Economic Analysis of Cultural Services

Executive Summary, December 2010

Susana Mourato, Giles Atkinson, Murray Collins, Steve Gibbons, George MacKerron and Guilherme Resende

Department of Geography and Environment

London School of Economics and Political Science

Houghton Street

London WC2A 2AE

United Kingdom

Summary:

In this executive report we present an economic evaluation of key cultural benefits provided by ecosystem services in the UK. We estimate both an aggregate measure of cultural benefits (as embodied in nature's amenity values) as well as selected individual cultural benefits (such as non-use values, education and ecological knowledge, and physical and mental health).

Firstly, we present a new hedonic price analysis of the *amenity value* provided by broad habitats, designated areas, private gardens and other environmental resources in the UK and in England. We define amenity value as the increased well-being associated with living in or within close proximity to desirable natural areas and environmental resources. This increased well-being can potentially be derived from increased leisure and recreational opportunities, visual amenity, increased physical exercise opportunities and possibly mental or psychological well-being. Our analysis is based on actual observed market data, namely house transactions, and assumes that the choice of a house reflects an implicit choice over the nearby environmental amenities so that the value of marginal changes in proximity to these amenities is reflected in house prices. Overall, we conclude that the house market in England reveals substantial amenity value attached to a number of habitats, designations, heritage sites, private gardens and local environmental amenities.

Secondly, we estimate the economic value of *educational and ecological knowledge* provided by ecosystem services based on the value of ecological knowledge acquired through school education in England. The core of our investigation is the ecological knowledge acquired through the national curriculum of subjects such as Geography and Biology, but we also look into other children's nature-based educational experiences such as school trips. Our findings suggest that the value of ecological knowledge embodied in successful student outcomes in (relevant) GCSE and A-level examinations is substantial at just over £2.1 billion.

Thirdly, we compute a measure of the ecosystem-related *non-use values* that can be observed in market data. Specifically, we analyse legacies to key nature and conservation organizations in the UK as a proxy for observable non-use values. Overall, the total legacy income earned by environmental charities in 2008/09 was £97 million which constitutes 7% of all charitable legacies.

We conclude our report with an analysis of the *physical and mental health effects* associated with natural spaces and related ecosystems in the UK. We analyse both the health benefits arising from increased physical exercise and those arising from more passive forms of contact with nature. Some of our analysis is based on geo-located data from a new national web-survey that estimated the physical functioning and emotional wellbeing associated with use of and proximity to natural spaces. We estimate that a change in natural habitats that causes a 1 percentage point reduction in sedentary behaviour would provide a total benefit of almost £2 billion across a range of conditions. However, we found no conclusive evidence on the strength of the relationship between the amount of green space in the living environment and the level of physical activity. We did find positive links between proximity of the home to specific habitat types (farmland, freshwater and broadleaf woodland) and the health-related utility score. We also found strong positive relationships between green views from the home and emotional wellbeing and health utility, and between regular use of gardens and green spaces and physical health, emotional wellbeing and health utility.

1. Amenity value of nature in the UK

Using a hedonic price approach (Sheppard, 1999), we estimate the *amenity value associated with proximity to habitats, designated areas, heritage sites, domestic gardens and other natural amenities*. There is a long tradition of studies looking at the effect of a wide range of environmental amenities and disamenities on property prices. But, to our knowledge, this is the first nationwide study of the value of proximity to natural amenities in England.

We analysed 1 million housing transactions over 1996-2008, with information on location at full postcode level, from the Nationwide building society, along with the sales prices and several internal and local characteristics of the houses. We considered a large number of environmental characteristics:

- broad habitats (which we constructed from the Land Cover Map 2000) describing the physical land cover in terms of the share of the 1km x 1km square in which the property is located (such as marine and coastal margins; freshwater, wetlands and flood plains; mountains, moors and heathland; semi-natural grasslands; enclosed farmland; coniferous woodland; broad-leaved / mixed woodland; urban; and inland bare ground);
- land use share variables, taken from the Generalised Land Use Database (CLG, 2007), depicting the land use share in the Census ward in which a house is located (such as domestic gardens, green space and water);
- designation status, reflecting the proportion of Green Belt land and of National Park land in the Census ward in which a house is located; and
- distance to various natural and environmental amenities, such as coastline, rivers, National Parks and National Trust properties.
- We used several control variables in the hedonic regressions to account for omitted characteristics that affect prices and are correlated with environmental amenities, and which would otherwise bias our estimates (e.g.

distance to transport infrastructure, distance to the centre of the local labour market, local school quality, land area of ward, population density and a range of house characteristics such as property type, floor area, tenure, age, number of bathrooms, number of bedrooms, etc).

We ran a number of ordinary least squares hedonic property value models in which the dependent variable was the natural log of the sales price, and the explanatory variables were the range of environmental attributes characterising the place in which the property is located plus the various control variables described above. Specifically, we ran models for England, for grouped Government Office Regions in England (London, South East and West; Midlands, East Midlands and East; North, North West and Yorkshire), and for major metropolitan regions within England. We also extended the analysis for Great Britain using a reduced model to reflect the fact that some data were not available outside of England.

Table 1 summarises the estimates of the *monetary implicit prices of environmental amenities in England and regions resulting from the hedonic regression model*. These implicit prices are capitalised values of marginal changes, i.e. present values, rather than annual willingness to pay. Long run annualised figures can be obtained by multiplying the present values by an appropriate discount rate (e.g. 3%).

Table 1: Implicit prices by region (£ capitalised values)

	ALL ENGLAND	LONDON, SOUTH EAST AND WEST	MIDLANDS, EAST MIDLANDS AND EAST	NORTH, NORTH WEST AND YORKSHIRE
Ward share of:				
Domestic gardens	***1,970	***1,769	***1,955	***2,487
Green space	***2,020	***2,068	***1,200	***1,773
Water	***1,886	***1,794	***1,179	***1,911
Domestic buildings	***4,242	***4,796	610	**2,292
Other buildings	***5,244	***5,955	***2,858	4,593
Green Belt	41	19	81	17
National Park	94	*-184	***256	131
Ward area (+10 km2)	***0.017	***0.034	**0.013	***0.009
Distance to:				
Coastline	-275	-56	-94	-348
Rivers	*-1,751	-2,446	***-2,711	-884
National Parks	***-461	**-348	-188	***-782
Nature Reserves	-143	-1,322	632	-402
National Trust properties	***-1,347	***-3,596	-212	***-1,117
Landcover share in 1km square:				
Marine and coastal margins	70	138	53	58
Freshwater, wetlands, floodplains	***768	***1,332	36	233
Mountains, moors and heathland	166	-155	-258	***832
Semi-natural grassland	-27	6	-32	**-191
Enclosed farmland	***113	***123	32	**71
Coniferous woodland	*227	***305	307	-131
Broadleaved woodland	***377	***495	***412	*240
Inland bare ground	***-738	***-1,055	-111	**-479
Sample size	1,013,125	476,846	341,527	194,752
Mean house price 2008	£194,040	£243,850	£181,058	£158,095

(1)The table reports implicit prices, i.e. marginal willingness to pay, evaluated at regional mean prices. The sample is Nationwide housing transactions in England, 1996-2008. Control variables are omitted from the table.
(2) For 'distance to' variables, the table shows the implicit prices associated with an increase of 1km to the specified amenity.
(3) For 'ward shares' the table shows the implicit prices for a 1 percentage point increase in the share of land in a specified use in the Census ward containing the property. For gardens, green space, water, domestic and other buildings the omitted category is other land uses not listed.
(4) For '1 km^2 land cover shares' the table shows implicit prices for 1 percentage point increase in share of the specified landcover in the 1km square containing the property (≈ 10000 m^2 within nearest 1 million m^2). Omitted category is urban.
(5) ***p<0.01, **p<0.05, *p<0.10.

Results for all of England (column 1) reveal *that many of the land use and land cover variables are highly statistically significant, and represent quite large implied economic effects*. Domestic gardens, green space and areas of water within the census ward all attract a similar positive price premium, with a 1 percentage point increase in one of these land use shares increasing house prices by around 1%. Translating these into monetary implicit prices indicates capitalised values of around *£2,000* for these land use changes at the mean transaction price of £194,000. Regarding land cover shares (within 1km squares) there is a strong positive effect from freshwater, wetlands and flood plain locations, broadleaved woodland, coniferous woodland and enclosed farmland with a one percentage point increase in the share of these land covers attracting a house price premium of 0.4%, 0.19%, 0.12% and 0.06% respectively (worth *£768, £377, £227 and £113 respectively)*. Given the scaling of these variables, these *implicit prices can also be interpreted as the willingness to pay for an extra 10,000* m^2 *of that land use within the 1 million* m^2 *grid in which a house is located.* Conversely, proximate marine and semi-natural grassland land cover does not appear to have much of an effect on prices.

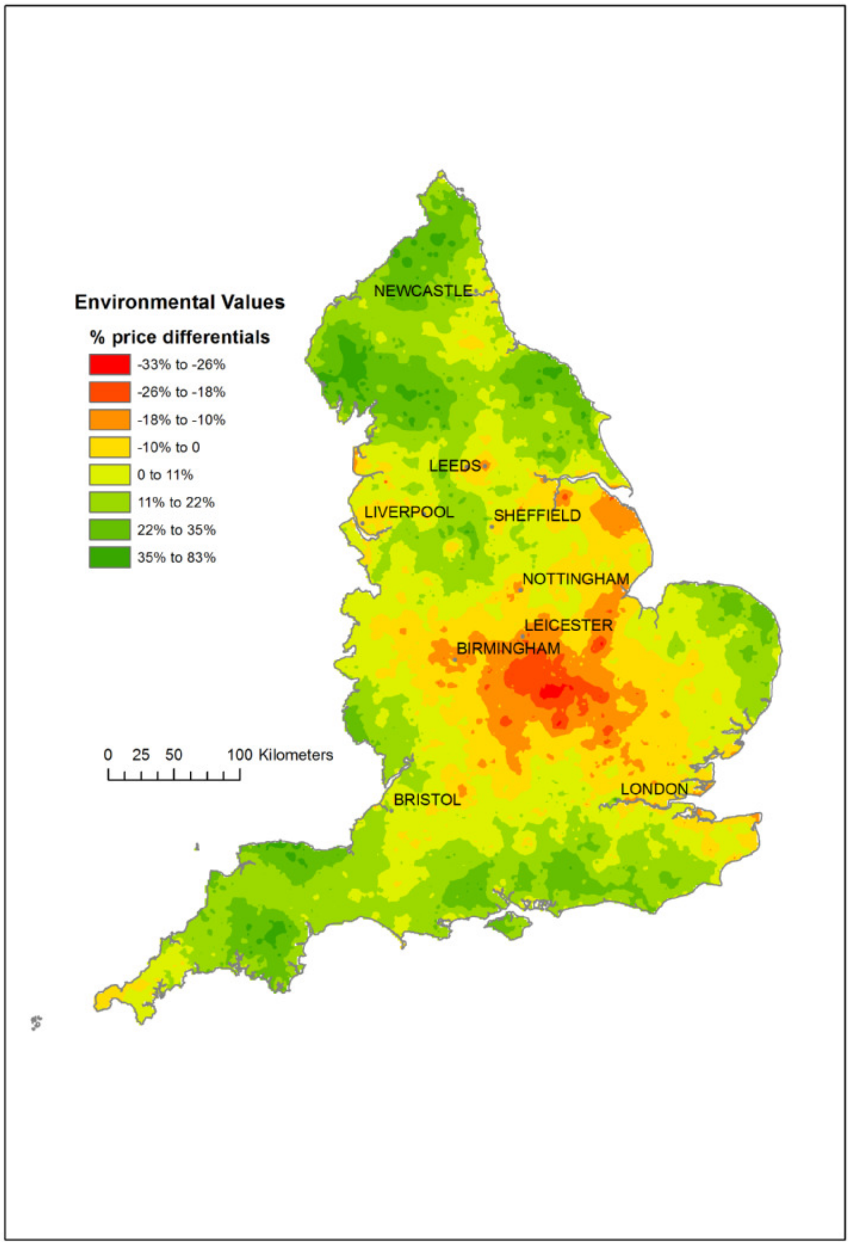
Neither Green Belt nor National Park designation show a strong statistical association with prices because the coefficients are not precisely measured at this level. But we do find that increasing distance to natural amenities is unambiguously associated with a fall in house prices. This finding is consistent with the idea that home buyers are paying for accessibility to these natural features. The biggest effect in terms of magnitude is related to distance to rivers, where a 1km increase in distance lowers house prices by 0.9% or *£1,750*. Each 1km increase in distance to the nearest National Park and to the nearest National Trust owned site lowers prices by 0.24% (*£460)* and 0.7% *(£1,350)*, respectively. Note that these values should not be used for non-marginal changes or out of sample predictions (our calculations are all within local labour markets).

The *estimates are fairly insensitive to changes in specification* which provides some reassurance that the hedonic price results provide a useful representation of the values attached to proximity to environmental amenities in England. Moreover, extending the analysis to the whole of Great Britain results in patterns of results similar to those in the regression for England only, *which is encouraging in terms of possible transferability of the estimates to Great Britain as a whole*.

We also *predicted the (log) house price differentials that can be attributed to variations in the level of environment amenities across England*. We do this using our hedonic model coefficients for England and expressing the variation in environmental quality in terms of deviations around their means, and ignoring the contribution of housing attributes and all other control variables in the regression. The resulting predictions therefore show the *variation in prices around the mean in England*, and are mapped in Figure 1.

Figure 1 shows the house price variation in 10 categories. The mean house price in 2008 was around £194,000, so, for example, the green shaded areas represent the places with the highest value of environmental amenities, amounting to valuations of £67,900 and above in present value terms. Annualised over a long time horizon, this is equivalent to a willingness to pay £2,000 per year at a 3% discount rate. These highest values are seen in areas such as the Lake District, Northumberland, North York Moors, Pennines, Dartmoor and Exmoor. The implication is that home buyers are willing to pay some £2,000 per year to gain the environmental amenities and accessibility of these locations, relative to the average place in England. Lowest levels of environmental value occur in central England, somewhere in the vicinity of Northampton. We estimate that people are prepared to pay around £2,000 per year to avoid the relatively poor accessibility of environmental amenities that characterises these locations relative to the average in England.

Figure 1: 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.

We also report separate results for grouped Government Office Regions in England. Columns 2-4 of Table 1 show the implicit prices (capitalised) for these groups, derived from separate regressions for each regional group sample and based on the mean 2008 house price in each sample (reported in the last row of the table). Looking across these columns, it is evident that there are differences in the capitalised values and significance of the various environmental amenities according to region, although the results are qualitatively similar. The ward land use shares of gardens, green space and water have remarkably similar implicit prices regardless of region. The first notable difference is the *greater importance of National Park designation in the midlands regions* (the Peak District and Broads National Parks), but lesser importance of National Trust sites. It is also evident that the *value of freshwater, wetlands and floodplain locations is driven predominantly by London and the south of England*. *Coniferous woodland attracts value in the regions other than the north, but broadleaved woodland attracts a positive premium everywhere*. Although *mountains, moors and heathland cover had no significant effect on prices in England as a whole, we see it attracts a substantial positive premium in those locations where this land cover is predominantly found, i.e. the North, North West and Yorkshire*.

Finally, restricting the sample to major metropolitan regions (not shown in Table 1) leads to a pattern of results that is broadly similar to those discussed above for England. Some effects become more significant, particularly those related to distance to coastline, rivers and National Parks. As might be expected, Green Belt designation becomes more important when looking at major metropolitan areas. The results indicate a *willingness to pay amounting to around £5,800 for houses in Green Belt locations,* which offer access to cities, coupled with tight restrictions on housing supply.

There are some limitations to this analysis. First, although we have several years of house price data, we do not have good information on changes in land cover and other environmental amenities over time. We therefore estimate the cross-sectional relationship between environmental amenities and prices, using control variables in our regressions to account for omitted characteristics that affect prices and are correlated with environmental amenities, and which would otherwise bias our estimates. It is, however, impossible to control for all salient characteristics at the local neighbourhood level because we do not have data on all potentially relevant factors (e.g. crime rates, retail accessibility, localised air quality) and if we had the data it would be infeasible to include everything in the regressions. Second, we do not have information on diversity of land cover outside the immediate vicinity of a property or on the benefits of accessibility to multiple instances of a particular amenity. Third, data from Scotland, Wales and Northern Ireland for the environmental (and other) variables that were used was limited. Fourth, the data lacks detail on view-sheds and visibility of environmental amenities, which would be infeasible to construct given the national coverage of our dataset. Fifth, the analysis focuses mostly on environmental amenities due to lack of data on disamenities such as proximity to landfill sites. Finally, we note that implicit prices, as estimated here, should only be interpreted as values for marginal changes in the level of the amenities of interest, i.e. they are not accurate welfare measures for non-marginal changes, which would require the estimation of demand curves for these amenities.

Overall, we conclude that the house market in England reveals substantial amenity value attached to a number of habitats, designations, heritage sites, private gardens and local environmental amenities. Despite the limitations of the analysis, the estimates are fairly insensitive to changes in specification and sample which provides some reassurance that the hedonic price results provide a useful representation of the values attached to proximity to environmental amenities in England. Although the pattern of results is very similar, for some amenities we found evidence of significant differences across regions within England. Many of the key results appear to be broadly transferable to Great Britain.

2. Education and ecological knowledge

Engaging with nature can lead to increased environmental knowledge. We define ecological knowledge broadly as nature's '*contribution to educational experiences and advancement of expert and lay environmental knowledges' (*Burgess et al., 2010). Our analysis is focused on ecological knowledge accumulation within the *formalized educational system for school age children*. Specifically, we consider two types of ecological knowledge experiences related respectively to indoor and outdoor learning: (i) the *ecological knowledge embodied in successful student outcomes in GCSE and A-level examination* in geography and biology, at the end of the school year 2009/10, in England; and, (ii) *nature-related school trips,* taking place outside the school, as well as *'citizen science' projects* taking place within (and around) school grounds. We provide what is, to our knowledge, the *first accounting study of the investment value of ecological knowledge in schools.*

An *economic interpretation* of ecological learning experiences is that they are one element of the output of the education sector – an *investment in human capital* – in the sense of the pioneering work of Jorgenson and Fraumeni (1989, 1992). Core to that method is the calculation of the present value (PV) of (lifetime) earnings from spending an *additional* year in formal education. Our framework is built on an approximation of the Jorgenson and Fraumeni approach where we first calculate the present value of future income of individuals that attained a GCSE and an A-level qualification, relative to having no qualification, and then try to identify the ecological component of this educational attainment and its value.

In order to do this, we assume that the starting wage of someone leaving school at 16 without any basic qualifications can be approximated by the current minimum wage for 16 to 18 years olds (£3.64 per hour). We then make use of estimates of the (gross) returns that individuals receive as a result of having a particular qualification (relative to not having it or any other 'replacement' qualification of that same level of attainment). Following Dearden (1999, 2000) and Blundell et al. (1999, 2004), we assume that having a GCSE – in the grade range from A to C – implies a return of 15%

while an A-level implies a return of 22% (relative to having no qualification). The earnings stream for such (representative) individuals in each group is adjusted by the survival probabilities (ONS, 2009) but not labour market participation rates. Using these data, we estimate the PV of future income from age 17 to 68 for successful GCSE students in 2010 and from age 19 to 68 in 2010 for successful A-level students (all passing grades). We take the discount rate to be 3.5% and income growth to be 1.5%.

We then seek to identify the ecological component of this educational attainment and its value. We focus on geography and biology (either directly or indirectly via a GCSE (Basic) science) as the fields of study where, at school level, there is formal evidence of significant ecological components to the curriculum, either in guidelines provided by national curricula and/ or official exam boards. Determining the precise weight that ecological education has in these studies is clearly contentious and subject to variation across schools. Nevertheless, on the basis of consulted documentation (AQA, 2010, 2009; Edexcel 2008a,b), we assume that the *weights reflecting the ecological components* to be the following: *GCSE Geography – 0.15; GCSE Biology – 0.25; GCSE (Basic) Science – 0.08; A-level Geography – 0.15; and, A-level Biology – 0.25.*

Results are provided in Table 2. On the left hand side of the table is given the number of students accomplishing specified examination outcomes. On the right hand side, are corresponding values. These are the product of pupil numbers and the 'ecologically adjusted' present values for representative individuals achieving, in 2010, the relevant qualifications (as estimated above). Our tentative findings indicate that the *value of ecological knowledge embodied in successful student outcomes in (relevant) GCSE and A-level examinations at the end of the academic year 2009-10 is substantial at just over £2.1 billion.*

Some caution is needed in interpreting these results. The data that we provide cannot be interpreted as the net benefit of the production of ecological knowledge (i.e. relative to other forms of education). Ours is purely an *accounting framework that attempts, in a very approximate way, to identify (some portion) of the ecological* *component of school education*. Nevertheless, we would argue that the findings are instructive not least in indicating, in explicit terms, that the value of this ecological knowledge is possibly substantial.

Table 2: The value of ecological knowledge in GCSE and A-level attainment (2010)

	Candidates ('000)		Value of Ecological Knowledge (£m)		
	GCSE	**A-level**	**GCSE**	**A-level**	**Total**
Geography	118.2	29.2	426.9	134.7	561.6
Biology	110.2	52.7	663.4	405.9	1,069.2
Science	258.4	n.a.	497.8	n.a.	756.2
Total	486.8	81.9	1,588.1	540.6	2,128.7

Note: the values refer to successful candidates who would have received their results in these GCSEs and A-levels in the Summer of 2010.

Our final analysis involved an investigation of two short case studies of ecological education *outside the classroom*. The first of these is an example of *nature-related school trips,* namely educational visits to *RSPB reserves around the UK*. The second short case study involves a 'citizen-science' project, specifically bird-watching within school grounds via the *RSPB Big School Bird Watch*. In both cases, we use a *'cost of investment' approac*h. This approach will *not* provide an estimate of the welfare benefit of the knowledge gained in nature visits or projects but rather an indication of outlay that is made in its acquisition.

The UK's *Royal Society for the Protection of Birds* (RSBP) runs 200 nature reserves across the UK, covering 142,044 hectares in 2008/09 (RSPB, 2010a). There were 1,968 recorded school trips to 51 RSPB reserves in 2009-10 comprising a total of 57,471 staff and students. This means that only about a quarter of all RSPB sites are known to have received educational visits. Our valuation is based on the *costs of making these trip 'investments'* in ecological knowledge. This, in turn, is based on the *travel costs* involved. We value both the *resource costs* to parents of meeting the costs of these trips and the *value of time spent travelling* and *waiting to travel*. Our intention here is to focus on the costs incurred *over and above those costs incurred in gaining knowledge* that would be provided *within a normal classroom environment.*

Transport-related costs are valued using the average costs for parents of a primary and secondary school day trip in the UK, which lie between £8 and £12 per pupil (Brunwin et al, 2004). It is assumed that the amount parents pay cover all vehicle costs and the entry fees for students and accompanying adults. We use the cost to the government of students in education (about £5,140 per student, per year) to value children's time in terms of the per hour cost (Department for Children, Schools and Family, 2009). The value of teachers' time (inclusive of social overheads) is implicitly included in this total. Origin (of school) post codes for visitors were not available and so it was not possible to estimate reserve-specific distances travelled. We therefore assumed that these travel times were between 20 and 40 minutes (each way). For the value of 'excess time' (time spent waiting or walking to and from school buses), we assume a fixed period of 15 to 22.5 minutes each way, totalling 30 to 45 minutes per trip. Following Mackie et al. (2003) we value 'excess time' at 250% of (in-vehicle) travel time. We apply this to staff time (based on an assumption about teachers' hourly wages) as well as pupil time. In total, the *costs of the investment expended, in 2009/10, in the pursuit of ecological knowledge on nature based trips to RSPB reserves by schools ranges from just under £850,000 to just over £1.3 million*. Clearly, these values are highly contingent on the range of assumptions made to calculate travel time values.

Regarding the *Big School Birdwatch*, it is one of a series of an annual citizen science surveys organised by the RSPB and that focuses solely upon the participation of children at school in bird watching. Groups of children, led by a teacher, count the numbers of different species of birds visiting their school for one hour on any day in a week between January and February. In 2010, 75,500 people participated (69,101 children and 6,275 adults) in 1,986 schools. On average, each school spotted around 35 individual birds. The most commonly seen species were blackbirds and starlings, with species such as the wren and goldfinch being amongst the least likely that will be spotted. We assume all adults and students involved spend one hour in this activity and that this birdwatching takes place during school-time. As above, we use the cost to government of students aged 3-19 in education for valuing the (investment) cost of children's time. *The value of this time is about £374,000*. This value is a proxy for the *ecological knowledge gained by participation in the Big School Birdwatch* in 2010. This corresponds to an average of about *£188 per school*.

Our discussion has highlighted many of the large data gaps existing in this area of research, as very little is currently known about the welfare value of educational knowledge for children in the UK. Substantially more information would be required if we were to estimate net benefit of the production of ecological knowledge (i.e. relative to other forms of education) rather than looking at investment costs as in our accounting approach. Within our approach, it would be desirable to have a more systematic way of assessing the ecological component of various disciplines, to incorporate labour market participation rates, to extend the analysis to the ecological education gained in years other than GCSE and A-level years, to investigate how the value of ecological education varies across primary, secondary and university education, and to see how values have changed across time. Regarding the value of nature-based school visits, our cost of investment approach does not provide an estimate of the welfare benefit of the knowledge gained in nature visits or projects but rather an indication of outlay that is made in its acquisition. Within our approach, there is no comprehensive database of school visits, with detailed information on origin and destination postcodes, or of nature-related after-school clubs and activities across the country. Finally, very little is known about the value of ecological education for adults as no systematic database of participation in nature-based educational activities exists.

4. Non-use value

Human wellbeing can be derived without making personal use of a good or service, such that a nature reserve may have value to an individual even though he has never visited nor intends to visit that nature reserve. *Non-use values* are the benefits that can be gained even though there is no use (either direct or indirect) made of a given product or service. Due to their non-market nature and their disconnection from actual uses, the valuation of non-use benefits is complex. Stated preference methods are thought to be the only economic valuation techniques capable of measuring non-use values but substantial doubts exist about the accuracy of such valuations (e.g. Cameron, 1992; Harrison, 1995). Moreover, there appears to be no national study of environmental non-use values.

Here we follow a very different approach and propose using *legacies to environmental charities as a simple and observable market indicator of environmental non-use values*. Legacies can be argued to represent a pure non-use value: individuals leaving a charitable bequest to an environmental organisation in a will, for the purposes of supporting their conservation activities, will not experience the benefits of this work. Specifically we look at the *value of legacies over time of three of the largest environmental charities in the UK: The National Trust, RSPB, and the National Trust for Scotland*. We also analyse how legacies to environmental charities compare with legacies to other areas of charitable activity.

Although there is a small literature on charitable bequests (see Atkinson et al., 2009, for a review) we have not found any other study of legacies as an indicator of environmental non-use values. Indeed, despite the importance of charitable bequests, surprisingly little is known in the UK about this form of transfer of wealth at death and even less in known about the causes supported by these legacies (Atkinson et al., 2009).

Atkinson et al. (2009) estimates that only 6% of all deaths in Britain in 2007 resulted in a charitable bequest (with this percentage rising considerably with the size of the estate). But despite the relatively small proportion of estates leaving a charitable bequest, legacies are a major source of income for charities. In 2008/09, charitable giving by individuals was almost £6 billion to the top 500 fundraising charities (Pharoah, 2010). *Legacies represent almost one quarter of this total (£1.4 billion),* with almost three quarters of charities reporting income from legacies.

Although *environmental charities rank 7th in terms of total fundraised income, they rank 4th in terms of legacy income* (within the top 500 charities in the UK), after cancer, animals and general social welfare charities. Legacy income is an important source of revenue for environmental charities comprising almost 30% of all their fundraising income. Overall, the *total legacy income earned by environmental charities in 2008/09 was £97 million which constitutes 7% of all charitable legacies* (Pharoah, 2010).

Table 3 depicts the top 5 environmental charities according to the fundraised and legacy income earned in 2008/09. Three of these charities (The National Trust, RSPB and WWF UK) rank within the top 50 largest charities in the UK. Environmental legacy income is considerable, with the National Trust attracting the largest number of legacies, constituting some 44% of their total fundraised income at almost £43 million (Pharoah, 2010). Had donors intended their legacy income to be spent on National Trust countryside, RSPB reserves or National Trust for Scotland countryside, we would have been able to estimate a legacy-based non-use value of around *£219 per hectare* of National Trust countryside, *£190 per hectare* of RSBP reserve and £53 *per hectare* of National Trust for Scotland's Scottish countryside for 2008/09, respectively. However, as noted above, donor's preferences about the allocation of their legacies are not known.

We further analysed the trends in legacies since 1989 to three of the largest environmental charities in the UK: The National Trust, RSPB and the National Trust for Scotland. Our results suggest that for the two largest environmental charities (National Trust and RSPB) the total value of annual legacies increased significantly over the last two decades and the proportion of estates leaving a legacy to environmental causes has risen, even in the light of falling death rates. However, we also found that as people get wealthier they leave relatively less charitable bequests to these causes. In contrast, legacies over time to the National Trust for Scotland do not appear to follow any clear pattern.

Table 3: Fundraised and legacy income of top 5 environmental charities (2008/09)

Environmental charity	Legacy income (£million and % of total fundraised income)		Total fundraised income (£million)	Rank within top 500 charities
The National Trust	42.8	44%	97.8	12
RSPB	26.6	41%	64.9	16
WWF UK	8.1	22%	37.4	32
The Woodland Trust	8.2	40%	20.6	58
National Trust for Scotland	4.0	21%	18.8	61

Source: constructed from Pharoah (2010)

Legacies are interesting proxies for non-use values in that they are observable in the market and not reliant on stated preference data. But clearly, they capture only one element of environmental non-use values, i.e. those that are reflected in the market place at the time of death. Further research is needed to ascertain the magnitude of the non-use values that are not reflected in the market. Moreover, there are major knowledge gaps in our analysis. In general, very little is known about charitable bequests in the UK. Data on charitable bequests, estates and demographic characteristics of donors is not easily accessible, particularly for analysis over time. Equally, comprehensive data on charitable giving over time, from the perspective of the recipient organizations, and covering a wide range of organizations is not freely available.

Health

Environmental quality and proximity to natural amenities is increasingly recognised as having substantial effects on physical and mental health, both directly and indirectly (e.g. Bird, 2004). Broadly this can happen in two ways. Firstly, natural settings can act as a catalyst for healthy behaviour, leading for example to *increases in physical exercise*, which affect both physical and mental health (Pretty et al., 2007; Barton and Pretty, 2010). Secondly, *simple exposure to the natural environment*, such as having a view of a tree or grass from a window, can be beneficial, improving mental health status (Pretty et al., 2005) and physical health (Ulrich, 1984). Health outcomes in this respect can be disaggregated into two categories: reductions in mortality and reductions in morbidity (including physical and mental health).

We conducted a preliminary investigation of the valuation of the impacts of marginal changes in the provision of natural habitats and green spaces on physical and mental health. We focus on both the pathways identified above: (1) *health improvements arising from additional exercise created by the provision of natural habitats and green settings*; and (2) *health benefits arising from more passive forms of contact with nature* such as viewing nature, being within natural spaces, etc.

Value of health benefits of green exercise

Willis (2005) identifies three key steps in the valuation of the health benefits of created exercise due to additional green space provision: (1) measuring the physical and mental health impact of exercise; (2) valuing the health benefits of exercise; and (3) estimating the probability of additional exercise with changes in green space. We analyse each in turn.

The only exercise that should be directly attributed to the provision of natural settings is what Willis (2005) calls *'created exercise'*, i.e. exercise which would not have occurred otherwise. Exercise which would have occurred anyway in another setting (e.g. the gym or urban pavements) should not be included in the calculations as it is not truly additional. It is however very difficult to identify created exercise. In our calculations we follow the Willis (2005) approach and attempt to focus on created exercise. We consider a scenario whereby *changes in countryside and parks management lead to an additional reduction of 1 percentage point in the numbers of sedentary people in the UK.* Reduction in sedentary life and increase in exercise lead to a number of proven health benefits which include reductions in mortality and morbidity due to: (1) *Coronary Heart Disease* (CHD); (2) *Colo-Rectal Cancer;* (3) *Stroke*; and (4) *Stress, anxiety and depression* (morbidity only). We obtained up-to-date data on mortality and morbidity for CHD, colo-rectal cancer, stroke and depression. We then calculated the change in excess cases of morbidity and mortality from these conditions associated with *a one percentage point reduction in sedentary behaviour*. We used the theoretically correct *willingness to pay* (WTP) approach (e.g. Pearce et al., 2006; Krupnick, 2004), based on the trade-offs that individuals would make between health and wealth, to estimate the economic value of these health impacts. For mortality, we use government estimates of the *value of a preventable fatality (VPF) of £1,589,800* (DfT, 2007); for morbidity the value used for CHD prevention is based on the Department for Transport's (2007) value for a slight injury (£13,769), while the stroke prevention value is based on its value for a serious injury (£178,640). The value we use for cancer prevention is taken from Hunt and Ferguson (2009) and reflects the existence of a 'dread' factor associated with diseases that are long and painful (£288,304). Finally, the value for reduction of mental illness is based on Morey et al.'s (2007) estimate of WTP to eliminate depression (£5,343).

Our estimates of the value of health benefits arising from a 1 percentage point reduction in the sedentary population are depicted in Table 4. We estimate that a *change in natural habitats that causes a 1 percentage point reduction in sedentary behaviour would provide a total benefit of almost £2 billion* (using WTP-based values), across the three physical conditions (CHD, colo-rectal cancer and stroke) and the mental health condition considered (depression, stress and anxiety). However, if all people over 75 years are excluded from the analysis – on the basis that they are less able or likely to be physically active – then the benefits fall to just over £750 million.

The key question left to answer is if a green living environment does indeed provide an incentive to be physically active, that is, how much true additional exercise is created with the extra provision of green spaces that would not have taken place otherwise. Unfortunately, there are large gaps in knowledge in this area as environmental attributes appear to be among the least understood of the known influences on physical activity. There is a limited but consistent body of evidence that appears to suggest patterns of positive relationships between some environmental attributes and physical activity, such as walking or cycling. Reviews by Humpel et al. (2002), Owen et al. (2004) and Lee and Maheswaran (2010) show that the aesthetic nature of the local environment, the convenience of facilities (such as footpaths and trails) and accessibility of places to walk to (such as parks and beaches) are often times associated with an increased likelihood of certain types of walking. However, several other studies found no link between recreational physical activity and green space provision. A recent large-scale study of 4.899 Dutch people by Maas et al. (2008) found that the amount of green space in people's living environment has little influence on people's level of physical activity. Overall, we found *no conclusive evidence on the strength of the relationship between the amount of green space in the living environment and the level of physical activity*. Hence, *it is not possible to accurately value, at the present time, the health benefits of created exercise due to additional green space provision.*

Table 4: Value of health benefits arising from a 1 percentage point reduction in the sedentary population (£m, per year, UK)

	Mortality			Morbidity			TOTAL	
	Number of cases of averted deaths			Number of cases of averted illness			Including > 75year olds	Excluding > 75 year olds
	Including > 75year olds	Excluding > 75year olds	VPF	Including > 75year olds	Excluding > 75year olds	WTP to avoid	WTP to avoid	WTP to avoid
CHD	597	192	£949.1	20,871	5,919	£287.4	£1,236.5	£415.2
Stroke	177	32	£281.4	1,092	689	£195.1	£476.5	£57.7
Colo-rectal cancer	74	33	£117.7	141	78	£40.7	£158.3	£251.1
Depression	--			8,259	7,466	£44.1	£44.1	£39.9
Total	848	257	£1,348.2	30,363	14,152	£567.2	£1,915.4	£763.8

Valuing the health benefits of exposure to nature

There is now a substantial body of evidence suggesting the existence of a wide range of health benefits associated with green space over and above those induced by increased exercise. In a recent review, Lee and Maheswaran (2010) reports *associations between contact with green spaces and a variety of psychological, emotional and mental health benefits, reduced stress and increased quality of life.* Moreover, research spanning over more than two decades suggests that mere views of nature, compared to most urban scenes lacking natural elements such as trees, appear to have more positive influences on emotional and physiological states, providing restoration from stress and mental fatigue (Ulrich, 1986; Kaplan, 2001) and even improve recovery following operations in hospitals (Ulrich, 1984). These health benefits of non-exercise related exposure to nature are likely to be substantial and pervasive, given the lack of substitutes and the size of the population potentially affected.

We used newly-commissioned *geo-located survey data to estimate the physical and mental health effects associated with UK broad habitats, domestic gardens, managed areas and other natural amenities*. Such work has not, to our knowledge, previously been undertaken for the UK. Data were collected by a web survey during August 2010. A total of 1,851 respondents completed the survey. For general and physical health, the RAND SF-36 Health Survey was employed. This is the leading general health measure, comprising 36 survey items, with standardised administration and item scoring to produce several validated sub-scales. We used the 'physical functioning' and 'emotional wellbeing' subscales as outcome variables. Regarding environmental characteristics, we used broad habitats describing the physical land cover within a 1km radius of the respondent's home location (such as woodland, freshwater, farmland or mountains). Additional nature-related items included were questions regarding views of green spaces and water from the respondent's home, frequency of use of domestic gardens, of open countryside, and of non-countryside green spaces such as parks, recreation grounds and cemeteries, as well as distance to various natural and environmental amenities, such as coastline, rivers, National Parks and National Trust properties. We controlled for a wide range of demographic variables including gender, age, qualifications, work status, religiosity and income as well as house prices and postcode.

We used ordinary least squares (OLS) regression estimates from models in which the dependent variables are respondents' physical and mental health indicators. Specifically, we used the *SF-36 physical functioning subscale* (ranging 0–100); the *SF-36 emotional wellbeing subscale* (range also 0–100); and the *SF-6D preference-weighted utility score*, which is calculated from a subset of the SF-36. The SF-6D is a preference-based single-index measure of health that can be used in economic evaluations, unlike the SF-36 which is not based on preferences (see Brazier et al., 2002). The explanatory variables include a number of environmental attributes characterising the place in which the respondent is located, and other variables as described above.

Our findings are summarized in Table 5. *Positive links were detected between proximity of the home to specific habitat types and the SF-6D health-related utility score*, although such links were not observed between habitat types and simple aggregate physical and emotional health indicators. There appear to be *strong positive relationships between green views from the home and emotional wellbeing and health utility*; and between *regular use of gardens and green spaces and all three measures*. Specifically, having a view of green space from one's house increases emotional well-being by 5% and the general health utility score by about 2%; using the garden weekly or more increases physical functioning and emotional wellbeing by around 3.6% and the heath utility score by 2.7%; using the non-countryside greenspace monthly or more increases physical functioning and emotional wellbeing by 3.4% and 2.6% respectively, and the heath utility score by 1.8%; and an increase in 1% of the area of freshwater, farmland and broadleaf woodland within the 1 km radius of the home increases health utility by 0.3%, 0.1% and 0.1% respectively.

It is important to note once again that *the associations we have estimated cannot be interpreted as causal effects*. There may be variables omitted from the models that cause changes in both the dependent and explanatory variables, and/or the dependent variable may itself be a cause of some explanatory variables.

Table 5: Health changes and contact with nature: Summary findings

Explanatory variable	Difference in explanatory variable	Associated health differences			
		Physical functioning	Emotional wellbeing	Health utility score	Tentative annual value per person
Having a view over green space from your house	No view → any view	–	+5.0%	+2.1%	£135 – £452
Use of own garden	Less than weekly → weekly or more	+3.5%	+3.7%	+2.7%	£171 – £575
Use of non-countryside green space	Less than monthly → monthly or more	+3.4%	+2.6%	+1.8%	£112 – £377
Local freshwater, wetland and flood plain land cover	+1% within 1km of the home (+ 3.14 out of 314 ha)	–	–	+0.3%	£20 – £68
Local enclosed farmland land cover	+1% within 1km of the home (+ 3.14 out of 314 ha)	–	–	+0.1%	£4 – £12
Local broad-leaved/mixed woodland land cover	+1% within 1km of the home (+ 3.14 out of 314 ha)	–	–	+0.1%	£8 – £27

Note: Based on OLS models of England and Wales.

As a last step in our analysis we tentatively calculate the value of the health changes estimated above. The general health measure SF-36 used in our survey is capable of detecting changes in health in a general population (Hemmingway et al., 1997). As such, it may be possible to use our survey results to tentatively estimate the monetary value of the health benefits associated with increasing the number of people making monthly visits to green spaces and having views of grass, or with increasing particular types of land cover.

In order to do that, and given that the SF-36 is not based on preferences, we first calculated a preference-weighted utility score from the SF-36 – the SF-6D health index described above, which can be used in economic evaluations (Brazier et al., 2002). Specifically, the SF-6D index can be used to generate Quality Adjusted Life Years (QALYs) associated with the environmental changes of interest, i.e. providing a green view, increasing use of the garden or visits to green spaces, and increasing particular types of landcover such as broadleaf woodland. QALYs are measures of health benefits that combine length of life with quality of life, where quality of life is assessed on a scale where zero typically represents death and one represents full health (Drummond et al, 1997).

Secondly, we could tentatively assign a monetary value to the QALYs associated with the environmental changes of interest. Although there is no consensus about what the monetary value of a QALY is and how to calculate it (Tilling et al., 2009; Willis, 2005)., there is nevertheless an emerging literature attempting to empirically estimate the it (e.g. Tillig et al., 2009; Jones-Lee et al., 2007; Mason et al., 2009). One possible approach involves deriving a 'value of a life year' from existing empirical estimates of the Value of a Preventable Fatality (VPF) (Jones-Lee at al., 2007). Of particular interest to us is a special case of this approach, proposed very recently by Mason et al. (2009), that consists of estimating the value of a QALY based only on *quality of life changes*. The Mason et al. (2009) study is based on UK figures and use as an anchor the value of prevention of a non-fatal injury (which range from injuries that will last only a few days and require no hospital treatment through to permanent paralysis and brain damage). They estimate monetary values of a QALY ranging from £6,414 to £21,519. Given that the environmental changes being considered are likely to have impacts mostly on quality of life (rather than on life expectancy) these seem to be the most appropriate values to use.

The last column of Table 5 contains the very tentative results of the calculation outlined above. It shows the estimated annual health benefits associated with having a view of nature, using the garden often, visiting green spaces regularly and increasing the proportion of broadleaf woodland, freshwater and farmland cover. We note that these figures are indicative only and subject to many assumptions as described above and should therefore be treated with caution.

References

Atkinson, A., Backus, P. and Micklewright, J. (2009) Charitable Bequests And Wealth At Death In Great Britain. Working Paper A09/03, University of Southampton.

AQA (2010) *GCE AS and A level Specification: Geography*. On-line: http://store.aqa.org.uk/qual/gce/pdf/AQA-2030-W-SP-10.PDF

AQA (2009) *GCE AS and A level Specification: Biology*. On-line: http://store.aqa.org.uk/qual/gce/pdf/AQA-2410-W-SP.PDF

Barton, J. and Pretty, J. (2010) What is the best dose of nature and green exercise for improving mental health? A multi-study analysis. *Environmental Science & Technology* **44(10):** 3947–3955.

Bird, W. (2004) Natural Fit: Can Greenspace and Biodiversity Increase Levels of Physical Activity? Royal Society for the Protection of Birds.

Blundell, R. Dearden, L. and Sianesi, B. (2004) Evaluating the Impact of Education on Earnings in the UK: Models, Methods and Results from the NCDS. Centre for the Economics of Education Working Paper CEE DP 47, London School of Economics, London.

Blundell, R. Dearden, L. Meghir, C. and Sianesi, B. (1999) Human Capital Investment: The Returns from Educations and Training to the Individual, the Firm and the Economy. *Fiscal Studies*, **20(1):** 1-23.

Brazier, J., Roberts, J. and Deverill, M. (2002) The estimation of a preference-based measureof health from the SF-36. *Journal of Health Economics* **21**: 271–292.

Brunwin, T., Clemens, S., Deakin, G. and Mortimer, E. (2004) The Cost of Schooling, Research Report RR588, Department for Education and Skills.

Burgess, J., Church, A., Ravenscroft, N., Bird, W., Blackstock, K., Brady, E., Crang, M., Gruffud, P., Pretty, J., Tolia-Kelly, D. and Winter, M. (2010) Chapter 15: Cultural Services, May version, National Ecosystem Assessment.

Cameron, T.A (1992) Nonuser Resource Values. *American Journal of Agricultural Economics* **74(5)**: 1133-1137.

CLG (2007) Generalised Land Use Database Statistics for England 2005. London: Department of Communities and Local Government.

Dearden, L. (1999) Qualifications and Earnings in Britain: How Reliable are Conventional OLS Estimates of the Returns to Education? IFS Working Paper W99/7, Institute for Fiscal Studies, London.

Dearden, L. McIntosh, S. Myck, M. and Vignoles, A. (2000) The Returns to Academic and Vocational Qualifications in Britain. Centre for the Economics of Education, London School of Economics, London.

Department for Children, Schools and Families (2009) Time Series: Revenue and Capital Funding per School Pupil 1997-08 to 2010-11. On-line: http://www.dcsf.gov.uk/rsgateway/DB/TIM/m002012/NSRStatsJuneGDP140809.pdfhttp

DfT (2007) *2005 Valuation of the benefits of prevention of road accidents and casualties: Highways Economics Note No. 1.* Department for Transport.

Drummond, M., O'Brien, B., Stoddart, G. and Torrance, G. (1997) *Methods for the economic evaluation of health care programmes* (2nd ed). Oxford: Oxford University press.

Edexcel (2008a) *Specification GCE Geography*. On-line: http://www.edexcel.com/migrationdocuments/GCE%20New%20GCE/UA024843%20GCE%20Geography%20Issue%203%20210510.pdf

Edexcel (2008b) *Specification GCE Biology*. On-line: http://www.edexcel.com/migrationdocuments/GCE%20New%20GCE/UA024831%20GCE%20in%20Biology%20Issue%204%20250510.pdf

Harrison, G.W. (1995) The measurement and decomposition of nonuse values: A critical review. *Environmental & Resource Economics* **5(3):** 225-247

Hemingway, H., Stafford, M., Stansfeld, S., Shipley, M., & Marmot, M. (1997) Is the SF-36 a valid measure of change in population health? Results from the whitehall II study. *BMJ* **315(7118)**: 1273-1279.

Humpel, N., Owen, N. and Leslie, E. (2002) Environmental factors associated with adults' participation in physical activity: A review. *American Journal of Preventative Medicine* **22(3)**:188–99.

Hunt, A. and Ferguson, J. (2009) Working Party on National Environmental Policies: A Review of recent policy-relevant findings from the environmental health literature. Organisation for Economic Co-operation and Development (OECD). ZNV/EPOC/WPNEP(2009)9/FINAL.

Jones-Lee, M., Loomes, G., and Spackman, M. (2007) Human costs of a nuclear accident: Final report. Health and Safety Executive. On-line: http://www.hse.gov.uk/economics/research/humancost.pdf

Jorgenson, D. and Fraumeni, B. (1989) The Output of the Education Sector. In: Griliches, Z. (ed.) *Output Measurement in the Service Sector*, National Bureau of Economic Research/ University of Chicago Press, Chicago.

Jorgenson, D. and Fraumeni, B. (1992) Investment in Education and U.S. Economic Growth. *Scandinavian Journal of Economics* **94** (supplement): S51-70.

Kaplan, R. (2001) The nature of the view from home: Psychological benefits. *Environment & Behavior* **33:** 507-542.

Krupnick (2004) Valuing Health Outcomes: Policy Choices and Technical Issues. Resources for the Future, Washington DC.

Lee, A. and Maheswaran, R. (2010) The health benefits of urban green spaces: A review of the evidence. *Journal of Public Health*: 1–11

Maas, J., Verheij, R., Spreeuwenberg, S. and Groenewegen, P. (2008) Physical activity as a possible mechanism behind the relationship between green space and health: A multilevel analysis. *BMC Public Health* **8**:206.

Mackie, P. et al. (2003) *Values of Travel Time Savings in the UK*, Institute for Transport Studies, University of Leeds. On-line: http://eprints.whiterose.ac.uk/2079/

Mason, H., Jones-Lee, M. and Donaldson, C. (2009) Modelling the monetary value of a QALY: A new approach based on UK data. *Health Economics* **18**: 933–950.

Morey, E., Thacher, J., Craighead, W. (2007) Patient preferences for depression treatment programs and willingness to pay for treatment. *Journal of Mental Health Policy and Economics* **10 (2)**: 87-99.

Office for National Statistics (2009) *Regional Trends*. Office for National Statistics, London.

Owen, N., Humpel, N., Leslie, E.,, Bauman, A. and Sallis, J. (2004) Understanding Environmental Influences on Walking Review and Research Agenda. *American Journal of Preventive Medicine* **27(1)**: 67-76.

Pearce, D., Atkinson, G. and Mourato, S. (2006) *Cost-Benefit Analysis and the Environment: Recent Developments*. OECD, Paris.

Pharoah, C. (2010) Charity Market Monitor 2010: Tracking the Funding of UK Charities, CaritasData, London.

Pretty, J., Peacock, J., Hine, R., Sellens, M., South, N. and Griffin, M. (2007) Green exercise in the UK countryside: effects on health and psychological well-being and implications for policy and planning. *Journal of Environmental Planning & Management* **50(2)**: 211–31.

Pretty, J., Peacock, J., Sellens, M., and Griffin, M. (2005) The mental and physical health outcomes of green exercise. *International Journal of Environmental Health Research* **15(5)**: 319-337.

RSPB (2010a) Facts and Figures. On-line: http://www.rspb.org.uk/about/facts.aspx

Sheppard, S. (1999) Hedonic analysis of housing markets. In: P. C. Cheshire & E. S. Mills (ed.), *Handbook of Regional and Urban Economics*, Edition 1, Volume 3, Chapter 41. Elsevier.

Tilling, C., Krol, M., Tsuchiya, A., Brazier, J., van Exel, J. and Brouwer, W. (2009) Measuring the value of life: Exploring a new method for deriving the monetary value of a QALY . HEDS Discussion Paper 09/14. University of Sheffield.

Ulrich, R. (1984) View through a window may influence recovery from surgery. *Science* **224**: 420-421.

Ulrich, R. (1986) Human responses to vegetation and landscapes. *Landscape and Urban Planning* **13**: 29-44.

Willis, K. (2005) Chapter 3: Measuring health impacts in economic terms. In: CJC Consulting, *Economic Benefits of Accessible Green Spaces for Physical and Mental Health: Scoping study*. Final Report for the Forestry Commission.