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Multiple factors shape the interaction of people with urban greenspace: Sweden as a case study

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ABSTRACT

This study identifies and analyses multiple factors that impact people's interactions with urban greenspace in Sweden. An unrestricted, self-selected online survey was used to collect the data. The survey questions were related to individual characteristics of respondents, including socio-demographic characteristics, self-reported nature connectedness, and self-reported constraints to greenspace usage; perceived characteristics of urban greenspace, including its availability, quality, and accessibility, and benefits and problems; and preferences of respondents regarding types of urban greenspace and activities. Additionally, several spatially explicit variables were included in the analysis. A total of 2806 respondents from 208 (of 290) municipalities completed the survey. Our findings indicate that greenspace users are highly heterogeneous and utilise diverse green spaces along the urban-peri-urban gradient for various benefits. The statistical analyses identified 61 explanatory variables that affect the frequency of interactions with urban greenspace. In addition, we identify key factors that shape critical differences between frequent and infrequent urban users, such as nature connectedness, perceptions of urban greenspace functions, and their perceived accessibility. Our results highlight the complex challenge facing urban planners and managers of green spaces, who have to consider and integrate a vast array of factors influencing the willingness of increasingly diverse urban populations to interact with greenspace.

1. Introduction

Accelerating global trends in environmental degradation (IPBES, 2018; Huang et al., 2019; Kulp and Strauss, 2019) risk multiple negative impacts on human health and wellbeing, particularly in urban areas (Ribeiro and Pena Jardim Gonçalves, 2019). Urban greenspace is crucial for urban resilience and is key to achieving environmental sustainability in these human-dominated systems. Scholars have documented multiple beneficial functions of urban greenspace in diverse contexts across the globe, showing that they reduce economic and social risks for city dwellers, improve water quality, support ecological diversity and generate ecological and social benefits essential for human health and wellbeing (Bowler et al., 2010; Hartig and Kahn, 2016; Kabisch et al., 2013; Reyes-Riveros et al., 2021; van den Bosch and Ode-Sang, 2017). In addition, recent studies have demonstrated the importance of urban greenspace to urban residents' mental and physical health during the COVID-19 pandemic and emphasised the need to have accessible urban green spaces to meet the needs of diverse groups of population (Geary et al., 2021; Ugolini et al., 2020; Venter et al., 2020).

A growing body of evidence indicates that the availability of, accessibility to, and quality of urban green spaces influence the frequency and types of use (Madureira et al., 2018; Peschardt and Stigsdotter, 2013; Schipperijn et al., 2010). These findings support the popular arguments that urban planners should plan and design green

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spaces within a specific functional distance from where people live to keep people's willingness to visit them or integrate new residential areas with existing green spaces. Much literature focuses on the use of greenspace in relation to demographic factors, particularly gender and age (Enssle and Kabisch, 2020; Ode-Sang et al., 2016), income level and socio-economic characteristics of the community (Cohen et al., 2012; de la Barrera et al., 2016). Research also shows that individual motivation to use greenspace is often influenced by a personal sense of connection to nature rather than the accessibility or availability of green areas (Gunnarsson et al., 2017; Lin et al., 2014). As a result, some scholars argue for a more culturally sensitive approach to studying urban greenspace visitation (Park et al., 2011; Ward Thompson, 2011). More broadly, the individual perception of natural environments and, consequently, relationship to nature are essential to how humans behave towards the environment. The biophilia hypothesis (Wilson, 1984), evolutionary roots of landscape perception (Appleton, 1975; Orians, 1986), connectedness to nature (Mayer et al., 2009), and related concepts have been used to interpret the formation of those relationships and measure its strength.

Maintaining urban greenspace in the face of rapid urbanisation is a global challenge (Elmqvist et al., 2019). New concepts in neo-traditional urban development and planning have emerged (de Jong et al., 2015) – e.g., the ecocity, the compact city – which provoke debates among scholars regarding the 'fate' of urban greenspace under each concept (Haaland and van den Bosch, 2015; Kabisch and Haase, 2013). New socio-political discourses (e.g., surrounding Sustainable Development Goals, climate change, biodiversity crisis) and the increasing demands of urban populations for physical and mental health require more multifunctionality of greenspace.

In Europe, many countries are currently undergoing rapid demographic and cultural changes. This raises new challenges for urban green planning regarding developing sustainable living environments that meet the requirements of all inhabitants in increasingly multicultural urban and peri-urban areas (e.g. Davies and Lafortezza, 2017). Alongside improved approaches to planning and management of urban greenspace (Lindholst et al., 2016), a better understanding of the factors that affect people's willingness to visit and interact with urban greenspace is crucial (Hitchings, 2013).

Despite a seeming abundance of previous studies on European urban greenspace users, most scholars to date have focused on relatively few factors (i.e. age, education, cultural background) on specific types of green space (e.g., parks, urban forests) or user patterns at the local- or city-scale. However, given the growing ethnic and cultural diversity of urban populations in Europe and the wide variety of types of urban greenspace potentially available for urban people, such studies may be too narrow in scope to understand the complexity of factors that shape interactions of people with urban greenspace, and risk errors of omission. This, in turn, leads to urban planning where certain groups are not included. Moreover, extensive case studies with a wide range of spatial and demographic variables to represent the breadth of human interactions with greenspace are still scattered (e.g., Nordh and Olafsson, 2021).

This study aims to identify and analyse multiple factors that influence people's interactions with urban greenspace across a wide range of settlement types in Sweden. In the context of this study, "urban greenspace" is broadly defined to encompass a spectrum of vegetated (green areas) and water objects (blue areas) of different sizes within urban and peri-urban areas (Taylor and Hochuli, 2017). These green and blue areas are characterised by varying human interventions and provide multiple benefits important for human wellbeing and biodiversity. We use the term "interactions with urban greenspace" to describe diverse direct uses of different types of urban greenspace to obtain desirable tangible (e.g. wild berries, health) or intangible (e.g., relaxation, social interactions) benefits. We focus on the following three research questions: (1) What socio-demographic characteristics influence the interactions with urban greenspace? (2) To what extent do personal preferences for and perceptions of urban greenspace influence the frequency of user interactions? (3) Do biophysical landscape conditions impact the mode of user interactions with urban greenspace? The improved understanding of these factors will help urban planners and other relevant stakeholders enhance people's interactions with the urban natural environment. Furthermore, it will assist future spatial planning with the new knowledge necessary to build more sustainable cities.

2. Methods

2.1. A study context

The study was conducted in Sweden, the largest Nordic country with a long urban planning tradition. Approximately 87% of the population live in urban areas (SCB, 2018). On average, 94% of the urban population have access to at least one green space within 200 m of their home (SE, 2018). Proximity to green spaces differs only slightly between large and small settlements. However, on average, the population in the smallest settlements had more than ten times more available greenspace (1980 m^2 per person) compared to residents in the largest settlements (183 m^2 per person) (Statistics Sweden, 2019). While the largest 100 cities in Sweden have an average of 20% forest cover in the cities and an even higher forest cover in the peri-urban areas (0–5 km from the city edge) (Nielsen et al., 2017). Moreover, 51.8% of the urban green spaces are lawns, covering 22.5% of the area of cities (Hedblom et al., 2017a). On average, about 37% of the total greenspace in settlements is linked to private residential gardens or inaccessible to the public in some other way (Statistics Sweden, 2019).

Many of Sweden's national policy documents acknowledge the importance of urban greenspace (EQO, 2015). For example, one of Sweden's 16 Environmental Quality Objectives (2005) is 'a good urban environment', which stresses the importance of parks and nature areas for the quality of life and recommends protecting greenspace and using every opportunity 'to create new attractive areas' (EQO, 2015). One of the criteria of this objective is that accessible, good quality nature and greenspace should be available close to built-up areas. Furthermore, Sweden's first national urban development strategy targets that a 'majority of municipalities make use of and integrate urban green spaces and ecosystem services in urban environments in the planning, building and managing of cities and towns' by 2025 (SE, 2018). The strategy also emphasises that green spaces should be designed and managed to help the built environment be more sustainable, healthy and attractive. The 290 municipalities in Sweden are primarily responsible for planning and maintaining urban green spaces following the national laws and regulations.

2.2. A survey tool design

An unrestricted, self-selected online survey (Fricker Jr, 2008) was used to collect the data across Sweden. To design a survey tool, we adopted a framework developed by Farahani and Maller (2018), synthesising evidence-based knowledge across different academic disciplines relating to understanding perceptions of and preferences for greenspace. Perceptions refer to various sensual experiences associated with greenspace and how users attribute meaning and value to them (Farahani and Maller, 2018). Preferences are understood as 'liking one area of land or landscape better than another' (Swanwick, 2009, quoted after Farahani and Maller, 2018). The usage of greenspace is affected by both people's perceptions of and preferences for greenspace; however, scholars have often studied these concepts separately. As well as integrating variables relating to both perceptions and preferences concepts, the framework also includes socio-demographic variables relating to the individual characteristics of users, such as age, gender, and cultural background.

Following the framework, we organised the questionnaire for our online survey into the three domains (see Appendix): (1) individual

characteristics of respondents, including socio-demographic characteristics, self-reported nature connectedness, and self-reported preventions of greenspace usage, (2) perceived characteristics of urban green space that includes perceived benefits, perceived availability, quality, and accessibility of and perceived problems in greenspace in and around settlements where respondents live; (3) preferences of respondents that contain questions on the desired state of urban greenspace, used urban green spaces, and types of activities. In addition, we validated the questionnaire during semi-structured interviews with urban greenspace planners in five municipalities (Malmö, Burlöv, Växjö, Örebro, and Umeå). The interview protocol included questions on the classification of urban green spaces, characteristics of green spaces considered in planning, and how users' needs and values were included in the planning and design of greenspace. These interviews helped formulate questions related to characteristics and preferences for green spaces. We also reviewed studies that applied surveys on people's use, preferences for and perceptions of greenspace in diverse contexts to formulate questions in each domain for our survey (e.g., de la Barrera et al., 2016; Farahani and Maller, 2018; Ode-Sang et al., 2016; Schipperijn et al., 2010). Finally, the online questionnaire was composed using the Survey Monkey software (www.surveymonkey.com) in Swedish and English languages. The questionnaire included a brief introduction that explained the purpose of the survey, how the collected data would be stored, used and reported, and 58 questions organised into the three domains. The questionnaire was pre-tested with 25 volunteers and sent to different municipalities for comments before distribution to the general public. These efforts helped to correct and improve the questionnaire based on suggestions and comments.

Additionally, we formed one more domain – external factors – that contains characteristics of biophysical conditions (mean annual temperature) and socio-economic attributes of municipalities (a proportion of built-up areas and population density) to test if these factors affect the frequency of urban greenspace usage. The variables in this domain were calculated separately from the survey and used in the data analyses (see Sections 2.3 and 2.4).

2.3. Data collection

Data was collected between October 2020 and September 2021. Distribution of the online questionnaire initially started through the authors' professional and personal networks, by emails and via social media (Facebook and LinkedIn). More than 200 posters about the survey, including its short description, the link and QR-code to the questionnaire, were distributed widely in 18 counties (out of 21) across Sweden to diversify respondents' geography and reduce biases. Posters were placed in libraries, on the information desks in nature reserves, city parks and recreational areas, shops and shopping centres. Additionally, seven municipalities (Malmö, Burlöv, Växjö, Hällefors, Västerås, Fagersta, and Umeå) posted information about the survey on their websites and social media accounts. Sweden's Biosphere Reserve network also helped distribute the information in Biosphere Areas in Sweden. In addition, outdoor clubs and ethnic associations were contacted to distribute the information about the survey via their networks and among their members. The distribution was performed using the snowballing method, as respondents were kindly asked to send the link to the questionnaire further to their contacts.

Regarding the fourth domain of variables, we calculated variables describing external factors at the municipality level. Mean annual air temperature (°C) was derived via a map algebra zonal function applied to the respective climate surface for 1970 – 2000 of the WorldClim2 database (Fick and Hijmans, 2017). The built-up area's shares (%) were calculated using a high-resolution ESRI global dataset (Karra et al., 2021). Population density data for year 2020 was acquired from Statistics Sweden (https://www.scb.se/).

2.4. Data analyses

Firstly, the survey data was prepared for the statistical analyses. Within the group *'How do you mostly use nature and green areas in and around your town'*, responses from some questions were merged as they were perceived to partly overlap: (i) '*Outdoor sports and games'* was created by merging *'Golf'*, *'Outdoor games'*, *'Sports/gym'*, *'Winter sports'* and *'Dancing'*; (ii) *'Social gathering'* was created by merging *'Social gatherings'* and '*Hanging with friends and family'*. Within the group *'What kind of problems are there in nature and green areas in and around your town'*, *'Dangerous plants and animals'* was created by merging *'Dangerous animals or pests'* and *'Poisonous plants'*. Two demographic questions were ignored as they had resulted in ambiguous responses and many missing values: (*'Do you have children?'*, *'How many children live in your household?'*). There were few respondents to the question *'How often do you visit nature and green areas in and around your town'* (hereafter *'How often'*) who scored *'have no access to such area'*, *'never'*, and *'almost never'*, which is why these three were merged to one category.

Secondly, to get an overview of the data, an exploratory multivariate analysis was conducted (using the CANOCO 5.12 software). In an RDA, Redundancy Analysis (Zuur et al., 2007), we used all questions as response variables (irrespective of domains), and the variable *'How often'* as the only explanatory variable. The purpose was to show: (1) How much of the total variation in the questions can be attributed to the variable *'How often'*; (2) Assess whether this variation is likely under the null hypothesis (that *'How often'* has no explanatory power); and (3) Show which questions had the strongest relationship with *'How often'*.

Finally, we analysed how visitation frequency *('How often')* – treated as a continuous variable – could be predicted by different combinations of explanatory variables. We used a model selection approach that selected the best model among all possible models (i.e. all possible combinations of questions). The Akaike Information Criterion (AIC) was used to compare models by estimating the amount of unexplained variation while applying punishment for increasing model complexity (Akaike, 1974). The best model is the one with the lowest AIC, but there might be other competing models that are so close in AIC that it is not justified to ignore them, given the uncertainty in data. Therefore, models within 2 AIC-units of the best model were considered as "competing models", and we compiled how often a question was included in the competing models as well as in the top 200 models (an exercise that could not be calculated for three groups of questions: External factors, "Quality" and "Logistics"). The model selection analyses were conducted in the software Statistica 13 (https://www.tibco.com), using Generalised Linear Models (with normal distribution and identity links).

3. Results

3.1. Overview

A total of 2806 respondents from 208 (out of 290) municipalities completed the survey. Socio-demographic characteristics and geographical coverage of respondents are further elaborated in Table 1 and Fig. 1.

The statistical analyses identified 61 explanatory variables that affect the frequency of urban greenspace visitation, which belonged to all four domains – external factors, individual characteristics of respondents, perceived characteristics of and preferences for urban greenspace (Table 2). The multivariate RDA showed that *'How often'* explained 0.39% of the variation in respondents' replies to all questions, and a permutation test (9999 permutations) showed this to be significant ($P = 0.0015$).

In general, respondents identified multiple benefits important for their wellbeing provided by urban green spaces. For example, more than 60% of respondents' *strongly agree'* that urban green spaces provided multiple physical health benefits for them and their kids *('important for*

Table 1
Socio-demographic characteristics of respondents.

Gender	64% of female, 35% of male and 1% of other
Age	1% of 18-20 years, 9% - 21-30, 15% - 31-40, 22% - 42-50 and 51-60, 17% - 61-70, 12% - 71-80, 1% - 81-90.
Marital status	18% - singles, 48% - married, 5% - divorced, 3% - widowed, 25% - living in partnership, 1% - other
Education	1% - no formal education, 3% - primary school, 20% - secondary school, 3% - college, 73% - university
Health	45% - very good, 49% - good enough, 5% - rather poor, 1% - poor
Employment status	51% - employed full-time, 6% - employed part-time, 7% - self-employed, 3% - unemployed, 3% - employed on zero hour contract), 6% - students, 24% - retired, 1% - long-standing sick leave, other – 2%
Economic situation	26% - very comfortable, 50% - comfortable, 21% - getting by, 4% - struggling to get by
Origin	88% - born in Sweden, 13% - born outside Sweden

my health', 'have been important for my physical and mental health during the Corona-virus pandemic', 'good for children's activities'), mental health benefits (*'good for leisure activities and relaxation'*), learning (*'provide a place to experience nature and wildlife'*), esthetical (*'make the town more attractive'*) and environmental benefits (*'help to improve the local environment in my town'*).

Approximately 66% of respondents were very satisfied or satisfied with the quality, 74% with accessibility and 56% with the availability of green spaces in and around towns where they lived. In total, 52% of respondents stated that the distance from their homes to the green space that they visited most often was less than 300 m, 28% of respondents reported that this distance was between 0.3 and 1 km, and for the rest (20%) 1–10 km. Of the various modes of transport available in the questionnaire, about 84% of respondents reported reaching these green spaces by foot, while 8% relied on public transport.

Respondents in different proportions selected all 16 types of green spaces listed in the questionnaire as places they visited. However, the proportions of respondents varied among the types of green spaces. More than 70% of respondents stated that they used forest and nature reserves to perform their activities. A relatively high proportion of respondents (50–70%) acknowledged large parks and lakes usage. The other green spaces were selected by less than 50% of respondents (Fig. 2).

The most selected activity was walking (selected by 92% of respondents). More than 50% of respondents acknowledged six more activities connected to urban green spaces: *'picking plants, berries and mushrooms; picnicking' 'swimming' 'enjoying the view' 'escaping the city' hanging out with friends and family'*. The other 15 types of activities were selected by less than 50% of respondents (Fig. 3).

Respondents associated different problems with urban green spaces within and around their settlements (Fig. 4). The majority of respondents (54%) identified litter in green spaces as a problem. At the same time, 36% of respondents acknowledged that there were no problems within the urban green spaces in and around their towns.

3.2. External factors

All three tested variables – mean annual temperature, a proportion of built-up area and population density per municipality – were explanatory variables of visitation frequency. Higher mean temperature and higher population density were linked with increased visitation frequency, while a higher proportion of built-up areas in municipalities was linked to lower visitation frequency (Fig. 5).

3.3. Individual characteristics of respondents

Socio-demographic characteristics. Six out of ten socio-demographic variables included in the questionnaire (age, health, formal education, country of origin, gender and work linked to nature) were identified as explanatory variables of visitation frequency (Fig. 6a). The age of respondents was amongst the most significant variables, and older people were more likely.

to use urban greenspace more often than those who were younger. For example, people aged 41–90 years more frequently reported using green areas every day than those aged 18–40. Respondents aged 21–40 more often reported not using green spaces – *'almost never'* – compared to those aged 61–70 and older.

Another highly significant variable was respondents' self-rated health condition. People with better health (*'very good' and 'good enough'*) were more likely to use green spaces than people having *'rather poor'* and *'poor'* health. For example, 97% of respondents who stated that they used green spaces every day or several times per week reported that they had *'very good' or 'good enough'* health conditions.

Level of education was also found to be a significant explanatory variable. People with higher education were more likely to be frequent users of green spaces. Our analysis also showed that respondents born in Sweden were likely to use greenspace more frequently than those born abroad. The gender of respondents was also important, with females being significantly more likely to use greenspace more frequently than males. Finally, respondents whose professional work was linked to nature were more likely to visit greenspace more often than others. In contrast, respondents' marital status, employment status, and self-rated individual economic situation were not selected to explain the frequency of urban greenspace usage.

Self-reported connectedness to nature. From eight variables related to self-reported nature connectedness, the statistical models identified four that explained the frequency of urban greenspace usage (Fig. 6b). Respondents who stated that *'My relationship to nature is an important part of who I am'* and *'It is important to be aware of environmental issues'* were more likely to use green spaces every day or several times per week. For instance, 93% of those who used green spaces every day scored *'strongly agree'* with the first statement. In contrast, respondents who stated that *'Land should be used more for housing instead of nature and green areas'* and *'Nature will recover from any human impact'* were more likely to visit green spaces less frequently.

Self-reported preventions of greenspace usage. Seven out of nine prevention variables included in the survey (*'do not want to', 'nothing stops me', 'lack of time', lack of knowledge where to go, what to see and what to do', 'lack of someone to go together with', 'lack of places to visit', 'health issues'*) were identified as explanatory variables of visitation frequency (Fig. 6c). One variable – *'nothing stops me'* – was selected by those respondents who were likely to visit greenspace more frequently. Conversely, respondents who selected the other six variables were more likely to visit greenspace less frequently.

'Do not want to' was amongst variables that were more likely to prevent respondents from visiting green spaces more frequently. *'Lack of knowledge where to go, what to do and what to see'* was selected by 50% of respondents who stated that they never used urban green spaces compared to only 6% of respondents who used green areas every day. *'Lack of someone to go together with'* was reported by 20–40% of respondents who stated of using green spaces *'once a month'* or *'never'* compared to 5–8% of respondents who used greenspace every day or several times per week. *'Lack of places to visit'* and *'health issues'* were selected more often by those who used green spaces *'never'*, *'almost never'* and *'once a month'* in contrast to those who visited these areas' *every day'* or *'several time per week'*.

Two variables – *'the area is too far away'* and *'lack of suitable transport'* – were not selected in the best model to predict the frequency of greenspace usage.

3.4. Perceived characteristics of urban green spaces

Perceived benefits. Out of 10 benefits listed in the questionnaire, four – *'important for my health', 'have been important for my physical and mental health during the Corona-virus pandemic', 'provide a source of wild foods'*

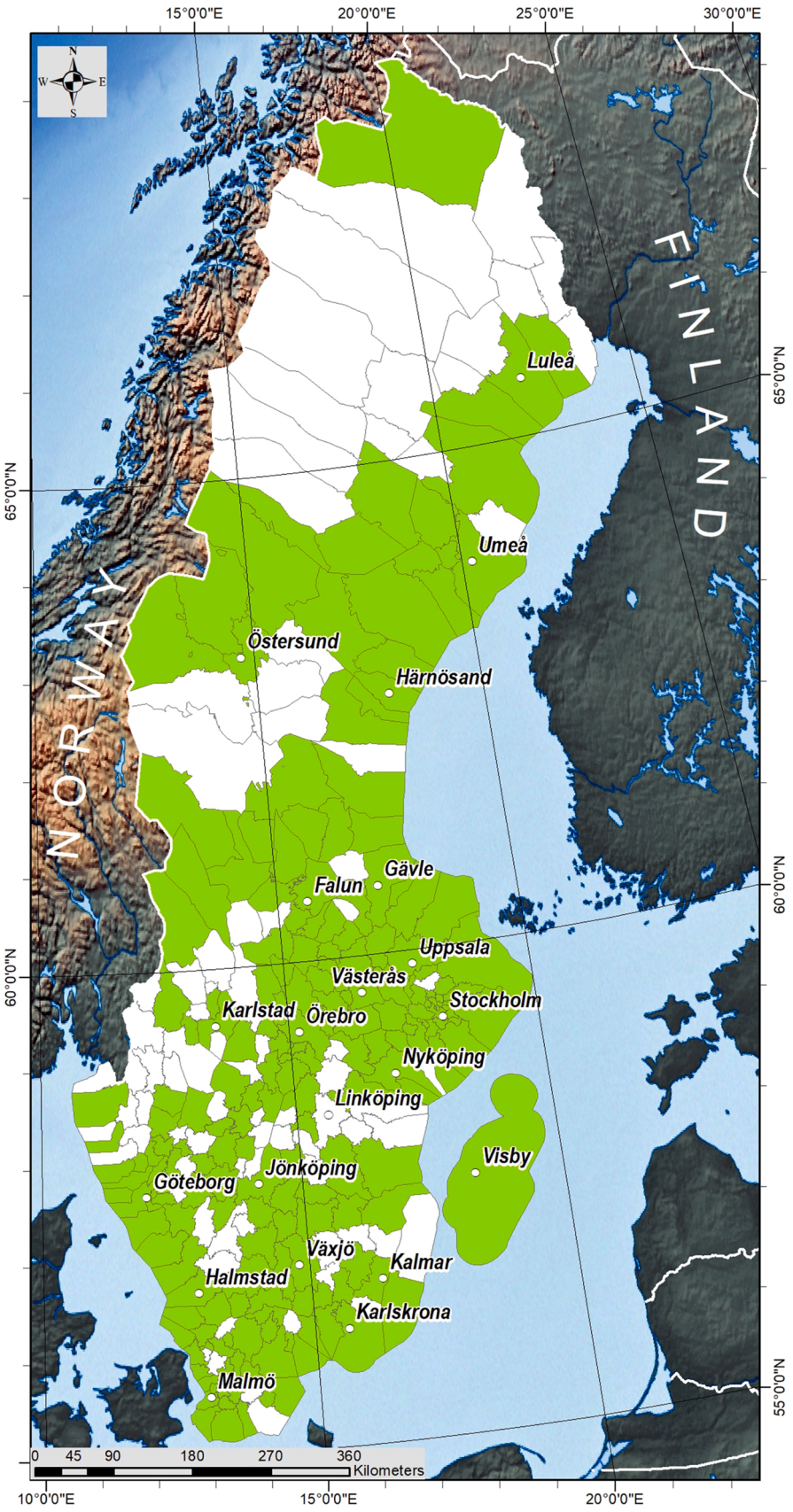

Fig. 1. Municipalities in which respondents participated in the survey.

Table 2
Explanatory variables of frequency of urban greenspace usage: variables in bold are more likely to increase urban greenspace usage or related to more frequent users of urban green spaces; the rest of the explanatory variables are more likely to have an opposite effect on the frequency of usage in both directions – increase and decrease.

Domain	Group of explanatory variables	Individual variable
1. External factors		***Mean temperature***
		Proportion of built-up area in municipality
		Population density in municipality
2. Individual characteristics of respondents	Socio-demographics	Age
		Health
		Education
		Origin
		Gender
		Work linked to nature
	Self-reported connectedness to nature	***'My relationship to nature is an important part of who I am'***
		'It is important to be aware of environmental issues'
		'Land should be used more for housing instead of nature and green areas'
		'Nature will recover from any human impact'
	Self-reported preventions of greenspace usage	'do not want to'
		'nothing stops me'
		'lack of time'
		lack of knowledge where to go, what to see and what to do',
		'lack of someone to go together with'
		'lack of places to visit'
		'health issues'
3. Perceived characteristics of urban green spaces	Perceived benefits	***'important for my health'***
		'have been important for my physical and mental health during the Corona-virus pandemic',
		'provide a source of wild foods'
		'provide a place for social interaction'
	Perceived quality, accessibility and availability	Perceived quality
		Perceived accessibility
	Self-reported accessibility	Distance from home
		By foot
		By public transport
	Perceived problems	***Do not see any problems***
		Litter
		Graffiti
		Feel unsafe
		Danger of injury
		Criminal activity
4. Preferences of respondents	Desired state of urban greenspace	***'as natural as possible'***
		'sport facilities and outdoor gyms'
		'have restaurants, café'
		'have tables and benches'
		'have fountains/statues'
		'have street light'
		'have playgrounds for kids'
	Used urban green spaces	***Forest***
		Meadow
		Allotment
		Own garden
		Nature reserve
		Wetland/bog
		Sport facilities
		Lawn
		Playground
		Sea
	Activities in urban green spaces	***Jogging***
		Cycling
		Picking wild foods
		Observing wildlife or plants
		Walking the dog
		Walking
		Photography
		Sport and games
		Fishing

and 'provide a place for social interaction' – were identified as explanatory variables for visitation frequency (Fig. 7a). Respondents that appreciated benefits related to their health, including during the COVID-19 period and wild foods provided by green areas were more likely to visit green spaces every day or several times per week compared to those who did not select such benefits. On the other hand, those who identified green spaces as a place for social interaction were less likely to be frequent visitors compared to who did not (Fig. 7a).

Perceived quality, accessibility and availability. Only quality and accessibility were explanatory variables for visitation frequency (Fig. 7b). The model selection analyses show that those who used green spaces often were more likely to be satisfied with the accessibility and quality of these spaces (Fig. 7b). Distance from home, and two transport modes –*'by foot'* and *'by public transport'* – were identified as explanatory variables for visitation frequency. More frequent visitation was more likely if the distance to urban green spaces was shorter and people could walk to places they like to visit (Fig. 7c). By contrast, greenspace visitation was likely to be less frequent if respondents used public transport.

Perceived problems. The statistical models showed that frequent users of green spaces were more likely to report *'do not see any problems'* or see '*litter* and/or *graffiti'* as problems. In contrast, infrequent users reported *'feel unsafe'*, *'danger of injury'* and *'criminal activity'* more often as problems than frequent users (Fig. 7d).

3.5. Preferences of respondents

Desired state of urban greenspace. Respondents who preferred to keep urban green spaces *'as natural and possible'* or with *'sport facilities or outdoor gyms'* were likely to visit green spaces more frequently than those who preferred green areas with restaurants, café , tables and benches, fountains/statues, street lights and playgrounds for kids (Fig. 8a).

Used urban green spaces. The statistical analyses showed that frequent users were more likely to prefer six types of green spaces: forest, meadows, allotments, own gardens, nature reserves, and wetlands/bogs. Conversely, four types – sport facilities, lawns, playgrounds and sea – were more likely to be preferred by infrequent users compared to frequent users (Fig. 8b).

Types of activities. Eight activities – *'jogging', 'cycling', 'picking plants, berries and mushrooms', 'observing wildlife or plants', 'walking the dog', 'walking', 'photography',* and *'sports and games'* – were positively associated with more frequent use of urban green spaces. Only one activity – *'fishing'* – was associated with less frequent use (Fig. 8c).

4. Discussion

4.1. Multiple factors shape people's interaction with urban greenspace

This study contributes to a better understanding of the multiple factors that shape interactions with a wide range of green spaces in and around different urban settlements in Sweden. We identified 61 explanatory variables and explicitly documented how socio-

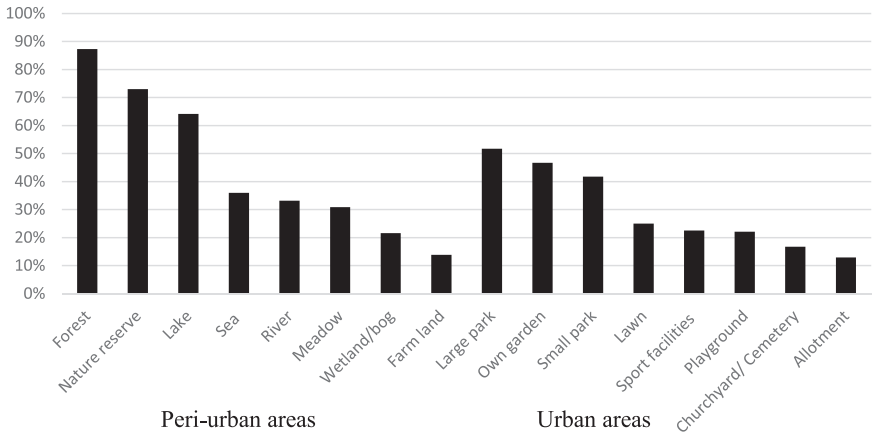

Fig. 2. Proportion of respondents that used different types of urban green spaces in peri-urban and urban areas.

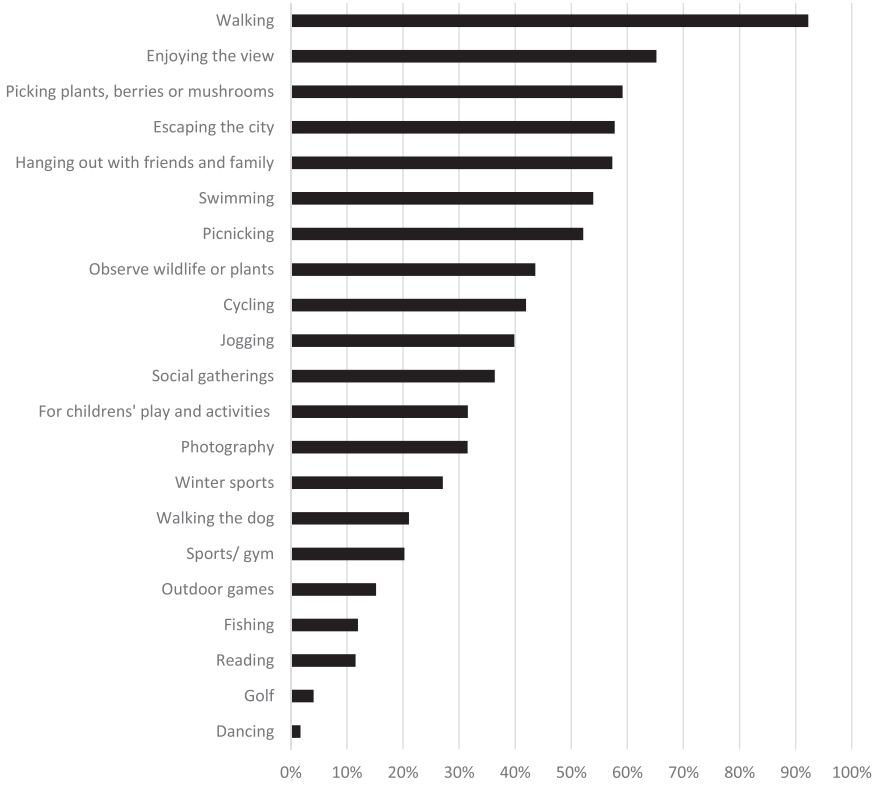

Fig. 3. Proportion of respondents that used different types of urban green spaces.

demographic characteristics, personal preferences for and perceptions of urban greenspace and biophysical conditions were linked to the frequency of urban greenspace usage.

Several of our findings regarding specific individual factors or perceptions of urban greenspace overlap with the results of previous research (e.g. Arnberger and Eder, 2015; Hedblom et al., 2014; Kabisch and Haase, 2014; Lin et al., 2014; Ode-Sang et al., 2016; Wenm et al., 2018). For example, we found that more frequent users (who use greenspace every day or several days per week) tend to be older, in good health, with higher formal education, and are more likely to be female and born in the country (Sweden). In contrast, infrequent users (who use greenspace once a month or almost never) are more likely to be males of younger age and with lower levels of formal education.

At the same time, this study highlights several factors that shape critical differences between frequent and infrequent users. *The first factor* is related to nature connectedness. Respondents with a stronger connection to nature are more likely to use greenspace more often than others. This is in line with some previous studies. For example, Lin et al. (2014) suggested that connectedness to nature was a more important factor affecting green space visitation rate than the availability of such spaces.

We did not investigate causal links among different explanatory variables. However, it seems likely that nature connectedness may affect preferences concerning desired urban greenspace. For example, our findings suggest that more frequent users mainly prefer greenspace in a more natural state ('as natural as possible) – such as forests, meadows, nature reserves and wetlands/bogs, while infrequent users prefer modified green spaces with fountains, street lights, toilets, benches, and restaurants. Yet, these apparent divergences in preferences beg the question: what does "quality" of green space mean to users? Should planners consider greenspace quality in terms of natural values, amenities, or maintenance? Or all of these aspects? Developing and

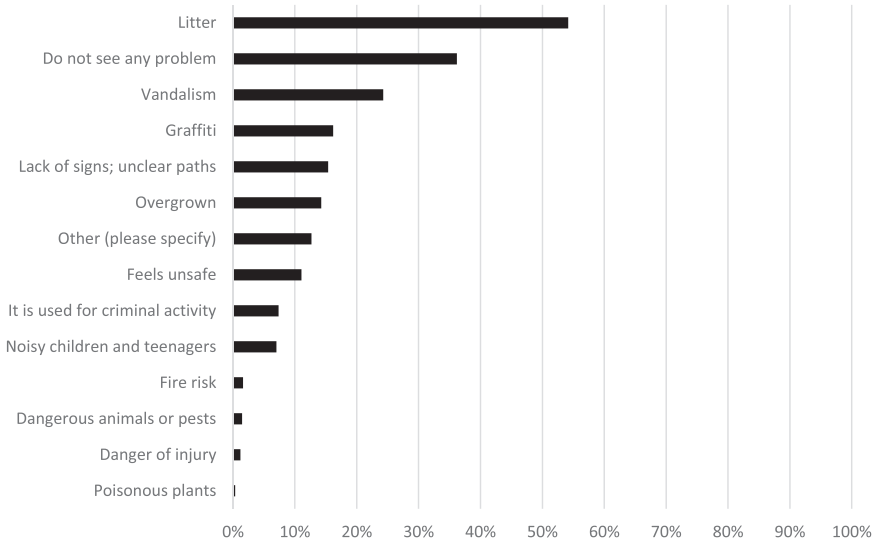

Fig. 4. Proportion of respondents that perceived different problems in urban green spaces across Sweden.

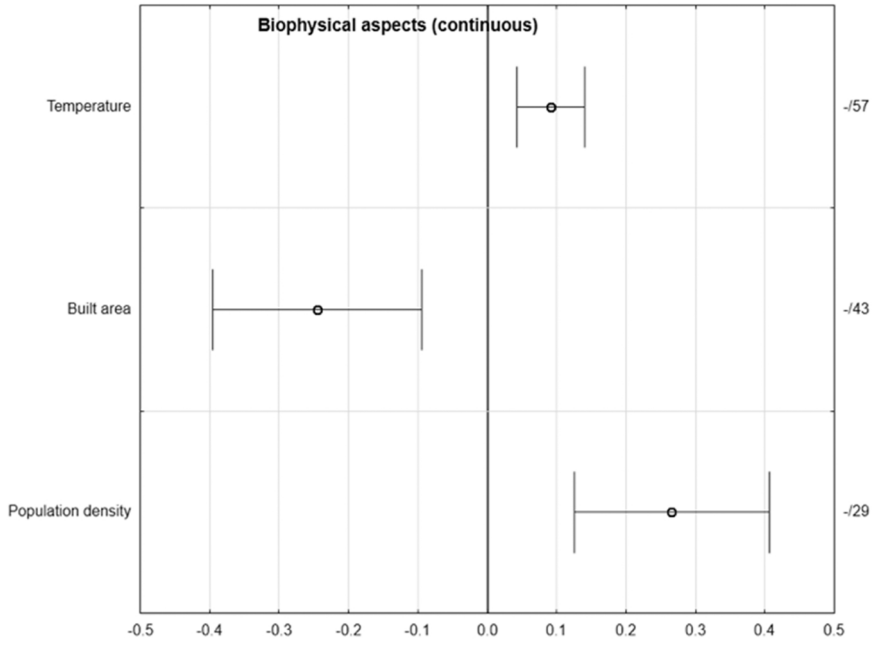

Fig. 5. Explanatory variables representing the external factors. Numbers are estimates of partial regression coefficients with CI95%. Numbers to the right of the graph are how frequently (%) the variable was selected among the competing models (i.e. those within 2 AIC of the top model).

managing high-quality urban greenspace is a critical objective for modern urban planning (Hadavi and Kaplan, 2016). Our results suggest a need to understand what greenspace quality means for different users in various environmental and cultural settings. A more expansive, multidimensional set of contextually-relevant definitions concerning greenspace quality might better guide planners on how green spaces could be re-designed or maintained to encourage visitation by a broader spectrum of users (Reyes-Riveros et al., 2021).

The second factor is respondents' perceptions of urban greenspace functions. Frequent users associated urban green spaces with multiple benefits relating to: physical and mental health, especially during the COVID-19 pandemic; gathering wild berries, mushrooms and other non-wood forest products; and as places for social interactions. On the other hand, infrequent users mainly associated greenspace with benefits relating to social activities. This factor might also relate to observed differences between these two groups concerning preferred activities in green spaces. Frequent users identified a broad spectrum of uses, whereas less frequent users selected relatively few activities. This suggests that frequent users are the primary beneficiaries of a more multifunctional urban greenspace.

The third factor relates to the perceived accessibility of green spaces. More frequent visitation was more likely if the distance to urban green spaces was shorter and people could walk to places they like to visit. The 'accessibility' of greenspace is widely acknowledged as a crucial aspect of a livable environment and human wellbeing, and is increasingly considered an environmental justice issue (e.g., Dai, 2011). A recent national survey found that 99% of the urban population in Sweden have access to at least one green area within 300 m of their home (Statistics Sweden, 2019). However, for 48% of our respondents, the distance to the green space they visited *most often* was more than 300 m from their home, including 20% for whom this distance was more than 1 km. Thus, an important issue is how accessibility to green spaces should be

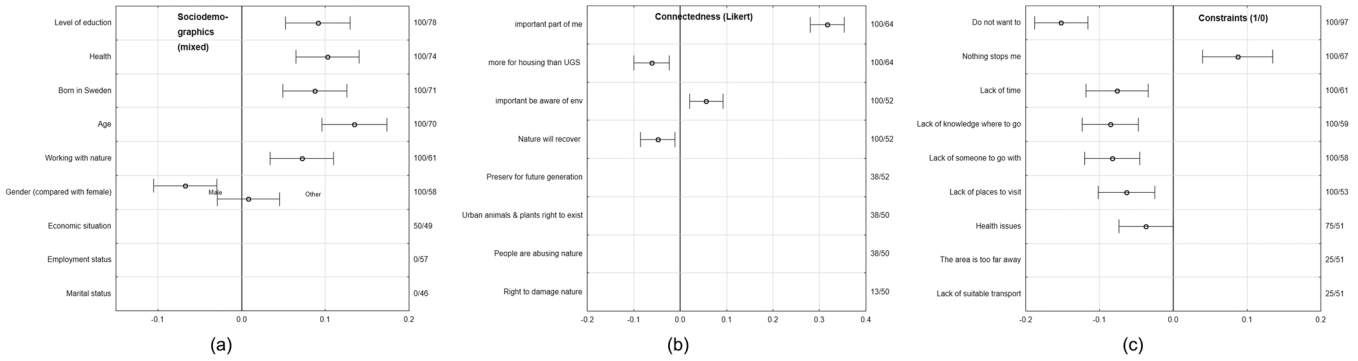

Fig. 6. Explanatory variables related to individual characteristics of respondents. Numbers are estimates of partial regression coefficients with CI95%. Numbers to the right of the graphs are how frequently (%) the variable was selected among the (i) top 200 models tested, and (ii) competing models (i.e. those within 2 AIC of the top model).

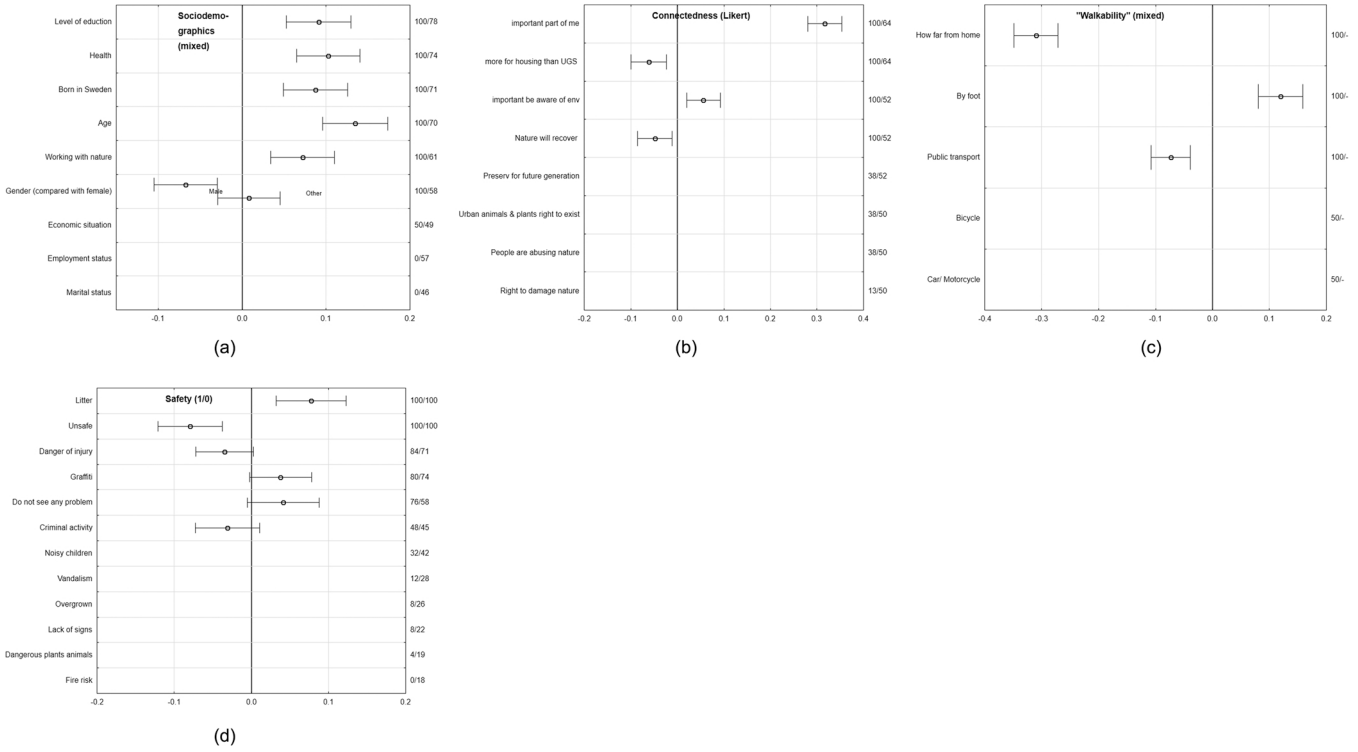

Fig. 7. Explanatory variables related to perceived characteristics of urban greenspace. Numbers are estimates of partial regression coefficients with CI95%. Numbers to the right of the graphs are how frequently (%) the variable was selected among the (i) top 200 models tested, and (ii) competing models (i.e. those within 2 AIC of the top model).

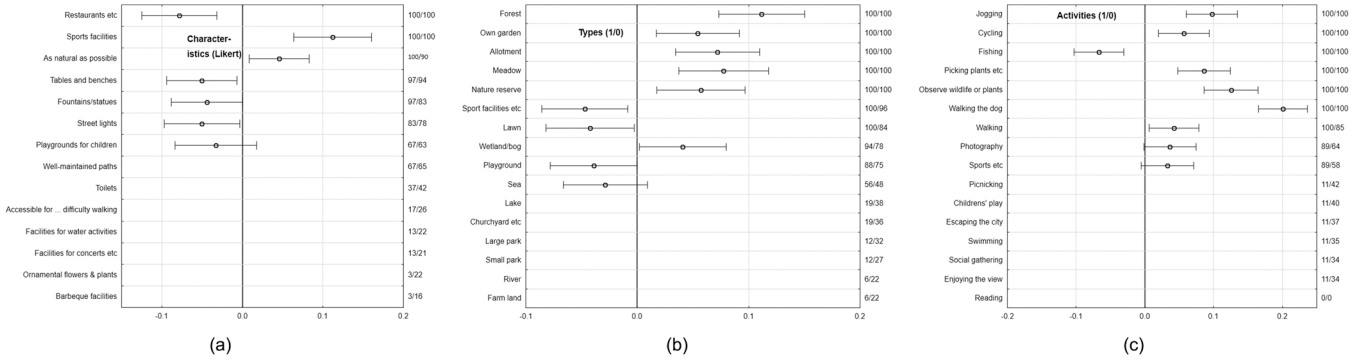

Fig. 8. Explanatory variables related to preferences of respondents. Numbers are estimates of partial regression coefficients with CI95%. Numbers to the right of the graphs are how frequently (%) the variable was selected among the (i) top 200 models tested, and (ii) competing models (i.e. those within 2 AIC of the top model).

assessed and measured: to any green space or particular green spaces? Our results suggest that accessibility to green space needs to be estimated in a more inclusive way that accounts for important differences in preferences and perceptions between different user groups. Therefore, the proximity measured by simple Euclidean distance or even functional distance that takes into account various possible modes of transport may not be adequate measures.

4.2. Diversity of greenspace along an urban-peri-urban gradient

Our study illustrates the importance of a broad range of greenspace types for urban residents, from parks of different sizes, lawns, and playgrounds to forests, nature reserves, wetlands, lakes and other green spaces in peri-urban areas. This is in line with the United Nations 2030 Agenda for Sustainable Development, which stresses that citizens must have universal access to green areas, and the connection between urban and peri-urban areas must be encouraged.

In this regard, three findings might be beneficial for urban green planning. First, more than 70% of respondents acknowledged using forests and nature reserves for multiple recreational benefits, highlighting these as core green space types. These green spaces are often located in peri-urban areas and are characterised by high natural (Croci et al., 2008; Sandström et al., 2006) and social values (e.g. Borgström et al., 2021) and, as such, provide significant assets for urban sustainability. Many surveys from Nordic countries show that natural areas with old trees, multi-layer vegetation structures, and simple recreational facilities are often preferred as recreational environments (Gundersen and Frivold, 2008). Sweden's National Board of Housing, Building and Planning included in the generation goals that everyone should have access to a national park, nature reserve or nature conservation area within 1000 m. Presently only 30% of the Swedish population have such access.

However, forests and nature reserves in peri-urban areas are under increasing pressure due to urban sprawl and the intensification of conventional agriculture and forestry, which cause their degradation, fragmentation, and loss (IPBES et al., 2018; Haaland and Van den Bosch, 2015). In Sweden, municipal forests in peri-urban areas are often kept for so-called 'future development', and the management goal of such forests is not clearly stated and often depends on the agenda of the leading party in a municipal government. Currently, local debates about peri-urban municipal forests are increasing on what functions of forests–economic, ecological or social – should be maintained (one example, https://www.lulea.se/kommun–politik/hallbar--utveckling/naturvard/naturvardsarbete-i-kommunen.html). This study provides strong evidence that the social functions of forests are crucial for urban people. However, urban inhabitants' recreational use of forests or forest-farm land might also lead to conflicts with forest owners and farmers. For example, Hedblom et al. (2017b) suggested that densification of cities reduces opportunities for recreation within the city borders and forces urban people to recreate in peri-urban areas, which increases conflicts with other land uses. Thus, cooperation between stakeholders, who could be potentially affected by recreational users, and municipalities would be crucial to developing a strategic vision and planning of recreational activities around urban areas (e.g., Eriksson, 2012). Innovative developments toward urban-rural linkages, including food cultivation in and around cities that reduce the distance between food producers and consumers and connect people with nature, may provide an opportunity to maintain greenspace in peri-urban areas (e.g. Kulak et al., 2013). An additional general suggestion for planning in the face of the climate crisis and increasing costs of using personal cars in urban- and peri-urban environments would be to support many different types of "green" mobility. In Sweden, with apparent seasonal differences, it could include both cycle highways and skiing paths as linkages to greenspace along the urban – peri-urban gradient.

Second, our results show that small green spaces (e.g., pocket parks, allotments, playgrounds etc.) in cities provide essential benefits for urban inhabitants, especially for less frequent users. However, formal urban planning documents often focus on flagship green spaces such as parks, urban forests, and street greenery (Feltynowski et al., 2018). Thus, there is a need to compile a more comprehensive database of existing types of green spaces along urban-peri-urban gradients for urban areas in Sweden than currently exists. Such data are likely also relevant to other countries (Daniels et al., 2018). The progress in collecting remote sensing data with high spatial and thematic resolution (e.g. with LiDAR technology) allows for detailed 3-d mapping and modelling of various greenspace benefits (Bartesaghi-Koc et al., 2019; Caynes et al., 2016; Degerickx et al., 2020) that could be applied in urban green planning. Moreover, availability assessments need to be conducted from the perspective of different user groups, including children, the elderly, people inexperienced with outdoor recreation, people with low socio-economic resources or with varying health conditions, etc. Future research is also needed to identify thresholds of greenspace availability for different user groups. For example, greenspace usage could be studied locally using citizen science as it has been successfully applied to identify various benefits of urban green infrastructure (e.g. Coventry et al., 2019; Newman et al., 2020; Schneider et al., 2020).

Third, our study also shows that water objects, or blue areas, are essential for diverse users. For example, 64% of respondents acknowledged using lakes for recreational activities. However, blue areas are often not included in greenspace planning. The importance of urban aquatic ecosystems for enhancing the aesthetic, recreational and ecological value of urban areas has been acknowledged by scholars (e.g., Iojă et al., 2021). Also, in concert with green spaces, water bodies in urban environments are essential for counteracting heat waves linked to climate change. Several European urban regions have adopted spatial plans that promote increased connectivity between green spaces and urban waters over the long term (Grădinaru and Hersperger, 2019). However, examples of such integration remain scarce.

4.3. Bringing people to nature

Taken together, our findings indicate that urban inhabitants are very heterogeneous in their perceptions, preferences for and usage of urban greenspace. Urban spatial planners are therefore challenged to secure a multitude of diverse types of greenspace in a time of increasing competition from other types of land use. Many efforts have been made to bring 'nature to people' by improving the accessibility and availability of green spaces in cities. However we argue that developing a more inclusive approach to urban greenspace planning and management is equally essential to ensure an attractive and inclusive mix of living environments in urban settings, which triggers 'bringing people to nature' (Haase et al., 2017). Rather than advancing one-size-fits-all solutions, there is a need for a broader view concerning the quality, availability, and accessibility of urban greenspace from the perspectives of different user groups, including those from different cultural backgrounds. We agree with Hitchings (2013) that urban planners have to start by understanding how different groups of people live and what this tells us about specific aspects of greenspace design that can tempt them into these spaces. This is particularly important given the rapid rate of demographic and cultural change in many contemporary societies. For example, in Sweden, nearly 20% of the current population is now born outside of Sweden or have parents who are born outside Sweden (https://www.scb.se/hitta-statistik/sverige-i-siffror/manniskorna-i-sverige/utrikes-fodda/). Increasingly multicultural urban and peri-urban areas raise new challenges regarding the development of sustainable living environments that meet the requirements of all inhabitants.

Haase et al. (2017) proposed prerequisites for inclusive urban greenspace development, several of which are relevant to this study: (1) involving diverse actors with different, even conflicting, demands and needs in the design, planning and implementation of greening strategies;

(2) planning and managing green spaces as places for the interaction among different groups of people; and (3) steering greenspace development using a multi-actor governance structure that includes stakeholders from public, private and civic sectors to ensure an inclusive representation of all residents. However, there are several barriers to inclusive urban greenspace development in Sweden and Nordic countries in general. First, greenspace management is highly fragmented. For example, Randrup et al. (2017) reported that green space management in Sweden is distributed among multiple stakeholders, including municipalities, public and private housing companies and organisations. Also, different municipal institutions are primarily interested only in those green spaces for which they are formally responsible. Second, urban greenspace managers are mainly involved in maintenance activities rather than long-term planning or collaborative activities (Randrup et al., 2017). Third, municipalities in Sweden have a so-called "planning monopoly" for urban areas. Therefore, how new actors and stakeholders can be successfully integrated into new governance structures concerning greenspace planning remains unclear. Previous studies (e.g., Elbakidze et al., 2015) have shown, for example, that efforts to integrate broader sets of stakeholder preferences in comprehensive municipal planning have not succeeded. The Swedish Environmental Protection Agency and the National Board of Housing, Building and Planning provided a guideline for urban green infrastructure planning to help municipalities (SEPA, 2022). We argue that there is a need for interdisciplinary studies on how multiple factors might be successfully integrated in the current urban green planning and whether current planning regimes are suitably equipped to manage the additional complexity that likely arises due to such integration, including potential interactions between factors over time.

Finally, our results highlight the importance of nature connectedness for more frequent use of greenspace. Scholars argue that nature connectedness in urban populations can be nurtured by improved science education and increased exposure to nature experiences (Lin et al., 2014), for example, already for preschool children (Ives et al., 2017). We, therefore, argue that such measures could provide the basis of complementary policies for encouraging greenspace usage and be integrated within the current education framework. Furthermore, directed education programmes can foster the level of nature connectedness among children and adults (Lankenau, 2018; Talebpour et al., 2020), which may be especially timely given that our results indicate a significant difference lower frequency of visitation amongst younger people in Sweden today.

5. Conclusion

This study reveals that the frequency of people's interactions with urban greenspace is influenced by an extensive and highly diverse set of factors relating to socio-demographic characteristics, personal perceptions and preferences concerning urban greenspace, and biophysical characteristics of urban landscapes themselves. These findings underline the complex challenges involved in planning and managing urban greenspace for increasingly diverse urban populations when decision-makers at all levels are increasingly looking to urban green space to provide many other benefits. There is a danger that the portrayal of green space as a panacea for urban planning may obfuscate the need to prioritise some benefits above others. These challenges suggest the need for the integration of improved tools for dealing with complexity into urban planning regimes, as well as indicating a need to redefine the availability, accessibility and quality of urban greenspace in a more inclusive way, which considers differences in preferences for and perceptions of green spaces among user groups. Additionally, our study shows the importance of peri-urban greenspace for urban residents in Sweden. It suggests a need for urban planners to go beyond urban administrative boundaries and consider peri-urban nature more explicitly in greenspace planning.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.ufug.2022.127672.

References

Akaike, H., 1974. A new look at the statistical model identification. IEEE Trans. Autom. Control 19, 716–723.
Appleton, J., 1975. The Experience of Landscape. John Wiley & Sons, London.
Arnberger, A., Eder, R., 2015. Are urban visitors' general preferences for greenspaces similar to their preferences when seeking stress relied? Urban For. Urban Green. 4, 872–882.
de la Barrera, F., Reyes-Paecke, S., Harris, J., Bascuñán, D., Manuel Farías, J., 2016. People's perception influences on the use of green spaces in socio-economically differentiated neighborhoods. Urban For. Urban Green. 2, 254–264.
Bartesaghi-Koc, C., Osmond, P., Peters, A., 2019. Mapping and classifying green infrastructure typologies for climate-related studies based on remote sensing data. Urban For. Urban Green. 37, 154–167.
Borgström, S., Andersson, E., Björklund, T., 2021. Retaining multi-functionality in a rapidly changing urban landscape: insights from a participatory, resilience thinking process in Stockholm. Sweden. Ecol. Society 4, 17.
Bowler, D.E., Buyung-Ali, L., Knight, T.M., Pullin, A.S., 2010. Urban greening to cool towns and cities: a systematic review of the empirical evidence. Landsc. Urban Plan. 97 (3), 147–155.
Caynes, R.J.C., Mitchell, M.G.E., Wu, D.S., Johansen, K., Rhodes, J.R., 2016. Using high-resolution LiDAR data to quantify the three-dimensional structure of vegetation in urban green space. Urban Ecosyst. 19 (4), 1749–1765.
Cohen, D., Han, B., Pitkin Derose, K., Williamson, S., Marsh, T., Rudick, J., McKenzie, T., 2012. Neighborhood poverty, park use, and park-based physical activity in a Southern California city. Soc. Sci. Med. 75 (12), 2317–2325.
Coventry, P.A., Neale, C., Dyke, A., Pateman, R., Cinderb,y, S., 2019. The mental health benefits of purposeful activities in public green spaces in urban and semi-urban neighbourhoods: a mixed-methods pilot and proof of concept study. Int. J. Environ. Res. Public Health 16, 15.
Croci, S., Butet, A., Georges, A., Aguejdad, R., Clergeau, P., 2008. Small urban woodlands as biodiversity conservation hot-spot: a multi-taxon approach. Landsc. Ecol. 23 (10), 1171–1186.
Dai, D., 2011. Racial/ethnic and socio-economic disparities in urban green space accessibility: where to intervene? Landsc. Urban Plan. 102 (4), 234–244.
Daniels, B., Zaunbrecher, B., Paas, B., Ottermanns, R., Ziefle, M., Roß-Nickoll, M., 2018. Assessment of urban green space structures and their quality from a multidimensional perspective. Sci. Total Environ. 615, 1364–1378.
Davies, C., Lafortezza, R., 2017. Urban green infrastructure in Europe: is greenspace planning and policy compliant? Land Use Policy 69, 93–101.
Degerickx, J., Hermy, M., Somers, B., 2020. Mapping functional urban green types using high resolution remote sensing data. Sustainability 12, 5.
van den Bosch, M., Ode-Sang, Å., 2017. Urban natural environments as nature-based solutions for improved public health – a systematic review of reviews. Environ. Res. 158, 373–384.
Elbakidze, M., Dawson, L., Andersson, K., Axelsson, R., Angelstam, P., Stjernquist, I., Teitelbaum, S., Schlyter, P., Thellbro, C., 2015. Is spatial planning a collaborative learning process? A case study from a rural-urban gradient in Sweden. Land Use Policy 48, 270–285.
Elmqvist, T., Andersson, E., Frantzeskaki, N., McPhearsonm, T., Olsson, P., Gaffney, O., Takeuchi, K., Folke, C., 2019. Sustainability and resilience for transformation in the urban century. Nat. Sustain. 2, 267–273.
Enssle, F., Kabisch, N., 2020. Urban green spaces for the social interaction, health and wellbeing of older people – an integrated view of urban ecosystem services and socio-environmental justice. Environ. Sci. Policy 109, 36–44.
EQO, 2015. Environmental quality objectives: a shared responsibility ⟨https://www.government.se/contentassets/a575d5a63d7b4e7a853671c3812f116a/environmental-quality-objectivs–a-shared-responsibility-summary-of-government-bill-200405150⟩ .
Eriksson, L., 2012. Exploring underpinnings of forest conflicts: a study of forest values and beliefs in the general public and among private forest owners in Sweden. Soc. Nat. Resour. 25 (11), 1102–1117.
Farahani, L., Maller, C., 2018. Perceptions and preferences of urban greenspaces: a literature review and framework for policy and practice. Landsc. Online 1, 1–22.

Feltynowski, M., Kronenberg, J., Bergier, T., Kabisch, N., Łaszkiewicz, E., Stohbach, M. W., 2018. Challenges of urban green space management in the face of using inadequate data. Urban For. Urban Green. 31, 56–66.
Fick, S., Hijmans, R., 2017. WorldClim 2: new 1-km spatial resolution climate surfaces for global land areas. Int. J. Climat 37 (12), 4302–4315.
Fricker, R.D., Jr, 2008. Sampling methods for web and email surveys. In: Fielding, N.G., Lee, R.M., Blank, G. (Eds.), The SAGE Handbook of Online Research Methods, pp. 195–216 (SAGE).
Geary, R., Wheeler, B., Lovell, R., Jepson, R., Hunter, R., Rodgers, S., 2021. A call to action: improving urban green spaces to reduce health inequalities exacerbated by COVID-19. Prev. Med. 145.
Grădinaru, S., Hersperger, A., 2019. Green infrastrcuture in strategic spatial plans: evidence from European urban regions. Urban For. Urban. Green. 40, 17–28.
Gundersen, V., Frivold, L., 2008. Public preferences for forest structures: a review of quantitative surveys in Finland, Norway and Sweden. Urban For. Urban Green. 7 (4), 241–258.
Gunnarsson, B., Knez, I., Hedblom, M., Ode Sang, Å., 2017. Effects of biodiversity and environment -related attitude on perception of urban green space. Urban Ecosyst. 20, 37–49.
Haaland, C., van den Bosch, C.K., 2015. Challenges and strategies for urban greenspace planning in cities undergoing densification: a review. Urban For. Urban Green. 14 (4), 760–771.
Haase, D., Kabisch, S., Haase, A., Andersson, E., Banzhaf, E., Bar, F., Brenck, M., Fischer, L., Frantzeskaki, N., Kabisch, N., Krellenberg, K., Kremer, P., Kronenberg, J., Larondelle, N., Mathey, J., Pauleit, S., Ring, I., Rink, D., Schwarz, N., Wolff, M., 2017. Greening cities – to be socially inclusive? About the alleged paradox of society and ecology in cities. Habitat Int. 64, 41–48.
Hadavi, S., Kaplan, R., 2016. Neighborhood satisfaction and use patterns in urban public outdoor spaces: multidimensionality and two-way relationships. Urban For. Urban Green. 19, 110–122.
Hartig, T., Kahn, P., 2016. Living in cities, naturally. Science 352, 938–940.
Hedblom, M., Andersson, E., Borgström, S., 2017b. Flexible land-use and undefined governance: from threats to potentials in peri-urban landscape planning. Land Use Policy 63, 523–527.
Hedblom, M., Heyman, E., Antonsson, H., Gunnarsson, B., 2014. Bird song diversity influences young people's appreciation of urban landscapes. Urban For. Urban Green. 13, 469–474.
Hedblom, M., Lindberg, F., Vogel, E., Wissmann, J., Ahrné, 2017a. Estimating urban lawn cover in space and time: case studies in three Swedish cities. Urban Ecosyst. 20, 1109–1119.
Hitchings, R., 2013. Studying the preoccupations that prevent people from hoing into green space. Landsc. Urban Plan. 118, 98–102.
Huang, K., Li, X., Liu, X., Seto, K.C., 2019. Projecting global urban land expansion and heat island intensification through 2050. Environ. Res. Lett. 14 (11), 114037.
Iojă, C., Badiu, D., Haase, D., Hossu, A., Niță, M., 2021. How about water? Urban blue infrastructure management in Romania. Cities 110.
IPBES, 2018. In: Rounsevell, M., Fischer, M., Torre-Marin Rando, A., Mader, A. (Eds.), The IPBES Regional Assessment Report on Biodiversity and Ecosystem Services for Europe and Central Asia. Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany.
Ives, Ch., Giusti, M., Fischer, J., Abson, D., Klaniecki, K., Dorninger, Ch., Laudan, J., Barthel, S., Abernethy, P., Martín-López, B., Raymond, Ch., Kendal, D., von Wehrden, H., 2017. Human–nature connection: a multidisciplinary review. In: Cur. Opin. Envir. Sust., pp. 106–113.
de Jong, M., Joss, S., Schraven, D., Zhan, C., Weijnen, M., 2015. Sustainable–smart–resilient–low carbon–eco–knowledge cities; making sense of a multitude of concepts promoting sustainable urbanisation. J. Clean. Prod. 109, 25–38.
Kabisch, N., Haase, D., 2013. Green spaces of European cities revisited for 1990-2006. Landsc. Urban Plan. 110, 113–122.
Kabisch, N., Haase, D., 2014. Green justice or just green? Provision of urban green spaces in Berlin, Germany. Landsc. Urban Plan. 122, 129–139.
Karra, K., Kontgis, C., Statman-Weil, Z., Mazzariello, J.C., Mathis, M., Brumby, S., 2021. Global land use/ land cover with Sentinel 2 and deep learning. IEEE International Geoscience and Remote Sensing Symposium IGARSS 4704–4707.
Kulak, M., Graves, A., Chatterton, J., 2013. Reducing greenhouse gas emissions with urban agriculture: a Life Cycle Assessment perspective. Landsc. Urban Plan. 111 (1), 68–78.
Kulp, S.A., Strauss, B.H., 2019. New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding. Nat. Commun. 10 (1).
Lankenau, G.R., 2018. Fostering connectedness to nature in higher education. Environ. Educ. Res. 24 (2), 230–244.
Lin, B., Fuller, R., Bush, R., Gaston, K., Shanahan, D., 2014. Opportunity or orientation? Who uses urban parks and why. PLoS 9, 1.
Lindholst, A., van den Bosch, Konijnendijk, Kjøller, C., Sullivan, C., Kristoffersson, S., Fors, H, A., Nilsson, K., 2016. Urban green space qualities reframed toward a public value management paradigm: the case of the Nordic Green Space Award. Urban For. Urban Green. 17, 166–176.
Madureira, H., Nunes, F., Vidal Oliveira, J., Medureira, T., 2018. Preferences for urban space characteristics: a comparative study of three Portuguese cities. Environment 5, 23.
Mayer, F.S., Frantz, C.M., Bruehlman-Senecal, E., Dolliver, K., 2009. Why is nature beneficial?: The role of connectedness to nature. Environ. Behav. 41 (5), 607–643.
Newman, G., Shi, T., Yao, Z., Li, D., Sansom, G., Kirsch, K., Casillas, G., Horney, J., 2020. Citizen science-informed community master planning: land use and built environment changes to increase flood resilience and decrease contaminant exposure. Int. J. Environ. Res. Public Health 17, 2.
Nielsen, A.B., Hedblom, M., Olafsson, A., Wiström, B., 2017. Spatial configurations of urban forest in different landscape and socio-political contexts: identifying patterns for green infrastructure planning. Urban Ecosyst. 20 (2), 379–392.
Nordh, H., Olafsson, A.S., 2021. Plans for urban green infrastructure in Scandinavia. J. Environ. Plan. Manag. 64 (5), 883–904.
Ode-Sang, Å., Gunnarsson, B., Knez, I., Hedblom, M., 2016. The effects of naturalness, gender, and age on how urban green space is perceived and used. Urban For. Urban Green. 18, 268–276.
Orians, G.H., 1986. An ecological and evolutionary approach to landscape aesthetics. In: Penning-Rowsell, E.C., Lowenthal, D. (Eds.), Landscape Meanings and Values. Allen & Unwin, pp. 3–22.
Park, J., O'Brien, L., Roe, J., Ward Thompson, C., Mitchell, R., 2011. The natural outdoors and health: assessing the value and potential contribution of secondary public data sets in the UK to current and future knowledge. Health Place 17, 269–279.
Peschardt, K., Stigsdotter, U., 2013. Associations between park characteristics and perceived restorativeness of small public urban green spaces. Landsc. Urban Plan. 112, 26–39.
Randrup, Th, Östberg, J., Wiström, B., 2017. Swedish green space management – the managers perspective. Urban For. Urban Green. 28, 103–109.
Reyes-Riveros, R., Altamirano, A., De La Barrera, F., Rozas-Vasquez, D., Vieli, L., Meli, P., 2021. Linking oublic urban green spaces and human wellbeing: a systematic review. Urban For. Urban Green. 61, 127105.
Ribeiro, P.J.G., Pena Jardim Gonçalves, L.A., 2019. Urban resilience: a conceptual framework. Sustain. Cities Soc. 50, 101625.
Sandström, U.G., Angelstam, P., Mikusiński, G., 2006. Ecological diversity of birds in relation to the structure of urban green space. Landsc. Urban Plan. 77, 39–53.
Schipperijn, J., Stigsdotter, U., Randrup, T., Troelsen, J., 2010. Influences on the use of urban green space – a case study in Odense, Denmark. Urban For. Urban Green. 9 (1), 25–32.
Schneider, A.-K., Strohbach, M.W., App, M., Schroder, B., 2020. The 'GartenApp': assessing and communicating the ecological potential of private gardens. Sustainability 12 (1), 1–15.
SE, 2018. Statistiknyhet 2018. Fortsatt ökning av befolkning i tätorter. ⟨https://www.scb.se/hitta-statistik/statistik-efter-amne/miljo/markanvandning/tatorter- arealer-befolkning/pong/statistiknyhet/befolkning-i-tatorter-2017/⟩.
SEPA, 2022. Grönplanera! En vägledingar att ta fram en grönplan. Naturvårdsverket. Boverket. Rapport 7025. Januari 2022.
Statistics Sweden, 2019. Green areas within and around urban areas 2015. ⟨https://www.scb.se/en/finding-statistics/statistics-by-subject-area/environment/land-use/green-areas-within-and-in-the-vicinity-of-urban-settlements/pong/statistical-news/green-areas-within-and-around-urban-areas-2015-/⟩.
Swanwick, C., 2009. Society's attitudes to and preferences for land and landscape. Land Use Policy 26, 62–75.
Talebpour, L.M., Busk, P.L., Heimlich, J.E., Ardoin, N.M., 2020. Children's connection to nature as fostered through residential environmental education programs: key variables explored through surveys and field journals. Environ. Educ. Res. 26 (1), 95–114.
Taylor, L., Hochuli, D., 2017. Defining greenspace: multiple uses across multiple disciplines. Landsc. Urban Plan. 158, 25–38.
Ugolini, F., Massetti, L., Calaza-Martínez, P., Cariñanos, P., Dobbs, C., Krajter Ostoić, S., Sanesi, G., 2020. Effects of the COVID-19 pandemic on the use and perceptions of urban green space: an international exploratory study. Urban For. Urban Green. 56.
Venter, Z.S., Barton, D.N., Gundersen, V., Figari, H., Nowell, M., 2020. Urban nature in a time of crisis: recreational use of green space increases during the COVID-19 outbreak in Oslo, Norway. Environ. Res. Lett. 15 (10), 104075.
Ward Thompson, C., 2011. Linking landscape and health: the recurring theme. Landsc. Urban Plan. 99, 187–195.
Wenm, Ch, Albert, Ch, Von Haaren, Ch, 2018. The elderly in green spaces: exploring requirements and preferences concerning nature-based recreation. Sustain. Cities Soc. 38, 582–593.
Wilson, E.O., 1984. Biophilia. Harvard University Press, Cambridge.
Zuur, A.F., Ieno, E.N., Smith, G.M., 2007. Principal component analysis and redundancy analysis. Analysing Ecological Data. Statistics for Biology and Health. Springer, New York, NY, pp. 193–224.