



CHILDREN AND NATURE

A QUASI-SYSTEMATIC REVIEW OF THE EMPIRICAL EVIDENCE

NOVEMBER 2011

LONDON **COMMISSION**
SUSTAINABLE DEVELOPMENT
COMMISSION

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Greater London Authority
November 2011

Published by
Greater London Authority
City Hall, The Queen's Walk
London SE1 2AA

www.london.gov.uk
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minicom 020 7983 4458

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A REPORT FOR THE LONDON SUSTAINABLE DEVELOPMENT
COMMISSION BY TIM GILL

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CHAPTER ONE

INTRODUCTION

This report sets out the findings of a review into the evidential support for claims about the benefits for children of experiences with nature. The review was part of a project exploring children's relationship with nature, commissioned by the London Sustainable Development Commission. The final report for the project was published separately as *Sowing the Seeds: Reconnecting London's children with nature*.

Some strong claims have been made about the importance of children spending time in nature. Natural environments are said to have restorative qualities that help in relaxing and coping with everyday stress. They are claimed to promote adaptive processes in child development (for instance motor fitness, physical competence and self-confidence). They are said to support learning and education. Finally, it is claimed that spending time in green outdoor environments as a child nurtures lifelong positive attitudes about nature and the wider environment¹

These claims are examined in detail, with the aim of producing a transparent, authoritative assessment of the evidence base for these claims that should be of value to the as-yet unconvinced. The literature review was also designed to shape recommendations for action.

CHAPTER TWO

KEY FINDINGS

Taken as a whole, the studies confirm that spending time in nature is part of a ‘balanced diet’ of childhood experiences that promote children’s healthy development, well-being and positive environmental attitudes and values. The findings are summarised in Table 1 below.

The evidence is strongest for claims about health, both physical and mental. In the case of mental health, emotional regulation and motor development, the evidence base includes a small number of more robust, cause-and-effect studies.

There is also good evidence of a link between time spent in natural settings as a child, and positive views about nature as an adult. The evidence base for these benefits covers a comparatively broad range of children from different countries and backgrounds. However, not all children are equally keen on nature

and the outdoors. Studies have found that a lack of regular positive experiences in nature is associated with the development of fear, discomfort and dislike of the environment².

A more modest body of evidence – from a diverse mix of studies - points to improvements in the quality of children’s outdoor play, in their self-confidence, language/communication and psychosocial health.

One further finding emerged from the literature review, which points to the value of more playful engagement styles such as free play, exploration, leisure and child-initiated learning. Across the pool of studies analysed, these styles were associated with both health benefits and positive environmental attitudes. However, less playful styles such as school gardening projects and field trips were mainly associated with educational benefits.

Table 1: Overall conclusions from the literature review

Claims that are well supported
<ul style="list-style-type: none"> • Spending time in natural environments as a child is associated with adult pro-environment attitudes and feelings of being connected with the natural world, and is also associated with a stronger sense of place. • Living near to green spaces is associated with greater physical activity. • Spending time in nearby nature leads to improvements in mental health and emotional regulation, both for specific groups of children (such as those with ADHD) and for children as a whole. • Children who take part in school gardening projects improve in scientific learning more than those who do not, and have healthier eating habits. • Experience of green environments is associated with greater environmental knowledge. • Play in natural environments leads to improvements in motor fitness for pre-school children.
Claims that have some good support
<ul style="list-style-type: none"> • Forest school and school gardening projects are associated with improved social skills; in addition, forest school leads to improved self-control and school gardening projects lead to increased self-awareness.
Claims with some support
<ul style="list-style-type: none"> • Nearby nature is associated with more outdoor play and hence improved well-being. • Forest school is associated with improved self-confidence and language and communication. • Conservation activities in school grounds and nearby open spaces are associated with improved psychosocial health.

CHAPTER THREE

WHAT CAN A REVIEW LIKE THIS TELL US?

Academics, advocates and practitioners have discussed the topic of children's engagement with nature extensively, and gaining an overview of current knowledge is difficult. What is more, as with many public policy arenas, there are variations in what different people regard as sound evidence. This review approaches the task by asking the question: what do the more reliable, empirical studies tell us?

The topic of children's engagement with nature has been surveyed in different ways by researchers with different theoretical starting points, interests and approaches. This review takes the common-sense position that the topic is amenable to empirical study and that an overview can be sketched out. It also assumes that there is value in bringing together material from different disciplines, even though they may have differing views on what counts as good evidence.

Researching the influences of nature on children is not easy. There are ethical and methodological challenges, and we only have a partial picture. Indeed there are debates (not pursued further here) about the degree to which it is possible to be impartial or objective on such topics.

Inevitably, an empirical focus means missing out on some of the more theoretical and descriptive material available. It means that some of the qualitative, subjective, even spiritual features of our relationship with nature – its texture and fabric as part of people's inner lives – can be underemphasised or omitted.

Moreover, care is needed when looking at the empirical evidence. The studies surveyed here explore the experiences of some very diverse groups of children (from different countries,

of a range of ages, and also from different socio-economic and cultural backgrounds). What studies count as 'nature' (or a 'natural environment') also varies widely, as does the style of children's engagement with those environments. The environments studied include urban green public spaces, school grounds, woodlands and private gardens. In some studies children are playing freely, while in others their engagement is facilitated by adults, sometimes through highly structured programs. It cannot be assumed that outcomes with one group of children, from experiences in one type of environment, or from one style of engagement, will transfer to other groups, environments or engagement styles.

While the body of evidence and authoritative opinion is growing, coverage is still patchy. For example, some writers argue that children build their resilience – their ability to bounce back from the ups and downs of life – when they play in natural environments. But such benefits are hard to study empirically, because of the ethical and methodological challenges.

Gathering robust evidence of cause-and-effect is particularly challenging. To take one example from the findings discussed here: people who feel close to nature as adults, or have a strong commitment to environmentalism, tend to have spent time in childhood in natural places - unlike people who feel less concerned about nature. What might explain this link? It could be that early experiences influenced or caused the later attitudes. Or it could be that some people are from an early age more inclined than others towards both natural environments and environmentalism. Cross-sectional studies - those that only gather data or information at a single point in time - can show a link between experiences and outcomes, but they cannot show cause and effect.

Longitudinal studies – ones that track children over time – can give more information about the potential outcomes of different experiences, since they can provide a baseline. But they still leave open the possibility that the outcomes are not caused by the experiences, but by other factors – perhaps the social background, characteristics or personalities of the children. To be more confident that the differences are caused by the experiences, intervention studies are needed that compare groups of children in ways that control for such factors as their backgrounds or personal characteristics. The strongest evidence is gained from studies where children are assigned randomly to different interventions, in randomised controlled trials. While such studies are common for clinical and other health interventions, there are ethical, financial and practical barriers to carrying them out in other disciplines. Some of the studies included in this review used more robust before-and-after methodologies. But most were cross-sectional.

As the field evolves, it is likely that the depth and robustness of the evidence base will grow. It is not unusual for exploration of a research topic to begin with qualitative or correlational/cross-sectional research, as a way of clarifying the territory and shaping later, more specific research questions that are more amenable to more robust study designs.



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CHAPTER FOUR

REVIEW METHODOLOGY

A thorough literature review was carried out, using a methodology similar to that used by the civil service³. This literature review is best described as 'quasi-systematic'. It conducted as exhaustive a search as possible for relevant studies, given the time and resource limitations available. It also categorised and evaluated each of the studies found in a consistent way, according to clearly stated criteria.

The topic of children and nature has been reviewed frequently in recent years; 15 published literature reviews were found as part of this review (see Table 2 below). This review differs from almost all the other reviews identified, since it includes explicit and transparent assessments of study quality alongside clear inclusion criteria (the exception is Ward Thompson et al 2006, which focused on older children). Reviews that do not state their inclusion criteria are open to criticism that their assessment is partial or biased (for instance, they may have ignored negative or inconclusive studies). Similarly, reviews that make no attempt to assess study quality, or that fail to describe how they do this, may not adequately reflect the weight of evidence. Hence this review marks a step forward in our understanding of the evidence base.

This review was undertaken in 3 stages. In stage 1, a search was carried out for relevant primary empirical studies with sound methodologies. In stage 2, the studies selected (61 in total) were analysed to pull out the benefits that were identified. This analysis also gathered information on the study quality, the type/s of environment and style/s of engagement under study, and the characteristics of the children/adults that were studied. In stage 3 the evidence for each category of benefit was pulled together to give an assessment that reflects the quality and number of relevant studies. Each stage is described in more detail below.

Stage 1: Search for relevant studies

The search for relevant studies began with a trawl (carried out in January and February 2011) through 32 relevant literature reviews, around half of which focused on children. These reviews were all undertaken between 2003 and 2010. Some of these reviews were known to the reviewer, while others came to light either as citations, or as a result of contacting one of a number of experts. The reviews are listed in Tables 2 and 3, the experts are listed in Table 4, and the inclusion/exclusion criteria are set out in Table 5 below. Tables 2 and 3 also state the referring source for each review, and state whether or not the review gave information about the methodological quality of the primary studies cited. Where this information was given, it was used in stage 2 – see below for more details.

Table 2: Relevant literature reviews that focus on children

Reference	Studies assessed?	Referring source (see Table 4)
Charles C and Senauer A (2010) <i>Health benefits to children from contact with the outdoors & nature</i> . Children & Nature Network	No	Known to reviewer
Charles C and Senauer A (2010) <i>Children's contact with the outdoors and nature: a focus on educators and educational settings</i> . Children & Nature Network	No	Known to reviewer
Chawla L and Cushing D (2007). 'Education for strategic environmental behavior', <i>Environmental Education Research</i> v13 n4 p437-452.	No	Known to reviewer
Huby M and Bradshaw J (2006) <i>A Review of the Environmental Dimension of Children and Young People's Well-being. A report for the Sustainable Development Commission</i>	No	Jake Reynolds
Lester S and Maudsley M (2006). <i>Play, Naturally: A review of children's natural play</i> . Play England.	No	Known to reviewer
Lovell R, O'Brien L and Owen R (2010) <i>Review of the research evidence in relation to the role of trees and woods in formal education and learning</i> . Forestry Commission.	No	Rebecca Lovell
Malone K (2008) <i>Every Experience Matters: An evidence based research report on the role of learning outside the classroom for children's whole development from birth to eighteen years</i> . Farming & Countryside Education.	No	Known to reviewer
Muñoz S (2009) <i>Children in the Outdoors: A literature review</i> . Sustainable Development Research Centre.	No	Marcus Sangster
New Economics Foundation (2006) <i>Review of the environmental dimension of children and young people's well-being. A report for the Sustainable Development Commission</i> .	No	Jake Reynolds
Parsons G (2007) <i>Heading Out: Exploring the impact of outdoor experiences on young children</i> . Learning through Landscapes.	No	Rebecca Lovell
Pretty J, Angus C et al (2009) <i>Nature, Childhood, Health and Life Pathways</i> . University of Essex.	No	Liz O'Brien
Raffan J, Robertson C et al (2000) <i>Nature Nurtures: Investigating the potential of school grounds</i> . Evergreen, Canada.	No	Known to reviewer
Rickinson M, Dillon J et al (2004) <i>A review of research on outdoor learning</i> . National Foundation for Educational Research and King's College London.	No	Known to reviewer
Sustainable Development Commission (2010) <i>Improving Young People's Lives: The role of the environment in building resilience, responsibility and employment chances</i> . Sustainable Development Commission.	No	Jake Reynolds
Ward Thompson C, Travlou P and Roe J (2006) <i>Free-Range Teenagers: The Role of Wild Adventure Space in Young People's Lives</i> . OPENspace (Published in 2010 by Natural England).	Yes	Known to reviewer
Woolley H, Pattacini L and Somerset Ward A (2009) <i>Children and the natural environment: Experiences, influences and interventions</i> . Sheffield University.	No	Helen Woolley

Table 3: Relevant literature reviews that do not solely focus on children

Reference	Studies assessed?	Referring source (see Table 4)
Bell S, Hamilton V et al (2008) <i>Greenspace and quality of life: a critical literature review</i> . Research Report by OPENspace for Greenspace Scotland.	Yes	Catharine Ward Thompson
Bird W (2004) <i>Natural Fit: Can Green Space and Biodiversity Increase Levels of Physical Activity?</i> Royal Society for the Protection of Birds.	No	CPIS
Bird W. (2007) <i>Natural thinking</i> . Royal Society for the Protection of Birds.	No	CPIS
Bowler D, Knight T and Pullin A (2009) <i>The value of contact with nature for health promotion: how the evidence has been reviewed</i> . Centre for Evidence Based Conservation, School of the Environment and Natural Resources, Bangor University.	Yes (the paper is a review of reviews)	Marcus Sangster
Bowler D, Buyung-Ali L et al (2010) <i>The importance of nature for health: is there a specific benefit of contact with green space?</i> Centre for Evidence Based Conservation: www.environmentalevidence.org/SR40.html	Yes	Natural England
Bowler D, Buyung-Ali L et al (2010) <i>A systematic review of evidence for the added benefits to health of exposure to natural environments</i> . BMC Public Health 10:456.	Yes	Natural England
Croucher K, Myers L and Bretherton J (2007) <i>The links between greenspace and health: a critical literature review</i> . Prepared for Greenspace Scotland; 2007. [Croucher et al 2007a]	Yes	Bowler et al 2009
Croucher, K., Myers, L. et al. (2007) <i>Physical Characteristics of Urban Neighbourhoods and Health: Critical Literature Review</i> . Glasgow Centre for Population Health. [Croucher et al 2007b]	Yes	Croucher et al 2007a
Davies P (2007) <i>Natural Heritage: a pathway to health</i> . Prepared for Countryside Commission for Wales	Yes	Bowler et al 2009
Faculty of Public Health (2010) <i>Great Outdoors: How Our Natural Health Service Uses Green Space To Improve Wellbeing An action report</i> . Faculty of Public Health in association with Natural England.	No	Jake Reynolds
Foster C, Hillsdon M, Jones A, Panter J (2006) <i>Assessing the relationship between the quality of urban green space and physical activity</i> . Prepared for CABE space	Yes	Bowler et al 2009
Health Council of the Netherlands (2004) <i>Nature and Health: The influence of nature on social, psychological and physical well-being</i> .	No	Marcus Sangster
NICE (2006) <i>Physical activity and the environment: Review 3: Natural Environment</i> . NICE Public Collaborating Centre - Physical Activity.	Yes	Bowler et al 2009
Newton J (2007) <i>Wellbeing and the Natural Environment: A brief overview of the evidence</i> . DEFRA (discussion paper).	No	Liz O'Brien
Sempik J, Aldridge J, Becker S (2003) <i>Social and therapeutic horticulture: Evidence and Messages from Research</i> . University of Loughborough.	Yes	Bowler et al 2009
Van den Berg A (2005). <i>Health impacts of healing environments: A review of the benefits of nature, daylight, fresh air and quiet in healthcare settings</i> . Groningen, Foundation 200 years University Hospital Groningen.	Yes	Bowler et al 2009

To supplement these literature reviews, 13 experts were contacted in January and February 2011 to ask for references and pointers to relevant material. They were asked in fairly general terms for information on 'post-2005 empirical studies relevant to children and nature'. The experts contacted are listed in Table 4 below.

Table 4: Experts contacted

Name	Institution	Referred by
Catherine Andrews	Learning through Landscapes	Known to reviewer
Dr William Bird	Natural England	Known to reviewer
Stephen Close	Play England	Known to reviewer
Anna Kassman-McKerrell	Children's Play Information Service (CPIS)	Known to reviewer
Rebecca Lovell	Forestry Commission	Marcus Sangster, FC
Dr Karen Malone	Wollongong University	Known to reviewer
Liz O'Brien	Forestry Commission	Marcus Sangster, FC
Jake Reynolds	Sustainable Development Commission	Known to reviewer
Marcus Sangster	Forestry Commission	Paddy Harrop, FC
Prof Chris Spencer	Sheffield University	Known to reviewer
Sam Thompson	New Economics Foundation	Known to reviewer
Dr Catharine Ward Thompson	OPENspace	Known to reviewer
Helen Woolley	Sheffield University	Known to reviewer

Inclusion criteria

Table 5 below sets out the inclusion and exclusion criteria in more detail. The application of these criteria is not an objective process, and judgements have had to be made. For instance, the distinction between descriptive and empirical research methods is not hard-and-fast. A considered view has been taken, in the light of the reviewer's expertise in the area. As a result of the search strategy set out above, 71 studies were identified for further analysis.

Table 5: Inclusion and exclusion criteria (adapted from Bell et al 2008)

Inclusion criteria	Exclusion criteria
Studies reporting the benefits or outcomes of children's experiences of nature.	Studies on children's experience of nature that do not consider benefits or outcomes.
The relevant experiences happened before the age of 12	Studies focusing on experiences after this age
The style of engagement is potentially a regular part of everyday childhood	Studies of residential, remote or wilderness experiences, where children are taken some distance away from their everyday environments
The environment under study is one of the following natural spaces: <ul style="list-style-type: none"> • Woodlands • Urban green public spaces • Outdoor green domestic spaces • School grounds, including school gardens • 'Wild areas' that may be found in or near urban areas 	The environment under study is one of the following natural spaces: <ul style="list-style-type: none"> • Outdoor spaces where there is no mention of nature or greenness • Remote wilderness areas • Studies focusing on experiences of animals or pets
Studies undertaken in developed countries	Studies undertaken in developing countries
Papers reporting primary studies of an evaluative and/or empirical nature (relevant literature reviews were not included, but any studies cited/referenced were considered for inclusion)	Papers not reporting empirical studies, for example, editorials, think-pieces, theoretical and methodological discussion papers Theses and dissertations
Papers published in English	Papers published in languages other than English
Papers published (in print or online) in a peer-reviewed journal or scholarly book, or by an authoritative source, including national governments, national public bodies, academic institutions and leading NGOs	Papers published by other sources (including local authorities, private individuals and private companies)
Papers published since 1990	Papers published before 1990

Stage 2: Analysis of relevant studies

In stage 2, for each of the 71 identified studies, an assessment was made about the quality of the research methods used in each study. This assessment was made using a simplified version of the approach taken in the literature review for Greenspace Scotland carried out by OPENspace (Bell et al 2008). The studies were assessed against the following three questions:

- Does the research test for a benefit/outcome, with clear aims?
- Is there a clear justified methodology?
- Is there a clear analysis?

Each study was graded 'good', 'fair', 'unclear' or 'poor' using the following criteria:

- Good - positive assessment against all three questions.
- Fair - positive assessment against most of the questions; no negative assessments.
- Unclear - unclear quality in accordance with all the questions.
- Poor - negative assessment against one or more of the questions.

The results of this assessment are given in Table 6. (Any studies that were cited in a literature review that incorporated inclusion criteria about the quality of the study's methodology were automatically assessed as 'good'.)

Table 6: Results of assessment of research methods

Grade	Number of studies
Good	46
Fair	13
Unclear	2
Poor	10

The 10 studies assessed as poor were excluded from any further analysis. The 61 remaining studies were categorised according to the specific benefit/s that were addressed. The references for these studies are listed in the appendix below. A small proportion of studies (9 in total) addressed more than one benefit; these were included under each relevant benefit category. The typology of benefits used –

set out in Table 7 below – was adapted from that used in Dr Karen Malone’s report *Every Experience Matters*⁴.

In addition, each study was also analysed for the following information:

- Key findings (usually taken from abstract)
- Type/s of environment under study
- Style/s of children’s engagement under study
- Characteristics of subjects studied (eg age, socio-economic background, ethnic background)
- Geographical location
- Caveats and other comments
- Referring source (one source given; note that many studies were cited by multiple reviews and experts)

Table 7: Typology of benefits (adapted from Malone 2008)

General Outcome	Specific Benefit	No. of relevant studies
Health	Physical activity	16
	Mental health	11
	Healthy eating	3
	Motor development	2
Well-being	Quality of outdoor play	2
	Psychosocial health	1
Cognitive	Scientific learning	4
	Environmental knowledge	2
	Language and communication	2
Social	Social skills	4
Emotional/behavioural	Self-control	2
	Self-confidence	1
	Self-awareness	1
Ethical/attitudinal	Concern for the environment	13
	Connectedness to nature	5
	Sense of place	4

Note: the total adds up to more than the total number of studies, because some studies were relevant to more than one benefit.

Stage 3: Synthesising evidence of benefits

The 61 studies were gathered together for each specific benefit, and the evidence was synthesised to give an overall assessment of the degree of support for that benefit. Table 8 below sets out how this synthesis was carried out. The results are given in Tables 10 - 12.

Given the heterogeneous nature of the studies, and the fact that, even taken as a whole, they only give a partial picture of the topic, there is limited scope for further analysis that might reveal some of the factors that shape or influence the benefits and outcomes for children. However, one factor was significant enough to warrant further exploration: the style of children's engagement with nature. This aspect is prominent in the theoretical and discursive literature⁵.

Therefore, the 61 studies were analysed in one further way. They were reviewed to judge the degree to which the engagement style under study could be described as 'more playful' or 'less playful'. More playful styles included free play, leisure, child-initiated learning (such as in forest school) and freely chosen gardening activities and games, while less playful styles included school gardening programmes, guided walks and field trips. Where both styles were studied, or the nature of the engagement style was unclear, this was also noted. The results (for the most common categories of benefit) are shown in Table 9.

No studies directly compared different styles of engagement. Nonetheless, some patterns emerged that point to the value of more playful engagement styles such as free play, exploration, leisure and child-initiated learning.

Table 8: synthesising the degree of support for each specific benefit

Assessment of level of support	Criterion
Well supported by good evidence	Two or more studies with positive findings, all assessed as 'good' and none with contradictory findings (there may also be other studies of varying quality, and there may also be some studies with neutral or non-significant findings).
Some support from good evidence	One study with positive findings, assessed as 'good' and none with contradictory findings (there may also be other studies of varying quality, and there may also be some studies with neutral or non-significant findings).
Some support, modest evidence	One or more studies with positive findings but none assessed as 'good'.

Table 9: Studies, outcomes and engagement styles

Outcome	'More playful' engagement style	'Less playful' engagement style	Both, or unclear engagement style
Physical activity	15	1	0
Concern for the environment	8	3	2
Mental health	7	1	2
Connected to nature	3	0	2
Scientific knowledge	0	4	0
Social skills	2	1	1
Sense of place	3	1	0
Total	38	11	7

For both health outcomes and feelings about nature, hands-on, playful and less structured engagement styles appear to be more significant than other styles of engagement. For cognitive and educational outcomes, and social, emotional and behavioural outcomes, more structured engagement styles such as school gardening schemes are more significant.

Consequently the main project report *Sowing the Seeds: Reconnecting London's children with nature* focuses on the goal of offering children 'engaging everyday nature experiences' – defined as experiences that involve repeated visits to the same site and that give children hands-on contact with nature, in which the engagement style is playful or exploratory, rather than didactic or curriculum-oriented.

Limitations of the evidence base

The evidence base presented here only gives a partial picture of the benefits that might arise from children's engagement with nature. More longitudinal research, ideally using control groups, would be helpful in further exploring the potential impact of different kinds of intervention. Questions remain to be explored about many other issues, including:

- The key qualities of the environment – landscape qualities, tree and plant cover, biodiversity, ambience, size – and how they influence benefits and outcomes;
- The effect of time spent in natural settings; while evidence points to the value of repeated visits, little is known about how patterns of use over time influence benefits and outcomes;
- The effects and influences of an adult presence (or absence); how benefits and outcomes are shaped by different adults, and different professional approaches;
- How benefits and outcomes vary for different children. While there are grounds for giving greater emphasis to the experiences

of younger children, the way children's relationship with nature changes with age is under explored, as are factors such as culture, socio-economic group, ability, and gender.

Limitations of the review methodology

This review differs from a full systematic literature review in several ways. These differences are all a consequence of the limited time and resources available.

No comprehensive trawls of academic databases were carried out, and the references/citations of individual papers and primary studies were not themselves used as sources of other potential studies (unless the papers referenced/cited were literature reviews). There is hence a risk that some relevant studies may not have been identified – especially studies that may have been published too recently to feature in any of the reviews surveyed. This limitation was partially addressed by contacting the experts above, and by drawing on the material on the Children & Nature Network website, which is proactive in publicising relevant material.

Furthermore, no independent checks of the assessments of study quality, categorisations or analyses were undertaken (in a full systematic review, analyses are often cross-checked through the use of two or more reviewers, whose judgements are compared for consistency). However, the review methodology was developed and refined with support from Dr Catharine Ward Thompson, Director, OPENspace, who has substantial experience of conducting and overseeing similar literature reviews.

Finally, the assessments of study quality made in this review fall short of what might be expected in – for instance – a clinical review. For example, no assessment was made of the

validity of any statistical tests used (although it should be noted that for material published in peer reviewed journals, such tests would often form part of the peer review process).

These limitations mean that this review is less rigorous than might be expected in a clinically-oriented literature review, for instance. Nonetheless it stands as the first such review of its topic area that is both transparent and systematic in its approach to searching, categorising, appraising and analysing the empirical evidence base. Research, programme evaluation and practical experience are all likely to be valuable in furthering our understanding of the topic.

Table 10: Benefits that are well supported by good evidence
In this table, the key studies are those assessed as 'good'.

Benefit	No. of relevant studies	Key studies	Types of environments studied	Typical style of engagement	Characteristics of subjects; other remarks
Physical activity	16	Bell et al 2008 De Vries et al 2007 Fjortoft 2004 Hume et al 2005 Lovell 2009 Mygind 2007 Ozdemir and Yilmaz 2008 Potwarka et al 2008 Roemich et al 2006 Roemich et al 2007 Scholz and Kromholz 2007 Timperio et al 2004	Green outdoor space; woodland settings; school grounds; urban green public space	Forest school; play; conservation activities	Larger studies and urban green space studies are not from UK. Hume et al 2005 and Potwarka et al 2008 have mixed findings.
Concern for the environment	13	Chawla 1999 Ewert et al 2005 Kals et al 1999 Lohr and Pearson-Mims 2002 Palmer and Suggate 1996 Palmer et al 1998 Skelly and Zajicek 1998 Waliczek and Zajicek 1999 Wells and Lekies 2006	Natural environments regularly visited; domestic outdoor spaces; school gardens	Play; leisure; gardening	3 studies from UK; Most studies are based on data from adults
Mental health	11	Faber Taylor and Kuo 2009 Faber Taylor et al 2001 Faber Taylor et al 2002 Korpela et al 2002 Kuo and Faber Taylor 2004 Mårtensson et al 2009 Roe 2009 Wells and Evans 2003	Woodland sites; urban green public space; domestic outdoor space; natural settings; school grounds	Play; guided walk; view from home; Forest school	Only one UK study – most from US. Korpela et al has neutral findings
Connected to nature	5	Bell 2005 Bixler et al 2002 Lohr and Pearson-Mims 2002 Lohr and Pearson-Mims 2004 Ward Thompson et al 2008	Woodland sites; wild environments	Visits; play	Two UK studies; some studies are based on data from adults

Table 10 (continued): Benefits that are well supported by good evidence
In this table, the key studies are those assessed as 'good'.

Benefit	No. of relevant studies	Key studies	Types of environments studied	Typical style of engagement	Characteristics of subjects; other remarks
Scientific learning	4	Dirks and Orvis 2005 Klemmer, et al 2005 Smith and Motsenbocker 2005	School gardens	Curriculum gardening schemes	No UK studies; all studies focus on similar interventions
Sense of place	4	Blizard and Schuster 2007 Min and Lee 2006	Woodland sites; urban green public space	Forest school; play; field trip; storytelling	Key studies not from UK
Healthy eating	3	Lineberger and Zajicek 2000 Morris and Zidenberg-Cherr 2002 Morris et al 2001	School gardens	Curriculum gardening schemes	No UK studies; all studies focus on similar interventions
Environmental knowledge	2	Milton et al 1995 Pilgrim et al 2007	Rural areas; neighbourhood park	Games and field studies projects	One UK study
Motor development	2	Fjortoft 2004 Scholz and Krombholz 2007	Pre-school grounds	Play	No UK studies. Both studies looked at pre-school children

Table 11: Benefits where there is some support from good evidence
In this table, the key studies are those assessed as 'good'.

Benefit	No. of relevant studies	Key studies	Types of environments studied	Typical style of engagement	Characteristics of subjects; other remarks
Social skills	4	Robinson and Zajicek 2005 Waliczek et al 2001	Woodland sites; school gardens	Forest school; school gardening	Two UK studies. Waliczek et al 2001 has neutral findings.
Quality of outdoor play	2	Faber Taylor et al 1998	Urban green public space; school grounds	Play	Varied locations, none in UK. Various ages
Self-control	2	Roe 2009	Woodland sites; school farms	Forest school; school gardening	Two UK studies
Self-awareness	1	Robinson and Zajicek 2005	School gardens	School gardening	US study; 5 – 8 year olds

Table 12: Benefits where there is some support, but modest evidence
 In this table, the key studies are those assessed as 'fair'.

Benefit	No. of relevant studies	Key studies	Types of environments studied	Typical style of engagement	Characteristics of subjects; other remarks
Language and communication	2	Davis and Waite 2005 O'Brien and Murray 2007	Woodland sites	Forest school	Two UK studies; small sample; not urban context
Self-confidence	1	O'Brien and Murray 2007	Woodland sites	Forest school	2 UK studies; small sample; not urban context
Psychosocial health	1	British Trust for Conservation Volunteers 2009	School grounds and nearby open spaces	Conservation activities	Children aged 7 - 11



Rachel Keeling Nursery, Tower Hamlets © Ben Hasan

APPENDIX

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ENDNOTES

- 1 Louv R (2005) *Last Child in the Woods: Saving our children from nature-deficit disorder* contains a helpful overview of claims
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- 5 See Louv R (2005) *Last Child in the Woods: Saving our children from nature-deficit disorder*

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Hindi

यदि आप इस दस्तावेज़ की प्रति अपनी भाषा में चाहते हैं, तो कृपया निम्नलिखित नंबर पर फोन करें अथवा नीचे दिये गये पते पर संपर्क करें

Bengali

আপনি যদি আপনার ভাষায় এই দলিলের প্রতিলিপি (কপি) চান, তা হলে নীচের ফোন নম্বরে বা ঠিকানায় অনুগ্রহ করে যোগাযোগ করুন।

Urdu

اگر آپ اس دستاویز کی نقل اپنی زبان میں چاہتے ہیں، تو براہ کرم نیچے دئے گئے نمبر پر فون کریں یا دیئے گئے پتے پر رابطہ کریں

Arabic

إذا أردت نسخة من هذه الوثيقة بلغتك، يرجى الاتصال برقم الهاتف أو مراسلة العنوان أدناه

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જો તમને આ દસ્તાવેજની નકલ તમારી ભાષામાં જોઈતી હોય તો, કૃપા કરી આપેલ નંબર ઉપર ફોન કરો અથવા નીચેના સરનામે સંપર્ક સાદો.

