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Current Opinion in Environmental Sustainability

# Human–nature connection: a multidisciplinary review

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In sustainability science calls are increasing for humanity to (re-)connect with nature, yet no systematic synthesis of the empirical literature on human–nature connection (HNC) exists. We reviewed 475 publications on HNC and found that most research has concentrated on individuals at local scales, often leaving 'nature' undefined. Cluster analysis identified three subgroups of publications: first, *HNC as mind*, dominated by the use of psychometric scales, second, *HNC as experience*, characterised by observation and qualitative analysis; and third, *HNC as place*, emphasising place attachment and reserve visitation. To address the challenge of connecting humanity with nature, future HNC scholarship must pursue cross-fertilization of methods and approaches, extend research beyond individuals, local scales, and Western societies, and increase guidance for sustainability transformations.

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**Current Opinion in Environmental Sustainability** 2017, **26–27**: 106–113

This review comes from a themed issue on **Open issue, part II**

Edited by **Eduardo Brondizio**, **Rik Leemans** and **William Solecki**

For a complete overview see the Issue and the Editorial

Available online 26th June 2017

Received: 22 November 2016; Accepted: 28 May 2017

http://dx.doi.org/10.1016/j.cosust.2017.05.005



## Introduction

The relationship between people and nature has attracted rising interest among scientists, given evidence of health and well-being benefits from human interaction with nature [1,2,3••] and its contribution to addressing sustainability challenges [4,5•,6]. Indeed, while humanity is ultimately dependent on natural resources, the urgent need for human populations (particularly those in the West) to be reconnected to nature or embedded within ecological limits has been recently emphasised by many sustainability scientists [7,8•,9–12]. These calls for (re)-connection to and embeddedness within nature have implied more than physical dependence, but active development of cognitive, emotional and biophysical linkages that positively shape human–nature interactions. Research on this topic has been characterised by a plurality of disciplinary and conceptual perspectives, language, methods and research approaches. With this heterogeneity, the literature has become fragmented, compromising the consolidation of ideas and their application to practice. A first step towards consolidation is to generate a coherent overview of existing scholarship.

In reviewing this literature, clear terminology is critical. We adopt the term 'human-nature' connection (HNC) as an umbrella concept, encompassing a broad range of terms from different disciplines and applications [13•], for instance connectedness with nature [14] or nature relatedness [6] in environmental psychology and (re-)connection to the biosphere [7,11] in sustainability science. Some reviews of HNC have emerged recently [3••,5•,15], but they are couched within particular disciplinary perspectives and use narrow definitions of 'connection'. In this study we elected not to prescribe a strict definition of 'nature', but were guided by the perspective of articles reviewed. Reviewed literature reported on places, landscapes and ecosystems that are not completely dominated by people, but also include non-human organisms, species and habitats. With this review we intend to provide a multidisciplinary space for academic and cultural integration, extension and cross-fertilization.

We report the findings of systematic review of scholarly publications from a range of disciplinary backgrounds that

have empirically investigated HNC. We sought to first, assess the diversity of subjects, methods and motivations of research on HNC; second, identify clusters of papers and their distinguishing characteristics; and third, consider how future research on HNC can better inform sustainability science.

## Methods

The Scopus database was queried with a search string comprised of 41 components that combined a variety of terms related to 'nature', 'people' and 'connection' (see Supplementary appendix 1a for full search string). The search was applied to Abstract, Title and Keywords on 16 November 2015 and returned 3849 papers, which was reduced to 2649 after restricting results to articles in English. Only English literature was selected because of the difficulties in systematically reviewing literature across multiple languages (e.g. the necessity of reviewers subjectively translating concepts into a common language, and the loss of meaning or misinterpretation this would likely entail). Articles were screened to ensure they were peer reviewed and published in an academic journal, reported on empirical data (i.e. excluding reviews, conceptual papers or critical commentary), and studied a type of relationship people have with green or natural environments (full inclusion criteria provided in Supplementary appendix 1b). We note that since the review focussed on articles studying connections between people and nature, literature that assumed this connection but did not address it explicitly (e.g. some research in forestry or agriculture) was not included. Screening returned a final set of 475 papers published between 1984 and 2015 (Supplementary appendix 2).

Each paper was coded for: (i) descriptive information about the article (e.g. country, journal and discipline); (ii) conception of 'nature'; (iii) social group analysed (e.g. individuals versus communities); (iv) class of HNC(s) studied; (v) methodological details; and (vi) the purpose of the study. Response categories for all questions were developed iteratively by the author team. The final typology distinguished between five classes of HNC: material (e.g. resource extraction), experiential (e.g. activities), cognitive (e.g. attitudes, values), emotional (e.g. fear, joy) and philosophical (e.g. ontological frameworks) (see Supplementary appendix 1c for full details and definitions). The first 10% of papers were coded by multiple authors, and response categories were clarified where inconsistencies were found.

Data on all reviewed publications were analysed in R [16] to generate descriptive statistics, multivariate clusters, and an ordination. Agglomerative hierarchical clustering was performed using the 'agnes' function in the 'cluster' package using a Euclidian measure of dissimilarity and Ward's clustering method. 'Indicator species analysis' was used to identify which variables most influenced these groups using the 'indval' function within the 'labdsv' package. Ordination of data was performed via Detrended Correspondence Analysis using the 'decorana' function in the 'vegan' package.

## Results

### Overview

Research on HNC is increasing (Figure 1), with 345 papers (72.6%) published from 2010 onwards. Nondescript or 'unspecified' forms of nature were most commonly studied (30.9%), followed studies on human connections to urban nature (14.1%), and protected areas (11.9%) (Figure 2). Most HNC research targeted individuals (76%), especially local people (24.3%). Most research has studied cognitive (35.9%), experiential (22.0%), emotional (21.8%), and philosophical (13.9%) connections to nature, whereas material connections (6.5%) have received less attention (Figure 2). Most studies addressed one (161 papers; 33.9%) or two (169 papers; 35.6%) types of HNC, 97 papers (20.4%) studied three types of connections, 38 papers (8.0%) four types, and 10 papers (2.1%) studied five types of connection.

### Methodological patterns

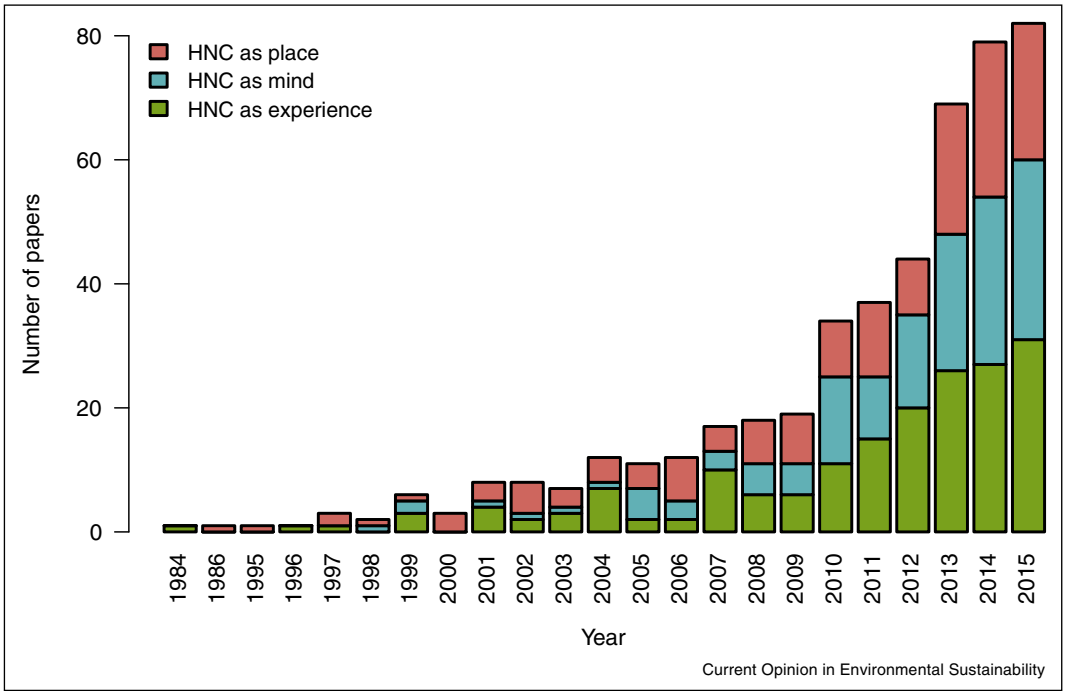
Empirical research on HNC has been biased towards western countries. The top five countries represented were USA (152 papers; 32.0%), Australia (54 papers; 11.4%), Canada (42 papers; 8.8%), United Kingdom (27 papers; 5.9%) and The Netherlands (22 papers; 4.6%). HNC has been mostly observed (87.8%), rather than experimentally tested (12.2%), using quantitative (48.8%), qualitative (32.0%), or mixed datasets (19.2%) (Figure 2).

Similar numbers of studies explored HNC as a predictor variable (31.2%), response variable (26.7%), or both a predictor and response (17.3%), suggesting that scholars have been equally interested in the drivers and effects of HNC. However, 24.8% of papers studied HNC as a variable in itself (i.e. neither as a predictor nor response). Substantial proportions of studies used psychometric scales (24.6%) or assessed place attachment (28.6%). Psychology was the most represented discipline in the literature (29.4%), followed by the social sciences (21.4%), environmental disciplines (15.2%), tourism (10.4%), education (10.3%), planning (7.0%), and health (6.4%).

### Multivariate analysis

Cluster analysis revealed three distinct subgroups of publications (Figure 3), characterised by different indicator variables (Table 1). We labelled the clusters as follows: *HNC as mind* (145 papers), *HNC as experience* (178 papers), and *HNC as place* (152 papers). The fastest growth in research over time occurred in publications in the *HNC as mind* cluster (Figure 1), characterised by studies that address cognitive and philosophical aspects of HNC at the individual level. These studies commonly investigated

**Figure 1**




Increase in the number of published studies on human–nature connection (HNC) by year. Colours within bars relate to the three groups as identified by the cluster analysis: HNC as mind, HNC as experience, and HNC as place.

students using quantitative research methods to explain, describe, and predict psychological dynamics and pro-environmental behaviours. However, in this cluster the concept of nature was generally undefined, and policy guidance was less common than in other clusters. In contrast to *HNC as mind*, both *HNC as experience* and *HNC as place* focussed on relationships between specific peoples and places. *HNC as experience* described qualitatively people's experiences of particular local areas and were characterised by an observational research approach. An example of this is Cosquer et al.'s study of people's interactions with everyday nature as part of a butterfly citizen science programme in France [17]. In contrast, research in the *HNC as place* cluster typically used quantitative questionnaires to study emotional connections to specific natural spaces, often at the landscape scale. These studies often also provided policy guidance to address sustainability issues. For example, Tonge et al. [18] applied place attachment concepts to explore how visitors related to the Ningaloo Marine Park in Australia and how this influenced conservation actions.

## Discussion

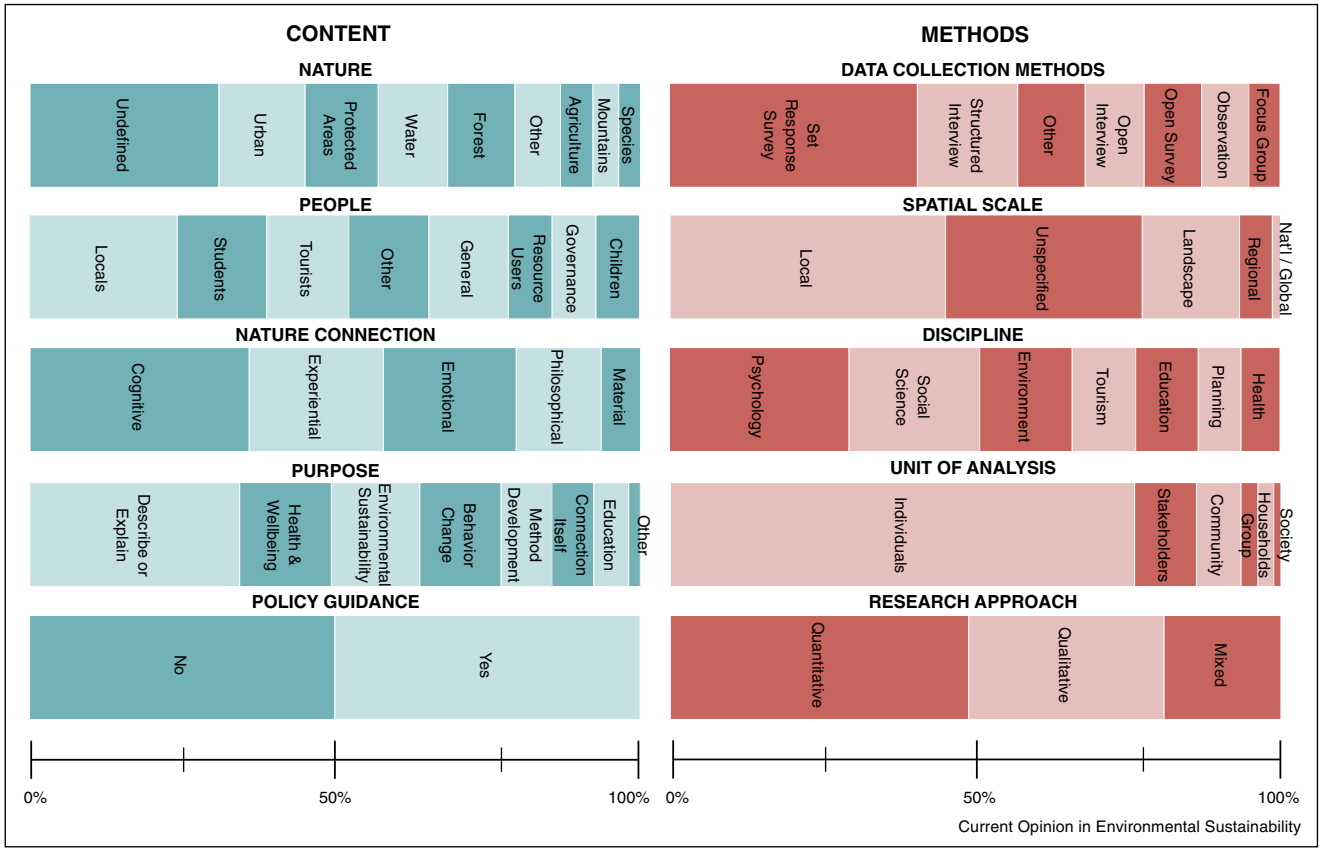
Our findings suggest that research on HNC is receiving increasing interest, but, being highly heterogeneous, has yet to reach its full potential in supporting humanity on a pathway towards sustainability. To this end, we propose three key priorities: first, greater integration of complementary perspectives in HNC research; second, further extension of HNC research; and third, more targeted application of insights to foster sustainability transformation.

### Complementarity and integration

The research clusters identified highlighted disciplinary, methodological and contextual differences (Table 1), which seem to represent co-existing epistemological positions in HNC research. The *HNC as mind* cluster typically encapsulates an objectivist epistemology. These publications draw upon theory and methods from psychology to understand nature connection as a real psychological entity that affects behaviour [see 6,14]. In contrast, the *HNC as place* cluster largely operates within a constructionist epistemology, with knowledge of nature connection derived through exploring relational interactions between people and specific places (see also [19••]). The *HNC as experience* cluster often adopts a subjectivist epistemology, observing and describing the uniqueness of individuals' experiences of nature. These epistemological differences suggest that resolving the longstanding challenge of defining nature (and non-nature) [see 20] in a way that unifies disciplines is likely to be difficult.

These perspectives are fundamentally different but they contribute complementary insights that may be integrated in future research. First, since *HNC as mind* rarely

**Figure 2**




Overview of the proportions of studies focusing on particular content or using particular methods. Each bar represents a question that was applied to reviewed papers.

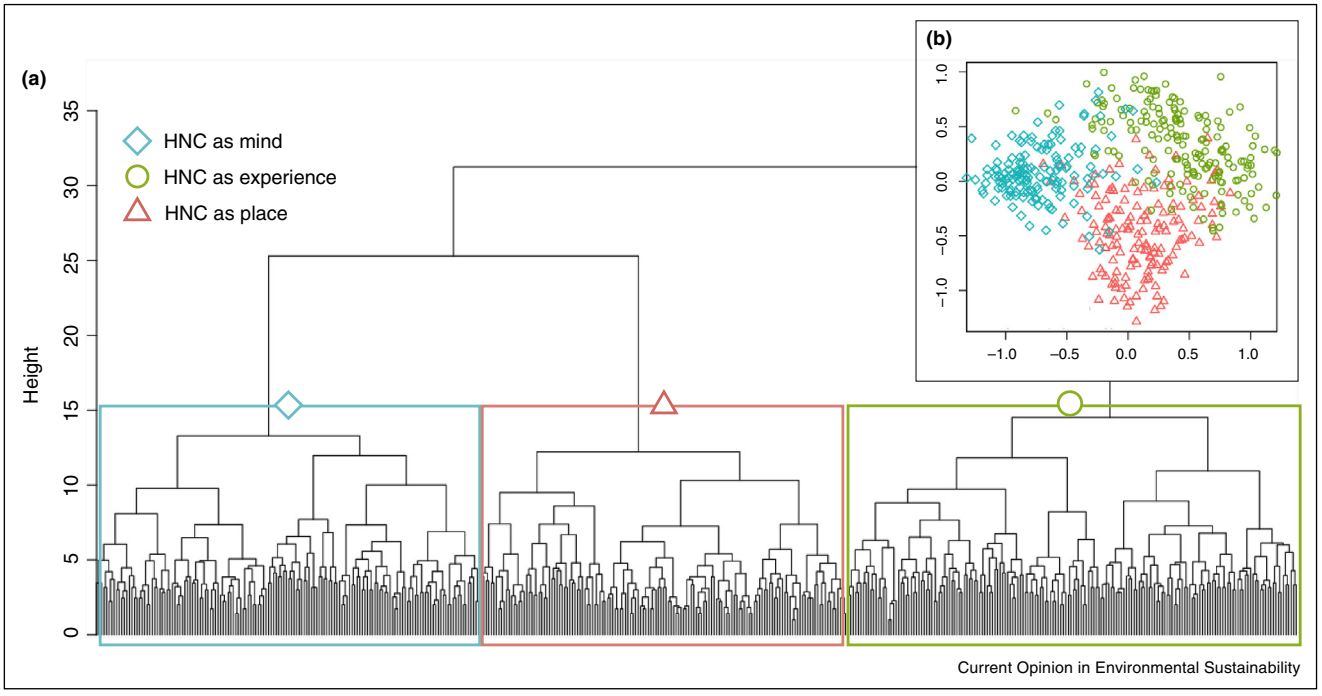
specifies the type of nature that people are connected to and focuses predominantly on individuals, *HNC as place* can contribute to this literature with an understanding of how HNC of communities is situated in geographical locations, while *HNC as experience* may offer deeper understandings via qualitative descriptions. Second, research on *HNC as place* could be enhanced by the quantitative and more generalisable perspectives of *HNC as mind*, along with the deep and nuanced insights offered by *HNC as experience*. Finally, the *HNC as experience* literature could benefit from the statistical rigour of *HNC as mind* and the applied focus of *HNC as place*. Full integration of these perspectives is likely to be difficult [21] and may not be feasible or even appropriate in every case. However, it would be worth exploring how sustainability science could facilitate cross-fertilization of HNC knowledge in order to pursue 'theoretically and empirically rich solutions-oriented research' [22].

## Extension

An integrated HNC research agenda for sustainability must address key gaps in the current literature. Of particular concern for sustainability is the relatively minor focus on material connections to nature (Figure 2). While there are many fields that study material connections to nature (e.g. natural resource management), our study focussed on the specific subset that explores human connections. Material HNC must be better understood as it shapes patterns of resource consumption, which in turn drive environmental sustainability outcomes [12,23,24]. Moreover, understanding the relationships between material connections and other 'internal' connections to nature (e.g. cognitive, emotional) will help to explore potential feedbacks and points of intervention for sustainability transformation [see [20]].

Second, HNC should be studied in and communicated across a greater diversity of cultural contexts. Of the published articles included in this review, the vast majority have largely been undertaken in post-industrial, Anglo-Saxon countries. However, this result may be biased due to restricting our review to articles in English. Relevant literature in non-western cultures might be published in other languages and express conceptualisations of HNC that are altogether different from those dominant in Anglo-Saxon cultures [26]. Thus, given the

**Figure 3**




**(a)** Dendrogram of the papers on human–nature connection (HNC) coded in this review. Each coded paper is represented by a vertical line at the bottom of the chart. The similarity between papers is indicated by their distance from one another along the lines of the 'tree'. **(b)** Ordination of reviewed papers highlighting three distinct clusters of articles: *HNC as mind* (blue diamonds), *HNC as experience* (green circles), and *HNC as place* (red triangles).

key sustainability challenges at play in the Global South [27], there is an urgent need for more research from these countries, increased support for publication of these studies in international journals, and extending HNC research beyond western cultural framings.

Third, future research (particularly in psychology) must specify the characteristics of nature that people are connected to. Without such information, it is difficult to know how policies and decisions for sustainability should be formulated. For example, there is scant evidence on whether interactions with forests, rivers, grasslands or urban parks are more effective in promoting health and well-being, or pro-environmental attitudes and behaviours.

Fourth, our review revealed an underrepresentation of research at the community or society level. Theories of sustainability transformation highlight the critical importance of action and change at this level [28–30,31•]. Therefore, we encourage future exploration of how groups of people, initiatives and organisations within society are connected to nature as a way of moving beyond the current focus on individuals.

Finally, there is a need to more strongly relate HNC to specific sustainability issues. Only a small portion of the literature addressed the importance of HNC for sustainability. Most literature simply described or explained people's connection to nature, and only publications within the *HNC as place* cluster regularly offered policy guidance. Directing future research to pressing sustainability challenges and explicitly offering practical recommendations appears important.

## Application

There are increasing calls in the literature for a 'biosphere-based sustainability science' [8•] whereby human development progress is intimately connected with stewardship of the planet. We affirm these calls, and suggest that such an integrated sustainability science could greatly benefit from incorporating the diverse insights from literature on HNC. These insights are critical for identifying which social–ecological settings can allow people to enhance their connection with nature, establishing how the multiple types of HNC can foster pro-environmental behaviours, and defining both the characteristics of a sustainable future and the pathways by which it can be reached.

A strong connection between people and nature is emphasised in key global sustainability agreements. For example, one target under Goal 12 (responsible consumption and production) of the Sustainable Development Goals is to

**Table 1**

**Results of the 'indicator species analysis' showing the most pertinent distinguishing characteristics of three clusters of papers on human–nature connection (HNC). The coded variables are listed as relating to either the content of the study, or methodological aspects for all of three clusters identified: *HNC as mind*, *HNC as experience*, *HNC as place*. Indicator value coefficients are listed (only those ≥0.2 reported), and denoted as follows: ***if coefficient ≥ 0.4; **if 0.4 > coefficient ≥ 0.3; *0.3 > coefficient ≥ 0.2.**

| Variable | HNC as mind | HNC as experience | HNC as place |
|---|---|---|---|
| Content | | | |
| Type of nature | *** Undefined (0.45) | | |
| People studied | *** Students (0.44) | * Other (0.21) | ** Locals (0.31) * Tourists (0.27) |
| Type of connection | * Cognitive (0.29) | * Experiential (0.21) | * Emotional (0.22) |
| Purpose | | * Other (0.22) | |
| HNC related to other variables | | * HNC as a variable in itself (0.23) | |
| Research on place attachment | *** No (0.46) | | *** Yes (0.47) |
| Spatial scale | *** Unspecified (0.52) | * Local (0.28) | * Landscape (0.22) |
| Policy guidance | * No policy guidance (0.28) | | * Provides policy guidance (0.22) |
| Methods | | | |
| Discipline | *** Psychology (0.50) | * Social sciences (0.26) | * Environmental studies (0.22) |
| Research approach | * Experimental research (0.28) | ** Observational research (0.37) | |
| Data type | *** Quantitative (0.45) | *** Qualitative (0.81) | |
| Data collection | | ** Structured interviews (0.36)<br>* Open interviews (0.21) | *** Set response survey (0.45) |
| Unit of analysis | ** Individual (0.38) | | |
| Type of analysis | *** Quantitative analysis (0.47) | *** Qualitative analysis (0.56) | |
| Use of psychometric scales | *** Yes (0.54) | *** No (0.44) | |

'ensure that people everywhere have…awareness for…lifestyles in harmony with nature'. Similarly, Goal 11 (sustainable cities) includes a target to provide 'universal access to safe, inclusive and accessible, green and public spaces'. The recent UN New Urban Agenda also seeks to promote 'healthy lifestyles in harmony with nature' [(32,s 14c)]. The implementation of these goals should draw on HNC research.

Finally, HNC research can help inform transformative or transitional pathways towards sustainability. Scholars have highlighted that the scale of change needed to reach a sustainable future is beyond what can be achieved via incremental adjustments to current systems [25•,33]. Accordingly, theories of social change have considered socio-technological transitions [34] and social–ecological transformations [35]. In this context, incorporating knowledge of how HNC influences environmental worldviews, values, attitudes and behaviours may help identify effective 'seeds' of change [29], 'protected niches' [36] and 'deep leverage points' [25•] for sustainability transformation. For example, insights from HNC research could inform the Smart Cities (IT-based sustainable cities) discourse, which has inadequately considered how technological solutions may affect people's interactions with nature. This is especially important for children, as deep seated environment-related attitudes are acquired during childhood [37] and persist through adulthood [38]. Furthermore, rapid land conversion for urbanisation, combined with increased internet access, population density and new technologies challenge people's direct sensory experience of nature, and will likely have negative implications for human health and well-being [39,40].

## Conclusion

The importance of HNC for sustainability is increasingly recognized. The task of sustainability scientists now is to establish how different types of nature connections may contribute to positive change for sustainability. This review has provided a foundation for this agenda. It has shown that a substantial body of empirical research has accrued, yet has remained disparate. We call for researchers and practitioners to take stock of this existing evidence, integrate insights across methodological, epistemological and geographic boundaries, and pursue novel interdisciplinary research that can generate knowledge for a sustainable future characterised by strong connections between humanity and the biosphere.

## Acknowledgements

This research was supported by the Volkswagenstiftung and the Niedersächsisches Ministerium für Wissenschaft und Kultur funded project 'Leverage Points for Sustainable Transformations: Institutions, People and Knowledge' (Grant Number A112269).

## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.cosust.2017.05.005.

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- •• of outstanding interest

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