

Health and Well-Being Benefits of Visits to Scotland's Forests

(Funded by the Scottish Government, FTR/002/20, Project title:
Developing an Approach to Monitoring the Health and Well-Being
Benefits of Visits to Scotland's Forests)

Vadim Saraev, Liz O'Brien, Gregory
Valatin, Jack Forster, Matthew Bursnell
and Mandy Cook

Forest Research is the Research Agency of the Forestry Commission and is the leading UK organisation engaged in forestry and tree related research.

The Agency aims to support and enhance forestry and its role in sustainable development by providing innovative, high quality scientific research, technical support and consultancy services.

Table of Contents

Table of Contents	3
Table of Figures	4
1 Executive Summary	5
2 Background to research study	13
3 Aims and Objectives.....	15
4 Methodology	15
5 Results	17
5.1 Evidence on Health and Well-being Benefits	18
5.1.1 Visits to Forests and Woodlands	19
5.1.2 Interventions and Monitoring Engagement in Forests and Woodland	20
5.1.3 Visits to the Natural Environment	22
5.1.4 Interventions and Monitoring Engagement in the Natural Environment.....	24
5.1.5 Living Near the Natural Environment	25
5.1.6 Equality Groups	26
5.1.7 Social Media-based Methodology	28
5.2 Evidence on Social and Cultural Benefits	28
5.2.1 Social Benefits	29
5.2.2 Cultural Benefits	36
5.3 Measuring and Monitoring	40
5.3.1 Mediating Factors	40
5.3.2 Health and Well-being Indicators.....	41
5.3.3 Monitoring Costs	45
5.3.4 Measuring and monitoring social and cultural benefits.....	47
5.3.5 Combining Social and Cultural Indicators	56
6 Discussion	57
6.1 Research Gaps and Implications	57
6.2 Recommendations for future social and cultural research	59
6.3 Recommended Indicators	60
7 Summary Recommendations.....	65
7.1 Indicators to use for Health and Well-being Monitoring	65
7.2 Approaches to Monitoring Health and Well-being Benefits	68

7.3	Recommended Approach	76
8	References.....	78
9	Appendix A Inception Report.....	85
10	Appendix B Literature Search Methodology	87
11	Appendix C Literature Review Tables.....	90
12	Appendix D Estimating Sample Sizes for Equality Groups.....	90
13	Appendix E Suitable Questions for Surveys	90
13.1	Questions for Intermediate Approach.....	91
13.2	Additional Questions for In-depth Approach.....	93
14	Appendix F Explanations for Health Metric Scales.....	95
15	Appendix G Specific Research Objectives	97

Table of Figures

Figure 1	Monitoring benefits of visits to Scottish forests.	12
----------	---	----

1 Executive Summary

This project reviewed evidence on the health and well-being benefits, and social and cultural benefits, of visits to forests, as well as the methods to measure and monitor them. It also provides recommendations for monitoring these benefits to support the implementation of Scotland's Forestry Strategy 2019-2029. **Evidence on Health, Well-being, Social and Cultural Benefits**

There is strong evidence that visits to forests deliver a wide range of health and well-being benefits, as well as social and cultural benefits. The benefits include:

- Supporting physical health, including by providing an attractive space facilitating people to be more physically active
- Alleviating stress and symptoms of depression and anxiety
- Supporting general well-being and happiness
- Facilitating social contacts and improving connection to nature.

The extent to which visits to forests deliver these benefits is influenced by a range of mediating factors:

- Dose and Exposure – A higher dose of nature, in the form of more frequent or longer visits, typically delivers greater benefits. More vigorous activities, such as brisk walking, cycling or jogging, deliver greater physical health benefits.
- Forest Characteristics - More biodiverse locations can provide greater well-being and immune response benefits.
- Individual circumstances and characteristics – societal, socioeconomic, cultural and environmental conditions can affect factors such as health status and income. These in turn can affect

how strongly an individual responds to nature and the mental health and well-being benefits obtained.

Measuring health and well-being

There is significant overlap between the domains of health. Mental health is important for supporting physical health and vice versa. However, single indicators to measure overall health are often biased towards physical health and can fail to capture fully the importance of mental health and well-being. The use of multiple indicators covering different health domains is best in quantifying the diverse health benefits and to provide a more comprehensive understanding.

There is no consensus on what constitutes 'gold-standard' indicators to use for different benefits and contexts. However, cost-effectiveness, specific policy needs, and the extent to which an indicator captures a broad conceptualisation of its health domain make certain health metrics more suitable than others. Recommended indicators for monitoring the implementation of Scotland's Forestry Strategy include:

- Physical Activity (PA) Levels – these are closely aligned to physical health, are comparable across activities and feature prominently in this field. There is also emerging research on monetising physical health benefits based on PA levels.
- Life Satisfaction – this is widely used and is a key component of the Office for National Statistics' recommended well-being measures. It has been used often for monitoring mental health in the environment and is an effective measure of population-level subjective well-being.
- Social and Cultural Mixed-Methods – A mix of indicators can be used including the Nature Connection Index (NCI) which is used to assess the relative importance of nature to people and was used in the Monitoring Engagement with the Natural Environment Survey in

England. The Pro-Nature Conservation Behaviour Scale can be coupled with the NCI as there is evidence of a positive association between nature connection, pro-environmental behaviours and wellbeing. Qualitative methods such as semi-structured interviews/focus groups can be combined with all of the above approaches to gain in-depth insights into motivations, benefits and experiences of forest visits.

Recommendations on monitoring approach

We have identified three approaches to monitoring health and well-being and social and cultural benefits from visits to Scotland's forests. The approaches are:

- i. Minimum (current approach)
- ii. Intermediate
- iii. In-depth

Our recommendation is that if resources allow then the 'in-depth' option should be considered as it would provide representation across equality groups, as a larger sample size can offer more effective representation across equality groups, and more questions can offer greater precision for understanding benefits. Both the in-depth and intermediate approach would provide a greater level of detail on the relevant benefits people derive from using forests and woodlands than is currently collated. References to questions or (Q) numbers are outlined in full within Appendix E.

- **In-depth Approach** – Bespoke longitudinal survey with a large, representative sample of participants. A sample size of 5,000 respondents would deliver a demographically representative Scottish sample covering all protected equality characteristics.

Questions should cover duration of visits and frequency of visits over a given time period (**Q1, Q2**) to understand the effects of exposure and scaling benefits.

Questions on types of activities conducted (**Q3**) and activity duration (**Q4**) could address physical health benefits. This data can provide the foundation for calculating through METs and QALYs (Moseley *et al.*, 2018), which can also be readily monetised.

Questions on mental health and well-being could be covered through life satisfaction (**Q5**). The use of the SWEMWBS scale could also offer additional coverage for understanding mental health benefits, offering more insight into improvements to psychological functioning (**Q11**).

Social and cultural benefits could be addressed through similar questions included in POF England (**Q6**), with open-ended questions for qualitative feedback (**Q7-8**). The Nature Connection Index Scale (**Q12**) could also be used. Inclusion of an opt-in question to take part in focus groups or semi-structured interviews would also offer an opportunity to collect qualitative data and gain in-depth insights into social and cultural benefits (**Q13**).

For comparison of benefits between visits to different sites, questions could be included to ask participants what type of woodland they last visited (**Q18**), as well as a list of what facilities were present on the site that they visited (**Q19**).

Socioeconomic questions should also be included to cover areas including income (**Q9**) and health status (**Q10**) as well as sex, (**Q14**), age (**Q15**), relationship status (**Q16**) and education level (**Q17**). Controlling for these factors is important for understanding causality when using health indicators, especially for mental health and well-being benefits. Questions on ethnicity, religion and number of children in households are less important for understanding

health and wellbeing causality but may be important inclusions for improving understanding on access to forests.

- **Intermediate Approach** – Adding questions into an existing dataset in order to more effectively monitor benefits. POF Scotland is recommended, due to its inherent focus on forestry.

An additional question inserted to capture duration of visits would allow POF to more effectively capture scale (**Q2**), alongside frequency of visits.

Questions on activities conducted (**Q3**) and time spent on activities (**Q4**) would allow physical activity levels to be understood in more depth. This data could also be used to provide estimates of QALYs and associated economic values.

To better capture mental health benefits, an additional question could be inserted on life satisfaction (**Q5**). Social and cultural benefits could be addressed through similar questions that are included in the England POF, with the inclusion of at least one open ended question to collect qualitative feedback. (**Q6-8**).

The survey could also be improved by modifying wording over key socioeconomic areas to include a question on income (**Q9**), rather than just working status, although questions on income are sometimes avoided by respondents on surveys.

This approach would be less costly than a more in-depth approach and potentially, given resource constraints, more feasible. Although, the survey's small sample size of just over 1,000 (in 2017) limits its effectiveness to separate out results for different equality groups.

The SPANS and POF Scotland are the national datasets that gather the most relevant data in relation to forest visits. However, both have several notable limitations in their current forms that hinder effectively

monitoring health, wellbeing, social and cultural benefits. Using datasets from these surveys without adding additional questions (a 'minimum' approach to monitoring) is considered insufficient to provide robust basis monitoring of health, well-being, social and cultural benefits of visits to Scotland's forests.

Our overall recommendation would be the adoption of the In-Depth approach. Total costs for this approach may be comparable to SPANS (~£100k), or the All Forest Survey 2012 (~£250k), if qualitative data collection is prominent.

If resources do not allow for adoption of the In-Depth approach, the Intermediate approach would be an effective alternative. Assuming estimates of £600 for an addition of a pre-coded question and £890 for an open-ended question, modifications through the Intermediate approach would cost £5,690.

These approaches can be flexible however. Although the Intermediate approach is an effective baseline, some additional questions or characteristics that are recommended under the In-Depth Approach could potentially be adopted under the Intermediate Approach, if there is budget availability and desire for greater precision in certain categories. For example, an increased sample size closer to 5,000 would be a highly effective modification for the Intermediate approach in improving representation across protected demographics.

A graphical summary of our research on evidence and potential monitoring approaches is presented in the following diagram below (Figure 1). It starts with the need to monitor and value benefits of forests visits; proceeds to the second box on what data are needed drawing upon existing research indicating forest site, visit and individual visitor characteristics and physical mediators that can impact on the magnitude of benefits; the third box covers data collection, highlighting some notable

indicators and metrics to underpin monitoring physical and mental health and well-being benefits of forest visits and social and cultural benefits. The flow ends with the fourth box which indicates that changes in the indicators and metrics yield monitoring outcomes and provide an opportunity to evaluate these changes.

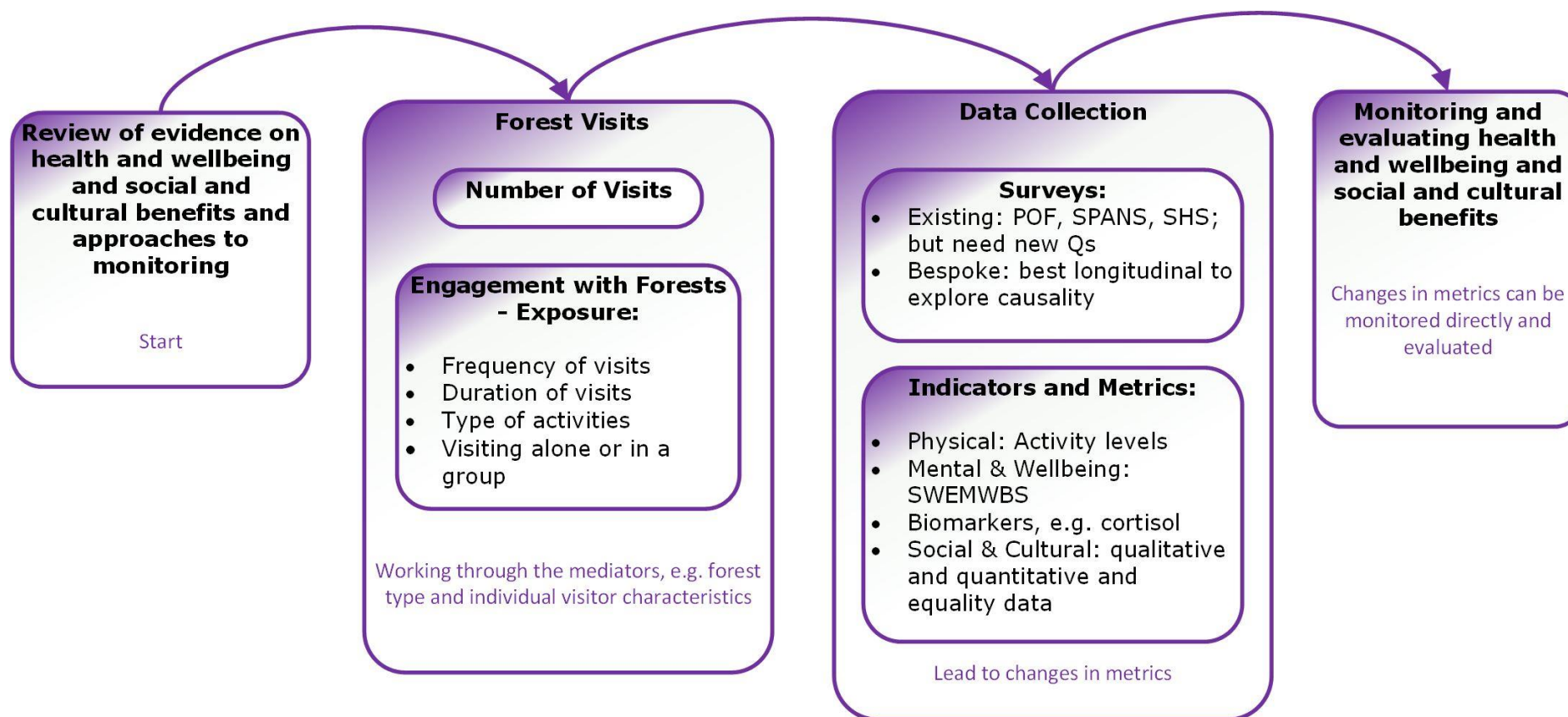


Figure 1 Monitoring benefits of visits to Scottish forests.

2 Background to research study

The Scottish Government published a set of high-level indicators to track and report progress against the Scotland's Forestry Strategy's 10-year objectives (refer to section 4 of Scotland's Forestry Strategy [SFS Implementation Plan 2020 – 2022](#)).

In addition to reporting on these indicators, the Scottish Government stated that it will continue to keep methods for monitoring sustainable management of Scotland's forests and woodland under review. This includes exploring opportunities to gather further data on the use of forests and the health and well-being benefits that people derive from their visits.

This study was commissioned as part of that exploration to better understand how health and well-being benefits of visits can be estimated and monitored.

The [Scottish Household Survey](#) (SHS) and the [Scotland's People and Nature Survey](#) (SPANS) (population-level quantitative surveys) provide evidence of a significant increase in visits to forests. Among the main reasons people give for visiting are for improvements to their health, to exercise and also to relax and unwind. However, questions related to understanding health and wellbeing benefits (H&WB) are limited in these surveys and as such, it is difficult to understand the extent to which these benefits are experienced.

Although there has been an increase to visits over the years, there has been no significant change in overall or weekly participation among members of the Black, Asian and Minority Ethnic (BAME) population. There is evidence of increased participation among people living in Scotland's most deprived areas, yet levels of participation remain lower than average.

There is accumulating evidence of the mental and physical health benefits as well as the cultural and social benefits of recreational visits to forests and woodlands. In recent years there has been an increasing awareness of the benefits that forests have especially in improving peoples' mental health, with a number of studies quantifying the impacts in different parts of the world. In particular, there has been significant media interest in 'forest bathing' ('shinrin yoku') - a practice developed initially in Japan which emphasises the health benefits of people spending time in forests (Furuyashiki *et al.*, 2019a); see also the [Guardian](#).

These and other health and well-being benefits of forests can be hard to measure and quantify. Current population-level surveys collecting data on visits to Scotland's forests are notably lacking in coverage for health and well-being benefits. It is in this context that the Scottish Government (SG), commissioned a study to identify the methods available to measure and monitor the health (physical and mental) and well-being benefits as well as cultural and social benefits of recreational visits to forests and woodlands. The review also considers approaches to monitoring the degree to which different population groups benefit from forests. The potential of innovative digital methods such as social media or other user generated data is considered too.

A variety of diverse approaches are available to capture the impacts of woodland visits on health and well-being – including both quantitative and qualitative methods. However, despite the growing number of case studies and evidence base on the benefits of forests for physical and mental health, as well as in terms of cultural and social ecosystem services, a significant gap remains concerning the best and most cost-efficient ways of measuring and monitoring of these benefits. Therefore, a review of existing literature and knowledge on the health and well-being benefits of visits to forests and how these can be measured is needed.

The study identifies appropriate options for surveillance and monitoring processes to measure the mental and physical health benefits as well as cultural and social benefits of recreational visits to forests and woodlands. The Covid-19 pandemic and associated lock-down restrictions have increased the profile of nature in the media, highlighting its importance - including the role of forests and woodlands as important venues that support people's physical and mental well-being and therefore this work is particularly timely (Derks et al. 2020; Ugolini et al, 2020).

3 Aims and Objectives

The project's two major aims are:

1. Identify, review and synthesise up-to-date evidence on the health and well-being benefits of visits to forests, and the methods available to measure and assess them; note the key findings, robustness of the evidence base, and any outstanding gaps in the evidence.
2. Identify and review recent approaches to measuring the health and well-being benefits of visits to forests; note their effectiveness, limitations and applicability in different contexts and make recommendations for monitoring as part of Scotland's Forestry Strategy.

Specific research objectives can be viewed in Appendix G.

4 Methodology

Forest Research worked closely with the project manager to establish the priorities for the review work.

The choice of terms for the literature search is critical and was guided by team members' specialist knowledge. Findings from other countries are included in the review, but literature published in English is the focus.

The Scopus database is used for our main searches. “Scopus is the largest abstract and citation database of peer-reviewed literature: scientific journals, books and conference proceedings” (www.scopus.com). Scopus coverage includes over 95% of Medline publications as well. The search focused on publications from 2015 to present. This was complemented with Google Scholar searches for grey literature. A spreadsheet table was created to capture the major evidence and categorise it according to specific criteria such as robustness, key findings, relevance and equality implications.

The review synthesised evidence on the health and well-being benefits of visits to forests and predominantly focused on indicators used for monitoring physical and mental health and well-being benefits derived by from forest visits. Cultural and social benefits in terms of increases in levels of equity, social connections and community cohesion are also included. Perceptions of well-being and forest/nature can be both highly culturally-dependent and regionally-specific. For example, the release of the biogenic volatiles associated with improvements in mental health may vary between forest types and countries, suggesting that the evidence of mental health benefits of forests from other countries may not be easily translatable to a Scottish context. The applicability of international research was considered in this context.

Consideration was given to interrelationships between physical and mental health and well-being and other ecosystem service benefits of forests. Potential issues relating to indicator monitoring and double-counting of benefits are also considered.

As researchers who have worked in this area for a number of years, we are aware of the breadth and amount of evidence available in this arena. For example, a recent publication for the Valuing Nature Programme on demystifying health metrics identified over 270 metrics associated with nature health relationships (Cracknell, 2019). In consultation with the

project manager, we have explored, ways to focus and bound the research to incorporate up to date evidence, key studies and systematic reviews, and focusing on evidence with a strong forestry content.

We recently completed a review on valuing the mental health benefits of forests and carried out interviews with twelve experts, (including Matt White, Catherine Ward-Thompson, Jenny Roe, Daniel Fujiwara among others) focusing on up to date literature and their views on the usefulness and robustness of relevant indicators for monitoring the economic value of mental health. Relevant perspectives expressed by these experts and the literature they flagged up were taken into account in the current review.

Two separate searches were performed, one to capture health and well-being benefits and another for social and cultural benefits. Health and well-being searches covered cumulatively 1,149 documents over the past 5 years and social and social and cultural benefits covered 271 documents.

Additional literature was also sourced using a 'snowballing' approach. This involved collecting relevant literature cited within previous review papers as they were encountered as well as utilising papers already known to the researchers. Appendix B discusses the search strategy in greater detail.

References were screened for their robustness and relevance. The main screening criteria was the use of a methodology that applied the use of a dedicated indicator to monitor changes in health or wellbeing or an indicator for social and cultural benefits. 66 references matched this criteria from our searches that used health and well-being related indicators, and 50 matched that examined social and cultural benefits.

5 Results

5.1 Evidence on Health and Well-being Benefits

Our review found a broad evidence base on the beneficial impacts for health and well-being of visits to forests. Many more studies were encountered analysing the effect of nature, greenspace or the natural environment in general than specifically of forests on health and well-being, although benefits appeared to be broadly consistent. Furthermore, some papers focus on aspects other than 'visits' to explore impacts on health, including metrics such as residential proximity to greenspace. It was also possible to separate visits into two categories: personal visits, taken as individual choice and organised visits, often taken as part of a group for a programme or as part of a research project. Organised visits often involved face-to-face surveys or in-person measurements, whereas personal visits often utilised self-survey methodology. For health and well-being benefits, the majority of studies encountered in the literature review utilised either short-term pre and post intervention comparisons or cross-sectional, self-report surveys. Few conducted any kind of long-term monitoring in forests and woodlands. Relatively little evidence was found for comparison between different equality groups.

A table of the literature used to inform these results can be found in Appendix C. Definitions for health scales encountered in the review that are used to measure changes in health can be found in Appendix F.

The following sections explore evidence for these health benefits across visits and interventions in forests and woodlands, as well as evidence for benefits from engagement with the wider natural environment. Benefits associated with living proximity are also explored, along with effects on equality groups and the effectiveness of papers that adopted a social media-based methodology. Health benefits are explored through both physical health benefits as well as mental health and well-being benefits across these sections.

5.1.1 Visits to Forests and Woodlands

For physical health benefits, visits to forests and woodland was found to be associated with consistent reductions in cardiovascular risk factors. Multiple small studies exploring the effects of forest bathing recorded slower heart rates and reduced systolic and diastolic blood pressure amongst participants (Li *et al.*, 2016; Chen, Yu and Lee, 2018). Extended forest bathing trips over multiple days was also found to reduce brain natriuretic peptide levels, a biomarker of heart failure, amongst elderly patients with cardiovascular disease (Mao *et al.*, 2018).

A large-scale review on forestry health benefits from Forest Europe supports these aforementioned benefits and also highlights the role of forests in attracting visitors for green exercise, with physical activity acting as a major pathway for generating physical health benefits (Marušáková *et al.*, 2019). Marušáková *et al.* (2019) also discussed the role of forests in strengthening the human immune response. A study on children in day-care recently explored this, following changes in their skin and gut microbiota and blood immune markers during a 28-day biodiversity intervention, which included enriching the day-care centre yard with forest floor and sod, as well as daily visits to nearby forests (Roslund *et al.*, 2020). The intervention was found to significantly enhance immunoregulatory pathways.

The role of forests in filtering air pollutants as a pathway for physical health benefits was also discussed by Marušáková *et al.* (2019). No primary research papers were encountered on this topic through our search strategy, predominantly due to the search's focus on 'visits' as a dimension for health benefits in order to complement the SFS's high-level indicators. Air pollutant removal as a health benefit is more broadly conceptualised as an area of effect benefit from long-term exposure, rather than to be gained from individual visits (Freire *et al.*, 2010; Tzivian *et al.*, 2015; de Keijzer *et al.*, 2017). The effect on air pollution on human health is a well-researched area however, with effects ranging from

respiratory irritation to asthma, cardiovascular disease and cancer (Kampa and Castanas, 2008).

Visits to forests and woodland have been found to deliver considerable benefit for mental health and well-being. Studies exploring the effects of forest bathing or forest walks observed improvements in a number of mental health outcomes, including improved mood (Li *et al.*, 2016; Chen, Yu and Lee, 2018; Furuyashiki *et al.*, 2019b; Koselka *et al.*, 2019), reduced anxiety (Guan *et al.*, 2017; Chen, Yu and Lee, 2018; Koselka *et al.*, 2019; Zhou *et al.*, 2019) and reduced stress (Yu *et al.*, 2016; Antonelli, Barbieri and Donelli, 2019; Koselka *et al.*, 2019). Marušáková *et al.* (2019)'s review of forestry and health also discussed numerous benefits for psychological health, highlighting a strong evidence base for short-term benefits.

5.1.2 Interventions and Monitoring Engagement in Forests and Woodland

In Scotland, several forestry-based interventions have been evaluated, including Scottish Forestry's Branching out programme and the long-term Woods in and Around Towns (WIAT) programme. Both evaluations used standardised health measurement scales associated with Health-Related Quality of Life (HRQoL), including EuroQuol-5-Dimensions (EQ-5D) as well as the 6 and 12-item Short Form Survey (SF-6D, SF-12). Both of these relate to overall health, although EQ-5D typically relates more strongly to monitoring physical health, whereas SF scores are more inclusive of questions that relate to mental health. The cohort of 359 participants, who were accessing mental health services, in the 6-week long Branching Out programme in 2014/15 were found to have significant improvements in SF scores (CJC Consulting, 2016). WIAT however, which was targeted at more deprived communities, was not found to deliver statistically significant differences at the community level in EQ-5D scores across 5,460 research participants. Some of these participants had visited the

WIAT sites while others had not, although researchers did find positive associations for improvements in physical activity levels (Ward Thompson *et al.*, 2019).

Forestry-based interventions have been found effective in wider settings, with improvements in SF-36 scores seen amongst participants in Sweden with high-stress as part of a 3-month long intervention (Dolling, Nilsson and Lundell, 2017) as well as improvements to physical activity levels for Wildlife Trust programme volunteers in England (Bagnall *et al.*, 2019).

Studies utilising dedicated mental health measures include the WIAT evaluation, with measures relating to stress, through the Perceived Stress Scale (PSS) and well-being, through the Short Warwick-Edinburgh Mental Well-being Scale (SWEMWBS). Similarly, to EQ-5D scores however, the intervention did not improve PSS or SWEMWBS scores in all groups, and in some cases these scores worsened. With WIAT operating at a community-level, compared to Branching Out's participant-level intervention, the WIAT study's authors note that other factors beyond the control of the study most likely contributed towards unexpected results. Follow-up surveys for both WIAT and Branching Out studies also highlighted that improvements in HRQoL scores had not been maintained 3 months post intervention. Bagnall *et al.* (2019) in the evaluation of Wildlife Trust programmes, of which the majority were forest-based, also used mental health measures, including SWEMWBS, finding improvements amongst its participants over the course of the interventions, but greater improvements for those who had moderate to high well-being scores at the beginning of the intervention.

An example of a long-term monitoring intervention is the Active Forests programme (AFP), which has been monitored and evaluated by Forest Research in close collaboration with Forestry England and Sport England since the inception of the pilot programme. The pilot programme ran for 3 years from 2014-2017 and has been followed up by Phase 2 of the

programme, lasting for 5 years. Forest Research has developed an interactive dashboard as a means of presenting the on-going research with qualitative and quantitative data. The quantitative dashboard allows for visitor numbers and the types of activities conducted on site to be easily visualised and compared between sites. The qualitative dashboard highlights diverse social and cultural benefits from participant feedback, including improved accessibility to exercise, being given the opportunity for socialisation, as well as having a non-judgemental space. The 18 sites hosting the AFP can explore the data relevant to their site in terms of visits and motivations as well as benefits from visiting. Two papers have been recently published on the programme (O'Brien, 2019; O'Brien and Forster, 2020).

5.1.3 Visits to the Natural Environment

In literature focused more broadly on the natural environment rather than forests, health benefits have generally been researched in greater depth with a better understanding of how different types of interactions can affect benefits. A large-scale analysis of responses to the Monitor of Engagement with the Natural Environment (MENE) survey by White *et al.* (2019) found that the likelihood of an individual reporting good health and high life satisfaction became significantly greater for those with a weekly natural environment contact ≥ 120 minutes. A similar study by White *et al.* (2017) also found regular visits to greenspaces associated with improvements to ONS4 scores, which relate to life satisfaction, worthwhileness, happiness and anxiety. Respondents who had reported visiting nature yesterday were generally happier, and the magnitude of the association between weekly nature visits and life satisfaction was comparable to major life circumstances, such as marital status.

In Scotland, a small survey exploring health-related quality of life amongst 276 children found a small, positive impact for regular greenspace users (McCracken, Allen and Gow, 2016). A larger, similar

survey in Lithuania of 1,489 children found that every additional hour spent in parks was associated with decreased sedentary behaviour and a lower risk of poor self-reported health (Andrusaityte *et al.*, 2020). In another survey of 4,033 representative UK adults, regular visitors to parks and greenspaces, who were defined as visiting at least once a month over the course of a year, were found to be 4.2% more likely to self-report as having good health than non-visitors (Jump and Simerica, 2018). The authors predicted the difference between these groups to be equivalent to roughly £111 million in national annual savings through reductions in GP related medical costs. Differences in life satisfaction scores between users and non-users were also observed. These differences were significantly greater, with the authors estimating life satisfaction value to users equivalent to £34.2 billion per year across the UK.

A range of studies found short-term health improvements associated with visits to the natural environment using a variety of mental health measures, including either life satisfaction, ONS4, SWEMWBS, PSS or SF scores (Henderson-Wilson *et al.*, 2017; van den Berg *et al.*, 2017; Coldwell and Evans, 2018; Chiang and Li, 2019; Hong *et al.*, 2019; Yuen and Jenkins, 2020).

Some studies also explored health benefits through visit motivations. Amongst 508 visitors to parks and protected areas around Barcelona in another study, 89.9% reported that physical health was an important motivation for visit (Romagosa, 2018). 88% of respondents also reported improvements in their physical health as a consequence of the visit. Perceived health benefits have been reported as an important driver for visits by multiple other studies (Doctorman and Boman, 2016; Henderson-Wilson *et al.*, 2017; Puhakka, Pitkänen and Siikamäki, 2017; Campagnaro *et al.*, 2020).

Multiple previous literature reviews were also encountered, highlighting the growing body of evidence for broad physical health benefits from interaction with the natural environment (Lovell, Depledge and Maxwell, 2016; Kondo *et al.*, 2018; Wolf *et al.*, 2020). Significant associations have also been broadly observed with multiple types of nature experiences and increased psychological well-being and a reduced burden of mental illnesses (Lovell, Depledge and Maxwell, 2016; McCormick, 2017; Houlden *et al.*, 2018; Bratman *et al.*, 2019; Wolf *et al.*, 2020). A consistent theme across reviews however is an acknowledgement of a lack of longitudinal studies in the field and lack of clarity around the duration of benefits. Particularly for mental health benefits, there is uncertainty around the causality of the relationship between many mental health measures and the natural environment (Kondo *et al.*, 2018; Roberts *et al.*, 2019; Collins *et al.*, 2020).

5.1.4 Interventions and Monitoring Engagement in the Natural Environment

Of studies implementing a monitoring-based methodology, Shanahan *et al.* (2016) reported lower rates of self-reported depression and high blood pressure amongst study participants who visited greenspaces for more than 30 minutes a week. A week-long study equipping participants with accelerometers and GPS devices found that those who visited parks at least once a week spent on average 14.3 minutes more of daily physical exercise than those who did not visit a park (Stewart *et al.*, 2016). A nature-based intervention to treat depression and anxiety was also encountered, which aimed to engage individuals accessing mental health services in wetlands over the course of 6 weeks. Amongst the 16 participants, significant improvements were observed across SWEMWBS and PSS scores, as well as improvements in anxiety, measured by the Generalised Anxiety Disorder-7 (GAD-7) (Maund *et al.*, 2019).

Few studies were encountered that compared differences across different types of natural environment, although some studies explored changes in health outcomes using metrics other than visits. Some of these employed longitudinal methodology. Astell-Burt & Feng (2019) reported health differences between residents with surrounding greenspaces that had varying levels of vegetation complexity. Monitoring over 6 years, residents who lived within close proximity to greenspaces with significant presence of trees, where tree canopy comprised $\geq 30\%$ of the greenspace, were more likely to self-report better general health and less likely to self-report depression or psychological distress than those whose surrounding greenspaces comprised predominantly of low-lying vegetation. A similar study, following children for 9 years, found that boys living in areas with neighbourhoods that had a 10% or greater coverage of greenspaces were significantly more likely to be physically active, although these findings were not observed amongst girls (Sanders *et al.*, 2015).

5.1.5 Living Near the Natural Environment

Further studies were encountered employing a proximity-based methodology to explore changes in health metrics. Associations have been found between proximity to the natural environment and measures such as ONS4 (Houlden *et al.*, 2019), depression or anxiety (Cox *et al.*, 2017; Gascon *et al.*, 2018; Braçe *et al.*, 2020), anti-depressant and anti-anxiety medication (Taylor *et al.*, 2015; Gascon *et al.*, 2018) as well as the General Health Questionnaire-12 (GHQ-12) (Dzhambov *et al.*, 2018; Pasanen *et al.*, 2019; Zhang and Tan, 2019) as a measure of minor psychiatric disorders. Larger scale studies exploring cross-sectional datasets have found more complex results. Analysing 21,097 responses to the Health Survey for England, Pasanen *et al.* (2019) found living near bluespace along the coast was associated with better self-reported health and better scores on the GHQ-12, although this may have been mediated by participation in outdoor activities. Exploring responses to the UK 2011

census in Sheffield, Mears *et al.* (2020) found that lower layer super output areas (LSOAs) tended to have higher average levels of poor general health and a higher rate of depression and anxiety when greenspaces were accessible to a high number of addresses. In LSOAs with low levels of green coverage however, increases in green coverage were associated with reduced levels of poor general health.

5.1.6 Equality Groups

Across the nine legally protected equality characteristics (HM Government, 2010) (Age, disability, gender reassignment, marriage and civil partnership, pregnancy and maternity, race, religion or belief, sex, sexual orientation), little research was encountered comparing health benefits from visits to the natural environment between equality groups, although their engagement patterns have been observed.

Multiple studies used children as participants (Janssen and Rosu, 2015; Sanders *et al.*, 2015; McCracken, Allen and Gow, 2016; Akpınar, 2017; Andrusaityte *et al.*, 2020; Roslund *et al.*, 2020) finding positive health associations. Elderly participants (MAO *et al.*, 2018), adult women (Yu *et al.*, 2016; Lanki *et al.*, 2017; Chen, Yu and Lee, 2018) and adult men have also been used as participants (Li *et al.*, 2016) with similar findings although no comparison across groups.

Individuals with low well-being, high stress or who are accessing mental health services were often found to have particularly strong health benefits from engagement with the natural environment (CJC Consulting, 2016; Dolling, Nilsson and Lundell, 2017; Furuyashiki *et al.*, 2019b; Maund *et al.*, 2019). However, some studies using similar participants have noted these groups receiving fewer, or close to no benefit as well (Bagnall *et al.*, 2019; Ward Thompson *et al.*, 2019), although this could sometimes be because of pre-existing factors (Henderson-Wilson *et al.*, 2017).

Differences between BAME groups and white counterparts have been explored in the usage of parks and greenspace (Jump and Simeonova, 2018). The authors noted BAME respondents were twice as likely than white respondents to use greenspaces to meet friends or for sports and also received greater welfare improvements in general from greenspace usage.

In engagement across forests and woodlands however, BAME groups, alongside lower socio-economic and disabled groups, have been found to be less likely to benefit from engagement with treescapes unless a targeted intervention is used to specifically support them in that connection (Morris *et al.*, 2011). This research also highlighted these groups as facing the greatest number of barriers in accessing benefits from engagement with treescapes. A recent study by Suárez *et al.* (2020) on outdoor recreation opportunities and barriers also noted that migrants and low-income households had relatively less access compared to their counterparts. Engagement barriers can be seen across MENE data, with the survey consistently highlighting fewer visits to the natural environment made by BAME, elderly and disabled groups, as well as these visits being typically within a shorter distance of their home (Natural England, 2020). To support further research into these areas, an analysis was performed to estimate appropriate sample sizes for statistical representation of various equality groups across forestry surveys in Scotland. Survey samples were assumed to be demographically representative of Scotland's population. The groups included sex (male/female), age (16-34; 35-44; 45-54; 55-64; 65+), accompanying children (no/yes), illness/impairment (no, limited a little, limited a lot), ethnicity (white; African, Caribbean or Black; Asian, Asian Scottish or Asian British; Mixed or multiple ethnic groups; other ethnic group), religion (Christian, Muslim, other, none), sexual orientation (LGBO yes/no) and index of multiple deprivation (1-10). A sample size of 1,000 or 2,500 respondents were both found to result in no statistical analysis

of LGBT+ demographics and substantially reduced analysis for ethnicity. Religion was also substantially reduced in a sample size of 1,000 respondents. In a sample of 5,000, statistical analysis was possible across all demographics, although analysis of ethnicity was partially reduced. For further detail on this analysis, Appendix C has additional information.

5.1.7 Social Media-based Methodology

Although not encountered prominently in the review, some studies had explored how the use of social media can increase cost-effectiveness in research design and increase accessibility to a larger range of respondents. Geo-tagged photographs to sites including Twitter and Flickr, as well as tweets, have been used as a reasonably effective proxy for quantifying visits (Sessions *et al.*, 2016; Sonter *et al.*, 2016; Song *et al.*, 2020). The use of social media also shows promise for understanding how differing environmental qualities act as drivers for visits (Donahue *et al.*, 2018), although mixed and inconsistent results have been found in this area (Brindley *et al.*, 2019). The ability of social media to capture health data is also limited. A study using sentiment analysis across Twitter data, using positive emotion in tweets as a proxy for well-being in and around greenspaces, found highly complex and mixed results (Plunz *et al.*, 2019). In contrast to greenspace indicators associated through traditional surveys, another study found no associated with social media indicators of greenspace usage and self-reported health Brindley *et al.* (2019). For specific data gathering and monitoring, social media-based methodology is as consistent or effective as survey-based methodology.

5.2 Evidence on Social and Cultural Benefits

This section of the report presents the results of a literature review focusing on the methods for assessing the social and cultural benefits of recreational visits to forests and woodland. The different indicators, methods and assessment tools provide different types of information, quantitative and qualitative, and each has their respective strengths and

weaknesses from a decision-support perspective. The section is presented in two parts, firstly the social benefits, followed by the cultural benefits. A general overview of the relevant indicators and methods is provided in each part, their application and some selected examples from the literature to illustrate them.

5.2.1 Social Benefits

Tyrväinen et al. (2008) note that recent outdoor recreation research tends to be based on the behavioural approaches of social psychology which suggest that people engage in activities to realise outcomes that are known, expected and valued, that is, they are goal- or demand-orientated actions (Ajzen 1991). This section is structured using headings from the Recreational Opportunity Spectrum (Driver & Brown, 1978), a framework adopting a behavioural approach which links activities, settings, motivations, and benefits. The framework suggests that recreationists participate in selected activities in specific settings to fulfil motivations that in turn lead to benefits. A review of the framework by Pettengill & Manning (2011) suggests that under this model, managers might be able to provide recreation opportunities (comprised of alternative activities and settings) designed to fulfil certain motivations and produce related benefits.

Activities

Traditionally, in outdoor recreation research, the experience of outdoor activities (i.e. the satisfaction of an activity need) was considered the essential benefit of outdoor recreation (Manning, 2010). The benefit of visiting forests is directly related to the frequency of visits – the more recreation that is undertaken, the more benefit is obtained (Tyrväinen et al., 2008). Methodologically, the demand for recreation is usually measured by participation rates in outdoor activities, as well as the amount of time devoted to each activity. Data collection focusing on activities is mainly conducted in target areas. Although a focus on

activities is seen as a more traditional approach to outdoor recreation research, relevant studies have still been identified in the literature search.

A study by Dadvand et al. (2019) used a sample of 10,856 adolescents (10–18 years old), living in urban and rural districts across 30 provinces of Iran, to evaluate the association of time spent in different types of green spaces with self-satisfaction and social contacts. Highlights from this study showed:

- Green space use was associated with enhanced self-satisfaction in Iranian adolescents.
- Use of green spaces was associated with number of friends and time spent with friends.
- Social contact could mediate the association of green space use and self-satisfaction.
- Associations were observed for different green space types (including forests).

The researchers suggest replicating these findings in other populations with different climates, cultures, and lifestyles.

An activity orientated approach was adopted by Wolf et al. (2015) who used questionnaires, with more detailed insights from semi-structured interviews, to investigate visitor experiences in a special model of thematically connected guided walking, biking, and 4-wheel drive tours in Australian national parks, with a focus on older adults. This study applied Outcome-Focussed Management (OFM) by Driver (2008) (an example of Benefits-Based Management) as a conceptual framework to define the range of benefits that participants experienced through recreational activities. The results reported a broad range of benefits, including developing strong social ties and promoting social well-being, gaining a sense of achievement from mastering a challenge, and fostering place

attachment. The researchers note the relevance of the findings to efforts in parks and elsewhere to better integrate older adults into the community and provide opportunities to increase their physical, mental, and social well-being. 'Such opportunities become limited, for example, when people retire from work or suffer health impairment' (Wolf et al., 2015, p358).

A UK based study conducted by Flowers et al. (2016) examined whether subjective indices associated with local green space were better predictors of visit frequency to local green space and physical activity levels compared to objectively measured quantity of local green space. A cross-sectional survey was designed. From a random sample, 2079 working age adults responded to an online survey. 'Demographics, self-reported physical activity, objective measures of the local environment (including local green space, road coverage, and environmental deprivation), were assessed in conjunction with perceptions of local green space and nature relatedness' (Flowers et al., 2016, p1). The results confirmed that nature relatedness was the strongest predictor for both visit frequency to local green space and meeting physical activity guidelines. Results show that perceived quality is a better predictor of visit frequency to local green space than objective quantity of local green space. 'The odds of achieving the recommended amount of physical activity was over four times greater for people who visited local green space once per week compared to never going' (Flowers et al., 2016, p1).

Attractiveness of the Setting

Much less research on the benefits of forest recreation has concerned the attractiveness of the settings and its values (Tyrväinen et al., 2008), but some relevant studies have been identified in the literature search. Values can include 'landscape aesthetics or scenic beauty, landscape meanings and sense of place, biological diversity, clean air, silence, the sounds of nature, cultural heritage of traditional management practices,

privacy or cool temperatures in summer' (Tyrväinen et al., 2008, p48).

O'Brien (2019) found participants in the Active Forests programme felt the scenic and attractive forest environments played an important role in terms of the motivations and benefits of being physically active.

A recent study by Suárez et al. (2020) focused on Oslo's metropolitan area (Norway) and used an Ecosystem Services Mapping Tool (ESTIMAP), combined with data on people's preferences for outdoor recreation (drawing on results of an existing web-based population survey), to map and assess nature-based outdoor recreation opportunities with a focus on green space accessibility for different social groups, discussing the results in light of environmental justice. Highlights from the study showed that:

- Large wooded areas, with high density of trees and presence of water are preferred for recreation, although
- Outdoor recreation preferences differ depending on age and place of residence.
- Areas for daily recreation are highly accessible to the whole population in the study area, but they are unequally distributed
- Migrants and low-income households have relatively less access.

The researchers suggest that their methodology could be applied in other cities and metropolitan areas to assess differences in accessibility to outdoor recreation opportunities.

Hong et al. (2018) conducted a study in North America which examined the moderating effect of perceived safety on the association of green space with neighbourhood social capital in older adults, with data drawn from 647 independent-living seniors who participated in the Senior Neighbourhood Quality of Life Study. The researchers noted that green space may play an important role in promoting neighbourhood social

capital and health for older adults; however, safety remains a significant challenge in maximizing the benefits of green space. The results suggest that certain green space elements, such as natural sights, may be beneficial to neighbourhood social capital of older adults. 'However, other types of green space, such as parks and street trees, may be less advantageous to older adults who perceive their neighbourhoods as unsafe for pedestrians' (Hong et al., 2018, p38). The researchers recommend that further studies using a longitudinal design are conducted to confirm the causality of the findings.

In contrast, a study in Sweden conducted by Nummelin et al. (2017) aimed to analyse university student's visions of future forests using a newly developed survey method based on mind mapping. The researchers note that forests are an important natural resource in Sweden. They are used for multiple purposes, for example, providing economic returns from timber harvest, conservation of biodiversity, provision of wild berries and mushrooms and recreational benefits. 'From a methodological point of view 'the use of mind map as a survey tool gave detailed insights about the visions of future forest and relations between different components of visions' (Nummelin et al., 2017, p816). The results indicated that students regard ecological, social and economic aspects of forests as important for future forests and their use. In particular, the role of non-wood forest products, like berries and mushrooms, as well as recreational features of forests were central to many of the students. The researchers suggest that forest management decisions of today, directing the future of forests, need to consider the forest preferences of younger generations.

Motivations (and Opportunities)

Tyrväinen et al. (2008) note that in regional studies motives for forest visits or the use of recreation areas in general have been identified inductively by means of qualitative interviews. They confirm that people

visit forests and participate in specific recreational activities driven by a wide variety of motives. Regarding the content of the motives, Tyrväinen et al. (2008) observed that forest visits are widely experienced as providing contrast to and compensation from everyday life and its burdens. This is supported by van den Berg et al. (2007) who state that the functions and benefits of outdoor recreation can be operationalised by asking residents about their goals and motives for visiting their nearby forests, as they normally know the effects based on prior experiences. The benefit of forest recreation can be approximately assessed as the product between frequency of forest visits and the associated motives.

Tang et al. (2014) used (457 valid) questionnaires in a study based in China which explored the behaviour model of urban forest recreationists and provided an analysis on the relationships between the constructs of destination image, recreation benefits, perceived value and behavioural intentions. Statistical analysis suggested that the four principal components of destination image construct were accessibility, attractiveness, brand and amenities. The study applied a structural equation modelling (SEM) technique and the results indicated that destination image has both direct and indirect effects on the behavioural intentions, and the recreation benefits influences the behavioural intentions through perceived value as a moderating variable. In addition, the researchers state that the relationship path of "destination image → recreation benefits → perceived value → behavioural intentions" has been proved evident in this study. A survey approach based on a self-administered questionnaire, as well as a SEM framework, was also used in a study by Marques et al. (2015) in Portugal to gain a better understanding of visitors' preferences and behavioural patterns in national parks and protected areas.

Meyer et al. (2019) investigated local recreation in an urban and a rural forest in southern Germany during a summer and a winter survey. The study mapped the visitors' paths and asked them to rate forest benefits

and to name reasons for pathway choice. Visitors' patterns of perceived forest benefits and spatial behaviour were analysed. Results showed that forest visitors concentrated their use along existing paths in limited parts of both forests. Most parts of the forest were used by multiple recreation groups, while specific groups (e.g., cyclists) dominated only small parts. Forest visitors gave high ratings to forest benefits such as fresh air, experiencing nature, escaping everyday life, or health. Meyer et al. (2019, p83) summarised that 'pathway choice was dominantly driven by habit, spontaneity, or vicinity to the visitors' homes and not attributable to specific forest characteristics'.

The Benefits

The literature has shown that research on the social benefits of forest visits predominantly focuses on a behavioural approach to recreation, involving activities, settings and motivations, alongside the characteristics of users, measurements of socio-demographic characteristics, population and social health e.g. social well-being, inequality, deprivation, sense of place. Dodev et al. (2020, p2) state that 'intuitively and based on their experience, people recognise various intangible benefits of interacting with forests. For that reason, traditionally the forest environment is a desirable setting for various activities aiming at improving human health, well-being and social outcomes'. The majority of studies encountered in the literature review focused on the benefits of urban forests and urban green space, led by an increasing recognition that provision and preservation of urban green space in a rapidly urbanising global context is important for a range of health, well-being and social outcomes (Hunter et al., 2019).

Dodev et al. (2020) state that understanding the benefits of interacting with forests is important for maintaining and improving human well-being and social outcomes and should be clearly identified and systematised as a basis for their inclusion into the forest policies and management at all

levels. 'An emergent body of evidence demonstrates benefits experienced by individuals after spending time in forest environments, and this link is becoming more recognised in current scientific literature' (Dodev et al., 2020, p2).

5.2.2 Cultural Benefits

Recent research on the cultural benefits of forest visits focuses predominantly on Cultural Ecosystem Services (CES). O'Brien (2020) states that cultural ecosystem services are one of the four key components identified in the Millennium Ecosystem Assessment and United Kingdom National Ecosystem Assessment, along with provisioning, regulating and supporting services. Cultural ecosystem services are identified as the benefits people gain from their interactions with different environmental spaces, such as woods or parks, and the activities, such as walking and cycling, they undertake in these spaces. O'Brien (2020) notes that these interactions give rise to a variety of well-being benefits that are wide ranging and can be valued in numerous ways, via monetary, qualitative, quantitative, and mixed methods. Cultural ecosystem services and benefits can include health, learning, social connections, sensory experiences, cultural and symbolic importance and identity (O'Brien, 2020). Health benefits are discussed in previous sections.

A review of literature by O'Brien et al. (2017) identified studies from fifteen different European countries and explored linkages between the types of green infrastructure, the practices undertaken in these spaces and the cultural ecosystem benefits gained. The results showed that there are few detailed linkages made between the types of green infrastructure and the practices and benefits associated with these. The researchers recommend further research to assess the differences in benefits and practices associated with different types of green infrastructure. A key message from the review is that the cultural ecosystem benefits identified are wide ranging, diverse and multiple. These included benefits associated

with people feeling connected to nature and benefits people gain from enjoying diversity and complexity in nature spaces – including open space, mixed habitats, and forests. The researchers suggest that the typologies and conceptual matrix developed in this paper could be utilised by green infrastructure practitioners to assist them in taking account of cultural ecosystem benefits in their management decision making processes.

A recent supply and demand-based study in Germany by Baumeister et al. (2020) looked at identifying the role of both natural and humanmade physical landscape features for CES of urban forests. The study examined the linkages between CES hotspots (demand) and physical landscape features (supply) to help urban forest managers identify natural resource management synergies and conflicts, and to focus management efforts on features that matter. A multi- method approach used Public Participation GIS- data (PPGIS), OpenStreetMap, inventory maps, high resolution LiDAR satellite imagery, and forest function maps of the federal states' forestry administration. Baumeister et al. (2020) used the Breiman and Cutler's random forest for regression to assess the contribution of urban forest characteristics for supply of CES. The results found that 'humanmade infrastructure like historic sites and sports infrastructure as well as blue space being most important for the supply of CES, whereas natural features and biophysical characteristics (habitat) were less important. Natural features were most important for cultural heritage-, inspirational- and spiritual values' (Baumeister et al., 2020, p1). The researchers concluded that forest managers may promote CES in urban forests best when simultaneously enhancing infrastructure besides considering aesthetic preferences in silviculture.

Cultural ES are the focus of the 'cultural benefits' search for this literature review. Papers focusing on the benefits of forest culture specifically have not been identified in the literature, but these are included in the wider benefits (O'Brien, 2020; O'Brien et al., 2017; Baumeister et al., 2020).

According to Dodev et al. (2020, p3): 'forest culture includes various cultural events taking place in forests (for example, music, dance and folk festivals, art workshops, traditional crafts and customs workshops); religious practices related to forests (for example, religious tourism related to sacred sites or places, centuries-old trees, etc.); spiritual activities related to forests (for example, visiting unique natural sites in forests; enjoying beautiful, symbolic and inspiring forest views (O'Brien et al., 2017; Collins et al., 2014; Keniger et al., 2013; Requardt et al., 2011; Williams and Harvey, 2001; Fredrickson and Anderson, 1999; Hine et al., 2009)). The target group could be people of all ages and families'.

The report by Collins et al. (2014) reflects on the process of working with a variety of stakeholders (including local residents, government agencies, universities and NGOs) who had a relationship with the trees and forest in the Black Wood of Rannoch, Perthshire, Scotland. The project involved working with a resident artist and culminated in a two-day workshop which explored the visual/sensual and the social/cultural meanings and values associated with this ancient semi-natural pinewood. Workshop participants demonstrated that the Black Wood is of national cultural importance: as a tangible embodiment of bio-cultural heritage (e.g. traditional forest practices); as a location for aesthetic and spiritual experiences and inspiration for artistic expression, and as places which people identify with and feel a sense of attachment and belonging (Forest Research, 2020).

A report by Tabbush (2010) notes that cultural histories, stories and meanings make the forest interesting and attractive to visitors, and states that managers can enhance these meanings and create new meanings in a way that increases the value of the forest (e.g. by holding cultural events or installing artworks). 'Furthermore, an increase in access brings with it all the potential other social benefits of woods (such as health and well-being, education and learning and opportunities for social networking)' (Tabbush, 2010, p6).

Dodev et al. (2020) state that the demographic trends and dynamics are one of the main challenges for Forest Cultural Ecosystem Services. As the population becomes increasingly urban, there are significant concerns that a lot of people are becoming disconnected from nature and that this is affecting their well-being. Dodev et al. (2020, p2) recognise that 'in order to perform their everyday activities in an inclusive, healthy, resilient, safe and sustainable living environments the urban population depends on both natural ecosystem services provided beyond the city area', in a perimeter of 500–1000 times larger than the city area itself (Folke et al., 1997), and those provided from urban ecosystems and green infrastructure (O'Brien et al., 2017).

Both the social and cultural benefits of recreational visits to forests and woodland identified in this literature review are relevant to the Scottish Forest Strategy Priority 'Engaging more people, communities and businesses in the creation, management and use of forests and woodlands' set out in the Scottish Forestry Strategy Implementation Plan (2020-2022). One of the most relevant forest strategy activities relevant is 'encouraging a more diverse range of people to value and use forests and woodlands, particularly those close to where they live' (The Scottish Government, 2020, p30).

This section set out the findings from the literature focusing on methods for assessing the social and cultural benefits of recreational visits to forests and woodland. Social benefits were presented using a behavioural approach to recreation, with a focus on activities, settings, motivations and subsequent benefits. Cultural benefits focused on cultural ecosystem services, but also explored forest culture.

5.3 Measuring and Monitoring

5.3.1 Mediating Factors

Our review highlighted numerous papers that discussed a range of influences that can affect the magnitude of health and well-being benefits (Shanahan *et al.*, 2016; Cox *et al.*, 2017; van den Berg *et al.*, 2017; White *et al.*, 2017, 2019). When considering approaches to monitoring, consideration of conditions that can influence health and well-being benefits can inform what components to collect data on. These include:

- **Duration and frequency of visits.** Greater time spent in nature has been associated with greater health benefits. White *et al.* (2019) found significant health benefits for those spending more than 120 minutes a week in nature, although there was little evidence for benefits below this threshold and a plateau of benefits beyond 200-300 minutes of weekly exposure. Another study by Shanahan *et al.* (2016) found significant health benefits for individuals spending time in greenspaces for more than 30 minutes a week, whereas a study by Cox *et al.*, (2017) found significant benefits for depression prevention when spending as little as 10 minutes a week visiting greenspaces.
- **Biodiversity and environment characteristics.** Although a limited number of studies were encountered exploring this in our review, there is growing evidence for positive associations between biodiversity richness and human health (Aerts, Honnay and Van Nieuwenhuysse, 2018; Astell-Burt and Feng, 2019). The quality of a particular site through its size, location, scenic appeal can also be influential (Shanahan *et al.*, 2016).

- **Activities and reasons for visiting.** More intensive activities can produce greater physical health benefits, especially when using physical activity levels to measure health benefits (Moseley *et al.*, 2018). However, when considering mental health benefits from relatively low-intensity activities such as forest bathing, activity intensity or type can be far less important (Antonelli, Barbieri and Donelli, 2019). Reasons for visiting can reflect what motivates people to spend time in nature (Henderson-Wilson *et al.*, 2017; Puhakka, Pitkänen and Siikamäki, 2017; Campagnaro *et al.*, 2020) and could gauge expected health benefits, although there can be a lot of overlap in benefits across different reasons for visiting.
- **Socioeconomic and external factors.** A variety of additional factors can also be highly influential, particularly for understanding mental health and well-being benefits, including things such as age, income, marital status, health status, education, physical and mental health status and personal values (Fujiwara and Dolan, 2014; Jivraj and Nazroo, 2014; O'Brien and Morris, 2014; Bagnall *et al.*, 2019).

5.3.2 Health and Well-being Indicators

Health benefits can be measured in a variety of ways. Table 1 summarises the common indicators that were encountered in our review to evaluate changes in health and well-being status. These types of indicators appeared at least twice across the papers included in our review or are included in context of wider applicability for monitoring. Indicators were also checked for their inclusivity, in regular Scottish-level surveys with questions on the natural environment, including the Scotland People and Nature Survey (SPANS), Scottish Household Survey (SHS) and the Public Opinion of Forestry (POS) Scotland.

Table 1 Indicators for monitoring health benefits from engagement with the natural environment.

Indicator	Health Measurement	Health Domain			Data Collection	Indicator, or similar, included in Scottish Surveys
		Physical Health	Mental Health and Well-being	Social and Cultural		
Reason for visiting	Response dependant (likely relating very broadly to one or more health domains)	x	x	x	Survey	SPANS
Health-related quality of life (HRQoL) scales	Health-related quality of life	x	x		Survey	
Self-reported health	General health	x	x		Survey	SPANS, SHS, POS

GP visits	Ill-health	x	x		Survey or clinical registry	
Physical activity levels / Active visits	Physical activity	x			Survey	SPANS, POS
Blood pressure	Blood pressure	x			In-person	
Heart rate	Heart rate	x			In-person	
Immune system markers	Immune response	x			In-person	
Anti-depressant/ anti-anxiety prescriptions	Depression or anxiety		x		Survey or clinical registry	
Salivary or hair cortisol	Stress		x		In-person	
Self-reported mental	Depression, anxiety or other disorder		x		Survey	SHS

health disorder						
General Health Questionnaire (GHQ-12)	Minor psychiatric disorders		x		Survey	
ONS4 well-being measures (All or any)	Life satisfaction, happiness, worthwhile, anxiety		x		Survey	
Short Warwick-Edinburgh Mental Well-being Scale (SWEMWBS)	Well-being, Psychological functioning		x		Survey	SHS (in previous years)
Perceived Stress Scale (PSS)	Stress		x		Survey	SPANS (Includes similar questions on stress)

Profile of mood states (POMS)	Positive and negative feelings		x		Survey	
-------------------------------	--------------------------------	--	---	--	--------	--

5.3.3 Monitoring Costs

Our review also highlighted a small number of projects that included project cost for implementation of an intervention or for monitoring. Costs were found to be variable, dependant on factors such as the methodology used, associated sample sizes and monitoring length as well as the types of indicators or measurements involved, as described by Table 2. An indicative estimate of 10% was taken from overall project cost to provide an estimate of monitoring costs when this information was not available. Estimates around this range are often recommended as a benchmark for what proportion monitoring should contribute a project's cost (Dugdill and Stratton, 2007; Big Lottery Fund, 2016). The table also includes cost information for surveys, with estimates established from email correspondence and expert knowledge.

Table 2 Examples of monitoring costs.

Reference	Monitoring Type	Monitoring Costs	Sample Size	Main Health Indicators used
(CJC Consulting, 2016)	Participant Intervention – 6 week project	Estimate: (£12,162) over project length	359 participants	SF-6D, SF-12



(Ward Thompson <i>et al.</i> , 2019)	Ongoing Community Intervention	£1,135,735 over 5 years	5,460 research participants, of which 609 were a longitudinal cohort	EQ-5D, PSS, SWEMWBS
(Bagnall <i>et al.</i> , 2019)	Participant Intervention – 6 to 12-week project	Estimate: (£13,024) over project length	139 participants	Self-reported activity levels, self-reported health, SWEMWBS
Public Opinion of Forestry Survey (Scotland) 2017	Survey – adding questions to existing face-to-face omnibus survey	Estimate: (£25,000) If changed to telephone or online only, this would be estimated at £15,000-£20,000	Roughly 1,000	Self-rated health, Frequency of active visits, perceived mental and social health improvements
Scotland's People and Nature Survey (SPANS)	Face-to-face omnibus survey using CAPI (Computer Assisted Personal Interviewing)	Total cost of survey (£92,300) Scottish Forestry's annual contribution is £10,000	11,100 10 year survey 2012-2022	Self-rated health, Time spent physically active outdoors, types of activities conducted, stress, nature closeness, social experience,

				feeling relaxed or energised
All Forests Survey 2 2012-13	Face-to face survey and observation	£250,000	1,970	Main activity, Duration of visit, Frequency of visit
Active Forest Programme (AFP) 2014/15 to present	Ongoing Community Intervention	£35,000* per year	Over 13,600 to date, Participant survey and 3-month follow-up 72 Observations, and 10 interviews and 13 focus groups with 133 people)	Physical activities, Main activity, Frequency of activity, Duration of activity, qualitative case study data

* The costs for the AFP reflect evaluation undertaken by Forest Research for qualitative data gathering and analysis, quantitative analysis, engagement with the Active Forests Team and Board and reporting through multiple approaches. This figure does not take into account the costs associated with Active Forest Coordinators, who gather survey data in-person.

5.3.4 Measuring and monitoring social and cultural benefits

What is being monitored?

The following values have been identified in the literature. There is overlap with the health and well-being benefits outlined in the previous

section, as many studies focusing on social and cultural values also capture aspects associated with health. Values here denominate the characteristics of goods (and are not economic values) that contribute to well-being (Tyrväinen et al., 2008).

The characteristics of the site:

- Characteristics of forests and woodlands e.g. size, age structure, tree species composition, forest cover (Grilli & Sacchelli, 2020).
- Quality of forests and woodlands, e.g. accessibility/proximity, facilities, maintenance, variation, naturalness, colourfulness, clear arrangement, shelter, absence of litter, safety and overall general impression (De Vries et al., 2013).

Behavioural patterns:

- Recreational use/value e.g. length of forest visit (duration), frequency, spatial distribution, opportunities.
- Recreational motivations and behaviour.

Population data (socio-economic and health):

- Socio-demographic characteristics – e.g. age, gender, ethnicity, education level, income, location, etc.
- Socio-economic groups – occupation, employment status.
- Population health data – this includes data about NHS screening programmes, immunisations, births, deaths, general health and lifestyle.
- Social health e.g. social well-being, inequality, deprivation, sense of place.

What is being measured?

Social and cultural benefits can be measured in a variety of ways. **Table 3** below summarises the most relevant papers encountered in this review and the indicators used. The majority of the papers are referenced in the social benefits (under the headings of activities, settings and motivations) and the cultural benefits sections of the report. These papers demonstrate the variety and combination of indicators used to measure social and cultural benefits, as well as research methods, the application of the indicators and the country where the research was carried out.

Table 3 Social and cultural benefits – What is being measured?

	Indicators	Research Methods	Application of Indicators	Country/Author(s)
1	Nature Connection Index (NCI)	Monitor of Engagement with the Natural Environment Survey (MENE) datasets	Social and cultural: presents the strengths and limitations of the NCI as an approach and provides insight into what the index reveals about nature connectedness in both children and adults.	UK Richardson et al. (2019)
2	Pro-Nature Conservation	Questionnaire	Social and cultural: develop and validate a questionnaire	UK

	Behaviour Scale (ProCoBS)		scale to measure pro-nature conservation behaviours (ProCoBS) according to the current standard for psychometric scale development.	Barbett et al. (2020)
3	Time spent in green spaces (separately for parks, forests and private gardens), self-satisfaction, social contacts (number of friends and time spent with friends), socio-demographic characteristics	Cross-sectional questionnaire	Social contacts: evaluate the association of time spent in different types of green spaces with self-satisfaction and social contacts in adolescents.	Iran Dadvand et al. (2019)
4	Visitor experiences, socio-demographic characteristics	Field and online self-completion questionnaire-based	Social well-being: investigate visitor experiences in a special model of thematically connected	Australia Wolf et al. (2015)

		surveying, semi-structured interviews	guided walking, biking, and 4WD tours in Australian national parks.	
5	Nature-relatedness scale, self-reported health, self-reported physical activity levels, visitor frequency, socio-demographic characteristics	Cross-sectional online survey	Social: examine, in a National UK sample, whether subjective indices associated with local green space were better predictors of visit frequency to local green space and physical levels compared to objectively measured quantity of local green space.	UK Flowers et al. (2016)
6	Supply, flow and demand of outdoor recreation opportunities, preferences for outdoor recreation	Ecosystem Services Mapping Tool (ESTIMAP), web-based population survey	Social: assess the spatial distribution of and access to outdoor recreational opportunities in connection to population's preferences across social groups.	Norway Suárez et al. (2020)
7	Social cohesion, social interaction,	Survey	Social capital (social cohesion and social interaction) and	North America

	exposure to greenspace (distance to nearest park from home), perceived safety, socio-demographic characteristics (part of Senior Neighbourhood Quality of Life Study)		safety: examines the moderating effect of perceived safety on the association of green space with neighbourhood social capital in older adults.	Hong et al. (2018)
8	Features of forests, products derived from forests, activities in forests	Online survey (mind mapping technique)	Social: analyse Swedish university student's visions of future forests using a newly developed survey method based on mind mapping.	Sweden Nummelin et al. (2017)
9	Constructs of destination image, recreation benefits, perceived value,	Questionnaire, structural equation modelling (SEM) technique	Social: explores the behaviour model of urban forest recreationists and provides an analysis on the relationships	China Tang et al. (2014)

	behavioural intentions		between the constructs of destination image, recreation benefits, perceived value and behavioural intentions.	
10	Environmental attitudes (modified NEP scale), motivation to visit parks, activities	Self-administered questionnaire, qualitative interviews	Social: proposed integrated model based on an expectancy-value theory and a decision process framework for outdoor recreation to investigate the effects of environmental attitudes, push and pull motivation, social norms and perceived behavioural control on activity preferences.	Portugal Marques et al. (2015)
11	Characteristics of recreational behaviour (duration and frequency of visits), forest	Paper based on site survey, GIS mapping	Social: focuses on recreational use, demand factors and on-site drivers of perceived forest	Germany Meyer et al. (2019)

	benefits (peace/tranquillity, fun and happiness, sport, cooling, time with family and friends, health, escape from everyday life, experience nature, fresh air, dog walking), spatial patterns of recreational use, forest characteristics, socio-demographic characteristics		benefits in an urban and a rural forest.	
12	Perception of cultural eco-system services in urban forests,	Map-based questionnaire tool (Mapita	Cultural: examined the linkages between CES hotspots (demand) and physical landscape features	Germany Baumeister et al. (2020)

	Public Participation GIS- data (PPGIS), biophysical characteristics, landform and land cover	www.maptionnaire.com, 2018), OpenStreetMap, inventory maps, high resolution LiDAR satellite imagery, forest function maps.	(supply) to help urban forest managers identify natural resource management synergies and conflicts, and to focus management efforts on features that matter.	
--	---	---	--	--

5.3.5 Combining Social and Cultural Indicators

An overview of different methods by Tyrväinen et al. (2008) shows a general trend in the direction of combining two or more indicators/methods to address policy questions, stating that 'benefit transfer could partially answer the need to develop and apply assessment approaches that can strengthen the policy–science interface by acting as decision support tools within wider forest and regional policy making contexts' (Tyrväinen et al., 2008, p57).

Popular combinations:

- Characteristics of forests and woodland and characteristics of the forest visits
- Characteristics of forests and woodland and population health data
- Characteristics of forests and woodland and socio-demographic characteristics
- Quality of forests and woodland and population health data
- Quality of forests and woodland and socio-economic data

Examples of how these characteristics have been combined are shown in the previous section, and the results. Commonly used methods identified were the combination of questionnaires with either on-site visual recording of elements or GIS data. Links between social and physical data were usually established either by using statistical tools or by overlaying different thematic maps (Meyer, Rathmann & Schulza, 2019). Ambrose Oji & Pagella (2012, p7) note that 'there is no clear prescription regarding the most appropriate spatial analysis methodology to apply when considering cultural and social ecosystem services. Universally accepted tools or methods are unlikely. It is important to find a method of plotting, describing, valuing, and weighting criteria and indicators which not only address specific management problems and questions, but are also accepted and legitimised by all the stakeholders involved'.

Mixed methods are often used to capture statistically robust data and combine this with more in-depth insight from qualitative approaches. The People and Nature

Survey in England, as a follow up to the MENE survey, has developed into an online only survey. In the future, it will include an element of qualitative data gathering, which can be a more effective method for covering in detail social and cultural benefits.

6 Discussion

6.1 Research Gaps and Implications

There are multiple research gaps that need to be addressed in order to better understand the health and well-being benefits from forest and woodland visits.

- **Forests and Woodland-specific research.** There are fewer studies in the review and in wider literature focused solely on forests or woodlands. Although health benefits may be broadly consistent with those in the wider natural environment (Marušáková *et al.*, 2019), the specific influence of forests and woodland environments requires further research, where high levels of biodiversity (Aerts, Honnay and Van Nieuwenhuysse, 2018) and presence of trees (Astell-Burt and Feng, 2019) may prove to be an important mediator for additional benefits.
- **Understanding scale, duration and consistency of effects.** The overall evidence base has struggled to establish causal relationships between components of the environment and health (Lovell, Depledge and Maxwell, 2016; Kondo *et al.*, 2018; Collins *et al.*, 2020). Almost all studies find only associative relationships that could be influenced by uncontrolled factors, which has made it difficult to draw conclusive recommendations (White *et al.*, 2019).
- **Understanding best-practice health indicators.** There are a broad range of health metrics commonly used in environmental research but there has

been relatively little work on appraising the relative effectiveness of different kinds of nature-relevant health metrics (Cracknell *et al.*, 2019). A previous review has evaluated several health metrics for community-based interventions, although only covered a limited number of health metrics (Dronavalli and Thompson, 2015).

For Scottish forestry monitoring, there are opportunities to contribute towards a better understanding of these research gaps as well as limitations to be conscious of.

- **Need for longitudinal cohort study.** There is a need for longer-term research projects to better define the health benefits from engagement with forests and the environment. Such projects can implement mixed-method research to better quantify changes in health. Modifications to the approach of monitoring health and well-being benefits in Scotland could make steps towards effectively addressing this research gap by committing to long-term monitoring programme.
- **Standardised health and well-being indicators.** With a wide variety of available health metrics and indicators, there lacks universal consensus on which are most effective for use in different applications (Cracknell *et al.*, 2019). This could prove problematic for long-term comparisons between different approaches to monitoring health and well-being benefits. Future research ideally needs to work towards standardising best-practice indicators for monitoring, exploring how well each metric reflects its desired health domain as well as suitability across different populations. Our recommendations for Scottish forestry monitoring are based on our expert judgement of the field.

6.2 Recommendations for future social and cultural research

Tyrväinen et al. (2008) recommend a standardisation of categories for recreation motives for visits to forests to provide more comparable data on benefits of forest recreation, which should be based on qualitative research (interviews, focus groups) in all types of regions (cultures, rural–urban, socio-economic context).

Meyer, Rathmann & Schulza (2019) recommend that further specification of recreational behaviour is needed beyond central indicators such as visitor number and frequency. They have identified that the relationship between demand aspects such as demographic factors or forest visitor groups and biophysical characteristics is insufficiently investigated. Hegetschweiler, Vries, et al. (2017) also recommend spatially explicit mapping of cultural ES and benefits in urban green spaces.

Dodev et al. (2020) recommend developing criteria/methodology for assessing the potential of forest areas to provide forest welfare services, identified as:

- Forest therapy (healing)
- Forest recreation
- Forest culture
- Forest sport activities

Cultural ecosystem services are the main focus of the 'cultural benefits' search for this literature review. Were a review of the benefits of forest culture needed, a separate, more focused search might be helpful.

- **Opportunity for using mixed methods.** There is a need to combine standardised metrics with targeted qualitative research (undertaken virtually, face to face or in-situ in a woodland) which could be used to explore specific

areas of interest such as focusing on the characteristics of woods that contribute to wellbeing, focusing on social engagement in woodland environments and connections to nature.

6.3 Recommended Indicators

The health indicators identified in Table 1 could each be considered relevant for monitoring health and well-being benefits. We note that there is yet no gold-standard metric or overall consensus in the scientific community for what measures to adopt when monitoring health and well-being (Cracknell *et al.*, 2019).

Nonetheless, there are measures that are becoming more commonly used in studies focused on nature and health and we will provide our own recommendations for choice of indicators. The social and cultural benefit indicators outlined in Table 3 are also considered relevant and are best captured through mixed method approaches.

Although indicators exist that aim to capture overall health, such as EQ-5D, SF-6D or self-rated health, these are subject to a growing body of criticism in their lack of sensitivity to capture changes in mental health (Fujiwara and Dolan, 2014; Frandsen *et al.*, 2016). The inter-linked relationship between physical and mental health is well-established and is increasingly acknowledged (Ohrnberger, Fichera and Sutton, 2017), but our recommendation is to capture different domains of health separately in order to build a more reliable picture of overall health. We recommend monitoring indicators capturing impacts in the different domains of health as follows:

Physical Health – Physical Activity Levels.

- Physical health benefits should be estimated in the first instance based upon data on physical activity levels, using questions along lines of those featuring

prominently in many surveys on engagement with the natural environment. Key questions to include are: (i) the proportion of time spent on different types of activities during woodland visits (where the types are distinguished primarily on the basis of different levels of physical exercise); (ii) the average length of a woodland visit; and (iii) the frequency of visits to woodlands over a given time period. Information needs to be collected on (i) and (ii) in order to understand the intensity of physical activity during visits and its duration, which can then be combined with data on (iii) frequency of visits to provide an overall indicator of the level of physical exercise associated with their visits to woodlands over a given period for each respondent.

- The metabolic equivalent tasks (METs) of these visits should can then be computed from this data. This can readily be converted into quality-adjusted life years (QALYs) and monetised (Moseley *et al.*, 2018).
- Collecting data on physical activity levels is generally far less costly than physical health indicators that require in-person data collection for accurate measurements, such as cortisol levels, blood pressure or heart rate levels, as physical activity levels can be self-reported. It is also widely accepted as a reliable basis for estimating physical health benefits which (in contrast to overall health metrics) allows these to be distinguished from mental health and wellbeing benefits, while also avoiding double-counting.
- In cases where information on specific physical health benefits is required in making a case for NHS spending on forest-based interventions for particular target groups, in-person monitoring of specific physical health benefits of visiting forests (e.g. blood pressure, heart rate, immune system markers) is recommended. This is because information on physical activity levels alone is considered insufficient as an evidence base for monitoring impacts of forest visits in terms of specific physical health conditions.

Mental Health and Well-being – Subjective Well-being Measures

- Mental health and well-being benefits should be monitored in the first instance based upon indicators of subjective wellbeing and how these change due to visits to Scotland's forests. Subjective well-being measures including SWEMWBS, ONS4 and life satisfaction have featured across a variety of national surveys on engagement with the natural environment, including MENE (White *et al.*, 2019), NSW (Saunders, 2019) and SHS.

These types of measures relate to a broader conceptualisation of mental health than simply the absence or presence of negative effects, such as diagnosable disorders or stress (Galderisi *et al.*, 2015), and reflect more of a balance of positive and negative emotions with reflection on one's life aspirations and goals (Kahneman and Krueger, 2006). Although no single measure of mental health is perfect, subjective well-being relates strongly with mental health (Tennant *et al.*, 2007; Lombardo *et al.*, 2018) and align closely to the WHO definition of mental health (Galderisi *et al.*, 2015).

- Subjective well-being measures are being increasingly adopted, featuring in an update to the HM treasury Green Book (HM Treasury, 2018) and have been recommended as an approach for valuing mental health benefits of forests (Saraev *et al.*, 2020). Recent tools such as Greenkeeper have also adopted subjective well-being measures to monetise mental well-being benefits, through the use of a life satisfaction approach (Vivid Economics, Barton Willmor and University of Exeter, 2020).
- Subjective well-being measures can be strongly influenced by socioeconomic characteristics however, including factors such as low household income, having a disability and being diagnosed with a chronic condition (Fujiwara, 2014; Jivraj and Nazroo, 2014). For a better understanding of how subjective well-being measures change in relation to forest visits, these and other key

socioeconomic factors should be controlled for Appendix E suggests key areas for this.

- SWEMWBS covers psychological functioning as well as subjective wellbeing across 7 questions (Tennant *et al.*, 2007) and can be effective at capturing some effects of mental ill-health. ONS4 covers both negative mental health components (anxiety) as well as wellbeing components (life satisfaction, happiness and worthwhileness). Life satisfaction as a standalone question is the most common metric of the three for evaluating wellbeing, and can effectively reflect population-level wellbeing and mental health (Jump and Simetrica, 2018; Vivid Economics, Barton Willmor and University of Exeter, 2020). We recommend life satisfaction for survey-based methodology, as an effective, simple and widely adopted metric for measuring population mental health and well-being. This can be combined with data on frequency of visits and visit duration to provide an understanding for the magnitude of benefit over a given time.
- In cases where information on specific mental health benefits is required in making a case for NHS spending on interventions for particular target groups, in-person monitoring changes in specific mental health related indicators (e.g. SWEMWBS, PSS or cortisol levels) due to visiting forests is recommended. Information on life satisfaction and ONS4 alone is considered insufficient as an evidence base for monitoring impacts of forest visits in terms of specific mental health conditions, due to lack of coverage of these measures across psychological functioning or mental ill-health.

Social and Cultural Benefits

- Social and cultural benefits should be monitored based upon combining two or more of the social and cultural indicators featured in Table 3. While each of these are relevant for monitoring social and cultural benefits, selection will

depend on the relevant answers needed to address the highest priority policy questions. We suggest that the Nature Connection Index be used to explore people's subjective sense of their relationship with nature (Richardson et al. 2019). This could be coupled with the Pro-Nature Conservation Behaviour Scale (Barbett et al. 2020) as there is evidence of a positive association between nature connection and outcomes including pro-environmental behaviour and wellbeing. Current questions within the England POF on woodlands as places to socialise, learn about culture/history/the environment and have fun are relevant and were developed following the study on the economic and social contribution of forestry for people in Scotland (Edwards et al. 2009).

- As with Physical Health (see above) key areas for questions include the types of activities conducted and visit duration, in order to understand intensity, as well as frequency of visits over a given time period. For social and cultural benefits this information should be combined with questions about socio-demographic characteristics and socio-economic groups, as well as motivations/opportunities and the characteristics and quality of forests and woodland (depending on the policy questions).
- Incorporating qualitative data gathering, along with quantitative data, such as through semi-structured interviews, focus groups or open questions within a survey should be used to gather more in-depth insights into social and cultural benefits depending on detail needed and the availability of resources.

7 Summary Recommendations

7.1 Indicators to use for Health and Well-being Monitoring

Table 4 summarises recommendations for best-practice health indicators to consider. Justification for these recommendations is discussed in greater detail in the previous section. Appendix E provides recommendations for specific questions to incorporate in surveys in order to provide the evidence needed to monitor different benefits.

Table 4. Recommended health indicators for different applications

Health Domain	Indicators for Surveys	Benefits (Survey indicator)	Indicators for Targeted Interventions of people with specific health problems	Benefits (Intervention indicator)
Physical Health	Types of Activities Undertaken Time spent on activities	MET values can be calculated and converted into QALYs (and can be monetised)	Blood Pressure, Heart Rate, Immune Markers	Provides greater detail on a participant's actual physical health
Mental Health	Life Satisfaction	Simple, widely adopted and effective measure of wellbeing (and can be monetised)	SWEMWBS, PSS, Cortisol levels	Can explore the effects of mental ill-health more effectively

Social & Cultural	<p>Nature Connection Index</p> <p>Pro-Nature conservation behaviour scale</p> <p>Open questions for qualitative comment within a survey (see Appendix E)</p>	<p>NCI is a simple 6 item measure with evidence of some links to wellbeing</p> <p>Those connected with nature are more likely to take action to conserve it. Use of ProCoBs and NCI would allow this issue to be explored in the context of forest visits by difference groups within society</p>	<p>Interviews, focus groups, in-situ data gathering, participant observation</p>	<p>Useful for understanding the process of how an intervention is working. Good for exploring in-depth the perceived effectiveness of the intervention</p>

7.2 Approaches to Monitoring Health and Well-being Benefits

We have identified different approaches to monitoring health and well-being benefits of visits to Scotland's forests. Survey approaches are recommended as less costly than in-person monitoring and as much more reliable than using social media data. These approaches complement the high-level monitoring of the 'Number of visits to forests and woodlands'. To inform these recommended approaches, we also provide an overview of how monitoring health and well-being benefits from forest visits would currently operate using existing, unmodified datasets. Use of these datasets in their current forms is not recommended, due to several shortfalls, although they could be considered a 'minimum' approach to monitoring health and wellbeing benefits.

- **Minimum Approach** – There are several notable limitations with currently available datasets that affect their ability to monitor health and wellbeing benefits effectively. Of annual national datasets in Scotland performing data collection in these areas, SPANS and POF Scotland have the most coverage across key categories and are discussed below.
- **SPANS** – Includes a variety of questions on engagement with the natural environment. The representative sample is large, around 11,100 adults (for the 2019-20 wave).

Questions include time spent physically active outdoors as well as what activities are undertaken, which would allow the associated physical health benefits to be estimated.

Mental health and social benefits are addressed on an agreement scale of 1-5 for perceived stress, energisation, good social experience and nature closeness. The coverage of mental health solely through stress is relatively

narrow and does not incorporate elements of well-being. Social and cultural questions cover useful areas for understanding benefits although there is no opportunity to give an open-ended response.

Questions are primarily focused on outdoors engagement rather than being woodland specific. 19% of visits were taken to a forest of woodland environment in 2019-20 but it is difficult to isolate benefits associated solely with visits to forests or woodlands due to the structure of the questioning. At a minimum, this percentage of visits to forests and woodlands could provide a crude estimate for the scale of health and well-being benefits as well as social and cultural benefits. However, this assumes a uniform distribution of types of activities and benefits? across all natural environments, which is unlikely to be the case but could be tested with a separate piece of work.

Given that benefits are aggregated across all natural environment types, comparisons cannot be drawn between different types of forest or woodland. SPANS however does collect some data on key socioeconomic areas that can influence health and wellbeing benefits, including data on health status, sex and age as well as employment status, which can be assumed to be closely associated with income.

POF Scotland – The most recent survey in Scotland covered a sample of 1,013 individuals, which would be considered on the low end for a representative sample.

Questions include visit frequency to forests and woodlands but without questions on duration and activity. The survey does include questions on number of active visits to woodlands, although this does not allow for an understanding of intensity of activity and provides less depth for an understanding of physical health benefits.

Questions on mental health and social and cultural benefits are binary, as to whether there is perceived benefit from a visit or not, which does not offer depth to adequately understand scale of benefits.

The wording of the questions in the health and well-being sections also currently reflect benefits from 'woodlands and the outdoors', rather than just for forests or woodlands.

Questions are included that cover different types of woodlands visited, to explore differences across site characteristics. POF Scotland also includes some questions that cover key socioeconomic areas for monitoring health and wellbeing benefits, including working status and presence of long-term illness or disability as well as sex and age.

Given issues across both surveys in their current forms, they give only a limited understanding of the health and social and cultural benefits in relation to forest visits. Table 5 summarises the extent to which the questions that are present across SPANS and POF Scotland address key areas required for monitoring health and wellbeing benefits. These areas are informed by our recommended indicators to use for monitoring health, well-being and social and cultural benefits, as well as key mediating factors identified in our review. These mediating factors include questions on visit duration and frequency of visits to understand scaling effects, questions addressing differing environmental characteristics across sites and questions collecting key socioeconomic data that influence health and well-being benefits. Appendix E provides a list of recommended questions for inclusions in surveys to cover these areas.

Table 5. Presence of sufficient coverage across key question categories for monitoring health and wellbeing benefits in relevant Scottish datasets

Dataset	Physical Health	Mental Health	Social and Cultural	Scaling Benefits for Forests and Woodlands	Key Socioeconomic data	Site Characteristics
SPANS	YES (Time spent physically active outdoors, types of Activity conducted)	NO (Stress)	PARTIALLY (Nature closeness, feeling relaxed or energised, social experience)	PARTIALLY (% of visits to forests in woodlands)	PARTIALLY (Sex, age, Health status, employment status)	NO

POF Scotland	PARTIALLY (Number of visits for physical activity)	NO (Perceived Mental Health Improvement)	NO (Perceived Social Health Improvement)	PARTIALLY (Frequency of visits)	PARTIALLY (Sex, age, Working status, presence of long-term illness or disability)	YES (Type of woodland visited)

Note: Some categories are marked as no coverage, despite the presence of seemingly relevant questions. This is because these questions are considered insufficient in their coverage to adequately address the category. Further discussion on limitations across these categories can be found in the text above.

To improve upon the limitations highlighted across current datasets, we can recommend two approaches, varying in the level of resources they require.

- **Intermediate Approach** - Adding additional questions into existing datasets to monitor health and well-being benefits from forest visits. Our recommended dataset to modify would be POF Scotland, due to its inherent focus on forestry and the difficulties that the use of SPANS gives in untangling forestry and woodland benefits from wider benefits in the natural environment. We recommend a conservative amount of modifications that could be made to POF Scotland in order to allow it to meet an effective threshold for monitoring. Appendix E provides a list for recommended questions.

Key questions to include are those to capture visit duration and visit frequency, in order to understand how the scale of health and wellbeing benefits can be scaled up. An additional question to include for POF Scotland would be on duration of visits, described by question 2 (**Q2**) in Appendix E.

Questions on activities conducted and time spent on activities would allow physical activity levels to be understood in more depth than is currently available. The insertion of additional questions, as described by **Q3** and **Q4** in Appendix E could provide this. This data could also be used to provide estimates of QALYs and associated economic values.

To better capture mental health benefits, an additional question could be inserted on life satisfaction (**Q5** in Appendix E). Social and cultural benefits could be addressed through similar questions that are included in the England POF, with the inclusion of at least one open ended question to collect qualitative feedback. (**Q6-8** in Appendix E).

The survey could also be improved by modifying wording over key socioeconomic areas to include a question on income (**Q9** in Appendix E),

rather than just working status. Subjective wellbeing measures can be highly sensitive to income and an understanding of this can improve the reliability of life satisfaction, although questions on income are sometimes avoided by respondents on surveys. Other key areas such as site characteristics are already included within POF Scotland.

This approach would be less costly than a more in-depth approach and potentially, given resource constraints, more feasible. The insertion of the priority questions listed in Appendix E would significantly improve Scotland's capacity to monitor health and well-being benefits associated with visits to Scotland's forests. However, the predominant limitation remains the relatively small sample size of POF Scotland, which would not be able to adequately provide representation across all equality groups.

- **In-depth Approach** - Development of a bespoke survey, ideally designed to run for several years to attempt to identify causal relationships between health and well-being benefits and visits to forests and woodlands in Scotland.

This could include a large sample of participants of at least 5,000 to be representative of multiple demographics. Alternatively, a large cohort of the same participants each year could be utilised, providing opportunity to follow engagement with forests and woodlands over multiple years and addressing key research gaps around causality (White *et al.*, 2019).

Questions should cover duration of visits and frequency of visits over a given time period (**Q1** and **Q2** in Appendix E) to understand the effects of exposure and scaling benefits.

Questions on types of activities conducted (**Q3**) and activity duration (**Q4**) could address physical health benefits This data can provide the foundation

for calculating through METs and QALYs (Moseley *et al.*, 2018), which can also be readily monetised.

This would also provide an opportunity for a longitudinal study to explore optimal exposure for benefits and to develop recommendations, an area that requires further research to better understand

Questions on mental health and well-being could be covered through life satisfaction (**Q5**). The use of the SWEMWBS scale could also offer additional coverage for understanding mental health benefits, offering more insight into improvements to psychological functioning associated with visits to forests and woodlands (**Q11**).

Social and cultural benefits could be addressed through similar questions as recommended for the Intermediate approach, with two open-ended questions (**Q6-8**), alongside the addition of the Nature Connection Index Scale (**Q12**) for additional insight into nature connectivity. Inclusion of an opt-in question to take part in focus groups or semi-structured interviews (virtual or face to face) would also offer an opportunity to collect qualitative data and gain in-depth insights into social and cultural benefits (**Q13**)

For comparison of benefits between visits to different sites, questions could be included to ask participants what type of woodland they last visited (**Q18**), as well as a list of what facilities were present on the site that they visited (**Q19**).

Socioeconomic questions should also be included to cover areas including income (**Q9**) and health status (**Q10**) as well as sex, (**Q14**), age (**Q15**), relationship status (**Q16**) and education level (**Q17**). Although this is an incomplete list of what would typically be desired when collecting socioeconomic data, these reflect key influential areas for control when monitoring health and wellbeing (Jump and Simerica, 2018; White *et al.*, 2019). Questions on ethnicity, religion and number of children in households

are less important for understanding health and wellbeing causality but may be important inclusions for improving understanding on access to forests.

The list of example questions to include to cover these areas can be found in Appendix E.

Although such an Approach would be relatively costly, it could be considered the 'gold standard'.

7.3 Recommended Approach

Table 6 below summarises these different Approaches, their relative pros and cons and their associated costs. The row 'Number of key questions' reflect the total number of questions suggested for inclusion in each area, outlined in greater detail Appendix E. For the Intermediate Approach costs are estimated at £600 for an addition of a pre-coded question and £890 for an open-ended question.

Table 6. Summary of the different Approaches for monitoring health and well-being benefits

	Minimum Approach	Intermediate Approach (POF Scotland Modifications)	In-depth Approach
Summary	Utilising existing surveys without changes	Modifying existing surveys with key additions	Developing a bespoke survey with all best-practice questions
Pros	Least expensive	Good understanding of H&WB benefits Less costly than In-depth approach	Very good understanding of H&WB benefits Representative of multiple equality groups
Cons	Poor understanding of H&WB benefits	Not fully representative of all equality groups (due to sample size)	Most Expensive
Number of key	-	Exposure – 2	Exposure – 2

questions required		Physical health – 2 Mental health – 1 Social and cultural – 3 (with 1 open-ended) Socioeconomic – 1	Physical health – 2 Mental health – 2 Social and cultural – 4 (with 2 open-ended) + Invitation for interview Socioeconomic – 6 Site characteristics – 2
Annual Cost Estimates	No additional costs	£5,690 for question insertions	Minimum £11,380 for key questions alone. Total costs may be comparable to SPANS costs (~£100k), or All Forest Survey 2012 (~£250k), if qualitative data collection is prominent.
Rank	3	2	1

Our overall recommendation would be the adoption of the In-Depth approach, as a larger sample size can offer more effective representation across equality groups and more questions offer greater precision for understanding benefits. If resources do not allow for adoption of the In-Depth approach, the Intermediate approach would be an effective alternative, acting as a baseline for monitoring across all critical categories. Key questions to include can be viewed in Appendix E.

These Approaches are not intended to be rigid recommendations however but can be flexible to fit requirements as necessary. Subject to resource constraints, some of the additional questions or characteristics that are recommended under the In-Depth Approach could potentially be adopted under the Intermediate Approach as well. For example, additional recommended socioeconomic

questions could improve the overall reliability of the Intermediate Approach for monitoring. Alternatively, increasing the survey size closer to 5,000 would significantly improve the representation of the sample.

8 References

- Aerts, R., Honnay, O. and Van Nieuwenhuyse, A. (2018) 'Biodiversity and human health: Mechanisms and evidence of the positive health effects of diversity in nature and green spaces', *British Medical Bulletin*. doi: 10.1093/bmb/ldy021.
- Akpinar, A. (2017) 'Urban green spaces for children: A cross-sectional study of associations with distance, physical activity, screen time, general health, and overweight', *Urban Forestry and Urban Greening*. doi: 10.1016/j.ufug.2017.05.006.
- Andrusaityte, S., Grazuleviciene, R., Dedele, A. and Balseviciene, B. (2020) 'The effect of residential greenness and city park visiting habits on preschool Children's mental and general health in Lithuania: A cross-sectional study', *International Journal of Hygiene and Environmental Health*. doi: 10.1016/j.ijheh.2019.09.009.
- Antonelli, M., Barbieri, G. and Donelli, D. (2019) 'Effects of forest bathing (shinrin-yoku) on levels of cortisol as a stress biomarker: a systematic review and meta-analysis', *International Journal of Biometeorology*. doi: 10.1007/s00484-019-01717-x.
- Astell-Burt, T. and Feng, X. (2019) 'Association of Urban Green Space with Mental Health and General Health among Adults in Australia', *JAMA Network Open*. doi: 10.1001/jamanetworkopen.2019.8209.
- Bagnall, A., Freeman, C., Southby, K. and Brymer, E. (2019) *Social Return on Investment analysis of the health and wellbeing impacts of Wildlife Trust programmes*.
- van den Berg, M., van Poppel, M., Smith, G., Triguero-Mas, M., Andrusaityte, S., van Kamp, I., van Mechelen, W., Gidlow, C., Gražulevičiene, R., Nieuwenhuijsen, M. J., Kruize, H. and Maas, J. (2017) 'Does time spent on visits to green space mediate the associations between the level of residential greenness and mental health?', *Urban Forestry and Urban Greening*. doi: 10.1016/j.ufug.2017.04.010.
- Big Lottery Fund (2016) *A guide to evaluation*. Available at: http://adviceservicestransition.org.uk/wp-content/uploads/2015/03/Big-Lottery-Fund-self_evaluation_guidance.pdf.
- Braçe, O., Garrido-Cumbrera, M., Foley, R., Correa-Fernández, J., Suárez-Cáceres, G. and Laforzezza, R. (2020) 'Is a View of Green Spaces from Home Associated with a Lower Risk of Anxiety and Depression?', *International Journal of Environmental Research and Public Health*, 17(19), p. 7014. Available at: <https://doi.org/10.3390/ijerph17197014>.
- Bratman, G. N., Anderson, C. B., Berman, M. G., Cochran, B., de Vries, S.,

- Flanders, J., Folke, C., Frumkin, H., Gross, J. J., Hartig, T., Kahn, P. H., Kuo, M., Lawler, J. J., Levin, P. S., Lindahl, T., Meyer-Lindenberg, A., Mitchell, R., Ouyang, Z., Roe, J., Scarlett, L., Smith, J. R., van den Bosch, M., Wheeler, B. W., White, M. P., Zheng, H. and Daily, G. C. (2019) 'Nature and mental health: An ecosystem service perspective', *Science Advances*. doi: 10.1126/sciadv.aax0903.
- Brindley, P., Cameron, R. W., Ersoy, E., Jorgensen, A. and Maheswaran, R. (2019) 'Is more always better? Exploring field survey and social media indicators of quality of urban greenspace, in relation to health', *Urban Forestry and Urban Greening*. doi: 10.1016/j.ufug.2019.01.015.
- Campagnaro, T., Vecchiato, D., Arnberger, A., Celegato, R., Da Re, R., Rizzetto, R., Semenzato, P., Sitzia, T., Tempesta, T. and Cattaneo, D. (2020) 'General, stress relief and perceived safety preferences for green spaces in the historic city of Padua (Italy)', *Urban Forestry and Urban Greening*. doi: 10.1016/j.ufug.2020.126695.
- Chen, H. T., Yu, C. P. and Lee, H. Y. (2018) 'The effects of forest bathing on stress recovery: Evidence from middle-aged females of Taiwan', *Forests*. doi: 10.3390/f9070403.
- Chiang, Y. C. and Li, D. (2019) 'Metric or topological proximity? The associations among proximity to parks, the frequency of residents' visits to parks, and perceived stress', *Urban Forestry and Urban Greening*. doi: 10.1016/j.ufug.2018.12.011.
- CJC Consulting (2016) *Branching Out Economic Study Extension: Final Report to Forestry Commission Scotland*.
- Coldwell, D. F. and Evans, K. L. (2018) 'Visits to urban green-space and the countryside associate with different components of mental well-being and are better predictors than perceived or actual local urbanisation intensity', *Landscape and Urban Planning*. doi: 10.1016/j.landurbplan.2018.02.007.
- Collins, R. M., Spake, R., Brown, K. A., Ogutu, B. O., Smith, D. and Eigenbrod, F. (2020) 'A systematic map of research exploring the effect of greenspace on mental health', *Landscape and Urban Planning*. doi: 10.1016/j.landurbplan.2020.103823.
- Cox, D. T. C., Shanahan, D. F., Hudson, H. L., Plummer, K. E., Siriwardena, G. M., Fuller, R. A., Anderson, K., Hancock, S. and Gaston, K. J. (2017) 'Doses of neighborhood nature: The benefits for mental health of living with nature', *BioScience*. doi: 10.1093/biosci/biw173.
- Cracknell, D., Lovell, R., Wheeler, B. and White, M. (2019) *Demystifying Health Metrics*.
- Doctorman, L. (Ellingson) and Boman, M. (2016) 'Perceived health state and willingness to pay for outdoor recreation: an analysis of forest recreationists and hunters', *Scandinavian Journal of Forest Research*. doi: 10.1080/02827581.2016.1143024.
- Dolling, A., Nilsson, H. and Lundell, Y. (2017) 'Stress recovery in forest or handicraft environments – An intervention study', *Urban Forestry and Urban Greening*. doi: 10.1016/j.ufug.2017.07.006.
- Donahue, M. L., Keeler, B. L., Wood, S. A., Fisher, D. M., Hamstead, Z. A. and McPhearson, T. (2018) 'Using social media to understand drivers of urban park visitation in the Twin Cities, MN', *Landscape and Urban Planning*. doi:

10.1016/j.landurbplan.2018.02.006.

Dronavalli, M. and Thompson, S. C. (2015) 'A systematic review of measurement tools of health and well-being for evaluating community-based interventions', *Journal of Epidemiology and Community Health*. doi: 10.1136/jech-2015-205491.

Dugdill, L. and Stratton, G. (2007) 'Evaluating sport and physical activity interventions: A guide for practitioners', *Salford University*.

Dzhambov, A. M., Markevych, I., Hartig, T., Tilov, B., Arabadzhiev, Z., Stoyanov, D., Gatseva, P. and Dimitrova, D. D. (2018) 'Multiple pathways link urban green- and bluespace to mental health in young adults', *Environmental Research*. doi: 10.1016/j.envres.2018.06.004.

Frandsen, L. S., Villumsen, L. B., Hjorth, C. F., Nielsen, B. J., Ullits, L. R., Torp-Pedersen, C., Bøggild, H. and Overgaard, C. (2016) 'The relationship between self-reported mental health and redeemed prescriptions of antidepressants: A register-based cohort study', *BMC Psychiatry*. doi: 10.1186/s12888-016-0893-7.

Freire, C., Ramos, R., Puertas, R., Lopez-Espinosa, M.-J., Julvez, J., Aguilera, I., Cruz, F., Fernandez, M.-F., Sunyer, J. and Olea, N. (2010) 'Association of traffic-related air pollution with cognitive development in children', *Journal of Epidemiology and Community Health*, 64(3), p. 223 LP-228. doi: 10.1136/jech.2008.084574.

Fujiwara, D. (2014) *Measuring the Social Impact of Community Investment: The Methodology Paper*.

Fujiwara, D. and Dolan, P. (2014) *Valuing mental health: how a subjective wellbeing approach can show just how much it matters*.

Furuyashiki, A., Tabuchi, K., Norikoshi, K., Kobayashi, T. and Oriyama, S. (2019a) 'A comparative study of the physiological and psychological effects of forest bathing (Shinrin-yoku) on working age people with and without depressive tendencies', *Environmental Health and Preventive Medicine*, 24(1), p. 46. doi: 10.1186/s12199-019-0800-1.

Furuyashiki, A., Tabuchi, K., Norikoshi, K., Kobayashi, T. and Oriyama, S. (2019b) 'A comparative study of the physiological and psychological effects of forest bathing (Shinrin-yoku) on working age people with and without depressive tendencies', *Environmental health and preventive medicine*. doi: 10.1186/s12199-019-0800-1.

Galderisi, S., Heinz, A., Kastrup, M., Beezhold, J. and Sartorius, N. (2015) 'Toward a new definition of mental health', *World Psychiatry*. doi: 10.1002/wps.20231.

Gascon, M., Sánchez-Benavides, G., Dadvand, P., Martínez, D., Gramunt, N., Gotsens, X., Cirach, M., Vert, C., Molinuevo, J. L., Crous-Bou, M. and Nieuwenhuijsen, M. (2018) 'Long-term exposure to residential green and blue spaces and anxiety and depression in adults: A cross-sectional study', *Environmental Research*. doi: 10.1016/j.envres.2018.01.012.

Guan, H., Wei, H., He, X., Ren, Z. and An, B. (2017) 'The tree-species-specific effect of forest bathing on perceived anxiety alleviation of young-adults in urban forests', *Annals of Forest Research*. doi: 10.15287/afr.2017.897.

Henderson-Wilson, C., Sia, K. L., Veitch, J., Staiger, P. K., Davidson, P. and Nicholls, P. (2017) 'Perceived health benefits and willingness to pay for parks by

- park users: Quantitative and qualitative research', *International Journal of Environmental Research and Public Health*. doi: 10.3390/ijerph14050529.
- HM Government (2010) *Equality Act 2010*, The Stationery Office Crown Copyright. doi: ISBN 978-0-10-541510-7.
- HM Treasury (2018) *The Green Book: Central Government Guidance on Appraisal and Evaluation*. Available at: <https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>.
- Hong, S. K., Lee, S. W., Jo, H. K. and Yoo, M. (2019) 'Impact of frequency of visits and time spent in urban green space on subjective well-being', *Sustainability (Switzerland)*. doi: 10.3390/su11154189.
- Houlden, V., Porto de Albuquerque, J., Weich, S. and Jarvis, S. (2019) 'A spatial analysis of proximate greenspace and mental wellbeing in London', *Applied Geography*. doi: 10.1016/j.apgeog.2019.102036.
- Houlden, V., Weich, S., de Albuquerque, J. P., Jarvis, S. and Rees, K. (2018) 'The relationship between greenspace and the mental wellbeing of adults: A systematic review', *PLoS ONE*. doi: 10.1371/journal.pone.0203000.
- Janssen, I. and Rosu, A. (2015) 'Undeveloped green space and free-time physical activity in 11 to 13-year-old children', *International Journal of Behavioral Nutrition and Physical Activity*. doi: 10.1186/s12966-015-0187-3.
- Jivraj, S. and Nazroo, J. (2014) 'Determinants of socioeconomic inequalities in subjective well-being in later life: a cross-country comparison in England and the USA', *Quality of Life Research*. doi: 10.1007/s11136-014-0694-8.
- Jump and Simetrica (2018) *Revaluing Parks and Green Spaces: Measuring their economic and wellbeing value to individuals*.
- Kahneman, D. and Krueger, A. B. (2006) 'Developments in the measurement of subjective well-being', *Journal of Economic Perspectives*. doi: 10.1257/089533006776526030.
- Kampa, M. and Castanas, E. (2008) 'Human health effects of air pollution', *Environmental Pollution*. doi: 10.1016/j.envpol.2007.06.012.
- de Keijzer, C., Agis, D., Ambrós, A., Arévalo, G., Baldasano, J. M., Bande, S., Barrera-Gómez, J., Benach, J., Cirach, M., Dadvand, P., Ghigo, S., Martinez-Solanas, È., Nieuwenhuijsen, M., Cadum, E. and Basagaña, X. (2017) 'The association of air pollution and greenness with mortality and life expectancy in Spain: A small-area study', *Environment International*, 99, pp. 170–176. doi: <https://doi.org/10.1016/j.envint.2016.11.009>.
- Kondo, M. C., Fluehr, J. M., McKeon, T. and Branas, C. C. (2018) 'Urban green space and its impact on human health', *International Journal of Environmental Research and Public Health*. doi: 10.3390/ijerph15030445.
- Koselka, E. P. D., Weidner, L. C., Minasov, A., Berman, M. G., Leonard, W. R., Santoso, M. V., de Brito, J. N., Pope, Z. C., Pereira, M. A. and Horton, T. H. (2019) 'Walking green: Developing an evidence base for nature prescriptions', *International Journal of Environmental Research and Public Health*. doi: 10.3390/ijerph16224338.
- Lanki, T., Siponen, T., Ojala, A., Korpela, K., Pennanen, A., Tiittanen, P.,

- Tsunetsugu, Y., Kagawa, T. and Tyrväinen, L. (2017) 'Acute effects of visits to urban green environments on cardiovascular physiology in women: A field experiment', *Environmental Research*. doi: 10.1016/j.envres.2017.07.039.
- Li, Q., Kobayashi, M., Kumeda, S., Ochiai, T., Miura, T., Kagawa, T., Imai, M., Wang, Z., Otsuka, T. and Kawada, T. (2016) 'Effects of Forest Bathing on Cardiovascular and Metabolic Parameters in Middle-Aged Males', *Evidence-based Complementary and Alternative Medicine*. doi: 10.1155/2016/2587381.
- Lombardo, P., Jones, W., Wang, L., Shen, X. and Goldner, E. M. (2018) 'The fundamental association between mental health and life satisfaction: Results from successive waves of a Canadian national survey', *BMC Public Health*. doi: 10.1186/s12889-018-5235-x.
- Lovell, R., Depledge, M. and Maxwell, S. (2016) *Health and the natural environment: A review of evidence, policy, practice and opportunities for the future*.
- MAO, G. X., CAO, Y. B., YANG, Y., CHEN, Z. M., DONG, J. H., CHEN, S. S., WU, Q., LYU, X. L., JIA, B. B., YAN, J. and WANG, G. F. (2018) 'Additive Benefits of Twice Forest Bathing Trips in Elderly Patients with Chronic Heart Failure', *Biomedical and Environmental Sciences*. doi: 10.3967/bes2018.020.
- Marušáková, Ľ., Sallmannshoferet, M., Tyrväinen, L., O'Brien, L., Bauer, N., Schmechel, D., Kašpar, J., Schwarz, M. and Krainer, F. (2019) *Human Health and Sustainable Forest Management*. FOREST EUR. Edited by Ľ. Marušáková and M. Sallmannshoferet. Bratislava, Slovak Republic: FOREST EUROPE, Liaison Unit Bratislava.
- Maund, P. R., Irvine, K. N., Reeves, J., Strong, E., Cromie, R., Dallimer, M. and Davies, Z. G. (2019) 'Wetlands for wellbeing: Piloting a nature-based health intervention for the management of anxiety and depression', *International Journal of Environmental Research and Public Health*. doi: 10.3390/ijerph16224413.
- McCormick, R. (2017) 'Does Access to Green Space Impact the Mental Well-being of Children: A Systematic Review', *Journal of Pediatric Nursing*. doi: 10.1016/j.pedn.2017.08.027.
- McCracken, D. S., Allen, D. A. and Gow, A. J. (2016) 'Associations between urban greenspace and health-related quality of life in children', *Preventive Medicine Reports*. doi: 10.1016/j.pmedr.2016.01.013.
- Mears, M., Brindley, P., Jorgensen, A. and Maheswaran, R. (2020) 'Population-level linkages between urban greenspace and health inequality: The case for using multiple indicators of neighbourhood greenspace', *Health & Place*, 62, p. 102284. doi: <https://doi.org/10.1016/j.healthplace.2020.102284>.
- Morris, J., O'Brien, E., Ambrose-Oji, B., Lawrence, A., Carter, C. and Peace, A. (2011) 'Access for all? barriers to accessing woodlands and forests in Britain', *Local Environment*. doi: 10.1080/13549839.2011.576662.
- Moseley, D., Connolly, T., Sing, L. and Watts, K. (2018) 'Developing an indicator for the physical health benefits of recreation in woodlands', *Ecosystem Services*. doi: 10.1016/j.ecoser.2017.12.008.
- Natural England (2020) *Monitor of Engagement with the Natural Environment (MENE)*. Available at: <https://www.gov.uk/government/collections/monitor-of->

engagement-with-the-natural-environment-survey-purpose-and-results.

O'Brien, L. (2019) 'Carrying out physical activity as part of the active forests programme in England: What encourages, supports and sustains activity?—A qualitative study', *International Journal of Environmental Research and Public Health*. doi: 10.3390/ijerph16245118.

O'Brien, L. and Forster, J. (2020) 'Sustaining and changing sport and physical activity behaviours in the forest: An evaluated pilot intervention on five public forest sites in England', *Urban Forestry and Urban Greening*, 55.

O'Brien, L. and Morris, J. (2014) 'Well-being for all? The social distribution of benefits gained from woodlands and forests in Britain', *Local Environment*. doi: 10.1080/13549839.2013.790354.

Ohrnberger, J., Fichera, E. and Sutton, M. (2017) 'The relationship between physical and mental health: A mediation analysis', *Social Science and Medicine*. doi: 10.1016/j.socscimed.2017.11.008.

Pasanen, T. P., White, M. P., Wheeler, B. W., Garrett, J. K. and Elliott, L. R. (2019) 'Neighbourhood blue space, health and wellbeing: The mediating role of different types of physical activity', *Environment International*, 131, p. 105016. doi: <https://doi.org/10.1016/j.envint.2019.105016>.

Plunz, R. A., Zhou, Y., Carrasco Vintimilla, M. I., Mckeown, K., Yu, T., Ugucioni, L. and Sutto, M. P. (2019) 'Twitter sentiment in New York City parks as measure of well-being', *Landscape and Urban Planning*. doi: 10.1016/j.landurbplan.2019.04.024.

Puhakka, R., Pitkänen, K. and Siikamäki, P. (2017) 'The health and well-being impacts of protected areas in Finland', *Journal of Sustainable Tourism*. doi: 10.1080/09669582.2016.1243696.

Roberts, H., van Lissa, C., Hagedoorn, P., Kellar, I. and Helbich, M. (2019) 'The effect of short-term exposure to the natural environment on depressive mood: A systematic review and meta-analysis', *Environmental Research*. doi: 10.1016/j.envres.2019.108606.

Romagosa, F. (2018) 'Physical health in green spaces: Visitors' perceptions and activities in protected areas around Barcelona', *Journal of Outdoor Recreation and Tourism*. doi: 10.1016/j.jort.2018.07.002.

Roslund, M., Puhakka, R., Grönroos, M., Nurminen, N., Oikarinen, S., Gazali, A., Cinek, O., Kramná, L., Siter, N., Vari, H., Soinen, L., Parajuli, A., Rajaniemi, J., Kinnunen, T., Laitinen, O., Hyöty, H. and Sinkkonen, A. (2020) 'Biodiversity intervention enhances immune regulation and health-associated commensal microbiota among daycare children', *Science Advances*, 6(42), p. eaba2578. Available at: 10.1126/sciadv.aba2578.

Sanders, T., Feng, X., Fahey, P. P., Lonsdale, C. and Astell-Burt, T. (2015) 'The influence of neighbourhood green space on children's physical activity and screen time: Findings from the longitudinal study of Australian children', *International Journal of Behavioral Nutrition and Physical Activity*. doi: 10.1186/s12966-015-0288-z.

Saraev, V., O'Brien, L., Valatin, G., Atkinson, M. and Bursnell, M. (2020) *Scoping*

- Study on Valuing Mental Health Benefits of Forests*. Edinburgh, UK.
- Saunders, K. (2019) *National Survey for Wales, 2016-17: Mental Wellbeing*. Available at: <https://gov.wales/sites/default/files/statistics-and-research/2019-02/national-survey-wales-mental-wellbeing-2016-17.pdf>.
- Sessions, C., Wood, S. A., Rabotyagov, S. and Fisher, D. M. (2016) 'Measuring recreational visitation at U.S. National Parks with crowd-sourced photographs', *Journal of Environmental Management*. doi: 10.1016/j.jenvman.2016.09.018.
- Shanahan, D. F., Bush, R., Gaston, K. J., Lin, B. B., Dean, J., Barber, E. and Fuller, R. A. (2016) 'Health Benefits from Nature Experiences Depend on Dose', *Scientific Reports*. doi: 10.1038/srep28551.
- Song, X. P., Richards, D. R., He, P. and Tan, P. Y. (2020) 'Does geo-located social media reflect the visit frequency of urban parks? A city-wide analysis using the count and content of photographs', *Landscape and Urban Planning*. doi: 10.1016/j.landurbplan.2020.103908.
- Sonter, L. J., Watson, K. B., Wood, S. A. and Ricketts, T. H. (2016) 'Spatial and temporal dynamics and value of nature-based recreation, estimated via social media', *PLoS ONE*. doi: 10.1371/journal.pone.0162372.
- Stewart, O. T., Moudon, A. V., Fesinmeyer, M. D., Zhou, C. and Saelens, B. E. (2016) 'The association between park visitation and physical activity measured with accelerometer, GPS, and travel diary', *Health and Place*. doi: 10.1016/j.healthplace.2016.01.004.
- Taylor, M. S., Wheeler, B. W., White, M. P., Economou, T. and Osborne, N. J. (2015) 'Research note: Urban street tree density and antidepressant prescription rates-A cross-sectional study in London, UK', *Landscape and Urban Planning*. doi: 10.1016/j.landurbplan.2014.12.005.
- Tennant, R., Hiller, L., Fishwick, R., Platt, S., Joseph, S., Weich, S., Parkinson, J., Secker, J. and Stewart-Brown, S. (2007) 'The Warwick-Edinburgh Mental Well-Being Scale', *Health and Quality of Life*.
- Tzivian, L., Winkler, A., Dlugaj, M., Schikowski, T., Vossoughi, M., Fuks, K., Weinmayr, G. and Hoffmann, B. (2015) 'Effect of long-term outdoor air pollution and noise on cognitive and psychological functions in adults', *International Journal of Hygiene and Environmental Health*, 218(1), pp. 1-11. doi: <https://doi.org/10.1016/j.ijheh.2014.08.002>.
- Vivid Economics, Barton Willmor and University of Exeter (2020) *Greenkeeper*. Available at: <http://www.greenkeeperuk.co.uk/the-tool/#hrf-entry-1389>.
- Ward Thompson, C., Silveirinha de Oliveira, E., Tilley, S., Elizalde, A., Botha, W., Briggs, A., Cummins, S., Leyland, A. H., Roe, J. J., Aspinall, P., Brookfield, K. and Mitchell, R. (2019) 'Health impacts of environmental and social interventions designed to increase deprived communities' access to urban woodlands: a mixed-methods study', *Public Health Research*. doi: 10.3310/phr07020.
- White, M. P., Alcock, I., Grellier, J., Wheeler, B. W., Hartig, T., Warber, S. L., Bone, A., Depledge, M. H. and Fleming, L. E. (2019) 'Spending at least 120 minutes a week in nature is associated with good health and wellbeing', *Scientific Reports*. doi: 10.1038/s41598-019-44097-3.

- White, M. P., Pahl, S., Wheeler, B. W., Depledge, M. H. and Fleming, L. E. (2017) 'Natural environments and subjective wellbeing: Different types of exposure are associated with different aspects of wellbeing', *Health and Place*. doi: 10.1016/j.healthplace.2017.03.008.
- Wolf, K. L., Lam, S. T., McKeen, J. K., Richardson, G. R. A., Bosch, M. van den and Bardekjian, A. C. (2020) 'Urban trees and human health: A scoping review', *International Journal of Environmental Research and Public Health*. doi: 10.3390/ijerph17124371.
- Yu, Y. M., Lee, Y. J., Kim, J. Y., Yoon, S. B. and Shin, C. S. (2016) 'Effects of forest therapy camp on quality of life and stress in postmenopausal women', *Forest Science and Technology*. doi: 10.1080/21580103.2015.1108248.
- Yuen, H. K. and Jenkins, G. R. (2020) 'Factors associated with changes in subjective well-being immediately after urban park visit', *International Journal of Environmental Health Research*. doi: 10.1080/09603123.2019.1577368.
- Zhang, L. and Tan, P. Y. (2019) 'Associations between urban green spaces and health are dependent on the analytical scale and how urban green spaces are measured', *International Journal of Environmental Research and Public Health*. doi: 10.3390/ijerph16040578.
- Zhou, C., Yan, L., Yu, L., Wei, H., Guan, H., Shang, C., Chen, F. and Bao, J. (2019) 'Effect of Short-term Forest Bathing in Urban Parks on Perceived Anxiety of Young-adults: A Pilot Study in Guiyang, Southwest China', *Chinese Geographical Science*. doi: 10.1007/s11769-018-0987-x.

9 Appendix A Inception Report

This is a minute of the inception meeting that took place on the 14/09/2020.

Participants at the meeting were: Kevin Lafferty (Scottish Forestry and project manager on the behalf of Scottish Government), Rhys Howell (Scottish Government), and from Forest Research (FR): Liz O'Brien, Gregory Valatin, Matthew Bursnell and Vadim Saraev (project manager on behalf of FR).

After initial personal introductions the meeting followed the tender document structure. After explaining the background and context for the required research Kevin confirmed two major aims of the study (as in the original tender document):

3. Identify, review and synthesise up-to-date evidence on the health and well-being benefits of visits to forests, and the methods available to measure and

assess them; note the key findings, robustness of the evidence base, and any outstanding gaps in the evidence.

4. Identify and review recent approaches to measuring the health and well-being, benefits of visits to forests; note their effectiveness, limitations and applicability in different contexts and make recommendations for monitoring as part of Scotland's Forestry Strategy.

This was followed by a general discussion. Liz noted relevant publication from the ongoing [Forest Europe](#) programme.

Next literature review and search strategy was discussed. It was agreed as in the tender document to use Scopus database and focus primarily on recent references published in the last 5 years.

It was agreed that the search terms and approach would be shared with Kevin and Rhys by the 18/09/2020 for comments. (This was subsequently done and the draft search strategy was approved on 24/09/2020 without changes, see Appendix B).

Measuring and monitoring the benefits was discussed. It was agreed that final recommendations should be presented in terms of high ('gold standard'), medium and low options in terms of precision/cost balance.

Given the later start to the project, it was agreed to shift the work schedule back by two weeks. (An updated Gantt chart was supplied on the 18/09/2020).

Fortnightly update meetings were agreed starting on the 29th of September between Kevin and Vadim with the rest of the team most welcomed to participate if available.

10 Appendix B Literature Search Methodology

Two separate searches were performed to capture academic literature. Scopus was the chosen database used for searching; note that Scopus content coverage includes over 95% of Medline publications as well. Papers were focussed to English language and due to the volume of results from preliminary searches, only those published in and between 2015 and 2020 were eventually included. The tables below summarise the search terms used and their combinations. Within each column, representing a wide concept, similar terms were combined with a logical Boolean "OR" operator and across columns terms were combined with "AND" operators.

Table 7 captures the first database search performed, with a broad selection of keywords. Initial searches across title, abstract and keywords yielded 80,606 hits from the last 10 years. This was narrowed by limiting searches to 5 years and only searching for terms in titles. This generated 41 hits.

Table 7 Primary searches.

Location (Forests)	Measurement (Mental Health, Physical Health)	Temporal
(tree* OR forest* OR wood* OR park* OR parks OR "urban green*" OR "green urban" OR "green space*" OR greenspace* OR "protected area*" OR blue AND space* OR bluespace* OR coast* OR sea* OR shore* OR natural OR environment* OR nature OR outdoor* OR countryside)	("mental health" OR well-being OR well-being OR "well being" OR "life satisfaction" OR health* OR physical* OR "quality of life" OR exercise OR activ* OR cycling OR walk* OR run* OR sport* OR recreation*)	(visit* OR trip* OR time)

Note: Search terms used within their component categories. Full search string is composed of bracketed terms in each column.

Table 8 captures the secondary search performed, with a narrower selection of keywords to create a more manageable number of hits but searching across title, abstract and keywords over the past 5 years. This generated 1,108 hits.

Table 8 Secondary searches.

Location (Forests)	Measurement (Mental Health, Physical Health)	Effect/Benefit	Temporal
(forest* OR wood* OR parks OR park OR "green space*" OR greenspace*)	("mental health" OR well-being OR well-being OR "well being" OR "life satisfaction" OR "physical health" OR "good health" OR "quality of life" OR exercise OR cycling OR walking OR running OR sport* OR recreation*)	("mental health" OR well-being OR well-being OR "well being" OR "life satisfaction" OR health* OR physical* OR "quality of life" OR exercise OR activ* OR cycling OR walk* OR run* OR sport* OR recreation*)	(visit* OR "trip" OR "trips")

Note: search terms used within their component categories. Full search string is composed of bracketed terms in each column.

A similar approach was used to explore approaches to measuring and monitoring the social and cultural benefits of visits to forests and woodlands. The search string for social and cultural benefits was as follows, resulting in 271 hits.

(TITLE-ABS-KEY (forests* OR woodlands* OR trees) AND TITLE-ABS-KEY (recreation* OR recreational OR visits*) AND TITLE-ABS-KEY (social OR culture* OR "social capital" OR "cultural capital" OR monitor* OR measure* OR metric* OR indicator*) AND TITLE-ABS-KEY (benefits*))

Additional literature was sourced using a 'snowballing' approach. This involved collecting relevant references cited within previous literature review papers as they were encountered. A recently completed Forest Research project titled 'Scoping Study on Valuing Mental Health Benefits of Forests' was also used to initially source relevant literature, as were previous similar Forest Research or adjacent projects.

11 Appendix C Literature Review Tables

An Excel spreadsheet containing further information on the literature included in the review is available upon request as supplementary material. The file comprises of a list of literature with their key findings and specific details of their methodologies.

12 Appendix D Estimating Sample Sizes for Equality Groups

An analysis on estimating appropriate sample sizes and demographic categorisations for forest surveys is available upon request as supplementary material. The file includes tables and graphs describing the results of the analysis, as well as a deeper discussion of the methodology.

13 Appendix E Suitable Questions for Surveys

The following section outlines suitable survey questions that cover key areas required for effective health and well-being monitoring. For supporting Table 4 in the Recommendations section, the following first set of questions are considered highest priority inclusions for the Intermediate Approach. Latter questions would be recommended for inclusion in the In-depth Approach, alongside also including previous questions.

These questions are recommended to cover their component categories effectively, although their wording may not be suitable for every context. These questions can be subject to further development and discussion with Scottish Forestry to finalise wording and arrangement.

13.1 Questions for Intermediate Approach

Exposure (Scaling Up)

1. How often have you visited a forest or woodland in the last 12 months?

(More than once per day, Every day, Several times a week, Once a week, Once or twice a month, Once every 2-3 months, Once or twice, Never)

2. How much time did you spent on-site during your last visit to a forest or woodland?

(Less than 1h, 1-2h, 2-3h, 4-5h, 5-8h, 8h+)

Physical Health

3. Which of these activities did you engage in during your last visit?

(Walking, running/jogging, cycling, horse riding, swimming, other [please state], none of the above)

4. For each of the activities you engaged in, how long did you spend on it?

(1-15 min, 16-30 min, 31-60 min, 1-2h, 2-3h, 3-5, 5+h)

Mental Health

5. Overall, how satisfied are you with life nowadays?

(0 'Not at all' – 10 'Completely')

Social and Cultural Benefits

6. . Now thinking specifically about woodlands and forests you have visited and why they are important to you personally please tell me how strongly agree, agree, disagree or strongly disagree with the following statements.

Woodlands and forests are important to me because...

(strongly disagree, disagree, neither agree or disagree, agree, strongly agree, don't know)

6.1 They are places where I can relax and de-stress

6.2 They are places where I can exercise and keep fit

6.3 They are places where I can have fun and enjoy myself

6.4 They are good places for me to socialise

6.5 They are places where I can learn about the environment

6.6 They are places where I can learn about local culture or history

6.7 They get me involved in local issues

6.8 They are places where I feel at home

Open-ended questions:

7. Please tell us something about your experiences of socialising during your visits to woodlands and forests (e.g. visiting with friends and family, meeting new people or just saying hello to other visitors)

8. Please tell us something about your experiences of the cultural aspects of the woodlands and forests you like to visit (e.g. any cultural associations such as local names for the woodland, links to the local community, old and valued trees, sculptures)

Socioeconomic Factors

We summarise previous surveys that analysed mental health measures closely in association with environmental engagement (Jump and Simeonova, 2018; White *et al.*, 2019) and identify recommendations to include questions on the following key areas for surveys, in order to improve reliability of mental health measures:

- Income (Q9)
- Health status (Q10)

Income can sometimes be captured to an extent similar categories such as employment or working status. Health status can reflect presence of long-term disabilities, illnesses or other chronic conditions. It should be noted that this is a non-exhaustive list of only high priority inclusions that common subjective well-being mental health measures can be sensitive to. Without controlling for these factors, mental health indicators would not operate effectively. However, there are likely many other socioeconomic areas of high priority for data collection that should be collected – this list only represents those highly relevant specifically for understanding for health and well-being benefits.

Other traditional socioeconomic questions that support other needs should also be included.

13.2 Additional Questions for In-depth Approach

Mental Health

11. Short-Warwick Edinburgh Mental Well-being Scale

Please tick the box that best describes your experience of each over the last 2 weeks (*None of the time, Rarely, Some of the time, Often, All of the time*)

11.1 I've been feeling optimistic about the future

11.2 I've been feeling useful

11.3 I've been feeling relaxed

11.4 I've been dealing with problems well

11.5 I've been thinking clearly

11.6 I've been feeling close to other people

11.7 I've been able to make up my own mind about things

Social and Cultural Benefits

12. Nature Connection Index Scale

The following questions are about you and nature. By nature we mean all types of natural environment and all the plants and animals living in them. Nature can be close to where you live in towns; the countryside or wilderness areas further away. Please tell us how much you agree or disagree with the following (1 strongly disagree to 7 strongly agree)

12.1 I always find beauty in nature

12.2 I always treat nature with respect

12.3 Being in nature makes me very happy

12.4 Spending time in nature is very important to me

12.5 I find being in nature really amazing

12.6 I feel part of nature

13. Identifying participants through a survey opt-in, where respondents consent to participate in short focus groups or interviews to explore your relationship with trees and woodlands.

About 1-5% of respondents from the survey might be expected to consent to further research. With a sample of 1,000, an estimate of 10-50 could be interviewed. If focus groups were the method used then 3-5 could be

conducted, each consisting of 8-10 people. It will be more cost effective to run the focus groups virtually than face to face, as savings can be made on venue hire and supporting participant's travel costs.

Socioeconomic Factors

The following are other important areas for socioeconomic questions that can influence mental health measures (Jump and Simetrica, 2018; White *et al.*, 2019). Although, these are slightly less influential than the previous two mentioned.

- Sex (Q14)
- Age (Q15)
- Relationship status (Q16)
- Higher education status (Q17)

Site Characteristics

18. What type of woodland or forest did you visit for your last visit?

(Broadleaved, Coniferous, Mixed, other [please state], don't know)

19. What types of facilities were present on the site that you last visited?

(Benches, play areas, car park, toilets, café, walking trails, cycling trails, information, other please specify)

14 Appendix F Explanations for Health Metric Scales

Health Metric Scale	Explanation
----------------------------	--------------------

EuroQuol-5-Dimensions (EQ-5D)	A standardised scale for evaluating health, used widely in clinical applications. Respondents rate their health across five dimensions (Mobility, self-care, unusual activities, pain/discomfort, anxiety/depression)
Short Form Survey (SF-6D, SF-12, SF-36)	A standardised scale for evaluating health, used widely in clinical applications. Multiple dimensions are covered including physical functioning, limitations, pain, energy/fatigue and emotional well-being.
General Health Questionnaire (GHQ-12)	Identifies non-psychotic and minor psychiatric disorders in the general population. Respondents
ONS4 well-being measures	Assesses well-being across four measures (life satisfaction, happiness, worthwhileness and anxiety), assessing evaluative, eudemonic and affective experience.
Short Warwick-Edinburgh Mental Well-being Scale (SWEMWBS)	Includes 7 positively worded statements relating to thoughts and feelings, with 5 response categories from 'none of the time' to 'all of the time'.

Perceived Stress Scale (PSS)	Widely adopted scale for measuring the perception of stress.
Profile of mood states (POMS)	Assesses mood across different areas including tension, depression, anger, vigour fatigue and confusion.

15 Appendix G Specific Research Objectives

Specific research objectives are:

- a. Identify, review and synthesise up-to-date literature on the health and well-being benefits of visits to forests and how they are measured. To include:
 - Identify key major published quantitative and qualitative research on measuring the mental, physical, cultural and social health benefits of recreational visits to forests and woodlands. The review will cover Scotland based research as well as relevant UK and international literature from both the academic and grey literature focusing on visits to forests and woodlands but also covering blue and green spaces in general.
 - Review each study in terms of:
 - Robustness of methodology
 - Key findings
 - Relevance to Scotland

- Consideration of equality groups
 - Synthesise the overall key findings from the research identified as robust and relevant, highlighting areas of agreement and disagreement between the results of different studies, consideration of inequality of benefits, and identifying areas in need of further research to fully understand the health and well-being, and social and cultural benefits of visits to Scotland's forests.
- b. Identify and review recent approaches to monitoring the health and well-being, social and cultural benefits of visits to forests to support recommendations for a Scottish approach. To include:
- Identify and categorise recent approaches to monitoring the health and well-being benefits focusing on visits to forests and woodlands but also covering blue and green spaces in general.
 - Reviewing these recent approaches in terms of:
 - Strengths and limitations of the methodology;
 - Outcomes and evidence of impact;
 - The degree to which they consider equality of benefits between population groups;
 - Applicability of the monitoring process and outputs in supporting the development and implementation of policies and interventions that encourage visits to forests;
 - The relevance of the approach to the Scottish context; and
 - Practical considerations, for example cost effectiveness and resources needed to support the monitoring;
 - Making recommendations for a long-term monitoring strategy for the health and well-being benefits of visits to Scotland's forests, that is most suited to demonstrating progress towards the objectives of Scotland's Forestry Strategy. This should include practical considerations and relevance to the Scottish context

Alice Holt Lodge

Farnham
Surrey, GU10 4LH, UK
Tel: **0300 067 5600**

**Northern Research
Station**

Roslin
Midlothian, EH25 9SY, UK
Tel: **0300 067 5900**

**Forest Research in
Wales**

Environment Centre
Wales
Deiniol Road, Bangor
Gwynedd, LL57 2UW,
UK
Tel: **0300 067 5774**

info@forestresearch.gov.uk
www.forestresearch.gov.uk

Forest Research will consider all requests to make the
content of our publications available in alternative formats.

Please send any such requests to: publications@forestresearch.gov.uk

© Crown copyright 2021