Forest Research

Childhood experiences of woodlands and adult environmental attitudes and behaviours

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1 Executive summary

There is mounting evidence about the benefits of childhood nature experience (CNE) for promoting adult pro-environmental attitudes and behaviours (APEAB), but there has been no review about the specific contribution of trees, woodlands, or forests (TWF), which this rapid evidence review seeks to address. The steps in the review were as follows: scoping searches to identify key studies and reviews, searches of the academic and grey literature using relevant terms, a two-stage screening process based on the eligibility criteria, and coding and quality appraisal of the included studies, with findings reported through a narrative synthesis. Fifteen studies satisfied the eligibility criteria and were included in the review. Eighty of the excluded studies assessed CNE and APEAB more broadly but did not consider the role of TWF in the analysis.

The findings (7 out of the 15 reviewed studies) identified positive associations between childhood experience of TWF and adult perceptions towards TWF. In two studies, adults enjoyed the same forest-based recreational activities that they had experienced as a child, for example foraging, hiking, and camping in forests. Three studies found that childhood experiences were negatively associated with fear and disgust as adults. These studies found that adults who had regularly played in or visited woodlands as children perceived woodlands as calming and comforting places, while adults with limited childhood experience were fearful of getting lost or being attacked, or expressed disgust about woodland features. Adults and teenagers were also less likely to describe forests as boring if they had regularly played in or visited woodlands as children, and adults who visited forests regularly were less likely to use electronic media during their general leisure time. Finally, adults who lived adjacent to woodlands as children were more likely to agree that trees had personal or spiritual meaning for them.

Another common finding was a positive association between frequency of woodland visits in childhood and adulthood, which featured in four studies. Results from two of these studies suggested that visits as a child had to be highly frequent (at least weekly) to influence adult visitation behaviours. Only one study explored adult pro-environmental *behaviours* (as opposed to attitudes), finding that women that spent a lot of time in forests as children contributed to forest advocacy work as adults.

Nine studies described the characteristics of the childhood experiences but did not consider how these could have influenced APEAB, or how these might compare to experiences in other types of greenspaces. In most cases, experiences were centred around creative play, for example making toys out of pinecones or creating dens, with woodlands often described as a place of freedom or escape. The environmental attitudes or behaviours of family members witnessed during childhood also influenced APEAB, although this relationship was only inferred, rather than tested, in some studies.

The 37 studies where TWF featured in the data collection but not in the analysis described further examples of childhood experiences of TWF. These included: tree climbing, planting a tree, visiting the forest after dark, getting lost in the forest, building a forest shelter, cutting a trail through bushes or a forest, photographing trees, losing a forest to a forest fire, playing monkey tag in a tree, playing under a tree, hearing the wind rush through the trees, or collecting twigs.

The limited number of studies identified by the review highlights the need for more empirical research investigating the potential influence of TWF-based CNE on APEAB. There were also significant evidence gaps, for example, about the role of TWF in career choice, volunteering, or broader sustainability practices. Furthermore, all studies were based on adult memories of childhood experience, which may not be a wholly reliable source of data. Longitudinal studies or those focusing on young people's recent experiences and emerging adult behaviours could be productive areas of enquiry.

2 Introduction

2.1 Background

There is a growing body of evidence about the association between childhood nature experience and adult pro-environmental attitudes and behaviours (e.g. Soga and Gaston, 2024). Childhood Nature Experience (CNE) describes physical or sensorial interactions with natural elements or processes, for example wild plants, wild animals, soil, and rocks. Some studies used access or proximity to nature from the childhood locality as a measure of CNE, but availability of nature in the living environment does not guarantee actual contact with it (Gong and Li, 2024). Adult pro-environmental attitudes and behaviours (APEAB) include visiting natural areas, pursuing careers in the environmental sector, conservation volunteering, and sustainability practices, among others. Pro-environmental determinants (e.g. beliefs, attitudes, behavioural intent) are also important to include in APEAB, as they can predict, or lead to, environmental behaviours (DeVille *et al.*, 2021). Determinants also include beliefs and values about nature and nature connectedness (a concept about an individual's affinity with nature; Soga and Gaston, 2024).

There is a limited amount of evidence to determine whether there are associations between CNE specifically occurring in trees, woods, and forests (TWF) and APEAB. We know that TWF provide rich possibilities for childhood play and promote children's environmental learning (e.g. Goodenough *et al.*, 2021). The Forest School movement, which has grown apace since its establishment in the UK in the 1990s, is shown to benefit childhood pro-environmental attitudes, for example environmental awareness and sense of place (Dabaja, 2022). We also know that woodlands have evocative qualities, since adults retain vivid memories of childhood experiences in them (Beery and Jørgensen, 2018; O'Brien, 2005). This review therefore aims to retrieve and analyse the limited evidence, to improve our understanding of the relationship, if any, between childhood TWF experiences and APEAB.

2.2 Policy relevance

Governments across Great Britain have recognised the personal and environmental benefits resulting from woodland visits and volunteering (UK Government, 2021; Scottish Government, 2019; Welsh Government, 2018). However, the Public Opinion of Forestry Surveys (Forest Research POFS, 2025) found that uptake was low for a range of woodland visits and environmental volunteering activities.

Governments also share an aspiration to improve people's connections with nature and the associated benefits for mental health, physical health, and cognitive and social development (e.g. UK Environment Act, 2021; England's 25-Year Environment Plan, 2018; The Nature Recovery Action Plan for Wales, 2020; Environment Strategy for Scotland, 2020). These policies all refer to the importance of conserving and creating woodlands for climate change mitigation and/or biodiversity, and the role of citizens in contributing to tree planting or other forms of environmental protection.

2.3 Review questions

The review questions were devised to contribute new understanding and evidence of relevance to the policy topics outlined above.

Primary question: What are the associations between childhood experiences with trees and woodland and adult pro-environmental attitudes and behaviours or determinants?

Secondary questions:

- Which types of CNE and APEAB were studied in the reviewed studies?
- How, if at all, do tree-related childhood nature experiences differ from broader childhood nature experiences?
- Which types of CNE are most closely related to APEAB?
- How are adult socio-demographic characteristics related to the extent of engagement with APEAB?
- Are any other factors in childhood nature experiences related to APEAB?
- To what extent can we characterise CNE and APEAB, using existing evidence, to produce a framework of categories that could be used in further research?
- What were the evidence gaps for this area of literature?

3 Methodology

This section describes the stages in the evidence review, namely the question framework and scoping, the development of review questions, the search strategy used, and the processes for identifying and characterising relevant studies.

3.1 Question framework

Research question frameworks help to guide the scoping, screening, and search processes in an evidence review. A suggested question framework for this enquiry is Population, Exposure, Outcome (PEO), a question framework for qualitative reviews (Butler *et al.*, 2016). In this case, the framework utilised was as follows:

- Population: adults of any age, nationality, and background.
- Exposure: childhood experience with trees, woodland, forests, and nature more broadly.
- Outcome: adult pro-environmental behaviours and/or behavioural determinants (e.g. beliefs, attitudes, behavioural intent).

3.2 Scoping

The first stage in the search process was initial scoping. The aim of the scoping was to identify a suite of relevant reviews and studies in this research field, which were used to refine the review questions, searching, screening, and coding protocols.

We undertook six targeted searches in Google Scholar using terms relating to TWF, CNE, and APEAB in December 2024 and screened the first five pages of studies each time (see Appendix 1). We completed three additional targeted searches in February 2025, specifically about CNE and career choices, as requested by the project steering group as areas of particular interest. In total, we retrieved 43 relevant studies and four reviews (Table 1; Appendix 1).

3.3 Search strategies

The search strategy comprised: (1) structured searches in the bibliometric database Scopus, (2) searches in Forest Research's publication repository, (3) expert consultation for grey and unpublished literature, (4) backward and forward citation searching of the included studies (i.e. searching the study's references section and looking up the studies that have cited that study since publication).

Based on an assessment of the scoping studies (Appendix 1), the search strings provided in Tables 2–4 were expected to capture about 85% of all relevant studies. The searches in Scopus were limited to the time range 2000–2025 (inclusive), studies in the English language, document types 'article' and 'conference paper', and the following subject areas: psychology, social sciences, arts and humanities, environmental science, agricultural and biological sciences.

Table 1. Results of the scoping searches

Theme	No. studies identified	No. reviews identified
Studies about the impact of TWF-related CNE on APEAB	8	0
Studies about the impact of CNE more broadly on APEAB	29 (10 studies specifically considered trees or woodlands as part of the broader nature experience)	4
Studies about the impact of TWF-related CNE on children's environmental attitudes or behaviours	3	0
Studies about the impact of CNE on adult career choices	3	0

Table 2 "Environmental behaviours" ("title only" search)

Term 1	Term 2	Term 3
child	adult	nature
"early life"	resident	woodland
"life path"	community	forest
family	experience	tree
		environmental

Terms in the same column are linked by an 'OR' operator; terms in separate columns are linked by an 'AND' operator

Table 3 "Environmental careers" ("title only" search)

Term 1	Term 2
forest	career
environmental	profession
"natural resource"	

Terms in the same column are linked by an 'OR' operator; terms in separate columns are linked by an 'AND' operator

Table 4 "Nature behaviours" ("title, abstract, keyword" search)

Term 1	Term 2	Term 3
child	adult	nature
		woodland
		forest

Terms in the same column are linked by an 'OR' operator; terms in separate columns are linked by an 'AND' operator

3.4 Screening

We retrieved 1470 studies from Scopus using the search strategies on 25th February 2025, and the study titles and abstracts were exported to the review platform Rayyan for screening against the eligibility criteria (Table 5). The first 100 studies (ordered by relevance) were double screened at title and abstract level in February 2025 by two assessors working independently. There were nine screening conflicts, which the assessors discussed to resolve conflicts, refining the eligibility criteria and screening approach where required (Appendix 2). A second set of 100 studies were double screened in a similar way and there were no conflicts in screening decisions by the two assessors. The rest of the studies were single screened by one assessor.

There were 118 included studies after title and abstract screening. Most of the full texts were downloaded from the internet or from electronic library subscriptions, but eight studies were inaccessible online and so were ordered from the British Library.

Two assessors independently double screened 10 studies by reading the full publication and assessing its suitability against the eligibility criteria. There were no screening conflicts between assessors but there were two differences in the understanding about the types of outcome variables (adult determinants) that were eligible for inclusion, so these were used to refine the eligibility criteria and are reported in Appendix 2.

From these pilot screening phases, we found studies that did not mention TWF as an exposure variable in the abstract but then it featured in the full text. For this reason, we decided to include studies with any nature-based childhood experiences at the title abstract screening level, but then only included studies at the full-text level if TWF was one of the exposure variables used.

The rest of the studies were split between the two assessors and single screened. The assessors conferred wherever there was uncertainty about the screening decision.

Outcomes from the full-text screening were as follows:

- 80 of the 118 studies featured at least one variable about CNE and at least one variable about APEAB (Appendices 3–4).
- 37 of the 80 studies had a CNE variable that included a TWF-related component, for example a series of survey questions or statements where one of these was about TWF, but where TWF was not mentioned in the overall variable description or in the analysis.
- 17 of the 80 studies had one or more CNE variables focusing explicitly on TWF and therefore satisfied all inclusion criteria in Table 5.
- There were two cases of duplicate reporting: in the first case, three studies were based on the same dataset, while in the second case, two studies were based on one dataset. In both cases, the suite of studies was treated as one study, resulting in 14 studies for coding.

Table 5 Eligibility criteria for studies

Question element	Inclusion criteria	Exclusion criteria
Population	Adults (18+ years) and adolescents (12–18 years).	Children under 12 years.
Exposure variable(s)	1. Childhood experiences of TWF 2. Childhood visitation rate to woodlands/forests.	1. Studies that have data only about childhood experiences **or** adult behaviours (not both). 2. Childhood experiences with no direct nature contact (e.g. broader environmental practices like recycling, indirect contact such as watching wildlife documentaries), or where nature experience is assumed rather than measured (e.g. geospatial data about greenspaces in child's locality).
Study design	1. Any type of observational/exposure, experimental, or quasi-experimental study. 2. Studies with or without statistical analyses. Studies with statistical analyses can have negative or non-significant results. 3. Analyses of documentary or archival data if novel data produced.	Reviews, meta-analyses, opinion papers.
Scope	International.	
Study type	1. Paper in an indexed or non-indexed journal. 2. Conference proceedings paper published by an academic conference or professional organisation with research remit. 3. Thesis or master's dissertation. 4. Report by governmental/non-governmental organisation with research expertise/remit. 5. Papers that have been moderated and published on an electronic preprint platform, where this is owned by an academic publishing group (e.g. Springer, Elsevier).	1. Book/book chapter 2. Other types of conference papers 3. Undergraduate dissertation 4. Other types of reports 5. Other types of preprints
Time range	2000–2025 inclusive.	1999 or earlier
Language	English only	
Outcome variable(s)	1. Adult behaviours/determinants relating to nature or the environment. 2. Adult outcomes include adult nature interactions, visitation rate, nature-based recreation, place attachment to natural environments.	Adult outcome(s) that are solely about health or wellbeing.

For the backward citation searching, one assessor screened all reference lists of included studies at title level, followed by abstract screening of any potentially relevant studies. For forward citation searching, the same assessor looked up the included study on Google Scholar and screened the citing articles using a similar approach. The eight shortlisted studies that resulted from these processes were screened at full-text level by two assessors, resulting in one additional TWF-focused study.

3.5 Coding of studies focused on TWF

The 15 studies were coded by two project members according to the socio-demographic characteristics of the participants, characteristics of the woodland experience, sample size, study design, methodological characteristics, and theoretical underpinning (Appendix 5). The project members independently coded three studies each and then conferred to address any subjective or redundant elements of the coding scheme and refine it.

They also completed a qualitative assessment of the study's internal and external validity. 'Internal validity' describes the extent to which the study is free from flaws in the study design or conduct, while 'external validity' describes the study relevance for the context of this review. One project member subsequently coded the rest of the studies.

3.6 A review of existing reviews

The same search strategies were used as those described in section 3.3. for identifying relevant reviews and meta-analyses. The same Scopus searches were undertaken, limited to the same subject areas but with document type limited to 'review' instead. A total of 135 publications were retrieved from Scopus on 6th April 2025, exported to Rayyan, and screened by one project member. Nine reviews identified at the scoping stage were also included. Any reviews wholly or partially investigating the relationships between CNE and APEAB and published between 2000–2025 (inclusive) were retained for consideration. Thirteen publications were subsequently retained at the title and abstract stage, of which four were retained after full-text screening (Appendix 6).

4 Results

This section first describes the broader findings about CNE and APEAB in the literature, before focusing on the reviewed studies that satisfied the inclusion criteria. The types of CNE and APEAB in the reviewed studies are described, followed by the main relationships between these variables and other factors that influenced APEAB. Finally, the main findings of the reviews are presented.

4.1 Childhood nature experiences and adult pro-environmental attitudes and behaviours

Eighty studies featured at least one variable about CNE **and** one variable about APEAB (Appendix 4). Based on study titles, approximately half of these studies sought to investigate the relationship between CNE and nature-related behaviours (e.g. frequency of visits to nature, engagement with biodiversity conservation activities, tolerance of wild animals), while the other half of the studies focused on broader environmental sustainability behaviours. Five of these studies focused specifically on nature-related or environmental careers.

4.1.1 TWF as a component of CNE

A majority (n=20) of the studies measured the frequency at which participants reported they had engaged in different nature-based recreational activities as a child. A few of these studies also compared different types of recreational activities (e.g. formal versus informal forms of nature engagement, or sports versus nature-based activities). Other key measurements included: the frequency at which they interacted with or played in different greenspaces or habitats as a child (n=11); free recall of specific CNE (e.g. mentioning the experience they felt was most significant) (n=8); and free recall of any CNE (n=11).

Of the 80 studies, 37 had a CNE variable based on collated data from a suite of survey questions or statements, one or more of which mentioned TWF (Appendix 4). Twelve studies collated data about the frequency of visiting or playing in different types of habitats or greenspaces, one of which was woodland (e.g. Azhar *et al.*, 2024).

Seven studies featured tree climbing as the TWF element, for example, Ngo *et al.* (2019), who used a variable called 'frequency of participation in nature-related activities', based on the mean level of participation in five activities, one of which was tree climbing. In three studies, the TWF element was 'walking in the forest' (e.g. Calogiuri, 2016).

Other elements, mentioned in just one or two studies, included: planting a tree, visiting the forest after dark, getting lost in the forest, building a forest shelter, cutting a trail through bushes or a forest, photographing trees, losing a forest to a forest fire, playing monkey tag in a tree, playing under a tree, hearing the wind rush through the trees, or collecting twigs (e.g. Křepelková *et al.*, 2020).

In terms of APEAB variables, a majority of studies (n=21) measured pro-nature attitudes or nature connectedness. These included measures of attitudes towards different (typically unpopular) wild animals, and preferences for cultivated versus wild outdoor spaces, as well as the perceived benefits and disbenefits of trees. Additionally, three studies measured other pro-environmental attitudes, such as separating waste or turning lights off. While pro-nature (or pro-conservation) behaviours, such as involvement in citizen science activities and engaging in responsible recreation behaviours, were mentioned (n=5), studies more commonly measured other pro-environmental behaviours (n=10), such as purchasing eco-friendly products, participating in climate marches, and choosing a career in the environmental sector. Other behavioural measures included the frequency in which participants engaged in different nature-based recreational activities as adults (n=8), or the frequency at which they visited different habitats or types of greenspaces (n=1).

Virtually all studies found a positive association between CNE and APEAB. The positive association was based either on statistical significance or qualitative analysis. Six studies also reported mixed relationships, for example a positive effect for nature connection but no significant effect for broader pro-environmental attitudes. One study collected data on both CNE and adult nature connection but did not assess the relationship between the two. CNE was based on adult recall of childhood activity in all studies.

4.2 Childhood experience focused on TWF

As noted previously, 15 of the 80 studies had one or more childhood nature experience variables focusing explicitly on TWF and therefore satisfied all inclusion criteria in Table 5. These studies are discussed in more depth below, with the aim of answering the review questions in 2.3.

4.2.1 Overview of studies focused on TWF

All 15 studies were published in indexed journals and based on a cross-sectional study design. They were published across a broad time-period (2005–2022) and a third took place in the UK or other Northern European countries (Table 6). Approximately half the studies specified the age range or mean age of participants (which was dispersed over a range of adult ages) or the socio-demographic background of participants, which varied from migrants (Jay and Schraml, 2014), to parents of young children (O'Brien, 2005; Truong *et al.*, 2022), to university students (Sugiyama *et al.*, 2021).

All but one of the studies had medium or high external validity (relevance to the review), but many studies had low internal validity, meaning there were significant flaws in the experimental design or delivery. The most common issue was the use of a single researcher to collect or analyse qualitative data, without taking steps to take account of how researcher's views were influencing the results. Studies with high internal validity would train the researcher in neutral interviewing techniques, use two independent researchers to analyse data, or describe the researcher's background in the study to allow readers to judge the likelihood of biased outcomes. There was also the risk of participants misinterpreting questions or having differing perspectives on focal concepts or phenomena due to ambiguity in the wording of survey questions (e.g. what nature is, which age range of childhood to focus on), which can partly be overcome through the use of prompts and cues, as used by Kronholm and Staal Wästerlund (2017) and Snell *et al.* (2020).

Table 6. Characteristics of included studies

Citation	Country	Sample size(s)	Method(s) of data collection	Internal validity	External validity
Bozok, 2024	Turkey	110	Walking interviews, observations	Low	High
Lohr 2002; 2004; 2005	USA	2004	Interviews	Low	High
Hosaka *et al.*, 2017	Japan	1030	Questionnaire	Medium	Low
Häggström, 2019a	Sweden	94	Questionnaire	Low	High
Häggström, 2019b	Sweden	12	Walking interviews, field notes	Low	High
Jay and Schraml, 2014	Germany	42	Interviews	Low	Medium
Kronholm and Staal Wästerlund, 2017	Sweden	49	Questionnaire, focus groups	Medium	High
Milligan and Bingley, 2007	England	16	Interviews, focus groups	Low	Medium
O'Brien, 2005	England	22	Focus groups	Medium	High
Oppliger *et al.*, 2019	Switzerland	643	Questionnaire	Medium	High
Snell *et al.*, 2020	42 countries	738	Questionnaire	Medium	Medium
Sugiyama *et al.*, 2021	Japan	267	Questionnaire	Medium	Medium
Taye *et al.*, 2019	9 European countries	8793	Questionnaire	Medium	High
Thompson *et al.*, 2005; 2008	Scotland	339	Questionnaire, focus groups	Low	Medium
Truong *et al.*, 2022	Japan	516	Questionnaire	Medium	Medium

4.2.2 How CNE was measured

Thirteen studies measured CNE by asking individuals to remember information without providing any specific cues or prompts to support recall, while two studies provided cues or prompts. In the first, participants were asked to select three cards that represented their childhood relationship to a forest from a deck of photographs, which formed the starting point for the subsequent discussions (Kronholm and Staal Wästerlund, 2017). In the second, participants were shown photographs of eight natural environments and asked to rate how frequently they visited each in childhood (Snell *et al.*, 2020). Three studies asked participants to focus on a specific age range in childhood, which was 0–12 years (Truong *et al.*, 2022) (Sugiyama *et al.*, 2021) and 6–12 years respectively (Snell *et al.*, 2020).

Seven studies asked participants to specify or describe how frequently they played in nature or TWF as a child. Five studies asked about childhood experiences with TWF more broadly, with no specific questions. Three studies asked about how often participants engaged in each of a suite of specified activities, for example, catching fish and frogs; playing with grass, flowers, and fruits; climbing trees or playing tag/hide-and-seek using a tree, and touching or catching insects (Truong *et al.*, 2022).

4.2.3 Characteristics of childhood experience of TWF

Nine studies explored participants' memories about the qualities or activities experienced in woodlands as children in depth, although with limited consideration of how these qualities might have influenced APEAB, or how qualities of woodland might differ from other types of ecosystems or greenspaces.

Participants in most studies described memories of creative play, for example making toys out of pinecones or creating dens, often with other children (Bozok, 2024; Häggström, 2019; Jay and Schraml, 2014; Kronholm and Staal Wästerlund, 2017; O'Brien, 2005; Snell *et al.*, 2020).

Participants described memories of TWF-related folk tales and storytelling in two studies, which had influenced their adult perceptions of TWF; for example, they used folkloric references when describing a specific forest (Bozok, 2024; Häggström, 2019).

Participants in five studies referred to foraging (e.g. berries, mushrooms) **and/or hunting** game (e.g. moose, rabbits) in forests or woodlands, although it was unclear in three studies whether these activities were carried out as children or just as adults (Bozok, 2024; Jay and Schraml, 2014; Kronholm and Staal Wästerlund, 2017; Oppliger *et al.*, 2019; Ward Thompson *et al.*, 2005).

Participants in three studies described forests or woodlands as providing a place of freedom or novel experiences as children and as having a sense of escape from everyday life in adulthood (Milligan and Bingley, 2007; O'Brien, 2005; Ward Thompson *et al.*, 2005).

In four studies, participants described forests or woodlands as being rich multisensory environments, providing examples of the sounds, smells, or sights in the forest, although it was unclear whether they were describing their perceptions as adults, or those recalled ones from childhood (Häggström, 2019; Milligan and Bingley, 2007; O'Brien, 2005; Ward Thompson *et al.*, 2005).

One study (Hosaka *et al.*, 2017b) found that **biodiversity-focused activities** in childhood **had a greater impact on adult pro-nature attitudes than physical activities in childhood**. The biodiversity-focused activities were catching insects, collecting wildflowers, and foraging for wild fruits, while the physical activities were tree climbing and wild swimming. Adult pro-nature attitudes were measured as attitudes towards a suite of wild animal species.

4.2.4 How APEAB was measured

All 15 studies relied on self-reported behaviours or determinants, with no direct measurements of these variables (e.g. video-based observation). Seven studies asked participants about their attitudes or perceptions relating to nature or TWF, for example perceived safety of woodlands (Jay and Schraml, 2014), attitudes towards urban trees (Lohr, 2016), and sense of place (Häggström, 2019). Five studies asked participants to specify or describe how frequently they visited nature or TWF and five studies asked about the type of activities that people engaged in when they were there (as an adult). Four studies asked people about their conservation behaviours, for example introducing children to TWF (Truong *et al.*, 2022), connections through conservation groups (Ward Thompson *et al.*, 2005), and protecting forests against deforestation threats (Bozok, 2024).

4.2.5 Associations between CNE and APEAB

Childhood experience of forests was positively associated with adult pro-conservation behaviours in only one study, based on ethnographic research. Turkish women who foraged in the forest and participated in protests against deforestation recounted rich childhood memories in the forest, which subsequently led to the formation of strong emotional relationships with it (Bozok, 2024). This was the only reviewed study where a positive association between CNE and pro-conservation behaviours was identified, as opposed to broader environmental behaviours (frequency of woodland visits), preferences, or attitudes.

Four studies identified a positive association between the frequency of woodland visits in childhood and adulthood, with this outcome based on statistical test results in three studies (Taye *et al.*, 2019; Oppliger *et al.*, 2019; Ward Thompson *et al.*, 2005) and the interpretation of qualitative data in one study (O'Brien, 2005). Results from two studies suggested that visits as a child had to be highly frequent (at least weekly) for visits to be frequent as an adult (Taye *et al.*, 2019; Ward Thompson *et al.*, 2005). Adults who had visited woodland frequently as a child were more likely to agree with a statement that they would visit woods to go walking alone, suggesting greater confidence in woodland environments (Ward Thompson *et al.*, 2005). One participant group was especially attracted to the more wild, less managed woodlands, which authors suggested was due to higher confidence and greater familiarity with the local woodlands because of their experiences earlier in life (O'Brien, 2005).

Adults' preferences for recreational activities in forests were positively associated with childhood experience in two studies. Adults enjoyed the same recreational activities that they had participated in as a child, which included picking mushrooms, hunting, or hiking (Kronholm and Staal Wästerlund, 2017). Participants' favourite forests were usually close to their home, and, in the same study, images of forests that resembled those of their childhood induced positive feelings. In one study where CNEs were measured as the frequency of visits to five ecosystems including forests, CNE was found to positively influence adult preferences for 10 outdoor recreational activities, three of which were forest-based (forest bathing, forest hiking, forest camping) (Sugiyama *et al.*, 2021).

Three studies identified a negative association between CNE and adult levels of fear and disgust towards TWF. Adults and adolescents who had undertaken unsupervised exploration of forests or frequently visited forests with parents as children expressed lower levels of fear (e.g. fear of getting lost or attacked in forests) and disgust (e.g. towards diseases and insects in forests; Oppliger *et al.*, 2019). Adults who had the opportunity to participate in unstructured, unsupervised play in woodland as children perceived woodlands as calming and therapeutic places to visit when feeling upset or stressed, while adults who had not had these childhood opportunities expressed feelings of anxiety and uncertainty about woodlands (Milligan and Bingley, 2007). CNE in five ecosystem types, one of which was woodland, had significant negative influences on adult 'disgust sensitivity' and 'fear expectancy', including examples specifically about TWF. Therefore, those with CNE were less likely to express disgust at the idea of sitting on a log or on the ground in woodland, and less likely to be fearful about hearing rustling in the bushes or getting lost in woodland (Sugiyama *et al.*, 2021).

Three studies identified a positive association between childhood experience and adult perceptions of TWF. Adults were significantly more likely to agree that trees helped people feel calm if they had participated in outdoor recreational activities, including planting trees, as children. Woodland experience in childhood and adolescence contributed to adults' emotional attachments to woodland for three participants (Häggström, 2019).

Adults' and adolescents' perception of forests as boring was negatively associated with levels of childhood experience, and respondents who visited forests frequently in the past were less likely to use electronic media during their general leisure time (Oppliger *et al.*, 2019).

One study identified a positive association between childhood experience and adult nature perceptions. Parents' score for the perceived importance of nature-based play for children was positively associated with their own childhood experience, based on the frequency of visits to four types of greenspace, including woodlands, and the frequency of participation in four play-based activities, including tree climbing and tag/hide-and-seek in a tree (Truong *et al.*, 2022). In the same study, levels of concern about children getting hurt or sick when engaged in nature-based play were lower for parents who themselves had a high level of childhood nature experience.

In contrast to the studies previously discussed, **one study identified divergent patterns about childhood and adult relationships with forests,** for migrants living in Germany (Jay and Schraml, 2014). Older Russian migrants felt nostalgia for the forests of their childhood where they regularly played and foraged but did not feel a similar connection to the forests in their new location and did not visit them. Younger migrants also shared positive childhood memories of forests but felt that their distancing from forests in their new locality was due to conflicting leisure interests and changing priorities in life. On the other hand, two Turkish migrants who had spent their childhoods in arid, non-forested environments expressed strong appreciation of the woodlands in their new location and visited them frequently, perceiving them as a place for retreat and regeneration.

4.2.6 Negative perceptions of TWF in adulthood

In six studies, participants' fear or lack of confidence about TWF in adulthood were associated with a lack of childhood experience. As discussed, levels of childhood experience were positively associated with levels of confidence about visiting woodlands as adults (Milligan and Bingley, 2007; O'Brien, 2005; Ward Thompson *et al.*, 2005) as well as adult disgust sensitivity and fear expectancy (Oppliger *et al.*, 2019; Sugiyama *et al.*, 2021). In a different study, six migrant women expressed feelings of unease and fear about forests and forest recreation due to a lack of experience and thus confidence, with one adding that she was forbidden from visiting the neighbouring forests as a child due to fears about the ethnic conflicts of the time (Jay and Schraml, 2014).

A few participants recounted that they had **felt fear or discomfort about being in the forest as children**, either because they felt so small compared to everything around them or were afraid of particular animals or insects (Kronholm and Staal Wästerlund, 2017), which affected adult perceptions.

Other factors that appeared to contribute to adults' negative perceptions were **sensationalised media accounts of crimes in woodland areas** (Milligan and Bingley, 2007; O'Brien, 2005; Ward Thompson *et al.*, 2005) or signs of anti-social behaviour and neglect (O'Brien, 2005; Ward Thompson *et al.*, 2005). Parents in two studies said they were concerned about their children's safety in woodlands, either because the trees reduced visibility, or they preferred to play in areas where they could see other children playing (O'Brien, 2005; Truong *et al.*, 2022).

4.2.7 Other factors in childhood or adulthood affecting APEAB

Parental factors affected APEAB in four studies. Fear of forests among adults and adolescents was strongly positively associated with their parents' fear of forests when they were children and whether their parents banned them from visiting forests alone (Oppliger *et al.*, 2019). Adults' preferences for both outdoor recreational activities and their reported levels of CNE (including forest-related ones) were significantly positively influenced by their parents'

attitudes to nature (Sugiyama *et al.*, 2021). Parents' attitudes had a stronger influence on levels of CNE than other factors such as participants' gender or level of neighbourhood greenness in this study. Adults who felt confident and calm in woodlands tended to report that their parents had felt this way about them engaging in unstructured play in woodlands when they were children, while adults who felt anxious in woodlands reported that their parents had exhibited anxiety towards woodland play (Milligan and Bingley, 2007). Adults who agreed with a statement that trees helped people feel calmer were significantly more likely to have parents with positive attitudes towards nature (Lohr and Pearson-Mims, 2004). Adult gender and age were also significant, with women and older participants being more likely to agree with this statement.

Three studies described family as playing an important role in childhood experiences of TWF but did not elaborate upon how this had affected APEAB. In the study by Bozok (2024) many of the Turkish women's childhood memories featured female family members, for example sharing stories, foraging together, or social gatherings in the forest. Participants in another study provided detailed accounts of visiting woodlands with families and friends as children to play games or have picnics (O'Brien, 2005). Adults' childhood memories frequently featured the family members that instigated the forest experiences, for example, in family excursions or being encouraged to go and play independently in the forest (Kronholm and Staal Wästerlund, 2017). There were gendered distinctions in these memories: fathers and grandfathers were mentioned more frequently for fishing and hunting, while mothers and grandmothers were mentioned more frequently for berry picking or family forest excursions.

The individual's age had a mixed effect on APEAB. Adult age was significantly and positively associated with frequency of engagement in TWF or nature-based activities in one study (Hosaka *et al.*, 2017a) but had no significant effect on woodland visitation frequency or the perceived importance of children's nature play (Truong *et al.*, 2022; Ward Thompson *et al.*, 2005).

A number of other factors, not relating to childhood, also affected APEAB. There was a positive association between parents' nature connectedness score, their self-reported level of CNE, their score for the perceived importance of nature-based play for children, their child's grade in primary school, and their own educational level (Truong *et al.*, 2022). The degree of urbanisation and distance to the nearest forest for the adults' current residence was positively associated with forest visitation frequency as an adult (Taye *et al.*, 2019). The rates of forest visitation were also higher for countries with a high proportion of forest cover (e.g. Switzerland, Czech Republic, and Slovakia) compared to countries with a low proportion of forest cover (e.g. UK). Adults' and adolescents' visitation rates to forests were positively associated with whether their friends liked to visit forests, perceived boredom when visiting forests, and whether the adult lived in a rural or urban locality (Oppliger *et al.*, 2019).

4.2.7 Findings from the review of existing reviews

Four reviews assessed international evidence, and all found a positive relationship between CNE and APEAB (Table 7). Between them they reviewed more than 80 studies. Examples of CNE included birdwatching and nature-based camping, while examples of APEAB included buying eco-friendly products and sustainable food choices. Two reviews briefly referred to TWF — 'playing in the woods' as an example of childhood experience, and tree planting as an example of adult pro-environmental behaviours — while two did not mention TWF at all.

Table 7 Characteristics of included reviews and meta-analyses

Citation	Type of review/ meta-analysis	No. studies	Time span	Results
DeVille *et al.*, 2021	Narrative review	67 studies	1980–2021	Twelve empirical studies assessed the relationship between CNE and APEAB, with 10 showing a positive association and two no association.
Soga and Gaston, 2024	Meta-analysis	12 studies	2006–2021	Based on a meta-analysis of 52 effect sizes, there was a consistently positive association between direct experiences of nature and APEAB. Effect size measures the strength of relationship between two variables. Thirty effect sizes were based on childhood experiences and 22 were based on adult ones. Thirteen effect sizes were specific to nature behaviours and 39 were general pro-environmental behaviours. **Adult** nature experience was found to promote APEAB to a similar extent to **childhood** nature experience.
Gifford and Nilsson, 2014	Literature review (no methodology)	Unspecified	Unspecified	Examined the personal and social influences on pro-environmental concern and behaviour, which the review suggested are diverse and complex. These influences were grouped into 18 categories, one of which was CNE.
Harbrow, 2019	Literature review (no methodology)	Unspecified	Unspecified	Highlighted the important role that recreation (both adult and childhood) plays in shaping APEAB.

5. Discussion and conclusion

The findings only provided partial answers to the primary review question (What are the associations between childhood experiences with trees and woodland and adult pro-environmental attitudes and behaviours or determinants?) because only one study measured behaviour and the other studies, on the whole, did not measure behavioural determinants that could be expected to be strong predictors of pro-environmental behaviour. There was insufficient evidence for us to answer three of the secondary review questions ('How, if at all, do tree-related childhood nature experiences differ from broader childhood nature experiences?', 'Which types of CNE are most closely related to APEAB?', and 'How are adult socio-demographic characteristics related to the extent of engagement with APEAB?').

5.1 The positive effect of childhood experience with TWF on adults' relationships with them

The most common findings in the 15 included studies were, first, a positive association between woodland visitation rate in childhood and adulthood, and second, a positive association between childhood TWF experience and adult attitudes and emotions, in terms of preferences for forest-based recreational activities and perceptions of woodlands as calming or comfortable places. The findings suggest that this is because childhood experiences foster individuals' familiarity and comfort levels towards woodland environments and activities, meaning they know what to expect from a woodland and are more used to accessing them for recreation and relaxation. Participants' childhood memories of TWF were overwhelmingly positive in the reviewed studies, so returning to valued trees and woodland sites they enjoyed as children was a source of pleasure and inspiration (O'Brien, 2005; Kronholm and Staal Wästerlund, 2017). The increased confidence could also explain why experienced adults are more likely to allow their children to play in woodlands and to visit wilder and less managed woodland sites (O'Brien, 2005). Another potential explanation for the positive association between child and adult visitation rates is that adults tend to live in the same or similar residential areas to where they grew up, meaning that their proximity, or ease of access, to woodlands is similar at different life stages and prompts similar visitation behaviours (Taye *et al.*, 2019).

There was limited evidence in the included studies about the potential role of childhood TWF experience in promoting pro-conservation behaviours in adulthood. Only one study investigated this relationship, and the ethnographic research found that rural Turkish women's childhood experiences in forests were a powerful motivating factor in their efforts as adults to defend the forest and protest against deforestation and development threats (Bozok, 2024).

The focus on adults' attitudes (and other behavioural determinants) in the reviewed literature has limitations, since pro-environmental attitudes do not necessarily lead to the expected behaviours (e.g. DeVille *et al.*, 2021). This is because the barriers (real or perceived) to developing pro-environmental behaviours and the required modifications to habitual behaviours also play a role, a theoretical construct known as the attitude-behaviour gap (Nguyen *et al.*, 2019). While many studies have shown that nature connectedness is positively associated with pro-environmental behaviours, it is more challenging to prove that there is a causal relationship due to the lack of intervention-based research in this area (Martin *et al.*, 2020).

5.2 The lack of evidence about TWF relative to other types of CNE

None of the included studies assessed how TWF experiences influenced adult outcomes compared to CNE in other settings (e.g. grassland, urban parks). Hosaka *et al.* (2017) found that biodiversity-focused activities in childhood had a stronger impact on adult pro-nature attitudes than physical activities (one of which was tree climbing) but it is possible that the biodiversity-focused activities also involved trees or occurred in woodlands. There was also scant consideration about the role of TWF in the other areas of literature. Virtually all 37 studies with a TWF component in data collection found a positive significant association between CNE (based

predominantly on frequency of engagement with a suite of nature-related activities or environments) and the adult outcome(s) (predominantly nature connectedness). However, the studies did not assess the influence of the TWF component on adult outcomes relative to the other types of natural elements or environments. The four reviews we assessed also found a high rate of positive associations between CNE and APEAB for the studies reviewed, but again, the potential role of TWF was not considered.

These findings suggest that there is a missed opportunity in this field of research to investigate the relative influences of different types of nature-based activities or environments during childhood on APEAB, since in the existing literature nature-based experiences have been treated as a homogenous phenomenon. The need to characterise the qualities and characteristics of nature-based interactions and experiences in more detail has been highlighted by Gaston and Soga (2020). The potential role of trees for developing connections with nature more widely across the lifespan of people is another under-explored area.

5.3 The qualities of TWF and how these might influence adult pro-environmental attitudes and behaviours

Two-thirds of the included studies explored participants' memories about the qualities of childhood TWF experience, which in most cases were centred around creative, unstructured play. Many experiences also involved social interactions (with other children or family members), and multisensory elements, and provided a sense of adventurousness or escapism. The emotions evoked by woodland ranged from interest and happiness to fear and disgust, with negative emotions most commonly expressed by individuals with limited TWF experience. These findings align with other studies about human-nature relationships, for example Stagg and White (2025), who found that children's levels of fear and disgust about invertebrates were related to their levels of nature experience.

5.4 The importance of family in childhood TWF experiences

The main factor influencing adult outcomes in the reviewed studies, other than CNE, was the attitudes or behaviours of family members during childhood. Adults play a key role in moderating CNE, since they control children's level of access to nature and what they can do there well into adolescence (Oppliger *et al.*, 2019; Truong *et al.*, 2022). Adults' own nature orientations affect their abilities to model positive interactions towards nature and to stimulate children's interests in natural phenomena (Soga *et al.*, 2018).

5.5 Limitations of the review

A key limitation in the review methodology was the inclusion of both qualitative and quantitative studies, which made it difficult to draw comparisons between studies, as methods of data collection and analysis were so different. The low number of studies obtained in the review will have limited the reliability of the findings.

A key limitation in the reviewed literature was the reliance on adults' recall of childhood experiences. A reliance on adult recall could introduce a variety of experimental bias, for example in visitation frequency, as regular visitors to woodlands are more likely to remember childhood visits, and individuals with higher nature connection tend to recall a wider range of CNE (Taye *et al.*, 2019). A focus on young adults may be preferable to one on older adults, so that less time has lapsed since childhood experiences occurred. Many of the studies also exhibited flaws in the experimental design or implementation, most commonly the use of self-reported measures of experiences and behaviours, which can be quite subjective. A further methodological flaw was not using measures that help to address researcher bias, for example using two researchers to analyse qualitative data so that personal interpretations of data can be addressed and reconciled.

An additional limitation was that, while many of the studies about CNE collected data about different types of nature-based activities or natural areas, these different types of data were amalgamated to produce a single variable, meaning that it was not possible to compare effects for different types of experience or

environment. Furthermore, few of the reviewed studies focused on a specific age range in childhood (and when they did the age range was very broad), perhaps because it was considered unrealistic to obtain data to that level of detail using adults' memory recall.

5.6 Evidence gaps and suggestions for further work

As discussed in previous sections, there were substantial gaps in both the breadth and depth of childhood TWF experiences and APEAB, highlighting a pressing need for more empirical research in this area. Notable gaps included the potential impact of TWF experiences on career choices and the impact of TWF on pro-environmental behaviours (as opposed to attitudes or other antecedents to behaviour). Another notable gap was the impact of Forest School on attitudes or behaviours in adolescence or adulthood. Forest school provides children with regular contact with woodland over an extended period of time and, due to the delivery through schools, reaches children who may not otherwise have regular contact with nature (O'Brien, 2020). One potential explanation for this evidence gap could be the fact that Forest School has only become popular in the UK in the last 20 years, although it has been established in Scandinavian countries for much longer (Dabaja, 2022).

A particular challenge for investigating impacts of childhood experiences on adult behaviours is the cost and commitment that longitudinal studies require. An alternative approach could be to conduct in-depth interviews with young adults about their childhood experiences and emerging behaviours. A categorisation framework for the different types of childhood TWF experiences and APEAB respectively could also be valuable for informing future enquiries. There are some existing examples of this. One approach for categorising childhood experiences used the depth or 'directness' of interactions between the child and the natural environment (Kahn and Kellert, 2002). Other approaches have been based on the types of interactions with natural objects and the body movements and cognitive and affective processes they involved (Giusti *et al.*, 2018; Gong and Li, 2024). Barbett *et al.* (2020) categorised adult behaviours that specifically support the conservation of biodiversity according to whether they were related to individual or civil advocacy or habitat creation in gardens or more broadly (Barbett *et al.*, 2020). Such approaches could be developed and adapted to study the connection between childhood experiences of TWF and APEAB.

5.7 Conclusion

Fifteen studies found positive associations between childhood TWF experience and adult behaviours or attitudes towards TWF, while 37 studies found a positive association between CNE (where TWF was mentioned) and APEAB. The most common findings were a positive relationship between woodland visitation rate in childhood and adulthood and between childhood TWF experience and adult perceptions of TWF.

However, there was limited evidence about whether childhood TWF experience led to adult pro-conservation (pro-nature) behaviours, or whether TWF experience had special properties compared to other types of greenspace. Childhood TWF experiences focused on creative play, foraging, and novel experiences. These findings offer some valuable insights for policy, although there were study limitations and research gaps, highlighting the need for further empirical work.

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6. Appendices

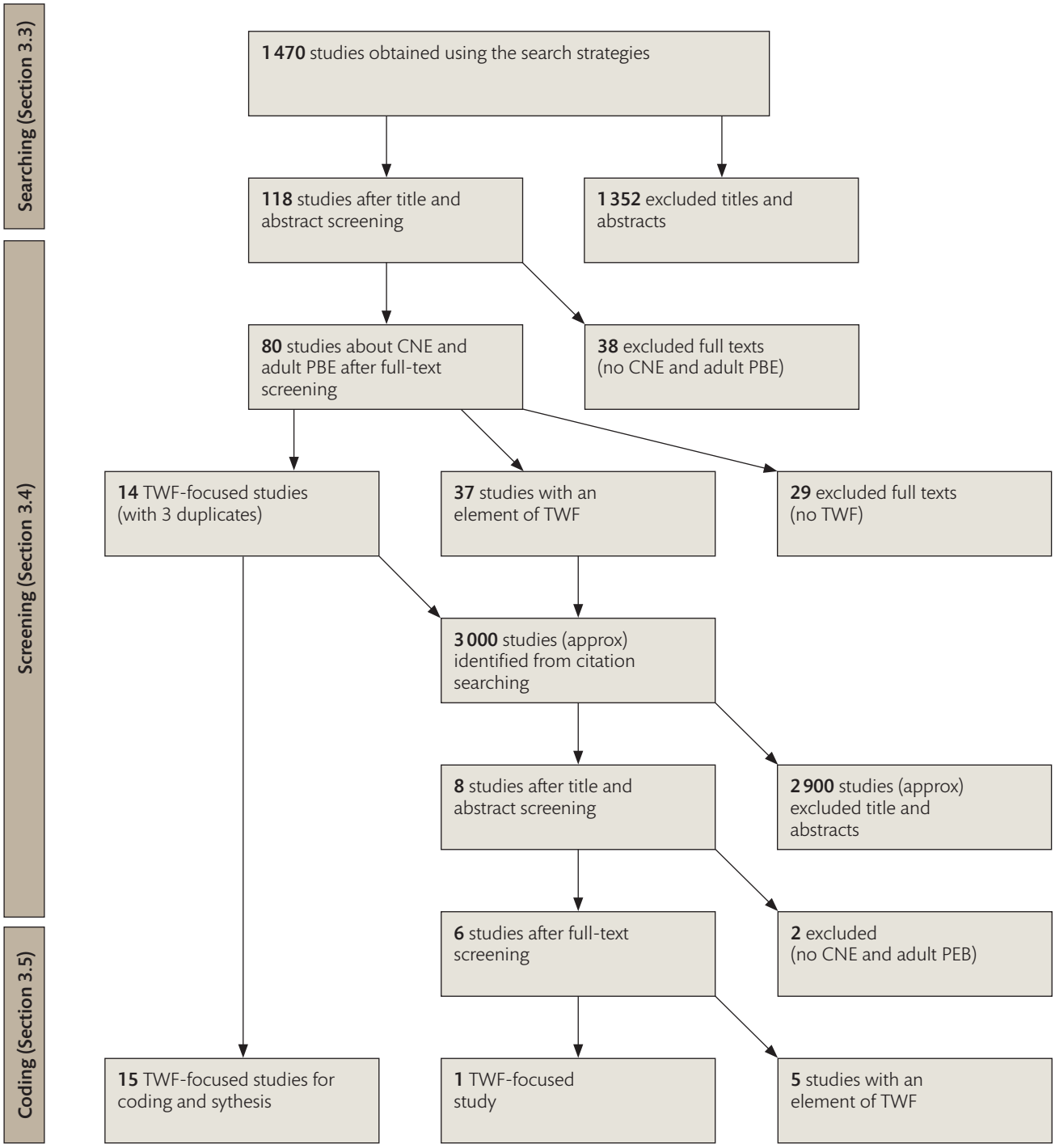
Appendix 1: scoping searches to identify key studies and reviews

The scoping searches Excel file is available on the Forest Research website.

Appendix 2: screening conflicts (differences in opinion between the two assessors about study inclusion/exclusion and how these were resolved)

The screening conflicts PDF is available on the FR website.

Appendix 3: flowchart showing the number of studies at each stage of the review process



Appendix 4: results of the full-text screening (where assessors read entire studies and assess them against the inclusion criteria)

The full-text screening results Excel file is available on the Forest Research website.

Appendix 5: coded studies (a completed categorisation scheme for the reviewed studies)

The coded studies Excel file is available on the Forest Research website.

Appendix 6: a list of the published literature reviews that were assessed for this evidence literature review

The list of assessed literature reviews is available on the Forest Research website as an Excel file.

There is mounting evidence about the benefits of childhood nature experience for promoting adult pro-environmental attitudes or behaviours, but there has been no review about the specific contribution of trees, woodlands or forests, which this rapid evidence review seeks to address. We identified and reviewed 15 relevant studies, seven of which found a positive association between childhood experience and positive perceptions, attitudes or behaviours relating to trees, woodlands or forests. We discuss the implications of the findings and evidence gaps for policy and practice.

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