

Do you have a tree friend?—Human–tree relationships in Finland

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Abstract

1. Trees are natural objects that carry practical, cultural and spiritual meanings to humans. Trees are an elemental part of human daily life, both in urban and rural environments, and even in locations where forests are distant. Conflicts related to tree removal in the close environments of humans indicate that individual trees may have special significance. Despite that, we have little knowledge of the ways these relationships are formed and the meanings they carry.
2. To examine how the properties of trees and humans influence the type of relationships that are formed between them, we conducted a large-scale survey ($n = 1758$). We used cluster analysis to identify typical groups of trees and human–tree relationships and conducted cross-tabulation to correlate human and tree types in the relationships. In studying the human–tree relationship, we applied the framework of natureculture to address how the lives of humans and trees are bound together in interspecies relationships.
3. Our results show that the strongest influence on tree–human relationships originates from human lifestyles and nature connections. Consequently, we identified three main types of human–tree relationships: (1) *Admiring relationships* towards large, old and charismatic trees, primarily grounded in sensory and emotional experiences, are common among urban nature-loving people. (2) *Nurturing relationships* that occur with young trees in people's own gardens, which is most typical for rural outdoorspeople owning houses. (3) *Nostalgic relationships* are associated with trees with symbolic value in the memories of people who no longer have a material connection to an important environment.
4. Our study revealed that the affection of humans for trees in their close environment strongly varied in emotional intensity and practical actions related to trees. We provide new knowledge of the correlations between human and tree characteristics in forming their interspecies relationship and how this relationship affects human emotional well-being. Based on our findings, we suggest that understanding human–nature interdependence helps to sustain and create emotionally supportive multispecies environments through green design and management.

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KEYWORDS

biophilia, charismatic trees, human–nature relationship, human–tree relationship, nature relatedness, natureculture, urban vegetation

1 | INTRODUCTION

The tree which moves some to tears of joy is in the Eyes of others only a Green thing that stands in the way. (Blake & Kazin, 1986)

The relationship between humans and trees regularly gains media attention when individual trees and tree groups are being cut down in parks, recreation areas, neighbourhoods or any location where people spend time. For example, in Stockholm, the 1971 Elm Conflict (Almstriden) was an infamous public protest over the felling of a group of trees in the city centre that remains a landmark of the development of civil activity in Sweden (Helldén, 2005). In the Netherlands, large-scale rescue attempts were made to save the horse chestnut that grows outside of Anne Frank's house and is mentioned in her diary, and the eventually succumbed tree was seen as a symbol of hope (Katz, 2010). In Finland, the fall of street elms sparked protests in 2017 and the memory of the trees was paid respect by decorating the tree stumps with candles and making memorial objects from the wood material (Helsingin Sanomat, 26.1.2017). These examples are just a few of many and show how the disappearance of trees has the potential to awaken deep emotions and public debate. As Jones and Cloke (2002) state in their work of tree-places, concern and conflicts that arise when trees are felled near human habitations provide some evidence to the emotional and symbolic importance of trees. In this context, the focus of media and research is mostly on societal conflicts between urban planners or decision makers who have plans to fall the tree(s) and those acting against those plans. However, how these emotional bonds between trees and humans are formed in the first place has slipped the radar of both the media and the scientific community. Furthermore, for most of their duration, human–tree relationships are not associated with conflicts, but occur in the everyday lives of people. The characteristics of these mundane, yet significant relationships have not so far been studied.

Historically and biologically, humans and trees are naturally adapted for co-living. Humans have learned to plant, grow and harvest the goods from trees, which has helped trees expand and remain in human-inhabited territories. Humans can have a physical effect on trees by planting them, taking care of them or eventually cutting them down. In recent decades, the practical use of trees has been acknowledged in urban environments assisting in the regulation of, for example, air quality, noise, dust, heat, moisture and pollutants (Carter et al., 2018; Grylls & van Reeuwijk, 2022; Nowak et al., 2014; Pathak et al., 2011). In line with these uses, the effects of trees on humans have been studied from the point of view of physiology, such as the connection to trees lowering the heartbeat and relieving mental stress (see, e.g. Hartig et al., 2003; Simkin et al., 2020; Ulrich

et al., 1991). In addition to material goods and services, trees are also valued spiritually and have been key elements in many mythologies (Harva & Anttonen, 2019). As observed in conflicts, contemporary symbolism associated with trees that may differ culturally around the world includes their role as carriers of cultural, national or political values; symbols of historical continuity; and focal points of local and global ecological concerns (Jones & Cloke, 2002; Rival, 1998). Furthermore, trees are long-living organisms compared to humans and thus can have strong connections to the personal and family history of humans (Rival, 1998). However, most tree-related research has focused on the physical aspects of relationships, neglecting the social and personal aspects.

Human–tree relationships can be expected to be very different in nature from those between a garden tree and the owner or between an urban resident and a park tree. The properties of humans and trees that predict the formation of such relationships consisting of different practical activities around the tree and displaying varying emotional intensity could be studied and classified with numerical methods. However, to capture also the biological and cultural aspects of tree relationships, they need to be studied in relation to environmental humanistic theories and ideas about human–nature relationships. Anthropologists have long acknowledged that cultures as symbolic systems derive symbolic meanings from natural elements (Ingold, 2011; Rival, 1998). The affection towards trees (and towards nature in general) has also been explained through human biological tendencies, to seek connections with the rest of life by perception on environment, and subconscious validation on aspects most useful for human survival. Nature connection, or *biophilia*, or 'Love of Life' is considered essential to our physical and mental growth and well-being, and thus proclaims a human dependence on nature that extends far beyond simple issues of material and physical sustenance to also encompass the human craving for aesthetic, intellectual, cognitive and even spiritual meaning, and satisfaction (De Lacy & Shackleton, 2017; Kellert & Wilson, 2013; Wilson, 1984).

Such co-living can be called *friendship* in the sense that Aristotle described the friendship concept 'philia' in his book *Nicomachean Ethics*. Although his focus is on human relations, he indicates that this sentiment can be felt towards other living beings (Aristotle, 1962). Santas proposes that biophilic friendships must be conceived more abstractly and broadly as an interconnecting characteristic of biotic systems (Santas, 2014). In this study, we are curious to explore whether the concept of biophilic human–tree relationships is adaptable to study interspecies human–tree relationships as a form of *beyond-human companionship* (Kohn, 2013).

The relationships between humans and trees or forests have mainly been studied from the point of view of benefits for humans and how humans alter their surrounding green spaces. Currently, the posthumanistic multispecies approach (Abram, 1997;

Haraway, 2008; Kirksey & Helmreich, 2010) aims to understand the relationships between humans and nonhumans, underpinning the observation that nonhumans are not only objects of our activities and tools to achieve physical well-being goals but they can also be subjects that affect human behaviour and experience and having an intrinsic value of their own. In this action, humans can be seen to cross the boundaries of culture and nature and create a new *nature-culture* (Haraway, 2008; Latimer & Miele, 2013). The concept of natureculture breaks the traditional subject-object division, where the human being is subject and the tree is the object of human desires or scientific measurements. In this work, we refer to the tree as *more-than-human* (Abram, 1997), seeing a tree not only as an individual being but also as an ecosystem of multiple species. A more-than-human perspective allows us to consider the lives of humans and trees as entwined.

Knowledge of human-tree relationships is essential in land use planning, especially given the conflicts that have arisen around trees in both urban and rural environments. In many countries, specific and notable trees are mapped and protected by law as historical and environmental monuments (Hall et al., 2011; Nolan et al., 2020; Potinkara, 2004). However, not all trees with emotional importance to humans can be listed in these inventories and not all can be protected by law. To account for the human-tree relationships, it is therefore important to know if and how they can be predicted based on the characteristics of humans and trees. Understanding human-tree relationships holistically, as cultural, social, and biological phenomena, could increase our understanding of human well-being as part of the natural world. To address the gaps in knowledge mentioned above, we conducted a national survey in Finland to study the properties of human-tree relationships aiming to answer the following questions: (1) What kind of relationships do people have with their favourite trees and (2) is the nature of human-tree relationships predictable based on human and tree characteristics or traits?

2 | MATERIALS AND METHODS

Finland is one of the most forested countries in the world. The rural landscape is covered by managed forests dominated by pine (*Pinus sylvestris*), Norway spruce (*Picea abies*) and birch (*Betula* spp.). In cities and gardens, the variation in species is richer and includes multiple nonnative and ornamental tree species. Historically, trees have had great cultural and spiritual importance as seen in Finnish folklore, where trees were significant for individuals and families as sacrifice places and as house guardians (Haavio et al., 1992; Malinen, 2015; Potinkara, 2004), memorial sites and marked physical and magical boundaries and routes (Drischenko, 2019; Haavio, 1967; Viikuna, 1992). Today, some older trees are protected as cultural and natural monuments, and knowledge of old traditions is of interest for artists and spiritually minded people (Kovalainen & Seppo, 2006; Potinkara, 2004). However, despite the widely documented historical and mythological importance of

individual trees, their meaning to human beings in modern everyday life is poorly understood.

2.1 | Data

We collected data for this study in Finland between 2019 and 2020 using an open web-based survey created with the electronic survey tool 'E-lomake' (E-Form) provided by the University of Eastern Finland. We had both closed-ended and open-ended questions, but the latter were not examined in the current analysis, since we were looking for the generalization of the quantitative data. It was possible to submit the survey without answering all the questions (Appendix S2: Survey form).

A questionnaire with 44 questions was divided into three themes: background information of the respondent, questions regarding the favourite tree and details of the human-tree relationship. Human characteristics covered demographic details, such as the age and education of the respondents (questions 27 and 36) and nature-related activities and valuations of the respondents (questions 40–44) (Table S2). The characteristics of the trees included in the survey covered, for example, the location of the tree (questions 3 and 4), the species of the tree (question 6), and the age and shape of the tree (questions 9 and 15) (Table S2). Questions related to human-tree relationships covered the duration of the relationship (questions 17, 18 and 23), the type of affective bond with the tree (question 20), the most important sensory traits of the favourite tree (question 16), the willingness of the respondent to defend the tree (question 21), tree ownership (question 26) and tree-related practices in the real world (question 22) (Table S3).

Information related to human and tree characteristics was collected to examine whether these characteristics can explain human-tree relationships. Given the absence of previous studies and theories of human-tree relationships, we had to narrow down characteristics that could be important ingredients or predictors of these relationships in the cultural context in Finland based on earlier literature on other human-non-human relationships. When planning the survey, we examined the factors that have been found in previous studies to be important for place relationships (e.g. Goodbody, 2011; Korpela & Ylén, 2007), human-nature relationships (e.g. Bashan et al., 2021) and human-forest relationships (Apajalahti et al., 2022; Halla et al., 2021). These are, for example, memories, childhood experiences, family background, values, identity questions, restorative outcomes and distance to favourite place. The sensory study approach offered us perspective on how people connect to places and environments through multisensory and affective experiences (Ingold, 2011; Järviluoma & Vikman, 2013). Therefore, we included questions about soundscapes, smell, visual phenomena, as well as pleasure and emotional aspects related to the participants' favourite tree. In line with environmental psychology, human nature relatedness (e.g. Mayer & Frantz, 2004; Nisbet et al., 2009) is linked to respondents' engagement in nature-oriented activities and their valuations. Hence, we included a set of questions to assess nature

connections, although we did not directly employ a known nature relatedness scale. Instead, we adopted key elements to gauge participants' fundamental orientation towards nature. We intend to develop the framework further in forthcoming studies.

To reach people with different backgrounds, lifestyles and values, we searched for survey respondents through various social networks (Facebook, Twitter and Instagram), through email lists of different stakeholder organizations and through the visibility of the mass media (Table S8). We also promoted our study at public events, such as a forest exhibition and a demonstration against the demolition of a park, on shared posters and flyers in public libraries and museums, in nature centres of national parks and in educational institutions. Geographically, our goal was to reach similar numbers of people from larger cities (e.g. Helsinki and Turku), smaller towns (e.g. Joensuu) and rural areas in Finland.

In total, 1659 responses were included in our analysis. A further 99 respondents did not indicate a specific favourite tree, but were interested in trees in general. Their responses were not included in this study. Details of our sample population are presented in Section 3.1, as this information was also used in the analysis. Due to the self-selection process, our survey primarily reached individuals with connections to trees. Although this aligns with our study's focus, it may not fully represent the diversity of opinions and perspectives in the broader population, especially those with weaker tree connections, which can differ not only in intensity but also in quality. Our sample was not designed to be representative of the entire Finnish population but rather aimed to capture the diversity in tree relationships among Finns. Although there was an overrepresentation of women, other demographic variables, such as age, education and regional distribution, matched the Finnish average.

The research ethics were carefully considered by the research group in designing the study. Research was carried out under the Responsible Conduct of Research (RCR) of the Finnish National Board for Research Integrity TENK. According to the national RCR guidelines provided by TENK, no ethical approval was required for this study, as there was no interference with the risks of physical integrity or safety of the participants. Data for the study were collected through a voluntary questionnaire with informed consent. Participants were informed of the data policies, confidentiality and the processing of personal data. All participants agreed to provide their anonymized answers for this research and other scientific applications. We avoided collecting unnecessary sensitive data about participants. However, the story of the tree and some personal data (contact information and city of residence) were collected to search for interviewees for the second part of the study. The study focus group was adults over 18 years of age, but some minors, with the permission of their parents, participated with them in the 'Science Night' event of the University of Eastern Finland. The safety of sensitive information has been ensured with the help of a data protection specialist. In this paper, the data were used without qualitative survey responses that could have revealed sensitive information. The anonymized data sets used in this study will be archived at the Finnish Forest Museum Lusto and will be found with the project

name 'Puut Lähellämmä (Trees Near Us)' (Finnish Forest Museum Lusto).

2.2 | Data analysis

Our questionnaire contained three sections that produced three data sets referred to as 'Humans' ($n=1625$), 'Trees' ($n=1565$) and 'Relationships' ($n=1647$) (Tables S1–S3). Respondents were advised to answer all three sections, although this advice was not always followed, which produced some variation in sample size between the groups.

First, we applied the principal component analysis (PCA) of mixed data (PCA_{mix}, Chavent et al., 2014) in R (R Core Team, 2017) to reveal the main gradients within these three data sets. This method allows the analysis of a mixture of categorical variables, continuous variables and ordinal variables. Questions with ordinal numerical categories, such as the age of the respondent or the height of the tree, were treated as quantitative variables using the class centre as a value. In the Results section, we report the results based on the three first PCA axes that explained most of the variation in the original data.

The clustering method of K-medoids (Reynolds et al., 1992; Schubert & Rousseeuw, 2019) was then performed with R using the PCA_{mix} results as a starting point. The aim of the clustering was to form homogeneous groups of responses within the three data sets (humans, trees, relationships). The number of clusters and PCA axes used was decided on the basis of the interpretability of the clusters after testing several combinations. We also visually interpreted the PCA scree plot to find a point after which further PCA axes provided little additional information of the original data (i.e. the point where the scree plot curve levels off). Our aim was to find clusters that were interpretable and that differentiated from each other.

Finally, the clusters of the human and tree data sets were cross-tabulated with the clusters of the relationship data set to assess whether the human and tree traits are related to various types of human–tree relationship. Cross-tabulation and associated χ^2 -tests were performed with SPSS (SPSS, version 27.0.1, IBM Corp, 2020). We considered that a 25% deviation from the expected frequency represented a notable connection (or disconnect) between the clusters (Appendix S1).

3 | RESULTS

3.1 | The characteristics of the respondents

The respondents ($n=1662$) represented a wide range of age groups, from children aged 4 years to the elderly up to 90 years (Table S1). People in all age groups participated in the survey in large numbers, but the largest group was women in the age group 50–59 years. With women comprising 81% of our study's participants, this aligns with the common trend in voluntary surveys. This distribution reflects

broader social norms in Finnish culture, where women often engage more openly in discussions on emotional topics compared to men. However, it is crucial to avoid generalizing these findings to imply that women are more likely than men to form emotional connections with trees. Human–tree relationships are influenced by various factors, so gender is just one aspect to consider. Young people under 18 years of age were underrepresented, as the survey was primarily aimed at adults. However, some children under 16 years of age participated in the study with the consent of their parents.

The place of birth and residence of the respondents were distributed throughout the country. The largest number of responses was collected from large cities such as Helsinki and Turku. The Joensuu people were statistically overrepresented since the study was physically placed on the Joensuu campus of the University of Eastern Finland and therefore received much attention in local media. In total, 72% of the respondents lived in large cities, suburban areas and small towns (Table S1). The self-defined identity of the respondents was divided equally between 'urban' (37%), 'countrymen/women' (32%) and 'both' (27%). The two most common housing types were 'detached house as an owner' (24%) and 'apartment building as a tenant' (18%). Most of the respondents (42%) had moved to another municipality one to three times in their lifetime.

Approximately half of the respondents (53%) had land property (Table S1). Most owned several types of land, such as a plot for a house and a forest. More than one-third of the respondents (38%) had jobs related to trees and forests. This included both direct roles, such as professional gardeners and forest experts, and indirect connections, such as teachers, creative artists and researchers.

Most of the respondents had a strong connection to nature (Table S1). Nature's qualities and assets, such as beauty (89%), recreation (82%), biodiversity (79%), spiritual experiences (64%) and natural products (61%), were widely appreciated, in contrast to financial benefits (10%). The most common activities near trees were walking (93%), collecting natural products (74%), relaxing (72%), observing nature (68%) and longer day hikes (66%).

According to PC analysis, the main gradients within the respondent data represented (i) strong versus weak interaction with nature (PCA axis 1; eigenvalue 5.6; Table S1; Figure S1), (ii) urban versus rural living environment and identity (PCA axis 2; eigenvalue 4.2; Table S1; Figure S1) and (iii) higher versus lower education (PCA axis 3; eigenvalue 2.3; Table S1; Figure S2). The PCA axis 1 separated respondents who reported multiple personally important activities related to nature and qualities of nature from those who did not. Along the PCA axis 2, urbanity was associated with younger age groups and living in an apartment or terraced house, while rurality was associated with older age groups, owning land and living in a detached house. Furthermore, urbanity was related to immaterial values and uses of nature, whereas the use and management of nature was related to rurality. Along the PCA axis 3, older age was associated with higher education, possibly because many younger respondents were still in the education system (PCA axis 3; eigenvalue 2.3; Figure S2). Cluster analysis utilized six PCA axes, but for the graphs, they were condensed into three PCA axes. This analysis identified three groups

of respondents: (1) rural outdoorspeople ($n=634$), (2) urban nature lovers ($n=605$) and (3) people with weak interaction with nature ($n=423$) (see Figure S3; Table 1).

Rural outdoorspeople had a rural identity and lived in a rural environment (questions 31D–E and 33B). They typically lived in a detached house and owned a plot of land with their house or a cottage, while some also owned a forest or a field (questions 34E and 38A–D). This group spent a lot of time outdoors with different activities, such as gardening, observing nature, forest work, hunting or collecting wild berries and mushrooms (questions 44E–I). They appreciated many immaterial and material aspects and assets of nature, such as beauty, biodiversity, recreational possibilities, peace, sounds and the experience of wilderness (questions 42A, 42C, 42F, 43F and 43G–I). They differed from *urban nature lovers*, as they exhibited a greater appreciation for a well-maintained environment, natural products and financial income (questions 42B, 42D and 43B). *Rural outdoorspeople* also tend to be older than urban nature lovers (questions 27C–D) (Table S1; Table 1).

Urban nature lovers had an urban identity and typically lived in urban areas (questions 31A–C and 33A). Renting or leasing an apartment in a block of flats or a terraced house was common (questions 34B and 34D). Typically, this group did not have land property (questions 38E). Like *rural outdoorspeople*, *urban nature lovers* appreciated many aspects and assets of nature, such as beauty, biodiversity, recreational possibilities, peace, sounds and the experience of wilderness (questions 42A, 42C, 42F, 43F and 43G–I). What made *urban nature lovers* different was their greater emphasis on natural experiences, wilderness and spirit raising (questions 42E, 43A and 43C–E). *Urban nature lovers* also placed more emphasis on camping, hiking and sport in nature (questions 44B–D and 44K). However, they liked to relax in nature, with the aim of 'just being there' (questions 44M). Typically, urban nature lovers were younger than *rural outdoorspeople* (questions 27A–B) (Table S1).

People with a weak interaction with nature were characterized by infrequent reports of activities related to nature and important qualities of nature. The people in this group could be urban or rural, of any age, with or without land property. However, the people in this group also indicated that they had a favourite tree.

3.2 | Tree traits

Most of the trees (80%) chosen by the respondents were standing and living trees (question 2A, Table S1). These trees were typically located in or near the home yard (41% and 12%), near a previous home (21%) or in a vacation spot (15%). A minority of trees (12%) were in a public urban environment, such as a city park or on a street. Most of the trees chosen stood alone, that is, not as part of a group or forest (66%) (question 2, Table S1).

Tall, thick and unusually formed trees were clearly the most popular trees (question 2, Table S2), hereafter called *charismatic trees* (Hall et al., 2011). Trees with thick trunks were particularly popular in our data set, as 49% of the favourite trees had a circumference

TABLE 1 Summary of the characteristics of human types according to the survey responses, PCA and clustering analysis (Table S1; Figures S1–S3).

Humans	Rural outdoorspeople	Urban nature lovers	People with a weak interaction with nature
Questions			
27. Age of the respondent	C mature D old	A young B adults	Any
31. In what kind of environment do you live?	E rural area D village	A big city B suburban area C small town	Any
33. Do you think of yourself more as an urban or rural person?	B Rural person	A Urban person	Any
34. What kind of housing do you live in?	E Owner in private house	B Tenant in apartment	Any
38. Do you own forest or other land?	A Forest property B Plot for a house C Plot for a cottage D Arable area/Field	E I do not own	Any
40. How often do you spend time in a forest or park?	+	+	–
42. What qualities do you value most in nature?	A Beauty of nature B Natural products C Recreation in nature D Financial income F Spiritual experiences	A Beauty of nature C Recreation in nature F Spiritual experiences E Biodiversity	No
43. What do you consider beautiful in nature?	A Wildness B Well maintenance D Richness of colour E Roughness and inhospitability F Ecological diversity G Peace and quietness H The sounds of nature I Wilderness-like	A Wildness C Greenness D Richness of colour E Roughness and inhospitability F Ecological diversity G Peace and quietness H The sounds of nature I Wilderness-like	No
44. What activities do you undertake near trees?	E Forest management F Gardening G Collecting natural products H Observing nature I Hunt and fishing	B Day hikes C Hiking D Fitness G Collecting natural products H Observing nature K Camping M Relaxation	No

greater than the reach of the respondents' arms. Older trees were significantly more popular than young ones, with young trees (0–20 years) with 6% popularity and the oldest age group (100+) with 28%. In this study, we also investigated sensory experiences that were related to favourite trees, but none of the traits was found to be more common than the others. Typically, people associate a wide variety of sounds, smells and visual features with their trees.

Coniferous (48%) and broadleaved (52%) trees were equally represented in our data set (Table S2). In total, 51 species or lower level taxa were reported (Tables S2 and S6). These numbers were strongly affected by our ready-made list of tree species in the questionnaire (codes 6A–6U in Tables S2). In this framework, the most popular taxa were common native species, such as Scotch pine *Pinus sylvestris* (22%), Norway spruce *Picea abies* (16%) and birch *Betula*

pendula and *pubescens* (11%). Oak *Quercus robur* (7%), maple *Acer platanoides* (4%) and rowan *Sorbus aucuparia* (4%) were also common, although oak and maple were more commonly found in the southern part of Finland where they naturally occur. We listed 21 of the most common tree taxa in the questionnaire, and these were included in the analysis, although the respondents reported many more species—particularly decorative exotic species—in the open field of the questionnaire (Table S6).

Based on PCA, the main gradients within the tree data depicted the variation between (i) coniferous and broadleaved trees (PCA axis 1; eigenvalue 7.1; Table S2; Figure S4) and (ii) small, young trees and large, old trees (PCA axis 2; eigenvalue 3.6; Table S2; Figure S4). Many other characteristics were combined with the coniferous-deciduous divide along PCA axis 1. Coniferous trees

were often self-seeded and located in a forest, whereas deciduous favourite trees were often planted and located in urban environments and yards. The year-round green colour, the smell of resin and the regular straight form were associated with coniferous trees, while the bright autumnal colours, the smell and sound of the leaves and the complex forms were associated with deciduous trees. Cluster analysis, using PCA axes 1–5, identified four typical tree groups. Two of these groups were located near people's homes, but were either curvy and branched or tall and straight. No significant differences were found in their relationships with people. Therefore, we combined these two groups into one, named 'neighbouring trees.' Consequently, we identified three tree groups based on survey responses: (1) charismatic conifers ($n = 748$), (2) saplings ($n = 269$) and (3) neighbouring trees ($n = 645$) (Figure S6; Table 2).

Charismatic trees were generally coniferous trees, either Scotch pine or Norway spruce native to Finland (questions 5A, 6A and 6B in Table 1). These trees were generally found to grow in isolation (questions 7A) and were in forests or outside urban settings and yards (questions 4E–G). Old age, large size and regular straight trunk appeared to be important traits within this tree group (questions 9, 10, 11, 15A and 15D). The resinous scent of

bark and twigs was also often emphasized (questions 13B, 13E and 13F) (Table S2).

Saplings were typically small deciduous trees located in yards and gardens (questions 3A and 5L). Fruit trees, such as apples (*Malus domestica*), were common taxa in this group of trees, but the group also included other small deciduous trees, such as rowan and bird cherry (*Prunus padus*) (questions 5D, 6R and 6J). *The saplings* were often young trees and were planted by the respondents or by someone they knew (questions 7B and 7C). The smell of flowers was often mentioned in relation to this group of trees (question 13D) (Table S2).

Neighbouring trees are large deciduous trees, which were typically larger and older compared to *saplings* (questions 9–11). Complex shapes, burls or curves in the trunk or numerous curved branches were common in this group (questions 15E and 15H). *The neighbouring trees* were often located in urban environments and outside the yards (questions 4A and 4B). Native species, such as birch, aspen, oak and maple, were common in this group (questions 5B, 6D, 6F, 6L and 6N). The origin of the tree was often unclear to the respondents (question 7Z). Sounds, such as rustling leaves, shivering branches and animal voices, were emphasized with respect to this tree group (questions 14C, 14D and 14E). The smell of leaves, also decaying leaves and bright autumnal colours were often reported as

TABLE 2 Summary of the characteristics of human types according to the survey responses, PCA and clustering analysis (Table S2; Figures S4–S6).

Trees	Charismatic trees	Saplings	Neighbouring trees
Questions			
4. In what kind of surroundings is the tree located?	E In the forest F On a hill G By the water	C Home yard	A Along the street B City Park
5. What type of tree is it?	A Native evergreen tree	D Fruit tree L Broadleaved tree	B Native deciduous tree
6. To which species does the tree belong?	A Pine (<i>Pinus sylvestris</i>) B Norway spruce (<i>Picea abies</i>)	R Apple tree (<i>Malus domestica</i>) J Rowan (<i>Sorbus</i>)	D Birch (<i>Betula</i>) F Aspen (<i>Populus tremula</i>) L Oak (<i>Quercus robur</i>) N Maple (<i>Acer platanoides</i>)
7. Has the tree been planted?	A The tree has established itself spontaneously	B I planted the tree myself C Tree has been planted by someone close to me	Z I do not know
9. What is the approximate age of the tree?	+	–	+
10. How high do you estimate the tree to be?	+	–	+
11. How thick is the tree trunk?	+	–	+
13. Does the tree have a specific scent?	B The scent of bark E The scent of twigs F The scent of resin	D The scent of flowers	C The scent of leaves G The scent of autumn
14. Does the tree make a sound?	–	A No sound	C Rustle of the leaves D Shivering branches E Animal/insect sounds
15. What is the shape of the tree trunk?	A Straight trunk D Trunk with regular shape		15C Burls on the trunk 15F Thick trunk E Crooked trunk H Lots of twigs on the trunk

important (questions 12C, 12E, 13C and 13G). In general, visual and sensory characteristics were important within this group of trees (Table S2).

3.3 | Human–tree relationships

The questions related to the relationship between humans and trees revealed that most of the respondents had several favourite trees (68%), even if they were asked to select only one for this study (question 23, Table S3). Most of these selected relationships have lasted several years (42%), several decades (23%) or even the lifetime of the respondent (22%). It was rare that the relationship lasted throughout the lifetime of the tree (4%) (question 17, Table S3). When asked what makes their tree special, location (52%), age (46%) and morphological characteristics, such as branch assemblage (42%), trunk shape (39%), height (36%), trunk diameter (34%) and bark texture (34%), were prominent responses. Respondents less frequently expressed smells (16%), sounds (16%) or shapes (12%), colours (15%) or autumnal colours (9%) of leaves or needles (question 16, Table S3).

More than half of the favourite trees were owned by the respondent or someone close to them (58%). In addition to the location of the tree, ownership probably affected the activities of the tree. Although most relationships were considered carefree (63%), many respondents cleaned the leaves (19%) or other debris from their tree (15%). The habit of visiting the favourite tree varied from daily visits (18%) to no visits (17%).

Favourite trees elicited many types of emotions, impressions and restorative outcomes. Perceived experiences were collected in the research questionnaire with a multiple choice question: 'What kind of emotional bond do you have with this tree? (You can choose several options)' About half of the respondents mentioned joy (61%), admiration (50%) and the feeling that the tree represented 'something bigger' (49%). The favourite tree was often an important bridge to memories (49%) (question 20, Table S3). When respondents were asked about their reaction to a hypothetical cutting of their tree, the most common reaction was to prevent felling by any means possible (31%) or alternatively by organizing (20%) or participating in (21%) action against the cutting. However, many respondents indicated that they would also understand the situation (22%) or hesitated to give their opinion (19%) (question 21, Table S3).

The main variation in human–tree relationships (PCA axis 1; eigenvalue 4.3; Table S3; Figure S7) was related to the presence of emotional and sensory experiences with the favourite tree. The second PCA axis (eigenvalue 3.5; Table S3; Figure S7) was related to the care activities around the tree. At the one end of the second axis, the relationship was characterized by preserving actions, and at the other, the relationship was effortless with emphasis on emotional experiences. The third PCA axis (eigenvalue 2.1; Table S3; Figure S8) was related to the length of the relationship. In long relationships, personal memories were important, while in the new relationship, the presence in everyday life was emphasized. Cluster analysis, using PCA axes 1–7, resulted in the formation of three clusters, which we

identified by their content related to questions and answers. These relationship types were named followingly: (1) nurturing ($n=437$), (2) nostalgic ($n=633$) and (3) admiring ($n=592$) (Figure S9; Table 3).

3.4 | The predictability of human–tree relationship type

The favourite tree was an integral part of the daily life of a respondent in the *nurturing relationship* (questions 20C and 20D, Table S3). Multiple caretaking activities, such as leaf raking, tree debris cleaning, harvesting fruits or other crops, protecting the tree from pests and supporting the tree, were important in this human–tree relationship (questions 22B–F, 22H; Table S3). Fruits, flowers and different colours and shapes of leaves were important traits of the trees (questions 16C–D and 16F–H, Table S3). The life of the animals (such as squirrels, different species of birds and insects) in the tree was also often highlighted (questions 16L, Table S3). Respondents with a nurturing relationship were more likely to express their willingness to take action to prevent the felling of their tree (question 21F, Table S3).

In the PCA, the *nostalgic relationship* was linked to a lack of characteristics associated with the human–tree relationship. They typically indicated that, for example, the favourite tree has no pleasant features (question 20A), there is no emotional bond with the tree (question 20A) and that they have not taken care of the tree (question 22A). However, memories elicited by the favourite tree were commonly reported (20G). In this type of relationship, the favourite tree seemed to be a bridge to the past, without the need or possibility of highlighting multiple sensory experiences and activities. Respondents with a nostalgic relationship were more likely to accept and understand the hypothetical felling of the tree (questions 21A–C and 21Z, Table S3).

Sensory and emotional experiences were emphasized instead of caretaking activities in the *admiring relationship*. The favourite tree evoked admiration, joy and strength and often represented something greater for a respondent (questions 20E–F, 20H and 20K, Table S3). The tree was often seen as a friend with whom the respondent could share worries and joy (questions 20I–J, Table S3). The age and physical appearance of the tree were important in this human–tree relationship (questions 16E and 16I–K, Table S3). Resisting a hypothetical felling of their tree by organizing or participating in negotiations, appeals or demonstrations was typical of the *admiring relationship* (questions 21D–E, Table S3).

Cross-tabulation of human–tree relationship clusters with the clusters of human and tree traits revealed that the *nurturing relationship* was associated with *rural outdoorspeople* and having a small deciduous favourite tree (Figure S1; Tables S4 and S5). *Admiring relationships* were common among *urban nature lovers*, and the target of admiration was usually a conifer tree, more so than with the other two types of relationship. *People with a weak interaction with nature* often had *nostalgic relationships* with their favourite tree, which could be any type of tree. Even if we found associations between

TABLE 3 Summary of the characteristics of human types according to the survey responses, PCA and clustering analysis (Table S3; Figures S7–S9).

Relationships	Nurturing relationship	Nostalgic relationship	Admiring relationship
Questions			
16. What qualities do you particularly like about this tree?	C Flowers D Fruits/berries/pinecones F Colour of leaves L Tree-dwelling animals/birds/insects	-	E The age of the tree I Shape of the trunk J Branches K Bark or surface of the trunk
17. How long have you had a special relationship with this tree?	+	+	-
20. What kind of emotional bond do you have to this tree?	C I see the tree often and pay attention to it D The tree is part of my everyday life	G There are important memories associated with the tree	E Seeing this tree brings me joy F I admire this tree H I turn to the tree to gain strength K The tree represents something bigger than me. I This tree is an important friend to me J I share my joy and sorrow with the tree
21. What would you be prepared to do if someone would propose that this tree should be felled?	F I would prevent the felling of the tree by any means	A I would do nothing; I would understand the situation B I would not like to be involved C I would help in felling the tree or I would fell it myself Z I do not know	D I would participate activism with others E I would act against felling the tree myself
22. Do you, or did you take care of the tree, or the outputs from the tree?	B Leaf raking C Cleaning of other debris caused by the tree D Harvesting E Preserving the tree F Protection of the tree from animals or insects H Preventing the felling of the tree	A No care of the tree	A No care of the tree
26. Do you own this tree or does someone close to you own it?	+	+ -	-

human-tree relationships, human traits and tree characteristics, our results also illustrated that the type of human-tree relationship cannot be accurately predicted based only on human or tree traits (Figure 1).

4 | DISCUSSION

4.1 | The nature of human-tree relationships

As a response to our first research question on what kind of relationships do people have with their favourite trees, our data showed a large variability in the type and intensity of these human-tree relationships. The most common emotions related to human-tree relationships were defined as joy, admiration, 'connectedness to

something bigger' and nostalgia. Based on our survey data, we distinguished three main types of human-tree relationships, naming them as *nurturing relationship*, *admiring relationship* and *nostalgic relationship*. A meaningful human-tree relationship was remarkably widespread among respondents of different properties and backgrounds. Typically, the favourite tree was part of daily life, and the trees in the gardens and close to home were taken care of. Our findings resonate with the *biophilia hypothesis*, which suggests humans having an intrinsic tendency to enjoy direct interactions with nature both aesthetically and emotionally (Kellert & Wilson, 2013). We see similarities in the observed tree relationships with an earlier case study of a communal school garden (Tammi et al., 2020), where the interaction between animals, plants and children who took care of them revealed that children understood nonhumans primarily as friends and even as relatives, rather than simply from the point of

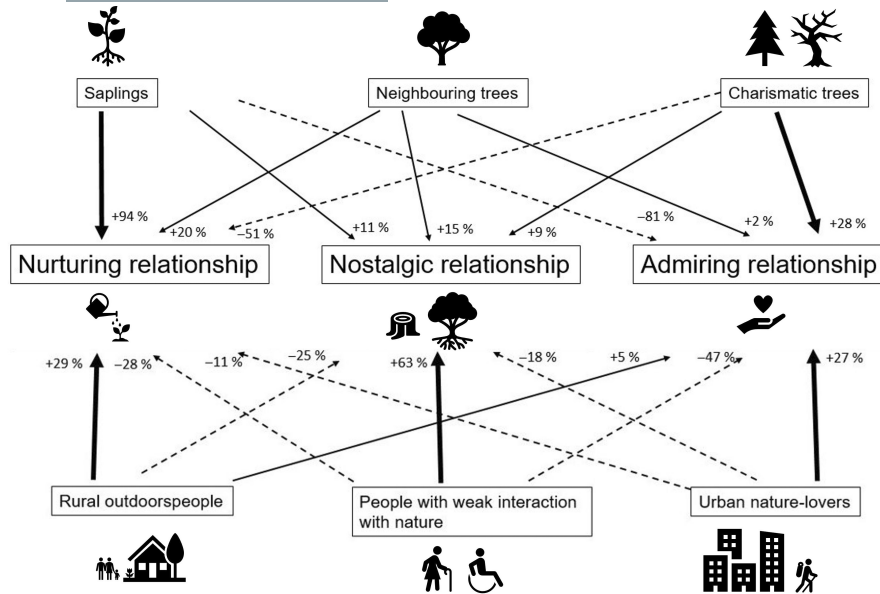


FIGURE 1 Connections between tree, human and relationship types based on cross-tabulation (Tables S4 and S5). Arrows represent connections that were >24.9% more common than expected (in bold), >24.9% rarer than expected (dashed) and near average values between (ordinal). These limits do not denote any specific significance level but are sufficiently conservative to be treated as significant differences. Percentages refer to the differences from expected frequencies (see Table S4).

view of benefits. Their caring activities were expressed through three different aspects: material and continuous efforts, emotional connections and ethical and political considerations. Similar aspects are to be found in our analysis, where efforts are seen in nurturing behaviour towards trees, emotional connections through sensory experiences and symbolic meanings (such as memories) in admiring and nostalgic relationships and ethical and political considerations in active or hypothetical actions for preserving the trees (against felling).

Compared to findings about other relationships between humans and nonhumans, the human–tree relationships seem to be poorly compatible with any existing framework. Although relationships with trees may have some similarities with the practical human–forest relationship (Apajalahti et al., 2022; Halla et al., 2021; Ritter & Dauksta, 2013) or symbolic relationships with places (Jones & Cloke, 2002; Karjalainen, 2009), the relationships with trees appear to be more private and ambiguous. In contrast to interspecies relationships with nonhuman animals, trees are less responsive in the relationships, although they can be seen to have an agency of their own (Jones & Cloke, 2002). Unlike most wild creatures, the longevity of trees allows humans to build lasting and intimate relationships with them, even over generations. Since trees are both tangible and symbolic, we chose to combine different interspecies approaches to study trees as nonhumans by nature. In other words, they are non-human entities but are filled with human-made symbolic meanings, being at the border of nature and culture. As trees exist in the everyday sphere of almost all humans, the relationship between humans and trees offers a unique point of view to the co-existence of humans and nonhumans, a key topic in the time of the Anthropocene.

4.2 | Predictability in human–tree relationships

Addressing our second aim, we found that there is predictability to some extent in the nature of human–tree relationships based on

human and tree characteristics. Among trees, the main variation was found between large conifers and small broadleaved trees, while among humans connection to nature (strong vs. weak) and living environment (urban vs. rural) were the most important characteristics dividing people. Based on the human and tree characteristics, we distinguished three groups of both, namely *rural outdoorspeople*, *urban nature lovers* and *people with weak connection to nature* for humans, and among trees *saplings*, *neighbouring trees* and *charismatic trees*. The characteristics of humans and trees were interlinked in the types of relationships.

Material caretaking of saplings and young trees in their garden was typical for rural outdoorspeople, which creates nurturing relationships. When forming this type of relationship, material connection through caretaking aspects, such as planting, harvesting, raking leaves and protecting the tree from natural threats, was one of the most important aspects. We found our tree relationship classification to be reminiscent of the interspecies biophilia categorisation of Santas (2014), which appeared as a very potential framework in which our results could be reflected (Table S7). Correlating aspects were found in ‘Symbiotic’ interspecies friendship, which Santas formulated based on Aristotle’s ‘Friendship Based on Usefulness’. Aristotle explains that ‘Friendship Based on Usefulness’ benefits both (such as between business partners and good neighbours), and similarly, Santas (2014) describes that symbiotic co-existence between species is created for benefit. *Nurturing human–tree relationships* can be based on two-sided benefits: The tree as an individual receives special care and attention and as a species can form larger geographic distribution than without human help. From the human point of view, the benefit is a goal to enjoy, for example, blooming flowers, fruits, shade from hot sun and sensory or symbolic enjoyment, or wood material as the tree grows. *Symbiotic friendships* are described to end when one party ceases to be useful and there is simply no reason to continue the association; affection quickly transforms into indifference or even hostility (Santas, 2014). For example, the fruit tree

will be removed when it produces no more fruit, the shading tree will be felled when it is considered a threat to the house, and the climbing tree will be removed when children start climbing dangerously high. In this sense, the *nurturing human-tree relationships* are unstable: Even though the partners are dependent on each other, the relationship can change fast.

The sensory connection with *neighbouring trees* and *charismatic trees* allows both *rural outdoorsmen* and *urban nature lovers* to enjoy multisensory phenomena with trees. For people with a rural lifestyle, the source of sensory experience were mainly *neighbouring trees* connected to *nurturing relationships*, and for urban people *charismatic trees* connected to *admiring relationships*. Among human traits, the connection to nature had the strongest impact on the type of human-tree relationship created. Regular visits to nature and the experience of sensory phenomena were highly correlated with *caretaking relationships* and *admiring relationships*. Sensory experiences and emotions appeared to be interlinked, and emotions were fed by smells, sounds and visual features. Respondents with *admiring relationships* experienced joy in physical connection, such as touching, hugging, observing, caring, relaxing, climbing, playing and photographing trees. Pleasantness is the key aspect in Aristotle's '*Friendship Based on Pleasure*', interpreted by Santas as '*Hedonistic*' interspecies friendships (Santas, 2014). Santas (2014) described them as 'associated in a mutual exchange' (i.e. sharing) of affection existing between two entities that seek each other's company because they enjoy it (Santas, 2014). Between humans and trees, hedonistic aspects can be found in relationships that bring joy to the everyday life. This relationship can be interpreted to be friendship between equals: human and tree as equal entities, simply enjoying the co-living. These relationships are replaceable, when the co-living comes to its end: The human moves to another place or finds another tree to enjoy.

Transcendent connection was found among *urban nature lovers* towards exceptional trees that were admired because of some perceived qualities, such as old age, big height or circumference and special shape. While, in other types of relationships, the properties of trees were not emphasized in responses, this *admiring relationship* was only felt towards trees with charismatic properties defined by exceptional age, height, diameter or species (Hall et al., 2011). In agreement with Lorimer (2007), these charismatic trees were considered attractive but also to possess special qualities. These *admiring relationships* towards charismatic trees have resemblance to '*Friendships Based on Virtue*' defined by Aristotle or, in the context between species, '*Kalondistic friendships*' (Santas, 2014) based on admirable excellence and virtue of perceived qualities. In trees, they can be outstanding physical properties as found in our study, but also cultural, historical and spiritual associations. In our data, this can be seen in the high popularity of the answer option 'The tree represents something bigger than me' to a multiple choice question about the potential emotional bond with the tree. This experience is connected to longevity, generations, greatness of nature and transcendent experience. Over time, human cultures have developed

traditions, mythology, spiritual practices and art to strengthen and emphasize transcendent connection towards such more-than-human entities (Ingold, 2011; Rival, 1998). Presumably, some traces of this can still be seen in our modern life and cultural practices. Most clearly, trees in sacred sites such as churchyards offer opportunities for transcendental experience, since these trees are often old and intriguing due to their species and aesthetics, helping people concentrate their attention for prayer and meditation (De Lacy & Shackleton, 2017). According to Santas (2014), *kalondistic friendships* are stable because small changes in circumstances will not lead to change. This is fitting to charismatic trees that may change more slowly than human beings; for a mature tree of 70 years might not cause dramatic changes while humans transform from childhood to old age.

Lastly, we observed symbolic connection to trees that creates a *Nostalgic Human-Tree Relationship*, typical among *people with weak interaction with nature*, who reported very few sensory phenomena related to their favourite tree. In these relationships, any of the tree types can be an object because they are not only connected to the physical tree traits, but more strongly on symbolic meanings (such as memories). These relationships are formed when material connection to a tree is lost, but the symbolic connection remains since it is not replaceable. Nostalgic relationships are based on pleasant or symbolically important memories, which are a connecting feature in Santas's hedonistic interspecies friendships. We interpret symbolic connection to be a human-oriented affection consisting of memories, connection to other people or to the person's own identity (Lummaa et al., 2023).

4.3 | Time-scales in human-tree relationships

People, trees and their relationships all change over time, but the time frames of a human and a tree are different. When parents plant a tree with a child, for a short time, they are both young saplings to be taken care of in a *nurturing relationship* with a third party. Soon they both become more independent, as equals enjoying each other's company in *hedonistic friendships*. When the tree becomes bigger than the child, *kalondistic feelings* and a relationship with admiration can be formed. When the child grows and moves away, the connection might be lost, and the relationship can turn into a nostalgic one. Nostalgic relationships can combine many features of interspecies friendships and human-tree relationships. Memories and experiences are present and absent at the same time, which makes them difficult to study with sensory methods and interpreted in Santas's (2014) biophilic friendship categories. In nostalgic relationships, pleasant feelings can be recalled even without direct interaction.

The tree and the human can be reunited later, reproduce, get ill or die, and due to the symbolic meanings, the relationships can become more complex, including, for example, overgenerational, anthropomorphic or biographic meanings (Lummaa et al., 2023). In our data, a tree was commonly a link to previous and coming generation;

grandchild can form a relationship with the tree that was planted with his grandfather and, at the same time, feel the link between the tree and his grandfather and his parents.

4.4 | Impacts of human–tree relationships to human society

In our study, the material connection with the tree influenced how respondents responded to the threat of felling, making respondents more likely to act against it. Symbolic connection creates a special value for the tree, making it not replaceable, increasing the willingness to maintain the connection. This suggests that the material connection and co-existence of humans and trees may benefit them both, in line with the ideas of Haraway (2008) about the companionship of humans and non-humans. According to the biophilia hypothesis (Wilson, 1984), the inherent inclination of humans to be interested in biotic processes and living entities can culminate in human ethics in caring for the nature and conservation of biodiversity (Jax et al., 2018; Kals et al., 1999; Kellert & Wilson, 2013). Emotional connection with nature can create environmental empathy and motivate people to participate in the care of their close environment, for example, their garden, neighbourhood and living area (Feral, 1998). Whether this would be the case with human–tree relationships could be a subject of further studies.

The multispecies companionship of humans and trees challenges the boundaries of the human and nonhuman world. Nonhuman species are increasingly considered emotionally significant others in a social, ethical, scientific and legal sense (Abram, 1997; Haraway, 2008; Kirksey & Helmreich, 2010; Kohn, 2013; Latimer & Miele, 2013). Some natural entities (e.g. mountains, rocks and trees) already have value of their own as they are mapped and protected by law, or have even been recognized as legal entities, for example, the religiously important Ganges River in India and the Whanganui River in New Zealand (Nolan et al., 2020; O'Donnell & Talbot-Jones, 2018). Since most of the favourite trees have value for 'only' individual humans, not on a larger scale ecologically or culturally, their recognition in urban planning is difficult. In this study, we have made their emotional and social importance visible and call for further efforts to find means to account for them. As a practical example of biophilic design from Finland and co-creation of green infrastructure in the individual districts in the city of Helsinki (and many others), have asked residents to mark the individual trees which need special attention, or they wish to save from upcoming loggings in their nearby green areas. Our results indicate that environments with more trees create not only healthier environments for people but also environments in which people can feel joy and connect emotionally.

AUTHOR CONTRIBUTIONS

Eeva-Stiina Tuittila, Aino Korrensalo and Karoliina Lummaa jointly developed the idea and designed the methodology. Kaisa Vainio collected the data and conducted a literature review. Kaisa Vainio

and Tuomo Takala were leading the writing of the paper. Aino Korrensalo, Aleksi Räsänen and Kaisa Vainio analysed the data. All authors critically contributed to the drafts and gave their final approval for publication.

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CONFLICT OF INTEREST STATEMENT

We have no conflicts of interest with respect to this study.

DATA AVAILABILITY STATEMENT

Data will be available from the Finnish Forest Museum Lusto archive from 2024 (<https://lusto.fi/en/collections/collections/>).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Appendix S1: Results.

Appendix S2: Survey form.

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