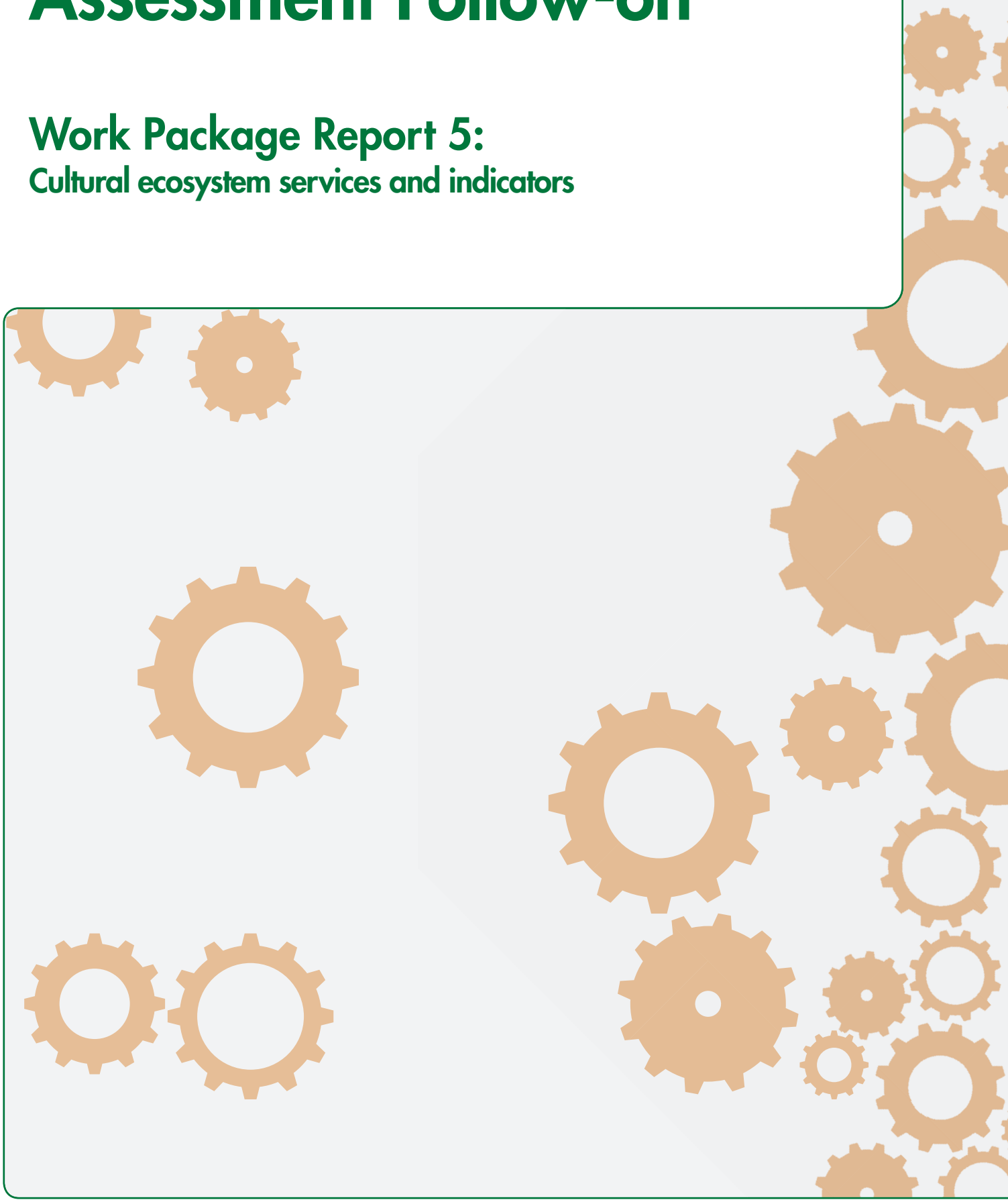
# UK National Ecosystem Assessment Follow-on

## Work Package Report 5:
### Cultural ecosystem services and indicators



**Principal Investigator:** Andrew Church[1]*

**Lead Authors:** Andrew Church[1]*, Rob Fish[2], Roy Haines-Young[3], Susana Mourato[4], Jamie Tratalos[4]

**Contributing Authors**: Lee Stapleton[5], Cheryl Willis[2], Peter Coates[6], Stephen Gibbons[4], Catherine Leyshon[7], Marion Potschin[3], Neil Ravenscroft[1], Rosa Sanchis-Guarner[4], Mike Winter[2], Jasper Kenter[8]

**Report Review editor**: Caitlin DeSilvey[7]

**Affiliations:**

[1]School of Environment and Technology, University of Brighton
[2]Centre for Rural Policy Research, University of Exeter
[3]Centre for Environmental Management, School of Geography, University of Nottingham
[4]Department of Geography & Environment, London School of Economics & Political Science
[5]Science and Technology Policy Research Unit, University of Sussex
[6]Department of History, University of Bristol
[7]Environment and Sustainability Institute, University of Exeter
[8]Aberdeen Centre for Environmental Sustainability, University of Aberdeen

* Correspondence to: Andrew Church, A.Church@brighton.ac.uk

**Suggested citation:** Church, A., Fish, R., Haines-Young, R., Mourato, S., Tratalos, J., Stapleton, L., Willis, C., Coates, P., Gibbons, S., Leyshon, C., Potschin, M., Ravenscroft, N., Sanchis-Guarner, R., Winter, M., & Kenter, J. (2014) UK National Ecosystem Assessment Follow-on. Work Package Report 5: Cultural ecosystem services and indicators. UNEP-WCMC, LWEC, UK.

# Contents

Contents ..... 2
Abbreviations and Acronyms ..... 4
Key Findings ..... 5
Summary ..... 7
5.S.1 Indicators for cultural ecosystem services ..... 7
5.S.1.1 Indicators for the physical supply of environmental spaces ..... 7
5.S.1.2 Indicators for the accessibility of environmental spaces. ..... 8
5.S.1.3 Indicators of demand for environmental spaces. ..... 8
5.S.1.4 Indicators on quality of environmental spaces. ..... 8
5.S.2 Quantitative analysis of well-being and practices in environmental spaces ..... 9
5.S.3 Participatory and interpretative approaches ..... 10
5.S.4 Conclusions ..... 11
5.1 Introduction and report structure ..... 12
5.1.1 The UK National Ecosystem Assessment Follow-on and cultural ecosystem services ..... 12
5.1.2 Conceptual development of cultural ecosystem services ..... 14
5.1.3 The empirical research on cultural ecosystem services ..... 14
5.2 Conceptual framework for cultural ecosystem services ..... 15
5.2.1 Key tenets of the framework ..... 16
5.2.1.1 Environmental spaces ..... 18
5.2.1.2 Cultural practices ..... 18
5.2.2 Cultural ecosystem benefits ..... 19
5.2.3 Summary ..... 20
5.3 Developing indicators of cultural ecosystem services ..... 21
5.3.1 Introduction ..... 21
5.3.2 Types of Indicator ..... 23
5.3.3 Supply related indicators: percentage cover and other area-based estimates ..... 24
5.3.4 Accessibility indicators ..... 28
5.3.5 Demand related indicators ..... 33
5.3.6 Local Urban Indicators and addressing the issue of quality ..... 34
5.3.7 Summary ..... 39
5.4 Quantitative analysis of well-being and practices in environmental spaces ..... 41
5.4.1 Introduction ..... 41

5.4.2 Methods and data ..... 41
5.4.3 Key results: demographic and visitation statistics ..... 43
5.4.4 Key results: environmental spaces ..... 47
5.4.5 Key results: cultural practices ..... 50
5.4.6 Key results: well-being ..... 53
5.4.7 Summary ..... 62
5.5 Participatory and interpretative approaches to cultural ecosystem services ..... 64
5.5.1 Participatory mapping of cultural ecosystem services ..... 64
5.5.2 Case Study 1: Participatory mapping in a Nature Improvement Area ..... 65
5.5.2.1 Key methods ..... 66
5.5.2.2 Key findings ..... 66
5.5.3 Case Study 2: Participatory mapping in the Inner Firth of Forth ..... 69
5.5.3.1 Key methods ..... 69
5.5.3.2 Key findings ..... 69
5.5.4 Case Study 3: Creative mapping of a farmland landscape ..... 70
5.5.4.1 Key methods ..... 70
5.5.4.2 Key Findings ..... 71
5.5.5 Case Study 4: linking farmland planning to community values on the Lizard Peninsula ..... 72
5.5.5.1 Key Methods ..... 72
5.5.5.2 Key Findings ..... 73
5.5.6 Summary ..... 73
5.6 Recommendations for the future development of CES within decision making ..... 74
5.6.1 Developing 'fit for purpose' CES indicators ..... 74
5.6.2 Developing the MENE survey as a CES database ..... 75
5.6.3 Developing Participatory and Interpretative CES Research ..... 76
References ..... 77
Appendix 5.1: WP5 Advisory Group ..... 82
Appendix 5.2: Executive Summary of Additional Cultural Values Work ..... 83
Appendix 5.3: A long list of possible CES indicators ..... 86
Appendix 5.4: Data sources and data processing ..... 91
Appendix 5.5: Modelling current and future patterns of cultural ecosystem services using Bayesian Belief Network ..... 101
Appendix 5.6: Regression Variables ..... 115

## Abbreviations and Acronyms

| | |
|---|---|
| **AH** | Arts and Humanities |
| **ANGSt** | Accessible Natural Greenspace Standard |
| **AONB** | Area of Outstanding Natural Beauty |
| **BBN** | Bayesian Belief Network |
| **CES** | Cultural Ecosystem Services |
| **CPT** | Conditional Probability Tables |
| **DMV** | Deliberative Monetary Valuation |
| **ES** | Ecosystem Services |
| **LAD** | Local Authority District |
| **LNR** | Local Nature Reserves |
| **LSOA** | Lower Superoutput Area |
| **MA** | Millennium Ecosystem Assessment |
| **MENE** | Monitor of Engagement with the Natural Environment survey |
| **NDNIA** | Northern Devon Nature Improvement Area |
| **NIA** | National Improvement Area |
| **NNR** | National Nature Reserves |
| **NT** | National Trust |
| **PROWs** | Public Rights of Way |
| **ROC** | Receiver Operating Characteristic |
| **SAC** | Special Areas of Conservation |
| **SPA** | Special Protection Areas |
| **SSSI** | Site of Special Scientific Interest |
| **UK NEA** | UK National Ecosystem Assessment |
| **UK NEAFO** | UK National Ecosystem Assessment Follow-on |

## Key Findings

**Cultural ecosystem services encompass the environmental spaces and cultural practices that give rise to a range of material and non-material benefits to human well-being.** These spaces and practices interact with contemporary cultural values to shape people's identities, provide experiences that contribute benefits in terms of well-being, mental and physical health, and equip people with a range of skills and capabilities. The UK NEAFO characterises the four key components of cultural ecosystem services as: environmental spaces; cultural values; cultural practices; and benefits. Our assessment of cultural ecosystem services to support decision-making is based on this understanding.

**A range of quantitative and interpretative research techniques are required to gather evidence for cultural ecosystem services and the benefits they provide to human well-being**. Although the assessment of cultural ecosystem services is generally recognised to be a conceptually and methodologically challenging area, the UK NEAFO shows that: (i) quantitative indicators and analysis of cultural ecosystem services can be developed, which draw on publically available datasets; and (ii) participatory and interpretative research techniques developed in the social sciences, and arts and humanities, can be used to assess and understand cultural ecosystem services in location- and community-based contexts. The approaches of these different disciplines vary considerably. Social science techniques often attempt to generalise and systematise knowledge about human relationships with place, locality, nature and landscape. Arts and humanities perspectives are grounded in the ambiguity, variety, irreducible difference, contingency, unpredictability and incertitude of human experience. Paying attention to these qualities improves, rather than impedes, understanding of the values and benefits attached to ecosystems and environmental spaces. Innovation towards accounting for cultural ecosystem services in decision-making relies on engaging with this diversity of approaches.

**The UK NEAFO developed and evaluated indicators of cultural ecosystem services to explore supply and demand in a range of environmental spaces. Our assessment reveals considerable regional variability across the UK in terms of the provision of environmental spaces and peoples' access to them. Additionally, it shows that domestic gardens represent a particularly important environmental space – up to a third of land cover in some areas.** Our work on these indicators also demonstrates their potential role in decision-making: they enable benchmarking and the comparison of local areas in terms of the provision of different types of environmental spaces. The interpretation of indicators in local areas, however, will generally need to be accompanied by locally specific data.

**With some further development, the Monitor of Engagement with the Natural Environment (MENE) survey has the potential to be used as a major evidence base for monitoring cultural ecosystem services in England in terms of well-being benefits and cultural practices associated with public and private environmental spaces.** Analysis of MENE survey data (boosted by extra questions on domestic gardens developed for the UK NEAFO) highlights that beaches are considered by MENE respondents as the most well-being enhancing environments (35%), with woodlands or forests (21%), and private gardens (19%) also considered significant. In addition, time spent outdoors, in either a domestic garden or a public cultural space, has a positive effect on well-being. People who live in Greater London gain the most in terms of well-being from domestic gardens, and, interestingly, women gain a higher level of enjoyment from gardens than men. Therefore, domestic gardens should be recognised as an important environmental space where people experience interactions with nature that enhance their well-being.

**The findings of the UK NEAFO reinforce the case for using mapping techniques to develop a participatory approach to assessing cultural ecosystem services.** Simple annotations of maps as part of an extensive social science questionnaire survey, or group-based exercise, provide a useful way of revealing concentrations of cultural benefits and identifying associated management issues. Participatory mapping produces new understandings of the cultural significance of ecosystems and helps bring latent cultural values to light, which may remain hidden when using other methods. The use of art-based mapping techniques can further animate and expand the understanding of cultural ecosystem services among communities. Creative approaches influenced by research in the arts and humanities not only provide new forms of evidence for decision-makers, but can help engage communities and engender stewardship of local natural resources; such approaches may be particularly effective when incorporated into a learning curriculum, for instance. Linking these techniques to wider tools and approaches developed in the landscape and heritage sector represents an opportunity for future innovations in the practical application of cultural ecosystem services concepts.

# Summary

The UK NEA (2011) advanced a 'settings' or place-based approach to cultural ecosystem services (CES). This approach highlighted a range of cultural goods and benefits associated with peoples' interactions with the natural environment. The UK NEAFO refines and elaborates this approach. It understands CES as both the environmental spaces (e.g. parks and beaches) within which people interact with the natural environment and the cultural practices (e.g. exercising and playing) that define these interactions and spaces. More generally these environmental spaces and practices are understood to shape and reflect a wider set of cultural (collective or shared) values about ecosystems.

Values, spaces and practices interact in complex and non-linear ways to give rise to a range of cultural benefits to human well-being; for instance, in terms of the *identities* they help frame (such as peoples' senses of place), the *experiences* they help enable (such as peace and tranquillity) and the *capabilities* they help equip (such as learning a new skill). The UK NEAFO develops a new conceptual framework for CES analysis that systematically measures and examines the relationships between these spaces, practices, values and benefits using a range of approaches, including (1) quantitative indicators, (2) social science quantitative and qualitative methods, and (3) a range of arts and humanities approaches.

## 5.S.1 Indicators for cultural ecosystem services

The UK NEAFO highlighted the need to develop quantitative indicators for cultural ecosystem services. Precise measurement of CES is generally considered difficult because of their qualitative and interpretative nature and the lack of easily accessible datasets. A range of potential new indicators was identified and evaluated by the UK NEAFO in consultation with policy and practice stakeholders. The four indicator types considered in detail focused on the measurement of CES in a range of environmental spaces in terms of (1) supply, (2) accessibility, (3) demand, and (4) quality. These indicators drew directly on publicly available datasets and were calculated mainly at Local Authority District (LAD) level for the whole of the UK. Many of the indicators can also be calculated at any level of geography based on aggregations of census output areas, such as Lower-Super output areas or parliamentary constituencies.

### 5.S.1.1 Indicators for the physical supply of environmental spaces.

These used percentage land cover (or a similar measure) as the basis for calculation. In total, an assessment of the supply of 14 environmental spaces was made, including ancient woodland, country parks, urban greenspace, designated areas, sports and leisure areas and parkland. Important findings were:

- There is variability across the UK in terms of the general supply of these environmental spaces. Variability is evident in the relative abundance of open access land in the North of England; the scarcity of designated sites in the Midlands; relatively little woodland in the Midlands and industrial areas of Northern England; a concentration of country parks in the North West and London area; and a concentration of National Trust land in the South and West.
- Domestic gardens represent a particularly important environmental space - up to a third of land cover in some areas. There is often a negative correlation between percentage cover of this type in local authority districts and presence of the other indicators, showing the importance of private gardens as a provider of CES in particular areas.

### 5.S.1.2 Indicators for the accessibility of environmental spaces.

These used the 'Accessible Natural Greenspace Standard' (ANGSt) methodology. The standard states that each resident should have at least one area of accessible environmental space conforming to the following size and distance criteria: 2 ha, <= 300 m from home; 20 ha, <= 2 km from home; 100 ha, <= 5 km from home; and 500 ha, <= 10 km from home. Some of these standards are difficult to meet in historic, built up-areas but are familiar to many decision-making organisations. On the basis of these standards, the UK NEAFO study calculated the average distance to each size of setting for a given human population and the proportion of the population fulfilling the distance criterion for the size of setting. Important findings were:

- The Midlands are relatively impoverished in terms of measures of accessibility, especially with respect to the proportion of the population living within the distance/size combination stipulated in the ANGSt criteria.
- Across Britain, there is some evidence for the most deprived and least deprived groups having better access to country parks and, when the average distance criteria were used, better access to ancient woodland and nature reserves in Scotland and Wales. The analysis also suggests that access to natural habitats improves with decreasing deprivation in England. Relationships with deprivation often differed according to whether average distance or the ANGSt distance criteria were used, and also according to the minimum size of setting considered, showing the importance of giving careful consideration to the precise specification of each indicator.

### 5.S.1.3 Indicators of demand for environmental spaces.

These indicators are based on innovative use of a Bayesian Belief Network (BBN) methodology to reveal the probability that a given individual would visit an environmental space and engage in particular cultural practice there, such as watching wildlife or walking. These calculations were done using the HUGIN[1] Expert software and the Monitor of Engagement with the Natural Environment (MENE) dataset, which is based on a questionnaire of over 50,000 individuals within England. This analysis involved calculations to generate probabilities for each local authority district in England, and was focussed on creating an indicator of demand for country parks (as sites designed to encourage certain cultural practices such as engagement with wildlife). The findings revealed that:

- The method could be used to produce proxy indicators of the degree to which supply matches demand for visits to country parks. Many local authority districts in eastern and northern England, and the West Midlands had low scores for this indicator, indicating that the supply of country parks does not meet potential demand.

### 5.S.1.4 Indicators on quality of environmental spaces.

These indicators examined a number of potential attributes of quality reflecting the characteristics of environmental spaces in terms of space, nature, culture and history, quietness and facilities – specifically in the context of 646 environmental spaces and 20 electoral wards within the City of Nottingham, the urban case study. The relationship between straight line distance to nature reserve boundaries and distance via a road network to reserve entry points was also examined. This analysis revealed that:

- There was a close, approximately linear, relationship between measures of accessibility by road and straight line distance. However, there were exceptions, with distance by road in some parts of Nottingham being over three times as great.

[1] www.hugin.com

- For most indicators, census wards around the centre of the Nottingham provide poorer access to certain environmental spaces than those to the South and North.
- While nation-wide indicators calculated at district level are useful in allowing local organisations to benchmark and compare themselves with other locations, there is a need to use locally available data to provide a richer picture of the availability and quality of environmental spaces.

### 5.S.2 Quantitative analysis of well-being and practices in environmental spaces

The UK NEAFO uses new data from Natural England's 'Monitor of Engagement with the Natural Environment' (MENE) survey to provide new insights into the well-being benefits associated with a unit of time spent in different types of environmental spaces (private and public) and participating in different types of interaction with nature. The study controls for a large number of potentially confounding factors. The new analysis was specifically designed to focus on aspects of the refined conceptual framework, in particular, the relationships between environmental spaces, cultural practices and well-being benefits. In this way, the MENE analysis extends the already very detailed studies provided in Natural England reports based on MENE (e.g. on the relationships between visit types, distance, travel cost and demographic characteristics).

The UK NEAFO analysis reveals that MENE has the potential to become a major dataset for monitoring CES in England. It is an on-going, face-to-face, in-home omnibus survey consisting of over 45,000 interviews per year. Questions are asked about a range of public environmental spaces (e.g. woodland, farmland, mountain, river, country park, city park, allotment, beach, etc.) and a number of cultural practices in these (e.g. relaxation, spend time with family and friends, entertain children, exercise and improve health, exercise the dog, enjoy scenery, enjoy wildlife, etc.). Alongside the analysis of this MENE data on public environmental spaces, the UK NEAFO also designed and implemented a new MENE module of questions focusing on the nature and extent of people's engagement with domestic gardens.

The results reported in the UK NEAFO are based on two subsets of information from the MENE survey: all the MENE survey observations for which well-being information was collected between 2009 and 2012 and for which there was information on all relevant control variables (N=3,224); and the new 2013 MENE garden module (N=2,659). The datasets are relatively small and have not been weighted; they are unlikely therefore to be fully representative of outdoor visitation patterns in the last 4 years. Similarly, they should not be directly compared with results published elsewhere using the full weighted MENE weekly survey dataset. They do, however, provide important new insights on the nature of environmental spaces, cultural practices and the well-being benefits associated with CES.

The analysis of MENE revealed that, in terms of **environmental spaces**:

- Beaches are considered by MENE respondents as the most well-being-enhancing environments (35%), with woodlands or forests (21%) and private gardens (19%) also significant.
- Time spent outdoors, in either a domestic garden or a public cultural space, has a positive effect on well-being. The effect on well-being of spending one hour outdoor ranges from 0.02 to 0.04 (with the well-being proxies varying from 1 to 5), when controlling for a large number of other factors. This is a relatively small effect but when all the trips and time spent in natural spaces throughout the year are taken into consideration, the cumulative effect could be significant.
- It is well-documented that income has a positive effect on subjective well-being; hence, a similar result might be expected to hold with green-spaces related well-being. After all, access to green spaces is more easily available to wealthier individuals who own a car and are likely to have

larger gardens. Conversely, some authors have found that green environments might reduce income-related health inequalities, by benefitting the least affluent the most. The MENE analysis of visits to environmental spaces found that the effect of socio-economic status on the attainment of well-being was ambiguous. The effect varies according to the type of well-being index considered and across datasets. Larger samples (and perhaps better defined well-being variables) are required to investigate the effect of socio-economic status on various forms of well-being connected with interactions with nature through cultural practices. It is possible that the effect of socio-economic status differs across type of green space and type of practices, but an analysis of this issue would also require a larger sample size.

- The MENE analysis of visits to environmental spaces found that the effect of socio-economic status on the attainment of well-being was ambiguous. The effect varies according to the type of well-being index considered and across datasets. Larger samples are required to investigate the effect of socio-economic status on various forms of well-being connected with interactions with nature through cultural practices.

In terms of **cultural practices,** the analysis of MENE revealed that:

- Relaxation is not only the most popular practice arising from an interaction with nature but is also the most well-being enhancing. The effect is particularly significant for those spending time in their garden. Socialising, green activities and other activities (such as reading, artistic activities, and DIY) carried out in the domestic garden also boost various forms of well-being. Walking the dog improves enjoyment and relaxation in public spaces, and exercising enhances the revitalising and refreshing effects of visits to such locations.
- The well-being effects of spending time in domestic gardens and in public outdoor spaces share many similarities. This suggests that domestic gardens should be considered a key space where well-being-enhancing nature interactions occur. Higher levels of enjoyment are gained from gardens by women compared to men, and residents of Greater London gain more in terms of well-being from domestic gardens compared to other regions. In this context, improving the limited available information on the condition of domestic gardens in terms of the occurrence of natural features and biodiversity seems warranted.

### 5.S.3 Participatory and interpretative approaches

The study shows how, alongside analysis of general quantitative datasets and the development of indicators, understanding of CES can be augmented by a range of other approaches derived from the social sciences and arts and humanities. Methods and approaches developed from a social sciences and arts and humanities perspective, which encompass a range of participatory and interpretative research techniques, can further aid analysis of this area of ecosystem assessment. In general, the values and benefits embedded in CES are most effectively accessed through the widest possible range of methods that yield evidence both quantitative and qualitative in nature.

The use of 'mapping' techniques provide a powerful way of developing interpretive and participatory approaches to CES study, in conjunction with stakeholders and communities. Mapping techniques can provide a platform for bringing together qualitative and quantitative data and exploring views and priorities, particularly through the use of creative, arts-based techniques. Mapping has been deployed as a key technique for engagement and deliberation in innovative CES research projects. The UK NEAFO built on this work to further demonstrate how a mapping approach, utilised in both urban and rural areas, can be deployed as a tool for surveying and engaging communities in a discussion of CES at the local level.

A CES mapping project developed in conjunction with the North Devon Nature Improvement Area conducted a survey of 1450 residents to solicit information on the cultural attributes residents associated with their local environmental spaces, the practices they engaged in and the types of cultural well-being benefit they derived. The use of the maps within the survey instrument allowed different types of cultural benefit and dis-benefit to be identified as the basis for informing management priorities.

A CES mapping project of the Inner Forth in the largely urban Central Belt of Scotland was used to support an RSPB-led partnership around a multi-purpose landscape management project involving managed realignment and habitat creation. Stakeholder mapping of CES was used to prioritise management plans alongside a process of deliberative monetary valuation.

Mapping approaches to CES linked to creative practice and arts-based inquiry were also applied to two farm-scale projects. The first project involved a series of community events on the Lizard peninsula, which encouraged people to share their memories, ideas, and views about a farm owned by the National Trust and undergoing a transition in tenancy. Informal conversations, field walks, and simple mapping exercises yielded material that was then presented in a creative spatial format and used to inform the drafting of a new tenancy agreement. The second project, carried out in the North Devon Nature Improvement Area with school children, involved a Google base map of local farm being incorporated with artefacts collected in the environment as well as photographs, sound recordings and personal reactions to this environment. The resulting map served as an educational device, and identified the environmental spaces and features that children value and the benefits they derive from them.

To further inform future CES research specifically from the arts and humanities decision makers can consider the innovations of a long tradition of landscape research, which offer site-specific assessment of the elements that shape the character of place. Foremost among these are the National Trust's 'Statement of Significance' and 'Spirit of Place' exercises, whose purpose is to communicate a shared understanding of the enduring qualities that make somewhere special.

## 5.S.4 Conclusions

The research presented in this Work Package seeks to understand and assess CES using a newly refined conceptual framework and the innovative use of a wide range of methods and approaches drawn from the quantitative and qualitative social sciences, as well as the arts and humanities. Such a multi-disciplinary approach to CES that utilises methods as varied as Bayesian Belief Networks and arts-based participatory mapping is unprecedented in formal ecosystem assessments. The Work Package, therefore, considerably expands the range of options available to decision-makers in selecting indicators, methods and approaches to analyse the different dimensions of CES and ensure that local policy-making addresses a variety of cultural contexts. The new conceptual framework can also be used by decision-makers to guide a range of policy analyses. The four key components of: (1) environmental spaces; (2) cultural practices; (3) cultural values; and (4) benefits need to be considered if CES are to be fully addressed in the ecosystem service framework. A series of general recommendations for taking forward the findings from this mixed methodological work are provided in the final section of the chapter.

## 5.1 Introduction and report structure

### 5.1.1 The UK National Ecosystem Assessment Follow-on and cultural ecosystem services

Advancing understanding of the cultural dimensions of human interactions with ecosystems was a key concern of the UK National Ecosystem Assessment (UK NEA). The Assessment argued that people draw many and diverse cultural goods and benefits from their relationships with UK ecosystems, and further, that ecosystems were replete with a range of cultural meanings and values. The concept of 'cultural ecosystem services' provides a way of understanding these relationships and associations in a systematic and dynamic way, although operationalising this idea in theoretical and methodological terms is generally recognised as a practically challenging area of ecosystem assessment. According to Plieninger *et al.* (2013, p.119) "cultural services differ in various aspects from other ecosystem services, presenting strong barriers toward their broader incorporation", while Chan *et al.* (2011, p.106) have suggested that, "few classes of value have been more difficult to identify and measure". However, consideration of this area is important for, as the UK NEA and others suggest, cultural ecosystem services encompass processes that resonate strongly with people and thus may act as important entry points for public engagement and concern in environmental matters, not least building wider public support for ecosystem protection (Daniel *et al.* 2010).

The work of the UK National Ecosystem Assessment Follow-On (UK NEAFO) work seeks to elaborate further this concept of cultural ecosystem services in a way that will have utility for policy and decision makers. It specifically picks up on the conclusion of the UK NEA that there remains the need for "more theoretical development combined with substantial methodological innovation in the collection and analysis of data, both quantitative and qualitative. These innovations will also need to be designed to understand the inequalities that currently exist in terms of how people experience the goods and benefits of cultural services" [680]

The UK NEAFO's approach to this issue, and the specific findings presented in this chapter and supporting appendices, have been guided by broad consultation with policy and practice stakeholders, as well as drawing in the academic perspectives from the wider social sciences and humanities which contain long standing traditions of work – both theoretical and applied – analysing the relationship between 'culture' and 'nature' and how an understanding of this relationship can be augmented through quantitative and interpretative research[2]. In particular, this process highlighted the need for:

1 Developing further the theoretical basis of cultural ecosystem services. To embed this concept in to decision making, there is the need to draw out theoretically the different processes and elements that would constitute the relationship between ecosystem services, culture and benefits to well-being.

   *The UK NEA advanced an 'environmental settings' approach to cultural ecosystem services. In general this approach sought to link ecosystem cultural goods and benefits to the interactions that arise between people and nature in particular places. The NEAFO framework elaborates further the different elements that make up this 'place based' approach, drawing out important distinctions between terms that are often confused in current approaches to assessment.*

2 Clarifying the range of methodologies and techniques that decision makers might use to measure and interpret different aspects of cultural ecosystem services, including an assessment of their strengths and weaknesses and contexts of appropriate use.

*The UK NEA argued for an approach to cultural ecosystem services that required mixed methodologies and techniques. Providing evidence for and about cultural ecosystem services in decision making would require quantitative and analytical as well as qualitative and deliberative approaches. The UK NEAFO study places emphasis on reviewing and applying these approaches across a range of spatial scales.*

In pursuing these concerns three issues have guided the UK NEAFO work and are central to the innovative aspects of the research. First, the NEAFO seeks to balance the need for a more sophisticated understanding of the idea of CES without making this aspect of ecosystem assessment obscure. The framework developed here endeavours to draw out key processes and elements that allow this concept to be approached in a systematic way, but this concern for clarity should not be confused with prescriptiveness. The framework is essentially heuristic (a 'rule of thumb') and open to adaptation and innovation. Second, balancing the need for novelty with the use of existing approaches to environmental surveillance and data infrastructures, the UK NEAFO advances participatory and mapping approaches as an area of potential innovation. Third, there is also a need to recognise the synergies and challenges associated with linking cultural ecosystem services to prevailing data infrastructures, and common approaches to evidence gathering. In the UK NEAFO we explore how understanding of CES might be advanced using existing data to develop indicators for cultural ecosystem services and by drawing on existing data sets that, while not purpose-built for cultural ecosystem services, may be analysed and augmented to enable insight in this area. The UK NEAFO develops new indicators that can be used to guide decision-making relating to CES in a number of contexts. Furthermore, the analyses of existing datasets, especially the Monitor of Engagement with the Natural Environment (MENE), is used to enhance our understanding of the benefits people get from interacting with nature in a variety of contexts and also to identify how a longer term national evidence base for CES can be advanced. In doing so, the report highlights to decision-makers a range of options for selecting methods and approaches that are not only useful for analysing the different dimensions of CES outlined in the conceptual framework, but also are appropriate to local policy-making and cultural contexts.

The findings on CES are presented in this report and are based on four integrated research activities, namely:

1. devising a conceptual framework for cultural ecosystem services;
2. developing indicators of cultural ecosystem services;
3. undertaking a quantitative analysis of well-being and practices in environmental spaces;
4. testing participatory and interpretive approaches to cultural ecosystem services.

The innovative dimension to the research is that it seeks to understand and assess CES by proposing a refined conceptual framework and by applying a wide range of methods and approaches drawn from the quantitative and qualitative social sciences and the arts and humanities. In doing so, the report highlights to decision-makers a range of options for selecting methods and approaches that are not only useful for analysing the different dimensions of CES outlined in the conceptual framework, but also appropriate to local policy-making and cultural contexts.

### 5.1.2 Conceptual development of cultural ecosystem services

The UK NEA noted that the conceptual approaches guiding CES study needed further refinement to be more sensitive to the many manifestations of culture arising from peoples' interaction with ecosystems. Section 5.3 presents a conceptual framework that builds on that used in the UK NEA and responds to key issues identified in relevant peer reviewed literature.

The development of the new conceptual framework was also informed by two expert groups and four stakeholder workshops. The first expert group was an advisory group set up to guide the research (membership is listed in Appendix 5.1). The second group was a Working Party on Arts and Humanities Perspectives on the Ecosystem Service Approach that was funded by the Arts and Humanities Research Council as part of the UK NEAFO. Two of the stakeholder workshops were conducted with members of staff from organisations who are members of the UK NEAFO stakeholder group and who have responsibilities for developing the ecosystem services framework within their organisations. The other two stakeholder groups involved individuals from the public, private and third sectors and were convened through the Ecosystem Knowledge Network. The components of the new conceptual framework have guided the empirical research in this report and the findings of this research allowed for further refinement of the framework.

### 5.1.3 The empirical research on cultural ecosystem services

The new conceptual framework highlights the complex range of spaces, practices, values and benefits that have to be analysed if CES are to be fully understood in environmental decision-making. The UK NEAFO study tested a range of empirical methods and approaches in order to address this complexity and to illustrate how different approaches to CES study may be applied in different contexts and situations, depending on, for example, the intended use of the resulting data, available skills and resources, desired levels of public engagement and other specific concerns. The three pieces of empirical work involved:

- The development of a set of quantitative indicators for CES that can be analysed at various geographical scales in England, Scotland and Wales, illustrated though an in-depth urban case study of Nottingham.
- A quantitative investigation of the well-being benefits linked to CES using new data collected as part of the Monitor of Engagement with the Natural Environment (MENE), a regular survey conducted by Natural England.
- A series of local case studies involving the use of a range of participatory, interpretative, deliberative and dialogue-based research approaches developed in the social sciences and the arts and humanities to understand the values and attitudes relating to CES.

The final section contains a series of recommendations arising from the use of the different methods and approaches.

## 5.2 Conceptual framework for cultural ecosystem services

The conceptual framework for CES is summarised in **Figure 5.1**. This framework represents an elaboration and development of what the UK NEA (2011) described as an 'environmental settings' based approach to cultural ecosystem services, and draws on the work of Fish and Church (2013). In general terms the approach articulated in the UK NEA highlighted that cultural goods and benefits associated with ecosystems arise from interactions between people and the natural environment. Put another way, an environmental settings approach emphasised a place, locality, landscape or seascape-based perspective to cultural ecosystem services (Church et al. 2011). Although these terms have their own distinct traditions and meanings, from the perspective of ecosystem assessment, the broad aims of a settings-based perspective is to explore the idea of culture in a geographical context. In Figure 1 the different components that make up the relationship between culture and ecosystems are represented graphically.

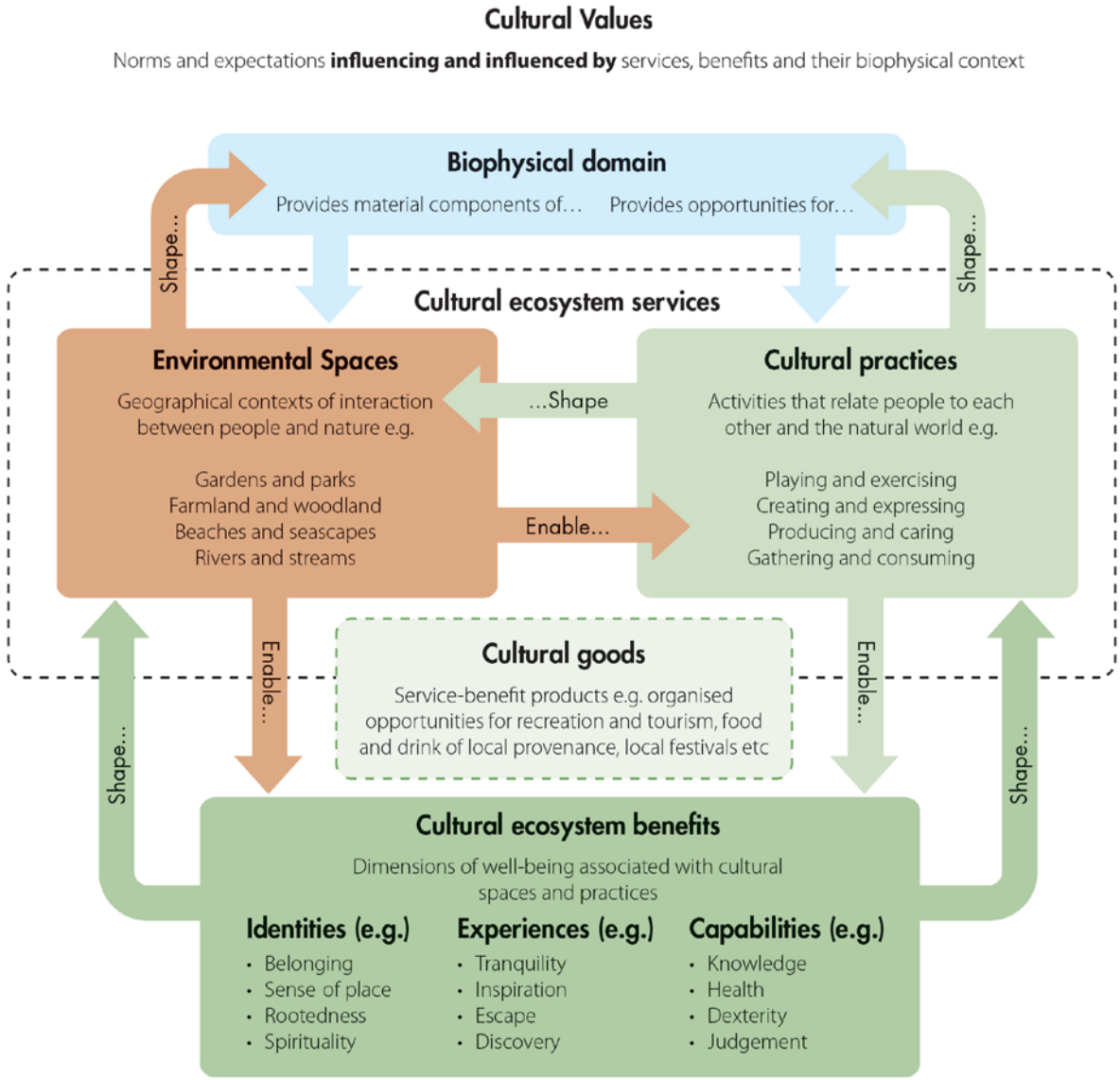



**Figure 5.1. Conceptual Framework (Fish and Church, 2013)**

### 5.2.1 Key tenets of the framework

A number of important analytical and empirical distinctions can help guide understanding of these cultural ecosystem services. In particular, the framework (**Figure 5.1**) makes a distinction between:

1. *Cultural values*, defined as the collective norms and expectations that influence how ecosystems accrue meaning and significance for people, referred to in the UK NEA (2011) in terms of 'shared social values' for ecosystems (Chapter 24); See also Appendix 5.2 (WP5 A&H Annexes 1-3) for a account of cultural values from and Arts and Humanities perspective.
2. *Environmental spaces*, defined as, the places, localities, landscapes and seascapes in which people interact with each other and the natural environment.
3. *Cultural practices,* understood as the expressive, symbolic, embodied and interpretive interactions between people and the natural environment.
4. *Cultural benefits*, the dimensions of human well-being that can be associated with and that derive from these interactions between people and the natural environment.

These distinctions are important. Most applications of ecosystem assessments follow the definition of the UN Millennium Ecosystem Assessment (MA 2005, p.29), by advancing understanding of cultural ecosystem services in terms of the "non-material benefits people obtain ecosystems". Although this definition tells us something important about the nature of cultural benefits that arise in conjunction with ecosystems (i.e. they are often intangible), it also conflates services with benefits. This leads to three inter-related problems. First, ecosystem assessment works on the basis of viewing benefits as the product of services, so by dissolving this distinction it is not clear analytically from where benefits would then arise. Second, the MA's definition confers the property of a benefit (i.e. intangibility) onto what the framework of ecosystem assessment would otherwise describe as a material process or thing (i.e. the cultural service), meaning that assessment of cultural ecosystem services tends to be associated with the measurement of immaterial processes alone, and thus the relationship to the biophysical domain is unclear. Third and finally, the MA's definition tends to obscure the way that human-ecosystem relationships can also have a material cultural dimension. Traditions of academic work in the social sciences and humanities, from archaeology to anthropology, have long used concepts such as 'material culture' and 'cultural materialism' to convey the way that culture resonates through, and adheres to things (material objects), and in the present context this point can also be extended to include ecosystems.

To some degree these problems of defining CES reflect the much wider debates over how to conceptualise nature and how to understand the relations between humans and the non-human. Castree (2014) argues that there are four different meanings to nature in Anglophone society which include: 'external nature' (the non human world); 'universal nature' (the entire physical world including humans); 'intrinsic nature' (the defining features of living and inanimate phenomena); and 'super-ordinate' nature (the organising principles of animate and inanimate phenomena). To add to this complexity, Castree (2014) observes that in western thought attempts to understand the relations between the human and non human involve fundamental philosophical debate and on-going disagreements relating to cognition, morality and aesthetics. Given this intellectual context, it is perhaps not surprising that academic and policy writings have critiqued the MA and other attempts to conceptualise CES for their over-simplification of the relations between humans and non-human phenomena (Fish, 2011; Chan et al. 2012). Despite this critique, where definitions of CES are put forward in the literature, these tend to correspond to the MA definition, either explicitly or implicitly. Alternative definitions are all but absent. Chan et al (2012, p. 9) modified the MA definition so that CES are defined as "ecosystems' contributions to the non-material benefits (e.g., capabilities and experiences) that arise from human–ecosystem relationships" (p. 9). This definition

is adopted by Plieninger et al. (2013) and Klain and Chan (2012) with the latter defining CES in terms of both Chan et al. (2012) and the MA.

One advantage of the MA approach, however, is that it highlights that an understanding of CES and their management within the ecosystem framework requires not just an assessment of the benefits humans gain from the natural environment, but also an analysis of how these benefits are shaped by a series of processes through which humans interact with the non-human world, such as spiritual enrichment, aesthetic appreciation and recreation. The conceptual framework outlined in this section, therefore, seeks to build on the MA in that the inclusion of cultural practices in the framework is designed to highlight how an examination of CES needs to address the process-based interactions between humans and the non-human. The framework enriches the 'settings' based approach of the earlier UK NEA which examined these interactions by considering the some of the key places that are the location for these interactions. The theoretical and empirical merits of a place based approach to ecosystem services in general compared to habitats based, systems or process based approaches have already been discussed in previous studies (Potschin and Haines-Young, 2013). By developing a conceptual framework that considers both places and practices the UK NEAFO focuses on some of the key processes and human experiences that long-standing philosophical thought and research has identified as being central to shaping human-nature relations (Descola 2013). The concept of environmental spaces maintains the idea of a physical location in relation to cultural ecosystem services developed in the 'settings' based approach of the UK NEA whilst the concept of cultural practices explicitly recognises the expressive, symbolic and interpretive interactions between people and the natural environment. Environmental spaces and cultural practices can, therefore, be considered as mutually reinforcing cultural services and it is primarily through them that a range of cultural benefits arise. In addition, the framework incorporates cultural values reflecting the emphasis placed on these values in both the MA and the UK NEA in the discussion of 'shared social values' in shaping how humans experience and interact with the non-human. The framework, like all such schematic summaries, is a simplification of the complex ways humans relate to the non-human but it acts as a heuristic device that can be used flexibly to guide ecosystem assessment and related decision-making For example, decision-makers can consider the degree to which they are seeking to manage each of these components (places, practices, values and benefits) and the potential impact of any change in management on these components.

In **Figure 5.1** 'environmental spaces' are what the UK NEA described as 'environmental settings'; they are places, localities, landscapes and seascapes that provide opportunities for interactions between people and nature and are associated with a range of cognitive, social and physical benefits to well-being. This change in terminology reflects feedback from stakeholders in the production of this study. 'Cultural practices' are effectively a mechanism that links environmental spaces with a contribution to well-being (i.e. the cultural benefit). Thus, our overall argument is that environmental spaces and cultural practices are linked in mutually reinforcing relationships, through which cultural well-being benefits are generated. In a biophysical sense, ecosystems are understood to provide the physical components of these spaces, and the opportunities for engagement in cultural practices associated with them. By understanding these interacting elements of culture - spaces, practices and benefits – and the cultural values they shape and reflect; researchers and decision makers are provided with a powerful framework by which to understand the cultural significance of ecosystems. This approach is consistent with wider developments in the cultural ecosystems services literature (Gee and Burkhard, 2010; Schaich *et al.* 2010; Bieling and Plieninger, 2013). Furthermore, the study of spaces, practices, values and benefits lends itself to a range of assessment approaches (including quantitative and qualitative measurement) that can provide a varied and robust evidence base for policy that seeks to address cultural ecosystem services.

#### 5.2.1.1 Environmental spaces

In practical terms these environmental spaces may be delineated in variety of ways: a stretch of footpath, a street, a hill, an expanse of green space, a protected shipwreck, a marine conservation zone, a national park or a nucleated settlement. All of these spaces may plausibly provide ways of locating cultural benefits in their wider geographical milieu and be associated with a range of culturally defined attributes (e.g. beauty, tranquillity, distinctiveness) that may be explored in the context of contributing natural capital. Approaches to classification and definition will vary according to underpinning purposes and resources, but a general philosophical point is that attributions of significance by decision makers, communities and individuals will often rest on prevailing - deeply historical - ways of valorizing a place. While no single taxonomy of spaces and attributes exist to delineate the cultural contexts of human interaction and ecosystem benefit, accumulated convention and experience allow individuals, groups and institutions to discriminate between places according to established registers of cultural value. In this sense, a landscape or seascape designated as a 'national park' or deserving of 'world heritage' status is not an absolute definition of cultural value, but neither is it purely arbitrary. Part of the task for researchers and decision makers, therefore, is to stay alert to countervailing tendencies, and to attend to spaces that are incongruent with dominant systems of value, such as the 'unofficial countryside' and the 'edgelands' of the urban hinterland (Shoard, 2002; Mabey, 2010).

#### 5.2.1.2 Cultural practices

As Figure 5.1 conveys, environmental spaces both enable, and are in turn shaped by, cultural practices. The symbolic, expressive and interpretive realm of human interactions with nature is inherently complex. Practices may be physical/embodied, textual/mediated and/or linguistic/discursive in form. Again, cultural practices reflect and constitute cultural values and are a discernible way that culture can be said to manifest itself, both at particular at moments in time (e.g. through recreational activity) and as part of a broad cultural realm of lived experience (e.g. through expression of a whole 'way of life') (Williams, 1983). In the conceptual framework, practices serve as the mechanism binding together cultural benefits to their biophysical/cultural contexts of production. Our framework distinguishes between four (often interrelated) types of cultural practice:

- *Playing and exercising,* that is, activities of non-work leisure time involving informal and physical interactions between people and the natural environment. These may be sedentary, active, social or solitary; examples include walking, dog walking, climbing, running, cycling, sitting, looking, listening, picnicking and paddling.
- *Creating and expressing,* that is, activities of non-work leisure time defined by the conscious construction of symbolic artefacts and processes. This may include solitary pursuits inspired by natural environment such as drawing, painting, photography, writing, and poetry, as well as organised performances and participation in customs and rituals that draw on and reflect the natural environment in some way, such as music, drama and storytelling; See Appendix 5.2 and WP5 A&H Annexes 1-3 for a more detailed account.
- *Producing and caring,* that is, activities that blur the distinction between labour and non-labour engagements with the natural environment. The multitude of environmental and land based professions are included in this category, as are more informal acts of physical conservation and management of features of natural environment, such as cultivating land for food production, fishing, environmental volunteering, citizen science, gardening and participation in agri-environmental stewardship.

- *Gathering and consuming,* that is, activities spanning passive and active engagements with the natural world and which occur in both work and non-work contexts, such as consuming food and drink of local provenance, collecting wild food, fibre and ornaments and consuming non - conversational media and genre about a place (e.g. local art/artefacts/popular media/performances).

To reiterate, these cultural practices are understood within the framework as occupying a mutually constitutive role in the formation of cultural services and cultural benefits. Places, localities, landscapes and seascapes enable cultural practices to occur but are also shaped by these practices. Equally, the identities, experiences and capabilities enabled through these practices also actively construct and reconstruct the character of cultural practices.

### 5.2.2 Cultural ecosystem benefits

While most applications of the cultural ecosystem services concept emphasise the intangible benefits that humans derive from nature, researchers and decision makers have generally struggled to disentangle what these many and diverse outcomes might be. We understand the contributions these environmental spaces make to well-being in three key ways: the *identities* they help frame, the *experiences* they help enable and the *capabilities* they help equip. By making these distinctions, the framework resists describing benefits in purely intangible terms. The cultural dimensions of human well-being are as visceral, embodied and 'felt' as they are constructed in thought, reason and cognitive processing of the environment (cf. Braat and De Groot, 2012). This broad classification represents a further development of the definition forwarded by Chan *et al.* (2011), thus:

With reference to *identities,* we are highlighting the signifying qualities of ecological phenomena and how these come to be enmeshed in processes of identity formation. For instance, ecosystems are replete with cultural meanings through which people understand themselves and their relationship to the world around them. An example of a cultural benefit that coincides with these symbolic roles of ecosystem would be the idea of belonging: ecosystems play a role in the process of place identification through which ideas of affiliation and attachment develop.

- With reference to *experiences,* we are concerned with the way ecological phenomena are encountered and understood through events. Experiences are benefits that are produced, mentally or physically, through immediate contact with ecosystems. Examples of an experiential cultural benefit might include feelings of calm arising from encountering some physical attribute of ecosystems, or an experience of nature deemed aesthetically pleasing. These contacts are not only embodied and proximate (such as the production of an experience through a walk in the forest or diving underwater), but also occur in dis-embodied and distant ways as well (such as the benefits associated with consuming nature through a television programme); and,
- With reference to *capabilities,* we are focusing on the role that ecological phenomena play in shaping individual and social capacities to understand and to take action. For instance ecological phenomena are utilised in processes of knowledge acquisition at the level of general intellectual and scientific advancement (such as making sense of biodiversity), but also in patterns of individual development, such as the acquisition of personal skills and knowledge through which people flourish as individuals (such as wisdom, judgment, insight) and advance their situation in life (for example through acquiring gainful employment). The idea of capabilities is therefore about capturing how people and human cultures more generally, equip themselves, through nature, to prosper.

As befits the objectives of ecosystem assessment, exploring these types of benefits situates concerns firmly within a *normative* account of culture. Assessment is concerned with understanding culture in terms of its virtuous and life enriching qualities, as opposed to something contested, limiting or indeed threatening. The framework we advance here is designed to conform to wider historical and popular discourse on what these benefits might comprise (see Williams, 1984) but the idea of a cultural benefit is, of course, highly interpretive: one person's cultural benefit may well be another's cultural dis-benefit (see Plieninger *et al.* 2013). In this sense, cultural benefits generally lack the apparent internal consistency of other arenas of ecosystem assessment. They also lack well defined measurement boundaries. For example, an experience of nature (e.g. aesthetic pleasure) can be read through the lens of identity (e.g. the construction of valued place identities) just as a capability (e.g. the ability to catch a fish) can be read through the lens of experience (e.g. a feeling of oneness with nature) and so forth. In practical terms it may be logical to explore how these benefits mutually reinforce each other in particular geographical contexts rather than attempt to separate them artificially. As the arts and humanities work for the UK NEAFO stresses, the values and benefits associated with CES are often mutually reinforcing and sometimes inextricably interwoven. For instance, it can be hard to determine when an aesthetic experience ends and a spiritual one begins (or vice versa).

### 5.2.3 Summary

Understanding cultural ecosystem services relies on exploring systematically the relationship between spaces, practices and benefits, and the cultural values they reflect and sustain. As the framework implies (and Figure 5.1 seeks to represent) there is a strong recursive and non-linear dimension to how we conceive of the relationship between environmental spaces, practices and benefits. Culture is not a property of ecosystems *per se,* but something co-produced and co-created between people and their environments through these relationships. The task of researchers and decision-makers is to understand each of these components of the framework and how they link together. This calls for a transdisciplinary approach where the focus is on developing diverse, non-prescriptive and complementary strategies for CES measurement and valuation. Decision-makers will also need to develop the skills to determine which measurement and valuation approaches are appropriate in different situations and settings. The following sections provide specific examples of how an understanding of the key dimensions of CES – spaces, practices, values and benefits – can be used to inform research, policy and management.

## 5.3 Developing indicators of cultural ecosystem services

### 5.3.1 Introduction

The aim of this section is to suggest a set of quantitative indicators which can be used to measure CES. The approach outlined in this section draws on accepted international criteria for the development of robust indicators, detailed in two decades of scholarship[3]. In general terms, it is agreed that indicators should seek to promote and support *simplification, quantification and communication.* Criteria that have been suggested for devising and selecting environmental indicators in a number of previous studies are shown in **Table 5.1**.

**Table 5.1. Criteria suggested for environmental indicators based on Anderson (1991), Environmental Challenge Group (1995), CSIRO (1998), Gabrielson & Bosch (2003), Audit Commission (2005).**

| |
|---|
| • Possible and practicable to measure using available data |
| • Meaningful and represent something believed to be important or significant in its own right |
| • Resonant, easy to understand and require little interpretation, with an agreed definition |
| • Should serve a useful purpose – e.g. to inform improvements in policy or the management of resources. |
| • Assist decision making by being effective and cost-efficient to use |
| • Help focus information to answer important questions |
| • Monitor change and show progress over time |
| • Assist decision making by being effective and cost-efficient to use |
| • Exhibit only a short time-lag between what is measured and the indicator becoming available |
| • Facilitate comparisons of performance between different geographical areas |
| • Stimulate debate and raise awareness |
| • Inform local community strategies and local area agreements |
| • Review, justify and set local objectives and priorities |
| • Enhance partnership working, shared ownership and joint action |
| • Ideally allow international comparison |

Thus far, relatively little has been done to develop robust indicators for CES. In a recent review, Hernández-Morcillo et al. (2013) found that the indicators used were often "deficient, concerning

[3] See for example, CSIRO: http://www.csiro.au/csiro/envind/code/pages/04.htm

their clarity of definitions, purposes and understanding of the processes to be measured and referring only marginally to trade-offs and bundles with other services. Only 17% performed multi-temporal assessments and 23% used spatially explicit information" (441). Complex issues associated with ecosystem assessment, such as considering how changes in bio-physical processes will affect cultural ecosystem services, are very rarely considered in discussions of indicators. In general, CES indicators have mostly been restricted to capturing visitor rates at specific sites as measures of demand (Plieninger *et al*. 2013) and do not, therefore, provide a basis for comparisons or benchmarking between locations. Exceptions to this have included the work of Bateman & Jones (2003), which measured potential access to forest recreation in Wales, Bateman *et al*. (2013), which developed an econometric model to measure accessibility to natural habitats (although neither of these studies set out to derive indicators), and county-level or regional studies using the Accessible Natural Greenspace Standard – ANGSt (Handley, 2003; Natural England, 2010b).

Measures of tranquillity produced for The Campaign to Protect Rural England have been modelled spatially for England, based on features in the landscape found to be important to people's sense of tranquillity, such as natural features (woodland, rivers etc.), light pollution and the presence of towns, cities and transport infrastructure (Jackson *et al.* 2008). There may be merit in using these data as the basis for an indicator, although the fact that tranquillity is modelled, rather than a well-understood characteristic of the environment, makes their interpretation difficult.

There are good reasons for the apparent lack of robust CES indicators. Firstly, when compared to other ecosystem services, the relationships between easily measurable physical characteristics and the level of service are often more complex and context specific in CES studies (Chan *et al*. 2012, Tenberg *et al*. 2012, Satz *et al*. 2013). Secondly, where it is possible to acquire data it is often expensive and time consuming to do so. When such data has been collected locally it is often not made publicly available. For example, GIS data sets for Public Rights of Way (PROWs), tree cover, parks and other open spaces, and tree preservation orders are often held by local authority GIS teams, but access is not readily available. The 'Rowmaps' website was established specifically to advise on how to obtain local authority GIS data sets for the definitive maps of Public Rights of Way PROWs[4].

When data are available on the location of individual environmental spaces (e.g. local parks and cemeteries) information which is crucial to understanding the benefits they provide is often difficult to obtain, at least for large areas. For example, urban parks and farmland differ markedly, both in aesthetic beauty and in opportunities for observing wildlife, according to the extent, configuration and species composition of the different habitats within the landscape. Although detailed data on habitat and species composition can be produced, they can only be acquired through site surveys or specialised processing of aerial or satellite imagery. This makes arriving at consistent measures across large areas problematic. Public access is also a key component in the delivery of CES, and few data sets provide information on this.

Even if all such readily-producible data could be made available, there are aspects of cultural ecosystem services which are highly site specific, and cannot be easily measured using national or even local data sets. For example, the cultural resonance that a particular site has to a local population, such as a village green or common land that has been used for generations as a site of recreation, social activity or husbandry cannot be readily measured without site specific studies of the meanings it has to the local community. Numerous case studies, including the work in North Devon reported in this chapter, illustrate the need to take into account local perspectives in

[4] http://www.rowmaps.com

assessments of CES (see, for example, van Berkel & Verburg, 2012; Casado-Arzuaga *et al*. 2013; Casalegno *et al*. 2013; Frank *et al*. 2013; Nahuelhaul *et al*. 2013; Plieninger *et al*. 2013; Schirpke *et al.* 2013), and it is instructive that Nature Improvement Areas (NIAs) in the UK allow for the development of area-specific indicators alongside those that can be compared between NIAs (Natural England, 2012c).

### 5.3.2 Types of Indicator

Cultural ecosystem services are delivered at the interface of society and nature and are therefore inherently complex and multifaceted (Plieninger *et al*. 2013). Categories of indicators relevant to CES have been identified and a long list of possible indicators was compiled (see Appendix 5.3). The development of the long list of indicators was based on research into the use of indicators for CES both in the UK and abroad, and was further refined in a series of workshops with stakeholders at which the role and purpose of different forms of CES indicator was discussed. These categories of indicators range from measures of the degree to which local residents are happy with their experiences of nature, to total financial expenditure on things such as eco-tourism and wildlife-related products. Each organisation needing to be aware of CES is likely to need its own indicators suited to its own areas of responsibilities. Workshops with stakeholders as part of this Work Package will continue until March 2014 in order to populate and refine the list of indicators and to arrive at a candidate short list of indicators for practical use. The indicators presented below were also chosen in response to the reviewer comments from a wide range of stakeholders to the first draft of this report.

This section of the report describes a set of indicators for CES which can be produced using publicly available data. These indicators are designed to measure the characteristics of local areas and access to environmental spaces. Analysis is presented through indicators of both the supply side – what environmental spaces are available in a given area – and indicators of the demand side – what environmental spaces do people seek out and what practices do they carry out there. In terms of the conceptual framework, these indicators mainly relate to the *environmental spaces* where *cultural practices* occur and where *cultural benefits* are enjoyed, but some of the demand indicators also directly measure cultural practices (such as watching wildlife) and the indicators of the historical richness of the landscape also take into account cultural practices, albeit through the relationship of past events and activities to culture.

The findings of stakeholder workshops suggested environmental decision-makers, especially at the local level, would potentially benefit more from CES indicators that were focussed on environmental spaces, rather than those which were more distributed or dislocated. Consequently, indicators were not calculated to measure subjects such as the consumption of CES through the media or interest in CES shown through the use of social media groups (but, as is discussed later, measures of this type are considered important by some stakeholders). The intent of this work is primarily to move discussion forward by exploring a range of possible indicators rather than presenting a definitive set of indicators.

The indicators calculated are of the following types:

1 Information on the *supply* of environmental spaces, measured through percentage cover and similar measures for a range of types of environmental space.

2 Measures of *accessibility* to environmental spaces (these focussed on ancient woodland, country parks, nature reserves and natural land cover as they offer opportunities for a range of cultural practices).

3 Measures of *demand* for certain types of environmental spaces or practices associated with them, such as watching wildlife or walking.

4 Indicators which may be used to measure the *quality* of environmental spaces such as parks – crime rates, noise levels, proxies for biodiversity and the availability of facilities such as play areas. We consider some of these in our section on local indicators for Nottingham (Section 5.3.6).

These indicators were calculated at Local Authority District (LAD) level for the whole of the UK, as this allowed for the production of maps whereby patterns could be discerned. However, these data can be readily disaggregated to comparative analysis of local authority sub-areas, wards, Lower Super Output Areas (LSOAs) (which cover approximately 500 households), and output areas (150 households). In an urban case study for Nottingham, similar data is examined at these finer scales. Appendix 5.4 provides a more detailed description of the methods and data used to produce these analyses.

### 5.3.3 Supply related indicators: percentage cover and other area-based estimates

It is possible to create indicators of percentage cover of a wide range of types of environmental spaces which have a role to play in cultural ecosystem services. The degree to which the public engage with the natural environment when they visit environmental spaces differs widely, from a mere appreciation of being in a pleasant environment to an intense and dedicated observation of wildlife and landscape, and active involvement in habitat management (see Keniger *et al*. 2013 who categorise 'Interactions' with Nature into 'Indirect', 'Incidental' and 'Intentional' types.). With this in mind, indicators were calculated based on the areal extent of a range of environmental spaces, some of which will be of more relevance to those seeking a limited connection to their environment, and others of which will be relevant to those more closely connected to nature conservation.

These indicators were calculated for the following types of environmental space, expressed as percentage of land-cover except where otherwise indicated:

- ancient woodland;
- broadleaved woodland;
- country parks;
- designated areas (includes AONB, LNR, NNR, NIA, RAMSAR, SAC, SPA, SSSI)
- grassland, mountain and moorland;
- national parks;
- National Trust Property (% cover and number of properties per 10,000 population), excludes Scotland;
- non-built - areas not predominantly consisting of built environment and gardens;
- open access Land (for England only);
- open fresh water ;
- parkland (for England only – excludes South East due to unavailable data);
- sports and leisure areas;
- total woodland; and
- urban greenspace.

Private gardens are important in the provision of CES, particularly in urban areas (see Section 5.4.5). The available data does not readily allow for the calculation of the average size of gardens, but it was

possible to calculate the total area occupied by them, and so indicators were produced for both percentage cover of gardens and garden area per household.

In order to present the different indicators into a single, summary measure, the value for each district and indicator was divided by the mean value of the indicator over all districts, and then calculated as the average of these values amongst all 17 indicators. Many eastern districts of England were found to have low values for this aggregated measure compared to the rest of the country (see **Figure 5.2 a**). Maps illustrating the distribution of some of the indicators are shown in **Figure 5.2 b-e**. Although in many cases there was considerable variability across the Great Britain, some regional patterns were evident, including:

- the relative abundance of open access land in the North of England;
- the scarcity of designated sites in the Midlands;
- relatively little woodland in the Midlands and industrial areas of Northern England;
- a concentration of country parks in the North West and London area;
- a concentration of National Trust Property in the South and West.

As might be expected, the absence of National Parks from central areas was evident, as was the relative lack of mountain, moor and grassland in eastern England. As might also be expected, urban areas showed a relatively low supply of CES as measured by these indicators. In interpreting these results it should be borne in mind that extent alone is unlikely to capture CES, and that pattern, shape and form, and relationship with the rest of the landscape may play major roles, and that different landscape features may differ in their significance depending on local context and personal perspective (Norton *et al*. 2012).

Spearman rank correlations between the indicators showed there was relatively little redundancy between them, with few showing correlations below -0.5 or above 0.5 (**Table 5.2**). Amongst the strong positive correlations were those between the three woodland indicators (all >= 0.68), between grassland, mountain and moor and open access land (0.59) and between the two National Trust Indicators (0.84). Percentage cover by gardens was negatively correlated with nine of the 16 other indicators, and showed only a 0.004 correlation with parkland. Garden area per household was strongly positively correlated with % non-built (0.84) and National Trust properties per square km (0.62), and negatively correlated with % urban green space (-0.73) and % Garden Cover (-0.86), highlighting the degree to which garden size tends to be higher in non-urban than urban areas. It was positively correlated with % parkland (0.18).

**Table 5.2. Spearman Rank Correlations between percentage cover/ area per household/ number per 10,000 population indicators calculated for GB districts. Correlation >= 05 are shown in green font, <= 05 in red.**

| | % Park | % Urb Gsp | % Sp & Leis | % Cntry Pk | % Open Acc. | % Nat Tr. | NT per Km$^2$ | % Nat Pk | % Desig | % Non-built | % F Water | % Wood | % B. Leaved | % Anc. Wood | % Grass, Mtn, Moor | % Garden | Gnd Area per Hsehold |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % Parkland | | -0.08 | 0.18 | 0.12 | -0.08 | 0.11 | 0.10 | -0.11 | -0.12 | 0.05 | -0.06 | 0.23 | 0.26 | 0.25 | -0.14 | 0.00 | 0.18 |
| % Urban Green Space | -0.08 | | 0.45 | 0.13 | -0.30 | -0.35 | **-0.50** | -0.28 | -0.31 | **-0.78** | 0.10 | -0.24 | -0.08 | -0.34 | -0.44 | **0.75** | **-0.73** |
| % Sport & Leisure | 0.18 | 0.45 | | 0.25 | -0.14 | -0.20 | -0.29 | -0.33 | -0.29 | **-0.59** | 0.10 | 0.00 | 0.21 | -0.09 | -0.35 | **0.66** | -0.36 |
| % Country Park | 0.12 | 0.13 | 0.25 | | 0.01 | -0.09 | -0.12 | -0.09 | -0.09 | -0.16 | 0.15 | 0.13 | 0.21 | 0.09 | -0.03 | 0.18 | -0.13 |
| % Open Access | -0.08 | -0.30 | -0.14 | 0.01 | | 0.44 | 0.41 | 0.47 | 0.47 | 0.42 | -0.04 | **0.54** | 0.43 | 0.35 | **0.59** | -0.35 | 0.34 |
| % National Trust | 0.11 | -0.35 | -0.20 | -0.09 | 0.44 | | **0.84** | 0.36 | 0.42 | 0.48 | -0.13 | 0.38 | 0.31 | 0.40 | 0.36 | -0.41 | 0.48 |
| Nat Trust props per 10,000 | 0.10 | **-0.50** | -0.29 | -0.12 | 0.41 | **0.84** | | 0.33 | 0.46 | **0.63** | -0.14 | 0.37 | 0.27 | 0.43 | 0.35 | **-0.56** | **0.62** |
| % National Park | -0.11 | -0.28 | -0.33 | -0.09 | 0.47 | 0.36 | 0.33 | | 0.25 | 0.38 | -0.10 | 0.31 | 0.13 | 0.29 | 0.45 | -0.37 | 0.23 |
| % Designated | -0.12 | -0.31 | -0.29 | -0.09 | 0.47 | 0.42 | 0.46 | 0.25 | | 0.43 | -0.05 | 0.32 | 0.21 | 0.29 | 0.39 | -0.36 | 0.41 |
| % Non-built | 0.05 | **-0.78** | **-0.59** | -0.16 | 0.42 | 0.48 | **0.63** | 0.38 | 0.43 | | -0.13 | 0.33 | 0.11 | 0.41 | **0.60** | **-0.95** | **0.84** |
| % Fresh Water | -0.06 | 0.10 | 0.10 | 0.15 | -0.04 | -0.13 | -0.14 | -0.10 | -0.05 | -0.13 | | -0.04 | -0.07 | -0.11 | 0.06 | 0.03 | -0.20 |
| % Woodland | 0.23 | -0.24 | 0.00 | 0.13 | **0.54** | 0.38 | 0.37 | 0.31 | 0.32 | 0.33 | -0.04 | | **0.85** | **0.76** | 0.40 | -0.25 | 0.38 |
| % Broad Leaved | 0.26 | -0.08 | 0.21 | 0.21 | 0.43 | 0.31 | 0.27 | 0.13 | 0.21 | 0.11 | -0.07 | **0.85** | | **0.68** | 0.13 | 0.01 | 0.28 |
| % Ancient Woodland | 0.25 | -0.34 | -0.09 | 0.09 | 0.35 | 0.40 | 0.43 | 0.29 | 0.29 | 0.41 | -0.11 | **0.76** | **0.68** | | 0.33 | -0.33 | 0.43 |
| % Grass, Mountain, Moor | -0.14 | -0.44 | -0.35 | -0.03 | **0.59** | 0.36 | 0.35 | 0.45 | 0.39 | **0.60** | 0.06 | 0.40 | 0.13 | 0.33 | | **-0.62** | 0.35 |
| % Garden | 0.00 | **0.75** | **0.66** | 0.18 | -0.35 | -0.41 | **-0.56** | -0.37 | -0.36 | **-0.95** | 0.03 | -0.25 | 0.01 | -0.33 | **-0.62** | | **-0.68** |
| Garden Area per Hsehold | 0.18 | **-0.73** | -0.36 | -0.13 | 0.34 | 0.48 | **0.62** | 0.23 | 0.41 | **0.84** | -0.20 | 0.38 | 0.28 | 0.43 | 0.35 | **-0.68** | |

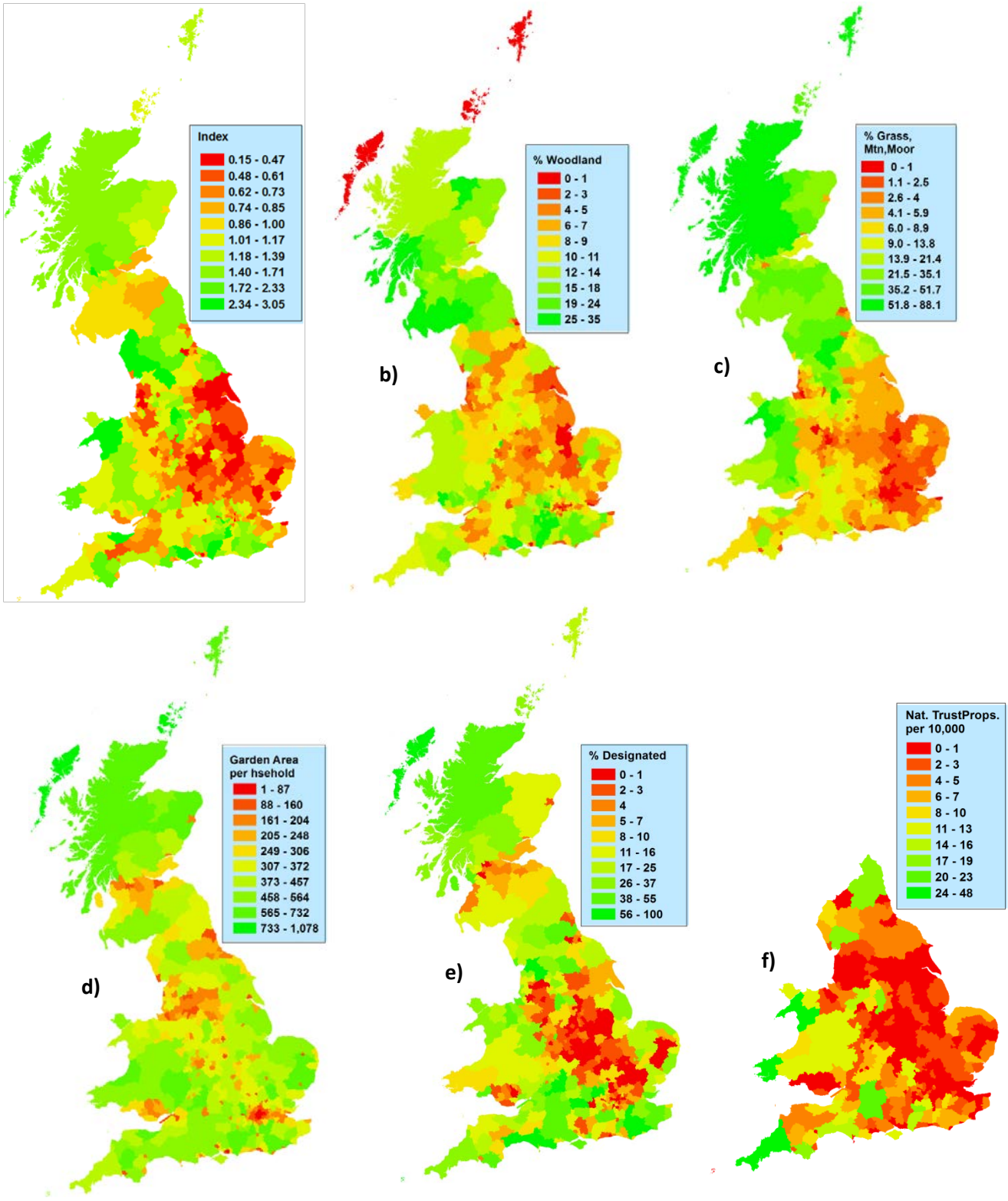



**Figure 5.2. Summary of 17 indicators for GB districts (a), and a selection of 5 of the indicators (b-f). The summary indicator (a) was calculated by first dividing the value for each district and indicator by the mean value of the indicator over all districts. The average of these values amongst all 17 indicators was then calculated for each district. Indicators included % urban, % country park , % national park, % ancient woodland, % broadleaved woodland, % total woodland (a), % sports & leisure areas, % urban green space, % mountain, moorland or grassland (b), % fresh water, % garden, area of garden per household (c), % designated areas (excludes national parks) (d); % open access land, % National Trust (NT) property, NT properties per 10,000 resident population (e) (data not available for Scotland). (©CEM, Nottingham)**

Feedback from stakeholder workshops revealed a desire for indicators measuring the degree to which environmental spaces hold an association with heritage. Furthermore, heritage values are recognized as a key component of CES (Tenberg et al. 2012) and are one of the 6 components of CES recognized by the Millennium Ecosystem Assessment (MA, 2005). Clearly these relationships can only be fully understood through an in-depth understanding of the historical and cultural associations of a given site (Tenberg *et al*. 2012); however, it was found that the 'heritage and antiquities' text labels within Ordnance Survey MasterMap data (N = 90, 841) could be used as a proxy measure of the heritage-related significance of environmental spaces. Two indicators were produced using these data. The first was a count, per square kilometre, of the number of these text labels containing at least one of 60 key words which might relate to the natural environment. Examples include 'earthworks', 'standing stone' and 'battlefield'. The second was a count per square kilometre of the number of these labels placed over non-built habitats identified in the CEH 2007 land cover map. It can be seen from **Figure 5.3** that these two indicators showed similar patterns across the Great Britain, suggesting that they may constitute a robust measure of the historical significance of environmental spaces, at least at a district level but further work is needed to establish the potential of such indicators for use by decision-making organisations. .

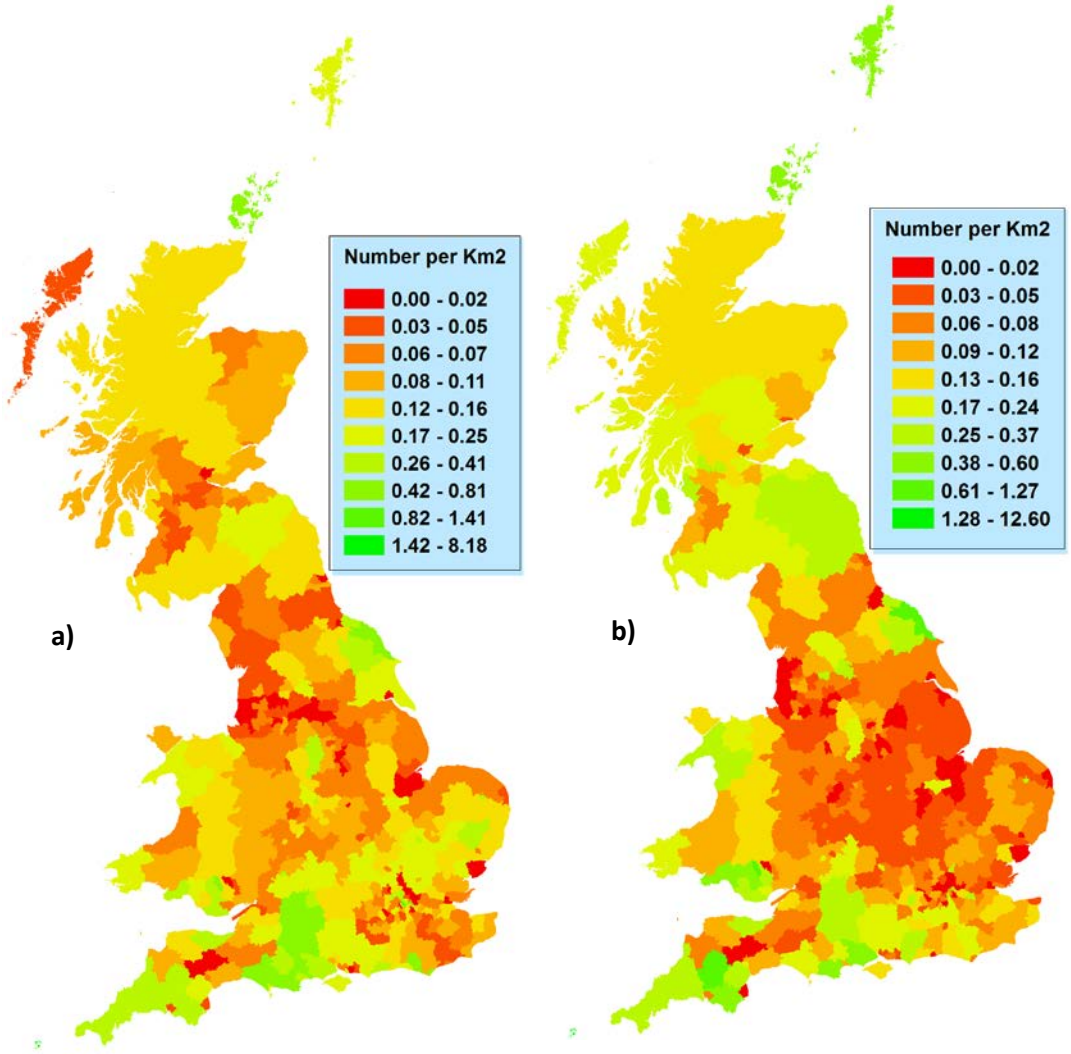



**Figure 5.3. Indicators of the historical associations with natural spaces, by Local Authority. The maps are based on Ornance Survey Mastermap labels for points of historic interest, and show the number of such points per square kilometer, for (a) labels sited over areas with natural cover (based on CEH Land Cover Map, 2007) and (b) labels refering to natural features. (© CEM, Nottingham)**

### 5.3.4 Accessibility indicators

Although these percentage cover indicators can give useful insights into differences in CES available at a local level, they take no account of the fact that access to environmental spaces will vary within an area, which is particularly significant for very local environmental spaces, and also that people living within one local area may benefit from access to environmental spaces outside it. With this in mind measures of accessibility were calculated for each 2011 Census Output Area in the UK (N = 181,408), for 4 different types of environmental space. Two methods were used to calculate accessibility. Both borrowed from the ANGSt methodology used to calculate access to public green space (Handley *et al*. 2003). The ANGSt criteria state that each resident should have at least one area of accessible environmental space conforming to the following size and distance criteria:

- ha, <= 300 m from home
- 20 ha, <= 2 km from home
- 100 ha, <= 5 km from home
- 500 ha, <= 10 km from home

The first method of measuring access simply took the straight line distance from each output area centroid to each of the four ANGSt size categories (in the Nottingham case study below distance via the road network is also used). This was used to calculate the average distance to each size of setting for a given human population. The second method classified this distance according to whether it was above or below the relevant ANGSt distance criteria. The second method was used to calculate the proportion of the population fulfilling the distance criterion for the size of setting.

The following four types of environmental space were selected for performing these calculations as they are sites which support a variety of cultural practices:

- Ancient Woodland. This indicator was selected because ancient woodlands are associated with particularly high levels of biodiversity (Erenier *et al*. 2010) and are thus arguably attractive to visitors interested in viewing wildlife, and are also more likely to be accessible than planted forests. This indicator therefore incorporates a further measure of quality in addition to size.
- National and Local Nature Reserves. This indicator was chosen because these sites allow access to the public and are likely to provide opportunities to observe nature.
- Country Parks. These were selected as they are designed for recreation, and because complete data sets are available for the whole of Great Britain (in contrast to urban parks, where the data is incomplete and differs between each of the three GB countries).
- Natural Habitats. This general term is used to refer to all land-cover types excluding urban, agricultural, improved grassland, the coast and fresh water. Coastal and freshwater areas were excluded as they often follow linear patterns which do not lend themselves to characterisation as a ‘patch’.

Using appropriate population-based weighting techniques, accessibility measures were calculated both for the overall resident population and for the children under 16 at Lower Superoutput Area (LSOA) (N = 34753) and LAD level. Equivalent measures were calculated for the proportion of the population living within the most deprived local quintile for each LAD, in order to explore social equity issues. Recent research provided the rationale for examining data for children separately, as a recent National Trust study has argued that children are increasingly becoming isolated from opportunities to enjoy natural outdoor environments and that this may have negative knock-on effects such as increasing obesity and mental health issues (Moss, 2012).

Maps showing a summary of the indicators calculated for the entire population of each district, by environmental space type and distance measure (average distance or proportion of the population) are shown in **Figure 5.4**. The maps reveal the following patterns:

- the Midlands appear relatively impoverished for these measures, especially in respect to the proportion of the population living within the distance size combination stipulated in the ANGSt criteria;
- the South of England and Wales show good access to ancient woodland (**Figure 5.4 a, e**);
- access to country parks tends to be poorest in the East Midlands, Central Wales and Northern Scotland, and generally good in a belt extending from London to the North West and from London to Southampton (**Figure 5.4 b, f**);
- access to nature reserves shows a quite patchy distribution, but is generally good in the South and South East England and North West Wales, and poor in the South Midlands (**Figure 5.4 c, g**); and,
- access to natural habitats was poor in the Central and East Midlands and good in most districts of Wales, Scotland and Southern England (**Figure 5.4 d, h**).

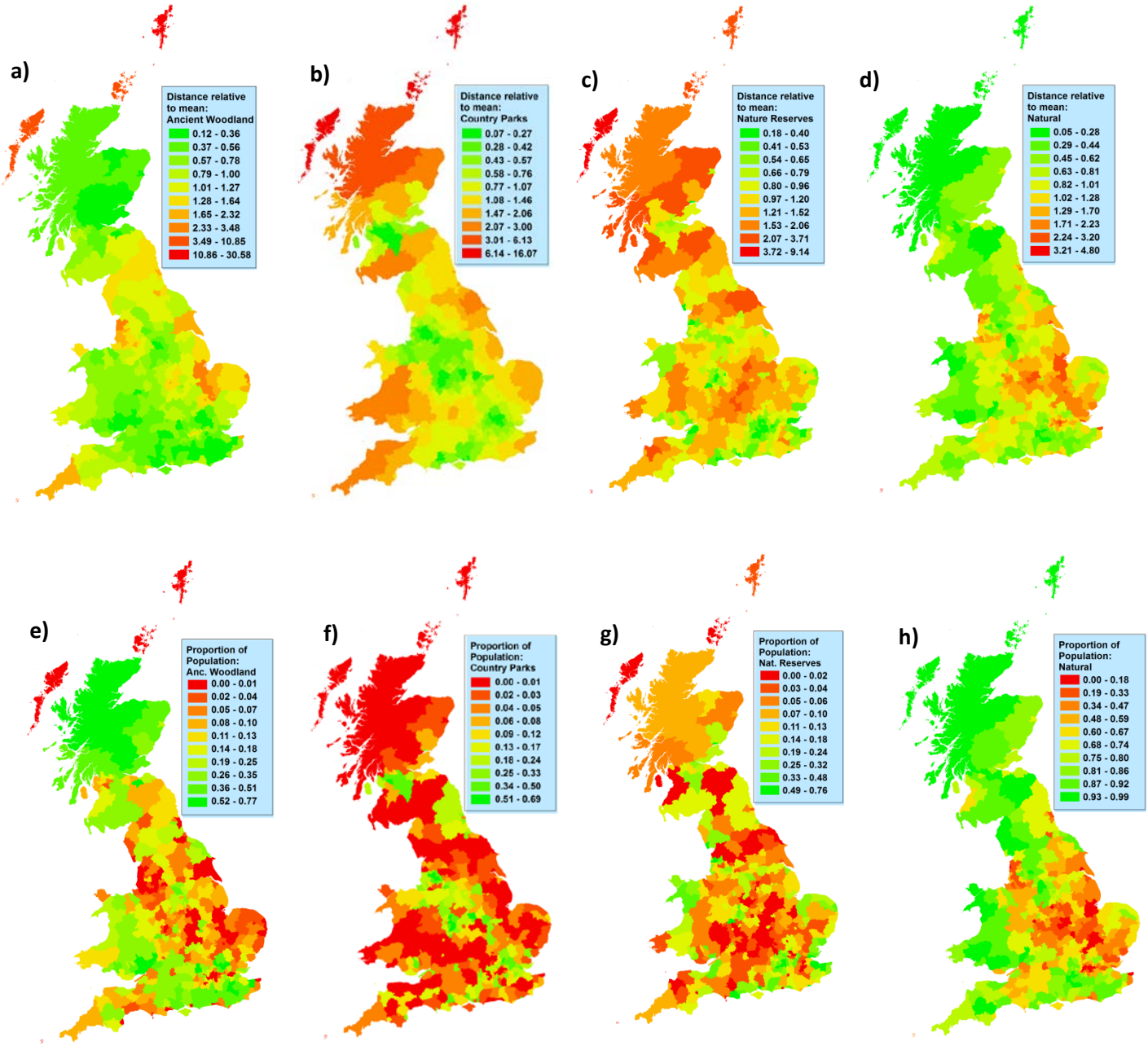



**Figure 5.4. Summed accessibility indicators. The top row shows average distance per resident for local authorities to patches of 2, 20, 100 and 500 ha, relative to the mean over all local authorities: Ancient Woodland (a), Country Parks (b), Nature Reserves (c), Natural Habitats (excludes Urban Environments, Agricultural/ Horticultural Land, Improved Grassland and Coastal and Fresh Water Environments). Bottom row shows equivalent data, but represented as the proportion of the human resident population within 300m, and 2, 5 and 10km, respectively of these patch sizes: Ancient Woodland (e), Country Parks (f), Nature Reserves (g), 'Natural Habitats (h). (© CEM, Nottingham)**

As might be expected, given their bio-physical properties and social history, the Outer Hebrides, Shetlands and Orkney Isles show especially poor access to ancient woodland, on both the average distance and ANGSt criteria. Also as might be expected there was a very close linear relationship

between indicators for the total population and those for children under 16, with R-squared values in all cases in excess of 0.99. However, in some cases the average child needed to travel over 10% further to visit a given environmental space type than an average member of the general population (the most notable outlier was West Somerset District Council for natural habitat >= 100ha, with average distance 1.36 km for the general population and 1.52 km for children). Similarly, in some cases a smaller proportion of children had access to environmental spaces of a given type and size, the most notable outlier being Cambridge District Council for country parks >= 100 ha (68.1 % versus 59.7%).

Comparing indicators across the different ANGSt size and distance categories showed relationships which were often very scattered, suggesting the need to maintain a number of size/minimum distance categories if these indicators are to give a comprehensive representation of potential access. An analysis of the relationship between the proportion of residents living within the appropriate ANGSt distance/ size criteria and the deprivation quintile of the LSOA they were living in showed very little difference between deprivation levels, whether benchmarked nationally (within England) or locally (within the district). This analysis was conducted separately for each of the three GB nations (England, Scotland, Wales) as their deprivation indices are not calculated in the same manner (**Figure 5.5**). Within England, it was noticeable that access to ancient woodland improved markedly with decreasing deprivation, which may be due to fact that ancient woodland tends to be located in the relatively affluent South of England. This trend was also evident, to some degree, at a local level**.**

Across all three nations, there was some evidence of better access to country parks for the most deprived and least deprived groups, and this phenomenon was also evident for average distance to ancient woodland and nature reserves in Scotland and Wales. Access to natural habitats appeared to improve with decreasing deprivation in England, but this phenomenon was not evident for the other two nations. Relationships with deprivation often differed according to whether average distance or the ANGSt distance criteria were used, and also according to the minimum size of setting considered, showing the importance of the need for careful consideration of the precise specification of each indicator. These results highlight the importance of robust national indictors that can be disaggregated at the local scale as patterns of supply are often complex and vary in terms of their association with social deprivation.


**Figure 5.5. Values for 32 indicators of access to open spaces by national and local deprivation quintile in England, Wales and Scotland. Figures a-c show the average distance to Ancient Woodland, Country Parks, Nature Reserves and Natural habitats of 2, 20, 100 and 500 ha, by national deprivation quintile, in England (a), Wales (b) and Scotland (c). Figures d-e show the equivalent data by local deprivation quintile. Figures f-h show, by national deprivation quintile, the proportion of the resident human population within certain distances of the same natural places/ patch sizes shown in a-f : 300m for 2 ha, 2 km for 20 ha, 5 km for 100 ha and 10 km for 500 ha. Figures i-l show equivalent data to f-h, for local deprivation quintiles. AW = Ancient Woodland, CP = Country Parks, NR = Nature Reserves, Nat = 'Natural Habitats' (excludes Urban Environments, Agricultural/ Horticultural Land, Improved Grassland and Coastal and Fresh Water Environments). 2, 20, 100 and 500 indicates size, in ha., of patches. (© CEM, Nottingham)**

### 5.3.5 Demand related indicators

The indicators described above can be used to monitor supply or access to environmental spaces. However, the demand side – the degree to which people would like to have access to CES - may differ locally, depending on the circumstances and characteristics of the local population. With this in mind, a Bayesian Belief Network (BBN) was produced showing the probability that a given individual would visit environmental places of various sorts and engage in certain activities within them within a given week. These calculations were done using the HUGIN[5] Expert software and the Monitor of Engagement with the Natural Environment (MENE) dataset; the work drew on a subset of 50,000 records from these which contained spatial information on the location visited, which is based on a questionnaire of over 50,000 individuals within England. The BBN itself, and how it was calculated, is described in Appendix 4.5. Using the BBN, it was possible to generate these probabilities for each LAD in England (see **Figure 5.6a** and **b** for wildlife watching and country parks). However, it is important to note that the estimated probabilities are based on the socio-demographic characteristics of the population alone, and do not take into account geographic location. They are therefore to some degree location-neutral and independent of local supply of CES.

Clearly, there is a difference between these demand-side data, which measure the probability of an individual engaging in certain activities, and the supply-side indicators, which measure the amount or proportion of a particular type of types of environmental space available. However, these indicators which measure the relationship between the two types of data can act as proxy indicators of the degree to which demand for CES matches supply. With this in mind, the mean values were calculated for the accessibility indicator measured in section 5.4.4 relating to the proportion of the adult population within the relevant ANGSt distance/ size criteria for country parks. This value was then divided by the probabilities predicted by the BBN for visiting country parks. This resulted in a proxy measure of the degree to which supply matches demand for visiting country parks (**Figure 5.6c**). It can be seen that many districts in eastern and northern England, and the West Midlands had low scores for this indicator.

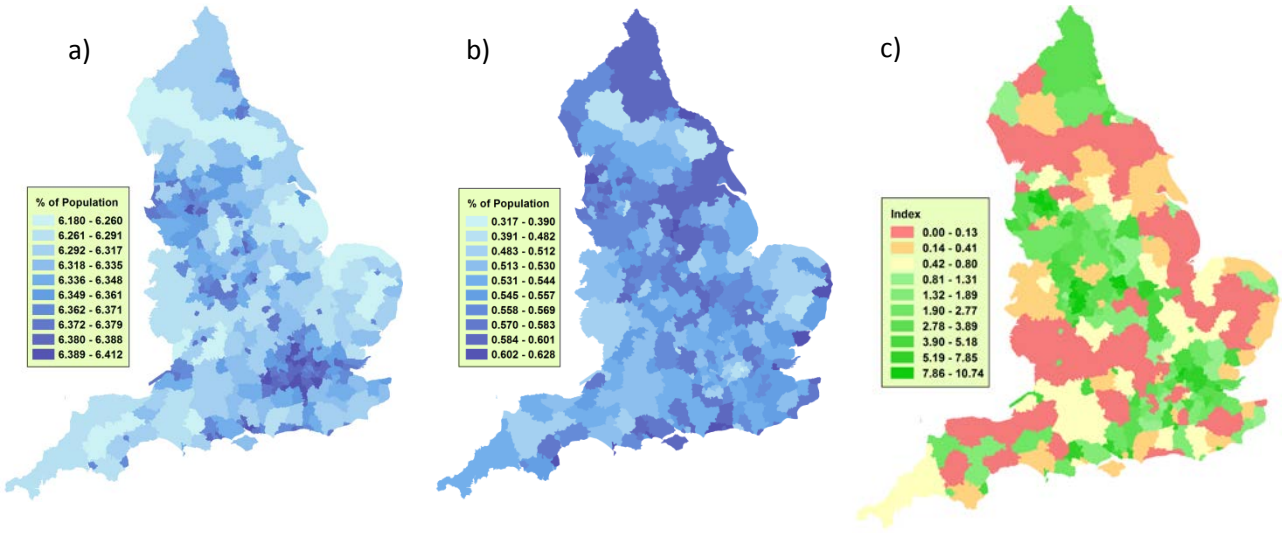



**Figure 5.6. Probability of visiting a country park (a) and watching wildlife (b) within a given week, calculated on the basis of the relationship between the socio-demographic profile of each English**

[5] www.hugin.com

**district and responses to the MENE questionnaire. Figure c shows an index of the relationship between supply and demand for country parks, calculated as the data shown in Figure 5.4f (the proportion of the population within the relevant ANGSt distance/ size criteria of country parks) divided by that shown in Figure5.6a here. (© CEM, Nottingham)**

### 5.3.6 Local Urban Indicators and addressing the issue of quality

The indicators described above utilise data available nationally, at least for the whole of England. However, there is a wealth of data available at a local level, often under the custodianship of local authorities, which allow a more in depth and richer examination of CES than is possible using national data sets. It is notable that the majority of the attempts to measure a range of CES have been done at a local or regional level. Keep Britain Tidy's use of the Green Flag Award for England and Scotland as a quality standard for local parks is a rare example of a peer-assessed standard operating at the national level. The focus of this section is on local analysis of quantitative indicators is to examine, for a single urban local authority what data is available locally to measure the quality of environmental spaces and electoral words, and combine this with nationally available data. The implications of calculating access via a road network are also examined, rather than the straight line distance calculation described in the earlier sections.

At a local scale, the attributes and characteristics of environmental spaces that contribute to their quality have been addressed by a number of studies. Amongst these, van Herzele *et al*. (2003) identified five characteristics of urban green spaces which contribute to their attractiveness: space (as this provides a sense of being able to move freely, away from the confines of the town); contact with nature (such as watching wildlife); culture and history (including opportunities for social activities as well as a connection to the past); quietness (the need for 'quiet and peaceful places'); facilities (such as places for children to play, access to green fields, benches, toilets, pools, picnic equipment). These measures of attractiveness provide one way of examining quality but it should be noticed that people's understanding of quality will arise not just from specific practices that occur in environmental spaces but also from how spaces are perceived in relation to people's cultural values, which is an issue considered in the next section. Also these measures of attractiveness may apply to other green space such as farmland, national parks and nature reserves. In addition, concerns over safety are also important in some contexts (Jorgensen & Anthopoulou, 2007) and water quality is likely to be important in the case of blue spaces (see Jorgensen & Anthopoulou, 2007; Morgan, 1990). Although Environmental Spaces are created by the practices that occur in them, and perceptions of quality produced through specific encounters, rather than inherent in these spaces, we believe that these characteristics can act as indicators of the degree to which such spaces will be thought to be attractive locations for such cultural activities.

For this work, a detailed data set related to environmental spaces within the city of Nottingham (N = 646) was acquired, which was found to be considerably more comprehensive and detailed than any data available at a national level (see **Figure 5.7**). Each of the quality criteria listed above – space, nature, culture and history, quietness and facilities - were examined using currently available data to assess the quality of green spaces, as follows:

- *Space* – Described by the size of the environmental space in hectares.
- *Nature* – Although there was much data available on biodiversity within the Nottingham area, none of this had been collected in such a way as to produce indicators for each green space. Three measures were calculated using nationally available data – the % area of non-human made cover (using very spatially detailed OS MasterMap data) (**Figure 5.8a**), the % area of all 'natural habitats' (defined in the same way as for the national analysis) (**Figure 5.8b**), and % area of woodland (map not shown).

- *Culture and history* – By recording the text labels available in OS MasterMap, it was possible to identify sites of cultural and historical significance in each environmental space, and use the number of such labels per square kilometre as an indicator (**Figure 5.8c**).
- *Quietness* – Defra noise maps[6], which have been generated for 7 UK cities, including Nottingham, were used to measure the average value, amongst six noise bands, for each park (**Figure 5.8d**)
- *Facilities* – Using an equivalent technique to that described for culture and history, the number of play areas, public conveniences and sports areas were counted in each environmental space (**Figure 5.8e**).
- *Safety* - Nationally available data on reported crime[7] was used to calculate the number of crimes per square km reported within each green space and within a 0.5 km buffer around it. Data were for the period May-August 2013. The reason for using the buffer technique was that relatively few crimes were reported within green spaces, but it was assumed that crime in the surrounding area would act as a suitable proxy for perceived levels of safety within it (**Figure 5.8f and Figure 5.8g**).

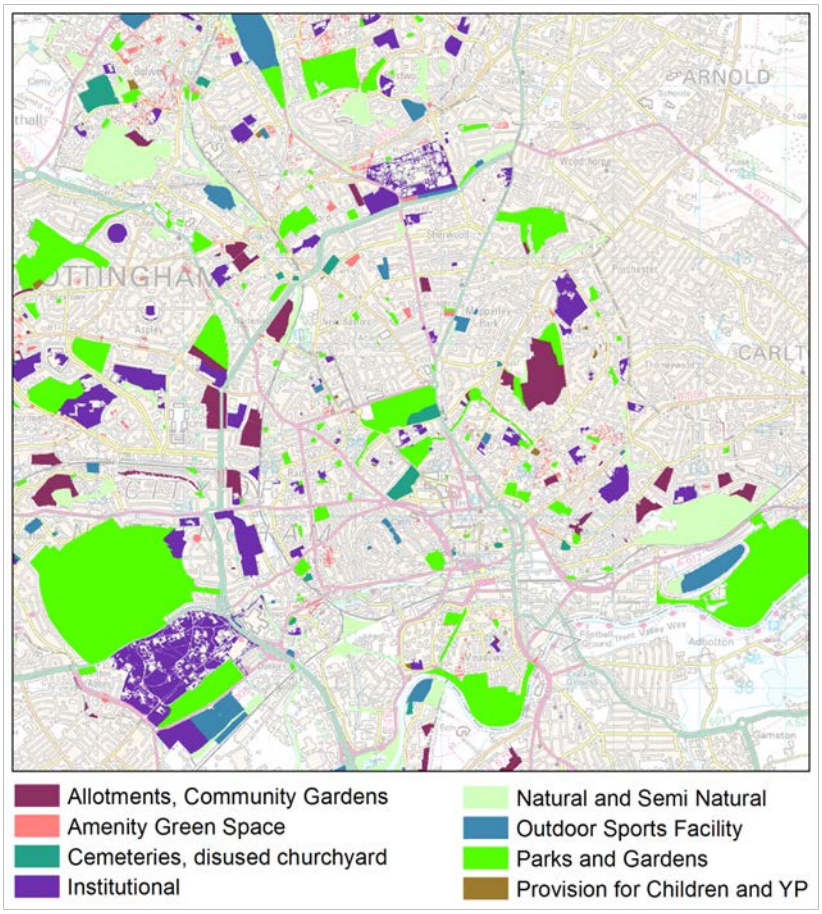



**Figure 5.7. Publicly accessible open spaces in Nottingham. Data provided by Nottingham City Council.**

[6] http://services.defra.gov.uk/wps/portal/noise. Note that these are provisional modelled data.
[7] http://www.police.uk/. Categories of crime generally associated with indoor environments were excluded.

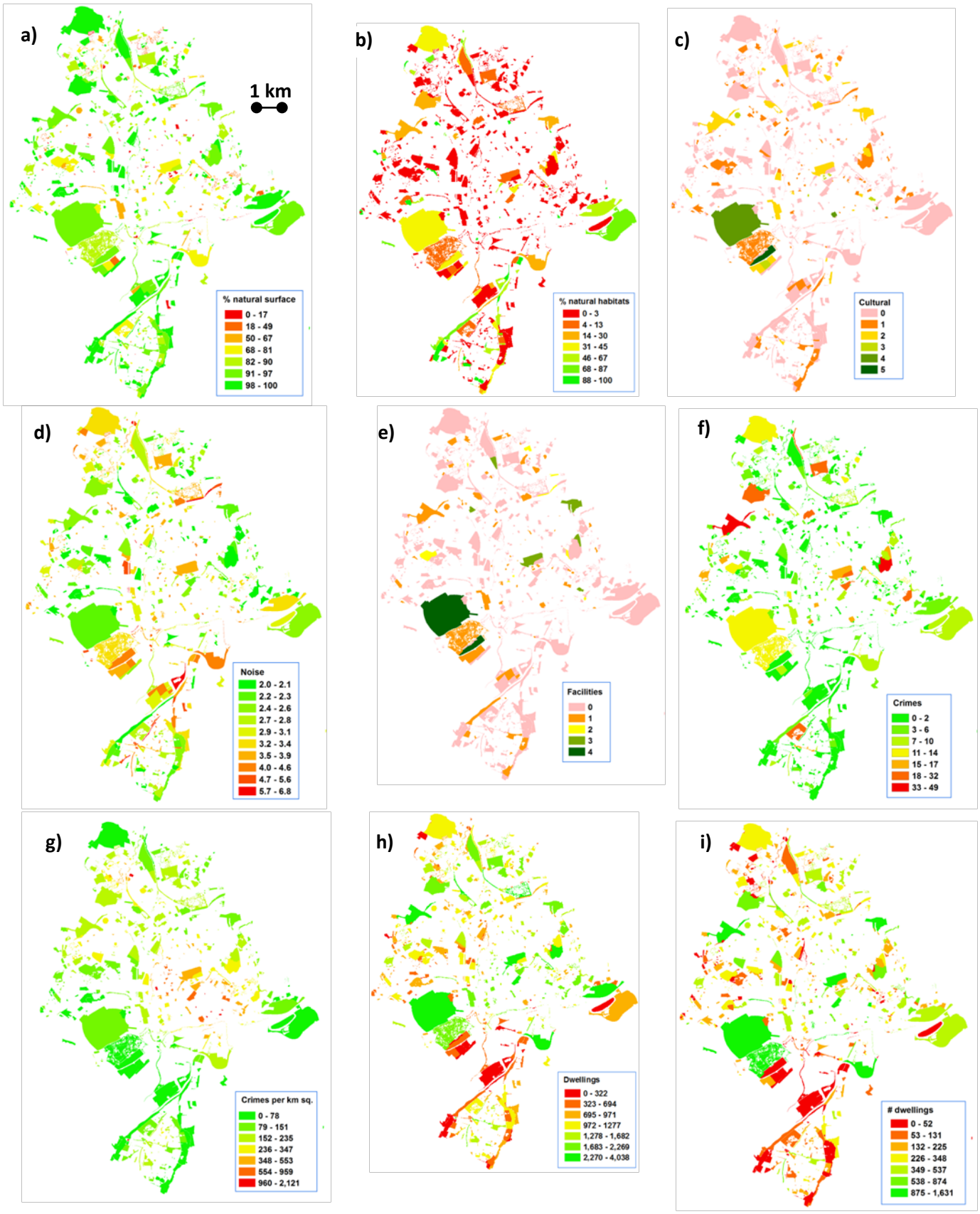



**Figure 5.8. Indicators for open spaces in the City of Nottingham, with sources used to calculate the data shown in parentheses. % natural surface (OSMM) (a); % surface area not comprising urban, agricultural or improved grassland (CEH Land Cover Map, 2007) (b); number of cultural, social or historical references revealed by OSMM text labels (c); average noise band (DEFRA noise modelling) (d); number of facilities revealed by OS MasterMap text labels (Ordnance Survey MasterMap – OSMM) (e); crimes of types typically committed outdoors (UK Police Force)– number of crimes reported within the open space (f) and density per Km$^2$ of crimes committed within 0.5 km of it (g); number of dwellings with 300m of boundary (h), and for which the open space is the nearest available (i) (Ordnance Survey Addresspoint). (© CEM, Nottingham)**

The potential level of benefits provided by an environmental space will usually be higher the more people are able to easily access it. With this in mind, for each of the Nottingham environmental spaces calculations were made of both the number of dwellings within 300m of it and also the number of dwellings which had that environmental space as the nearest available to them (**Figure** 5.**8h** and **Figure 5.8i**). An examination of the indicators (**Figure 5.8**) showed that few of the larger environmental spaces performed poorly or well on all indicators, although it was noticeable that Wollaton Park (the large area shown indicated with WH in **Figure 5.8a**) performed better than average for all of them with the exception of the number of crimes reported within it, and it is perhaps not surprising that an area of this size hosted a large number of crimes.

The degree to which indicators could be developed for local wards in Nottingham (N = 20) was also examined. In addition to those indicators generated from nationally available data (see **Figure 5.9a to 5.9d, and 5.9h**), information was acquired on the location of tree preservation orders, which was used as a proxy for the 'leafiness' of the ward (**Figure 5.9i**), and the location of definitive Public Rights of Way (PROWs), neither of which are available as national data sets. Although complete tree cover maps for the whole of the City of Nottingham have been produced, and could have been used to calculate an indicator, Nottingham City Council were not able to supply these for legal reasons, as they have been produced by a private company. The PROW data and Ordnance Survey data were used to calculate the length of minor roads, urban paths and PROWs within one mile (1.6 km) of each ward boundary which pass through non-urban environments (**Figure 5.9e to 5.9g**).

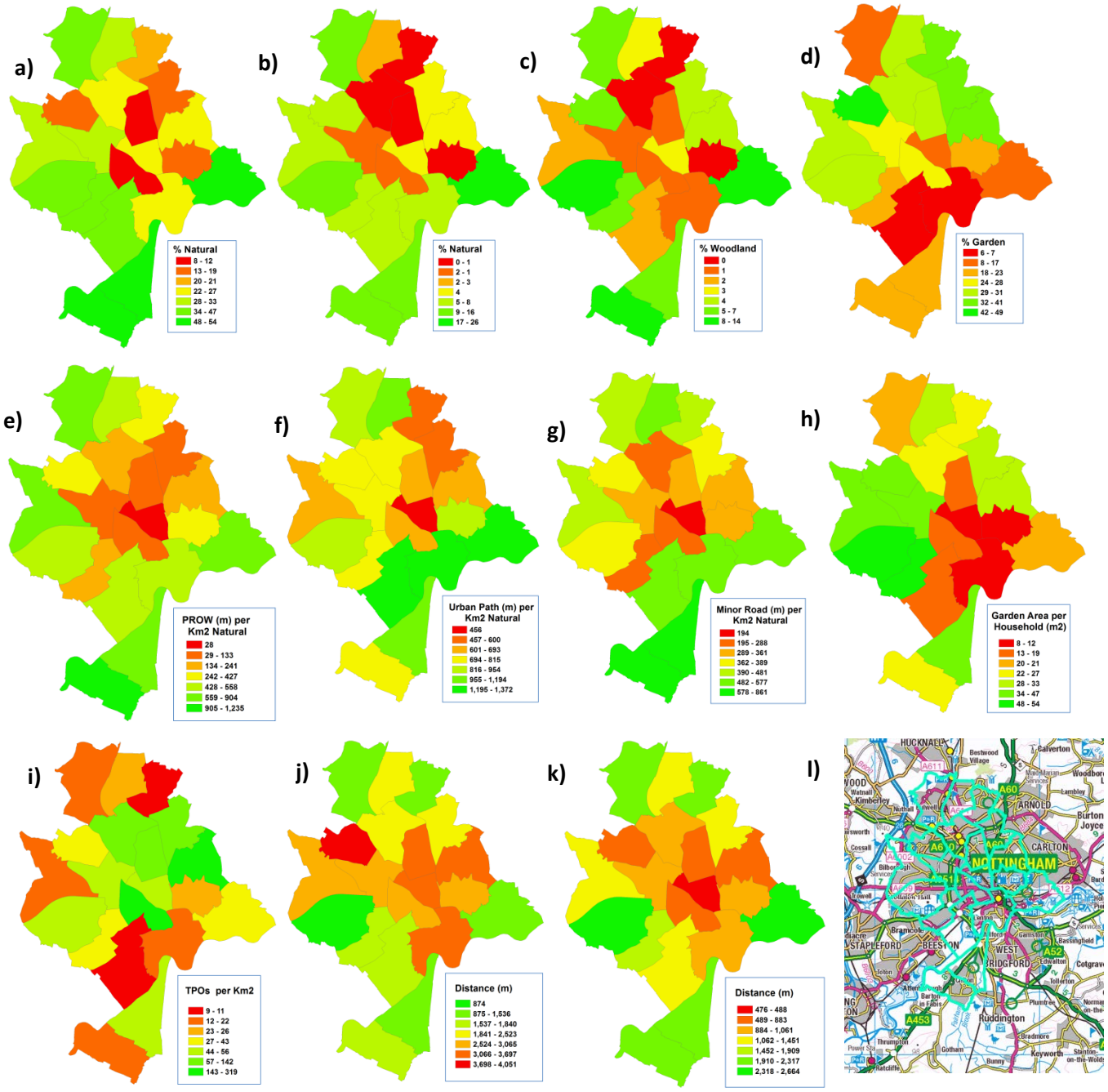



**Figure 5.9. Indicators for City of Nottingham wards, with sources used to calculate the data shown in parentheses.** Percentage cover of natural surfaces (from OS MasterMap - OSMM) (a), areas excluding urban, agriculture and improved grassland (from CEH Land Cover Map 2007 – LCM07) (b), woodland (LCM07) (c), and gardens (OSMM) (d). Length of Public Rights of Way (City of Nottingham Council - CNC) (e), Urban paths and minor roads (OSMM) passing through non-urban environments (LCM07) (f,g). Garden area per household (OSMM & UK census 2011) (h). Tree preservation orders per $km^2$ (CNC), Average distance to nearest nature reserve (English Nature) per resident, measured from output area centroids (UK Census 2011), through a road network (OSMM) to park entrances (j) and as straight line distance to reserve boundary (k). Location of the wards within Nottingham (l). (© CEM, Nottingham)

As a measure of accessibility to environmental spaces potentially facilitating a range of practices based around interactions with nature, a measurement was calculated of the distance to the nearest nature reserve from each output area within each ward, and from this was calculated the average distance to the nearest reserve for residents of each ward. When measuring access to environmental spaces it is useful to take into account the fact that visitors need to travel through some form of transport network to get there (see Higgs *et al*. 2013, who found that the techniques employed to measure distance to green spaces could have a significant effect on the results). One may also take into account that sites often need to be accessed via discrete entrances. To examine the effect that this might have on accessibility calculations for Nottingham, straight line distances from output area centroids (using the same techniques as used for the district-level accessibility indicators) were compared with measurements via a road network to the entrances to each nature reserve site.

Generally, there was a close, approximately linear, relationship between the two measurements. However, there were some notable outliers, with distance by road in some cases over three times as great when straight line distance was less than a kilometre. It can been seen from **Figure 5.9, j, k**, that, at a ward level, the spatial patterns were similar whichever accessibility measure was used, with wards around the centre of the district providing poorer access than those to the South and North. However, there were some differences, and when the data were ranked amongst the 20 wards; only 3 had the same rank for both distance measures, and two changed by as much as 4 rankings.

Looking at all the indicators together (**Figure 5.9**), no wards appeared to perform poorly or well across all of them, although in general those covering the outskirts of the district performed better than those in the central areas. As was the case for the indicators for environmental spaces in Nottingham, and the district level indicators described earlier, this lack of redundancy between them shows that a suite of indicators may be necessary, and, if they are combined into a summary indicator, careful consideration should be made of which are most relevant to the issue at hand and how much importance, or what weighting, should be given to each.

In addition to the potential of local data to provide a richer picture of the availability of setting, it is also important to be aware that what might be important in one locality may not be relevant in another. Whilst in some cases this will be obvious – for example, there may be little demand for access to public parks for dog owners in rural communities with access to public rights of way – in other cases one may need to engage with local communities to understand their relationship with CES. An in depth understanding of the characteristics of CES that are important in a local context can often only be discovered via engagement with the public in the form of questionnaires, workshop and focus groups, much of which may not be practical at a national level. This was beyond the scope of the urban Nottingham study, but the rural North Devon case study reported in Section 5.5.4 provides examples of this approach in practice.

### 5.3.7 Summary

In this section the calculation of a suite of national CES indicators has been presented, along with some additional indicators at the local level. However, as discussed above, these were calculated as a ‘work in progress’ and should not be seen as a definitive set, but rather to illustrate a range of options. It is anticipated that this material will enable further work with stakeholders to identify their precise needs with regard to a short list of CES indicators. It is likely that different indicators will be needed for different purposes – for example, indicators to evaluate the success of agri-environment schemes are likely to be different to those for Nature Improvement Areas. Indicators

such as those described here, and others based on measures such as visitor numbers, revenues and user experience (s presented in the supplementary material) will need to be adapted accordingly. The set of indicators presented in this section are relatively straightforward to calculate and to understand, and can provide information to allow decision makers to benchmark and compare areas. Use of these indicators will foster better appreciation of how CES varies spatially across the UK, and allow decision-makers to put in place measures, such as the development of Nature Improvement Areas, or creation of new nature reserves or country parks, to address this. The national level indicators calculated at district level allow local authorities to benchmark themselves against each other and also to monitor change over time. However, these indicators can be calculated at any scale based on aggregations of census output areas, and as such could be used to compare any type of geography based on these, including Lower-Superoutput areas, electoral wards, parliamentary constituencies, county council areas, government regions and areas such as national parks and Nature Improvement Areas.

The approach adopted examined the degree to which publicly available data can be used to produce quantitative indicators of CES. The strengths of this approach are that it can used to develop a standardised methodology which allows comparison of CES across different geographies and time periods throughout the U.K, and can be matched to other data available at the same scales, such as the socio-demographic information contained in the UK 2011 census. The limitations of this approach are that it does not get at the fine detail of the public's relationship with environmental spaces and the benefits they derive from it. This detail can only be understood through in-depth surveys, workshops and local-level studies of the geography of specific locations, as presented in the following two sections.

## 5.4 Quantitative analysis of well-being and practices in environmental spaces

### 5.4.1 Introduction

This section presents new empirical evidence which provides insights into the application of the revised CES conceptual framework, outlined in section 5.3. The framework identifies cultural benefits as the dimensions of human well-being associated with the interactions between environmental spaces, cultural practices and cultural values. Specifically, new evidence is presented on the link between well-being and environmental spaces and cultural practices, for a range of demographic characteristics. Of particular interest is a large-scale comparison between the benefits derived from cultural practices involving nature interactions in private gardens and those experienced in outdoor spaces, which represents a significant contribution to existing CES literature.

There is growing evidence of the beneficial impacts that natural environments have on well-being and mental health (e.g. MacKerron & Mourato, 2013; Pretty *et al*. 2011). The section adds to this body of evidence by using new data from the Monitor of Engagement with the Natural Environment (MENE) survey to explore the well-being benefits associated with a unit of time spent in different types of environmental spaces (private and public), participating in different types of interaction with nature. The study controls for a large number of potentially confounding factors and extends the already very detailed studies provided in Natural England reports based on MENE (e.g. on the relationships between visit types, distance, travel cost and demographic characteristics).

### 5.4.2 Methods and data

Our analysis is based on *new* and *existing* data from the Monitor of Engagement with the Natural Environment (MENE), the most comprehensive survey available of people's use and enjoyment of the natural environment in England. MENE is an on-going, face-to-face, in-home omnibus survey of over 45,000 interviews per year. It has been run since 2009 by TNS Research International on behalf of Natural England, the Department for Environment, Food and Rural Affairs (Defra) and the Forestry Commission. Data are collected on use of the natural environment in the 7-day period prior to the interview and detailed information is elicited on a randomly selected visit during that period. The survey is conducted across England and throughout the whole year: a core set of questions is asked weekly, extra questions are asked on a monthly basis and a few additional questions are asked once every three months. MENE is intended to provide baseline and trend information on how people use the natural environment and, uniquely, also collects information on the respondent's home and on the location of the outdoor recreational site visited.

Crucially, the decision to work with the MENE dataset was taken partly because it has the potential to become the dataset that monitors CES in England, for the various spaces and practices of interest. It is already being used to provide an evidence base for public health outcomes (Natural England, 2012d). Questions are asked about a range of environmental spaces (e.g. woodland, farmland, mountain, river, country park, city park, allotment, beach, etc.) and a number of cultural practices (e.g. experiencing peace and quiet, relaxing and unwinding, spending time with family and friends, entertaining children, exercising, walking the dog, enjoying scenery, enjoying wildlife, etc). In the quarterly survey waves, questions are also asked about well-being, in the form of agreement with a number of statements about how the visit made people feel (e.g. I enjoyed it; it made me feel calm and relaxed; it made me feel fresh and revitalised, etc.). Hence, although improvements could be made in the way these questions are asked for the purposes of measuring and monitoring CES, as we

discuss later, the survey collects relevant information on the core elements of the new CES conceptual framework.

A key shortcoming of MENE, for the purposes of measuring CES, is the fact that it does not monitor use of private gardens, which is arguably a fundamental environmental space in terms of frequency of human interactions and resulting well-being. For example, Gibbons *et al*.'s (2013) study of the value of environmental amenities in England found that domestic gardens attracted large price premiums. To fill in this gap, we designed and implemented a new MENE module of questions focusing on the nature and extent of people's engagement with domestic gardens, in the seven day period prior to the interview. This module was added to three of the 2013 weekly MENE waves in April (coinciding with the additional monthly questions), May (coinciding with the additional quarterly questions) and June 2013 (coinciding again with the additional monthly questions). The new garden module asked questions about access to a private garden, number of visits to the garden in the last seven days (excluding routine activities such as putting the rubbish out or hanging clothes to dry), general reasons for visiting the garden, general well-being contribution of the garden, attitudes towards various features and size of the garden, and a comparison of preferred activities in private gardens and/or public outdoor places. More detailed questions were also asked in relation to the last visit conducted to the garden in the last seven days, including reasons for the visit and well-being associated with the visit. These questions were designed to be comparable with equivalent questions in the MENE survey about public outdoor visits. A final question asked respondents to list the three public outdoor places that they found most beneficial in terms of well-being (whether they visited or not).

A total of 2,659 respondents were interviewed in the new garden module (Table 5.3) and, of those, 2,081 had access to a private or communal garden (78%). In total, 64% of the sample (and 82% of those with access to a garden) made a visit to their garden in the last 7 days (N=1710). Of those, garden well-being information was collected for 1,707 people across all 3 survey waves (and for 595 people in Week 22 survey wave, the wave that also collected information about outdoor visits and well-being).

During the 3 MENE survey waves where the new garden module was implemented, 43% of the sample made a visit to public outdoor spaces in the last 7 days (N=1,136, Table 5.3). Of these, we only have consistent trip information for 948 people (where reported trip duration does not exceed 24 hours and is larger than estimated travel time). Furthermore, as well-being information is only collected quarterly on the MENE survey, well-being data associated to trips to the public outdoor spaces is only available for one of the waves (Week 22), for a total of 881 people. Of those people, only 386 made an outdoor visit in the relevant period. A further 36 people were excluded from the analysis as no postcode was recorded for their home and a further 33 people for which the estimated travel time exceeded the reported trip duration. Hence, the well-being analysis is based on a subset of 317 people for which complete information on well-being and trip variables was available.

**Table 5.3. New garden module MENE data set information.**

| Survey wave 2013 | Total | Has access to garden | Visited garden | Visited outdoors |
|---|---|---|---|---|
| Week 17 | 897 | 714 | 554 | 389 |
| Week 22 | 881 | 683 | 595 | 386 |
| Week 26 | 881 | 684 | 561 | 361 |
| Total | 2,659 | 2,081 | 1,710 | 1,136 |

The full MENE dataset from 2009-2012 was also analysed. There were 160,376 initial observations. Of those, only 56,771 made an outdoor visit in the last 7 days. Observations were dropped when an easting and northing coordinate for either the home or the visit location was not recorded, leaving a sample of 44,494 people. Well-being data was only collected for 3,528 of those observations. A further 280 observations were excluded where the estimated travel time was larger than the reported visit duration, and a further 24 observations for which Index of Multiple Deprivation information could not be assigned. The final sample size for the full MENE well-being dataset is therefore 3,244.

To summarise, the results reported in the followings sections are based on two subsets of information from the MENE survey:

i. All the MENE survey observations for which well-being information was collected between 2009 and 2012 (henceforth referred to as the 'full MENE well-being dataset') and for which information is available for all relevant control variables (N=3,224);
ii. The new 2013 MENE garden module (henceforth referred to as the 'new garden module') described above (N=2,659).

The two subsets of data are relatively small and have not been weighted; they are unlikely therefore to be fully representative of outdoor visitation patterns in the last 4 years. Similarly, they should not be directly compared with results published elsewhere using the full weighted MENE weekly survey dataset.

### 5.4.3 Key results: demographic and visitation statistics

**Table 5.4** presents detailed demographic statistics for the full new garden module 2013 sample (N=2,659) and for the full MENE well-being survey (N=3,224). Just over half of both samples are female (54%), and the mean age lies in the 45-54 years bracket. Approximately a third of people have children, 16-24% have a long standing illness or disability and a large majority (86-92%) have a white ethnic background. Some 44-55% of respondents (depending on the sample) are in employment, 24-29% are retired, 6% are in education and 16-21% are not working. About 17-25% of people are in the AB social grade, 46-50% in C1C2, and 26-37% in DE (it should be noted that in the new garden module the DE social group seems to be relatively overrepresented while the AB social group is relatively underrepresented in relation to the MENE survey). Between 24 and 33% of people, depending of the survey, have a dog.

**Table 5.4. Demographic characteristics.**

| Demographics | New garden module | | MENE well-being survey | |
|---|---|---|---|---|
| | N=2,659 | | N=3,224 | |
| | N | % | N | % |
| **Gender** | | | | |
| Men | 1,213 | 45.6 | 1,472 | 45.7 |
| Women | 1,446 | 54.4 | 1,752 | 54.3 |
| **Age** | | | | |
| 16-24 | 375 | 14.1 | 437 | 13.6 |
| 25-34 | 447 | 16.8 | 518 | 16.1 |
| 35-44 | 421 | 15.8 | 636 | 19.7 |
| 45-54 | 391 | 14.7 | 493 | 15.3 |
| 55-64 | 346 | 13.0 | 516 | 16.0 |
| 65+ | 679 | 25.5 | 624 | 19.4 |
| **Children** | | | | |
| Child | 800 | 30.1 | 1,113 | 34.5 |
| No child | 1,859 | 69.9 | 2,111 | 65.5 |
| **Working status** | | | | |
| Full time | 833 | 31.3 | 1,251 | 38.8 |
| Part time | 337 | 12.7 | 507 | 15.7 |
| Retired | 773 | 29.1 | 779 | 24.2 |
| In education | 168 | 6.3 | 179 | 5.6 |
| Not working | 548 | 20.6 | 508 | 15.8 |
| **Illness/ Disability** | | | | |
| Yes | 631 | 23.7 | 530 | 16.4 |
| No | 2,028 | 76.3 | 2,694 | 83.6 |
| **Ethnic background** | | | | |
| White | 2,293 | 86.2 | 2,973 | 92.2 |
| Other | 366 | 13.8 | 251 | 7.8 |
| **Social grade** | | | | |
| A | 68 | 2.6 | 118 | 3.7 |
| B | 396 | 14.9 | 677 | 21.0 |
| C1 | 696 | 26.2 | 958 | 29.7 |
| C2 | 516 | 19.4 | 637 | 19.8 |
| D | 450 | 16.9 | 421 | 13.1 |
| E | 533 | 20.1 | 413 | 12.8 |

| | | | | |
|---|---|---|---|---|
| **Region** | | | | |
| North (East) | 176 | 6.6 | 167 | 5.2 |
| Yorks & Humberside | 275 | 10.3 | 338 | 10.5 |
| North West | 342 | 12.9 | 415 | 12.9 |
| West Midlands | 266 | 10.0 | 319 | 9.9 |
| East Midlands | 238 | 9.0 | 280 | 8.7 |
| East Anglia | 67 | 2.5 | 380 | 11.8 |
| South West | 269 | 10.1 | 433 | 13.4 |
| South East | 639 | 24.0 | 572 | 17.7 |
| Greater London | 387 | 14.6 | 320 | 9.9 |
| **Has a dog** | | | | |
| No | 2,011 | 75.6 | 2,160 | 67.0 |
| Yes | 648 | 24.4 | 1,064 | 33.0 |

**Table 5.5** reports selected trip characteristics for the outdoor visits to public spaces. Most visits take place within 5 miles of a respondent's home (71-74%) with a large proportion taking place less than a mile from home (34%). This is consistent with the fact that about half the sample walked to their destination. An overwhelming proportion of people declared their home as the starting point of their journey (94-96%). Nature trips are found to be very popular, with 83% of the MENE sample (and 51% of the new garden module) stating that they engage in nature trips at least once a week on average. Indeed some 22% of people (11% in the new garden module) say they make daily trips. Only 1% and 12% of the MENE and garden samples, respectively, state they never make any nature trips to public outdoor spaces. This information is however based on a self-assessment of average visitation patterns over the last 12 months, and is likely to suffer from recall problems.

**Table 5.5. Visitation statistics.**

| **Visitation statistics** | **New garden module** | | **MENE well-being survey** | |
|---|---|---|---|---|
| | **N=2,659** | | **N=3,224** | |
| | **N** | **%** | **N** | **%** |
| **Distance travelled** | | | | |
| Less than 1 mile | 387 | 34.1 | 1082 | 33.6 |
| 1 or 2 miles | 267 | 23.5 | 701 | 21.7 |
| 3 to 5 miles | 191 | 16.8 | 517 | 16.0 |
| 6 to 10 miles | 103 | 9.1 | 302 | 9.4 |
| 11 to 20 miles | 85 | 7.5 | 254 | 7.9 |
| 21 to 40 miles | 50 | 4.4 | 177 | 5.5 |
| 41 to 60 miles | 21 | 1.9 | 76 | 2.4 |
| 61 to 80 miles | 16 | 1.4 | 41 | 1.3 |
| 81 to100 miles | 5 | 0.4 | 32 | 1.0 |

| Visitation statistics | New garden module | | MENE well-being survey | |
|---|---|---|---|---|
| | N=2,659 | | N=3,224 | |
| | N | % | N | % |
| More than 100 miles | 11 | 1.0 | 42 | 1.3 |
| **Mode of transport** | | | | |
| On foot\ walking | 570 | 50.2 | 1554 | 48.2 |
| Car or van | 448 | 39.4 | 1405 | 43.6 |
| Public bus or coach (scheduled service) | 40 | 3.5 | 85 | 2.6 |
| Bicycle\ mountain bike | 35 | 3.1 | 76 | 2.4 |
| Train (includes tube\underground) | 22 | 1.9 | 57 | 1.8 |
| Coach trip\ private coach | 7 | 0.6 | 17 | 0.5 |
| Other | 6 | 0.5 | 11 | 0.3 |
| Motorcycle\ scooter | 4 | 0.4 | 6 | 0.2 |
| On horseback | 2 | 0.2 | 3 | 0.1 |
| Taxi | 1 | 0.1 | 7 | 0.2 |
| Boat (sail or motor) | 1 | 0.1 | 3 | 0.1 |
| **Starting point of trip** | | | | |
| Your home | 1063 | 93.6 | 3095 | 96.0 |
| Someone else's home | 25 | 2.2 | 50 | 1.6 |
| Work | 5 | 0.4 | 10 | 0.3 |
| Holiday accommodation | 27 | 2.4 | 49 | 1.5 |
| Somewhere else | 16 | 1.4 | 20 | 0.6 |
| More than once per day | 63 | 2.4 | 145 | 4.5 |
| Every day | 232 | 8.7 | 555 | 17.2 |
| Several times a week | 534 | 20.1 | 1201 | 37.3 |
| Once a week | 525 | 19.7 | 759 | 23.5 |
| Once or twice a month | 514 | 19.3 | 393 | 12.2 |
| Once every 2-3 months | 246 | 9.3 | 90 | 2.8 |
| Once or twice a year | 239 | 9.0 | 53 | 1.6 |
| Never | 306 | 11.5 | 28 | 0.9 |

### 5.4.4 Key results: environmental spaces

New garden module respondents were asked to name the three types of public outdoor places in England that they found most beneficial in terms of well-being. These included locations that people visit, pass by when travelling, see on TV, would like to visit in the future, or indeed locations people appreciate even though they don't visit them. The results show that beaches are perceived to be by far the most beneficial environmental spaces, mentioned by 35% of the sample (Table 5.6). More broadly, blue spaces generally (beaches, rivers, seaside/coast) are chosen by 65% of respondents. This finding accords with the findings of MacKerron and Mourato (2013), which used a sophisticated momentary well-being tracking technology to uncover that marine and coastal margins are the 'happiest' locations. Private gardens are the third most mentioned space (19%), closely following woodlands or forests (21%). Some 41% of respondents cite designated or protected spaces such as National Parks, National Trust sites and World Heritage sites.

**Table 5.6. Perceived well-being-enhancing environmental spaces (N=2,659).**

| Environmental Space | % of respondents |
|---|---|
| Beaches | 34.7 |
| Woodland or forests | 20.9 |
| Your private garden\ communal garden | 18.6 |
| Rivers, lakes, canals, wetlands or lagoons | 17.3 |
| National Parks | 16.0 |
| Nature parks, wildlife parks or reserves | 14.7 |
| Public parks in towns, cities or villages | 14.1 |
| Country parks | 13.6 |
| Other seaside or coastlines | 13.4 |
| Mountains, hills or moorland | 13.2 |
| National Trust properties (with outdoor areas) | 13.1 |
| World Heritage Sites (with nature elements, e.g. Stonehenge and Avebury, Royal Botanical Gardens…) | 11.4 |
| Children's playgrounds | 9.9 |
| Playing fields or other recreation areas | 6.6 |
| Farmland | 5.9 |
| Paths, cycleways or bridleways | 5.2 |
| Other open space in the countryside | 5.2 |
| Farms or city farms | 4.9 |
| The grounds of buildings that are not public parks e.g. stately homes | 4.2 |
| Grassland | 3.5 |
| Other open spaces in towns or cities | 2.8 |
| Tree-lined streets | 2.6 |
| Burial grounds, churchyards or cemeteries | 1.9 |
| Allotments or community gardens | 1.8 |

In the new garden module, information is recorded about both visits to private gardens and to public outdoor places for the same sample, so visitation patterns can be compared. About 82% of those with access to a private or communal garden (N=2,081) made at least one visit to their garden in the last 7 days prior to the interview, while 43% of the sample (N=2,659) made at least one visit to a

public outdoor place in the same period. The average number of times respondents visited their garden in the last 7 days was 4 and the number of times they visited other public outdoor places was 1. Those that visited the garden in the last 7 days (N=1,710) had a median visit duration of 60 min. Those that visited a public outdoor place in the same period spent on average 144 minutes in their selected place, excluding travel time. Unsurprisingly, visits to one's own garden are more frequent but the duration is lower than visits to other environmental spaces. We note that this information was only collected for 3 survey waves (April to June 2013) so will not be representative of yearly visitation patterns.

Table 5.7 shows the proportion of visits to public outdoor places by type of place and the average duration of the visits, both in terms of time spent on-site and time spent travelling. The travel distances and travel times were calculated from Google maps using the *traveltime3* Stata command (Bernhard, 2013) which takes into account two travel modes only: driving (used for private motor, public motor or train) and walking (used for walking, bike, horse, boat and others). A small number of people reported travel times that exceeded a day or travel times larger than the whole trip duration. These observations were excluded in any calculations involving travel time, reducing the sample of outdoor visits from 1,136 to 948 as noted earlier.

**Table 5.7. Number of visits, travel time and time spent in outdoor spaces.**

| | MENE well-being survey 2009-2012 (N=3,224) | | | New garden module 2013 (N=948) | | |
|---|---|---|---|---|---|---|
| **Outdoor places visited** | **% visits** | **Mean on-site time (minutes)** | **Mean travel time (minutes)** | **% visits** | **Mean on-site time (minutes)** | **Mean travel time (minutes)** |
| A park in a town or city | 24.4 | 105.4 | 20.0 | 27.7 | 107.5 | 17.5 |
| Another open space in the countryside | 9.6 | 132.9 | 27.0 | 6.7 | 143.4 | 24.3 |
| Another open space in a town or city | 7.4 | 122.3 | 26.0 | 6.5 | 159.0 | 27.0 |
| A beach | 7.1 | 221.2 | 51.1 | 8.0 | 198.9 | 37.3 |
| Country park | 7.1 | 154.2 | 27.0 | 7.7 | 160.1 | 36.1 |
| A path, cycleway or bridleway | 6.3 | 81.0 | 23.8 | 5.9 | 86.1 | 21.7 |
| A playing field or other recreation area | 6.2 | 117.2 | 17.9 | 5.3 | 162.3 | 15.8 |
| A woodland or forest | 6.0 | 101.0 | 28.7 | 4.1 | 102.3 | 27.5 |
| A river, lake or canal | 5.7 | 148.1 | 25.9 | 5.4 | 218.0 | 27.3 |
| Other | 4.5 | 186.3 | 25.2 | 5.7 | 167.6 | 28.6 |
| Other coastline | 4.1 | 208.0 | 42.5 | 3.3 | 168.0 | 48.2 |
| A village | 3.9 | 122.5 | 28.5 | 3.3 | 113.8 | 24.6 |
| A children's playground | 3.1 | 139.4 | 17.6 | 5.2 | 139.7 | 15.3 |
| Farmland | 2.6 | 147.8 | 24.0 | 3.2 | 139.4 | 25.4 |
| A mountain, hill or moorland | 1.4 | 201.0 | 44.3 | 1.9 | 271.0 | 50.7 |
| An allotment or community garden | 0.5 | 112.5 | 14.2 | 0.2 | 204.7 | 35.3 |

Comparing **Table 5.7** with **Table 5.6** shows that the most visited environmental spaces by far, urban parks (24-28% of all visits), are associated with relatively shorter visits (105-108 min) and do not top the well-being chart**.** Beaches, the highest ranked spaces in terms of generating well-being, are nevertheless amongst the top 4 most popular spaces to visit in both surveys. Amongst environmental spaces, the MENE well-being survey shows that beaches, coastline and mountains are

associated with the longest visits (201-221 min); mountains and beaches are also associated with some of the lengthier visits in the smaller garden module survey. These counterintuitive patterns occur because the popularity of a type of space is determined by both the benefits of visiting a space and the time costs involved in getting there. For the average, city-dwelling person the costs of reaching a space within or close to a city (e.g. an urban park where average travel time is 18-20 min) are low so the spaces can be popular even if the benefits are relatively low. On the other hand, the costs and time involved in reaching more remote destinations (e.g. beaches, coastline and mountains, with average travel times in the range of 43-51 minutes in the MENE well-being data) are high, which deters popularity even if the benefits are high. In a nutshell, popularity is uninformative about the perceived benefits of spaces unless the costs are also taken into account.

For the purposes of the well-being analysis, the detailed list of public outdoor places in Table 5.7 was grouped into broader geographical categories: blue spaces (i.e. river, lake or canal; beach; other coastline), green spaces (i.e. woodland; farmland; mountain; village; country park; other space in countryside; urban park; and countryside paths, playgrounds, playing fields, open spaces), and brown spaces/other (i.e. urban paths, playgrounds, playing fields, open spaces, other). Summary statistics for these broader categories are listed in **Table 5.8.**

**Table 5.8. Number of visits, travel time and time spent in broad outdoor place categories.**

| | MENE well-being survey (N=3,224) | | | New garden module (N=948) | | |
|---|---|---|---|---|---|---|
| **Outdoor places visited** | **% visits** | **Mean on-site time (minutes)** | **Mean travel time (minutes)** | **% visits** | **Mean on-site time (minutes)** | **Mean travel time (minutes)** |
| Green | 66.3 | 120.8 | 24.4 | 65.0 | 127.3 | 23.5 |
| Blue | 16.9 | 193.3 | 40.5 | 16.7 | 199.0 | 36.2 |
| Brown/Other | 16.8 | 129 | 21.5 | 18.4 | 151.1 | 21.9 |

Overall, a similar pattern of results emerges. Green spaces receive the most visits (65-66%) which is hardly surprising as they are the predominant land cover, but, on average, people spend more time visiting (and travelling to) blue spaces (193-199 min) than green spaces (121-127 min). It is worth recalling that these figures relate to one selected visit within the last week only. When the high frequency of visits made to environmental spaces in a whole year is considered (see Table 5.5), the time spent interacting with nature becomes very significant.

Finally, in the new gardens module survey information was collected about features and characteristics of private gardens that people enjoy. Table 5.9 contains the results. The attitudinal statements suggest that gardens are well liked and people enjoy spending time in this domestic environmental space. Privacy and safety are valued characteristics: the private nature of a garden is mentioned as a positive factor (47%) as well as being a place where children can play (27%). Natural features such as plants/grass, birds, wildlife, trees are each cited by about a third of the sample as conferring enjoyment, with others noting nice views and water features. Gardening and growing fruit and vegetables are noted as well-being enhancing activities by 45% and 23% of the sample, respectively. Negative views are scarce: less than 2% of people dislike their garden, while 4% consider it to be too large and 11% too small.

**Table 5.9. Perceived enjoyment of garden features (N=1,710, multiple answers allowed).**

| Domestic garden features | % of respondents |
|---|---|
| I like spending time in my garden | 57.9 |
| My garden is an important place to me | 46.8 |
| I enjoy my garden because it is private | 46.8 |
| I enjoy gardening | 44.6 |
| I enjoy the grass\ plants in my garden | 36.3 |
| I enjoy the wildlife in my garden | 33.4 |
| I enjoy feeding birds in my garden | 31.0 |
| I encourage wildlife in my garden | 29.9 |
| My garden is a place where children can play | 27.3 |
| I enjoy the trees in my garden | 26.8 |
| I like to grow fruit, vegetables or herbs in my garden | 22.9 |
| I enjoy my garden because of its views (e.g. of land, sky, water) | 16.0 |
| My garden is too small | 11.1 |
| I enjoy the pond\ water features in my garden | 7.4 |
| My garden is too large | 4.4 |
| I don't like my garden | 1.8 |

### 5.4.5 Key results: cultural practices

In the full MENE well-being dataset, the most frequently performed activities are walking without and with a dog, followed by playing with children. But the activities respondents spend longer undertaking are beach activities (over 5.5 hours), followed by water sports (almost 5 hours) and fishing (over 4.5 hours). Walking with a dog is the activity where the least time is spent (just over 1 hour). Respondents appear to be prepared to travel for longer to reach a beach or the seaside (around 74min), followed by swimming outdoors (70min) and water sports (64min). The full set of activity results are displayed in **Table 5.10**.

However, activities performed are a somewhat narrow indicator of the reasons why people visit environmental spaces. Some visits might not involve a specific activity, but may be focused more on contemplative or relaxing practices. Asking respondents to state the reasons why they visit nature is arguably a broader indicator of cultural practices linked to interactions with nature. The stated reasons that people reported for making a visit, linked to the types of nature interactions associated with these reasons, were grouped into broad cultural practice categories:

- relaxation (i.e. experience fresh air; appreciate scenery);
- exercise (i.e. play);
- socializing (i.e. spend time with family, friends and children, picnic);
- pets (i.e. exercising dog);
- green activities (i.e. enjoy wildlife, bird-watching, learn about outdoors, feed wildlife or fish, fishing);
- other activities (i.e. reading, artistic activities, DIY, using the Summer house/shed, smoking);
- gardening (i.e. gardening, mowing lawn, growing fruit and vegetables);
- a residual 'other' category (i.e. challenge yourself, other reasons, don't know).

**Table 5.11** lists the types of cultural practices involving interactions with nature that respondents engaged in while visiting their garden or a public outdoor place (the latter, for both the MENE well-being dataset 2009-12 and the new MENE garden module 2013). Some of these practices such as relaxation are closely linked to benefits. They are referred to as practices as a person may identify taking part in these practices as the reason for visiting an environmental space but this does not mean they gain a benefit as a result of the visit. The well-being benefits measured in this analysis are discussed in the next sub-section and are based on respondents regarding the outcome of the visit. In this way we maintain our conceptual distinction between practices and benefits. The most popular type of cultural practice identified by the reason for making a visit is relaxing for both garden visitors and outdoor place visitors (41% and 42-45% of all practices respectively). In the case of private gardens, the second most popular practice is gardening (18%) and green activities (15%); while those visiting other outdoor spaces favour socializing (22-25%) and exercising (14%). In terms of visit duration for the various types of cultural practice (**Table 5.11**), the longest visits are associated with socializing, relaxing and green activities for both garden and outdoor visits (excluding the residual category), with socialising being associated with the longest trip duration in outdoor visits (171-173 min).

**Table 5.10. Activity frequency, travel time and time spent performing various activities (N=3,224, multiple activities allowed, % calculated in relation to the total number of activities mentioned).**

| Activities performed outdoors | % | Mean travel time (minutes) | Mean on-site time (minutes) |
|---|---|---|---|
| Walking without a dog (incl. short walks, rambling) | 29.1 | 27.5 | 128.3 |
| Walking with a dog (incl. short walks, rambling) | 21.0 | 18.7 | 72.9 |
| Playing with children | 11.9 | 25.5 | 145.3 |
| Eating or drinking out | 7.3 | 43.8 | 232.6 |
| Visiting an attraction | 5.7 | 49.2 | 273.0 |
| Wildlife watching | 3.4 | 42.3 | 205.3 |
| Informal games and sport (e.g. Frisbee) | 3.0 | 29.8 | 198.1 |
| Picnicking | 2.7 | 46.9 | 241.6 |
| Appreciating scenery from a car | 2.6 | 55.8 | 248.9 |
| Running | 2.1 | 19.4 | 75.5 |
| None of the activities in the list | 2.0 | 26.8 | 196.8 |
| Beach, sunbathing or paddling | 1.8 | 73.5 | 339.7 |
| Any other outdoor activities | 1.7 | 30.8 | 257.9 |
| Road cycling | 1.2 | 50.7 | 97.7 |
| Off-road cycling or mountain biking | 1.1 | 54.4 | 151.7 |
| Fishing | 1.0 | 33.9 | 281.6 |
| Swimming outdoors | 0.6 | 70.1 | 239.5 |
| Horse riding | 0.5 | 23.6 | 187.1 |
| Water sports | 0.5 | 63.8 | 296.2 |
| Field sports | 0.4 | 23.2 | 205.7 |
| Off-road driving or motorcycling | 0.3 | 44.6 | 167.7 |

**Table 5.11. Type and length of cultural practices involving interactions with nature (multiple practices allowed, % calculated in relation to the total number of interactions).**

| Cultural practices | New garden module | | | | MENE well-being survey | |
|---|---|---|---|---|---|---|
| | Private garden (N=1,710) | | Public outdoor place (N=948) | | Public outdoor space (N=3,224) | |
| | % total interactions | Average on-site duration (minutes) | % total interactions | Average on-site duration (minutes) | % total interactions | Average on-site duration (minutes) |
| Relaxation | 40.6 | 145.9 | 42.4 | 161.8 | 44.7 | 149.2 |
| Gardening | 18.4 | 132.6 | - | - | - | - |
| Green activities | 14.7 | 149.6 | 5.4 | 158.4 | 5.7 | 152.6 |
| Socializing | 13.9 | 138.1 | 24.6 | 172.7 | 21.9 | 170.5 |
| Other activities | 5.0 | 134.2 | - | - | - | - |
| Pets | 3.2 | 98.0 | 10.5 | 88.3 | 10.6 | 68.9 |
| Exercising | 2.7 | 137.2 | 13.7 | 127.1 | 13.9 | 103.8 |
| Other | 1.6 | 168.4 | 3.4 | 201.8 | 3.04 | 190.3 |

For each type of cultural practice involving an interaction with nature, we asked respondents with access to a garden (N=2,081) in the new garden module where they would rather pursue it, in a private garden or in a public outdoor places. Results are described in **Table 5.12**. The majority of people did not express a preference for either environmental space. The clearer results emerge for gardening and relaxation, where 22% and 18% of people, respectively, prefer to use their own garden. Conversely, there is a small preference for walking pets and exercising in public outdoor places (7% and 6% respectively).

**Table 5.12. Preference for private or public places for cultural practices involving interactions with nature (N=2,081, i.e. those with access to a garden).**

| Cultural practices | Prefer private garden (%) | Prefer public outdoor places (%) | Indifferent (%) |
|---|---|---|---|
| Gardening | 22.4 | 1.3 | 76.4 |
| Relaxing | 18.3 | 9.3 | 72.4 |
| Socializing | 13.3 | 9.6 | 77.2 |
| Other activities | 7.3 | 2.0 | 90.8 |
| Green activities | 6.1 | 5.5 | 88.4 |
| Other | 2.1 | 6.8 | 91.2 |
| Pets | 2.5 | 7.1 | 90.4 |
| Exercising | 1.2 | 6.3 | 92.5 |

### 5.4.6 Key results: well-being

Three subjective well-being proxies from the MENE survey are used and these are defined as the extent to which respondents agreed (5-strongly agree to 1-strongly disagree) with the following statements regarding their selected visit to the garden or the outdoors:

- 'I enjoyed it',
- 'It made me feel calm and relaxed',
- 'It made me feel fresh and revitalised.'

The first statement can be interpreted as a proxy for recalled momentary subjective well-being (MacKerron and Mourato, 2013), while the other two statements share similarities with measures of mental well-being particularly of recalled emotional restoration (White *et al*. 2012). The interpretation of these well-being proxies is limited by the fact that they are cast as a level of agreement with statements rather than actual levels of well-being. It would be highly desirable to change the way well-being is elicited in the MENE survey.

**Table 5.13** compares the average value of the well-being proxies for private garden and public outdoor spaces visits, for two subsets of respondents: those for whom well-being information was available on both visits to gardens and visits to public outdoor places (Wave 22 of the new 2013 garden module MENE survey, first two columns); and the full new garden module along with the MENE well-being dataset (for which we have well-being information and other key variables for garden visits and public outdoor visits respectively, last two columns).

**Table 5.13. Average well-being proxies for garden and outdoor visits.**

| | **New garden module** | | | **MENE well-being survey** |
|---|---|---|---|---|
| | **Wave 22** | | **All sample** | |
| **Well-being proxy (5-strongly agree, 1-strongly disagree)** | **Private garden visit** | **Public outdoor place visit** | **Private garden visit** | **Public outdoor place visit** |
| I enjoyed it | 4.27 | 4.49 | 4.25 | 4.40 |
| It made me feel calm and relaxed | 4.10 | 4.17 | 4.06 | 4.09 |
| It made me feel refreshed and revitalised | 4.00 | 4.07 | 3.91 | 4.06 |
| N | 595 | 386 | 1,707 | 3,224 |

**Figures 5.10** and 5.**11** depict the distribution of well-being across the various sub-samples for both garden and public outdoor space visits. There is evidence of large and similar levels of well-being associated with both types of recreational visit. Very few respondents disagree with the well-being statements and the response distribution is heavily skewed to the left.

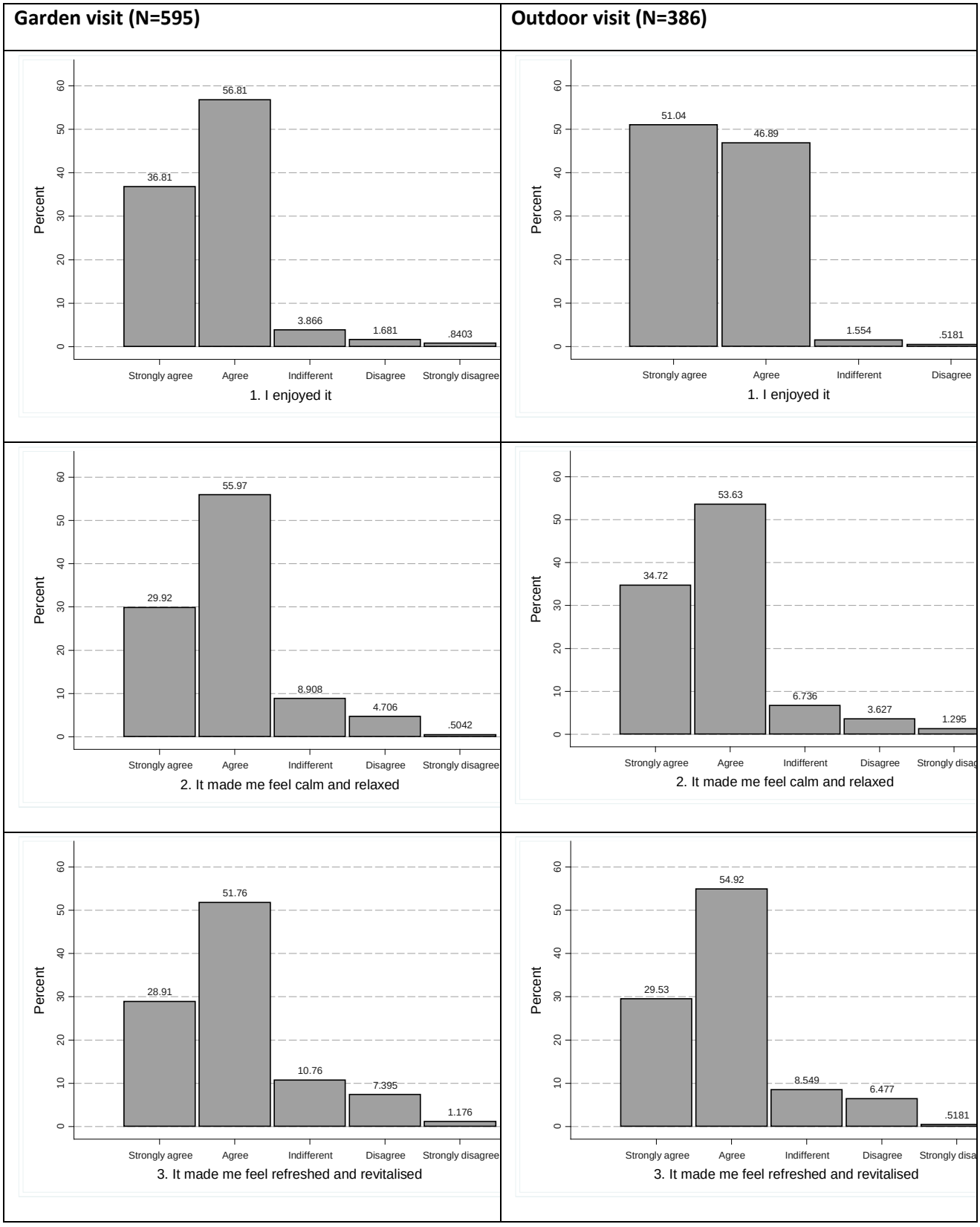



**Figure 5.10. Distribution of well-being proxies for private garden and public outdoor visits (Wave 22, new garden module).**

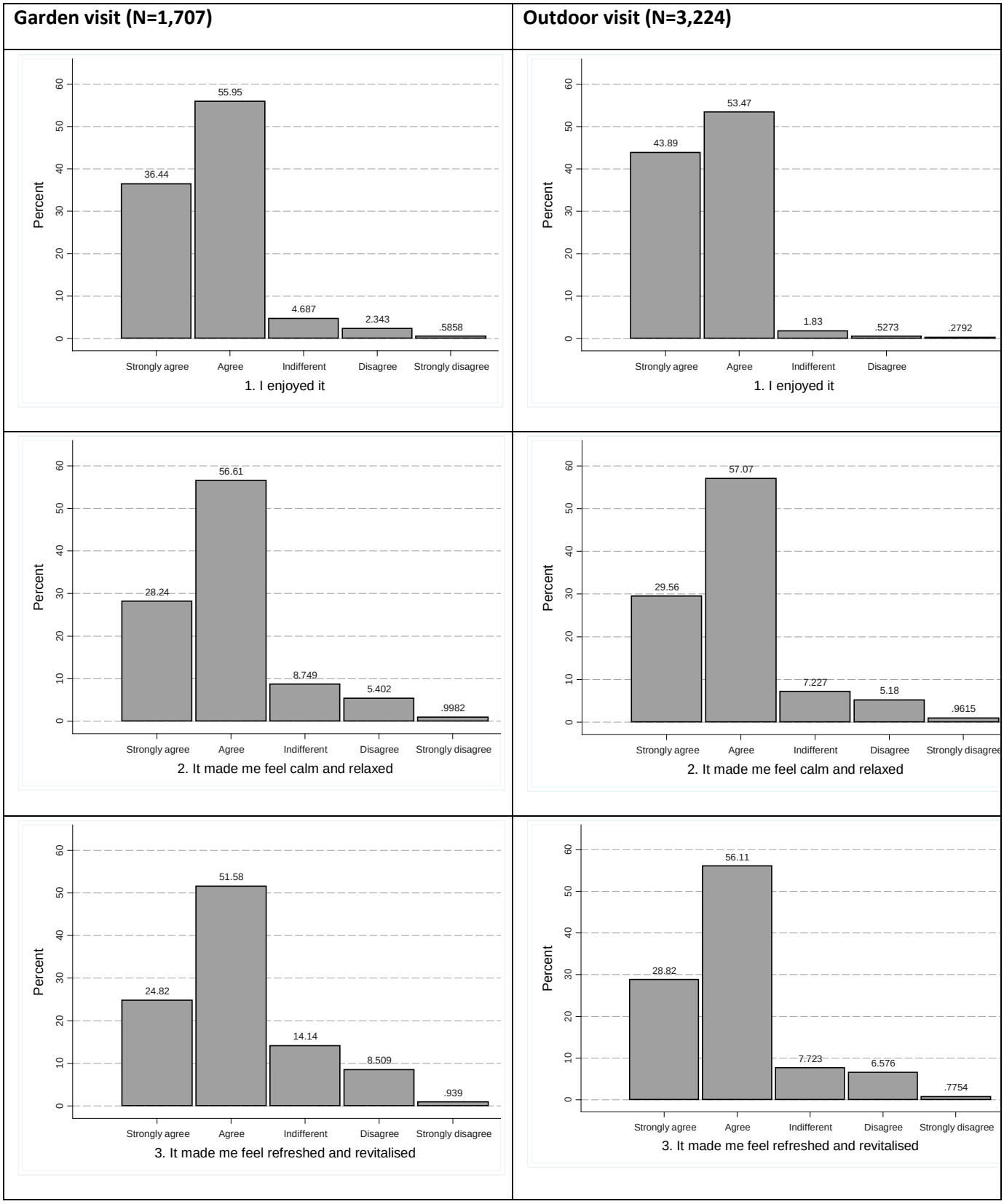



**Figure 5.11. Distribution of well-being proxies for private garden and public outdoor visits (new garden module, MENE well-being sample).**

Ordinary Least Square regressions were run with robust standard errors to explain the factors that affect well-being across the same subsamples as in **Table 5.13** (with small adjustments to account for the lack of geocoded location data and consistent travel time information, as explained in Section 5.4.2 above). As noted initially, the aim is to investigate the link between environmental spaces, cultural practices and well-being and the focus is on analysing the well-being associated with a unit of time spent in different types of environmental spaces, undergoing different types of interaction with nature. Of particular interest is the novel comparison between private gardens and public outdoor places.

Specifically, the aim here is to estimate the change in well-being associated with an additional hour spent at an environmental space. Unfortunately, the information available on trip duration is a combination of time spent travelling and time spent at the destination. For garden visits, this is not a problem, because it can be assumed that travel time is zero. For non-garden visits it is important to control for differences in travel time, and this was done by controlling for trip travel mode and time of the journey imputed from origin and destination coordinates via Google maps, as noted above. In the regressions, the dependent variables are the three well-being proxies described in **Table 5.13** and **Figures 5.10** and 5.**11**, coded as scale variables varying from 1-5. The independent variables include:

- Hours spent on the selected visit. This allows the estimation of the relationship between well-being and the duration of a visit.
- Demographic controls: e.g. gender, age, marital status, employment, children, ethnicity, social grade, house ownership, disability, Index of Multiple Deprivation.
- Area controls: region, urban indicator.
- Type of cultural practice and interaction with nature: exercising, relaxing, socialising, spending time with/caring for pets, engaging in green activities, engaging in other activities, and gardening (the latter for garden visits only).
- Type of environmental space visited (for public outdoor places visits only): green, blue, brown/other.
- Garden controls: access to private (rather than communal) garden; size of garden (for garden visits only).
- Trip characteristics (for public outdoor spaces visits only): trip starting point (incl. holiday trip), time travelled, mode of transport.

Regressions were performed on the subset of the MENE dataset for which well-being information on outdoor visits was available (N=3,224) and on the full new module garden dataset for which well-being data associated with domestic garden visits was available (N=1,707), as well as complete data on all other relevant variables. In addition, separate regressions were performed on the Wave 22 new gardens module dataset for which well-being data was available for <u>both</u> visits to the garden (N=595) and visits to public outdoor places (N=317). Tables 5.14 and 5.15 present the summary results for the various well-being regressions (the full set of results is available at Appendix 5.6). Many alternative specifications of the models below were tested, including a logit model with well-being coded as a dummy variable, with similar results.

**Table 5.14. Effect on well-being of visit duration, environmental spaces and cultural practice involving interaction with nature (Wave 22 of new garden module)**

| | IN THE GARDEN (N=595) | | | | | | IN A PUBLIC OUTDOOR PLACE (N=317) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Well-being effect** | **I enjoyed it** | | **It made me feel calm and relaxed** | | **It made me feel refreshed and revitalised** | | **I enjoyed it** | | **It made me feel calm and relaxed** | | **It made me feel refreshed and revitalised** | |
| 1 hour spent outside | 0.0321 | *** | 0.0424 | *** | 0.0235 | | 0.0208 | ** | 0.0392 | * | 0.0175 | |
| Green space (base=Brown/other) | | | | | | | 0.0485 | | 0.1150 | | 0.2700 | * |
| Blue space (base=Brown/other) | | | | | | | 0.1422 | | 0.2774 | * | 0.4504 | *** |
| Relaxing | 0.3674 | *** | 0.4039 | *** | 0.3799 | *** | 0.1548 | ** | 0.3096 | *** | 0.1649 | |
| Green activities | 0.0463 | | 0.0128 | | 0.1298 | | 0.1342 | | -0.0607 | | -0.0424 | |
| Other activities | 0.0886 | | 0.2742 | *** | 0.3599 | *** | 0.0551 | | -0.2993 | | 0.0385 | |
| Gardening | 0.0221 | | 0.0608 | | -0.0618 | | | | | | | |
| Exercise | 0.1356 | | 0.1664 | | 0.1387 | | 0.0380 | | 0.1046 | | 0.2135 | ** |
| Socializing | 0.1543 | *** | 0.0054 | | 0.1970 | ** | 0.1051 | | 0.0034 | | 0.0505 | |
| Pets | 0.0298 | | -0.1300 | | -0.0650 | | 0.1654 | * | 0.2409 | * | 0.0728 | |
| Female | 0.1217 | ** | 0.0725 | | 0.0436 | | 0.1044 | | 0.0724 | | 0.1883 | * |
| Age | 0.0050 | | 0.0058 | | 0.0128 | | 0.0154 | | 0.0245 | | 0.0539 | *** |
| Ethnicity: non-white | -0.0955 | | 0.0320 | | 0.2086 | * | 0.0518 | | -0.0373 | | 0.3811 | *** |
| Disability | 0.0010 | | 0.0570 | | 0.0386 | | 0.0816 | | 0.0221 | | -0.0466 | |
| Region: Greater London | -0.0536 | | -0.1006 | | 0.0244 | | -0.2494 | ** | -0.0574 | | -0.0932 | |
| Social grade D (base=E) | -0.3141 | *** | -0.2219 | * | -0.3092 | ** | -0.1632 | | -0.4250 | ** | -0.4213 | ** |
| Social grade C2 (base=E) | -0.1545 | | -0.2339 | ** | -0.2992 | ** | -0.1217 | | -0.2759 | * | -0.4799 | *** |
| Social grade C1 (base=E) | -0.1816 | ** | -0.2173 | ** | -0.3601 | *** | -0.1501 | | -0.4632 | *** | -0.6733 | *** |
| Social grade AB (base=E) | -0.0916 | | -0.1951 | | -0.2858 | ** | -0.0566 | | -0.4726 | ** | -0.5047 | *** |
| Garden too small | -0.1206 | | -0.1252 | | -0.1282 | | | | | | | |

| | IN THE GARDEN (N=595) | | | | | | IN A PUBLIC OUTDOOR PLACE (N=317) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Well-being effect** | **I enjoyed it** | | **It made me feel calm and relaxed** | | **It made me feel refreshed and revitalised** | | **I enjoyed it** | | **It made me feel calm and relaxed** | | **It made me feel refreshed and revitalised** | |
| Garden too big | -0.0447 | | -0.1835 | | -0.2266 | | | | | | | |
| Mode of transport: walking | | | | | | | -0.0645 | | -0.0510 | | -0.0329 | |
| Mode of transport: bike/boat/other | | | | | | | 0.2500 | | -0.0232 | | 0.6411 | *** |
| Adjusted R2 | 0.1539 | | 0.1122 | | 0.1203 | | 0.0734 | | 0.0175 | | 0.1419 | |
| Other controls: marital status, IMD, children, mortgage, working status, area, urban indicator | Yes | | Yes | | Yes | | Yes | | Yes | | Yes | |
| Garden controls: access to private garden | Yes | | Yes | | Yes | | | | | | | |
| Trip controls: trip characteristics, travel time, year of survey | | | | | | | Yes | | Yes | | Yes | |

Note: Model is OLS, correcting for heteroskedasticity. The stars indicate statistical significance levels *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

**Table 5.15. Effect on well-being of visit duration, environmental spaces and cultural practices involving interaction with nature (all new garden module + MENE well-being dataset).**

| | IN THE GARDEN (N=1,707) | | | | | | IN A PUBLIC OUTDOOR PLACE (N=3,224) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Well-being effect** | **I enjoyed it** | | **It made me feel calm and relaxed** | | **It made me feel refreshed and revitalised** | | **I enjoyed it** | | **It made me feel calm and relaxed** | | **It made me feel refreshed and revitalised** | |
| 1 hour spent outside | 0.0384 | *** | 0.0344 | *** | 0.0241 | ** | 0.0174 | *** | 0.0016 | | 0.0011 | |
| Green space (base=Brown/other) | | | | | | | 0.0461 | | 0.1469 | *** | 0.1562 | *** |
| Blue space (base=Brown/other) | | | | | | | 0.0490 | | 0.2062 | *** | 0.2348 | *** |
| Relaxing | 0.3097 | *** | 0.4079 | *** | 0.3722 | *** | 0.0864 | *** | 0.2187 | *** | 0.1862 | *** |
| Green activities | 0.0803 | ** | 0.0522 | | 0.1371 | *** | 0.1119 | *** | 0.1658 | *** | 0.0896 | ** |
| Other activities | 0.0539 | | 0.1348 | *** | 0.1655 | *** | 0.0908 | ** | -0.1187 | * | -0.0351 | |
| Gardening | 0.0389 | | 0.0342 | | -0.0115 | | | | | | | |
| Exercise | 0.0580 | | 0.0811 | | 0.1178 | * | 0.0744 | *** | 0.0396 | | 0.0864 | *** |
| Socializing | 0.1557 | *** | 0.1091 | *** | 0.1459 | *** | 0.0235 | | -0.1056 | *** | -0.0739 | ** |
| Pets | -0.0030 | | -0.0578 | | -0.0177 | | 0.0112 | | 0.0903 | ** | -0.0044 | |
| Female | 0.1255 | *** | 0.1103 | *** | 0.1764 | *** | 0.0292 | | -0.0094 | | 0.0276 | |
| Age | 0.0088 | | 0.0155 | ** | 0.0158 | ** | 0.0052 | | 0.0106 | * | 0.0093 | |
| Ethnicity: non-white | -0.0254 | | 0.0489 | | 0.1373 | ** | -0.0205 | | 0.0795 | | 0.0963 | * |
| Disability | -0.0127 | | -0.0321 | | -0.1205 | ** | -0.0104 | | -0.0555 | | -0.1566 | *** |
| Region: Greater London | 0.0954 | * | 0.1176 | * | 0.2280 | *** | 0.0096 | | 0.1202 | ** | 0.1204 | ** |
| Social grade D (base=E) | -0.1329 | ** | -0.0969 | | -0.1233 | | -0.0249 | | -0.0325 | | 0.0290 | |
| Social grade C2 (base=E) | -0.0346 | | -0.0637 | | -0.1119 | | -0.0157 | | -0.0210 | | -0.0298 | |
| Social grade C1 (base=E) | -0.0804 | | -0.1280 | * | -0.1348 | * | 0.0366 | | 0.0005 | | 0.0525 | |
| Social grade AB (base=E) | -0.0089 | | -0.0318 | | -0.0504 | | 0.0460 | | -0.0142 | | 0.0371 | |
| Garden too small | -0.0404 | | -0.1357 | ** | -0.0591 | | | | | | | |

| | IN THE GARDEN (N=1,707) | | | | | | IN A PUBLIC OUTDOOR PLACE (N=3,224) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Well-being effect** | **I enjoyed it** | | **It made me feel calm and relaxed** | | **It made me feel refreshed and revitalised** | | **I enjoyed it** | | **It made me feel calm and relaxed** | | **It made me feel refreshed and revitalised** | |
| Garden too big | -0.1527 | * | -0.1004 | | -0.2483 | ** | | | | | | |
| Mode of transport: walking | | | | | | | -0.0224 | | 0.0255 | | 0.0428 | |
| Mode of transport: bike/boat/other | | | | | | | 0.0949 | | 0.0707 | | 0.1662 | * |
| Adjusted R2 | 0.1176 | | 0.1076 | | 0.1153 | | 0.0414 | | 0.0551 | | 0.0526 | |
| Other controls: marital status, IMD, children, mortgage, working status, area, urban indicator | Yes | | Yes | | Yes | | Yes | | Yes | | Yes | |
| Garden controls: access to private garden | Yes | | Yes | | Yes | | | | | | | |
| Trip controls: trip characteristics, travel time, year of survey | | | | | | | Yes | | Yes | | Yes | |

Note: Model is OLS, correcting for heteroskedasticity. The stars indicate statistical significance levels *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

The key findings from the well-being analysis are reported below and Tables 5.14 and 5.15 contain the details on which the discussion is based. Time spent outdoors, in either a domestic garden or a public outdoor place, has a positive effect on well-being. The relationship is always significant for the momentary well-being proxy (enjoyment) and, in all but one case, for the calm and relaxation restoration proxy. In contrast, there is weaker evidence of a link between one hour spent outdoors in an environmental space and the refreshing and revitalising restoration proxy, as it is only significant in the new garden module. The effect on well-being of spending one hour in an environmental space ranges from 0.02 to 0.04 (with the well-being proxies varying from 1 to 5), when controlling for a large number of other factors. The magnitude of the well-being effect is very similar between time spent in private gardens and in public outdoor places, although the relationship is stronger in the private garden regressions. It is a relatively small effect, but when considering all the trips and time spent in environmental spaces throughout the year, the cumulative effect could be significant. Policy makers should work with planners, architects, builders and those interested in green infrastructure to improve access and usability of both public green and blue spaces but also private gardens so as to expand access and facilitate increased time spent outdoors engaging with nature. Domestic gardens are an important component of urban green infrastructure that can potentially play a significant role in the provision of ecosystem services (e.g. by providing a wildlife habitat or flood mitigation) although this is still not well understood or quantified and therefore is unlikely to be fully capitalised into house prices. Recognising the potential environmental and health functions provided by private gardens, there is an opportunity for planners and policy makers to enhance this type of green infrastructure by incentivising the introduction of more gardens, larger gardens, green roofs, for example, within new build developments. The potential environmental benefits of private gardens are however complex and highly dependent on the type of garden, its management and the presence of certain features (e.g. ponds). Providing more information and incentives to individuals and communities to manage private gardens sensitively for wildlife or even to create networks of private gardens could also enhance the wellbeing effects of these spaces.

This finding supports and extends previous evidence on the effects of engagement with nature and particularly on the effect of duration of exposure (Pretty *et al*. 2011). Barton and Pretty (2010) for example found that mental well-being was most improved during the first five minutes of activity, suggesting an immediate effect from the start of green exercise. Conversely, not much is known about the links between effect of duration of exposure and momentary subjective well-being. In the large state-of-the-art Mappiness study of happiness in natural environments, information on duration of the exposure is not collected (MacKerron and Mourato, 2013)

Several demographic factors are found to have a significant influence on well-being:

- Women appear to have a higher level of enjoyment of private garden visits than men (ranging between 0.11-0.18), for all well-being proxies. The effect is more noticeable in the full sample of the new garden module and does not extend to public outdoor places.
- There is some evidence that older people achieve higher levels of restoration from nature visits.
- People suffering from a long-term illness or a disability feel significantly less refreshed and revitalised in their nature trips, although this negative effect does not extend to other forms of well-being.
- Social grade appeared to have a striking result in the small Wave 22 dataset. Access to green spaces might be more easily available to wealthier individuals who own a car and are likely to have larger gardens. Yet, the well-being benefits of interaction with nature appeared to be relatively higher for social grade E. This finding is broadly in line with Mitchell and Popham's (2008) notion that green environments might reduce income-related health inequalities. They found that green space seemed to benefit the least well-off the most, if readily available.

However, the result weakens in the larger dataset, with social grade becoming insignificant in most cases.

- In the larger datasets, those residing in Greater London, are found to reap greater well-being from their garden and also from visits to other public outdoor places, perhaps because those spaces are less abundant and/or more expensive in large urban areas.

In public outdoor locations, visits to blue spaces are significantly more well-being enhancing than visits to brown/other spaces. The effect of blue spaces occurs for the restoration proxies. The effect on feeling refreshed and revitalised is particularly large and significant, adding 0.23 to the well-being score in the full MENE well-being dataset. Although the effect is not as large, visits to green spaces are also found to improve restoration, when compared to brown spaces. Past studies support these findings. Barton and Pretty (2010) for example, found that green exercise in natural places led to significant improvements in mental health outcomes (mood and self-esteem). Of particular relevance, habitats with open water were found to be the most beneficial for mental well-being. MacKerron and Mourato (2013) found that marine and coastal margins were by far the happiest locations in terms of momentary subjective well-being. Gibbons *et al.* (2013) also found large values associated with proximity to rivers, and increase in the land use share of freshwater. The latter two studies find positive links between most types of green spaces and well-being/values.

In terms of cultural practices, relaxation is not only the most popular type of interaction with nature (**Table 5.11**), but is also the most well-being enhancing (**Tables 5.14** and 5.**15**) influencing all three well-being measures. The effect is particularly large for those spending time in their domestic garden. For example, someone spending one hour in their garden for relaxation purposes can expect a boost to their level of calm and relaxation of 0.44 (0.0344 + 0.4079, **Table 5.15**); whilst an hour spent in a public nature space would enhance this measure of emotional restoration by 0.22 (0.0016+0.2187, **Table 5.15**). Socialising, green activities and other activities (such as reading, artistic pursuits, DIY, using the summer house/shed, smoking) carried out in one's garden, also boost various forms of well-being; while green activities in other environmental spaces improve all forms of well-being, walking the dog improves enjoyment and relaxation, and exercising enhances the subjective well-being and the revitalising and refreshing effects of visits to such locations. The latter result is in line with findings from the Mappiness study by MacKerron and Mourato (2013) that report increased levels of happiness associated with vigorous outdoor pursuits.

Mode of transport appears to have little effect on the well-being associated with visits to environmental spaces. The exception is for those travelling by bike, boat or other form of transport, who seem to enjoy enhanced refreshing and revitalising feelings.

### 5.4.7 Summary

In sum, despite the relatively small sample sizes, there is evidence of a significant well-being effect of spending time in natural spaces, based on analysis of data derived from the MENE dataset. Blue spaces are especially well-being enhancing when compared to brown urban spaces and relaxation is the most beneficial practice in terms of both momentary well-being and emotional restoration proxies. It is also the case that the well-being effects of spending time in domestic gardens and in public outdoor spaces share many similarities. This suggests that domestic gardens should be considered a key space where well-being-enhancing nature interactions occur. Table 5.9 showed how respondents seemed to enjoy many of the natural features present in gardens, from the grass to the wildlife. In this context, improving the limited available information on the condition of domestic gardens in terms of the occurrence of natural features and biodiversity seems warranted. These findings are based on the new module of MENE questions that extended the scope of the

survey to cover private gardens. In the final section further recommendations are made for developing and applying this resource to the future analysis of CES.

Overall though this section reinforces the point that to understand the significance of CES it is essential to have precise, representative and generalizable numerical evidence of the environmental spaces that people visit (or engage with in other ways), the types of cultural practices involving an interaction with nature they perform, and the multiple benefits they receive from those spaces and practices. Furthermore, understanding the distribution of CES requires detailed demographic and socio-economic information on the people engaging with environmental spaces and undertaking the cultural practices. Detailed quantitative and geo-located datasets such as the MENE provide such an evidence base. This type of structured quantitative data, where a large number of representative cases can be collected, is amenable to statistical treatment, such as the well-being analysis presented in this section. Conducting multivariate statistical analysis can potentially control for the confounding effects of many variables and allow the establishment of more credible causal relationships, such as the effect of certain types of environmental spaces on well-being, or the effect of particular types of practices on mental or physical health.

Quantitative CES analysis is only as good as the data it is based on, however. Having high quality, precise, complete and representative data on CES is essential. Moreover CES change over space and time. CES data must therefore be up-to-date, collected on a regular basis and covering a wide geographical area. More generally, methods which rely on quantitative data are less suited to analysis of complex, site-specific phenomena that might benefit from more in-depth, qualitative investigation. This could be the case, for example, with investigation of the importance of historic features in the landscape or the religious benefits of nature interactions. Finally quantitative analysis may not be appropriate when a situation calls for an in-depth understanding of how participants interpret CES and construct their own meanings, in their own words and from their point of view. Alternative qualitative and interpretive approaches, more suited to application in the settings described above, are the focus of the following section.

## 5.5 Participatory and interpretative approaches to cultural ecosystem services

Advancing understanding of CES through the use of general quantitative datasets and the identification of indicators, as discussed in the previous sections, can be augmented and supplemented by approaches drawn from the qualitative social sciences and the arts and humanities. The need to broaden and deepen understanding of the many and varied ways people interact with, relate to, and draw benefit from, ecosystems in cultural terms was a key knowledge gap identified by the UK NEA (2011). A range of participatory and interpretative research techniques, developed from models in the social sciences and the arts and humanities, can further understanding in this area of ecosystem assessment (See Appendix 5.2; WP5 A&H Annexes 1-3).

As the UK NEA highlighted, participatory and interpretative approaches may generate information and insight in a variety of ways. Such approaches may involve surveying people about their general values and attitudes towards CES, through the use of extensive structured questionnaires, semi-structured interviews (including oral histories) and focus group discussions. They may also involve the use of deliberative and dialogue-based methods of research, such as extended in-depth discussion groups and creativity sessions using storytelling and mapping methods. These methods may seek to further probe the reasoning that underlies attitudes about CES; activate hitherto unarticulated or latent values; encourage exchange of perspectives on matters of mutual interest and concern and evaluate different types of evidence. More generally, these conversational and interactive research techniques may be complemented by the analysis of (non-deliberative and non-conversational) cultural texts in both historical or contemporary terms. For instance many popular television, magazine, cinema, art and literature texts carry motifs and narratives about the cultural values and benefits associated with ecosystems, and there are a range of analytical techniques - such as content, semiotic and discourse analysis – that can be employed to develop sophisticated readings of these texts.

In an overall sense, the application of participatory and interpretative research can help investigate the complexity that underlies the personal and collective values associated with cultural ecosystem services, and such research may potentially be linked to a range of policy and practice tools and approaches already well developed in the landscape sector (See **Box 5.1**). Participatory and interpretative approaches facilitate the study of the fine-grained, time-profound texture of the relations of particular people with particular places at particular times, and are conducive to the process of negotiating the resolution of clashes between values (through social learning). Collectively, these approaches are capable not only of generating evidence that can be mobilised in order to shape future management priorities of ecosystems, but also have the ability to foster future stewardship of localities and landscapes.

### 5.5.1 Participatory mapping of cultural ecosystem services

The use of mapping techniques provides one powerful way of developing a participatory and interpretative approach to CES and is consistent with the conceptual framework's emphasis on the cultural practices and benefits that occur in particular places. Mapping in the form of multi-layered GIS resources is becoming a core inter-disciplinary tool for analysing and presenting information on ecosystem services in general, and cultural ecosystem services in particular. There is a range of publically accessible academic research on the use of these techniques in decision-making contexts (e.g. Brown and Raymond, 2007; Fagerholm and Käyhkö, 2009; González, *et al.* 2010; Bieling and Plieninger, 2013; Plieninger *et al.* 2013). In a UK context, some experimental mapping work on CES

has recently been conducted by Natural England in the context of their ecosystem pilots work (see Natural England, 2009a; 2012c).

From an arts and humanities perspective, current work in the so called 'geo-spatial humanities' is also exploring how interactive mapping can serve both as research method and as a novel way of assembling and disseminating research findings (see Appendix 5.2; WP5 A&H Annexes 1-3). Prominent examples include: a literary GIS project on the Lake District (University of Lancaster) (See Cooper and Gregory, 2009; 2011); the 'Singing Landscapes' county folk music maps, which draw on research carried out by folk song collectors a century ago in Hampshire, Gloucestershire and Somerset (University of Bournemouth) (see Staelens, 2011); Bristol University's 'Know Your Place' and 'Know Your Bristol Stories' projects, pursued interactively in conjunction with Bristol City Council and community organisations (Bristol City Council, 2013; National Coordinating Centre for Public Engagement, 2013); Bristol University's Quantock Hills 'Fallen Fruits' orchard decline mapping project (see Dudley, 2012 and Nourse, 2013); and PlaceBook Scotland, a web-based project sponsored by Scottish Natural Heritage that allows contributors to express and share their views of special places through poetry, prose, artwork, photographs, video, sculpture, music and song.

In many respects these examples should be seen as part of a much longer tradition of landscape and heritage-oriented research that seeks to inform the management of local environments in cultural and historical terms. For example, one particularly useful precedent consistent with arts and humanities traditions can be found in the parish/neighbourhood mapping initiative led by the organisation Common Ground in the 1980s. They used a creative mapping approach to encourage members of communities to identify and chart the everyday and commonplace things and places that they valued in their immediate environmental spaces, and that contributed to 'local distinctiveness' (see Crouch and Matless, 1996) (see Appendix 5.2; WP5 A&H Annexes 1-3).

The UK NEAFO builds on this work to further demonstrate how a mapping approach can by deployed as a tool for surveying and engaging communities in discussion of CES at the local level. Four case studies of the mapping of cultural ecosystem services are described below. First, a CES mapping project developed in conjunction with the Northern Devon Nature Improvement Area (NDNIA), one of 12 pilot nature restoration projects established under the commitments of the Natural Environment White Paper (Defra, 2011). Second, a CES mapping project of the Inner Forth in the Central Belt of Scotland, which supported project design and implementation for a multi-purpose landscape management project involving managed realignment and habitat creation, in a partnership led by the Royal Society for the Protection of Birds (RSPB). Third, and finally, we explore two mapping projects which used creative practices and arts-based inquiry to inform management and decision-making at the farmland scale.

### 5.5.2 Case Study 1: Participatory mapping in a Nature Improvement Area

The NDNIA CES study was designed to help the Devon Wildlife Trust – the lead NIA project partner – to both capitalise on and extend its community engagement processes, as well as to help develop understanding of cultural ecosystem services in the context of management and reporting goals. This included helping to contextualise priorities for the development of local level CES indicators. The NDNIA includes both private and public green spaces, and within this, a range of more specific environmental spaces including open access woodland, farmland, nature reserves, common land, parkland, lakes and rivers, as well as derelict land. Paths, bridleways and cycle paths criss-cross the landscape, including major sections of the Tarka Trail, a recreational foot path promoted on the grounds of the area's literary heritage.

#### 5.5.2.1 Key methods

A mixed methodology was employed, including an extensive self-completed questionnaire survey and area mapping exercise and follow-up community discussions. A hand posted questionnaire was issued to each household in the major settlements of the area (1450 in total) which solicited information on the cultural attributes residents associated with their local environmental spaces, the practices they engaged in, and the types of cultural well-being benefit they derived from it. Respondents were also asked to allocate green and red dots to an accompanying map to signify those spaces they considered (green) special, significant and valuable or (red) unpleasant, neglected or challenged. They were also asked to provide short explanatory narratives with each dot to elaborate the basic reasoning behind their choices. In total this process returned 294 useable responses, the results of which were presented at three community events, comprising 50 survey respondents who expressed interest in further participation. Here participants were exposed to the findings of the survey and mapping exercise, and discussion around these was used to stimulate understanding of local priorities for management with participating NIA staff.

#### 5.5.2.2 Key findings

The study revealed that perceptions of the rurality of local environmental spaces were positively associated with ideas of character, tranquillity, beauty, tradition, timelessness, stillness and wildness. Nearly three quarters of respondents associated their decision to live in the area with a sense of affiliation with the local natural environment. Although the NDNIA is promoted on the grounds of its unique natural heritage, it was notable that what tended to make this rural environment special to residents was nature's ordinary and everyday quality: in this place, nature was perceived to be real, present and abundant. Many respondents were unaware of the formal environmental designations for the area and did not see these as important to their own understandings of why the locality was special.

The study also revealed a large and varied set of cultural practices involving interactions with nature occurring within this rural locality. Informal, non-specialised engagements were prominent across the sample: walking (including walking with dogs); sitting around, taking in a view and eating and drinking outside (including in pub gardens). Gardening emerged as prominent activity among respondents, with the exception of the youngest age group (16-24 year olds). The survey also revealed that for 67% of those with access to a garden the privacy of the garden contributed to their enjoyment of it.

Environmental spaces which enable interaction with local nature, such as woodland, open moorland and river environments, were strongly associated with self-reported benefits to physical and mental health (see **Table 5.16**). Respondents spoke of their engagements with the natural world as keeping them 'sane'; and as 'essential for well-being and achievement of happiness and the feel-good factor'; and, for some, as having definitive effects on physical health. Others linked experiences in local nature to the idea of freedom and happy memories of childhood.

**Table 5.16. Well-being benefits of a rural landscape: evidence from north Devon*.**

| Rank | Experiences associated with nearby rural nature | % total strongly & tend to agree (n=294) |
|---|---|---|
| 1. | Health / exercise | 95 |
| 2 | Renewal | 93 |
| 3 | Escaping | 92 |
| 4 | Relaxation | 92 |

| | | |
|---|---|---|
| 5 | Inspiration | 86 |
| 6 | Solitude | 83 |
| 7 | Sharing/socialising | 80 |
| 8 | Discovery/skills & learning | 74 |
| 9 | Belonging | 70 |
| 10 | Spirituality | 43 |

*Notes: in the NDNIA resident survey respondents to consider the extent to which their local environment was associated with particular types of experience; experiences that are conventionally registered in the literature as contributing positively to human well-being. This table present an overall summary of findings. Each category of experience is drawn from one or a combination of survey questions with experiences that are the pretext of a range of physical and mental benefits for well-being.

The mapping exercise identified and located patterns of cultural practice and associated cultural benefit (and dis-benefit) across the landscape. Individual red and green dots were incorporated into a GIS to reveal overall patterns that group-based discussion could then help interpret and elaborate (See **Figure 5.12**). The patterns revealed by this process highlighted how specific features and sites of landscape accrue cultural significance for people. The exercise also highlighted opportunities for promoting further access to valued areas, particularly rivers and streams, where access is often impeded by poor infrastructure and inadequate information.

The mapping was also important in identifying key threats and revealing small clusters of benefit/dis-benefit that may not be captured by environmental surveillance systems based on large secondary data sets. Regarding the identification of threats, the mapping and discussion process revealed that rural environments are often valued on the grounds of their 'unspoilt' character, with new housing, traffic and renewable energy developments cited as key threats. The opportunity to make these general sentiments explicit, with respect to particular locations, was a key benefit of using this participatory mapping approach. In general, the use of the maps within the survey instrument and as part of a discussion process was positively received by participants in the study. The mapping exercise was cited as both a reason why residents chose to respond to the questionnaire and a useful tool for animating a practical discussion of CES with NDNIA staff.

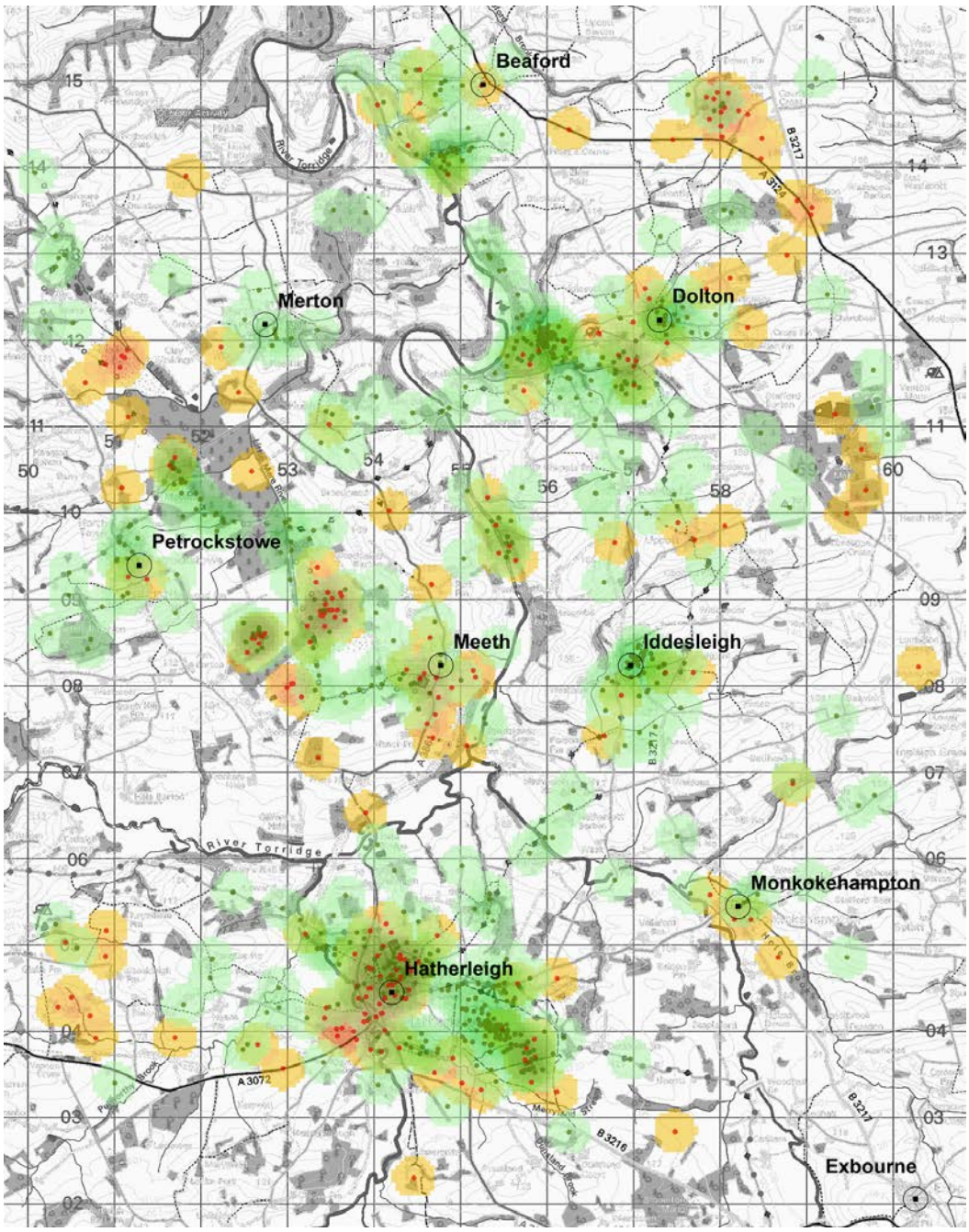



**Figure 5.12. Mapping cultural ecosystem services hotspots using a GIS*.**

*Notes: In the NDNIA study survey respondents were asked to apply up 3 green dots to indicate places that were special and significant to them, and up to 3 red dots to those areas considered neglected, damaged or unpleasant. The application of these dots was accompanied by respondents providing an explanatory (qualitative) narrative so that reasoning and themes could be discerned. By using this approach within an extensive survey researchers are able to identify simple patterns of potential cultural benefit/dis-benefit that can then be elaborated through in depth group discussion and thus provide a useful pretext for decision makers to begin to understand 'what matters where and why' for people.

### 5.5.3 Case Study 2: Participatory mapping in the Inner Firth of Forth

The UK NEAFO's Inner Firth of Forth Study of CES featured as part of a wider research project which deployed the technique of deliberative monetary valuation (DMV) (see WP6 Chapter Section 6.4.2) and assessed shared values around a suite of ecosystem service benefits (such as water quality, recreation, biodiversity). As in the NDNIA case study, the project in the in the Inner Forth, which was led by the RSPB, emphasised the involvement of stakeholders and local people. The project developed here was designed to feed into the RSPB's efforts by establishing perspectives on, and articulating values for, the key benefits of this landscape.

#### 5.5.3.1 Key methods

Consideration of CES was integrated into a multi-stage workshop methodology. The first stage, which included representatives from a wide range of sectors (community groups, local and Scottish government, businesses and NGOs), focused on identifying key ES and relating them to a wider social-ecological context in a conceptual systems model. The second stage involved the valuation of key ecosystem services, with the mapping of CES featuring as part of nine one-off workshops across the region with 52 representatives of local community councils. This mapping exercise followed a similar format to the NDNIA case study, although in this study map features were established by small groups of 4-6 participants, rather than individuals. Groups considered a large, laminated map of the Inner Forth area and each group was asked to identity cultural practices they engaged in across this landscape and to indicate special and problematic features using green and red dots, and through verbal elaboration. As part of this process participants were required to rank, by way of a voting process, features that merited special attention by the Project team.

#### 5.5.3.2 Key findings

Like the NDNIA study, the research revealed that long-term residents of the area engage in a range of informal cultural practices in the area such as walking, cycling, angling and bird watching. Participants emphasised a range of features of landscape value in terms of their cultural and natural attributes. Similarly too, terms such as 'beautiful', 'peaceful', 'historic' and 'wildlife' were commonly used to describe what made these features of rural landscape special. In terms of features of the area prioritised for protection, it was notable that areas that formally registered as nationally significant or unique were not particularly emphasised by participants, again a finding that resonates with the NDNIA study. Instead, aspects of the landscape singled out by participants as meriting attention by the Project were those more closely related to local affiliation and identity, such as local estates and other spaces where natural and cultural features of landscape were perceived as closely intertwined.

Again, as in the NDNIA study, the mapping process revealed that the cultural amenity benefits of a rural landscape were perceived to be compromised by the visual and environmental impact of industry, as well as energy infrastructures (such as the presence of powerlines and proposed windfarms), and the noise of traffic. In terms of local priorities for this area's future management, the need to promote and facilitate access, especially along river foreshores, was a key message for the Project. This included suggestions to improve connections between local access options across the region (identified through the mapping and ranking process), but also calls to simply inventory and publicise the many places available where people can engage with the landscape.

Participants found the mapping exercise a rewarding experience. It helped reflect how participants viewed the landscape of the Inner Forth, but it also influenced their perceptions about the area's

attributes and values. As one put it: “I was surprised we came to much more green than red dots. This is not an area that people know for being attractive. It is not really beautiful in the way that people usually think about places like the Highlands or the West coast. But looking at it this way I feel quite proud of this place.” The use of mapping also served as a helpful counterpoint and supplement to the more abstract procedures of monetary valuation, which were conducted as part of the same process (see Work Package 6, Section 6.4.2 for details on DMV outcomes).

### 5.5.4 Case Study 3: Creative mapping of a farmland landscape

The NDNIA survey and mapping exercise described above was complemented by a further experimental mapping exercise, which used arts-based practice to engage local residents in conversations about the environmental spaces of North Devon. As part of the UK NEAFO, researchers worked with UK’s largest rural arts organisation – Beaford Arts – to undertake a creative mapping exercise with school children living in the NDNIA. The exercise explored how young people experience, relate to and prioritise aspects of its woodland, culm and river habitats.

#### 5.5.4.1 Key methods

The exercise involved 50 school children (Years 1-4) in developing a map to creatively record significant attributes and experiences connected to their exploration of nearby farmland. Arts education practitioners worked with two schools as part of the curriculum to introduce pupils to the different ways a map can be used and created: with a GPS device, a piece of paper, and with their own machine, which they created to record a walk. Maps were created as part of a field-based walk in which pupils learnt not simply how to ‘look’ at the landscape, but also how to investigate and interrogate an environment with all of their senses, asking: if the whole self experiences a space how can we record that? Pupils were challenged to visually record and respond to what they could see, feel, hear, smell and taste, and were given the creative tools and teaching to do so. Pupils were asked to consider prior knowledge of subjects within the curriculum to support their personal responses and enquiry (e.g. literacy, through the use of descriptive words ; geography and history, through enquiry into place and space; science, in their understanding of the senses and of species and habitat cycles; and the arts, through creative, imaginative and emotional responses to the environment). In terms of material used, a Google base map was incorporated with artefacts collected in the environment as well as photographs, sound recordings and personal reactions to this farmland landscape (see **Figure 5.13**).

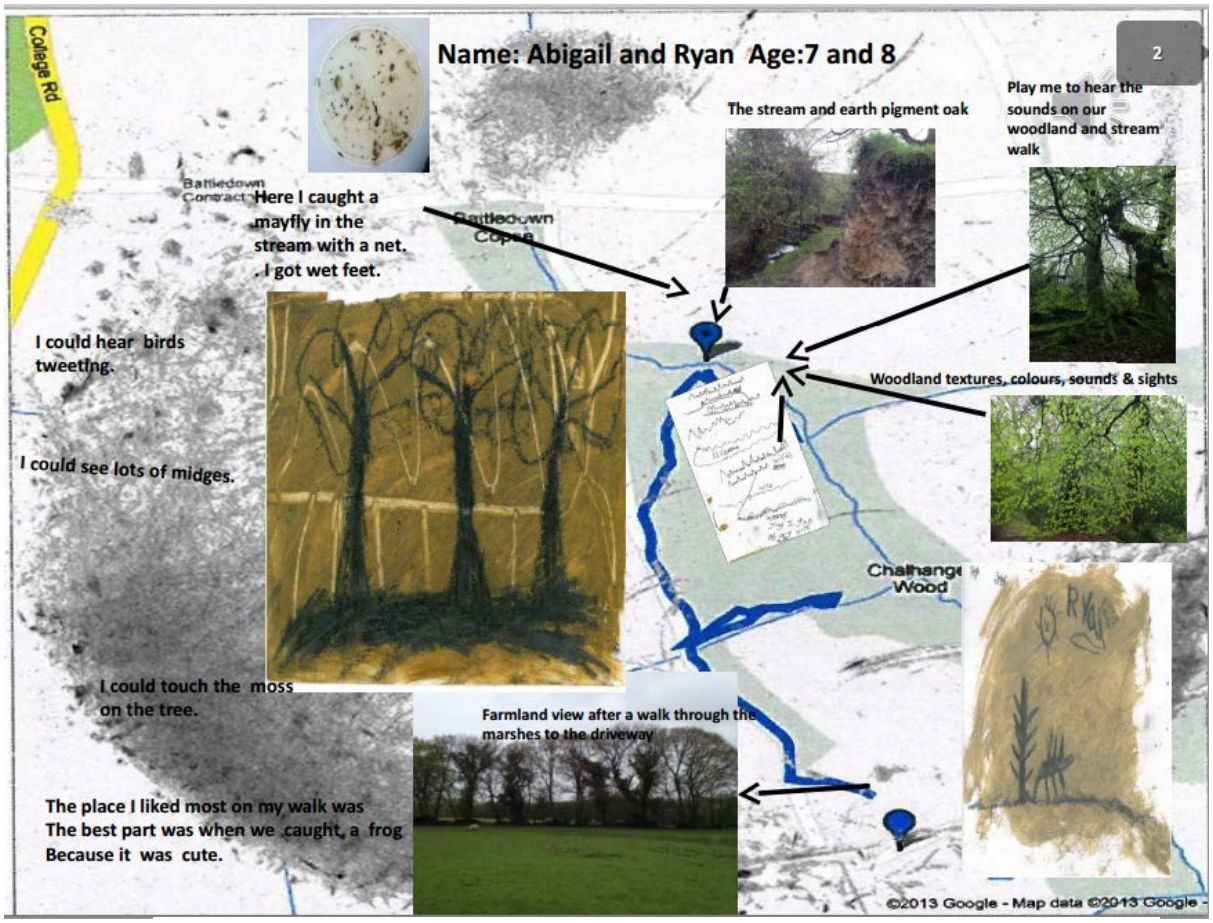



**Figure 5.13. Discovering and making connections with environmental spaces through the arts*.**
*Notes: these maps were based on geographical overlays of different materials. A Google base map was incorporated with artefacts collected in the environment as well as photographs, sound recordings and personal reactions to the setting.

### 5.5.4.2 Key Findings

The arts have an important role to play in raising the awareness and participation of younger generations and in improving their understanding of ecosystems and the benefits they provide. Children were encouraged to learn about nature's value through practical experiential learning and in a creative and accessible way. The use of maps enhanced environmental literacy by helping to nurture an investigative and explorative approach to ecosystems, and enabling children to enjoy discovering the world around them using their creativity and imagination. Feedback from teachers indicated that working with schools in this way also inspires the teachers to consider new and creative ways to respond to the environment, and link this in directly into teaching programmes: "It has given all the children a different perspective and view on both nature and art. They were all enthused and loved working in a different way to capture the senses around them, rather than just observational sketching. It really extended them to think, look, hear, smell and feel the environment". These approaches are not only educational devices. They are also constructions of the world; highlighting what people value in their local environments. While the material developed here was not used to inform a specific management outcome, the resulting maps identified the features of the farmland space that children value and the benefits they derive from this environment. The approach offers a creative way of implicitly emphasising what matters where and why, and could potentially be integrated into a resource with management and policy applications.

### 5.5.5 Case Study 4: linking farmland planning to community values on the Lizard Peninsula

In the final case study we describe a recent example of creative mapping techniques, used as part of project on the Lizard Peninsula in Cornwall. The area is part of an Area of Outstanding Natural Beauty (AONB) and is a Site of Special Scientific Interest (SSSI). Undertaking a search for a new tenant in 2011-12, the National Trust worked with the University of Exeter, Natural England, Cornwall Wildlife Trust, National Farmers Union, and the Area of Outstanding Natural Beauty through the Linking the Lizard Countryside Partnership to engage the local community in the process of articulating the future of Tregullas Tarm. The farm is owned by the National Trust and situated at Lizard Point, the symbolically important most southerly point in mainland Britain. The process involved the National Trust and those agencies with whom they work in partnership acknowledging , first, the local landscape as a lived cultural experience with a unique geography and, second, the value of non-expert knowledge about the farm and the village.

#### 5.5.5.1 Key Methods

The Partnership held a series of workshop events in the community to encourage people to share their memories, ideas, and views of the farm's future through simple interactive techniques. Eschewing the use of village-hall meetings or information-delivery exercises, which tend to position participants as highly qualified 'expert' and uninformed 'public', the approach focused on conversations, field walks, and simple, creative mapping exercises, such as that undertaken by the local primary school. (See **Figure 5.14**) A small survey was also conducted, via Survey Monkey. Community events were deliberately small scale and convivial, providing the opportunity to drop in, have a cup of tea and a conversation, or simply stick a post-it note with some thoughts on a plan of the farm. Linking the Lizard partners also started conversations about the project with farmers, business owners, parish councillors and other s in the course of their normal day-to-day working routines.


**Figure 5.14. Creative mapping of a future farm: the Lizard Peninsula.**

#### 5.5.5.2 Key Findings

The process revealed that local people identified a working farm as a priority, but that other ecosystem service benefits, including local food, wildlife, access to walks and views across the countryside and sea were also important to them. The case study of Tregullas Farm reveals that matters of scale are critical to the identification and management of cultural benefits arising from environmental settings. While much of the appeal of Tregullas comes from its situation at the iconic 'most southerly point', the farm landscape also draws on and contributes to the appeal of the Lizard Peninsula as a whole. In response to feedback produced during the public consultation, the Trust specified in the application pack for prospective tenants the unique qualities of the farm as a space of high cultural and environmental value to landscape managers and the local community. The process produced qualitative evidence of the cultural ecosystem service benefits that are produced in this specific landscape, and this evidence was used to inform future management of the space to maintain and enhance these benefits. The case study also established a way of working both in partnership with local agencies (via the Linking the Lizard group) and with communities that hold a sense of ownership in relation to local environmental settings. The method was founded on an incremental, iterative approach which drew on existing social networks and relationships between landscape managers and the community to achieve a co-produced vision for the farm. Critical to the success of such an approach is recognizing that 'engagement' happens in many different spaces and conversations rather than in set-piece village hall meetings where the boundaries between 'experts' and 'non-experts' can be starkly drawn.

### 5.5.6 Summary

Mapping techniques provide a pretext and a platform for creatively engaging people in discussion of how places, localities and landscapes resonate as culturally significant. From a social sciences and arts and humanities perspective, mapping is fundamentally about creating spatial representations of the relationship between environment and culture: maps can facilitate and foster understanding about meanings and values associated with the natural world. As a form of modelling, mapping is both metaphorical and material. Maps can combine and display a range of multi-layered information: past, present and projected; textual as well as pictorial. They can encompass representations of cultural memory and allow for exploration of possible future scenarios. While the application of art and humanities methodologies within the ecosystem services framework has to date been limited, there is scope for substantial innovation in finding novel ways of identifying the cultural practices that link people to specific environmental spaces and that produce specific cultural benefits. Such methods are capable not only of generating evidence that can be mobilised in order to shape future management priorities, but also have the ability to foster future stewardship of localities and landscapes and engender more intimate interactions with the natural environment through cultural practices.

## 5.6 Recommendations for the future development of CES within decision making

Creating robust accounting mechanisms for CES is a rapidly developing area of innovation in ecosystem assessment. The general purpose of this component of the UK NEAFO was to further advance conceptual, methodological and empirical understanding of CES in ways that have direct utility within decision making processes. In this final section, we present recommendations for developing and elaborating aspects of this work.

### 5.6.1 Developing 'fit for purpose' CES indicators

The indicators presented in this study can only act as proxies for the benefits derived from environmental spaces and the practices undertaken in them. There is a need for more research work to identify the precise nature of the benefits produced (see Keniger *et al*. 2013), who the beneficiaries are (Satz *et al*. 2013) and how different assemblages or environmental spaces may complement each other (Martin-Lopez *et al*., 2009). Research is also needed on aspects such as space size, landscape heterogeneity, land cover patch size and accessibility. Robust measures of quality need to be developed to address issues such as environmental noise and soundscapes, aesthetic appeal (van Berkel and Verbrug, 2012; Casalegno *et al*. 2013; Schirpke *et al*. 2013; Frank *et al*. 2013), biodiversity (Fuller *et al*. 2007; Dallimer *et al*. 2012), safety and the cultural and heritage aspects of environmental spaces (Tenberg *et al*. 2012).

At one of the UK NEAFO CES workshops, policy and practice stakeholders were asked to suggest ideas for possible indicators which might help them in their work. In the resulting conversation, it was clear that the demand for CES indicators was not accompanied by a clear understanding of what they might be used for, how the data might be acquired to calculate them and how indicators could be grouped into useful categories. However, a number of stakeholders suggested indicators which were not associated with specific environmental spaces, such as sales of wildlife related products, viewing of TV programmes or use of social media, and it is recommended that research is undertaken, possibly using existing studies, into the role that such indicators could play in measuring public engagement with CES.

The indicators presented in this study specifically measure issues related to the supply of, accessibility to and demand for certain types of environmental spaces, and the practices that take place within them. Using the BBN probabilities to develop demand-side indicators is still at an emerging methodology and the integrated metrics that combine ideas about supply and demand need to be investigated further. Despite the preliminary nature of the work, however, it does seem that the map-based interface to the BBN might be a useful tool for decision makers, because it can be used both to represent the supply side indicators at district level as well and the associated patterns of demand given the nature of the local population. In this way the web-based tool might be used to investigate where the potential supply of CES might fall short of the different types of demand.

In the long list of indicators (see Appendix 5.3) we show additional indicators of demand and supply, and other types, which could be produced using currently available data, in addition to those which could be produced if more data were made available. Two key components are missing from the indicators, which could be addressed if more efforts were put into data acquisition. One of these is the quality of the environmental spaces measured; the local level study of Nottingham, combined with the stakeholder engagement case study in Devon, provide some insights into the way that issues of quality can be addressed. The other gap is related to public access. Although spaces such as

nature reserves and country parks are by their nature accessible to the public, others, such as ancient woodland and fresh water environments do not always provide public access but are often important environmental spaces for visitors (see the discussion of blue spaces in section 5.4.3). It is recommended that public access to such areas is mapped so that accessibility measures can be calculated taking this information into account.

It is also recommended that efforts to make locally available data accessible to a wider range of researchers and policy makers should be encouraged. The INSPIRE programme, which seeks to bring together locally held data sets and make them more widely available[8], is an important step forward here. Particularly useful data sets in this regard are PROWs and tree cover. Natural England's Paths for Communities Programme[9] provides funding for the creation and development of new Rights of Way and it would be useful if proposals for these were based on data which benchmarked the availability of PROWs and the environmental spaces that they give access to.

For most of the accessibility measures straight-line distance was used, or, in the case of Nature Reserves in Nottingham, travel via a road network. Further work is needed to assess the differences between access via road networks and public paths such as PROWs, bridal ways and urban paths, and as well as travel via public transport. Urban paths are available as a GIS layer in the OS Mastermap Integrated Transport Network, and online tools such as Google Maps[10] allow users to calculate travel distances through public transport for single journeys. Mapping of entrances to public environmental spaces would also allow more sophisticated approaches to calculation of travel distances. Access to locally-held data on tree cover could be used to assess the attractiveness of urban environments, as well as the presence of tree-lined streets.

### 5.6.2 Developing the MENE survey as a CES database

The analysis of the MENE data set was in part designed to assess its potential role as a national evidence base for CES in England and the research identified a series of recommendations for developing the MENE survey in order to increase its effectiveness as a possible measuring tool for CES.

A key recommendation is that The MENE survey should be extended to collect information on visits to domestic gardens. The new garden module provides examples of useful questions (access to garden, number of visits, duration of visits, activities and reasons to visit, and well-being). Information on garden characteristics would be useful to assess which features are more well-being and health enhancing: size of garden, presence of natural features (trees, flowers, lawn, pond, etc), wildlife/birds, and views, presence of outbuildings (shed, cabin, greenhouse, etc). Some measure of quality could also be collected (maintenance level, garden improvements). Questions should also be added on features and quality of environmental spaces: e.g. level of congestion, noise, heritage features, religious meanings, accessibility, available facilities, cleanliness, maintenance of paths/ rivers/ plants, noticeable changes over time. A further useful question would be one where respondents have an opportunity to rank the key types of environmental spaces in terms of how they affect their well-being (as was included and tested in the new garden module).

A series of improvements are recommended in the approach to measuring well-being in MENE. The measurement of well-being should be undertaken with higher frequency, for example, monthly. As it is, we only had N=3,224 visit observations with well-being information (and other key variables) in all

[8] http://data.gov.uk/location/inspire
[9] http://www.naturalengland.org.uk/ourwork/access/rightsofway/p4c.asp
[10] https://maps.google.com/

the MENE data collected between 2009 and 2012. The current measures of well-being should be modified to better reflect how well-being is measured in the literature. Instead of levels of agreement with enjoyment and appreciation statements, proper well-being numerical scales should be used. A measure of recalled subjective well-being should be included as well as measures of mental health that are compatible with other measures being used in the literature. If possible, a measure of physical activity could also be included, perhaps on a quarterly basis. A question on whether respondents are on holiday should be added, as that is very likely to influence well-being in a positive way. A better understanding of how CES enhance well-being might also be achieved by revising the list of activities and reasons for a visit so that some categories are added (e.g. reading, sunbathing, photography and other artistic pursuits), and others perhaps deleted (e.g. learn something, challenge yourself, be somewhere you like). In addition, improvements in the analysis of the relationship between CES and well-being would be facilitated by further demographic information on respondents (e.g. education, income, membership of environmental organisations) and by more quantitative information on the ways people enjoy nature without physically visiting (e.g. programmes seen on TV, money spent on paintings or arts and crafts, donations to environmental charities, membership of environmental organisations, views from home or the office.)

At the moment, although MENE provides plenty of data to support in-depth analysis of visits to environmental spaces, it lacks the depth and breadth necessary if it is to provide robust quantitative evidence for CES measurement, in the light of the conceptual model being proposed. Nevertheless, the potential is there; the large number of visits recorded and the geo-located data are all significant advantages and the suggestions above indicate a way forward.

### 5.6.3 Developing Participatory and Interpretative CES Research

Section 5.5 emphasised that wider approaches in social sciences and the arts and humanities can provide methods and tools to augment generalised quantitative understanding of CES. They provide the qualitative and interpretative depth essential for exploring the complex ways in which CES matter to people and communities. The need to be sensitive to context is important to future advances in this area of environmental decision-making. Just as different people at different times and in different places would understand cultural ecosystem services differently, different people at the same time and in the same place will also understand them differently. Participatory mapping techniques have been proposed in this section as a key way of animating and advancing a place-based, context specific approach. The creative and systematic exploration of CES through mapping techniques is an area of current innovation but remains in its infancy. A general recommendation arising from this work is the need for further research to experiment with the cartographic representation of CES as part of qualitative and quantitative research processes involving dialogue with stakeholders and publics. There is also a need to explore further the diversity of content (imaginative, empirical, retrospective and prospective) that could be brought to bear on accounts of CES in practical decision-making.

More generally, many of the materials and techniques used and analysed by the social sciences and humanities remain weakly considered in the context of current approach to CES. The role of paintings, sculpture, exhibitions, plays, poems, books (fiction and non-fiction), documentary and other films, talks and websites have yet to be fully evaluated in the context of probing and engaging people in the cultural dimensions of ecosystem management. Finally, in developing policy and practice in this area, there remains a need to explore further synergies between the analysis of CES and wider methodologies and frameworks in the landscape and heritage sector, including *inter alia* Natural England's landscape character area framework, English Heritage's Historic Landscape Characterisation programme, and the National Trust's Statements of Significance.

## References

**AHRC.** (2013). The human world: the arts and humanities in our times. AHRC strategy 2013-18. Available from:
http://www.ahrc.ac.uk/News-and-Events/News/Documents/AHRC-Strategy-2013-18.pdf

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

**Bateman, I.J.** & Jones, A.P. (2003). Contrasting conventional with multi-level modelling approaches to meta-analysis: An illustration using UK woodland recreation values. Land Economics **79,** 235-258.

**Bateman, I.J.**; Harwood, A.R.; Mace, G.M.; Watson, R.T.; Abson, D.J.; Andrews, B.; Binner, A.; Crowe,A.; Day, B.H.; Dugdale, S.; Fezzi, C.; Foden, J.; Hadley, D.; Haines-Young, R.; Hulme, M.; Kontoleon, A.; Lovett, A.A.; Munday, P.; Pascual, U.; Paterson, J.; Perino, G.; Sen, A.; Siriwardena, G.; van Soest, D. & Termansen, M. (2013). Bringing ecosystem services into economic decision making: Land use in the UK. Science, **341**, 45-50.

**Bernhard, S.** (2013). TRAVELTIME3: Stata command to retrieve travel time and road distance between two locations. Statistical Software Components S457670, Boston College Department of Economics.

**Bieling, C.** & Plieninger, T. (2013). Recording manifestations of cultural ecosystem services in the landscape. Landscape Research, doi: 10.1080/01426397.2012.691469

**Braat, L.C.** & De Groot, R.S. (2012) The ecosystem services agenda: bridging the worlds of natural science and economics, conservation and development, and public and private policy. Ecosystem Services, **1**, 4-15.

**Brown, G.** & Raymond, C. (2007). The relationship between place attachment and landscape values: toward mapping place attachment. Applied Geography, **27,** 89-111.

**Bristol City Council.** (2013). 'Know your place'. Available from: http://www.bristol.gov.uk/page/planning-and-building-regulations/know-your-place

**Casado-Arzuaga, I**.; Onaindia, M.; Madariaga, I. & Verburg, P.H. (2013) Mapping recreation and aesthetic value of ecosystems in the Bilbao Metropolitan Greenbelt (northern Spain) to support landscape planning. Landscape Ecology. doi 10.1007/s10980-013-9945-2.

**Casalegno, S**.; Inger, R.; DeSilvey, C. & Gaston, K.J. (2013). Spatial Covariance between Aesthetic Value & Other Ecosystem Services. PLoS ONE **8** (6): e68437. doi:10.1371/journal.pone.0068437.

**Castree, N.** (2014). Making Sense of Nature, (Routledge, Abingdon).

**Chan, K.M.A**.; Goldstein,. J; Satterfield, T. et al., (2011). Cultural services and non-use values. In: P.Kareiva, T.H Ricketts et al (eds). Natural Capital: Theory and Practice of Mapping Ecosystem Services. University Press, Oxford, 206–228.

**Chan, K.M.A**.; Satterfield, T. & Goldstein, J. (2012). Rethinking ecosystem services to better address and navigate cultural values. Ecological Economics **74**, 8–18.

**Church, A**., Burgess J and Ravenscroft N, Bird, W. Blackstock, K. Brady, E. Crang, M. Fish, R. Gruffudd, P. Mourato, S. Pretty, J. Tolia-Kelly, D. Turner, K. and Winter, M. (2011) Cultural Services UK National Ecosystem Assessment Chapter 16 (UNEP-WCMC, Cambridge) 633-92

**Cooper, D.** & Gregory, I. (2009a). Thomas Gray, Samuel Taylor Coleridge and geographical information systems: A literary GIS of two Lake District Tours. International Journal of Humanities and Arts Computing, **3**, 61-84.

**Cooper, D.** & Gregory, I. (2011b). Mapping the English Lake District: A literary GIS'. Transactions of the Institute of British Geographers, **36**, 89-108.

**Crouch, D.** & Matless, D. (1996). Refiguring geography: the parish maps of common ground. Transactions of the Institute of British Geographers, **21**, 235-55.

**Dallimer, M.;** Irvine, K.N.; Skinner, A.M.J.; Davies, Z.G.; Rouquette, J.R.; Armsworth, P.R.; Maltby. L.M.; Warren,PH. & Gaston, K.J. (2012). Biodiversity and the feel-good factor: understanding associations between self-reported human well-being and species richness. BioScience, **62**, 47-55.

**Defra**. (2011). The natural choice: securing the value of nature. Available from: http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf

**Descola, P.** (2013). Beyond Nature and Culture. (University of Chicago Press, Chicago).

**Dudley, M.** (2012). Fallen fruits: mapping orchard decline in the Quantock Hills AONB. University of Bristol. Available from: http://www.environmentalhistories.net/?p=716

**Erenier, H.E**.; Ashton, P.A.; Gillman, M.P. & Ollerton, J.(2010). Factors determining species richness of soil seed banks in lowland ancient woodlands. Biological Conservation, **19,** 1631-1648.

**Fagerholm, N.** & Käyhkö, N. (2009). Participatory mapping and geographical patterns of the social landscape values of rural communities in Zanzibar, Tanzania. Fennia, **187**, 43-60.

**Fish, R.D.** (2011). Environmental decision making and an ecosystems approach: some challenges from the perspective of social science: Progress in Physical Geography 35, 671-680.

**Fish, R.** and Church, A (2013). A conceptual framework for Cultural Ecosystem Services Working Paper. (Centre for Rural Policy Research: University of Exeter)

**Frank, S.;** Fürst, C.; Koschke, L.; Witt, A. & Makeschin, F. (2013). Assessment of landscape aesthetics—Validation of a landscape metrics-based assessment by visual estimation of the scenic beauty. Ecological Indicators, **32,** 222–231.

**Fuller, R.A.**; Irvine, K.N.; Devine-Wright, P.; Warren, P.H. & Gaston, K.J. (2007). Psychological benefits of greenspace increase with biodiversity. Biology letters **3**, 390-394.

**Gee, K.** & Burkhard, B. (2010). Cultural ecosystem services in the context of offshore wind farming: a case study from the west coast of Schleswig-Holstein. Ecological Complexity 7(3): 349-358.

**Gibbons, S.,** Mourato, S. and Resende, G. (2013). The amenity value of English nature: A hedonic price approach. Environmental & Resource Economics (in press, DOI: 10.1007/s10640-013-9664-9)

**González, V.,** Balteiro, L.D. & Martínez, E.L.P. (2010). Spatial valuation of recreation activities in forest systems: application to province of Segovia (Spain). Forest Systems, **19**, 36-50.

**Handley, J.;** Pauleit, S.; Slinn, P.; Lindley, S. Baker, M.; Barber, A & Jones, C. (2003). English Nature Research Report 526: Accessible Natural Green Space Standards in Towns and Cities: A Review and Toolkit for their Implementation. Peterborough.

**Hernández-Morcillo, M.;** Plieninger, T. & C. Bieling (2013). An empirical review of cultural ecosystem service indicators. *Ecological Indicators,* **29**, 434-444.

**Higgs, G.;** Fry R. & M. Langford (2012). Investigating the implications of using alternative GIS-based techniques to measure accessibility to green space. Environment and Planning B: Planning and Design, 39, 326-343

**Jackson, S.;** Fuller, D.; Dunsford, H.; Mowbray, R.; Hext, S.; MacFarlane R. & Haggett, C.(2008). Tranquillity Mapping: developing a robust methodology for planning support. Report to the Campaign to Protect Rural England, Centre for Environmental & Spatial Analysis, Northumbria University, Bluespace environments and the University of Newcastle upon on Tyne. http://www.cpre.org.uk/what-we-do/countryside/tranquil-places/in-depth/item/1688-how-we-mapped-tranquillity

**Jorgensen, A**. & Anthopoulou, A. (2007). Enjoyment and fear in urban woodlands – Does age make a difference? Urban Forestry & Urban Greening, **6,** 267–278.

**Keniger, L.E**.; Gaston, K..J.; Irvine, K.N. & Fuller, R.A. (2013). What are the Benefits of Interacting with Nature? International Journal of Environmental Research and Public Health, **10**, 913-935.

**Klain, S.C.** and Chan, K.M.A. (2012). Navigating coastal values: participatory mapping of ecosystem services for spatial planning. Ecological Economics, **82**, 104-11

**MA (Millennium Ecosystem Assessment)** (2005). Ecosystems and Human Well-being: Synthesis. Washington, DC: Island Press.

**Mabey, R.** (2010). The Unofficial Countryside (Little Toller Books: Dorset)

**MacKerron, G.** and Mourato, S. (2013). Happiness is Greater in Natural Environments. Global Environmental Change, **23**, 992-1000.

**Martín-López, B.;** Gómez-Baggethun, E.; Lomas & P.L. & Montes, C. (2009). Effects of spatial and temporal scales on cultural services valuation. Journal of Environmental Management, **90**, 1050–1059.

**Mitchell, R.** and Popham, F. (2008). Effect of exposure to natural environment on health inequalities: an observational population study. The Lancet **372**, 1655-1660.

**Morgan, R.** (1990). Preferences and Priorities of Recreational Beach Users in Wales, UK. Journal of Coastal Research, **15**, 653-667.

**Moss, S.** (2012). Natural Childhood. National Trust. Available from: http://www.nationaltrust.org.uk/document-1355766991839/

**Nahuelhual, L.;** Carmona, A.; Lozada, P.; Jaramillo, A. & Aguayo, M. (2013). Mapping recreation and ecotourism as a cultural ecosystem service: An application at the local level in Southern Chile, Applied Geography, **40**, 71–82.

**National Coordinating Centre for Public Engagement**. (2013). Know your place, know your Bristol. Available from: http://www.publicengagement.ac.uk/know-your-place-know-your-bristol

**Natural England.** (2009a). Experiencing Landscapes: Capturing the cultural services and experiential qualities of landscape (NECR024).

**Natural England.** (2010b). Nature Nearby: Accessible Natural Greenspace Guidance (NE265). Available from: http://publications. 97 pp. naturalengland.org.uk/publication/40004?category=47004

**Natural England.** (2012c). Nature Improvement Areas Monitoring and Evaluation Framework. Available from: http://www.naturalengland.org.uk/Images/monitor-evaluation-framework_tcm6-33143.pdf

**Natural England** .(2012d). Health and Natural Environments – An evidence based information pack. Available from: http://www.naturalengland.org.uk/Images/health-information-pack_tcm6-31487.pdf

**Norton, L.R**.; Inwood, H.; Crowe,A. & Baker, A (2012). Trialling a method to quantify the 'cultural services' of the English landscape using Countryside Survey data. Land Use Policy, **29,** 449-455.

**Nourse, N.** (2013). Fallen fruits II: mapping orchard decline in the Quantock Hills at parish level with tithe record and map data. University of Bristol.

**Plieninger, T**.; Dijks, S.; Oteros-Rozas, E. & C. Bieling (2013). Assessing, mapping, and quantifying cultural ecosystem services at community level. Land Use Policy, **33**, 118– 129.

**Potschin, M.** and Haines-Young, R., (2013). Landscapes, sustainability and the place-based analysis of ecosystem services. Landscape Ecology, **28**, 1053-1065

**Pretty, J.,** Barton, J., Colbeck, I., Hine, R., Mourato, S., MacKerron, G. and Wood, C. (2011) Chapter 23: Health Values from Ecosystems, National Ecosystem Assessment. Final Report to United Nations Environment Programme (UNEP) / World Conservation Monitoring Centre (WCMC).

**Satz, D.**; Gould, R.K.; Chan, K.M.; Guerry, A.; Norton, B.; Satterfield, T.; Halpern, B.S.; Levine, J.; Woodside, U.; Hannahs, N.; Basurto ,X. & Klain, S. (2013). The challenges of incorporating cultural ecosystem services into environmental assessment. Ambio, **42**, 675-84.

**Schaich, H.,** Bieling, C. & Plieninger, T. (2010). Linking ecosystem services with cultural landscape research. GAIA, **19**, 269-277.

**Schirpke, U**.; Tasser, E. & Tappeiner, U. (2013). Predicting scenic beauty of mountain regions Landscape and Urban Planning, **111**, 1–12.

**Scottish Natural Heritage.** (2008). PlaceBook Scotland. Available from: http://www.placebookscotland.co.uk/

**Shoard, M**. (2002). Edgelands. In: J. Jenkins (Ed) Remaking the Landscape. London: Profile Books.

**Staelens,Y.** (2011). Mapping the Singing Landscape. Journal for the Centre for the History of Music in Britain, the Empire and the Commonwealth (CHOMBEC), 5-7.

**Tengberg A.,** Fredholm S. , Eliasson I. , Knez I.; Saltzman K. & Wetterberg, O. (2012) Cultural ecosystem services provided by landscapes: Assessment of heritage values and identity. Ecosystem Services, **2,** 14-26.

**UK National Ecosystem Assessment.** (2011). The UK national ecosystem assessment: synthesis of the key findings. UNEP-WCMC, Cambridge. Available from: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx

**Van Berkel, D.B.** & Verburg, P. H. (2012). Spatial quantification and valuation of cultural ecosystem services in an agricultural landscape. Ecological Indicators. http://dx.doi.org/10.1016/j.ecolind.2012.06.025

**Van Herzele, A.** & Wiedemann, T. (2003). A monitoring tool for the provision of accessible and attractive urban green spaces. Landscape and Urban Planning, **63,** 109–126.

**White, M.P.,** Pahl, S., Ashbullby, K., Herbert, S. and Depledge, M.H. (2012). Feelings of restoration from recent nature visits: Analysis of the English Monitoring Engagement with the Natural Environment survey (2009-2011). Under submission.

**Williams, R.** (1983). Keywords. Fontana, London.

## Appendix 5.1: WP5 Advisory Group

| | |
|---|---|
| Prof. Kai Chan,<br>Institute for Resources, Environment & Sustainability,<br>University of British Columbia,<br>AERL, 438 - 2202 Main Mall<br>Vancouver, BC V6T 1Z4<br>Canada<br>E-mail: kaichan@ires.ubc.ca | Dr. Diana Mortimer<br>JNCC,<br>Monkstone House,<br>City Road,<br>Peterborough, PE1 1UA<br>E-mail: Diana.mortimer@jncc.gov.uk |
| Prof. Steve Daniels,<br>School of Geography,<br>University of Nottingham,<br>University Park,<br>Nottingham, NG7 2RD<br>E-mail: stephen.daniels@nottingham.ac.uk | Michelle Parker,<br>National Federation of Parks and Green Spaces<br>E-mail: greenclaws@hotmail.com |
| Dr. David Edwards,<br>Forestry Commission,<br>Forest Research,<br>Northern Research Station,<br>Roslin,<br>Midlothian, EH25 9SY<br>E-mail: david.edwards@forestry.gsi.gov.uk | Dr Ruth Waters,<br>Natural England,<br>Standards Team,<br>4th Floor, Foss House,<br>Kings Pool, 1-2 Peasholme Green,<br>York, YO1 7PX<br>E-mail: ruth.waters@naturalengland.org.uk |
| Dr. Mark Everard,<br>Environment Agency,<br>King's Meadow House,<br>King's Meadow Road,<br>Reading, Berkshire, RG1 8DQ<br>E-mail: mark@pundamilia.co.uk | |
| Dr. Linda Monckton<br>English Heritage<br>27 Craven Road<br>Rugby, CV21 3JX<br>E-mail: linda.monckton@english-heritage.org.uk | |
| Dr. Jake Morris,<br>Forestry Commission,<br>Forest Research,<br>Alice Holt Lodge,<br>Farnham,<br>Surrey, GU10 4LH<br>E-mail: jake.morris@forestry.gsi.gov.uk | |

# Appendix 5.2: Executive Summary of Additional Cultural Values Work

**This work can be found as separate Annexes to this report and is referred to as 'WP5 A&H Annexes 1-3'.**

**For full report contact: Peter Coates, Department of Historical Studies, School of Humanities, University of Bristol, BS8 1TB: p.a.coates@bristol.ac.uk**

The purpose of this Additional Cultural Values Work project (July-November 2013) is to review available materials on cultural values relevant to UK NEAFO from an arts and humanities (AH) perspective. Materials consulted comprised policy-relevant scholarly literature, grey literature such as technical reports and working and white papers, where available, and, most importantly, examples of down-to-earth, eminently tangible and deeply material practices and engagements, often in conjunction with land managers and environmental practitioners, that address concrete, useful and measurable values and benefits.

Building on the two chapters (16 and 24) of UK NEA's report dedicated to cultural services and shared values, and in step with UK NEAFO's WP5 and WP6, the report on this project has two main objectives. Firstly, to locate and assemble information and knowledge on the ways in which values and benefits that are culturally grounded and shared emerge from environmental settings (places, localities and landscapes) that are time, place and socially specific. Secondly, to provide a set of instructive examples of work on cultural values and benefits that can be assist with incorporation of cultural values into ES approaches to planning and decision-making. Site specific case studies, which are also a central component of WP5 and WP6, provide the best opportunity for the development of a consistent approach to CES research and to build up a database that can inform future site specific case work. The undertaking of novel empirical work was not part of the brief.

Research that seeks to generalize and systematize knowledge about human relationships with place, locality, nature and landscape only gets us so far. Research conducted for UK NEAFO into values that are shared, social and plural highlights their 'context-specific nature', their status as 'outcomes of local circumstances, of specific times and particular places' and the 'spatially explicit' character of ecosystem services and benefits that are rooted in specific environmental settings, whose scale cannot be predefined: cultural spaces (places, localities and landscapes in which people interact with the natural environment and each other) host cultural practices (expressive, symbolic and interpretative interactions between people and natural environments, such as gardening, walking, painting and watching wildlife programmes) that yield cultural benefits (dimensions of human wellbeing that have come to be associated with these interactions between people and the natural environment) (Fish and Church, 2013). Moreover, arts and humanities perspectives are grounded in the ambiguity, variety, irreducible difference, contingency, unpredictability and incertitude of human experience, and highlighting their role is a strength rather than a weakness, and paying attention to these qualities improves rather than impedes understandings of the values and benefits attached to ecosystems and environmental settings.

The cultural benefits of ecosystems, though habitually described as 'intangible', 'non-use' and 'non-monetary', are just as tangible as the benefits associated with the other three categories of provisioning, regulating and supporting services, and no less material than water and timber. To access and appreciate the full range and depth of cultural ecosystem values, services and benefits, a broad range of perspectives, methods and tools is required. Non-deliberative (survey), deliberative

and participative methods yield data and insights on cultural values both quantitative and qualitative.

Qualitative data are also clearly articulated, however, and arguably exercise their greatest authority, through a broad range of (non-deliberative and non-conversational) media and genres associated primarily with arts and humanities perspectives and methodologies. These include written texts, storytelling (including oral history), mapping, performance and visual forms such as film, artwork and photography. A number of these cultural forms will be discussed in connection with various recent UK projects that, though not consciously or explicitly conceived pursued within an ES framework, nonetheless demonstrate shared research interests.

Though some values are over-arching as well as more strictly contextual, values identified as 'transcendental' (or 'deeper') are frequently place-bound, anchored in, rendered explicit and reinforced by particular places. Arts and humanities approaches confirm that cultural meanings, whether individual or shared/plural, reside primarily in specificity, the fine-grained, time-sensitive texture of the relations of particular people with particular places at particular times and for particular reasons.

This case study approach remains particularly appropriate given the obstacles that benefits transfer methods face in the application of individual case study evidence across a range of heritage assets, whose distinguishing characteristic is heterogeneity rather than the homogeneity to which value transfer is best suited. There may well be no alternative to the commissioning of a host of individual studies (including digital mapping projects) to the end of building up a databank extensive enough to capture the full spectrum of ecosystems, environmental settings, landscapes and places that supply CES.

As AH scholars emphasize the importance of philosophical reflection and political critique, this report encompasses existing and potential contributions of individual AH subject areas to the filling of 'knowledge gaps' in our understanding of CES, and how AH perspectives and approaches can inform future research by raising fundamental issues. At the same time, the AH domain also embraces practice and action, including mapping projects, exhibitions, documentary films and site-based performance, as they engage directly with the physical world and its meanings. This report pays due regard to the substantial body of policy-relevant literature and the evidence already available of hands-on, intellectual-cum-practical collaboration between AH researchers and those who plan for and manage the environmental settings that deliver CES. These case studies indicate that AH researchers work most effectively with specific examples of places, landscapes and ecosystems, as well as with their individual ingredients.

To inform future CES research, the arts and humanities can usefully draw on a number of current initiatives that emerge from a long tradition of landscape research that offers site-specific assessment of the elements that shape the character of place. Foremost among these are the National Trust's 'Statement of Significance' and 'Spirit of Place' exercises, whose purpose is to communicate a shared understanding of the enduring qualities that make somewhere special (not just anywhere). Particular attention is also paid to the achievements to date and rich potential of mapping and map-works to capture the character and complexity of cultural spaces and to provide a distinctive indicator of cultural ecosystem values.

The last two sections shift from a primary focus on the role and relevance of AH research within ES research to the more open-ended question of how the AH community envisages its collective contribution to environmental research and the promotion of a more ecologically sustainable future, specifically, the role of AH researchers in communication and public engagement, and the emergence of a new cluster of interests around the notion of the environmental humanities. First,

though, this report provides some background and context for ES discourse and activity, as well as coverage of attempts to date to factor in cultural values and benefits, and the methodologies that have been employed.

# Appendix 5.3: A long list of possible CES indicators

| Measure | Source | Notes |
|---|---|---|
| Area of land supported by Agri-environmental measures | Adapted from Ecosystem Services Indicators Database | Data availability needs to be investigated. |
| Area of landscape maintained by culture-related trusts such as The National Trust | Adapted from Ecosystem Services Indicators Database | With the exception of the National Trust, data availability need to be investigated |
| Employment in the eco-tourism industry | Adapted from Ecosystem Services Indicators Database | Data availability needs to be investigated. |
| Landscape fragmentation | Adapted from Ecosystem Services Indicators Database | Methodology needs to be derived |
| Membership of angling clubs/ fishing licences sold | Adapted from Ecosystem Services Indicators Database | Data availability needs to be investigated. Information on fishing as an activity available in MENE |
| Number of tourist facilities (hotels, restaurants etc.) with a certain distance of environmental spaces | Adapted from Ecosystem Services Indicators Database | Some data could be generated using OSMasterMap text labels and OS Addresspoint information |
| Populations of species found to be important to people | Adapted from Ecosystem Services Indicators Database | Species would need to be identified from questionnaires |
| Quality of the marine environment | Adapted from Ecosystem Services Indicators Database | Would need to be generated using an agreed methodology, related to factors such as water quality, marine dumping, by-catch and trawling |
| Spending on agri-environment schemes | Adapted from Ecosystem Services Indicators Database | Data should be available through FOI requests |
| Strength of cultural connection with local environment | Adapted from Ecosystem Services Indicators Database | Would need to be generated from surveys, with agreed methodology |
| Total government and local government spending to support maintenance and creation of environmental spaces | Adapted from Ecosystem Services Indicators Database | Should be available nationally and for local authorities through FOI requests |
| Value of grants/ incentives to maintain traditional features of the cultural/ historical landscape | Adapted from Ecosystem Services Indicators Database | Data should be available through FOI requests |
| Value of housing near certain environmental spaces | Adapted from Ecosystem Services Indicators Database | Could use nationally available data on house prices |
| Value of recreation and tourism | Adapted from Ecosystem Services Indicators Database | May not be possible on a large scale due to commercial sensitivity |
| Value of recreational hunting | Adapted from Ecosystem Services Indicators Database | May not be possible on a large scale due to commercial sensitivity |
| Willingness to pay for improved quality of certain environmental spaces | Adapted from Ecosystem Services Indicators Database | Would need to be generated from surveys, with agreed methodology |
| Inclusion of nature and rural tourism in land use and other policy decisions | Ecosystem Services Indicators Database | Could be generated via a survey of local government planning departments. Would need an agreed methodology |
| Irreplaceability value | Ecosystem Services Indicators Database | Would need to be generated from surveys, with agreed methodology |
| Spending on nature tourism | Ecosystem Services Indicators Database | May not be possible on a large scale due to commercial sensitivity |
| Urbanization | Ecosystem Services Indicators Database | CEH land cover map could be used, or could be generated from remote sensing |
| Value of recreational fisheries | Ecosystem Services Indicators Database | May not be possible on a large scale due to commercial sensitivity |
| Length of PROWs per km in Agri-Environment Schemes | Meeting at English Nature | Would need maps of extent of schemes |
| % of care homes with access to green space | Exeter workshop | May be obtainable via FOI requests |
| % of schools delivering green flag programme | Exeter workshop | May be obtainable via FOI requests |
| Census question on access to Green space/ Wildlife gardening | Exeter workshop | If part of The National Census, could only be updated every ten years |
| Count of FB, twitter etc. activity | Exeter workshop | Data protection rules would apply |
| Financial value of agri-environment schemes | Exeter workshop | May be obtainable via FOI requests |
| Frequency of visits from MENE + more in depth questions on experiences | Exeter workshop | Data could be obtained from MENE, but would need to identify further questions |
| Heritage Lottery spend | Exeter workshop | May be obtainable via FOI requests |
| Incomes / GVA from nature conservation | Exeter workshop | May be commercially sensitive |
| Jobs through environmental volunteering | Exeter workshop | May be obtainable via FOI requests |

| Measure | Source | Notes |
|---|---|---|
| Media sales – e.g. Wildlife Magazines | Exeter workshop | Magazine Sales Information is available. See: http://www.pressgazette.co.uk/node/49860. Would need to be sure we have a comprehensive list |
| Membership values, fishing and gun licenses | Exeter workshop | May be commercially sensitive |
| Membership/ Volunteer number of National /Local Groups (e.g. NT, Scouts, RSPB) | Exeter workshop | Should be obtainable from these organisations - see, for example, http://www.rspb.org.uk/about/facts.aspx |
| Questionnaire: satisfaction with access to outdoors re activities/ places | Exeter workshop | Would need to identify questions |
| Questions on recognition of local species | Exeter workshop | Is this a robust proxy for CES, or rather measures level of education? |
| Sales of wildlife related products | Exeter workshop | May be commercially sensitive |
| Site based surveys on satisfaction with visit | Exeter workshop | Would need to identify questions |
| Survey of engagement with nature | Exeter workshop | Would need to identify questions |
| Survey of well-being at a local level | Exeter workshop | Would need to identify questions |
| Visitor rates to Nature Reserves and other sites | Exeter workshop | Could use secondary research but may not be comprehensive |
| Countryside Quality Counts Indicators | http://webarchive.nationalarchives.gov.uk/20101219012433/http://countryside-quality-counts.org.uk/results.html | Formerly used as a national indicator |
| Light Pollution Indicators | SNH | Can be modelled from data on transport infrastructure and urbanisation. The potential to use remote sensing for this could also be investigated. Not a direct measure of CES but may indicate attractiveness of environmental spaces |
| Indicators of Perceived Naturalness | SNH/ CCW | Need an agreed methodology to measure this. |
| Indicators of Remoteness | SNH/ CCW | Need an agreed methodology to measure this. |
| Indicators of Landscape Quality | SNH/CCW/CRC | Need an agreed methodology to measure this. |
| Noise Indicators | SNH/CCW/CRC | Can be modelled from data on Transport Flows. Not a direct measure of CES but may indicate attractiveness of environmental spaces |
| Air Quality Indicators | Tranquillity Mapping (Jackson et al., 2008) | Used as an Indicator in UK Government Quality of Life Counts. Not a direct measure of CES but may indicate attractiveness of urban parks, for example |
| Modelled Tranquillity | Tranquillity Mapping (Jackson et al., 2008) | Modelled data only |
| Cleanliness/ tidiness of public places | UK Government Quality of Life Counts | Not a direct measure of CES but may indicate attractiveness of environmental spaces |
| Water quality indicators for publicly accessible environmental places | UK Government Quality of Life Counts/ Countryside Quality Counts/ State of the Countryside Reports | Accessibility would need to be measured. Rivers, Canals and the Marine Environment have been sampled for water quality |
| % of public green spaces accessible by wheelchair | Various - general research | Data availability would need to be investigated. Would need an agreed methodology |
| % of schools with an accessible green play area adjacent to the school | Various - general research | Could be generated from GIS data on school property boundaries, although accessibility for children would need to be investigated |
| % total green space cover | Various - general research | Definition of green space needs to be agreed. Could be calculated across GB if based on MasterMap 'Natural Surface' or CEH Land Cover Maps. Otherwise, comprehensive mapping is only available locally |
| % green space with a certain distance of heritage feature such as battlefields and scheduled monuments | Various - general research | Could be generated from data available from English Heritage and CEH Land Cover Map 2007 |
| % Natural habitats with a certain distance of each UK output area | Various - general research | Could be generated from currently available data |
| % of households owning a dog | Various - general research | Could be generated from MENE at a national level, otherwise would need local surveys, or a question on the UK census |
| % of households with access to a garden | Various - general research | Could be incorporated into MENE to obtain a national figure |
| % of parents who are unable to play with or be with their children in a natural area on a regular basis but are unable to do so. | Various - general research | Would need surveys, or a question on the national census |

| Measure | Source | Notes |
|---|---|---|
| % of people who believe there are enough trees/ natural areas/ wildlife in their neighbourhood | Various - general research | Would need surveys, or a question on the national census |
| % of people who feel there is a strong connection between their community identity and the character of the landscape | Various - general research | Would need to be incorporated into surveys, with an agreed methodology |
| % of people who grow vegetables in their garden/ allotment (as a hobby) | Various - general research | Would need surveys, or a question on the national census |
| % of people who raise livestock (as a hobby) in their garden/ allotment | Various - general research | Would need surveys, or a question on the national census |
| % of people who say they are satisfied or highly satisfied with their ability to experience nature | Various - general research | Would need surveys, or a question on the national census |
| % of people who take their children to see nature at least 4 times a month i) within and ii) outside the local authority area. | Various - general research | Could be generated from MENE at a national level, otherwise would need local surveys |
| % of people who visit natural areas to meet with friends/ family | Various - general research | Would need to be incorporated into surveys, with an agreed methodology |
| % of people who walk, exercise, socialise, play sports/ activities, play with children in a natural area at least 4 times a month. | Various - general research | Could be generated from MENE at a national level, otherwise would need local surveys |
| % of people who wish to walk or exercise their dog in a natural area but feel unable to do so. | Various - general research | Would need surveys, or a question on the national census |
| % of population living on a tree-lined street | Various - general research | Data available from many local councils. Could be generated from remotely sensed data (LIDAR & NDVI), or digitised directly from aerial photographs |
| % of population taking their children to play in an environmental space per week | Various - general research | Could be generated as a national measure for England from MENE, otherwise would need local surveys |
| % of population visiting a local park per week | Various - general research | Could be generated as a national measure for England from MENE, otherwise would need local surveys |
| % of population visiting an environmental space per week | Various - general research | Could be generated as a national measure for England from MENE, otherwise would need local surveys |
| % Public park and gardens in a town | Various - general research | Comprehensive data is only currently available locally |
| % Tree cover with a certain distance of each UK output area | Various - general research | Data available from many local councils. Could be generated from remotely sensed data (LIDAR & NDVI), or digitised directly from aerial photographs |
| Accessibility to areas of cultural significance – e.g. World Heritage Sites, National Trust properties, scheduled monuments or battlefields hosting areas of natural vegetation. | Various - general research | Could be based on CEH Land Cover Map 2007 and OS MasterMap |
| Area inhabited by charismatic, reasonably visible British species – e.g. red squirrels, herons, large birds of prey. | Various - general research | This could be generated from the estimated current range of these species, or, using a more sophisticated approach, maps of where suitable habitat exists for them within these ranges. |
| Area of accessible woodland/broadleaved woodland/ancient woodland/coppiced woodland. | Various - general research | Would need information on public access and, ideally, the presence of PROWs |
| Area of natural land accessible within a 100 m to 500 m buffer. | Various - general research | Could be based on CEH Land Cover Map 2007. Would need information on public access and, ideally, the presence of PROWs |
| Area of, and accessibility to, allotments. | Various - general research | Would require mapping of allotments, currently only available locally |
| Area of, and accessibility to, places where children can play. | Various - general research | Would require mapping of these sites currently only available locally |
| Average score (Likert scale) for “Connecting with nature is important to me” | Various - general research | Would need to be incorporated into surveys |
| Average score (Likert scale) for “I am satisfied with the opportunities I get to be amongst nature” | Various - general research | Would need to be incorporated into surveys |
| Biodiversity Indicators | Various - general research | May be a measure of the attractiveness of sites, although comprehensive data is not currently available at an appropriate scale. Proxies include habitat composition and heterogeneity from the CEH Land Cover Map 2007 and Local Phase I and II Habitat Surveys |

| Measure | Source | Notes |
|---|---|---|
| Condition of natural settings of special cultural significance to the local population within a given area | Various - general research | Would require local surveys and an agreed methodology for attributing 'special cultural significance' and establishing criteria for condition |
| Distance from nearest publicly accessible pond or lake - walking, straight line or via a transport network | Various - general research | Would need data on accessibility and PROWs. Ponds could probably be mapped using OS data |
| Distance from the coast - straight line or via a transport network | Various - general research | Could be calculated for entire UK using currently available data |
| Distance from the nearest beach - straight line or via a transport network | Various - general research | Could be calculated for entire UK using currently available data |
| Distance from the nearest blue flag beach - straight line or via a transport network | Various - general research | Could be calculated for entire UK using currently available data |
| Distance from the nearest publicly accessible stretch of river - straight line or via a transport network | Various - general research | Would need data on accessibility and PROWs |
| Estimated obesity/mental health savings/costs for NHS due to good/ poor natural environment | Various - general research | Could be modelled using nationally available data on hospital admissions/ GP appointments |
| Frequency with which people visit their local park or countryside | Various - general research | Could be generated from MENE at a national level, otherwise would need local surveys |
| Landscape diversity | Various - general research | Methodology needs to be derived |
| Length of power lines visible | Various - general research | Could be modelled using available data. Although not really a CES, could be an indicator of quality of experience in some environmental spaces. |
| Length of power lines with a certain radius | Various - general research | Data is available. Although not really a CES, could be an indicator of quality of experience in some environmental spaces. |
| Length of road with scenic beauty. | Various - general research | Could be digitised from road maps which display this, such as the Michelin maps. |
| Light pollution - from space | Various - general research | Not a direct measure of CES but may indicate attractiveness of local environments and environmental spaces |
| Light pollution - modelled from proximity to urban centres and infrastructure | Various - general research | Not a direct measure of CES but may indicate attractiveness of local environments and environmental spaces |
| Litter per square metre on publicly accessible beaches | Various - general research | Current availability of data would need to be investigated. Not really a CES, but could be used as an indicator of attractiveness |
| Lottery funding for Access to Nature Scheme | Various - general research | Could be generated from available data |
| Noise pollution - measured | Various - general research | Not a direct measure of CES but may indicate attractiveness of local environments and environmental spaces |
| Noise pollution - modelled from transport infrastructure | Various - general research | Not a direct measure of CES but may indicate attractiveness of local environments and environmental spaces |
| Number of “natural” sites identified as having a strong connection to local culture | Various - general research | Would need to be incorporated into surveys, with an agreed methodology |
| Number of BTCV/Natural Trust/ Local Environmental Group Volunteers per head of population | Various - general research | Data would need to be obtained from volunteer organisations |
| Number of local festivals/ events associated with the natural environment/ nature | Various - general research | Data availability would need to be investigated. Would need an agreed methodology |
| Number of people visiting rivers, lakes or ponds in a given week | Various - general research | Could be generated from MENE for national level data, otherwise would need surveys. MENE does not separate the three types of space. |
| Number of people visiting the coast/ beaches in a given week | Various - general research | Could be generated from MENE for national level data, otherwise would need surveys |
| Number of visitors per km of people | Various - general research | Highly variable according to seasonal, weather and calendar-related factor. Aerial surveys could overcome some of these obstacles |
| Number of wind-farms visible | Various - general research | Could be modelled using available data. Although not a direct measure of CES, could be an indicator of quality of experience in some environmental spaces. |
| Number of wind-farms within a certain radius | Various - general research | Data is available. Although not a direct measure of CES, could be an indicator of quality of experience in some environmental spaces. |

| Measure | Source | Notes |
|---|---|---|
| Number/total area of natural settings of special cultural significance to the local population with in a given area; | Various - general research | Would require local surveys and an agreed methodology for attributing 'special cultural significance' |
| Proportion of households/children/most deprived households within 500m walking distance to land hosting natural vegetation. | Various - general research | Ideally should be calculated using PROW information |
| Proportion of residential streets lined with trees. | Various - general research | Would need major mapping exercise from remotely sensed data or compiling of locally available data |
| Proportion of the population of a given area residing within half an hour travel time of a natural setting of special cultural significance to them. | Various - general research | Would require local surveys and an agreed methodology for attributing 'special cultural significance' |
| Proportion of time spent outdoors in a natural environment by the general population and by children | Various - general research | Could be generated from MENE at a national level, otherwise would need local surveys (although MENE data only include cases where a journey was made, and would not include cases where children travelled by themselves) |
| Revenue generated from farm based holidays | Various - general research | Commercial sensitivity may be an issue |
| Site or location based question: "do you feel any different? what did you feel on your walk, has it made you feel any better/happier/etc.?" | Various - general research | Would need site-based surveys |
| Site or location based questionnaire: How do you feel now as you enter the site. What are you expecting of your visit? And later: How do you feel now after your visit? People could be asked to give two or three words to describe their feelings, or possibly might be shown prompt cards with an array of possible words, which would encompass the whole range of possible emotions. | UK NEAFO reviewer comment | Would need site-based surveys |
| Visitor numbers in environmental spaces | Various - general research | Would need site-based surveys |
| Volunteer hours per capita with BTCV/ Woodland Trust etc. | Various - general research, NIA indicator | Data availability would need to be investigated |
| Water quality indicators for UK beaches | Various - general research | Data currently available for specific sampling points |
| Total extent of land managed to maintain and enhance landscape character | Adapted from NIA indicators | Would need to be locally gathered |
| Length of Public Rights of Way (PROW) & permissive paths improved | Adapted from NIA indicators | Would need to be locally gathered |
| The number of historic environment features 'at risk' | Adapted from NIA indicators | These data should be available, at least locally |
| Access to natural green space and/or woodland (using ANGSt criteria) | Adapted from NIA indicators | Could be generated from nationally available data, although public access would need to be determined |
| Attitudes of local community to biodiversity, geo-diversity and the natural environment | Adapted from NIA indicators | Would need to be locally gathered using an agreed methodology |
| Number of educational visits | Adapted from NIA indicators | Would need to be locally gathered |
| Number and social mix of visitors to NIA sites | Adapted from NIA indicators | Would need to be locally gathered |
| Number and social mix of people attending NIA activities and events | Adapted from NIA indicators | Would need to be locally gathered |
| Level of outdoor recreation by NIA residents | Adapted from NIA indicators | Would need to be locally gathered using an agreed methodology |
| Number of volunteer hours on NIA activities | Adapted from NIA indicators | Would need to be locally gathered |

# Appendix 5.4: Data sources and data processing

This document describes the data sources and data processing techniques used to calculate the indicators described in Section 5.3 of the Cultural Ecosystem Services and Indicators (WP5) UK NEA Follow-on chapter.

### A 5.4.1 Percentage cover and other area based estimates (Section 5.3.3)

Percentage cover estimates were calculated in ArcGIS version 10 (see: http://www.esri.com/software/arcgis). The ArcGIS Intersect method was used to obtain a layer in which the cover types described by the indicators were mapped within the 2011 borders of each Local Authority District in Great Britain. The ArcGIS Dissolve method was then used to obtain single polygons for each combination of LAD and cover type. The sizes ($m^2$) of these areas were then calculated as a percentage relative to the total extent of the Local Area District (LAD). In two cases (National Trust properties per 10,000 Population and Garden Size per Household) data on the 2011 population size and number of households were obtained from the UK 2011 census to calculate the indicators.

- **Ancient Woodland**
  A complete GB-wide GIS layer for Ancient Woodland in Great Britain was obtained from the Forestry Commission:
  See: http://www.forestry.gov.uk/forestry/infd-8g5bx3

- **Broadleaved Woodland**
  These data consisted of habitat patches categorised as broadleaved, mixed and yew woodland in the CEH Land Cover Fine Scale Vector Map 2007 (minimum mappable unit – 0.5 ha) :
  See: http://www.ceh.ac.uk/landcovermapping.html

- **Country Parks**
  This indicator was calculated from separate data sets obtained from each of the three GB nations:
  - For England – obtained from Natural England:
    See: http://www.naturalengland.org.uk/publications/data/
  - For Wales – obtained from The Countryside Council for Wales:
    See: http://www.ccgc.gov.uk/landscape--wildlife/protecting-our-landscape/gis- download---welcome/gis-dataset-information.aspx
  - For Scotland – obtained from Scottish National Heritage:
    See: https://gateway.snh.gov.uk/natural-spaces/

- **Designated Areas** (included AONB, LNR, NNR, NIA, RAMSAR, SAC, SPA, SSSI).
  This indicator was calculated from separate data sets obtained from each of the three GB nations:
  - For England – obtained from Natural England:
    See: http://www.naturalengland.org.uk/publications/data/
  - For Wales – obtained from The Countryside Council for Wales:
    See: http://www.ccgc.gov.uk/landscape--wildlife/protecting-our-landscape/gis- download---welcome/gis-dataset-information.aspx
  - For Scotland – obtained from Scottish National Heritage:

See: https://gateway.snh.gov.uk/natural-spaces/

- **Grassland, Mountain and Moorland.**

  These data consisted of habitat patches categorised as Acid Grassland, Calcareous Grassland, Neutral Grassland, Rough low-productivity grassland, Bog, Dwarf Shrub Heath, or Mountain Habitats in the CEH Land Cover Fine Scale Vector Map 2007:

  See: http://www.ceh.ac.uk/landcovermapping.html

- **National Parks**

  This indicator was calculated from separate data sets obtained from each of the three GB nations:

  - England – obtained from Natural England:

    See: http://www.naturalengland.org.uk/publications/data/
  - Wales – obtained from The Countryside Council for Wales:

    See: http://www.ccgc.gov.uk/landscape--wildlife/protecting-our-landscape/gis- download---welcome/gis-dataset-information.aspx
  - Scotland – obtained from Scottish National Heritage:

    See: https://gateway.snh.gov.uk/natural-spaces/

- **National Trust Properties.**
  A GIS map of National Trust properties was obtained from The National Trust (ContractorPortal@nationaltrust.org.uk).

- **Non-built Areas**

  These data consisted of habitat patches not categorised as Urban Areas and Gardens in the CEH Land Cover Fine Scale Vector Map 2007:

  See: http://www.ceh.ac.uk/landcovermapping.html

- **Open Access Land** (for England only).

  Data were obtained from Natural England and consisted of Countryside Rights of Way Act Land (CROW): Section 16, Registered Common Land and Conclusive Open Country:

  See: http://www.naturalengland.org.uk/publications/data/

- **Fresh Water**

  These data consisted of habitat patches categorised as Fresh Water in the CEH Land Cover Fine Scale Vector Map 2007 (minimum mappable unit – 0.5 ha) :

  See: http://www.ceh.ac.uk/landcovermapping.html

- **Parkland**

  These data were produced from the Natural England Wood Pasture and Parkland GIS layer. Land classed as Wood Pasture was excluded prior to the calculation of the indicator. Data were not available for the South East of England

  See: http://www.naturalengland.org.uk/publications/data/

- **Sports and Leisure Areas**

  These data were obtained from the Corine 2006 European Land Cover Map produced by the European Environment Agency:

  See: http://www.eea.europa.eu/data-and-maps/data/clc-2006-vector-data-version-2

- **Total Woodland**

  These data consisted of habitat patches categorised as woodland in the CEH 2007 Landcover Map Fine Scale vector map (minimum mappable unit – 0.5 ha) :

  See: http://www.ceh.ac.uk/landcovermapping.html

- **Urban Green Space**

  These data were obtained from the Corine 2006 European Land Cover Map produced by the European Environment Agency:

  See: http://www.eea.europa.eu/data-and-maps/data/clc-2006-vector-data-version-2

- **Gardens**

  Indicators related to cover by gardens were calculated from GIS data mapped as 'multi-surface area' in OS MasterMap, which indicates the presence of gardens. The percentage cover of gardens was calculated, as well as the average size of gardens per household, based on the number of households for the LAD listed in the 2011 UK census.
  See: http://www.ordnancesurvey.co.uk/docs/user-guides/os-mastermap-topography-layer-user-guide.pdf

- **Indicators of the historical associations with natural spaces - labels sited over areas with natural cover**

  Ordnance Survey MasterMap Annotation labels classified as related to 'history and antiquities' were mapped across Great Britain in ArcGIS 10 (N = 90,841). The number of these text labels which were situated above land classified as anything other than 'Built-up areas and Gardens' in the CEH Land Cover Fine Scale Vector Map 2007 was calculated for each LAD.

  For a description of Ordnance Survey MasterMap, see:
  http://www.ordnancesurvey.co.uk/docs/user-guides/os-mastermap-topography-layer-user-guide.pdf

- **Indicators of the historical associations with natural spaces - labels refering to natural features**

  Ordnance Survey MasterMap Annotation labels classified as related to 'history and antiquities' were mapped across Great Britain in ArcGIS 10. Fifty nine key words were identified which we thought were likely to be related to natural features, or features typically situated within a natural or semi-natural location. The number of such text labels was calculated for each LAD.

  The key words chosen were as follows: Barrow, Battlefield, Beech, Bowling Green, Bridge, Burial Ground, Cairn, Canal, Causeway, Country Park, Dale, Dam, Dell, Dike, Ditch, Down, Earthwork, Elm, Enclosure, Farm, Farmstead, Field, Field System, Fishpond, Foss Way, Garden, Green, Hedge, Hill, Hut Circle, Hut Circle and Field System, Knoll, Lynchets, Maze, Millpond, Moat, Motte and Bailey, Mound, Mount, Oak, Orchard, Plain, Pool, Quoit, Rock, Sheep Shelter, Spring, Standing Stone, Stepping Stones, Stone Circle, Tor, Tree, Tump, Tumulus, Turf, Well, White Horse, Wood, Yew Tree

### A 5.4.2 Accessibility Indicators (Section 5.3.4)

The accessibility indicators were calculated as follows:

i) Discrete patches of continuous cover were produced in a GIS. This was done using one of two methods. For Ancient Woodland and 'Natural Habitats' the original vector data were converted to 50m raster datasets in ArcGIS 10. Patches were calculated as areas where it was possible to move from one grid square to its neighbour whilst remaining within the mapped cover type (Ancient Woodland or 'Natural Habitats' respectively). This was done so as to represent as single patches cases where narrow linear features such as minor roads or small rivers intersected a patch. For Country Parks and Nature Reserves, each entity (a Nature Reserve or Country Park) had already been assigned a unique ID, so all areas with the same ID were counted as a single patch, including cases where features such as a road intersected them.

ii) The size of each patch was calculated in ArcGIS 10, and each patch was categorised according to whether it fell within the following size categories: >= 2 ha, >=20 ha, >=100 ha, >=500 ha.

iii) Population-weighted centroids of each output area from the 2011 UK census were mapped and their distance to the nearest patch of each size/ cover type was calculated. Census output areas are the smallest geographic units using to aggregate data from the UK National Census. For England and Wales Output Areas typically contain approximately 125 households and for Scotland 50 households. Population centroids are the central point of the output area, adjusted to take account of the distribution of the population within it.

See: http://www.ons.gov.uk/ons/guide-method/geography/beginner-s-guide/census/output-area--oas-/index.html

and: http://www.ons.gov.uk/ons/guide-method/geography/products/census/spatial/centroids/index.html

iv) These distances were then multiplied by the total number of residents in each Output Area and then summed across all Lower Superoutput Areas (LSOAs) in England and Wales, Data Zones in Scotland and Local Authority Districts (LADs) in Great Britain. To obtain the average distance to the nearest patch (for each of the 4 patch sizes), these data were then divided by the total resident population of the LSOA, Data Zone or LAD.

LSOAs are aggregations of Output Areas from the UK census, and comprise between 400 and 1,200 households in England and Wales. Data zones are the equivalent to LSOAs in Scotland and contain between 500 and 1,000 household residents.

v) The data for each Output Area were used to calculate whether the human population living within each output area were within the relevant ANGSt straight-line distance of each patch: 300m for areas >= 2ha, 2 km for areas >= 20ha, 5 km for areas >=100 ha, and 10 km for areas >= 100 ha.

vi) The data calculated in v) above were used to calculate the proportion of the population of each LSOA or Data Zone and LAD in Great Britain who were living within the relevant patch size/ distance.

vii) Equivalent techniques to those outlined in steps i – vi above to calculate statistics for the population of children (under 16) living within each LSOA, Data Zone or LAD

viii) To calculate statistics related to levels of deprivation, the deprivation score of each LSOA (in England and Wales) or Data Zone (in Scotland) were ranked and aggregated into national or local quintiles. National deprivation quintiles are based on how deprived an area is relative to deprivation scores across the whole of a country (England, Scotland or Wales), whereas Local deprivation quintiles are based on how deprived an area is relative to deprivation

scores with the relevant LAD. These data were then aggregated across each quintile to produce summary statistics by quintile for each quintile and country.

Data sources for the four environmental space types used in the analysis (Ancient Woodland, Country Parks, Nature Reserves and 'Natural Habitats') were as follows:

- **Ancient Woodland**

  The same data was used as for the Ancient Woodland Percentage Cover Indicator (See Section 5.S.1 above).

- **Country Parks**

  The same data was used as for the Country Parks Percentage Cover Indicator Indicator (See Section 5.S.1 above).

- **Nature Reserves** - Local and National Nature Reserves.

  Data were obtained from the following sources:

  - England – obtained from Natural England.:

    See: http://www.naturalengland.org.uk/publications/data/

  - Wales – obtained from Natural Resources Wales:

    See: www.naturalresourceswales.gov.uk. Note that these data are somewhat out of date and may need updating.

  - Scotland – obtained from Scottish National Heritage:

    See: https://gateway.snh.gov.uk/natural-spaces/

- **'Natural Habitats'**

  These data consisted of habitat patches categorised as Acid Grassland, Calcareous Grassland, Neutral Grassland, Rough low-productivity grassland, Bog, Dwarf Shrub Heath, or Mountain Habitats in the CEH Land Cover Fine Scale Vector Map 2007 (minimum mappable unit – 0.5 ha) :

  See: http://www.ceh.ac.uk/landcovermapping.html.

### A 5.4.3 Demand related indicators (Section 5.3.5)

These data were calculated using the Bayesian Belief Network described in Appendix 5.4. They consisted of the estimated probability of a given adult (over 16) engaging in the following activities or visiting the following types of environmental space in a given week.

**Activities:**
Eating or Drinking Out, Fieldsports, Fishing, Horse Riding, Off Road Cycling or Mountain Biking, Off Road Driving or Motorcycling, Picnicking, Playing with Children, Road Cycling, Running, Appreciating Scenery from a Car, Swimming Outdoors, Beach, Sunbathing Or Paddling, Visiting An Attraction, Walking Without a Dog (including short walks, rambling or hill walking), Walking With a Dog (including short walks, rambling or hill walking), Watersports, Wildlife Watching, Informal Games and Sport (for example Frisbee or gold), Any Other Outdoor Activities, none of the activities in the list

**Environmental Spaces:**

Woodland or Forest, Farmland, Mountain, Hill or Moorland, River, Lake or Canal, Village, Path, Cycleway or Bridleway, Country Park, another open space in the Countryside, Park in a Town or city, Allotment or Community Garden, Children's Playground, Playing Field or Other Recreation

Area, another Open Space in a Town or city, a Beach, Other Coastline, other places not in the list, don't know

They were calculated on the basis of the socio-demographics characteristics of each Local Authority District and the relationship between these same socio-demographic characteristics amongst interviewees of the Monitor of Engagement in the Natural Environment (MENE) questionnaire[11] and their answers to Questions 4 and 5 of the questionnaire. For a description of the MENE questionnaire, see: http://www.naturalengland.org.uk/ourwork/evidence/mene.aspx

The socio-demographic data used to estimate these probabilities were as described in Appendix 5.4. They included:

*Age* (16-24, 25-34, 35-44, 45-54, 55-64, 65+), *Household Size* (1,2,3,4,5 residents), *Children in Household* (Some/ Any), *Work Status* (At school, Full-time higher education, Part-time < 8 hrs, Part-time 8-29 hrs, Full-time 30+ hrs, Unemployed, Not seeking work, Retired), *Tenure* (Private Rent, Social Rent, Mortgage, Own Outright, Other), *Deprivation* (top 10% most deprived, top 10% least deprived or between 10th and 90th percentile), *Rurality* (Urban, Rural, Town Fringe), *Social Group* (AB, C1, C2, DE).

### A 5.4.4 Local Urban Indicators (Section 5.3.6) – Open Spaces

- **Space.**

  The area of Open and Green Spaces in the City of Nottingham were obtained as a GIS data-set from City of Nottingham Council:

  See: http://info.nottinghamcity.gov.uk/insightmapping/#

- **Area of non-human made cover**

  The data used to calculate this indicator consisted of all areas in Ordnance Survey MasterMap Topographic data not described as man-made or multi-surface (gardens).

  For a description of Ordnance Survey MasterMap, see: http://www.ordnancesurvey.co.uk/docs/user-guides/os-mastermap-topography-layer-user-guide.pdf

- **Natural habitats**

  The same data used in the 'natural habitats' accessibility indicator used for LADs (see Section 5.3.4 above), from the CEH Land Cover Fine Scale Vector Map 2007 (minimum mappable unit – 0.5 ha).

  See: http://www.ceh.ac.uk/landcovermapping.htm

- **Woodland**

  The same data used in the 'Total Woodland' percentage cover indicator used for LADs Indicator (See Section 5.S.1 above), from the CEH Land Cover Fine Scale Vector Map 2007.

  See: http://www.ceh.ac.uk/landcovermapping.htm

- **Culture and history**

Ordnance Survey MasterMap Annotation labels were mapped over each open space in Nottingham and examined individually. The number of text labels indicating a cultural or historical association were calculated for each open space. These labels included:

Bandstand, D H LAWRENCE, Dovecote, War Memorial, Windmill, Wollaton Hall, Cemetery, Deer Park, Graveyard, (site of), Castle, Gatehouse, Mortimer's Hole, Nottingham, Stepping, Stones, Water Mill, Fountain, Well, Memorial, Obelisk, Statue, Statues, War, Windmill, (remains of).

For a description of Ordnance Survey MasterMap, see: http://www.ordnancesurvey.co.uk/docs/user-guides/os-mastermap-topography-layer-user-guide.pdf

- **Noise**

Data were obtained from Defra Round 1 strategic noise mapping results for the Nottingham agglomeration (within the Nottingham City Council area), and consisted of road traffic noise map results for the LA10, 18h indicator. Noise bands were coded as follows:

| Code | LA10, 18h Level (dB) |
|---|---|
| 7 | ≥ 75 |
| 6 | 70.0-74.9 |
| 5 | 65.0-69.9 |
| 4 | 60.0-64.9 |
| 3 | 55.0-59.9 |
| 2 | < 55 |

More Information on the methodology used to produce these data can be found at http://services.defra.gov.uk/wps/portal/noise. Note that these are provisional modelled data. These data were derived to assist the fulfilment of the Environmental Noise (England) Regulations 2006 (as amended). As such, they provide a strategic representation of the noise environment. Any interpretations, decisions or actions drawn from these data are done so solely at the user's risk and at no liability to Defra.

- **Facilities**

Ordnance Survey MasterMap Annotation labels were mapped over each open space in The City of Nottingham and examined individually. The number of text labels indicating the presence of facilities such as sports areas, public conveniences, play areas and car parks were calculated for each open space. The full list of text labels was as follows:

Adventure Playground, Boating Lake, Bowling Green, Bowling Greens, Car, Car Park, Cricket Pitch, Croquet Courts, Cycle Track, Football Ground, Football Pitch, Forest Recreation Ground, Games, Games Court, Games Courts, Gardens, Glapton Wood, Golf Course, Golf Range, Hockey Centre, Miniature Golf Course, Mooring Stage, Nottingham Tennis Centre, Paddling Pool, Path and Cycle Track, Pavilion, PC, PCs, Play Area, Playground, Playgrounds, Playing Field, Playing Fields, Putting Green, Queen Anne's Bowling Green, Recreation Ground, Running Track, Slipway,

Sports Arena, Sports Centre, Sports Facility, Sports Ground, Tennis, Tennis Court, Tennis Courts, Track

For a description of Ordnance Survey MasterMap, see:
http://www.ordnancesurvey.co.uk/docs/user-guides/os-mastermap-topography-layer-user-guide.pdf

- **Crime**

  Crime data for the period May-August 2013 were obtained for the City of Nottingham Area and a buffer 0.5 km around it, from the crime statistics website http://www.police.uk/. In the case of crime reported within open spaces, all crime data were used. In the case of crime reported within a 0.5 km buffer around each open space, the following categories of crime were used: anti-social behaviour, bicycle-theft, criminal-damage-arson, drugs, other theft, possession of weapons, public order, robbery, theft from person, vehicle crime, violent crime.

### A 5.4.5 Local Urban Indicators (Section 5.3.6) - Wards

Indicators for City of Nottingham Wards were calculated as described below. Except where otherwise stated, these were calculated as percentage cover relative to the size of the ward, using the same techniques used to calculate the percentage cover LAD indicators:

- **Percentage cover of natural surfaces**
  This indicator used the same Ordnance Survey Master Map data used for the area of non-human made cover Open Spaces Indicator (see above).

  For a description of Ordnance Survey MasterMap, see:
  http://www.ordnancesurvey.co.uk/docs/user-guides/os-mastermap-topography-layer-user-guide.pdf

- **Areas excluding urban, agriculture and improved grassland.**
  These data were obtained from the CEH Land Cover Fine Scale Vector Map 2007 (minimum mappable unit – 0.5 ha). All land cover data with the exception of Arable and horticulture, Built-up areas and gardens and Improved Grassland were used.
  See: http://www.ceh.ac.uk/landcovermapping.html.

- **Woodland**
  These data consisted of the same data used for the LAD level Total Woodland Indicator (see 5.S.1 above).

  See: http://www.ceh.ac.uk/landcovermapping.html.

- **Gardens**
  This consisted of areas mapped as multi-surface area in Ordnance Survey MasterMap, which indicates the presence of gardens.

  The percentage cover of gardens was calculated as well as the average size of gardens per household, based on the number of households for the ward listed in the 2011 UK census.

  For a description of Ordnance Survey MasterMap, see:
  http://www.ordnancesurvey.co.uk/docs/user-guides/os-mastermap-topography-layer-user-guide.pdf

- **Length of Public Rights of Way (PROWs)**
  GIS mapping of PROWs within the City of Nottingham and the County of Nottinghamshire were obtained from The City of Nottingham district council and Nottinghamshire County Council respectively.

  A 1.6 km (1 mile) buffer was created around each ward in ArcGIS 10. The extent of all PROWS which both lay within the buffer and crossed land cover not identified as built up areas and gardens within the CEH 2007 Landcover Fine Scale Vector Map was calculated.

- **Length of Urban paths**
  A vector map of urban paths within the Ordnance Survey MasterMap Integrated Transport Network (ITN) was obtained for the City of Nottingham and a 1.6 km buffer around it. The same techniques as described above for PROWs was used to calculate an equivalent indicator for urban paths.

  For a description of the ITN layer, see: http://www.ordnancesurvey.co.uk/business-and-government/products/itn-layer.html

- **Length of Minor roads**
  A vector map of urban paths within the Ordnance Survey MasterMap Integrated Transport Network was obtained for the City of Nottingham and a 1.6 km buffer around it. The same techniques as described above for PROWs and urban paths was used to calculate an equivalent indicator for minor roads.

  For a description of the ITN layer, see: http://www.ordnancesurvey.co.uk/business-and-government/products/itn-layer.html

- **Number of Tree preservation orders**
  Mapping of Tree Preservation Orders (TPOs) were provided by Nottingham City Council. See http://info.nottinghamcity.gov.uk/insightmapping/#. In most cases these were identified as individual trees, but in cases were a group of trees were identified the coordinates of the centroid of the patch was calculated as a single point within ArcGIS 10. These data were used to calculate the number of TPOs per square kilometre within each ward.

- **Distance to Nature Reserves – straight line distance**
  ArcGIS 10 was used to calculate the straight line distance between nature reserves and output area centroids from the UK 2011 census which are located within The City of Nottingham. Equivalent techniques to those used to calculate the LAD level accessibility indicators (see Section 5.3.4 above) were used to calculate the average distance per ward resident to the closest nature reserve.

  GIS layers of National and Local Nature Reserves obtained from Natural England were used to map Nature Reserves.

  See: http://www.naturalengland.org.uk/publications/data/

- **Distance to Nature Reserves – through a road network.**
  Similar techniques to those described above for Distance to Nature Reserves – straight line distance were used. However, in the case of this indicator distance to nature reserve entrances was calculated via the OS MasterMap Integrated Transport Layer Road Network, using the ArcGIS 10 Network Analyst extension. Park entrances were mapped in ArcGIS 10 from Ordnance Survey 1:10,000 and 1: 25,000 raster maps.

For a description of the ITN layer, see: http://www.ordnancesurvey.co.uk/business-and-government/products/itn-layer.html

For the Ordnance Survey Raster layers, see:
http://www.ordnancesurvey.co.uk/business-and-government/products/25k-raster.html
http://www.ordnancesurvey.co.uk/business-and-government/products/50k-raster.html

# Appendix 5.5: Modelling current and future patterns of cultural ecosystem services using Bayesian Belief Network

*Supplementary material prepared in support of the UK NEA Follow-on, November 2013*

Haines-Young, R and Tratalos, J. School of Geography, University of Nottingham

### A 5.5.1 Introduction and context

The UK NEA made a significant theoretical contribution to our understanding of CES and how to characterise them, by developing the notion of an 'environmental setting' (Church *et al.*, 2011). 'Settings' were defined as 'locations and places where humans interact with each other and nature that give rise to cultural goods and benefits that people obtain from ecosystems'. The work of the UK NEA clarified the distinction between services and benefits that is often blurred in discussions of CES. It was argued that we need to identify the biophysical characteristics of ecosystems that support it if we really want to unpack the notion of ecosystem services. In the first phase of the UK NEA it was argued that the idea of 'settings' (or places or locations) did precisely this. Moreover, it was noted that as a physical, spatially bounded entity, a setting was easier to characterise and assess, than less tangible things such as people's responses to them or the benefits they derived.

The conceptual framework for cultural ecosystem services has been refined in UK NEAFO (Church et al. 2013) by making a further distinction between *environmental spaces* and *cultural practices*. Settings have been renamed as environmental spaces as discussed in the main text and this concept maintains the idea of a physical location in relation to cultural ecosystem services, whilst the concept of cultural practices tries to explicitly recognise the expressive, symbolic and interpretive interactions between people and the natural environment.

In the work described here we have sought to explore and operationalise the new conceptual framework for CES developed in UK NEAFO using Bayesian Belief Networks (BBNs). The work was designed to support the development of indicators in WP5and an exploration of how CES might be impacted under the different UK NEA scenarios in WP7. Both components assume that the contributions that ecosystems will make to people's well-being depend on the capacity of the environment to supply these services and people's demand for them. Patterns of demand and changes in demand over time are assumed to reflect changes in tastes and economic circumstance. The supply side is assumed to be determined by patterns of land cover and use, alongside land management which affects both the stock and quality of the different types of setting. If CES are to be modelled successfully either for the present or the future under the different scenario assumptions, then both the demand and supply side have to be captured and linked in some way.

### A 5.5.2 Data and Methods

In the analysis described here, we examine these theoretical ideas about CES empirically, using the Monitor of Engagement with the Natural Environment (MENE) data (Natural England, 2011, a,b)[12]. MENE is generated by a rolling, monthly survey of people's engagement with the natural environment. The information collected includes the types of destination (or setting) visited, the duration of the visit, mode of transport, distance travelled, spend, main activities and motivations for the visit. Significantly it records what people do (i.e. the cultural practices involved) when visiting the different type of place or setting, such as walking or watching wildlife. The respondents also provide information about themselves, so that they can be categorised in terms of their socio-demographic characteristics. The MENE data are collected as part of a larger omnibus survey of

[12] http://www.naturalengland.org.uk/ourwork/evidence/mene.aspx

people in their homes and is restricted to the resident population of England. It began in 2009, and involves interviewing around 45,000 each year (roughly 800 per week).The MENE data is especially useful for understanding aspects of the demand for CES, at least in terms of the types of environmental spaces that the different socio-demographic groups visit for different cultural practices. In the analysis that follows we look at what these data can tell us about the present and how patterns of use and activity relate to indicators of access to 'green spaces' as a type of environmental space that have been developed in WP5. To do this we have used the MENE data for the years from 2009 through to 2012. From the 160,000 records a subset of roughly 50,000 has been extracted covering those respondents who both made a visit of some kind, and who were interviewed in detail to find out what they did and where they went. In addition to the details of their trip, their home location and their socio-economic profile, the data provides a grid reference for the origin and destination of the trip, the location of the place visited and whether it was a setting that was designated in some way.

The spatial reference for the visit destination has also enabled us to look at the character of the land cover in the neighbourhood of the sites visited. To do this we have used the 1km resolution land cover data for the present day and the scenario outcomes generated in the UK NEA. We have focussed on woodland and farmland in particular, as there are marked contrasts between the scenarios in terms of the way these two elements change over time. In terms of analysing present day patterns, we have investigated whether the land cover in the 1km x1km cell in which the visit occurred differed according to the characteristics of the visit (i.e. its duration, distance travelled and activity). For the analysis of the scenarios we have looked at how the characteristics of the land cover would change in the cells had the same visits occurred in these future worlds, to determine whether the opportunity to access CES is likely to improve or decline (assuming all other things are constant).

The analysis of the MENE data in WP5 and 7was initially undertaken using GIS techniques and spread sheet analysis of the spatially referenced subset of the MENE data. While these approaches have been useful in exploring the datasets, they are not easily made interactive. Thus to explore how the MENE data and the scenarios can be made more accessible, the work has also considered how some of the key theoretical relationships can be represented by means of a Bayesian Belief Network (BBN), using the HUGIN Expert software. The MENE data are well suited to analysis using a BBN, which typically estimate probabilities by segmenting the data into specific groups from which dependencies are estimated (see Kjærulff, U.B and Madsen, 2012); in MENE nearly all variables are categorical.

The work focussed on looking at how the socio-demographic characteristics of the respondents linked to the cultural practices they undertook and the environmental spaces they used. An initial step has therefore been to develop a BBN model based on the UK NEAFO conceptual framework for CES. In UK NEAFO we have investigated the extent to which it could be used interactively to evaluate the impact of changes in the 'demand side' of CES brought about through socio-demographic or environmental change under the scenarios. The BBN mode for CES was developed both as a stand-alone system and as a web-based application.

The latter was created in order to show how a BBN could be used to create a more general-purpose and interactive way of accessing the MENE data; it also had the added advantage that the model and the associated data could be linked to mapping tools, which allowed a link to the work on spatial CES indicators to be made.

### A 5.5.3 The Bayesian Model for CES

In the first phase of the UK NEA, Bayesian Belief Networks (BBNs) were used to model the patterns of land cover change under the different scenario assumptions. Although the land cover transition probabilities for each scenario were based on expert judgment, the approach showed some potential for modelling relationships derived from empirical data. Thus maps of vegetation carbon densities per $km^2$ were prepared using standardised parameters for each land cover type derived from the scientific literatures (see Haines-Young et al. 2011, Figure 25.21). BBNs have been used widely in the natural sciences to model various phenomena, and more recently to model ecosystem services (see for example, Haines-Young, 2011; Barton, 2008; Landuyt et al. 2013).

Bayesian Belief Networks are useful in situations where different types of data need to be brought together and the relationships between them understood and modelled. They are also valuable in situations where there is an underlying theoretical understanding of a system that can be represented as a set of causal relationships that need to be expressed in probabilistic terms. Thus a BBN consists of a set of 'nodes' that represent the variables making up the system and a set of 'directed edges' that define the way they are linked. The states that the nodes can assume can be represented by a set of categories or a set of numerical ranges; for each node the BBN displays the probability that a node is in a given state, given the states of the other surrounding nodes that influence it. **Figure 5.A5.1** illustrates the form of a BBN. Such diagrams are also known as 'influence diagrams'. This particular example represents the UK NEAFO conceptual framework for CES and shows how environmental spaces might be linked to the activities (i.e. cultural practices) that people undertake in them, and some of the other factors that might influence patterns of use. Its key features are as follows:

For the link between activities and environmental spaces it is assumed that the activities people choose determine the environmental spaces visited hence the direction of the arrow from activities to environmental spaces.

That the choice of activity and setting determine the duration of the visit and the distance travelled - and hence the type of transport used. In the model, distance, duration and type of transport use are therefore regarded as attributes of the visit.

The links between activities and environmental spaces, and the responses of people who made the visit are shown at the top of the influence diagram. These are assumed to represent some aspects of the 'cultural benefits' defined in the UK NEAFO conceptual framework for CES. People were asked to rank, on a 5-point Likert scale, the strength of their feelings about the visit in terms of: whether they enjoyed it; whether it made them more calm and relaxed; whether it refreshed and revitalised them; helped them appreciate their surroundings; helped them learn something about the natural world; brought them closer to nature. The model assumes that the feelings (i.e. cultural benefits) are determined by the activities and the environmental spaces selected by people.

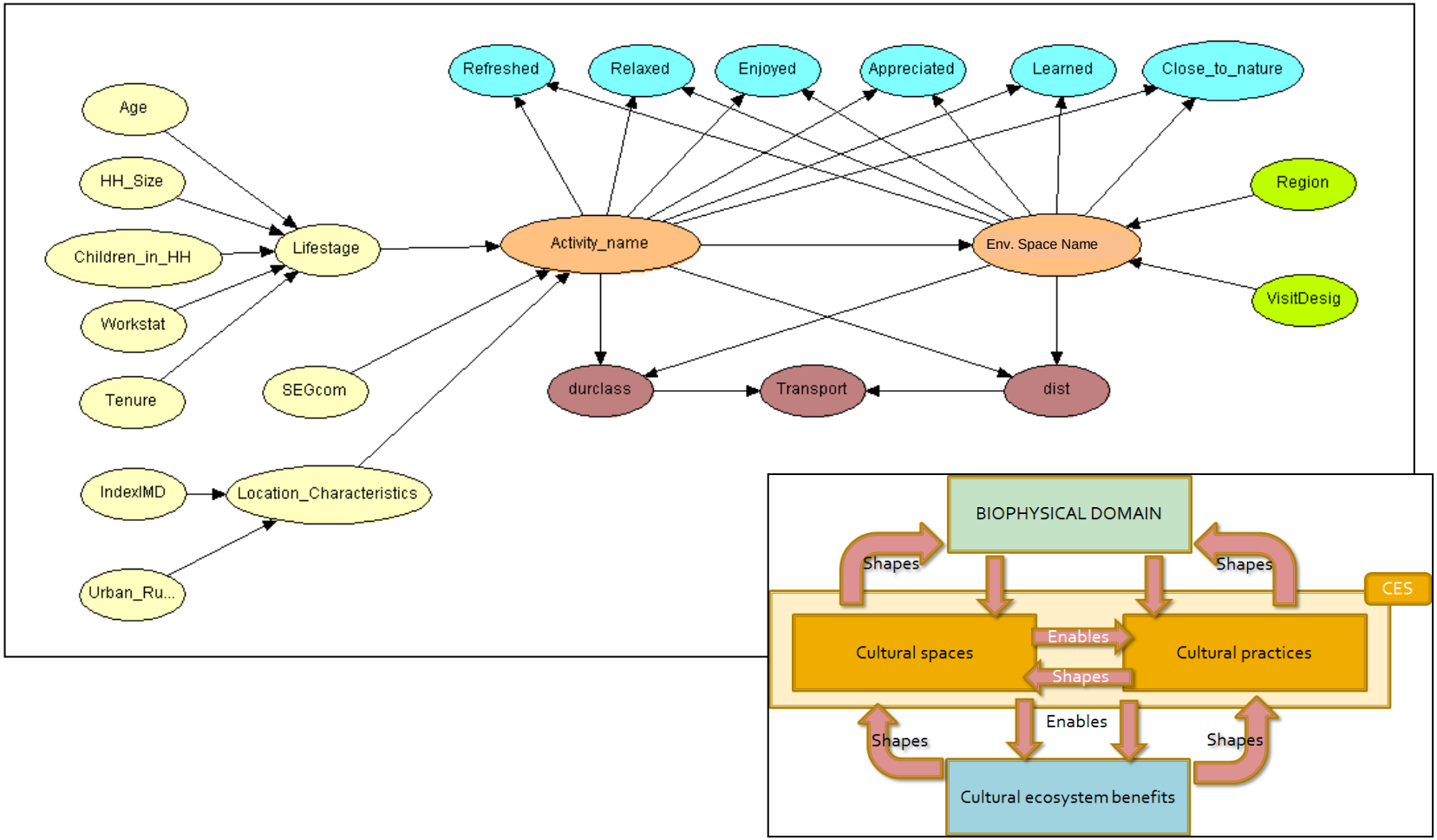



**Figure 5.A5.1. Bayesian Belief Network (BBN) for data from the Monitor of Engagement in the Natural Environment (MENE) survey.**

The socio-demographic characteristics of the people determine the activities they choose. MENE provides a range of information on the socio-demographic characteristics of the people surveyed. For the purposes of the model these have been organised into the three groups shown in the left hand part of the influence diagram. These were: lifestage, socio-economic group (social-grade) and the type of location where the people surveyed live. The choice of these variables was partly determined by the need eventually to link this model to data that could be derived from the census. While lifestage is not currently available from the census, exploratory work suggested that it was a strong influence on the activities chosen by people, and so it was retained for the purposes of the model. In order to operationalise it, however, a separate structural learning exercise was undertaken for the socio-demographic variables and lifestage to determine how it could be predicated from the variables contained in the census, such as age, household size, the presence of children in the household, tenure and work status. It was found that the lifestage assigned in MENE could be predicted with almost complete certainty using the simple structure and the 5 individual socio-demographic variables shown on the extreme left of **Figure 5.A5.1**.

Finally, two further variables were used in the influence diagram, namely the region in which the visit was made and the status of the setting in terms of one of the environmental designations recognised in MENE (i.e. whether it was in a National Park, AONB, NNR, LNR, World Heritage Site, National Trust Property, land covered by the CROW Act, Heritage Coast, Forestry Common land, Green Belt, or an SSSI, SAC, SPA or RAMSAR site). The latter were included as an additional way of characterising the setting. Region in which the visit was made was included to take account of the frequency of different types of setting in different parts of England. As will be shown below, this variable influenced the choice of environmental spaces for some activities quite strongly, and so was retained in order to provide a potential link to the 'supply side' analysis.

In terms of the overall logic represented by the network in Figure 5.A5.1, it should not be taken to suggest that, in terms of socio-demographic characteristics, attributes such as tenure and work status do not also determine social grade. The rationale for the structure shown is that in terms of linking such a model to census data, social grade is known, whereas lifestage is not. The model is designed to assemble what data are available from the census and predict lifestage, and then use this, alongside social grade and location, to predict the kinds of activities undertaken. The hierarchical approach in handling the socio-demographic variables was also designed to reduce the size of the Conditional Probability Tables (CPT) needed to compile the network; these link probabilistically the states of the input nodes to the states of the outputs nodes. Given the number of different types of activity recorded by MENE, had all the socio-demographic variables been linked directly to this node, then the CPT would have been too very large indeed; probably too large to be estimated with any confidence given the volumes of data available.

Before the results obtained using the BBN are discussed in detail, it is important to review the structure of the nodes for activities and environmental spaces in more detail in order to better understand the complexities of the BBN approach, and some of its potential advantages. The activity data recorded in MENE are complex, in that people can report going to more than one setting and taking part in several activities during a single visit. There is no simple way, using the MENE data, to determine what the main activity or main setting was. The motivation data also recorded in MENE, which has not been used here, also allows 'multiple choice'. As a result of the structure of the MENE data the nodes for activities and environmental spaces include a number of combinations. However, in order to make each activity class contain a large enough sample to be amenable to the probabilistic estimation we have simplified them to a set comprising: i) all those activities which were of a single type; ii) all those combinations of activities whose sample size was at least as large as any of the single type activities; and, iii) grouped all other combinations of activity as "other

combination". We have used the same approach with visits to single and multiple environmental spaces.

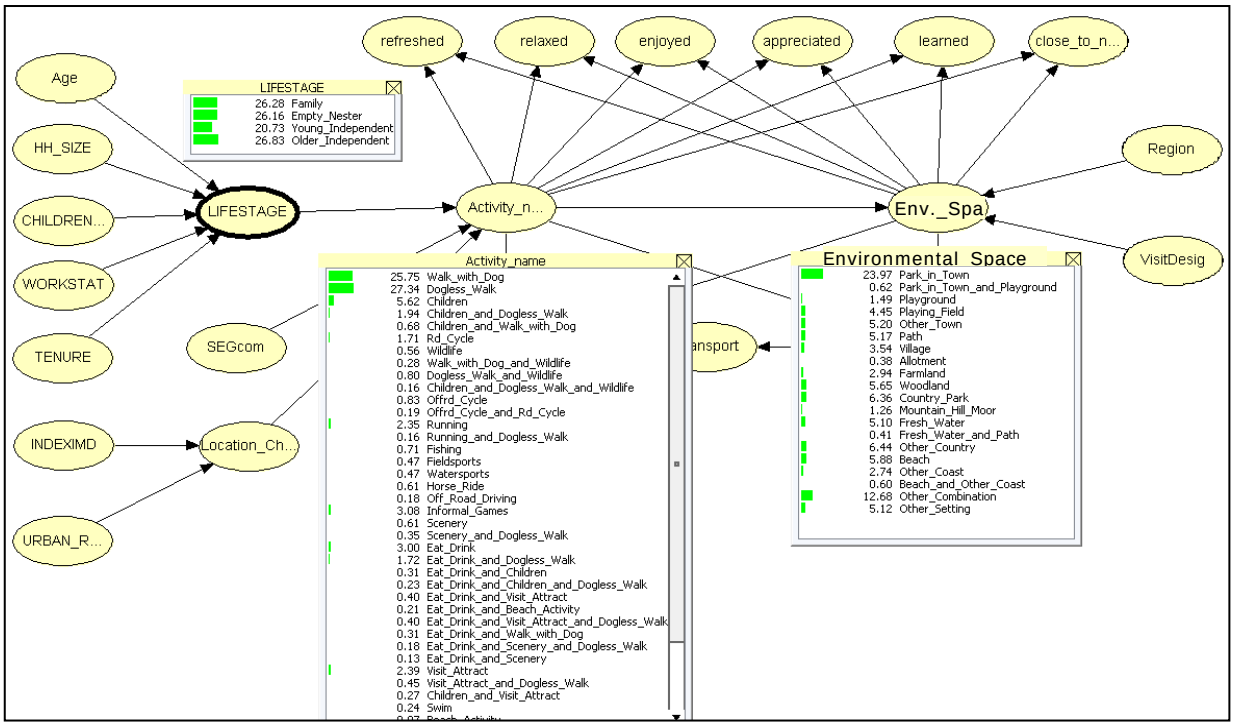



**Figure 5.A5.2a. The BBN shown in Figure 5.A5.1, showing probabilities according to Lifestage, Activity Name and Environmental Space Name.**

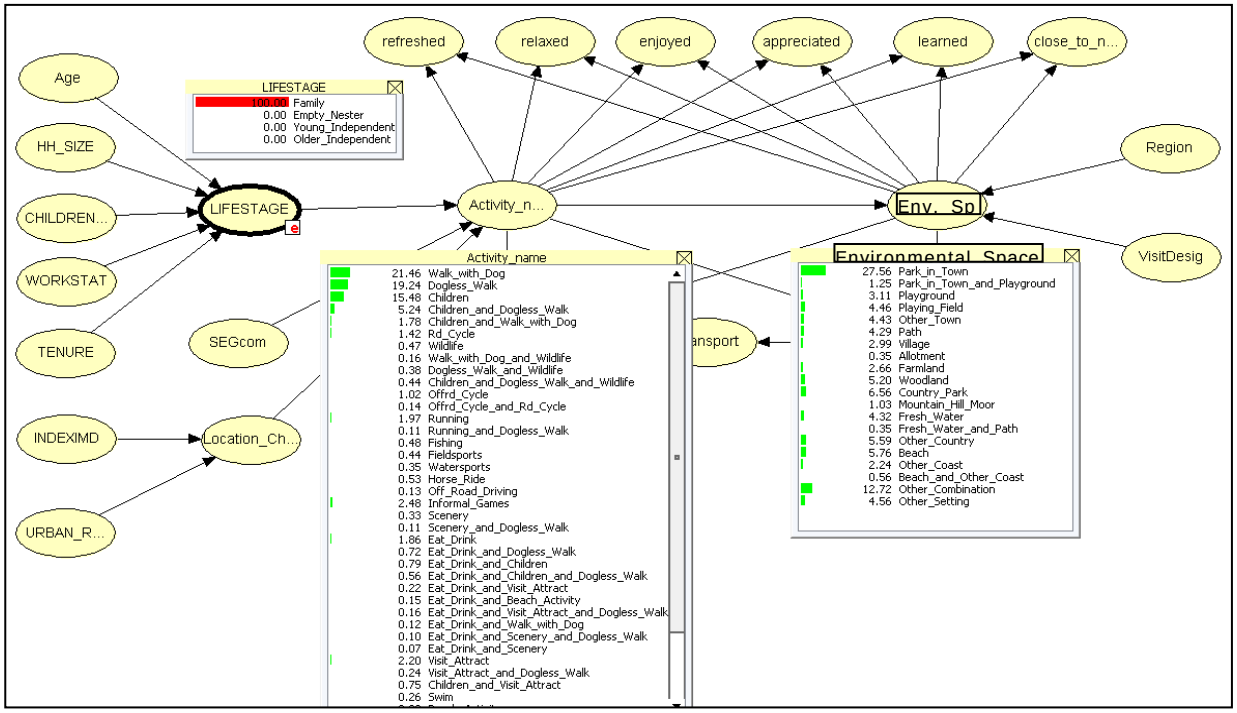



**Figure 5.A5.2b. The BBN shown in Figures 5.A5.1 and 5.A5.2a, showing probabilities for each Activity Name and Environmental Space Name when only those records for the 'Family' Lifestage are selected.**

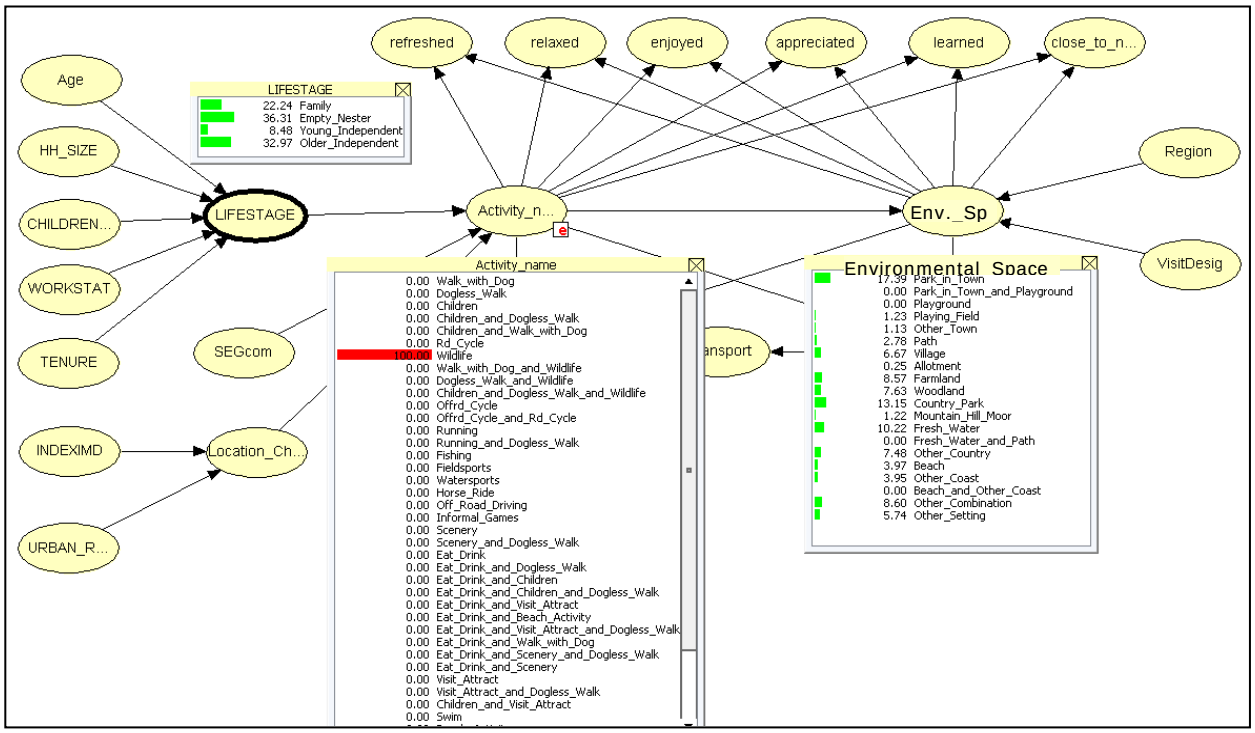



**Figure 5.A5.2c. The BBN shown in Figures and 5.A5.2a and b, with probabilities for Lifestage and Environmental Space Name when only those records for Wildlife Watching are selected.**

The HUGIN software enables users to visualise the relationships between the nodes using 'monitor windows' that show how the probabilities associated with them change as the inputs vary. The advantage of this approach in the context of using MENE is that it allows the data to be rapidly 'segmented' in different ways so that the patterns in the underlying data can be explored more easily. Thus in Figure 2a, for example, the monitor windows show the node states for activities and environmental spaces. In future work we propose to try to reduce the complexity of these categories by looking at the association of activities and setting types in more detail to determine whether a more hybrid structure can be developed (this would be guided in part by the results from the WP5 indicator component). During the preliminary stage, however, we preferred to retain as much of the original structure of the MENE data as possible so that the robustness of the BBN could be more easily tested.

Figure **5.A5.**2a shows the status of the nodes for activities, environmental spaces and lifestage after calibration of the network. In this state the network shows the probabilities of observing the activities undertaken and environmental spaces used by a respondent of a particular lifestage. The probabilities expressed for the lifestage node are based on the proportions of the different lifestage categories recorded in the MENE data. The BBN shows that the two 'walking' activities (with and without a dog) are the most likely activities. Parks in town, country parks and woodland are the most likely venues.

The BBN tool now lets us explore how our beliefs would change if we know or have evidence about the lifestage available to us. For example, if we set the probability of family to 100% for the lifestage node (i.e. only look at what families do and where they go) then the probability that the visit involves a park in a town increases (Figure **5.A5.**2b). Alternatively if we set the activity node to

'wildlife' (Figure **5.A5.**2c), then we would predict from the data that this should involve a higher proportion of 'empty nesters' and 'older independents' compared to when all activities are looked at together. Moreover, the probability of a respondent using a park in a town declines while there are increases in environmental spaces of a more rural character, such as farmland, woodland, country parks and fresh water. Although we do not show the corresponding diagrams here, when road cycling is selected, the monitor windows show that the probability of this being undertaken by an older independent increase substantially, and this is most likely to involve 'path' environmental spaces.

An important feature of any BBN is that this analysis illustrates is that as the probabilities at one node are changed the impacts are propagated across the network, as determined by the direction of the arrows in the influence diagram. Thus changing the category value selected in the activity node shows that people tend to travel shorter distances to observe wildlife than to observe scenery, and the duration of the visits are shorter. The nodes for distance and duration have states that are set to numerical ranges, and the software provides an estimate of the mean and variance of the resulting distribution. The mean distance travelled to observe wildlife is around 18 miles, whereas if observing scenery had been selected, it is just over 22 miles. The average length of trip for scenery is about 3.3 hours compared to 2.7 for observing wildlife.

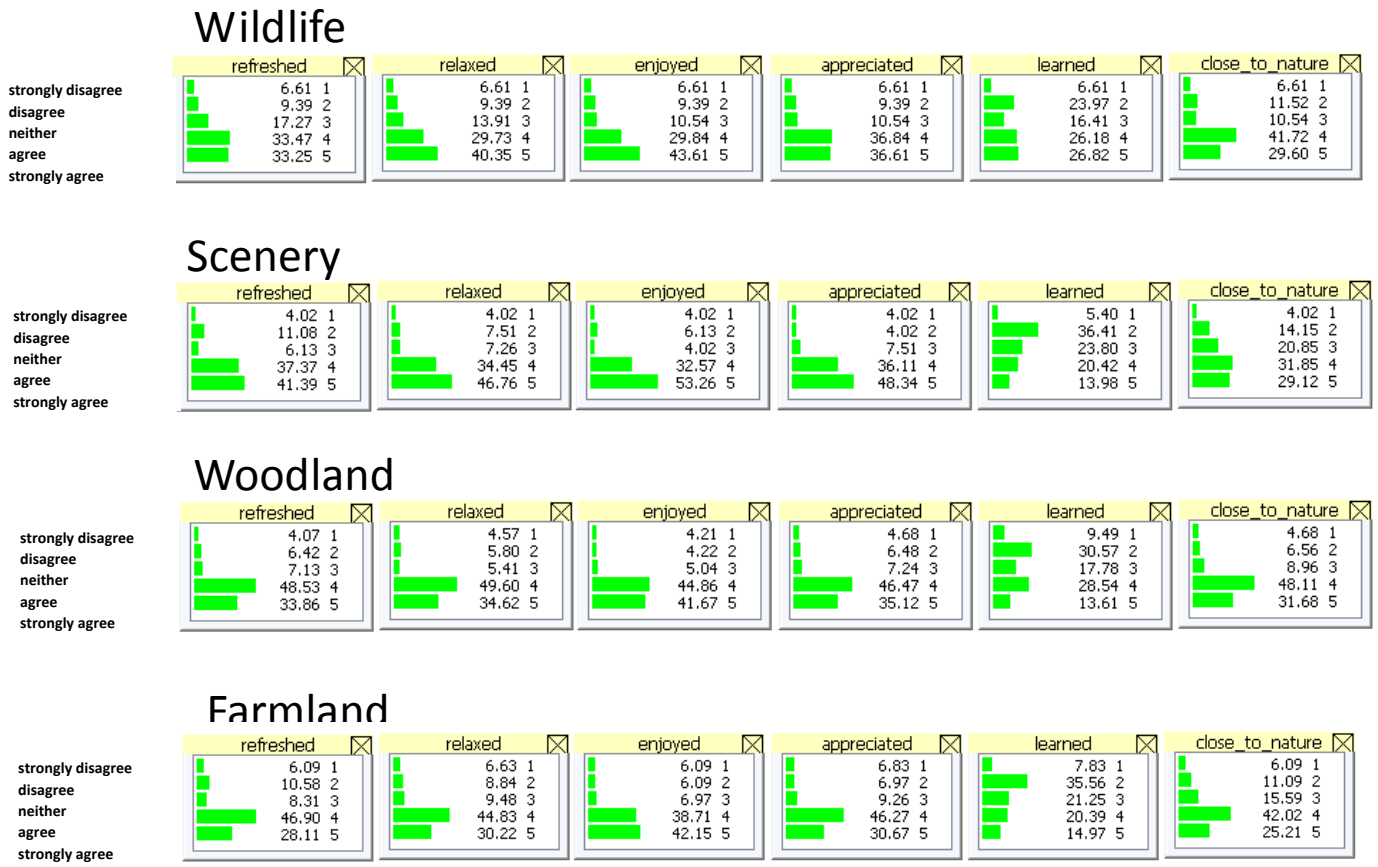



**Figure 5.A5.3. Proportion of records in the MENE dataset where the interviewee had said that strongly disagreed, disagreed, neither agreed nor disagreed, agreed or strongly agreed, with various statements about their experience of their visit: i) that they felt refreshed and revitalised, ii)had felt calm and relaxed, iii) had enjoyed the experience, iv) had taken time to appreciate their surroundings, v) had learned something new about the natural world, or vi) felt close to nature, for two types of activity – watching wildlife and enjoying scenery and two types of environmental space –woodland and farmland.**

The network shown in Figure **5.A5.**1 has also been used to investigate the data MENE provides for the strength of feelings they had about the visit (i.e. cultural benefits). The model suggests, for example, that people felt more strongly that they were 'close to nature' and had 'learned' from the experience when engaged in activities involving observing wildlife than when they were observing scenery (**Figure 5.A5.3**). The BBN showed that a similar difference in response arose when comparing the experience of visiting woodland and farmland.

In order to make the network more easily accessible to users we have created a web-based version of the network that can be used interactively[13]. This tool also allows exploration of the differences in patterns of behaviour in different areas across England. It takes the socio-demographic characteristics of Local Authorities across England as recorded in the census of population for 2011, and uses these to populate, or 'instantiate', the network, which then shows the predicted pattern of activities and sites visited used for a population with those characteristics. Some of the results gained from using this network will be discussed below.

### A 5.5.4 Results

*Network Performance*

In addition to testing the plausibility of the outcomes predicted by the BBN, and making a comparison of the outputs with published summaries of the patterns shown in the data, we also undertook a series of sensitivity and accuracy tests for the network using the HUGIN software. The tool provided by the HUGIN software for constructing the 'Receiver Operating Characteristic' (ROC) curve was used, for example, to test the prediction for 'Park' as the setting selected by people as opposed to any other location. Parks were selected as the target for analysis because it was one of the most frequently visited environmental spaces. This test was performed on the 10% subset of test data selected at random from the 56,000 records initially extracted from the MENE data for 2009-12; the method takes the known setting and compares it other predicted one. The area under the ROC curve gives a measure of the performance of the classifier, and the closer it is to 1.0 the better it is. The area calculated was 0.76 which is generally regarded as 'good'. Inspection of the confusion matrix underlying this test suggests, however, that the classification error rate is around 20% (**Table 5.A5.1**); using the BBN as a simple binary classifier to predict the use of Parks; the BBN seems to detect fewer visits than actually occur.

**Table 5.A5.1. Error rate for predicting visits to a park in the MENE dataset using the BBN**

| | Actual not in park | Actual in park | Total |
|---|---|---|---|
| Predicted not in Park | 3779 | 848 | 4627 |
| Predicted in Park | 279 | 492 | 771 |
| Total | 4058 | 1340 | 5398 |
| Error rate | 21% | | |

**Table 5.A5.2** illustrates the outcome of a complementary approach for testing the performance of the network. Here a confusion matrix has been constructed for *all* the setting types. This matrix shows better the patterns of misclassifications and highlights that the 'other combination' and 'other setting' groups stand out as the most problematic. While further work is clearly needed to find better ways of grouping these data it was concluded that the network could be used as a

[13] http://nea-scenarios.hugin.com/

starting point to explore how it might support the work on indicators and scenarios, at least for the more disaggregated types of visit and setting.

**Table 5.A5.2. Confusion Matrix between settings in the MENE dataset**

| | | Predicted | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Row Labels | Allotment | Beach | Beach_and_Other_Coast | Country_Park | Farmland | Fresh_Water | Fresh_Water_and_Path | Mountain_Hill_Moor | Other_Coast | Other_Combination | Other_Country | Other_Setting | Other_Town | Park_in_Town | Park_in_Town_and_Playground | Path | Playground | Playing_Field | Village | Woodland | Grand Total |
| Actual | Allotment | | | | | | | | | | 2 | | 2 | | 10 | | | | 1 | | 2 | 17 |
| | Beach | | 102 | 1 | 16 | | 10 | | 6 | 6 | 69 | 3 | 14 | | 78 | 1 | 5 | | 1 | | 14 | 326 |
| | Beach_and_Other_Coast | | 9 | | 2 | | | | 1 | | 8 | | | | 3 | | | | | 1 | | 24 |
| | Country_Park | 1 | 19 | 1 | 45 | 2 | 2 | | 7 | 2 | 70 | 12 | 8 | 5 | 121 | | 4 | | 6 | 3 | 37 | 345 |
| | Farmland | | 5 | | 6 | 5 | 2 | | 4 | 1 | 46 | 3 | 3 | 2 | 64 | | 2 | 1 | 3 | | 10 | 157 |
| | Fresh_Water | | 12 | | 17 | 1 | 27 | | 6 | 1 | 54 | 2 | 4 | 3 | 104 | | 5 | | | 2 | 14 | 252 |
| | Fresh_Water_and_Path | | | | 1 | | | | 1 | | 7 | | | | 7 | | | | | | 2 | 18 |
| | Mountain_Hill_Moor | | 8 | | 8 | 1 | 2 | | 5 | 1 | 16 | 1 | | 2 | 12 | | 1 | | 1 | | 6 | 64 |
| | Other_Coast | | 22 | | 14 | 1 | 8 | 1 | 3 | 5 | 30 | 2 | 6 | 1 | 41 | | 4 | | 2 | 2 | 11 | 153 |
| | Other_Combination | | 39 | 1 | 37 | 6 | 6 | 2 | 15 | 5 | 211 | 17 | 11 | 12 | 245 | | 28 | 4 | 3 | 6 | 32 | 680 |
| | Other_Country | | 18 | 1 | 22 | 5 | 7 | | 7 | 5 | 70 | 11 | 10 | 8 | 122 | | 12 | | 18 | 2 | 37 | 355 |
| | Other_Setting | 2 | 12 | | 8 | 1 | 1 | | | 3 | 36 | 10 | 53 | 6 | 115 | | 11 | | 6 | 2 | 10 | 276 |
| | Other_Town | | 8 | | 4 | | | | 1 | 3 | 38 | 9 | 12 | 18 | 164 | 1 | 9 | | 6 | 1 | 9 | 283 |
| | Park_in_Town | 3 | 19 | 1 | 36 | 3 | 8 | | 5 | 4 | 105 | 11 | 22 | 18 | 1000 | 1 | 32 | 6 | 30 | 6 | 30 | 1340 |
| | Park_in_Town_and_Playground | | | | 1 | | | | | | 5 | | | | 33 | | 1 | 2 | | | 2 | 44 |
| | Path | | 1 | 1 | 4 | 3 | 1 | | 4 | 1 | 52 | 7 | 2 | 12 | 150 | | 27 | | 1 | 1 | 7 | 274 |
| | Playground | | 3 | | 2 | | | | | | 3 | | 2 | | 68 | | 2 | 2 | | | | 82 |
| | Playing_Field | 1 | 4 | 1 | 7 | 1 | | | 2 | 1 | 27 | 5 | 6 | 5 | 121 | | 3 | | 52 | 2 | 6 | 244 |
| | Village | 1 | 11 | 1 | 13 | 2 | 2 | | 1 | 3 | 40 | 5 | 11 | 4 | 85 | | 10 | | 5 | 4 | 1 | 199 |
| | Woodland | | 11 | | 14 | | 2 | | 9 | 2 | 67 | 4 | 6 | 1 | 111 | | 11 | 1 | 2 | 1 | 41 | 283 |
| | **Grand Total** | **8** | **303** | **8** | **257** | **31** | **78** | **3** | **77** | **43** | **956** | **102** | **172** | **97** | **2654** | **3** | **167** | **16** | **137** | **33** | **271** | **5416** |

*Linking to CES Indicators*

The web-based BBN that links to the mapping at LAD level is a valuable analytical tool in the context of the indicators work that has been undertaken in UK NEAFO. A particular focus has been on understanding better the patterns of demand. This was dealt with in the work on Demand related indicators (Section 5.4.5) in the CES chapter.

The analysis of demand is based on the assumption that the degree to which people would like to have access to CES may differ locally, depending on the circumstances and characteristics of the local population. With this in mind, the BBN shown in Figure **5.A5.**1 was used to estimate the probability that a given individual would visit environmental places of various sorts and engage in certain activities within them. The probabilities for wildlife watching and country parks were derived using the census data to 'instantiate' the network for each LAD area (**Figure 5.A5.4a** and **b**); it is important to note that the estimated probabilities are based on the socio-demographic characteristics of the population alone, and do not take into account the effect of geographic location on the frequency of setting types. They are therefore to some degree location neutral and independent of *local* supply of CES.

The results show that there is a difference between these demand-side data, which measure the probability of an individual engaging in certain activities, and the supply-side indicators investigated in WP5, which looked at the amount or proportion of a particular type of types of environmental space available. The BBN offers the possibility of linking these two components and potentially to develop proxy indicators of the degree to which demand for CES matches supply. To illustrate this,

the mean values were calculated for an accessibility indicator based on the proportion of the adult population within the relevant ANGSt distance/size criteria for country parks. This value is then divided by the probabilities predicted by the BBN for visiting country parks. This resulted in a measure of the degree to which supply matches demand for visiting country parks (**Figure 5.A5.4c**). It can be seen that many districts in eastern and northern England, and the West Midlands had low scores for this indicator.

*Exploring Future Changes*

Thus far we have described the use of the tool to investigate current patterns of behaviour. We now turn to the problem of using the networks to support thinking about the impact of the scenarios developed by the UK NEA. A number of possibilities exist. We could, for example, investigate the impact of changing socio-demographic structure on demand. If we assume that patterns of behaviour and tastes remain the same across the different socio-economic groups into the future then we could use the network to predict for a given area the impact of, say, an 'ageing population'. This would be done by changing the proportions of the different life-stage groups in the network. An alternative approach would be to investigate how present-day geographical differences in the use of different environmental spaces might translate across the different UK NEA futures.

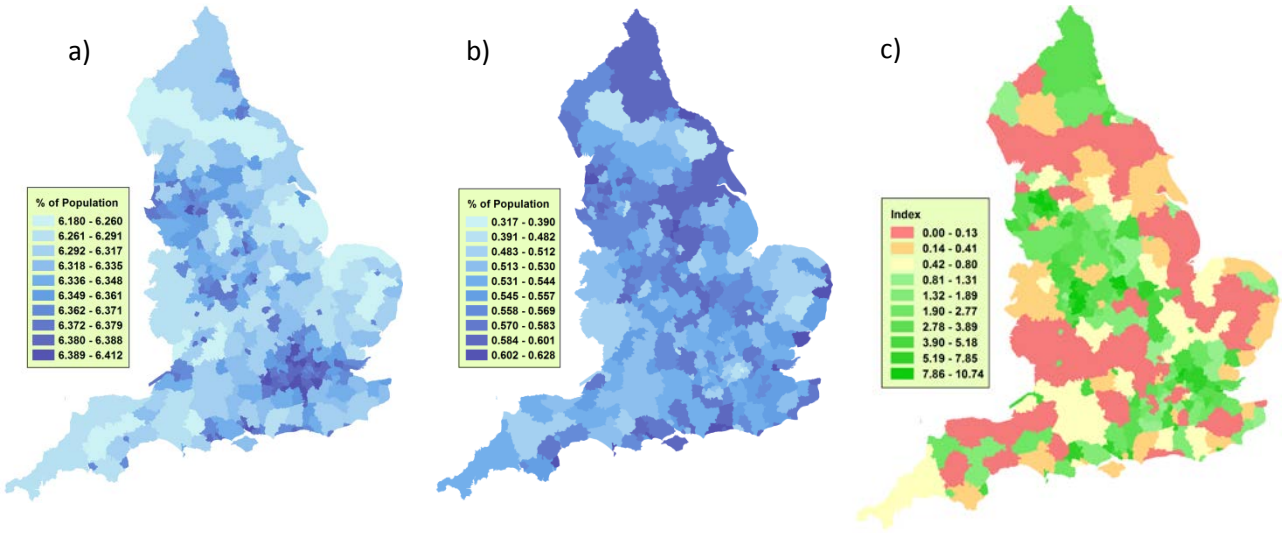



**Figure 5.A5.4. Probability of visiting a country park (a) and watching wildlife (b) within a given week, calculated on the basis of the relationship between the socio-demographic profile of each English district and responses to the MENE questionnaire. Figure c shows an index of the relationship between supply and demand for country parks, calculated as the data shown in Figure 5.4f of the main report (the proportion of the population within the relevant ANGSt distance/ size criteria of country parks) divided by that shown in Figure 5.A5.4a here (© CEM, Nottingham).**

For example, the facility of segmenting the data by region in the network shows that the patterns of activity and setting used by people in London and the South East are very different to other parts of England. People in these areas make many more trips to parks and other urban environmental spaces (**Figure 5a** and **b**). Under the *World Markets* scenario the influence of London is assumed to strengthen, and the South East in particular is projected to experience marked development in this future scenario. If the South East therefore becomes more like London, then we would expect the

importance of parks to increase, and planning for more urban green space in urban areas would seem to be an implication.

The data for the present day also suggests that across England people show some preference for areas that are designated in some way (e.g. 'Country Parks') (see **Figure 5.A5.5c** and **d**). The network also indicates that they feel marginally 'closer to nature' when visiting a designated site. The changing status and implied quality of sites under *World Markets* might also suggest potential modifications to patterns of use and derived benefit under this storyline. Perhaps the most significant implication is that when taken in taken in conjunction with the results of the spatial analysis of the MENE data, the reduction of the opportunity to visit woodlands near to where they live under, say, the *World Markets* scenario, would potentially limit their ability to feel 'close to nature', if present day preferences and tastes persist.

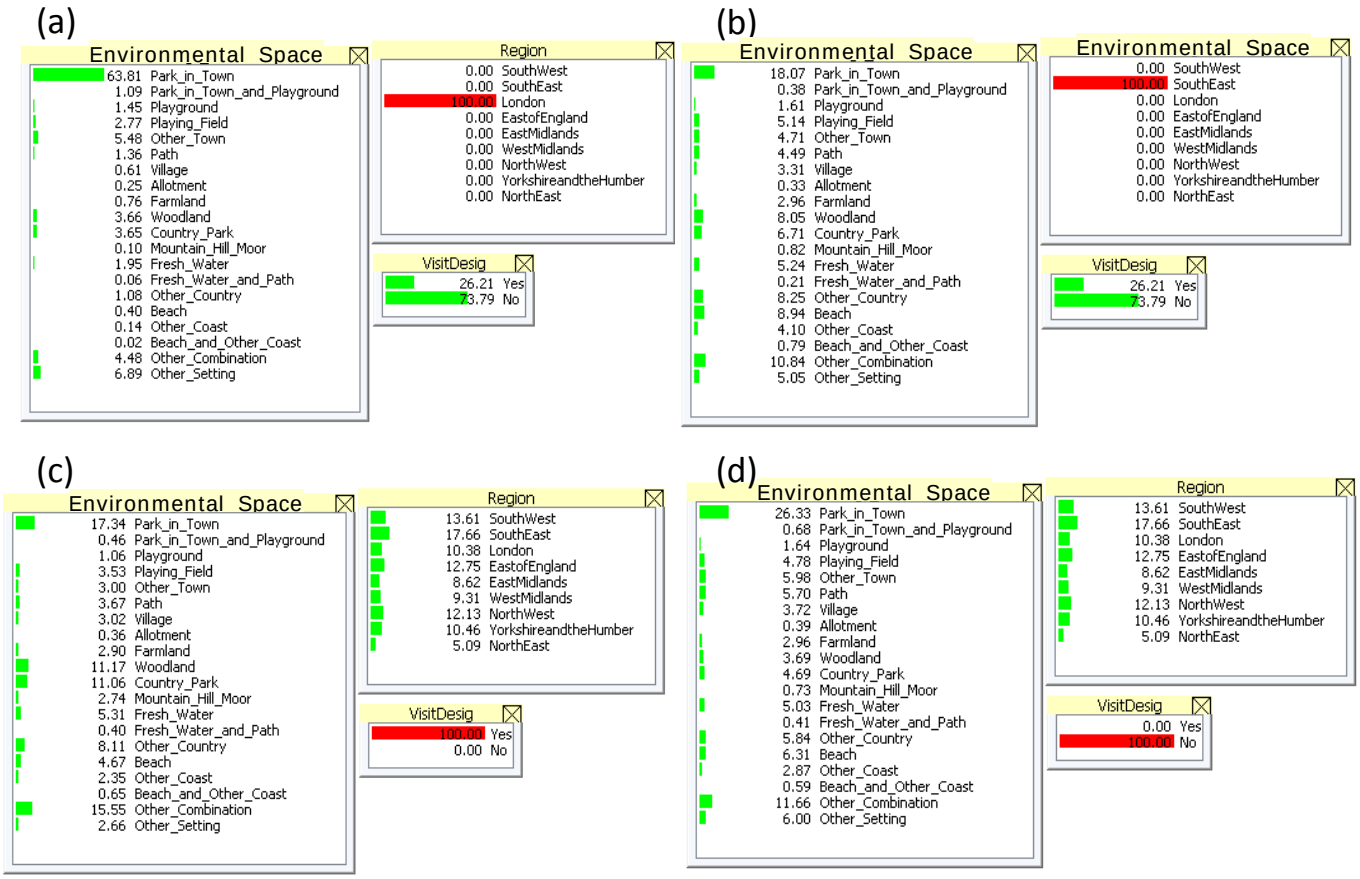



**Figure 5.A5.5. Probabilities of visiting different types of environmental space according the region (5a – data restricted to London residents, 5.A5.5b- data restricted to South East England residents) and whether the location of the visit was covered by an environmental designation (5.A5.5c, d), shown by the MENE data BBN illustrated in Figures 5.A5.1 and 5.A5.2 a,b,c.**

### A 5.5.5 Discussion and conclusions

The aim of the work described here was to better understand how CES can be framed in the context of the UK NEA indicators and scenarios work. CES are amongst the most difficult to conceptualise operationally and so the availability of the MENE provides an important opportunity for those working in this area to examine some of the issues empirically.

By using a Bayesian Network model to capture the relationships in the MENE data, the work has shown that it is possible to bring together this important information resource and the conceptual work on CES undertaken in UK NEAFO. The BBN described provides users with a way of rapidly exploring the MENE data and of understanding the dependencies between the key variables. The web-based version of this network that links to the 2011 census also demonstrates that it is possible to 'downscale' the findings, so that it can be used to inform analysis at more local levels. However, while the main contribution of this network is that it provides a new window on the current situation in relation to people's cultural practices and use of environmental spaces, it also offers the potential for thinking about how these might change under the different assumptions about the future. The task of modelling CES is a complex one because it involves an understanding of the biophysical characteristics and geography of the spaces people use, as well as people's motivations and practices. Thus the work reported here is of a preliminary nature and much remains to be done if we are to understand the relationships between the demand for and supply of CES. Nevertheless, the study demonstrates that by looking at the development of such models and current data sources new insights might be generated that can support the development of current thinking.

### A 5.5.6 References


**Natural England.** (2011a). *Monitor of Engagement with the Natural Environment.* Retrieved May 1, 2011, from http://www.naturalengland.org.uk/ourwork/enjoying/research/monitor/

**Natural England.** (2011b). *NECR122 - Monitor of Engagement with the Natural Environment: The national survey on people and the natural environment - Technical Report from the 2012-13 survey)*. Retrieved October 16th, 2013 from http://publications.naturalengland.org.uk/publication/1708625

**Barton, D. N.,** et al. (2012): Bayesian Networks in Environmental and Resource Management. *Integrated Environmental Assessment and Management* **8**(3): 418–429.

**Haines-Young, R.** (2011): Exploring ecosystem service issues across diverse knowledge domains using Bayesian Belief Networks. *Progress in Physical Geography* **35**(5): 681-700.

**Henriksen, H.J.** et al. (2011): Use of Bayesian Belief Networks for dealing with ambiguity in Integrated groundwater management. *Integrated Environmental Assessment and Management* , **8** (3), 430–444.

**Kjærulff, U.B** and Madsen, A.L. (2013): *Bayesian Networks and Influence Diagrams: A Guide to Construction and Analysis*. Second Edition. Springer.
See: http://link.springer.com/book/10.1007/978-1-4614-5104-4/page/1

**Kuikka, S.,** et al. (1999): Modeling environmentally driven uncertainties in Baltic cod (*Gadus morhua*) management by Bayesian influence diagrams*. Canadian Journal of Fisheries and Aquatic Sciences* **56**(4): 629-641.

**Landuyt, D.,** et al. (2013): A review of Bayesian belief networks in ecosystem service modelling, *Environmental Modelling & Software* http://dx.doi.org/10.1016/j.envsoft.2013.03.011

**McCann, R.,** et al. (2006): Bayesian Belief Networks: applications in natural resource management. *Canadian Journal of Forest Research* **36**: 3053-3062.

# Appendix 5.6: Regression Variables

### A 5.6.1 Variables used in the MENE wellbeing dataset regressions (N=3,224)

| CONTROL VARIABLES<br><br>MENE WELLBEING DATASET (N=3,224) | | Excluded variables | |
|---|---|---|---|
| **WAVE** | | | |
| dwave_id2 | Year==y1011 | dwave_id1 | year==y0910 |
| dwave_id3 | Year==y1112 | | |
| **SOCIOECONOMICS** | | | |
| age | Age - interval mid-points | | |
| age_sq | Age to the square | | |
| female | Female | | |
| dmarried1 | Married | | |
| nowhite | Ethnicity not white | | |
| disabled | Disabled or with long tern illness | | |
| child | Presence of children | | |
| dtenure2 | Own/Mortgage | | |
| dsoc_class2 | soc_class==2: D | dsoc_class1 | soc_class==1: E |
| dsoc_class3 | soc_class==3: C2 | | |
| dsoc_class4 | soc_class==4: C1 | | |
| dsoc_class5 | soc_class==5: A+B | | |
| dwork2 | workstat==2: FT Working | dwork1 | workstat==1: Not working |
| dwork3 | workstat==3: PT Working | | |
| dwork4 | workstat==4: Retired | | |
| dwork5 | workstat==5: In Education | | |
| **AREA** | | | |
| urban | OA urban Census 2001 | | |
| dregion2 | region==2: Yorks & Humberside | dregion1 | region==1: South-East |
| dregion3 | region==3: North West | | |

| | | | |
|---|---|---|---|
| dregion4 | region==4: West Midlands | | |
| dregion5 | region==5: East Midlands | | |
| dregion6 | region==6: East Anglia | | |
| dregion7 | region==7: South West | | |
| dregion8 | region==8: North East | | |
| dregion9 | region==9: Greater London | | |
| dIMD_5q2 | IMD_5quant==2 | dIMD_5q1 | IMD_5quant==1 |
| dIMD_5q3 | IMD_5quant==3 | | |
| dIMD_5q4 | IMD_5quant==4 | | |
| dIMD_5q5 | IMD_5quant==5 | | |
| **REASONS** | | | |
| mene_relax | Relaxation (outdoor visit) | None, they are non-exclusive | |
| mene_social | Socializing (outdoor visit) | | |
| mene_pets | Exercising pets (outdoor visit) | | |
| mene_actgr | Green activities (outdoor visit) | | |
| mene_exerc | Exercising (outdoor visit) | | |
| mene_other | Other activities (outdoor visit) | | |
| **TRIP** | | | |
| dplace2 | q5_mene_places==Green | dplace1 | q5_mene_places==Brown/Other |
| dplace3 | q5_mene_places==Blue | | |
| dtrip_from2 | trip_from==Holiday accommodation | dtrip_from1 | trip_from==Home |
| dtrip_from3 | trip_from==Other | | |
| dmode_transp2 | mode_transp==Public motor or train | dmode_transp1 | mode_transp==Private |
| dmode_transp3 | mode_transp==Walking | | |
| dmode_transp4 | mode_transp==Bike/Horse/Boat/Oth | | |
| hrs_out | Trip to public outdoor space duration (hours) | | |
| travel_time_hrs | Travel time (hours) | | |

### A 5.6.2 Variables used in the new garden dataset regressions

| CONTROL VARIABLES<br><br>NEW GARDEN DATASET | | Excluded variables | |
|---|---|---|---|
| **WAVE** | | | |
| dwave_id2 | wave==Week 22 | dwave_id1 | wave==Week 17 |
| dwave_id3 | wave==Week 26 | | |
| **SOCIOECONOMICS** | | | |
| age | Exact age | | |
| age_sq | Age to the square | | |
| female | Female | | |
| dmarried1 | cmari2==Married\Living as Married | | |
| nowhite | Ethnicity not white | | |
| disabled | q22_mene==Disabled or with long term illness | | |
| child | Presence of children | | |
| dtenure2 | Own/ Mortgage | | |
| dsoc_class2 | soc_class==2: D | dsoc_class1 | soc_class==1: E |
| dsoc_class3 | soc_class==3: C2 | | |
| dsoc_class4 | soc_class==4: C1 | | |
| dsoc_class5 | soc_class==5: A+B | | |
| dwork2 | workstat==2: FT Working | dwork1 | workstat==Not working |
| dwork3 | workstat==3: PT Working | | |
| dwork4 | workstat==4: Retired | | |
| dwork5 | workstat==5: In Education | | |
| **AREA** | | | |
| urban | OA urban Census 2001 | | |
| dregion2 | regions==2: Yorks & Humberside | dregion1 | region==1: South East |
| dregion3 | regions==3: North West | | |

| | | | |
|---|---|---|---|
| dregion4 | regions==4: West Midlands | | |
| dregion5 | regions==5: East Midlands | | |
| dregion6 | regions==6: East Anglia | | |
| dregion7 | regions==7: South West | | |
| dregion8 | regions==8: North East | | |
| dregion9 | regions==9: Greater London | | |
| dIMD_5q2 | IMD_5quant==2 | dIMD_5q1 | IMD_5quant==1 |
| dIMD_5q3 | IMD_5quant==3 | | |
| dIMD_5q4 | IMD_5quant==4 | | |
| dIMD_5q5 | IMD_5quant==5 | | |
| **REASONS** | | | |
| mene_relax | Relaxation (outdoor visit) | None, they are non-exclusive | |
| mene_social | Socializing (outdoor visit) | | |
| mene_pets | Exercising pets (outdoor visit) | | |
| mene_actgr | Green activities (outdoor visit) | | |
| mene_exerc | Exercising (outdoor visit) | | |
| mene_other | Other activities (outdoor visit) | | |
| gard_relax | Relaxation (garden visit) | None, they are non-exclusive | |
| gard_social | Socializing (garden visit) | | |
| gard_pets | Exercising pets (garden visit) | | |
| gard_actgr | Green activities (garden visit) | | |
| gard_exerc | Exercising (garden visit) | | |
| gard_actoth | Other non-green activities (garden visit) | | |
| gard_garden | Gardening (garden visit) | | |
| gard_other | Other (garden visit) | | |
| **TRIP** | | | |
| dplace2 | q5_mene_places==Green | dplace1 | q5_mene_places==Brown/Other |
| dplace3 | q5_mene_places==Blue | | |

| | | | |
|---|---|---|---|
| dtrip_from2 | trip_from==Holiday accommodation | dtrip_from1 | trip_from==Home |
| dtrip_from3 | trip_from==Other | | |
| dmode_transp2 | mode_transp==Public motor or train | dmode_transp1 | mode_transp==Private motor |
| dmode_transp3 | mode_transp==Walking | | |
| dmode_transp4 | mode_transp==Bike/Horse/Boat/Oth | | |
| hrs_out | Trip to public outdoor space duration (hours) | | |
| travel_time_hrs | Travel time (hours) | | |
| hrs_garden | Trip to the garden duration (hours) | | |
| **GARDEN** | | | |
| Access to private garden | Dummy | | |
| Garden is too small | Dummy | | |
| Garden is too large | Dummy | | |

**A 5.6.3 Wellbeing associated with a visit to a public outdoor space: effects of visit duration, natural spaces and interaction with nature (MENE wellbeing dataset, N=3,224; SD in parenthesis; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$)**

| **WELLBEING ASSOCIATED WITH A VISIT TO A PUBLIC OUTDOOR SPACE**<br>**MENE WELLBEING DATASET (N=3,224)** | | | |
|---|---|---|---|
| **Cols 1-3: Wellbeing as scale variables (5 strongly agree, 1 strongly disagree)** | | | |
| | **W1** | **W2** | **W3** |
| | **I enjoyed it** | **It made me feel calm and relaxed** | **It made me feel refreshed and revitalised** |
| hrs_out | 0.01737 | 0.00161 | 0.00113 |
| | [0.00465]*** | [0.00719] | [0.00784] |
| travel_time_hrs | 0.00952 | 0.02161 | 0.00923 |
| | [0.02373] | [0.02712] | [0.03106] |
| q5_mene_places==Green | 0.04614 | 0.14691 | 0.1562 |
| | [0.02906] | [0.04052]*** | [0.04139]*** |
| q5_mene_places==Blue | 0.04896 | 0.20619 | 0.23482 |
| | [0.03632] | [0.04831]*** | [0.04981]*** |
| mene_relax | 0.08635 | 0.21874 | 0.18623 |
| | [0.02255]*** | [0.03172]*** | [0.03160]*** |
| mene_social | 0.02347 | -0.10555 | -0.07386 |
| | [0.02492] | [0.03499]*** | [0.03477]** |
| mene_pets | 0.01116 | 0.09034 | -0.00443 |
| | [0.02600] | [0.03522]** | [0.03766] |
| mene_actgr | 0.11188 | 0.16578 | 0.08964 |
| | [0.02981]*** | [0.03838]*** | [0.04566]** |
| mene_exerc | 0.07438 | 0.03958 | 0.08643 |
| | [0.02318]*** | [0.03037] | [0.03266]*** |
| mene_other | 0.09077 | -0.11874 | -0.03512 |
| | [0.04593]** | [0.07062]* | [0.06390] |

| | | | |
|---|---|---|---|
| age | 0.00515 | 0.01057 | 0.00934 |
| | [0.00403] | [0.00585]* | [0.00594] |
| Age to the square | -0.00004 | -0.0001 | -0.00007 |
| | [0.00004] | [0.00006] | [0.00006] |
| Female | 0.02921 | -0.00943 | 0.02757 |
| | [0.02114] | [0.02862] | [0.03044] |
| dmarried1 | 0.00246 | -0.04162 | -0.01968 |
| | [0.02380] | [0.03360] | [0.03374] |
| nowhite | -0.02046 | 0.07949 | 0.0963 |
| | [0.04292] | [0.04980] | [0.05253]* |
| disabled | -0.01043 | -0.05545 | -0.15662 |
| | [0.02889] | [0.03984] | [0.04374]*** |
| child | -0.01669 | -0.04074 | -0.01177 |
| | [0.02637] | [0.03566] | [0.03690] |
| dtenure2 | 0.00732 | -0.00847 | 0.01449 |
| | [0.02567] | [0.03601] | [0.03708] |
| soc_class==2: D | -0.02494 | -0.03249 | 0.02904 |
| | [0.04417] | [0.05803] | [0.06291] |
| soc_class==3: C2 | -0.01567 | -0.02102 | -0.0298 |
| | [0.04330] | [0.05376] | [0.05993] |
| soc_class==4: C1 | 0.03661 | 0.00054 | 0.05249 |
| | [0.03994] | [0.05198] | [0.05641] |
| soc_class==5: A+B | 0.04601 | -0.0142 | 0.03712 |
| | [0.04178] | [0.05466] | [0.05917] |
| workstat==2: FT Working | 0.05772 | 0.02527 | 0.09528 |
| | [0.03568] | [0.04890] | [0.05185]* |
| workstat==3: PT Working | 0.07315 | -0.0119 | 0.11551 |
| | [0.04019]* | [0.05578] | [0.05891]** |
| workstat==4: Retired | 0.09349 | 0.06713 | 0.10335 |

| | | | |
|---|---|---|---|
| | [0.04978]* | [0.07133] | [0.07347] |
| workstat==5: In Education | 0.06499 | 0.03959 | -0.01512 |
| | [0.05705] | [0.07857] | [0.08609] |
| OA urban Census 2001 | -0.05613 | -0.04171 | -0.06201 |
| | [0.02678]** | [0.03626] | [0.03782] |
| region==2: Yorks & Humberside | 0.01474 | -0.00121 | 0.00629 |
| | [0.04239] | [0.05804] | [0.05920] |
| region==3: North West | -0.01912 | -0.01461 | 0.0127 |
| | [0.03620] | [0.05271] | [0.05314] |
| region==4: West Midlands | 0.06924 | 0.04277 | 0.00776 |
| | [0.04016]* | [0.05406] | [0.05860] |
| region==5: East Midlands | 0.06002 | 0.03433 | -0.0051 |
| | [0.04157] | [0.06312] | [0.06474] |
| region==6: East Anglia | -0.00624 | 0.02036 | -0.02347 |
| | [0.03997] | [0.05159] | [0.05314] |
| region==7: South West | -0.00754 | -0.03389 | -0.02936 |
| | [0.03665] | [0.04952] | [0.05277] |
| region==8: North East | -0.00827 | 0.02686 | 0.14333 |
| | [0.05427] | [0.07299] | [0.07511]* |
| region==9: Greater London | 0.00956 | 0.12022 | 0.12044 |
| | [0.04178] | [0.05468]** | [0.05625]** |
| IMD_5quant==2 | 0.0019 | 0.00505 | 0.05522 |
| | [0.03282] | [0.04355] | [0.04734] |
| IMD_5quant==3 | 0.03247 | 0.01629 | 0.11878 |
| | [0.03068] | [0.04322] | [0.04542]*** |
| IMD_5quant==4 | 0.05227 | 0.01954 | 0.12572 |
| | [0.03428] | [0.04664] | [0.04827]*** |
| IMD_5quant==5 | 0.01505 | -0.08136 | 0.02113 |
| | [0.03709] | [0.05321] | [0.05513] |

| | | | |
|---|---|---|---|
| trip_from== Holiday accommodation | -0.02061 | 0.05278 | -0.11043 |
| | [0.07443] | [0.10199] | [0.11749] |
| trip_from==Other | -0.05643 | -0.08186 | -0.21115 |
| | [0.07186] | [0.10636] | [0.11885]* |
| mode_transp== Public motor or train | 0.01495 | -0.08116 | 0.01619 |
| | [0.06273] | [0.08871] | [0.08023] |
| mode_transp==Walking | -0.02243 | 0.02552 | 0.04282 |
| | [0.02380] | [0.03277] | [0.03419] |
| mode_transp== Bike/Horse/Boat/Oth | 0.09493 | 0.07066 | 0.1662 |
| | [0.05798] | [0.09136] | [0.08740]* |
| year==y1011 | -0.03478 | -0.02089 | 0.03557 |
| | [0.02583] | [0.03569] | [0.03722] |
| year==y1112 | -0.05412 | 0.0001 | 0.03841 |
| | [0.02464]** | [0.03387] | [0.03526] |
| Constant | 4.03981 | 3.63568 | 3.36503 |
| | [0.10545]*** | [0.14831]*** | [0.15710]*** |
| Observations | 3224 | 3224 | 3224 |
| r2 | 0.05508 | 0.06863 | 0.06608 |
| r2_a | 0.0414 | 0.05514 | 0.05256 |
| F | 4.46438 | 4.99495 | 4.55573 |

**A 5.6.4 Wellbeing associated with a visit to a public outdoor space: effects of visit duration, natural spaces and interaction with nature (New garden module, Wave 22, N=317; SD in parenthesis; *** p < 0.01, ** p < 0.05, * p < 0.10)**

| **WELLBEING ASSOCIATED WITH A VISIT TO A PUBLIC OUTDOOR SPACE**<br><br>**NEW GARDEN MODULE -WAVE 22 (N=317)** | | | |
|---|---|---|---|
| **Cols 1-3: Wellbeing as scale variables (5 strongly agree, 1 strongly disagree)** | | | |
| | **W1** | **W2** | **W3** |
| | **I enjoyed it** | **It made me feel calm and relaxed** | **It made me feel refreshed and revitalised** |
| hrs_out | 0.02076 | 0.03923 | 0.01746 |
| | [0.01047]** | [0.02214]* | [0.01890] |
| travel_time_hrs | -0.00077 | 0.01741 | -0.12266 |
| | [0.07210] | [0.10210] | [0.10395] |
| q5_mene_places==Green | 0.04851 | 0.11497 | 0.27003 |
| | [0.09475] | [0.13068] | [0.14028]* |
| q5_mene_places==Blue | 0.1422 | 0.27744 | 0.45036 |
| | [0.11687] | [0.15808]* | [0.16524]*** |
| mene_relax | 0.15484 | 0.30958 | 0.16491 |
| | [0.06984]** | [0.10479]*** | [0.10288] |
| mene_social | 0.10512 | 0.00335 | 0.05053 |
| | [0.08990] | [0.14693] | [0.12917] |
| mene_pets | 0.16541 | 0.24091 | 0.07277 |
| | [0.09404]* | [0.14094]* | [0.13386] |
| mene_actgr | 0.13419 | -0.06074 | -0.04243 |
| | [0.09002] | [0.17337] | [0.16303] |
| mene_exerc | 0.038 | 0.10461 | 0.21353 |
| | [0.07149] | [0.12032] | [0.09942]** |
| mene_other | 0.05508 | -0.29929 | 0.03848 |
| | [0.10782] | [0.26260] | [0.18713] |

| | | | |
|---|---|---|---|
| Exact age | 0.01542 | 0.02449 | 0.05394 |
| | [0.01199] | [0.01618] | [0.01524]*** |
| Age to the square | -0.00014 | -0.00029 | -0.00058 |
| | [0.00013] | [0.00019] | [0.00017]*** |
| Female | 0.10437 | 0.07243 | 0.18828 |
| | [0.07117] | [0.10795] | [0.10002]* |
| dmarried1 | -0.00648 | -0.02782 | -0.0745 |
| | [0.07622] | [0.12251] | [0.11331] |
| nowhite | 0.05184 | -0.03732 | 0.3811 |
| | [0.11089] | [0.15850] | [0.14087]*** |
| disabled | 0.08164 | 0.02211 | -0.04658 |
| | [0.08641] | [0.14229] | [0.15112] |
| child | -0.09565 | -0.03406 | -0.00937 |
| | [0.08908] | [0.12810] | [0.12280] |
| dtenure2 | -0.02507 | 0.02936 | -0.0977 |
| | [0.08032] | [0.12603] | [0.10530] |
| soc_class==D | -0.1632 | -0.42504 | -0.42127 |
| | [0.13124] | [0.17913]** | [0.17709]** |
| soc_class==C2 | -0.12178 | -0.2759 | -0.47991 |
| | [0.13081] | [0.16623]* | [0.17202]*** |
| soc_class==C1 | -0.15011 | -0.46324 | -0.6733 |
| | [0.12584] | [0.16347]*** | [0.17540]*** |
| soc_class==A+B | -0.05659 | -0.47256 | -0.50469 |
| | [0.13596] | [0.19278]** | [0.18515]*** |
| workstat==FT Working | -0.0368 | 0.13699 | 0.24301 |
| | [0.10343] | [0.14796] | [0.12840]* |
| workstat==PT Working | 0.00611 | 0.06706 | 0.15525 |
| | [0.11035] | [0.18892] | [0.15551] |
| workstat==Retired | -0.01412 | 0.18921 | 0.22662 |

| | | | |
|---|---|---|---|
| | [0.13953] | [0.24668] | [0.21069] |
| workstat==In Education | 0.23759 | 0.12027 | 0.51478 |
| | [0.18460] | [0.25308] | [0.19581]*** |
| OA urban Census 2001 | -0.01161 | -0.10111 | 0.01872 |
| | [0.08686] | [0.14308] | [0.13481] |
| regions== Yorks & Humberside | -0.12731 | -0.0264 | -0.04117 |
| | [0.10523] | [0.12106] | [0.13766] |
| regions==North West | -0.03178 | -0.25708 | -0.23682 |
| | [0.09880] | [0.19947] | [0.16628] |
| regions== West Midlands | -0.1323 | -0.11922 | -0.19726 |
| | [0.10974] | [0.15634] | [0.15531] |
| regions== East Midlands | -0.02645 | -0.08202 | -0.16612 |
| | [0.12850] | [0.24057] | [0.17048] |
| regions==East Anglia | 0.07022 | -0.13048 | -0.7644 |
| | [0.19046] | [0.74935] | [0.68389] |
| regions==South West | -0.10553 | 0.00408 | -0.23083 |
| | [0.12995] | [0.16666] | [0.16515] |
| regions==North | -0.20874 | -0.35525 | -0.27373 |
| | [0.14101] | [0.20816]* | [0.17363] |
| regions== Greater London | -0.24941 | -0.05742 | -0.09322 |
| | [0.12642]** | [0.15422] | [0.14799] |
| IMD_5quant==2 | -0.13511 | -0.14925 | -0.13616 |
| | [0.09718] | [0.19494] | [0.15428] |
| IMD_5quant==3 | -0.26151 | -0.11806 | -0.31669 |
| | [0.10621]** | [0.18966] | [0.15013]** |
| IMD_5quant==4 | -0.02586 | 0.12142 | -0.24583 |
| | [0.10948] | [0.19383] | [0.17036] |
| IMD_5quant==5 | -0.09414 | -0.05905 | -0.36128 |
| | [0.10962] | [0.18631] | [0.17427]** |

| | | | |
|---|---|---|---|
| trip_from== Holiday accommodation | 0.21172 | 0.05439 | 0.03405 |
| | [0.17018] | [0.26749] | [0.34410] |
| trip_from==Other | 0.0951 | -0.25809 | -0.36916 |
| | [0.16120] | [0.25741] | [0.26216] |
| mode_transp== Public motor or train | -0.01473 | -0.03166 | 0.29766 |
| | [0.12547] | [0.21430] | [0.15721]* |
| mode_transp==Walking | -0.06452 | -0.05102 | -0.03293 |
| | [0.07785] | [0.13508] | [0.11724] |
| mode_transp== Bike/Horse/Boat/Oth | 0.24999 | -0.02315 | 0.64109 |
| | [0.16057] | [0.39268] | [0.17764]*** |
| Constant | 4.09635 | 3.74341 | 3.13482 |
| | [0.31115]*** | [0.43010]*** | [0.40463]*** |
| Observations | 317 | 317 | 317 |
| r2 | 0.20238 | 0.15428 | 0.26135 |
| r2_a | 0.07335 | 0.01747 | 0.14186 |
| F | 2.24434 | 1.63461 | 3.63826 |

**A 5.6.5 Wellbeing associated with a visit to the garden: effects of visit duration and interaction with nature (New garden module, N=1,707; SD in parenthesis; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$)**

| WELLBEING ASSOCIATED WITH A VISIT TO THE GARDEN<br>NEW GARDEN MODULE (N=1,707) | | | |
|---|---|---|---|
| **Cols 1-3: Wellbeing as scale variables (5 strongly agree, 1 strongly disagree)** | | | |
| | **W1** | **W2** | **W3** |
| | **I enjoyed it** | **It made me feel calm and relaxed** | **It made me feel refreshed and revitalised** |
| hrs_garden | 0.03838 | 0.03439 | 0.02409 |
| | [0.00880]*** | [0.00990]*** | [0.01108]** |
| gard_garden | 0.03887 | 0.03415 | -0.01145 |
| | [0.03721] | [0.04509] | [0.04693] |
| gard_relax | 0.30966 | 0.40794 | 0.37219 |
| | [0.03641]*** | [0.04252]*** | [0.04548]*** |
| gard_social | 0.15566 | 0.10914 | 0.14589 |
| | [0.03676]*** | [0.04459]** | [0.04745]*** |
| gard_pets | -0.00304 | -0.05776 | -0.01771 |
| | [0.05393] | [0.06687] | [0.06815] |
| gard_actgr | 0.08028 | 0.05223 | 0.13705 |
| | [0.03846]** | [0.04527] | [0.04911]*** |
| gard_actoth | 0.05388 | 0.13482 | 0.16547 |
| | [0.04797] | [0.05190]*** | [0.05775]*** |
| gard_exerc | 0.05803 | 0.08111 | 0.11776 |
| | [0.04991] | [0.06254] | [0.06896]* |
| gard_other | -0.05623 | -0.02414 | -0.06533 |
| | [0.08809] | [0.10036] | [0.11259] |
| Exact age | 0.0088 | 0.01554 | 0.01579 |
| | [0.00588] | [0.00676]** | [0.00690]** |
| Age to the square | -0.00005 | -0.00011 | -0.00012 |

| | | | |
|---|---|---|---|
| | [0.00006] | [0.00007] | [0.00007]* |
| Female | 0.12549 | 0.11033 | 0.17638 |
| | [0.03434]*** | [0.04131]*** | [0.04555]*** |
| dmarried1 | 0.04783 | -0.02866 | -0.02475 |
| | [0.03789] | [0.04536] | [0.04865] |
| nowhite | -0.02539 | 0.04894 | 0.13728 |
| | [0.05851] | [0.06399] | [0.06991]** |
| disabled | -0.01265 | -0.03207 | -0.12046 |
| | [0.04386] | [0.05238] | [0.05794]** |
| child | -0.04117 | -0.06109 | -0.02375 |
| | [0.04573] | [0.05059] | [0.05390] |
| dtenure2 | 0.02102 | 0.00023 | -0.00371 |
| | [0.04159] | [0.04734] | [0.04969] |
| soc_class==D | -0.13285 | -0.09693 | -0.12333 |
| | [0.05993]** | [0.07221] | [0.07560] |
| soc_class==C2 | -0.03464 | -0.06369 | -0.1119 |
| | [0.05845] | [0.07009] | [0.07548] |
| soc_class==C1 | -0.08041 | -0.12802 | -0.13481 |
| | [0.05675] | [0.06877]* | [0.07270]* |
| soc_class==A+B | -0.00892 | -0.03177 | -0.0504 |
| | [0.05870] | [0.07208] | [0.07739] |
| workstat==FT Working | 0.0057 | 0.04904 | 0.01444 |
| | [0.05560] | [0.06320] | [0.06918] |
| workstat==PT Working | 0.03599 | 0.109 | 0.06715 |
| | [0.06477] | [0.07620] | [0.07736] |
| workstat==Retired | -0.02726 | -0.02221 | 0.0042 |
| | [0.07016] | [0.08970] | [0.09641] |
| workstat==In Education | 0.00656 | 0.09604 | -0.04694 |
| | [0.10661] | [0.10107] | [0.11677] |

| | | | |
|---|---|---|---|
| Access to private garden | -0.08695 | 0.09526 | -0.05942 |
| | [0.09696] | [0.13104] | [0.12968] |
| Garden is too small | -0.04036 | -0.13573 | -0.05911 |
| | [0.04970] | [0.06298]** | [0.06748] |
| Garden is too large | -0.15273 | -0.10038 | -0.24832 |
| | [0.08425]* | [0.11102] | [0.11789]** |
| OA urban Census 2001 | -0.05243 | -0.05765 | -0.03736 |
| | [0.04149] | [0.04980] | [0.05426] |
| regions== Yorks & Humberside | -0.05951 | -0.06274 | -0.09269 |
| | [0.05993] | [0.07535] | [0.07991] |
| regions==North West | -0.02772 | -0.0425 | -0.06593 |
| | [0.05835] | [0.06909] | [0.07855] |
| regions== West Midlands | -0.07421 | 0.02928 | 0.04268 |
| | [0.06205] | [0.06951] | [0.07557] |
| regions== East Midlands | -0.06262 | -0.04036 | -0.05711 |
| | [0.06350] | [0.06818] | [0.08105] |
| regions==East Anglia | 0.0892 | -0.02155 | 0.27419 |
| | [0.11320] | [0.13860] | [0.13461]** |
| regions==South West | -0.11756 | -0.1327 | -0.09975 |
| | [0.05993]** | [0.06794]* | [0.07581] |
| regions==North East | 0.01281 | -0.24228 | -0.17494 |
| | [0.06662] | [0.08768]*** | [0.09426]* |
| regions== Greater London | 0.09536 | 0.11759 | 0.22803 |
| | [0.05791]* | [0.06312]* | [0.06946]*** |
| IMD_5quant==2 | 0.09276 | 0.08039 | 0.10035 |
| | [0.05311]* | [0.06108] | [0.06742] |
| IMD_5quant==3 | -0.06663 | -0.01949 | -0.05163 |
| | [0.05558] | [0.06481] | [0.07196] |
| IMD_5quant==4 | 0.02238 | 0.08461 | 0.02952 |

| | | | |
|---|---|---|---|
| | [0.05772] | [0.06403] | [0.07451] |
| IMD_5quant==5 | -0.02991 | 0.04256 | -0.00468 |
| | [0.05938] | [0.07035] | [0.07774] |
| wave==Week 22 | -0.02846 | 0.00394 | 0.07696 |
| | [0.04045] | [0.04578] | [0.05070] |
| wave==Week 26 | 0.02799 | 0.02827 | 0.01704 |
| | [0.04072] | [0.04836] | [0.05203] |
| Constant | 3.72087 | 3.19947 | 3.20081 |
| | [0.21092]*** | [0.23304]*** | [0.23358]*** |
| Observations | 1707 | 1703 | 1704 |
| r2 | 0.13982 | 0.13016 | 0.13767 |
| r2_a | 0.11758 | 0.10761 | 0.11534 |
| F | 6.71904 | 6.45841 | 7.14515 |

**A 5.6.6 Wellbeing associated with a visit to the garden: effects of visit duration and interaction with nature (New garden module, Wave 22, N=595; SD in parenthesis; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$)**

| **WELLBEING ASSOCIATED WITH A VISIT TO THE GARDEN**<br><br>**NEW GARDEN MODULE -WAVE 22 (N=595)** | | | |
|---|---|---|---|
| **Cols 1-3: Wellbeing as scale variables (5 strongly agree, 1 strongly disagree)** | | | |
| | **W1** | **W2** | **W3** |
| | **I enjoyed it** | **It made me feel calm and relaxed** | **It made me feel refreshed and revitalised** |
| hrs_garden | 0.03209 | 0.04239 | 0.02348 |
| | [0.01162]*** | [0.01302]*** | [0.01620] |
| gard_garden | 0.02214 | 0.06079 | -0.06184 |
| | [0.06146] | [0.07226] | [0.08093] |
| gard_relax | 0.36743 | 0.40387 | 0.37991 |
| | [0.06174]*** | [0.07531]*** | [0.08397]*** |
| gard_social | 0.15429 | 0.00542 | 0.19704 |
| | [0.05809]*** | [0.07315] | [0.07680]** |
| gard_pets | 0.02979 | -0.13003 | -0.06497 |
| | [0.09425] | [0.11772] | [0.11338] |
| gard_actgr | 0.04627 | 0.01279 | 0.12984 |
| | [0.06136] | [0.07154] | [0.08179] |
| gard_actoth | 0.08864 | 0.27416 | 0.35994 |
| | [0.08764] | [0.09335]*** | [0.09231]*** |
| gard_exerc | 0.13557 | 0.16635 | 0.13867 |
| | [0.09309] | [0.11390] | [0.12659] |
| gard_other | -0.01583 | -0.11514 | -0.30379 |
| | [0.12251] | [0.17898] | [0.19320] |
| Exact age | 0.00496 | 0.00583 | 0.01276 |
| | [0.00988] | [0.01122] | [0.01141] |

| | | | |
|---|---|---|---|
| Age to the square | -0.00004 | -0.00006 | -0.00015 |
| | [0.00009] | [0.00012] | [0.00012] |
| Female | 0.12173 | 0.07246 | 0.04359 |
| | [0.05648]** | [0.06985] | [0.07783] |
| dmarried1 | -0.00013 | 0.0077 | -0.10675 |
| | [0.06210] | [0.07638] | [0.08335] |
| nowhite | -0.09551 | 0.03197 | 0.20857 |
| | [0.09948] | [0.11273] | [0.11374]* |
| disabled | 0.001 | 0.05704 | 0.03861 |
| | [0.07276] | [0.09043] | [0.10578] |
| child | -0.06056 | -0.02126 | -0.00186 |
| | [0.07450] | [0.08059] | [0.09246] |
| dtenure2 | -0.00999 | -0.02806 | 0.02061 |
| | [0.07259] | [0.07858] | [0.08830] |
| soc_class==D | -0.31411 | -0.22194 | -0.30915 |
| | [0.09750]*** | [0.12230]* | [0.13947]** |
| soc_class==C2 | -0.15452 | -0.23391 | -0.29915 |
| | [0.10092] | [0.11769]** | [0.13699]** |
| soc_class==C1 | -0.18156 | -0.21727 | -0.36014 |
| | [0.09218]** | [0.10573]** | [0.12574]*** |
| soc_class==A+B | -0.09158 | -0.19506 | -0.28578 |
| | [0.09503] | [0.11977] | [0.13713]** |
| workstat==FT Working | -0.10106 | 0.12807 | 0.21769 |
| | [0.09325] | [0.10879] | [0.12626]* |
| workstat==PT Working | 0.04821 | 0.23417 | 0.23308 |
| | [0.10287] | [0.13093]* | [0.15756] |
| workstat==Retired | -0.17394 | -0.02483 | 0.11746 |
| | [0.10991] | [0.15229] | [0.17110] |
| workstat==In Education | -0.10352 | 0.12117 | -0.00566 |

| | | | |
|---|---|---|---|
| | [0.18238] | [0.17141] | [0.19148] |
| Access to private garden | -0.16609 | -0.23665 | -0.12464 |
| | [0.13648] | [0.14008]* | [0.14839] |
| Garden is too small | -0.12061 | -0.12522 | -0.12822 |
| | [0.07801] | [0.09553] | [0.12174] |
| Garden is too large | -0.04474 | -0.1835 | -0.22663 |
| | [0.14597] | [0.20595] | [0.20730] |
| OA urban Census 2001 | -0.04573 | -0.11477 | -0.07133 |
| | [0.06264] | [0.07477] | [0.09178] |
| regions== Yorks & Humberside | -0.1726 | -0.23159 | -0.2228 |
| | [0.09786]* | [0.12743]* | [0.13249]* |
| regions==North West | -0.06172 | -0.17449 | -0.24516 |
| | [0.09483] | [0.11413] | [0.14037]* |
| regions== West Midlands | -0.10413 | -0.13361 | -0.11983 |
| | [0.08276] | [0.10555] | [0.11760] |
| regions== East Midlands | 0.10007 | 0.04319 | -0.02471 |
| | [0.09273] | [0.10506] | [0.15255] |
| regions==East Anglia | -0.0278 | -0.07548 | 0.48438 |
| | [0.31375] | [0.29657] | [0.20263]** |
| regions==South West | -0.06206 | -0.06601 | -0.06872 |
| | [0.10709] | [0.11499] | [0.13665] |
| regions==North East | 0.1447 | -0.18783 | -0.10529 |
| | [0.09907] | [0.12855] | [0.16681] |
| regions== Greater London | -0.05361 | -0.10055 | 0.02437 |
| | [0.10055] | [0.10979] | [0.11495] |
| IMD_5quant==2 | -0.12741 | 0.01017 | -0.0192 |
| | [0.08152] | [0.10219] | [0.12076] |
| IMD_5quant==3 | -0.36288 | -0.20585 | -0.28294 |
| | [0.08352]*** | [0.10021]** | [0.12282]** |

| | | | |
|---|---|---|---|
| IMD_5quant==4 | -0.19173 | -0.05609 | -0.12914 |
| | [0.08720]** | [0.10315] | [0.13277] |
| IMD_5quant==5 | -0.24125 | -0.04983 | -0.09423 |
| | [0.09260]*** | [0.11496] | [0.13772] |
| Constant | 4.36585 | 4.13939 | 3.90524 |
| | [0.35235]*** | [0.34522]*** | [0.35084]*** |
| Observations | 595 | 595 | 595 |
| r2 | 0.21233 | 0.17351 | 0.181 |
| r2_a | 0.15393 | 0.11223 | 0.12028 |
| F | 4.11904 | 3.30966 | 3.37894 |