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Abstract

The paper looks at people's preferences for the changes in selected ecosystem services resulting from new management strategies of forest areas in Poland. It applies a generalized multinomial logit (G-MNL) model to interpret the results of a discrete choice experiment (DCE) study administered to a representative sample of 1001 Poles. The questionnaire included three physical attributes, namely: protecting the most ecologically valuable forest ecosystems, reducing litter in forests, and improving recreation infrastructure. The selection of these attributes was motivated by extensive qualitative research of what indicators of biodiversity, nature protection and recreation possibilities people are the most sensitive to. The fourth attribute was monetary – additional cost of the new programs which would have to be financed out of increased taxes. The results allowed for a robust estimation of implicit prices of the choice attributes and calculating welfare measures of specific forest management scenarios. In addition, the study revealed interesting connections between respondents' current forest recreation patterns and the importance they place on different attributes of forests. The results make it possible to utilize respondents' preference heterogeneity, to a large extent determined by their current recreational use patterns, in designing future forest management strategies.

Keywords:
Biodiversity, forest recreation, discrete choice modeling, generalized multinomial logit model

JEL:
D12, H44, Q23, Q26, Q51

1. INTRODUCTION

A better understanding of human attitudes towards environment is an essential element for obtaining support for protection programs from the public. Additionally, it can improve decision-making processes by framing environmental goals in an efficient way under limited public financial sources. One of the key problems associated with conservation policy decisions is that environmental benefits are often not directly reflected in market prices and therefore conservation is mostly viewed as a cost burden instead of an investment in social values. Economic sciences, however, have developed methods that allow to estimate the economic value provided by non-market goods and services by using either revealed or stated preferences of individuals. Recommendations concerning the use of the results of non-market valuation studies in designing and implementing conservation policies have recently been made by the Millennium Ecosystem Assessment (MEA, 2005) and The Economics of Ecosystems and Biodiversity initiative (Sukhdev, 2010).

Non-market valuation techniques and stated preference methods have been applied to value forest externalities for several decades now. Most of the available studies focused on estimating recreational benefits (see Giergiczny, 2009 for a comprehensive review). Considerable number of empirical studies was devoted public preferences for different types of forest and the attributes that characterize them (e.g., Yarrow, 1966; Daniel et al., 1976; Arthur, 1977; Zube et al., 1982; Jensen et al., 2000; Lee, 2001; Blasco et al., 2009; Edwards et al., 2012). The main goal of these studies was to provide information to forest managers on the types and features of forests that are likely to improve recreational and aesthetic values.[1] However, most of them relied on images of forest stands which were scored by respondents, and did not necessarily provide monetary estimates associated with the changes and only a handful focused on the valuation of the benefits associated with changes in forest management practices (e.g., Mattsson et al., 1994; Horne et al., 2005; Mill et al., 2007; Nielsen et al., 2007).

Giergiczny (2009) identified 140 non-market valuation studies concerning changes in forest management conducted across Europe. These studies provided 280 estimates of different non-timber benefits offered by forests. Yet only a few studies from this list have been carried out in Central and Eastern Europe (CEE) – the relevant work published in peer reviewed journals is limited to Czajkowski et al. (2009a) and Bartczak et al. (2012).[2] These studies reveal different forest recreation and valuation patterns in Poland than in the other European countries. Somewhat surprisingly, both trip frequency and per-trip recreational benefits are substantially higher in CEE than in the Western Europe. Better understanding why these

[1] Some of these studies were carried out using the Delphi method – a technique that seeks to provide a reliable group opinion on how to solve a complex problem through the use of expert judgment.

[2] We were also able to identify some grey literature and conference presentations referencing additional studies conducted in CEE region (Šišák et al., 1997; Melichar, 2001; Nagypal, 2005; Melichar, 2007).

values differ, how it influences the associated welfare measures, and the resulting optimal management strategy require further investigation.

Our study adds to the literature by investigating individual preferences for changes in forest management strategies in Poland. We applied a discrete choice experiment (DCE) on a high quality, representative sample of adult Poles and provide implicit prices of the attributes which were used to describe these new management strategies, as well as the welfare changes associated with possible policy scenarios. The novelty of our study arises from the fact that forest management changes were framed from the social perspective, which is not necessarily equivalent to what the experts and foresters believe to be the most important. For this purpose we utilized extensive qualitative analysis to identify the forest attributes that people would like to see changed the most.[3] Regarding the methodological aspects this study – to the authors' best of knowledge – is one of the first applications of a generalized multinomial logit (G-MNL) model allowing for accounting for taste and scale heterogeneity in the environmental context.

A substantial body of the literature has been devoted to researching heterogeneity of respondents' preferences with respect to different characteristics of the forests, especially heterogeneity determined by the accessibility and spatial configuration of environmental qualities (e.g., Schläpfer et al., 2003; Bateman et al., 2006; Nielsen et al., 2007; Kuminoff, 2009; Baerenklau et al., 2010). Our study adds to this literature by determining the differences in preferences towards forest management based on respondents' recreation patterns. Results from previous studies have not been unequivocal in this respect. For example, Hanley et al. (1998) show that non-users have lower valuations for landscape improvements than users; on the other hand, Kniivilä (2006) found no difference between the users and non-users groups in their willingness to support sustained conservation. In this study, we investigate to what extent (1) the frequency of forest recreation trips and (2) the number of different locations visited correlate with respondents' preferences, and find that these two indicators have substantially different impacts.

This paper is organized as follows. Section 2 provides the methodological background and introduces the econometric approach. Section 3 describes the case study area, scenarios and the design of the discrete choices, the sampling procedure and the survey administration. Section 4 presents results while Section 5 offers conclusions.

[3] We note that this approach is in the line with one of the main conditions necessary for incentive compatibility of a stated preference study (Carson et al., 2007), namely the consequentiality of the survey. The vast majority of forests in Poland (more than 80%) are state owned and administrated by the State Forest Enterprise (SFE). Polish law allows and encourages the society to participate in public goods management including the national forests management. We utilized these aspects of our study setting to ensure the truthful revelation of respondents' preferences.

2. METHODS

The discrete choice experiment is a popular method to elicit preferences and monetary values associated with non-market goods and the attributes that comprise such goods (Carson et al., forthcoming). Respondents are usually asked to state which of the several alternatives they prefer the most. A standard practice is to pool choice data from individuals and estimate a population model. Since respondents are likely to have heterogeneous preferences and differ in error variances (scales) it becomes crucial to account for this preference and scale heterogeneity in modelling approach.

There have been many attempts to allow for heterogeneous tastes in discrete choice modelling. The most straightforward is based on including interactions between attributes and socio-demographic variables into utility function (Brock et al., 2007). This approach allows to account for systematic taste variation only, and not for unobserved taste heterogeneity. Another frequently used approach is the random parameters logit model (RPL, Revelt et al., 1998; McFadden et al., 2000). It extends the multinomial logit model to allow for unobserved preference heterogeneity by making the utility function parameters random variables that follow an a priori specified type of distribution; parameters of these distributions are estimated using maximum likelihood methods.

In the above model specifications the utility function has a scale (error term variance) that has been implicitly normalized to allow for identification. An alternative cluster of models – scale heterogeneity models – allow for the scale coefficient to be heterogeneous in the population (e.g. the Heteroscedastic Extreme Value Model, Allenby et al., 1995; Bhat, 1995; or Covariance Heterogeneity Nested Logit Model, Bhat, 1997). These models allow for otherwise homogeneous utility weights to be proportionally scaled up or down for different respondents, making the deterministic part of their utility function larger or smaller in relation to the non-observable random part.

Only recently it has been proposed to combine these 'preference-heterogeneity' and 'scale-heterogeneity' approaches into one Generalized Multinomial Logit Model framework (Fiebig et al., 2010). The model nests both approaches and allows to simultaneously account for both preference and scale heterogeneity. In this paper we employ this state-of-the-art method to simultaneously account for preference and scale heterogeneity.

2.1. THE G-MNL MODEL

In the G-MNL model (Fiebig et al., 2010) the random utility expression of an individual i's utility function associated with alternative j at choice situation t is:

$$U_{itj} = \left[\sigma_i \mathbf{b} + \gamma \boldsymbol{\eta}_i + (1-\gamma)\sigma_i \boldsymbol{\eta}_i \right]' \mathbf{x}_{itj} + \omega_{itj} . \quad (1)$$

The utility associated with each alternative is a function of observed attributes $\mathbf{x}_{ij}$ and accompanying individual-specific (random) parameters, $\boldsymbol{\beta}_i = \mathbf{b} + \boldsymbol{\eta}_i$, where $\mathbf{b}$ is a vector of population means of these parameters, and $\boldsymbol{\eta}_i$ is a vector of random errors with zero means and a specified variance-covariance matrix over the population (usually following multivariate normal distribution). By introducing the error term ω_{itj} the modeller assumes utility levels to be random variables, as it is otherwise impossible to explain why apparently equal individuals (equal in all attributes which can be observed) may choose different options. This error term can further be disaggregated to $\omega_{itj} = \mathbf{Y}'_{itj} \boldsymbol{\Omega}_{itj} + \varepsilon_{itj}$, where $\boldsymbol{\Omega}_{itj}$ is a vector of stochastic components of utility function which follow identical and independent distribution specified by a modeller, and $\mathbf{Y}_{itj}$ is a vector of loadings that map the error component according to the desired structure (and hence allow for generic correlations). This specification of the random term of the utility function allows to include numerous error structures, and hence to account for heteroscedascity, correlation, cross-correlation, and autoregression of error components (Hensher et al., 2003; Greene et al., 2007; Train, 2009).

In addition to this usual specification of any random parameters logit model, σ_i is an (individual) scale of the error term ε_i, and γ is a new parameter between 0 and 1 that governs how the variance of preference heterogeneity varies with scale.[4] From this generalized model one can obtain the usual RPL model (if $\sigma_i = \sigma = 1$), the scale-heterogeneity model (if $\text{var}(\boldsymbol{\eta}_i) = 0$) or a simple MNL model (if $\sigma_i = \sigma = 1$ and $\text{var}(\boldsymbol{\eta}_i) = 0$).

Since the person-specific scale coefficient should be positive, to impose it in estimation it is convenient to assume it is log-normally distributed, i.e.:

$$\sigma_i = \exp(\bar{\sigma} + \tau \varepsilon_i), \text{ where } \varepsilon_i \sim N(0,1). \quad (2)$$

The new parameter τ captures the scope of scale heterogeneity – as it approaches 0 the model becomes the usual RPL model, and for any $\tau > 0$ there is individual scale heterogeneity in the model.

[4] See Fiebig et al. (2010) for a discussion.

3. EMPIRICAL STUDY

Our empirical study was based in the context of environmental protection – management changes in the protection of Polish forests. We were interested in the attributes of the Polish forests that are the most significant for the general public in terms of recreation and biodiversity conservation. Through the extensive qualitative studies we discovered that the forest attributes that Poles would like to see changed the most were: (1) protection of the most ecologically valuable forests, (2) less litter in forests, and (3) an increasing the amount of recreational infrastructure. These were the attributes that we used for the hypothetical scenario of our CE study.

Of the 90 000 km^2 Polish forests about 3% are forests which are the most ecologically valuable in terms of having many of the characteristics of natural forests, such as age and structure of trees, the presence of natural environmental processes, large amounts of dead wood, rare species of fauna and flora and high biodiversity in general (see Annex 1a for illustration). About 50% of these forests are currently properly protected, usually in the form of national parks and nature reserves. The rest is under much human pressure and often is treated as regular economic forests. Annex 2 provides a map of locations and areas of the most ecologically valuable forests in Poland. Therefore, the first attribute in our CE scenario was the area change of ecologically valuable forests that could be protected. The possible levels of this attribute were:

Status quo
Passive protection of **50%** of the most ecologically valuable forests
(1,5% of all the forests)

Partial improvement
Passive protection of 75% of the most ecologically valuable forests
(2,25% of all the forests, 50% increase)

Substantial improvement
Passive protection of 100% of the most ecologically valuable forests
(3% of all the forests, 100% increase)

The second attribute used in the final study was the amount of litter that was present in the forest. This could be left in forests by tourists or as illegal trash-dump sites (see Annex 1b for illustration). Litter obviously decreases recreational value of a forest, may leak dangerous substances, and constitutes a hazard for animal life and health. In our hypothetical scenario it was proposed to reduce the amount of litter by 50% or by 90%, though tougher law enforcement and increasing forest cleaning services. The available levels of this attribute were:

Status quo
No change in the amount of litter in the forests

Partial improvement
Decrease the amount of litter in the forests by half
(50% reduction)

Substantial improvement
Litter found in the forests only occasionally
(90% reduction)

Qualitative pretesting also showed that for the recreational value of forests it was important that enough tourist infrastructure was available. This could include local roads allowing easier access to a forest, parking places, paths and trails for tourists, organized resting areas (e.g. picnic sites) or toilets. Our scenario proposed and described two levels of increased amount and quality of infrastructure. It was explained that such infrastructure would be built only where necessary and only in a way that does not influence the environment. In short, these were:

Status quo
No change in tourist infrastructure

Partial improvement
Appropriate tourist infrastructure in **a half more** forests
(50% increase)

Substantial improvement
Appropriate tourist infrastructure available in **twice more** forests
(100% increase)

The last attribute was monetary – additional annual cost per household, in the form of increased income taxes.

The final survey was conducted on a representative sample of 1001 Poles. We hired a professional polling agency that collected the questionnaires using high-quality, face-to-face computer-assisted surveying techniques. The choice sets utilized in our study were prepared using Bayesian d-efficient design optimized for the RPL model (Sándor et al., 2001; Ferrini et al., 2007; Bliemer et al., 2008; Scarpa et al., 2008). To obtain initial estimates (priors) and to verify the qualitative properties of the questionnaire itself we conducted a pilot study on a sample of approximately 50 respondents.

Each respondent was faced with 26 choice-situations, each consisting of 4 alternatives. Each alternative was described with the 4 attributes specified above. Our design was counterbalanced – we randomized the order of 26 choice-sets presented to each respondent. In addition, we randomized the order of the 3 non-status-quo alternatives for each choice-

situation and each respondent. An example of a choice card shown to respondents is given in Figure 1.

Figure 1. Example of a choice card

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Protection of ecologically valuable forests	 **Status quo** Passive protection of **50%** of the most ecologically valuable forests (1.5% of all forests)	 **Status quo** Passive protection of **50%** of the most ecologically valuable forests (1.5% of all forests)	 **Status quo** Passive protection of **50%** of the most ecologically valuable forests (1.5% of all forests)	 **Substantial improvement** Passive protection of 100% of the most ecologically valuable forests (3% of all forests, 100% increase)
Litter in forests	 **Status quo** No change in the amount of litter in the forests	 **Partial improvement** Decrease the amount of litter in the forests by half (50% reduction)	 **Status quo** No change in the amount of litter in the forests	 **Partial improvement** Decrease the amount of litter in the forests by half (50% reduction)
Infrastructure	 **Status quo** No change in tourist infrastructure	 **Status quo** No change in tourist infrastructure	 **Partial improvement** Appropriate tourist infrastructure in 50% more forests (50% increase)	 **Substantial improvement** Appropriate tourist infrastructure available in double the current forests (100% increase)
Cost	0 PLN	10 PLN	25 PLN	100 PLN
Your choice	☐	☐	☐	☐

4. RESULTS

We estimated our G-MNL model using 1000 shuffled Halton draws. We accounted for the fact that each respondent faced 26 choice tasks by allowing for individual-specific random coefficients and scale. The qualitative attributes were dummy coded with status quo as a reference level, and so the variables represent:

- NAT_1, NAT_2 – partial (50%) and substantial (100%) improvement in the area of passively protected ecologically valuable forests,
- TRA_1, TRA_2 – partial (50%) and substantial (90%) reduction of litter in the forests,
- INF_1, INF_2 – partial (50%) and substantial (100%) increase of forests with tourist infrastructure present,
- FEE – monthly cost per household in PLN,
- SQ – alternative specific constant for the status quo alternative (no change).

All the coefficients were modelled as normally distributed random parameters. In addition we allowed for correlations between all random parameters.[5]

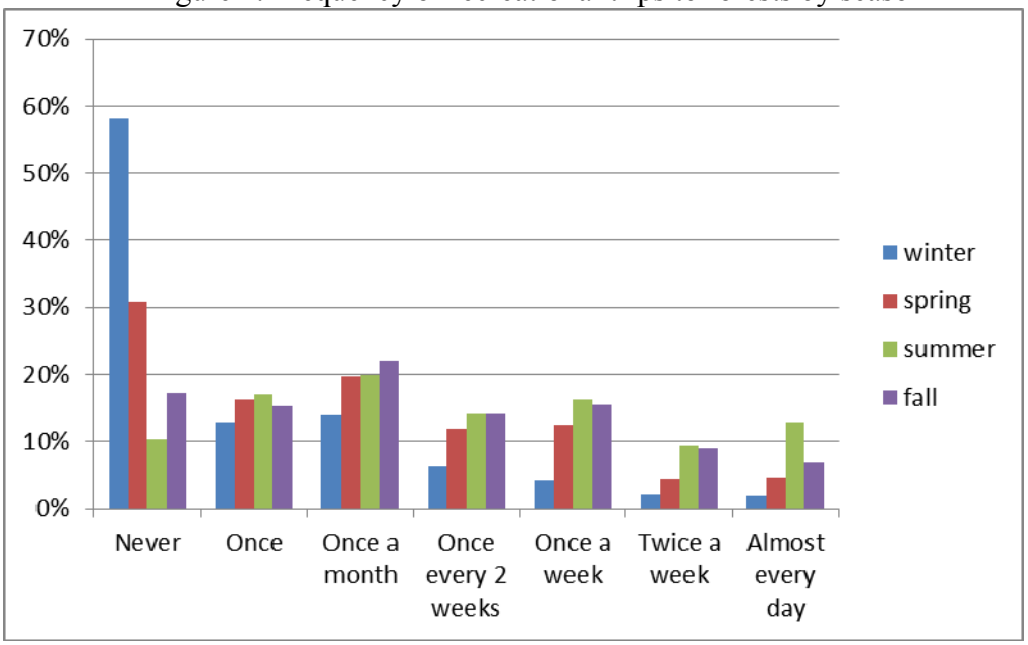
One of the reasons for this study was to investigate if preferences of respondents who use the forests more often and more extensively differ from those who do not. Therefore, we included two use-related questions in the survey which elicited information related to (1) how often a respondent visits the forests for recreation and (2) how many different locations he had visited in the last 12 months.

The results of the survey showed that forests are extensively used for recreation in Poland. In our sample of 1001 respondents there was not a single person who would declare that he or she had not visited any forest in the previous 12 months. The mean number of recreational trips to forests in the last 12 months was 49, while the median was 27.[6] The most trips take place in the summer (40%), followed by fall (29%), spring (21%) and winter (10%). Figure 2 presents the histogram of the declared number of visits with seasonal breakdown.

[5] The estimated variance-covariance matrix is available from the authors on request.

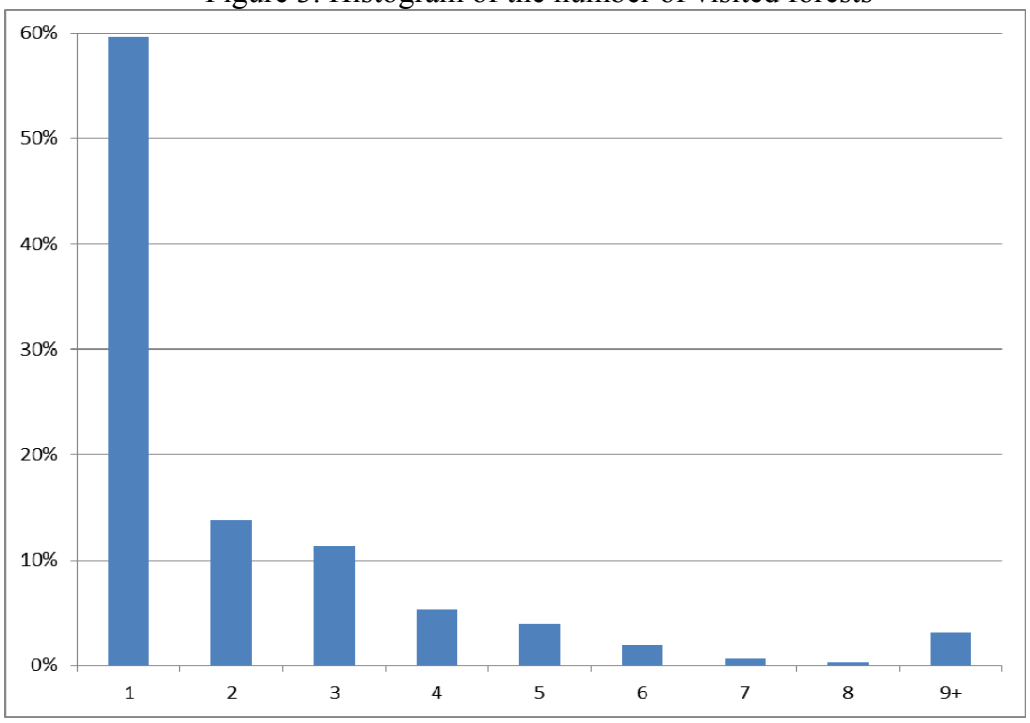
[6] These results could be compared with a similar study recently conducted in Lorraine, France (Abildtrup et al., forthcoming). In their study 96% of respondents have visited a forest more than once during the past 12 months, whereas 77% have visited different forests during the period.

Figure 2. Frequency of recreational trips to forests by season



Our data also shows that many respondents visit different forests (mean 3.18), although the most had visited only one. Figure 3 presents the histogram of the number of forests visited in the last 12 months.

Figure 3. Histogram of the number of visited forests



In what follows we used these indicators to investigate if the respondents who (1) visit the forests more frequently and (2) visit more different forest locations have significantly

different preferences than the others. This was done by including these respondent-specific characteristics as explanatory variables (vis_loc and vis_trip, respectively) of the means of the random preference parameters. The estimation results of the G-MNL model are presented in Table 1.

We begin by noting that all explanatory variables turn out to be significant determinants of choice and are of the expected sign. The statistical significance of the coefficients associated with the standard deviations of the random parameters' distributions indicates that they are all significantly different from zero, and hence that the variables should indeed be modeled as random. This is a strong evidence of unobserved preference heterogeneity. On the other hand, the tau scale coefficient is significantly larger than 0 what indicates significant heterogeneity in individual scale coefficients. Therefore, we found strong evidence of unobserved heterogeneity in both preferences and scale.

Our results indicate that respondents who use the forests more heavily, both in terms of the number of recreational trips and the number of visited locations, are overall less likely to choose the status quo (no change) alternative over one of the improvement alternatives – the mean of the alternative specific constant associated with the status quo alternative is significantly lower for these respondents. This is an indication of the expected relationship that the respondents who are the users of the forests are generally willing to pay more for improvements in their quality.

Respondents who had visited more different forest locations were generally more concerned with the improvements in the protection of ecologically valuable forests. Interestingly, this was true for respondents who visited more forest locations and not necessarily those, who made more trips; in the latter case the effect was not statistically significant. This finding shows that respondents who visit more forest locations, and are therefore likely to be more experienced, may prefer the forests which are more natural.

Removing the litter from the forests was significantly more important for the respondents who both, visit more forest locations as well as for those who make more trips to forests. This is an expected result, since litter in the forests is likely to affect recreational, i.e. use value. Interestingly, however, the improvements in tourist infrastructure had a more mixed effect. Being a more intensive user influenced observed preferences in the case of partial improvements only (appropriate infrastructure in 50% more forests) and not in the case of substantial improvements. In addition, we found that the respondents who visit more forest locations preferred more infrastructure, while the respondents who, ceteris paribus, make more trips preferred less infrastructure.

Table 1. The results of the Generalized Multinomial Logit Model (standard errors given in parentheses)

	Means of normally distributed random parameters	Standard deviations of normally distributed random parameters	Covariates of the random parameters' means	
			vis_loc – the number of different forests visited in the last 12 months	vis_trip – the number of forest trips in the last 12 months
SQ – alternative specific constant for the status quo alternative (no change)	1.8147*** (0.6792)	7.4859*** (0.3367)	-0.7032*** (0.0617)	-0.6180*** (0.0986)
NAT_1 – partial (50%) improvement in the area of passively protected ecologically valuable forests	1.5223*** (0.2815)	1.2461*** (0.0635)	0.1292*** (0.0230)	0.0295 (0.0374)
NAT_2 – substantial (100%) improvement in the area of passively protected ecologically valuable forests	1.8063*** (0.3646)	1.9737*** (0.0827)	0.2341*** (0.0307)	0.0633 (0.0487)
TRA_1 – partial (50%) reduction of litter in the forests	2.0189*** (0.2687)	0.8799*** (0.0714)	0.0523** (0.0214)	0.0469 (0.0355)
TRA_2 – substantial (90%) reduction of litter in the forests	2.1957*** (0.3381)	1.4931*** (0.0892)	0.0916*** (0.0285)	0.1751*** (0.0451)
INF_1 – partial (50%) increase of forests with tourist infrastructure present	1.4209*** (0.2753)	0.8714*** (0.0648)	0.0358* (0.0208)	-0.0642* (0.0351)
INF_2 – substantial (100%) increase of forests with tourist infrastructure present	1.6674*** (0.2667)	1.0719*** (0.0633)	0.0257 (0.0207)	0.0426 (0.0357)
FEE – monthly cost per household in PLN	-9.7622*** (0.7343)	4.6703*** (0.1869)	0.0976 (0.0645)	0.4595*** (0.0951)
G-MNL structural parameters				
γ – gamma parameter	2.9794*** (0.1020)			
τ – tau scale parameter	-0.4731*** (0.1032)			
Model characteristics				
Log-likelihood	-16796.1309			
Pseudo-R^2 (McFadden's)	0.5345			
AIC (normalized)	1.2955			

***, **, * – Significance at 1%, 5%, 10%

4.1. IMPLICIT PRICES OF THE ATTRIBUTES AND WELFARE ESTIMATES

We now turn to estimating the implicit prices of the attribute levels. This can be done by calculating the marginal rate of substitution of monetary parameter for an attribute of interest. Table 2 shows median implicit prices in EUR[1], along with the simulated 95% confidence intervals. These were generated using parametric bootstrapping similar to the Krinsky and Robb method (Krinsky et al., 1986).

Table 2. Implicit prices of the choice attributes (95% confidence intervals presented in parentheses) [EUR]

	Non-users[2]	Users[3]
SQ – alternative specific constant for the status quo alternative (no change)	5.29 (1.78 – 9.23)	-9.99 (-12.07 – -7.91)
NAT_1 – partial (50%) improvement in the area of passively protected ecologically valuable forests	3.69 (2.36 – 5.09)	6.37 (5.80 – 6.94)
NAT_2 – substantial (100%) improvement in the area of passively protected ecologically valuable forests	4.32 (2.60 – 6.09)	8.57 (7.80 – 9.32)
TRA_1 – partial (50%) reduction of litter in the forests	4.97 (3.61 – 6.42)	7.97 (7.41 – 8.52)
TRA_2 – substantial (90%) reduction of litter in the forests	5.34 (3.72 – 7.06)	11.76 (10.97 – 12.58)
INF_1 – partial (50%) increase of forests with tourist infrastructure present	3.48 (2.14 – 4.86)	4.07 (3.60 – 4.55)
INF_2 – substantial (100%) increase of forests with tourist infrastructure present	4.13 (2.85 – 5.49)	5.70 (5.23 – 6.17)

The results indicate that the attribute that consumers are willing to pay the most for is the reduction of litter in the forests. This finding is similar to what we found in qualitative analysis conducted during pretesting, and at the time was surprising to us. Respondents seem to be concerned about this, primarily because it reduces their surplus from spending recreational time in the forests they most often visit, as indicated by higher implicit prices of users vs. non-users.

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[1] At 1 EUR = 4 PLN.

[2] Respondents with zero simulated number of trips ($vis\_trip = 0$) and visited locations ($vis\_loc = 0$).

[3] Respondents with mean simulated number of trips ($vis\_trip = \text{sample mean}$) and visited locations ($vis\_loc = \text{sample mean}$).

The next attribute consumers found important was extending the area of passive protection over the area of ecologically valuable forests in Poland which are currently not protected. Since these forests needed not be located nearby respondents' homes, we expect their WTP was mostly driven by non-use values. Interestingly, however, we found that the respondents who visit more forest locations, and visit forests more often, have higher WTP for these improvements, possibly because through experience they learn to appreciate these natural forests.

We found that the respondents were generally willing to pay for tourist infrastructure to be extended. In the case of this attribute, however, the WTP of users was only moderately higher than those of non-users. This result coincides with the stylized fact that some respondents may believe there is too much recreational facilities in the forests (e.g., Despres et al., 1998; Abildtrup et al., forthcoming).

Finally, we found that non-users were generally satisfied with the current management of Polish forests, while the users were willing to pay to avoid the status quo alternative, irrespectively of the attribute levels associated with the other alternatives. We find this result a yet another manifestation of the fact that respondents' WTP might depend not only on the physical attributes of the good, but may also consist of a constant component associated with the value of a label (Czajkowski et al., 2009b).

Finally, we calculated median equivalent variations associated with minimum and maximum improvement scenarios for both classes of respondents. Note that these are not simply the sum of implicit prices of the attribute levels, since we allowed the utility function parameters to be correlated. These results are presented in Table 3. Overall, the users' welfare measures associated with the improvement scenarios are substantially higher. We note that considering the scale of improvements and the fact that the programs would be implemented in all the forests in the country, the estimated welfare measures are in line with the estimates from the other stated preference studies conducted in the CEE region (e.g., Czajkowski et al., 2009a).

Table 3. Welfare change estimates associated with the new management scenarios (95% confidence intervals presented in parentheses) [EUR]

	Non-users[4]	Users[5]
Minimum improvement scenario $-SQ + NAT_1 + TRA_1 + INF_1$	6.87 (3.25 – 10.24)	27.98 (24.97 – 31.01)
Maximum improvement scenario $-SQ + NAT_2 + TRA_2 + INF_2$	8.59 (4.76 – 12.07)	38.09 (34.59 – 41.44)

[4] Respondents with zero simulated number of trips ($vis\_trip = 0$) and visited locations ($vis\_loc = 0$).

[5] Respondents with mean simulated number of trips ($vis\_trip = \text{sample mean}$) and visited locations ($vis\_loc = \text{sample mean}$).

5. SUMMARY AND CONCLUSIONS

In this study we investigated the issue of preferences for forest management strategies in Poland. Our study provides interesting results in terms of general public preferences for alternative management options of forests in Poland. We found that the respondents are willing to pay considerable amounts to reduce the amount of litter in the forests, passively protect the most ecologically-valuable forests, and provide more recreation and tourist infrastructure. The willingness-to-pay per household seems high, but is plausible considering the scale of improvements and the fact that the programs would be implemented in all the forests in the country.

We found evidence of substantial preference heterogeneity which to a large extent was determined by respondents' recreational use profiles. The frequency of forest recreation trips and the number of different locations visited correlated significantly with respondents' preferences and were reflected in their implied welfare change measures. This result is likely to be more general, and since the forests in CEE countries are more extensively used for recreation that forests in Western Europe (Bartczak et al., 2008), this could explain why the forest-related benefits reported in CEE countries are typically higher than in the Western Europe.

Interestingly, we found that the frequency of forest visits and the reported number of visited locations had different impacts on the preferences associated with the choice attributes. A respondent who in the last 12 months had visited more forest locations can be expected to be more experienced and to have a better knowledge of different types of forests. This could explain why such a respondent placed higher importance on passively protecting the ecologically valuable forests, which in addition to their unique environmental qualities are scarcer. On the other hand, respondents who ceteris paribus made more recreational trips were found to care about the improvements in recreational facilities. This effect was the opposite for respondents who visited more forest locations. Overall, these results indicate that preferences might be to a large extent determined by the recreational use profile, however, the relationship is not necessarily straightforward.

In summary, our study lays foundations for designing future forest management strategies in Poland and provides a valuable comparison for the studies in other countries. The forest management changes investigated in our study were designed from the social perspective, which is not necessarily equivalent to what the national experts and foresters believe to be the most important. In effect, our results provide the policy-makers with inputs necessary to devise a strategy aiming at maximizing social welfare, which has been shown to be to a large extent determined by the non-market forest externalities, namely recreation and biodiversity protection. Comparing the benefits of possible changes with the costs of their implementation in a cost-benefit analysis framework would provide clear indications of how to manage forests in the future.

REFERENCES

Abildtrup, J., Garcia, S., Olsen, S. B., and Stenger, A., forthcoming. Spatial preference heterogeneity in forest recreation. *Ecological Economics*, (0).

Allenby, G., and Ginter, J., 1995. The Effects of In-Store Displays and Feature Advertising on Consideration Sets. *International Journal of Research in Marketing*, 12:67-80.

Arthur, L. M., 1977. Predicting Scenic Beauty of Forest Environments: Some Empirical Tests. *Forest Science*, 23(2):151-160.

Baerenklau, K. A., González-Cabán, A., Paez, C., and Chavez, E., 2010. Spatial allocation of forest recreation value. *Journal of Forest Economics*, 16(2):113-126.

Bartczak, A., Englin, J., and Pang, A., 2012. When are Forest Visits Valued the Most? An Analysis of the Seasonal Demand for Forest Recreation in Poland. *Environmental and Resource Economics*, 52(2):249-264.

Bartczak, A., Lindhjem, H., Navrud, S., Zandersen, M., and Żylicz, T., 2008. Valuing Forest Recreation on the National Level in a Transition Economy: The Case of Poland. *Forest Policy and Economics*, 10(7-8):467-472.

Bateman, I. J., Day, B. H., Georgiou, S., and Lake, I., 2006. The aggregation of environmental benefit values: Welfare measures, distance decay and total WTP. *Ecological Economics*, 60(2):450-460.

Bhat, C., 1995. A Heteroscedastic Extreme Value Model of Intercity Mode Choice. *Transportation Research*, 29B(6):471-483.

Bhat, C. R., 1997. Covariance heterogeneity in nested logit models: Econometric structure and application to intercity travel *Transportation Research Part B: Methodological*, 31(1):11-21.

Blasco, E., González-Olabarria, J., Rodriguéz-Veiga, P., Pukkala, T., Kolehmainen, O., and Palahí, M., 2009. Predicting scenic beauty of forest stands in Catalonia (North-east Spain). *Journal of Forestry Research*, 20(1):73-78.

Bliemer, M. C. J., Rose, J. M., and Hess, S., 2008. Approximation of Bayesian Efficiency in Experimental Choice Designs. *Journal of Choice Modelling*, 1(1):98-127.

Brock, W. A., and Durlauf, S. N., 2007. Identification of binary choice models with social interactions. *Journal of Econometrics*, 140(1):52-75.

Carson, R., and Groves, T., 2007. Incentive and informational properties of preference questions. *Environmental and Resource Economics*, 37(1):181-210.

Carson, R. T., and Czajkowski, M., forthcoming. The Discrete Choice Experiment Approach to Environmental Contingent Valuation. In: *Handbook of choice modelling*, S. Hess and A. Daly, eds.

Czajkowski, M., Buszko-Briggs, M., and Hanley, N., 2009a. Valuing Changes in Forest Biodiversity. *Ecological Economics*, 68(12):2910–2917.

Czajkowski, M., and Hanley, N., 2009b. Using Labels to Investigate Scope Effects in Stated Preference Methods. *Environmental and Resource Economics*, 44(4):521–535.

Daniel, T. C., Boster, R. S., and Forest, R. M., 1976. Measuring landscape esthetics: the scenic beauty estimation method. USDA Forest Service Research Paper RM-167, Rocky Mountain Forest and Range Experiment Station Forest Service, U.S. Department of Agriculture.

Despres, A., and Normandin, D., 1998. Demande et évaluation des services écologiques et récréatifs des forêts en Lorraine. Nancy.

Edwards, D., Jay, M., Jensen, F. S., Lucas, B., Marzano, M., Montagné, C., Peace, A., and Weiss, G., 2012. Public preferences for structural attributes of forests: Towards a pan-European perspective. *Forest Policy and Economics*, 19(0):12-19.

Ferrini, S., and Scarpa, R., 2007. Designs with a priori information for nonmarket valuation with choice experiments: A Monte Carlo study. *Journal of Environmental Economics and Management*, 53(3):342-363.

Fiebig, D. G., Keane, M. P., Louviere, J., and Wasi, N., 2010. The Generalized Multinomial Logit Model: Accounting for Scale and Coefficient Heterogeneity. *Marketing Science*, 29(3):393-421.

Giergiczny, M., 2009. Summary of forest valuation studies in Europe. In: *Review of instruments and valuation methods for multifunctional forest policy*, A. Bartczak, ed., http://www.polforex.wne.uw.edu.pl/docs/R-2008-157_review_final-03-10.pdf.

Greene, W. H., and Hensher, D. A., 2007. Heteroscedastic Control for Random Coefficients and Error Components in Mixed Logit. *Transportation Research Part E: Logistics and Transportation Review*, 43(5):610-623.

Hanley, N., Wright, R., and Adamowicz, V., 1998. Using Choice Experiments to Value the Environment. *Environmental and Resource Economics*, 11(3):413-428.

Hensher, D., and Greene, W., 2003. The Mixed Logit model: The state of practice. *Transportation*, 30(2):133-176.

Horne, P., Boxall, P. C., and Adamowicz, W. L., 2005. Multiple-use Management of Forest Recreation Sites: a Spatially Explicit Choice Experiment. *Forest Ecology and Management*, 207(1-2):189-199.

Jensen, F. S., and Koch, N. E., 2000. Measuring Forest Preferences of the Population - A Danish Approach. *Schweizerische Zeitschrift fur Forstwesen*, 151(1):11-16.

Kniivilä, M., 2006. Users and non-users of conservation areas: Are there differences in WTP, motives and the validity of responses in CVM surveys? *Ecological Economics*, 59(4):530-539.

Krinsky, I., and Robb, A. L., 1986. On approximating the statistical properties of elasticities. *The Review of Economics and Statistics*, 68(4):715-719.

Kuminoff, N. V., 2009. Decomposing the structural identification of non-market values. *Journal of Environmental Economics and Management*, 57(2):123-139.

Lee, T. R., 2001. Perceptions, attitudes and preferences in forests and woodlands. Technical Paper - Forestry Commission.

Mattsson, L., and Li, C.-Z., 1994. How do Different Forest Management Practices Affect the Non-timber Value of Forests?—an Economic Analysis. *Journal of Environmental Management*, 41(1):79-88.

McFadden, D., and Train, K., 2000. Mixed MNL Models for Discrete Response. *Journal of Applied Econometrics*, 15(5):447-470.

MEA, 2005. Ecosystems and Human Well-Being: Synthesis. Island Press, Washington, DC.

Melichar, J., 2001. Ekonomická stránka problematiky kurovce v NP Šumava [Infestation of the Spruce Bark-beetle - Economic View]. In: *Environmentální ekonomie, politika a vnejší vztahy Ceské republiky. 3. seminár doktroandských studentu a mladých vedeckých a výzkumných pracovníku [Environmental Economics, Policy and International Environmental Relations. 3rd Seminar of Postgraduate Students, Young Scientists and Researchers]*, P. Šauer, ed., Prague: Nakladatelství a vydavatelství litomyšlského semináre, 176-192.

Melichar, J. (2007). "Economic Valuation of Forest Quality Change in the Jizerske hory Mountains: the Evidence from Contingent Behavior Study." In: *Ninth Annual Bioecon Conference*, Kings College, Cambridge.

Mill, G. A., van Rensburg, T. M., Hynes, S., and Dooley, C., 2007. Preferences for multiple use forest management in Ireland: Citizen and consumer perpectives. *Ecological Economics*, 60(3):642-653.

Nagypal, N. C., 2005. Review of Environmental Valuation Studies in Hungary. Department of Environmental Economics, Budapest University of Technology and Economics.

Nielsen, A. B., Olsen, S. B., and Lundhede, T., 2007. An Economic Valuation of the Recreational Benefits Associated with Nature-Based Forest Management Practices. *Landscape and Urban Planning*, 80:63-71.

Revelt, D., and Train, K., 1998. Mixed Logit with Repeated Choices: Households' Choices of Appliance Efficiency Level. *Review of Economics and Statistics*, 80(4):647-657.

Sándor, Z., and Wedel, M., 2001. Designing conjoint choice experiments using managers' prior beliefs. *Journal of Marketing Research*, 38(4):430-444.

Scarpa, R., and Rose, J. M., 2008. Design Efficiency for Non-Market Valuation with Choice Modelling: How to Measure it, What to Report and Why. *Australian Journal of Agricultural and Resource Economics*, 52(3):253-282.

Schläpfer, F., and Hanley, N., 2003. Do Local Landscape Patterns Affect the Demand for Landscape Amenities Protection? *Journal of Agricultural Economics*, 54(1):21-34.

Šišák, L., Pulkrab, K., and Kalivoda, V., 1997. Význam návštevnosti lesa a sberu hlavních lesních plodin obyvateli území s lesy výrazne postiženými imisemi [Importance of Forest Frequentation and of Main Non-wood Forest Product Collection by Inhabitants in Regions with Forests Considerably Afflicted by Emmissions]. *Lesnictví - Forestry*, 43:245-258.

Sukhdev, P., 2010. The economics of ecosystems and biodiversity : mainstreaming the economics of nature : a synthesis of the approach, conclusions and recommendations of TEEB. TEEB, [S.l.].

Train, K. E., 2009. Discrete Choice Methods with Simulation. Cambridge University Press, New York.

Yarrow, C., 1966. A Preliminary Survey of the Public's Concepts of Amenity in British Forestry. *Forestry*, 39(1):59-67.

Zube, E. H., Sell, J. L., and Taylor, J. G., 1982. Landscape perception: Research, application and theory. *Landscape Planning*, 9(1):1-33.

ANNEX 1A – THE ILLUSTRATION OF ECONOMIC FOREST AND CLOSE-TO-NATURAL FOREST

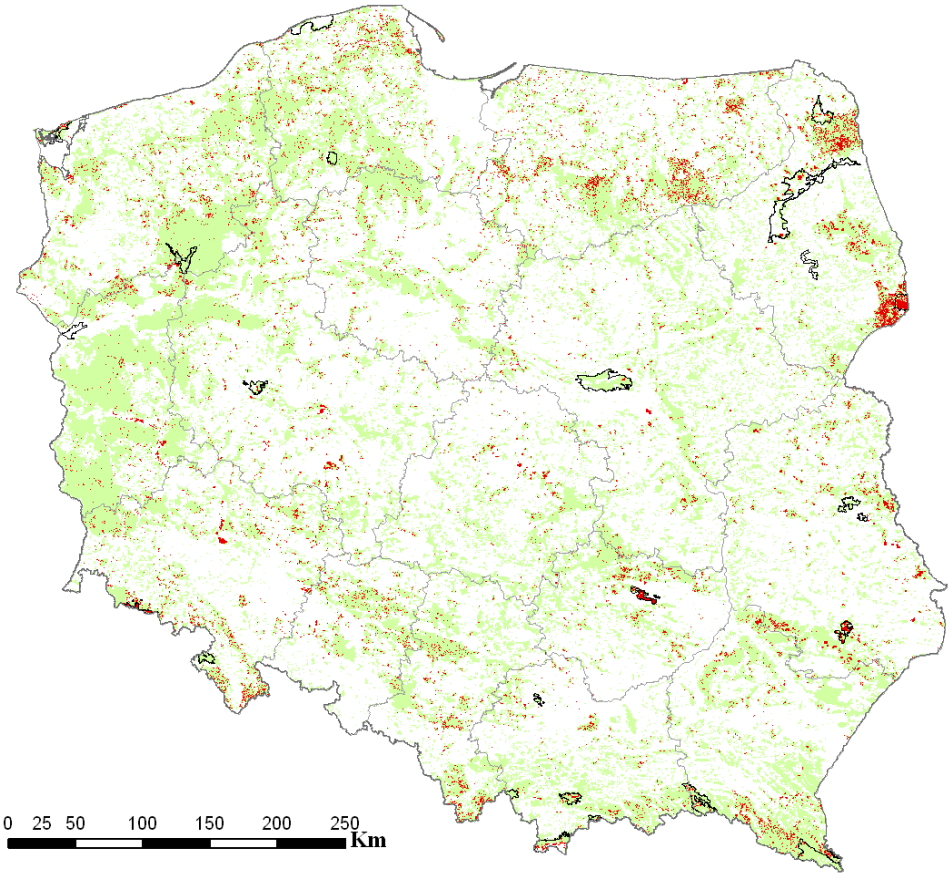
Economic forest

Close-to-natural forest

ANNEX 1B – THE ILLUSTRATION OF LITTER IN THE FORESTS

ANNEX 1C – THE ILLUSTRATION OF TOURIST INFRASTRUCTURE

ANNEX 2 – THE MOST ECOLOGICALLY VALUABLE FORESTS IN POLAND



Ecologically-valuable forests

Other forests

National parks

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