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## **DOCTOR OF PHILOSOPHY**

### **Revealing components of the economic value for environmental goods and services from forest : an application of stated preference methods for forest valuation and conservation**

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## PhD thesis

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Revealing components of the economic value for environmental goods and services from forest:

An application of stated preference methods for forest valuation and conservation.



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## **Preface**

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The present study has produced the following four papers under supervision of Professor Jette Jacobsen and Professor Niels Strange respectively as the principle supervisor and co-supervisor from department of Food and Resource Economics, University of Copenhagen, and Dr James Gibbon from the School of the Environment, Natural Resources & Geography, University of Bangor who supervised the study:

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*Fatemeh Bakhtiari*

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- 18<sup>th</sup> Annual Conference of the European Association of Environmental and Resource Economists- June 2011, Rome-Italy
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- **Bakhtiari**, F. Jacobsen ,JB. Helles, F.(2011) Taking a step backwards in using discrete choice experiment for forest biodiversity valuation (work in progress). Scandinavian Society of Forest Economics, SSFE conference. Tampere, Finland.
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<b>Name of the course</b>	<b>Organizer</b>	<b>Date: From (dd/mm/yyyy)</b>	<b>Date: To (dd/mm/yyyy)</b>	<b>ECTS</b>
The Art of Scientific writing	Ku-life	9-02-2012	13-04-2012	3
Introduction course for PhD student	Ku-life	14-10-2012	20-10-2012	2
Discrete choice analysis predicting demand and market shares	Transport and mobility laboratory, Switzerland	20-03-2011	25-03-2011	7.5
Economics valuation methods and cost benefit analysis	Ku-life	11-06-2010	27-02-2011	7.5
Philosophy of science and research ethics	Ku-life	30-01-2012	30-6-2012	3
Case studies in natural resource management	S&L	27-03-2011	1-09-2011	7.5
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## **Abstract**

The overall purpose and contribution of this thesis is increasing the understanding of components of the value of environmental goods. It investigates how the public perceive environmental goods (lay people's perception) and the elements of it that they value. Providing such knowledge contributes to improving valuation methods e.g. the use of the Choice Experiment (CE) for valuing forest biodiversity conservation. Increasing knowledge of lay people's perception and mental constructs of environmental goods can help researchers to know how they can present environmental goods in CEs which align with respondents' perceptions and to further understand the appropriate way of measuring these values.

To fulfill the aim of the thesis, the broadleaved forests in southern Scandinavia were chosen as a case study area where both qualitative and quantitative methods were applied to increase understanding of lay people's perception of forest environmental goods and services and to use this for improving stated preference valuation methods.

The thesis includes two parts. The first is an introduction to the overall framework of the thesis, an overview of the objectives and an explanation of the main theories behind the CE method. The second part includes four papers. The first two papers mostly focus on improving methodological aspects of CEs, while the next two papers use the result of a CE to generate a better and more comprehensive information base for policy formulation and decision making procedures. The first paper provides input for the three other papers which investigate lay people's perceptions and mental constructs of concepts of nature, forest environmental goods and services. The results contribute to the research field by illustrating that 'diversity of animals and plants', 'natural appearance and dynamics of ecosystem', and 'peace and quiet' are the most preferred attributes of forest ecosystems which were most frequently mentioned by lay people compared with other attributes of forest ecosystems. In addition, it was found that regardless of familiarity with the various ecological scientific terminologies, lay people had an intuitive understanding of ecological concepts such as biodiversity. The analyses demonstrate that respondents' perceptions and values of biodiversity could be framed in two categories: as a good in itself, and for its regulatory function. It was also revealed that attitudes to forest and its biodiversity may be rooted in respondents' mental constructs. This can be useful in targeting policies concerning conservation management.

The second paper applies these insights from the qualitative investigation of nature perception to estimate WTP for forest biodiversity conservation. Environmental goods are complex and it is not an easy task to provide enough information to precisely elicit respondents' preferences while not providing new information and thereby affecting preferences. This paper furthermore, focuses on contextual embedding and scope bias which may occur in CE results due to imprecise presentation of the good for respondents. Avoiding these biases is of importance for the validity of the estimated results. In this study, we challenge this problem (bias) by testing the presence of what we term contextual embedding, arising from the functional characteristics of biodiversity as opposed to biodiversity being presented by species richness (number of species) alone. A higher WTP for a group informed about the stability and resilience of the ecosystem was found, compared to a group who did not receive this information in addition to species richness, when presented with the biodiversity attribute. This may be due to information and/or an embedding effect. By designing splits, we were able to rule out that it is due solely to additional information.

Sensitivity to scope for biodiversity within the different splits was investigated as well. It was found that for all splits respondents were sensitive to increases in provision compared to the status quo. Furthermore, respondents who were informed about forest stability and resilience valued the levels of changing of biodiversity differently. They were scope sensitive to the improvements levels and had lower variance when compared to respondents valuing species richness alone. Therefore, the present study indicates the importance of taking in-depth qualitative evidence of lay people's mental constructs of complex environmental goods such as biodiversity into account to increase the validity of WTP results.

Based on Outputs of the qualitative study in understanding how people perceive environmental goods in Paper One we also raised some policy relevant issues. For example the location of forest conservation influences on respondents' preference for conservation policies. However, an underlying assumption in many international efforts to coordinate conservation policy is that biodiversity protection is a global public good and, specifically, that the value of biodiversity protection is independent of the geographical and political jurisdiction of provision. We investigated if comparable biodiversity protection measures and outcomes in two countries are indeed valued as a global public good by the population in those same two countries. We were able to distinguish an effect of nationality from distance by exploring the extent to which willingness to

pay for policy alternatives was affected by the nationality of respondents, the country where the protection is implemented and the distance to the protection location. We found a clear effect of both. WTP decreased by 152 DKK/year for a policy concerning forest ecosystem improvement implemented in the foreign, rather than in the home, country.

We also found that experiencing peace and quiet was one of the main characteristics of an ideal forest to visit, which can be considered as a motive of recreational activities in the forest. The result of qualitative analysis (Paper One) illustrated that there was evidence of perceived conflicts among respondents on visiting forest due to meeting many other visitors. One way to solve this could be to separate different forest user groups spatially in the forest.

Thus, in Paper Four we focused on the concept of ‘perceived conflicts and crowding’ among forest users. It gives an overview of respondents’ marginal utility to travel in order to avoid crowded forests and consequently avoid conflict. Providing knowledge on the preference for reducing crowding among different forest users may help forest managers to be able to separate areas in the forest for different user group based on how far they are willing to travel.

On average respondents from different forest user groups preferred to travel further to reach a forest with few visitors. We have identified three types of users depending on their willingness to travel, WTT, to reach a forest with few other visitors.

The first group is forest user groups who are willing to travel further than the average. Groups namely ‘Mountain Bikers’, ‘Horseback riders’ and ‘Peace Lovers’ are included. The second group which includes ‘Exercise’ group are those who had lower willingness to travel than the average. It suggests that they are more willing to meet many people during their visit compared to other groups such as ‘Peace and nature lovers’. The third group are those whose WTT is not significantly different from the average WTT. This type consists of ‘Picnickers’ ‘Cyclists’ and ‘Overnighters’ which addresses visitors who stay overnight in the forest. They are not willing to travel as far as ‘Peace Lovers’ to be in a forest with few visitors.

Thus, Paper four addresses the issue of perceived conflicts among different forest user groups in Denmark to deliver a better foundation for future planning and management of recreational activities in forests.

Understanding the components of the environmental value of forest ecosystems by looking at the lay people's perception is the overall objective of the present thesis. The study investigates how to present enough information for precisely eliciting respondents' preferences, yet not as much as to provide them new information and thereby affect their preferences. The study aims to improve the valuation methods (Paper One and Two) and consequently provide more reliable estimation results. In addition, the study makes a linkage to policy relevant measurements namely for forest biodiversity transnational conservation policy framework (Paper Three) and recreation planning (Paper Four).

## Dansk resume

Formålet med denne PhD afhandling er at øge forståelsen af de værdielementer, som miljøgoder består af. Afhandlingen undersøger befolkningens opfattelse af miljøgoder og hvilke elementer de tillægger værdi. Denne viden bidrager til at forbedre værdisætningsmetoder som for eksempel valgeksp eksperimenter (Choice Experiments) til at værdisætte biodiversitets beskyttelse i skove. Øget forståelse af offentlighedens opfattelse og mentale konstruktioner (mental constructs) vedrørende miljøgoder kan give forskere viden om hvordan de kan præsentere miljøgoder bedst muligt for respondenterne baseret på deres opfattelse, og hvad der vil være den korrekte måde at estimere værdien af disse goder.

For at opfylde afhandlingens formål, så er løvtræsskove i den sydlige del af Skandinavien blevet brugt som case område hvor både kvalitative og kvantitative metoder er blevet anvendt for at øge forskeres forståelse af den offentlige opfattelse af miljøgoder fra skove og for at bruge dette til at forbedre 'stated preference' værdisætningsmetoder.

Afhandlingen består af to dele. Første del er en introduktion til den overordnede ramme for afhandlingen, en oversigt over formålene og forklaring af hovedteoriene bag valgeksp eksperiment metoden. Anden del indeholder fire artikler, hvor de første to artikler hovedsageligt fokuserer på at forbedre metodemæssige aspekter ved valgeksp eksperimenter. De sidste to artikler benytter resultaterne fra valgeksp eksperimentet til at skabe et bedre fundament af viden for beslutningstagning og den politiske proces. Den første artikel skaber input til de tre andre artikler, som undersøger offentlighedens opfattelse og mentale konstruktioner vedrørende natur og miljøgoder fra skove. Resultaterne bidrager til det forskningsmæssige felt ved at illustrere at 'diversitet af dyr og planter', 'økosystemers naturlighed og dynamik' og 'fred og stilhed' er de foretrukne elementer ved skovøkosystemer; sammenholdt med andre attributter, så blev disse oftest nævnt af lægmænd. Herudover fandt vi, at uanset om folk havde kendskab til de forskellige videnskabelige termer for økologi, så var der en rig forståelse af koncepter såsom biodiversitet blandt lægmænd. Analysen viser, at individers opfattelse og værdier forbundet med biodiversitet kan opdeles i to kategorier: som et gode i sig selv, eller for dets funktion. Det blev også afdækket, at individers holdning til skov og skovens biodiversitet kan udspringe af deres mentale konstruktioner. Denne viden kan bruges til at målrette politiske tiltag vedrørende naturbeskyttelse.

Den anden artikel anvender disse indsigter fra den kvalitative undersøgelse af naturopfattelser til at estimere betalingsvilligheden for biodiversitetsbeskyttelse i skove. Natur og miljøgoder er

komplekse, og det er ikke nogen let opgave at give tilstrækkelig information til at kunne udlede respondenters præferencer og samtidig ikke give ny information, så man præger deres præferencer. Herudover fokuserer denne artikel på kontekst afhængighed (contextual embedding) og 'scope bias', som kan optræde i data fra valgekspirimeter på grund af upræcis præsentation af godet for respondenterne. Det er vigtigt at undgå disse fejlkilder for at sikre at resultaterne er pålidelige. I studiet her undersøger vi disse problemer ved at teste hvad vi refererer til som kontekst afhængighed, som kommer fra biodiversitets funktionelle karakteristika i modsætning til når biodiversitet bliver præsenteret alene ved antal af arter. Vi fandt, at folk som var blevet informeret om økosystemers stabilitet og modstandsdygtighed (resiliens), havde en højere betalingsvillighed sammenlignet med folk som ikke fik denne information sammen med antallet af arter, når de blev præsenteret for biodiversitet som element. Det kan være på grund af informationen og/eller kontekst afhængighed. Ved nøje at udforme splits var vi i stand til at udelukke, at forskellen kun skyldtes den yderligere information.

Følsomhed over for mængden af godet ('scope') med hensyn til biodiversitet blev også undersøgt ved hjælp af splits. For alle splits blev det vist, at respondenterne reagerede på øget mængde af biodiversitet i forhold til status quo. Ydermere, respondenter der blev informeret om skovenes stabilitet og modstandsdygtighed værdisatte også niveauerne af biodiversitetsforbedringen forskelligt – højere niveau gav øget værdiestimat. Dette var ikke tilfældet for respondenter der værdisatte biodiversitet alene på baggrund af antallet af arter. Dette studie viser derfor hvor vigtigt det er, at inddrage kvalitative data vedrørende folks mentale konstruktioner af komplekse miljøgoder som biodiversitet, for at øge pålideligheden af de værdiestimater man får ud af det.

Resultater fra det kvalitative studie om at forstå hvordan folk forholder sig til miljøgoder (artikel 1) er tillige policy relevante. For eksempel betyder det noget for respondenterne hvor naturbeskyttelsen i skove finder sted. I mange former for international koordinering af miljøbeskyttelsestiltag antager man at beskyttelse af biodiversitet er et globalt gode og specifikt, at værdien af biodiversitets beskyttelse er uafhængig af det geografiske og politiske miljø den finder sted i. Vi undersøger om sammenlignelige tiltag til at beskytte biodiversitet i to lande rent faktisk bliver værdisat som globale goder af befolkningen i de respektive lande. Vi kunne skille effekten af nationalitet fra effekten af afstand til hvor naturbeskyttelsen finder sted. Vi fandt, at der var en klar effekt af begge dele. Villigheden til at betale faldt med 152 DKK/år for et tiltag der forbedrer skovøkosystemet, hvis det finder sted i et andet land end ens hjemland.

Herudover var det at opleve fred og stilhed et af de vigtigste elementer ved et besøg i skoven, og i sig selv et motiv for rekreative besøg i skoven. Resultatet af den kvalitative analyse (artikel 1) viste at respondenter oplevede konflikter med andre besøgende i skoven. Én måde at forsøge at løse dette kunne være at adskille forskellige aktiviteter rumligt i skoven.

I artikel fire fokuserer vi på konceptet 'oplevede konflikter og trængsel' blandt brugere i skoven. Den giver et overblik over respondenternes marginal nytte ved at fragte sig længere (willingness til travel) for at undgå trængsel i skovene og dermed konflikter. Øget viden om forskellige brugergrupperes præferencer for at undgå trængsel, kan benyttes af skovforvaltere til at etablere separate områder i skovene til forskellige brugergrupper – baseret på hvor langt de er villige til at fragte sig.

Generelt set var respondenter fra forskellige brugergrupper alle villige til at fragte sig længere for at være i en skov med få besøgende. Vi har identificeret tre typer af brugere baseret på deres villighed til at fragte sig for at være i en skov med kun få andre besøgende. Den første er brugere af skove, som er villige til at fragte sig længere end gennemsnittet. Hertil hører 'mountain bikere', 'ryttere' og 'folk der holder af fred og ro'. Den anden gruppe, som inkluderer dem der bruger skoven til at dyrke sport, har lavere villighed til at fragte sig end gennemsnittet. Det tyder på at de er mere villige til at møde mange andre besøgende i forhold til andre grupper såsom 'folk der holder af fred og ro'. Den tredje gruppe indeholder folk hvis villighed til at fragte sig er ligesom gennemsnittet og består af 'folk på picnic', 'cyklister' og 'overnattende skovgæster'. De er ikke villige til at fragte sig så langt som gruppe 1 for at være i en skov med få besøgende.

Artikel fire adresserer konflikter mellem forskellige brugere af skovene i Danmark for at skabe et bedre grundlag for fremtidig planlægning og forvaltning af rekreative aktiviteter i skove.

Denne Ph.d. afhandlings overordnede formål er at forstå de værdielementer som miljøgoder fra skovøkosystemer består af, ved at se på befolkningens opfattelser. Afhandlingen undersøger hvordan man giver respondenterne nok information til at udlede deres præferencer, men undgår at give dem ny information som kan påvirke deres præferencer. Studiet har også til sigte at forbedre værdisætningsmetoderne (artikel 1 og 2) and hermed bidrage til mere pålidelige værdiestimater. Herudover knytter afhandlingen disse resultater til policy relevante tiltag og naturvidenskab indenfor transnational beskyttelse af biodiversitet i skove (artikel tre) og planlægning med hensyn til rekreative aktiviteter (artikel 4).



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# **1. Introduction**

## **1.1. Overall aim, objective**

Decision makers in policy and project assessments need unbiased and reliable values, for example to include in Cost-Benefit Analysis. Since valuations of non-market goods and services often cannot be estimated from real behaviour, stated preference methods (SPM) are frequently used to guide policymaking (Freeman 1993), where the preferred method in recent years has been the Choice Experiment (CE) method (Hoyos 2010).

This section introduces the focal issues for the thesis, and aims to provide a broader perspective in which the present thesis should be viewed. First, concepts of environmental value are presented which clarify that the focus in the present thesis is on the economic value of environmental goods. Second, market failure is introduced, including how it arises and the classification of environmental goods and a brief review on valuation methods. Third, the research questions and hypotheses for each paper are presented which fulfil the general aim of the thesis. Fourth, the theoretical background behind qualitative methods used is discussed. The qualitative methods focus on understanding the component of value which was inspired by the theory of concept. Finally, a brief review of the two theories behind CE (the quantitative method used in this thesis) namely Lancasterian and random utility theory are presented. It continues with a presentation of the concepts of individual utility and preference as well as welfare measures. Reviewing the characteristics of the theoretical framework makes it clear why CEs are used to fulfil the overall purpose of the present study.

## **1.2. Environmental value from the economic angle**

In the present thesis the focus is on identifying and estimating environmental values, thus, it is necessary to first describe what I mean by value. Interpretations of the term 'environmental value' vary depending on the field (e.g. social science, philosophy, natural science), and the concept of the value of nature is complex and multidimensional (Turner et al. 2003).

For the purpose of the present thesis, which is estimating monetary value of forest ecosystems, the economics definition is taken as a point of departure. In the following, the definition of environmental values and then different types of environmental goods are presented.

In economics, the values of environmental resources or goods in general, are measured by the degree of usefulness the resources have for humans. In other words, economic value is a measure which takes the benefit that a consumer can achieve from either a good or service into account (Pearce and Turner, 1990; Hanley and Spash, 1993). The concept of ecosystem services is closely related and is applied throughout the Introduction as a linkage between nature and economy which addresses the flows of value to people as a consequence of the amount of natural capital (TEEB 2010).

The economic value of ecosystem services is divided into two main groups: use and non-use values (Figure 1). Use values relate to the actual use of the good either directly (direct use value) such as crops, livestock, fish, and water, or indirect use value. In terms of ecosystem services the direct benefits are provisioning services. Indirect benefits from ecosystem services can e.g. be water purification, climate regulation (e.g. carbon sequestration), and pollination. In ecosystem terms these are regulating services.

Direct and indirect uses of the good are clear concepts. However, potential use values could also be important since people may have a utility from maintaining a good in order to preserve the option of using it in future. This category of use value is called option value (Batemen et al. 2002).

Non-use value is an associated value that does not concern our use, either direct or indirect, of the environment, its resources or services. Non-use values are categorised as follows: a) existence value, b) altruistic value and 3) bequest value. Existence value refers to the value which people derive from the knowledge of the existence of a good, such as a forest (Hageman, 1985; Loomis and White, 1996). Thus, the benefit is often a sense of well-being from knowing a good exists, even if it is never used or experienced.

Bequest value is the value of ensuring the availability of the good for future generations. It indicates a perception of benefit from the knowledge that resources and opportunities are being delivered to offspring [Beaumont et.al 2007]).

Altruistic value is the value which an individual has for others' use of the asset or resource. The value includes individual willingness to pay for maintaining an asset or resource that is not used by the individual, so that others may make use of it.

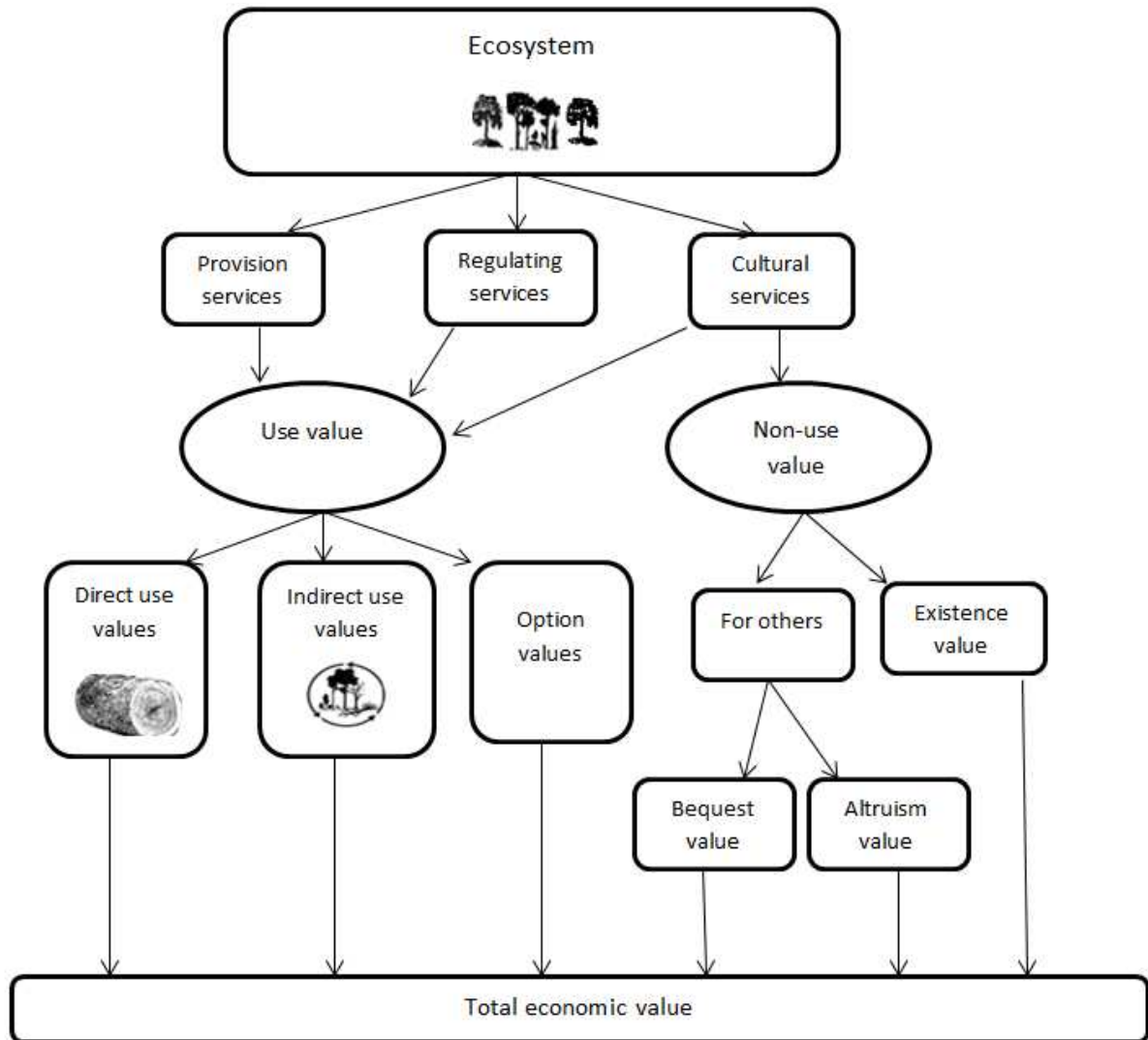


Figure 1 Total economic value of ecosystem (Adapted from Pearce et al. 2006)

Economic theory assumes that the market price reflects the true economic value of resources only when a perfect (or a close to) markets exist. Although the unit of measurement in e.g. cost benefit analysis is money, the conceptual basis is utility. For many years, it was a difficult issue translating utility into a cardinal measure. Utility functions are representations of things that make a person happy are instead used to rank objects of choice to generate ordinal measure of preference. People are asked to make a trade-off among different choices and maximize their utility.

Generally, economic value is measured by *the marginal welfare change* as expressed via stated or revealed individual preferences. So, the explanation is therefore "what is the maximum amount of

money a specific individual is willing and able to forgo to be better-off, or avoid being worse-off, due to changes in environmental goods or service"? Measurement of welfare changes can be in terms of changes in the price of goods or its quality. To obtain a fundamental measure which approximates an underlying utility change, money metrics of underlying utility change are used. I.e. the maximum amount that someone is willing to pay to acquire more of something desirable, or less of something undesirable.

A more precise definition of both WTA and WTP can be provided by the concept of the 'exact welfare measure'. This measure was first suggested by Hicks in 1943 in the context of changes in prices for consumer goods. When considering a policy that would increase the price of a good to households, Hicks define the compensation variation of this move as the minimum compensation an individual would have to be offered to make her well off without the price change, compared to the situation where prices were low and no compensation was offered. This is her minimum WTA. It is worth mentioning that there may be situations where individuals are quantity-constrained, e.g. respondents face pre-defined changes in levels of conservation policies and cannot choose what level of conservation to enjoy. This will often be the case in the present thesis, the concepts used for welfare measurement change somewhat (Hanely and Barbier 2009). Thus, WTP which has been used in the present thesis is based on compensating surplus which tries to determine the maximum price that each individual is willing to pay to receive a good or to avoid something undesired.

What we measure in valuation methods is social costs and benefits of an action, that is the costs and benefits to all members of society. The marginal social cost is made up of the marginal private cost and any external costs. The marginal private cost is the cost to the firm (or individual) of producing a given good or service. External costs (also known as negative externalities) are costs which affect society on top of those costs the firm has already paid. Examples could include pollution or health costs. These external costs are added to the private cost to give the total social cost.

One of the main issues in measuring welfare and the value of environmental goods and services is market failure. It occurs when the market fails to measure the costs and benefits to society for different reasons. Being aware of this issue is important in doing valuation studies. The concept of market failure is now presented.

### **1.3. Market failure**

The fundamental ideas of the market failure principle refer to the theory of perfect competition and the fundamental welfare theorems that link this idea to the optimum allocation of resources in an economy.

Market failure is a focal concept in understanding the welfare economics of environmental goods and services. Most environmental goods and services are categorised as non-market goods and so various types of market failure are associated with them. Thus, decisions regarding ecosystem management including cost-benefit analysis are complicated tasks. Market failures occur when markets do not reveal the full social costs or benefits of a good. For example, the price of fossil fuel does not completely reflect the costs, in terms of air pollution, that are forced on society by the consumption of e.g. gasoline. Market failures related to environmental goods and services include the facts that: (i) many environmental goods and services are public goods; (ii) most of environmental goods and services are affected by externalities which occur when one person's actions affect another person's well-being and the relevant costs and benefits are not reflected in market prices.; and (iii) property rights related to ecosystems and their services are often not clearly defined (Hanely 1997; Begg et al 1997).

Environmental goods and services are often public goods, which mean that they may be enjoyed by any number of people without affecting other peoples' enjoyment (non-rival) and people cannot be prohibited from enjoying them (excludability). The problem with public goods is that, although people value them, no one person has an incentive to pay to maintain the good so free-riding is possible.

Externalities can be negative or positive. They occur when the production or consumption of a good, has a positive or negative effect on other people not involved in the production or consumption (Hanely and Barbier 2009). For example, if a river is polluted by runoff from agricultural land, the people downstream experience a negative externality. The main issue with negative externalities is that the people they are imposed upon are generally not compensated for the damages they bear. Externalities may also be positive. For example there are many externalities from forests and nature which offer benefits for society which individuals do not have to pay for (Hanely and Barbier 2009).

Finally, externality problems often occur in market economies when property rights are not properly assigned. If property rights for natural resources are not clearly defined, they may be overexploited,

because there is no encouragement to conserve them. When property rights cannot be established, the effectiveness of markets in terms of the distribution, pricing and limiting of these resources is considerably reduced.

Many resources have no specific or identifiable owner, and are collectively available for everyone to use. An absence of boundaries allows free-riders uncontrolled access, which can result in the over-exploitation or misuse of the resource.

As mentioned, market failures occur when markets do not reveal the full social costs or benefits of a good. Thus, valuation methods can help resource managers to deal with the effects of market failures, by measuring the total social costs and benefits to society. Valuation methods are presented briefly in the section below.

#### **1.4. Valuation methods**

Different methods have been applied to measure the true economic value of non-market environmental goods and services. The available valuation methods can be categorised as revealed and stated preference methods (Bateman 2002). Revealed preference methods are used to value non-market benefits/impacts by observing behavior and relationships between non-market goods and actual market therefore, they are indirectly dependent on the presence of an actual market. Stated preference methods are applied when estimating the monetary value of non-market goods by creating a market. When it comes to estimation of the total economic value of a non-market good, stated preference is superior to revealed preference because non-use values can only be estimated using stated preference methods. These methods can provide ex-ante use and non-use benefit estimates and are highly flexible and applicable to a wide variety of goods and scenarios (Powe 2005). However, one common criticism of stated preference methods is hypothetical bias. Hypothetical bias occurs in stated preference valuation studies when respondents report a willingness to pay (WTP) that exceeds what they actually would pay using their own money in reality. The presence of hypothetical bias challenges the validity of the results estimated from stated preference methods. Unfortunately, there is no widely accepted general theory of respondent behavior that explains hypothetical bias (Loomis 2011). Meta-analyses (List and Gallet 2001, Little and Berrens 2003, Murphy et al. 2005) have been implemented to investigate study design elements affecting hypothetical bias. According to List and Gallet (2001) private good studies result in less

hypothetical bias than studies in which public goods are valued, and that hypothetical bias is larger in willingness to accept studies than willingness to pay studies.

Cheap talk is an ex-ante mitigation technique where a text script is shown to respondents before starting an experiment which hints to respondents about possible bias and emphasizes the importance of the respondent's answers despite the hypothetical nature of the chosen task. Cummings and Taylor (1999) suggested a reminder known as "Cheap Talk" (CT) to be effective. However, in subsequent studies the effectiveness of cheap talk has proven to be vague (Aadland and Caplan 2006; List et al. 2006).

In the present thesis the inclusion of non-use value, in addition to use value, is important, so the CE approach (a stated preference technique) has been selected. In the following section, different types of environmental goods, specifically the ones considered in the present thesis, are reviewed.

### **1.5. Types of environmental goods**

Apart from the different categories of environmental values mentioned above, researchers need to be aware of different types of environmental goods and their characteristics, especially when the focus is on the linkage between valuation and policy formulation (e.g. Paper three in the thesis).

In economics, based on the specific characteristics of the goods, there are different classifications. Samuelson (1954) focuses on subtractability as a distinctive characteristic of the goods and divides all goods into two categories namely public and private. A good is subtractable when one person's consumption deducts from the total consumption which is available to others. Musgrave (1959) addresses another characteristic of the good which is excludability. In fact, addressing the attributes of a good which make it (im)possible to exclude someone from benefiting from the good. From his view, private goods are excludable while public goods are not.

In the present thesis the classification provided by Ostrom (2003) is used which is a combination of the classification by Samuelson (1954) and Musgrave (1954). Ostrom (2003) uses both characteristics of excludability and subtractability and suggests four categories of goods namely, private, public, common-pool resource and club goods. Needless to say, the degree of subtractability and excludability is relative since a lot of goods cannot be placed into the pure categories. Therefore, according to Ostrom (2003), public goods are characterised by being non-excludable and non-rival in consumption (Figure 2). Well known examples of pure public goods include flood control systems, street lighting and national defense. A flood control system cannot be



limited to those who have paid for the service. Also, the consumption of the service by one household will not diminish its availability to others. For example, an aesthetic view is a pure public good. No matter how many people enjoy the view, others can also enjoy it. In most cases, no individual user would pay for a good that could be used for free. Many of environmental goods are categorised as public and the issue of free-riding is an obvious reason for market failure for putting a price on them.

		<i>Subtractability</i>	
		<i>Low</i>	<i>High</i>
<i>Excludability</i>	<i>Low</i>	Public good	Common-pool good
	<i>High</i>	Club good	Private good

*Figure (2) adopted from Ostrom 2003*

In the third paper, the nature of biodiversity as a public good is investigated. It discusses to what extent it can be considered as global or local public good. This is of importance for policy formulation in transnational coordination of conservation effort. According to Perrings and Gadgil (2003) some biodiversity values, like the preservation of the information contained in the global gene pool, are categorised as pure public goods because of providing long-term benefits at a global scale (global public goods). Others, such as the regulation of productivity in grasslands, the control of soil erosion, are impure public goods since they provide benefits at a much more local scale (local public goods) on a much shorter time-scale (Perrings and Gadgil2003).

The international coordination of conservation policy and management is widely expected to reduce costs and increase effectiveness. An underlying assumption is that biodiversity protection is a global public good and, specifically, that the value of biodiversity protection is independent of the geographical and political jurisdiction of provision.

The research question that this paper addresses, is how far biodiversity protection can be considered a global public good, with benefits extending beyond national borders? Traditional public goods and services, such as national defence, libraries and fire brigades, have fairly well-defined benefit distributions at local, state or national scale. However, the geographical distribution of benefits from

some public goods and services (especially non-use values), including the protection of biodiversity is not quite as obvious (Deacon and Schlapfer 2010). Therefore, the degree to which biodiversity protection implies public goods is often discussed in relation to whether the spatial location should matter for biodiversity protection valuation (Johnston et al 2002, Bateman 2009, Brouwer et al. 2010, Schaafsma 2011), including whether non-use values are also sensitive to site (here country) of provision (Hanley et al., 2003, Schaafsma 2011). This discussion and research question is of interest, because international coordination of biodiversity conservation may face challenges, the less people share and value the public good aspect of biodiversity protection across borders.

## **2. Research questions and hypotheses**

The overall objective of the present thesis is to understand the components of environmental value by examining lay people's perception. Hypotheses and research questions in Paper One targeted increasing the current knowledge on the lay people's perception of nature and the most frequent characteristics of forest ecosystems that people find prefer. Hypotheses and research questions in Paper Two use knowledge gained from Paper One for estimating the value of forest ecosystem and, consequently, decreasing the anomalies such as contextual embedding and scope insensitivity bias. Hypotheses and research questions in Paper Three have been framed to use the result of a CE to formulate policies in concern with protecting forest ecosystems i.e. biodiversity coordination in paper three and conflict management in forest recreation in Paper four). Research questions, hypotheses and methods of data collection are summarized in Table 1.

Table 1. Research questions, hypotheses, and methods of data collection

	Research questions	Hypotheses	Methods of data collection
Paper one	<p>1-How do lay people perceive nature?</p> <p>2- To what extent do lay people understand ecological concepts?</p> <p>3- What are the most frequent characteristics of forests that people mention?</p> <p>3- What mental constructs do lay people have surrounding the concept of biodiversity?</p>	<p>The perceptions of lay people about environmental goods are different from those which are commonly held by the research community when they select attributes and levels for inclusion in stated preference valuation exercises.</p>	<p>Qualitative techniques, such as focus group discussions, individual interviews. Cognitive methods, such as thinking aloud and drawing pictures</p>
Paper two	<p>Does informing respondents about the stability and resilience services of biodiversity as opposed to only presenting biodiversity as species richness decrease the (contextual) embedding issue in respondents' WTP for species richness?</p>	<p>If respondents are presented with attributes of biodiversity that are incompatible with their own mental constructs this will decrease the contextual issue in their WTP for biodiversity preservation</p>	<p>Results of the qualitative methods from Paper one and a CE</p>
	<p>Does informing respondents of the stability and resilience services of biodiversity as opposed to only presentation biodiversity as species richness change the respondents' sensitivity to scope of study?</p>	<p>Overall hypothesis : Presenting the attribute (biodiversity) compatible with respondents' mental construct makes respondents scope sensitive about different levels of the biodiversity provided:</p> <p>- WTP of respondent who are only presented by species richness is not statistically significant different among different levels while this is not the case when they get informed by stability and resilience services of biodiversity</p>	<p>Results of the qualitative methods from Paper one and a CE</p>

	Research questions	Hypotheses	Methods of data collection
Paper three	To what extent can biodiversity protection be considered a global public good, with benefits extending beyond national borders?	<p>Overall hypothesis: Biodiversity protection is a global public good and specifically that the value of biodiversity protection is independent of the geographical and political jurisdiction of provision:</p> <p>(i) Neither distance to, nor the nationality of, the site of conservation affects WTP estimates for a given policy alternative.</p> <p>(ii) Only distance to (and not nationality of) the site of conservation affects WTP estimates for a given policy alternative.</p> <p>(iii) Only nationality of (and not distance to) the site of conservation affects WTP estimates for a given policy alternative.</p> <p>(iv) Distance to as well as nationality of the site of conservation affects WTP estimates for a given policy alternative.</p>	A CE, delivered online
Paper four	(i) Does any potential evidence of conflict among forest user groups exist in Denmark, (if so,) who disturbs whom and to what extent?	There is no evidence of disturbance and potential conflict among different forest user group in Denmark	online survey
	(ii) How much further each forest user group is willing to travel (WTT) to avoid meeting many forest visitors and thereby encounter potential conflicts? Are some user groups more willing to travel further than others?		CE method-online survey

### **3. Theoretical framework**

#### **3.1. Theoretical framework for the qualitative approaches used**

Paper one, identifies categories of forest ecosystems, as an environmental good to be valued, grounded in focus groups and individual interviews. However, concepts from previous studies and theories implemented on lay people perception and representation of nature and biodiversity were used (Van den Born et al. 2001; Hunter and Rinner 2004; Buijs et al. 2006, 2008 ,2009, Fischer and Yuan 2007).

The approach of Fischer and Young (2007) was mainly applied. It is based on using ‘the theory of concept’ to build individual’s mental constructs surrounding concepts. The theory of concept consists of using three systematic steps which helped to reach the categories of biodiversity.

This approach has three steps which is helpful to cascade individual mental constructs: (i) an explicit word or expression which categorises a concept and (ii) definition of a concept, (iii) an ideal illustration or image which is a representative of the concept. At the first step understandable categories for a concept e.g. biodiversity, was found by understanding lay people’s a perceptions of biodiversity and using lay people’s speech and then expanded it by collecting data about ideal image of the concept. Since one undeniable step of understanding biodiversity is getting a deep understanding of human relationships with biodiversity (Biljs 2009), in addition to the steps presented by Fischer and Young (2007), we investigated participants’ attitudes toward forest ecosystems to see how lay people frame their view towards biodiversity management policies. Since in valuation methods we usually present hypotheses in a frame of conservation policies, this step helps us to frame them according to lay people’s mental constructs to decrease heterogeneity and help approach their true value (willingness to pay) for biodiversity.

For finding categories for biodiversity, steps (i) and (ii), Mace et al.’s view on biodiversity (2012) was used to see the extent to which the lay people view is similar to these categories. Mace et al. looked at biodiversity with an ecology perspective and put biodiversity into 3 main categories; biodiversity as a good *per se*, biodiversity as a regulator of ecosystems and biodiversity as a final ecosystem services. However the authors do not provide any qualitative view point from the general public regarding these categories. Therefore the question can be posed that if all these categories are embedded in a lay person’s mental construct about biodiversity, are the categories of any use in valuation studies? Our findings from qualitative investigations, proved the presence of two of

categories presented by Mace et al. (2012) in participants' mental constructs. These are biodiversity as a good and biodiversity as a regulator of ecosystem function.

### **3.2. Theoretical framework of the selected quantitative approach (CE)**

The theoretical framework of the CE method which was applied in Papers two, three and four is based upon neoclassic welfare theory, the Characteristics Theory of Value (Lancaster 1966) and Random Utility Theory (McFadden 1974). Neoclassical welfare economic theory presumes that individuals are rational, have well-defined preferences over alternative bundles of goods and they maximize their utility at the time of making a choice. Therefore, each consumer is able to rank a realistic set of goods and choose the one which gives the highest preference. (Freeman 1993; Gravelle and Rees 1992). In economic theory people's preference are assumed to be complete, transitive and reflexive (Gravelle and Rees, 1992). This means that people are able to express a preference of indifference between any pairs of consumption bundles; they have consistent preference meaning that if they prefer X over Y and Y over Z, and then they also prefer X over Z and any bundle is indifferent to itself. Paper 2 addresses a situation where respondents' estimated value for the two bundles of a good are inconsistent (scope insensitivity) and discusses one possible solution for such issues.

The CE method, which is a questionnaire based approach, presents a survey to respondents with a hypothetical market where they are asked to choose between two or more alternative compositions of a good in a choice set. Each alternative is described by a set of attributes in accordance with Lancaster's attribute theory of value, where a good can be described as consisting of a bundle of characteristics at certain levels where utility is not derived from the good as such, but rather from the specific attributes. Thus, total utility of the good is the sum of the attribute utilities (Lancaster 1966). Paper one and two use this theory and address the importance of selecting and presenting the attributes of a good in order to increase the validity of the estimated result.

When prioritizing a relevant policy for provision of the environmental goods and services is the main aim of estimating respondents' preference, it is necessary to probe and clarify what the value of the environmental goods and service is. This value consists of the social benefits and social costs and such values are measured over all individuals' value. Economic theory of consumer choice (McFadden 1974; Lancaster 1966) taking the fact that respondents are rational and maximize their

utility over different choices so it can be applied to assess these values in real life settings. In depth understanding the value of the environmental goods and services is what the Paper three and four are referring to.

### 3.3. Individual utility function

The first step of estimating marginal utility is framing the individual utility function. Individual utility function,  $U$ , of a  $j$ th alternatives in the  $n$ 'th choice occasion respondent,  $i$ , faces a choice between a status quo and two management alternatives, can be described by (Lancaster 1966):

$$U_{ni} = U(x_{ni}, Z_n)$$

Where individual  $n$  derives utility,  $U$ , from good  $i$  depending on a vector of attributes of the good,  $x$ , and a vector,  $Z$ , describing the socioeconomic characteristics of the individual. If the individual gets a choice between two goods  $i$  and  $j$ , it is assumed that the rational individual will maximize their utility by comparing the two goods and choosing the one which gives the higher utility. Therefore good  $i$  is chosen over good  $j$  if and only if:

$$U_i > U_j, \forall i \neq j$$

Difficulties in completely describing the good in terms of its attributes, differences in how individuals perceive and value the attributes or simple measurement errors mean it is impossible to observe this utility with certainty by examining the choices made (Bateman et al. 2002). What the analyst actually observes is an indirect utility function,  $V$ . In a specific case, where a respondent,  $i$ , faces a choice between a status quo and two management alternatives, the utility,  $U$ , of these  $j$  alternatives in the  $n$ 'th choice occasion can be described by:

[3]

$$U_{ijn} = \begin{cases} V(ASC, x_{ijn}, \check{\beta}_i, \beta) + \varepsilon_{ijn} \rightarrow \text{If } j = 1(\text{statusque}) \\ V(x_{ijn}, \check{\beta}_i, \beta, \sigma_i) + \varepsilon_{ijn} \rightarrow \text{if } j = 2,3; \end{cases}$$

Here the indirect utility,  $V$ , is a function of the vector of explanatory variables,  $x_{ijn}$ , containing characteristics of the individual, the alternative and the choice situation, as well as the vectors of individual-specific random parameters,  $\tilde{\beta}_i$  and fixed parameter,  $\beta$ . An alternative Specific Constant (ASC) is specified for the status quo alternative in order to capture the systematic component of a potential status quo effect (Scarpa et al., 2005). Assuming a linear function for  $U_{ij}$  and collecting all the arguments in the vector  $x_{ij}$  for alternative  $j$  and individual  $i$ , we can write  $U_{ij} = \tilde{\beta}x_{ij}$ , where  $\beta$  is a vector of parameters. Assuming the error term  $\varepsilon_{ki}$  is IID extreme value distributed, (see Hausmann and McFadden 1984) the probability of choosing alternative  $k$  among  $j$  alternatives by individual  $i$ , according to Train (2003), is:

(4)

$$P_i(k) = \frac{\exp(\mu\tilde{\beta}_i x_{ij})}{\sum_j \exp(\mu\tilde{\beta}_i x_{ij})}$$

where  $\mu$  is a scale parameter which is inversely related to the error variance and can be estimated by applying a scale test (e.g see Bierlaire, 2003). Typically in a CE, the price of the good is included as one of the attributes and if an estimated  $\beta$ -coefficient for one of the attributes,  $x$ , is divided by the  $\beta$ -coefficient for the price attribute,  $\beta_{price}$ , and multiplied by -1, the result is known as the implicit price or the WTP for that specific attribute (Louviere et al. 2000):

$$WTP_x = -\frac{\beta_x}{\beta_{price}} \quad [5]$$

Willingness to Pay (WTP) and Willingness to Accept (WTA) are two examples of existing devices that are used to determine the price of a good. It is well known that the concepts of WTP and WTA are derived from the Hicksian welfare measures of the compensating variation (CV) and the equivalent variation (EV). Below a brief review of Hicksian welfare measurement provided.

#### 4. Progress and contribution

The previous section addressed the assumed theoretical framework as well as basic assumptions behind the CE method in order to derive preferences from choice. The Lancaster (1966) theory



behind CE assumes that individuals derive their utility from the characteristics of goods rather than from the goods themselves. Any technical or conceptual incapability in presenting attributes or characteristics in the design of questionnaires may cause a bias.

Some of the well-known biases which have been probed in the literature include: hypothetical bias (Carlsson and Martinsson 2001; Johansson-Stenmann and Svedsätter 2008), starting point bias (Ladenburg and Olsen 2008), status quo bias (Scarpa et al. 2005; Boxhall et al. 2009), price vector bias (Carlsson and Martinsson 2001) and protest zero bias (Meyerhoff and Liebe 2009). The literature mainly focuses on finding better ways to analysis data and develop models that can account for some of this observed behaviour, however, there are fewer studies which examine the earlier stage of formulating an environmental good and framing the questionnaire to be compatible with respondents mental construct (addressed in Paper one and two), and then applying the result for conservation practices (addressed in Paper three and four).

#### **4.1. Paper One**

Title: Revealing general public perceptions of forest biodiversity value components and its application for valuation methods. The aim of a CE as a stated preference method in environmental valuation is to understand preferences and trade-offs within a particular population for a particular good/service/state (Coast et al. 2012). Therefore, the identification and characterisation of what is to be valued must be understood by respondents. CE enables the consideration of a broad range of policy changes, and respondents must be able to make trade-offs between the attributes in question (Coast et al. 2012). It has been argued that a lack of understanding of biodiversity issues by the lay people is a barrier to their effective participation in valuation and management programmes (Spash and Hanley 1995; Hunter and Brehm 2003) and consequently we may be measuring the preferences of only those individuals who have above-average knowledge of nature. Ensuring that attribute descriptions reflect lay people's perceptions and knowledge may help address this problem.

The qualitative techniques of focus group discussions, individual interviews, and other cognitive methods such as thinking aloud and drawing pictures, have been used to improve the awareness of respondents' perception, understanding and categorisation of environmental goods when they are answering questionnaires (Johnson et al. 1995; Fischer and Young 2007). This has resulted in improved information statements (Loomis et al. 1993; Boyle et al. 1994; Henwood and Pidgeon

2001; Powe et al. 2005; Levy and Kellstadt 2012 ) but a remaining problem is the inter-linkage between this improved knowledge of perceptions and the need for a reductionist and measurable description of the environmental attributes, as required in valuation exercises, management, and prioritisation. The aim of the study is to derive measurable attributes, from qualitative interviews, of biodiversity for a CE that captures the nature perceptions of lay people and are relevant to management.

Methods, i.e. focus group discussions and individual interviews, and picture drawing as a supplementary cognitive method were applied to investigate lay people's mental constructs about biodiversity and people's attitudes to biodiversity management. Applying a systematic coding strategy derived from grounded theory revealed that 'diversity of animals and plants', 'natural appearance and dynamics of ecosystem', and 'peace and quiet' were the attributes of forest ecosystems most frequently mentioned by lay people. In addition, it was found that lay people had an intuitive understanding of ecological concepts such as biodiversity even though various ecological scientific terminologies were unfamiliar for them.

The study has three key findings which may be useful for improving the design of questionnaires and environmental economic valuation studies. First, the value of functionality of biodiversity and the value of species richness are inseparable according to general public understanding. Therefore, valuation studies using only species richness may not reflect the true value of nature and there is a risk of ignoring its functionality value.

The second issue refers to the fact that in designing CE always the present situation is used as a benchmark for lay people and asks them to make a trade-off based on that, but according to the qualitative results we found that this may not always be the case. Respondents have an ideal image of nature or good as a benchmark and may use this as reference point to capture their preferences.

The last issue refers to the management scheme preferred by lay people to be considered by managers and policy makers in defining the policies to be supported by lay people. Lay people were mainly in favour of a type of management which is in between active and passive management because they do not want large-scale human intervention in ecosystems, but they are in favour of management which they can be involved in. This shows those participants at the time of answering a valuation exercise, in addition to the preference they have for biodiversity conservation; also care about how biodiversity is conserved. This refers to the framing of different hypothetical alternatives

which should be in tune with respondents' preferences. As a conclusion, we suggest that thorough qualitative assessment of respondents' perception of nature may facilitate the development of identifying appropriate attributes and alternatives for valuation methods. There are, however, unresolved challenges associated with the qualitative work, most particularly in the tension between the usual purpose of such work (to obtain deep understanding of phenomena) and the essentially reductive aim of describing all the key concepts of a case in as few attributes as possible (Coast et al. 2012).

## **4.2. Paper Two**

Title: How should biodiversity be presented in valuation studies? Testing for embedding and information bias.

Embedding effects play a crucial role in the validity of stated preference outcomes, often arising from imprecise presenting of goods such as biodiversity. Biodiversity is considered central to supporting all ecosystem services (Balvanera et al. 2006), but is often not thought of as a service itself (Mace et al 2012). In valuation studies, species richness, number of species, has often been used by researchers (e.g. Hoyos et al. 2012), among other reasons because it is simple to understand by respondents, fairly neutral, and it is possible to translate into a quantifiable management units for which causes, patterns and consequences are relatively well documented. However, the value that people place on the species richness may not fully capture the value people have for biodiversity as a whole. Therefore, in the current study, results from the qualitative study were used (Paper One), to describe the attribute biodiversity in a CE survey based on the mental constructs held by participants in the study instead of following previous literatures and using species richness. Qualitative findings (Paper one) showed that species richness and ecosystem stability arising from species diversity<sup>1</sup> are the most frequent characteristics when the lay people conceive biodiversity and they see them as interlinked.

Then it comes to another question which addresses which type of species should be chosen as an indicator of biodiversity for CE? The majority of respondents during preliminary-interviews addressed common species as possible indicator of biodiversity. Comparing this with species conservation practice, it generally emphasises endangered species (e.g. the Endangered Species Act, Red Lists, and protection of biodiversity hot-spots), while recent studies in ecology underlines the

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<sup>1</sup> when people state stable they describe it by being 'in balance' and elaboration of it leads to what we call hereafter, stability and resilience of ecosystem.(Bakhtiari et al .2014a)

significance role of common species to ecosystems function (Gaston and Fuller 2007) which is likely to be more strongly delivered by the common than the rare. Although there is growing evidence that more diverse systems (i.e. those that retain the rare as well as the common) both deliver higher functionality and are more resilient to change. Species richness and functionality of common species was chosen to be used for the present study as an indicator for biodiversity. People may or may not consider ecosystem stability and resilience as a part of biodiversity. So it may cause embedding issue in the valuation study. Embedding effects occur when a particular good obtains different valuations when respondents put value on independently or as a part of a bigger good. Embedding effects happens e.g. when a good is a part of a larger good (Loomis et al. 1993, Carson and Mitchell 1995, McDaniels et al. 2003, Svedsater 2007). Embedding issue also arises due to difference in spatial scales, e.g. one river representing all rivers or due to time scales when the good may only be provided for a short period but respondents believe it to be for a longer period (Brown and Duffield 1995, Clark and Friesen 2008).

An issue which has not been investigated a great deal in literature is when two components of a good are interlinked and complementary in a respondent's mind. Therefore, respondents have an implicit utility for the combination of two components. However, if respondents are presented with an indicator which only addresses one part of the good, respondents cannot be expected to express a value for the whole good. So, the difference between the value expressed by respondents when they are presented differently to a good, addresses contextual embedding effect.

The main aim of the current study is to test whether we can identify such contextual effects in a choice experiment valuing biodiversity. As 'species richness' and 'stability and resilience' of an ecosystem are functionally linked, we cannot split it into two attributes which vary independently from one another. Therefore, a split sample was applied where half of the respondents ( $\text{Group}_{\text{species}}$ ), receive a questionnaire where biodiversity is described by the number of common species only, and half of the respondents ( $\text{Group}_{\text{biod}}$ ) receive the same questionnaire, but with information on the stability consequences also in the form of an additional graphically described attribute within the choice set. Information effects and contextual embedding effects were distinguished by designing follow up questions and investigating WTP differences between those who answered 'yes' to a follow-up question on whether they considered stability and resilience service when they answered the choice sets and those who answered 'no'. Insensitivity to scope often arises from an imprecise presentation of information, and thus an imprecise understanding of the quantity of a good

provided. Consequently, the presentation of a more precise the description of a good being valued should improve scope sensitivity. Sensitivity to scope for biodiversity for the different splits was tested and it was found for all splits, that respondents are sensitive to increases in provision compared to the status quo.

The overall conclusion would be that WTP for biodiversity differs significantly between the two splits. It can be concluded that using a measure such as the number of species may underestimate people's valuation of biodiversity as it does not capture the lay people perception of biodiversity function. Furthermore, it was found that explicitly adding a description of the role of biodiversity in the ecosystem to the choice set improved sensitivity to scope.

### **4.3. Paper Three**

Title: Valuation of biodiversity protection across borders: Limits to the public good?

The continued loss of biodiversity at the global scale has prompted national and international actions and policies targeting also internationally coordinated efforts (e.g. Natura<sup>1</sup> 2000, Rio Earth Summit<sup>2</sup>, CBD2010 Nagoya<sup>3</sup>). In spite of this, the rate of biodiversity loss does not appear to be slowing (Butchart et al, 2010), many countries did not meet targets set by the Conservation on Biological Diversity (Perrings et al. 2010), and renewed pledges were made at Nagoya (CBD2010 Nagoya). There may be several reasons why trans-national agreements have made little progress: for example, simply the issue of free-riding (Olson 1965; Ostrom 1990), making it difficult to get individuals and nations to pursue their joint welfare in the case of global public good provision. An underlying assumption is that biodiversity protection is a global public good, and specifically that the value of biodiversity protection is independent of the geographical and political jurisdiction of provision.

Therefore, in this paper we examine the extent to which biodiversity protection can be considered a global public good, with benefits extending beyond national borders. Therefore, the degree to which

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<sup>1</sup> Natura 2000 is an ecological network of protected areas in the territory of the European Union:

<http://www.natura.org>

<sup>2</sup> UN's 2012 Rio Earth Summit (Rio +20): [www.earthsummit.info](http://www.earthsummit.info)

<sup>3</sup> Convention on Biological Diversity's (CBD) 2010. 10<sup>th</sup> meeting. Nagoya Japan-cop10: <http://www.cbd.int/cop10/>

biodiversity protection implies public goods is often discussed in the context of whether spatial location should matter for its valuation (Johnston et al 2002, Bateman 2009, Brouwer et al. 2010, Schaafsma 2011). Similarly, we wished to establish whether non-use values, such as existence values, are global public goods and are also sensitive to the location of the site of provision (cf Hanley et al., 2003, Schaafsma 2011). This discussion and research question is of interest, because international coordination of biodiversity conservation may face increased challenges if public good benefits are only distributed across relatively small geographical extents, i.e. if so-called “global” public goods are, in fact, not global at all..

To address this we designed a CE valuation study focused on biodiversity protection measures in beech (*Fagus sylvatica*) forests in southern Scandinavia. We selected three regions, two in Denmark (Fuen and Zealand) and one in Sweden (Scania). All three sites are separated from one another by at least one bridge. As the forests were similar in type and geographical location, the same protection measures would provide enhancements to biodiversity of comparable quality. With that design the current study successfully distinguished the effect of the distance to site of provision from the country of provision, which is novel to the literature. We found distance related attributes reflect transport costs (bridge tolls., per kilometre costs), and we found Swedes and Danes to prefer provision in their own country over that delivered in the neighbouring country. The overall results of this study have policy-relevant implications for global conservation efforts. The underlying assumption in most conservation management models is that the benefit of biodiversity protection is independent of spatial scale, culture or nationality. However, our results suggest that this is not necessarily true and so has to be taken into consideration for future transnational coordination programmes.

#### **4.4. Paper Four**

Title: Willingness to travel to avoid conflict for forest recreation planning.

Conflicts among forest visitors have direct effects on the quality of a recreational experience. As the number of visitors to forests close to residential areas increases, as well as the number of different activities, so does the potential for perceived conflicts. Previous studies have emphasised the importance of outdoor recreation for Danes (Jensen and Koch, 2004). Increasing the number (and diversity) of visitors will increase the probability of crowding and encounter rates which reduce the

quality of an outdoor experience (Absher and Lee, 1981; Shelby et al., 1989; Kleiber, 2001; Hall and Cole, 2007). The presence of conflicts is one indicator of the social carrying capacity in recreation and tourism settings being exceeded. In a European context, there has been little focus on the relationship between conflicts and crowding (Hammit and Schneider 2000 ; Arnberger and Mann 2008 ).

Conflicts are more persistent and stable beyond a particular visit. Owens (1985) suggests that the conflict itself is an experience which can be measured on a scale from dissatisfaction and frustration to confrontation. It may or may not regulate actual behaviour.

Following Owens (1985), we look at conflicts as a 'persistent' concept, and therefore we ask people for their general view of disturbance from other people. Opposed to many other studies (e.g. Vaske et al., 2000; Thapa and Graefe, 2003; Vaske et al., 2007) that focus on the actual encounters, we will therefore take mainly occurrence of disturbance into account. We do not get a good measure of the actual experienced conflict(s), but rather a measure of the perception of conflicts. Likewise, we use crowding as an indicator for the potential of conflicts. Here we follow Jacob and Schreyer (1980) who argue that crowding is a subjective judgment of an individual that e.g. there are too many other people there. So the 'too many' can refer to different number of people according to different individuals. Therefore, we do not use actual numbers of visitors, but rather terms like "Few" and "Many". It may be individually perceived how many "Few" are, but the relevant measure we are looking at is how willing people are to travel to avoid crowding and thereby the potential of conflicts.

There is some evidence of existing potential conflict among forest user groups in Denmark. To avoid conflicts we need to understand what causes it. Therefore the first research question of the present paper investigates who disturbs whom and to what extent.

The results show that the user groups which have been mostly reported as disturbing group by other group are 'Mountain Bikers', 'Horseback riders', 'Runners', 'Group-runners', 'Dog owners' (Dog walker).

As one coping strategy, recreationists may decide to visit an alternative location either within the same recreational area (i.e., intra-site displacement) or in a completely different recreation setting (i.e., inter-site displacement) (e.g. Hall and Shelby 2000). If they do the latter, they may be willing to travel further to avoid the potential of conflicts. Thus how far people are willing to travel to avoid

crowding would be an indicator of how important they find it. So, travel cost may be an indicator of the economic value of crowding avoidance.

Therefore the second research question of the paper is how much extra people are willing to travel (WTT) to avoid meeting many forest visitors and thereby encounter potential conflicts? Are some user groups more willing to move than others?

One way to avoid conflicts is to distribute people better way. We therefore generate a simple CE, with a focus only on the travel distance and crowding. We are therefore able to put the emphasis on the crowding aspect alone by utilising straight forward trade-offs within the choice cards. Furthermore, we use a subjective measure of crowding as an attribute, thereby directly focusing on people's perceived utility. We estimate how many kilometres each forest user group is willing to travel extra to reach a forest with a few visitors. This is new to the literature on investigating conflict management and recreation planning for forest. In general respondents have a negative preference (WTT) for increasing travel distance.

Comparing the marginal willingness to travel of different user groups suggests that some groups have a willingness to travel further than average to reach a forest with few visitors.

the groups of 'Mountain bikers', 'Peace and nature lovers', and 'Horse riders' have an extra marginal willingness to travel (WTT) of 4 km, 4.3 km and 4.4 km, respectively, in addition to the average preferred travel distance of 6 km, to reach to a forest with "Few" visitors. At the other end we find respondents who exercise (Exercise group) having a negative marginal WTT of a magnitude of 2 km. The marginal WTT for groups of 'Picnickers', 'Cyclists' and 'Overnighters' is not significantly different from the average WTT.

In conclusion, the present study revealed that there is evidence of perceived conflict among different forest users in Danish forests which needs to be dealt with by managers. The study gives an overview of respondents' marginal utility to travel in order to avoid crowded forests and consequently avoid conflicts. Providing knowledge of the preference for reducing crowding among different forest users may help managers and planners to distribute them along with their own preference.



## **5. Policy perspective**

A challenge in applying CEs to valuing environmental goods is how to present enough information in order to elicit respondents' precise preferences, yet not present too much detail as to provide them new information and thereby affect their preferences. Paper One and Two take a more theoretical view point on validity of the estimated result and focus on the methodological improvement of choice experiments. Applying qualitative interviews in several iterations, we carried out an in-depth investigation of human perceptions of nature (here taking forests as representative of nature) which brings some practical knowledge to be used in designing the CE questionnaire. For example, it provides measurable attributes of forest as an environmental good for a CE that captures the mental construct of the relevant target group (here lay people).

Paper two, is built on the result of Paper One and illustrate the effect of framing choice experiment questionnaire in tune with lay people's mental constructs of biodiversity. It shows the increase the validity of WTP results in the sense that respondents are more scope sensitivity and have a lower variance. We recommend that future studies use a detailed presentation of biodiversity which includes stability and resilience and uses a qualitative survey to identify how to present biodiversity in the relevant case. It seems clear that the value biodiversity both as a good itself (e.g. by species richness) and as an important contributor to ecosystem functionality.

Paper Three and Four have a more empirical policy perspective and try to investigate public preferences for policy formulation. This is of importance for bringing public support for environmental policies (Fischer and Yung 2007). From a preliminary qualitative study, it came out that although forests and biodiversity have been considered as global public goods respondents indicated that the location and country within which the goods were located were important properties. Paper Three therefore investigates whether comparable biodiversity protection measures and outcomes in two countries are indeed valued as a global public good by the population in those same two countries. Using a CE, the individuals' marginal willingness to pay (WTP) for comparable biodiversity protection measured and outcomes across country borders were estimated for locations in Denmark and in southern Sweden. The overall results of this study have relevant policy implications for global conservation efforts. While, the underlying assumption in most conservation management models is that the benefit of biodiversity protection is independent of spatial scale, culture or nationality, our results suggest that this is not completely true. This study stresses that a focus solely on cost-effectiveness may disregard important aspects of the allocation of social

benefits and result in loss of significant welfare economic gains. This is of importance for the design of trans-national conservation policies, as not only effectiveness and efficiency needs to be considered, but also welfare distribution across borders.

Getting peace and quiet from forest ecosystems is one of the most frequent characteristic of an ideal forest to visit given by respondents. This can be considered as a motivation for recreational activities in the area. On one hand, the results of qualitative analysis (Paper one) illustrate that there is evidence of perceived conflicts among respondents visiting forests. On the other hand, providing knowledge about the recreation benefits of user groups helps forest managers to be able to distribute them in accordance with their own preference. Thus, in Paper four we focus on the concept of 'perceived conflicts and crowding' among forest users. The CE method is again used to estimate the average value of getting peace and quiet from a visit to a forest and the amount of money (as a travel cost) which each forest user group would pay to avoid the conflict and crowding. The result could be used for recreational management and planning. On average, respondents are willing to travel 6 km extra to reach to a forest with fewer visitors compared with a forest with many visitors. Comparing marginal willingness to travel of different user groups suggests that some groups have a willingness to travel further than the average to reach a forest with few visitors ('Mountain bikers', 'Peace and nature lovers' and 'Horse riders'). In contrast we find the "Exercise" group who are willing to travel less than the average to reach a less crowded forest. It means that they are less sensitive to meeting many other people in forest in compared with, for example, Peace and nature lovers.

Conflict situations potentially endanger the success of a forest recreation planning. Identifying a problem is necessary but not sufficient condition. The aim of this study has been the identification alone, such that informed decision making can take place afterwards.

In addition to the above results, Paper One raised lay people perception regarding forest ecosystems 'management. Although the following results are beyond the scope of current thesis, it is worth mentioning them as they may be of use for future studies. Based on what participants addressed during interviews in regard with human relation with biodiversity and its management we could find some common concepts among their perception and 'adaptive management perspective'. Looking at the literature, Holling (1978); Norton (2005) and Evans et al. (2008) argue that adaptive management emerges from recognition and integration of the following six concepts which we also found as underlying principles in people's perception of human-biodiversity relationships, namely;

(1) variability, in that natural resources always change due to both human management actions and natural variation; which we found that participants most often refer to this issue; (2) unpredictability, in that some of these changes will be quite surprising: we came across this view among participants when they were talking about forest benefit in reducing unexpected consequence in future and they have believed that by conserving diversity of ecosystem we could have a sort of insurance and resistance against environmental changes; (3) uncertainty, which addresses the fact that management actions will always have to be initiated in the face of surprises and imperfect information; (4) experimentation, in that all management interventions should be treated as provisional experiments from which new observations, hypotheses, and knowledge about the managed resource can be developed: Looking at individual interviews reveals that participants perception was in line with issues 3 and 4 as well. (5) flexibility, in that all management policies should be continuously modified to reflect new discoveries about the managed resource; and (6) participatory, in the sense that local citizens should be involved as partners with managers and scientists in building basic knowledge and future goals for better managing the resource. This issue was also raised by participants who felt themselves responsible for conserving diversity of ecosystems and they wanted to be part of the management chain. Therefore, respondents perceived a sort of adaptive management which identifies uncertainties, and then establishes methodologies to test hypotheses concerning those uncertainties. It uses management as a tool not only to change the system, but as a tool to learn about the system. It is concerned with the need to learn and the cost of ignorance, while traditional management is focused on the need to preserve and the cost of knowledge (Holling 1978). Therefore, taking the derived knowledge from respondents view point of nature management and formulate the relevant policies, increases better support from individuals and consequently society.

To sum up, environmental concepts are complex in nature which makes valuation methods a challenging area. The present thesis illustrates the positive effect of undertaking mixed approaches which enrich our understanding of the preferences of the general public regarding environmental issues and consequently decreases the complexity and anomalies in estimation results. However, there is still a need to developing such mixed approaches in order to be able to link more directly to valuation approaches and policy.

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# **Research papers**

# **Paper One**

# Revealing general public perceptions of forest biodiversity value components and its application for valuation methods

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## Abstract

Valuation studies about environmental goods, e.g. biodiversity, often use characteristics and indicators that seem ecologically sound. But ecological value and public value are not necessarily the same. Therefore, combining ecological indicators with public knowledge and language in framing valuation studies may improve the consistency of outcomes. Using focus group discussions and individual interviews, and picture drawing as a supplementary cognitive method, we investigated lay people's mental constructs about biodiversity and human attitude to biodiversity management.

Applying a coding strategy for analysing qualitative data from individual interviews and group discussions revealed that 'diversity of animals and plants', 'natural appearance and dynamics of ecosystem', and 'peace and quietness' were the attributes of forest ecosystems most frequently mentioned by lay people. In addition, it was found that regardless of familiarity with the various ecological scientific terminologies, lay people had an intuitive understanding of ecological concepts such as biodiversity. The analyses demonstrated that individuals' perceptions and values of biodiversity could be framed in two interlinking categories: as a good in itself, and its regulatory function. In addition, respondents expressed an ideal image of forest biodiversity which may be used as a benchmark for valuation methods and is not always in accordance with the present situation (status quo). It was also revealed that individuals' attitude to forest and its biodiversity may be rooted in their mental constructs and can be useful in targeting policy and conservation management.

Key words: Individual mental construct, Biodiversity, Qualitative method, Choice Experiment, Attribute definition.

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## 1. Introduction

The aim of a Choice Experiment (CE) as a stated preference method in environmental valuation is to understand preferences and trade-offs within a particular population for a particular good/service/state (Coast et al. 2012). Therefore, the identification and characterisation of what is to be valued must be understood by respondents. CE enables consideration of a broad range of policy changes, and respondents must be able to make trade-offs between the attributes in question (Coast et al. 2012). The Lancaster (1966) theory behind CE assumes that individuals derive their utility from the characteristics of goods rather than from the goods themselves. Therefore, any technical or conceptual flaws in the presentation of attributes or characteristics in the design of questionnaires may cause a bias. The qualitative techniques of focus group discussions, individual interviews, and other cognitive methods such as thinking aloud and drawing pictures, have been used to improve the awareness of researchers regarding respondents' perceptions, understanding and categorisation of environmental goods when they are answering questionnaires ( Gobster 1998; Fischer and Young 2007). This has resulted in improved information statements ( Powe et al. 2005; Levy and Kellstadt 2012) but a remaining problem is the inter-linkage between this improved knowledge of perceptions by researchers and the need for a reductionist and measurable description of the environmental attributes, as required in valuation exercises, management, and prioritisation. The aim of this study is to derive, from qualitative interviews, measurable attributes of biodiversity for a CE that align with perception of lay people and are relevant to management.

It has been argued that the public's lack of understanding regarding biodiversity issues is a barrier to their effective participation in valuation and management programmes (Spash and Hanley 1995; Hunter and Brehm 2003). Researchers in valuation studies usually take into account the preferences of those respondents who, according to follow up questions, indicate a proper understanding of questions and discard the respondents who do not display the characteristics researchers are looking for and therefore answer inconsistently. Consequently what happens is that researchers measure the preferences of only those individuals who have above-average knowledge of the goods in question, e.g. forest biodiversity in our case.

Thus, securing attribute descriptions, scientifically, which reflect lay people's perceptions may alter this. An obvious critique is that what if people have an objectively wrong knowledge of the good – do we want to value this wrong knowledge? The question is whether or not the wrong knowledge arrives from the information provided to them. The answer therefore is, in our opinion, that

although focus groups and exploration of the “lay people’s mental construct” are useful tools for building such an explanation of attributes, we need to ensure that the explanation is scientifically sound. In the current study we satisfied this by consulting with a group of scientists<sup>1</sup>.

In present study we focus on forest biodiversity and use the terms ‘biological diversity’ and ‘biodiversity’ interchangeably to address.

The article is structured as follows: First we present a literature review of studies using stated preference techniques for monetary valuation of forest biodiversity and identify the ways in which researchers have described biodiversity, e.g. using indicators such as number of endangered species and species richness. This is followed by a review of psychological studies of lay people’s perceptions of biodiversity, in an attempt to present an overview of the various perceptions exhibited by the public as described in other studies to help interpret our results. The methods section presents the qualitative analysis of lay people’s perceptions and their mental constructs of forest biodiversity which was undertaken. The results section shows how individuals perceive forest and suggests some categories and definitions for future communication, and how individuals explain their attitude to and their main relation with forest biodiversity, and consequently with its management. The analysis is based on categorisations found in the literature. Beyond these outcomes regarding forest biodiversity, the results provide the possibility of identifying other important aspects of forest ecosystems from lay people’s point of view which can be applied in CE. Then we discuss this integrated approach to understand the concept of forest biodiversity and other characteristics of forest ecosystems to be valued and the way in which they could be presented to lay people.

### **1.1. Review of studies using Choice Experiment for valuation of biodiversity**

According to Hanley et al. (2001) and Barkmann (2008) insufficient attempts have been made in valuation studies to clarify how lay people perceive unfamiliar and complex terms like biodiversity or species and functions thereof. However, studies on environmental ethics and psychology have tried to clarify lay people’s perceptions using qualitative methods. For example, Buijs et al. (2008) suggest that lay people use very deep and complex social representations of biodiversity to argue

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for particular approaches to biodiversity management. This refers to the situation that although in many cases they cannot explain what biodiversity is, they have some intuitive understanding or awareness of what it is.

From an ecological view point, Mace et al. (2012) distinguish between three categories of biodiversity: biodiversity as a good in itself, biodiversity as a regulator of ecosystem, and biodiversity as final ecosystem services, but they do not provide any lay people view of these categories which is qualitatively based, and it can be questioned whether the categories are embedded in lay people's mental constructs about biodiversity to be used in valuation studies.

A literature review was used to reveal how researchers have described the characteristics of biodiversity and the integration of the concept into CE. Web of Science was searched for studies, using the keywords (biodiversity\* OR "biological diversity\*") AND (Choice Experiment\*). From the search results, studies were selected based on their primary focus on valuation and the use of biological diversity (biodiversity) as an attribute in CE, i.e. excluding studies that used CE but not biodiversity as an attribute, or used biodiversity valuation but not through CE. The search on Web of Science resulted 125 studies and the primarily skimming showed that 50 of 125 were relevant according to the scope of our research. 45 articles used species number as an/the indicator of biodiversity, and 29 out of the 45 focused on endangered species. Only 5 studies included both the number of species with the role of species diversity in the stability and resilience of ecosystems (Table A in appendix).

## **1.2. Concepts of nature and biodiversity in psychological studies**

Several studies has found a lack in lay people's knowledge of scientific definitions (Spash and Hanley 1995; Hunter and Brehm 2003) and as a result has suggested better education of the public (Nisiforou and Charalambides 2012; Sekercioglu 2012). On the contrary Buijs et al. (2008) argue that lay people's definition and understanding of biodiversity is not in the same category as scientific definitions but derived from lay people's daily practice and experiences as well as their emotions and knowledge from their surrounds which help them perceive biodiversity. This may explain why a number of studies find that lay people have a deep perception of biodiversity and ecosystem services despite their limited educational background and knowledge of scientific terms (Buijs et al. 2008; Nisiforou and Charalambides 2012; Sekercioglu 2012).

According to Robertson and Hull (2001), Buijs et al. (2006) and Fischer and Young (2007) interconnection and stepwise thinking are the main components of individuals' mental constructs. So, the present study has tried to look at individuals' mental constructs of concepts to emphasise attitudes to biodiversity and forest in a stepwise manner and use this as the basis for attribute generation. Among the categorisations made, the two first mentioned by Mace et al. (2012), i.e. biodiversity in itself and the functionality of biodiversity, are what comes closest to the findings of the present study (see section 3.2).

## **2. Materials and methods**

### **2.1. Case study**

The study was conducted in the southern region of Scania. The case areas are densely populated: ([www.statistikbanken.dk](http://www.statistikbanken.dk), [www.ssd.scb.se](http://www.ssd.scb.se)). These highly visited case areas were selected to allow local participants to use their experience of biodiversity and being in a natural ecosystem like forest when they state their attitude to biodiversity management and conservation.

### **2.2. Qualitative methods**

In the present study, a broad range of qualitative approaches have been applied: unstructured, semi-structured, in-depth interviews focus group discussions, thinking aloud, and drawing pictures. Such approaches have been used to explore phenomena and intuitive understanding of public views of biodiversity related concepts.

Focus group discussions and individual interviews are research techniques used in marketing and social sciences, and increasingly applied to environmental topics ( Robertson and Hull 2001; Busch et al. 2012) in which data are obtained from a relatively small group of respondents selected from a broader population. The techniques require small groups, led by a facilitator who encourages participants to pursue their own priorities on their own terms and in their own words. This enables the group to address those issues that are perceived as particularly relevant by the participants, rather than issues chosen by the researcher. In addition, the techniques encourage discussions and interactions amongst participants (Bryman 2008). The number of respondents in qualitative studies are much smaller than those used in quantitative studies (Ritchie et al. 2003; Burke and Larry 2012) because studying the meaning and not making generalised hypothesis statements is the main aim (Crouch and McKenzie 2006). Finally, because qualitative research is very labour intensive,

analysing a large number of respondents can be time consuming and is often simply impractical. So, researchers generally use theoretical saturation<sup>1</sup> as a guiding principle during their data generation (Bryman 2008) . In the present study 8 focus group discussions and 18 individual interviews include unstructured, semi-structured, in-depth interviews have been conducted (see Table 1). Participants' ages have been ranged between 18 and 75 years and the respondent pool was made up of the same age distribution as society generally. Group size varied between three and ten participants and all the groups were mixed in gender. Participants had a broad range of backgrounds, including urban and rural lay people, and natives as well as immigrants who have/had been living in the country for more than 20 years. Participants were chosen randomly from local citizens who are living both near and far from forest areas. Respondents participated either in one focus group or individual interview but not both.

Table 1. Information about interviews and focus groups discussions

Type of interview	Participants no.	Age range, years			Country-region	Sex
		18-36	37-59	+60		
<sup>b</sup> FG1-F <sup>a</sup>	3	2	1		Denmark-Funen	M/F
FG2-F	5	2	2	1	Denmark-Funen	M/F
FG3-F	5	2	1	2	Denmark-Funen	M/F
FG1-Z <sup>c</sup>	5	4	1		Denmark-Zealand	M/F
FG2-Z	5	5			Denmark-Zealand	M/F
FG3-Z	4	2	2		Denmark-Zealand	M/F
FG1-S <sup>d</sup>	3		2	1	Sweden-Scania	M/F
FG2-S	3	2	1		Sweden-Scania	M/F
In <sup>e</sup> -F	4	2	2		Denmark-Funen	M/F
In-Z	8	3	3	2	Denmark-Zealand	M/F
In-S	6	1	4	1	Sweden-Scania	M/F

<sup>a</sup> F: Funen, <sup>c</sup> Z: Zealand, <sup>d</sup> S: Scania <sup>b</sup>FG: focus group discussion <sup>e</sup> In: individual interview

In addition to individual interviews and focus group discussions, we made use of picture drawing during individual interviews to mitigate any constraining feelings amongst respondents caused by unfamiliarity with technical words and allow them to express their own perceptions by drawing

<sup>1</sup> Theoretical saturation is the phase of qualitative data analysis in which the researcher has continued sampling and analyzing data until no new data appear and all concepts in the theory are well-developed. Concepts and linkages between the concepts that form the theory have been verified, and no additional data are needed.

their answers rather than communicating them verbally. This method has been successfully used by Matthews (1985), Gobster (1998) and Fischer and Young (2007). The present study has the same objective as Fischer and Young (2007) in the characterisation of individual mental constructs of biodiversity but additionally tries to use this information as a basis for defining attributes and relevant policy levels to be used in valuation methods. Attempts were also made to identify a management scheme which is in tune with what lay people expect from policy makers. We had some questions which helped us to see how lay people frame their views of biodiversity management (see research questions in the appendices).

- (A) Introduction to the rationale of the study: a discussion group on the perception of ecosystems (which refers to the perception of nature).
- (B) Open discussion of different aspects of nature (ecosystem) (to learn what laymen perceive as a representative of nature in this case).
- (C) Open discussion to investigate personal experience of forest, e.g. any favorite animals or plants.  
Participants are asked to draw a picture of their preferred forest.
- (D) Open discussion to find out whether participants are able to apply and perceive ecological principles which they have implicitly mentioned, e.g. their knowledge about biodiversity and ecological concepts. They are shown pictures of forests differing in terms tree species and asked to state which one they prefer and why.
- (E) Open discussion of man-forest/biodiversity relationship and asking for suggestions to improve forest quality.
- (F) Open discussion and in-depth individual interview to identify understandable equivalent for central terms used in CE.

Figure 1. The focus group and individual interview guideline which is implemented stepwise.

### **2.3. Data coding**

The focus groups and interviews in Danish, Swedish and English, were digitally recorded and then later transcribed through the help of trained translators. The initial research questions were used to design the discussion guideline for the first focus group, and were subsequently adjusted. The coding strategy, used in a stepwise manner (Glaser and Strauss (1967), guided the data analysis to provide insight and an easy understanding of public perceptions.

Fischer and Young's (2007) approach was applied to individuals' mental constructs and includes a stepwise procedure: (i) an explicit word or expression which categorises a concept, (ii) definition of the concept, and (iii) an ideal illustration or image which is a representative of the concept. First, researchers developed clearly defined categories of the concept through understanding lay people's perceptions of biodiversity using their own wording, and then expanded on this by collecting data regarding an ideal image of the concept. Based on evidence from qualitative studies, a fundamental step towards understanding biodiversity is through acquiring an in-depth knowledge of the human relation to biodiversity (Buijs et al. 2006; Fischer and Young 2007). In addition to the steps presented by Fischer and Young (2007), participants' attitudes to forest ecosystems were analysed to see how lay people frame their view of biodiversity management.

## **3. Results and Discussion**

The results and discussion are organised into three parts. The first part is on lay people's mental constructs of forest biodiversity in order to find suitable labels and definitions for concepts, the second part illustrates their ideal image of the concepts, and finally their perception of the relationship between man and forest – and consequently its biodiversity – is described and discussed.

### **3.1. Lay people's mental construct of forest biodiversity**

#### **3.1.1. Knowledge of and familiarity with the scientific term 'biodiversity' (Identification of categories of forest biodiversity)**

In order to investigate participants' knowledge of and familiarity with the scientific term forest biodiversity they were, at the beginning of the discussions, asked if they had heard about the term and if so, what it meant to them. The aim was not to identify any right or wrong answers but to find the range of lay people's understandings of the term.

The answers were divided into three groups: (i) had not heard about the term and could not give any definition, (ii) had heard about the term in the media but could not give a definition, and (iii) could give a definition of the term. The latter group mainly consisted of members of organisations dealing with ecosystems (e.g. NGOs for natural resource conservation), regular forest visitors (e.g. activities such as fishing, hunting, horseback riding, and walking) and school teachers, especially elementary school. They stated some definitions, where the following is a quite general view:

“[Biodiversity] is not a common word in daily life but I think it means variety in everything that is related to living creatures.” (FG-Z1)

Some respondents, mostly students, provided more specific definitions, e.g. they defined forest biodiversity as different animals and plants, and some referred to diversity of species as well as genes:

“Today we need a variety of animals and plants and their genes because they are important to us when making drugs. So forest biodiversity is a variety of genes.” [FG-F1]

Among lay people who knew the term from the media, several had misunderstood it. They defined forest biodiversity as a tool for maintaining ecosystems, and some of them connected it with debates about climate change. This shows that the term has been widely used in the media which has attracted lay people’s attention to it, and some participants restricted their description to headlines and stereotypes.

The results are in line with Fischer and Young (2007) who suggest that lay people are more familiar (though not in a scientifically precise manner) with the term forest biodiversity than what has been found in earlier studies, e.g. Spash and Hanley (1995) and Hunter and Brehm (2003).

Through undertaking focus group discussion and individual interviews as well as drawing pictures, we found that regardless of their educational level, participants had a deep understanding of their environment, forest biodiversity and ecological concepts such as equilibrium of ecosystem, nutrient cycle (food chain), and natural dynamics. Drawings were used as a way to construct a normative image of forest biodiversity and ecosystems, see Matthews (1985), Gobster (1998) and Fisher and Yuan (2007). This was revealed at the later stages of discussions in particular. Respondents could illustrate more depth to their perceptions about the subject through drawing as compared to when they were interviewed and had to answer faster. This notion of giving time for respondents to



increase their preference certainty has been touched upon in some stated preference studies, and the result is in line with Lauria et al. (1999), Svedsäter (2007) and Cook (2012) who argue that in most cases, especially for unfamiliar goods, giving time to respondents may help them discover their preferences and consequently increase their certainty when answering hypothetical questions.

### **3.1.2. Definition of categories**

#### **3.1.2.1. Perception of forest biodiversity as a good in itself**

Respondents' definition of forest biodiversity during interviews showed that variety of living beings in public surroundings was a dominating value. It was found that the aesthetic value of forest biodiversity was the first reason for its value. This shows that lay people value of forest biodiversity includes cultural values such as appreciation of wildlife and sceneries, and educational and recreational values. Most participants held holistic views in their appreciation of forest biodiversity and referred to a diverse landscape, including different animals, plants and colours, and sometimes different habitats and genes. Participants were explicit that the existence of a variety of animals and plants was more important than any specific species.

Relatively small number of respondents<sup>1</sup> mentioned charismatic animals and plants, such as old beech trees and native birds, and they put negative value on invasive species. In their view, existence and observation of some specific species (use and non-use value) is superior to diversity of species per se:

“I personally like to have a mixed forest but sometimes you see only Christmas trees. And there I don't like to go for a walk. But I can walk for hours in a forest which has only beech trees”. (FG-S1)

Existence value was a motive found implicitly in many parts of lay people's wordings. It covers valuing ecosystem for its inherent value regardless of its usefulness to man. For example, it was mentioned in one of the focus groups in Zealand:

“I like forests and think about them, and I am happy to hear that they are still alive, even if sometimes I don't have time to go there” (FG-Z1).

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<sup>1</sup> 5 persons during focus group interviews and 3 persons during individual interviews

### **3.1.2.2. Perception of forest biodiversity as regulator of ecosystem**

During the discussions, it was revealed that most participants had an intuitive understanding of the contribution of forest biodiversity to ecosystem processes. One of the concepts frequently stated to advocate for conservation of forest biodiversity was biodiversity as a regulator of ecosystem processes and its role associated with ecosystem resilience:

“When I see pictures of two forests, one with few different animals and plants and the other with lots of them, I would say that the forest with different species is the more stable. In case of some diseases I would say that if forest has just one species, it will die but in case of different species it can survive.” [FG-Z1]

Participants mentioned the concept of stability in connection with food chain, showing that they think maintenance of natural productivity helps the stability and balance of ecosystems. Similar results are reported by Fischer and Young (2007).

“I think all of these species need each other. Cows and sheep need grass and wolfs like sheep. When there are a variety of animals, they have different food choices and never stay hungry if they lose one type of food.” [FG-S2]

A member of a farmer family explicitly pointed to food chain as natural cycle:

”The interesting thing is that there are different animals in the forest, such as beetles and birds, and there are flowers. They show a hidden cycle within ecosystem which is like a chain connecting living creatures.” [I4-Z1]

The two categories above (sections 3.1.2.1 and 3.1.2.2) are in line with two of three categories suggested by Mace et al. (2012). However, our results from interviews did not support the third category: forest biodiversity as a final ecosystem service. This category mainly refers to the biological diversity which contributes to some goods and values at the level of genes, e.g. the potential value of wild medicines.

### **3.1.2.3. Discussion of the two categories of forest biodiversity in valuation**

The two categories supported by Mace et al. (2012) are based on ecological viewpoints and show biodiversity categories within the concept of ecosystem. Buijs et al. (2008) consider biodiversity in itself and its functions in one category called “the functions and benefits associated with biodiversity”, including aesthetics and recreational value. Our results show that these values are more related to forest biodiversity as a good in itself, while such values as ecosystem resilience or ecosystem regulator are more related to ecosystem balance, and forest biodiversity is a factor that complement and enhance some ecosystem services. Distinguishing between these two categories is important in framing conservation policies since, according to Mace et al. (2012) they can each be a separate target for policy. For example, although people value places with more diversity of species, particularly charismatic species, policies sometimes target keeping a specific species which is valuable in terms of its function for ecosystem and favour conditions which do not support a diverse community, e.g. heather moorland in the UK. The issue is that if policy makers want to obtain public support they should consider whether policies are in line with what target groups (e.g. lay people) prefer about forest biodiversity.

Studies that consider both functionality and value of biodiversity as a good in itself, e.g. Christie et al. (2006), Czajkowski et al. (2009), Eggert and Olsson (2009) and McVittie and Moran (2010), are fairly in line with our argument because our understanding of individual mental construct illustrated that what is important is not just species number or biodiversity as a good in itself (e.g. appreciation of biodiversity, and spiritual, educational, recreational and cultural values) but biodiversity also has a value as a regulator of ecosystem processes and functions. Even if the four studies above cover both dimensions of biodiversity corresponding with lay people’s mental constructs, their line of investigation is a bit different from that of the present study. First, they use a scientific term towards lay people. We argue that not only identification of attributes is important to valuation studies, but also to use terms phrased in lay people’s language is essential in increasing familiarity with the concept and presumably in getting more valid results. Next, formulating attributes (goods) compatible with lay people’s mental construct is important. In our study, it turned out that the two aspects of biodiversity, mainly presented as species number and functionality are interconnected and lay people perceive them as one attribute, while they have been presented separately in the above studies. The idea is that one can get people thinking of a broad concept of forest biodiversity and use indicators to communicate different levels and compositions of biodiversity. So, using

species numbers as an attribute of a CE study would not cover the true value the general public has for biodiversity. This is the case in the majority of studies reviewed. Therefore, we argue that a bottom-up procedure for attribute selection, based on images of lay people's mental construct towards abstract concepts (e.g. biodiversity and forest) may be a better way to secure alignment of lay people's perceptions and environmental policy.

### **3.2. An idealistic image of forest biodiversity, and its importance to valuation**

It was revealed that participants had two images of forest biodiversity. One image covered the present situation of biodiversity and the other was a normative concept used as an ideal condition of biodiversity in their region. Participants' drawing and discussion showed that for most participants<sup>1</sup> and the ideal condition included a very low level of human interventions and most of them agreed that when forest cannot manage itself, expert intervention is needed at some point.

“I definitely think that it is man who destroys forests with his immature thought and plan. They have to be left alone, but in situations where forest has been destroyed, it needs extra help from the outside to be recovered, and man should do something to save forest and help it.” (FG-Z2)

This perspective has also been reported by Hull et al. (2003) who found that among participants an understanding of natural dynamics and balance was rooted in the context of nature, while Fischer and Young (2007) reported absence of human intervention as the ideal picture among their participants.

Regarding animals they had a holistic view which included all kinds, not only a specific group such as endangered species, but mostly native species, as the ideal. This is in line with Buijs (2009) who tries to investigate our understanding of lay people's interpretation of the intrinsic value of nature. Within the wilderness image, the intrinsic value of nature is interpreted in a holistic manner and directed at species and ecosystems (“eco-centrism”).

The above description of the idealistic images is important for the reference point respondents take in a valuation survey. Typically, we assume that people's marginal utility depends mainly on the current situation which we use as the reference point. However, if people use an idealistic image of

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<sup>1</sup> (14 of 18 individual interviews and more than half of participants in each focus groups)

nature as their reference point, it may be problematic to use – changes may be perceived as much larger. So if what respondents have in mind as a reference point is too different from what we determine as a reference point for them (sq), respondents may refuse or not able to (fully) take on the role we ask them to. As a reference point, people may take the context and habits, they are used to, when making a trade-off. This means that they may apply this as their response frame, regardless of what role or frame the researcher asks them to take (Samuelson and Zeckhauser 1988). Presumably, this causes an underlying variation and mismatch regarding respondents' preferences. Our argument of the importance of determining reference points originates from Prospect Theory (Kahneman and Tversky 1979). In the literature regarding risk perception numerous studies building on the prospect theory find that people are influenced by their own perceptions of risk when evaluating choices with specific risks attached (e.g. Jakus and Shaw 2003). The issue has been addressed in some valuation studies such as Hu et al. (2006), Sugden (2009), Hasund et al. (2011), Ericson and Fuster (2011) and Lundhede et al. (2012). These authors argue that the value that an individual expresses for an attribute is not derived from its fixed level, but is based on its departure from a reference level or point. The reference point can depend on experience with the good to be valued, expectations which we here call ideal image or current situation, and pertains to 'what it is now'. Identifying the perceived reference point in valuation studies is therefore important. Not using idealist images of nature as a reference point in valuation studies does not necessarily invalidate the estimated results. However being aware of it, would be useful knowledge for better interpretation of the respondents' desires and preferences, and may reduce the existing mismatch/discrepancy in preferences and improve the accuracy of aggregate measures for decision making documents.

### **3.3. Man-nature relationship and public attitudes to forest biodiversity conservation**

Respondents used the term nature to address a concept which covers the entire ecosystem of which forest is one example and biodiversity is its component.

Results illustrate three views of the perceived relationship between man-nature (3.3.1 to 3.3.3) and continues with lay people' attitudes of biodiversity (3.3.4):

### **3.3.1. Man perpetually belongs to the ecosystems like forest**

“We are part of nature and connected with nature no matter whether we are in the city or in the forest, because nature is everywhere.” (FG-F1)

Some participants took a holistic view by saying that man is part of the ecosystem. They considered ecosystem as a ‘home’ and therefore, they argued, being in an ecosystem like the forest made them feel responsible for all ecosystems and their components, e.g. biodiversity. This group of participants were in favour of conservational activities and management with little human intervention to improve the natural condition. They had an eco-centric view, believing that biodiversity and nature are entitled to be conserved. They were mostly lay people who visit the forest regularly or are members of NGOs for conservation activities.

### **3.3.2. Man’s relation to the ecosystems like forest when situated in it**

Some responses revealed that lay people may have different feelings about the forest depending on whether they, so to say, are part of it or not. Not staying in or close to the forest meant less worry about forest. In addition, such participants mostly approved of management with focus on both ecosystem regulation and human benefits, i.e. they had a combination of eco-centric (dominating) and anthropocentric views.

“When I am in the forest I feel I am part of nature but when I am in the city I don’t think much about forest since I am not part of it anymore, with that noise and stress. I believe the forest can manage itself and its natural processes and we do not need man to turn its wheel. But when we want to make man-made forest or gardens which are not natural, they need our help and management to survive and become mature.” [FG-Z2]

### **3.3.3. Ecosystem management for human needs**

“We should manage ecosystem and take care of it because we need nature for our life. I believe that when we need to keep our home warm, we can remove trees from the forest for making fire. Leaving deadwood in the forest is like not using fruits which we all know is a waste of resource.” (FG-Z2)

Some interviewees viewed forest ecosystems as a source of meeting human needs, such needs weighing more than maintaining the natural ecosystems. They were in favour of applying management for human well-being, not because of biodiversity or ecosystem itself.

### **3.4. Man-forest biodiversity relationship and its importance to valuation**

Based on our results, we argue that participants distinguished between ‘bio’ and ‘diversity’. They paid attention to ‘bio’ in a holistic view, with little regard to species charisma or whether species were rare or endangered. This is in line with Buijs et al. (2008) and Lundhede et al. (2012). However, many valuation studies tend to focus on specific species. Thus, some studies such as Loomis and white (1996), White et al (1997and 2001), Jacobsen et al. (2008), Richardson and Loomis (2009) found that charismatic or iconized species (for example elephants, pandas and otter) are valued higher than non-charismatic species like brown hare. We do not make a real comparison, but we do find that using specific species, charismatic or not, is probably not a good way to describe biodiversity as it does not cover the entire concept – if the aim is to define biodiversity. However, some participants did reveal a moral obligation to take care of specific species, and if this is a dominating view in the general population, it may drive the higher WTP often revealed when valuing specific species instead of species in general. And this may be even more pronounced when dealing with endangered species, see, e.g. Jacobsen et al. (2008). Since according to our interview results, participants had a holistic view of biodiversity, therefore, our conclusion is that when specific species are valued, this value does not necessarily reflect the value of ‘bio’.

Another insight from our results is that participants had different views regarding the relationship between man and forest biodiversity conservation. ‘Man is responsible for maintaining biodiversity and they want to be part of conservation activities’ was a dominating statement among participants and they perceived human activities as the main reasons for ecosystem degradation. This shows participants, in addition to the preference they have for biodiversity conservation; also care about *how* forest biodiversity is conserved. This is in line with Hanley et al. (2003) who say that information on relative preferences for a conservation policy, e.g. goose conservation, is essential since it can help policymakers adjust conservation policy more closely with taxpayer requests. The general public doesn’t necessarily have the same preferences as experts (Hanely et al. 2003). Thus, an obvious discussion would be whose preferences are most central in designing policy. What this

study suggests is framing economic methods such as choice experiments in accordance with general public preferences from the early stages and at the same time, using iteration steps, try to secure scientific credibility of good definitions and policy frameworks as well.

#### **4. Conclusion and contribution of the qualitative method to valuation study design**

The design of a choice experiment implies decisions about the policy alternatives, which attributes, how many attribute levels, and which attribute combinations are feasible (Louviere et al. 2000). The discussion above reveals that a thorough qualitative assessment of respondents' perceptions of nature may facilitate a translation into useful attributes and alternatives. There are, however, unresolved challenges associated with the qualitative work, most particularly in the tension between the usual purpose of such work (to obtain an intuitive understanding of phenomena) and the essentially reductive aim of describing all the key concepts of care in as few attributes as possible (Coast et al. 2012).

In Regard with the dominating attributes of forest ecosystems from lay people's view, the first dominating component was forest biodiversity where participants revealed a holistic view (combination of animals, plants, and micro-organisms). Most participants put values on biodiversity more than just species number in ecosystem. So a broad attribute capturing biodiversity is therefore more appropriate than using current indicators such as species richness. Secondly, participants showed that the concept of 'naturalness' in ecosystems is very important to them. In their view, maintenance of naturalness of ecosystem through a low level of intervention, such as leaving deadwood in the forest, was an acceptable way of maintaining food chain and balance of nature as well as its natural appearance and structure.

Getting peace and quietness was another dominating characteristic emphasised by lay people, especially people who lived near forests. This would be used in CE studies as a measurable attribute of forest ecosystems.

Apart from identifying dominating attributes of forests from lay people' views, this study has three key findings which may be useful for improving the design of questionnaires and environmental economic valuation studies. First, one issue is the inseparable essence of functionality value and



value of biodiversity in itself in lay people's mental construct. Therefore, valuation studies using only species numbers may not reflect the true value of nature and there is a risk of ignoring its functionality value.

The second issue refers to the fact that in designing choice experiments we have the present situation as a benchmark for lay people, and ask them to make a trade-off based on that. But according to the qualitative results we found that respondents in some cases have an ideal image as a point of departure which is not fully matched with the status quo. Therefore, being aware of the ideal image of respondents, would be useful for better interpretation of the respondents' desires and preferences, and may reduce mismatch/discrepancy in preferences and improve the accuracy of aggregate measures for decision making documents.

The last issue refers to the management scheme preferred by lay people to be considered by managers and policy makers in defining the policies to be supported by lay people. It shows that participants at the time of answering a valuation exercise, in addition to the preference they have for biodiversity conservation; also care about *how* biodiversity is conserved. This refers to the framing of different hypothetical alternatives which should be in tune with respondents' preferences.

Lay people were mainly in favour of a type of management which is in between active and passive management because they do not want large-scale human intervention in ecosystems, but they are in favour of management which they can be involved in.

## **5. Acknowledgements**

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## Appendix:

Table A: List of article used in literature review:

Biodiversity as:		a good in itself			a regulator of ecosystem process
		species number	endangered species	habitat preserved	
1	(Hanley et al. 1998)	x			
2	(Boxall and Macnab	x	x		
3	(Lehtonen et al. 2003)	x	x		
4	(Scarpa et al. 2003)	x	x		
5	(Garber-Yonts et al.	x	x		
6	(Watson et al. 2004)	x	x		
7	(Hanley et al. 2005)	x			
8	(Colombo et al. 2005)	x	x		
9	(Powe et al. 2005)	x			
10	(Horne et al. 2005)	x	x		
11	(Naidoo and Adamowicz	x	x		
12	(Christie et al. 2006)	x	x		x
13	(Nielsen et al. 2007)	x	x		
14	(Jacobsen et al. 2008)	x	x		
15	(Barkmann et al. 2008)	x	x	x	
16	(Travisi and Nijkamp	x	x		
17	(Meyerhoff et al. 2009)	x	x	x	
18	(Do and Bennett 2009)	x	x		
19	(Verissimo et al. 2009)	x			
20	(Lundhede et al 2013)	X		x	
21	(Eggert and Olsson 2009)	x	x		x
22	(Rajmis et al. 2009)	x	x		
23	(Czajkowski et al. 2009)	x	x		x
24	(Chan-Halbrendt et al.	x			
25	(Susaeta et al. 2010)	x			
26	(Westerberg et al. 2010)	x	x		
27	(Asrat et al. 2010)				x
28	(Hasund et al. 2011)	x	x	x	
29	(Hanley et al. 2010)	x	x		
30	(Juutinen et al. 2011)	x	x		

Continue on the next page

Table A:

Biodiversity as:		a good in itself			a regulator of ecosystem process
		species number	endangered species	habitat preserved	
31	(Jacobsen et al. 2011)	x			
32	(Christie and Gibbons)	x	x		x
33	(Zander and Garnett)			x	x
34	(Drechsler et al. 2011)	x	x		
35	(Rossi et al. 2011)			x	x
36	(Glenk and Colombo)			x	
37	(Hynes and Campbell)	x		x	
38	(Jacobsen et al. 2012)	x			
39	(Broch and Vedel)	x			
40	Zhao et al 2013	x			
41	(Adamowicz et al.	x	x		
42	(Blamey et al 2000)	x	x		
43	(Shoyama et al.2013 )	x	x		
44	(Broch et al. 2013)	x			
45	(Rogers et al 2013)	x	x		
46	(Jacobsen et al 2013)	x			
47	(Cerda et al 2013)	x			x
48	(Ingea et al 2013)	x			
49	Hoyos et al (2012)	x	x		
50	Thein et al (2012)	x		x	



# **Paper Two**

# How should biodiversity be presented in valuation studies? Testing for embedding and information bias.

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## **Abstract**

Embedding and scope effects play a crucial role in the validity of stated preference outcomes, often arising from imprecise presentations of environmental goods such as biodiversity. Qualitative evidence shows that people tend to think of biodiversity in terms of its role in the ecosystem function such as stability and resilience, yet many studies focus solely on quantitative measures of biodiversity such as the Species richness. This may induce a contextual embedding bias, i.e. valuation measures that capture less of the good in question than intended. We report a split sample choice experiment (CE) study, in which willingness to pay (WTP) for biodiversity was evaluated in two different embedding contexts: one version where biodiversity was presented as the Species richness and one where we also included an attribute, fully correlated with the biodiversity attribute, describing the role of biodiversity in ecosystems. By comparing WTP across splits and subgroups constructed based on follow-up questions, we were able to distinguish embedding from information effects and investigate scope sensitivity of respondents in each split as well. We found WTP for biodiversity to differ significantly between different splits and groups. We conclude that using a measure such as the Species richness may underestimate people's valuation of biodiversity as it does not capture the public perception of biodiversity function. Furthermore, we found that adding a description of the role of biodiversity in ecosystem explicitly in the choice set improved sensitivity to scope.

**Key words:** Embedding, environmental valuation, choice experiment, scope effect.

## 1. Introduction

When valuing biodiversity by stated preference methods the understanding and perception of the term becomes crucial for the outcome. However, understanding the relation between biodiversity and ecosystem services and the impacts on human welfare is complex (Bateman et al. 2011). Biodiversity is considered central to supporting all ecosystem services (Balvanera et al. 2006), but is often not thought of as a service itself (Mace et al. 2012). A concise single definition of biodiversity, regardless of the context, is therefore not possible. For valuation, species diversity in terms of Species richness has often been used (e.g. Lehtonen et al. 2003, Horne et al. 2005, Hoyos et al. 2012, Juutinen et al. 2011, Drechsler et al. 2011). The advantages of this are that it is easily understandable to respondents, fairly neutral, and possible to translate into a quantifiable management unit of which causes, patterns and consequences are relatively well documented. However, the value of species numbers may not reflect the value people have of biodiversity. Therefore, in the current study, we instead use results from a qualitative study (Bakhtiari et al. 2014) to describe the attribute biodiversity in a choice experiment (CE) based on the mental construct of the term by participants in the study. Findings showed that species number and ecosystem stability arising from species diversity<sup>1</sup> are the most frequent characteristics when the public conceive biodiversity and they perceive these characteristics as interlinked. In addition, the majority of respondents addressed number of common species as a possible indicator of biodiversity. Comparing this with species conservation practice, it generally emphasises endangered species (e.g. the Endangered Species Act, Red Lists, and protection of biodiversity hot spots), while recent studies in ecology underlines the significance role of common species to ecosystems (Gaston and Fuller 2007) function which is likely to be more strongly delivered by the common than the rare. Although there is growing evidence that more diverse systems (i.e. those that retain the rare as well as the common) both deliver higher functionality and are more resilient to change.

Species richness and functionality of common species was chosen to be used for the present study as an indicator for biodiversity. However, people may or may not consider ecosystem stability and resilience as a part of biodiversity. In the valuation literature, looking at 50 articles found on Web of Science when searching for (biodiversity\* OR "biological diversity\*") AND (Choice Experiment\*), 45 articles used the Species richness as indicator of biodiversity, and 29 out of the 45 focused on

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<sup>1</sup> When people state 'stable' they describe it by being 'in balance' and elaboration of it leads to what we hereafter term, 'stability and resilience of ecosystem'. (Bakhtiari et al. 2014a).

endangered species. Only 5 studies combined the Species richness with the role of species diversity in the stability and resilience of ecosystem (Table A in appendix).

Embedding effects occur when a particular good obtains different valuations depending on the context, e.g. when a good is a part of a larger good (Loomis et al. 1993, Carson and Mitchell 1995, McDaniels et al. 2003, Svedsater 2007), or due to difference in *spatial scales*, e.g. one river representing all rivers or *time scales* when the good may only be provided for a short period but respondents believe it to be available for a longer period (Brown and Duffield 1995, Clark and Friesen 2008). An issue which has not been much investigated in the literature is when two components of a good are interlinked and complementary in respondents' mind. This implies that respondents have an implicit utility of the combination of two components, but if respondents are presented with an indicator which only addresses one part of the good, they cannot be expected to express the value of the whole good and the contextual embedding effect arises.

The main aim of the current study is to test if we can identify such contextual effect in a CE valuing biodiversity. As the attributes 'species number' and the 'stability and resilience' of the ecosystem are functionally interlinked, they cannot vary independently of each other. Therefore, we test the contextual embedding using a split sample approach, where half of the respondents (*Group<sub>species</sub>*) receive a questionnaire in which biodiversity is described by the quantity of common species only, and half of the respondents (*Group<sub>biod</sub>*) receive the same questionnaire, but with information on the stability consequences also in the form of a graphically shown extra attribute in the choice set which describes this level. We argue that the latter reflects the concept of biodiversity better. As the two attributes are fully correlated they cannot be estimated separately, but the difference in the estimated parameter of the species number attribute between the splits can be tested.

An argument against such a test is that we cannot distinguish the contextual embedding effect from an information effect. It is well documented in the valuation literature that information increases the estimated WTP (Bergstrom and Dillman, 1985, Bergstrom et al. 1989, Kahnemann 1999, Jacobsen et al. 2008, Napolitano et al. 2008). As the embedding effect we are looking for is contextual, it is impossible to present a different context to people without varying the information they receive. Consequently, we acknowledge that the effect we see may be an information effect. However, by splitting *Group<sub>species</sub>* based on follow-up questions on whether respondents considered stability

issues when valuing the species number, we are able to compare the WTP elicited by this group with the WTP from the group receiving more information, *Group<sub>biod</sub>*. This allows us to differentiate the information effect from the contextual embedding effect.

Finally, our study tests scope sensitivity within the different split samples. One reason for scope insensitivity may be that the good is poorly described and incompatible with respondent perception of the good. Consequently, respondents assign values to goods different from those that the researcher has formulated and presented to them (Boyle et al. 1994, Carlsson and Martinsson 2003, Donoso et al. 2010, Morkbak et al. 2011). Some studies in the early 1990s show failures in passing a scope test (Kahneman and Knetsch 1992, Carson and Mitchell 1993, Diamond and Hausman 1994, Carson and Mitchell 1995, Smith and Osborne 1996; Desvousges et al. 1993) . However, other studies, including meta-analyses indicate that the scope test is passed successfully (Boyle et al. 1994, Schkade and Payne 1994, Czajkowski et al. 2009). In this study, we specifically test whether scope sensitivity differs in the two different contexts in which we present biodiversity, i.e. with or without emphasis on the stability and resilience of the ecosystem. This means that we put emphasis on whether the researcher's presentation of quantities corresponds to the respondents' understanding of quantities.

The rest of the paper is organised as follows: In section 2 we formulate the hypotheses, followed by a description of the survey and the econometric model in section 3. Section 4 presents the results, which are discussed in section 5, followed by a brief conclusion in section 6.

## 2. Hypothesis formulation

We formulate a hypothesis in which contextual embedding has no effect on WTP. This implies that informing respondents about the stability and resilience service of species diversity has no effect:

$$H_0 \text{ no contextual embedding or information bias: } WTP (Group_{species}) = WTP (Group_{biod})$$

If  $H_0$  no contextual embedding or information bias is not rejected it can either be because people do consider the stability and resilience services when being asked to value species numbers only, or because they do not value stability and resilience.

If  $H_{0}$  contextual embedding or information bias is rejected, it means that when presented with a different context, including more aspects of the complex value of biodiversity, the value changes. Thus, either a contextual embedding bias or an information bias is present. Following, we separately test a contextual and information hypothesis.

Thus, our second hypothesis is that respondents who deliberately stated that they considered stability and resilience services ( $Group_{species/yes}$ ) have no different WTP estimates than those who did not state so ( $Group_{species/no}$ ). Thus:

$$H_{0_{no\ contextual\ embedding}}: WTP (Group_{species/no}) = WTP (Group_{species/yes})$$

Given we find contextual embedding (i.e.  $H_{0_{no\ contextual\ embedding}}$  is rejected), our third hypothesis, with focus on information bias, is that respondents who deliberately stated that they considered stability and resilience services ( $Group_{species/yes}$ ) have the same WTP as  $Group_{biod}$  because the valuation context is similar.

$$H_{0_{no\ information\ bias}}: WTP(Group_{species/yes}) = WTP(Group_{biod})$$

If  $H_{0_{no\ information\ bias}}$  is not rejected, it implies that presenting biodiversity with more aspects of the value does not change respondents' value.

Finally, we have an internal scope test for the species number attribute, taking the levels 1000, 1500 and 2000 common species being present as:

$$H_{0_{no\ scope\_general}}: WTP (1000\ species) = WTP (1500\ species) = WTP (2000\ species).$$

To the extent that the reason for lack of scope sensitivity is an imprecise definition of the good, we would expect it more likely that  $H_{0_{no\ scope}}$  is rejected for  $Group_{biod}$  than for  $Group_{species}$ . We are specifically interested in the last two terms, namely whether respondents are sensitive to different increases of the good. Therefore, we specify the general scope test to a more specific one, again with the expectation that it is more likely rejected for  $Group_{biod}$  than for  $Group_{species}$ :

$H_{0_{no\ scope}}: WTP (1500\ species) = WTP(2000\ species)$ . The illustration of the above hypotheises is shown in Figure 1.

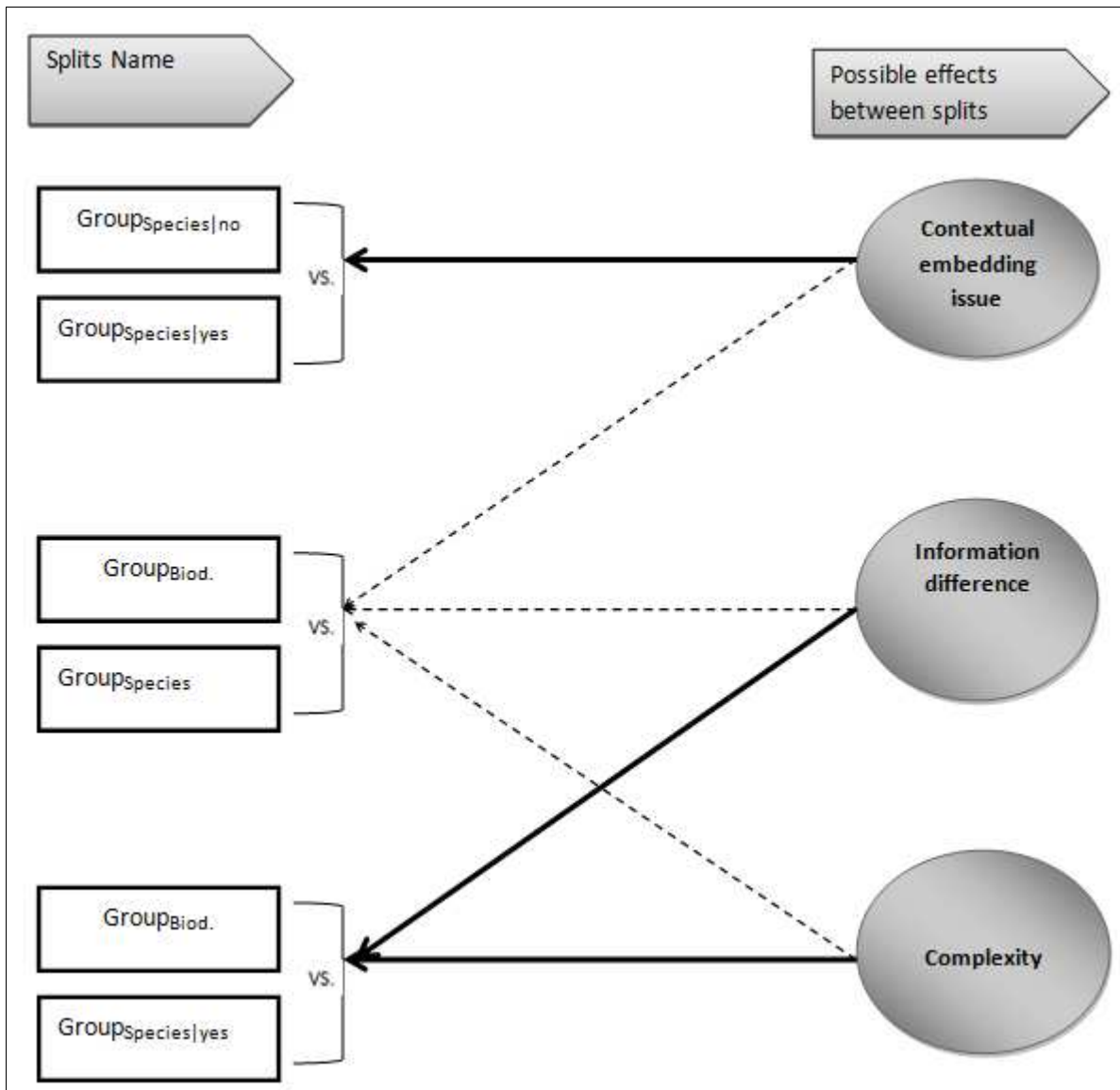


Figure (1) Contextual, information and complexity effect in different splits.

### 3. Methods

#### 3.1. Survey design and Data collection:

Our study was conducted in a region of Southern Scandinavia with similar ecological characteristics: a mixed landscape of agriculture and broadleaf dominated forests situated on high productive soils. We sampled respondents from the two main islands in Denmark, Funen and Zealand, and in the southern part of Sweden, Scania, adjacent to Funen and Zealand. The broadleaved forests in these sites have rather similar biodiversity and are dominated by Beech (*Fagus sylvatica*), but also with presence of species such as Oak (*Quercus spp*), Ash (*Fraxinus excelsior*) and Birch (*Betula spp*). The majority of these forests are managed for timber production, but often they are also multi-purpose forests<sup>1</sup>.

The questionnaire<sup>2</sup> was designed by using the results from eight focus group interviews and two pre-tests<sup>3</sup> and in collaboration with a group of consulting biologists at the Centre of Macroecology, Evolution and Climate (CMEC) located in Copenhagen<sup>4</sup>. Focus groups and the pre-test were prerequisites to test the appropriateness of the attributes and their levels included in the choice tasks and to select a proper payment vehicle for estimating respondents' marginal welfare change in terms of WTP estimate. Some revision in the draft questionnaire was included based on feedbacks. The final questionnaire started with a section including various warm-up questions to allow respondents to think about the concepts presented later on in choice tasks. These questions focused on respondents' idea of the presence of biodiversity and deadwood in forest by using visual aids (pictures) (See Figure A and B in appendice). Respondents were asked to choose among different pictures of forests with different levels of biodiversity and deadwood and express the reason behind their choice. Subsequently, they were introduced to the assumed policies and forest protection programme, the CE section, and follow-up questions on their attitudes and reasons of their choices to identify protesters and strategic answers. Finally, we asked socioeconomic questions.

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1 [www.statistikbanken.dk](http://www.statistikbanken.dk), [www.ssd.scb.se](http://www.ssd.scb.se)

2 The questionnaire can be obtained from the authors upon request and is attached here for review purposes.

3 One pre-test on 12 respondents was undertaken in March 2012 and after revising questions and discussing the survey with experts the second pretest was implemented on 13 respondents in May 2012 in Southern Scandinavia.

4 <http://macroecology.ku.dk/>



Respondents received questions regarding crowding and conflict among forest users which were targeted for another study by Bakhtiari et al.(2014) but we expect results to be unaffected. The questionnaires were designed in English and translated into Danish and Swedish. These were tested again through a pilot<sup>1</sup> study and revisions made in terms of language simplification, specification and alternative policy levels applied based on the feedback of participants.

Data collection was implemented during July-August 2012 through an internet-based questionnaire managed by the survey institute 'Analyse Denmark'. The survey institute uses an online panel that invites a number of members to participate in the survey and re-invites until getting a desired number and representative mix of responses. One of the advantages of an internet-based questionnaire is that it may prevent respondents from altering their choices in response to the follow-up questions. This functionality was chosen here. With a response rate of 20%, a total of 1800 questionnaires were collected equally between the two splits and three areas.

Each choice task consists of two alternatives and one status quo option. The status quo has the lowest level of all attributes (see Table1). The choice tasks had four attributes:

(i) Biodiversity presented as species numbers with and without specific mentioning of the role of species diversity in stability and resilience of ecosystem. Respondents were told that in the investigated habitat approximately 10,000 species exist<sup>2</sup>. However, on a given site much fewer will be present, and how many will depend on the size and characteristics of the area. The relevant size to look at for a respondent may vary, so to anchor them to a joint status quo, they were told that 1,000 species are common. For comparison, Lawesson et al. (1998) find 90 plant species to be present on average in a forest (of varying size) out of 447 plant species found. According to Gaston and Fuller (2007), the common species of any ecosystem are relatively few in numbers. Indeed, of 127,000 specimens distributed over 2,738 species of tropical marine molluscs , only less than 1% had a total count of 1,000 individuals or more (Bouchet et al. 2002). Similarly, according to Ellingsen and Gray (2002), an inventory of Atlantic marine invertebrate species sampled over 101 sites in Western Norway showed that only 2.2% of the species were present at half the number of

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<sup>1</sup> A pilot study on 40 respondents was undertaken in June 2012 in Southern Scandinavia. Respondents were lay people selected randomly from different places with different educational and occupational background.

<sup>2</sup> An expert assessment, see also <http://www.allearter.dk> for general information about the region's species.

sites or more, and similar trends are found in tropical lagoon species (Schlacker et al. 1998) as well as in tropical forest trees (Pitman et al. 2001). Thus 1,000 seems a reasonable number for the common species (not only plants), given that we look at the better soils (with more species), yet managed forests (with fewer species).

Respondents were presented with policies that would increase this diversity to 1,500 or 2,000 species. Such policies will likely change the distribution of not only the endangered species, but also less common species. The policies therefore targeted 'general' biodiversity and not the endangered species. Obviously, it could have an effect on the endangered species, but that is not what we focus on here.

ii) Maintaining the natural cycle<sup>1</sup> of the forest ecosystem was the second identified attribute and leaving deadwood in the forest was used as a proxy represented by two levels plus a status quo level. Today, in Southern Scandinavia we see deadwood occasionally left in forests. If we apply alternative management policies to improve the presence of the forest's natural cycle, the number of retained dead trees in the forests can be increased by seven per hectare (level 1) or 15 dead trees per hectare (level 2).

(iii) Location of policy implementation, four levels where status quo referred to the situation without new policy implementation in any of the three locations, namely Zealand, Funen and Scania. The other three alternatives referred to policy implementation in each of the three locations (this attribute is not in focus in this paper as it is not related to the hypotheses tested here).

(iv) The cost of the policy in terms of increased tax payment had five levels, where the range was selected based on asking open questions regarding people's WTP during group discussions and individual interviews.

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<sup>1</sup> In a qualitative study by Bakhtiari et al. (2013a) it was found that the word 'cycle' was more understandable for laypersons in compared with dynamic. Therefore, in the questionnaire we used the wording 'natural cycle' instead of 'natural dynamics'.

Table (1) attributes and levels presented to respondents in choice tasks. **Status quo (sq)** levels are the lowest levels and **bold**.

<b>Attribute</b>	<b>Description given to the respondent</b>	<b>Coding and levels</b>
Species number	Number of common animals and plants	<b>1000</b> ,1500,2000
<i>*Forest stability and resistance against disturbance (Biodiversity Function)</i>	<i>Forest Stability</i>	<i><b>Low, Medium ,High</b></i>
Presence of natural cycle	Presence of natural cycle in the forest by introducing deadwood management leaving trees for natural decay	(i) <b>occasionally leaving old trees</b> (ii) Leaving 7 old trees per hectare (iii) Leaving 15 old trees per hectare
Location of policy	The place where new policies take place	(i) <b>no new policy</b> (ii) Funen (iii) Zealand (iv) Scania

A split sample approach was used, where polled respondents were randomly divided into two groups and each group received one of the two versions of the questionnaire. For one group (*Group<sub>species</sub>*) biodiversity was presented by species number in the questionnaire and the other group (*Group<sub>biod</sub>*) received a questionnaire where biodiversity was presented by species number as well as by its role in stability and resilience of ecosystem. The description of the role of species diversity, which was stated before the sections of choice sets, used in the split for *Group<sub>biod</sub>* was as follows:

*“Having a variety of animals and plants (biodiversity) provides functions such as insurance, resilience for forests to tolerate environmental changes better than forests with just one or few types of species”.*

The *Group<sub>biod</sub>* choice sets also contained an extra row, graphically showing an attribute of the stability and resilience of ecosystem due to biodiversity in three levels (low, medium and high), but

statistically fully correlated with species number. See Fig. 1 and Fig. 2 in the appendix for specifications.

*Group<sub>species</sub>* received the part about the description of the role of species diversity in ecosystem (stability) after their choice task and were asked if they had included this concept in their value for species number or not. Based on their answers respondents are divided to two subgroups *Group<sub>species/yes</sub>* and *Group<sub>species/no</sub>*. The question was formulated as “*in previous tables, when you were choosing your preferable number of animals and plants under different policies, did you include the stability of forest as a value of species diversity?*”, where the wording “*stability of forests*” was taken as a measure of the role of species number based on the wordings used in the focus groups and interviews.

The focus groups and qualitative interviews revealed that income tax was an acceptable way of financing such projects through public funds. To avoid any free riding it was highlighted in the questionnaire that all tax payers were expected to contribute. Respondents were informed that this amount would be additional to current tax payments. The tax attribute had a small cheap-talk script along the budget reminder:

*“We would like to let you know that results from similar studies have shown that respondents have a tendency to overestimate how much they actually are willing to pay through these kinds of compulsory contributions. Therefore, we ask you to carefully consider the different alternatives in relation to your household income. Please note that the additional payment will reduce your spending on other goods and services in your everyday life.”*

In addition, respondents were informed that their answers would be used in designing forest conservation policies to give an incentive to answer honestly (cf. Vossler 2012).

A fractional factorial design was used where the combination of alternatives was arranged through NGENE optimising for d-efficiency for multinomial logit model (Scarpa and Rose 2008) with 24 alternatives. These were divided into four blocks to give six choice tasks per respondent. The design with zero priors and adding a status quo had an ex-ante d-error of 0.07 when the d-error was evaluated for a continuous variable for tax and dummy variables for the rest. The design, when evaluated ex post, had a d-error of 0.0005 when evaluated as a multinomial logit. Data were analysed by using Biogeme (Bierlaire, 2003) and Nlogit 5.0.

## 3.2. The econometric models

### 3.2.1. Basic model assumption

The underlying theory of the CE method is based on random utility theory (McFadden 1974) and Lancaster's Consumer Theory (Lancaster 1966) where the utility of a good is described as a function of its attributes, and people choose among composite goods by evaluating their attributes.

In a specific case, where a respondent  $i$ , faces a choice between a status quo and two management alternatives, the utility,  $U$ , of these  $j$  alternatives in the  $n$ 'th choice occasion can be described by:

(3)

$$U_{ijn} = \begin{cases} V(ASC, x_{ijn}, \check{\beta}_i, \beta) + \varepsilon_{ijn} \rightarrow \text{If } j = 1(\text{status\_quo}) \\ V(x_{ijn}, \check{\beta}_i, \beta, \sigma_i) + \varepsilon_{ijn} \rightarrow \text{if } j = 2,3; \end{cases}$$

Here the indirect utility,  $V$ , is a function of the vector of explanatory variables,  $x_{ijn}$ , containing characteristics of the individual, the alternative and the choice situation, as well as the vectors of individual-specific random parameters,  $\check{\beta}_i$  and fixed parameter,  $\beta$ . An alternative Specific Constant (ASC) is specified for the status quo alternative in order to capture the systematic component of a potential status quo effect (Scarpa et al., 2005). An error component additional to the usual error term with Gumbel-distribution is added to the model to capture any remaining status quo effects in the stochastic part of the utility. This error component,  $\sigma_i$ , an individual-specific random parameter with zero-mean and normal distribution, is allocated exclusively to the two non-status quo alternatives. A general error component across these two alternatives is specified to take a correlation pattern in utility over these alternatives into account (Greene and Hensher 2007; Ferrini and Scarpa 2007; Scarpa et al.2008).

We specify the utility function as:

(2)

$$\begin{aligned}
U_{ij} = & (\alpha_j + \beta_{1i} (\text{species1500})_j + \beta_{2i} (\text{species2000}) + \beta_{3i}(\text{leaving5deadwood/ha})_j + \\
& \beta_{4i}(\text{leaving7deadwood/ha})_j + \beta_{5i} \text{location}(\text{funen}) + \beta_{6i} \text{location}(\text{zealand}) + \beta_{7i} \text{location}(\text{scania}) \\
& + \beta_{8(\text{Group}_{\text{biod.}})_i} (\text{species1500\_stability})_j + \beta_{9(\text{Group}_{\text{biod.}})_i} (\text{species2000\_stability})_j \\
& + \beta_{10(\text{Group}_{\text{biod.}})_i} (\text{leaving5deadwood/ha})\_stability_j + \beta_{11(\text{Group}_{\text{biod.}})_i} (\text{leaving7deadwood/ha})\_stability_j \\
& + \beta_{12\text{Group}_{\text{biod.}})_i} \text{location}(\text{Scania})\_stability + \beta_{13\text{Group}_{\text{biod.}})_i} \text{location}(\text{zealand})\_stability + \beta_{14} \text{Tax} + \varepsilon_{ij}
\end{aligned}$$

$\beta_8$  to  $\beta_{13}$  refer the additional utility obtained from receiving information on stability, thus the variable levels get the underscore Stability, taking the value 1 if the information is provided and zero otherwise.

Assuming a linear function for  $U_{ij}$  and collecting all the arguments in the vector  $x_{ij}$  for alternative  $j$  and individual  $i$ , we can write  $U_{ij} = \tilde{\beta}x_{ij}$ , where  $\beta$  is a vector of parameters. Assuming the error term  $\varepsilon_{ki}$  is IID extreme value distributed (see Hausmann and McFadden 1984) the probability of choosing alternative  $k$  among  $j$  alternatives by individual  $i$  is, according to Train (2003):

(3)

$$P_i(k) = \frac{\exp(\mu\tilde{\beta}_i x_{ij})}{\sum_j \exp(\mu\tilde{\beta}_i x_{ij})}$$

$\mu$  is a scale parameter which is inversely related to the error variance and can be estimated by applying a scale test (see, e.g. Bierlaire, 2003). We presumed that there could be a difference in scale between the two splits as they do not get the same amount of information. This was tested and data from two splits were merged after correcting for scale differences (Hensher et al. 1999). We followed the approach suggested by Swait and Louviere (1993) to test for scale and correct for it afterwards.

We estimated a number of different models, including a random parameter logit (RPL) together with error component, generalised mixed logit (GLMLOGIT) and the scaled multinomial logit (SMNL).

The RPL model (Revelt and Train 1998) relaxes the assumption of independence of irrelevant alternatives (IIA) and assumes that taste parameters are random within the population with a given distribution. The SMNL model allows scale rather than preference heterogeneity which can be interpreted as a difference in individual ability to choose between alternatives (Christie and Gibbons 2011). The generalised mixed-logit (Fiebig et al. 2010) extends the RPL model to explicitly account for scale heterogeneity in the presence of preference heterogeneity. For all models we held tax and alternative specific constant invariant across individuals<sup>1</sup> while other variables were assumed to be random within the population. For a full discussion of the models available for analysing choice experiments, see Train (2003), Hensher and Greene (2003) and Fiebig et al. (2010).

We calculated WTP for the attributes estimated in preference space by using the marginal rate of substitution between each of the attributes and the attribute for payment:

(4)

$$WTP = \beta_b / -\beta_t$$

Where  $\beta_b$  is the estimated parameter of an attribute  $b$  (e.g., species number), and  $\beta_t$  is the estimate of the tax parameter.

## 4. Results

### 4.1. Comparison of samples with target population

The two splits slightly under-represented respondents in the middle and low ( $p=0.15$ ) income groups compared with the population in the selected regions. However, there was no statistically significant difference in age, education, gender and income between the two splits ( $p>0.1$ ).

Since our main hypothesis is related to whether people include the role of species diversity in ecosystem stability and resilience in their valuation of species number, we used a follow-up question for *Group<sub>species</sub>*. Within this group, 45% of respondents answered they have included the role of species number in ecosystem in their value for species number, *Group<sub>species/yes</sub>*, 30% of

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<sup>1</sup> In the present paper, the focus is on relative size. Therefore, a constant error variance is assumed for price variable across respondents to avoid problems of finding the distribution of WTP.

respondents answered they did not, *Group<sub>species/no</sub>* and the rest said “I don't know”. All these respondents were kept in the sample.

### 4.3. Estimation results using econometrics models

The scale of *roup<sub>biod</sub>* was significantly higher than for *Group<sub>Species</sub>* (scale=1.33), and consequently rescaled for the estimation (Swait and Louviere, 1993). Thus, on average respondents in *Group<sub>Species</sub>* had lower error variance. We tested for the IIA assumption of the conditional logit model using a Hausman McFadden test (1984) which indicated that the IIA assumption was violated, and therefore we estimated a set of models without this assumption. These models have different assumptions regarding error structure and preference heterogeneity. Table (2) reports the standard evaluation criteria for the analysed models. The RPL model together with error component was best supported, and therefore the results of this model are presented in detail. The estimation results are shown in Table 3 and 4, where all main attributes are significant with positive sign and the tax coefficient is negative as expected. The locations are seen as opposed to Funen, and we have no a priori expectations of their sign. Table 5 also shows the WTP for the attributes. As is seen, WTP for species is significantly higher at the 10% level for *Group<sub>biod</sub>* than for *Group<sub>Species</sub>*. Thus, hypothesis  $H_0$  no contextual embedding or information bias must be rejected.

Table (2) comparing different logit models in terms of standard criteria

Model fit criteria	RPL	GMXLOGIT	SMNLOGIT
Log-likelihood	-6553.1	-7157.6	-7784.07
$\bar{\rho}^2$	0.26	0.23	0.11
AIC	13102.3	14426	15598
Tau scale	-	1.2	1.2
Gamma MXL	-	-	0



Table 3. Estimation of parameters and WTP estimated using a RPL model together with Error component (RPL+EC) \*\*\*  $P < 0.01$ , \*\*  $P < 0.05$

	Attributes	Parameters ( $\beta$ ) and z value [ ] standard deviation ( $\sigma$ )		WTP (DKK <sup>1</sup> /Year) and z value [ ] (95% confidence interval)	
		$\beta$	$\sigma$		
<b>Group</b> species	1500 species	$\beta$	1.03 [5.90]	422.26 [5.93] (282.99 ; 562.59)	
		$\sigma$	1.5 [8.4]		
	2000 species	$\beta$	0.95 [7.90]	392.48 [7.67] (292.24 ; 492.73)	
		$\sigma$	1.04 [7.33]		
	Natural cycle(leaving 7 deadwood/ha)	$\beta$	0.42 [2.43]	172.64 [2.43] (33.50 ; 311.79)	
		$\sigma$	0.08 [0.12]		
	Natural cycle(leaving 15 deadwood/ha)	$\beta$	0.66 [4.39]	262.96 [4.42] (146.48; 379.44)	
		$\sigma$	1.56 [12.45]		
	Location(Scania)	$\beta$	-1.16 [-7.26]	-479.27 [-6.93] (-614.88; -343.67)	
		$\sigma$	2.10 [13.62]		
	Location(Zealand )	$\beta$	-0.28 [-1.36]	-101 [-1.78] (-214.27 ; 10.51)	
		$\sigma$	2.17 [14.73]		
	<b>Additional utility for <math>Group_{biod}</math>, i.e. adding stability and resilience</b>	(1500 species)	$\beta$	0.34 [1.46]	142.40* [1.45] (-49.47 ; 334.28)
			$\sigma$	0.31 [0.43]	
(2000 species)		$\beta$	0.82 [3.25]	336.44 [4.54] (191.17; 481.71)	
		$\sigma$	0.81 [3.11]		
Natural cycle(leaving 7 deadwood/ha)		$\beta$	-0.005 [-0.02]	-2.1 [-0.2] (-181.97 ; 176.84)	
		$\sigma$	0.47 [1.28]		
Natural cycle(leaving 15 deadwood/ha)		$\beta$	0.19 [1.03]	80 (-71.70 ; 230.35)	
		$\sigma$	0.47 [1.28]		
Location(Scania)		$\beta$	0.71 [3.25]	294.41 [3.23] (115.54 ; 473.28)	
		$\sigma$	0.31 [0.51]		
Location(Zealand )		$\beta$	-0.25 [-1.36]	-117.67 [-1.35] (-287.33 ; 52.46)	
		$\sigma$	0.31 [0.51]		
Sigma E01		3.83***			
Const		-2.43***			
Tax		-0.002***			
AIC		13163.3			
LL		-6556.67			
$\bar{\rho}^2$		0.28			
N		1,556			

<sup>1</sup>DKK (1Danish Kroner = 0.18 US Dollar)

Table4. Estimation of WTP for *Group biod* (According to estimation results of *Group Species* and additional utility for stability reported in table 3 ).

	Attributs	WTP (DKK <sup>1</sup> /Year) and z value [] (95% confidence interval)
<i>Group biod</i>	(1500 species)	565.17 [6.98] (406.39 ; 723.94)
	(2000 species)	728.98 [11.54] (605.09; 852.78)
	Natural cycle(leaving 7 deadwood/ha)	170.46 [2.23] (20.44 ; 320.47)
	Natural cycle(leaving 15 deadwood/ha)	342.28 [5.53] (221.05 ; 463.52)
	Location(Scania)	-184.86 [-2.85] (-312.14 ; -57.57)
	Location(Funen)	-219.55 [-3.28] (-350.55 ; -88.56)

<sup>1</sup>DKK (1Danish Kroner = 0.18 US Dollar)

Table 5 shows WTP for the two sub-groups within *Group species*, *GroupSpecies/yes* and *Group species /no*. For WTP comparison we applied the Poe et al. (2005) convolution test (results not shown). The difference in WTP was significantly larger in *Group species/yes* than in *Group species/no* for both levels of biodiversity (Species 1,500 and Species 2,000). Thus,  $H_{0_{\text{no contextual embedding}}}$  gets rejected.

Table 5: Estimation of parameter and WTP applying RPL model together with Error component (RPL+EC) for two subgroups (*Group<sub>species/yes</sub>*) and (*Group<sub>Species/no</sub>*) within *Group<sub>Species</sub>*. \*\*\*  $P < 0.01$ , \*\*  $P < 0.05$

	Attributes	Parameters( $\beta$ ) and z value [] standard deviation ( $\sigma$ )		WTP DKK/Year and z value [] (95% confidence interval)
<i>Group<sub>species/no</sub></i>	(1500 species)	$\beta$	0.35 [1.39]	158 [1.38] (-66.3 ; 383.6)
	(2000 species)	$\beta$	0.48 [2.97]	214 [2.93] (71.1 ; 357.7)
	Natural cycle(leaving 7 deadwood/ha)	$\beta$	0.06 [-0.24]	28 [0.24] (-214.9 ; 270.3)
	Natural cycle(leaving 15 deadwood/ha)	$\beta$	0.33 [1.67]	149 [1.72] (-20.8 ; 320.7)
	Location(Scania)	$\beta$	0.26 [1.33]	116.3 8 [1.36] (-50.9 ; 283.7)
	Location(Zealand)	$\beta$	0.17 [1.01]	79.8 [1.00]
	Sigma E01			5.83
	Const			0.74
	Tax			-0.002***
	AIC			2470.7
	LL			-1205.8
	$\bar{\rho}^2$			0.38
	N			250
<i>Group<sub>species/yes</sub></i>	(1500 species)	$\beta$	0.72 [4.81]	492 [4.68] (321.1; 663.1)
	(2000 species)	$\beta$	0.71 [7.28]	488 [6.72] (345.6; 630.5)
	Natural cycle(leaving 7 deadwood/ha)	$\beta$	0.43 [2.70]	297.7 [2.69] (81; 514)
	Natural cycle(leaving 15 deadwood/ha)	$\beta$	0.70 [5.80]	479 [5.85] (318.6 ; 639.5)
	Location(Scania)	$\beta$	-0.45 [-3.62]	-311 [-3.38] (-472.12 ; -150.74)
	Location(Zealand)	$\beta$	0.07 [0.67]	51 [0.67] (-100.2; 203.4)
		$\sigma$	1.3 [8.319]	
	Sigma E01			2.87***
	Const			-1.39***
	Tax			-0.001***
	AIC			4535.6
	LL			-2202.19
	$\bar{\rho}^2$			0.3
N			350	

Comparing the WTP of *Group<sub>species/yes</sub>* with *Group<sub>biod</sub>* reveals that there is no significant difference for WTP for 1,500 species. So,  $H_{0_{\text{no information bias}}}$  is not rejected.

However, WTP for improvement of the Species richness to 2,000 species is statistically different ( $p < 0.05$ ) and bigger in *Group<sub>biod</sub>*.

Comparing WTPs within *Group<sub>Species</sub>* (Table 3) shows that respondents are scope insensitive to the different levels of species as the WTPs are not significantly different from each other. The WTPs of *Group<sub>biod</sub>* show evidence of scope sensitivity for both improvement level of biodiversity (Species 1,500 and Species 2,000). Thus, we can reject  $H_{0_{\text{no scope}}}$  for *Group<sub>biod</sub>* but not for *Group<sub>Species</sub>*. This indicates that the contextual embedding issue may affect sensitivity to scope.

A scope sensitivity test shows that within *Group<sub>species/yes</sub>* respondents do not have statistically different WTPs for both improvement levels of biodiversity (Species 1,500 and Species 2,000) while respondents in *Group<sub>biod</sub>* are scope sensitive because they have statistically different WTPs for both improvement levels of biodiversity (WTP for 2,000 species > WTP for 1,500 species).

## 5. Discussion

### 5.1. Contextual embedding vs. information bias

A challenge to the use of choice experiments to value environmental goods is how to provide enough information for precisely eliciting respondents' preferences, yet not to provide them with new information and thereby affecting their preferences. In this paper we have addressed the challenge in the form of testing the presence of what we call contextual embedding, arising from the functional characteristics of biodiversity as opposed to biodiversity being presented with species number alone. Though this effect is inevitably linked with the information we give to respondents, we try to distinguish these two effects. We test this in several steps. First, we test whether presenting biodiversity as (common) species number alone to *Group<sub>Species</sub>* results in a different (higher) WTP compared with the group of respondents who were also informed about the stability and resilience services of biodiversity, *Group<sub>biod</sub>*. We find that to be the case. This may be a result of both an information effect and a contextual embedding effect. To distinguish these two, we

compare the WTP of *Group<sub>biod</sub>* with WTP of the part of *Group<sub>Species</sub>* stating that they considered stability and resilience service when answering the choice sets, *Group<sub>Species/yes</sub>*. These are not significantly different from each other for the medium attribute level, but they are at the high attribute level. The group who answered “no” to the follow-up question has a significantly lower WTP than the group who answered “yes”. Consequently, as also illustrated in Fig. 1, we conclude that there is a presence of contextual embedding if we do not inform respondents of the stability and resilience of biodiversity (functionality of biodiversity). This is a problem relevant to the majority of studies valuing biodiversity by looking at species numbers alone.

## **5.2. Scope sensitivity**

Insensitivity to scope often arises from an imprecise presentation and thus little understanding of the quantity of a good provided. Consequently, the more precise the description of a good being valued, the better sensitivity scope. We test sensitivity to scope for biodiversity for the different splits and find that for all splits, respondents are sensitive to increase in provision compared to the status quo. Furthermore, *Group<sub>biod</sub>*, getting the most detailed information on the attribute, resulted in scope sensitivity to the improvements whereas this was not the case for *Group<sub>Species</sub>*. Looking at the difference in scale between the two splits also reveals that scale is lower, and thus error variance is higher, in *Group<sub>Species</sub>* than in *Group<sub>biod</sub>*. Thus, we conclude that providing the extra information on biodiversity increases the understanding of the good – again addressing the importance of presenting the value of biodiversity to a sufficiently detailed degree.

## **5.3. Presentation of biodiversity to respondents**

One could argue that there could be many ways to define the functionality of biodiversity, which would all result in different values. The approach taken here, and the reason we dare to conclude that the more detailed the description is the better, is that the current study is based on a qualitative in-depth study of people’s perception, or mental constructs of biodiversity (Bakhtiari et al., 2014). For example, to present the concept of sustaining the natural dynamics of the forest, we used the term ‘natural cycle’ and the attribute of the policy action: leaving deadwood in forest. In addition,

for presenting the role of species diversity in ecosystem, the questionnaire was formulated in accordance with public preferences revealed during interviews. These iterations targeted the design of the embedding and scope test and facilitated the interpretation of the results.

Furthermore, because the qualitative study revealed that respondents care about diversity and not only endangered species, and because the functionality of biodiversity is more linked to diversity than to the presence of endangered species, we used the presence of a number of common species instead of conservation of endangered species like in Campbell et al. (2013). The study thus contributes to current literature on biodiversity valuation by suggesting a formulation for biodiversity as ‘number of common species’ together with its role in ecosystem function, e.g. ‘resilience and insurance’ which built on public mental construct and supported by recent ecological evidence of the importance of conservation of common species.

The results show that people do care about diversity itself and probably this is also the reason why we find the presence of contextual embedding if respondents are not informed of the functional aspects of biodiversity. Had we focused on endangered species, the effect would likely have been smaller.

#### **5.4. Possible caveats**

To test contextual embedding it would be desirable to use a single test. However, because it relies on the information given to respondents, it is not possible to distinguish the two effects. Yet we find the issue so crucial for valuation that an attempt must be made. Therefore, we did it in a two-step procedure, testing it by excluding the effects in different splits (see Fig. 1). One possible caveat is, therefore, that the respondents in  $Group_{Species/yes}$  simply value the good more than the respondents in  $Group_{Species/no}$  and therefore get closer to the WTP of  $Group_{biod}$  which is higher. This may happen, e.g. due to difference among respondents in terms of socio-demographic characteristics e.g. age, gender, income. However, the group of respondents who do not value biodiversity a lot should also be present in  $Group_{biod}$  and thereby affecting the size of WTP here. In addition, two splits ( $Group_{Species}$  and  $Group_{biod}$ ) were identical in terms of socio-demographic characteristics. Consequently, we do not believe this to draw the differences in WTP found.

By providing respondents with extra information in the choice sets, we increase complexity, which could lead to more uncertain choices and lower valuation (DeShazo and Fermo 2002 ). However, we find the opposite to be the case based on the size of the scale. Therefore, we do not believe complexity drives the differences.

## **6. Conclusion**

Applying choice experiments for valuation of environmental goods, e.g. biodiversity, is a challenging area to researchers. Environmental goods are complex and it is not an easy task to provide enough information for precisely eliciting respondents' preferences while not providing new information and thereby affecting preferences. In this study, we challenge this problem by testing the presence of what we term contextual embedding, arising from the functional characteristics of biodiversity as opposed to biodiversity being presented by species number alone. We find a higher WTP for the group informed about the stability and resilience of the ecosystem in addition to species number when presented with the biodiversity attribute. This may be due to information or/and embedding effect.

To distinguish these two possible effects, we used a follow up-question and within the group, where biodiversity is presented by species number alone, two subgroups were identified. The assumption was that since both groups received the same questionnaire, the information given to them is the same. Thus, the difference between their WTPs confirms the presence of contextual effect. It was found that the group who did not consider stability and resilience service in their choice for species number have a significantly lower WTP than the group who did. This confirms the presence of contextual embedding when presented with species number alone. This is a relevant problem to the majority of valuation studies valuing biodiversity by only presenting species numbers alone to respondents.

We also tested sensitivity to scope for biodiversity for the different splits and found for all splits that respondents were sensitive to increase in provision compared to the status quo. Furthermore, respondents who were informed about stability and resilience exhibited scope sensitivity to the improvements, whereas this was not the case for respondents valuing species numbers alone. Therefore, the present study indicates the importance of taking in-depth qualitative evidences of public mental constructs of complex environmental goods such as biodiversity into account to

increase the validity of WTP results in the sense that respondents are more scope sensitive and have a lower variance.

We recommend that future studies use a detailed presentation of biodiversity which includes stability and resilience. It seems clear that the public value biodiversity both as a good in itself (e.g. by species number) and as an important contributor to ecosystem functionality.

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# **Paper Three**

# Valuation of biodiversity protection across borders: Limits to the public good?

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## Abstract

The international coordination of conservation policy and management is widely expected to reduce costs and increase effectiveness. An underlying assumption is that biodiversity protection is a global public good and specifically that the value of biodiversity protection is independent of the geographical and political jurisdiction of provision. We investigate if comparable biodiversity protection measures and outcomes in two countries are indeed valued as a global public good by the population in those same two countries.

Using a choice experiment (CE), the individuals' marginal willingness to pay (WTP) for comparable biodiversity protection measures and outcomes across country borders were estimated for locations in Denmark and in southern Sweden.

We were able to distinguish an effect of nationality from distance by exploring the extent to which willingness to pay for policy alternatives was affected by the nationality of and the distance to the protection location. We found a clear effect of both. WTP decreased by 152 DKK/year for a forest ecosystem improvement policy implemented in a foreign rather than home country. In addition the cost of bridge tolls was estimated as -397DKK and transport -2 DKK/km broadly similar to the actual cost. This suggests that respondents view biodiversity protection measures and outcomes more as a local than a global public good. Our findings, if extendable to broader settings, suggest that the cost-effectiveness approach to international coordination of biodiversity protection is not likely to be optimal from a welfare economic point of view.

Keywords: Choice experiment, beech forest, Sweden, Denmark, international coordination policy, nationality, distance.



## 1. Introduction

The continued loss of biodiversity at the global scale has prompted national and international actions and policies targeting international coordination of efforts (e.g. Natura<sup>1</sup> 2000, Rio summit<sup>2</sup>, CBD2010<sup>3</sup>, MA<sup>4</sup> 2005). In spite of this, the rate of biodiversity loss does not appear to be slowing (Butchart et al. 2010), many countries did not meet targets set by the Conservation on Biological Diversity (Perrings et al. 2010), and renewed pledges were made at Nagoya.

It is unclear how far these agreements and initiatives have increased the geopolitical coordination of biodiversity conservation (Bladt et al. 2009), in spite of many advantages of this approach.

The challenge of migratory species conservation, habitat fragmentation and variation in conservation costs at the continental scale and across countries means that coordinating species conservation at the trans-national scale is likely more cost effective than independent national planning. The expected impact of climate change on species distributions and ranges further reinforces the need for improved cross country- coordination (Thomas et al. 2004; Thuiller et al. 2005; Bladt et al 2009; Bakkenes et al. 2002; Strange et al. 2011).

Several studies illustrate the extent of cost-efficiency gains of internationally coordinated conservation policies (Rodrigues & Gaston, 2002; Strange et al. 2006; Bladt et al. 2009, Moilanen and Arponen 2011). There may be several reasons why trans-national agreements have made little progress: Conflicts with national priorities, difficulties legitimately incorporating them in national law (Bennett and Ligthart 2001; Dimitrakopoulos et al. 2004; Paavola 2004; Pinton 2001), or simply the issue of free-riding (Olson 1965; Ostrom 1990), making it difficult to get individuals and nations to pursue their *joint welfare* in the case of global public good provision.

The research question that this paper addresses, is just how far biodiversity protection can be considered a global public good, with benefits extending beyond national borders? Traditional public goods and services, e.g. national defence, libraries, fire brigades, have fairly well-defined benefit distributions at local, state or national scale. However, the geographical distribution of

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<sup>1</sup> A network of European protected areas.

<sup>2</sup> Rio de Janeiro, Brazil, 1992

<sup>3</sup> Convention on Biological Diversity's (CBD) 2010 Biodiversity Target : <http://www.cbd.int/>

<sup>4</sup> Millenium ecosystem assessment

benefits from some public goods and services (especially non-use values), including the protection of biodiversity is not quite as clear (Deacon and Schläpfer 2010). As pointed out by Perrings and Gadgil (2003), some biodiversity values, like the option value embedded in the preservation of the *global gene pool*, are global public goods. Other use values potentially resulting from biodiversity protection, like the regulation of productivity in grasslands, or recreational benefits are rather to be considered local public goods. An open question is, if non-use values, like existence values, are global public goods. Therefore, to the degree that biodiversity protection implies public goods, it is often discussed whether the spatial location should matter for its valuation (Johnston et al. 2002; Bateman 2009; Brouwer et al. 2010; Schaafsma 2011), including if non-use values are sensitive to site (i.e. nationality) of provision (Hanley et al. 2003; Schaafsma 2011). This discussion and research question is of interest, because international coordination of biodiversity conservation may face challenges, the less people share and value the public good aspect of biodiversity protection across borders.

Our research question is an empirical one; can we disentangle the effects that country of provision may have on value elements from the role that distance to the provision site may have? None of the existing studies successfully disentangle distance to site of provision from the country of provision. To address this we designed a Choice Experiment (CE) valuation study focused on biodiversity protection measures in Beech forests (*Fagus sylvatica*) in Southern Scandinavia. We selected three regions, two in Denmark (Fuen and Zealand) and one in Sweden (Scania), separated by bridged waters, where these measures would provide biodiversity protection benefits of comparable quality. With that design the current study successfully distinguished the effect of the distance to site of provision from the country of provision, which is novel to the literature. We found distance related attributes to reflect quite perfectly the bridge tolls and per kilometre transport costs, and we found Swedes and Danes to prefer provision in own country over a neighbouring country.

In the following, we first review the literature on the effect of nationality and distance on WTP for protection of biodiversity. We then present the case study and experimental design in section 2, followed by a formalization of the hypotheses in section 3. Section 3 also includes the econometric methods. Results are presented in section 4, and we end the paper by a discussion of the results in section 5 and a few concluding remarks in section 6.

## 1.1. Related literature

The values that people associate with biodiversity conservation measures may be both use-value types (direct recreational use-values, indirect use values through other ecosystem functions or cultural services) and non-use value types (e.g. option, bequest and existence types). Even if these can all be thought of as public good based values, it is intuitively clear that for any group of people the site of provision, (*where* the biodiversity conservation takes place), may matter for the at least some of the values derived, and not surprisingly it is often discussed whether the spatial location should matter for its valuation (Johnston et al 2002; Bateman 2009; Brouwer et al. 2010; Schaafsma 2011). If the protection of a given species or habitat is a pure global public good, its value to people should be independent of how far they live from the site of protection.

However, a negative relation (distance decay) between some use-values related to biodiversity conservation and distance to the conservation site is to be expected, e.g. because of the increased cost of reaching the site and benefiting from the good (Hanley et al. 2003; Pellegrini and Fotheringham 2002). On the other hand, some indirect use values may be quite insensitive to distance and site of provision (e.g. watching documentaries about whales or polar bears). Thus, it is not generally likely to be valid to suggest as Garrod and Willis (1997) and Morrison et al (2002) that since most of their respondents had never visited the remote forest under valuation, their values were most likely non-use benefit estimates. Similarly, the sensitivity of non-use values to distance and/or site of provision is also not clear. Bateman et al (2002) and Hanley et al. (2003) argued that a sense of ownership or spatial identity may be important for some environmental values. This may also carry over to non-use values like existence and bequest values. Further reasons may include a sense of responsibility or expectations of international reciprocity; leading individuals to favour action at home (first) in the hope that “putting your own house in order” will induce reciprocity and raise international commitment. Thus, we may formulate the hypothesis that, an individual may derive higher non-use values from biodiversity conservation in their own country, than from similar measures in other countries. Clearly, as distance tend to increase as activities move to other countries, such patterns may result in findings that non-use values also decay when distance increases, or more precisely, when site of provision changes.

Some studies do indicate that also non-use values may be sensitive to distance to and/or site of provision (Hanley et al. 2003; Schaafsma 2011). While these studies addressed the effect of distance, they were not able to separate distance effects from cultural and nationality effects of site

of provision. These are particularly important when analysing the value of public goods in an international context.

Thus, for both use and non-use values, there are indications that distance to and/or site of provision matters for people. The exact role remains an empirical question. According to Hanley et al (2003) and Bateman et al (2006) although a significant distance decay effect for non-users exists, the relationship is stronger for users than for non-users. Other studies show ambiguous results; some report significant negative correlations between distance and WTP for non-use values (Jørgensen et al. 2012; Sutherland and Walsh 1985; Hanley et al. 2003; Loomis 1996) while Pate and Loomis (1997) and Bateman and Langford (1997) found no significant relation between distance and WTP for public goods with presumably large non-use value elements.

Assessing biodiversity conservation measures across national borders generally coincide with a longer distance for respondents, making it difficult to distinguish nationality effects (affecting e.g. cultural identity, ethical concerns) from distance effects (related in particular to use values). To the authors' knowledge, no studies have so far considered systematically if the nationality of the site of a biodiversity conservation measure matters for the WTP of respondents of different nationality. Thus, investigation into nationality effects on WTP for conservation measures have generally focused on respondent nationalities only, keeping the site of the good fixed (e.g. Horton et al. 2003; Hoyos et al. 2009; Ressurreição et al. 2012).

Therefore, as explained in the introduction the current study developed a choice experiment designed to analyse the effects of nationality of and distance to site of provision and respondents independently.

## **2. Case study and experimental design**

### **2.1. Case study**

Our experiment used as the biodiversity conservation case in focus the enhanced protection of biodiversity in temperate broadleaved forests situated in one of three regions across two countries in Southern Scandinavia. Measures include setting forests aside for biodiversity and enhancing the number of old, dying and dead trees and dead wood in the forest.

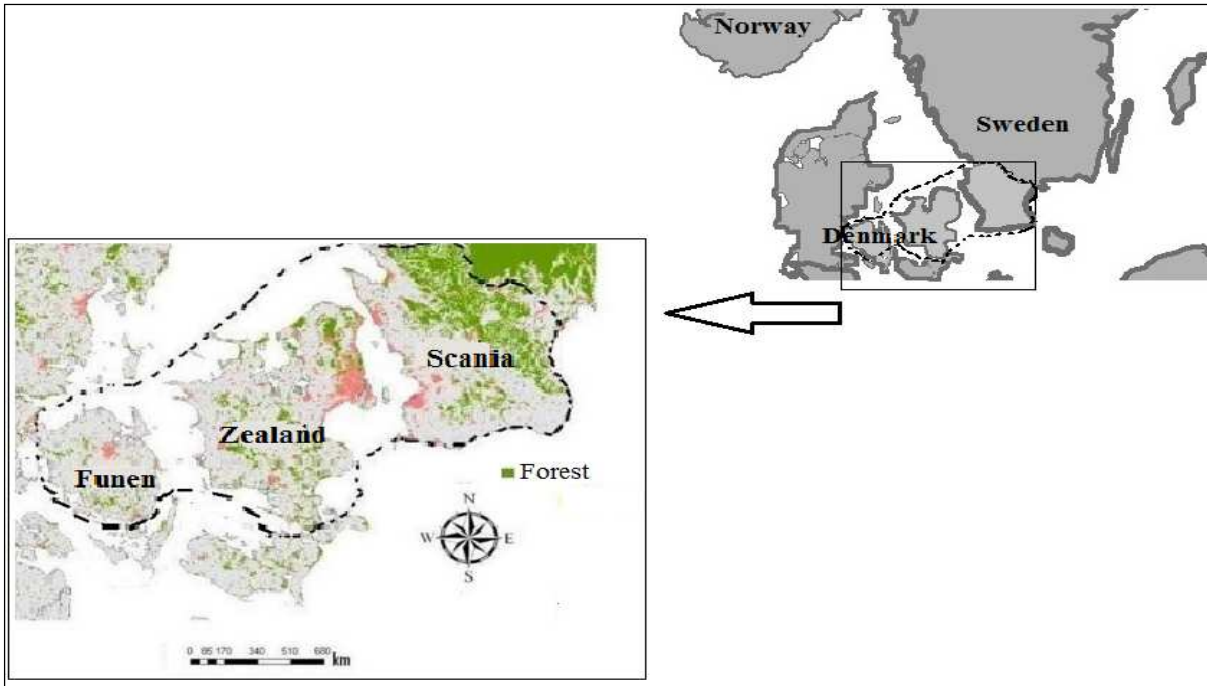


Figure1: map of the study area. The green and pink colours indicate the forest cover and urban areas, respectively. The stapled line show the border lines of the three study regions.

The three locations where the conservation policy could be implemented and where the respondents were sampled were Funen and Zealand in Denmark and Scania in Sweden. Travel distances between Funen & Zealand (within national boundaries) and Zealand and Scania (across national boundaries) are approximately identical, whereas that between Scania and Funen is doubled, allowing us to distinguish between distance and nationality. This also includes the cost of a toll-bridge over the Great Belt (between Funen and Zealand) as well as the Oresund (between Zealand and Scania). The broadleaved forests in these locations have similar biodiversity and conservation potentials and are dominated by beech (*Fagus sylvatica*), but also with presence of tree species such as oak (*Quercus robur*), ash (*Fraxinus excelsior*) and birch (*Betula pendula*).

## 2.2. Data collection and survey design

Data were collected through an internet-based questionnaire managed by the survey institute ‘Analyse Denmark’ during July-August 2012. We received 600 completed questionnaires (a 20% response rate) for each of the three locations (1800 in total). Survey respondents were informed that the hypothetical policy presented in the questionnaire would improve biological diversity as well as enhance the natural dynamics of the forests. The proxies used to describe these ecosystem services

were two attributes: 1) keeping old trees in the forest to age, die and turn into deadwood in the forest through natural decay and 2) increasing the number of species in the areas in focus by improving the living conditions for animals, plants and other organisms otherwise.

Respondents were informed that across the regions some 10,000 species in total are potentially associated with this type of broadleaved forests<sup>1</sup>. However, on any given forest area, much fewer will in general be present depending on the size of the area as well as the availability of microhabitats often related to conservation status. For example, according to Lawesson et al (1998) there are 90 plant species on average in a Danish broadleaved ‘natural’ forest (of different size) out of 447 plant species found across all forests in a region. To anchor respondents at a relevant shared status quo level, they were told that 1000 species were currently common in the area in focus. Respondents were then presented with policies that would increase this diversity to 1500 or 2000 species in the forest conservation area, including common, rare as well as potentially endangered species.

An important additional attribute was the location of the policy implementation which was presented as 4 levels which the current situation “no policy implementation” as opposed to three locations of the policy, namely Funen, Zealand and Scania’. Finally we included a tax attribute as an increase in the annual income tax. Table 1 shows the attributes and levels. The status quo represents the current and it is equal to the lowest level of each of the attributes<sup>2</sup>.

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<sup>1</sup> An expert assessment and see also <http://www.allearter.dk> for general information about the regions species.

<sup>2</sup> In the same questionnaire respondents received a larger CE regarding different conservation measures used for another study (see Bakhtiari et al., 2013a,b). However, as it rthe section followed the current crowding CE, we expect the WTT-results to be unaffected by that.

Table 1. Attributes and levels presented to respondents in choice tasks. Current situation (Sq) is lower level and is shown with **bold** format

Attribute variable	Attribute level
Location of policy area	<p><b>(i) no new policy</b></p> <p>(ii) Funen</p> <p>(iii) Zealand</p> <p>(iv) Scania</p>
Forest species number in area	<p><b>(i) 1000</b></p> <p>(ii) 1500</p> <p>(iii) 2000</p>
Presence of natural dynamics in area	<p><b>(i) occasionally leaving trees to age, die and decay</b></p> <p>(ii) Leaving 7 trees/ hectare</p> <p>(iii) Leaving 15 trees/ hectare</p>
Annual income tax (DKK/ year)	<p><b>0</b> ,250, 500, 750, 1000, 1250</p>

\*1DKK=0.18 USD\$ and 0.13 Euro

A previous qualitative study implemented on the same study area by the authors( ), using focus groups and open-end questionnaires, showed that income tax among most of Danish and Swedish citizens was an acceptable way of financing biodiversity policies. In order to avoid any free riding, it was emphasised in the questionnaire that all tax payers in both countries should contribute. In addition, it was emphasised that this amount will be additional to current tax payments. Similarly, a reminder about respondents' budget restriction was inserted before the choice tasks. The questionnaire also included questions of visiting frequency, distance to forests visited as well as various questions on forest activities to make respondents reflect on both use and non-use values and location issues. After the data collection we also constructed additional variables, including a variable capturing the variance among respondents in the distance from the respondents' mid-point postal code area to the policy site, a dummy variable for number of bridges between the respondent and a dummy variable for weather the policy site was in your own country or not.

A complete factorial design of the attributes gave 180 combinations of alternatives from which choice sets that did not add much information were removed (e.g. they included dominating alternatives). We applied a fractional factorial design to give 24 alternatives which were divided into four blocks of 6 choice tasks per respondent. The designs (ex ante) with zero priors and adding a status quo, had a d-error of 0.07, when the d-error was evaluated with a continuous variable for tax and dummy variables for the other variables. The design, when evaluated ex post, had a d-error of 0.0005 for the pooled data model and 0.0003, 0.0004, 0.0004 for the splits, Zealand, Scania and Funen, when evaluated as a multinomial logit.

Respondents received questions regarding crowding and conflict among forest users which were targeted for another study by Bakhtiari et al.(2014) but we expect results to be unaffected. The questionnaires were translated into Danish and Swedish. They were tested through focus groups and a pilot study and some revision in terms of language simplification and alternative policy levels were applied, based on participants' feedback.

### **3. Hypothesis formulation and Econometric analysis**

#### **3.1. Hypothesis formulation**

Based on the literature and our experimental design the following null-hypothesis was formulated:

*H0: Neither distance to nor the nationality of the site of conservation matters for people's WTP for a given policy alternative.*

We test this hypothesis in a model using the pooled sample from all three regions, as well as in models using specific regional sub-samples. We test it up against the competing alternative hypotheses:

*H1: Only distance to and not nationality of the site of conservation matters for peoples WTP for a given policy alternative.*

*H2: Only nationality of and not distance to the site of conservation matters for peoples WTP for a given policy alternative.*

*H3: Distance to as well as nationality of the site of conservation matters for peoples WTP for a given policy alternative..*



In our pooled model, we incorporate the ‘distance’ variable, a variable ‘bridge’ for the number of toll bridges to be crossed from respondent to site and the nationality dummy ‘foreign’ (being 1 if policy is not in respondent’s home country) and the  $H0$  is rejected if the parameter (WTP) for either is significantly different from zero, with the expected sign being negative. If all are significantly (negative) different from zero, we can reject also  $H1$  and  $H2$ , whereas if this is true for only one of them,  $H3$  is rejected, as is also either  $H1$  or  $H2$ .

Secondly we test the hypotheses on two subsamples. As Zealand is located in the middle with equal distance to Scania and Funen, we can evaluate  $H0$  in the sub-sample for Zealand using a dummy coding of the locations, which embeds distance for ‘Funen’ and distance and nationality for ‘Scania’, relative to Zealand. Thus, under  $H0$  we expect the marginal effect of the location to be equal:

$$H0_{Zealand}: WTP_{Zealand}(Scania) = WTP_{Zealand}(Funen) = WTP_{Zealand}(Zealand),$$

where the subscript refers to the location of the respondents and parenthesis to the location of the policy. Under the two alternative hypotheses that only either nationality or distance matters, we would expect not to be able to reject the following for the WTP effect of the location dummy:

$$H1_{Zealand}: WTP_{Zealand}(Funen) = WTP_{Zealand}(Scania) < WTP_{Zealand}(Zealand)$$

if only distance matters and

$$H2_{Zealand}: WTP_{Zealand}(Funen) = WTP_{Zealand}(Zealand) > WTP_{Zealand}(Scania)$$

if only nationality matters. If both matters, we can reject  $H0$  as well as  $H1$  and  $H2$ . Under the final alternative,  $H3$ , we would expect the following:

$$H3_{Zealand}: WTP_{Zealand}(Scania) < WTP_{Zealand}(Funen) < WTP_{Zealand}(Zealand),$$

Because the parameters for the Scania-dummy would include both a distance and a nationality effect, whereas the Funen dummy will include only the distance effect.

We are also able to test the  $H0$  hypothesis on the sample from Scania, with the same form as above.

The alternatives  $H1$  and  $H3$  cannot be tested on this sample as nationality effects in the location dummy cannot be separated from distance to Zealand and Funen. However, under  $H2$  we would expect:

$$H2_{Scania}: WTP_{Scania} (Scania) > WTP_{Scania} (Zealand) = WTP_{Scania} (Funen).$$

For the sample on Funen, none of the alternative hypotheses can be tested because both the nationality and distance effect are entangled and inseparable in the location dummy.

### 3.2. Econometric specifications

We test our hypotheses, by estimating a utility function for our pooled dataset as well as each of the study locations Zealand and Scania. *A priori* we would not expect scale differences between respondents from different locations, but as it would affect the testing of our main hypothesis, we tested for scale differences between respondents from Funen, Scania and Zealand using Biogeme<sup>1</sup> (Bierlaire 2003).

The utility function of our pooled dataset can be described as:

(1)

$$U_{ij} = (\text{ASC}_j + \beta_{1i}(\text{Foreign})_j + \beta_{2i}(\text{Distance})_j + \beta_{3i}(\text{Bridge})_j + \beta_{4i}(\text{Biodiversity1500})_j + \beta_{5i}(\text{Biodiversity2000}) \\ + \beta_{6i}(\text{Leaving7trees/ha})_j + \beta_{7i}(\text{Leaving15trees/ha})_j + \beta_8(\text{Tax})_j + \eta_{ij}) + \varepsilon_{ij}$$

Where  $i$  =individual and  $j$  =alternative. *Foreign* is a dummy variable (coded as 1 if policy not in respondent's country), *Distance* measures the nearest distance from the residence (midpoint of the postal code) to the nearest entrance point (being bridge or ferry) to the region, and *Bridge* is a variable for how many bridges must be crossed to get from the respondent to the region. These three variables relate specifically to *H0-H3*. In addition, *Biodiversity1500-2000* and *Leaving 7-15 trees* addressed enhanced species numbers and the establishment of natural dynamics in the forest respectively.

Using Zealand as an example of the sub-sample models, the utility of respondent  $i$  from Zealand for the policy alternative  $j$  is

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<sup>1</sup> <http://biogeme.epfl.ch/>

$$U_{Zealand,ij} = (ASC_j + \beta_{Zealand,2i}(Funen)_j + \beta_{Zealand,3i}(Scania)_j + \beta_{Zealand,4i}(Biodiversity1500)_j + \beta_{Zealand,5i}(Biodiversity2000)_j + \beta_{Zealand,6i}(Leaving7\ trees/ha)_j + \beta_{Zealand,7i}(Leaving\ 15\ trees/ha)_j + \beta_{Zealand,8i}(Tax)_j + \eta_{ij}) + \varepsilon_{ij} \quad [2]$$

Where the locations  $(Funen)_j$  and  $(Scania)_j$  address the utility of a resident in Zealand for implementing forest protection policy  $j$  in Funen or Scania respectively as opposed to implementation in Zealand.

The preference models are estimated using a random parameter error component logit model (RPL) (Revelt and Train 1998; Ben-Akiva et al. 2001; Scarpa et al. 2005) where the utility of a good is described as a function of its attributes, and people choose among composite goods by evaluating their attributes. In a specific case, where a respondent,  $i$ , faces a choice between a status quo and two policy alternatives, the utility,  $U$ , of these  $j$  alternatives in the  $n$ 'th choice occasion can be described by:

$$U_{ijn} = \begin{cases} V(ASC, x_{ijn}, \check{\beta}_i, \beta) + \varepsilon_{ijn} \rightarrow \text{If } j = 1 (\text{status quo}) \\ V(x_{ijn}, \check{\beta}_i, \beta, \sigma_i) + \varepsilon_{ijn} \rightarrow \text{if } j = 2,3; \end{cases} \quad [3]$$

Here the indirect utility,  $V$ , is a function of the vector of explanatory variables,  $x_{ijn}$ , containing characteristics of the individual, the alternative and the choice situation, as well as the vectors of individual-specific random parameters,  $\check{\beta}_i$  and fixed parameter  $\beta$ . An alternative Specific Constant (ASC) is specified for the status quo alternative in order to capture the systematic component of a potential status quo effect (Scarpa et al., 2005). An error component additional to the usual error term with Gumbel-distributed is added to the model to capture any remaining status quo effects in the stochastic part of the utility. This error component,  $\sigma_i$ , is an individual-specific random parameter with zero-mean and normal distribution and it is allocated exclusively to the two non-status quo alternatives. A general error component across these two alternatives is specified to take a correlation pattern in utility over these alternatives into account (Greene and Hensher 2007; Ferrini and Scarpa 2007; Scarpa et al. 2008).

In mixed logit models the stochastic element of utility is fragmented additively into two parts (Hensher and Greene 2003): one part is potentially correlated over alternatives and heteroskedastic over individuals and alternatives; the other is i.i.d. over alternatives and individuals. According to Train (2003), the Mixed Logit probabilities can be described as integrals of the standard conditional logit function evaluated at different  $\beta$ 's with a density function as the mixing distribution. Furthermore, this specification can be generalised to allow for repeated choices by the same respondent, i.e. a panel structure, by letting  $k$  be a sequence of alternatives, one for each choice occasion,  $k = \{k_1, \dots, k_N\}$ . Thus, the utility coefficients vary over people but are constant over the  $N$  choice occasions for each individual. If the density, as in this paper, is specified to be normal, the probabilities of individual  $i$  choosing alternative  $k$  out of  $J$  alternatives can be defined as:

$$\Pr(ik) = \int \left( \prod_{n=1}^N \left[ \frac{\exp^{\lambda_{ikn} \beta'_i x_{ikn}^n}}{\sum_j \exp^{\lambda_{ikn} \beta'_j x_{ijn}^n}} \right] \right) \phi(\beta | b, W) d\beta$$

The ASC and error terms from eq. (1) are left out for simplicity.  $\beta$ ' is a vector of all betas, and the distribution function for  $\beta$  is  $\phi(\beta | b, W)$ , with mean  $b$  and covariance  $W$ . The analyst chooses the appropriate distribution for each parameter in  $\beta$ .

The model estimates parameters up to a scale factor,  $\lambda$ , which is inversely related to the error variance, may differ between subsamples and can be estimated by using scale tests (e.g. see Bierlaire 2003). We presumed that there could be a difference in scale between the three subsamples (i.e. Funen, Zealand and Scania) as they belong to different geographical location. The approach suggested by Swait and Louviere (1993) was applied to test for scale and correct for it afterwards. Data from three subsamples were merged after correcting for scale differences.

#### 4. Results

The three sub-samples slightly underrepresented respondents in middle and low income groups compared with the population in Denmark and Sweden. However, in terms of socio-demographic variables such as age, education, gender and income there was no statistically significant difference among samples taken from the three locations. Respondents (2% of those who responded in the

survey) who chose the status quo alternative in all six choice sets and explained this with ‘I don't want to pay more tax’, rather than ‘It was too expensive as compared to the benefits I would experience’ were removed, as they were considered protest bidders.

To present a picture of how often respondents travel to forests in their own and neighbouring regions Table 2 shows that respondents on Zealand visit the other locations more frequently than vice versa. It also shows a clear distance effect in that respondents living in Scania visit Funen the least (and vice versa).

Table 2. The number of respondents who have checked the different frequency alternatives for the different locations

	More than 3 times a week	1-3 times a week	1-3 times a month	1-12 times a year	Once a year	Less than once a year	Never visit
<b>Respondents in Scania</b>							
<b>Forest in Funen</b>	0	2	0	1	2	67	528
<b>Forest in Zealand</b>	0	18	0	21	21	90	450
<b>Forest in Scania</b>	72	88	111	231	39	41	18
<b>Respondents in Zealand</b>							
<b>Forest in Funen</b>	0	0	0	8	51	291	250
<b>Forest in Zealand</b>	9	54	30	384	49	55	19
<b>Forest in Scania</b>	0	3	2	28	47	120	400
<b>Respondents in Funen</b>							
<b>Forest in Funen</b>	0	78	0	307	135	70	10
<b>Forest in Zealand</b>	0	0	0	50	57	199	294
<b>Forest in Scania</b>	0	0	0	5	14	97	484

## **4.1. Estimation results applying econometric models**

### **4.1.1 Scale test and model selection**

The scale test showed that respondents in Danish Zealand and Funen had similar scales (scale=1), while the Swedish Scania sample had a statistically smaller scale (0.33) and hence greater variance. Therefore, before merging samples, we modified the variables of the splits according to the scale difference (see Ben-Akiva and Lerman 1985, Louviere et al. 2000, Train 2003). According to standard criteria namely log likelihood, pseudo- $R^2$  and AIC, the Random Parameter Logit model together with error component (RPL+EC) was best supported.

### **4.1.2 Investigating the nationality and distance hypothesis in pooled data set**

The results of model estimation on the pooled data set are shown in Table 4. They show that both environmental attributes as well as the error components are significant with expected positive signs, and the tax coefficient is negative as expected. The alternative specific constant (ASC) is negative and significantly different from zero. The ‘distance’ and ‘foreign’ variables are both significant and negative, the implication being that  $H0$ ,  $H1$  and  $H2$  are all rejected. Table 3 shows the average distance among case study locations.

Table 3. parameter and WTP estimates in pooled data set using (RPL+EC)

Attributes	Parameters (standard error)		WTP (DKK <sup>1</sup> /year) (95% confidence interval)
	$\beta$		
Foreign location	$\beta$	<b>-0.27***</b> (0.08)	<b>-152</b> (-252.93 ; -51.72)
	$\sigma$	<b>0.97***</b> (0.12)	-
Distance <sup>3</sup>	$\beta$	<b>-0.004***</b> (0.001)	<b>-2</b> (-3.01 ; -1.2)
	$\sigma$	0.01*** (0.006)	-
Bridge	$\beta$	-0.70*** (0.06)	<b>-397</b> (-462.08 ; -332.25)
1500 species	$\beta$	0.88*** (0.09)	<b>493</b> (389.6;597.19)
	$\sigma$	1.02*** (0.14)	-
2000 species	$\beta$	0.81*** (0.06)	<b>452</b> (382.72; 521.92)
	$\sigma$	0.7*** (0.08)	-
Natural dynamic(leaving 7 deadwood/ha)	$\beta$	0.25*** (0.09)	<b>142</b> (43.04;242.66)
	$\sigma$	0.09 (0.9)	-
Natural dynamic(leaving 15 deadwood/ha)	$\beta$	0.35*** (0.07)	<b>201</b> (118.79;283.75)
	$\sigma$	1.02 (0.07)	-
Tax	$\beta$	0.002*** (0.0005)	-
ASC <sup>2</sup>		-2.24*** (0.19)	
AIC/N		1.47	
$\chi^2_2$		0.34	
LL		-7710.86	
Sigma		4.42***	

<sup>1</sup>DKK =0.18 USD \*\*\*statistically significant at the 1‰ level, \*\* at the 1% level and \* at the 5% level.

<sup>2</sup>ASC is the utility from status quo as opposed to any of the policies. <sup>3</sup>Distance is measured in kilometre.

### 4.1.3 Investigating the hypotheses in selected study locations

We estimated a model for each of the locations Zealand and Scania, see Table 4. The results are comparable with the model for the pooled data.

We found that residents in Zealand had the largest WTP for a policy implementation in their own location (Zealand) compared with other locations, as the WTP for each location should be seen as additions to the ASC, which is negatively correlated with respondents own location (Figure 1). Thus, for Zealanders, the WTP (*ceteris paribus*) for a policy implemented in Funen is lower than for Zealand, but significantly larger than for implementing a similar alternative in Scania. Therefore  $H3_{Zealand}$ ,  $WTP_{Zealand}(Scania) < WTP_{Zealand}(Funen) < WTP_{Zealand}(Zealand)$ , cannot be rejected, but all of  $H0-H2$  can.

Since 'Bridge' was 1 for both alternative locations, we didn't include it in the model. Note that the cost of passing the bridge going from Zealand to Scania is similar to those of the the bridge from Zealand to Funen.

We furthermore found that respondents in Scania prefer Scania over the two other locations, but the difference between Funen and Zealand dummies is significant, Thus, for this sub-sample, we cannot reject  $H3_{Scania}$  that both distance and nationality matters, nor can we reject  $H1$  that only distance matter (because we cannot weed out a nationality effect for both Funen and Zealand), but we can reject  $H0$ , and  $H2$ .



Table 4. Parameter estimates in 2 location samples using RPL+EC. Parameters in **bold** format relates to the hypotheses. Locations are as opposed to the location of the respondents' own location

Geographical locations: Attributs	Zealand			Scania	
	Parameters (Standard error)	Marginal WTP (DKK/year) (95% confidence interval)	Parameters (Standard error)	WTP (DKK/year) (95% confidence interval)	
Location(Scania)	$\beta$	<b>-1.87***</b> (0.12)	<b>-943<sup>a</sup></b> (-11101.10 ; -885.64)	-	-
	$\sigma$	<b>1.1***</b> (0.17)	-	-	-
Location(Funen)	$\beta$	<b>-1.40***</b> (0.09)	<b>-706<sup>a</sup></b> (-888.7 ; -598.16)	<b>-1.54***</b> (0.10)	<b>-1155<sup>a</sup></b> (-1289.82 ; -1021.63)
	$\sigma$	<b>0.9 ***</b> (0.90)	-	<b>0.71***</b> (0.13)	-
Location(Zealand)	$\beta$	-	-	<b>-1.27***</b> (0.10)	<b>-953<sup>a</sup></b> (-1017.18 ; -838.37)
	$\sigma$	-	-	<b>0.51***</b> (0.19)	-
1500 species	$\beta$	0.88 *** (0.14)	457 (310.60 ;604.22)	0.69*** (0.08)	543 (312.87 ;772.92)
	$\sigma$	0.62 (0.37)	-	0.52*** (0.14)	-
2000 species	$\beta$	0.80*** (0.10)	400 (287.41 ;512.31)	0.72*** (0.14)	514 (384.12 ;643.19)
	$\sigma$	0.9*** (0.13)	-	0.94*** (0.24)	-
Natural dynamic(leaving 7 deadwood/ha)	$\beta$	0.19* (0.16)	99 (-65.11 ;264.65)	0.05* (0.12)	41 (-139.54 ;221.49)
	$\sigma$	0.03 (1.9)	-	0.14*** (0.83)	-
Natural dynamic(leaving 15 deadwood/ha)	$\beta$	0.38*** (0.13)	190 (61.33 ;317.99)	0.36*** (0.09)	270 (129.73 ;409.49)
	$\sigma$	0.93*** (0.14)	-	0.66*** (0.12)	-
ASC <sup>b</sup>	$\beta$	<b>-2.64***</b> (0.31)	<b>-1254</b> (-1557.83; - 949.58)	<b>-2.87***</b> (0.34)	<b>-2145.91</b> (-2616.86 ; -1674.95)
Tax	$\beta$		<b>-0.0019***</b> (0.0009)		<b>-0.001***</b> (0.0008)
Sigma	$\beta$		4.43 ***		4.92***
$\chi^2$			0.35		0.32
LL			-2577.6		-2145.8
AIC/N			1.43		1.49

\*\*\*Statistically significant at the 1% level, \*\* at the 1% level and \* at the 5% level.

a =\*WTP amount for policy implementation in Scania and Funen as opposed to Zealand.

b = ASC is the utility from status quo (doing nothing) as opposed to policy implementation in respondents own location.

To test if the location was more important for some attributes than for others, we tried to interact the location attributes with biodiversity and natural dynamic but it wasn't statistically significant (results not shown<sup>1</sup>).

## **5. Discussion**

Biodiversity conservation is an issue for national as well as international policies and coordination efforts, and the conservation management literature have focused on cost effectiveness gains from planning and coordination (Bladt et al. 2009, Bakkenes et al. 2002; Thomas et al. 2004; Thuiller et al. 2005), and been less concerned with performance of conservation efforts in terms of value (welfare) for money (costs) though exceptions exist (Strange et al 2007).

An underlying assumption, which is questioned in our study here, is that biodiversity protection is a global public good and specifically that the value of biodiversity protection is independent of the geographical and political jurisdiction the site of provision. This study designed and implemented an experiment to test the validity of this assumption. More specifically, we designed an experiment to disentangle the role of distance to and nationality of the site of biodiversity conservation measures for respondents of varying nationality.

We are not the first to consider distance effects on the valuation of biodiversity conservation improvements, or to study how respondents' of different nationalities value such measures. However, previous studies have generally been either geographically specific (considering sites in a specific country) and/or respondents didn't have similar travel access to the targeted location or varied in nationality (e.g. Carlsson et al. 2010; Jørgensen et al. 2012; Sutherland and Walsh 1985). Thus, our study is the first to evaluate people's willingness to pay for biodiversity protection policies from a multi-location and multi-nationality perspective, where the population in two countries evaluate comparable measures in both of these countries.

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<sup>1</sup> Can be provided upon request

### 5.1. Evaluating main findings

The results of the pooled dataset, consisting of respondents from all three locations, proved a significant effect of travel distance from respondents' residence to the policy region as well as a nationality effect. In addition, respondents had a positive and bigger utility for forest improvement in their own country. Thus, we cannot reject our *H3* that both distance to and nationality of the site of provision matters, whereas all three competing hypotheses fall.

With regard to the credibility of the result, we note that the WTP estimates for distance (=2DKK per Km) is quite well in correspondence with the travel cost per km in Denmark and Sweden as assessed by the tax authorities, which are in the range of 2-4 DKK/km<sup>1</sup>. In addition, the WTP for 'Bridge' is corresponding very well with the real cost of a return ticket, which drivers should pay to cross the bridge. Thus, the travel cost related parameters correspond to the cost of visiting the forests in the other regions typically once per year, which is also a frequency well in accordance with the observed frequencies in the respondent samples (cf. Table 2). Of course, these variables are likely linked to the direct use values of the biodiversity protection for respondents.

To test if the hypotheses are the same in subsamples, we looked at the Zealand subsample to see whether the respondents prefer Funen or Scania for forest protection implementation. Based on the marginal effects of location attributes we again conclude that both distance and nationality matters, and hence all hypotheses but *H3* can be rejected. The fact that nationality has a separate effect once distance effects have been corrected for suggests that non-use values may be sensitive to the site of provision.

For the second subsample, respondents in Scania assessing forest protection policy in Funen and Zealand, these latter localities only differ in terms of travel distance to the policy location, and we found that the respondents in Scania have larger marginal WTP for implementing a forest protection policy in Zealand compared with Funen. Consequently, we can reject *H0* and *H2*, but we cannot reject *H1* or *H3*. Notice that by construction of the test it is not possible to distinguish *H1* from *H3*. It is worth noting that the majority of the Scania respondents (87% and 75% respectively) have never visited a forest in Funen or Zealand, respectively.

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<sup>1</sup> See for Denmark: <http://www.skat.dk/SKAT.aspx?oId=2064181>, and for Sweden <http://www.skatteverket.se/privat/svarpavanligafragor/beloppprocentsatser/privatbeloppfaq/bilavdraghurstortardet.5.10010ec103545f243e8000220.html>

## 5.2. Possible reasons and consequences

That respondents of different nationality may hold systematically different preferences for a specific public goods is also reported by Ressurreição et al. (2012), Carlsson et al. (2010) and who found nationality and the degree of attachment to the location as significant factors; whereas Horton et al. (2003) did not. However, none of these studied preferences across nationalities of both respondents and policy sites.

Our results show that in the current case biodiversity protection benefits are not perceived by respondents as a pure global public good, to the degree that the value is independent of geographical and political jurisdiction. The specific effect of the location of provision – when correcting from distance and other travel cost variables – suggest that perhaps even non-use values like existence and bequest values are sensitive to site of provision.

This is in line with Brock and Xepapadeas (2003) who identified a number of distinct values of biodiversity conservation that benefit people at different spatial and temporal scales. Some values of biodiversity are categorised as pure and global public goods providing long-term benefits at a global scale, while others are impure and more local public goods since they provide benefits at a much more local scale and in a rather short run (Perrings and Gadgil 2003).

In our case area, a large number of respondents never or very rarely visited forest areas in any of the other regions. This suggests that recreational benefits (providing direct use values) are not the main reason for the WTP differences across different locations that we find. The effects may be due to other co-benefits, or to the cultural value, and hence often values associated with protecting biodiversity nationally or even locally (see e.g. Jacobsen and Thorsen 2010 for regional effects of similar nature). If that is the case, biodiversity protection improvements (both use and non-use value components such as existence value) may possess mainly – or at least to a significant extent - local public good characteristics.

The role of nationality of site of provision is in line with Hanley et al. (2003) who argued that ownership or spatial identity may be important for some environmental assets even for non-use value. Although it is worth mentioning that the result of the study by Perrings and Halkos (2012) suggests that countries (as political actors) care about the biodiversity within their national borders only if the development priorities allow and the value of protection is perceived to be superior to the alternative use of land and related assets.

Thus, our result add further to the findings and thoughts of Perrings and Halkos (2012), who suggested that the optimal level of biodiversity conservation might be expected to vary depending on the spatial scale at which the problem is analysed, and depending on which groups (nationality) are involved in conservation decisions.

### **5.3. Caveats and further work**

Factors such as trust and power in and across countries have not been in the scope of the present paper, but they are relevant factors that may induce differences in public preferences for biodiversity coordination policies across borders. In our case, one could perceive e.g. that Swedes would trust their own country (rules, laws, compliance, governance) better to deliver than Denmark (and vice versa), or – following Hanley et al. (2003) - feel more in control of the implementation.

Thus, lack of mutual trust among residents from different countries and regions, in relation to designing and implementing a joint coordination program could be a reason for the differences observed. In a similar vein, we found, during focus group interviews, that participants were not willing to pay as much if efforts were to be implemented by an international agency, as they would if their own government engaged in coordinating protection programmes across borders. Thus, trust and control issues could and should be investigated further in the future, and may help in explaining possible individual variation in preference for local (national) provision.

In addition to the effects of trust and power on public WTP for biodiversity conservation, differences in factors such as national income, species richness, pressures on biodiversity and conservation infrastructure, are all likely to be associated with differences in national conservation effort (Perrings and Halkos 2012). In our case areas, all of these factors where rather similar at sub-sample level. Future studies would probably benefit from investigating these issues across a wider range of cases, even if this may imply difficulties in keeping the public good delivered fairly comparable across cases.

## **6. Concluding remarks**

The current study successfully distinguished the effect of the distance to site of provision from the country of provision, which is novel to the literature. We found distance related attributes to reflect bridge tolls and per kilometre transport costs, and we found Swedes and Danes to prefer provision in own country over neighbouring countries.

The overall results of this study have relevant policy implications for global conservation efforts. The underlying assumption in most conservation management models is that the benefit of biodiversity protection is independent of spatial scale and culture or nationality. Several studies demonstrate the magnitude of cost-efficiency gains of internationally coordinated conservation policies (Rodrigues and Gaston 2002; Strange et al. 2006; Bladt et al. 2009; Moilanen and Arponen 2011). This study stresses that a mere cost-effectiveness focus may disregard important aspects of the allocation of social benefits and result in loss of significant welfare economic gains.

This is of importance for the design of trans-national conservation policies, as not only effectiveness and efficiency needs to be considered, but also welfare distribution across borders. Lack of attention to these issues may create a mismatch in policy design across borders, where due attention is needed for both the distribution of costs as well as benefits. Policy proposals may fail to gain wide support if benefits net of costs are mainly focused in a specific region.

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# **Paper Four**

# Willingness to travel to avoid recreation conflicts in Danish forests

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## Abstract

Conflicts among forest visitors have direct effects on the quality of a recreational experience. As the number of visitors to forests close to residential areas increases, as well as the number of different activities, so does the potential for perceived conflicts. According to the literature, expanding knowledge of conflict characteristics and their causes is important for recreation planners and managers who aim to reduce conflict.

In the present study, different forest user groups were identified and categorised according to their pursued activities, and for each group causes of conflict were identified. Furthermore, a choice experiment was constructed to estimate the distance visitors are willing to travel to encounter few visitors as opposed to many visitors, and thereby potentially experience fewer conflicts. Comparing marginal willingness to travel (WTT) of different user groups suggests that some groups have a WTT further than the average to reach a forest with “Few” visitors. The average WTT to reach a forest area with “Few” visitors is 6 km per visit. ‘Mountain bikers, ‘Peace and nature lovers” and ‘Horse riders’ are willing to travel 4 km more than the average per visit to reach a less crowded forest. At the other end, we find people who are doing physical exercises are willing to travel 2 km less than the average to reach a less crowded forest

Key words: Willingness to travel, recreation conflicts, forest users, (perceived) conflicts, crowding

## 1. Introduction

There is a current political focus on encouraging people to visit forest areas to pursue recreational activities which, among other things, is assumed to increase health and wellbeing (Olsen et al., 2013). For example, a study in Sweden by Grahn and Stigsdotter (2003) suggests a lower rate of sickness reporting caused by stress among people who visit forests more often. An epidemiological study implemented in the Netherlands by Maas et al. (2006) illustrated that residents in neighbourhoods with rich green space are likely to, on average, enjoy a better general health.

In Denmark, the average adult citizen visits forests 33-38 times per year (not adjusted for exaggeration) for recreational purposes (Jensen and Koch, 2004; Jensen, 2012a). Most previous studies show that the Danish population will ask for significant compensation for reductions in their current access rights to forest and other habitats (Jacobsen et al., 2012). In addition, a trend can be seen that the forests situated nearby residential areas are becoming more and more attractive sites for (more diverse) recreational activities (Jensen, 2012b). This illustrates the importance of outdoor recreation for Danes.

Increasing the number (and diversity) of visitors will increase the probability of crowding and encounter rates which reduce the quality of an outdoor experience (Absher and Lee, 1981; Shelby et al., 1989; Kleiber, 2001; Hall and Cole, 2007). The presence of conflicts is one indicator of the social carrying capacity in recreation and tourism settings being exceeded.

Several studies have focused on the crowding perception in various tourism and recreational areas, in countries such as the United States, Australia, and New Zealand. In a European context, especially Denmark, there has been little focus on the relationship between crowding and conflicts. In the following, we define the terms conflict and crowding, and how they have been used in the literature (Hammit and Schneider, 2000; Arnberger and Mann, 2008, Arnberger and Haider 2007). On this basis we formulate our hypotheses in section 1-2.

### 1.1. Definition of crowding and conflict

Conflicts in recreation have been categorised into two classifications: (i) interpersonal conflicts which occur as a result of goal interference when one or more persons disturb or affect a goal of another person, and (ii) social value conflicts which mainly happen as a result of contradictory

views about the social acceptability of different behaviours in specific recreation settings (Vaske et al., 2007). According to the second classification, conflicts do not necessarily require people to be in physical proximity to one another. Therefore, conflicts can be two different constructs: actual conflicts and perceived conflicts. Perceived conflicts can be felt due to different psychological, social and environmental factors. Investigating perceived conflicts would be a required step in conflict management for reaching a balanced *status quo* (Jenkins and Pigram, 2013). Therefore, this study aims at investigating the presence and causes of perceived conflicts.

The presence of many other people can exacerbate the negative feeling of potential conflicts – when experienced as crowding. Research has documented that high visitor density leads to high encounter rates which can result in crowding and reduce the quality of an outdoor experience (Absher and Lee, 1981; Shelby et al., 1989; Hall and Cole, 2007). Crowding is a negative evaluation of a particular density of people in an area (Stokols, 1972; Rapoport, 1975; Kuss et al., 1990). Arnberger and Haider (2005) state that crowding is an individual's subjective experience. Jacob and Schreyer (1980) and Owens (1985) attempt to distinguish conflict and crowding from a goal oriented social and psychological perspective. According to them, social interrelationships and differences among users is the root of the problem rather than the actual physical influences they might have on one another. According to Owens (1985) crowding is considered as an instant reaction to present conditions and therefore is temporary.

Conflicts are more persistent and stable beyond a particular visit. Owens (1985) suggests that the conflict itself is an experience which can be measured on a scale from dissatisfaction and frustration to confrontation. It may or may not regulate actual behaviour.

Following Owens (1985), we look at conflicts as a 'persistent' concept, and therefore we ask people for their general view of disturbance from other people. Opposed to many other studies (e.g. Vaske et al., 2000; Thapa and Graefe, 2003; Vaske et al., 2007) that focus on the actual encounters, we will therefore take mainly occurrence of disturbance into account. We do not get a good measure of the actual experienced conflict(s), but rather a measure of the perception of conflicts. Likewise, we use crowding as an indicator for the *potential* of conflicts. Here we follow Jacob and Schreyer (1980) who argue that crowding is a subjective judgment of an individual that e.g. there are too many other people there. So the 'too many' can refer to different number of people according to different individuals. Therefore, we do not use actual numbers of visitors, but rather terms like "Few" and "Many". It may be individually perceived how many "Few" are, but the relevant



measure we are looking at is how willing people are to travel to avoid crowding and thereby the potential of conflicts.

Following Owens (1985), in this paper we look at conflicts as a 'persistent' concept, and therefore we ask people for their general view of disturbance from other people. Opposed to many other studies (e.g. Vaske et al., 2000; Thapa and Graefe, 2003; Vaske et al., 2007) that only focus on the actual encounters, we will therefore focus mainly on the perception of disturbance. Although it is not a good measure of the actual experienced conflicts, but rather it measured the perception of potential conflicts. Further, we use crowding as an indicator for the potential conflicts.

According to the literature, there are several types of conflicts among participants in similar or different types of outdoor recreation (see Manning et al., 1980, 1999 and Manning 2011 for reviews). Conflicts between users engaged in different activities (e.g., Hikers versus Mountain bikers) are known as 'out-group' conflicts whereas conflicts between participants in the same activity (e.g., hikers versus other hikers) are known as in-group conflicts (Manning, 1999). We follow this notation and identify 'in-group' as well as 'out-group' conflicts by asking people for their general view on disturbance from others. We use the term 'disturbance' to identify perceived conflicts. This term, disturbance, addresses the user's emotional feeling about o a particular environment or situation.

## **1.2. Case study and research questions**

There is some evidence of existing potential conflict among forest user groups in Denmark. To avoid conflicts we need to understand what causes it. Therefore, the **first research question** investigates who disturbs whom, and to what extent.

According to Jensen (2006) a noticeable share of research on crowding and conflicts has taken place in wilderness or remote areas in North America. In this study, the topic is discussed in a very different setting, namely Danish forests, characterised by a relatively high number of inhabitants on a relatively small and intensively exploited land area; 5.4 million inhabitants on 43,000 km<sup>2</sup> of which 11% is forest and 10% constituted by other nature areas, (Danish Forest and Nature Agency, 2002).

Bell et al. (2007) shows that in densely populated countries, out-group conflicts tend to dominate (e.g., Belgium, Denmark, and Germany). This may happen since there are often many (different) user groups competing for space (Vedel et al., 2009).

According to Jensen (1999), in Danish forests different types of forest visitors exist with presumably different needs. Among other activities, approximately two-thirds of forest visitors had gone for walks during their visits. Just over half had “enjoyed nature”, while exercising, and going for a drive and walking the dog were both activities selected by 10-15% of visitors. Relatively “Few” visitors to the forest (1-2%) engaged in activities such as riding, hunting, or fishing (Jensen and Koch, 2004).

Jensen (2006) indicated that crowding and conflicts between different user groups, in general, was not a major problem in Danish outdoor recreation at the time of his study (1996-97). However, recently the Danish Nature Agency has reported (Søderlund, 2012) that in several places in the state forests, sharp nails have been hammered into tree roots on mountain biking tracks in an attempt to discourage bikers. Not only do metal nails present a high risk of puncture and throw, it may also present a danger to forest animals. The set-up of ropes across mountain biker routes has also been reported. The Agency reports forest user complaints of mountain bikers and group cyclists who often shout to the other cyclists and warn when there are walkers along the path. This disturbs people walking in the forest who are seeking peace and quiet (Stenar, 2012).

In Denmark there has been a recent political focus on improving the quality of recreation, e.g. by avoiding conflicts, out-group conflicts in particular. This has been done by establishing trails targeted for different user groups in selected areas (Danish Forest and Nature Agency, 2009; Vedel, 2010). But the individual is also likely to avoid conflicts. Some visitors are more averse to perceived conflict than others, and one coping strategy for recreationists is to avoid crowded forests, and thereby potential conflicts. For example, forest user groups who feel disturbed may shift the time of visit from weekends to weekdays or off-peak time periods (e.g., Hammitt and Patterson, 1991). Recreationists may also decide to visit an alternative location either within the same recreational area (i.e., intra-site displacement) or visit completely different recreation settings (i.e., inter-site displacement) (e.g., Hall and Shelby, 2000; Johnson and Dawson, 2004,). If they do so, they may be willing to travel further to avoid potential conflicts. Thus, the distance people are willing to travel to avoid conflicts may be an indicator of how important they perceive the conflict to be, and thus the travel cost may even be an indicator of the economic value of it.

Therefore, the **second research question** is how much **farther people** are willing to travel (WTT) to avoid meeting (too) many forest visitors and thereby avoid potential conflicts? And are some user groups more willing to travel further than others?

In economics, stated preference methods are a common approach to evaluate willingness to pay to obtain certain benefits, including recreation. Choice experiment (CE) is one such method, where the individual is asked to choose between different alternatives with varying characteristics (attributes), thereby creating trade-offs between the characteristics. We use this method to investigate WTT to avoid crowding and as a result to avoid potential conflicts. Within the crowding and conflicts literature, Arnberger and Haider (2005) have used an image-based stated choice experiment to investigate the conditions determining visitors' preferences for visits to an urban forest in Vienna, where one attribute was whether they felt crowded (perceived crowding) or not. Respondents evaluated several sets of images illustrating trail use scenarios with different levels of social crowding conditions and several types of social interferences.

Arnberger et al. (2010) also use a choice experiment, with a latent class approach, which investigates preference heterogeneity for social conditions of urban forest visitors in Vienna and Sapporo. They discuss whether preferences for social conditions and crowding perceptions are related. They find that to maximise utility of the users, establishing zones in urban forests including different types and quantities of recreational facilities, trails, access possibilities, dog zones, etc. will help to satisfy different users with different needs.

Finally, Kleiber (2001) finds that 50 % of urban forest visitors in Allschwil, Switzerland, felt disturbed by at least one other user group. Every fifth visitor is willing to pay for the exclusion of the most disturbing group. This exclusion payment could be used to offer a substitute recreational area for the disturbing group.

Compared to these studies we derive a simpler CE, with focus only on the travel distance and the crowding. That makes the trade-offs simple and allows us to put emphasis mainly on the crowding aspect. Furthermore, compared to the other studies, we use the subjective measure of crowding as an attribute, thereby focusing directly on people's perceived utility.

The rest of the paper is organised as follows. In section 2 the method is described. In section 3 we present results focusing on: (i) identifying different forest user groups using survey data based on 1200 respondents in eastern Denmark, (ii) addressing the extent to which perceived conflict exists

within and among various recreation activity groups in forests (research question 1), and (iii) examining forest user groups' WTT to avoid conflict (research question 2). We end the paper with a discussion and conclusion in section 4.

## **2. Method**

### **2.1. Study area**

The study was conducted among citizens in the eastern part of Denmark. The forests in the area are dominated by broadleaved tree species and are mostly urban forests within a mixed landscape of agriculture. The broadleaved forests are dominated by Beech (*Fagus sylvatica*), but also with presence of species such as Oak (*Quercus spp*), Ash (*Fraxinus excelsior*) and Birch (*Betula spp*). The majority of these forests are managed for timber production, but often they are also multi-purpose forests (Danish Forest and Nature Agency, 2002).

In the study area, state forest districts and many private forest districts have established numerous facilities for public use such as playgrounds, simple camp sites, information boards, visitor centres, barbecue sites, bird watching towers, etc. Each year, more than 500,000 people in total participate in a range of activities in Danish forests, and nature schools and forest kindergartens are increasingly popular.

### **2.2. Data collection and survey design**

The data were collected through an internet-based questionnaire managed by the survey institute 'Analyse Denmark' during July-August 2012. We received 1200 completed questionnaires. Respondents were asked about their motivation for going to the forest as well as the activities they do in the forest. Respondents were also asked whether they found activities from other people disturbing. The questionnaire (obtainable from authors upon request) was designed using the results from two focus group interviews and pre-tests. Some modifications of the draft questionnaire were included based on feedback.

The final questionnaire began with a section including questions about the frequency of visit and recreation activities respondents pursue in forests to identify different forest user groups. Then

followed questions about which activities carried out by other people are disturbing to forest visitors. Since we are examining the *perceived* disturbance and conflict, levels were provided in qualitative terms: ‘Often’, ‘Sometimes’, ‘I meet them but they don’t disturb me’, and ‘I never meet them’. These results are used to answer the first research question. In addition, respondents were asked if they were disturbed by people doing the same activity as them. This would address the potential of in-group conflicts.

Subsequently, respondents were introduced to the choice experiment (CE) section where the results are used to estimate different forest user groups’ WTT to avoid crowding and thereby potential conflicts.

Finally, respondents were asked follow-up questions on their socio-demographic characteristics<sup>1</sup>.

### **2.3. Choice attributes and levels**

Each choice task consisted of two alternatives and a possibility of choosing to visit the forest or not. An example is shown in Fig. 1. The attributes of each alternative were the amount of other visitors encountered (“Few”, “Many”) and the travel distance from the respondents’ home to the forest (2, 5, 10, 15 km). Using a nine-point Likert scale to measure crowding (e.g., Shelby et al., 1989; Jensen, 2003) is a common practice in the crowding and conflict literature. However, as mentioned in the introduction, we do not look at the actual visit and visitor numbers/encounters, but more at respondents’ perceptions of crowding. Therefore, we chose a simpler approach and used just two levels.

Using eight (2\*4) alternatives all combinations were possible and they were matched to each other by using NGENE software, optimising for d-efficiency for multinomial logit modelling (Scarpa and Rose, 2008). These were divided into four blocks to give two choice tasks per respondent.

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<sup>1</sup> In the same questionnaire respondents received a larger CE regarding different conservation measures used for another study (see Bakhtiari et al., 2013a,b). However, as it the section followed the current crowding CE, we expect the WTT-results to be unaffected by that.

**Your preferred forest to visit!**

**Assume you have the option to visit forest A or forest B. They are identical\* in most aspects but different in terms of:**

1-Number of people you meet during your forest visit

2-The distance from your home

**Look at following choices (choice 1 and choice 2), which forest would you choose to visit?**

	Forest A	Forest B	None of these
Number of visitors	Many visitors	Few visitors	
Distance from your home(KM)	5 KM	10 KM	
Your choice (choose only one option)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

\* Identical in terms of e.g. forest facilities and forest user types, forest covers and so on.

Figure1: An example of a choice task given to the respondents.

**2.4. Econometrics estimation**

CE is a stated preference technique that has been extensively used in the past decade in environmental valuation (Louviere et al., 2000; Bennett and Blamey, 2001).

The random utility model is the basis for estimation and can formally be described as:

(1)

$$U_{ij} = V_{ij}(t_j, x_j, z_i) + \epsilon_{ij}$$

Where  $U_{ij}$  is the utility of individual  $i$ , by paying a cost equal to  $t$  (e.g., income tax, or in this case travel distance) to achieve the good described by alternative  $j$ .  $V_{ij}$  is the deterministic part of  $U_{ij}$  and depends on income;  $x_j$ , the characteristics of the good, and  $z_i$ , socio-economic characteristics of the individual. The term  $\epsilon_{ij}$  is stochastic which means that its variation cannot be observed by the

researcher (Train 2003). We assume it to be independent and identically distributed random variables (i.i.d.).

Assuming a linear function for  $U_{ij}$  and collecting all the arguments in the vector  $x_{ij}$  for alternative  $j$  and individual  $i$ , we can write

(2)

$$U_{ij} = ASC + \beta_1 * Few + \beta_2 * distance + \varepsilon_{ij}$$

Where  $\beta$  is a vector of parameters.

The specification in equation (2) parameterises utility in “preference space.” Thus, the implied WTT for each attribute is the estimated ratio of the attribute’s coefficient ‘ $\beta$ ’ divided by the travel distance coefficient which is assumed to have a fixed distribution:  $WTT = \beta_1/\beta_2$ . To allow for heterogeneity in the distribution of both parameters we estimate it in willingness-to-pay space (Train and Weeks, 2005), whereby the parameter estimates can be interpreted directly as the WTT to encounter “Few” instead of “Many” other forest visitors. Thus, the utility can be rewritten as:

(3)

$$U = \beta_2 [distance + \theta_1 * ASC + \theta_2 * Few] + \varepsilon$$

Where  $\theta_i$  is  $\beta_i/\beta_2$ .

Assuming the error term  $\varepsilon_{ij}$  is IID extreme value distributed (see Hausmann and McFadden, 1984), the probability of choosing alternative  $k$  among  $j$  alternatives by individual  $i$ , is, according to Train (2003):

(4)

$$P_i(k) = \frac{\exp(\tilde{\theta}_i x_{ij})}{\sum_j \exp(\tilde{\theta}_i x_{ij})}$$

Because we work in WTP space, we avoid the issue of scaling (see Train and Weeks, 2005).

Estimating respondents' WTT away from perceived crowding gives us the average WTT to decrease crowding in forest. In addition, we are interested in knowing the magnitude of WTT to decrease crowding for each user group that reported feeling disturbance in forests. In the survey we presented 31 statements related to forest activities (individual and group activities) and asked respondents to choose among them by answering 'Have you participated in or would you like to take part in some of the following activities within the last year, when you have visited the forest?'

Many forest visitors do different activities on different visits to the forest. Therefore they may fall into more than one of the above mentioned categories (31 presented categories). Thus, in order to avoid multicollinearity in our model, we use factor analysis to identify those user groups which have correlation and merge them into bigger groups.

### 3. Results

#### 3.1. User group attitudes for different activities in forests: "Who disturbs whom?"

Estimation of respondents' perceived disturbance at different levels shows that 249 out of the 1200 total interviewees (21%) often felt disturbed by other visitors during their forest visits. In addition, 700 (58%) indicated they have sometimes been disturbed during their visits. Only 37 (3%) answered they were not disturbed thus far. The rest, 214 respondents (18%), chose the option 'I don't know'.

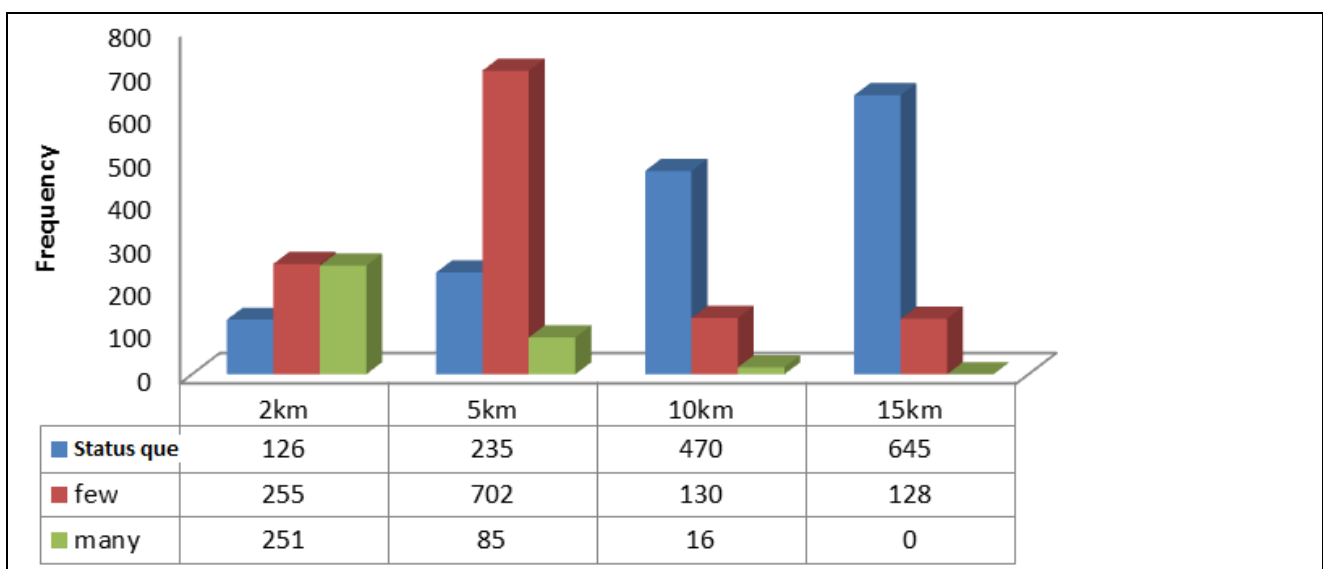


Figure 2: Distribution of forest choice in relation to number of visitors and distance



Figure 2 shows the frequency of choices of forest over distance in relation to the number of other visitors. When the distance is 2 km, the number of respondents who chose to go to a forest with “Few” and “Many” visitors is very similar, but as distance increases respondents mostly chose forest with “Few” visitors. Status quo addresses the number of respondents who chose not to visit forests and stay at home even though they were provided one of the shorter distances (2 or 5km) in their choice tasks.

Table 1. Characteristics of respondents who chose to stay at home even though they had the possibility to choose minimum distance

Age							
Gender	18-28	29-39	40-50	51-60	61-70	71-99	Total
Female%	16	14	24	23	22	1	100
Male%	5	15	23	27	29	0	100

The result of the t-test (Table 1) shows that there is no statistically significant difference ( $p=0.4$ ) among frequency of men and women who stay at home within different age groups.

Table 2, below, illustrates which user groups often felt disturbed by other user groups during their visits last year.

Table 2 shows the presence of perceived conflict among some user groups. Keeping a threshold of 20% for the disturbance rate among user groups (the dark grey fields), the table shows that ‘Mountain Bikers’, ‘Horseback riders’, ‘Runners’, ‘Group-runners’, ‘Dog owners’ (Dog walkers) are considered the most disturbing groups by at least two other user groups in the forests.

The light grey cells in table 2 and table A in appendix, refer to in-group conflicts – showing that runners have the highest frequency of ‘in-group’ disturbance.

Table 2. Percentage of disturbing user groups and groups who often feel disturbed in the case study area during the past year.

Disturbed Group	Disturbing user groups											
	Mountain biker	Working in the forest	Observing animals and plants	Gathering mushrooms and berries	Making barbeque and using stove	Horseback riders	Runner	Group runner	and school class (education)	People playing ball game	Playing children	Dog walker
Mountain biker	12.20	2.44	0.00	0.00	12.20	4.88	17.07	4.88	4.88	7.32	4.88	29.27
Working in the forest	13.64	4.55	4.55	2.27	4.55	9.09	11.36	6.82	4.55	18.18	4.55	15.91
Observing animals and plants	21	1.5	2	1.5	4.5	13	21.5	20.5	2.5	2.5	3.5	21
Gathering mushrooms and berries	22	2	1	1	6	11	21	23	3	5	6	13
Making barbeque and using stove	10.53	5.26	10.53	5.26	0.00	10.53	15.79	15.79	5.26	5.26	5.26	10.53
Horseback riders	30.8	0.0	0.0	0.0	7.7	15.4	7.7	7.7	0.0	23.1	0.0	7.7
Runner	21.05	0.00	1.05	1.05	5.26	5.26	21.05	15.79	3.16	4.21	7.37	14.74
Group runner	20.5	12.8	2.6	2.6	5.1	7.7	6.4	15.4	5.1	7.7	7.7	14.1
Enjoying the peace and quiet of nature	21.6	1.6	1.2	1.2	5.7	11.0	15.9	20.8	4.1	5.3	4.1	7.3
Going for a picnic	22.2	3.7	2.5	0.0	7.4	6.2	23.5	19.8	2.5	3.7	8.6	9.9
Biking	22.9	0.8	1.7	0.8	4.2	8.5	21.2	20.3	3.4	3.4	4.2	8.5
Going for a walk	22.5	1.5	1.5	1.1	1.8	21.8	22.2	24.0	1.8	1.5	1.8	11.3
Overnight stay in the forest	10.3	3.4	3.4	0.0	0.0	13.1	13.8	6.9	3.4	24.1	3.4	6.9
Other users	4.3	8.7	8.7	0.0	0.0	8.7	8.7	8.7	13.0	13.0	17.4	8.7

With regard to socio-demographic variables, results show that people in the age group 50-70 years ( $p < 0.05$ ) felt significantly more disturbed by other people than other age classes. Likewise, men felt more disturbed by other people than women ( $p < 0.05$ ).

### 3.2. Willingness to travel to avoid crowding and potential conflicts in forests

To estimate WTT to avoid conflicts, we specify a utility function where different user groups are interacted with the variable “Few” in order to identify heterogeneity in the preferences. The larger user groups/groups disturbing are the ones used, cf. Table 2.

Results of the factor analysis (Appendix 1) of user groups show that among the categories, the groups who are ‘Observing animals and plants’, ‘Enjoy the peace and quiet’, ‘Gathering mushrooms and berries’, and ‘Going for a walk’ loaded on one factor. Thus, we merged these groups and call the new group ‘Peace and nature lovers’. Also, ‘Making barbeque and using stove’ and ‘Going for a picnic’ loaded on another factor, so we merged them and called the new group ‘Picnickers’. ‘Running and group-running’ also merged in one group called ‘Exercise group’. Note that we did not include the ‘Dog walker group’ in our model for WTT estimation because people who go to the forest for walk cannot be distinguished of people who walk with dogs. So we merged the dog walkers with ‘Going for a walk’ to avoid possible multicollinearity in our model.

Internal consistency of each factor was estimated using Cronbach’s Alpha (Cronbach (1951) which indicates a high internal consistency, in general, values of 0.70 are recommended as the minimum level of Cronbach's alpha (Kline, 1993).

The final utility function can therefore be written as:

5)

$$U_{ij} = (\alpha_j + \theta_{1i}(\text{Distance})_j + \theta_{2i}(\text{Few}) + \theta_{3i}(\text{Few} * \text{Mountain biker})_j + \theta_{4i}(\text{Few} * \text{Peace and nature lover})_j + \theta_{5i}(\text{Few} * \text{Excercise group})_j + \theta_{6i}(\text{Few} * \text{Horserider})_j + \theta_{7i}(\text{Few} * \text{Picnicker})_j + \theta_{8i}(\text{Few} * \text{Cyclist})_j + \theta_{9i}(\text{Few} * \text{Overnight})_j) + \varepsilon_{ij}$$

*Distance* refers to travel distance to the forest and *Few* addresses “Few” visitors in the forest whom respondents meet during the visit in contrast to “Many”.

The WTT space model is estimated through BIOGEME using 15000 iterations with the CFSQP algorithm (Bierlaire, 2003). The results in Table directly show the WTT for each attribute.

Table 3: WTT estimates using WTT space mode

Attributes	WTT (confidence interval) (km/visit)		Standard error	WTP <sup>a</sup> (DKK/visit)
	$\beta$			
Few visitor	$\beta$	6*** (5.09; 6.09)	0.05***	24
	$\sigma$	0.005***	0.08***	-
Distance	$\beta$	-1.07***	0.05***	-
	$\sigma$	0.2***	0.1***	-
ASC	$\beta$	-2.13*** (-2.28; -1.97)	0.08***	-
few * Mountain biker	$\beta$	4*** (1.64 ; 6.35)	1.2***	24
few * Peace and nature lovers	$\beta$	4.3*** (3.22 ; 5.37)	0.55***	25.2
few * Exercise group	$\beta$	-2*** (-0.94 ; -3.05)	0.54***	-10
few * Horseback rider	$\beta$	4.4*** (0.87 ; 7.93 )	1.8***	28.4
few * Picnicker	$\beta$	0.3	0.6	1.2
few * Cyclist	$\beta$	0.04	0.5	0.8
few *Overnighters	$\beta$	2.4	0.1	0.16
<i>AIC/N</i>	<i>1.2</i>			
$\chi^2$	<i>0.44</i>			
<i>LL</i>	<i>-2031</i>			
<i>N</i>	<i>1200</i>			

a The monetary value of WTT estimation is based on the total transport cost per km in Denmark which is 4 DKK/km (1 DKK= 0.18 USD). (Federation of Danish Motorists – FDM).

As seen in the table, the alternative specific constant (ASC) is significant and negative, showing respondents have a positive WTT to visit a forest rather than staying at home, regardless of the characteristics of the visit. The average marginal WTT for forests with few visitors is significant with a positive sign, showing that on average respondents are more willing to travel to be in a forest with few visitors compared to a forest with many visitors.

To analyse the differences of WTT between different user groups, we look at the interaction between each user group and the attribute *few visitors*<sup>1</sup>.

As seen in Table. 3, the groups 'Mountain bikers', 'Peace and nature lovers', and 'Horse riders' have an extra marginal willingness to travel (WTT) of 4 km, 4.3 km and 4.4 km, respectively, in addition to the average preferred travel distance of 6 km, to reach to a forest with "Few" visitors. At the other end we find respondents who exercise (Exercise group) have a negative marginal WTT of a magnitude of 2 km.

The marginal WTT for groups of 'Picnickers', 'Cyclists' and 'Overnighters' is not significantly different from the average WTT.

#### **4. Discussions and Conclusion**

In 2007/08 Danish forests had approximately 70 million visits by the adult (15-78 years) population (Jensen, 2012a). To set more focus on all the societal and personal benefits that visits to nature can provide, the Minister of Environment, in 2012, initiated a process to formulate a national outdoor recreation policy (Miljøministeriet, 2012). In addition, at the municipal level there have been an increasing number of policy initiatives from various administrative branches during the last decade to promote outdoor activities.

To highlight some of the present and future planning and management challenges of forest recreation, the present study addresses the issue of perceived conflicts among different forest user groups in Denmark.

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<sup>1</sup> result can be shown upon request

We asked people for their general view of disturbance from other visitors. Contrary to many other studies (e.g., Vaske et al., 2000; Thapa and Graefe, 2003; Vaske et al., 2007) that focus on the actual encounters, we focused on the occurrence of *feeling* disturbances. It is therefore not a measure of the experienced conflicts, but rather a measure of the *perception* of conflicts. Likewise, we used crowding as an indicator for the *potential* of conflicts. Here we follow Jacob and Schreyer (1980) who argue that it is an individual's subjective measure of crowding. We therefore did not use actual numbers of visitors, but rather terms like "Few" and "Many". The perception of how many "Few" constitutes may vary, but the relevant measure we are looking at is how willing people are to travel to avoid crowding and thereby the potential of conflicts.

As a first step, the study identified the existence of perceived conflicts among forest user groups, where we used the presence of disturbance-feeling caused by other visitors as a measure of conflicts. It turned out that 21% of the total sample stated that they have 'often' felt disturbed either by their "own" user group or other user group types during their last visit. This is an evidence for the presence of some kind of conflict.

However, Jenkins and Pigram (2013) state that there is a linkage between the importance of gender/age in leisure and outdoor recreation as well as the feeling disturbance. This pattern has also been showed in our results since people in the age group 50-70 years ( $p < 0.05$ ) felt significantly more disturbed by other people than other age classes. Likewise, men felt more disturbed than women ( $p < 0.05$ ).

Among different user groups in our sample, respondents who categorised as 'Peace and nature lovers' expressed they felt disturbed more often than other user groups. This is in line with Stewart and Cole (2001), who found that visitors seeking solitude and silence experienced the most negative effect from disturbance due to crowding. Presumably, There are a couple of potential responses to such disturbances. Some visitors are more averse to crowds than others, while within the site the crowd-averse have a tendency to move furthest away from points of access (Chambers and Price, 1986). One way to avoid conflicts is to more effectively distribute people in space and time. Thus, at the second step, the present study attempts to understand how many additional kilometres each forest user group is willing to travel to reach a forest with "Few" visitors as opposed to 'many' visitors. To our best knowledge, this is new to the scientific literature on conflict management and recreation planning for forest. Applying a CE, the WTT further to encounter fewer visitors was estimated.

On average, respondents are willing to travel 6 km further to reach a forest with “Few” visitors compared to a forest with “Many” visitors. Assuming a total transport cost of 4 DKK/km results in 24 DKK/visit. In general, respondents have a negative preference (WTT) for increasing travel distance. This is in line with studies by Tyrväinen (1999, 2001), Jensen and Koch (2004), and  Degenhardt et al. (2011), which report the positive effect of proximity of forest on the frequency of visit. Thus, increase in travel distance will decrease preference of forest visit.

Comparison of the WTT of different user groups suggests that some groups, namely ‘Mountain bikers’, ‘Peace and nature lovers’ and ‘Horseback Riders’, do have a WTT further than the average respondent to reach a forest with fewer visitors. To support the credibility of our findings, it is worth mentioning that we defined the distance levels from zero to 15 km. In the Danish context, for such a distance, we expect that respondents include travel with car in their preference for travelling further to find a forest with few visitors. For example, ‘Mountain bikers’ as well as ‘Horseback riders’ happen to use a car to reach the forest of interest.

In addition, we find the ‘Exercise group’ willing to travel less than the average travel distance to reach a less crowded forest. It can be interpreted as this group of forest users, contrary to, e.g. ‘Peace and nature lovers’, are more willing to meet many other people in the forest and do not feel as much disturbed. Also, people that exercise are committed to doing this so many times a week, and maybe don’t let their feeling of disturbance get in the way of their exercise regime. And exercise is not exactly recreation/relaxation.

‘Picnickers’ and ‘Cyclists’ are the ones who do not have any “extra” preference than average preference for forest with few visitors. This is not far from our expectation. A possible interpretation is that since ‘Picnickers’ are mainly doing social activities, and cyclists mainly go around the forest by bike, they are not very much dependent on a specific forest site compared to ‘Peace and nature lovers’.

On average, respondents from different forest user groups preferred to travel further to reach a forest with “Few” visitors. We identified three reaction types among different groups regarding WTT to reach a forest with few visitors. First are forest users who had larger WTT than the average which suggests that they are willing to move further to avoid others – namely ‘Mountain bikers’, ‘Horseback riders’ and ‘Peace and nature lovers’. The second group includes the ‘Exercise group’, who were less willing to travel further than the average. This suggests that they would like/don’t

mind to meet many people during their visit, and their experience are not as affected by encounters, compared to groups like the 'Peace and nature lovers'.

The third group includes those who's WTT is not significantly different from the average WTT.

In Denmark and many other countries, there has been focus on encouraging people to go to the forest or other green spaces to exercise. And as can be seen from the results, the 'Exercise group' is not willing to travel further to avoid crowding and meeting "Many" visitors. It can be interpreted as their needs do not require major management initiatives as their demand is relatively "humble" – combining small (urban)forest areas and paths would be a management option to benefit this group.

For groups like 'Mountain bikers', 'Horseback riders' and 'Peace and nature lovers' who are willing to bear a cost (travel further) to fulfil their needs, new forest plantations could be an option as this will increase the space and thereby potentially decrease the feeling of "Many" visitors. Another management act will be to separate different user groups by zoning, so e.g. the 'Mountain bikers' and the 'Horseback riders' are given priority in some areas – and are excluded from others for the benefit of 'Peace and nature lovers'.

In conclusion, the present study revealed that there is evidence of perceived conflict among different forest users in Danish forests which needs to be dealt with by managers. The study gives an overview of respondents' marginal utility to travel in order to avoid crowded forests and consequently avoid conflicts. Providing knowledge of the preference for reducing crowding among different forest users may help managers and planners to distribute them along with their own preference.

Investigating conflicts among forest user groups in different forest settings was beyond the scope of this study, but would be an area for future studies to see if forests with different characteristics such as size, tree species, topography, and facilities, will show the same WTT pattern among different forest user groups or not.

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## Appendices

Table A. Total number of disturbing user groups and groups who often feel disturbed in the case study area during the past year.

Disturbed Group	Disturbing user groups												
	Mountain biker	Working in the forest	Observing animals and plants	Gathering mushrooms and berries	Making barbeque and using stove	Horseback riders	Runner	Group runner	Kindergarten and school class (education)	People playing ball game	Playing children	Dog walker	Total
Mountain biker	5	1	0	0	5	2	7	2	2	3	2	12	43
Working in the forest	6	2	2	1	2	4	5	3	2	8	2	7	48
Observing animals and plants	42	3	4	3	9	26	43	41	5	5	7	32	210
Gathering mushrooms and berries	22	2	1	1	6	11	21	23	3	5	6	13	108
Making barbeque and using stove	2	1	2	1	0	2	3	3	1	1	1	2	20
Horseback riders	4	0	0	0	1	2	1	1	0	3	0	1	15
Runner	20	0	1	1	5	5	20	15	3	4	7	14	100
Group runner	10	10	2	2	4	6	5	12	4	6	6	11	68
Enjoying the peace and quiet of nature	53	4	3	3	14	27	39	51	10	13	10	18	255
Going for a picnic	18	3	2	0	6	5	19	8	2	3	7	8	86
Biking	27	1	2	1	5	10	25	24	4	4	5	10	122
Going for a walk	62	4	4	3	5	60	61	31	5	4	5	31	306
Overnight stay in the forest	3	1	1	0	0	7	4	2	1	7	1	2	32
Other users	1	2	2	0	0	2	2	2	3	3	4	2	24

Table B Appendix I. Statements related to the forests activities pursued in forests and activities which disturb visitors. Principal component analysis, varimax rotation.

Have you participated or would like to participate in any of the following activities within the last year, when you have visited the forest?	Activities	Factor1	Factor 2	Factor 3
	Overnight stay	-	-	
	Observing animals and plants	<b>0.5292</b>	-	-
	Gathering mushrooms and berries	<b>0.5192</b>	-	-
	Going for a picnic	-	<b>0.5102</b>	-
	Enjoying the peace and quiet of nature	<b>0.5945</b>	-	-
	Biking	-	-	
	Horseback riding	-	-	-
	Kindergarten and school class (education)	-	-	-
	Group-running			<b>0.5232</b>
	Walking	<b>0.5000</b>	-	-
	Mountain biking	-	-	-
	Making barbeque and using stove	-	<b>0.5102</b>	-
	Working in the forest	-	-	
	Running			<b>0.5421</b>



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## Appendices

### Appendix 1 : Semi-structured individual, focus group discussion guide

**1. What does nature mean to you? Explain nature and explain its role in your life.**

*You could draw a picture of what you think of nature.*

**2- What would you feel of your relation with nature? Explain your answer?**

**2-1 Choose the option you are most agree with:**

-I am a part of nature.

- I am not a part of nature because I live in a city and not find myself in nature.

-I am not a part of nature because man is part of nature.

- I feel like a part of nature when I'm in the woods but when I'm in a city so I do not feel like a part of nature.

*If you want to answer anything other than what has been proposed above, write your answer here:---*

**3-In the table below you will see different reasons for visiting a forest. To what extent these reasons are important to you?**

When I visit a forest, it is important for me:

	Not at all important	A little important	Somewhat important	Important	Very important
To see the beautiful scenery.					
To look at plants and animals.					
To relax					
To experience peace and tranquility.					
To feel free.					
To escape from					

the everyday routine.					
To be alone.					
Being with friends and family					
Experience something exciting/adventure					

If you have other reasons please talk about it.

**4- Have you heard about biodiversity?**

**5-What does the term biodiversity mean to you?**

**6-What difference do you see in a forest with the presence of many different species of plants and animals compared to a forest with a low degree of biological diversity (with a few different species of plants and animals)?**

**7-Can you name your favorite trees, plants or animals?**

**9-look at below photos:**

**-Which forest do you prefer? Explain why.**



**10-What do the consequences will be if around half of biodiversity of forests in your country, i.e. 50% of tree, plant and animal species, are dying out?**



Look at the two photos:



Old and dead trees

**11-What do you think it is best to do with the dead trees in the forest? Explain your reasons.**

- I prefer to leave the more mature trees to decay in forests.
- I prefer removing old and dead trees from the forest and use them.

**12-If you would be willing to pay for forest improvement, where would you prefer to see your money used?**

- Near where I live in my own country.
- Near where I live, regardless the fact that it is in my home country or in a neighboring country
- In my country.
- Where nature is threatened.
- Where the quality of nature is high.

Please explain your reason:

**14- Considering the current situation of forests in your country what do you think of the necessity of a project to conserve and enhance forest and nature? Explain your reason.**

**15-What do you think about putting restrictions on the use of nature to protect it? Explain your reason.**

Table 1: Example of coding stepwise process.

Name	Question	Original text speech	Open code	Axial code	Selective code
Mitra 51 IT counselor	Meaning of nature	It reminds me forest mountain water lake .All of these different non-human made things.	All of these different and non-human made things.	Perception about nature which is a general concept and non-human made	Nature is not artificial.  Diversity as a part of nature
	Relation between human and nature	My relationship toward nature is that we are responsible to take care of it .don't damage it. We are a part of nature. I love nature, albeit green nature I don't like desert and dry lands. I like flowers	We are responsible to take care of it .don't damage it. We are a part of nature	Human is responsible for conserving nature	Responsibility for Conserving and management.
	Nature in what aspect is valuable for you?	It is valuable .Our heath depends on nature. If forests and waters get polluted and destroyed we can't have a healthy life as well.	Our heath depends on the health of nature and forest	Natural process of forest to keep its health	Natural process of forest to keep itself health and sustain

	Use of nature	<p>: I think recreation and walking in the forest camping and picnic are enjoyable for me. I remember when my kids were in elementary school their teachers took them in the forest and showed them leaves, trees and they taught them .So forest can be like a class for study nature.</p> <p>Honestly I scare most of animals like snake bears and don't like to the forest fore just watching them. But it doesn't mean I don't like them to be alive and live.</p>	<p>I think recreation and walking in the forest camping and picnic are enjoyable for me.</p> <p>So forest can be like a class for study about nature .</p>	recreation and walking are enjoyable	<p>Recreation value of forest(Use value of forest)</p> <p>Education value of forest (Use value of forest)</p>
	Role of people and government in conserving nature	I think the role of human in nature is that they should be careful not to ruin and pollute it not try to manage it because nature has been before us and know to manage itself better.	They should be careful not to ruin and pollute it not try to manage it because nature has been before us and know to manage itself better by its natural actions.	<p>Nature is not seen as fragile, but as resilient and robust. The protection of nature is also important, but</p> <p>they believed nature can adapt itself individually to changing circumstances.</p>	<p>autarkic and self-sufficiency of nature =natural ecological process</p> <p>-Passive management</p> <p>its power and sustainability</p>

	<p>Meaning of biodiversity</p>	<p>it means different living creatures, and different places</p> <p>I prefer forest with different animals and trees because first I think it is much more beautiful than that of having just one species and I enjoy more . Next, I think it is an essence of nature to have different and mix trees and animals and it is useful for wildlife because they need each other some of them are the foods of the others and it is a principle or mystery of nature.I like to see flowers grassland bushes trees rivers. When I go to the forest.</p>	<p>it means different places and living creatures</p> <p>I prefer forest with different species because first I think it is much more beautiful</p> <p>it is an essence of nature to have different and mix living creatures ,it is useful for wildlife because they need each other some of them are food of the others and it is a principle or mystery of existence of nature .</p>	<p>Aesthetic aspect of Diversity of species and its diversity helps forest and nature existence.</p>	<p>Aesthetic aspect of biodiversity (Use value of forest)</p> <p>Biodiversity makes forest more Stable and flexible=stability of nature because of diversity of animals</p>
	<p>Effect and benefit of biodiversity</p>	<p>I think all of these species need each other and being more diverse help forest to be sustain.</p>	<p>all of these species need each other and being more diverse help forest to be sustain.</p>	<p>Perception of diversity</p>	<p>Functionality of biodiversity</p>

	Dead wood	I think as much as possible we should try to keep forest and avoid intervention in its naturalness by avoiding removing dead trees and leaved from the forests. (it looks natural with old tress)	avoid intervention in its nature  avoiding removing dead trees and leaved from the forests  it looks natural with old	Keep naturalness of forest by remaining deadwood there	Naturalness of forest ecosystem
	Restriction	I think restriction for improving forest is a well acceptable scheme but just remain some open place for us	restriction for improving forest is a well acceptable scheme	Positive reaction for restricting parts of forest in order to improve it as a passive management.	Acceptance of restriction for conservation.  Passive management
	Conserving of nature	I am ready to limit my need a little bit to save forest for next generation .forests are our heritage .their presence has value for me	limit my need a little bit to save forest for next generation .forests are our heritage .their presence has value for me	Think about nature is for next generation.	non-use value

	<p>Considering the current situation of forests in your country what do you think of the necessity of a project to conserve and enhance forest and nature?</p>	<p>Here the constitution is in favour of nature compare with developing country because of poverty, Governments can't pay attention to nature much and people's need is the first priority for them.</p> <p>Actually as an another example, here my neighbour wanted to cut some trees in front of our building to extend the parking space but the municipality didn't let him .And it is a kind of lesson and also enforcement for us to learn that we should not destroy nature.</p> <p>I think managing nature or forest should be with layman cooperation otherwise people can't accept some.</p>	<p>constitution is in favour of nature</p> <p>Managing nature or forest should be with layman cooperation otherwise people can't accept some restriction and rules.</p>	<p>Enforcement in conservation programme</p> <p>Cooperation in management</p>	<p>Reliability and enforcement in policy</p> <p>Passive management but with layman cooperation</p>
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**B:**

**Appendix2: A brief definition of coding strategy used for the present study:**

In the current study coding processes which are applied particularly in grounded theory were used. Bellow a brief explanation of each coding process is provided:

Open coding or substantive coding is hypothesizing on the first level of generalization. Transcripts are *conceptualized line by line*. In the beginning of a study researcher starts coding everything to find out about the problem and how it is being fixed. For instance, the coding is often done in the border of the field notes. *Researcher is conceptualizing all the incidents in the data, which produces*

*many concepts. These are compared as he codes more data, and merged into new concepts, and eventually renamed and modified. The GT researcher goes back and forth while comparing data, constantly modifying, and sharpening the growing theory at the same time as she follows the build-up schedule of GT's different steps. Strauss and Corbin (1990, 1998)*

Strauss and Corbin (1990, 1998) also proposed axial coding happens after open coding which includes "a set of procedures whereby data are put back together in new ways after open coding, by making connections between categories." They suggested a "coding paradigm" (also discussed, among others, by Kelle, 2005) that involved "conditions, context, action/ interactional strategies and consequences." (Strauss & Corbin, 1997).

Selective coding is done after having found the core variable or what is thought to be the core. The core explains the behavior of the participants in resolving their main concern. The tentative core is never wrong. It just more or less fits with the data.

After choosing the core variable, researcher should selectively code data with the core guiding his coding, not bothering about concepts with little importance to the core and its sub cores.

According to Glaser, 1998, Selective coding set the limits on the study, which makes it, move fast. This is indeed encouraged while doing GT since GT is not concerned with data accuracy as in descriptive research but is about generating concepts that are abstract of time, place and people. Selective coding could be done by reviewing old field notes or memos which are already coded once at a former stage or by coding newly collected data.

### **Related references for coding process:**

Strauss A.L., Corbin J, Grounded Theory in Practice. (1997) Sage 280 pp.

Strauss, A. L., Corbin, J. M. 1990. Basics of qualitative research: grounded theory procedures and techniques. Thousand Oaks, CA: Sage.

Strauss, A. L., Corbin, J. M. 1998. Basics of qualitative research: Grounded theory procedures and techniques (2nd ed.). Thousand Oaks, CA: Sage.

Kelle, Udo .2005. "Emergence" vs. "forcing" of empirical data? A crucial problem of "grounded theory" reconsidered, Forum : Qualitative Social Research, 6(2), Art. 27, available at : <http://nbn-resolving.de/urn:nbn:de:0114-fqs0502275>

**Appendix3: : Questionnaire for Group<sub>biod</sub> (group who was informed about biodiversity by species number and stability consequences)**

Questionnaire link English: <http://www.survey-xact.dk/LinkCollector?key=RL46UXCFC63P>

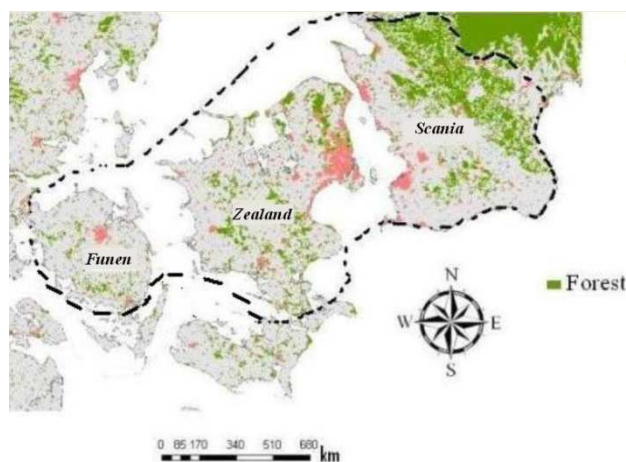
Questionnair link Danish: <http://www.survey-xact.dk/LinkCollector?key=XZSW5R9A9JCK>

**Welcome to the survey**

**“Forest conservation in eastern Denmark and southern Sweden”**

I am doing my PhD at the University of Copenhagen in collaboration with the Swedish University of Agricultural Science (SLU). I work on a project which mainly focuses on environmental services from Danish/Swedish temperate forests located in Funen, Zealand and Scania.

Environmental services provided by forests include timber, recreational opportunities, clean air and living spaces for plants and animals. However, current management practices may not support these functions. This questionnaire focuses on your views and valuation of different options for enhancing the provision of environmental services from the forests. The answers will be used for scientific purposes and it will be kept confidential. The questions focus on your opinion; therefore, there are not right or wrong answers.



Area of study



## Maintenance of the natural cycle through leaving dead trees in forests



Natural Forest dynamic or Natural forest cycle is a phrase that denotes a set of natural processes that allows forests to remain healthy over long periods of time. Dead trees are a part of this cycle, but have little presence in today's forests. Dead trees provide habitat, shelter and food source for birds, bats and other mammals and are particularly important for the less visible animals and plants: insects, beetles, fungi and lichens.

**Presence of dead trees also influences how the forest looks. Look at the following photos :**



**Do you think dead trees should be left in the forest?**

- (1)  Yes
- (2)  No

**Please read these statements and indicate at what level you agree with each statement.**

	Agree	Neither agree nor disagree	Disagree	I don't know
Presence of dead trees in forests is beautiful.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
When dead trees decay naturally in forests, they fertilise forest soil.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Dead trees are habitats for other species.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Dead trees help forests to keep their natural life cycle and remain healthy.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>

**Please read these statements and indicate at what level you agree with each statement?**

	Agree	Neither agree nor disagree	Disagree	I don't know
Wood is a resource which we could use. It should not be left to rotten.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Dead trees occupy spaces between trees and make walking in forests more difficult.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Forests without dead trees seem more organized .	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Forests without dead trees seem more pretty.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>

## **"Biodiversity"**

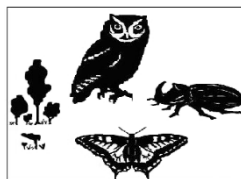
**Have you heard about the term "Biodiversity"?**

- (1)  No  
 (2)  Yes

**Below there are some descriptions about biodiversity. Please read them and indicate at what level you agree?**

	Agree	Neither agree nor disagree	Disagree	Don't know
Biodiversity refers to all the variety of animals and plants.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Biodiversity refers to all the variety of small creatures such as fungi and microorganisms.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Biodiversity refers to all the variety of habitats in which animal, plants and small creatures live.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Biodiversity refers to all the variety of human life and cultures.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>

### "Species diversity in forests"



Biodiversity refers to all the variety of life that can be found on Earth (plants, animals, fungi and micro-organisms) as well as to the communities that they form and the habitats in which they live. Forests host different plants and animals. A variety of animals and plants is a one component of biodiversity. We say a forest is diverse when it hosts a variety of animals and plants.

**Please read the statements below about the importance of conservation of biodiversity and indicate at what level you agree?**

	Agree	Neither agree nor disagree	Disagree	Don't know
<b>It is important</b> so that future generations can benefit from biodiversity.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
<b>It is important</b> so that animals and plants can get	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>

	<b>Agree</b>	<b>Neither agree nor disagree</b>	<b>Disagree</b>	<b>Don't know</b>
better living conditions.				
<b>It is important</b> so that my family and I can enjoy the biological diversity, when we're out in nature.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
<b>It is important</b> so that other people can get benefit from biodiversity when they are out in nature.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
<b>It is important</b> so that people can use biodiversity as a resource.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
<b>It is important</b> for us to have the option to discover new thing from forest in future.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
<b>It is important</b> for ecosystems like forests to have variety of animals and plants to be more flexible against stresses and environmental changes.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
<b>It is important</b> so that Plants and animals have as much right as humans to exist.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>

Other reasons, please specify:

## Forest Stability

There is a relation between health and stability of forest and biodiversity (different animals and plants). Having a high variety of animals and plants (high biodiversity) can decrease the level of disturbances in ecosystem .It may provide insurance, resistance and stability for forest to tolerate disturbances and environmental changes (such as drought or human degradation) better than forest with just one or few species.

Have you heard about this argument (stability of forest) before?

- (1)  No  
(2)  Yes

**Do you believe that this is the case?**

- (1)  Yes  
(2)  No  
(3)  I don't know

## Forest Recreation

How often do you visit the forest located in the following area?

	More than 3 times a week	1-3 times a week	1-3 times a month	1-12 times a year	Once a year	Less than once a year	I never visit the forest in this region
Funen	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>	(5) <input type="checkbox"/>	(6) <input type="checkbox"/>	(7) <input type="checkbox"/>
Zealand	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>	(5) <input type="checkbox"/>	(6) <input type="checkbox"/>	(7) <input type="checkbox"/>
Scania	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>	(5) <input type="checkbox"/>	(6) <input type="checkbox"/>	(7) <input type="checkbox"/>

How far do you live from the forest you visit most often?

- (1)  Less than 1km
- (2)  1-3 km
- (3)  3-8 km
- (4)  8-15 km
- (5)  15-25 km
- (6)  More than 25 km

How long a distance would be the ideal from your residence to the forest, you most often visit, if you could choose? (Here please ignore the real distance and instead relate to what you would like if everything was possible)

- (1)  Less than 1km
- (2)  1-3 km
- (3)  3-8 km
- (4)  8-15 km
- (5)  15-25 km
- (6)  More than 25 km

**Your favourable forest type in Denmark and Sweden we have forests with conifers and with broadleaved trees. Assume that you want to spend an hour of your time walking in a forest. How much of the forest area you walk in would you ideally like to be broadleaved forest? (The rest will be coniferous forest)?**

- (1)  0% broadleaved forest
- (2)  25% broadleaved forest
- (3)  50% broadleaved forest
- (4)  75% broadleaved forest
- (5)  100% broadleaved forest

**How much of the forest you visit most often do you think is broadleaved forest area (approximately)?**

- (1)  0% broadleaved forest
- (2)  25% broadleaved forest
- (3)  50% broadleaved forest
- (4)  75% broadleaved forest
- (5)  100% broadleaved forest

**How important are the following motives for you when you visit the forest?**

	<b>Important</b>	<b>Not important</b>	<b>I don't know</b>
Enjoy nature	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
Get health benefits	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
Escape everyday life	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
Enjoy the solitude	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
Spend time with family and friends	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
Experience something exciting/adventure	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
Find stress relief	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>

**Have you participated in some of the following activities within the last year, when you have visited the forest?**

- (1)  Observing animals and plants
- (2)  Spending the night in the forest
- (3)  Working in the forest
- (4)  Doing exercise
- (5)  Gathering mushrooms or berries
- (6)  Going for a picnic
- (7)  Enjoying the peace and quiet of nature
- (8)  Biking
- (9)  Riding
- (10)  Fishing and Hunting
- (11)  Educational visit
- (12)  Going for walk
- (13)  Mountain biking
- (14)  Horse riding
- (15)  Making barbeque and using stove
- (16)  Cooking
- (17)  Others:

**When you use the forest for recreation, have you found the following activities from other people disturbing?**

	<b>Often</b>	<b>Sometimes</b>	<b>I meet them but they don't disturb me</b>	<b>I don't meet them</b>
Mountain bikers	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
People with baby pram	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Horse riders	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
People with dogs	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Bird watchers	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Playing children	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
large group of people who are playing ball games	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
people who are gathering berries or mushrooms	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
People who are using cooking stove	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>

	<b>Often</b>	<b>Sometimes</b>	<b>I meet them but they don't disturb me</b>	<b>I don't meet them</b>
and having barbeque				
Kindergarten and school classes	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Forest workers	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Hunters	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Runners	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Runners in big groups	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>

**Other reasons:**

### **Your preferable forest to visit!**

**Assume you have the option to visit forest A or forest B. They are identical but different in terms of :**

1-Numbers of people who visit them

2-The distance from your home

**Look at following choices (choice 1 and choice 2), Which Forest would you choose to visit?**

	<b>Forest A</b>	<b>Forest B</b>	<b>None of these</b>
<b>Number of visitor</b>	Many Visitors	Few visitors	
<b>Distance from your home(Km)</b>	10 Km	5 Km	
<b>Your choice (select only one option)</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



**Look at following choices (choice 1 and choice 2), Which Forest would you choose to visit?**

	<b>Forest A</b>	<b>Forest B</b>	<b>None of these</b>
<b>Number of visitor</b>	Many Visitors	Few visitors	
<b>Distance from your home(Km)</b>	5Km	10Km	
<b>Your choice (select only one option)</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Which of the following statements do you most agree with? (choice of one or more) When I walk in the forest which I visit it most:**

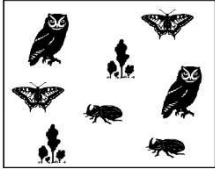


- (1)  I like to meet many other people
- (2)  I like to meet just a few other people
- (3)  I do not care if I meet other people
- (4)  I do not like to meet many other people
- (5)  I do not like to meet other people at all

### **Change in policy**

In this section, we show you different statements of forests under the 'current policy /present situation' of forests and under 'new policies' which can help improve conditions for animals and plants, natural cycle and create recreational opportunities, in eastern Denmark and southern Sweden.


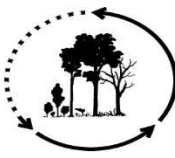

Statement 1: Species diversity Forests host different plants and animals. A forest is more diverse when it hosts a larger variety of animals and plants. Today, the total number of different animals and plants species in Funen, Zealand and Scania is around 10,000. Around 1,000 of these are considered common and not endangered. The rest are endangered and may become extinct under today's forest management policy. We can implement conservation policies to improve the living conditions for plants and animals in general and thereby decrease the number of endangered species. Depending on the intensity of the policy we may increase the number from 1000 to 1500 or 2000.

In table you see Current policy and two suggested new policies (policy 1 and policy 2). Which policy would you prefer?

	Current policy	Policy 1	Policy 2
Number of abundant species	1,000 	1,500 	2000 
Your choice (select only one option)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Statement 2: Presence of the natural cycle of forest through leaving dead trees in forests To enhance the condition for the natural cycle of forests, one way could be leaving more dead trees in the forest to decay naturally and improve its nutrient cycle. Today, in eastern Denmark and Southern Sweden we see deadwood occasionally left in forests. If we apply alternative management policies to improve presence of natural cycle of forest, we can increase the number of dead trees in forests up to 7 old trees per hectare or 15 old trees per hectare.

In table you see Current policy and two suggested new policies (policy 1 and policy 2). Which policy would you prefer?

	Current policy	Policy 1	Policy 2
Maintenance of forest natural cycle	Dead wood occasionally left in forest 	7 trees left in each hectare of forests 	15 trees left in each hectare of forests 
Your choice (select only one option)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### **Statement 3: the location where the policies take place**

Regarding the location of forest conservation policies, if you choose 'current policy' it means that there will be no new policy in any of our targeted forest areas i.e. "Funen, Zealand and Scania" and if you choose suggested policies, depending on the location of policy, an extra improvement will take place in one of 3 regions which are Funen, Zealand and Scania.

### **Statement 4: Payment to support conservation policies**

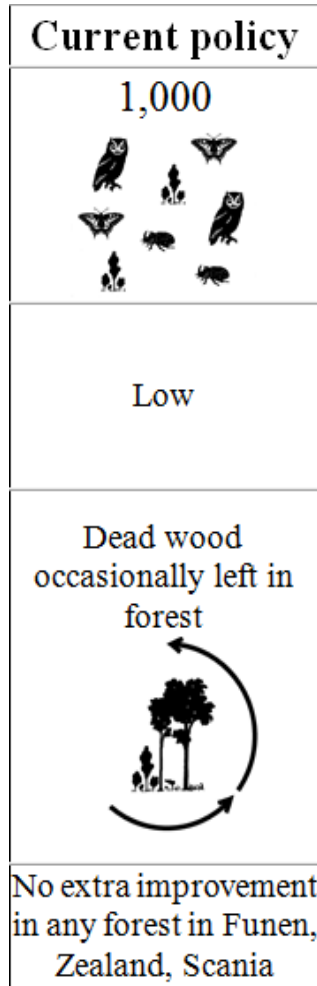
Nature does not follow country boundaries and many preservation strategies are coordinated internationally at a European level. Payment for these programmes typically goes through national budgets, i.e. each citizen in involved countries contributes through a tax payment.

Imagine that a policy of forest management is contingent upon the public paying for it. Therefore, it will be necessary to impose an extra annual income tax on all Danish households also yours. In addition, citizens in Sweden and other countries involved are also contributing. If you are interested in the suggested policies, it costs money therefore; you should imagine that this amount is to be paid

by your household as **an extra annual income tax** in order to have improvement in forests. Each policy concerns only forest in either Funen, Zealand or Scania. **If you don't want any of the suggested policies you have to choose 'No policy' and then you will of course not pay more.**

## Situation of forests under current policy

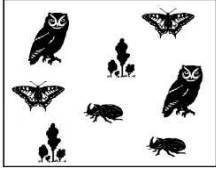
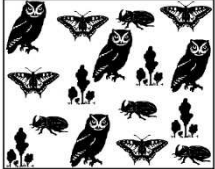
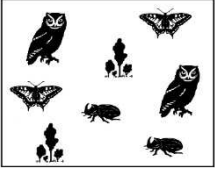



Under current policy or present situation of forests located in Funen, Zealand and Scania, dead trees are left in forests occasionally and 1000 of total species living in forests are common and are not endangered. Since we don't apply a new management in this situation, payment would be zero (0).



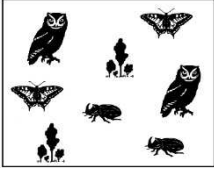



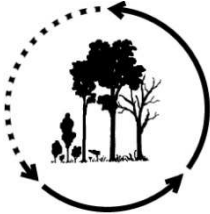

Now we present you different policies which are the combination of statements which you have seen in previous pages. Results from similar studies have shown that respondents have a tendency to overestimate how much they actually are willing to pay through this kind of contributions. Therefore, I ask you to carefully consider the different policies in relation to your household income. Please note that the additional payment will reduce your spending on other goods and services in your everyday life. In following you will see 6 figures which show policies which are the combination of statements. I would like you to continue with following figures and choose between policies 1, policy 2 and current policy.

Please remember that there are no right or wrong answers as we would only like to know your opinion.

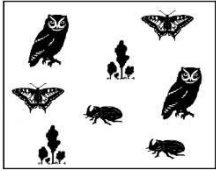

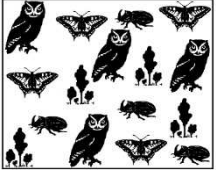



Which policy do you prefer?

	Current policy	Policy 1	Policy 2
Number of abundant species	1,000 	2,000 	1,000 
Forest stability and resistance against disturbance	Low	High	Low
Presence of forest natural cycle	Dead wood occasionally left in forest 	Dead wood occasionally left in forest 	<u>15</u> trees left in each hectar of forests 
Where new policy takes place	No extra improvement in any forest in Funen, Zealand, Scania	Zealand	Zealand
Annual income tax (Dkk /Year)	0 DKK	250 DKK	1,050 DKK
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

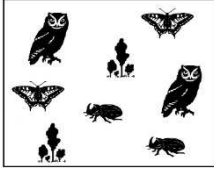

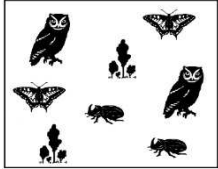



Which policy do you prefer?

	Current policy	Policy 1	Policy 2
Number of abundant species	1,000 	1,500 	2,000 
Forest stability and resistance against disturbance	Low	Medium	High
forest natural cycle	Dead wood occasionally left in forest 	<u>7</u> trees left in each hectar of forests 	<u>15</u> trees left in each hectar of forests 
Where new policy takes place	No extra improvement in any forest in Funen, Zealand, Scania	Funen	Scania
Annual income tax (Dkk /Year)	0 DKK	1,250 DKK	250 DKK
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Which approach do you prefer?**

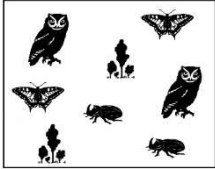
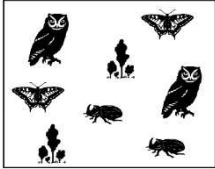
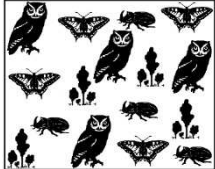


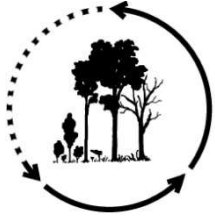
	<b>Current policy</b>	<b>Policy 1</b>	<b>Policy 2</b>
<b>Number of abundant species</b>	<p>1,000</p> 	<p>1500</p> 	<p>2,000</p> 
<b>Forest stability and resistance against disturbance</b>	Low	Medium	High
<b>forest natural cycle</b>	<p>Dead wood occasionally left in forest</p> 	<p><u>15</u> trees left in each hectar of forests</p> 	<p>Dead wood occasionally left in forest</p> 
<b>Where new policy takes place</b>	No extra improvement in any forest in Funen, Zealand, Scania	Scania	Zealand
<b>Annual income tax (Dkk /Year)</b>	0 DKK	1000 DKK	250 DKK
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Which approach do you prefer?**

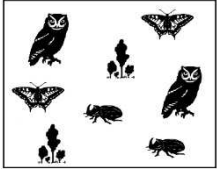
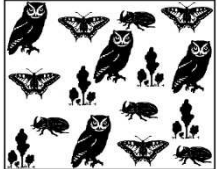




	<b>Current policy</b>	<b>Policy 1</b>	<b>Policy 2</b>
<b>Number of abundant species</b>	1,000 	1,500 	1,000 
<b>Forest stability and resistance against disturbance</b>	Low	High	Low
<b>forest natural cycle</b>	Dead wood occasionally left in forest 	Dead wood occasionally left in forest 	<u>15</u> trees left in each hectar of forests 
<b>Where new policy takes place</b>	No extra improvement in any forest in Funen, Zealand, Scania	Funen	Zealand
<b>Annual income tax (Dkk /Year)</b>	0 <b>DKK</b>	1,250 <b>DKK</b>	250 <b>DKK</b>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



**Which approach do you prefer?**

	<b>Current policy</b>	<b>Policy 1</b>	<b>Policy 2</b>
<b>Number of abundant species</b>	1,000 	1,000 	2,000 
<b>Forest stability and resistance against disturbance</b>	Low	Low	High
<b>Presence of forest natural cycle</b>	Dead wood occasionally left in forest 	7 trees left in each hectar of forests 	7 trees left in each hectar of forests 
<b>Where new policy takes place</b>	No extra improvement in any forest in Funen, Zealand, Scania	Funen	Scania
<b>Annual income tax (Dkk /Year)</b>	0 <b>DKK</b>	250 <b>DKK</b>	750 <b>DKK</b>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Which approach do you prefer?

	Current policy	Policy 1	Policy 2
Number of abundant species	1,000 	2,000 	1,500 
Forest stability and resistance against disturbance	Low	High	Medium
Presence of forest natural cycle	Dead wood occasionally left in forest 	15 trees left in each hectar of forests 	Dead wood occasionally left in forest 
Where new policy takes place	No extra improvement in any forest in Funen, Zealand, Scania	Scania	Funen
Annual income tax (Dkk /Year)	0 <b>DKK</b>	250 <b>DKK</b>	1,250 <b>DKK</b>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**To which degree did each individual attribute play a role in your choices in previous questions?**

	Not at all	A little	To some extent	To a larg extent
Number of abundant species	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Stability and resistance of forest against dangers and environmental changes	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Maintanance of forest natural cycle through leaving dead trees in forests	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Location where the policy takes place	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Minimization of the monthly extra income tax	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>

**Would increases in the following attributes make your recreational experience of a visit to the forest better, worse or not change it?**

	Better	Worse	Not change
Variety of animals and plants	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
Maintenance of natural cycle of forest through leaving dead trees in forest	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>

**Please explain your reason.**

**In the above choice sets, you have selected the status quo option every time. Could you tell us what was the reason? (Please mark the one that suits you more)**

- (1)  It was too expensive as compared to the benefits I would experience.
- (2)  The questions were difficult to answer.
- (3)  My actual income does not allow me to pay the requested amount.
- (4)  I already pay enough taxes and the government should pay for this programme.
- (5)  I prefer to spend my money on other things.
- (6)  I don't find it important to finance this program.
- (7)  I do not believe that the initiatives would work.
- (8)  I do like to pay but already pay for different environmental projects and can't afford an extra one.

- (9)  I would prefer other methods to protect the environment/create environmental benefits.
- (10)  I prefer that the management of these forest areas continue as it is today.
- (11)  I prefer to pay for my forest of my own country.
- (12)  Another reason \_\_\_\_\_

**If you rarely or never chose the “Current situation” option in any of the choice sets above, please indicate the reason:**

- (1)  I like the idea that we would do something to improve the environment.
- (2)  I always choose the best alternatives for nature, regardless of the cost.
- (3)  When comparing the alternatives, I never found the status quo to be the most preferred.
- (4)  Other reason, please write \_\_\_\_\_

**Your first and last choice Forests in Funen, Zealand and Scania are almost similar in terms of trees, plant and animals. Assume that you want to choose a policy to get an extra improvement in the living conditions of forest species (animals and plants) only for one of these areas. Please indicate which area will be your first and your last choice?**

	Forest in Funen	Forest in Zealand	Forest in Scania
My first choice	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
My last choice	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>

**Public and private ownership** Some forests in Denmark and Sweden are publicly owned, others are privately owned. The above mentioned policies can be carried out in both public and private forests. If the cost and the potential improvements are the same for public and private forests, where would you prefer the policies to be implemented mainly?

- (1)  In publicly owned forest
- (2)  In privately owned forest, financed by public support
- (3)  In privately owned forest, financed by the forest owner him/herself
- (4)  I am indifferent

Please explain your reason.

---

## Personal question

Now we would like to ask you some questions about yourself for statistical purposes. Please note these data are confidential and the aim is checking whether people with features similar to yours do give similar answers.

### How old are you?

\_\_\_\_\_

### Your gender

- (1)  Female
- (2)  Male

### Where do you live?

- (1)  Funen
- (2)  Zealand
- (3)  Scania

### In which area do you live now?

- (1)  I live in the countryside with less than 3000 citizens.
- (2)  I live in small town with 3000-20000 citizens.
- (3)  I live in town with more than 20000 citizens.
- (4)  Other:

### Which of following do you own?

- (1)  Property with garden
- (2)  Property without garden
- (3)  Summer cottage
- (4)  land (agricultural land, forest ..)
- (5)  None of them

**Which of the following describe your connection to the other focus regions except the region that you are living now?**

	<b>Funen</b>	<b>Zealand</b>	<b>Southern Sweden</b>
I work there today.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
I used to work there.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
Place of spouse's work.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
I have summer house.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
I visit family and friends there.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
I was born there.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
I used to live there.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>

**Would you please write your postal code of the area you live now?**

\_\_\_\_\_

**Do you have any education related to forestry or environment?**

- (1)  Yes \_\_\_\_\_  
 (2)  No

**How many children do you have?**

Number of children living with you \_\_\_\_\_

Number of children living separately \_\_\_\_\_

**In this study we consider a household is composed of a number of people living on the same address and from the same/joint income.**

Considering this, Could you please let us know about the structure of your household?

The number of adult \_\_\_\_\_

The number of adults earning a salary \_\_\_\_\_

The number of children under the age of 18 \_\_\_\_\_

**How much is your annual household income before tax per year (incl. pension etc.)? (Household is composed of a number of people living on the same address and from the same/joint income)**

- (1)  Under 100.000 DKK
- (2)  100.000-199.999 DKK
- (3)  200.000-299.999 DKK
- (4)  300.000-399.999 DKK
- (5)  400.000-499.999 DKK
- (6)  500.000-749.999 DKK
- (7)  750.000-999.999 DKK
- (8)  over 1.000.000 DKK
- (9)  Do not know / do not wish to disclose

**What is your present occupation?**

- (1)  Independent businessperson
- (2)  Co-working spouse
- (3)  Wage earner, full time (minimum 32 hours per week)
- (4)  Wage earner on reduced time
- (5)  Unemployed
- (6)  On leave
- (7)  Student
- (8)  Pensioner
- (9)  Other (please indicate) \_\_\_\_\_

**Are you a member of any of the following outdoor or environmental associations?**

- (1)  Danish Nature Conservation
- (2)  WWF
- (3)  Birdlife International
- (4)  Hunters' association
- (5)  Anglers' association
- (6)  Mountain bikers association
- (7)  Association for the protection of animals

**Other associations related to nature activities (please write the name)**

\_\_\_\_\_

**Have you within the last year donated any funds to an environmental conservation association?**

- (1)  Yes, how much : \_\_\_\_\_
- (2)  No

**Thank you for your time and consideration!**

**If you have any question you can contact by email.**

**My email address: [fba@life.ku.dk](mailto:fba@life.ku.dk)**



**Appendix4: Questionnaire for Group species (group who was informed about biodiversity by species number)**

Questionnaire link in English: <http://www.survey-xact.dk/LinkCollector?key=9F6CWF9A15C2>

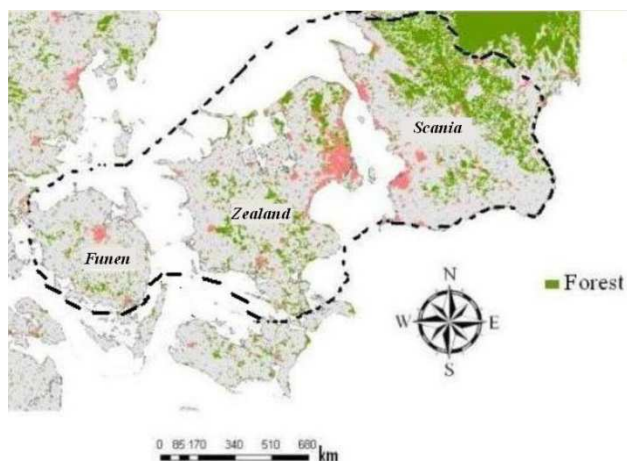
Questionnaire link in Danish: <http://www.survey-xact.dk/LinkCollector?key=FVA5PE1FC6C5>

**Welcome to the survey**

**“Forest conservation in eastern Denmark and southern Sweden”**

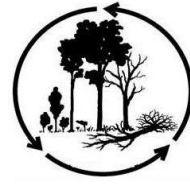
I am doing my PhD at the University of Copenhagen in collaboration with the Swedish University of Agricultural Science (SLU). I work on a project which mainly focuses on environmental services from Danish/Swedish temperate forests located in Funen, Zealand and Scania.

Environmental services provided by forests include timber, recreational opportunities, clean air and living spaces for plants and animals. However, current management practices may not support these functions. This questionnaire focuses on your views and valuation of different options for enhancing the provision of environmental services from the forests. The answers will be used for scientific purposes and it will be kept confidential. The questions focus on your opinion; therefore, there are not right or wrong answers.



Area of study

## Maintenance of the natural cycle through leaving dead trees in forests



Natural Forest dynamic or Natural forest cycle is a phrase that denotes a set of natural processes that allows forests to remain healthy over long periods of time. Dead trees are a part of this cycle, but have little presence in today's forests. Dead trees provide habitat, shelter and food source for birds, bats and other mammals and are particularly important for the less visible animals and plants: insects, beetles, fungi and lichens.

**Presence of dead trees also influences how the forest looks. Look at the following pictures :**



**Do you think dead trees should be left in the forest?**

- (1)  Yes  
(2)  No

**Please read these statements and indicate at what level you agree with each statement.**

	Agree	Neither agree nor disagree	Disagree	I don't know
Presence of dead trees in forests is beautiful.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
When dead trees decay naturally in forests, they fertilise forest soil.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>

	Agree	Neither agree nor disagree	Disagree	I don't know
Dead trees are habitats for other species.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Dead trees help forests to keep their natural life cycle and remain healthy.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>

**Please read these statements and indicate at what level you agree with each statement?**

	Agree	Neither agree nor disagree	Disagree	I don't know
Wood is a resource which we could use. It should not be left to rotten.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Dead trees occupy spaces between trees and make walking in forests more difficult.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Forests without dead trees seem more organized .	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Forests without dead trees seem more pretty.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>

## "Biodiversity"

**Have you heard about the term "Biodiversity"?**

- (1)  No  
(2)  Yes

**Below there are some descriptions about biodiversity. Please read them and indicate at what level you agree?**

	Agree	Neither agree nor disagree	Disagree	Don't know
Biodiversity refers to all the variety of animals and plants.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Biodiversity refers to all the variety	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>

**Agree**                      **Neither agree nor disagree**                      **Disagree**                      **Don't know**

of small creatures such as fungi and micro organisms.

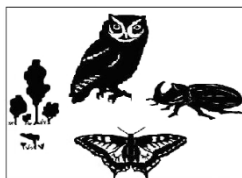
Biodiversity refers to all the variety of habitats in which animal, plants and small creatures live.

(1)                       (2)                       (3)                       (4)

Biodiversity refers to all the variety of human life and cultures.

(1)                       (2)                       (3)                       (4)

### "Species diversity in forests"



Biodiversity refers to all the variety of life that can be found on Earth (plants, animals, fungi and micro-organisms) as well as to the communities that they form and the habitats in which they live. Forests host different plants and animals. A variety of animals and plants is a one component of biodiversity. We say a forest is diverse when it hosts a variety of animals and plants.

### Forest Recreation

**How often do you visit the forest located in the following area?**

	More than 3 times a week	1-3 times a week	1-3 times a month	1-12 times a year	Once a year	Less than once a year	I never visit the forest in this region
Funen	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>	(5) <input type="checkbox"/>	(6) <input type="checkbox"/>	(7) <input type="checkbox"/>
Zealand	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>	(5) <input type="checkbox"/>	(6) <input type="checkbox"/>	(7) <input type="checkbox"/>
Scania	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>	(5) <input type="checkbox"/>	(6) <input type="checkbox"/>	(7) <input type="checkbox"/>

**How far do you live from the forest you visit most often?**

- (1)  Less than 1km
- (2)  1-3 km
- (3)  3-8 km
- (4)  8-15 km
- (5)  15-25 km
- (6)  More than 25 km

**How long a distance would be the ideal from your residence to the forest, you most often visit, if you could choose? (Here please ignore the real distance and instead relate to what you would like if everything was possible)**

- (1)  Less than 1km
- (2)  1-3 km
- (3)  3-8 km
- (4)  8-15 km
- (5)  15-25 km
- (6)  More than 25 km

**Your favourable forest type In Denmark and Sweden we have forests with conifers and with broadleaved trees. Assume that you want to spend an hour of your time walking in a forest. How much of the forest area you walk in would you ideally like to be broadleaved forest? (The rest will be coniferous forest)?**

- (1)  0% broadleaved forest
- (2)  25% broadleaved forest
- (3)  50% broadleaved forest
- (4)  75% broadleaved forest
- (5)  100% broadleaved forest

**How much of the forest you visit most often do you think is broadleaved forest area (approximately)?**

- (1)  0% broadleaved forest
- (2)  25% broadleaved forest
- (3)  50% broadleaved forest
- (4)  75% broadleaved forest
- (5)  100% broadleaved forest

**How important are the following motives for you when you visit the forest?**

	<b>Important</b>	<b>Not important</b>	<b>I don't know</b>
Enjoy nature	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
Get health benefits	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
Escape everyday life	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
Enjoy the solitude	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
Spend time with family and friends	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
Experience something exciting/adventure	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
Find stress relief	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>

**Have you participated in some of the following activities within the last year, when you have visited the forest?**

- (1)  Observing animals and plants
  - (2)  Spending the night in the forest
  - (3)  Working in the forest
  - (4)  Doing exercise
  - (5)  Gathering mushrooms or berries
  - (6)  Going for a picnic
  - (7)  Enjoying the peace and quiet of nature
  - (8)  Biking
  - (9)  Riding
  - (10)  Fishing and Hunting
  - (11)  Educational visit
  - (12)  Going for walk
  - (13)  Mountain biking
  - (14)  Horse riding
  - (15)  Making barbeque and using stove
  - (16)  Cooking
  - (17)  Others:
-

**When you use the forest for recreation, have you found the following activities from other people disturbing?**

	<b>Often</b>	<b>Sometimes</b>	<b>I meet them but they don't disturb me</b>	<b>I don't meet them</b>
Mountain bikers	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
People with baby pram	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Horse riders	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
People with dogs	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Bird watchers	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Playing children	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
large group of people who are playing ball games	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
people who are gathering berries or mushrooms	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
People who are using cooking stove and having barbeque	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Kindergarten and school classes	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Forest workers	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Hunters	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Runners	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Runners in big groups	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>

Other reasons:

### **Your preferable forest to visit!**

**Assume you have the option to visit forest A or forest B. They are identical but different in terms of :**

1-Numbers of people who visit them

2-The distance from your home

Look at following choices (choice 1 and choice 2), Which Forest would you choose to visit?

	Forest A	Forest B	None of these
Number of visitor	Many Visitors	Few visitors	
Distance from your home(Km)	10 Km	5 Km	
Your choice (select only one option)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Look at following choices (choice 1 and choice 2), Which Forest would you choose to visit?

	Forest A	Forest B	None of these
Number of visitor	Many Visitors	Few visitors	
Distance from your home(Km)	5Km	10Km	
Your choice (select only one option)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Which of the following statements do you most agree with? (choice of one or more) When I walk in the forest which I visit it most:

- (1)  I like to meet many other people
- (2)  I like to meet just a few other people
- (3)  I do not care if I meet other people
- (4)  I do not like to meet many other people
- (5)  I do not like to meet other people at all

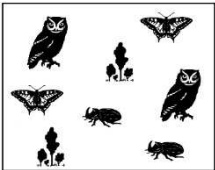


## Change in policy

In this section, we show you different statements of forests under the 'current policy /present situation' of forests and under 'new policies' which can help improve conditions for animals and plants, natural cycle and create recreational opportunities, in eastern Denmark and southern Sweden.






**Statement 1:** Species diversity Forests host different plants and animals. A forest is more diverse when it hosts a larger variety of animals and plants. Today, the total number of different animals and plants species in Funen, Zealand and Scania is around 10,000. Around 1,000 of these are considered common and not endangered. The rest are endangered and may become extinct under today's forest management policy. We can implement conservation policies to improve the living conditions for plants and animals in general and thereby decrease the number of endangered species. Depending on the intensity of the policy we may increase the number from 1000 to 1500 or 2000.

In table you see Current policy and two suggested new policies (policy 1 and policy 2). Which policy would you prefer?

	Current policy	Policy 1	Policy 2
Number of abundant species	1,000 	1,500 	2,000 
Your choice (select only one option)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Statement 2:** Presence of the natural cycle of forest through leaving dead trees in forests To enhance the condition for the natural cycle of forests, one way could be leaving more dead trees in the forest to decay naturally and improve its nutrient cycle. Today, in eastern Denmark and Southern Sweden we see deadwood occasionally left in forests. If we apply alternative management policies to improve presence of natural cycle of forest, we can increase the number of dead trees in forests up to 7 old trees per hectare or 15 old trees per hectare.

In table you see Current policy and two suggested new policies (policy 1 and policy 2). Which policy would you prefer?

	Current policy	Policy 1	Policy 2
<b>Maintenance of forest natural cycle</b>	Dead wood occasionally left in forest 	<u>7</u> trees left in each hectare of forests 	<u>15</u> trees left in each hectare of forests 
<b>Your choice</b> (select only one option)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Statement 3: the location where the polices take place**

Regarding the location of forest conservation policies, if you choose 'current policy' it means that there will be no new policy in any of our targeted forest areas i.e "Funen, Zealand and Scania" and if you choose suggested policies, depending on the location of policy, an extra improvement will take place in one of 3 regions which are Funen, Zealand and Scania.

#### **Statement 4: Payment to support conservation policies**

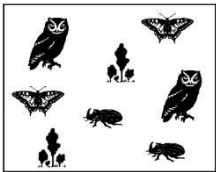

Nature does not follow country boundaries and many preservation strategies are coordinated internationally at a European level. Payment for these programmes typically goes through national budgets, i.e. each citizen in involved countries contributes through a tax payment.

Imagine that a policy of forest management is contingent upon the public paying for it. Therefore, it will be necessary to impose an extra annual income tax on all Danish households also yours. In addition, citizens in Sweden and other countries involved are also contributing. If you are interested in the suggested policies, it costs money therefore; you should imagine that this amount is to be paid

by your household as **an extra annual income tax** in order to have improvement in forests. Each policy concerns only forest in either Funen, Zealand or Scania. **If you don't want any of the suggested policies you have to choose 'No policy' and then you will of course not pay more.**

## Situation of forests under current policy

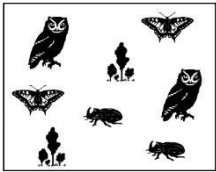
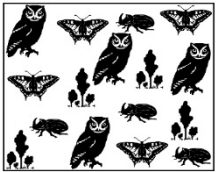
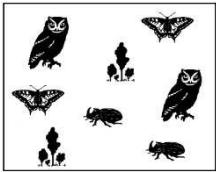



Under current policy or present situation of forests located in Funen, Zealand and Scania, dead trees are left in forests occasionally and 1000 of total species living in forests are common and are not endangered. Since we don't apply a new management in this situation, payment would be zero (0).

<b>Current policy</b>
1,000
Animals and plants

Dead wood
occasionally left in forest

No extra improvement in any forest in Scania, Funen and Zealand,
0
DKK

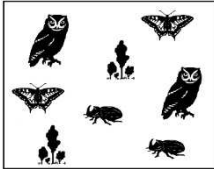
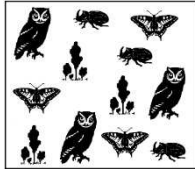


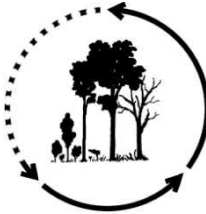

Now we present you different policies which are the combination of statements which you have seen in previous pages. Results from similar studies have shown that respondents have a tendency to overestimate how much they actually are willing to pay through this kind of contributions. Therefore, I ask you to carefully consider the different policies in relation to your household income. Please note that the additional payment will reduce your spending on other goods and services in your everyday life. In following you will see 6 figures which show policies which are the combination of statements. I would like you to continue with following figures and choose between policies1, policy 2 and current policy.

Please remember that there are no right or wrong answers as we would only like to know your opinion.

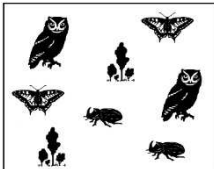
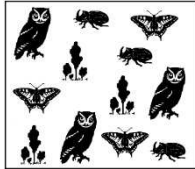
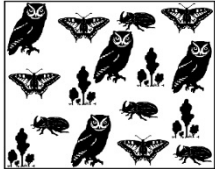



Which policy do you prefer?

	Current policy	Policy 1	Policy 2
<b>Number of abundant species</b>	1,000 	2,000 	1,000 
<b>Presence of forest natural cycle</b>	Dead wood occasionally left in forest 	Dead wood occasionally left in forest 	15 trees left in each hectare of forests 
<b>Where new policy takes place</b>	No extra improvement in any forest in Funen, Zealand, Scania	Zealand	Zealand
<b>Annual income tax (Dkk /Year)</b>	0 DKK	250 DKK	1,050 DKK
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

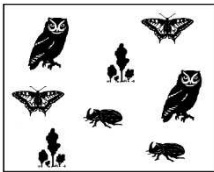
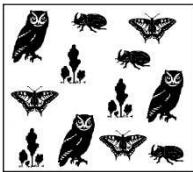
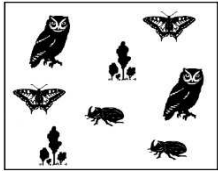



Which policy do you prefer?

	Current policy	Policy 1	Policy 2
<b>Number of abundant species</b>	<p>1,000</p> 	<p>1,500</p> 	<p>2,000</p> 
<b>forest natural cycle</b>	<p>Dead wood occasionally left in forest</p> 	<p><u>7</u> trees left in each hectare of forests</p> 	<p><u>15</u> trees left in each hectare of forests</p> 
<b>Where new policy takes place</b>	No extra improvement in any forest in Funen, Zealand, Scania	Funen	Scania
<b>Annual income tax (Dkk /Year)</b>	0 DKK	1,250 DKK	250 DKK
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Which approach do you prefer?

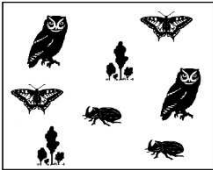
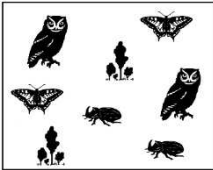



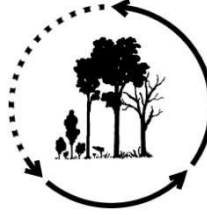
	Current policy	Policy 1	Policy 2
Number of abundant species	<p>1,000</p> 	<p>1,500</p> 	<p>2,000</p> 
forest natural cycle	<p>Dead wood occasionally left in forest</p> 	<p><u>15</u> trees left in each hectare of forests</p> 	<p>Dead wood occasionally left in forest</p> 
Where new policy takes place	No extra improvement in any forest in Funen, Zealand, Scania	Scania	Zealand
Annual income tax (Dkk /Year)	0 DKK	1000 DKK	250 DKK
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Which approach do you prefer?

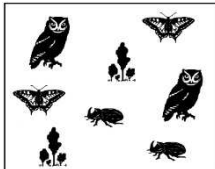





	Current policy	Policy 1	Policy 2
<b>Number of abundant species</b>	<p>1,000</p> 	<p>1,500</p> 	<p>1,000</p> 
<b>forest natural cycle</b>	<p>Dead wood occasionally left in forest</p> 	<p>Dead wood occasionally left in forest</p> 	<p><u>15</u> trees left in each hectare of forests</p> 
<b>Where new policy takes place</b>	No extra improvement in any forest in Funen, Zealand, Scania	Funen	Zealand
<b>Annual income tax (Dkk /Year)</b>	0 DKK	1,250 DKK	250 DKK
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



**Which approach do you prefer?**

	Current policy	Policy 1	Policy 2
<b>Number of abundant species</b>	1,000 	1,000 	2,000 
<b>Presence of forest natural cycle</b>	Dead wood occasionally left in forest 	7 trees left in each hectar of forests 	7 trees left in each hectar of forests 
<b>Where new policy takes place</b>	No extra improvement in any forest in Funen, Zealand, Scania	Funen	Scania
<b>Annual income tax (Dkk /Year)</b>	0 DKK	250 DKK	750 DKK
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Which approach do you prefer?**

	<b>Current policy</b>	<b>Policy 1</b>	<b>Policy 2</b>
<b>Number of abundant species</b>	1,000 	2,000 	1,500 
<b>Presence of forest natural cycle</b>	Dead wood occasionally left in forest 	<u>15</u> trees left in each hectare of forests 	Dead wood occasionally left in forest 
<b>Where new policy takes place</b>	No extra improvement in any forest in Funen, Zealand, Scania	Scania	Funen
<b>Annual income tax (Dkk /Year)</b>	0 DKK	250 DKK	1,250 DKK
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**To which degree did each individual attribute play a role in your choices in previous questions?**

	<b>Not at all</b>	<b>A little</b>	<b>To some extent</b>	<b>To a larg extent</b>
Number of abundant species	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Stability and resistance of forest against dangers and environmental changes	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Maintenance of forest natural cycle through leaving dead trees in forests	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Location where the policy takes place	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
Minimization of the monthly extra income tax	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>

**Would increases in the following attributes make your recreational experience of a visit to the forest better, worse or not change it?**

	<b>Better</b>	<b>Worse</b>	<b>Not change</b>
Variety of animals and plants	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
Maintenance of natural cycle of forest through leaving dead trees in forest	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>

Please explain your reason.

**Please read the statements below about the importance of conservation of biodiversity and indicate at what level you agree?**

	<b>Agree</b>	<b>Neither agree nor disagree</b>	<b>Disagree</b>	<b>Don't know</b>
<b>It is important</b> so that future generations can benefit from biodiversity.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
<b>It is important</b> so that animals and plants can get better living conditions.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
<b>It is important</b> so that my family and I can enjoy the biological diversity, when we're out in nature.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
<b>It is important</b> so that other people can get benefit from biodiversity when they are out in nature.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
<b>It is important</b> so that people can use biodiversity as a resource.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
<b>It is important</b> for us to have the option to discover new thing from forest in future.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
<b>It is important</b> for ecosystems like forests to have variety of animals and plants to be more flexible against stresses and environmental changes.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>
<b>It is important</b> so that Plants and animals have as much right as humans to exist.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>	(4) <input type="checkbox"/>

Other reasons, please specify:

\_\_\_\_\_

## Forest Stability

There is a relation between health and stability of forest and biodiversity (different animals and plants). Having a high variety of animals and plants (high biodiversity) can decrease the level of disturbances in ecosystem. It may provide insurance, resistance and stability for forest to tolerate disturbances and environmental changes (such as drought or human degradation) better than forest with just one or few species.

**Have you heard about this argument (stability of forest) before?**

- (1)  No
- (2)  Yes

**Do you believe that this is the case?**

- (1)  Yes
- (2)  No
- (3)  I don't know

**In previous tables, when you were choosing your preferable number of animals and plants under different policies.**

**Did you think about stability of forest as a value of species diversity?**

- (1)  Yes
- (2)  No
- (3)  I don't know

**In the above choice sets, you have selected the status quo option every time. Could you tell us what was the reason? (Please mark the one that suits you more)**

- (1)  It was too expensive as compared to the benefits I would experience.
- (2)  The questions were difficult to answer.
- (3)  My actual income does not allow me to pay the requested amount.
- (4)  I already pay enough taxes and the government should pay for this programme.
- (5)  I prefer to spend my money on other things.
- (6)  I don't find it important to finance this program.
- (7)  I do not believe that the initiatives would work.
- (8)  I do like to pay but already pay for different environmental projects and can't afford an extra one.
- (9)  I would prefer other methods to protect the environment/create environmental benefits.
- (10)  I prefer that the management of these forest areas continue as it is today.
- (11)  I prefer to pay for my forest of my own country.
- (12)  Another reason \_\_\_\_\_

**If you rarely or never chose the “Current situation” option in any of the choice sets above, please indicate the reason:**

- (1)  I like the idea that we would do something to improve the environment.
- (2)  I always choose the best alternatives for nature, regardless of the cost.
- (3)  When comparing the alternatives, I never found the status quo to be the most preferred.
- (4)  Other reason, please write \_\_\_\_\_

**Your first and last choice Forests in Funen, Zealand and Scania are almost similar in terms of trees, plant and animals. Assume that you want to choose a policy to get an extra improvement in the living conditions of forest species (animals and plants) only for one of these areas. Please indicate which area will be your be your first and your last choice?**

	Forest in Funen	Forest in Zealand	Forest in Scania
My first choice	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
My last choice	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>

**Public and private ownership** Some forests in Denmark and Sweden are publicly owned, others are privately owned. The above mentioned policies can be carried out in both public and private forests. If the cost and the potential improvements are the same for public and private forests, where would you prefer the policies to be implemented mainly?

- (1)  In publicly owned forest
- (2)  In privately owned forest, financed by public support
- (3)  In privately owned forest, financed by the forest owner him/herself
- (4)  I am indifferent

**Please explain your reason.**

---

### Personal question

Now we would like to ask you some questions about yourself for statistical purposes. Please note these data are confidential and the aim is checking whether people with features similar to yours do give similar answers.

**How old are you?**

---

**Your gender**

- (1)  Female
- (2)  Male

**Where do you live?**

- (1)  Funen
- (2)  Zealand
- (3)  Scania

**In which area do you live now?**

- (1)  I live in the countryside with less than 3000 citizens.
- (2)  I live in small town with 3000-20000 citizens.

- (3)  I live in town with more than 20000 citizens.  
 (4)  Other:

**Which of following do you own?**

- (1)  Property with garden  
 (2)  Property without garden  
 (3)  Summer cottage  
 (4)  land (agricultural land, forest ..)  
 (5)  None of them

**Which of the following describe your connection to the other focus regions except the region that you are living now?**

	Funen	Zealand	Southern Sweden
I work there today.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
I used to work there.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
Place of spouse's work.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
I have summer house.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
I visit family and friends there.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
I was born there.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>
I used to live there.	(1) <input type="checkbox"/>	(2) <input type="checkbox"/>	(3) <input type="checkbox"/>

**Would you please write your postal code of the area you live now?**

\_\_\_\_\_

**Do you have any education related to forestry or environment?**

- (1)  Yes \_\_\_\_\_  
 (2)  No

**How many children do you have?**

Number of children living with you \_\_\_\_\_

Number of children living \_\_\_\_\_



seperately

**In this study we consider a household is composed of a number of people living on the same address and from the same/joint income.**

**Considering this, Could you please let us know about the structure of your household?**

The number of adult \_\_\_\_\_

The number of adults earning a salary \_\_\_\_\_

The number of children under the age of 18 \_\_\_\_\_

**How much is your annual household income before tax per year (incl. pension etc.)? (Household is composed of a number of people living on the same address and from the same/joint income)**

- (1)  Under 100.000 DKK
- (2)  100.000-199.999 DKK
- (3)  200.000-299.999 DKK
- (4)  300.000-399.999 DKK
- (5)  400.000-499.999 DKK
- (6)  500.000-749.999 DKK
- (7)  750.000-999.999 DKK
- (8)  over 1.000.000 DKK
- (9)  Do not know / do not wish to disclose

**What is your present occupation?**

- (1)  Independent businessperson
- (2)  Co-working spouse
- (3)  Wage earner, full time (minimum 32 hours per week)
- (4)  Wage earner on reduced time
- (5)  Unemployed
- (6)  On leave
- (7)  Student
- (8)  Pensioner
- (9)  Other (please indicate) \_\_\_\_\_

**Are you a member of any of the following outdoor or environmental associations?**

- (1)  Danish Nature Conservation
- (2)  WWF
- (3)  Birdlife International
- (4)  Hunters' association
- (5)  Anglers' association
- (6)  Mountain bikers association
- (7)  Association for the protection of animals

**Other associations related to nature activities (please write the name)**

\_\_\_\_\_

**Have you within the last year donated any funds to an environmental conservation association?**

- (1)  Yes, how much : \_\_\_\_\_
- (2)  No

**Thank you for your time and consideration!**

**If you have any question you can contact by email.**

**My email address: [fba@life.ku.dk](mailto:fba@life.ku.dk)**