The Natural Capital Initiative

Ecosystem services and the delivery of health benefits

Towards optimised health and environment planning

A one day interdisciplinary workshop,
organised by the Natural Capital Initiative at the British Library

SUMMARY REPORT

FOR POLICY MAKERS

Workshop held on *Tuesday 28th September 2010*
The British Library Conference Centre, London

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www.naturalcapitalinitiative.org.uk

Contents

The Natural Capital Initiative (NCI)

The NCI was formed to support the development of policy and practice aligned with the ecosystem approach; a way of considering whole ecosystems in decision-making which takes account of the benefits they provide for human wellbeing.
The NCI aims to:

- create a forum for debate that is independent and inclusive;
- identify gaps in science, policy and its implementation and facilitate the debate about how to address these gaps;
- liaise with and advise other key government and research council initiatives, and
- engage the public and inspire the next generation.

The NCI is a partnership of the Society of Biology, the Centre for Ecology and Hydrology (CEH) and the British Ecological Society (BES).

Summary Report

Synopsis

This report summarises the views and ideas expressed during a workshop organised by the Natural Capital Initiative (NCI), in co-operation with the British Library. The NCI is an independent forum for discussion of policy and practice aligned with an ecosystem approach. Views presented here are based solely on workshop discussions and are not intended to represent a distillation of wider literature or discussion. The event brought together 58 participants from a variety of relevant stakeholder groups to discuss the potential to improve health and ecosystem service outcomes by integrating policy and planning.

In response to evidence of environmental hazards to human health, many countries have adopted laws to impose standards on air and water quality and to require identification of potential health hazards within the environmental assessment phase of planning applications. Similarly, evidence of harm to the environment from some human activities has prompted policies intended to reduce these risks. Recently, just as evidence for the direct and indirect benefits of the environment for human health and wellbeing has been increasing, there has also been rising concern that the flows of benefits which humans derive from the environment (ecosystem services) are generally under pressure or in decline. This has prompted calls for action to preserve and restore these ecosystem functions.

The 'ecosystem approach' focuses on integrated decision-making to maximize the human welfare benefits derived from our natural environment. The expertise of many sectors is needed to equip policymakers to respond to the challenges of not only protecting human health and ecosystem services, but ensuring overall maximum benefit. A broad coalition of health, environment and social science researchers and practitioners, as well as urban planners, the public, and many others, is vital to inform debates around these issues and to frame policy objectives and plans.

This workshop aimed to review how health considerations could be integrated beneficially into the implementation of an ecosystem approach (as well as into planning and development decisions more broadly), and to generate recommendations as a contribution to this emerging field. Of particular interest was the research and information needed to attempt to map health and environment interactions so as to derive sound evidence of linkage, causality or otherwise.

The **Key Messages** derived are presented overleaf and background discussions are detailed in the Workshop Proceedings. Consensus participant responses to the **three overarching questions** which informed the workshop themes are summarised thereafter.
Individual messages proposed by delegates for the attention of Ministers or Policy-Makers, Professionals or Groups, or a Recipient of Choice are hosted on the website.

Key Messages

Key Messages were derived from discussions throughout the workshop; they are not listed in order of priority. A more detailed report of the discussion is presented on pages 9 to 17.

1. **The evidence base describing links between ecosystem services and health benefits is indicative but not yet robust. Restricted access to databases is a frequent barrier to rapid progress in this area. Researchers and funders should address this.**

2. **Indicators of wellness are needed to guide practice; enable evaluation of interventions, and assist policymaking.**

3. **Biodiversity underpins many processes which deliver ecosystem services. The development of a better understanding of the complex relationship between biodiversity, ecosystem services, and health and well-being is essential for the development of appropriate policies. Interdisciplinary research will be needed to meet this challenge.**

4. **A White Paper outlining broad aims and objectives for the achievement of health benefits through ecosystem service delivery could be helpful across government departments, and serve to focus attention on this issue. 'No regrets' interventions (which may provide benefit and are unlikely to harm) should be identified rapidly, and their implementation encouraged. These interventions could take the form of pilot studies with in-built evaluation.**

5. **The economic case must be made for any potential health benefits delivered through appropriately-managed ecosystems. Criteria for health spending could be developed to facilitate reward for ecosystem service management which delivers health benefits.**

6. **Human behaviour in ecosystem service use has implications for human health. The activity of the health sector in support of the prevention and cure of human illness also has implications for the environment. It is important to understand these processes and balances and account for them in policymaking.**

7. **Communication of the need for integrated policies is challenging but vital. Keen public interest in health issues may enable communication of the potential implications of altered ecosystem service delivery more readily than for example, climate change.**

8. **There is an urgent need for greater interdisciplinarity in training, research and practice which will bring together and inform health and environment practitioners, researchers, managers and policymakers. This should also be reflected in medical student training.**

9. **Many ecosystem services which influence human health are sourced overseas while others critically depend upon proximity and access (for example access to green space). This should be recognized overtly in planning to reduce our impact on the global environment and optimise sustainable gains from local services.**

10. **Policy makers should identify areas of potential risk to both human health and ecosystem service flows and act to ensure measurable improvements in sustainable and mitigating practices.**

Workshop Themes

The mood of the workshop was of keen interest to understand the mechanisms underlying human interactions with the environment which influence well-being. Whilst accepting that there is emerging evidence for delivery of benefits for well-being through specific ecosystem services, there was concern that the general evidence base needs to be strengthened and augmented. It was agreed that this will rely critically upon encouragement and facilitation of interdisciplinary work. In contrast there were strong requests that a combination of early indicative evidence and common sense should not be ignored in motivating early 'no regrets' pilot programmes of combined environment and health management, and that these should be evaluated. A view that health considerations had received attention only late in the evolution of the climate change debate in part motivated this desire to set a different course in ecosystem services debates.

Does the evidence base linking ecosystem services and health warrant changes in policy and practice?

We encountered strong agreement that policy and practice changes were called for despite the recognition that more research is also needed.

How can medical and environmental professionals work together to deliver improvements in the UK's health?

The consensus was that improvements in health could be delivered if awareness is raised and integrated research programmes are initiated to gather underpinning evidence for good practice.

What are the future challenges in monitoring and evaluating health outcomes of environment policy and practice?

There was agreement that more information, delivered at lower cost, will be needed to enable these assessments, and that innovation will be required to deliver these.

Workshop Proceedings

Introduction

Evidence of interconnections between outdoor environmental quality and human health has grown considerably in recent years. Public policy responses to this evidence have generally focused on measures to avoid potentially harmful impacts, for example the inclusion of health considerations in environmental impact assessments.

Environmental protection measures focused on reducing the likelihood of harm have undoubtedly protected health. However, they may not fully reflect current understanding of the relationships between the environment and human health. In particular, through improved management, there may be scope to enhance the *benefits* that natural environments can provide for health and wellbeing.

Ecosystems generate and maintain a variety of services from which we benefit, including the quality of the air, water and soil, and places for relaxation, psychological restoration and physical exercise. Ecosystem properties such as biodiversity are an important influence on some of these functions. These environmental outputs which serve our physiological and psychological needs are often referred to as 'ecosystem services'.[1]

Integrated public policies and practices that maximise the human welfare *benefits* which can be derived from the natural environment have been proposed as a logical and cost-effective development pathway within the 'ecosystem approach'.[2] This approach poses challenges to the evidence base that describes the links between human health and the natural environment, and to the collection of data on aspects of health and environment research. It also requires innovation in the way that environmental and other professions work together.

Through this workshop, the Natural Capital Initiative (NCI) aimed to facilitate debate around the evidence and policy options for maximising human welfare benefits from sustainable ecosystem management. NCI and the British Library hosted the workshop and invited participants from across a range of stakeholder groups to achieve an inclusive debate, effectively evaluate evidence, raise awareness, and thereby generate recommendations to improve decision-making.

Workshop aim

To review how health considerations can be beneficially integrated into the implementation of the ecosystem approach (as well as into planning and development decisions more broadly) and to generate recommendations.

Workshop themes

- Does the evidence base linking ecosystem services and health warrant changes in policy and practice?
- How can medical and environmental professionals work together to deliver improvements in the UK's health?
- What are the future challenges in monitoring and evaluating health outcomes of environment policy and practice?

[1] Millennium Ecosystem Assessment (2005) *Ecosystems and Human Well-being: General Synthesis*. Island Press, Washington, DC. 137p. See also Annex C.

[2] A strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. *Convention on Biological Diversity, COP 5, Decision V/6*

Reporting

This report has been prepared by the NCI as a summary of the views and ideas expressed by participants at a workshop on 28th September, 2010. The aim is to provide material of benefit to policy makers evaluating the topic, as well as those organisations wishing to contribute to greater integration of health and environment research and practice, including funders. The report records the breadth of views and perspectives expressed on the day, summarises the main ideas to emerge from the discussion and highlights areas of consensus.

Because the NCI acts to provide an independent forum, omission or inclusion of a view or idea in this summary report does not indicate any judgement on its value, or any position of the NCI. The views and ideas expressed are not necessarily those of all the individuals present at the workshop, or their affiliated organisations. The workshop was conducted under the Chatham House Rule. Observations and recommendations captured in the report are not attributed to individuals or organisations. The report uses illustrations and examples used in the presentations and briefing material with the agreement of the original authors, or proper attribution, as appropriate.

Workshop format

The event involved 58 experts drawn from a range of different organisation types, including the health and environment professions, government, regulatory agencies, the non-profit sector and academia. The presentations were chosen to highlight some of the basic issues for consideration and to inform the discussions. The workshop was designed to be interactive and inter-disciplinary, with contributions from all participants.

In inviting participants, the NCI aimed for a balance of different types of organisation, perspective and expertise to be present at the event. A briefing document was sent to all participants in advance, highlighting a number of key issues, and providing working definitions (see Annexes). We recommended that participants avoided technical terms and acronyms wherever possible; where their use was essential, explanations were sought.

Participants were assigned to groups of between seven and ten and care was taken to ensure a balance of expertise and view which reflected the group overall. Each group was led by a technical lead and discussions were recorded by a scribe. Professor Michael Depledge of the European Centre for Environment and Human Health chaired the plenary sessions and provided closing remarks. The notes of both plenary and discussion group sessions provided the source material for production of this report.

Short briefing presentations (summarised in **Annex A**) set the context for group discussion. The workshop programme (**Annex B**); the definitions and references provided (**Annex C**); the questions posed (**Annex D**), and a list of participants (**Annex E**) are contained in this report. Further material is available via the dedicated event page on the NCI website at www.naturalcapitalinitiative.org.uk.

Key message discussion

The key messages are not listed in order of priority

1. **The evidence base describing links between ecosystem services and health benefits is indicative but not yet robust. Restricted access to databases is a frequent barrier to rapid progress in this area. Researchers and funders should address this.**

   To date most of the focus has been on environment and well-being, particularly on potential environmental hazards to health with little concentration on potential benefits. Examination of the evidence in terms of ecosystem services will benefit analysis.[3]

   There is a pressing need for more robust studies to provide evidence on the linkages between ecosystem services and health and to provide mechanistic evidence including on defined effects; underlying mechanisms; relationships to desired outcomes, and behavioural and social barriers to the derivation of benefit. Much of the current evidence base is correlative rather than providing causal links; studies are often small and with potentially confounding influences and effects. There is a need to improve the power and quality of studies but funding is limited. The causes of likely variability of data in this area will need to be understood and where possible controlled as the field progresses. Reliance upon indirect evidence could hamper development of clearly-directed policy responses. Health Impact Assessment (HIA) analysis has provided useful information but not all sectors are engaged.

   In many cases it will not be possible to conduct randomised controlled trials as in clinical practice so the definition of what will constitute compelling, policy-relevant evidence is important. Epidemiological evidence requires very strong associations to be persuasive, for example with regard to smoking and lung cancer. Some may argue that there is insufficient evidence of linkages between ecosystem services and health, but at existing levels this may be adequate to guide policymakers. Local communities and central government may value and understand the evidence base differently.

   The interactions between demographic change, ecosystem services, and health are complex and require both individual and overall assessment. For example, aggregate benefits to health in the western world have resulted in expanding but ageing populations which generally consume more pharmaceuticals and these end up in the environment, especially in waterways. As well as population expansion, population decline and economic contraction also have impacts on the environment.

   Mapping of health and environmental indices could provide powerful information, but careful interpretation of the data will be essential.

   A curated repository of publicly funded and available databases could be helpful.

[3] See http://environmentalevidence.org/SR40.html

Opportunities to capture information on health benefits have often been lost. The health dimension has been missed when framing the initial research focus of pilot studies and experimental schemes such as the South Pennines Watershed project, and other water catchment, agriculture, and moorland management projects. There is a need to improve the design of evidence gathering to generate data, derive lessons and to resource policy adaptation and learning. The design of evidence gathering should focus on elucidating direct mechanisms if possible.[4]

2. **Indicators of wellness are needed to guide practice; enable evaluation of interventions, and assist policymaking.**

Objective measures should be identified and evidence gathered; e.g. the number of GP visits in an area or study group etc.

The choice of health metrics will be very influential for policymakers, it is important to emphasise that well-being comprises more than 'health' and is difficult to measure. Well-being includes spiritual as well as physical aspects and is about aspiration as well as actuality. The development of metrics should be across all the disciplines in order to encourage acceptance of them and the resulting data. For example, at present agriculturalist-developed metrics of health benefits are not often used by medical researchers.

There is an unhelpful bias towards those things which can be counted thereby missing those benefits which are harder to measure but nonetheless matter to well-being. It is difficult to identify a good set of indicators to assess outcomes and interpret the evidence base for example with respect to self-esteem, mental well-being, and cancer ratios, amongst other factors. Policy makers will need to be vigilant in assessing whether the choice of indicators is over-reliant on easily-quantified data.

There is a need to understand definitively whether environmental degradation and isolation begets anti-social and unhealthy behavior and if so to what extent.

3. **Biodiversity underpins many processes which deliver ecosystem services. Developing a better understanding of the complex relationship between biodiversity, ecosystem services, and health and wellbeing is essential for the development of appropriate policies. Interdisciplinary research will be needed to meet this challenge.**

The relationship between biodiversity and those ecosystem services that are easily measured is not well understood. Measurements of biodiversity (both for inter- and intra-specific genetic diversity) is difficult. The lack of accepted and agreed metrics by

[4] See Frank et al (2005) *Linking Objectively Measured Physical Activity with Objectively Measured Urban Form. Findings from SMARTRAQ* Am J Prev Med 2005;28(2S2). Available at http://www.act-trans.ubc.ca/documents/Franketal_AJPM_2005.pdf

which to measure human well-being compounds the difficulty of plotting the relationship between biodiversity and health.

The value of broad categories of service may be debated, for example biodiversity is associated with the positive benefits of access to green space, and may also act to deliver ecological resilience, but can harbour sources of infectious disease, or other harm (e.g. stings and bites, physical attack, etc.). Therefore, different assessments will rate components of biodiversity positively or negatively but are unlikely to do so on a unified scale. This further highlights the importance of developing inter-disciplinary working.

Green space[5] is not necessarily biodiverse space. A good urban park, adequate to the delivery of health benefit, may not support as much biodiversity as a rich wetland.

4. **A White Paper outlining broad aims and objectives for the achievement of health benefits through ecosystem service delivery could be helpful across government departments, and serve to focus attention on this issue. 'No regrets' interventions (which may provide benefit and are unlikely to harm) should be identified rapidly, and their implementation encouraged. These interventions could take the form of pilot studies with in-built evaluation.**

It would be useful to identify the potential co-benefits of interventions. This was achieved in the Lancet series on climate change and health[6].

A key challenge will be to inform ministers of potential benefits to human health, social cohesion and the economy of good management of ecosystem services (food security, carbon management etc.).

Decision-making mechanisms and guides will be required to deal with potentially conflicting outcomes where health benefits and ecosystem service delivery or natural capital outcomes are not aligned. For example there is often tension between wilderness access and protection of biodiversity.

Policy overlaps should be seen as an opportunity rather than a hindrance –government in silos will not work well for environment and health, as indeed for many other areas of co-benefit (or co-disbenefit). To ensure that high-level aspirations are translated into effective delivery of benefits it will be necessary to integrate management strategies and, where possible, government department priorities. Responsibility for delivery should be established without losing sight of cross-departmental co-operation.

[5] Consistent with concepts outlined in Planning Policy Guidance 17 of the Department of Communities and Local Government available at http://www.communities.gov.uk/documents/planningandbuilding/pdf/ppg17.pdf but intuitively interpreted.

[6]Managing the Health effects of Climate Change (2009) http://www.thelancet.com/climate-change;
Health co-benefits of policies to tackle climate change (2010) The Lancet, Volume 376, Issue 9755, Pages 1802 - 1804, 27.

Adaptive learning and flexible policymaking are needed to learn from pilot studies. However, the existence of significant time lags between specific conditions or interventions and an associated health outcome means that we may not see results that indicate causality for many years (possibly thirty years or more). There may also be time lags between beginning communication strategies and success in influencing individuals to see the relevance of environmental decisions in terms of health. (See Key Message 5)

A 'Stern-style review' of health and ecosystem services should be considered. Internationally the World Health Organisation (WHO)[7], and nationally the Marmot Review[8] have looked at social determinants of health, there are also environmental factors and implications which warrant consideration. Anticipated alterations in demographics should be incorporated into short and long term analyses.[9]

A number of structural and analytical interventions were suggested by participants:

1. That government should consider establishing a Commission on Green Infrastructure to examine broad issues in this area and in particular to focus on assessing human well-being benefits, alongside potential benefits of the planned and managed environment.
2. That asystematic review of literature, in the style of Living With Environmental Change (LWEC) initiative may not find enough material for conclusive recommendations but should at least help to identify knowledge gaps[10].
3. That a UK version of the "Sustaining Life[11]" report, aimed at Treasury, could be useful.

5. The economic case must be made for any potential health benefits delivered through appropriately-managed ecosystems. Criteria for health spending could be developed to facilitate reward for ecosystem service management which delivers health benefits.

Novel systems and approaches to valuation are needed to capture ecosystem service worth and enable appropriate policy-making and delivery. There is a case for a comprehensive review of health costs, benefits and impacts in relation to natural and managed ecosystem function.

The economic arguments should be considered in a holistic manner. For example, comparison should be made between the economic drivers of unhealthy food consumption and the economic costs of ill-health. Cost- Benefit Analysis of action and inaction is needed from across a range of sectors, including scientific, economic, social, medical and ecological.

[7] WHO Social Determinants of Health http://www.who.int/social_determinants/en/
[8] Strategic Review of Health Inequalities in England Post 2010 http://www.marmotreview.org/
[9] The Royal Commission on Environmental Pollution (RCEP)). 2011. Demographic Change and the Environment, London.HM Stationery Office. http://webarchive.nationalarchives.gov.uk/20110322143804/http://www.rcep.org.uk/reports/29-demographics/documents/Demography_final_report.pdf
[10] http://environmentalevidence.org/SR40.html
[11] Sustaining Life: How Human Health Depends on Biodiversity http://chge.med.harvard.edu/programs/bio/lecture.html

Holistic approaches (e.g. an ecosystem approach) should be adopted by high level policy-makers to attempt to address the large scale at which benefits to health are likely to accrue.

The design of any incentive scheme should be carefully refined to avoid creating opportunities for potential abuse in practice and the development of perverse incentives.

The 'additionality' of the natural ('green space' and 'blue space') environments in encouraging exercise is being recognised but remains difficult to quantify. Novel visualization methods for explaining the interconnections between the environment and human health should also be explored further.

The proportion of the economic cost of mental ill-health attributable to environmental influence is not known but there are reasons to believe that good environmental access is beneficial.[12],[13]

6. **Human behaviour in ecosystem service use has implications for human health. The activity of the health sector in support of the prevention and cure of human illness also has implications for the environment. It is important to understand these processes and balances and account for them in policymaking.**

Green space is not necessarily used by people, even if it is accessible to them. There is a need to understand the behavioral and psychological barriers which exist in these circumstances, and how to overcome them. Providing public access to suitable green space is important, but it is not a proxy for adequate protection of ecosystem services.

Concepts of behavioural economics[14] should be examined in terms of implications for analysis and influence and as a component of efforts to understand, persuade and change behaviour.

There are examples of current research projects focusing on relevant behaviour change. The CHARM Initiative[15] is measuring physical activity against a background of information about group norms as a way of influencing and assessing behaviour.

Public health research holds a great deal of expertise and understanding on how people behave and perceive benefit. This valuable resource should be utilised in analysis and policymaking.

[12] *Foresight Mental Capital and Wellbeing Project (*2008). http://www.bis.gov.uk/assets/bispartners/foresight/docs/mental-capital/mentalcapitalwellbeingexecsum.pdf "Similarly, interventions to improve the physical environment could offer benefits to mental health. However, such cases offer particular challenges, since the principal benefiting Government department would be different from the departments that would resource the intervention." p42.

[13] *What is the best dose of nature and green exercise for improving mental health? A multi-study analysis.* Barton J, and Pretty J.(2010) Environ Sci Technol. 44(10):3947-55. http://www.ncbi.nlm.nih.gov/pubmed/20337470

[14] See http://www.neweconomics.org/publications/behavioural-economics

[15] A social norm-approach study of sustainable behaviour. Details available at http://business.kingston.ac.uk/charm and http://www.projectcharm.info/

Localism may provide an opportunity to develop agendas around behaviour analysis and information at a suitable scale. However, in certain cases top-down approaches to behaviour regulation can also work, for example the ban on smoking.

There is robust evidence for behavioural responses to environmental circumstances. There is experimental evidence of abnormal feeding and socialisation in rodents in altered environments. In studies of human health, depression, obesity and psychiatric disorders have been linked to lack of access to nature. There are potential implications here for urban design.

Longitudinal interventional studies may be seen as needed but are problematic in this field (See Key Message 1).

7. Communication of the need for integrated policies is challenging but vital. Keen public interest in health issues may enable communication of the potential implications of altered ecosystem service delivery more readily than for example, climate change.

Public perception of the linkage between ecosystem services and health is not well understood. Understanding these current perceptions will be important for communication, engagement and policy development. There is a gap not only in the knowledge of how the public understands these issues but of how they might wish to see them solved. .

There is a need to urgently communicate the call for action on health matters; a 4% spend on prevention is not enough to adequately resource measures to reduce the occurrence of ill-health.[16] There is a need not only to focus on prevention but for medicine to become an advocate for environment-based health benefits and cures.

Communication to the public should not just involve provision of more information. The health and environment sectors need to develop the capacity to explain implications beyond simple Cost Benefit Analysis and details of the likely economic outcomes. There is a perceived public fatigue with 'big numbers', the ability to express opportunity costs and marginal changes could be helpful.

The language of health benefits (e.g. DALYs[17], etc) also presents a communication challenge. The latency period before the apparent benefit of some interventions, and the diversity of response (producing benefits in only a proportion of the population) exacerbates this challenge. There is a need for appropriate language to express results and evidence.

Although in their private lives, many individuals across sectors are members of environment-focused groups which aim to promote understanding of ecosystem

[16] The Marmot Report. (2010) Fair Society, Healthy Lives. A strategic review of health inequalities in England post-2010. p32.

[17] DALY: Disability Adjusted Life Years is defined by the World Health Organisation as "The sum of years of potential life lost due to premature mortality and the years of productive life lost due to disability."

services in broad context, they often do not succeed in translating this to their professional practice.

8. **There is an urgent need for greater interdisciplinarity in training, research and practice which will bring together and inform health and environment practitioners, researchers, managers and policymakers. This should also be reflected in medical student training.**

Research must be trans-disciplinary. Messages about the desirability of and support for interdisciplinarity should not just be seen as emanating from the conservation/environmental community but importantly also from the NHS, planners and others. There is a strong need for engagement not just across the medical profession but also between agriculturalists, social scientists, geographers, ecologists etc. There is a potential risk of just focusing on the health community and ecologists.Training on ecosystem service and health interactions should be incorporated into the medical curriculum, and vice versa.

Relatively few interdisciplinary papers detailing study in this area are published in medical journals. [18] Academic recognition in publications and perceived applicability is important.

Interdisciplinary studies should include economic considerations and be experimental.

Iteration of shared objectives and outcomes is very important to drive the essential funding of interdisciplinary research and practice. Reports from the Rural Economy and Land Use (RELU)[19] programme and The Economics of Ecosystems and Biodiversity (TEEB)[20] contain reflections on good examples of this.

Interdisciplinary programmes need to develop a coherent voice and plans – a coherent voice is more powerful. Collaboration is often at a strategic level but work at other levels is needed. Successful collaborations should be repeated and scaled up; their potential is not yet fully exploited.

It is still challenging to get different medical specialities together. The voice of public health is not strong in some fields, for example transport.

The Research Assessment Exercise (RAE) did not, and possibly its successor the Research Excellence Framework (REF) may not, sufficiently encourage collaborative or applied research across disciplines. Impact assessments may not be a suitably clear route to recognition and reward. Review panels should be encouraged and enabled to accommodate the sharing of expertise necessary for assessment of cross-disciplinary work.

[18] Bowler et al (2010) *A systematic review of evidence for the added benefits to health of exposure to natural environments* *BMC Public Health* 2010, **10:**456. Available at http://www.biomedcentral.com/1471-2458/10/456/abstract
[19] http://www.relu.ac.uk/
[20] http://teebweb.org/

The Research Councils should be encouraged to fund appropriately applied work.

Some Department of Health initiatives recognise that green spaces are important, for example Alderhey Children's Hospital plans to incorporate benefits of increasing access to green space into plans for the hospital's redevelopment.[21] Comprehensive medical care does and should include wider environmental factors.

9. **Many ecosystem services which influence human health are sourced overseas while others critically depend upon proximity and access (for example access to green space). This should be overtly recognised in planning to reduce our impact on the global environment and optimise sustainable gains from local services.**

Ecosystem service delivery at all scales (local, regional, national and international) will impact on health and this should be considered in planning and analysis. Local water quality is often affected by actions taken at a distance (or at 'catchment scale'). Many ecosystem services on which we depend are sourced from overseas e.g. imported food and timber, or operate at a global scale e.g. climate regulation. The dependence of UK populations on international ecosystems receives little attention in the current evidence base;in effect there are no distant problems and contaminating a distant environment will have eventual impacts here.

10. **Policy-makers should identify areas of potential risk to both human health and ecosystem service flows and act to ensure measurable improvements in sustainable and mitigating practices.**

The emergence of litigious culture and patients' expectations of treatment and cure means that pharmaceutical prescriptions are more likely. Consumption of medicines is not always desirable and should the current level of drug prescription continue there are likely to be cumulative environmental consequences, some of which may be health and environment disbenefits.

The likely impacts of climate change, as projected in peer-reviewed models, should be taken into consideration in future planning and design of ecosystem and health-related projects.

[21] http://www.alderhey.nhs.uk/Childrens_Health_Park.asp

Horizon Scanning

This section presents 'horizon' predictions which were adopted by working groups and proved popular when presented to the entire workshop.

1. It will become important to increase the extent to which the Millennium Development Goals (MDGs) are linked to ecosystem service thinking.
2. It will become common practice to connect the ecosystem services and health (ES&H) agenda to other objectives, for example reducing antisocial behaviour, engaging youth and enhancing corporate involvement,. The relationships between changes in biodiversity and ecosystems services and their implications for health and wellbeing are already the focus of a number of horizon scanning activities within government (e.g. Environment Agency, Natural England, Defra) and in the academic community (e.g. the NERC Biodiversity Horizon Scanning programme led by Prof. William Sutherland, University of Cambridge). The results of these studies should be widely disseminated and ultimately, should be reflected in the actions of policy-makers.
3. There will be increased awareness of the need for a green infrastructure plan.
4. The involvement of commerce in this area will increase. There will be a growth in the policy and practical influence of studies demonstrating linkage between productivity (output and profit) and workers' access to green space. Case studies demonstrating increased productivity following increased green access are already known.
5. Ecosystem services and human health considerations will be incorporated into design of measures for mitigation of and adaptation to climate change.
6. There will be increased awareness of the importance of early life engagement by children with nature (including through education and the curriculum).
7. There will be a need to recognise the potential of persistent organic pollutants (so-called POPs) and other chemicals, to influence patterns of diseases. In particular, proper analysis and planning will be required to accommodate the uncertainties around whole life exposure to, and environmental cycling of, a range of compounds. The list of compounds of interest is likely to include bisphenol A (BPA), perfluorinated compounds (PFCs), lead (Hg), nanomaterials and others. In contrast, the environmental benefits (in terms of decontamination action etc.) of some compounds (including nanomaterials) will also need consideration.
8. The leaching of bioactive compounds from contaminated land will become a greater concern.
9. The impact of transport on a range of issues will warrant investigation.

Annexes

Annex A – Summary of the key points in introductory talks

Prof Michael Depledge (Presentation)

The DSPIR model used by the Sustainable Development Commission[22] was outlined (driving forces, pressures, state, impact, responses) as a useful framework for assessing ecosystem services and health interactions.

Huge populations are dependent on ecosystem services and the economics of this are coming to the fore. As a society we need to determine how we convert economic value to other values. We need to be objective about the evidence of the value of nature.
There are predictions that after 2050 there will be a decline in the global economy associated with declining populations in significant regions. At present, and in the interim, demographic changes (an aging population) will fuel pharmaceutical use.

Urban environments are ecosystems and have as important elements trees, green space and water. Choice experiments conducted using members of the public, using photographs, shows preferences for a little bit of green and a lot of blue (e.g. coastal scenes). This has economic value which is measurable in terms of willingness to pay for property.

There are known responses to isolation from nature, including behavioural abnormalities such as overfeeding. Depression and obesity are currently seen as significant ill-health burdens on both individuals and on the state.

Dr Jo Barton (Presentation)

The potential value of 'green exercise' was examined by gathering data from laboratory based experiments and studies based on self-reporting following exercise in chosen settings. The Rosenberg self-esteem scale was used in a number of cases.

Studies show a measurable preference for certain desirable landscapes and a benefit from interacting with nature in outdoor pursuits. Assessments of young offenders enrolled in the Turnaround Project[23] showed benefit of outdoor pursuits over a nine month period.

Combined results have been published outlining a 'Dose of Nature' (Barton and Pretty, 2010)[24] and further analyses are ongoing including an Economic and Social Research Council-funded study on physiology.

Dr Linda Beale (Presentation)

The Small Area Health Statistics Unit at Imperial College is compiling a map to combine data on environment and health. There are significant challenges in constructing this in terms of concepts, acquisition of data and interpretation. Experience to date shows GIS is a good tool

[22] http://www.sd-commission.org.uk/
[23] http://www.turnaroundproject.org.uk/
[24] Barton, J. and Pretty, J. (2010) What is the Best Dose of Nature and Green exercise for Improving Mental Health? A Multi-Study Analysis. *Environmental Science and Technology,* 44 (10), pp. 3947-3955.

which can be combined well with rapid inquiry facilities. It also indicates that health data is good but that environmental data is patchy and sub-optimal for England and Wales. Data on people is being treated as postcode sized packets (approximately 15 houses) with occupants assumed to be static for interpretation purposes. Particular attention is being paid to restricting the mapping processes to those where robust inquiry is possible.

Access to datasets, including long-term datasets remains a persistent problem and this restricts some of the potential of this project. It is hoped that access to publicly-funded material will improve.

Dr Kate Jones (Presentation)

Biodiversity can play a role in disease regulation as both a source and a sink. Meta-analysis suggests that biodiversity can affect the abundance, behaviour and condition of pathogens and hosts, thereby influencing disease transmission, regulation and persistence. Biodiversity within hosts should also be considered in terms of hosts' own internal microflora, which can be characterised as a 'microbiome'.

Her results have formed part of a global study have been published in Nature.[25]

Prof Hugh Montgomery (Presentation)

Attention was drawn to the overwhelming scientific consensus relating to climate change, and the severity and immediacy of its likely impacts on humans and upon the ecosystems on which they depend. While framed by many as an issue of concern only to 'environmentalists', climate change, was described an issue of open concern to business, the military, and banking sectors.The case for action to combat the drivers of climate change is therefore compelling and urgent. There are significant risks to health from climate change and these are being recognised, even if rather later in the debate than some characteristics.

Dr William Bird (Presentation)

Parents often keep children indoors because of perceived risks of outdoor activity and traffic but inactivity in children is as dangerous as obesity. It receives considerably less attention however. There are other risks of indoor lifestyle including rickets, and a number (100+ p.a.) of cases are appearing annually.

Transport also has other implications in that studies have shown a lower degree of social networking in areas of higher traffic, with implications for health. For short distances it should be emphasised that the energy balance of moving a car and a person is similar.

[25] Keesing *et al* (2010) Impacts of biodiversity on the emergence and transmission of infectious diseases. *Nature* **468**:647-652.

There is increasing recognition in international medicine that environment is important. This includes work to combat malaria, which is now seen as intimately linked to concern for rainforests.

Nationally the case for access to usable green space should be recognised. Regents Park should be seen as an asset to the NHS to the tune of £643,000 p.a. in terms of its contribution to fitness.

Positivity and connectedness can be difficult concepts to communicate in medicine which is habituated to concepts of active 'anti-' therapies.

Annex B – Workshop programme

10:15 – 10:30	Introduction	**Prof Sir Kenneth Calman** University of Glasgow and British Library Board
10:30 – 10:50	Overview	**Prof Michael Depledge** (Chair) European Centre for Environment and Human Health, Peninsula College of Medicine and Dentistry, Universities of Exeter and Plymouth
10:50 – 11:10	A Dose of Nature	**Dr Jo Barton** Interdisciplinary Centre for Environment and Society, University of Essex
11:10 – 11:30	SAHSU's Environmental Health Atlas	**Dr Linda Beale** Small Area Health Statistics Unit, Imperial College London
11.30 – 11.50	**Coffee**	
11:50 – 12:10	Biodiversity and the emergence and transmission of infectious diseases	**Dr Kate Jones** Institute of Zoology.
12:10 – 12:30	Lessons from Climate Change Research	**Prof Hugh Montgomery** Institute for Human Health and Performance, University College London
12:30 – 12:50	Healthy by Nature. Human development through healthy green space.	**Dr William Bird** Natural England
12:50 – 13:00	Workshop assignment	
13:00 – 13:45	**Lunch**	
13:45 – 15:15	Workshop	
15:15 – 15:45	**Coffee**	
15:45 – 16:30	Workshop synthesis	

Annex C

Definitions and references provided to participants

Health and ecosystem services

- An **ecosystem** is a dynamic complex of plant, animal, and microorganism communities and the nonliving environment, interacting as a functional unit. Humans are an integral part of ecosystems.[26]
- **Ecosystem services** are the benefits people obtain from ecosystems. These include **provisioning services** such as food and water; **regulating services** such as flood and disease control; **cultural services** such as spiritual, recreational, and cultural benefits; and **supporting services**, such as nutrient cycling, that maintain the conditions for life on Earth.
- **Human well-being** has several key components: the basic material needs for a good life, freedom and choice, health, good social relations, and personal security. Well-being exists on a continuum with poverty, which has been defined as "pronounced deprivation in well-being."
- **Biodiversity** is the variability among living organisms. It includes diversity within and among species and diversity within and among ecosystems. Biodiversity is the source of many ecosystem goods, such as food and genetic resources, and changes in biodiversity can influence the supply of ecosystem services.
- An assessment of the condition of ecosystems, the provision of services, and their relation to human well-being requires an **integrated approach.** This enables a decision process to determine which service or set of services is valued most highly and how to develop approaches to maintain services by managing the system sustainably.

From The Millennium Ecosystem Assessment: *Ecosystems and Human Well-being.*

- The **ecosystem approach** is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. It is based on the application of appropriate scientific methodologies focused on levels of biological organization which encompass the essential processes, functions and interactions among organisms and their environment. It recognises that humans, with their cultural diversity, are an integral component of ecosystems.

From The Convention on Biological Diversity (CBD, 2000; www.cbd.int/ecosystem)

References

A reading list of suggested and relevant papers is available on the NCI website at www.naturalcapitalinitiative.org.uk

[26] *Other definitions in the literature are regularly cited (Costanza et al, 1997; Daily, 1997; MEA, 2005)*

Annex D – Questions addressed in the discussion groups

Breakout Group briefing and questions:

There were six groups with no more than ten members in each.
A leader and scribe were pre-assigned to each group to lead and record discussions.
Three roving facilitators reported to the Chair at the end of the session with the help of the leader and scribe. The Facilitators and Leaders reported to the workshop synthesis session.

1. **EVIDENCE:**

What are the strengths and weaknesses of the current evidence base?
e.g. What are the challenges in terms of the generation of evidence?
e.g. What are the challenges in terms of the communication of evidence?

How can we improve the gathering of evidence on the relationship between accrual of health benefits and sustainable ecosystem function and use?
e.g. What kinds of assessments could guide commissioners or planners?
e.g. Are indicators of wellness sufficiently advanced to provide useful information?

2. PRACTICE:

What are the areas in which health and environment professionals currently collaborate well?
e.g. What are the characteristics of a good collaboration?
e.g. Where are there gaps or limitations on progress?
e.g. What else is needed?

What are the challenges of interdisciplinary and cross-sectoral work which apply in this area?
e.g. What are the funding challenges?
e.g. What are the recognition and reward challenges?

3. Key Messages:
What are the **top five** messages to advance policy and practice in this area in the short to medium term (5 – 10 years)?
Address:

- **two messages to Ministers and authors of public policy**;
- **two to professionals and professional bodies in medicine, science and the environment, and**
- **one message to a recipient of your choice.**

Each participant designed their own messages and posted them on boards provided. Participants voted in favour of other proposals from the group with which they agreed. The group then distilled the top five messages.

4. Horizon scanning:

The group identified horizon and emerging issues which may require policy adaptation in the longer-term.

Annex E – List of participants

Dr Silvia Alonso-Alvarez	Lecturer in Veterinary Public Health	Royal Veterinary College
Dr Nichola Badcock	LWEC Coordinator	Living With Environmental Change
Dr Jo Barton	Lecturer in Sports and Exercise Science	Department of Biological Sciences, University of Essex
Dr Linda Beale	SAHSU Scientific Coordinator	Small Area Health Statistics Unit, Imperial College London
Dr Laura Bellingan	Senior Science Policy Adviser and NCI Secretariat	Society of Biology and Natural Capital Initiative
Dr William Bird	Strategic Health Advisor	Natural England
Francesca Booker	Policy Intern	Natural Capital Initiative
Prof David Bradley	Emeritus Professor	London School of Hygiene and Tropical Medicine
Prof Nic Bury	Senior Lecturer	Division of Nutritional Sciences, Kings College London
Charles Butt	Nature After Minerals Planning Adviser	Royal Society for the Protection of Birds
Dr Cassidy Johnson	Building and Development Planning Unit	University College London
Prof Sir Kenneth Calman	Chancellor	University of Glasgow
Dr Richard Campen	Director	Peak District National Park Authority
Dr Greg Carson	Chair, External Affairs Committee	Institute of Ecology and Environmental Management
Eleanor Carter	Policy Officer	British Trust for Conservation Volunteers
Ben Cave	Associate	Ben Cave Associates Ltd
Prof Andrew Church	Professor of Human Geography	University of Brighton
Prof Anthony Costello	Director of the Institute for Global Health	University College London
Prof Michael Depledge	Interim Director	European Centre for Environment and Human Health, Peninsula College of Medicine and Dentistry, Universities of Exeter and Plymouth
David Dench	Head of Conservation	Worcestershire Wildlife Trust
Lisa Drewe	Assistant Director, Business Sustainability	National Trust
David Edwards	International Sustainability Unit	The Prince's Charities' International Sustainability Unit
Mark Elton	Regional Director	WSP Environment and Energy
Prof Alan Fenwick	Director of Schistosomiasis Control Initiative	Imperial College London
Prof Les Firbank	Visiting Professor	University of Leeds
Dr Matthew Fisher	Senior Lecturer	Faculty of Medicine, Imperial College London
Dr Rita Floyd	British Academy Postdoctoral Fellow	Institute for Environmental Security, University of Warwick
Dr Peter Glaves		Division of Environmental Management, Northumbria University
Prof Rosie Hails	CEH Section Head and Chair of NCI	Centre for Ecology and Hydrology and Natural Capital Initiative
Dr Wendy Harrison	Deputy Director	SCI, Imperial College London
Dr Kathy Hartley		East of England Public Health and Social

		Care Directorate
Jon Heuch	Chair	Arboricultural Association
Dr Bruce Howard	NCI Science Policy Liaison Officer	Natural Capital Initiative
Dr Kate Jones	Senior Research Fellow	Zoological Society of London
Dr Sarah Kemmitt	Environmental Sciences Programme Manager	British Library
Dr Pamela Kempton	Programme Manager	Natural Environment Research Council
Dr Johanna Kieniewicz	Environmental Sciences Research Officer	British Library
Dr Suzanne King	Director	People Science and Policy Ltd
Dr Teri Knight	Senior Research Fellow	Bangor University
Conor Kretsch	Executive Director	COHAB Initiative
Prof Paul Leonard	Consultant and NCI Steering Group	Independent Consultant and Natural Capital Initiative
Dr Connor Linstead	Research Associate	SWIMMER, University of Liverpool
Prof Ed Maltby	Director	SWIMMER, University of Liverpool
Ceri Margerison	Policy Officer and NCI Secretariat	British Ecological Society and Natural Capital Initiative
Prof Hugh Montgomery	Director	Institute for Human Health and Performance, UCL
Dr Frances Mortimer	Director	Campaign for Greener Healthcare
Dr Louise Newport	Scientific Policy Manager	Legislation & Environmental Hazards, Department of Health
Prof Tim O'Riordan	Emeritus Professor and NCI Steering Group	University of East Anglia and Natural Capital Initiative
Jamie Page	Chief Executive	Cancer Prevention and Education Society
Helen Rawlinson	Project Officer	REVIVE, Cheshire West and Chester
Dr Kelly Redeker	Senior Lecturer	University of York
Dr Nigel Reeve	Head of Ecology	Head of Ecology, Royal Parks
Prof Yvonne Rydin	Professor of Planning Environment and Policy	University College London
Noah Scovronick	PhD Student	London School of Hygiene and Tropical Medicine
Dr James Smith	Public Health Specialty Registrar	NHS Bedfordshire
Jemima Stokton	PhD Student	University College London
David Stone	Principal Specialist in Environment and Human Health	Natural England
Dr Allan Sudlow	STEM Relationships Manager	British Library
Prof Jeff Waage	Director	London International Development Centre
Dr Karen Walshe	Biosciences Research Officer	British Library
Dr Ursula Wells	Policy Research Programme	Department of Health, R&D Directorate
Dr Piran White	Reader	University of York
Linda Yost	Deputy Chief Executive	Institute of Ecology and Environmental Management
Paul Whaley	Editor	Environment and Health