Benefits of Biodiversity Enrichment due to Forest Conversion: Evidence from two Choice Experiments in Germany

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Abstract

Forest biodiversity has recently received increasing attention because forest ecosystems are critically important habitats in terms of biological diversity. However, although many non-marketed non-timber products provided by forest ecosystems have been subject to non-market valuation studies, little is known about the economic value of forest biodiversity at present apart from the value of genetic information. This applies to both tropical and temperate forests. In order to determine the benefits from enriched forest biodiversity, we employed choice experiments in two regions in Lower Saxony, Germany. As they are attribute based, we expected to obtain more information about how people value changes in biodiversity compared to the contingent valuation but the choice experiments only provided limited information about this since we found no significant differences between several implicit prices. Calculating the welfare measures shows that including the alternative specific constant or not switches the measure from negative to positive and vice-versa. This is also the case when we exclude all the respondents who always chose the status quo option.

JEL Classification: Q23; Q51; Q57

Keywords: Alternative specific constant, choice experiment, forest biodiversity, forest conversion, implicit price, welfare measure

Introduction

Among the non-marketed non-timber products forests provide, biodiversity has recently received increasing attention. Forest ecosystems are said to harbour most of the terrestrial biological diversity and therefore the majority of animal and plant species that are becoming extinct come from forest ecosystems (Secretariat of the CBD, 2002). Accordingly, forests are critically important habitats in terms of the biological diversity they contain and the ecological functions they serve. However, while the value of many non-marketed non-timber goods and services provided by forests has been determined through non-market valuation worldwide, little is known about the value of forest biodiversity at present apart from the value of genetic information, and according to the report by the CBD Secretariat on the value of forest ecosystems, this applies to both tropical and temperate forests (Secretariat of the CBD, 2001).

Due to this knowledge gap, the main objective of the FOREST Project (Forest conversion: ecological and socio-economic assessment of biodiversity) presented here was to determine the benefits people would derive from enriched forest biodiversity in two regions in Lower Saxony, Germany (Lüneburger Heide, Solling and Harz). In response to a high percentage of coniferous trees in both regions, the government of Lower Saxony launched a long-term ecological forest development programme (LÖWE) for the state-owned forests in 1991 (Niedersächsische Landesregierung, 1991). The changes intended by the programme will lead to different levels of biodiversity. For example, a higher proportion of broad-leaved forests will affect both the kind and number of plant and animal species in the relevant forest. As the FOREST Project was part of the research programme "Biosphere Research – Integrative and Application-Oriented Model Project" initiated by the German Federal Ministry of Education and Research (BMBF) the focus was primarily on biodiversity and not on forestry. The research priority was to assess the economic value of biodiversity but not to investigate whether, for example, all benefits arising from the long-term ecological forest development programme LÖWE will outweigh the costs. To determine the economic value of enriched forest biodiversity we employed the choice experiment approach.[1] Willis et al. (2000) suggest that when a number of biodiversity standards have to be compared and valued, each for instance with different combinations and quantities of flora and fauna, then an approach based on some form of choice experiment is more appropriate. (See also Secretariat of the CBD, 2001.) Therefore, we expected to obtain more information about forest biodiversity values than by applying the contingent valuation method.

The aims of the present paper are twofold. First, we will present the results of the choice experiments with respect to peoples' preferences for forest biodiversity and discuss whether our

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[1] In the project, parallel to the choice experiments in each study region, we also used the contingent valuation method. The results are presented in Meyerhoff et al. (2006).

choice experiments provide more information for forest management than a contingent valuation would have. This argument is often presented in favour of choice experiments instead of the contingent valuation for assessing multidimensional changes (cf. Stewart and Kahn, 2006). Second, we will discuss different variants of calculating welfare measures for the environmental change in question. To our knowledge, it has not been agreed in the literature to date whether the alternative specific constant (ASC), representing either choice of the current situation or of the alternatives presented, has to be recognised or not when welfare measures are calculated. Under certain conditions, the welfare measures can become negative when the ASC is included in the calculation (Adamowicz et al., 1998). Thus, excluding the ASC may be one way to respond to this situation. Another option might be to exclude all the respondents who always chose the status quo from further analysis. Also in this case the welfare measure can switch from negative to positive (Horne, 2006).

In the next section, we briefly introduce choice experiments and summarise their employment with respect to forest biodiversity. This is followed by a description of both study areas and the way we determined the attributes of the choice experiments through focus groups. Next, we describe the main survey and the design of the choice experiments. Subsequently, the model specifications are introduced, different treatments of the alternative specific constant (ASC) in calculating welfare measures are given and the estimations of our study are presented. The final section concludes.

Choice Experiments and Forest Biodiversity

Choice experiments belong to the group of stated preference methods, i.e., they establish a hypothetical market in order to value environmental changes.[2] In contrast to the contingent valuation they are attribute based and ask respondents to make comparisons between environmental alternatives characterised by a variety of attributes and the levels of these. Therefore, in choice experiments the focus is more on the attributes than on the overall change in the provision of the public good. Given that one of the attributes is the monetary cost, it is possible to estimate how much people are willing to pay to achieve more of an attribute as well as the willingness to pay to move away from the status quo to a bundle of attributes that correspond to the policy outcomes that are of interest. Typically, respondents are offered multiple choices during the survey with each choice consisting of two alternative designs of the environmental change in question, say programme A and B, and the option to choose neither. Often the latter is represented

[2] Choice experiments are also called attribute-based methods (ABM) or choice modelling. For an introduction see, for instance, Holmes and Adamowicz (2003) or Stewart and Kahn (2006). Comprehensive descriptions are provided by Louviere et al. (2000), Hensher et al. (2005) and in the volume edited by Kanninen (2006).

by the status quo, i.e., the situation without any environmental management and therefore also without additional costs for the respondent. The record of the choices among the alternatives is used to estimate the respondents' WTP by modelling the probability of an alternative being chosen. Choice experiments are very useful for multidimensional changes because they provide a wide range of information on trade-offs among the attributes of the environmental change in question. Varying the level of the attributes of each of the alternatives makes it possible to measure the individual's willingness to substitute one attribute for another.

Holmes and Boyle (2003) point out that the application of choice experiments to forest valuation is relatively new. From their literature review comprising eight studies they conclude that the general public is willing to pay for changes in forest management and timber harvesting operations that reduce the biological and amenity impacts on forest ecosystems. This finding was confirmed by their own results which show that the general public in Maine in the US was willing to pay a considerable amount for timber harvesting practices that reduced the biological and amenity impacts on forest ecosystems. Table 1 summarises details of studies on peoples' willingness to pay for forest ecosystems and/or forest biodiversity. It mainly comprises studies that were conducted subsequently to the one by Holmes and Boyle. However, the first one was presented in 1997 by Garrod and Willis. They used a contingent ranking approach to estimate the general public's willingness to pay for various forest management practices that would promote an increase in forest biodiversity in the UK. A study published in 2003 was conducted by Lethonen et al. (2003). They investigated Finnish citizens' valuations of forest conservation programmes for southern Finland. Xu et al. (2003) presented WTP values for forest ecosystem management with respect to the three attributes biodiversity, aesthetics, and rural employment impacts in Washington State, US. The willingness to pay for changes in levels of biodiversity protection under different conservation programmes in the Coast Range of Oregon, US, is presented by Garbor-Yonts et al. (2004). In the same year, Watson et al. (2004) employed a choice experiment in the Robson Valley in east-central British Columbia, Canada, to examine trade-offs inherent in conserving biodiversity in the interior forests. Finally, Horne et al. (2005) investigated preferences for forest management at five adjacent municipal recreation sites in Finland using a spatially explicit choice experiment. Supporting the conclusion by Holmes and Boyle (2003) from their review, the studies published subsequently support the finding that in general people are willing to pay for protection and enhancement of forest ecosystems. The study by Horne (2006) differs from the other studies as it examines the factors that affect the acceptability of biodiversity conservation contracts among private forest owners in Finland, and the amount of compensation needed to ensure that the forest owners are at least as well off as before the contract.

Table 1. Choice experiments eliciting willingness to pay for forest ecosystems and/or biodiversity

Reference	Country	Attributes	CE design	Choice cards/sets per respondent	Survey type	Sample size (useable)
Garrod & Willis, 1997*	UK	Standard 0 -> do nothing and maximise timber production; Standard A -> basic standard of biodiversity conservation; Standard B -> enhanced standard of biodiversity conservation; Standard C -> conversion to natural woodland	Orthogonal design***	Four cards each presenting one combination of attributes; respondents had to rank them	Face-to-face interview	648
Holmes & Boyle, 2003**	US	Forest road density, dead trees after harvest, live trees after harvest, maximum size of harvest area, available for harvesting, width of riparian buffers, slash disposal, one-time tax increase	Completely randomised design across individuals***	One card with four management alternatives, no status quo	Mail survey	278
Lethonen et al., 2003	Finland	Information and education, conservation contracts, conservation areas, biotopes at favourable levels of conservation, number of endangered species, increases in annual income tax 2003-2012	Randomised main effects design***	Eight choice sets, each with current situation and two alternatives	Mail survey	602
Xu et al., 2003	US	Information and education, conservation contracts, conservation areas, biotopes at favourable levels of conservation, number of endangered species, increases in annual income tax 2003-2012	Design takes into account the utility balance among management plans by selecting choice sets from a set of fractional factorial design candidates that optimise the	Four choice sets with four alternatives	Mail survey	1,245

Reference	Country	Attributes	CE design	Choice cards/sets per respondent	Survey type	Sample size (useable)
			estimation of the MNL model***			
Garbor-Yonts et al., 2004	US	Salmon habitat, endangered species protection, forest age management, biodiversity reserves and the price a household would have to pay.	Not clearly specified, SAS macros provided by Kuhfeld were used	Four choice sets each with a stats quo and two alternatives	Mail survey	1,090
Watson et al., 2004	Canada	Protected areas in percent of total region, age of stands, recreation access, biodiversity levels, changes in taxes	Orthogonal main effects design***	Seven choice sets, each with two alternatives and the current situation	Mail survey	1,003
Horne et al., 2005	Finland	Species richness at each site, average species richness, variance of species richness, scenery at each site and change in municipal taxes.	Main effects design***	Six choice sets, each with two forest management alternatives and the current situation	On-site interview	431
Horne, 2006	Finland	Initiator of the contract, restrictions on forest use, compensation/ha/year, duration of contract, cancellation policy	No details given	Six choice sets, each with two contract alternatives and the status quo	Mail survey	1,240

For the WTP values the reader is requested to consult the original publications because of the broad range of values that can be calculated based on the estimation results. * This study used the contingent ranking method. ** This study also used contingent ranking but the details reported relate to choice experiment. *** The description of the CE design is taken almost literally from the publication.

Study area and selection of biodiversity attributes

Approximately one quarter of Lower Saxony, Germany, is covered by forests (1.1 million hectares). Of this, 32 percent is owned by the state of Lower Saxony and 46 percent is privately owned. The remaining forests are owned by communities and cloisters. One of the study regions is the Lüneburger Heide (LH) located in the relatively humid north-western part of Germany. Due to historic land uses, large parts of the landscape are covered with heath and, at present, with pine monocultures. The other region is the area of the Solling and the Harz (SH). Both the Solling and Harz are part of the mountain ranges in the south of Lower Saxony. There are naturally occurring beech forests on nutrient-poor and acidic sandy soils. However, historical land use such as intensive forest grazing and timber use led to widespread devastation at the end of the eighteenth century. Thus, the heaths were reforested mainly with Norway spruce, which still covers large areas of the mountain ranges.

As a response to the domination of coniferous trees, in 1991 the government of Lower Saxony introduced the forest strategy programme “LÖWE” (Langfristige Ökologische Waldentwicklung; long-term ecological forest development) for the state forests in Lower Saxony. It comprises 13 principal objectives for forest management such as enlarging broad-leaved and mixed forests, choice of tree species appropriate to site and improvement of stand structure (Niedersächsische Landesregierung, 1991). In accordance with the programme, the proportion of broadleaves will increase to 65% and conifers will decrease to 35%. Thus, implementation of the programme will cause changes in forest biodiversity. For example, a higher proportion of broad-leaved forests will affect both the kinds of plant and animal species present and the number of species.

In order to present to respondents the expected changes in forest biodiversity, a set of seven attributes was preselected in cooperation with the ecologists and forest scientists involved in the project. As the main focus of the choice experiment was on forest biodiversity, it was decided to address all attributes directly related to aspects of forest biodiversity and not to include attributes such as jobs in the forestry sector or access restrictions in the forest due to conservation. The attributes were intended to assess the changes at the species level, the forest stand level and the landscape level. The set of attributes consisted of “habitat for endangered and protected plant and animal species” (HAB), “species diversity” (SPE), “forest stand structure” (FSS), “landscape diversity” (LCD), “share of broad-leaved area” (SBO), “amount of dead wood” (ADW) and “percentage of non-native species” (NNS).[3]

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[3] The first attribute (HAB) refers to the number of habitats in which endangered or protected plant and animal species live while the second attribute, species diversity (SPE), focuses solely on the number of plant and animal species present in the forests. Forest stand structure (FSS) describes whether the trees are of a similar age, and, accordingly, similar height. Landscape diversity (LCD) is low when extended areas of coniferous trees, for instance,,are present and it is high when the forest consists of small compartments with

The focus group meetings were carried out to determine, among other thing, the attributes of the choice experiment for the main survey. In March 2004, meetings of three focus groups in different cities in the Lüneburger Heide and the Solling and Harz region were conducted each time. Participants were invited by telephone using random digit dialling. Overall, 46 people participated in the six focus groups. 40 percent of them were female and the average age was 50 years (min. 19, max. 80 years). The average household income was €2,075 per month. Participants were requested to choose three attributes from seven that are most important to them and to rank them. To determine the most important attributes among all participants, each attribute ranked No. 1 by a participant was given a score of 3, the one ranked No. 2 a score of 2 and the one ranked No. 3 received a score of 1. Subsequently, all the scores were added up. According to the results reported in Table 1, the most important attribute is landscape diversity (a score of 56). This is closely followed by the number of endangered animal and plant species (a score of 55) and forest stand structure (a score of 41). Next follow the number of plant and animal species (a score of 33) and the share of broad-leaved tress (a score of 30). The least important attributes are the amount of dead wood (13 scores) and percentage of non-native species (each with a score of 9). The four attributes ranked most important by the participants of the focus groups as well as the attribute price were used to design the alternative scenarios of the choice experiment. There was no difference with respect to the first four attributes between both study regions.

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mixed forests. Share of broad-leaved trees (SBO) describes the share of coniferous and broad-leafed trees that would be present after forest conversion. Finally, amount of dead wood (ADW) indicates how much dead wood would be left in the forest under each forest conversion programme and non-native species (NNS) gives the percentage of non-native species, for instance, tree species such as Douglas firs that would be present in the forest.

Table 2. Ranking of biodiversity attributes by focus group participants (N = 41)

Attribute	Number of people who chose attribute	Sum of scores
Landscape diversity	26	56
Habitat for endangered and protected plant and animal species	29	55
Forest stand structure	18	41
Species diversity	18	33
Share of broad-leaved trees	18	30
Amount of dead wood	5	13
Percentage of non-native species	3	9

An attribute ranked No. 1 by a participant was given a score of 3, the one ranked No. 2 a score of 2 and the one ranked No.3 a score of 1.

Main survey and design of choice experiments

The general structure of the questionnaire used in the main survey was the same in both samples. First, respondents were asked about the frequency of their visits to the forest in each region and their knowledge about the general conditions of forests in Lower Saxony. Then they were presented a map showing the areas where forest conversion would be possible. The meaning of forest conversion was briefly explained and people were informed that the conversion may take at least 50 years. Next, they were presented a card describing potential impacts of forest conversion on forest biodiversity in each region. This card also showed the pictographs designed to represent the attributes. Further, the interviewees were introduced to the hypothetical market. They were informed that is had not been decided to what extent forest conversion would take place but that it could not be financed solely by public money in any case. Therefore, one possibility would be to establish a ‘forest conversion’ fund to which people could contribute in order to promote the management actions. This fund would be managed by the Forest Planning Office (Forstplanungsamt) of Lower Saxony and people were told that it would report regularly on the progress of the conversion on the Internet, for instance. In addition to the choice cards, the questionnaire included, for instance, items on respondents’ attitudes towards forest conversion and on their views on environmental problems (i.e., environmental concern). Finally, socio-demographic information was requested.

Depending on the status quo (see Table 3), the four attributes “habitat for endangered and protected plant and animal species”, “species diversity”, “forest stand structure” and “landscape diversity" have two (medium and high) or three levels (low, medium and high) while the price attribute has six levels in both designs (€5, 10, 20, 35, 50, 75). These attributes and their levels would result in a complete factorial design of $(2^2 * 3^2 * 6^1) * (2^2 * 3^2 * 6^1)$ different combinations for the Lüneburger Heide and of $(2^1 * 3^3 * 6^1) * (2^1 * 3^3 * 6^1)$ for the Solling and Harz region. As this number would in both cases be too large, a fractional factorial main effects design was used in order to minimise the number of choice combinations presented to respondents. Using a main effects design, we assume that interactions among the attributes are not statistically significant (cf. Louviere et al. 2000). The SAS macros provided by Kuhfeld (2005) were utilised to design a statistically efficient subset of all possible alternatives (based on D-optimality[4]). Some additional restrictions were imposed on the macro: first, in each alternative at least one level of the biodiversity attributes should be higher than the status quo in order to avoid people being presented an alternative that is equal to the current situation but has a positive price. Second, no alternative should contain lower levels of all non-monetary attributes than the other alternative but with a higher price. The design resulted in 36 alternatives. As this number was also too large to be presented to each respondent, we divided them – again using the SAS macros – into six blocks, each with six alternatives. The value of the D-efficiency score is 97.89 percent for the Lüneburger Heide region and 98.04 percent for the Solling and Harz region. Figure 1 shows a choice card as it was used in the LH version of the questionnaire.

[4] Huber and Zwerina (1996) identify four principles which when all satisfied indicate that a design has maximum D-efficiency. The principles are: orthogonality, level balance, minimal overlap and utility balance. Orthogonality is satisfied when the levels of each attribute vary independently of one another. Level balance is satisfied when the levels of each attribute appear with equal frequency. Minimal overlap is satisfied when the alternatives within each choice set have non-overlapping attribute levels. Utility balance is satisfied when the utilities of alternatives within choice sets are the same (Kuhfeld, 2005; see also Johnson et al., 2006).

Table 3. Attributes of the Choice Experiments

Attribute	Study region			
	Lüneburger Heide		Solling and Harz	
	CE	LÖWE	CE	LÖWE
Habitat for endangered and protected species (HAB)	<u>medium</u>, high	high	<u>low</u>, medium, high	medium
Species diversity (SPE)	<u>medium</u>, high	medium	<u>medium,</u> high	medium
Forest stand structure (FSS)	<u>low</u>, medium, high	high	<u>low</u>, medium, high	medium
Landscape diversity (LCD)	<u>low</u>, medium, high	medium	<u>low</u>, medium, high	medium
Contribution to forest conversion fund (€)	<u>0*</u>, 5, 10, 20, 35, 50, 75		<u>0*</u>,5, 10, 20, 35, 50, 75	

Status quo is underlined; the price zero was only used to describe the status quo. For each region, the expected levels when the LÖWE programme is implemented are also reported.*

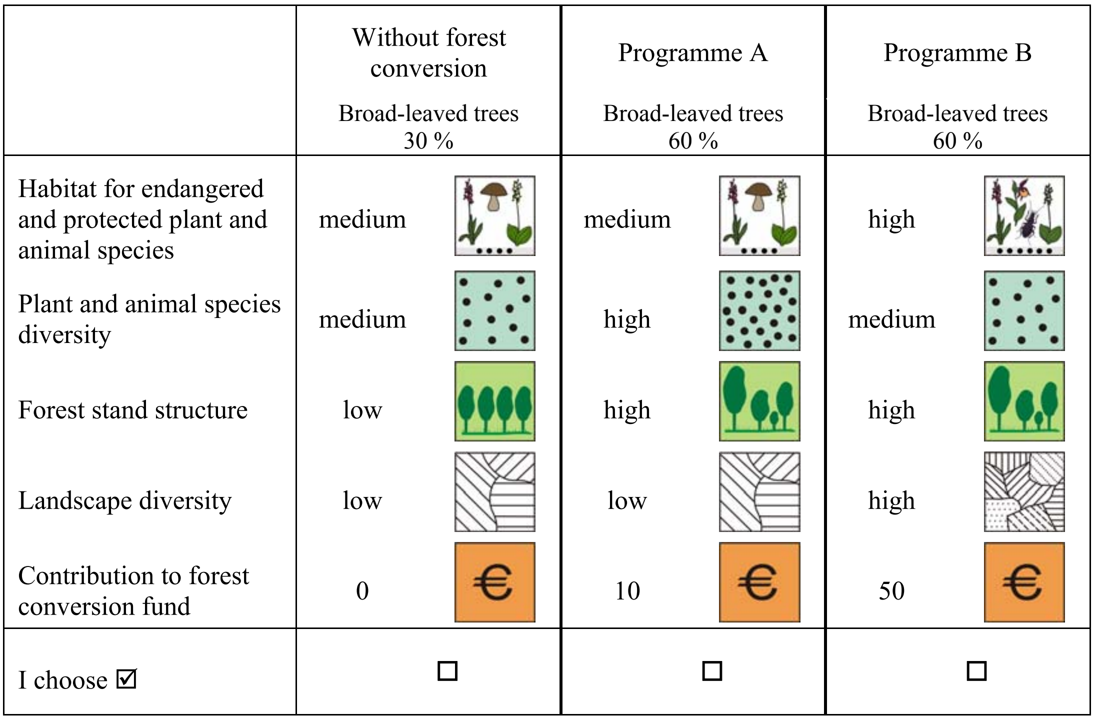

Fig. 1: Example of a Choice Card from the Lüneburger Heide

The data was collected in September and October 2004 by a survey company in face-to-face interviews. The sampling population was restricted to citizens aged 18 and older, living in private households in one of the study regions. Furthermore, the survey company was required to conduct at least 300 interviews in each study region. Random sampling was obtained using a three-stage process (cities/sample points representative for the study region/population; households selected by a random walk; and randomly determined respondents within households, cf. Liebe et al., 2006).

Model specification and estimation

In order to link actual choices with the theoretical construct utility, the random utility framework is used. A random utility function considers individual preferences (subscript n) to be the sum of systematic (V_{in}) and random (ε_{in}) components:

$$U_{in} = V_{in}(x_{in}, p_{in}) + \varepsilon_{in} \qquad [1]$$

where U_{in} is the true but unobservable utility associated with alternative i, x_{in} is a vector of attributes associated with alternative i, p_{in} is the cost of alternative i, and ε_{in} is a random term with zero mean. In a linear-in-parameters function, utility is represented as

$$U_{in} = \sum_{k=1}^{l} \beta_k x_{ink} + \beta_p p_{in} + \varepsilon_{in} \qquad [2]$$

Selection of one alternative − consisting of a bundle of attributes − over another implies that the utility (U_{in}) of that alternative is greater than the utility of the other alternative:

$$P(i) = \Pr ob(V_i + \varepsilon_i > V_j + \varepsilon_j) \quad \forall\, j \in C, j \neq i \qquad [3]$$

Assuming that the error components are distributed independently and identically (IID) following a type 1 extreme value distribution, the probability of choosing alternative i takes the form

$$P_{in} = \frac{\exp(\mu V_{in})}{\sum_{j \in C} \exp(\mu V_{jn})} \qquad [4]$$

where μ is a scale parameter which is commonly normalised to 1 for any one data set. The basic conditional logit model is estimated using maximum likelihood estimation (Louviere et al. 2000).

In our specification, a respondent's utility for a specific alternative is modelled using the following linear-in-parameters functional form:

$$V_i = \beta_1 ASC_{SQ} + \beta_2 HAB + \beta_3 SPE + \beta_4 FAC + \beta_5 LCD + \beta_6 FUND \qquad [5]$$

where the alternative specific constant (ASC_{SQ}) was specified to equal one when the status quo was selected and to equal zero when either forest conversion programme A or B was selected. In general, the ASC captures the average effect on utility of all factors that are not included in the model (Train, 2003). Depending on the researchers' interest in generic choice experiments, the ASC can represent the alternative describing the current situation or be associated with the designed alternatives. The former is preferred when a status quo effect is of interest (Scarpa et al., 2005). The remaining expressions in equation [5] represent the attributes used in the choice experiment.

However, the validity of the CL is limited to cases where the "independence from irrelevant alternatives"(IIA) assumption is satisfied. It implies that the probability of choosing one alternative over another is independent of the presence/absence of any other alternatives. As the IIA property is often violated in practice, models have been developed which move away from the assumption of IIA between all alternatives (Swait, 2006; Train, 2003; Winkelmann & Boes, 2006). One approach that can be used to bypass the limitation of the CL is to allow for correlations among the error terms within different subsets of alternatives by estimating a nested logit model. The rationale of the nested logit is to partition the set of alternatives faced by a decision maker into subsets or nests. For alternatives in the same nest, the ratio of probabilities is independent of the attributes or existence of all other alternatives, that is, IIA holds within each nest. But IIA is not expected to hold in general for alternatives in different nests (Hensher et al., 2005).

In the present application, a two-level nested choice model with two branches was estimated. In the upper level, respondents were expected to make a choice between whether they would support biodiversity enrichment or not. In the lower level, conditional on supporting biodiversity enrichment, respondents were assumed to choose between the two forest conversion alternatives (an almost identical tree structure was used, for example, by Mogas et al., 2005, 2006). The nested logit model was estimated using the random utility model 2 (RU2) specification in NLOGIT 3.0 (Hensher and Greene, 2002), i.e. the upper level parameters were normalised and the lower level scale parameter was allowed to be free. The utility functions for the upper level alternatives are,

$$V_{\text{Forest conversion}} = \alpha_1 IV_{\text{Forest conversion}} \qquad [6]$$

$$V_{\text{Status quo}} = \alpha_2 IV_{\text{Status quo}}, \qquad [7]$$

where $V_{\text{Forest conversion}}$ is the utility associated with the forest conversion option, $V_{\text{Status quo}}$ the utility obtained from the current situation, IV the inclusive value that represents a measure of the expected utility associated with a given nest, and α_1 and α_2 are the inclusive value parameters. At the lower level, the utility associated with the attributes and their corresponding levels is given by

$$V_i = \beta_1 ASC_{SQ} + \beta_2 HAB + \beta_3 SPE + \beta_4 FAC + \beta_5 LCD + \beta_6 FUND. \quad [8]$$

Welfare measures

The use of choice experiments is often motivated by the fact that they can provide more information for resource management than the contingent valuation. They not only make it possible to estimate welfare measures for a number of policies that fall within the range of attribute levels considered in the choice set but also to calculate implicit prices (IP), also known as part-worths. They are derived by dividing the coefficient for an attribute by the negative of the coefficient for the monetary attribute and identifying the monetary amount associated with a one unit change in the attribute in question (Stewart and Kahn, 2006). In a linear model, the implicit prices are given by

$$IP = -\beta_{Attribute}/\beta_{Money}, \quad [9]$$

where $\beta_{Attribute}$ represents the coefficient of the corresponding non-monetary attribute, and β_{Money} represents the marginal utility of income. The estimates are made on a ceteris paribus basis. Accordingly, they indicate the willingness to pay of respondents for a change in the attribute of concern, given that everything else remains constant. Implicit prices can be used to compare models directly because the scalar variance terms are cancelled out of the equations and the confounding effect of the error variance is eliminated (Bennett and Adamowicz, 2001: 64). They enable some understanding of the relative importance people place on the attributes within the design.

However, choice experiments only provide more information than a contingent valuation when the implicit prices significantly differ from each other. For example, Hanley et al. (2006) found that people place insignificantly different values on the three attributes of their choice experiment on river ecology (attributes: ecology, aesthetics and river banks). According to the authors, one interpretation of this finding is that all three attributes are seen as indicators of a “healthy river” which is all people really care about. Given this result, the employment of the contingent valuation might have been more straightforward.

In a state of the world model, the welfare change for a combination of changes in attributes is expressed as

$$CS = -1/\beta_{Money}(V_0 - V_1) \quad [10]$$

where CS is the compensation surplus welfare measure, β_{Money} is the marginal utility of income, and V_0 and V_1 represent the conditional indirect utility associated with the base situation (subscript 0) and the changed situation (subscript 1).

Treatment of ASC in present studies

Equation [8] indicates that the utility of a forest conversion programme in our specification also depends on the value of the alternative specific constant (ASC) associated with the status quo. However, welfare measure calculations for environmental changes differ with respect to the inclusion of the ASC in empirical studies. Among many other studies, Rolfe et al. (2000), Bennett et al. (2001), and Birol et al. (2006) included the value of the ASC when calculating the welfare measure without reporting unexpected results, i.e., negative values of the measure. Moreover, Birol et al. explicitly point out that it is necessary to include the ASC in order to estimate overall WTP. Mogas et al. (2005) present two welfare measures from a choice experiment about afforestation that only differ with respect to the inclusion of the ASC. The welfare measure calculated including the ASC is higher but both are positive.

On the other hand, Adamowicz et al. (1998) report that when they included the ASC, their linear CE specification produced a negative welfare measure for the proposed environmental change. The ASC equalled one when the status quo option was not chosen and had a negative sign indicating that respondents are not in favour of moving away from the status quo. They consider the significant and negative ASC to be a form of status quo bias or endowment effect and suggest as possible explanations for respondents' choices, inter alia, mistrust in the providing organisation, complexity in the choice task or protest against the survey. When Adamowicz et al. excluded the ASC, the welfare measure was positive. Another example is the study by Horne et al. (2005). They investigated visitors' preferences for forest management at five adjacent municipal recreation sites in Finland. The ASC in this study represented the current situation and was significant at the 1% level in each model and positive. The compensation variation measure of their new management scenario with changes in scenery and the levels of species richness was a loss of -€10.36 for the whole sample. Horne et al. (2005) explain the negative welfare effect with the changes in management. As the ASC is strongly positive in their model, they conclude that any change in management would need to bring large benefits to compensate for the negative impact of moving away from the current situation.

Horne (2006) examined the factors that affect the acceptability of biodiversity conservation contracts among private forest owners. The ASC was again assigned to the status quo alternative and was positive and statistically significant indicating preferences for no additional conservation. Calculating the welfare measure based on an estimation using all data resulted in a welfare measure of -€224 per hectare annually. Accordingly, forest owners would have to be compensated for biodiversity conservation services. In contrast, calculating the welfare measure for the same contract based on an estimation that excluded all those respondents who have always chosen the status quo resulted in a positive figure of €62 per hectare annually. Leaving out those who never chose an alternative to the status quo changes not only the magnitude of the welfare measure but also the sign indicating whether people would have to be compensated or not.[5]

As the brief overview shows, the treatment of the ASC can strongly affect the welfare measures resulting from stated choice experiments. But whether the ASC is included or not seems to be decided more or less ad hoc. Moreover, it has not yet been agreed in the literature what the ASC represents, for example, whether it represents a preference for the status quo or whether it also comprises some form of bias such as choice task complexity and protest responses.

Results

Choice experiment results

All in all, 614 interviews were useable for further analyses, 298 from the Lüneburger Heide and 316 from the Solling and Harz region. Table 4 reports basic socio-economic characteristics of both samples. As the figures show, the two samples do not differ very much from each other. Only the percentage of female respondents and the number of years a resident has lived in the place where the interview was held show greater differences. While the proportion of female respondents is higher in the LH sample, the number of years living in that place is greater in the SH sample. The two samples also differ with respect to the percentage of people who are willing to pay for biodiversity enrichment. A respondent was deemed to be willing to pay if he or she chose an alternative to the status quo at least once. According to this, in the LH sample 41% of respondents were willing to pay and in the SH sample 51%.

[5] Another example of a study where all those who always chose the status quo were deleted is Watson et al. (2004). However, they only report results for the estimation without these respondents and therefore it is not clear to what extent this affected the welfare measure.

Table 4. Descriptive statistics of respondent characteristics of both samples (mean values)

Characteristic	Study region	
	Lüneburger Heide (N = 298)	Solling and Harz (N = 316)
• Equalised income (€ per month)	1,309.82 (506.88)	1,297.27 (563.90)
• Age (in years)	47.00 (17.00)	49.00 (18.00)
• Sex (1 if female)	0.59 (0.49)	0.46 (0.50)
• Education (in years)	10.00 (3.00)	10.00 (3.00)
• Number of people per household	2.72 (1.37)	2.44 (1.12)
• User (1 if respondent visited forest within last 12 months)	0.65 (0.47)	0.65 (0.48)
• Number of years living in place of residence	26 (19)	30 (20)

The data were weighted for descriptive analyses because due to sample selection non-weighted data is only representative of households but not of individuals. The equalised income was estimated by dividing the household net income by the square root of the number of all household members. (See Liebe and Meyerhoff, 2007 or Liebe et al., 2006 for further details.)

In order to calculate different welfare measures, we estimated the CL and NL models for each region and the sample of all respondents as well as for the subsample of those who were willing to pay, i.e., who chose an alternative to the status quo at least once. Starting with the estimation comprising all respondents (upper part of Table 5), all coefficients have the anticipated sign for the attributes, i.e., higher levels of the forest biodiversity attributes increase the probability of a programme being chosen. And all except SPE in the Lüneburger Heide and FSS in the Solling and Harz region are significant at the 10% level or higher. While SPE is only insignificant in the CL model, FSS is insignificant in both the conditional and the nested logit model for the Solling and Harz region. Changes in forest stand structure appear to have no influence on respondent's choices in the Solling and Harz region. The ASC_{SQ} is positively significant at 1% in both samples. The positive sign indicates that for respondents the impact of moving away from the current situation is on average negative. Finally, the inclusive value parameter $\alpha_{1\ \text{Forest conversion}}$ in the nested logit models is in the (0-1) interval, and hence is consistent with utility maximization (Train, 2003). Comparing the conditional and the nested logit models for all respondents, we observe that the nested logit model achieves a better fit.

Table 5. Model results

	Lüneburger Heide				Solling Harz region			
	CL		*NL*		*CL*		*NL*	
All respondents								
	N = 298				**N = 316**			
ASC_{SQ}	1.458	***	0.996	***	1.007	***	0.628	***
HAB	0.204	**	0.087	**	0.208	***	0.088	**
SPE	0.129		0.069	*	0.242	**	0.137	**
FSS	0.171	**	0.039	*	0.045		0.022	
LCD	0.142	**	0.045	*	0.101	**	0.051	*
FUND	-0.022	***	-0.006	**	-0.021	***	-0.011	***
Inclusive value parameters								
$\alpha_{1\ \text{Forest conversion}}$			1.000	Fixed			1.000	Fixed
$\alpha_{2\ \text{Status quo}}$			0.167	**			0.349	***
$LogL_{Constant}$	-1,437.85		-1,437.85		-1,764.05		-1,764.05	
$LogL_{Model}$	-1,379.85		-1,352.67		-1,690.06		-1,675.29	
Respondents who always opted for the status quo were deleted								
	CL		*NL*		*CL*		*NL*	
	N = 122				**N = 162**			
ASC_{SQ}	-0.525	**	-0.594	***	-0.735	***	-0.734	***
HAB	0.476	***	0.403	***	0.246	***	0.246	***
SPE	0.337	**	0.295	**	0.357	***	0.357	***
FSS	0.208	**	0.185	**	0.066		0.067	
LCD	0.199	**	0.175	**	0.196	**	0.196	**
FUND	-0.035	***	-0.029	***	-0.032	***	-0.032	***
Inclusive value parameters								
$\alpha_{1\ \text{Forest conversion}}$			1.000	fixed			1.000	fixed
$\alpha_{2\ \text{Status quo}}$			0.759	***			1.003	***
$LogL_{Constant}$	-800.41		-800.41		-1,050.61		-1,050.61	
$LogL_{Model}$	-692.97		-691.63		-941.27		-941.27	

*** 1% level, ** 5% level, * 10% level.

The lower part of Table 5 shows the results for the subsample of those who are willing to pay. Again the signs of all coefficients for the attributes are as anticipated and all attributes except FSS in the Solling and Harz region are significant at the 5% level or higher. The result remains the same in the subsample, confirming that FSS is not an important attribute for respondents in the Solling and Harz region. An obvious difference between the two estimations is the sign of the ASC_{SQ}. While it was negative in the estimation with all respondents, it becomes positive in the subsample. Accordingly, respondents who chose an alternative to the status quo at least once appear to be in favour of moving away from this status quo. Another difference is that the estimate of the inclusive value parameter is only in the (0-1) interval in the Lüneburger Heide. In the nested logit model $\alpha_{1\ \text{Forest conversion}} = 1$. In this case, the nested logit model reduces to the conditional logit model (Train, 2003). The fact that the two models do not differ significantly is also indicated by the log-likelihood values for the complete models. Therefore, in the subsample without those who always chose the status quo alternative, the conditional logit is sufficient.

Implicit prices

Table 6 gives the implicit prices for the significant biodiversity attributes for both regions and both logit models. They were calculated on the basis of the estimation for all respondents. The 95% confidence intervals are also reported. These were calculated using the Krinsky and Robb bootstrapping procedure with 1,000 draws. Table 6 also gives the responses to the question asking which attribute was the most important one out of all choices. It was asked after respondents had finished their last choice card. They were presented a list with the attributes of the choice cards and the percentage of broad-leaved trees (SBO). People might have chosen a forest conversion programme because they are mainly interested in having fewer coniferous trees. The share of coniferous versus broad-leaved trees was reported on each choice card for the status quo as well as the alternative programmes but does not vary between the two alternatives (see Figure 1).

The implicit prices indicate that the attribute HAB or SPE is more important for respondents than the other two attributes. In the Lüneburger Heide, the implicit prices for HAB are the highest in both models. This corresponds to the statement by 31 percent of those who are willing to pay that HAB was the most important attribute for their choice. In the Solling and Harz region, the attribute SPE achieves the highest implicit price. Again, this corresponds to the most important reason for respondents' choices in this region. 29 percent of those who are willing to pay in the SH sample stated that species diversity was the most important attribute from their point of view.

Table 6. Implicit prices for forest biodiversity attributes

	Lüneburger Heide		***Solling and Harz region***	
	CL	*NL*	*CL*	*NL*
HAB	9.29 *(0.63 - 18.36)*	13.37 *(3.66 - 26.06)*	9.69 *(4.85 - 14.89)*	8.03 *(3.21 - 13.19)*
SPE	5.89 *(-2.94 - 14.46)*	10.61 *(-0.95 - 22.88)*	11.32 *(3.68 - 18.55)*	12.47 *(4.10 - 19.78)*
FSS	7.78 *(2.58 - 13.65)*	6.07 *(-1.86 - 14.16)*	*	*
LCD	6.45 *(1.05 - 12.63)*	6.86 *(-1.09 - 15.14)*	4.71 *(0.03 - 9.68)*	4.59 *(0.23 - 10.11)*
Most important choice attribute of those who chose an alternative to the status quo at least once (in %)				
	N = 122		**N = 162**	
HAB	31		23	
SPE	27		29	
FSS	4		7	
LCD	17		12	
FUND	12		18	
SHARE	9		11	

** The attribute is not significant; the 95% confidence intervals, given below the mean value, were calculated using the Krinsky & Robb approach with 1,000 draws.*

The strongly overlapping confidence intervals indicate that the implicit prices of the attributes probably do not differ significantly. In order to obtain statistically more exact results, we used the complete combinatorial approach proposed by Poe et al. (2005). It tests whether we can reject the null hypothesis of equivalence between two implicit prices or not. The test gives the value of $\hat{\gamma}$ which is seen in analogy to the p value. For example, if the value is below 5%, we can reject the null hypothesis of equivalence at this level. Table 7 shows that only two implicit prices differ significantly at the 10% level. In the Lüneburger Heide, the IP_HAB differs from the IP_FA and in the Solling and Harz region, the IP_SPE differs from the IP_LCD. In all other cases, there is no significant difference between the implicit prices.

Table 7. Test of equivalence of implicit prices (nested logit model)

Null hypothesis	$\hat{\gamma}$ LH (N = 298)	$\hat{\gamma}$ SH (N = 316)
H_0: IP_HAB = IP_SPE	30.79	17.48
H_0: IP_HAB = IP_FSS	**9.15**	*
H_0: IP_HAB = IP_LCD	10.66	15.32
H_0: IP_SPE = IP_FSS	21.17	*
H_0: IP_SPE = IP_LCD	24.82	**5.12**
H_0: IP_FSS = IP_LCD	41.53	*

** The attribute "forest stand structure" was not significant in the Solling and Harz region.*

Welfare measures with and without ASC

The welfare effects of a change in the biodiversity attributes were calculated for the LÖWE conversion programme. The attribute levels for this programme will differ from the status quo as follows. (See also Table 3.) In the Lüneburger Heide, the attribute level of habitat (HAB) will change from medium to high, the level of forest stand structure (FSS) from low to high and the level of landscape diversity will change from low to medium. Species diversity will remain at the same level. In the Solling and Harz region, the attribute levels for HAB, FSS and LCD will all change from low to medium, while species diversity will again remain at the same level.

Table 8. Welfare measures for LÖWE forest conversion programme with and without ASC

	Lüneburger Heide		*Solling Harz region*	
	CL	*NL*	*CL*	*NL*
All respondents				
With ASC	-35.03 *(-56.36 − -20.33)*	-121.03 *(-605.85 − -55.40)*	-32.59 *(-47.84 − -21.57)*	-44.44 *(-83.82 − -28.22)*
Without ASC	31.30 *(13.88 − 50.90)*	32.39 *(8.21 − 56.23)*	14.40 *(7.14 − 22.44)*	12.62 *(5.94 – 20.37)*
Respondents who always opted for the status quo deleted				
With ASC	45.86 *(37.67 − 55.30)*	52.4 *(41.02 − 68.39)*	36.92 *(30.03 − 44.27)*	36.83 *(27.16 − 53.75)*

The 95% confidence intervals were calculated using the Krinsky & Robb approach with 1,000 draws.

Table 8 reports the welfare measures based on estimations for all respondents (upper part) and for the subsample of respondents who chose an alternative to the status quo at least once. In the latter case, we only report the welfare measures calculated by incorporating the ASC. Starting with the upper part of Table 7, we observe something similar to Adamowicz et al. (1998). If we recognise the ASC, the welfare measures are negative in both study regions. Interpreting these figures as an expression of the average respondents' utility from implementing the LÖWE programme would indicate that people have to be compensated. If we exclude the ASC from calculating the welfare measure, we obtain positive figures for both regions and both models. In this case, respondents' welfare would change positively if the LÖWE programme were implemented. Finally, if we calculate the welfare measure for the subsample of those who are willing to pay and include the ASC, the welfare estimates are positive for both regions and both models. Moreover, the estimates are significantly higher than those calculated without the ASC. Dropping all the respondents who always chose the status quo changes the influence of the ASC completely.

In the present study, we calculated the welfare measure for subsequent analysis such as a cost-benefit analysis based on estimations for the whole samples but without including the ASC. To obtain a rather conservative measure we multiplied the average compensation variation by the number of respondents who are willing to pay and divided the result by the number of all respondents in the corresponding sample. Based on the nested logit, this results in €13.26 (7.73 – 19.02) per year in the Lüneburger Heide sample and €6.47 (3.61 – 8.98) per year in the Solling and Harz sample. One explanation for the difference between the two measures is that the attribute forest stand structure is not significant in the Solling and Harz region and is thus not recognised in the calculation.

Discussion

This study has provided new information about the benefits of biodiversity enrichment due to forest conversion in temperate forests. The benefits were determined using the choice experiment approach in two regions in Lower Saxony, Germany. While in the Lüneburger Heide approximately 40 percent of the respondents are willing to pay, in the Solling and Harz region approximately 50 percent chose an alternative to the status quo at least once. However, at €13.26 in the first region, the average WTP value is higher than in the second region where it is only €6.47. The most important reasons for being willing to pay were the attribute "number of habitats for protected and endangered species" in the Lüneburger Heide and "species diversity" in the Solling and Harz region. In both cases, these reasons correspond to the highest implicit prices.

Do our choice experiments provide us with more information for forest management than a contingent valuation? They do indeed, at least to a certain degree. The comparison of the implicit prices shows that in fact in each study region only two prices differ significantly. Accordingly, habitats for endangered and protected species seem to be more important for respondents than forest stand structure in the Lüneburger Heide. For the Solling and Harz region, we can conclude that species diversity is more important than landscape diversity. The other implicit prices do not differ significantly. Moreover, we gain additional information from the choice experiment in the Solling and Harz region because the attribute forest stand structure (FSS) is not significant. People's choices in this region seem to be unaffected by varying stand structures indicating that they may be satisfied with the current status of this attribute in their region.

One reason why the other attributes did not result in significantly differing implicit prices might be that the attributes were too close to each other. When we designed the choice experiment, we felt that it would be advantageous to assign all attributes directly to aspects of forest biodiversity in order to obtain more information about peoples' preferences for forest biodiversity. Therefore, we decided not to include attributes such as jobs in the forestry sector or access restrictions to certain parts of the forests. From the results we now see, it appears that from the respondents' point of view there are no meaningful potential trade-offs between many attributes. Although all attributes were deemed to be important by participants of the focus groups, in the main survey those who are willing to pay may have focused mainly on the attribute "habitat for endangered and protected plant and animal species" or "plant and animal species diversity".

Calculating the welfare measures for the LÖWE conversion programme, we found that including the ASC results in both regions resulted in a negative compensation variation. Since the ASC is strongly positive, a change in forest management according to the LÖWE programme would not compensate for the negative impact of moving away from the current situation. Excluding the ASC results in positive measures in both cases. When we excluded all the respondents who always chose the status quo, the compensation variation including the ASC was even higher than when the ASC was excluded. Similar results have been reported by other authors. This raises the question of which of the three measures is the correct or at least more appropriate one? While the first approach, i.e., including the ASC, may result in an underestimation of the benefits from biodiversity enrichment, the other two approaches could result in an overestimation. Including the ASC may not be justified because probably not all respondents who always chose the status quo would require compensation for moving away from the current situation. From discussions during the focus groups we had the impression that many people are not willing to pay because they simply do not care or have other priorities than enriching forest biodiversity. But they would not suffer any loss if biodiversity is enriched according to the other respondents' willingness to pay. Because of these results we decided not to include negative prices in the choice design which would have made it possible to measure respondents' willingness to accept. Moreover, implementing the LÖWE programme would not have a major impact on the local economy, for example, through job losses. The forestry sector is only of minor significance for the economy in both study regions and therefore does not explain why people might prefer the current situation.

On the other hand, excluding the ASC completely or calculating the welfare measure based on an estimation comprising only respondents who chose the status quo at least once might result in an overestimation for the same reason. Although there are hints that many people would not suffer any loss, we cannot conclude that this applies to all respondents. In a study investigating what motivates people to choose the status quo using the data of the present study, Meyerhoff & Liebe (2006) found that a negative attitude towards forest conversion is one reason, together with protesting and choice task complexity. This indicates that some people may indeed prefer the current situation because, for instance, they prefer higher shares of coniferous forests than there would be after forest conversion. Therefore, a more appropriate welfare measure would probably require decomposing the ASC according to people who would experience disutility from biodiversity enrichment, then according to those who are not willing to pay because they do not care, and, finally, according to those who always chose the status quo because of high choice task complexity or as a protest, for instance.

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