Scoping Study on Valuing Ecosystem Services of Forests Across Great Britain

Case Study (Annex 3)

for the Forestry Commission

October 2011

eftec
73-75 Mortimer Street
London W1W 7SQ
tel: 44(0)2075805383
fax: 44(0)2075805385
eftec@eftec.co.uk
www.eftec.co.uk

This document has been prepared by:

Economics for the Environment Consultancy Ltd (eftec)
73-75 Mortimer Street
London
W1W 7SQ

Study team (in alphabetical order):

Prof. Ian Bateman (University of East Anglia and eftec associate)
Dr Amii Darnell (University of East Anglia)
Mr Adam Dutton (eftec)
Mr Tom Haynes (NatureBureau)
Mr Lawrie Harper-Simmonds (eftec)
Dr Paul Munday (University of East Anglia)
Miss Zara Phang (eftec)
Mr Allan Provins (eftec)
Dr Antara Sen (University of East Anglia)
Dr Rob Tinch (eftec)
Prof. Ken Willis (University of Newcastle upon Tyne and eftec associate)

Acknowledgements

The study team would like to thank the members of the steering group, consultees, and others who have helped with input and comment throughout the study: Pat Snowdon (Forestry Commission GB), Jennifer McVey (Forestry Commission GB), Sarah Andrews (Defra), Nick Atkinson (Woodland Trust), Stuart Goodall (CONFOR), Gordon Patterson (Forestry Commission Scotland), Jonathan Spencer (Forestry Commission England), Gregory Valatin (Forest Research), Mike Wood (RSPB), Julia Garritt (Forestry Commission Scotland), Chris Nixon (Forestry Commission Scotland), Mike Christie (Aberystwyth University), Rob Gazzard (Forestry Commission), Julian Harlow (Natural England), Jane Karthaus, Donald McPhillimy (New Caledonian Woodlands), Tanya Ogilvy (SEPA), Chris Quine (Forest Research), Joanna Silver (Markit Environmental), Jason Sindon (UPM Tillhill), Jo Treweek (Treweek Environmental Consultants) and Bill Watts (Environment Agency for England and Wales). With apologies to any inadvertent omissions from this list. As ever, any errors are the responsibility of the authors alone.

ANNEX 3: CASE STUDY – RECREATION VALUE OF ESTABLISHING NEW URBAN FRINGE WOODLAND

Introduction

This case study considers a scenario in which 100 hectares (ha) of farmland is converted into a recreation-focussed, urban fringe, woodland site. The aim is to test the approach for valuing recreation developed and demonstrated in the UK NEA by Sen et al. (2011). The analysis provides a useful counterpoint to the approach applied in eftec (2010b) which derived per hectare recreation values based on available evidence for recreation benefits and visitor numbers (**Box A3.1**).

Box A3.1: The economic contribution of the public forest estate in England

eftec (2010b) sets out a methodology for a broad assessment of the social, economic, and environmental contribution to public benefit of the public forest estate (PFE) managed by the Forestry Commission (FC) in England. Included within this is the use of value transfer to estimate the benefits of the provision of recreation facilities. Based on available literature the following values per visit are assumed:

- 'High facilities' woods and forests: £12.50 per visit; and
- 'Low facilities' woods and forests: £2.50 per visit.

Using data provided by FC England, the analysis assumes visits range from 74 visits per hectare per year for rural woodland with low facilities, to 400 visits per hectare per year for peri-urban woodland with high facilities, and 1,145 per hectare per year for urban community woodlands. Combining this with the area covered by each woodland type, the following value per hectare estimates are calculated:

- Urban community woodland: £2,850 per ha per year;
- Peri-urban, high facilities: £4,000 per ha per year;
- Peri-urban, low facilities: £400 per ha per year;
- Rural, high facilities: £2,400 per ha per year; and
- Rural, low facilities: £180 per ha per year.

In aggregate these figures result in a total estimate of around £160m per year for recreation in the PFE, or about £740 per hectare per year. Notably this is higher on a per hectare basis than implied by previous estimates (e.g. Willis et al., 2003 as part of the SEBF), although this is expected since eftec (2010b) applied higher values per visit, which in part is based on higher values reported in Christie et al. (2005) (see Section 3.2.3).

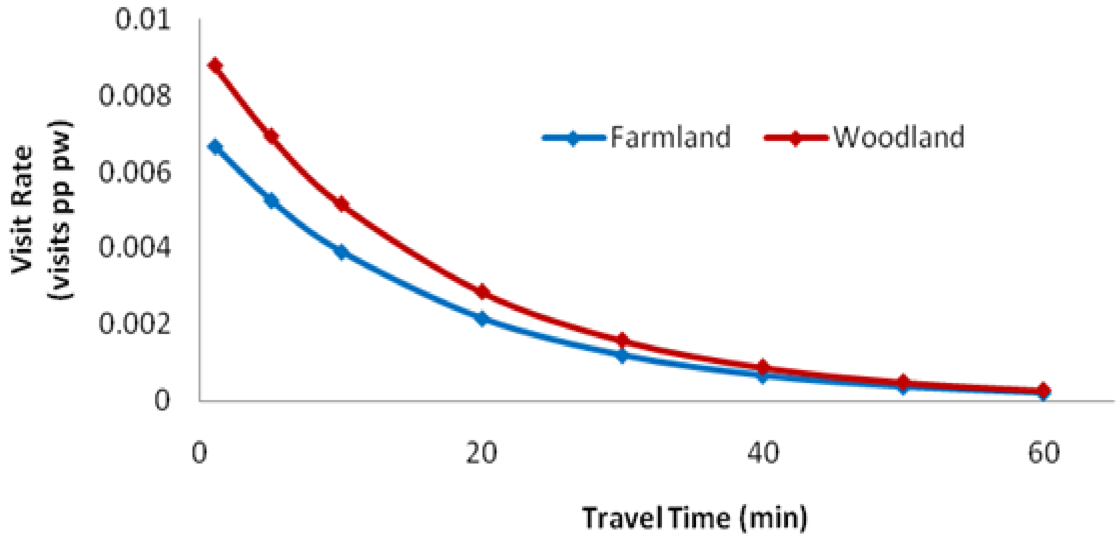
eftec (2010b) notes that there are significant reservations about using values per hectare for recreation benefits. In particular neither visit numbers nor per visit values are linearly related to forest size, but rather both diminish rapidly once a forest reaches a certain size. Moreover the number of visitors also diminishes rapidly as distance from population increases (the 'distance decay' effect – see the Jones et al. (2010), Bateman et al. (2006)). It suggests that a spatial analysis in a GIS framework, taking explicit account of location and substitute sites, would be the preferred approach.

The approach presented in the UK NEA features a trip generation function (TGF) that is used to predict recreation visits to various habitat types, including coastal and marine, urban, freshwater, grassland, enclosed farmland, and mountain (see **Appendix A**). It enables the estimation of visit numbers to a given site from a specified outset area; i.e. where visitors start their journey from, typically defined in terms of a Census lower super output area[1].

The UK NEA methodology considers all feasible outset areas (including up to, if desired, all of the UK). This approach has certain advantages, since it means that along with characteristics of the destination site (e.g. woodland, farmland, etc.), the characteristics of each separate outset area can be controlled for in the analysis. These include: (i) the travel time and cost from each potential outset area to the destination site; (ii) the availability of substitute recreational resources; and (iii) a selection of household socio-economic characteristics (including income).

To provide an illustration of the TGF results, **Figure A3.1** shows that, at almost any travel time, woodland is significantly more attractive to recreational visitors than enclosed farmland. However, the strong influence of travel time shows that both land uses become relatively less attractive for visits the further away a site is from an outset location, demonstrated by the decline in visit rate (per week) as travel time increases.

Figure A3.1: TGF predictions - travel time impacts on visit rate for woodland and farmland sites (Sen et al., 2011)



Source: Sen et al. (2011) and the SEER project.

Figure A3.1 therefore shows the classic 'distance decay' effect. This means that the site location is a significant determinant of the number of visitors that are attracted to the area. An implication of this is that urban fringe woodland sites close to large populations are likely to attract more visitors than similar sites with similar facilities located in more remote areas.

Identifying a case study site

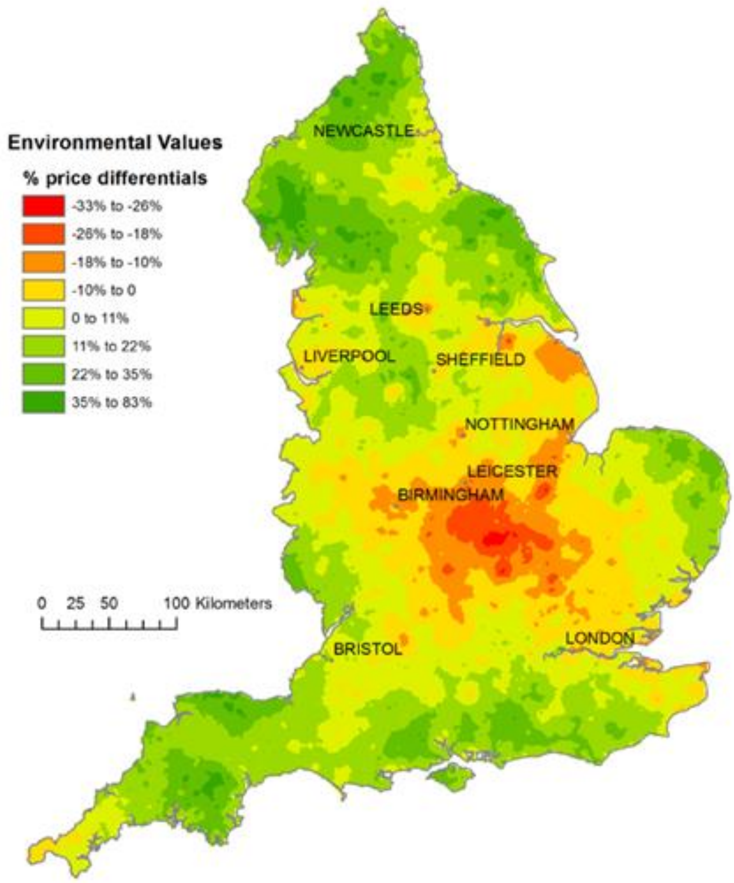
Prior work (e.g. Jones et al., 2010) shows that locating recreational resources in areas which already have large number of substitute sites is unlikely to provide a clear demonstration of the potential impact for gains from such policies. Therefore this case study focuses on an area with demonstrably relatively poor environmental resource availability. Such a site is provided by the analysis of environmental amenity values undertaken by Mourato et al. (2010) as part of the UK

[1] Lower super output area (LSOA) is a geographical area designed for the collection and publication of small area statistics. They have a minimum population of 1,000 (mean average population across all is 1,500). In England and Wales there are 34,378 LSOAs.

NEA. Mourato et al. undertake a hedonic property pricing analysis to predict house price differentials that can be attributed to variations in the level of environmental amenities across England. This is achieved by holding constant the difference in house types and non-environmental characteristics across areas and only looking at the impact on house prices arising from variations in environmental quality.

The resulting predictions show the variation in prices (around the mean house price value) in England that arise due to variations in environmental quality. The results are mapped in **Figure A3.2**. Areas in which environmental quality has the strongest positive impact on house prices are shaded in green, while negative impacts are shown in red. Given that the mean house price in 2008 was just under £200,000, this implies that in areas of the highest environmental amenity values, implicit prices were up to £68,000 higher than the average. Annualised over a long time horizon, this is equivalent to nearly £2,000 per year using the Green Book (HM Treasury, 2003) discount rates. The highest values are seen in areas such as the Lake District, Northumberland, North York Moors, Pennines, Dartmoor and Exmoor.

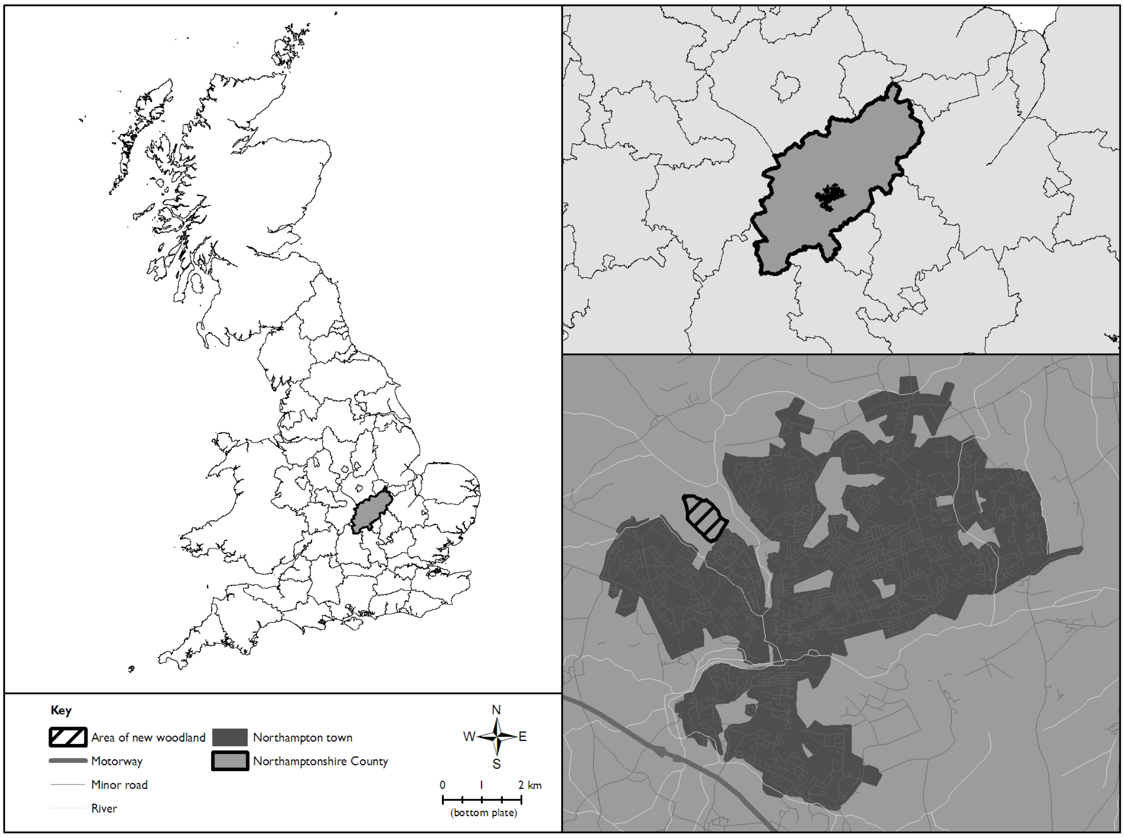
Figure A3.2: Geographical distribution of environmental value (predicted price differentials from property value regressions)



Note: % price differentials are based on log price differentials, and correspond to maximum % differentials relative to the national mean price level. Source: Mourato et al. (2010).

Based on Figure A3.2, the town of Northampton (the centre of the red area in the figure) can be suggested as an appropriate case study site. Examining this area in detail, it is possible to identify a potentially suitable site, which would be an area currently under agricultural use, very close to the city centre and surrounded by developed land on three sides (housing and industrial use). Such an area is shown in **Figure A3.3** which features some woodland and a golf course to the north. The site ('area of new woodland') is 100 ha (1 km^2).

Figure A3.3: Location of case study site, urban fringe of Northampton



Notes: Centre-point located at Easting: 473117, Northing: 263422.

Predicting visitor numbers

Based on the characteristics of the case study site, the TGF can be applied to predict the annual number of visitors that would arrive at the new woodland[2]. The TGF is applied to predict visitor numbers for the baseline situation (without the woodland site) and for the scenario with the woodland. The estimated change in the number of predicted annual visits to the case study site is presented in **Figure A3.4**.

[2] The total number of visits per annum is calculated by calibrating the predicted weekly visits obtained from the TGF to data for total estimated visits for outdoor recreation in England reported in the MENE survey (Sen et al., 2011). Estimated visit numbers are generated for the 5km × 5km cell in which the 100 hectare woodland site is located.

Figure A3.4: Estimated change in annual visit numbers to case study site

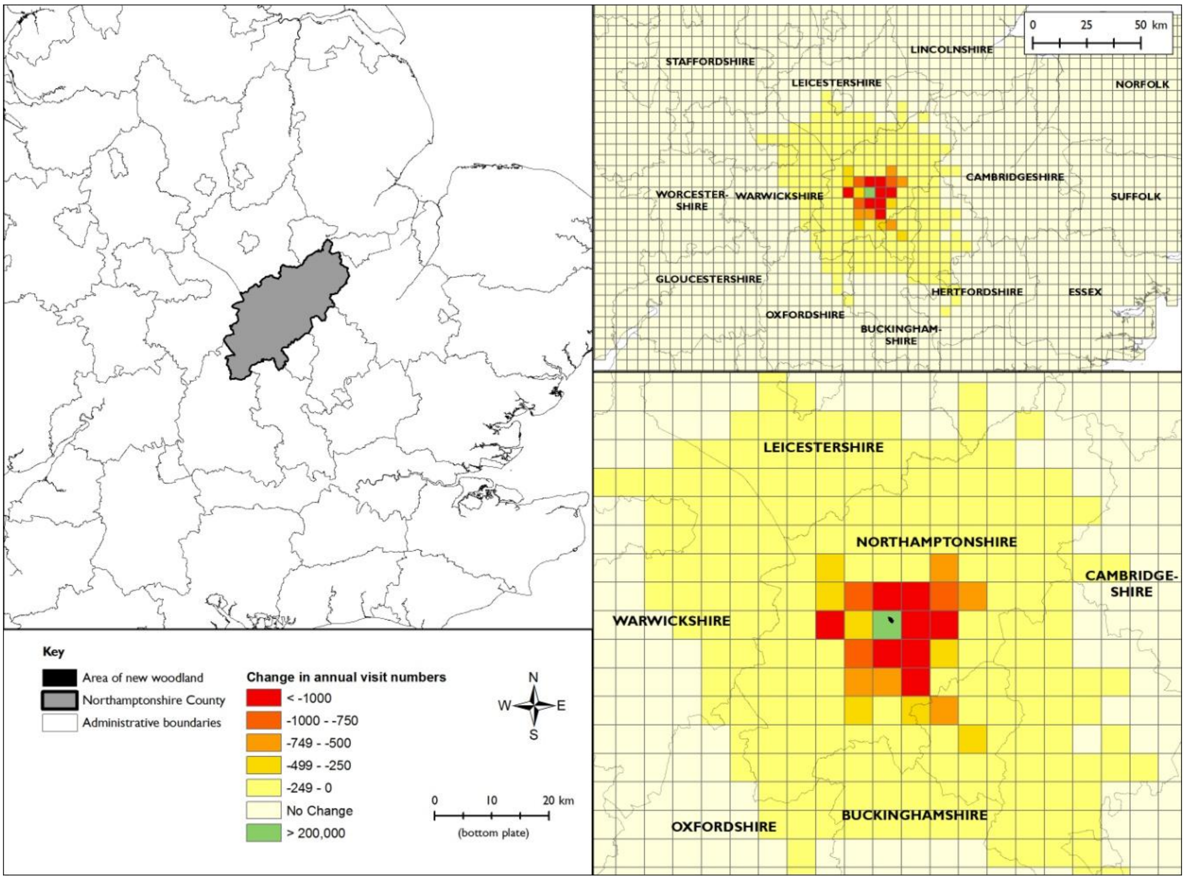


Figure A3.4 shows that visits to the 5 km × 5 km cell that contains the new 100 hectare woodland site increase by approximately 215,000 per year. The analysis also predicts a small decline in visit numbers to surrounding 5 km × 5 km cells due to substitution effects; i.e. visits that are transferred to the new woodland site from other sites in the local area.

Valuing the change in recreation visits

Sen et al. (2011) undertake a meta-analysis of over 100 valuation studies encompassing methods ranging from travel cost analyses (that examine visit behaviour relative to the costs of trips) to stated preference methods (which use surveys to directly elicit visitors' valuations) (see **Appendix B**). The meta-analysis model estimated by Sen et al. explains recreational values obtained from the various studies as a function of: (i) the characteristics of the recreational site being valued (i.e. whether the site is a mountain, freshwater lake, grassland etc. and whether the site is designated or not); (ii) the characteristics of the studies used in the meta-analysis (e.g. the sample size, whether substitute sites were considered, the valuation methods used, etc.); and (iii) the characteristics of the country in which the study sites are located (e.g. population density). To enable comparability across studies, the value estimates from non-UK studies are adjusted using a purchasing power parity index and all estimates are converted to consistent UK £ (2010) prices.

The results indicate that a recreational trip to woodland generates a higher value than a trip to a farmland site. Applying the model to estimate the value of visits to the new woodland site gives an estimated mean WTP of £3.20 per visitor per trip. Over 215,000 visits per year this equates to an annual recreation benefit value of approximately £0.69 million per year[3].

For the purpose of sensitivity testing, the Sen et al. estimate can be compared to values reported in previous studies and also the 'per hectare' approach applied in eftec (2010b)(Box A3.1). For example, Bateman and Jones (2003) in their meta-analysis of the informal recreational value of woodlands estimate WTP values between £0.12 - £5.04 per visitor per trip (in 2010 prices). Similarly Scarpa (2003) reports values in the range £2.00 - £3.20 per visit (in 2010 prices). **Table A3.1** provides a comparison of estimated annual benefits.

Table A3.1: Comparing estimated benefit values

Source	*Unit value (2010 prices)*	*Estimated annual benefit*
Sen et al. (2011)	£3.20 per visit	£0.69m
Bateman and Jones (2003)	£0.12 - £5.04 per visit	£0.03m - £1.09m
Scarpa (2003)	£2.00 - £3.20 per visit	£0.42m - £0.70m
eftec (2010b)	£400 - £4,000 per hectare	£0.04m - £0.40m

Based on Table A3.1, the annual benefit value estimate using the Sen et al. meta-analysis model is comparable to high end estimate using Scarpa (2003) results, and a 'mid-point' estimate based on Bateman and Jones (2003). Comparison to the eftec (2010b) estimate provides an interesting result; while the unit value is much higher in eftec (2010b), the predicted number of visits is much lower. That is, explicitly controlling for site characteristics, travel distance, substitute availability and socio economic factors yields a higher total benefit estimate. Depending on woodland type the assumed number of visits ranges from 75 – 1,145 per hectare in eftec (2010b); the implied figure for the new woodland site using the TGF is 2,150 visit per hectare.

The key caveat to the comparison of the eftec (2010b) approach and that of the UK NEA is that – using the empirical findings of Mourato et al. (2010) - the case study selects a site location that has relatively poor environmental resource availability. It represents an 'extreme' case where the benefit of establishing a new woodland site is likely to be significant. Therefore it is reasonable to expect that the eftec (2010b) approach will under-estimate potential benefits in these circumstances given that is based on 'average' visit rates across the entire public forest estate. Overall this comparison ably demonstrates the point highlighted in Section 2.2.1 of the main report that ecosystem service values are context-specific and determined by a range of spatially dependent factors.

Comparing costs and benefits of establishing a new woodland site

In practice comparing the various annual benefit estimates presented in Table A3.1 is only informative to a certain point; i.e. emphasising that estimating visit numbers is as equally important as the actual unit values that are applied when estimating benefits. The practical

[3] This is likely to represent a slight over-estimate of *net* benefits since it does not account for visits that are transferred from other sites in the local area (see Figure A3.4). However the substitution effect is relatively small compared to the additional visits that are generated. Furthermore as the meta-analysis model results demonstrate, woodland trips are valued relatively highly compared to most other habitats, so even the individual 'transferred' visits will receive higher benefit from woodlands than the previous location.

significance of this issue, and the importance of assumptions made in light of limited information availability, should be assessed by considering the wider decision-making context. For instance sensitivity in benefit estimates can be compared to indicative costs of woodland establishment to determine the accuracy and 'weight of evidence' required to support decision-making.

The costs of woodland establishment range between £7,000 - £10,000 per hectare in England, depending on woodland type and various other factors such as the stocking density of trees[4]. Note that this is based on Forestry Commission woodland establishment costs (but it is assumed to be indicative of private woodland establishment costs) and covers various activities required over the first 5 years of operation. It does not include the cost of land purchase.

The RICS Rural Land Market Survey reports that the current national average price for farmland transactions is approximately £7,500 per acre (about £18,500 per hectare), while the assessed 'bare' land value is approximately £6,100 per acre (about £15,000 per hectare)[5]. Using the lower of the two values, this is gives an indicative total land purchase cost of approximately £1.53 million for 100 ha. Adding in the cost of woodland establishment gives an estimated total (undiscounted) cost for the site of between £2.5 million and £3 million.

Comparing the indicative cost to the results in Table A3.1 suggests that the recreation benefits *alone* from the new woodland site would 'pay back' the land purchase and establishment costs within a maximum of 15 years (assuming that visits commence in year 5 following initial woodland establishment actions). Specifically the 'pay back' period is 10 years if the Sen et al. estimate is used (approximately £3.3 million present value over 10 years); 8 years if Bateman and Jones (2003) estimate is used (£3.6 million present value over 8 years) and 14 years if the eftec (2010b) estimate is used (£3.0 million present value over 14 years). Overall the comparison of estimated benefits (based on the range of sources) to indicative costs suggests, on cost-benefit grounds at least, there is a strong case for woodland establishment, particularly given that wider benefits (e.g. potential carbon sequestration gains) are not considered.

More generally, the case study provides further and explicit recognition of the substantial non-market values that can be derived by local populations from woodlands. This emphasises the need for decision-making at both the local and national to take account of all ecosystem services (market and non-market) that arise from land use management options.

[4] Pers. Comm. J.McVey (Forestry Commission), July 2010.
[5] See RICS Rural Land Market Survey (2011):
http://www.rics.org/site/download_feed.aspx?fileID=10220&fileExtension=PDF
Note that these values may over-estimate the unit cost of land purchase, since forest planting tends not to happen on high quality agricultural land. The bare land value excludes the residential element of farmland.

ANNEX 3 – APPENDIX A

Trip generation function: Predicting visit numbers from an outset location to a site destination

Variable	Variable definition	Coefficient	z
Travel time from a LSOA/DZ to a site	Time from population weighted centroid of LSOA or DZ to destination cell geometric centroid	-0.1753***	(-163.03)
Coast substitute availability	Percentage of habitat (NEA definitions) within 10 km radius of outset point. Outset taken as pop w centroid of LSOA or DZ.	-0.0210***	(-5.98)
Urban substitute availability		-0.0226***	(-28.46)
Freshwater substitute availability		-0.1085***	(-7.00)
Grassland substitute availability		-0.0204***	(-7.64)
Woodland substitute availability		-0.0212***	(-8.60)
Other marine substitute availability		-0.0057***	(-4.81)
Mountain substitute availability		0.0088	(1.80)
% of coast in site	Percentage of habitat (NEA definitions) within each 1 km cell (estimation) and 5 km cell (prediction).	0.0050*	(2.84)
% urban in site		-0.0064***	(-11.28)
% of freshwater in site		0.0196***	(7.11)
% of grasslands in site		0.0023	(1.72)
% of woodlands in site		0.0082***	(7.45)
% of estuary and ocean in site		-0.0282***	(-17.70)
% of mountain & heath in site		0.0251***	(9.00)
% non-white ethnicity		-0.0051***	(-5.20)
% Retired		0.0068***	(3.63)
Median Household Income		0.0000117***	(11.55)
Total Population of outset area		0.000277***	(6.92)
Constant		-1.122***	(-12.33)
lnsig2u			
Constant		-0.705***	(-19.31)
Observations		4139440	

Notes: The dependent variable is the number of visits from a specified small area Census unit (LSOA in England and Wales; DZ in Scotland) to a specified site.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
The substitute availability variables are calculated as the percentage of a specified land use type within a 10km radius of the outset point.
Enclosed farmland is taken as the base case for both the 'substitute availability' and 'site' characteristic variables.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Notes: log sigma2u = natural logarithm of the variance of the random intercept term in the multilevel model. The random intercept term captures the unobserved heterogeneity between the different sites.
Estimated using a Multilevel Poisson regression model

Source: SEER project (n.b. the TGF reported above is an updated version of the results reported in Sen et al., 2011)

ANNEX 3 – APPENDIX B

Meta-analysis (MA) model of recreational value estimates (£, 2010) (Sen et al., 2011)

Variable	Variable definition	Coefficient	t-stat
Good characteristics[1]			
Mountains & heathlands	1 if recreational site valued is mountain or heath; 0 otherwise	1.771*	(1.834)
Grasslands, farm & woods	1 if recreational site valued is Grasslands, farm and woodlands; 0 otherwise	0.579*	(1.886)
Freshwater, marine &coastal	1 if recreational site valued is Freshwater, marine &coastal; 0 otherwise	0.222	(0.763)
Designated site	1 if recreational site is holds some official designation; 0 otherwise	0.0225	(0.121)
Study characteristics			
Published	1 if study published in peer-reviewed journal or book; 0 otherwise	0.133	(0.468)
Survey year	Discrete variable: 1 = published in 1975, to 29 = published in 2008	0.0360	(1.364)
Log sample size	Logarithm of sample size	-0.493**	(-2.143)
in-person interview	1 if survey mode is in-person; 0 otherwise	0.130	(0.469)
Use value only	1 if use value study; 0 otherwise	0.372*	(1.787)
Substitutes considered	1 if substitute sites included in the valuation study; 0 otherwise	-0.117	(-0.570)
Valuation unit[2]			
Per household per year	1 if value in terms of per household per year; 0 otherwise	2.825****	(8.583)
Per person per year	1 if value in terms of per person per year; 0 otherwise	2.090****	(6.251)
Other valuation unit	1 if value in terms of per household/person, per day/ month; 0 otherwise	2.101****	(4.648)
Valuation method[3]			
RPM & mixed valuation	1 = revealed preference or mixed valuation methods; 0 otherwise	1.494**	(2.335)
Open-ended format	1 = stated preference using open-ended WTP elicitation format; 0 otherwise	-0.363*	(-1.838)
Payment vehicle-tax	1 = payment vehicle is a tax; 0 otherwise	0.351	(1.316)
Study country characteristics			
Log of population density	Population density of state/country in which the site is located	0.360	(1.206)
Non-UK countries[4]	1 = study conducted overseas; 0 otherwise (UK)	1.193***	(3.215)
Constant		-0.110	(-0.123)
Observations		193	

Dependent variable is logarithm of recreational value (WTP or consumer surplus) (£, 2010)

1. Omitted land use base case = urban environments
2. Base case for valuation units is per person per visit
3. Base case for valuation method is close-ended stated preference methods
4. Non-UK countries considered: North America, Western Europe, Australia and New Zealand.

Estimated using OLS with Huber White standard errors * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

REFERENCES

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.

Bateman, I. and Jones, A. (2003), Estimating the value of informal recreation at British Woodlands: A multilevel meta-analysis, Part 2 in Jones, A., Bateman, I. and Wright, J *Estimating arrival numbers and values for informal recreational use of British woodlands*, Final report to the Forestry Commission, CSERGE.

Christie, M., Hanley, N., Garrod, B., Hyde, T., Lyons, N., Bergman, A., and S. Hynes (2005), *Valuing Forest Recreation Activities*: Final Phase 2 report, Report to the Forestry Commission.

eftec (2010b), *The Economic Contribution of the Public Forest Estate in England*, Report to Forestry Commission England.

HM Treasury (2003), *The Green Book: Appraisal and Evaluation in Central Government*. The Stationery Office, London.

Jones, A., Wright, J., Bateman, I. and Schaafsma, M. (2010), Estimating Arrival Numbers for Informal Recreation: A Geographical Approach and Case Study of British Woodlands, Sustainability, MDPI, *Open Access Journal*, vol. 2(2), pages 684-701, February.

Mourato, S., Atkinson, G., Collins, M., Gibbons, S., MacKerron, G., Resende, G., Church, A., Molloy, D., Morling, P., & Pretty, J. (2010), *UK National Economic Assessment: Assessment of Ecosystem Related UK Cultural Services*.

Scarpa, R. (2003), The Recreation Value of Woodlands. Social & Environmental Benefits of Forestry Phase 2, Report to the Forestry Commission, Edinburgh. Centre for Research in Environmental Appraisal and Management, University of Newcastle upon Tyne.

Sen, A., Darnell, A., Crowe, A., Bateman, I.J. and Munday, P. (2011), Economic Assessment of the Value of Open-Access Recreation in UK Ecosystems: A Scenario Analysis, Report to the UK National Ecosystem Assessment, Centre for Social and Economic Research on the Global Environment (CSERGE), School of Environmental Sciences, University of East Anglia.

Willis, K., Garrod, G., Scarpa, R., Powe, N., Lovett, A., Bateman, I.J., Hanley, N., Macmillan, D.C. (2003), *The social and environmental benefits of forests in Great Britain*. Forestry Commission.