found a persistent difference between them (Payne 1985, Glass and Holyoak 1986,
Meller et al. 1998, Slovic 1995). Smith et al. (1990) proposed that quantitative risk information should be provided to respondents, otherwise their responses to small changes in risks may have artificial thresholds.

The contribution of this study is to apply CV and risk perception to uncertain forest amenities. It seems that Rekola and Pouta (2002) is the first CV study to examine uncertainty in forest amenities due to forest management. To measure risks Rekola and Pouta (2002) the study applied the fractile method (Ferrell 1985, Slovic et al. 1988). The method is apparently a novel risk communication vehicle in CV. The consistency of risk perceptions was also analyzed and some inconsistencies were found, for example, in connection with the so-called law of small numbers.

3 THEORETICAL FRAMEWORK

3.1 Classifications of decision models

It is emphasized here that the neo-classical consumer theory underlying CV is a particular model among several decision models used in economics and psychology. In a CV context, ethical beliefs (Edwards 1986, Stevens et al. 1991, 1993) and essential social and biological functions (Lockwood 1996b) have been suggested to limit the substitutability assumed by consumer theory. Lexicographic preferences were analyzed in this study because they had already been used in a few CV studies and they seemed to have potential for further research.

Table 2 illustrates several ways to classify different decision models and sets up a framework to understand the relationship of lexicographic preferences and neo-classical consumer theory to other decision models (Andrews and Manrai 1988, Lee and Geistfeld 1988, Slovic et al. 1988, p. 719, Lockwood 1996a, 1997). The first classification is based on the existence of trade-offs between attributes (Slovic et al. 1988, Lockwood 1996a, 1997). An attribute provides a scale for measuring the degree to which it satisfies a respective objective (Keeney and Raifa 1976, 32). Alternatives are called weakly comparable when a person can choose between alternatives but is not able to produce a general value ranking (O’Neill 1993, Lockwood 1996a). Compensatory models assume that trade-offs

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9 Hammit and Graham (1999) provide a summary of studies of WTP for risk reduction. They conclude that studies relying on subjective rather than objective probabilities have performed somewhat better regarding sensitivity of WTP to the magnitude of risk change.
exist. For example, a linear additive model sums up the scores of attributes to the total value of an alternative so that a high score on one attribute can offset a low score on another attribute. Noncompensatory models assume that no trade-offs exist. For example, a conjunctive model eliminates any alternative that fails to reach/exceed a criterion value for any attribute (Huber and Klein 1991). An elimination-by-aspect model eliminates an alternative at each stage of the decision-making process that does not include the selected aspect (Tversky 1972). A disconjunctive model selects any alternative that meets at least one of the criteria (Wright 1974). Finally, a lexicographic model selects the alternative that is superior on the most important dimension. If more than one alternative has the same score, then the next most important attribute is considered and so on (Fishburn 1974).

Table 2. Classifications of decision models according to Slovic et al. (1988) and Lockwood (1997, 1996a)

<table>
<thead>
<tr>
<th>Classification</th>
<th>Categories</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classification I</td>
<td>Weakly comparable</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Compensatory</td>
<td>linear additive model</td>
</tr>
<tr>
<td></td>
<td>Noncompensatory</td>
<td>conjunctive, disconjunctive, lexicographic</td>
</tr>
<tr>
<td>Classification II</td>
<td>Intra-alternative</td>
<td>compensatory, conjunctive</td>
</tr>
<tr>
<td></td>
<td>Dimensional rule</td>
<td>lexicographic, disconjunctive</td>
</tr>
<tr>
<td>Classification III</td>
<td>Decision under certainty</td>
<td>neo-classical consumer theory</td>
</tr>
<tr>
<td></td>
<td>Decision under uncertainty</td>
<td>expected utility</td>
</tr>
</tbody>
</table>

The second classification is based on the fact whether decision applies criteria within an alternative (intra-alternative rules) or between alternatives (dimensional rules). The third, frequent way to classify decision models depends on whether the decision making is taking place under certainty or uncertainty. The obvious examples are under certainty neo-classical consumer theory (section 3.2 and 3.3) and under uncertainty the theory of expected utility (section 3.4).
3.2 Axioms of consumer theory

Axioms of consumer theory are defined over bundles of goods, e.g., $x$, $y$, and $z$, in a choice set $X$. The choice set is not restricted, i.e., an individual may construct preferences regarding unattainable bundles or possibilities, whereas an opportunity set or a budget set is restricted by income. The choice set is typically defined on the basis of the bundles of goods but it can, in principle, be described using, for instance, the welfare of other people (Deaton and Muellbauer 1980, Varian 1992):

The symbol $\succeq$ denotes “at least as good as”, called a weak preference. Strict preference, $x \succ y$, is defined to mean not $y \succeq x$. Three axioms for the choice are written as follows:

1. Reflexivity: for any bundle of goods $x$, $x \succeq x$.

2. Completeness: for any two bundles $x$ and $y$, either $x \succeq y$ or $y \succeq x$. If $x \succeq y$ and $y \succeq x$, then $x \approx y$ denotes “$x$ is indifferent to $y$”.

3. Transitivity: for all bundles $x$, $y$, and $z$, if $x \succeq y$ and $z \succeq y$, then $x \succeq z$.

Axioms from 1 to 3 define preference ordering. According to them, all bundles can be arranged in order from the most to the least preferred. A utility function, $u(x)$, is often a convenient way of describing preferences\(^{10}\):

$$u : X \rightarrow \mathbb{R} \mid u(x) \geq u(y) \text{ iff } x \succeq y$$

In order to formulate a utility function, the following three assumptions are needed (Varian 1992, 95, Deaton and Muellbauer 1980, 27, Gravelle and Rees 1992):

4. Non-satiation: a consumption bundle $x$ is preferred to $y$ if $x$ contains more of at least one good and no less of any other.

\(^{10}\)The term ‘utility’ has been used in the literature of ethics, political philosophy, and economics in the number of meanings (see Sen 1991 for a brief summary). Here ‘utility’ is used as in Varian (1992 p. 95): “A utility function is often a very convenient way to describe preferences, but it should not be given any psychological interpretation. The only relevant feature of a utility function is its ordinal character.” Therefore, utility is assumed here to be nothing but a way of describing preferences. However, the basis for the preferences can be ethical or whatever. In this sense, lexicographical preferences are similar to neo-classical preferences. Lexicographic preferences may be motivated by ethical concerns. More specifically, in Study I, sub-utility functions in L*-ordering were labeled as wants. The wants were described to cover all objectives whether they are, for instance, subsistence needs, wants related to self-realization or ethical commitments.
5. Continuity: for any bundle \( x \) in \( X \), the sets \( \{ x \; : \; x \succeq y \} \) and \( \{ x \; : \; x \succeq y \} \) are closed sets, from which it follows that \( \{ x \; : \; x \succ y \} \) and \( \{ x \; : \; x \prec y \} \) are open sets.

Continuity means that a trade-off between goods exists and that in a choice situation an individual is indifferent about which bundle is preferred.

6. Strict convexity: If \( x \succeq y \), then for \( 0 \leq \lambda \leq 1 \), \( \lambda x + (1 - \lambda)y \succeq y \).

All preference orderings do not fulfill axioms 4 to 6. For example, lexicographic preferences satisfy axioms 1 to 4, but they do not fulfill the continuity axiom. Therefore, lexicographic preferences cannot be defined using a utility function. Instead, a vector of utility functions is needed (Hayakawa 1978).

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**Figure 3. Framework of individual choice models**

A summary of decision models and their relationships to the axioms of consumer theory is depicted in Figure 3. All decision models cover every decision model whether they fulfill the axioms of preference orderings or not. A subset of all models are preference orderings, which cover axioms 1 to 3. A subset of preference orderings is consumer theory using utility functions. They fulfill complete all six axioms.
3.3 Consumer surplus measures: certainty

In this section, we define economic welfare change measures of consumer theory (e.g., Deaton and Muellbauer 1980, Varian 1992). These measures construct theoretical concepts behind WTP and WTA in a CV survey. In order to do that we first introduce a direct utility function, ordinary demand functions, and an indirect utility function.

An individual’s preferences for market goods, a vector $x$, and a public good, $q$, can be described by a direct utility function

$$ u = u(x, q). \tag{1} $$

The direct utility function is ordinal. This means that $u$ can be any monotonic transformation that assigns one set of numbers into another set of numbers in a way that preserves the order of the numbers. A utility function is assumed to be increasing in all of its arguments, continuous, convex and twice differentiable.

Utility functions can be presented using indifference curves in a two-commodity space. Let us denote a particular market good with $x_i$. In Figure 4 the x axis shows the amount of good $x_i$ and the y axis the amount of good $q$. The mix of $x_i$ and $q$ that provides the same utility is shown with an indifference curve, $u^0$.

An individual’s choice is constrained by budget or time. Let us assume that the demand for market goods is constrained by income $y=px$, where $p$ is the vector of
prices for market goods. An individual will choose a vector of market goods that maximizes his/her utility. The individual’s utility maximization problem can be written as

$$\text{max } u(x, q) \quad \text{s.t. } y - px \leq 0. \quad (2)$$

If preferences fulfill axioms 1-6, a solution to problem (2) is a set of ordinary demand functions

$$x = x(p, q, y). \quad (3)$$

The solution to (2) with given $p$, $q$ and $y$ can also be written with an indirect utility function by substituting the demand function for $x$ into (1):

$$v = v(p, q, y). \quad (4)$$

This indirect utility function gives maximum utility for the given exogenous parameters, $p$, $q$, and $y$, and therefore it provides a convenient way to define economic, monetary, welfare change measures.

Welfare change measures are illustrated in Figure 5. The x axis shows the amount of a particular market good, $x_i$, which is take to be the *numeraire*. The units of $x_i$ are chosen so that the price of $x_i$ is equal to one. Thus, $x_i$ can be represent income. The y axis shows the amount of environmental good $q$. At the initial stage, the individual’s income is $y$, the amount of $q$ is labeled with $q^0$, and prices of goods with $p^0$. The indirect utility now indicates the *initial* level of utility as follows: $v^0 = v(p^0, q^0, y)$.

This level of utility is shown with Indifference curve $v^0$ in Figure 5. Let us assume a policy that will increase $q$ from $q^0$ to $q^1$. After the increase, an individual’s *final* utility level is $v^1 = v(p^0, q^1, y^0)$, which is shown with the indifference curve $v^1$ in Figure 5. The compensating surplus (CS) is the amount of money that an individual is willing to give up for the increase in $q$ to leave him/her indifferent between the initial and final utility levels. Therefore $CS^{11}$ satisfies the following equation:

$$v^0 = v(p^0, q^0, y) = v(p^0, q^1, y - CS). \quad (5)$$

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11 Compensating surplus and compensating variation are equivalent measures when the rationed good is without price, i.e., we are dealing with a public good (e.g., Freeman 1993,78). The assumption with the compensating surplus and the equivalent surplus is that an individual cannot choose the level of the good.
In the other welfare change measure, with equivalent surplus (ES), the individual will attain the final level of utility. In other words, if income is increased by ES while holding $q$ constant, the individual will achieve the final utility level $u'$. ES is described as follows:

$$v^1 = v(p, q^1, y) = v(p, q^0, y + ES).$$  \hspace{1cm} (6)

The choice between CS and ES is a question of property rights and of the direction of the change in the environmental good (Mitchell and Carson 1989, 30). In the case that the supply of the environmental good is increased, CS assumes that the individual has no right to the increased level of the good but has to pay for it. In contrast, ES assumes that the individual has a right to the increased level of good and is entitled to compensation if that level is not attained.

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12 Other criteria are practicability and path dependence (Johansson 1987, 81-82; Morey 1984, Hanley and Spash 1993).
3.4 Consumer surplus measures: uncertainty

The value of uncertain prospects is defined in terms of (subjective) expected utility (Neumann-Morgenstern 1944, Savage 1954). Under some assumptions, the expected utility function can be expressed as the sum of linear products of probability of events and their outcomes (Hirshleifer and Riley 1992, 14):

$$U(x) = \sum_{s=1}^{S} \pi_s v(c_{ss}),$$

(7)

where $U(x)$ is the expected utility associated with an action $x$, $\pi_s$ is the individual’s perception of the state of the world, $s$, and $v$ is the elementary utility of prospects. A prospect $c_{ss}$ is defined as a consequence of action $x$ in $s$. Risks are attached to an individual’s perceptions of the probabilities of $s$. The states of the world can contain information about ecological variables, such as the weather or the number of endangered species; economic variables, such as prices, or an individual’s income and preferences (Ready 1995). There is no uncertainty in individual’s elementary utility when the state of the world is known. In this respect, function $v$ is an ex post utility function.

Let us assume a non-forest owner who enjoys the amenity values of a particular private forest area. A conservation proposal is made to abandon all cuttings in this area. There is no uncertainty in this individual’s income, $m$, or his/her preferences. However, cuttings without policy remain uncertain because the individual does not know the forest owner’s cutting plans. Let us describe the prospects $c_{ss}$ in (7) with variable $c_{is}$ when the policy is implemented, and $c_{01}$ when policy is not implemented. State of the world, $s$, is denoted simply using two discrete states, $s=0$ “small amount of cuttings” and $s=1$, “high amount of cuttings”. The probabilities, $\pi_s$, are denoted with $\pi$ for the probability of $s=0$, and $(1-\pi)$ for $s=1$. The expected utility of an individual can be written as follows:

$$U(m,x) = \pi v(m,c_{01}) + (1-\pi) v(m,c_{11}).$$

(8)

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13 There is substantial empirical evidence that undermines the validity of the theory of expected utility as a descriptive behavioral model (Kahneman and Tversky 1979, Arrow 1982, Machina 1987, Hirshleifer and Riley 1992). Several alternative models of choice under uncertainty have been proposed, and modifications of the expected utility have been introduced, for example, in the prospect theory by Kahneman and Tversky (1979), the regret theory of Loomes and Sudgen (1982), non-expected utility models by Fishburn (1983), and Kreps-Porteous-Selden (Kreps and Porteous 1978, Selden 1978).
The individual’s WTP for a policy corresponds to a sum of money that leaves him/her indifferent between $s=0$ and $s=1$. Consider a policy that requires citizens to pay a contingent sum of money for its implementation: if $s=0$ occurs, then a payment $g=g_0$, and if $s_1$ occurs, then $g=g_1$. Payment vector $g = (g_0, g_1)$ is called a contingent compensation payment. It is possible to suggest several combinations of payments that keep the individual’s utility at the same level. These payments are called the willingness-to-pay (WTP) locus (Ready 1995):

$$\pi v(m - g_0, c_{00}) + (1 - \pi) v(m - g_1, c_{10}) =$$

$$\pi v(m - g_0, c_{01}) + (1 - \pi) v(m - g_1, c_{11}).$$

(9)

Compensating surplus (CS) under uncertainty can be defined as the maximum amount that an individual would be willing to pay for the policy, i.e. to get $x=1$ rather than $x=0$, given that he/she knows the state of the world. The expected compensating surplus, $E(CS)$, is a probability weighted sum of compensating surpluses over all states of the worlds. It can be defined as follows:

$$E(CS) = \pi CS_0 + (1 - \pi) CS_1.$$  

(10)

Using the WTP locus we can define the option price (OP) as the maximum ex ante WTP such that $g_0 = OP$ and $g_1 = OP$. The option price is therefore the largest sure payment that an individual is willing to pay for the policy before uncertainty is resolved.

The WTP locus, CS, and OP are illustrated in Figure 6. The axes represent the contingent payments $g_0$ and $g_1$. A concave and downward sloping curved line is the WTP locus. If an individual is risk-averse and the marginal utility of income is positive, the WTP locus can be shown to be concave and always downward sloping. The point with the contingent payments $g_0 = CS_0$ and $g_1 = CS_1$ can also be found from the WTP locus. In Figure 6 we draw a line with slope $\pi/(1-\pi)$ through this point. All points on this line have the same expected value. We can measure $E(CS)$ by looking for the point on this line where $g_0 = g_1$. The 45° line from the origin includes all contingent payments where $g_0 = g_1$. Thus $E(CS)$ occurs when the two lines cross. From Figure 6 we can see that the OP is larger than the expected utility.
The difference between OP and E(CS) is, in general, called an option value (OV). It was defined by Cicchetti and Freeman (1971) as follows:

\[ OP = E(CS) + OV. \]  

Figure 6. Willingness-to-pay (WTP) locus.

The size and sign of OV have been subsets important theoretical and empirical discussions (Weisbrod, Schmalensee 1972, Bishop 1982). The answer depends on the source of uncertainty (Ready 1995). If income or preferences involve uncertainty of income, the sign of the option value is indeterminate, whereas if only the supply of the good is uncertain, the option value is always positive. In real-world situations there are typically many sources of uncertainty, and the sign of the option value will typically be indeterminate.
3.5 Models of lexicographic preferences

According to Georgescu-Roegen (1954) Carl Menger (1840-1921) was first to introduce the idea of a lexicographic order of “concrete needs” into economic theory. Georgescu-Roegen (1954) himself introduced the economic lexicographic threshold model. Several variants of lexicographic models have been proposed since the 1950s (Fishburn 1974, Luce 1978, Nakamura 1997). Fishburn (1974) provides an extensive survey of lexicographic orders, utilities and decision rules.

Luce (1978) was the first to suggest a model that combines lexicographic preferences with local value trade-offs. The model was further developed by Fishburn (1980) and Nakamura (1997). Blume (1989) provided an overview of lexicographic choice under uncertainty. The model proposed by Georgescu-Roegen (1954) was termed L*-ordering by Hayakawa (1978) and Encarnación (1990).

In this section we first introduce the simplest, textbook version of lexicographic preferences, followed by a more realistic version called L*-ordering and, finally, by inverse demand functions under L*-ordering.

The simplest, textbook version of lexicographic preferences is called lexicographic ordering or L-ordering (Hayakawa 1978, Deaton and Muellbauer 1980, 27, Gravelle and Rees 1981, 99-101). According to this L-ordering, an individual first orders goods in terms of importance. Then he/she chooses the bundle of goods that contains the greatest amount of the most important good. If several bundles contain the same amount of the most important good, then the second-ranked good is selected and the bundles are ordered based on that, and so on. For example, if we assume that certain words are like goods, alphabetical ordering will give the order of preference “preference” of these words. Words are ordered in a lexicon using this rule, thus the name for the model.

To formally present L-ordering, let us assume bundles of goods $g'$ and $g''$. Furthermore, the goods are ordered so that good 1, $g_1$, is more important than good 2, $g_2$. Assuming only two goods and two bundles, bundle $g'$ is preferred to bundle $g''$ if it contains more $g_1$, no matter what the level of $g_2$. If both bundles contain an equal amount of $g_1$, bundle $g'$ is the choice if it contains more $g_2$. This can be written as follows:

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14 One of the most popular and often cited theories of human motivation by Maslow (1943) conceptualizes a hierarchy of human needs. According to Maslow each lower need must be met before moving to the next higher level. This idea is the same as the rule described with lexicographic preferences.
\[ g'_1 > g''_1 \text{ implies } g' > g'' \]  
\[ g'_1 = g''_1 \text{ and } g'_2 > g''_2 \text{ implies } g' > g'' \].

Figure 7 illustrates L-ordering using two bundles of goods, bundle A and bundle B. Both bundles consist of two goods, \( g_1 \) and \( g_2 \), plotted on axes y and x. If the choice between the bundles is made according to (12), the amount of \( g_1 \) is the first criterion. A is preferred to all bundles below the line through DC, and any bundle above this line is preferred to A. For this reason bundle A is preferred to bundle B.

The lack of indifference curves in L-ordering can also be illustrated with Figure 7. Segment of a line, AC, provides the same amount of good 1 as bundle A, but more of good 2. Therefore, all the bundles along this segment are preferred to A. Using the same criterion, A is preferred to the bundles along segment AD. There is no other bundle besides bundle A itself that provides the same utility. As a result, no indifference curves or utility functions exist, and preferences lack any trade-off between goods.

The textbook version of lexicographic preferences has been criticized for being unrealistic, among other reasons because a choice between bundles can be based

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**Figure 7.** Textbook version of lexicographic preferences
and L*-ordering with a one-to-one relationship between wants and goods.
solely on the amount of a single good (Deaton and Muellbauer 1980). All subsequent goods are thus meaningless attributes in the choice. Certainly, more appealing models of lexicographic preferences exist, such as L*-ordering proposed by Georgescu-Roegen (1954). L*-ordering assumes that individuals’ choices are made according to incommensurable \textit{wants} that are hierarchically ordered from the most to the least important one (Hayakawa 1978, Encarnación 1990). Furthermore, all elements in the hierarchical list of utility attributes have a utility satisfaction threshold denoted by the symbol $^*$. Typically, in L*-ordering there is a difference between goods $g_n$ and wants $i$ so that a bundle of $n$ goods, $g = (g_1, g_2, ..., g_n)$ satisfies a want $i$ with the function $u_i(g)$. The utility of $g$ can be written as a vector of sub-utility functions:

$$u(g) = (u_i(g), u_2(g), ..., u_{m-1}(g), u_m(g), ...) .$$

The choice in L*-ordering can be written as follows:

$$g' \succ g^2 \text{ if and only if there exists a want } j \text{ such that for all } i < j$$

$$\{ \text{either } u_i(g') = u_i(g^2) < u_i^* \text{ or } u_i(g') \geq u_i^* \}$$

and

$$\{ u_j(g^2) < u_j^* , u_j(g') \geq u_j(g^2) \} .$$

(13)

It is the satisfaction property that makes L*-ordering different from the textbook lexicographic model. In contrast to the textbook version, in L*-ordering the most important want is definite only as long as the satisfaction level has not been reached.

Vector $u(g)$ may obey separate utility structures to indicate different relationships between individual goods and wants. The two most extreme structures are presented with a one-to-one utility structure, where only a particular good contributes to the particular want, and with a many-to-many utility structure, where all goods contribute to all wants (Georgescu-Rogen 1954, Hayakawa 1978).

Figure 7 can be used to describe L*-ordering in the case of a one-to-one relationship between wants and goods. The line through AC depicts the function $u_1(g)$ that satisfies want 1, and the line through AG depicts the function $u_2(g)$ satisfying want 2. These lines are now called behavioral curves. Because good 1 contributes only to want 1, and good 2 only to want 2, these curves appear as straight lines. The choice between A and B is again A. Let us assume that A satisfies the first
want precisely, so that no more good 1 is needed. Now, the line through DC describes $u_1^*$, the satisfaction threshold for want 1. Because A exactly satisfies the first want, the goal is then to satisfy the second want. For this reason, not all bundles above the line through DC are necessarily preferred to A.

The line through GA in Figure 7 shows the satisfaction of want 2 by bundle A. Bundle E is not preferred to A because it is left of this line and decreases the satisfaction of want 2. On the other hand, F is preferred to bundles A and E because it provides more satisfaction in respect to the second want. The example shows that the textbook version omits the satisfaction thresholds, but it is otherwise similar to L*-ordering with a one-to-one utility structure.

Although textbook version of lexicographic preferences have no utility functions, they may have demand functions. By definition, in all models of lexicographic preferences, compensated demand and welfare measures cannot exist because no two points represent the same level of utility. Therefore, all WTP amounts in the following represent uncompensated demand.

Figure 7 can also illustrate WTP in a one-to-one relationship. Let as assume that good 1 is a subsistence good measured with income, and that good 2 is an environmental good. Bundle E describes an individual’s endowment. His/her willingness to pay for an increase of the environmental good from E to A is $g_1^E - g_1^A$. In fact, WTP is the same for any increase of the environmental good. We observe an individual’s WTP to be insensitive to the scope of the environmental good.

The many-to-many relationship between wants and goods is illustrated in Figure 8. The idea is that several goods can satisfy a want, and a particular good can satisfy several wants. The shape of the behavioral curves show that both goods contribute to both wants. Although a trade-off between goods regarding a particular want exists, wants are incommensurable. The curve $u_1^*$, for example, indicates that, moving from A to B, the decrease in good 1 can be compensated for by increasing the amount of good 2, keeping the satisfaction of want 1 constant. However, as B provides more satisfaction in respect to want 2, B is now preferred to A.

15 See Gravelle and Rees (1981, 94) for an example of the demand function for a textbook model of lexicographic preferences.
In a many-to-many relationship, WTP functions are different than in a one-to-one relationship. An individual with an endowment, $E$, is willing to pay $Eg_1 - Ag_1$ for an increase of the environmental good from $Eg_2$ to $Ag_2$ (Figure 8). The function $Au_2$ describes the WTP function until point $A$ is reached. From this point forward, the first want is a constraint, and $u_1^*$ defines WTP. In fact, the shape of the WTP function can be very close to the shape of WTP function derived from standard preferences. As a result, the WTP function is sensitive to scope, but preferences are still incommensurable.
4 DATA

4.1 The Natura 2000 Network (Studies II and III)

The Natura 2000 Network, which is the European Union’s nature protection program, is intended to protect natural habitats of wild fauna and flora. The implementation of this program in Finland began in the spring of 1997 with a proposal by the Ministry of Environment. The proposal called for the protection of a total of 3.5 million ha of land (11.9% of the total Finnish land area). These areas were selected on purely biological criteria. Subsequently, in November 1997 Kuuluvainen, Pouta, Rekola, Tahvonen and Li conducted a CV survey together with the environmental impact assessment of the Natura 2000 Network in Finland. The assessment considered the impacts on nature conservation, forestry and socio-economic aspects.

A questionnaire was mailed to a sample of 2400 Finns between the ages of 18 and 70. It consisted of 8 pages, along with a cover letter and a postage-paid envelope (an English translation of the Finnish questionnaire is given in Appendix 1). The questionnaire was tested in a pilot survey in October and then the slightly revised questionnaire was mailed in November 1997. After the first mailing, reminder postcards were sent. No focus group or re-mailing of the questionnaire was possible because of the timing of the environmental impact assessment. The response rate was 45%.

The CV scenario was based on a proposal prepared by the Finnish Ministry of Environment. The change in the baseline protection was described in terms of percentage change in land area, viz. a 3, 6 or 9% increase in the conservation level. To analyze the effect of the policy planning method, two different scenarios were designed. First, nature conservation was associated directly with the Natura 2000 program, which had been criticized as being bureaucratic. Second, the project was introduced within the context of a general question about nature conservation which was described as involving the principles of participatory planning. In both scenarios, payment was to be made through taxes, and the willingness-to-pay question was in a dichotomous choice referendum format.

The survey used attitude statements to measure lexicographic preferences. The lexicographic preferences for nature conservation were measured based on reactions to a five-point statement: “Nature conservation is always more important than increasing income level.” If the respondent agreed with this, he was in general accord with the tenet that income cannot compensate for nature conservation, and he thus reveals lexicographic preferences. Lexicographic preferences for pri-
vate property rights were measured using the statement: “Nature conservation can never be based on compulsory purchase of land even if private landowners are compensated.” Agreement with this statement indicated incommensurability between private property rights and nature conservation.

The survey also measured the degree of the respondent’s confidence in his/her choice, the perceived budget constraint, and attitudes toward nature conservation in general and toward the proposed program in particular. They were all measured with either a five-point Likert-scale or a five-point semantic differential scale.

4.2 Regeneration cuttings in private non-industrial forests (Study IV)

A survey on a national regeneration cutting policy, in particular the preservation of wildlife and decayed trees (DWT) in private forests, was carried out using two different mail questionnaires. The aim was to test empirical measures for lexicographic preferences with the first questionnaire applying paired comparisons and the second applying statements (English-language translations of the Finnish questionnaires are given in Appendices 2.1 and 2.2). To develop the different questionnaires we had discussions with the representatives of stakeholders.16

A total of 1100 Finnish households were sampled from the Finnish Census register. A pilot survey was done in October, and the main survey was carried out in November 1998. A reminder postcard was sent after one week, and a new questionnaire was mailed out two weeks thereafter. The number of responses was 254 (46.2%) for the first and 249 (45.3%) for the second sub-sample.

First, the questionnaire measured beliefs concerning forest regeneration cuttings as well as the frequency of observing cuttings. Next, the regulation and guidance regarding forest regeneration was described and an information leaflet was provided describing three alternative forest regeneration policies with graphical illustrations of cuttings. In addition, some questions were asked to obtain information about respondents’ perceptions of property rights.

The sample was split into two equal sub-samples. In the first sub-sample, the questionnaire was structured in such a way as to categorize respondents into three different endowment categories based on their perceptions of property rights.

16 Comments on the survey design and questionnaire were requested from the representatives of the following organisations: The Central Union of Agricultural Producers and Forest Owners (MTK), The Finnish Environment Institute (SYKE), The Forestry Development Centre (Tapio), The Ministry of agriculture and Forestry, The Ministry of Environment, and WWF.
Three sets of paired comparisons were made separately for these categories. Each set had at least one open-ended WTA or WTP question.

In the second sub-sample, all respondents had the same scenario, and the measurement response data on their perceptions of property rights were taken into account in the analysis stage. The WTP questions were in dichotomous choice and open-ended formats. After that, statements concerning the lexicographic preferences for preservation of DWT and income were presented. Finally, the questionnaires sent to both samples requested information about respondents’ socioeconomic background.

4.3 Regeneration cuttings in the Municipality of Loppi (Study V)

The data used in study V came from Loppi, a small rural municipality with 6,000 inhabitants in southern Finland. The data were collected in two steps. The population of the first survey was comprised of all the residents of the municipality, and those who may have resided elsewhere, but owned a summer cottage in Loppi (Erkkonen 1995). The first survey measured mainly forest-related activities and socioeconomic variables. The sample size of 600 with a response rate of 76% produced 456 observations. After removing respondents above 70 years of age and those who responded incompletely, there were 316 useable observations. Of these, 53 observations were selected at random for a pilot survey testing a CV scenario. There remained 263 (=316-53) individuals for the second survey, which dealt with contingent valuation of forest regeneration cuttings. This CV survey produced 173 responses, with a response rate of 66%.

The sample of 263 was next split into two sub-samples: uncertainty and certainty (English-language translations of the Finnish questionnaires are given in Appendices 3.1 and 3.2). The CV questionnaires were developed based on qualitative results obtained from phone interviews using open-ended questions. The final version, with 12 pages, was tested in face-to-face interviews and a pilot mailing. The CV questionnaires began with questions measuring forest-related activities and attitudes, attitudinal evaluations and beliefs. After this, the scenario was presented (Pouta and Rekola 2001).

In both samples, the forest area, covering 50 ha of old forests potentially to be regenerated, was first described to respondents. Two maps of the area were also included. In addition, a brief description of forest management in general was given.

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17 The idea was to make this study comparable with another study and to maximize the number of respondents with a similar scenario in these studies (Pouta 2003).
In the uncertainty sub-sample, respondents were told that the forests are privately owned, and no information was given about on the future cuttings. After that, the scenario was described using a brief text and referring to the map presented earlier. Respondents were told that a general land use plan regulating only regeneration cuttings, but nothing else, would be implemented. Of the potential cutting area, 30% would be allowed to be felled. Risk perceptions were measured before and after the scenario using the fractile method: respondents’ perceptions of minimum and maximum cuttings were requested. Finally, the willingness-to-pay questions applying dichotomous and open-ended formats were presented.

In the certainty sub-sample respondents were told that on average 50% of the economically mature forests had been regenerated during the last ten years in Loppi municipality and that this would also be the cutting rate in the study area. The policy was described in a similar way as in the uncertainty sub-sample. The exception was that harvesting rate under the policy was described to be exactly 30%, i.e., the maximum allowed. The WTP question was similar to that given to the uncertainty sub-sample.
5 SUMMARY OF THE STUDIES


Earlier CV literature has suggested that some respondents have incommensurable preferences and do not make any trade-off between money and environmental goods. It has been argued that the main reasons for such responses are to be found in ethical considerations or limitations in decision making (Edwards 1986, Stevens et al. 1991). The model of lexicographic preferences, especially L*-ordering, has been proposed to describe the incommensurable preferences (Spash and Hanley 1995, Lockwood 1999b). L*-ordering assumes that individuals’ choices are made according to the incommensurable wants. Each want, such as a subsistence need and a desire for environmental conservation, are hierarchically ordered from the most to the least important.

In this study, L*-ordering is elaborated further in order to study the structure and the existence of inverse demand functions (WTP or WTA). The structure and existence of inverse demand functions are shown to a function of three elements, viz. the relationship between wants and goods, WTA/WTP format and the endowment of the good. The relationship between goods and wants can be either a one-to-one or a many-to-many relationship. The former is relevant when goods are grouped into broad categories, i.e., broadly defined goods, for example a national nature conservation program as an environmental good. The latter define environmental goods narrowly, and in this case fewer LP responses are predicted by the theory, and even compensated inverse demand functions may exist. Study I shows that the WTA format produces more LP responses than the WTP format. This has also been shown in empirical studies. In addition, the lower the endowment level of the good, the more LP responses are given.

An illustration using data from earlier CV studies is provided in support of the theoretical framework. Especially, there is a correlation between broadly defined goods (one-to-one relationship) and high share of CV responses revealing lexicographic preferences.

18 Equation 3, line 4 should read:

> 0, when \( u_e < u_e^*, u_e \geq u_e^* \).
This study analyses the preferences of Finnish households for the Natura 2000 nature conservation program. A dichotomous choice contingent valuation survey, with a sample of 2400 Finns aged from 18 to 70, was conducted in autumn 1997. To gain insight into the controversies of the Natura 2000 program, two tests were designed. First, the effect on the scope of the conservation program on WTP was analyzed using an increase of the conservation area by 3, 6, or 9 per cent. Second, the effect of the institutional context of policy planning on valuation was explored. The conservation program was either directly linked to the Natura 2000 program or described as a revision of a national nature conservation plan without reference to the Natura 2000 program.

Dichotomous choice responses were explained in a logit regression model, and the probability of a person supporting the proposed conservation level depended significantly on income, age, urban-rural background, and the institutional context of policy planning. However, the proposed increase in the size of conservation area had no statistically significant effect on support. To study the influence of attitudes and beliefs, an attitude-behavior framework was applied. The main beliefs explaining positive attitudes toward the proposal were connected with the importance of the flora and fauna, and biotope conservation. On the other hand, the primary belief statements against the program were connected to landowner rights and costs to the national economy.

Responses were further used to estimate WTP for the project at a 3 per cent increase in conservation level. Mean WTP per household was €100 and aggregated benefits for all Finnish households were 230 million € a figure that was found to exceed the costs to the forestry. This study was a part of the environmental impact assessment of the program, and the results were included in the resolution of the Finnish government.

19 All WTP amounts in this study are lump sum payments.
In the literature of contingent valuation, respondents’ commitment to rights-based environmental ethics, in other words absolute nature rights, has frequently been regarded as the main reason for incommensurability (Stevens et al. 1991, Hanley et al. 1995). In addition, the complexity of the choice task has also been proposed as a reason for incommensurability (Opaluch and Segerson 1989, Slovic 1995). In the present study respondents’ commitments to the guaranteeing of private property rights and to absolute nature rights were explored. It has been suggested that incommensurability can be modeled with lexicographic preferences, in particular the model of L*-ordering (Georgescu-Roegen 1954, Fishburn 1975).

Lexicographic preferences were measured with five-point attitude-like statements. It was found that incommensurability was attributable more often to private property rights than to nature rights. The empirical results on perceived choice complexity revealed that respondents having lexicographic preferences for nature rights had based their choice more on ethical judgments, whereas lexicographic preferences for property rights could rather be explained with the complexity of the choice task.

Logit models were estimated to explain the dichotomous WTP question. Incommensurability had significant explanatory power in these models. In specific, lexicographic preferences for nature rights increased the probability of choosing the nature conservation project in dichotomous CV question while lexicographic preferences for property rights decreased that probability. This result, supported by the theory, validated the incommensurability measurement. Study III concludes that individuals’ preferences may include several incommensurable attributes and that it is possible to measure them in a contingent valuation survey.

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20 The introduction of this paper contains the assertion that “to many people, landowners’ rights belong to the category of inviolable rights such as human rights”. This is, first of all, because property rights are among the constitutional rights. An example demonstrating the importance of private property rights is the debate concerning Natura 2000 Network in Finland. The ministry of Environment received almost 15 000 complaints and the issue was one of the main topics in the media (see e.g., Kiijärvi 2002).

This study examined two empirical methods, viz. paired comparisons and statements, that have been used to measure lexicographic preferences in contingent valuation. The model of lexicographic preferences, especially L*-ordering, has been proposed to provide a rigorous model for respondents who indicate incommensurable values and whose responses thus indicate scope insensitivity. The content validity of the methods was analyzed theoretically. For this purpose, some reasons for lexicographic preferences, such as ethical commitments, warm glow, and ambivalence, were examined. From the point of the view of the total number of respondents with LP, the validity of paired comparisons is superior to that of statements because paired comparisons operate directly with respondents’ choices. However, statements can be used to find reasons for lexicographic preferences. It is probable that the reasons for lexicographic preferences correlate with the existence of informed and stable preferences, to which a policy process typically attaches importance (Arrow et al. 1993, Fischhoff & Furby 1988). Therefore, it is also important not only to determine the exact number of respondents with lexicographic preferences, but why they responded as they did.

The first empirical test of different instruments within the same survey, which dealt with decayed and wildlife trees (DWT) in forest regeneration cuttings, showed that both methods produce similar results. Only 1% of the respondents indicated lexicographic preferences for DWT. However, both methods have to be calibrated in terms of response scales. In particular, when measuring statements with Likert scales, one needs to decide on the scale the value where the interpretation of preferences switches from ordinary to lexicographic. When using paired comparisons one needs to decide the number of comparisons and the magnitudes of the good as well.

Private forests provide an exceptional mix of private timber management and public nonmarket benefits in Nordic countries. According to the so-called everyman’s right the general public has access to private lands for recreation. Landowners, however, do not have to take into account the value of recreation, aesthetics or other amenities in their planning. Because private landowners’ forest management planning is not public, the supply of amenities is uncertain. Of all forestry operations regeneration cuttings have, perhaps, the largest effect on forest amenities. To measure the monetary value of these effects, a contingent valuation (CV) survey was carried out. The survey investigated the general public’s willingness to pay (WTP) for a hypothetical land use policy regulating private regeneration cuttings in a particular forest area. Data were collected with postal mail survey from Loppi, a rural municipality in Southern Finland, in 1995.

To test the effects of supply uncertainty, a sample was split into two. In the first sub-sample future cuttings were described without uncertainty, in the second sub-sample no information on future cuttings was given. Instead, respondents’ own perceptions were measured. A risk perception measure, the fractile method, was applied for the first time in a CV study (Ferrell 1985). The results showed some inconsistencies in risk perception. For instance, respondents did not seem to grasp that on a particular site, cutting intensity may vary considerably more than it does on the average. Based on the attitude measurement, regeneration cuttings had only slightly negative impacts on recreation. On the other had, respondents’ WTP for a proposed land use policy was higher when future cuttings were remained uncertain (€ 13.30) compared to the second sub-sample (€ 9.30), where cuttings were described without uncertainty. Based on Jensen’s inequality (Johansson 1987, 166), this indicates that respondents were risk-averse and believed they would be better off if information on forest management plans were available.
6 CONCLUSIONS

The first aim of the thesis was to create a more general model of lexicographic preferences than that used in earlier CV studies. The other aims were mostly empirical. The second aim was to explore whether respondent’s commitment to private property rights and commitment to the claim that natural objects have absolute rights are reasons for lexicographic preferences. The third aim was to analyze the content validity of the two empirical measures for lexicographic preferences. The fourth aim of the thesis was related to uncertainty: to analyze people’s perceptions of and risk attitudes toward future regeneration cuttings.

The theoretical contribution of the thesis was to introduce the general model of lexicographic preferences, L*-ordering, considering two different utility structures. Utility structure 1 assumes that a particular good satisfies only a particular want, and that a want can be satisfied only by a particular good. This one-to-one relationship between wants and goods, implicitly assumed in earlier CV literature, indicates non-existing or scope-insensitive WTA/WTP functions.

Assuming the second utility structure, namely a many-to-many relationship between goods and wants, individuals have incommensurable wants or values, however they may have several ways to satisfy a particular want. People may consider that although nature conservation and personal consumption of market goods cannot in general compensate each other, market goods can be used to satisfy a want for environmental conservation to a certain extent, and vice versa. A marginal WTP function, according to utility structure 2, could be smooth and downward sloping, and thus be similar to a function from standard preferences to the extent that satisfaction thresholds of wants are not met.

The WTP (or WTA) measures from both utility structures, however, do not, according to a proper Hicksian inverse demand function, measure economic welfare changes. This is because, by definition, an individual with lexicographic preferences is never indifferent to both of two alternatives. Instead, a respondent’s WTP leaves him/her better off but increasing this WTP by 1% makes him/her worse off. Empirical estimation of WTP typically has standard errors such as 5%. In this respect, it is not a problem that someone having lexicographic preferences cannot announce WTP indicating exactly the “Hicksian indifference”. Therefore, WTP estimates emerging from lexicographic preferences do not exclude the usage of the Pareto criterion and cost-benefit analysis. The earlier literature has proposed
that incommensurability induces protest responses in a CV survey. This proposition should be analyzed theoretically in the future.

Moreover, the very interpretation of WTP, based on lexicographic preferences, depends on the reasons for incommensurability. First, if subsistence needs are concerned, one-to-one and many-to-many utility structures are possible. As far as an individual is here assumed to maximize his/her personal utility, WTP can be interpreted as above.

A second reason for incommensurability, ethical commitment (Sen 1977), is based on an individual choosing against his/her personal welfare, so that WTA/WTP have no meaning as welfare change measures. In this case, an individual perceives some ethical rules as strict constraints that he/she has to obey. Ethical preferences are a problem in welfare economics in general and their difficulty is not limited to contingent valuation.

Impure altruism as a third potential reason is argued in this thesis to be a reason only for scope insensitivity not for incommensurability. Now, an action of paying for a nonmarket good, i.e., doing good, provides utility, a warm glow, no matter what the exact target. The warm glow, however, as a source of utility is commensurable with utility from other sources and therefore does not indicate incommensurability in preferences. Impure altruism is certainly a problem in public environmental policy because people are not interested in the environmental good itself but in “purchasing moral satisfaction”. The scope insensitivity problem and lexicographic preferences have been quite distinct research subjects so far but they could be analyzed together in the future.

The fourth reason for incommensurability, namely ambivalence, has several policy implications. Here, an individual meets tradeoffs among characteristics that cannot be easily compared and has a cognitive inability to make a decision. The interpretation of ambivalence can be very close to ethical commitments. Instead of applying compensatory rules, an ambivalent individual applies lexicographic preferences as a “thumb of rule”, for example the rights of species is set in first place prior to income. To the extent that this thumb of rule is based on unstable, labile considerations there is a doubt whether these preferences should be taken as seriously in policy making as preferences motivated by ethical commitments. The challenge in future research will be to separate various reasons for lexicographic preferences theoretically and especially empirically.

In an empirical CV survey of this thesis, it was found with respect to the Nature 2000 Network that private property rights were a reason for lexicographic
preferences, even more frequently than nature rights. This is in contrast to earlier literature, where people’s ethical beliefs in nature rights have been stressed. However, private property rights could be explained more often than nature rights with an ambivalent preference construction. It is concluded that several reasons for incommensurability may exist, and they have to be explored case-specifically. In this sense, decision confidence as a measure for ambivalence seems to be useful.

This study found that the empirical measurements of lexicographic preferences, paired comparisons and attitude statements, can produce similar results. Paired comparisons are in general more content valid than statements, but only statements can be used to reveal reasons for lexicographic preferences. Empirical measures for lexicographic preferences have, in principle, assumed a one-to-one utility structure. The need to explore the implications of this assumption seems evident.

The fourth aim of the thesis was to examine uncertainty related to forest cuttings in private lands. Risk perceptions of cuttings were measured with a new method in CV. The results indicated some inconsistencies in risk perceptions. To certain extent, they could be due to well-known limitations in the ability to process risk information and may not necessarily indicate any weakness in the method itself. The WTP results demonstrated that people would be better off if information about cuttings were provided beforehand. The data of the study came from a rural municipality. Uncertainty regarding forest amenities could well be analyzed close to urban areas, as well. It is concluded that CV research on several nonmarket goods should explicitly analyze uncertainty and include it in a CV scenario in order to improve the realism of the survey.
REFERENCES


SELOSTE

Johdanto

Metsien- ja ympäristönsuojelua voidaan tarkastella taloustieteessä julkishyödykkeen käsitteen avulla. Julkishyödykkeellä (public good) ymmärretään sellaista aineellista tai aineetonta hyödykettä, jonka käyttöä ei voida rajoittaa (poissulkemattomuus, non-excludability) ja jonka kulutus ei vähennä hyödykkeen tarjontaa (kilpailemattomuus, non-rivalness). Hyvänä esimerkkinä tästä teoreettisesta käsitteestä voidaan pitää luonnon monimuotoisuutta eli biodiversiteettiä, jonka säilyminen on nykyisin luonnonsuojelun päättävä. Valtaosa biodiversiteetin hyödyistä on ilmeisesti niin sanottu olemassaoloarvoa (existence value) — pelkkä tietoisuus siitä, että monimuotoisuutta on suojeltu, on useille ihmisille arvokasta. Tämän tietoisuuden arvoa ei puolestaan vähennä se, että muutkin kokevat samoin.


Talouskenteen osin viime vuosikymmenenä kehitetty julkishyödykkeiden arvottamismenetelmä. Näistä yleisimmin käytetty on kysely- ja haastattelutekniikoita hyödyntävä ehdollisen arvottamisen (contingent valuation, CV) menelemä. CV-kyselyssä vastaajalle esitetään markkina- tai äänestystilanne, jonka jälkeen selvitetään hänen halukkuuttaan maksaa (willingness-to-pay, WTP) tietyillä kyselyysä hänelle kuvatuilla ehdoiilla (contingent) tapahtuvasta julkishyödykkeen määrän lisäämisestä. Vaihtoehtoisesti voidaan selvittää hänen halukkuutensa...
hyväksyvä kompensaatiota (willingness-to-accept, WTA) julkishyödykkeen määrän vähennemisestä.

Yksi CV-menetelmän käyttöön liitetty ongelma on se, että ihmiset eivät välttämättä pysty arvottamaan kaikkia julkishyödykkeeseen liittyviä seikoja rahamääräisesti. Erää tietyn suojelun piirteet, kuten jonkin eliölajin säilyminen, ja omat tukot voidaan kokea keskenään yhteismitattomiksi, mikä on vastoin taloustieteen vakio-oletuksia. Yleisesti ottaen yhteismitattomuudella tarkoitetaan tilannetta, jossa käsitä olevia asioita ei voida mitata samalla asteikolla. Taloustieteessä ja psykologiassa on kehitetty useita malleja kuvaamaan yhteismitattomuutta päätöksenteossa. Näistä on CV-tutkimuksen yhteydessä käsitelty erityisesti leksikografisten (lexicographic) preferenssien mallia.


tōksi näiden julkishyödykkeiden tarjonnasta siltä osin kun heidän metsänkäsittelynsä vaikuttaa niihin. Tämän seurauksena yksityismetsien tarjoamat julkishyödykkeet ovat ei-metsänomistajille epävarmoja, mikä myös mutkistaa niiden ehdollista arvottamista.

**Tutkimuksen tavoitteet**

Tutkimus käsittelee yhteismitattomuutta kansalaisten luonnonsuojelua ja erityisesti metsien suojelua koskevissa preferensseissä sekä metsien julkishyödykkeiden tarjonnan epävarmuutta ehdollisessa arvottamisessa. Tutkimus koostuu viidestä osajulkaisusta joiden tavoitteet ovat seuraavat.

1. Luodaan aikaisempaa CV-kirjallisuutta yleisempi leksikografisten preferenssien malli. Analysoidaan käänteisten kysyntäfunktioiden olemassaoloa ja rakennetta sekä havainnollistetaan tutkimuksen mallia käyttäen aiempien tutkimuksen tuloksia (osajulkaisu I).


3. Analysoidaan leksikografisten preferenssien empiriseen mittaamiseen käytettyjen menetelmien validisuutta. Menetelmän, pareittaisia vertailuja ja asenneväättämiä, testataan kyselyssä, jonka aiheena on säästöpuiden jättäminen uudistushakkuuissa (osajulkaisu IV).

4. Analysoidaan ihmisten riskihavaintoja ja -asenteita liittyen yksityismetsien uudistushakkuuksiin epävarmuuden vallitessa sekä halukkuutta maksaa hakuuiden säätelystä. Aineisto koostuu tapaustutkimuksesta Lopelta eteläisestä Hämeestä (osajulkaisu V)

Tavoitteet voidaan tiivistää seuraavasti. Teoreettiisena tavoitteena on analysoida yhteismitattomuuden käsitettä leksikografisten preferenssien avulla. Empirisenä tavoitteena on kehittää CV-tutkimuksessa leksikografisten preferenssien mittaamista ja tarjonnaltaan epävarmojen ympäristöhyödykkeiden arvottamista.

**Leksikografiset preferenssit**

Leksikografisista preferensseistä on useita erilaisia malleja ja käytännön sovelluksia. Käytännön esimerkkeinä sanakirja ja aakkosjärjestys; ”leksikografinen” tarkoittaa sanankirjaan liittyvää seikkaa. Sanakirjassa sanat järjestetään siten, että


Tutkimuksessa (osajulkaisu I) määritellään monenkeskisen version käänteisten kysyntäfunktioiden (maksuhalukkuuden ja kompensaatiohyvänvääntöyhtälöiden) olemassaolon ja rakenteiden ehtoja. Näitä ehtoja on kolme: 1) tarpeiden ja hyödykkeiden välinen suhde 2) arvottamismuoto (WTA tai WTP) ja 3) alkuvarallisuus (endowment).
Suomalaisten Natura 2000 arvostuksista


Leksikografisten preferenssien mittaamismenetelmät


Pareittaisten vertailujen todetaan olevan pätevämpi mittaustapa erityisesti leksikografisten vastaajien määriin arvioimiseen, koska pareittaiset vertailut hyödynnävät suoraan vastaajan tekemiä valintoja. Väittämät puolestaan mahdollistavat leksikografisten preferenssien syiden tutkimisen. Molempien menetelmien mukaan noin yhdeksä prosentilla vastaajista oli leksikografiset preferenssit...
säästöpuiden suhteen. Tämän perusteella voidaan päätellä, että säästöpuut nähdään etupäässä teknisluonteisena menetelmänä, jolla ei ole arvoa sinänsä. Sen sijaan tulojen suhteen menetelmät antoivat tilastollisesti erilaisia tuloksia, väittämien noin 6 prosentista pareittaisten vertailujen 20 prosenttiin.

Epävarmuus yksityismetsien uudistushakkuissa

Johtopäätökset
Tämän tutkimuksen teoreettisena tuloksena on aiempia CV-tutkimuksiin verrattuna yleisempi leksikografisten preferenssien malli. Mallin tarkastelustaan voidaan yleistää todeta, että leksikografiset preferenssit eivät välttämättä tee maksuhalukkuusluvuista käyttökelvottomia hyöty-kustannus –analyysissä, vaikka nämä luvut eivät täsmällisesti ottaen vastaakaan hyvinvoinnin muutosten taloudellisia mittoja.

Sitoimus yksityisten omistusoikeuksien loukkaamattomuuteen ja luonnonsuojelun sekä oman minimitoimeentulon turvaamisen näyttävät nousevan yleisimmiksi leksikografisten preferenssien lähteiksi Natura 2000 ohjelmaa ja säästöpuiden jättämistä koskevissa kyselyissä. Leksikografisten preferenssien mitattaamiseen käytetyt menetelmät, pareittaiset vertailut ja asenneväittämät, pystyvät tuottamaan samanlaisia tuloksia. Voidaan
todeta, että molemilla menetelmillä on kuitenkin omat etunsa, joita toisella menetelmällä ei voida saavuttaa.

Yksityismetsien uudistushakkuihin liittyvän epävarmuuden osalta voidaan päätellä, että vastaajat olivat valmiita maksamaan hakkuiden säätelystä enemmän, jos myös hakkuihin liittyvää epävarmuutta voitiin pienentää. Toisin sanoen eimetsänomistajat hyötyisivät siitä, että hakuusuunnitelmista voisi saada etukäteistietoa.
Appendix 1. English translation of the Finnish questionnaire for studies II and III.

Nature conservation in Finland
- what is your opinion?

Depart of Forest Economics
University of Helsinki
November 1997

Map: Finnish Environment Institute

1. **First some questions concerning your nature related leisure activities.**

Do you read literature concerning nature?  
- Never  
- Sometimes  
- Often

Do you read magazines or articles concerning nature?  
- Never  
- Sometimes  
- Often

Do you watch nature programs on TV or radio?  
- Never  
- Sometimes  
- Often

Do you spend your leisure time in natural settings?  
- Never  
- Sometimes  
- Often

Does your work take you out into nature?  
- Never  
- Sometimes  
- Often

2. **Consider if you fully agree, agree, disagree or fully disagree with following statements.**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nature conservation has already been taken care of well enough in Finland.</td>
<td>strongly agree</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Profound changes in life style are needed to save nature for future generations.</td>
<td>strongly agree</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Pristine nature should be protected even at high cost.</td>
<td>strongly agree</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Nature conservation is needed even if it causes unemployment.</td>
<td>strongly agree</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Nature conservation allows society regulate private land use.</td>
<td>strongly agree</td>
<td></td>
</tr>
</tbody>
</table>
Nature conservation in Finland 1997
-the total nature conservation area is 11.3 % of land area

The following concerns the Natura 2000 nature conservation program.

3. How familiar are you with the NATURA 2000 nature conservation program?

1  not at all, turn to the following page.
2  only slightly familiar
3  quite familiar
4  very familiar

4. Evaluate the following statements; are they true or false?

<table>
<thead>
<tr>
<th></th>
<th>True</th>
<th>False</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
BASIC INFORMATION ON NATURA 2000

The aim of Natura 2000 is to protect typical and important biotopes and bird species in the European Union. The program follows an international agreement on protecting biodiversity, endorsed in Rio de Janeiro in 1992.

The planning and implementation of Natura is based on the EU directives. There are almost 200 important biotopes in Europe, 50 of which exist in Finland. Examples are old growth forests, minerotrophic bogs, balsa marshes and rich fens, and different biotopes on the coastline of the Baltic sea. Of the 200 bird species considered as important, 60 are found in Finland. These include the diver, crane, white-backed woodpecker and great grey owl.

Local environment agencies have proposed protection areas according to EU guidelines. The Ministry of the Environment has created a tentative national Natura 2000 program based on theses proposals. The proposal is on display in municipalities from April to June of this year. The proposal has resulted in claims and comments that suggest both increasing and decreasing conservation areas.

The Natura 2000 program does not seem to have a big impact on Finnish nature conservation. In the preliminary proposal, about 95% of the areas are composed of nature conservation areas that were founded previously. The Natura 2000 program does not create new restrictions in existing conservation areas. The basic principle is that only land use that endangers protected biotopes is restricted. For example, forestry is not restricted on protected eskers, but extraction of soil resources is forbidden. Such restrictions exist already in areas of previous conservation programs; thus Natura 2000 does not create new restrictions.

Two thirds of the new areas are on private lands. However, the majority of these areas can be used as before. Land owners will be compensated for any new restrictions of the Natura program according to the Nature Conservation Act. In some cases land use is supervised using other regulations such as the Water Act. In these cases restrictions are usually on a small-scale and not compensated.

It should be taken into account that Natura does not prohibit projects of public interest, if no alternatives for them exist. In these cases the power to make decisions remains in Finland.

The Government will deal with Natura 2000 during autumn 1997. After that the Finnish proposal will be delivered to the EU commission.

5. What is your opinion about the Natura 2000 nature conservation program?

<table>
<thead>
<tr>
<th>The Natura 2000 program as a whole is</th>
<th>necessary</th>
<th>positive</th>
<th>negative</th>
<th>worthless</th>
<th>objectionable</th>
</tr>
</thead>
<tbody>
<tr>
<td>(one mark per row)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6. Please evaluate how important you consider the following issues related to the Natura 2000-program.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Importance Options</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Considering landowner rights</td>
<td>of no significance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conserving animal and plant species is</td>
<td>of no significance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compensating economic loss to private landowners is</td>
<td>of no significance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conservation of biotopes like eskers and swamps is</td>
<td>of no significance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taking into account the costs of conservation to national economy is</td>
<td>of no significance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Following EU-regulations is</td>
<td>of no significance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Informing the public when planning new conservation programs is</td>
<td>of no significance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. Evaluate the Natura nature conservation program with the help of the following statements. Even though you may feel that you are not knowledgeable enough about the issue, respond according to your own perception.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Response Options</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Natura nature conservation program takes land owners’ rights well into account.</td>
<td>agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natura conserves animal and plant species well.</td>
<td>agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natura does not cause considerable economic loss to land owners.</td>
<td>agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natura conserves biotopes well.</td>
<td>agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natura causes considerable costs to the national economy.</td>
<td>agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>By implementing the program Finland follows EU-regulation.</td>
<td>agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Informing the public is taken well into account in planning Natura.</td>
<td>agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
NATURA 2000 PROPOSAL

The Natura 2000 nature conservation program is now being prepared. Several alternatives are to be evaluated.

In the following we ask you to familiarize yourself with two alternatives to the implementation of the Natura 2000 nature conservation program in Finland:

<table>
<thead>
<tr>
<th></th>
<th>Option 1</th>
<th>Option 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nature conservation area</strong></td>
<td>same as current area</td>
<td>6% larger than current area</td>
</tr>
<tr>
<td>% of the land area of Finland</td>
<td>11.3 %</td>
<td>11.9 %</td>
</tr>
<tr>
<td><strong>Conserved nature types</strong></td>
<td>Currently conserved: swamps, lake shores, bird wetlands, eskers, wilderness, old-growth forests, groves</td>
<td>In addition to option 1: rich fens, springs, lakes, rivers, river deltas, sea shores</td>
</tr>
<tr>
<td><strong>Change in the income tax of your household</strong></td>
<td>No change</td>
<td>340 FIM increase in income tax</td>
</tr>
</tbody>
</table>

Your opinion is important

The expenses of option two consist of the compensations paid for land expropriated to create new conservation areas. Compensations are assumed to be funded by taxes collected for the year 1998.

8. Please choose which of the previous alternatives you support.

I support option number __________
9. Do you agree or disagree with the following statements.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>agree</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>It was difficult to compare the pros and cons of the program.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I am certain about my opinion of the Natura-program.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>It was very difficult to compare the alternatives.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>It is always important to compare costs and benefits when the level of nature conservation is under decision.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Nature conservation may never be based on compulsory purchase of land even if the landowners were compensated.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>The nature conservation project (Natura 2000) has no meaning for me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Costs and benefits of nature conservation cannot be compared.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Increasing income level is always more important than nature conservation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>I do not have enough money for nature conservation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Nature conservation is always more important than increasing income level.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Finally some questions on your background.

10. Year of birth? _________

11. Are you

- [ ] male
- [ ] female

12. What is your all-round education? Have you graduated from:

- [ ] high school
- [ ] elementary school
- [ ] lower elementary school
- [ ] none of the previous

13. What is your professional education. Have you graduated from

- [ ] vocational school
- [ ] vocational college
- [ ] college
- [ ] university
- [ ] none of the previous
14. Are you working in the field of
☐ forestry or timber industry
☐ environmental conservation
☐ another field

15. Which of the following best describes your living environment?
☐ urban area
☐ suburb
☐ rural municipality center
☐ other rural population center
☐ sparsely populated area
☐ I do not know

16. Household income before taxation?
☐ under 50 000 FIM/year
☐ 50 000-100 000 FIM/year
☐ 100 000-150 000 FIM/year
☐ 150 000-200 000 FIM/year
☐ 200 000-250 000 FIM/year
☐ 250 000-300 000 FIM/year
☐ 300 000-350 000 FIM/year
☐ 350 000-400 000 FIM/year
☐ over 400 000 FIM/year

17. Number of household members? _________ persons, of whom ________ are under 18 year of age.

18. Do you or your close relative own more than over 5 ha of forest land?
☐ Yes ☐ No

19. If you or your family members own land, are there any nature conservation reservations on your land?
☐ Yes ☐ No ☐ I do not know

20. Date: __________ 1997

If you have questions or comments related to nature conservation you can write them here.

________________________________________________________________________

________________________________________________________________________

Thank you for your time.
Appendix 2.1. English translation of the Finnish questionnaire for Study IV. Sub-sample of attitude statements.

*Forest management in Finland*

*What is your opinion?*

*Department of Forest Economics*

*University of Finland*

1998
1. **How often have you been out in forests during the last month?**

1. □ daily
2. □ several times per week
3. □ about once a week
4. □ several times a month
5. □ I have not been there during the last month

2. **Which of the following things have you done at least once during the last 12 months?**

1. □ walked in a forest
2. □ picked berries
3. □ picked mushrooms
4. □ fished
5. □ hunted
6. □ hiked
7. □ camped
8. □ worked in the forest during my leisure time
9. □ worked in my own forest for income
10. □ driven frequently (by car) in forest areas
11. □ been in a forest because of my work
12. □ I live close to a forest
13. □ my summer residence is close to a forest
14. □ I have obtained information about forest issues from the media
15. □ I have discussed forest issues with other people
16. □ I have not been a forest at all
FOREST REGENERATION

The next part of the survey deals with cuttings that regenerate forests. Forests to be regenerated are rather old and the timber growth has slowed as they have aged. Forest regeneration consists of regeneration cutting and growing of new plants.

Regeneration cuttings in a particular site removes all or the majority of trees. After that a new generation of trees is allowed to grow. The soil is frequently prepared. Some seedling trees can be left in the area for a couple of years so that plants will germinate from their seeds. It is also possible to plant seedlings or seed the area.

Of the forests in Finland, less than 1% are regenerated annually. A forest owner decides to do regeneration cuttings in order to sell raw wood to the forest industry. Of the industrial raw wood, around three fourths is obtained from regeneration cuttings.

Before the growth of new stands the regeneration areas are seen as open spaces, where waste wood, crowns and branches can be found. Forest regeneration affects landscape, ground- and surface water, as well as flora and fauna. The environmental effects of regeneration cuttings depend on, for instance, the wildlife and decayed trees left in the area.
3. Evaluate the following statements. (one mark per row)

<table>
<thead>
<tr>
<th></th>
<th>Statement</th>
<th>Agreement Level</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Forest regeneration reduces scenic beauty.</td>
<td>fully disagree</td>
<td>7 6 5 4 3 2 1 fully agree</td>
</tr>
<tr>
<td>2</td>
<td>Forest regeneration guarantees future growth.</td>
<td>fully disagree</td>
<td>7 6 5 4 3 2 1 fully agree</td>
</tr>
<tr>
<td>3</td>
<td>Forest regeneration diminishes fauna diversity.</td>
<td>fully disagree</td>
<td>7 6 5 4 3 2 1 fully agree</td>
</tr>
<tr>
<td>4</td>
<td>Forest regeneration diminishes flora diversity.</td>
<td>fully disagree</td>
<td>7 6 5 4 3 2 1 fully agree</td>
</tr>
<tr>
<td>5</td>
<td>Forest regeneration hinders hiking in the forest.</td>
<td>fully disagree</td>
<td>7 6 5 4 3 2 1 fully agree</td>
</tr>
<tr>
<td>6</td>
<td>Forest regeneration is economically efficient.</td>
<td>fully disagree</td>
<td>7 6 5 4 3 2 1 fully agree</td>
</tr>
<tr>
<td>7</td>
<td>Forest regeneration cuttings that I have seen have emerged unexpectedly</td>
<td>fully disagree</td>
<td>7 6 5 4 3 2 1 fully as expected</td>
</tr>
<tr>
<td>8</td>
<td>Forest regeneration cutting as currently practiced is detrimental</td>
<td>detrimental</td>
<td>7 6 5 4 3 2 1 very beneficial</td>
</tr>
</tbody>
</table>

4. How often do you see forest regeneration areas?

1. daily or several times a week
2. several times a month
3. several times a year
4. almost never
REGULATION AND INSTRUCTION IN FOREST REGENERATION

This questionnaire regards only regeneration cuttings in private forests. About 65% of the forest area in Finland belongs to private forest owners. On private forest lands the landowner makes the decisions on forest regeneration. Other citizens, purchasers of forest products, public authorities and civic organizations also propose various objectives for forest regeneration.

Objectives related to forest regeneration include:

- Timber production
- Nature conservation
- Consideration of forest scenery
- Suitability of forests for outdoor recreation

For the purpose of reconciling these objectives, regeneration of private forests are guided by recommendations, financial support and legislation. In recent years guidance and regulation have especially promoted biodiversity. However, currently the consideration of forest conservation and forest scenery is mostly voluntary; only conservation of valuable biodiversity sites is regulated by law.

In evaluating the regulation of forest regeneration it is important to know citizens’ opinions on

- whether forest regeneration should be developed in a more environmentally oriented direction
- how much public funds could be used to finance environmentally oriented forestry

ALTERNATIVES OF FOREST REGENERATION CUTTINGS

The info sheet enclosed presents three alternatives of forest regeneration cutting. In the following pages you are asked to evaluate the alternatives. You may have the info sheet available when answering the questions.

Please, read the info sheet next!
5. Evaluate alternatives A, B, and C from the nature conservation and forestry point of view using the school grades from 4 to 10.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>How favorable are the alternatives from the nature, conservation point of view? Please grade.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>A.</td>
</tr>
<tr>
<td>2</td>
<td>B.</td>
</tr>
<tr>
<td>3</td>
<td>C.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alternative</th>
<th>How favorable are the alternatives from the forestry point of view? Please grade.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>A.</td>
</tr>
<tr>
<td>5</td>
<td>B.</td>
</tr>
<tr>
<td>6</td>
<td>C.</td>
</tr>
</tbody>
</table>

6. Forest owners and authorities could, if needed, implement forest regeneration in several ways. Let us assume that no public financing is used for the implementation nor it will have any effect on your household’s income or timber sales. Please compare the following pairs of alternatives and choose the one you prefer.

<table>
<thead>
<tr>
<th>I prefer</th>
<th>A.</th>
<th>B.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
**COMPARISON OF FOREST REGENERATION ALTERNATIVES**

In each occasion, forest policy can regulate forest regeneration practices and forestry subsidies in the best ways. There are several alternative policy directions. In the following, two alternatives, to be implemented in all private forests, are assumed.

*Alternative B* would be implemented by maintaining the current recommendations and law.

*Alternative C* would be implemented with laws and binding regulations. This would result in income loses to forest owners, that would be compensated using tax funds from the extra taxes on households. The change in taxation would be permanent, in every year following this point forward.

7. Compare the following alternatives and choose the one you prefer.

<table>
<thead>
<tr>
<th></th>
<th>B.</th>
<th>C.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>your taxes will <strong>not change</strong></td>
<td>your annual taxes will <strong>increase</strong> FIM 100</td>
</tr>
<tr>
<td>I prefer</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

8. Above, the tax increase was FIM 100. How much could the increase of taxes for your household be at maximum so that you will still prefer alternative C?

FIM __________

9. If alternative C would *not* have caused costs to your household, would you have preferred it?

☐ yes

☐ no
DIVISION OF COSTS FROM FOREST REGENERATION CUTTINGS

Let us assume that cutting practices would be changed from the present practice B to alternative C. This will cause forest owners to lose income. Therefore, the change would not necessarily be implemented as a voluntarily action.

10. Do you agree or disagree with the following statement.

<p>| | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Forest owners will change cutting practices voluntarily because only the timber grown in an environmentally friendly way can be sold.</td>
<td>fully disagree</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>In my opinion, the present practice (alternative B) has already caused losses, such as costs to forest owners, that should have been compensated.</td>
<td>fully disagree</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

11. How should the taxpayers and forest owners share the costs, in your opinion, if the present practice B is replaced by alternative C.

<table>
<thead>
<tr>
<th>Forest owners’ share should be:</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 10 20 30 40 50 60 70 80 90 100</td>
<td></td>
</tr>
<tr>
<td>Taxpayers pay all</td>
<td></td>
</tr>
<tr>
<td>Forest owners pay all.</td>
<td></td>
</tr>
</tbody>
</table>
12. Do you agree or disagree with the following statements?

<table>
<thead>
<tr>
<th></th>
<th>The implementation of alternative C is <strong>always</strong> more important for me than an increase in my income level.</th>
<th>fully</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>fully disagree</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Environmental benefits related to forest regeneration cuttings and monetary expenses cannot be compared at all.</td>
<td>fully</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>fully disagree</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>agree</td>
</tr>
<tr>
<td>3</td>
<td>An increase in my income is <strong>always</strong> more important for me than the implementation of alternative C.</td>
<td>fully</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>fully disagree</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>agree</td>
</tr>
<tr>
<td>4</td>
<td>Environmental benefits related to forest regeneration cuttings and monetary expenses cannot be compared at all.</td>
<td>fully</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>fully disagree</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>agree</td>
</tr>
<tr>
<td>5</td>
<td>I cannot afford to pay for the implementation of alternative C.</td>
<td>fully</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>fully disagree</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>agree</td>
</tr>
<tr>
<td>6</td>
<td>I am satisfied with current forest regeneration practice.</td>
<td>fully</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>fully disagree</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>agree</td>
</tr>
<tr>
<td>7</td>
<td>Forest regeneration cuttings are insignificant to me.</td>
<td>fully</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>fully disagree</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>agree</td>
</tr>
<tr>
<td>8</td>
<td>To decide regeneration cuttings it is always important to weight costs and benefits.</td>
<td>fully</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>fully disagree</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>agree</td>
</tr>
</tbody>
</table>
13. Gender

1  ☐  female  
2  ☐   male

14. Year of birth? __________

15. Education

1  ☐  lower elementary school
2  ☐   elementary school  
3  ☐   vocational school  
4  ☐   high school  
5  ☐   vocational college  
6  ☐   college or university  
7  ☐   other education

16. Occupation (Pensioners and previous occupation of unemployed)

1  ☐   Farmer   
2  ☐   Entrepreneur  
3  ☐   Upper-level employee  
4  ☐   Lower-level employee  
5  ☐   Manual worker  
6  ☐   Other occupation

17. Are you currently employed?

1  ☐   Yes  
2  ☐   No

18. What is your field of occupation?

1  ☐   forestry or timber industry  
2  ☐   field related to environmental conservation  
3  ☐   another field

19. Household income before taxation?

1  ☐   under 50 000 FIM/year  
2  ☐   50 000-100 000 FIM/year  
3  ☐   100 000-150 000 FIM/year  
4  ☐   150 000-200 000 FIM/year  
5  ☐   200 000-250 000 FIM/year  
6  ☐   250 000-300 000 FIM/year  
7  ☐   300 000-350 000 FIM/year  
8  ☐   350 000-400 000 FIM/year  
9  ☐   over 400 000 FIM/year
20. Number of household members?

__________ persons, of whom _________ are under 18 year of age

21. What is your living environment?

1  ☐ rural center
2  ☐ sparsely populated area
3  ☐ city or town

22. What province do you live in?

1  ☐ Province of Southern Finland
2  ☐ Province of Western Finland
3  ☐ Province of Eastern Finland
4  ☐ Province of Oulu
5  ☐ Province of Lapland

23. Do you belong to any environmental organization?

1  ☐ Yes
2  ☐ No

24. Do you or any of your household members own forest (land area over 5 ha)?

1  ☐ Yes, about _____ ha, (if joint ownership, the share of your household)
2  ☐ No, skip the following question

25. How do you evaluate the importance of the forest for your economy?

1  ☐ not important
2  ☐ somewhat important
3  ☐ quite important
4  ☐ very important
If you have questions or comments related to nature conservation you can write them on the following lines.

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

THANK YOU FOR YOUR ANSWERS!
Appendix 2.2. English translation of the Finnish questionnaire for Study IV. Sub-sample of paired comparisons.

5. Evaluate the nature conservation and forestry sides of alternatives using the school grades from 4 to 10.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>How favourable are the alternatives from the nature conservation point of view? Please grade 4-10.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alternative</th>
<th>How favourable are the alternatives from the forestry point of view? Please grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
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<tr>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

6. Forest owners and authorities could, if needed, implement forest regeneration in several ways. Let us assume that no public financing is used for the implementation nor it will have effect on your household’s income or timber sales. Please, compare the following pairs of alternatives and choose the one you prefer.

I prefer A. □    B. □

If you preferred alternative B, move on to the next page. TO PAGE 6

If you preferred alternative B, move on to the page 7. TO PAGE 7
DIVISION OF COSTS FROM FOREST REGENERATION CUTTINGS

Let us assume that cutting practices would be changed from the present practice B to the alternative C. For forest owners this will cause a loss of income. Therefore, the change would not necessarily be implemented as a voluntarily action.

7. Do you agree or disagree with the following statement.

Forest owners will change cutting practices voluntarily because only the timber grown in an environmentally friendly way can be sold

Fully disagree 7 6 5 4 3 2 1 Fully agree

8. How the taxpayers and forest owners should share the costs, according to your opinion, if the current practice B is replaced by the alternative C.

The share of costs to forest owners should be: %

<table>
<thead>
<tr>
<th>Taxpayers will pay all</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
</tr>
</thead>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If you cross 60 - 100 %, please, continue to page 10.

If you cross 0 - 50 %, continue to the following page.

TO PAGE 10

TO PAGE 7
DIVISION OF COSTS OF FOREST REGENERATION

9. Do you agree or disagree with the following statement.

In my opinion, the present practice (alternative B) has already affected losses, such as costs to forest owners, that should have been compensated.

Fully disagree 1 2 3 4 5 6 7 Fully agree

If you crossed 5 - 7, move on to the following page.

If you crossed 1 - 4, move on to page 9.
PAIRED COMPARISONS OF FOREST REGENERATION ALTERNATIVES

Forest policy may direct regeneration cuttings and forest subsidies in a new way seen as appropriate. Several policy options are available. In the following, we describe how the policy options described in the info sheet could be implemented in all private forests.

*Alternative A* would be implemented with the recommendations from 1980’s.

*Alternative B* would be implemented by continuing current recommendations and legislation.

*Alternative C* would be implemented by law and regulation. This would cause forest owners income losses that would be compensated.

Alternatives may cause reductions in the subsidies for environmental conservation or increases in forest subsidies. Therefore, alternatives may change your taxes. The change in taxes would be permanent beginning from this year.

Forest regeneration alternatives are described in detail in the info sheet. You may have it available as you make choices in the following.

10. Compare pairs of alternatives and choose the one you prefer. Please choose an alternative in each line even if they both are unpleasant.

<table>
<thead>
<tr>
<th></th>
<th>A. No change in taxation</th>
<th>B. Taxes reduce by FIM 700</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I prefer</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2</th>
<th>A.</th>
<th>B. Taxes reduce by FIM 700</th>
</tr>
</thead>
<tbody>
<tr>
<td>I prefer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>A. No change in taxation</td>
<td>B. Taxes reduce by FIM 2500</td>
</tr>
<tr>
<td>I prefer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>A. No change in taxation</td>
<td>B. Taxes reduce by FIM 2500</td>
</tr>
<tr>
<td>I prefer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>B. No change in taxation</td>
<td>C. Taxes reduce by FIM 2500</td>
</tr>
<tr>
<td>I prefer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>A. No change in taxation</td>
<td>B. Taxes reduce by FIM 2500</td>
</tr>
<tr>
<td>I prefer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>B. No change in taxation</td>
<td>C. Taxes reduce by FIM 2500</td>
</tr>
<tr>
<td>I prefer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>A. Taxes reduce by FIM 700</td>
<td>B. Taxes reduce by FIM 2500</td>
</tr>
<tr>
<td>I prefer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>A. Taxes reduce by FIM 700</td>
<td>B. Taxes reduce by FIM 2500</td>
</tr>
<tr>
<td>I prefer</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11. Above, the maximum tax reduction was FIM 2500. What would be the *minimum* tax reduction that you would accept if there is a change from alternative A to alternative C?_____________FIM
**PAIRED COMPARISONS OF FOREST REGENERATION ALTERNATIVES**

Forest policy may direct regeneration cuttings and forest subsidies in a new way seen as appropriate. Several policy options are available. In the following, we describe how the policy options described in the info sheet could be implemented in all private forests.

*Alternative A* would be implemented with the recommendations from 1980’s. Tax reductions would be due to reductions in subsidies to forest owners.

*Alternative B* would be implemented by continuing current recommendations and legislation. Your taxation would not change substantially. Possible tax reductions would be due to reductions in subsidies to forest owners.

*Alternative C* would be implemented by law and regulation. This would cause forest owners income losses that would be compensated. Compensations would be financed from extra taxes on households.

The change in taxes would be permanent beginning from this year.

Forest regeneration alternatives are described in detail in the info sheet. You may have it available as you make choices in the following.

12. Compare pairs of alternatives and choose the one you prefer. Please choose an alternative in each line even if they both are unpleasant.

<table>
<thead>
<tr>
<th></th>
<th>B.</th>
<th>C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No change in taxation</td>
<td>Taxes increase by FIM 700</td>
</tr>
<tr>
<td>I prefer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Taxes increase by FIM 700</td>
<td>Taxes increase by FIM 2500</td>
</tr>
<tr>
<td>I prefer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>No change in taxation</td>
<td>Taxes increase by FIM 2500</td>
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<tr>
<td>6</td>
<td>Taxes reduce by FIM 700</td>
<td>Taxes reduce by FIM 2500</td>
</tr>
<tr>
<td>I prefer</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

13. Above, the maximum tax increase was FIM 2500. What would be the maximum tax increase that you could accept, if there would be a change from alternative B to alternative C? FIM___________

14. Above, the maximum tax reduction was FIM 2500. What would be the minimum tax reduction that you would accept if there is a change from alternative B to alternative A? FIM___________
PAIRED COMPARISONS OF FOREST REGENERATION ALTERNATIVES

Forest policy may direct regeneration cuttings and forest subsidies in a new way seen as appropriate. Several policy options are available. In the following, we describe how the policy options described in the info sheet could be implemented in all private forests.

Alternative A would be implemented with the recommendations from 1980’s.

Alternative B would be implemented by continuing current recommendations and legislation.

Alternative C would be implemented by law and regulation. This would cause forest owners income losses that would be compensated.

Possible tax changes would be due to increases in subsidies to forest conservation and reductions in subsidies to forest owners. The change in taxes would be permanent beginning from this year.

Forest regeneration alternatives are described in detail in the info sheet. You may have it available as you make choices in the following.

15. Compare pairs of alternatives and choose the one you prefer. Please choose an alternative in each line even if they both are unpleasant.

<table>
<thead>
<tr>
<th></th>
<th>C. No change in taxation</th>
<th>B. Taxes reduce by FIM 700</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I prefer</td>
<td>Taxes reduce by FIM 700</td>
</tr>
<tr>
<td></td>
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<td>2</td>
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<td>A. Taxes reduce by FIM 2500</td>
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<td></td>
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<td>A. Taxes reduce by FIM 2500</td>
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<tr>
<td></td>
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<td>C. No change in taxation</td>
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<tr>
<td></td>
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</tr>
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<td>8</td>
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</tr>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td>9</td>
<td>C. Taxes reduce by FIM 700</td>
<td>B. Taxes reduce by FIM 2500</td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

16. Above, the maximum tax reduction was FIM 2500. What would be the minimum tax reduction that you would accept if there is a change from alternative C to alternative A? FIM__________
### FOREST REGENERATION INFORMATION

<table>
<thead>
<tr>
<th>Alternative A.</th>
<th>Alternative B. (present practice)</th>
<th>Alternative C.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trees to be left on the cutting area</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Trees are left to decay on the cutting area. They are not seed trees which will be removed later.</td>
<td>0 trees per hectare</td>
<td>15 trees per hectare</td>
</tr>
<tr>
<td>- Preserved trees will increase the amount of decaying wood, which is necessary for many endangered fungi and insect species living in old growth forests.</td>
<td>(hectare =100 x 100m)</td>
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<tr>
<td>- The relationship between the amount of decaying wood and endangered species is not well known.</td>
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<tr>
<td>- Preserved trees also have an effect on forest scenery.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cutting potential</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Preserved trees reduce the area producing timber and thus forest growth as well.</td>
<td>16% more than actual use.</td>
<td>14% more than actual use.</td>
</tr>
<tr>
<td>- To ensure the sufficiency of timber, cuttings could be increased in all alternatives.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- The use of timber is sustainable when cuttings and forest growth balance each other out in the long-term.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Turn on the page!*
Appendix 2.3. Information sheet with the questionnaire in Study IV.

**Alternative A.**

0 trees per hectare

(hectare = 100 x 100 m)

**Alternative B.**

(present practice)

15 trees per hectare

**Alternative C.**

35 trees per hectare
Appendix 3.1. Questionnaire for study V. Sub-sample of uncertainty.

FOREST
REGENERATION CUTTINGS
IN LOPPI
WHAT IS YOUR OPINION?

University of Helsinki
Department of Forest Economics
May 1995
The questionnaire deals with the Myllymetsä forest in Loppi. We are studying local inhabitants’ opinions about forest regeneration cuttings in this area.

The area has been selected purely for scientific reasons – forest owners, authorities, political decision makers or political organizations, or other organizations have not affected the decision to deal with this particular area.

The location and size of the area are described in the following maps.
The *Myllymetsä* area, outlined in the map, is located directly adjacent to the Loppi center. In the north the area extends to the vicinity of the road to Jokiniemi and in the east to the vicinity of the road to Läyläinen. There are forest roads in the area. In the north, a small river runs down to Lake Loppijärvi. The forest area is about one kilometer long and wide. The size of the area is about 100 hectares. Forest owners have the option to regenerate about half of the total area. This area is marked with stripes on the map.
1. **How have you been in contact with the Myllymetsä area? Select all items that are correct.**

   1. I live close to the area
   2. my summer residence is close to the area
   3. I pass the area repeatedly (by car)
   4. I enjoy outdoor activities in the area
   5. I pick mushrooms in the area
   6. I pick berries in the area
   7. I fish in the vicinity of the area
   8. I hunt in the area or its vicinity
   9. a relative or a friend lives close to the area
   10. a relative or a friend owns land in the area or close to it
   11. other reasons, what? ____________________________

   12. the location of the area is unclear to me, ⇒ move to question 4
   13. I have not been in touch with the area at all, ⇒ move to question 4

2. **How often have you traveled in or passed the area?**

   1. Daily or several times per week
   2. A few times per month
   3. A few times per year

3. **Have you noticed any cuttings in this area?**

   1. yes
   2. no
This questionnaire mainly consists of statements such as those below. Please respond to them by placing an x in one box for each item.

4. Think about the importance of the following items related to the Myllymetsä forest. Please mark whether you agree or disagree (an x in one box per item).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Strength of the opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>It is important for me to take care of the forest scenery in the Myllymetsä.</td>
<td>agree 1 2 3 4 5 6 7 disagree</td>
</tr>
<tr>
<td>2</td>
<td>It is important for me to take care of the future growth in the Myllymetsä forest.</td>
<td>agree 1 2 3 4 5 6 7 disagree</td>
</tr>
<tr>
<td>3</td>
<td>It is important for me to take into consideration of wildlife in the Myllymetsä forest.</td>
<td>agree 1 2 3 4 5 6 7 disagree</td>
</tr>
<tr>
<td>4</td>
<td>It is important for me that the vegetation is preserved unchangeable in the Myllymetsä forest.</td>
<td>agree 1 2 3 4 5 6 7 disagree</td>
</tr>
<tr>
<td>5</td>
<td>Easy access to enjoy the outdoors in the Myllymetsä forest important for me.</td>
<td>agree 1 2 3 4 5 6 7 disagree</td>
</tr>
<tr>
<td>6</td>
<td>It is important for me that the Myllymetsä forest has continuously growing stands of trees.</td>
<td>agree 1 2 3 4 5 6 7 disagree</td>
</tr>
<tr>
<td>7</td>
<td>It is important for me that the forest owners of Myllymetsä have the possibility for earning an income from the forest.</td>
<td>agree 1 2 3 4 5 6 7 disagree</td>
</tr>
</tbody>
</table>
FOREST REGENERATION

The following part of the questionnaire deals with forest regeneration. To regenerate forests, all or most trees are cut in a particular site. During regeneration attention is paid to the production of seedlings. If trees are left in the regeneration area, young trees will grow up from the seeds produced by these trees. On the other hand, if all trees have been removed, seedlings are planted or seeds are sown. Forests to be regenerated are rather old.

When thinning is made in rather young forests, a small proportion of the trees are selected and cut. Usually, larger trees are left to grow.

FOREST REGENERATION IN THE MYLLYMETSÄN AREA

In the map on page 3, striped areas indicate rather old forests, which forest owners may regenerate if they want over the next ten years.

The magnitude of future cuttings planned by forest owners is not publicly known. Future cuttings are affected by income needs of forest owner and timber prices. Probably forest owners’ logging is at a minimum if the timber price is low. On the other hand, cuttings are at a maximum if the timber price is high.

In the following, we ask about your expectations regarding cuttings.
Note! Nobody has exact information on future cuttings.
Please answer according to your own estimate!

5a How much do you believe old-growth forests in this area will be cut at the minimum in the next 10 years?

<table>
<thead>
<tr>
<th>Nothing</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>all do not know</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
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</tr>
</tbody>
</table>

5b How much do you believe old-growth forests in this area will be cut at the maximum in next 10 years?

<table>
<thead>
<tr>
<th>Nothing</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>all do not know</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>
6. **Assess forest regeneration in the Myllymetsä area with the help of the following statements. Please answer whether you agree or disagree (an x in one box per item).**

<table>
<thead>
<tr>
<th></th>
<th>Forest regeneration cutting would deteriorates the forest scenery.</th>
<th>Strength of the opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>agree</td>
<td>fully</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

|   | Forest regeneration cutting guarantees forest growth.             | agree                              | fully  | quite  | slightly | neither agree- nor disagree | slightly | quite  | fully  | disagree |
| 2 |                                                                  | 1   | 2     | 3       | 4       | 5    | 6     | 7      | disagree |

|   | Forest regeneration cutting in the area deteriorates wildlife conditions. | agree                              | fully  | quite  | slightly | neither agree- nor disagree | slightly | quite  | fully  | disagree |
| 3 |                                                                  | 1   | 2     | 3       | 4       | 5    | 6     | 7      | disagree |

|   | Forest regeneration cutting changes vegetation.                  | agree                              | fully  | quite  | slightly | neither agree- nor disagree | slightly | quite  | fully  | disagree |
| 4 |                                                                  | 1   | 2     | 3       | 4       | 5    | 6     | 7      | disagree |

|   | Forest regeneration cutting reduces accessibility in the area.    | agree                              | fully  | quite  | slightly | neither agree- nor disagree | slightly | quite  | fully  | disagree |
| 5 |                                                                  | 1   | 2     | 3       | 4       | 5    | 6     | 7      | disagree |

|   | Forest regeneration cutting in the area increases forest owners’ incomes. | agree                              | fully  | quite  | slightly | neither agree- nor disagree | slightly | quite  | fully  | disagree |
| 6 |                                                                  | 1   | 2     | 3       | 4       | 5    | 6     | 7      | disagree |

|   | Forest regeneration cuttings reduce forest owners’ cutting potential in the near future. | agree                              | fully  | quite  | slightly | neither agree- nor disagree | slightly | quite  | fully  | disagree |
| 7 |                                                                  | 1   | 2     | 3       | 4       | 5    | 6     | 7      | disagree |

7. **Forest regeneration**  
in the *Myllymetsä* area is generally speaking  
1 useful | 1 | 2 | 3 | 4 | 5 | 6 | 7 | useless  
2 good | 1 | 2 | 3 | 4 | 5 | 6 | 7 | bad  
(mark one box per row)  
3 acceptable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | unacceptable  
4 positive | 1 | 2 | 3 | 4 | 5 | 6 | 7 | negative
LAND USE PLAN REGULATION OF CUTTINGS

House and road construction, forest cuttings, and several other activities that change the environment are based on different plans. The planning of land-use is called zoning. A general land-use plan is done for a whole municipality, and a partial general land-use plan covers only a part of a municipality. Land-use plans can also regulate forest cuttings.

In the following, we present a hypothetical situation designed only for this research. It is not connected with actual decision making in the municipality.

<table>
<thead>
<tr>
<th>Location:</th>
<th>General plan area is presented on the map at the beginning of the questionnaire. It includes 50 ha of regenerable old forest.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contents:</td>
<td>Regeneration cutting regulation. Only 30% of the maximum forest area (area of old growth forests) is allowed to be cut in Myllymetsä. Other forest management or building regulation remains unrestricted.</td>
</tr>
<tr>
<td>Time frame:</td>
<td>Restriction covers the years 1996-2005, after which it can be continued or canceled.</td>
</tr>
<tr>
<td>Expenses:</td>
<td>Forest owners might lose income because cutting amount is restricted, but they would receive lump sum compensations from the community of Loppi in 1996. The compensations claimed are not yet known.</td>
</tr>
<tr>
<td>Funding:</td>
<td>Expenses are covered with local taxes collected from every community member during the year 1996. Residents will pay higher local income taxes and nonresident property owners higher property taxes.</td>
</tr>
<tr>
<td>Decision:</td>
<td>The plan is implemented if the majority of the community members are willing to pay the compensations needed by forest owners.</td>
</tr>
</tbody>
</table>
YOUR CHANCE TO HAVE AN INFLUENCE

Think about the proposed land use plan of Myllymetsä. Do you believe that regulating forest regeneration in Myllymetsä will be worth paying the extra tax?

8. Do you accept the proposed plan if its total cost for your household was 50⁸ Finnish marks? The cost would be paid in 1996 by income taxes.

   1  ☐ yes
   2  ☐ no
   3  ☐ I do not know
   4  ☐ do not want to answer

9. What is the maximum your household would pay for the proposed cutting regulating plan?

    ________ mk

If you did not answer the question above or you answered 0 mk, please, continue to question 10. Otherwise go ahead to question 11.

10. I did not answer question 9 or I answered 0 mk, because

   1  ☐ I am pleased with forest management in Myllymetsä and I don’t want any change.
   2  ☐ Forest management in Myllymetsä doesn’t concern me.
   3  ☐ I cannot afford to pay for forest quality in Myllymetsä.
   4  ☐ It is unfair to expect me to pay for forest quality in Myllymetsä.
   5  ☐ I refuse to think about forest quality in Myllymetsä in monetary terms.
   6  ☐ It is not right that forest management is regulated in Myllymetsä
   7  ☐ other reason, why?______________________________

11a Suppose the land use plan is executed. What do you believe will be the minimum area of old forests to be regenerated in the next ten years?

<table>
<thead>
<tr>
<th></th>
<th>non</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>all</th>
<th>don't know</th>
</tr>
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<tbody>
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</tbody>
</table>

11b Suppose the land use plan is executed. What do you believe will be the maximum area of old forests to be regenerated in the next ten years?

<table>
<thead>
<tr>
<th></th>
<th>non</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>all</th>
<th>don't know</th>
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</tr>
</tbody>
</table>

² Bid levels are FIM 50, 200 and 500
12. Assess the Myllymetsä plan with the help of the following statements. Please mark whether you agree or disagree (mark one box per row).

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strength of the opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>fully</td>
</tr>
<tr>
<td>1  It is possible for me to contribute to this plan.</td>
<td>agree</td>
</tr>
<tr>
<td>2  Most people important in my life would approve my supporting the proposed plan.</td>
<td>agree</td>
</tr>
<tr>
<td>3  The proposed plan will violate private property rights.</td>
<td>agree</td>
</tr>
<tr>
<td>4  Taking care of private property rights is important to me.</td>
<td>agree</td>
</tr>
<tr>
<td>5  The proposed plan violates the community coherence.</td>
<td>agree</td>
</tr>
<tr>
<td>6  Taking care of the community coherence is important to me.</td>
<td>agree</td>
</tr>
<tr>
<td>7  The proposed plan involves common people in payment of compensations.</td>
<td>agree</td>
</tr>
<tr>
<td>8  Fare payment share for common people in payment of compensations is important to me.</td>
<td>agree</td>
</tr>
<tr>
<td>9  The proposed plan saves natural state of forest from human intervention.</td>
<td>agree</td>
</tr>
<tr>
<td>10 Saving natural state of forest is important to me.</td>
<td>agree</td>
</tr>
<tr>
<td>11 The proposed plan would improve the quality of forests.</td>
<td>agree</td>
</tr>
<tr>
<td>12 Most people important in my life think that I should support the proposed plan.</td>
<td>agree</td>
</tr>
<tr>
<td>13 I cannot afford to support the plan</td>
<td>agree</td>
</tr>
</tbody>
</table>
13. **Assess the Myllymetsä land use proposal with the help of the following statements**

<table>
<thead>
<tr>
<th>Strength of the opinion</th>
<th>fully</th>
<th>quite</th>
<th>slightly</th>
<th>neither agree-nor disagree</th>
<th>slightly</th>
<th>quite</th>
<th>fully</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 useful</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 good</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 acceptable</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>4 positive</td>
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</tbody>
</table>

From my point of view supporting the proposed plan would be (mark one box per line).

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</tbody>
</table>

14. **Evaluate the questionnaire with the help of the following statements.**

<table>
<thead>
<tr>
<th>Strength of the opinion</th>
<th>fully</th>
<th>quite</th>
<th>slightly</th>
<th>neither agree-nor disagree</th>
<th>slightly</th>
<th>quite</th>
<th>fully</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 I responded to the questionnaire seriously.</td>
<td>agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 It took a long time to think about the answers.</td>
<td>agree</td>
<td></td>
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<td>3 I understood all the questions.</td>
<td>agree</td>
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<td>4 The questionnaire was interesting.</td>
<td>agree</td>
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</tbody>
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Thank you for your response.
If you have comments on this questionnaire, forests, or forest regeneration, please write them here.

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________________________________________________________________________
Appendix 3.2. Questionnaire for study V. The sub sample of certainty.

**FOREST REGENERATION IN THE MYLLYMETSÄ AREA**

In the map on page 3, striped areas indicate rather old forests that forest owners may regenerate over the next ten years. The area of these forests comprises about 50 ha or half of the total area.

In Loppi, of the rather old forests around 50%, have been regenerated during the past ten years. Also, the Myllymetsä forest owners will do on average regeneration cuttings with this amount. Therefore, **25 ha of regeneration cutting areas is anticipated in the following ten years.**

<table>
<thead>
<tr>
<th><strong>GENERAL PLAN OF MYLLYMETSÄ FOREST AREA</strong></th>
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<tbody>
<tr>
<td><strong>Location:</strong> The general plan area is presented on the map at the beginning of the questionnaire. It includes 50 ha of regenerable old forest. <strong>Without regulation in the following 10 years forest owners will cut about half of the area shown in the map.</strong></td>
</tr>
<tr>
<td><strong>Contents:</strong> Regeneration cutting regulation. Of the rather old forest, 30% is allowed to be cut in Myllymetsä. In other words, <strong>one third of the area shown in the map will be cut during the following 10 years.</strong> Other forest management or building regulation remains unrestricted.</td>
</tr>
</tbody>
</table>