

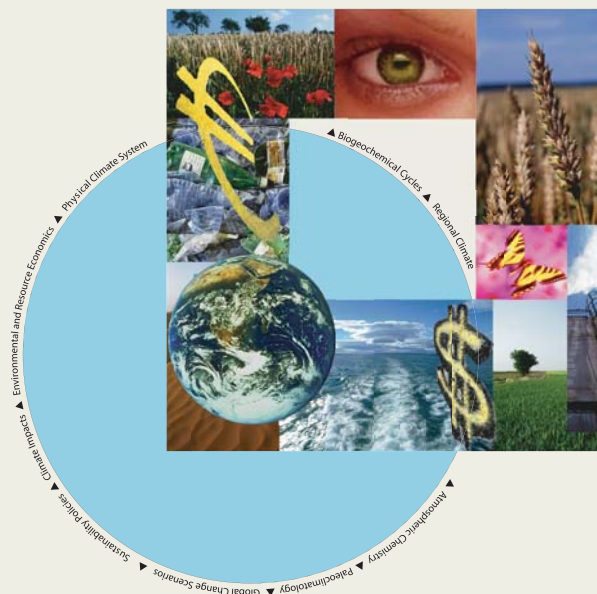


International Max Planck Research School on EARTH SYSTEM MODELLING

"Valuing Forest Recreation in Europe: Time and Spatial Considerations"

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EXECUTIVE SUMMARY

Forests produce a wide variety of useful market and non-market goods and services, such as timber, sequestration of carbon, protection of biodiversity and groundwater reservoirs and, especially in the developed world, also popular destinations for recreation. Since the UN Conference on Environment and Development in Rio 1992 and subsequent international and European Agreements, forests in Europe are now managed to a large extent as multi-purpose forestry, where recreation is acknowledged as one of the main contributors to welfare derived from forestry.

The forest resource covers nearly half of land area in Europe and continues to grow by approximately 802.000 ha per year. However, it is becoming increasingly difficult to find land suitable for afforestation, due to a competition for use of land, which drives up the cost of new afforestation activities (Miljøministeriet, 2000; MCPFE & UNECE/FAO, 2003). The emphasis on multi-purpose forestry means that economic appraisals of forest management practices and afforestation projects should take into account the provision of non-market benefits, such as recreation opportunities. It is therefore important for forest managers, planners and politicians to have appropriate economic tools that quantify the non-market benefit implications of how to manage the current forest resource and how and where to establish new forest sites.

This thesis estimates and analyses the values of forest recreation in Europe and considers the spatial and time aspects of valuing existing and new forest sites, given preferences for forest characteristics. The analysis of forest recreation values in Europe is conducted with a meta-analysis, which has not previously been done for Europe and includes exogenous variables on site characteristics, which is also new to meta-analysis. The estimation of total forest recreation values is carried out on state owned forests in a region in Denmark in 1977 and 1997 using a mixed logit specification of the random utility model (RUM) combined with Geographic Information System (GIS). A series of benefit transfers are conducted over time and space and validated against the 'true' values to ascertain the efficiency of transfers under different conditions. Validated benefit transfers over 20 years have not been attempted previously, primarily due to a lack of adequate data. Also the use of the mixed logit specification and GIS is novel in benefit transfer. The findings of the thesis reveal the variance of forest recreation values in Europe and identifies the main influences on

welfare. It also sheds light on the error structure of benefits transfers over time and space and provides policy relevant advice on valuing not yet established forest sites.

FOREST RECREATION BENEFITS IN EUROPE

Forest recreation values in Europe vary considerably. The meta-analysis on forest recreation valuation studies having applied the travel cost methods (TCM) showed that consumer surplus range as much as from €0.66 to €112 per trip with a median of €4.52 per trip (in PPP 2000 values). The meta-analysis, based on 25 studies from nine countries since 1979, ascertains the type of components that influence the value of forest recreation. It is conducted with a step-wise increasing number of variables where level I includes only data available from the studies, level II adds aggregate socio-economic variables and level III further includes site specific characteristics such as diversity of vegetation, fraction of open land, and location. The model selected as the best overall summary was the log of consumer surplus with an overall R^2 of 87%, which is considerably higher than in previous meta-analyses on outdoor recreation.

Main influences on forest recreation values in TCM studies are related both to the specification of the travel cost demand parameters and to the observed behaviour. In terms of influences from model specification, studies carried out by K.G. Willis, surveys conducted in Italy, the use of the individual TCM, as well as the inclusion of opportunity cost of time and the level of costs per kilometre, appeared to increase consumer surplus. This illustrates that modelling assumptions and research designs play a significant role in valuing sites, as has been found previously in the literature (Smith and Kaoru, 1990a; Smith and Kaoru, 1990b). In terms of observed behaviour, the average distance travelled by visitors and site characteristics including large forests and sites with many visits, monotone vegetation and diverse age classes positively influences consumer surplus. The chapter shows that meta-analyses would gain considerably from site attributes being included as additional data in original valuation studies.

PREDICTING CHANGES IN RECREATION VALUES OVER TIME

Assessing future values of forest recreation is highly relevant when planning long-term afforestation projects. In order to test the performance of predicting values over time, two different benefit functions of forest recreation are transferred from 1977 to 1997 and

compared with the 'true' value of recreation in 1997. The transfers are conducted over 52 state owned forests in the Copenhagen region of Denmark. In addition, changes in welfare over the same period and forests are quantified. Both the transfers and quantification of welfare in 1977 and 1997 show substantial changes.

The data used is based on two identical national visitor surveys in forests from 1976/77 and 1996/97 (Koch, 1980; Jensen, 2003) and representative national household surveys in 1977 and 1994 (Koch, 1978; Jensen and Koch, 1997). The benefit transfers and valuations of forest recreation are specified with multi-site discrete choice models that link mixed logit specifications of the random utility model (RUM) and a count data model to estimate total value of access per site. The estimation process is combined with Geographic Information Systems (GIS), which together with the mixed logit allows for heterogeneous preferences across the population and captures a larger proportion of site heterogeneity.

Some preferences for forest characteristics in the Copenhagen region in Denmark changed. People have developed a heterogeneous preference with 62% of the population preferring a species rich forest and 76% a dense forest whereas the 1977 sample did not show significant evidence of variance in preferences. Also, the full sample in 1997 appears to prefer tree stands older than 60 years compared to 82% in 1977. Commonalities of taste between the 1977 and 1997 sample include a favourable attitude towards coniferous vegetation (60%-64% of the sample), large forests (albeit at a marginal declining rate), sloped terrain and coastal proximity. The preference for coniferous forests in this region contrasts with findings at the national level, where only 40% prefer coniferous sites (Termansen, 2004b). A probable explanation is the prevalence of broadleaf forests in the metropolitan region, making sites dominated by coniferous vegetation seem more attractive.

The transfers over time compare the efficiency of transferring benefits over 20 years between a functional transfer model that update car-borne forest recreation demand to recent years (transfer type A) and a functional transfer that does not update the demand function to recent years (transfer type B). The non-updated transfer type B produces an error margin across the 52 sites of 434% on average. Updating the transfer model with present demand for recreation (Transfer type A) improves the error margins considerably by a factor of 4 on average. The median transfer error of model A is 4%, ranging from -74% to 234% of the 'true' value. 32 transfers of model A are found to be within a $\pm 50\%$

and 15 transfers within a $\pm 20\%$ error margin of the 'true' value. The confidence intervals of the two transfer models indicate that the values of 13 forests of transfer type A overlap the confidence interval of the 'true' model whereas only one transfer value of type B overlaps the confidence intervals of the 'true' model. The 14 transfers with overlapping confidence intervals were also the most successful transfers, producing error margins less than $\pm 24\%$.

A main contributor to the poor results of the transfer type B and the relatively good results of transfer type A is a pronounced shift in transport mode over the period towards other means of transport than cars when visiting forests. The transfer type B therefore predicts far more car-borne visits in 1997 than was observed (Koch, 1978; Jensen and Koch, 1997) and estimated in this thesis. A related aspect to the shift in transport mode is the higher travel cost parameter in the 1977 RUM, which indicates a preference for longer trips in 1977 than in recent times, despite a relatively higher petrol price in 1977. Transfer model A therefore tends to underestimate urban fringe forests close to Copenhagen by between -9% and -80% and to overestimate the value of remote forests by up to 240% .

The quantification of changes in welfare over time illustrates the effects of changes in site and travel preferences on recreation valuation. Generally, urban fringe forests have gained in value on average by 280% and values of forests further away from the densely populated areas have decreased by up to 100% . In addition, the case study of Vestskoven, which is a relatively new forest that was established in the 1970s on former agricultural and horticultural land at the outskirts of Copenhagen, showed a dramatic increase in value by nearly 70 times. This alters the ranking of the new forest from one of the least attractive in 1977 to one of the most attractive sites in the region in 1997. Both the gradual afforestation, increasing maturity and diversification of the vegetation in Vestskoven as well as the general change in preference towards urban forests has led to the steep increase in welfare over time.

PREDICTING RECREATION VALUES OVER SPACE

Benefit transfers over space remain the only option to quantify the value of new sites when using revealed preference valuation methods. Using the case study of Vestskoven and the 1997 discrete choice framework of the previous section, we perform and test three different scenarios of spatial benefit transfers where the choice set of policy sites differ

between i) a benefit transfer function based on 51 forests; ii) a benefit transfer based on attractiveness and iii) a benefit transfer based on urban fringe forests.

The first scenario clearly shows the importance of having the right variation in the policy site choice set in order to successfully transfer values to study sites. As Vestskoven was planned and managed differently from the remaining forest sites in the region, the variance in the policy site choice set is not sufficient to transfer a value close to the 'true' value. The transfer to Vestskoven therefore exaggerates the 'true' value by as much as 346%, which is the highest error produced across the 52 transfers. For the large majority of forests (36), transfers perform within a $\pm 20\%$ error margin.

The second scenario, which excludes the most attractive or the least attractive sites from the policy site choice set, indicates that excluding the most extreme sites worsen transfer efficiency and reconfirms the importance of appropriate variance in the policy site choice set. The Vestskoven transfer, when excluding the least attractive forests, leads to fairly decent results (31%-36% error) compared to a 330% transfer error when excluding the most attractive sites. The large transfer error of excluding the most attractive sites is attributable to the fact that Vestskoven is today one of the most popular forests, and hence excluding comparable sites from the choice set removes the appropriate variance in the transfer model.

The third scenario, where the choice set of policy sites only includes urban fringe forests, illustrates the importance of designing sampling with a sufficient variety in distances in order to estimate the marginal utility of income. The spatially narrow choice set excludes people who are willing to travel far and thereby prevents the model to detect a trade off in preferences between travelling further to an attractive site or visiting a local non-attractive forest. As a result, all forests in the region are underestimated and the transfer to Vestskoven is close to the average under-prediction (57% below the 'true' value).

CLOSING COMMENTS

This thesis attempts to illustrate the influences on welfare derived from forest recreation over space and time. Revealed preference valuation methods are well known to be sensitive to the specification of demand parameters and the substantial randomness in non-linear functions (Haab and McConnell, 2002). The reason can be found in the connection that the researcher creates between observed market behaviour and values, through strategic research decisions. The meta-analysis shows this clearly through the

significant influence of some authors and countries on consumer surplus or the use of the individual TCM approach leading to higher values than when using the zonal TCM.

The discrete choice models are also subject to the same sensitivity in the specification of the demand framework. For instance, we voluntarily omit the opportunity cost of time from the overall travel costs to avoid a purely researcher defined level of time value.

Previous travel cost studies have used average wage rates ranging from 0% to 100% of hourly wages. Adding this component would increase the estimated values. Another influence on welfare is the strategic choice of recreation demand modelling, which in this thesis follows the approach of Bockstael, Hanemann and Strand (1986) by linking the site selection and visit frequency in two stages. This can be modelled differently, for instance by using the approach of the Kuhn-Tucker model (Wales and Woodland, 1983; Hanemann, 1978) or the repeated nested logit model (Morey et al., 1993), where the site selection and participation decision are modelled simultaneously. It could be useful to assess the differences between these models on the Danish datasets in future research.

This thesis also shows that recreational welfare depends to a large extent on the characteristics of sites, the ease of access and substitution possibilities. It is therefore more than necessary that original studies start to include detailed information on site characteristics for use in benefit transfers and meta-analyses.

The performance of benefit transfers over space and time clearly indicates that we cannot completely do without original valuation studies, especially when we wish to value sites that are atypical and/or when determinants of welfare, such as recreation patterns, change substantially over time.