Social & Environmental Benefits of Forestry
Phase 2 :

THE RECREATION VALUE OF WOODLANDS

Report to

Forestry Commission

Edinburgh

from

Riccardo Scarpa

Centre for Research in Environmental Appraisal & Management
University of Newcastle

http://www.newcastle.ac.uk/cream/

March 2003

Social & Environmental Benefits of Forestry
Phase 2:

THE RECREATION VALUE OF WOODLANDS

Riccardo Scarpa

March 2003

1. Introduction

The recreational value of woodlands is a special case of the larger set of values from outdoor recreation. As leisure time and population mobility increased in the post world war II period a large number of applied studies focussed on the social benefits of outdoor recreation. Initial attempts were predominantly academic exercises, but soon the benefit estimation methodologies developed by academics were embraced by various sectors of society. Nowadays the economic benefits from outdoor recreation are well understood as a result of extensive investigations. The methods to derive them are routinely taught in environmental valuation modules in the higher education system and are in continuous refinement through the work of researchers in the field.

A perusal of the relevant U.K. and international literature shows that the number of applied studies on economic valuation of woodland recreation is second only to water recreation studies. In the particular case of the U.K. a large number of applied studies in forest recreation is available. Many are methodological in nature and are mostly directed to the academic audience. Many others were carried out to provide answers to specific policy questions as perceived by central and regional government agencies.

The present report covers the specific findings of a study belonging to the second set. The objective is to find the total and marginal recreational value of British forests. The estimates reported are partly based on generic estimates of willingness to pay to access forests, as derived from new primary data obtained from contingent valuation surveys. In part these estimates are also based on the estimation of forest-specific recreation benefits. The latter were derived from benefit functions estimated from 1992 data and updated with the new surveys administered in 2002. More precisely the methodology employed is known as value transfer from benefit functions. The main advantage offered by such methodology is that of consistently combining newly collected primary data with previously collected data, hence building on previous knowledge and thereby achieving a higher level of accuracy than that achievable using the newly collected data in isolation. More importantly, in the context of this type of studies, such an approach has the potential to provide large savings in survey expenses necessary for basing the valuation entirely on new primary data.

The report is structured as follows: section 2 outlines the relevant theoretical and empirical issues in recreation benefit estimation, with a particular focus on the task at hand and on the literature on estimation of recreational values from benefit function transfers; section 3 lays out the methodology and describe the data employed in this study, while section 4 reports the estimation results. Section 5 presents the non-market benefit estimates from recreation in woodlands of the U.K.

2. Estimating woodland recreation values

2.1. Theoretical points of relevance

In estimating benefits from visits to outdoor recreation sites the most frequently used theoretical object under investigation is the so-called "compensating variation", or *cv*. This is a money measure of the loss of utility individual visitors would suffer from site closure. Suppose that the utility level of an individual visitor can be modelled by the bundle of goods he consumes indicated by the vector **z**, the income he enjoys *m*, and ability to access the site, indicated by the scalar $x^0=1$.
Implicitly this means that the i^{th} visitor is thought as possessing the right to visiting the site and hence is entitled to utility level $u_i(x^0_i,\mathbf{z}_i,m_i)=u^0_i$. Under these assumptions the compensating variation is the amount of money sufficient to return him/her to the level of utility u^0 when access to the site is precluded because of closure, i.e. $x^1=0$. Implicitly this quantity (*cv*) is defined as:

$$u_i(x^0_i,\mathbf{z}_i,m_i) = u^0_i = u_i(x^1_i,\mathbf{z}_i,m_i - cv).$$

Notice that this measure is all-inclusive, and it is net of income substitution and other substitution effects. This theoretical measure can be easily derived from stated preference data, but it is of difficult exact derivation from observed data on transactions (revealed preference data) (Hausmann, 1981). However, under plausible conditions it can be adequately approximated by other easy-to-measure quantities, such as consumer surplus measure (*cs*) (Willig, 1976, 1979).

Consumer surplus for site closure is defined as the integral under the inverse Marshallian (uncompensated) demand function between the observed cost of access and a "choke price" (i.e. a cost of access that would reduce visitation rates to zero). Marshallian demand functions are readily estimated from individual site visitation data using the cost of travelling to the site as a proxy for individual cost of access, e.g. from travel-cost data. As a consequence the benefit from outdoor recreation in U.K. woodlands has often been estimated from zonal or individual travel cost data (Willis, 1991; Willis and Garrod, 1991a, 1992; Bateman *et al.* 1996).

However, although the theoretical discrepancy between exact utility-based benefit measures, such as *cv*, and their approximations from demand functions, such as *cs*, are shown to be small under the prevalent circumstances of choice for recreational decisions, this may well not carry over to large-scale estimation studies, such as the one under consideration. The literature in applied travel cost methodology has illustrated a plethora of potential empirical sources of bias in applied travel cost studies (Randall 1994). For example, even the simple choice of including substitute destinations in the system of demand for travel cost studies can be more difficult than one may think at first (Caulkins et al. 1986). Household decisions are often not simply framed around the issue of "what *woodland* site shall we go and visit?". More frequently they are framed on a broader set of alternatives. For example, around the issue of "what *outdoor* site shall we go and visit?", or even a more generic "what shall we do with this nice day?". The modelling of the last two decision contexts would require a much larger set of substitutes than a listing of close-by woodland sites to the one visited. The omission of such a complete set of alternatives from the estimation demand will bias the derivation of the benefit estimates. This may be unavoidable even when the researcher employs complex choice-probability travel cost models based on random utility analysis combined with count data (e.g. Hutchinson *et al.* 2002). As a consequence it will introduce a further "empirical" bias, which adds to the existing theoretical discrepancy between *exact* and *approximate* benefit estimates.

The above point illustrates the complexity surrounding the decision of what empirical measure to choose for non-market recreation values, such in the case of benefits from woodland recreation. The analyst is torn between choosing amongst a number of approaches, each providing advantages and disadvantages. For example, travel cost methodologies are often purported as superior as they derive from revealed preference data, but as seen above they are not free from theoretical as well as empirical biases. On the other hand stated preference methods, such as contingent valuation approaches, have the advantage of focussing on the theoretically exact benefit measure, but they may display significant sources of empirical bias. Such is the case when incentives for hypothetical bias are prevalent, and their effects unadjusted for.

A collection of issues complicating the estimation of economic benefits from outdoor recreation via the travel cost method is reported in Randall (1994). Overall, with costly data collection, many of these complications can be overcome, but when the objective is to define a per visit benefit estimate—such as in this case—it would appear that uncomplicated stated preference approaches such as the one employed here, are preferable. In particular, the focus on the benefit value at the woodland gate is conceptually appealing because it is robustly linked to the experience in the woodland, and unfettered by other issues prior to the decision of access, such as the length, type and potential multiple-destinations of the journey.

2.2 Objectives and framework of the present investigation

In the case of the study at hand the objective is that of providing an estimate of the benefits from recreational function of woodlands in the U.K., and break it down by country and tourist regions. This total estimate must be consistent with the main microeconomic tenets of individual choice and display – in as much as possible – sensitivity to measurable forest attributes determining the benefits from the recreational experience.

In other words, it must be made-up of an aggregation over individual benefit estimates from visit, each of which should be sensitive – to the extent possible – to variation in recreationally important measurable woodland attributes. The fact that it is not possible to obtain a complete description of the determinants of the benefit of each single visit to woodlands for lack of measurable descriptors introduces a measurement error in the modelling framework, which adds to other missing variable errors, such as those linked to a poor quantitative description of the visitor type. A poor descriptor is one that does not match well the metric with which the attribute affects recreation, and the quality of the metric will depend on the way these attributes are, on average, perceived by visitors, rather than the way they are measured.

A further objective constraining the choice of methodology is that the estimates to be obtained can only in a small part be derived from new primary data. This is because the budget constraints for this study were such that only about 400 new completed surveys could be afforded. This constraint alone dictates the need to base the estimation methodology on the practice of benefit transfer. In other words the information on benefit valuation studies carried out at some forest sites are to be transferred to many other forests, which were not studied. Sensitivity of the benefit to recreational woodland attributes is also investigated here in the form of a coherent benefit function transfer for woodland recreation, which is derived from a merging of new and old data. Such a reliance on previously collected data further limits the choice of methodology restricting it to the only one employed for a large enough previous study, namely CVM. Furthermore, it compels the researcher to adhere to a set of assumptions, the most restrictive of which is arguably that of preference stability between responses to identical CVM questions collected in different moments in time.

The largest scale benefit valuation study from woodland recreation sharing a common contingent valuation survey instrument is the European Union funded CAMAR study conducted in 1992 by Ni Dhubhain et al. (1994). The socio-economic component of the study involved the surveying of 28 woodland sites in the U.K. (14 in Scotland and 14 in Northern Ireland) and 14 in the Republic of Ireland, with an average sample size of over 350 per site (over 15,000 observations). Such data collection supported a number of woodland recreation benefit investigations (Scarpa *et al.* 2000a, b, c, d; Hutchinson *et al.* 2001, 2002; Strazzera *et al.* 2001, 2003) and is amenable to extension and integration by supplementing it with data from new survey administrations in key woodland sites.

Most noticeably, for the present purpose of a total estimate of woodland recreation in the U.K., the EU-CAMAR dataset requires a geographical extension to woodland sites in England and Wales, as well as a purchase power parity update to a 2002-pound value. The data extension provides an opportunity for both validating the value estimates based on the old data and for expanding the set of forest attributes values at which willingness to pay responses are recorded. This is particularly valuable considering that the final objective is to develop a benefit function conditional on these attributes from which to derive an estimate of benefit for all the woodlands in the U.K.

2.3 Evidence on U.K. forest recreation benefit estimates from transfer functions

Benefit value transfer methods are routinely employed in all studies where it is impractical to obtain site-specific estimates for all recreation sites of interest. A typical approach is that of deriving a per visit benefit estimate and then expanding such an estimate to the estimated total number of visits (Willis, 1991). Indeed this has been the rationale driving most of previous applications, and it underlies much of the current study.

However, it has been authoritatively argued that such an approach is undesirable when benefits can be systematically linked to specific site determinants. In such instances a 'benefit function' transfer approach has been suggested and argued to be superior because capable of diminishing bias (Opaluch and Mazzotta, 1992). A number of U.K. studies have identified such type of sensitivity in estimates of recreation benefits from woodlands (e.g. Hanley and Ruffell 1993, Scarpa *et al.* 2000d). One specific study (Scarpa *et al.* 2000c) systematically tested the transferability of forest recreation function estimates in Ireland. This shows that under the assumption of expected zero difference the hypothesis of no-difference between site estimates and transferred estimates cannot be statistically rejected in more than fifty percent of the cases. This would seem to suggest that new primary data collections for recreation benefit estimates provide estimates that are statistically undistinguishable from those derivable from the benefit function. Of course, the true benefit value remains unobserved in both cases, and it is therefore a matter of substituting a lower cost estimate (the transfer one) with a higher cost estimate (the on site one).

In a recent paper by Kristofersson and Navrud (2002) it is argued that the null hypothesis of no-difference is in fact too restrictive. They propose it would make more sense for analysts to expect a difference between the on-site and the transferred value estimates. Such difference would be due to the obvious inability of the transfer function to account for all determinants of value and leave a zero-mean error. From this standpoint analysts should define transfer estimates acceptable when the relative difference with the on-site ones is less than some low percentage (e.g. 10 percent). This is suggestive that the results of the transferability assessment in the Irish study are underestimated, and the transfers are even more frequently valid than concluded in that study. Also, it suggests the conclusion that for the purpose of the estimation of the average economic benefit from a woodland visit the benefit function approach is quite adequate.

With a function specified in terms of measurable woodland attributes, recreation benefits are made woodland-specific via the effect of such attributes on the estimate.

For those woodland sites for which such attributes are not available the simpler method of a generic per-visit benefit estimate can still be used.

The major limit in the use of the benefit function transfer approach for the Forestry Commission remains the availability of data on woodland-specific attributes, which are employed as benefit predictors. For woodlands for which this information is missing, the average benefit estimate can be employed, i.e. the estimate for WTP of access unconditional on woodland attributes.

3. Methodology and data

In the benefit transfer framework described in the previous section, one of the two methodologies is that of a data augmentation of the larger original 1992 study, so as to extend the sample from which to estimate the benefit function to some woodland sites in England and Wales.

Of course, to guarantee consistency across time and studies the new contingent valuation survey format replicated and improved on the one used in the EU-CAMAR. In the new data collection the value elicitation followed a dichotomous choice with follow-up, and a final open-ended question. In practice respondents, who were selected amongst visitors who had just completed their visit to the forest, were asked whether they were willing to pay a given amount to access the forest rather than going without the experience. In case of a first positive response the question was reiterated with a higher amount, while in case of a first negative response the question was reiterated at a lower amount.

The 1992 survey was criticised by some researchers in that it did not account for intended changes in visiting behaviour. For example, visitors were not asked if although they were willing to pay the proposed entry charge they would reduce their pattern of visitation to the site, and if so by how much. This is of importance in the present study as the value aggregation across the total number of visits is assumed to take place without a change in the total number of visits. For this reason in the new survey the debriefing to the first response included a question aimed at clarifying this issue. Respondents were asked if they would pay the proposed amount but decrease the number of visits. The answers to these questions showed the original criticism to be a valid one. 33.64% of the respondents answered that they would pay yet they would reduce the number of visits. Hence these respondents were showing that they would pay, but adjust the quantity of recreation demanded by lowering it to a level of consumption that is below the current one.

The stated intention involved substantial changes in visiting behaviour: 54% of this portion of the sample would halve the number of visits, and 26% would more than halve it. Only 20% would reduce it to less than half the current level. In any event these responses to contingent valuation questions would constitute improper marginal values, and were hence dropped from the sample used in estimation, which was therefore restricted to those who would either pay or not pay the proposed amount without changing their visitation pattern. In our sample these were 279 observations, collected in 7 woodland sites in England and Wales.

The distribution of positive numbers of yearly visits to the forest in which visitors were sampled is reported in Table 1. From its contents it is apparent that more than 80% of respondents make fewer than 10 visits a year to the woodland of interest. It is also noteworthy how data are grouped around focal values, such as 10, dozen, 20 etc. Less than 8% of the sample make more than 20 visits per year. These statistics reflect findings previously observed in the CAMAR study and other similar studies.

Table 1

Number of visits	Cases	Frequencies	Cumulative Frequencies
0	184	0.43	0.43
1	47	0.11	0.54
2	33	0.08	0.62
3	24	0.06	0.67
4	20	0.05	0.72
5	11	0.03	0.75
6	20	0.05	0.79
7	4	0.01	0.80
8	2	0.00	0.81
9	1	0.00	0.81
10	11	0.03	0.84
11	2	0.00	0.84
12	12	0.03	0.87
15	3	0.01	0.88
20	20	0.05	0.92
50	8	0.02	0.94
100	9	0.02	0.96
200	5	0.01	0.97
300	11	0.03	1.00

Distribution of number of visits in the sample.

It is worth noticing from Table 2 that the majority of the sample motivated the cost of travel as predominantly due to the visit to the woodland where they were sampled. For example, 70% of the respondents declared that more than 90% of the day out travel cost was entirely to be attributed to the visit to the forest, while 83% attributed to it at least 70% of the cost. Less than 13% declared that the visit to the forest accounted less than 50% of the total travel cost. This would seem to indicate that trip cost sharing might be a minor problem in this type of outdoor recreation.

Table 2.

Percent of travel cost	Cases	Frequencies	Cumulative Frequencies
10	3	0.01	0.01
20	14	0.03	0.04
30	5	0.01	0.05
40	14	0.03	0.08
50	8	0.02	0.10
60	11	0.03	0.13
70	7	0.02	0.14
80	12	0.03	0.17
90	26	0.06	0.23
100	328	0.77	1.00

Percent of travel cost attributed to visiting the forest.

The contingent valuation questions used a follow-up format allowing for a variety of potential model specifications (see Haab and McConnell, 2002), such as the classic single bounded (Bishop and Heberlein, 1979; Hanemann 1984), the more efficient double bounded (Hanemann, Kanninen 1991), the more rigorous bivariate (Cameron and Quiggin, 1994) and the potentially less biased one-and-a-half-bound (Cooper, Hanemann, Signorello). For the sake of comparison with other studies in this literature and with the previously published EU-CAMAR studies we report here only the results for those specifications, which are most commonly employed in the literature, that is the linear in the bid and log-linear in the bid single and double bounded models. More flexible forms can also be estimable as illustrated in Scarpa et al. (2000a), however these flexible forms do not normally produce estimates which are substantially different from those obtained with more conventional approaches.

3.1 Data from open-ended responses

In the first instance we report the statistics of the open-ended WTP responses. Mean maximum WTP is £1.66 (standard deviation 1.4) and the median is £1.5, suggesting a skewed distribution, as one would expect. The relevant frequencies of maximum WTP values are broken down in Table 3.

Table 3.

Pounds	Cases	Frequencies	Cumulative Frequencies
0	73	0.17	0.17
0.5	42	0.10	0.27
1	91	0.21	0.48
1.5	25	0.06	0.54
2	98	0.23	0.77
2.5	13	0.03	0.80
3	36	0.08	0.88
3.5	5	0.01	0.89
4	26	0.06	0.96
5	14	0.03	0.99
6	2	0.00	0.99
7	1	0.00	1.00
7.5	2	0.00	1.00

Distribution of WTP at selected cut-off points.

The statistics in table 3 suggest that approximately 80% of respondents are willing to pay less than £2.50, about one quarter is willing to pay £2 and one fifth £1. Notice that 17% is willing to pay less than 50 pence (16.3% less than 20 pence). Perhaps, a better description of the overall distribution can be obtained in the kernel-smoothing graph reported in Figure 1.

When maximum WTP values are stated after a sequence of dichotomous choice elicitation questions may be subject to “anchoring”. This is a well-known effect, often reported in the literature and it consists of a form of dependence of the maximum WTP values on the initial bid used in the discrete-choice scenario. To test the degree to which such dependence is present in the data we report the results of an ordinary least square regression of stated maximum WTP values on the initial bid-response. This is a crude way of diagnosing linear dependency and “anchoring”.

As one can see from Table 4 the R^2 values are very close to zero and the hypothesis of a linear relationship can be rejected, hence suggesting that anchoring is not present in these responses. This is suggestive that these open-ended responses could be used to derive benefit value estimates.

Table 4.

```
+----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = MAXWTP   Mean=   1.660304450    , S.D.=   1.396663244     |
| Model size: Observations =     427, Parameters =   2, Deg.Fr.=    425 |
| Residuals:  Sum of squares= 830.9844847    , Std.Dev.=        1.39831 |
| Fit:        R-squared=  .000000, Adjusted R-squared =         -.00235 |
| Model test: F[  1,    425] =     .00,    Prob value =          .99244 |
| Diagnostic: Log-L =   -748.0408, Restricted(b=0) Log-L =    -748.0409 |
|             LogAmemiyaPrCrt.=     .675, Akaike Info. Crt.=      3.513 |
| Autocorrel: Durbin-Watson Statistic =   1.56260,   Rho =       .21870 |
+----------------------------------------------------------------------+
```

Variable	Coefficient	Standard Error	t-ratio	P[|T|>t]	Mean of X
Constant	1.658892933	.16354256	10.143	.0000	
BID	.5702153473E-03	.60146095E-01	.009	.9924	2.4754098

OLS regression of stated max-WTP on initial bid

3.2 Responses with zero-WTP

The 70 respondents who indicated to be unwilling to pay any of the proposed amounts were posed debriefing questions to permit the identification of true zero-WTP behaviour. Accounting for zero-WTP is clearly important in mean and median WTP estimation (Kristrom, 1997; Strazzera *et al.*, 2003). For example the open-ended mean WTP inclusive of zero values is £1.66, while if these are to be excluded it is £1.99. To be conservative it may be appropriate to use the former, but this may well be an under-estimate of the true WTP for the individual visit.

In order to investigate whether or not the zero-WTP response was genuine or dependent on the initial amount a Probit regression was estimated. This attempts to explain the probability of a zero-WTP status on the basis of the initial bid amount presented to the respondent. Under the hypothesis of independence the initial bid amount should not be a significant explanatory variable. The results of this regression from the entire data set are reported in table 5.

Table 5.

```
+---------------------------------------------+
| Binomial Probit Model                       |
| Dependent variable              ZERO_WTP    |
| Number of observations               428    |
| Log likelihood function        -189.3160    |
| Restricted log likelihood      -190.6793    |
| Chi squared                     2.726484    |
| Prob[ChiSqd > value] =          .9869634E-01 |
+---------------------------------------------+
```

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]	Mean of X
Index function for probability					
Constant	-1.252210390	.18290938	-6.846	.0000	
BID	.1072955622E-02	.65210050E-03	1.645	.0999	246.96262

As can be seen the initial bid effect is marginally significant, suggesting that zero-WTP status and initial bid are not independent. It is therefore concluded that zero-WTP probability estimates are unlikely to represent true zero-WTP, but they seem to be statistically linked to the bid amount asked, perhaps due to protest responses. For this reason the issue of zero-WTP is ignored in the benefit estimation based on probability models from discrete responses which follows.

3.3 Data from the closed-ended responses with follow-up

The budget for the additional observations was spent to sample six new sites in England: Sherwood (*N*=72), Delamere (*N*=58), Epping (*N*=76), New Forest (*N*=56), Dartmoor (*N*=55), Thetford (*N*=55), and one (Brenin) in Wales (*N*=56).

The choice of sites was dictated by the need for efficient sampling. These woodlands have a higher than average recreational use and may be thought as highly recreationally valuable. So, they may produce samples with higher than average willingness to pay for forest visits. This is the inevitable cost to pay for a cost-efficient sampling.

Once the responses from those who declared they would change visiting behaviour are removed from the sample, 279 responses are left for the estimation of the probability models from which to derive estimates of benefits. The breakdown of the data is reported in Table 6. These values illustrate how the recorded responses are consistent with economic theory. For example, the amount of respondents willing to pay both first and second bid are reported as Yes-Yes and by and large they decline as the bid amount increases. Similarly, the number of those who are not willing to pay either of the bid amounts presented to them (No-No) by and large increases with the bid amount.

Table 6.

Bid value	Yes-Yes	Yes-No	No-Yes	No-No
£1	23	34	5	23
£2	10	17	1	32
£3	4	20	0	42
£4	9	16	6	37

CVM Discrete choice responses

3.4 Data on forest attributes integration with previous data

The new data were pooled with the old EU-CAMAR dataset and analysed jointly after obtaining the woodland descriptors from woodland district managers and updating the bid values by the consumer purchase parity index (one 1992 GB pound is worth 1.26 2002 GB pound). This created a dataset of 12,185 discrete-choice CVM all linked to forest attributes.

3.5 Methodology for benefit estimation and aggregation

Two methods are used to derive estimates of benefits from woodland recreation. Both are benefit transfer methods and both are based on the benefit from a single visit. The first employs a generic (site-independent) value transfer, while the second employs site-specific value estimates, constructed on the basis of woodland attributes showed to be of importance to visitors.

While the generic value transfer has a history of applications in the context of aggregate value estimates (Willis 1991), the site-dependent value transfer is a relatively new approach (Scarpa *et al.* 2000c), but has potentially more accuracy and it is based on a benefit value function. However, one limiting factor for its applicability is the availability of adequately measured site-attributes for the large numbers of woodlands in the U.K.

The approach taken here is therefore that of providing aggregate value estimates for England, Scotland and Wales on the basis of estimated number of visits (as reported in the UK Leisure Day Visits, 1996, 1998). This aggregation is done prevalently using the generic estimate of benefit from a woodland visit, except for the few cases for which the relevant woodland attributes are available to enable the computation of a site-dependent estimate by means of the benefit value function.

3.6 Estimation of the generic estimate

This is based on the expected value of compensating variation and is derived via contingent valuation method. The estimation is conducted on the basis of the data described above. The open-ended data are used to derive mean, median and other features of the distribution. Because of a series of problems, amongst which lack of incentive compatibility (respondents are thought to have incentives to provide untruthful answers), some authors recommend to derive estimates by means of dichotomous choice responses (Carson *et al.* 1999). In this report we provide estimates of expected compensating variation from both open-ended and closed-ended data. We use both for the purpose of value aggregation, to illustrate the range of potential variation.

From the discrete choice responses with follow-up, both single-bounded and double-bounded probability estimates are derived. The latter provide higher accuracy, but may be prone to bias. However, some evidence seems to suggest that the efficiency gains may be higher than the risk of mis-specification (Alberini, 1995).

3.7 Estimation of the site-specific estimates from benefit function

This estimates are derivable only on the basis of large data collected at many different sites for which there exists site-specific attributes. Such sample size is obtained by data pooling between the newly collected data (2002) and with the EU-CAMAR contingent valuation dataset, after up-dating bid-amounts to account for purchase parity to 2002 pound values, as the EU-CAMAR was collected in 1992. This procedure relies on the assumption of preference stability between the two moments in time. However, this seems a defensible stance in the context of forest recreation and it appears a cost worth paying to achieve the estimation of a benefit function, which would otherwise be not available.

Data for the benefit function estimation are also derived from dichotomous choice contingent valuation responses with follow-up. As in the case of the generic estimates they are also derived using single and double-bounded assumptions.

The single bound linear in the bid estimate from the integrated dataset is reported in table 11 along with the implied estimates of mean WTP. This provides an estimated mean WTP of 172 pence per visit, with an approximate st. err. of 3.11 pence.

The same data was employed to derive the benefit function conditional on woodland attributes reported in Table 12. The value estimates reported show that total forest area in hectares (TOTAR) has a positive effect on utility, along with the percent coverage of broadleaves (BDLEAF), larch (LARCH), the presence of nature reserves (SSSI, etc.). On the other hand the marginal effect of conifers (CONIFS) and a measure of congestion (yearly visits/car parks capacity CONGEST) are negative. While the above results are all consistent with theoretical expectations, we register a negative and significant effect of old trees (PRE1940). The dummy variables for countries show only one significant effect, that for England, while Wales, Northern Irish and Scottish WTP data seem not to be significantly different from the Irish baseline

The function was then employed to predict the values of mean WTP for access at the seven newly surveyed forest sites, by applying the formula for probit models with linear indirect utility:

$$E(WTP) = -\frac{\alpha + \sum_{k=1} x_k \gamma_k}{\beta},$$

where: α denotes the constant, β denotes the marginal utility of money, k denotes the list of forest attributes, x denotes their values, and γ_k the estimated parameters of the indirect utility function.

This is an illustration of the type of benefit transfer estimate that can be obtained if woodland attributes were made systematically available. In this illustration benefit estimates dependent on the forest attributes range from a minimum of 110 pence per visit in Epping, to a maximum of 300 pence in Delamere.

Consider an English woodland with the following attributes: total areas in hectares = 900, percent of area in conifers = 60, percent of area in broadleaves = 20, percent in larch = 12, percent of trees planted earlier than 1940 = 5, with a nature reserve, and a congestion index of 20. This would give a value of mean *WTP* of per visit of 147.54 pence.

This value would be obtained as follows. From table 12 α = 0.805 and β = –0.0048. The coefficients for the attributes are to be multiplied by the attribute values and added-up, which gives:

$$\sum_{k=1} x_k \gamma_k = -0.271,$$

therefore one derives the value of:

$$E(WTP) = -\frac{\alpha + \sum_{k=1} x_k \gamma_k}{\beta} = -\frac{0.805 - 0.271}{-0.0048} = 147.54 \text{ pence.}$$

4. Estimation results and aggregation

4.1 Open-ended estimates of willingness to pay

Under the assumption of random sampling the central limit theorem suggests that the limiting distribution of the sample mean is normal. So, given the size of our sample (*N*= 428) we consider this property to be valid in this case, and an unbiased estimate of the mean WTP of the population of visitors is the sample mean of the stated WTP values. We denote this as $E(\text{WTP}_{\text{OE}})$ = 1.66 pounds, with a standard deviation of 1.4. An estimate of the median or $M(\text{WTP}_{\text{OE}})$ is the sample median, which is 1.5.

Open-ended responses are known in contingent valuation to produce estimates of benefits that are systematically lower than those produced by close-ended responses. Furthermore, some game theorists contend (Carson *et al.* 1999) that only dichotomous choices have the potential to be truth-revealing mechanisms. So, our attention now turns to this type of estimates.

4.2 Close-ended estimates of willingness to pay

These estimates are derived in 4 different forms, according to a:

a) single-bounded linear-in-the-bid model (Table 7) [SBlin]

b) single-bounded log-in-the-bid model (Table 8) [SBlog]

c) double-bounded linear-in-the-bid model (Table 9) [DBlin]

d) double-bounded log-in-the-bid model (Table 10) [DBlog]

In all these the underlying assumption is that of a random utility model. Estimates were derived for both mean and median WTP. These vary between 2.19 (±0.30) for the SBlin, to 2.78 (±0.10) for the DBlin, and to £ 2.75 (±0.68) for the mean of the DBlog, which also gives a media of 1.91 (±0.24).

These estimates are slightly higher than those obtained from the 1992 study. For example, the estimated mean WTP from a probit single bound model using all 11,906 observations from 1992 (with up-dated bid values to 2002 purchase parity values) produces an estimated mean WTP of £1.71 (±0.03). This would suggest that the WTP for a visit to woodland was higher in 2002 than in 1992.

From the close-ended analysis one is tempted to adopt the value of 2.75 as an intermediate estimates of mean WTP from the close-ended because it is generated from a model with a relatively good fit, consistent with the notion of skewed distribution of WTP, which in turns is a property consistent with the observed distribution of household income.

4.3 Aggregation results from generic estimates

The results of aggregation are based on the number of visits estimated in the Leisure Day Visit Survey (1998), which for woodland are estimated in 346 million of trips per year: 313 for England, 21 for Scotland and 12 million for Wales.

Using the various mean WTP estimates we obtain a range of total recreation benefit values for Britain, which is between a point estimate of 574 million pounds from the inference based on the open-ended CVM estimates and that of 962 million pounds from the highest of the close-ended CVM estimates.

Breakdowns of the benefit estimates by tourist region are reported in Table 13, while those by Government Office Regions are reported in Table 14.

It is important to appreciate that the validity of the aggregate estimates relies on the assumption that both the Day Visit Survey and the surveys conducted for this forest recreation study relate to the same type of visit, which we define here as purposeful woodland visits. There is evidence that a number of woodland visit types may well be associated with lower WTP values for the marginal visit than those estimated here. For example, Willis and Garrod (1991b) find that dog walkers have lower consumer surplus than other visitor types. This position is supported in another study of the recreational value of woodland planted under the community woodland supplement, where Crabtree *et al.* (2001) estimated that the mean use value per household (for households within 4 miles) of CWS woodland, varied from a lower bound estimate of £0.13 to an upper bound estimate of £0.56 per household per year.

It is unclear how adjustments for these lower value visits can be made in this context. I would contend that the number of pet-related woodland walks likely to be reported as Day Visits is quite low, and an estimate of their number at the national level is also not available. This kind of visits have a recreational value which is not considered here.

On the other hand, if distance travelled is an important conditional variable in mean WTP for true day visits to woodland, as it would be theoretically plausible, then aggregating across round-trip distance categories of visits may be seen as desirable. With this approach one can divide the woodland visits in two categories, the first including round-trip travel distances below 10 miles and the second above this threshold. The first category would include recreational experiences to local woodland, while the second those to more distant ones. As shown in table 15, conditional on having travelled a round-trip distance shorter than 10 miles the open-ended WTP responses show a mean WTP of £0.9 (st. dev. 1.2), while conditional on a longer trip the open-ended mean WTP is £1.8 (st. dev. 2.3).

The U.K. Day Visit Survey (Forestry Statistics 2002, Table 2.2) reports an estimate of 77% as the proportion of visits falling in the first category of "short-distance" visits, which is therefore representative of a value of 273 million visit/year. Estimating these at a mean WTP value of £0.9 produces a value of £246 million/year for this fraction. The second category of "long-distance" visits is therefore estimated at 82 million/year, with an average value of £1.8, producing an additional fraction of £146 million/year. This aggregation strategy produces a more realistic total estimate for woodland recreation of £392 million/year, which at a capitalization rate of 3.5% gives an asset value for recreation of approximately just over £12,000 million. A regional breakdown is provided in Table 13.

Table 15.

	less 10 miles	from 11 to 25 miles	from 26 to 50 miles	from 51 to 75 miles
Mean WTP	0.9	1.5	1.8	1.8
St. Dev. WTP	1.2	2	2.3	2.1
	from 76 to 100 miles	from 101 to 150 miles	greater than 150 miles	Greater than 10 miles
Mean WTP	2.1	2.5	2.4	1.8
St. Dev. WTP	2.2	3.1	2.7	2.3

Conditional mean WTP by distance of journey

5. Conclusions

The main objective of this study was to provide an estimate of the outdoor recreation benefits linked to U.K. woodland. Estimates were obtained from a contingent valuation survey carried out in 2002 which involved sampling at 7 woodland sites, 6 in England and one in Wales.

From these surveys we obtained both open-ended and closed-ended responses that were then used to derive the benefit estimates in the form of compensating variation for foregoing a visit to the woodland. As usual, the estimated amount varies according to the method of estimation, ranging from a minimum of 1.66 pounds per visit from the open-ended responses to a maximum of 2.78 pounds per visit from the double-bounded dichotomous choice linear-in-the-bid approach.

A secondary aim was that of estimating a benefit function from which it is possible to transfer values for recreational woodland for which there is no available primary data on visitors WTP. This was achieved by integrating old with new forest recreation data in a systematic fashion. Such benefit function predicts theoretically better as it is dependent on forest attribute with an important recreational role. An example of on-sample prediction is proposed in support of the argument that such an approach should be used to provide more accurate estimates that account for site-specific woodland traits.

6. Bibliography

Alberini, A., 1995. Efficiency vs Bias of WTP estimates: bivariate and interval-data models, Journal of Environmental Economics and Management, 29:169-180.

Bateman, I.J., Garrod, G.D., Brainard, J.S. and Lovett, A.A. 1996. Measurement, valuation and estimation issues in the travel cost method: A geographical information systems approach. Journal of Agricultural Economics, 47(2):191-205.

Bishop, R. C., Heberlein, T. A., 1979, Measuring Value of Extra Market Goods: Are Indirect Measures Biased? American Journal of Agricultural Economics, 61:926-930.

Cameron, T. A.nn and Quiggin, J. 1994. Estimation using contingent valuation data from a dichotomous choice with follow-up questionnaire, Journal of Environmental Economics and Management, 27:218-234.

Carson, R. T., Groves, T. and Machina, M. J. 1999. Incentive and Informational Properties of Preference Questions, Paper presented at the IX Conference of the European Association of Environmental and Resource Economists, Oslo 25-27 June, 1999.

Caulkins, P. P., Bishop, R. C. and Bouwes, N. W., 1986. The travel cost model for lake recreation: a comparison of the methods for incorporating site quality and substitution effects, American Journal of Agricultural Economics, 68(2):291-297, May; (86-5)

Cooper, J. Hanemann, W., and Signorello (forthcoming) One and One-Half bids for contingent valuation, The review of economics and statistics.

Crabtree, J. R., Chalmers, N., Thorburn, A., MacDonald, D., Eiser, D., Potts, J. and Colman, D. 2001. Economic Evaluation of the Community Woodland Scheme. Macaulay Land Use Research Institute. Report to the Forestry Commission.

Haab, T. and McConnell, 2002. Valuing environmental and natural resources. Edward Elgar Publisher

Hanemann, W. M., 1984. Welfare Evaluations in Contingent Valuations Experiments with Discrete Responses, American Journal of Agricultural Economics, 66:332-341.

Hanemann, M., Loomis, J. and Kanninen, B. 1991. Statistical Efficiency of Double Bounded Dichotomous Choice Contingent Valuation, American Journal of Agricultural Economics, 73:1255-1263.

Hanley, N., and Ruffell, R. 1993. The contingent valuation of forest characteristics: two approaches. Journal of Agricultural Economics, 44(2):218-229.

Hausman, J. A. 1981. Exact consumer's surplus and deadweight loss. American Economic Review, 71(4):662-676

Hutchinson, W.G., Scarpa R., Chilton S.M., and Mc Callion, T. 2001. Parametric and non-parametric estimates of willingness to pay for forest recreation in Northern Ireland: a multi-site analysis using discrete choice contingent valuation with follow-ups. Journal of Agricultural Economics. January, 52(1):104-122.

Hutchinson, W.G., Scarpa, R., Chilton, S. M. and McCallion, T. 2002. Spatial Distribution Versus Efficiency Effects Of Forest Recreation Policies: Using a Regional Travel Cost Model. Forthcoming in The New Economics of Outdoor Recreation. Edited by N. Hanley, D. Shaw and R. Wright. To be published by Edward Elgar.

Kristofersson, D. and Navrud, S. 2002. Validity Tests of Benefit Transfer: Are we performing the wrong tests? Paper presentated at the 2nd World Congress for environmental and Resource Economists, June 24-27 2002 Monterey, California, USA.

Kriström, B., August 1997, Spike Models in Contingent Valuation. American Journal of Agricultural Economics, 79 (3): 1013-1023 (97-34)

Ni Dhubhain, A., Gardiner, J., Davis, J. Hutchinson, G. Chilton, S., Thomson, K., Psaltopoulos, D. and C. Anderson. 1994. Final Report EU CAMAR. Contract No 8001-CT90-0008. The Socio-Economic Impact of Afforestation on Rural Development, by University College of Dublin, The Queens University of Belfast and University of Aberdeen.

Opaluch, J. J. and Mazzotta M. J. 1992. Fundamental issues in benefit transfer and natural resource damage assessment, in Benefit transfer: procedures, problems and research needs. Workshop proceedings, AERE, Snowbird, UT, June.

Randall Alan, 1994, A Difficulty with the Travel Cost Method. Land Economics, February, 70 (1):88-96 (94-8)

Scarpa, R., Chilton S. and Hutchinson, G. 2000a. Benefits From Forest Recreation: Flexible Functional Forms For WTP Distributions. Journal of Forest Economics, February, 6(1):41-54.

Scarpa, R., Chilton S., Hutchinson, G. and Buongiorno, J. 2000b. Valuing the Recreational Benefits from the Creation of Nature Reserves In Irish Forests. Ecological Economics. April, 33(2):237-250.

Scarpa, R., Hutchinson, G., Chilton S. and Buongiorno, J. 2000c. Reliability of Benefit Value Transfers from Contingent Valuation Data with Forest-Specific Attributes. FEEM Working Paper n. 34.00. Forthcoming in Environmental value transfer: issues and methods. Edited by Ståle Navrud and Richard Ready, Kluwer Academic Publisher.

Scarpa, R., Hutchinson, W. G. Chilton, S. M. and Buongiorno, J. 2000d. Importance of Forest Attributes in the Willingness To Pay for Recreation: A Contingent Valuation Study of Irish Forests. Forest Policy and Economics. December, 1(3-4):315-329.

Strazzera, E., Genius, M., Scarpa, R. and Hutchinson, G. 2001. The Effect of Protest Votes on the Estimates of Willingness to Pay for Use Values of Recreational Sites, (FEEM Working Paper n. 97.01) *Forthcoming* in Environmental and Resource Economics.

Strazzera, E., Scarpa R., Calia P., Garrod G.D., and K. G. Willis. 2003. Modelling zero values and protest responses in contingent valuation surveys. Applied Economics, 35(2):133-138.

Willig, R. D. 1976. Consumers' surplus without apology. American Economic Review, 66(4):589-597

Willig, R. D. 1979. Consumers' surplus without apology. Reply. American Economic Review, 69(2):469-74

Willis, K. G., 1991. The Recreational Value of the Forestry Commission Estate in Great Britain: A Clawson-Knetsch Travel Cost Analysis, Scottish Journal of Political Economy, February, 38(1):58-75.

Willis, K.G. and Garrod, G.D. 1991a. An individual travel cost method of evaluating forest recreation, Journal of Agricultural Economics, 42(1):33-41.

Willis, K.G. and Garrod, G.D. 1991b. Valuing Open Access Recreation on Inland Waterways: on-site recreation surveys and selection effects. Regional Studies, 25(6):511-524.

Willis, K.G. and Garrod, G.D. 1992. On-Site Recreation Surveys and Selection Effects: Valuing Open Access Recreation on Inland Waterways, in Tourism and the Environment: Regional, Economic and Policy Issues, J. Van der Stratton and H. Briassoulis (eds.), Kluwer Academic Publishers.

Tables with model estimates

Table 7. ML estimates for single bounded linear-in-the-bid model

```
Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Binomial Probit Model                       |
| Maximum Likelihood Estimates                |
| Dependent variable                 Y        |
| Weighting variable              None        |
| Number of observations           279        |
| Iterations completed               4        |
| Log likelihood function    -184.9140        |
| Restricted log likelihood  -193.0851        |
| Chi squared                 16.34209        |
| Degrees of freedom                 1        |
| Prob[ChiSqd > value] =      .5287580E-04    |
| Hosmer-Lemeshow chi-squared =  11.68804     |
| P-value=  .16567 with deg.fr. =      8      |
+---------------------------------------------+
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
 α           .5841158043       .17770661    3.287   .0010
 β       -.2663418255E-02  .66552759E-03   -4.002   .0001     241.93548

+-----------------------------------------------+
| WALD procedure. Estimates and standard errors |
| for nonlinear functions and joint test of     |
| nonlinear restrictions.                       |
| Wald Statistic            =     56.44591      |
| Prob. from Chi-squared[ 1] =       .00000     |
+-----------------------------------------------+
+---------+-------------+---------------+--------+---------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] |
+---------+-------------+---------------+--------+---------+
mean/median   219.3105807       29.190621    7.513   .0000
```

Table 8. ML estimates of double-bounded linear-in-the-bid model.

User Defined Optimization	
Maximum Likelihood Estimates	
Dependent variable	Function
Weighting variable	None
Number of observations	279
Iterations completed	8
Log likelihood function	188.9092
Restricted log likelihood	.0000000
Chi squared	377.8183
Degrees of freedom	2
Prob[ChiSqd > value] =	.0000000

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
α	2.357012906	.25001522	9.427	.0000
β	-.8472550813E-02	.90377875E-03	-9.375	.0000

WALD procedure. Estimates and standard errors for nonlinear functions and joint test of nonlinear restrictions.	
Wald Statistic =	802.81593
Prob. from Chi-squared[1] =	.00000

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
median/mean	278.1940124	9.8183789	28.334	.0000

Table 9. ML estimates of single bounded probit log-bid model

Binomial Probit Model	
Maximum Likelihood Estimates	
Dependent variable	Y
Weighting variable	None
Number of observations	279
Iterations completed	4
Log likelihood function	-183.7489
Restricted log likelihood	-193.0851
Chi squared	18.67236
Degrees of freedom	1
Prob[ChiSqd > value] =	.1552092E-04
Hosmer-Lemeshow chi-squared =	9.87857
P-value= .27365 with deg.fr. =	8

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]	Mean of X
α	3.168073299	.75939194	4.172	.0000	
β	-.6029472540	.14111516	-4.273	.0000	5.3519991

WALD procedure. Estimates and standard errors for nonlinear functions and joint test of nonlinear restrictions.	
Wald Statistic =	61.99800
Prob. from Chi-squared[2] =	.00000

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
mean WTP	275.2990333	63.716225	4.321	.0000
median WTP	191.3898619	24.713140	7.744	.0000

Table 10. ML double bounded probit log-bid model

User Defined Optimization	
Maximum Likelihood Estimates	
Dependent variable	Function
Weighting variable	None
Number of observations	279
Iterations completed	9
Log likelihood function	184.7613
Restricted log likelihood	.0000000
Chi squared	369.5226
Degrees of freedom	2
Prob[ChiSqd > value] =	.0000000

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
α	11.59133669	1.0887712	10.646	.0000
β	-2.100720458	.20435137	-10.280	.0000

WALD procedure. Estimates and standard errors for nonlinear functions and joint test of nonlinear restrictions.	
Wald Statistic =	653.42633
Prob. from Chi-squared[2] =	.00000

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
mean	20554.13800	17255.924	1.191	.2336
median	249.0842318	10.937821	22.773	.0000

Table 11. ML single bounded probit linear-bid model

Binomial Probit Model	
Maximum Likelihood Estimates	
Number of observations	12185
Log likelihood function	-6587.852
Restricted log likelihood	-7834.074
Chi squared	2492.444
Degrees of freedom	1
Prob[ChiSqd > value] =	.0000000
Hosmer-Lemeshow chi-squared =	51.05100
P-value= .00000 with deg.fr. =	8

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]	Mean of X
Index function for probability					
α	.8058015627	.27952601E-01	28.827	.0000	
β	-.4666419E-2	.10270111E-03	-45.437	.0000	282.42421
Mean(WTP)	172.6808971	3.1159186	55.419	.0000	

Table 12. ML single bounded probit linear bid model

```
+---------------------------------------------+
| Binomial Probit Model                       |
| Maximum Likelihood Estimates                |
| Model estimated: Feb 26, 2003 at 05:14:19PM.|
| Dependent variable                  Y       |
| Weighting variable               None       |
| Number of observations          12185       |
| Iterations completed                6       |
| Log likelihood function     -6287.673       |
| Restricted log likelihood   -7834.074       |
| Chi squared                  3092.801       |
| Degrees of freedom                 12       |
| Prob[ChiSqd > value] =       .0000000       |
| Hosmer-Lemeshow chi-squared =  61.24910     |
| P-value=  .00000 with deg.fr. =       8     |
+---------------------------------------------+
```

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]	Mean of X
	Index function for probability				
α	.9903671041	.65644924E-01	15.087	.0000	
β	-.4878949695E-02	.10619106E-03	-45.945	.0000	282.42421
TOTAR	.1271365283E-04	.37780745E-05	3.365	.0008	1373.5907
CONIFS	-.3309704783E-02	.82934960E-03	-3.991	.0001	42.874731
BDLEAF	.8104661703E-02	.96707732E-03	8.381	.0000	24.351094
LARCH	.9633908198E-02	.16950719E-02	5.683	.0000	7.4271645
PRE1940	-.3106662797E-02	.72262083E-03	-4.299	.0000	18.202740
NATRES	.2873574877	.30292357E-01	9.486	.0000	.32531801
CONGEST	-.6315187633E-01	.32921960E-02	-19.182	.0000	5.5037303
WALES	.7094920043E-01	.25454934	.279	.7805	.22979073E-02
ENGL	.6301329516	.10009067	6.296	.0000	.20599097E-01
SCOT	-.7875290817E-02	.34766697E-01	-.227	.8208	.33048831
N_IRE	.1688453087E-01	.44035203E-01	.383	.7014	.29421420

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
Delamere	305.5804407	19.349657	15.793	.0000
New Forest	200.5737700	23.173733	8.655	.0000
Brenin	141.6821951	52.210412	2.714	.0067
Thetford	196.0631043	19.051522	10.291	.0000
Dartmoor	178.2721233	18.202935	9.794	.0000
Epping	110.6369625	22.818789	4.849	.0000
Sherwood	230.4512608	17.977462	12.819	

Table 13. Aggregate benefits by tourist regions (£ million/year)

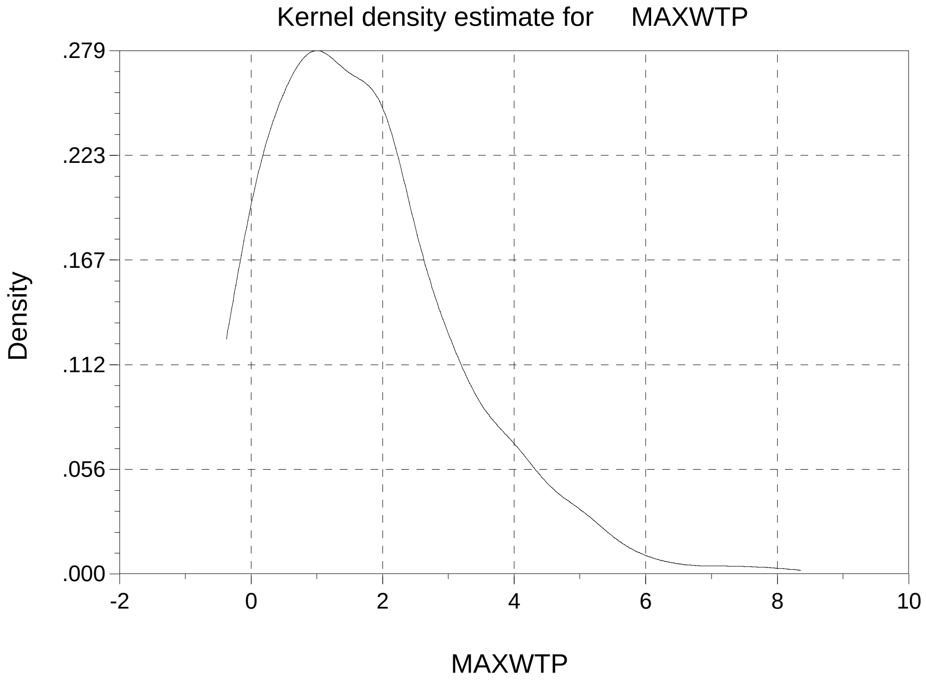
				Aggregate Estimates			
				WTP_{OE}	SBlin	DBlog	DBlin
	Visits in millions	Estimated WTP per visit	0.9/1.8	1.66	2.19	2.75	2.78
English Tourist Regions							
Cumbria	0.7		0.77	1.16	1.53	1.93	1.95
Northumbria	3.2		3.54	5.31	7.01	8.80	8.90
North West	30.4		33.65	50.46	66.58	83.60	84.51
Yorkshire & Humberside	42.9		47.49	71.21	93.95	117.98	119.26
Heart of England	39.0		43.17	64.74	85.41	107.25	108.42
East Midlands	31.9		35.31	52.95	69.86	87.73	88.68
EastAnglia	54.5		60.33	90.47	119.36	149.88	151.51
London	13.9		23.07	30.44	38.23	38.64	65.44
West Country	34.6		38.30	57.44	75.77	95.15	96.19
Southern	32.6		36.09	54.12	71.39	89.65	90.63
South East	36.3		40.18	60.26	79.50	99.83	100.91
Scottish Tourist Regions							
Highland	1.4		1.55	2.32	3.07	3.85	3.89
Grampian	2.1		2.32	3.49	4.60	5.78	5.84
Dundee&Angus	0.3		0.33	0.50	0.66	0.83	0.83
Fife	4.3		4.76	7.14	9.42	11.83	11.95
Edinburgh & Lothians	2.7		2.99	4.48	5.91	7.43	7.51
Perthshire	4.0		4.43	6.64	8.76	11.00	11.12
AILLST	3.1		3.43	5.15	6.79	8.53	8.62
Glasgow & Clyde Valley	2.5		2.77	4.15	5.48	6.88	6.95
Ayrshire & Arran	0.7		0.77	1.16	1.53	1.93	1.95
Borders	0.7		0.77	1.16	1.53	1.93	1.95
Dumfries and Galloway	0.4		0.44	0.66	0.88	1.10	1.11
Welsh Tourist Regions							
North Wales	2.7		2.99	4.48	5.91	7.43	7.51
Mid Wales	2.5		2.77	4.15	5.48	6.88	6.95
South West Wales	2.6		2.88	4.32	5.69	7.15	7.23
South East Wales	4.7		5.20	7.80	10.29	12.93	13.07
Total	354.7		392.65	588.80	776.79	975.43	986.07

Table 14. Aggregate benefits by Government Office Regions.

			WTP estimates in GBP			
			WTP_{OE}	SBlin	DBlog	DBlin
	Day visits in millions (1998)	0.9/1.8	1.66	2.19	2.75	2.78
North East	3.20	3.54	5.31	7.01	8.80	8.90
North West	31.10	34.43	51.63	68.11	85.53	86.46
Yorkshire and Humberside	42.86	47.45	71.15	93.86	117.87	119.15
East Midlands	31.87	35.28	52.90	69.80	87.64	88.60
West Midlands	38.30	42.40	63.58	83.88	105.33	106.47
South West	35.88	39.72	59.56	78.58	98.67	99.75
Eastern	54.48	60.31	90.44	119.31	149.82	151.45
South East	68.35	75.66	113.46	149.69	187.96	190.01
London	13.94	15.43	23.14	30.53	38.34	38.75
England - Total	319.99	354.22	531.17	700.76	879.95	889.54

Figures

Figure 1



Appendix

Figure A1. Scatter plot and cumulative distribution of WTP and distance travelled

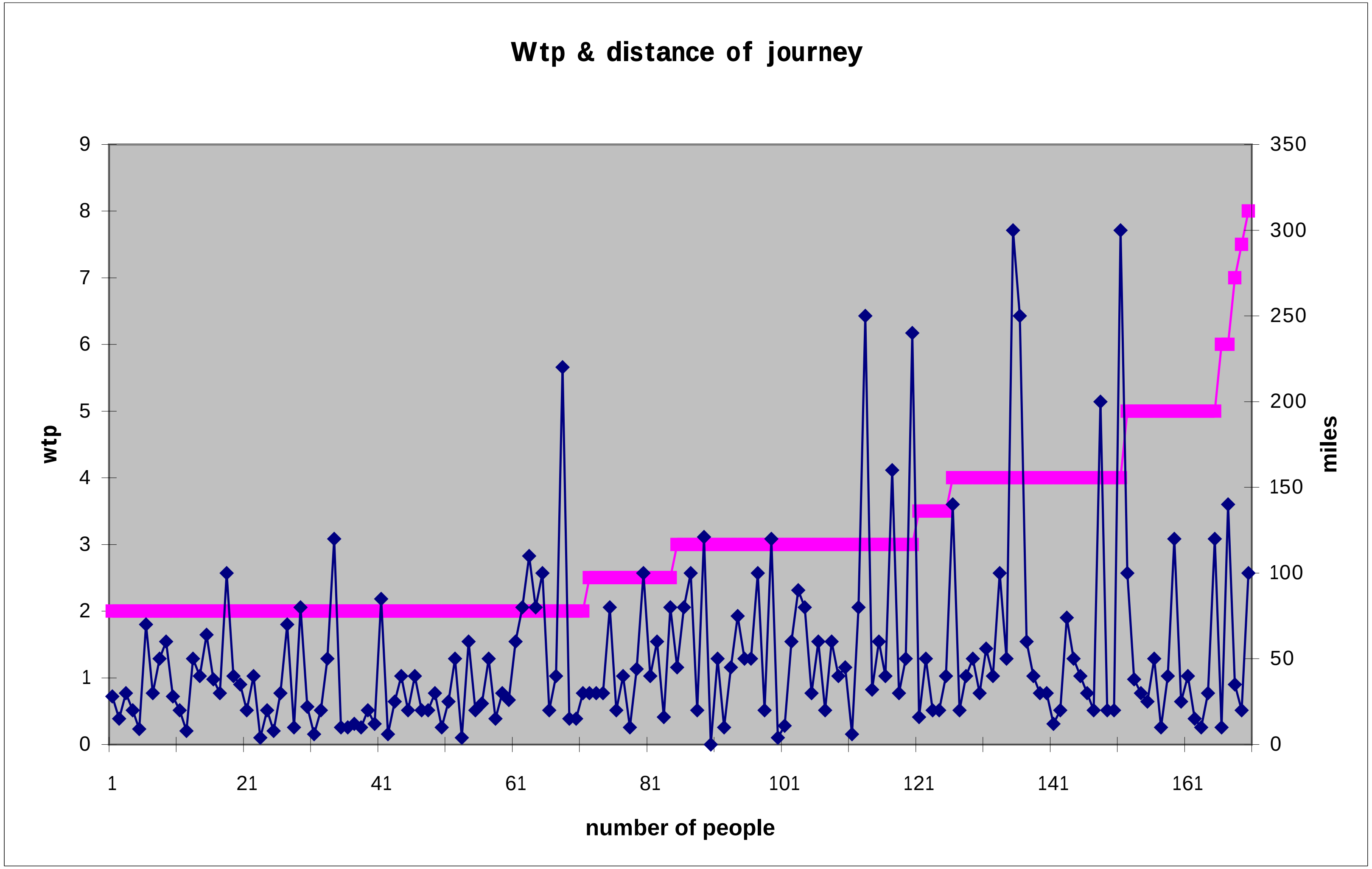


Figure A2. Histogram of number of visits per year by classes of travel distance.

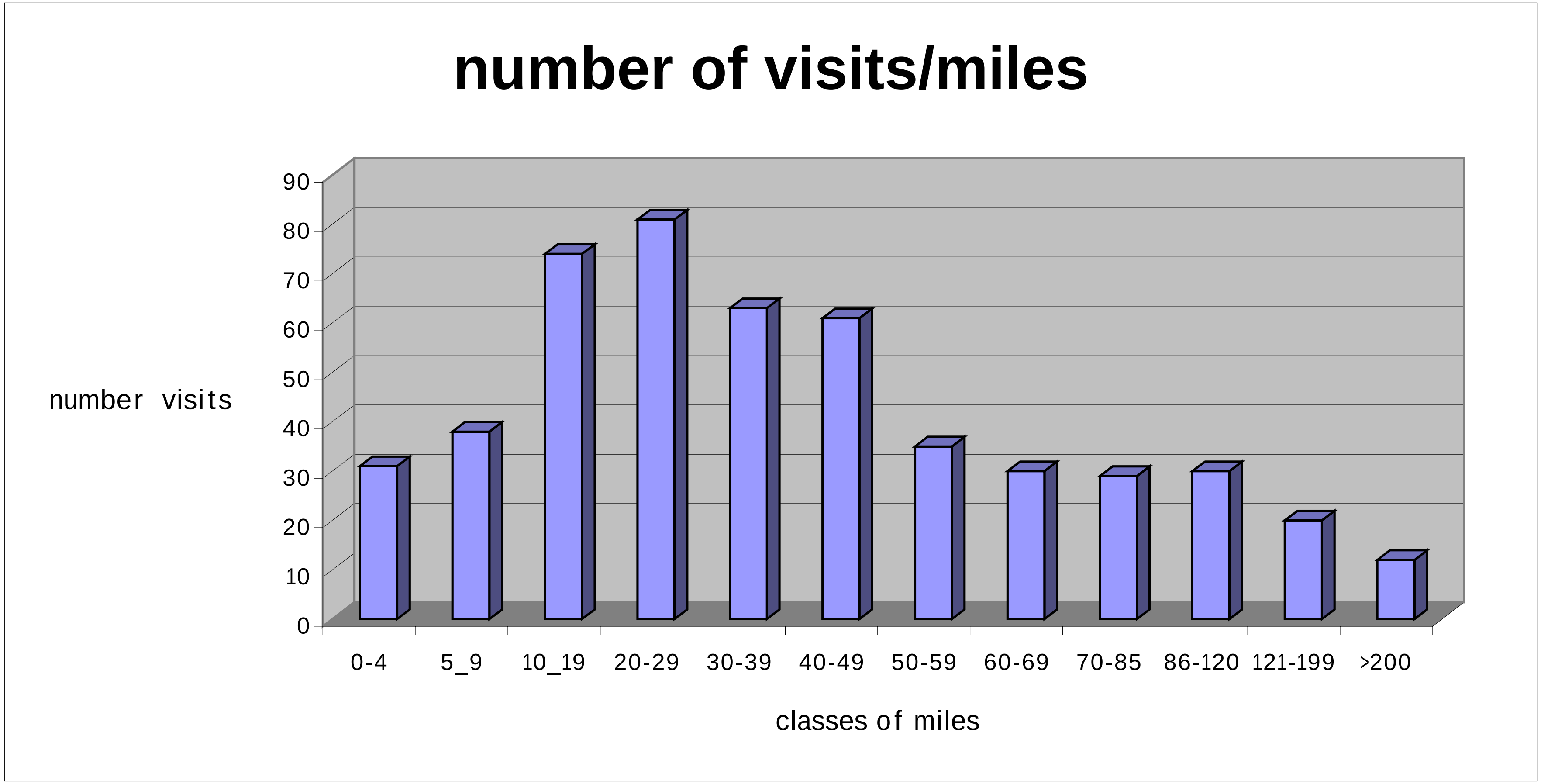


Table A1. Correlation among variables

	wtp	number	other vis.	miles route	% propo
WTP	1				
Party size	0.080	1			
Frequency of visit	-0.227	-0.172	1		
Distance travelled	0.273	-0.028	-0.177	1	
Percent of trip cost to forest visit	0.074	-0.087	-0.017	0.281	1

Table A2. Conditional mean WTP by frequency of visit

	less 2	from 2-5	from 6-10	from 11-50	greater than 50
Mean WTP	2.09	1.6	1.47	1.15	0.61
St. Dev. WTP	1.52	1.42	1.34	1.04	0.80

Table A4. Conditional mean WTP by size of visiting party

	less or equal 2	from 3 to 5	from 6 to 10	more than 10
Mean WTP	1.51	1.65	1.78	1.77
St.Dev. WTP	1.97	2.17	2.29	2.32