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Connection to nature

October 2025

Natural England Evidence Information Note

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Foreword

Natural England commission a range of reports from external contractors to provide evidence and advice to assist us in delivering our duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

Contents

Purpose of the briefing

This briefing note is one of a series that summarises evidence of the links between the natural environment and a range of outcomes. They are based on rapid reviews, not systematic reviews. Rapid reviews can be undertaken in different ways, for example, the search methodology may be more limited than a systematic review and less time available to review data to answer the research questions. Please refer to the Methodology in Annex 1 for further details on the method and search strategy for this review. They build on the evidence but are not comprehensive and should be read together with the original notes:

• EIN015 Connection to Nature

• EIN018 Links between natural environments and mental health

• EIN019 Links between natural environments and physical activity

• EIN020 Links between natural environments and physiological health

• EIN021 Links between natural environments and obesity

This briefing note focuses on the evidence for connection to nature (CTN). This is an update of EIN068 Connection to Nature (2022): Dr Helen Seers, Dr Rabya Mughal and Professor Helen Chatterjee, National Academy for Social Prescribing, UK. The notes are aimed at: policy makers, practitioners, practice enablers (including Natural England), local decision makers, and the wider research community. They highlight some of the implications for future policy, service delivery and research. It is intended that this note will help to inform practitioner planning, targeting and rationales, but not the identification of solutions or the design of interventions. Barriers to access or use of natural environments are not considered in this note. The note draws on international evidence and draws out policy implications relevant to the UK for both adults and children. Terms marked with an asterisk (*) are defined in the glossary.

Extent of the issue

There is concern that significant proportions of the population (particularly children and young people) are ‘disconnected’ (whether physically, spiritually, or emotionally) from the natural world (Beament, 2020). This disconnection from nature is argued to be detrimental to health and wellbeing (Sandifer, Sutton-Grier, & Ward, 2015).

- Contact and connection to nature (CTN)*, health and wellbeing, and pro-environmental* behaviours are inter-related with possible additional impacts on environmental outcomes, such as climate change goals (Barrows et al., 2022; Richardson, Passmore, et al., 2020).

- It is thought the types of factors which influence ‘disconnection from nature’ could be due to a range of influencing factors. Increased urbanisation (Giusti, 2019; Maathai, 2021; Zylstra et al., 2014) may play a part, as experiencing nature may be less accessible and less common in urban areas. Also psychological, emotional and cultural factors are thought to influence nature disconnection. Maathai (2021) suggests that humans’ tendency to view nature as something to be consumed, commodified or dominated, rather than life sustaining contributes to our disconnection from it. Others mention a philosophical tendency of humans to view themselves as separate from nature (Barragan-Jason et al., 2022; Maathai, 2021) and a loss of respect, humility, and empathy with nature to the relative attractions of indoor sedentary entertainment (Zylstra et al., 2014).
- The COVID-19 pandemic and the resulting changes in behaviour and lifestyle (Arora & Grey, 2020) may have caused people to reassess their relationship with nature and how it impacts health, wellbeing*, and society. This worldwide event has caused non-government organisations, Natural England and a host of large and small organisations (including charities such as The Wildlife Trusts, RSPB, The National Trust) and Government departments and agencies including Defra and the NHS, to provide new programmes of support to improve people’s emotional or cognitive CTN. It is important that these interventions are grounded in the best available evidence.

Summary statement

This evidence summary focuses on the literature around people’s connection to nature (CTN). Two other evidence summaries in this series assess the association between exposure to nature and mental and physical health. Please note that these other summaries present some evidence around CTN, but most of this research evidence comes from contact *with* nature, rather than *connection* to nature. There is a distinct difference: *contact with* nature describes the process of spending time in nature, whereas *connection to* nature is a psychological construct looking at an individual’s feeling and attachment to the nature around them, and its subsequent health and wellbeing impact. For more evidence on the benefits of nature on mental and physical health see EIN065 and EIN066. There are other approaches to conceptualising and measuring people’s CTN, derived from disciplines other than psychology. For example, the concept of ‘relational values’ from human geography and sociological thinking about nature and self. This report looks mostly at the psychological literature, but scoped evidence from wider disciplines also.

CTN is an umbrella term that encompasses a set of constructs, for example ‘nature relatedness’. Nature relatedness refers to an individual’s subjective sense of their “relationship with the natural world” (Nisbet, Zelenski, & Murphy, 2009, p. 719). As a concept CTN has received substantial amounts of research attention in the last few years. CTN research is different to the research carried out assessing people’s experiences of

contact with, or exposure to nature (the latter is looked at in terms of proximity, time spent in nature or quality of experience).

There is increasing evidence that CTN is related to human wellbeing, educational outcomes, pro-environmental and pro-conservation* behaviours which have important implications for society's action for climate change, the biodiversity crisis, or other environmental challenges. A variety of factors may have a role in the development of CTN including contact with the natural world, childhood experiences, activities or engagement with nature, the geographical area somebody lives in, socioeconomic status, and lifestyle. The impact of the recent global COVID-19 pandemic and climate change may also be changing how and why people contact or connect to nature. The evidence base is growing, likely due to the relatively recent interest in assessing and understanding CTN. In recent years there have been good quality systematic reviews* and meta-analyses* adding to the evidence base. Increasing experimental evidence is available to suggest a causal association between CTN with outcomes such as health and wellbeing and Pro-Environmental Behaviour, however, much of the existing research is still drawn from the types of studies which cannot reveal direction of effect* and causality*. Some of the new evidence has attempted to understand and adjust for potential confounders. However, there is still a lack of research which considers longer-term health and wellbeing outcomes, and inclusion of atypical sample populations. Further robust research is needed to inform potential delivery and intervention options.

Review of the evidence

What is connection to nature?

According to the biophilia hypothesis (Katcher & Wilkins, 1993; Kellert & Wilson, 1995, Wilson, 1984), humans have an instinctive biological predisposition and attraction to nature. Connection to nature (CTN) is one of a set of concepts which refer to an individual's subjective sense of their relationship with the natural world (Capaldi, Dopko, & Zelenski, 2014). CTN relates to a person's sense of their interconnectedness* with nature or their sense of inclusion in nature. Natural environments are recognised as salutogenic* (i.e. health supporting) and one way in which they exert a salutogenic effect is through CTN (Kesebir & Kesebir, 2017). It is hypothesised that CTN may mediate health and wellbeing gains from exposure to or use of the natural environment and may play a role in pro-environmental and pro-conservation attitudes and behaviours. The research literature refers to the concept of CTN as both a trait, meaning that stable differences between individuals and groups of people can be observed, but also as a state, reflecting the point that it is thought to vary in the short term according to exposures, experiences or contexts (Capaldi, Dopko, & Zelenski, 2014; Tam, 2013).

Measuring connection to nature

An international scoping review (Keaulana et al, 2021) of measures of connectedness identified four categories of measures; nature connectedness and relatedness; attitudinal and value-based; cultural and spiritual, and paradigm-based. Wellbeing and eco-friendly behaviours were typically included in the connectedness and relatedness measures. Attitudes and values measures included outcomes such as environmental citizenship, commitment to environmental values and love and care for nature. Culturally based scales included interconnections with other dimensions including family, and culture as well as to nature and land. Typically, culture-based scales research involved indigenous communities with traditional reverence for nature and who ascribe overt cultural significance to nature and land. Spiritually based approaches considered nature as a spiritual entity as well as a mechanism for fostering resilience. Paradigm-based approaches viewed CTN using an ecological systems approach as part of a wider ecological worldview (Keaulana et al., 2021). The following section summarises the qualitative, quantitative and 'holistic' measures used in recent literature.

Qualitative measures of CTN

- Measures of CTN can include subjective evaluations of incorporation of nature into self-definition (Mackay & Schmitt, 2019), how far people's self-identity includes the natural environment and experience of belonging with nature, key in defining CTN'. (Whitburn, Linklater, & Abrahamse, 2020), and the extent to which people see themselves as part of nature (Barragan-Jason et al., 2022). The theoretical basis of CTN comes from biophilia hypothesis. Researchers have developed several ways to assess CTN, some have used qualitative* approaches (Bell et al., 2014).
- Researchers in Hawaii recently developed the Āina Connectedness scale which comprises qualitative and quantitative components. It is based on the native Hawaiian perspective that optimal health includes balance with all our relationships including with Āina (land, nature, environment). The scale measures CTN through how connected people feel, would like to feel, barriers to connection and beliefs and behaviours in relation to Āina (Antonio et al., 2023).

Quantitative measures of CTN

There are more than 17 different quantitative scales that measure CTN (Whitburn, Linklater, & Abrahamse, 2020), These different quantitative tools typically use self-reporting and aim to measure different aspects of CTN.

- The AIMES connection with nature scale (Meis-Harris, Borg, & Jorgensen, 2021) was developed using a theoretically informed approach to CTN and validated using a representative sample of Australian adults. The AIMES scale is based on five types of CTN: attachment, cognition/identity, materialist consumptions, experiential and spiritual connection. As such it is intended to provide a more comprehensive

and theoretically informed measure than typical measures that include attachment, cognition/identity only.

- The Inclusion of Nature in the Self scale (INS) measures the overlap between ‘self’ and ‘nature’ by showing two circles labelled ‘self’ and ‘nature’ with increasing overlaps, and asking people to choose which set of overlaps represents them (Mackay & Schmitt, 2019).
- A model of five pathways to nature connectedness has been proposed as a framework for mapping how CTN occurs by researchers at the University of Derby (Lumber, Richardson, & Sheffield, 2017). The five pathways are: Contact, Beauty, Meaning, Emotion and Compassion. Richardson et al. (2019) proposed the six-item Nature Connectedness Index (NCI) that operationalises these five pathways. The NCI has six questions about affective and experiential aspects of nature: emotion, amazement and awe, beauty, meaning, compassion and sense of feeling part of nature.
- The Connection to Nature Scale (CNS) is a well-used and validated questionnaire with a Likert scale for answering 14 questions about affective CTN (Lovati et al., 2023; Mackay & Schmitt, 2019).
- The ‘Love and Care for Nature Scale (LNS) presents as a ten item scale that understands nature as the objective of love through two main constructs; connectedness (as an attachment to nature), and wellbeing, as the positive feelings people have from contacted nature (Pasca, Paniagua, & Aragonés, 2020).
- Other measures include the Connection to Nature Index (Cheng & Monroe, 2012) and Nature Relatedness Scale (NR-6) (Nisbet & Zelenski, 2013).

What factors influence connection to nature?

How CTN develops or is maintained is not yet fully understood. It is hypothesised that contact with or exposure to the natural world, childhood experience, and socio-cultural factors may be important. Intentional (rather than passive) interactions with nature are also argued to be important (Lemieux et al., 2012; Wright & Matthews, 2014). However, in the last few years evidence is emerging which explores how CTN is developed and maintained and how this is moderated by other factors. CTN is a subjective experience which varies between individuals and groups (Tam, 2013). A review looking at the predictors of CTN showed that three mechanisms may be at work: (i) situational, (ii) individual differences such as demographics e.g., geographic location or socioeconomic status, personality or beliefs (iii) internal psychological state* (Lengieza & Swim, 2021).

Situational factors

Time spent outdoors

- One study found that the amount of time people spent outdoors was a predictor of levels of CTN (Russell et al., 2013), however other studies have found no relationship (Ernst & Theimer, 2011; Zylstra et al., 2014).
- The duration of interventions was important. In some studies CTN has been shown to increase regardless of the duration of nature interventions but the effects were only sustained or more for interventions longer than 2 days (Barragan-Jason et al., 2022; Sheffield, Butler, & Richardson, 2022).

Characteristics of the natural environment

- A large UK survey (Barrera-Hernández et al., 2020) found that respondents recalled greater connectedness to nature following visits to rural and coastal locations compared with urban green space.
- Wilderness or vast expanses of nature have been associated with a sense of 'awe' for centuries (Staver, 1955).This type of sublime and transcendent emotion from nature viewed as vast, powerful and mysterious, has been associated with a sense of harmony with the universe and eternity, as well as feelings of vitality, joy, energy, oneness and freedom (Bethelmy & Corraliza, 2019).
- A cross-sectional study in Italy found that wilderness was seen as more restorative than domesticated or urban environments. However, preferences for type of nature were moderated by individual levels of nature connectedness, with individuals with higher connectedness preferring wilderness and those with lower nature connectedness preferring more domesticated environments (Barbiero et al., 2023).
- During the COVID-19 pandemic, gardens were found to serve as a place or safety and refuge in a world considered unsafe. An international survey study distributed to countries that were experiencing lockdown measures between June to August 2020 found that caring, creating, cultivating or simply being in gardens was associated with a sense of attunement to nature. Attunement in this context was defined as an intimate relationship, or flow of energy and communication between humans and the non-human world (Marsh et al., 2021).

Activities and engagement

- The Wildlife Trusts report (Sheldrake, Amos, & Reiss, 2019) showed that time spent on outdoor activities increased children's CTN and wellbeing.
- A large English survey found that contact, emotion, meaning, and compassion, with the latter mediated by engagement with natural beauty, were predictors of connection with nature (Lumber, Richardson, & Sheffield, 2017).
- A British survey by Barrows et al. (2022) found that engagement with nature's beauty was associated with higher CTN.
- A meta-analysis of 59 experimental studies, mostly based in westernised industrial countries, found significant increases in nature connectedness after interventions

involving contact with nature, in particular mindfulness practices emerged as having the strongest relationship with CTN (Barragan-Jason et al., 2022).

- Forest bathing * has been found to be associated with feelings of connection with nature and being part of the 'web of life' (Keller et al., 2023, p. 12).
- An Australian study found that somatic dance could facilitate CTN as well as environmental stewardship (Laidlaw & Beer, 2018).
- Using a national UK survey, researchers found that noticing nature, through activities that involve active sensory engagement with wildlife including watching, listening to, and photographing wildlife were significantly associated with higher CTN, whereas simply spending time in nature, studying nature, looking at scenery through windows, observing celestial phenomena and collecting shells were not (Richardson, Hamlin, et al., 2021).
- Evidence about education and learning with CTN is mixed. A study of English primary school children attending forest school sessions found that knowledge about nature, such as naming plants and animal species fostered a sense of connection (Harris, 2021). A cross-sectional questionnaire-based study (Otto & Pensini, 2017) investigated the effect of taking part in a nature-based environmental education programme in Germany. Results showed that increased participation in nature-based environmental education resulted in more pro-environmental behaviour, and this was mediated by CTN and nature knowledge. This complements the UK evaluation of 'learning about nature' and 'learning within nature' events from The Wildlife Trusts (Sheldrake, Amos, & Reiss, 2019) which found associations between participation in the learning events with CTN. However, other evidence has found no association between studying nature with CTN (Richardson, Hamlin, et al., 2021). A meta-analysis of 59 experimental studies found no significant effect of environmental education on nature connectedness. The authors of this study suggested this may be due to the style of the education, which they perceived as potentially disconnected and rationalised rather than emotive/empathic. The authors hypothesised that more empathic, compassionate education style, with a focus on the similarities between humans and other species, may produce different results (Barragan-Jason et al., 2022).
- An international systematic review of children's arts-in-nature interventions delivered in nature and outdoors were found to increase CTN, environmental awareness and pro-environmental behaviours as well as a decline in eco-anxiety (Moula, Palmer, & Walshe, 2022), highlighting the potential of nature-based interventions directly targeting CTN.
- Kesebir & Kesebir (2017) added a temporal dimension to measuring CTN showing a decline since the mid-20th Century. They found that references to nature in works of English fiction had a negative correlation to their year of appearance between 1950 to the year 2000. The authors concluded that this represents a cultural shift and disconnect from nature over time.

Demographics and individual factors

- Contextual data (not about nature connectedness) about time spent in nature from the English Monitor of Engagement with the Natural Environment Survey (MENE) 2019 (England, 2015) show that time spent outside in nature declines as children get older with the lowest time spent outdoors dipping in the teenage years; and that children from minority ethnic groups are less likely to spend time outdoors and time outdoors varies by region. Another study used two measures of CTN in a cross-sectional UK sample finding that CTN declined from childhood to a low in mid-teens (15-16 years) and then rose in the early 20s age groups (Hughes et al., 2019). Similarly, a study by (Richardson, 2019) showed a decline in CTN scores in late childhood and adolescence.
- Parenting style may influence levels of CTN, one study of Spanish adolescents finding that adolescents who experienced a more 'indulgent' parenting style (higher acceptance/implication, low severity/imposition) had higher CTN than those raised with 'neglectful' style (low acceptance/implication, low severity/imposition) (Musitu-Ferrer et al., 2019).
- A national Canadian study of adolescents found that increased use of electronic screens was associated with lower perceived importance of CTN. As well as the addictive properties of technology other barriers to CTN included the perception that being indoors was safer and more comfortable (Michaelson et al., 2020).
- A study of Finnish 18 year old males found higher physical activity, higher self-rated health and father's higher socioeconomic status (SES) were significantly associated with CTN when controlling for confounders in a multiple regression analysis (Puhakka et al., 2018).
- In a cross-sectional study of 435 young adults in Brazil and the US, found an association between preference for taking part in recreation outside and more frequent participation in nature-based recreation with a stronger CTN concluding that fostering CTN may encourage nature-based recreation. The study also found that women had higher CTN than men and a stronger preference for outdoor recreation yet were less likely to engage in nature-based recreation than men. The authors raised concerns about gender equity in the outdoors (Rosa et al., 2023).
- An international cross-sectional study of approximately 14,000 adults from 14 European countries (Richardson et al., 2022) found a positive association between CTN with:
    - Biodiversity (strong association)
    - The proportion of older adults in the country (moderate association)
    - Higher levels of cultivated land (moderate association)

  The study found a negative association between CTN with:
    - Smartphone ownership (strong association)
    - Extinction of nature experience (loss of orientation and opportunity to engage with nature) (moderate association)
    - Levels of urban population (moderate association)

    - Income (moderate association)
    - Power consumption (weak association)
- Pet ownership may be correlated with CTN; an Austrian study of 178 horse riders aged 45 years and older significantly higher nature relatedness, significantly higher overall wellbeing and mood rating compared to people without pets and similar scores compared to dog owners (Schwarzmüller-Erber et al., 2020).

Does connection to, or contact with, nature vary according to social demographic group?

- One study assessing CTN and pro-environmental behaviour found that women have higher levels of emotional connectedness to nature than men (Anderson & Krettenauer, 2021). Similarly, a study of Spanish adolescents found that females, regardless of the style in which they had been parented, had greater CTN (Musitu-Ferrer et al., 2019). These findings are echoed by research that found higher CTN in females of all ages including children. (Hughes et al., 2019, Richardson et al., 2019)
- In a Canadian study of 1,251 participants, rural participants reported significantly lower levels of pro-environmental behaviour compared to urban participants, but not levels of emotional connectedness to nature (Anderson & Krettenauer, 2021).
- Research carried out on data from the MENE survey for England (Richardson et al., 2019) found that CTN was consistent across different adult population groups and the only variation was that those from lower socio-economic groups and adult males tended to have lower CTN than their counterparts. In this study ethnicity was seen to have little or no relationship to a person's CTN.
- During the COVID-19 pandemic, CTN was highlighted in the media, and the role of nature was widely discussed. However, access to nature, and therefore opportunities for CTN, are not distributed equally due to a lack of suitable, good-quality local provision and more complex societal barriers (Holland, 2021; Natural England, 2015; Richards et al., 2020). Furthermore, there have been fluctuations and differences in accessing nature during the pandemic (The Wildlife Trusts, 2021). Given this inequality in access and contact with nature, there exists a gap in evidence regarding equality to the benefits of CTN across different population groups.
- There are well known sociodemographic trends in access to nature. Public Health England data shows that people who live in more deprived areas have lower, and worse quality access to natural spaces. Additionally access varies by age, sex, ethnicity and physical and neurological differences, with groups who are already marginalised and disadvantaged typically having lower access (Public Health England, 2020). Grey literature from the UK, published by The Wildlife Trust written in the context of COVID-19 impact and recovery (The Wildlife Trusts, 2021), states that CTN is essential for health, but that access to nature is deeply unequal in the UK.

- A survey of nature-based activity with 1,000 people from Southeast Asia in 2020 found that older people, those with lower incomes, and those without degrees were less likely to visit most types of outdoor space and engage with most types of nature-related activities (Richards et al., 2020).
- Recent UK data show that time outside in nature (and therefore the potential to develop CTN) declines as children get older and that children from minority ethnic groups are less likely to spend time outdoors (Natural England, 2015).
- A New Zealand study into children's use of, and connection to, nature found that children's movements were constrained by logistical and parental restrictions and children's exposure to nature occurred mostly in private gardens (Hand et al., 2017).
- Research into connection with nature in older adults found that nature connections were especially valued by adults over 65 and that age both positively and negatively impacts on older people's ability to connect with nature. For those who were retired yet mobile and had residential access to nature felt they had more time to connect. Conversely, people experiencing frailty found their opportunities for nature connection were more limited, as well as those living in residential accommodation where access to nature was restricted (Freeman et al., 2019).

Does connection to nature influence environmental and nature conservation behaviours?

For this note pro-environmental behaviour (PEB) (e.g., recycling) is defined as the intensity of current individual behaviours to reduce energy use related to daily life housing, transport, consumption. Pro-conservation behaviour (e.g., volunteering for a nature organisation to maintain local environment) has also been investigated by some literature in relation to CTN.

Pro-environmental behaviours, values and connection to nature

- If people view nature as part of their self-definition, and intrinsically valuable they may be more likely to engage in PEB (Mackay & Schmitt, 2019). Five meta-analyses published in the past six years found positive associations between CTN and pro-environmental behaviour (PEB) (Barragan-Jason et al., 2022; Mackay & Schmitt, 2019; Schutte & Malouff, 2018; Sheffield et al., 2022; Whitburn et al., 2020). One study found evidence of a publication bias in experimental evidence with a bias in favour of reporting positive effects, however, after adjustment for this bias, a positive association remained (Mackay & Schmitt, 2019). Some of the studies included experimental evidence giving more weight to the claim that CTN causes PEB (Mackay & Schmitt, 2019).
- Although positive associations between CTN and PEB were found across different measures of CTN, there is a difference in the strength of association depending on the measures of CTN used, the scales used have been found to be significant

moderators in the relationship (Mackay & Schmitt, 2019; Whitburn, Linklater, & Abrahamse, 2020). Multi scale measures had stronger associations. Single item scales had lower associations. This may be because multidimensional scales reflect a more holistic measure of CTN and therefore provide a better predictor of PEB (Whitburn, Linklater, & Abrahamse, 2020).

- The way in which PEB is measured has an impact on the strength of association between CTN and PEB. Again, aggregate measures which considered multiple aspects of PEB showed stronger association than single measures of behaviour (Whitburn, Linklater, & Abrahamse, 2020). PEB is typically measured by self-report, which can lead to inflated associations as people tend to overestimate their PEB (Mackay & Schmitt, 2019), however, measuring actual PEB is difficult, as habitual PEB is not easily observable and a single action would not be a valid measure (Whitburn, Linklater, & Abrahamse, 2020).
- There were no significant differences between females and males found in a meta-analysis of CTN with PEB (Whitburn, Linklater, & Abrahamse, 2020), or between CTN and PEB for different age groups or mean age (Whitburn, Linklater, & Abrahamse, 2020), despite older age and being female typically being associated with higher CTN (Whitburn, Linklater, & Abrahamse, 2020). Although one meta-analysis found that the correlation between CTN and PEB was strongest in children, this was not statistically significant (Whitburn, Linklater, & Abrahamse, 2020).
- A cohort study from the US provides evidence that CTN indirectly affects the relationship between mindfulness and pro-environmental behaviour (Barbaro & Pickett, 2016).
- A study in Mexico showed a significant relationship between CTN and environmentally sustainable behaviours in children in association with perceived happiness (Barrera-Hernández et al., 2020).
- A UK evaluation of ‘learning about nature’ and ‘learning within nature’ events from The Wildlife Trusts (Sheldrake, Amos, & Reiss, 2019) showed that both CTN and agreement with pro-environmental values statements increased for primary school aged children after taking part in an event. Future research could investigate whether this correlation is causative in either direction.
- A recent large survey (Barrows et al., 2022) of over four thousand people in England found correlations between nature contact, nature connectedness, health, and eudaimonic wellbeing*, and pro-environmental behaviours. Similarly, a representative sample of the UK adult population of England (n=4,960) found a positive association between CTN with pro-environmental behaviour as well as eudaimonic wellbeing (Martin et al., 2020), although due to the cross-sectional study design it was not possible to draw conclusions about the direction of the relationship.
- A large study in China found that nature connectedness mediated the positive association between domestic waste sorting behaviour and individual’s wellbeing (Gong, Li, & Sun, 2023).

Is there an association between connection to nature and health, wellbeing, developmental and educational outcomes?

There is increasing evidence, as set out below, to suggest that higher levels of CTN are positively correlated with outcomes such as better wellbeing, quality of life and educational performance. There are also limitations related to research design, such as cross-sectional study designs which cannot show the direction of causation, and lack of adjustment for confounding factors. Therefore, our understanding of whether CTN causes (directly or indirectly) any of the health, wellbeing, developmental and educational outcomes, or is itself potentially caused by health, wellbeing, developmental and education outcomes is limited. There may be bi-directional effects in which both statements are true – they could cause each other. If there were a causal relationship, the strength of association* is not yet known. There could also not be any causal relationship behind the associations found.

CTN and wellbeing outcomes

- A study involving a sample of 2,096 adults in the UK compared outcomes for connecting and engaging with nature versus spending time in nature. The results showed that nature connectedness and engaging with nature (for example, smelling flowers) were significantly associated with better mental health and wellbeing including happiness, perceiving that life was worthwhile and lower prevalence of depression and anxiety, whereas simply spending time in nature was not (Richardson, Passmore, et al., 2021). The authors concluded that that the way in which people were spending time in nature is more important than simply the duration of the visit. However, other research used Natural England's people and nature survey (PANS) data to assess associations between time in nature, nature connectedness and noticing of nature, finding that both nature connectedness and longer amounts of time spent in nature were positively associated with life satisfaction, worthwhile life and happiness during the COVID-19 pandemic (Richardson & Hamlin, 2021).
- An experimental study using a noticing Three Good Things in Nature tasks during a nature-based walk found significant increases in CTN and positive affect compared to the control group who completed an urban walk (Keenan et al., 2021). A study conducted by the University of Sheffield on the same intervention which used an app to prompt a group of adults to notice the good things about urban nature found clinically significant improvements in quality of life and nature connectedness scores following using the app for seven days, which were sustained at a 1-month follow-up, including for people experiencing diagnosed mental issues. The researchers concluded that the improvements were partly explained by significant increases in CTN and positive affect (McEwan et al., 2019).

- The Wildlife Trusts' '30 days Wild' project (Richardson et al., 2016) found an increase in CTN, pro-nature conservation behaviours, wellbeing, and happiness after the completion of the programme (although they did not test whether these outcomes were linked).
- In a large scale representative sample of UK adults CTN was associated with greater eudaimonic wellbeing in a cross-sectional study (Martin et al., 2020).
- A theoretical paper used supporting empirical evidence to argue that CTN supports a human need for meaning by addressing our need to find coherence, significance/mattering, and purpose and enhancing our experiential appreciation for life (Passmore & Krause, 2023).
- A meta-analysis of 147 correlational studies found that people reporting higher nature connectedness were significantly happier and healthier than those with lower nature connectedness (Barragan-Jason et al., 2022). The authors also found associations with social health, with higher CTN to be associated with a stronger sense of being part of communities within society and a stronger sense of moral responsibility to other humans. Another meta-analysis (Pritchard et al., 2020) from 2019 collating over 4,500 data points from 20 questionnaire studies dating between 2004 to 2016 looking at the relationship between CTN and eudaimonic wellbeing* showed that people with greater CTN tended also to have greater eudaimonic wellbeing and higher levels of self-reported personal growth.
- A recent meta-analysis of 49 studies from the US, Canada, the UK, China, Japan, South Korea, the Netherlands, Poland, Finland, Iceland, and Denmark found exposure to natural environments had a medium to large effect on both increasing positive affect* and decreasing negative affect, concluding that this this finding supported the anticipated emotional dimension of the biophilia hypothesis that CTN includes an emotional dimension (Gaekwad et al., 2022).
- A Mexican study found a significant positive association of children's connectedness to nature, sustainable behaviours and happiness (Barrera-Hernández et al., 2020).
- Some evidence suggests that CTN mediates associations between nature and wellbeing, with people who have higher CTN reporting beneficial outcomes. For example, a study into associations between exposure to nature and work motivation for working-age adults in the US and UK found that for those with higher nature connectedness scores experienced affective benefits of exposure to nature leading to higher subsequent work motivation. However, for employees with lower levels of nature connectedness contact with nature had no effect on their work motivation (Klotz et al., 2022).
- A mixed methods study in Australia on responses to the 'Black Saturday' bushfires in 2009 reported that a strong attachment to the environment was associated with reduced psychological distress, fewer symptoms of major depression and fire-related PTSD, and higher levels of resilience, post-traumatic growth and life satisfaction. While having a strong CTN could also be associated with experiencing

considerable grief at its devastation, people also drew solace from its subsequent regeneration (Block et al., 2019).

CTN and health and wellbeing outcomes

- A UK cross-sectional study of 877 adults aged over 18 years found that the percentage of green space in participants' residential environment was not significantly associated with scores on any of the mental health outcomes but that higher participant CTN was associated with significantly lower depression and stress, and improved wellbeing (Wicks et al., 2023).
- A review of volunteering with The Wildlife Trusts (Rogerson et al., 2017) found that volunteering was positively associated with CTN. Volunteering also improved physical and mental health, increased pro-environmental behaviour and levels of physical activity
- For people who had a pre-existing long term condition during the COVID-19 pandemic, nature connection and the therapeutic benefits of nature engagement were found to be an important pathway for restoration and supporting health and wellbeing outcomes in a qualitative study of 17 adults in the UK during the first UK lockdown (Darcy et al., 2022).
- For some higher CTN may be associated with negative health outcomes, particularly when these are related to eco-anxiety.* In a Hungarian study higher nature relatedness was found to be associated with higher Electromagnetic hypersensitivity* and Modern Health Worries (MHW)* (Dömötör, Szemerszky, & Köteles, 2019).
- A disconnection from nature has been associated with a range of mental health issues including eating disorders, bipolar personality disorder, post-traumatic stress disorder and depression (Gandy et al., 2020). These authors suggest that supporting CTN can help to address these issues and can be used in conjunction with therapeutic psychedelic administration which may constitute an independent and complementary pathway towards improvements in mental health. Similarly, a UK study found that frequency of psychedelic use was positive corrected with nature relatedness and this increase was positively correlated with concomitant increases in psychological wellbeing, concluding that the effect of psychedelic use on nature relatedness bears relevance for psychedelic treatment models in mental health (Kettner et al., 2019).
- A study (Martyn & Brymer, 2016) investigated the relationship between anxiety and CTN. The qualitative results revealed seven themes explaining the nature-anxiety relationship: relaxation, time out, enjoyment, connection, expanse, sensory engagement, and a healthy perspective. Further results indicated that CTN was significantly related to lower levels of anxiety. The authors suggest that CTN may reduce "unhelpful anxiety".
- A cross-sectional* study (Piccininni et al., 2018) in Canadian adolescents with nearly 30,000 responses showed that perception of CTN as 'important' was

associated with a 25% reduction in the prevalence of high psychosomatic symptoms. This shows the potential importance of adolescent engagement with nature as protective for their psychological wellbeing.
- A Finnish study of 914 young men who attended military service call-up found those with higher CTN had higher self-rated health (Puhakka et al., 2018).

CTN and developmental and educational outcomes

- A questionnaire-based cohort study with preschool children in Hong Kong (Sobko, Jia, & Brown, 2018) provided evidence that increased CTN relates to less distress, hyperactivity, behaviour and peer and emotional difficulties, and increased prosocial behaviour.
- A longitudinal* cohort* study in Scotland (Aggio et al., 2015) found that mothers' perceived distance from home to green/open spaces was associated with child's viewing TV time length, at 5.9 years of age. Perceived distance to green/open spaces is not equivalent to CTN, but the study may suggest the opportunity for future research exploring the relationship between CTN and children's screentime.
- A study finding a positive association between forest bathing and adolescent mental health, concluded that education settings should consider provision of forest bathing opportunities to support adolescent wellbeing (Keller et al., 2023).
- Children's ability to identify and name aspects of nature such as birds and plants was found to support a sense of connection and affinity with nature and developing a sense of ownership, ethos of care and pro environmental behaviour (Harris, 2021).
- Another study of children's forest schools found that where schools provide forest school opportunities on their sites, such provision is conducive to supporting more creative practices (Cudworth, 2021).

Implications for policy, service delivery and research

Policy and service delivery

There is increasing evidence that CTN may have a role in mediating the wellbeing effects of the natural environment (Richardson, Maspero, et al., 2020). Policy makers could shift their focus from simply spending time in nature to including supporting a CTN (Richardson, Passmore, et al., 2021). For population level shifts in CTN public health initiatives could support sustained nature engagement to leverage CTN alongside promoting other health behaviours such as physical activity and healthy eating (Sheffield, Butler, & Richardson, 2022). CTN can be enhanced by provision of opportunities to foster a connection with nature Including through the provision of quality green and blue spaces in which to

establish a CTN, particularly in areas with low levels of nature and high footfall. Richardson, Passmore, et al., (2021) suggest these could include walkways, public transport routes and shopping areas. Targeted and long-term interventions by institutions such as schools, business and training and education organisations could support CTN and wellbeing, for example through supporting mindfulness and noticing nature in these spaces.

- Employment organisations should consider the potential benefit of facilitating access to nature on site or during the working day to support associated benefit in work productivity. This this may not be beneficial for everyone but more so for those who already have a strong CTN, but spending time in nature has also been shown to support the development of CTN so the benefits may accrue even for those who do not appear to have a strong CTN at the outset.
- The findings in relation to children and creating opportunities for children to actively engage with and participate in pro conservation and pro environmental activities would support development of pro conservation and pro environmental attitudes and behaviours. Additionally, reincorporating learning about nature could support children's wellbeing as they develop into adolescents and adults as well as their pro-environmental behaviours, supporting global, national and local sustainability goals. As such policy makers should consider incorporating opportunities to learn in, and about, nature.
- Mental health issues are on the rise and supporting mental health is a matter of national and international policy priority and post-COVID-19 pandemic recovery agenda. CTN offers a way to support mental health outcomes (Keenan et al., 2021; McEwan et al., 2019; Sheffield, Butler, & Richardson, 2022).
- Considering the current adolescent mental health crisis and the evidence demonstrating lower CTN in adolescents, provision of opportunities to support CTN, such as in education settings, could improve health and wellbeing in this vulnerable group.
- The assumed impact of COVID-19 on people's CTN has stimulated nature organisations to create more engagement programmes to encourage people to visit the natural environment. Further investigation into how the designs of these interventions affect benefits received, including CTN, and how this connects to the needs of specific communities could be investigated.
- Facilitating a stronger CTN may result in greater pro-environmental behaviour (PEB) (Whitburn, Linklater, & Abrahamse, 2020). PEB contributes towards the sustainability agenda and environmental conservation sustainability policies (Barragan-Jason et al., 2022; Sheffield, Butler, & Richardson, 2022),given the dual challenges of climate change and supporting the healthcare needs of a growing and changing population, policy could utilise this to encourage action for climate change and nature recovery, potentially offering part of the solution to the joint challenges of human wellbeing, and mitigating climate change and nature degradation (Keenan et al., 2021; Sheffield, Butler, & Richardson, 2022).

- Nature-based social prescribing (NBSP) provides a pathway to experiencing nature and local and national policy should include NBSP as part of social prescribing across all areas. This is particularly important for those who are otherwise less likely to access nature such as those with experiencing higher deprivation or different access needs and may help to ameliorate inequalities in CTN. NBSP projects have been shown to have the capacity to adapt to individual needs and circumstances thus facilitating access (Kenyon et al., 2023). NBSP may also be prescribed (to appropriately trained practitioners) as a waiting list activity to support people on a waiting list for other mental health treatments.

Future Research

Understanding how CTN varies

- A range of tools for measuring CTN exist. More clarity on the appropriate use of tools for different audiences (children, adults, older people with cognitive decline) would be helpful. Clarity on how the tools can be used in different contexts should also be obtained (e.g., type of intervention being evaluated, time scale, geographic scale, data required). The construct validity and reliability of existing and new tools should be tested further (Ernst & Theimer, 2011; Tam, 2013). Researchers could explore the potential of using implicit approaches (i.e., assessing CTN without requiring individuals self-report their own subjective assessment of their CTN) in new tools.
- Further research could seek to explain the many ways in which humans interact with nature (including artistic and other types of representations of nature, spiritual, social, and cultural interactions), how these change through time, and the subsequent impact on CTN (Ernst & Theimer, 2011; Richardson et al., 2016; Russell et al., 2013) and whether alternative, complementary constructs or concepts can improve the utility of CTN when used together. For example, the use of qualitative and other methodologies could be used to explore the richness, depth, and implications of CTN Human interaction with nature (Bell et al., 2015; Richardson, Hallam, & Lumber, 2015). Using inclusive perspectives and survey tools may support the development of work in this area.
- Future studies could consider exploring the following types of study design for exploring CTN:
    - Much of the evidence around CTN is observational and/or correlational. More longitudinal and experimental studies are required exploring CTN, to provide evidence of a causal associations (Barragan-Jason et al., 2022; Whitburn, Linklater, & Abrahamse, 2020).
    - Where relevant, future quantitative studies should seek to adjust models for confounding factors.
    - Applied research (with outcomes assessed over longer time periods) could help guide the development of interventions to increase CTN or nature-

based interventions which seek to use CTN as a pathway to other outcomes (Zylstra et al., 2014) Improving our understanding of how CTN develops through childhood, and whether and how CTN is, or is not, maintained through to adulthood would help identify key intervention points.
    - Human-nature interactions and connections form a complex system of interactions influenced by factors such as culture**,** bodies**,** demographic and behavioural traits, environments and spatial contexts. These interactions may be different in different times and different places. Future research should adopt methodologies that specifically recognise these complexities in human nature connections and appreciation of the complexity relationship between nature and humans which may have reciprocal interactions and unintended consequences.
    - More work could consider incorporating citizen science activities and CTN (Sheffield, Butler, & Richardson, 2022).
- There is increasing concern regarding the use of technology, particularly by children and young people and some research highlights the link between use of technology and disconnection from nature (Michaelson et al., 2020). However, technology can also support engagement and connection with nature, for example through using apps to support users immersing themselves in nature. For example, a mobile phone app that prompts users to notice nature has shown promising outcomes (McEwan et al., 2019). The role of technology in inhibiting and supporting CTN is an emerging field that merits further research.
- There was occasionally conflicting evidence about which type of nature-based activities are associated with CTN. Further research is needed To understand how different forms of engagement with nature influence CTN (Sheffield, Butler, & Richardson, 2022).
- Further research could consider exploring the differences between different demographic groups (Sheffield, Butler, & Richardson, 2022), including children (Barragan-Jason et al., 2022; Whitburn, Linklater, & Abrahamse, 2020), as well as how attitudes affect CTN and associated policy implications.
- Interventions that support nature connection are often small scale and unpublished (even within grey literature). This means that there is likely to be underreporting of smaller, local initiatives that may fall under the radar of traditional academic publications. Pro-active and inclusive approaches to research and co-creation could help to address this gap in the evidence.
- There is a need to understand more about potential barriers to (Sheffield, Butler, & Richardson, 2022) and disconnection from (Beery et al., 2023) CTN.
- Most of the evidence published is from western and industrialised countries. More evidence from non-western cultures is needed (Barragan-Jason et al., 2022; Whitburn, Linklater, & Abrahamse, 2020).

CTN and health and wellbeing

- CTN appears, from a limited number of studies, to have a protective effect on eco-anxiety and support resilience however, a higher CTN is also associated with a higher eco-anxiety and greater sensitivity to environmental stressors. Further research should be carried out into the relationship between CTN and “eco-anxiety”.
- Future studies on the health, wellbeing, and developmental impacts of exposure to nature and in relation to pro-environmental behaviours could investigate CTN as a potential explanatory mechanism or mediating factor (Bell et al., 2014; Nisbet & Zelenski, 2011; Pritchard et al., 2020).
- Future research could consider the therapeutic potential of CTN to support resilience (Antonio et al., 2023; Block et al., 2019; Darcy et al., 2022) in disruptive or traumatic times due to large scale disruption such as political, environmental or cultural (Marsh et al., 2021).

CTN and environmental outcomes

- There is a need for research which explores how CTN can inform environmental planning and conservation strategies for the purposes of future urban planning and citizen wellbeing (Restall & Conrad, 2015) and behaviours that focus on the reduction of carbon footprint/climate change (Keaulana et al., 2021).
- The research reviewed points towards a symbiotic relationship between connectedness, pro-environmental/conservation behaviour and happiness; people who are more connected are more likely to engage in sustainable behaviours and both these augment their personal happiness (Barrera-Hernández et al., 2020; Gong, Li, & Sun, 2023; Martin et al., 2020). Improving mental health outcomes and promoting sustainable behaviours are contemporary policy priorities, future research should explore this relationship and build on the findings of recent research indicating that CTN is correlated with pro-environmental behaviour (Barrows et al., 2022) and explore causality.

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Glossary

Association(s)	See Correlation
Blue space	Outdoor environments–either natural or manmade–that prominently feature water and are accessible to people, e.g., the collective term for rivers, lakes or the sea.
Brownfield	A brownfield investment is when a company or government entity purchases or leases existing production facilities to launch a new production activity.
Causal, causality, causation	When something has an actual effect on something else- and is not simply correlated with it
Cohort	Cohort studies are a type of longitudinal study—an approach that follows research participants over a period of time (often many years)
Confounding factors	There are other factors that may affect the primary result of a study.
Connection to nature	The term 'connection to nature' is frequently used to describe our enduring relationship with nature, including emotions, attitudes and behaviour. Research shows that people with a greater connection to nature are more likely to behave positively towards the environment, wildlife and habitats.
Correlation	A correlation reflects the strength and/or direction of the relationship between two (or more) variables. The direction of a correlation can be either positive or negative. This is also sometimes referred to as an association.
Cortisol	A stress hormone
Cross-sectional	A cross-sectional study involves looking at data from a population at one specific point in time.
Direction of effect	This refers to whether there is a positive or negative association between two variables

Eco-anxiety	Anxiety relating to the environment and environmental degradation.
Empirical evidence	Empirical evidence is information that is acquired by observation or experimentation.
Epidemic	An epidemic is the rapid spread of disease to a large number of hosts in a given population within a short period of time.
Eudemonia/ Eudemonic	Eudemonic wellbeing refers to the type of happiness or contentment that is achieved through self-actualisation and having meaningful purpose in one's life.
Forest bathing	From the Japanese *Shinrin-yoku,* Forest bathing involves spending time in and making contact with forests and taking in the atmosphere of a forest.
Green space	Green space refers to land that is partly or completely covered with grass, trees, shrubs, or other vegetation. Green space includes parks, community gardens, and cemeteries.
Grey literature	Literature, such as a report, which is not peer reviewed
Hedonic wellbeing	Hedonic wellbeing is based on the notion that increased pleasure and decreased pain leads to happiness. Hedonic concepts are based on the notion of subjective wellbeing. Subjective well-being is a scientific term that is commonly used to denote the 'happy or good life'.
Interconnectedness	See Connection to nature*
Internal biome	Refers to all the microbes - bacteria, fungi, protozoa and viruses - that live on and inside the human body
Intervention	An external variable that comes between someone and an outcome, that changes someone's eventual outcome as a result
Limbic responses	The limbic system is the part of the brain involved in our behavioural and emotional responses, especially when it

	comes to behaviours we need for survival: feeding, reproduction and caring for our young, and fight or flight responses
Longitudinal	A long-term study in which as Cohort is visited at different time points to get a long-term understanding of an effect
Mental health	Mental health includes our emotional, psychological, and social well-being. It affects how we think, feel, and act. It also helps determine how we handle stress, relate to others, and make choices. Mental health is important at every stage of life, from childhood and adolescence through adulthood.
Meta-analysis	Meta-analysis is a research process used to systematically synthesise or merge the findings of single, independent studies, using statistical methods to calculate an overall or 'absolute' effect.
Modern Health Worries (MHW)	Health concerns relating to non-natural modern phenomena such as chemicals in food, technology and GM foods.
Neuropsychology modelling	A neuropsychological model is a computerised or mathematical representation of an individuals or group of individuals brain or thought patterns
Non communicable disease	A non-communicable disease (NCD) is a disease that is not transmissible directly from one person to another. NCDs include Parkinson's disease, autoimmune diseases, strokes, most heart diseases, most cancers, diabetes, chronic kidney disease, osteoarthritis, osteoporosis, Alzheimer's disease, cataracts, and others.
Parasympathetic nervous activity	The parasympathetic nervous system predominates in quiet “rest and digest” conditions while the sympathetic nervous system drives the “fight or flight” response in stressful situations. The main purpose of the PNS is to conserve energy to be used later and to regulate bodily functions like digestion and urination.
Peer reviewed	A study which goes through a process of fact checking by several experts in the field

Perinatal health	Perinatal refers to the time before and after the birth of a child.
Pilot study	A pilot study, also called a 'feasibility' study, is a small-scale preliminary study conducted before any large-scale quantitative research in order to evaluate the potential for a future, full-scale project.
Positive affect	Experiencing pleasant emotions, feelings or states.
Pro-conservation	Pro-conservation behaviour refers to behaviours in which individuals engage in environmental, animal, marine or human conservation - including natural resources, forests, wildlife, plants and biodiversity.
Pro-environmental	Pro-environmental behaviour, also known as green-, sustainable-, or environmentally friendly (eco-friendly) behaviour, is defined as behaviours in which individuals take protective actions toward the environment.
QALY	The quality-adjusted life year or quality-adjusted life-year (QALY) is a generic measure of disease burden, including both the quality and the quantity of life lived. It is used in economic evaluation to assess the value of medical interventions. One QALY equates to one year in perfect health.
Qualitative	Qualitative data describes qualities or characteristics. It is collected using questionnaires, interviews, or observation, and frequently appears in narrative form. For example, it could be notes taken during a focus group, or responses from an open-ended questionnaire
Quantitative	Quantitative data is data that includes numbers and figures. These can include scores on tests, number of hours of study, or weight of a subject. These data can be open to statistical interpretation. Qualitative data is not expressed as a number.
Reliability	Data reliability means that data is complete and accurate

Salutogenic	Health supporting. Based on Anton Antonovsky’s salutogenesis concept.
Scoping review	A review that is less rigorous than a Systematic review or Meta-analysis
Strength of association	The extent to which two variables are closely or loosely aligned or correlated with each other
Sympathetic nervous activity	The sympathetic nervous system directs the body's rapid involuntary response to dangerous or stressful situations. A flash flood of hormones boosts the body's alertness and heart rate, sending extra blood to the muscles.
Systematic review	A systematic review is a summary of all the literature on a particular topic, that meets pre-defined eligibility criteria
Validity	Data validity means that data is complete and accurate
Wellbeing	The extent to which a person is in a state of being comfortable, healthy or happy

Annex 1 - Methodology for Update of Natural England Evidence Information Note EIN 068: Connection to Nature

Search strategy

As this is an update the purpose of the search was to identify:

1. Evidence published since the last EIN was published.
2. Relevant evidence omitted from previous EIN

Given the short time frame given for this project it was necessary to apply stringent criteria to reducing the volume of material to review. Literature was initially prioritised as per the following criteria:

1. Evidence reviews published since February 2022
2. Relevant evidence reviews published between January 2016 – February 2022 omitted from the previous guidelines.
3. Relevant primary evidence published since February 2022.
4. Primary research published between January 2016 – February 2022 not included in the previous review.

Search Terms

The PICO framework was used to guide the research strategy but as there is no specific comparison group the C category was not populated. There was no specific population group and test searches run using sub population test search terms made little difference to results so the P category was not populated. The AND function was used between the Intervention and Outcome keyword groups.

Category	Search terms
Intervention	Nature OR outdoor* OR Green* OR “blue space*” OR environment OR garden OR wild* OR rewild OR Conservation OR regenerat* OR outdoor education OR environment OR rural OR countryside OR outside OR wood* OR forest* OR park* OR social prescri* OR green social prescri* OR adventure OR therapeutic landscape OR play in nature
Outcomes	nature Connect* OR biophilia OR nature relatedness OR nature steward* OR conservation behaviour OR nature attachment OR mental health OR loneliness OR social isolation OR health* OR wellbeing OR Well-being OR “well-being” OR Pro-environmental behaviour OR Relationship with

Category	Search terms
	nature OR Pro-environmental behaviour OR Environmental values OR Environmental stewardship OR Pro-nature behaviour OR Quality of life

Nature OR outdoor* OR Green* OR “blue space*” OR environment OR garden OR wild* OR rewild OR Conservation OR regenerat* OR outdoor education OR environment OR rural OR countryside OR outside OR wood* OR forest* OR park* OR social prescri* OR green social prescri* OR adventure OR therapeutic landscape OR play in nature AND nature Connect* OR biophilia OR nature relatedness OR nature steward* OR conservation behaviour OR nature attachment OR mental health OR loneliness OR social isolation OR health* OR wellbeing OR Well-being OR “well-being” OR Pro-environmental behaviour OR Relationship with nature OR Pro-environmental behaviour OR Environmental values OR Environmental stewardship OR Pro-nature behaviour OR Quality of life

Inclusion and exclusion criteria

Inclusion	Exclusion
Evidence that presented information on connection to nature (CTN) according to the definition of CTN on p.4 of Natural England’s Evidence Information Note EIN 068 Connection to nature.	Evidence that did not present information on connection to nature (CTN) according to the definition of CTN on p.4 of Natural England’s Evidence Information Note EIN 068 Connection to nature.
Evidence that plausibly relates to a UK context (assessed on a case-by-case basis, relating to factors such as social, cultural geographic, meteorological and demographic comparability/similarity)	Evidence that did not plausibly relate to an English context (assessed on a case-by-case basis, relating to factors such as social, cultural geographic, meteorological and demographic comparability/similarity)
Evidence published between March 2022 – February 2024 (for evidence pathways 1 and 3 described above). **Evidence published between January 2016 – February 2024 (for evidence pathways 2 and 4 described above).**	Evidence already included in previous review. Evidence published prior to January 2016.

Inclusion	Exclusion
Evidence that could be accessed in English	Evidence that could not be accessed in English.
Evidence relating to adults and children of all ages and any physical, sensory or emotional differences.	
	Evidence relating to 'second hand' virtual or digital nature such as VR, pictures, photographs or nature sound recordings rather than real time contact.

Databases searched

Cochrane Library, PubMed, Google Scholar were used for peer reviewed literature.

Grey literature was identified through Google and opengrey.eu.

Team

Anna Kenyon has devised the methodology and has consulted with Samantha Pywell, UCLan Social Prescribing Unit Co-ordinator and Louise Smith, Senior Faculty Librarian for the School of Medicine & Dentistry, UCLan. The methodology was reviewed by Laura Taggart, Senior Specialist in Social Science and Em Pope, Specialist in Social Science.

Data extraction

Papers were manually reviewed based on title key words initially by Aderonke Ajiboye. Relevant titles were selected and abstracts reviewed by Aderonke Ajiboye and Anna Kenyon. Evidence was selected if the abstracted indicated it included evidence relating to the definition of CTN as per the original review of the evidence and for meeting the inclusion criteria described in this document. All authors reviewed the final selection of papers. End Note software was used to store and organise included literature.

Papers from PubMed (300) Google Scholar (200) and Cochrane (25) were reviewed with 37 selected for inclusion plus an additional 18 hand searched sources.

Limitations

This evidence update did not use a systematic review approach. Therefore, it is possible that some published evidence was omitted and sources of bias were not reviewed systematically.

However, a wide range of search criteria were applied and a large number of papers from multiple databases were screened for eligibility, to ensure the inclusion of a comprehensive range and up-to-date evidence.

About Natural England

Natural England is here to secure a healthy natural environment for people to enjoy, where wildlife is protected and England's traditional landscapes are safeguarded for future generations.

Further Information

This report can be downloaded from the Natural England Access to Evidence Catalogue. For information on Natural England publications or if you require an alternative format, please contact the Natural England Enquiry Service on 0300 060 3900 or email enquiries@naturalengland.org.uk.

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