frontiers | Frontiers in Environmental Science

TYPE Original Research
PUBLISHED 19 June 2023
DOI 10.3389/fenvs.2023.1225044

OPEN ACCESS

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RECEIVED 18 May 2023
ACCEPTED 05 June 2023
PUBLISHED 19 June 2023

CITATION
Beery T, Djerf H, Wünsche TU and Fridberg M (2023), Broadening the foundation for the study of childhood connectedness to nature.
Front. Environ. Sci. 11:1225044.
doi: 10.3389/fenvs.2023.1225044

Broadening the foundation for the study of childhood connectedness to nature

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The spatial aspect of access to nature experience is considered a key factor for studying school-age educare and connectedness to nature. While the standard approach for questions of connectedness to nature is to study at the individual level using methods such as observations, psychometric scaling, and interviews, less common are spatial methods applied to structural or collective aspects of these questions; connectedness to nature study rarely considers the human relationship with nature across sociocultural/structural/institutional levels. Spatial analysis is presented as a step toward a broader consideration of connectedness to nature; careful consideration of connectedness to nature/disconnection must explore the forces beyond the individual shaping access and opportunity. Specifically, the study considers access through proximity to nature from school-age educare sites in the Swedish city of Malmö. Using spatial methodology, proximity to nature was measured at 67 school-aged educare sites. The results provide a complex picture of a range from high to low-quality access to nature for children at the sites. The results help highlight the importance of access via proximity while also opening the door to a mix of other sociocultural/structural/institutional factors to be considered in support of children's access to nature experience.

KEYWORDS

connectedness to nature (C2N), extinction of experience, disconnection from nature, school-aged educare, spatial analysis, urban access to nature

1 Introduction

The spatial aspect of access to nature experience is part of an initial investigation to study the potential for school-age educare (SAEC) to support connectedness to nature. This research is situated within the breadth of connectedness to nature scholarship (Beery and Wolf-Watz, 2014). Numerous useful constructs are used to consider or in an attempt to measure the human relationship with nature, from biophilia to relatedness, and many of these connectedness to nature ideas overlap or are nearly synonymous; this article uses the term 'connectedness to nature' and the simplified abbreviation 'C2N' to reference an affective, cognitive, and embodied relationship with more than human nature (Beery, 2013a). The specific interest in access to nature as a foundation for C2N study is based on a wealth of research literature documenting the importance of proximity, time, opportunity, and other specific factors of access to nature to support C2N (Beery, 2020; Buchecker and Degenhardt, 2015; Moran et al., 2017; Richardson et al., 2017).

Connectedness study often begins and ends at the individual level, yet there is a need to consider the human relationship with nature more broadly across sociocultural and structural/institutional levels. While it is common for questions of connectedness to be studied at the individual level using methods such as observations, psychometric scaling, and interviews with teachers, children, and other youth professionals (Salazar et al., 2021), less often are spatial methods applied to structural aspects of these questions. We can better consider multiple aspects of C2N with a physical-infrastructural, i.e., spatial understanding of the opportunity, or potential, for nature experience and connectedness as a foundation. Previous research has shown that direct physical access to nature experience is critical to developing connectedness (Soga et al., 2016; Chawla, 2020).

This push to go beyond individual measures and consideration of C2N more broadly is related to the recent consideration of disconnection from nature (Beery et al., 2023). This critical examination of the myriad of interacting factors that may shape disconnection from nature reminds us that we must go beyond individual factors, such as experience, learning, and emotion, and consider the individual as a part of complex socio-ecological systems. This effort is in sync with the idea of C2N, supporting individuals' perception of self as belonging to the whole of nature (Thomashow, 2001; Wilson, 2019). Therefore, this study uses the spatial arrangement of SAEC sites to explore whether these locations may support access to nature for children in Malmö, a city in the south of Sweden. This article will use spatial data and analysis as a starting point to consider broader societal questions of connection to and disconnection from nature. Given the explorative nature of this study, a specific hypothesis regarding measures of access is not presented; instead, the study will explore the value of a spatial foundation for access and proximity to nature for inclusion in studies of C2N in young children.

2 Background

To provide a background to the spatial analysis of SAEC sites in Malmö, Sweden, nature, nature experience, and C2N are presented. The critical factors of children's time in and access to nature from previous research will be highlighted. In addition, given the context of this study, a look at the specific case of Sweden will also help provide a foundation for considering children's access to nature from the perspective of green-space measurements and the unique institution of SAEC in Sweden. In addition to this foundation, it is hoped that exploring these topics will help broaden how we approach C2N studies with greater attention to sociocultural factors.

2.1 Nature and nature experience

Given the use of the often-contested term "nature" in this study, a definition is helpful. To do so, we draw upon post-humanistic thinking, emphasizing the critical aspect of human inclusion in our conceptions of nature. Wilson (2019) emphasizes the idea of kinship to avoid the idea of nature as "other" or outside/beyond the human. How does this post-humanistic thinking translate into a tidy definition? It does not. We can, however, lean on various existing definitions that make space for this entanglement of the human and non-human. For example, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) broadly presents nature as stocks and flows of materials, organisms, or energy while recognizing non-material elements (Brondizio, 2019). "Stocks and flows" are interpreted as cycles, such as the hydrologic cycle, cyclical ecologic patterns, such as succession, or systems, such as the biotic/abiotic ecosystems found in and around the children's schoolyards. This definition of nature provides plenty of room for humanity. However, just what this definition looks like in practice is an interesting question. Coupling post-humanist ideals with our focus on children, we argue that defining nature via actions and interactions will emphasize relations and belonging (Zylstra et al., 2014; Gibson et al., 2015). Thus, children's nature experiences of interest are those interactions that support a connection in the form of kinship; these experiences put children in direct contact with nature while also may support children seeing themselves as a part of systems and cycles. An operationalized definition of "nature" is included in the methods section.

2.1.1 Extinction of experience

In 1993, Robert Pyle used the phrase extinction of experience to describe the trend of people having diminished contact with more than human nature in their everyday lives. Louv (2008) took up this concern in his book Last Child in the Woods, using a wealth of research to support this concern. The book, a popular scientific literature review, energized parents, educators, and scientists on the question of the value of nature experience; for example, consider the emergence of the Children and Nature Network, a North American organization with roots in growing concern for children's nature experience brought to public light, in part, by Louv's work.

A critical aspect of concerns over the extinction of nature experience has emphasized time in nature for health and wellbeing benefits (Bratman et al., 2012; Martin et al., 2020). Strife and Downey (2009) explored research in environmental health, environmental education, and environmental psychology and highlighted the cognitive, emotional, and physical importance of childhood exposure to nature coupled with inequalities in children's access and exposure to the natural world. Research regarding time in nature has also shown that children spend more time indoors and less time in nature (Hofferth and Sandberg, 2000; Pyle, 2002; Chawla, 2006; Louv, 2008). Several time/access studies have attempted to quantify a specific nature time dosage necessary for benefits. For example, a study of college students found that as little as 10 min in natural settings significantly and positively supported mental wellbeing (Meredith et al., 2020). White et al. (2019) found that at least 120 min per week is necessary to ensure the good health and wellbeing benefits of time in nature. Additional studies have also linked time in nature with the development of pro-environmental behavior (DeVille et al., 2021). Highly relevant to this current study, Chawla (2020) identified time in nature as a key theme in her review of childhood C2N.

Other studies have explored access not from the specific focus of time or dose while still emphasizing access and access-time potential

(i.e., the assumption that proximate access may be able to support increased time in nature). Richardson et al. (2017) highlighted neighborhood parks and private gardens for supporting positive social, emotional, and behavioral outcomes for 4-6-year-old children. Beery (2020) found proximate access to be a key factor for using city parks by early childhood education centers. These questions have been explored qualitatively as well, as in the quality of access, not from a distance perspective but from a safety and positive experience perspective. For example, studies emphasizing park quality, safety, and social norms are important for proximate accessibility for park users (Buchecker and Degenhardt, 2015; Moran et al., 2017).

Related to this emphasis on time in nature in the research literature, Richardson et al. (2021) make a compelling case for avoiding over-reliance on time in nature, or dosage, and calls for a more qualitative approach in consideration of the nature/wellbeing relationship, i.e., consideration of a breadth of nature-oriented experience variables that contribute to human wellbeing. As part of this push to consider the quality of experience and not simply quantity, Richardson and Butler (2022) use the phrase "moments not minutes" (p. 8) regarding nature experience in their practitioner handbook for nature connectedness. Note that while this focus on quality experience is important, this current study presents potential access as a critical antecedent to both the amount and quality of time spent in nature, promoting a *moments and minutes* approach. An overemphasis on exceptional experience is likely one of individual experience and may contribute to narrowing the focus to the individual in C2N study.

Concerns over the growing extinction of experience trend continue. During the short span of two generations, childhood exposure to nature has significantly decreased (Bratman et al., 2012). For example, consider these possible indicators, a loss of free-roaming proximity exploration (Chawla, 2020), less free time for play (Palmer, 2007), an increase in screen-based recreation time (Schilhab, 2021), and increased pressure on early childhood learning assessment (Bølling et al., 2018). With this concern over the extinction of experience comes a concern for the loss of benefits from direct nature contact (Gaston and Soga, 2020). Soga and Gaston (2016) provide a review of literature in which they not only highlight the loss of interaction and benefits relating to human health and wellbeing but also highlight the danger of a relationship between the diminished experience of nature and diminished positive emotions, attitudes, and pro-environmental behavior. Pro-environmental behavior is how people can participate positively as part of nature, i.e., the reciprocal value of human belonging to nature (Beery and Lekies, 2021).

Ultimately, the concern for this extinction of experience is that human wellbeing suffers from a lack of experience with nature; further, the extinction of experience concerns includes a fear that the loss of engagement will have a negative impact on nature (via human behavior) as our sense of connection with nature moves to the periphery of people's priorities. Securing time and accessibility to natural environments is one of the numerous essential factors in order for developing a meaningful relationship with nature, a sense of belonging to nature, and a motivation to learn about and care for nature (Soga and Gaston, 2016; Ives et al., 2017; Giusti, 2019). Hence, this study has attempted to consider this factor directly to broaden the overall consideration of children's nature experience and development of C2N.

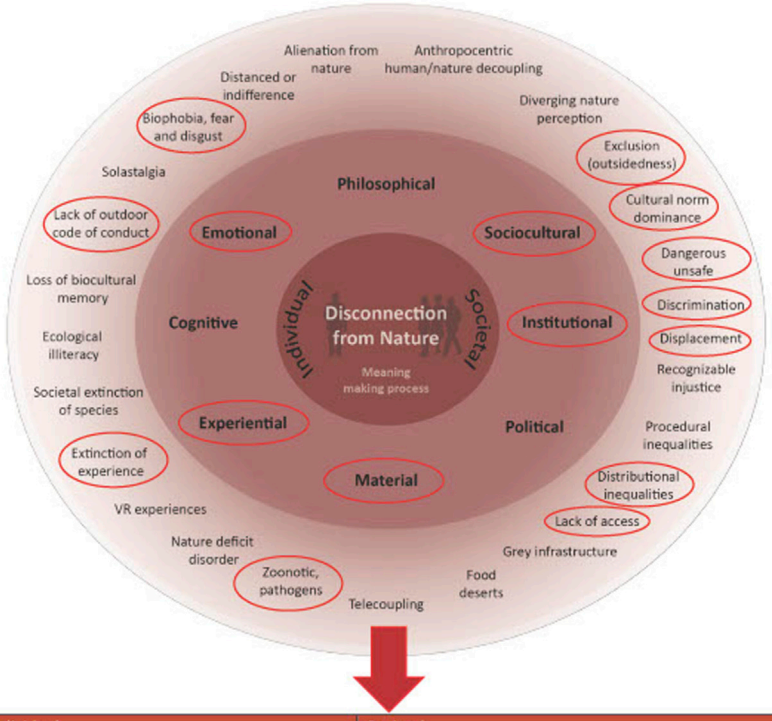
2.2 Connection to nature

In light of the noted long-term and ongoing fears of adverse outcomes of a lack of nature experience, an interest in C2N has emerged. C2N is described as a human relationship with nature by using terms such as affinity, biophilia, commitment, ecological self, identity, inclusion, relatedness, and sensitivity (Wilson, 1986; Bragg, 1996; Kals et al., 1999; Schultz, 2002; Stedman, 2002; Mayer and Frantz, 2004; Nisbet et al., 2009; Chawla, 2020; Richardson et al., 2021). Within this broad grouping, the primary emphasis is on the experience of and direct encounters with generalized or non-specific nature (Beery and Wolf-Watz, 2014). Wilson (1986), proposing the Biophilia hypothesis, argues that the human-nature relationship is founded deep in our evolutionary history (Kals et al., 1999), and in the innate affinity human beings have toward the natural world (Kellert and Wilson, 1995). The topophilia hypothesis proposed decades later has similar human evolutionary roots, yet from a geographical perspective, emphasizing the existence of human attachment to place (Tuan, 1974; Sampson, 2012). C2N research further emphasizes a merging of nature and the concept of self (Schultz, 2002; Kleespies et al., 2021) and a sense of unity, kinship, oneness, or transcendence with nature (Mayer and Frantz, 2004; Mayer et al., 2009).

C2N is viewed broadly and put forward as a crucial component in a movement toward an increase in societal environmental responsibility (Schultz, 2002; Chawla, 2020), facilitating a human mindset change from an ego-centric toward an eco-centric worldview, resulting in the development of ecological attitudes and pro-environmental behaviors (Nisbet et al., 2009; Frantz and Mayer, 2014). Further, C2N is found to correlate positively with better learning capabilities (Eshach and Fried, 2005), increased working memory (Schilhab, 2021), and an increase in physical and mental health and eudemonic wellbeing (Nisbet and Zelenski, 2011; Capaldi et al., 2014), making it an attractive objective for a wide variety of groups such as parents, educators, health professionals, and landscape planners. Given this perception of C2N as an attractive objective, numerous scales exist to measure the various C2N constructs (Beery, 2013b). These scales are often used to consider individual perspectives and program impacts (Salazar et al., 2021).

2.2.1 Disconnection from nature

One way to expand understanding of C2N is by considering the factors that disconnect people from nature. We do not wish to present disconnection from nature as a binary opposite to C2N. Instead, we contend that the more we know about why or how people are disconnected from nature serves our interest in supporting C2N. To this end, recent consideration of disconnection from nature provides valuable guidance. The wheel of disconnection image (Figure 1) from the recent scholarship exploring and defining disconnection (Beery et al., 2023) provides a visual presentation of disconnection from nature that can serve to provide a deeper understanding or understanding of both C2N and disconnection from nature (see Figure 1); the visual can help to illustrate how a myriad of factors, on both individual and



Individual			Societal		
Domain	Examples	Details	Domain	Examples	Details
Experiential	Extinction of experience	Loss of time begets loss of time	Socio-cultural	Exclusion, Cultural norm dominance	Lack of social access via traditions or norms
Emotional	Fear	Perceived fear discouraging nature time	Institutional	Discrimination, Displacement, Distributional inequalities	Institutionalized social arrangements that block nature time
Material	Zoonotic pathogens	Sickness preventing or discouraging nature time	Material	Lack of (physical) access, Dangerous/ unsafe Lack of outdoor code of conduct	Lack of proximate nature Unsafe proximate nature Social disregard for common nature space

FIGURE 1
Access to nature is more complicated than time and proximity (adapted from Beery et al., 2023).

collective levels, may contribute to a diminished human relationship with nature. The middle circle presents eight potential dimensions of disconnection, while the outer circle provides specific types or examples. For the purpose of this paper, access and, relatedly, time are highlighted; these factors appear in the figure in numerous ways; consider a sample of themes from the wheel of disconnection, both dimensions and types of disconnection (circled in red). These examples are further developed in the chart below the wheel to expand a review of the access-time linkage (see Figure 1).

Note, in this effort to broaden how we look at C2N via a better understanding of disconnection, we must constantly remind ourselves that the forces of connection and disconnection are not exclusively individual or social, but most often both and highly intertwined; we draw inspiration from related work exploring individual and social determinants of pro-environmental behavior (Bamberg and Möser, 2007).

2.3 The case of Sweden

Sweden presents an interesting context to consider access to nature for children's after school time, given the history and practice of *Fritidshem* (the institutionalized SAEC of Sweden), universal access rights, outdoor education traditions, and available green structure data (Beery, 2013a; Remmen and Iversen, 2022; Statistics Sweden, 2022). For the specific context of this study, two of these elements were included in the background; one, available urban green structure data from Statistics Sweden (2022) inspires considering children's access to nature.

Furthermore, the history and tradition of fritidshem are presented to provide insight into the research context. It needs to be acknowledged that other sociocultural forces shaping access are important as well; for example, awareness of the reality of a dynamic cultural situation in Sweden, with extensive immigration and social change, may be able to support a more comprehensive understanding of the sociocultural forces at play (Jönsson and Kojan, 2017).

2.3.1 Green structure

Urban green structure data and analysis are publicly available in Sweden for the largest community of one million inhabitants (Stockholm) down to communities of just 200 inhabitants (Statistics Sweden, 2022). Statistics Sweden also delineates green structure as green space and green areas; definitions are helpful for this deeper consideration of children and nature:

- *Green space* is defined as the total green structure (parks, open lawns, wooded or grassland spaces, green construction sites, residential gardens, green spaces between multi-dwelling buildings, *etc.*).
- *Green areas* are defined as contiguous green spaces of at least 0.5 ha accessible to the public.

An average of 94% percent of the Swedish urban population have access to at least one green area within 200 m of their residence (Statistics Sweden, 2022). Of course, not all green spaces are available to the public, with 37% of Sweden's total urban green space classified as private gardens or restricted in some way. To zoom in a little for this study, a query in the Statistics Sweden database was conducted for the share of urban population 7–15 years with public green areas within 200 m from dwelling by locality. The results indicated that 87% of Malmö children ages 7–15 had access to at least 0.5 ha of green spaces from their residences. This high percentage is a positive indication, and while not as nuanced a measure as compared to the definition of nature used in this study, it is nonetheless a hopeful indicator regarding access to nature for children.

2.3.2 The tradition of fritidshem

While institutionalized out of school time care takes many forms throughout the world, the Swedish tradition of institutionalized leisure activity programs for children before and after the formal school day, school-age educare (SAEC), is unique; Swedish SAEC has a long-standing history, a dedicated curriculum, specific teacher requirements, and high levels of participation. Swedish SAEC dates back over a century (Rohlin, 2012; Hippinen, 2017) and follows the overall Swedish school law and general curriculum for preschool, elementary school, and school-age educare (Skolverket, 2022). Within the general curriculum, Swedish SAEC has four main content areas, including "*nature and society*" and "*play, physical activity, and outdoor activities*" (Skolverket, 2022, pp. 24–26). Swedish SAEC teachers must have a university undergraduate degree. Despite SAEC being non-compulsory, >85% of Swedish 6–9 year old children are enrolled (Statistics Sweden, 2022). SAEC's educational aim is to support formal educational learning goals. The pedagogical aim is to ensure children's meaningful leisure time, recreation, and social care; this aim is often viewed as a unique leisure pedagogy or a SAEC didactic framework (Lago and Elvstrand, 2019). SAEC aims to secure the possibility of curiosity and intrinsic motivation-driven activity (Halldén, 2007), as well as time and opportunity for free play and exploration (Holmberg and Kane, 2020).

In 2016, SAEC experienced a shift in governmental affiliation from the Health and Welfare Department to the Education Department; this shift changed the legal circumstances and pedagogical practices of SAEC (Lago et al., 2022). Hence, an accompanying shift concerning pedagogical aim and practice began from an original focus on children's psychological and personal development to a focus on children's learning and cognitive development (Hippinen, 2017; Haglund and Ackesjö, 2021). Post affiliation shift, a SAEC report conducted in 2018 set out to evaluate the new affiliation context and found that almost 50% of SAEC nationwide needed to improve education in order to "*benefit pupils' possibilities to explore and describe phenomena and connections in both nature and society*" (Skolinspektionen, 2018, p. 23). This combination of the non-compulsory aspect of SAEC with the Department of Education affiliation creates a conflict between the institution existing as a voluntary leisure institution vs. primarily serving as a support towards a greater educational curricular goal (Hjalmarsson, 2013). This conflict is often viewed as a threat of the *schoolification* of the SAEC institution, i.e., a movement toward a more formal instruction model (Djurberg, 2021), causing SAEC teachers to fear a loss of value in their profession (Hjalmarsson and Löfdahl Hultman, 2015). This situation creates a growing demand for clarity of the aim and purpose of each institution under the school curriculum (Lago et al., 2022).

3 Materials and methods

This section will describe the spatial analysis methods used to consider the direct factor of access. Time to access or time spent in nature by SAEC children is not measured; however, we contend that time in nature and the potential for time can be assumed from a barrier-free estimate of distance; this approach to measuring nature contact has recently been documented in a narrative review (Holland et al., 2021). The distance measurement and a simple landscape rating system provide a process for analyzing the level of access to nature from 67 public SAEC sites in Malmö, Sweden. In order to provide clarity in the methods, we operationalize the term nature from the definition provided in the background coupled with Statistics Sweden's definition of green space and green areas. The relational idea of kinship or belonging is the critical element that binds these ideas together (see Figure 2).

3.1 Spatial analysis

A spatial analysis was conducted to consider the proximate access to nature for children attending public SAEC sites in Malmö, Sweden. Maps were created based on measured distances and a simple landscape rating system. Data sets to create the Malmö SAEC proximate nature map were acquired from Malmö municipality and

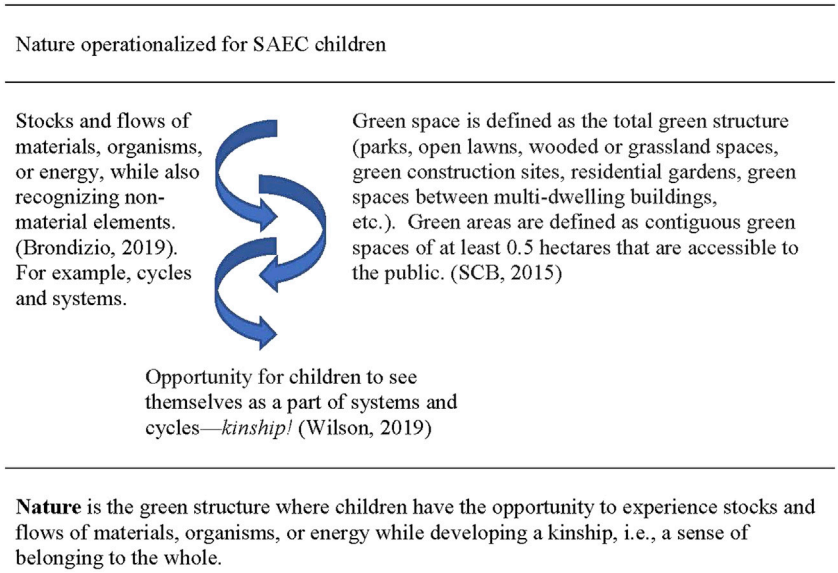


FIGURE 2
Nature operationalized for SAEC children.

Lantmäteriet (Swedish land surveyor). From Malmö municipality, a vector dataset was used, providing roads, surface areas, and school locations. From Lantmäteriet an orthophoto (0.5 m x 0.5 m) was used. Software used where Qgis 3.22.11-Białowieża used.

The following criteria were used to select the SAEC facilities to include in the analysis:

- Facilities must be located within the boundary of Malmö municipality.
- Facilities must represent public SAEC sites.

The initial plan was to use network analysis, starting from each SAEC site (Shih, 2006). However, during the literature review and initial data review process, it was clear that this method would not reflect reality. People generally move freely on both public and private lands in Sweden, and children have high levels of independent mobility due partly to earlier planning regimes (Mårtensson and Nordström, 2017). This access mobility in Sweden is usually considered part of the land access rights of allemansrätt, a freedom inscribed by Swedish Law (Regeringsformen 2kap 15§). However, urban aspects of this open mobility also exist less formally. For example, green urban space tends to be fluid between public and private (notwithstanding private fenced gardens and immediate proximity to residences); green spaces between multi-dwelling buildings most often have an open, accessible quality. Further, Sweden has a discussion regarding access rights in the city as a form of urban access rights (Rydén, 2016). Therefore, the network analysis based on registered municipal roads provided misleading results.

The automation of network analysis was also made more difficult because the areas judged most suitable for nature access were mostly rudimentary areas that needed to be classified correctly in that set, e.g., small forest groves and unmanaged edge zones. Given these concerns for network analysis, the procedure was adjusted based on buffers of 200 and 400 m. These measures are derived from previous studies (Wolch et al., 2005; Scherer, 2006) and the Parma Declaration emphasizing access to green space for play and physical activity for children (Sobko et al., 2019). Further, Statistics Sweden's use of the 200 m measurement in Swedish green space/areas analysis (Statistics Sweden, 2023) supports the methods. In addition to the buffers, a visual assessment was conducted against the orthophoto and google street view. The schoolyard analysis was completed based on previous research highlighting the importance of the immediate schoolyard for nature experience (van Dijk-Wesselius et al., 2020; Askerlund et al., 2022). Since only 67 SAEC sites were included in this study, this was more appropriate than creating an automated network analysis.

The review process of consideration of the 200/400 m buffers in conjunction with a visual assessment (orthophoto and google street view) was conducted twice by two research team members. The initial analysis helped the researchers fully establish the scoring protocol; a simple point system of 0–3 points based on reviewing the 200/400 m buffers and a 1–4-point analysis of the schoolyard (see Table 1). A second analysis was conducted by the same two researchers using a refined protocol to ensure the results of the first analysis were valid measures; part of this second review step was carefully considering the areas seen as highly managed green areas. The final validity test involved ground truthing. Ground truthing was conducted on seven SAEC sites; this process involved visiting the sites, walking the 200/400 m buffer, and making a field observation of the schoolyard. Two sites were field-checked based on difficulty interpreting orthophotos during the data review process. Five additional sites were randomly chosen from the list of remaining school sites and checked for comparison

10.3389/fenvs.2023.1225044

TABLE 1 Criteria for categorizing SAECs.

	Category	Score
Vicinity	No nature within 400 m buffer	0
	Highly managed green space within 400 m (e.g., tended grass and garden areas; individual trees)	1
	Nature within 400 m buffer (areas of untended green space)	2
	Nature within 200 m buffer (areas of untended green space)	3
School Yard	No schoolyard nature	0
	Only hard surface	1
	Green playground (trees, bushes interspersed)	2
	Nature areas (areas of untended green space)	3

with the analysis results. All 67 SAEC sites were categorized according to the criteria specified in Table 1. The criteria provided a score for the neighborhood around the school and the schoolyard itself.

4 Results

Figure 3 provides a map of the 67 SAEC sites in Malmö. The results from the criteria scoring are color-coded to indicate values from the vicinity and schoolyard analysis.

The results from the review of schoolyards show generally positive schoolyard opportunities for nature access, with an average score of 2.2 (σ 0.7) (see Table 2) out of 3 possible; Seven schoolyards scored a 1, the lowest possible score for a schoolyard. For the vicinity score, the average was 2.1 (σ 0.9) out of a possible 3, where the majority had inviting green areas within 400 m and many within 200 m. Four out of 67 were classified with a score of 0, i.e., lacking green areas within 400 m. The average score (sum of both classes) was 4.2 (σ 1,4), with two SAEC sites earning the minimum of one point and 16 (24%) earning the maximum of six points.

Given the efforts to fine-tune the analysis as outlined in the methods, and efforts to review results based on field site checks at seven SAEC sites in Malmö, several other results emerged. In general, rating the schoolyards was complicated. For example, it was noted that at many of the recently built schools, there was little nature *yet*. However, tree planting and landscape efforts

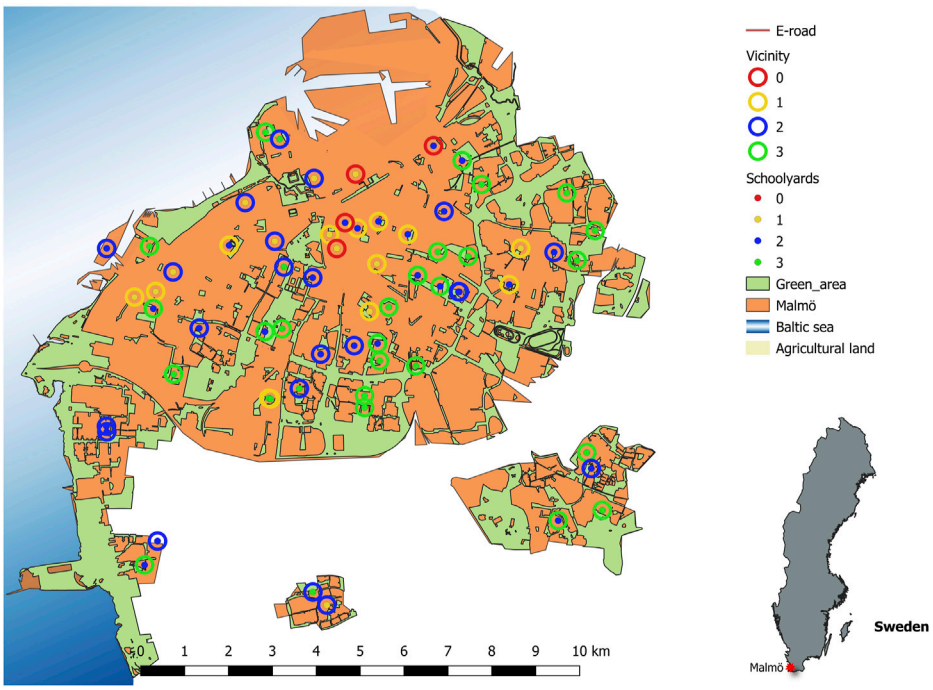


FIGURE 3
67 SAEC sites in Malmö, color-coded to indicate values from the vicinity and schoolyard analysis.

TABLE 2 Descriptive statistic table.

	Vicinity	Schoolyard	Sum (vicinity + schoolyard)
Mean	2.1	2.2	4,3
Sd	0.9	0.7	1,6
Min	0	1	1
Max	3	3	6

(N = 67).

gave the appearance of a potential future nature play space (see Figure 4).

There were also sites with minimal actual areas of unmanaged nature, yet with evidence of children taking advantage of whatever was available, *micro spaces*. Consider the pathways behind the bushes in Figure 5.

Another observation from ground-truthing the methods was the observation of deliberate efforts to create active and engaging playscapes at many of the SAEC sites–playscapes that often had a low point value regarding nature (given the managed aspect of the site or minimal space), while still offering the potential for unique affordances to support quality outdoor play (see Figure 6).

Yet another observation from the field site checks was the deliberate inclusion of nature elements as part of the site design, some elements with play potential and others not (See Figure 7). These elements may communicate a value in nature as a part of the children's daily environment, even if some were not accessible to the children.

5 Discussion

The general results of this study provide consideration of outdoor SAEC learning environments. In addition, these results help us to consider the critique that there may be an overreliance of focus on individual measures in questions of connectedness (Beery et al., 2023). Proximity data can help us take steps toward more comprehensive considerations of connectedness. This section will address both spatial methods that can best serve connectedness to nature questions of this type and provide a short review of this access to nature opportunity in Malmö SAEC. However, the main focus of this discussion is the bigger question of a more holistic approach to addressing collective barriers and opportunities in consideration of children's nature experience and C2N.

5.1 Spatial analysis method

One aspect of the spatial analysis to be considered is the method itself. This particular analysis started with a network approach based on previous research (Shih, 2006). The network analysis was quickly abandoned, given an assessment of public access in a Swedish urban context. The network analysis was changed to 200m and 400 m distance measures. The combination of the schoolyard and the 200/400 m assessments was deemed helpful for providing a realistic picture of proximate access. Ground truthing added yet another element of complexity, an up-close view of schoolyards. While supportive of spatial analysis ratings, the visits to school yards provided an additional perspective of the potential for nature experience not easily captured via GIS mapping and orthophoto/google street view of the spatial analysis process. For example, Figure 5 featured a micro-nature space at one of the schools—schoolyard trails used by children in tiny schoolyard spaces. One can imagine a potentially rich nature experience for children crawling through the bushes. The on-site details do not provide a conclusive picture of access to nature but provide insight into the opportunity. Thus, it is recommended to include ground-truthing as an integral step in spatial analysis of this type for a more comprehensive understanding of access to nature in future studies.

5.2 Opportunity in Malmö

Not inclusive of the schoolyard analysis, 26 schools out of the 67, or 39%, had access to nature within 200 m. Compared to the previously noted statistics from Statistics Sweden indicating 87% of children in Malmö aged 7–15 have access to green space from

FIGURE 4
Potential future nature play space.

FIGURE 5
Micro nature spaces.

FIGURE 6
Affordances to support quality outdoor play.

their residence, it seems low. Of course, two key factors must be considered when comparing these outcomes; one, the 39% statistic uses a more nuanced definition of nature than Statistics Sweden's definition of green space. Moreover, schoolyards were not included in the 39% outcome. If we add schoolyards earning the highest rating for nature, then 31 schools, or 46%, had access to nature at this highest level.

The difference between the Statistics Sweden measure and the measure used in this study is a critical consideration. If we relied upon the 200m/87% access indicator, we would feel quite optimistic about the current nature access situation for children in Malmö. If we take to heart the literature on the extinction of nature experience, we must broaden it to consider physical spaces that provide rich sensory access to systems, cycles, and living organisms. We, therefore, use the rating system in this pre-study, resulting in an unfortunate outcome. We can use the combined schoolyard and vicinity score to gain a better overall sense of nature access opportunity, given the combined mean average of 4.2/6.

Beyond the scoring, the ground-truthing follow-up provided the researcher with an important reminder that we can consider schoolyards from the perspectives of quality, safety, and positive experience (Buchecker and Degenhardt, 2015; Moran et al., 2017). Quality of accessible nature can be considered in many ways, for example, through the opportunity for children's wild play to ecological measures such as biodiversity indicators (Muvengwi et al., 2019); however, such quality measurement was beyond the scope of this study. One aspect of quality noted in

FIGURE 7
Nature elements as part of the site design.

the observation notes from the ground truthing was levels of human waste in the form of garbage present in the observed schoolyards and proximate nature. Garbage in bushes may create a sense of risk. It may deter the use of such spaces by caregivers such as parents and teachers setting boundaries for play or by the children themselves, i.e., children not feeling safe or comfortable playing where garbage is accumulated in bushes, trees, and other green spaces (Beery, 2020).

5.3 Proximate access as a gateway to a collective C2N approach

The study's results can remind some schools of the opportunities they have close at hand. Other schools may be reminded of the challenges they face regarding access to nature for SAEC children. We propose that the potential challenges be seen as a motivation for schools to consider how proximity to nature can be modified; the following questions can be asked:

- How can Malmö SAEC teachers take full advantage of existing nature experience potential?
- How can Malmö schoolyards be redesigned to facilitate nature experience?
- Do proximate gray spaces exist that can be converted/restored and prioritized for child nature experience?
- What mechanisms exist or can be developed for regularly getting kids off school campus to nature-rich sites?

The results provide helpful information for those Malmö city planners, schoolteachers, and school administrators responsible for planning and managing the intersection between physical space and educational programming; they can use this information to improve poor access or maintain good access. We see the above questions like the above highly relevant to Malmö and other similar cities heavily investing in a gray-to-green transition (Tsegaye et al., 2019); we argue that along with climate mitigation, climate adaptation, new housing, and other urban needs, children's access to nature should be prioritized (Beery and Lekies, 2021).

This initial emphasis on children's school-based proximity and access to nature demonstrates how these factors of disconnection are intertwined. For example, we are especially interested in considering these questions from the context of the SAEC, given noted concerns that SAEC sites are taking on a more school-like role, i.e., formal school-based outcomes vs. more play-based or recreational outcomes (Hipinnen, 2017; Boström and Berg, 2018). Such concerns fit within the wheel of disconnection (Figure 1) as an example of the philosophic domain leading to further extinction of experience. We see concerns in a false choice narrative that pits academic outcomes against the value of nature play and nature experience (Sahlberg and Doyle, 2019). The SAEC is a critical arena to address this false choice for children's wellbeing and development as they operate in both in-school and beyond the formal school day contexts. Moreover, whether in a formal or non-formal school setting, research has shown that children's direct nature experiences support specific wellness outcomes, not least health, cognitive, affective, and physical growth and a connection in the form of kinship (Bratman et al., 2012; Chawla, 2015; 2020; Beery and Lekies, 2021).

5.4 Beyond the spatial

Given the importance of spatial considerations indicated in previous research, we separated the proximity factor from the myriad of other C2N variables and focused on it. The next research step beyond this current study will be to put the spatial data back into the mix of other factors to continue considering access to nature via SAEC programs. Beyond physical proximity, numerous other school factors, such as teacher preferences, curriculum, and institutional norms may play a substantial role in the opportunity for nature experience. Moreover, numerous other sociocultural factors can impact children's opportunities for nature experiences beyond school context factors. Table 3 provides examples of factors that can hinder children's nature experience; Table 3 is a direct follow-up to The Wheel of Disconnection (Figure 1). These examples are not meant to be exhaustive but rather to remind us further that access to nature experience is complex and collective factors can play a significant role in nature access opportunity; in addition to a listing of potential barriers, the table also provides examples of programs or actions that challenge these potential barriers and may be able to provide insight into addressing disconnection.

TABLE 3 Nature experience, example of collective barriers, and engaged response.

Domain	Examples	Details	Sample research	Addressing the barrier through practice (positive examples of action)
Socio-cultural	Exclusion	Lack of social access	Byrne (2012)	• Black to Nature podcast (Dunning, 2021)
	Cultural norm dominance	Role of adults	Skar et al., 2016	• Outdoor Afro group (Outdoor Afro 2022)
				• Save the Children's Child to Sea and Forest program in Malmö (Wail et al., 2018)
Institutional	Discrimination	Institutionalized arrangements that hinder nature experience	Rigolon and Németh 2021	• Using nature-based solutions to address equity issues (Boyland et al., 2022)
	Displacement		Engelberg et al., 2016	• Six ways to approach urban green spaces in the push for racial justice and health equity (Hassen, 2021)
	Distributional inequalities			
Material	Dangerous/unsafe	Lack of safe proximate nature	Lapham et al., 2016	• National Wildlife Federation Safe Spaces Initiative (NWF, 2022)
	Lack of outdoor code of conduct	Inappropriate outdoor ethical behavior	Shortt and Ross 2021	• Park safety audit process of the National Recreation and Park Association (2023)

6 Conclusion

Access to nature experiences for children is complex. In this study, we explored the critical variable of proximity access to nature variable while avoiding implying that distinct variables exist free from the whole of other factors. Thus, we have attempted to quantify access using a refined spatial measure for application with other measures of nature experience and C2N in studying children and nature in the real-world context of SAEC. Given the noted concern for the extinction of experience, we must consider where and how our children spend their time and what opportunities or potential opportunities, along with barriers, exist. We must go beyond the individual child's experience and consider collective barriers. Perhaps most important, as we consider barriers to connection, is the interplay between individual and collective factors that may support or diminish C2N (Beery and Jørgensen, 2018; Byrne, 2012; Orwehag, 2020; Pyle et al., 1993; Richardson et al., 2022; Wells and Lekies, 2006).

Data availability statement

The raw data supporting the conclusion of this article will be made available by the authors, without undue reservation.

Author contributions

TB was involved in all aspects of conception, research and manuscript development. HD completed GIS analysis and contributed to manuscript development. TW and MF were involved in project conception and manuscript development. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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