Visitors' perceptions of urban wilderness

A case study of Jiangyangfan Ecological Park in Hangzhou, China

Chen, Yuan; Nijhuis, Steffen; van Dorst, Machiel

DOI
10.1016/j.ufug.2024.128319

Publication date
2024

Document Version
Final published version

Published in
Urban Forestry and Urban Greening

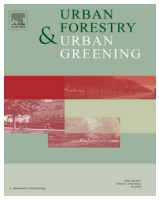
Citation (APA)
Chen, Y., Nijhuis, S., & van Dorst, M. (2024). Visitors' perceptions of urban wilderness: A case study of Jiangyangfan Ecological Park in Hangzhou, China. *Urban Forestry and Urban Greening*, *95*, Article 128319. https://doi.org/10.1016/j.ufug.2024.128319

Urban Forestry & Urban Greening 95 (2024) 128319

Contents lists available at ScienceDirect

Urban Forestry & Urban Greening

journal homepage: www.elsevier.com/locate/ufug



Visitors' perceptions of urban wilderness. A case study of Jiangyangfan Ecological Park in Hangzhou, China

Yuan Chen *, Steffen Nijhuis, Machiel van Dorst

Urbanism, Faculty of Architecture and The Built Environment, Delft University of Technology, Building 8, Julianalaan 134, Delft 2628 BL, the Netherlands

ARTICLE INFO

Keywords:
Case study
Environmental perception
Landscape planning and design
Urban wilderness

ABSTRACT

Numerous studies show the benefits of wilderness to humans and the environment. Therefore, preserving and developing wilderness areas within urban settings are crucial to combat and mitigate challenges like biodiversity decline resulting from urbanization. According to previous studies, human-wilderness interactions can be contradictory, e.g., relaxing while feeling anxious and insecure. How individuals perceive and comprehend intentional urban wilderness, what dimensions contribute to their perceptions, and how these dimensions influence the visitors' perceptions remain to be investigated. Selecting Jiangyangfan Ecological Park (Hangzhou, China) as a survey case, this research investigates if and how people perceive intentionally incorporated and designed urban wilderness and how various dimensions of attributes shape their perceptions. This study identified three dimensions that may contribute to visitors' perceptions of the urban wilderness; namely, cognitive landscape attributes, perceived environmental attributes, and their visitation experience. A mixed-method approach was employed using a questionnaire, mental maps, and environmental behaviour observation as diverse data sources to assess visitors' urban wilderness perceptions and comprehension from the three dimensions. Results indicate a high propensity to visit the park as an urban wilderness. Our findings also revealed that visitors' perceptual environmental attributes, e.g., the existence of vegetation and waterbodies and encounters with wild animals, as well as their visit experiences, e.g., their satisfaction with the visit and their motivation for experiencing nature, significantly influence their perceptions. In contrast, prior knowledge and experience-based cognition of urban wilderness attributes showed no significant influence on their perceptions. Moreover, attributes like plant diversity, water visibility, and plant density emerged as critical factors shaping visitors' perceptions. These findings underscore the importance of considering visitors' on-site perception of environmental attributes and actual visit experience when assessing the value and acceptability of urban wilderness areas. Future implications of this study for urban wilderness planning and management were also discussed.

1. Introduction

Urbanization is one of the greatest challenges of this century. High-density urban environments often displace valuable ecosystems (Kowarik, 2011). Simultaneously, numerous studies support the significance of green in urban environments for enhancing biodiversity and the health of city residents (e.g., TEEB, 2010; Botzat et al., 2016), moderating the urban microclimate (e.g., Macháč et al., 2022), and providing recreational space (e.g., Vargas-Hernández et al., 2018). In parallel, there are currently numerous studies and practices aimed at addressing the urbanization crisis and establishing sustainable and resilient strategies for various categories of green spaces (De Sousa, 2003; Rupprecht and Byrne, 2014a).

Urban planners and landscape researchers have worked on green structures and parks for centuries, recognizing green as a component of livable, healthy, and aesthetically appealing environments (Ulrich, 1983), focusing primarily on specific green typologies, e.g., parks, metropolitan parks, linear parks (e.g., Tate, 2001). As one typology of urban green space, however, urban wilderness is often neglected or not entirely accepted (Kowarik, 2005; Martin and Hill, 2021).

Urban wilderness, also known as urban wildscapes (Jorgensen and Keenan, 2011) or urban wildness (Martin and Hill, 2021), is an expanding concept of wilderness as human civilization and urbanization progress. Urban wilderness is a green space category with many ecological, educational, aesthetic, and social values (e.g., Jorgensen and Tylecote, 2007; Threlfall and Kendal, 2018). It has been demonstrated

* Corresponding author.
E-mail address: Y.Chen-15@tudelft.nl (Y. Chen).

https://doi.org/10.1016/j.ufug.2024.128319
Received 9 November 2023; Received in revised form 27 March 2024; Accepted 28 March 2024
Available online 29 March 2024

that wilderness areas can provide natural habitats for native wildlife in and around the city (Threlfall et al., 2016), as well as for migratory animals in the vicinity, both of which contribute to the biodiversity of the urban environment (Kowarik, 2013). There are also studies on the positive effects of wilderness space on the urban environment and human wellbeing, e.g., the healing influence of natural wilderness space on urban residents (Harper et al., 2019; Sui and Cai, 2021). Wilderness also increases the opportunities for city dwellers to interact with wildlife and provides a sense of remoteness for people immersed in modern urban life to appreciate the grandeur of nature's original state, thereby promoting their physical and mental health (Botzat et al., 2016a; Kendal et al., 2008).

Due to the limited availability of primary wilderness in urban settings, an increasing number of research and projects focus on green areas, such as urban woodlands and ecological parks transformed or reconstructed based on previously abandoned areas. These green areas can be regarded as a category of 'designed' urban wilderness (Kowarik, 2005; Müller et al., 2018), which intentionally incorporates or creates wilderness to provide habitats and to conduct a variety of nature-related recreation or informal activity (Rupprecht and Byrne, 2014b). It is a type of urban wilderness facilitated by spatial planning and management and is open to the public. Research indicates that there are contradictory perceptions regarding the interaction between humans and urban wilderness areas, e.g., visitors claimed to feel calm despite experiencing anxiety and insecurity and viewed wilderness as a potential threat (Jorgensen et al., 2007), which also implied the importance of investigating the visitors' perceptions for the specific category of 'designed' urban wilderness.

Some research indicates that environmental perception can be evaluated by different influencing attributes, including external attributes, e.g., spatial features of the environment, and internal attributes, e.g., visitors' experience and motivations (Marques et al., 2020) . Lev et al. (2020) examined the relationship between the public's visit experience and the environmental wildness of space, showing that relatively non-intervened natural features positively affected environmental perceptions and enhanced people's visit experiences. Mathey et al. (2018) explored the public's perception and attitude toward the natural environment in different stages of succession, showing various vegetation densities. Researchers also explored how people's profiles influenced their wilderness perceptions. For instance, Li et al. (2019) examined the residents' ecological and aesthetical perceptions of wild-grown vegetation in urban parks. They discovered that citizens' acceptance and recognition of spontaneous plants may be related to their educational attainment. As demonstrated by Lutz et al. (1999), urban and rural residents hold differing perceptions and understandings of wilderness. In addition, research has been conducted on the differences in perception between different age groups of urban residents (Jorgensen and Anthopoulou, 2007). However, limited research discussed the combination of external environmental attributes and internal cognitive attributes, e.g., attitudes based on people's previous visiting experience and their on-site experience, and investigated how these attributes contribute to forming visitors' urban wilderness perceptions from a planning and management perspective.

Additionally, from the perspective of spatial planning and design, quantitative techniques, e.g., questionnaires and statistical and modelling analysis, are employed to explore wilderness perception. For instance, Kliskey (1994) explored participants' perceptions using multivariate analysis and geographic information systems (GIS) to provide insights for wilderness planning and management, and Tyrväinen et al. (2007) used a postal survey and followed GIS software to evaluate people's attitudes toward green space. Zhang and Tan (2019) proposed that the public's attitude and perceived spatial accessibility prominently influenced their visiting demand after evaluating the relationship between the public's environmental behaviours and their park use via household survey and structural equation modelling (SEM). To understand people's perceptions of the environment, conventional qualitative methods such as semi-structured or focus group interviews and mental maps are commonly conducted in environmental psychology and behaviour studies (e.g., Downs and Stea, 1977; Gieseking, 2013).

To inform the planning and design of urban wilderness, knowledge-based design principles need to be identified that are built on the visitors' urban wilderness perception. This implies that a type of research that addresses multiple layers of attributes is needed and can only be effectively explored by mixed methods (Deming and Swaffield, 2011). Nonetheless, this comprehensive research approach is lagging. Only a few researchers have employed mixed methods to explore visitors' urban wilderness perceptions. Examples include research on how environments serve as restorative spaces for physical and mental wellbeing. For example, Grace et al. (2024) conducted mixed methods to explore participants' experiences of the restorative urban blue spaces by collecting solicited diaries. However, the current body of knowledge lacks a comprehensive understanding of the combination of diverse evaluated dimensions regarding visitors' perception of urban wilderness. This, coupled with a relatively homogenous approach to investigating this intricate realm of wilderness perception, may pose challenges to comprehending visitors' perceptions and, subsequently, the effective planning and management of urban wilderness areas.

This research examines if and how visitors perceive the intentionally designed urban wilderness as wilderness and how various perceived dimensions influence their overall perceptions. This study 1) investigates how visitors perceive, experience, and interact within the urban wilderness and 2) identifies the key attributes that significantly shape a user's perceptions of an urban wilderness. Therefore, the study employs a mixed-methods approach to explore a range of attributes across various levels. The findings are expected to yield insights for the future planning and management of wilderness space within urban areas.

Jiangyangfan Ecological Park (Hangzhou, China) serves as a study case. Hangzhou represents a high-density urban environment where natural green spaces coexist harmoniously with the urban landscape and its inhabitants. Large amounts of green spaces and ecological parks attract residents and tourists, providing a rich and diverse pool of responses for this study. Jiangyangfan Ecological Park, the specific case selected, is considered as a representative urban wilderness park in China, located within the West Lake Scenic (Cao et al., 2019). The park is the result of a 20-hectare land reclamation initiative (see Fig. 1). Extensive site investigation informed the park's primary design objective, which is the preservation of a substantial portion of its pristine wildlife, therefore fostering human-nature interactions within an urban context (Wang and Lin, 2011).

(Source: adapted from http://bzdt.ch.mnr.gov.cn/ and http://www.atelierdyjg.com/content/details2_176.html)

2. Methodology

2.1. Research design

To assess an individual's perceptions of and experience within the urban wilderness, focusing on landscape planning and design, a range of evaluation attributes has been chosen from distinct layers of the designed urban wilderness, namely natural, cultural, and social layers (Fig. 2).

According to Grahn and Stigsdotter (2010), the natural layer in an environment distinguishes the wilderness space from artificial facilities. From the natural layer, this study intends to assess how visitors' urban wilderness perceptions are influenced by the existence of fundamental physical elements within the environment, e.g., the vegetation and waterbodies that have been proven to be the most prominent physical attributes that form people's environmental perceptions (e.g., Deng et al., 2020; Yuan et al., 2023), and are also the discipline of spatial planning and landscape design frequently adapt to. In addition to the

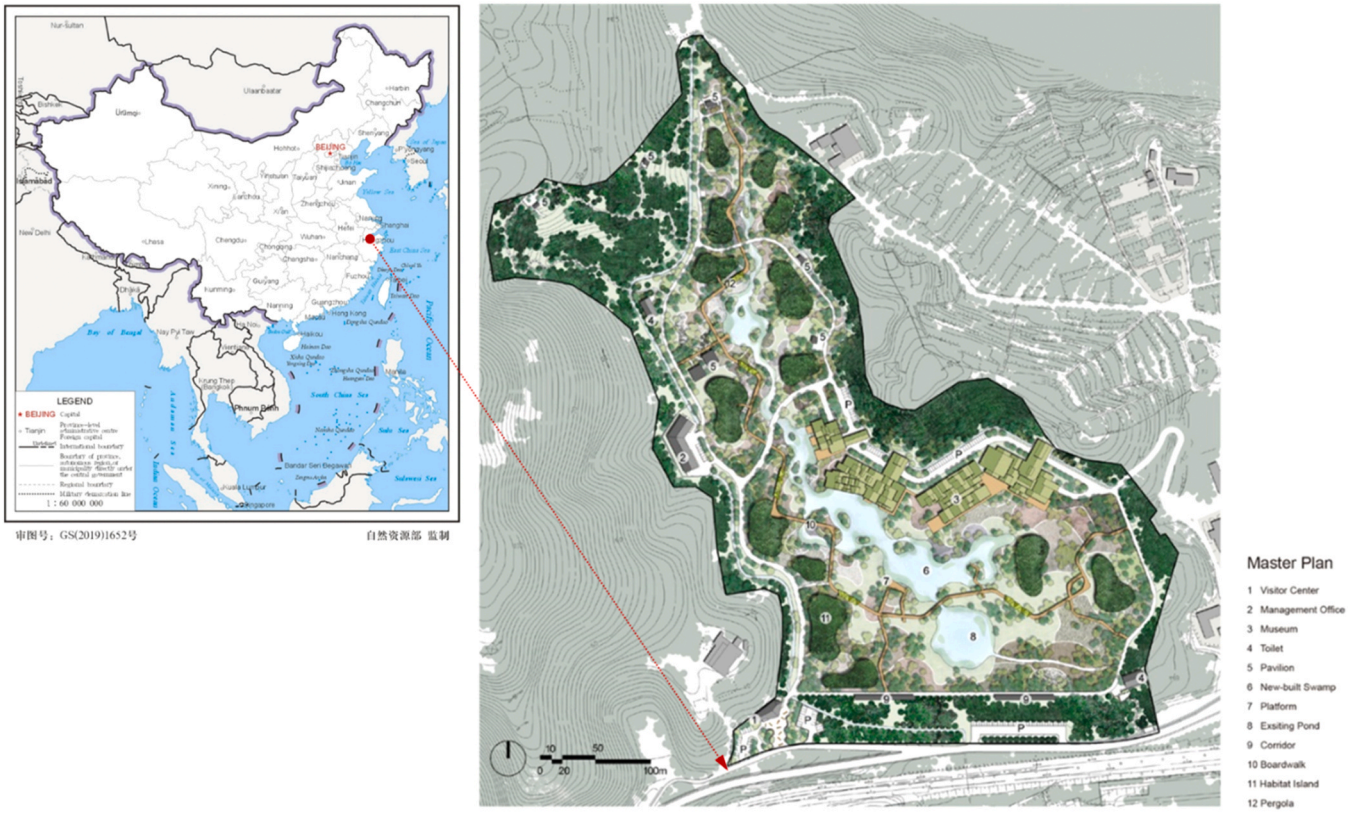


Fig. 1. The location and master plan of Jiangyangfan Ecological Park.

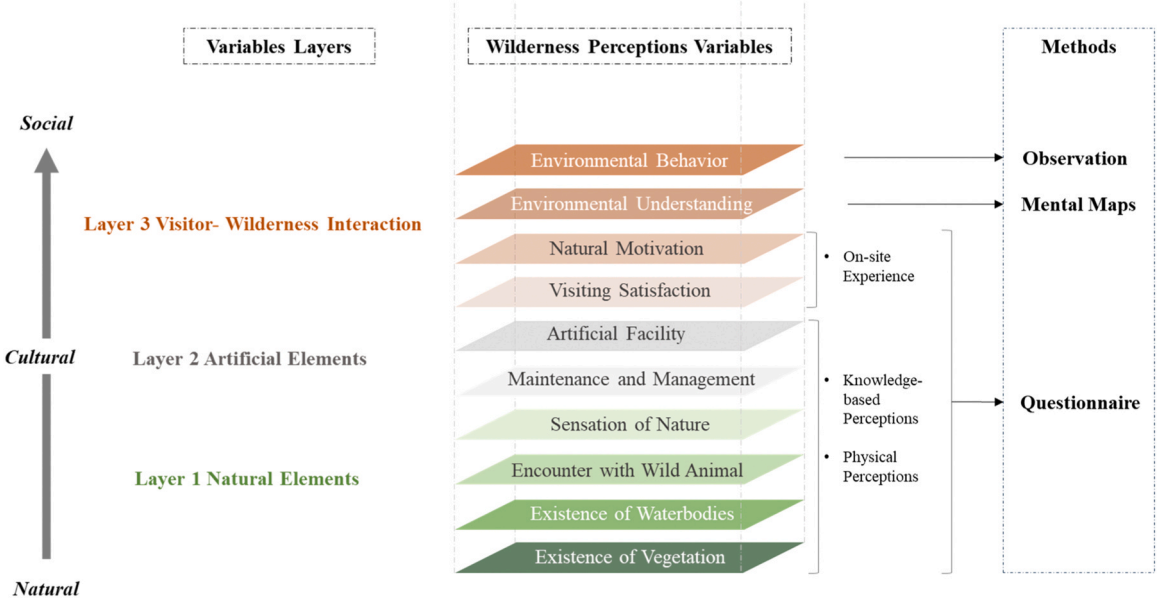


Fig. 2. The three layers of evaluation dimensions in investigating visitors' urban wilderness perceptions.

fundamental landscape elements, wilderness areas also possess a range of environmental characteristics that contribute to visitors' environmental perceptions; 'encounter with wild animal' (e.g., Hester et al., 1999; Grahn and Stigsdotter, 2010) and 'sensation of nature' (e.g., Kaplan and Kaplan, 1990) were selected in the matrix based on precedent studies. The cultural layer encompasses the artificial elements in common landscape spaces that may influence visitors' perceptions and be experienced as the link between natural settings and human interaction. It reveals how people engage with the environment through planning and design interventions, e.g., the landscape facility and the maintenance and management after construction. The uppermost layer pertains to the social dimension in perception assessment, including the interactions between visitors and the urban wilderness, i.e., how people experience, understand, and behave in the environment.

Multiple methods were employed to explore the perception variables within the three layers. As depicted in Fig. 2, the natural and cultural

layers were examined using a questionnaire about visitors' perceptions of diverse attributes. These attributes encompass vegetation, the existence of waterbodies, encounters with wildlife, the sensation of nature, maintenance and management, and man-made facilities. The questionnaire not only probed into visitors' current physical perceptions during their visits and their pre-existing knowledge-based perceptions within these natural and cultural attributes but also considered two extra variables from the social layer, namely visitors' natural motivations and their overall satisfaction with the visit. To investigate visitors' understanding of wilderness within the social layer, the study employed mental maps, a conventional research method to gain insights into environmental understanding (Gould and White, 1986). This approach also allowed participants to recollect and describe their experiences during their site visits. The researcher observed visitors' environmental behaviour within the chosen case to eliminate the possibility of subjective or ambiguous feedback from participants and to enhance the validity of other data sources.

2.2. Data collection

A comprehensive multi-methods survey was conducted following the objectives of this study during the period spanning from June to October 2022. Prior to the start of data collection, the management committee of the West Lake Scenic Area reviewed and approved the related materials. Notably, the data collection process was conducted anonymously and with the informed consent of all participants.

2.2.1. Questionnaire

Responses to the questionnaire were gathered through an online survey platform, and respondents could access the questionnaire via a QR code or, if they preferred, complete a printed version. The questionnaire began by clearly stating the study's purpose and assuring participants of the privacy and security of their personal information. Participants were only directed to proceed with the questionnaire if they willingly agreed to share their personal data.

Notably, this study was conducted in Hangzhou City, China, the participants were Chinese citizens in the selected site, and the questionnaire was designed and conducted in Chinese. Since most visitors, the common public, might not understand the professional definition of urban wilderness, the research team decided to replace the term 'urban wilderness' with 'wild nature in urban settings' in the questionnaire to avoid confusion (see the original Chinese version of the questionnaire in Appendix 2).

The questionnaire began with a question that required the respondents to answer to what extent they regard the site as an urban wilderness to evaluate an overview of the respondent's perception of the site as an urban wilderness. The rest of the questionnaire predominantly comprised three dimensions: the respondents' perceptions of physical attributes, their cognitions of urban wilderness attributes based on previous experience, and their on-site visit experiences. Each dimension consisted of a range of statements designed to capture an individual's perceptions of various environmental attributes and personal experiences. Respondents were asked to respond using a five-point Likert scale, inviting them to indicate the extent of their agreement or disagreement with the statements, expanding from '1-completely not' to '5-completely yes' (see Appendix 1).

1) Environmental perception has been defined as the interaction process between people and surrounding environments and how people comprehend it (Ittelson, 1973). The physical setting in the environment has been proven to be prominent in influencing people's perceptions (e.g., Tuan, 1990). This study included questions to assess visitors' perceptions of the diverse physical environmental attributes of the site as an urban wilderness during their visit, e.g., the vegetation, the waterbodies, encounters with wild animals, the facilities, the sensation of nature, and the management and maintenance of the site (see Questions 2-a to 2-f in Appendix 1).
2) Distinct from perception, cognition of an environment reflects people's previous knowledge and awareness of the space (Ittelson, 1973) To evaluate respondents' cognition and understanding of an urban wilderness based on their previous experience, one question required the respondents to fill in an example of an environment they visited before and regarded as an urban wilderness while distinctive to the study site. This was followed by a series of questions focused on their perception of various landscape elements that contributed to their perceptions of the example they gave, which contained the same categories of landscape elements with physical environmental attributes (see Question 5 and Questions 6-a to 6-f in Appendix 1).
3) Grahn and Stigsdotter (2010) claimed that people's environmental perceptions may be relevant to their visiting expectations and experiences. The questionnaire also investigated respondents' on-site experience and satisfaction with their visit via related questions.
4) Personal profiles were collected via the questionnaire, including gender, age groups, residence, and whether respondents lived in rural or city areas. Notably, the investigation of individual perceptions of different groups of the public was not the main focus of this study; individual backgrounds such as income and educational level were regarded as sensitive by some residents during the random interviews during the study. Therefore, the questionnaire did not include the socioeconomic status, e.g., the annual income of the respondents and their education level.

Furthermore, the questionnaire also includes questions to investigate, for example, what environmental attribute the respondent regarded as the most influential one contributing to their urban wilderness perceptions, whether the respondents were first-time visitors or not, whether the respondent had a professional interest experience in natural parks, the purpose of the respondents' visit, and the activities they engaged in, to learn more details about respondents' visiting experience in the site.

2.2.2. Mental maps

Mental maps, also called cognitive maps, have been recognized as a valuable tool for assessing an individual's comprehension and the material imagery they hold of their environment (Gould and White, 1986). To investigate participants' understanding and their subjective reflections on the environment, mental maps were employed as supplementary data sources to augment the findings obtained through other research methods.

The recruitment of participants was conducted on the site. Visitors aged between 10 and 65, able to draw by memory, and already or almost finished with their visit were invited to join the map drawing. During the study, participants were requested to sketch their visit experience on A4-sized sheets of paper based on their recollections and impressions, with no specific time constraints imposed, including their walking routes and the most remarkable landmarks or elements encountered during their visit.

All participants finished their drawings on the site, after or during their visit, which ensured a fresh and concise memory of the visit. The mental maps were collected at three nodes in the park, namely the main entrance, the corridor, and the central pavilion, where visitors commonly gather and rest during or after their visit.

2.2.3. Behavioural observations

The researcher performed behavioural observations using a non-participate approach to avoid disturbing the visitors' activities. By investigating the layout and states of the site, three nodes with the highest visitor concentrations were chosen as study locations, encompassing the central pavilion, the southern corridor, and the lotus pond.

Observations of the visitors' environmental behaviours in these locations were carried out on distinct dates and at diverse periods. An

observing protocol (see Appendix 3) was employed during the study process, which included both descriptive and reflective notes, respectively documenting visitor behaviour (also including information, e.g., the weather, the location, activities, and the exact observing period) and the observer's interpretation of the interaction between visitors and their surroundings, including assessment of whether the environment and facilities supported or hindered the behaviours.

2.3. Data analysis

During the analysis of the questionnaire responses, a reliability test was conducted on the perception questions in the three dimensions, namely the physical environmental attributes, the knowledge-based cognitive attributes, and the participants' on-site experience. The test used a five-point Likert scale (Questions 2-a to 2-f, Questions 6-a to 6-f, Question 7 and Question 8 in Appendix 1), which yielded a Cronbach's α value of 0.898, exceeding the threshold of 0.7, indicating a high level of internal consistency among the designed questions in assessing participants' urban wilderness perceptions (see Appendix 5),. Furthermore, the KMO (Kaiser-Meyer-Olkin) and Bartlett's test of the perception questions in the three dimensions showed a KMO value of 0.864 and a significant value of <.001(see Appendix 5). These results suggest a strong correlation among the questions used across various dimensions, thus supporting the feasibility of conducting a factor analysis in the following steps.

A correlation analysis was conducted to explore the relationships between the three assessed dimensions and participants' perceptual rankings of the site as an urban wilderness. Subsequently, we conducted ordinal logistic regression using IBM SPSS Statistics 29 (IBM corporation, Somers, New York, USA) to model the relationship between the three factors output from the factor analysis and participants' perceptual rankings of the site as an urban wilderness.

The sketching responses from the participants during mental maps were coded by the analytic matrix proposed by Gieseking (2013), which was influenced by Lynch's classic study (1960). Table 1 displays the analytic techniques and components of mental maps, which include four categories for tracing trends in research findings. Some analytic elements were excluded from the original matrix, considering this study's main objective and focus scale. Besides, according to Stea (1969b) and Ittelson (1973), people's drawings of locations and paths could also indicate their environmental perception, which is why the relevant analytic elements were considered in this study.

As shown in Table 1, the mechanics of the method (MOM) include nine analytics that reveal participants' understanding of spatial reality and their response to sketching. The drawing element (DE) consists of six analytics demonstrating how participants drew the core elements and how the maps are expected to appear and convey information. The narratives of place (NOP) include eleven analytics that reveal how the physical elements in space influence participants' understanding. The personalization (P) component consists of two analytics indicators of the participants' significant individual experience. The respondents' sketches were coded and analyzed through the four analytics categories to investigate the visitors' understandings and experiences on the site.

According to (Marques et al., 2020), people's behaviours indicate their interactions with their surroundings and how they perceive them. Therefore, in this study, observation records were combined with the feedback from the questionnaire and mental maps. The various data sets will be compared and used to complement each other by checking the consistency between participants' behaviour patterns in various locations, the impressive experience shown in mental maps and responses to the questions related to participants' experiences and conducted activities in the questionnaire.

Table 1
Analytical categories of mental maps.
(Source: adapted from Gieseking, 2013).

Category	Analytic
MOM	Drawing sequence; Count of drawn items; Text labelling; Map elements about one another; Drawing anxiety; Drawing skills; Enjoyed mapping process; Used the entire paper; Mirror the physical space
DE	Centre; Borders; Symbols; Legend; Shapes; Included elements at various scales
NOP	Built environment elements; Physical environment elements; Districts; Edges; Nodes; Landmarks; Paths and roads; Personal paths; Went to and from space often; Discuss emotions through physical space; Remembering intimate spatial details
P	First-drawn element; Last-drawn element

Note: MOM = mechanics of method; DE = drawing element; NOP = narratives of place; P = personalization

3. Results

3.1. Descriptive results from the questionnaire

The online questionnaire platform registered 262 subjects, 13 of whom did not complete all questions or provided ambiguous responses, leaving 249 (95.0%) participants with complete and accurate data for further analysis. Table 2 shows the frequency of demographic variables of the participants.

When participants were asked about the extent to which they perceive the site as an urban wilderness, using a Likert scale ranging from 'completely not' (1) to 'completely yes' (5), the mean score for all responses averaged 3.96, indicating that the vast majority of participants perceived the site as an urban wilderness with 'completely agree' (15.3%) or 'mostly agree' (71.5%) (see Question 1 in Appendix 1). Among all the physical environmental attributes that contribute to forming participants' perceptions of the site as an urban wilderness, 'vegetation' was regarded as the most prominent attribute, with a mean score of 3.38 (see Question 2 in Appendix 1). More specifically, for the characteristics that contributed to forming visitors' urban wilderness perception, the density and variety of species of vegetation were the most prominent chosen ones. Besides, water quality was also considered significant according to the responses (see Question 4 in Appendix 1). For the respondents' previous experience and cognition of urban wilderness, responses showed that 'vegetation' was also reported as the most influential environmental attribute, with a mean score of 3.96 (see Question 6 in Appendix 1).

Fig. 3 illustrates the distinct contributions to urban wilderness perceptions from cognitive environment attributes (CEA) and site physical environmental attributes (SEA). The natural layer, encompassing attributes such as the existence of vegetation, waterbodies, encounters with wild animals, and the sensation of nature, emerges as the most influential environmental attribute. Positive responses (score ≥4) dominate both the SEA and CEA dimensions, with the CEA dimension displaying

Table 2
Frequency of demographic variables in the questionnaire (N=249).

Variables	Options	Frequency	Percent
Age groups	<18	14	5.6%
	18–35	112	45.0%
	36–50	89	35.7%
	51–65	26	10.4%
	>65	8	3.2%
Gender	Female	142	57.0%
	Male	103	41.4%
	Prefer not to tell	4	1.6%
Residence	Hangzhou/local	223	89.6%
	Non-local	26	10.4%
City or countryside	City	232	93.2%
	Countryside	17	6.8%
First-time visitor or not	Not first time	125	50.2%
	First-time visitor	124	49.8%

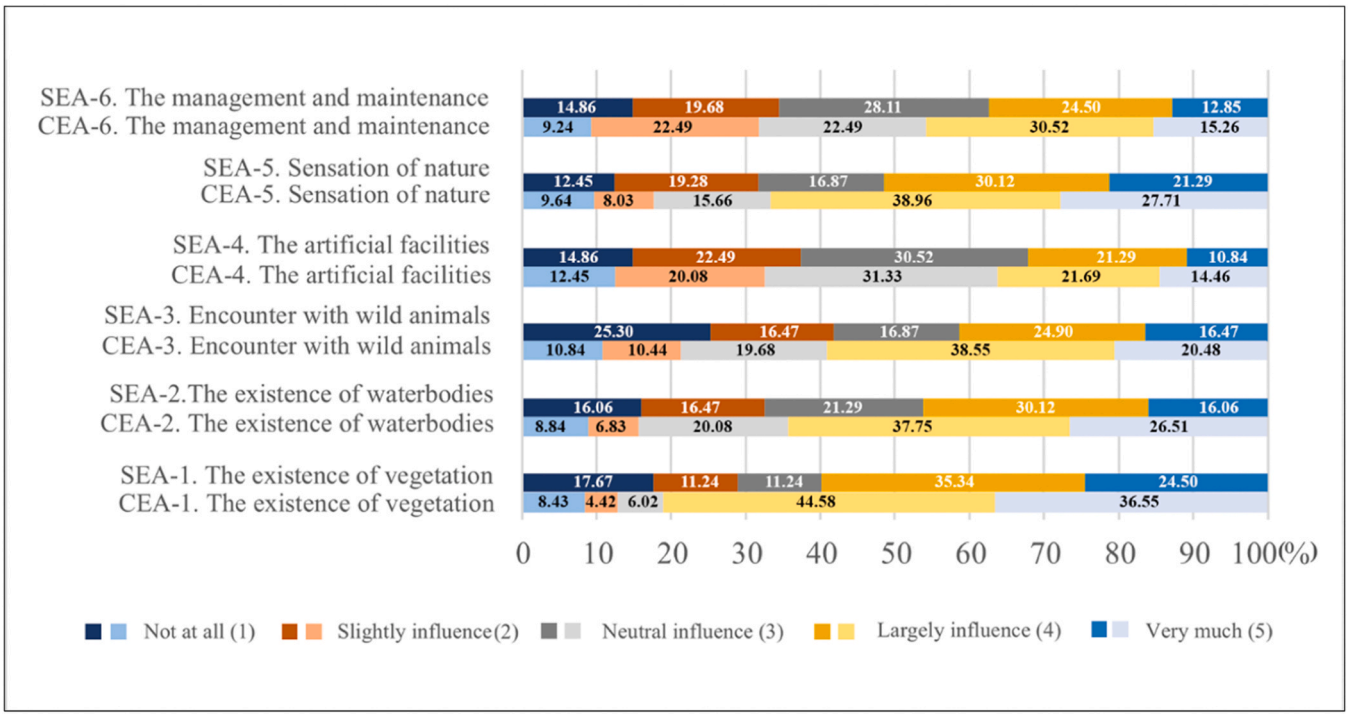


Fig. 3. Comparative responses to the extent to which urban wilderness perception is influenced by physical perceptual attributes and experience-based cognitive attributes (Question 2 and Question 6 in Appendix 1).

significantly more positive responses for the perceived impact of vegetation in the urban wilderness (81.13% compared to 59.84% in the SEA dimension). Similar trends are observed for other natural attributes, with the CEA dimension consistently yielding more positive responses than the SEA dimension.

In contrast, the cultural layer, which includes artificial facilities, management, and maintenance, predominantly elicits neutral and negative responses (score ≤ 3) regarding their contribution to participants' urban wilderness perceptions. Notably, there is no significant difference in the number of responses across scores for these cultural environmental attributes between the SEA and CEA dimensions.

Furthermore, respondents' experiences in an urban wilderness were also shown in their willingness to revisit the site, with 'mostly agree' (37.4%) and 'completely agree' (28.1%) being the predominant responses (see Question 8 in Appendix 1). 50.2% of the respondents were not first-time visitors (see Question 9 in Appendix 1), and despite over half of them expressing 'no particular interests' (48.6%) or being 'not sure' (19.3%) about ecological parks and stating a lack of general comprehension of the specific type of urban wilderness park (see Question 10 in Appendix 1), the majority of visitors perceived and comprehended the nature and characteristics of the urban wilderness.

The most common motivations to visit the site, as claimed by the respondents, were 'to get close to and experience the wild nature,' 'to spend leisure time with families,' and 'to enjoy the beautiful natural landscape.' The most common activities the respondents employed during their visits were 'hiking', 'taking a walk', and 'wildlife observing and bird watching'. When asked what facilities they expect on the site, the respondents regarded 'cabin for bird watching', 'pavilions', and 'lounge seats' as the most relevant. The most preferred path material by the respondents was 'unpaved landscape path' (37.85%), followed by 'part with marble/wood or other soft materials' (35.46%) and 'path well-accessible' (26.69%). Importantly, 32.13% of the respondents claimed they 'relax in a natural environment within an urban city' as their most meaningful experience on the site. At the same time, 'get close to the wildlife' and 'find and enjoy different natural scenery' came in a close second at 21.29% and 19.28%, respectively (see Questions 11–15 in Appendix 1).

3.2. Correlation and regression analyses

To further build the correlation between urban wilderness perceptions (UWP) and diverse influential factors, including cognitive environment attributes (CEA), site environmental attributes (SEA), and visiting experience (VE), we conducted a two-step analysis consisting of correlation and regression analysis.

Pearson correlation tests found no significant correlation between CEA and UWP. Meanwhile, significant positive correlations between UWP and SEA, between SEA and CEA, between SEA and VE, between VE and UWP, and between CEA and VE were found, see Table 3.

A factor analysis on the perception questions in the three dimensions was performed, and the rotated factor matrix showed consistency between the output factors and the initially designed factors. The table below shows that the physical site environmental attributes (SEA) exhibit strong loadings on Factor 1. The cognitive environment attributes (CEA) are substantially loaded on Factor 2. And the visiting experience attributes (VE) load significantly on Factor 3. The factor loading value of all attributes is higher than 0.6, indicating the effectiveness of the attributes to represent correspondent factors. The results

Table 3
Pearson correlation tests between participants' urban wilderness perception, their cognitive environmental attributes, physical attributes of the site, and their visiting experience.

Variables	UWP	SEA	CEA	VE
UWP	1			
SEA	.201**	1		
CEA	0.097	.524**	1	
VE	.230**	.256**	.254**	1

Note: **. Correlation is significant at the 0.01 level (2-tailed).
UWP=urban wilderness perception; SEA=site environmental attributes; CEA=cognitive environment attributes (based on previous experience); VE=visiting experience

also indicate that Factor 1 contributes the most to the total variance, followed by Factor 2 and 3. Cumulatively, the three factors explain 66.909% of the total variance. The result indicates that the perception questions and factors exhibit sufficient structural validity (Table 4.).

The model performance evaluation indicates the reliability of using the SEA, CEA, and VE variables in the regression model to predict the UWP p (significance value of < 0.001). The test of parallel lines showed a significant value of $0.089 > 0.05$, which indicated that all significant variables passed the assumption of proportional odds (see Appendix 6).

As shown in Table 5, both SEA and VE showed a statistically significant impact on UWP, whereas CEA presented no statistically significant. Furthermore, VE showed a more substantial positive impact on UWP than SEA. The results implied that perceptions of urban wilderness environmental attributes and visiting experiences have strong, substantial, and positive impacts on participants' perception of the site as an urban wilderness rather than those environmental attributes based on visitors' previous experience.

3.3. Visitors' mental maps sketching

Approximately 50 respondents were asked to participate in mental maps; 40 (80.0%) agreed to sketch and leave valid maps for analysis (examples shown in Fig. 5; for all the maps, see Appendix 4). Among the participants, 9 (22.5%) of the participants visited the site by themselves, 5 (12.5%) in couples, 17 (42.5%) with their families, and 9 (22.5%) with their acquaintances. The most popular location on the site, where 25 (62.5%) of the participants completed their sketches, was the park's central pavilion. 9 (22.5%) of the participants drew in the corridor at the southern entrance, while 6 (15.0%) sketched in random locations while visiting (Fig. 4).

Note: Different shades of red circle indicate the number of maps drawn at the corresponding location; the darker the color, the more maps there are. The number on the circles indicates the exact frequency of maps

Note: The content in red was added as extra information by the researcher according to the participants' explanation

According to the analytic matrix adapted from Gieseking (2013), specific information was abstracted from participants' sketches in categories of MOM (mechanics of method), DE (drawing element), NOP (narratives of place), and P (personalization).

During the sketching process, participants' MOM (mechanics of method) revealed several common patterns. Among the forty mental maps sketched, the most prevalent sketching sequence and method involved starting with the entrance, visiting routes, and adding nodes or landmarks that participants deemed significant or remarkable. On average, each map possessed approximately 6–7 drawing items (precisely 6.65), indicating the wealth of information provided by the participants. Notably, the researcher added the majority of text labelling on these maps, as participants generally preferred to convey information orally while sketching. Interestingly, many participants found the mapping procedure an enjoyable way to recall their visit experiences, while several displayed nervousness and anxiety while sketching. Furthermore, the majority of them did not exhibit exceptional sketching abilities. Several participants only utilized a small portion of the paper to sketch fragments rather than the entire park, indicating that mirroring the physical space of the site could be difficult for most participants.

The sketching details showed DE (drawing element) features of participants. Most participants sketched without a 'centre' in their maps, and some marked pavilions or buildings as prominent elements. Participants rarely outlined the border of the entire site, but some drew the waterbody and edge of surrounding mountains from memory. During sketching, participants used symbols and legends, demonstrating their comprehension of various elements. Most participants drew elements with regular shapes, such as circles or rectangles. Several participants replicated the shapes of the elements based on their observations. Most participants sketched various environmental elements using the same scale. However, a few of them preferred to use distinct scales to denote the relative importance of the elements.

Participants' NOP (narrative of place) analytic modes could be extracted from their maps. All forty participants sketched elements of the built and physical environments. However, for the majority of them, built elements were more prevalent. Most participants divided their maps into districts and depicted the boundaries between districts. The park's most frequently drawn nodes and landmarks were the central pavilion, buildings, corridors near the southern entrance, lakes, and lotus ponds, where participants always congregate. Nearly all participants drew their visiting paths and routes, but only a few mentioned the park's overall transportation system, including roads and paths. Several participants indicated their locations before entering or subsequently revealed information about the site's connectivity with its surroundings. Some participants discussed their sentiments or impressions of the spaces they visited. Some participants also mentioned intimate spatial details while experiencing particular emotions or personal sentiments in a particular space, e.g., nervousness or insecurity.

The P (personalization) analytic elements were revealed from the maps, which revealed distinct patterns. Most participants initiated their sketching by drawing their routes, often starting with the southern entrance. After illustrating their routes or roads, some participants added other elements to indicate a clear site layout. In some cases, participants marked their next destination by marking it with the last-drawn elements.

Table 4
Rotated Factor Matrix[a].

	Factor		
	1	2	3
SEA1. The existence of vegetation	0.842		
SEA2. The existence of water bodies	0.850		
SEA3. Encounter with the wild animal	0.794		
SEA4. Artificial Facilities	0.643		
SEA5. Sensation of nature	0.844		
SEA6. Management and maintenance	0.645		
CEA1. The existence of vegetation		0.747	
CEA2. The existence of water bodies		0.746	
CEA3. Encounter with the wild animal		0.673	
CEA4. Artificial facility		0.803	
CEA5. Sensation of nature		0.808	
CEA6. Management and maintenance		0.806	
VE1. Importance of natural experience when visiting parks			0.730
VE2. Visiting experience (willingness to revisit)			0.802
Initial Eigenvalues	6.185	1.919	1.263
% of Variance	28.592	27.538	10.779
Cumulative %	66.909		

Extraction Method: Principal Factors Analysis. Rotation Method: Varimax with Kaiser Normalization

a. Rotation converged in 4 iterations

3.4. Behavioural observation

Our study's three designated observation sites afford visitors an optimal vantage point to appreciate the urban wilderness scenery, complemented by well-designed artificial amenities catering to visitor needs. The central pavilion emerged as a focal point, offering shelter from sun exposure and rain, with lush vegetation enhancing the experience for visitors. Wooden tables and benches facilitate diverse activities such as rest, chatting, picnics, natural education, and playing instruments. The southern corridor, adjacent to the main entrance, features wooden benches and shelter spaces for visitors' respite. The lotus pond, our third observation site, centrally positioned near the pavilion, lacks dedicated resting facilities but offers an unobstructed view of lotus blooming and wetland scenery, complemented by a wooden platform and natural educational board.

During the study process, the total number of visitors observed was

Table 5
Parameter Estimates of the ordinal regression tests.

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	UWP = 1	-5.765	1.002	33.100	1	0.000	-7.729	-3.801
	UWP = 2	-2.945	0.279	111.361	1	0.000	-3.492	-2.398
	UWP = 3	-2.038	0.202	101.719	1	0.000	-2.434	-1.642
	UWP = 4	1.869	0.188	98.577	1	0.000	1.500	2.238
Location	SEA	0.446	0.145	9.477	1	0.002	0.162	0.729
	CEA	0.057	0.138	0.174	1	0.677	-0.212	0.327
	VE	0.536	0.143	14.049	1	0.000	0.256	0.816

Link function: Logit.

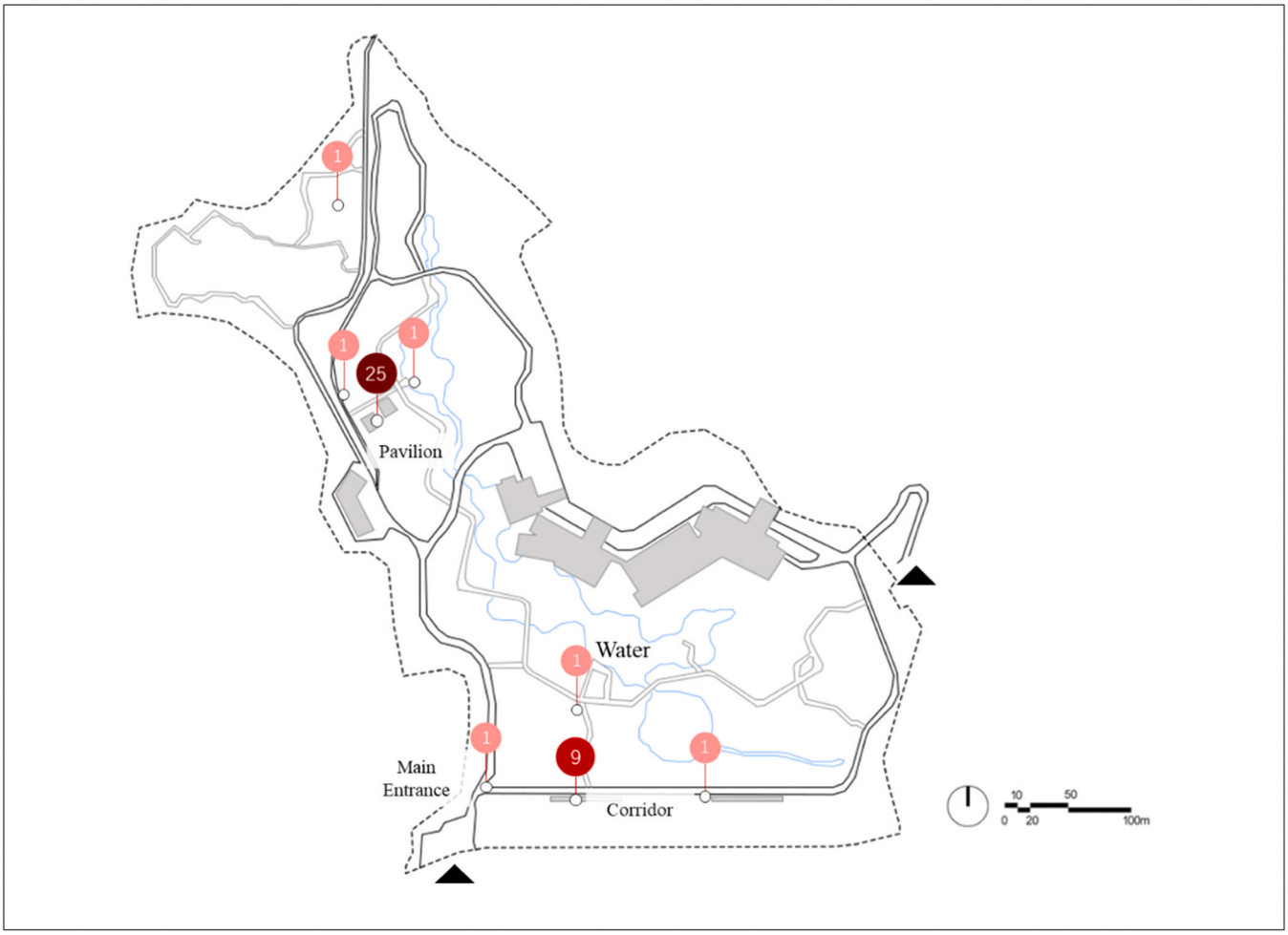


Fig. 4. Distribution of participants' locations when sketching mental maps.

573. The number of activities they conducted was 999, as 363 of them (63.4%) were participating in more than one activity (Fig. 6). Table 5 displays the statistical composition of observed activities, and various activities were divided into three categories, including social activities, natural activities, and those in between (Table 6).

Social activities were the most frequently performed category, with 'resting or eating' as the most frequent, followed by 'chatting' and 'having fun', while 'reading or working' was the least frequent in this category. In the category of natural activities, 'bird watching' was the rarest one, which was also observed as the most minor activity in all categories. The number of visitors who participated in 'natural education' accounted for a large proportion of this category and the total activity. As shown in Table 6, in the category of activities in between, 'picnicking' was the most popular activity, 'walking' was the second most popular activity in the category of intermediate activities, and 'taking photos' appeared to be the least popular.

Table 6 also displays the distinctions between different visitor groups. The observed visitors were grouped into four categories according to the number of people in each group, including 'alone,' 'couple,' 'family,' and 'with friend or other. The table shows that solo visitors engaged in the fewest activities, accounting for only 1.5%. Individuals who visited the park with friends or with others engaged in the largest number of activities, accounting for 65.3% of all. 26.6% of the observed activities were conducted by visitors in the park with families. Approximately 6.6% of all activities were performed when individuals visited the park in couples.

In addition, Table 6 reveals that visitors who visited the park alone and in couples engaged in 50% and 58.3% of the total types of activities,

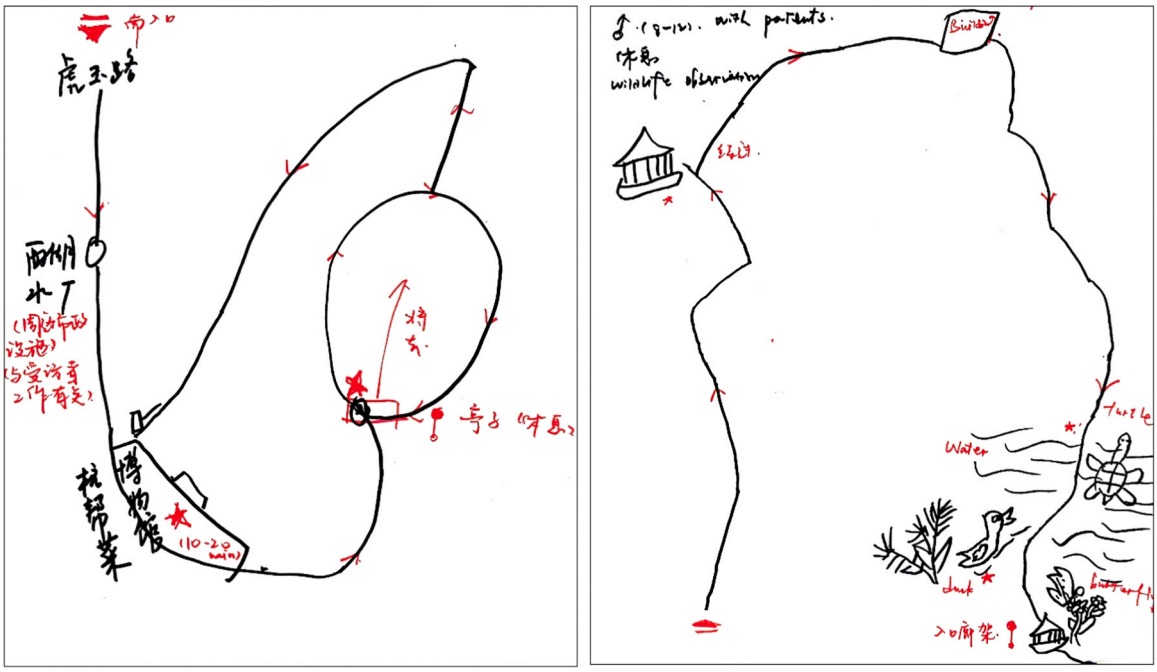


Fig. 5. Examples of mental maps sketched by participants.

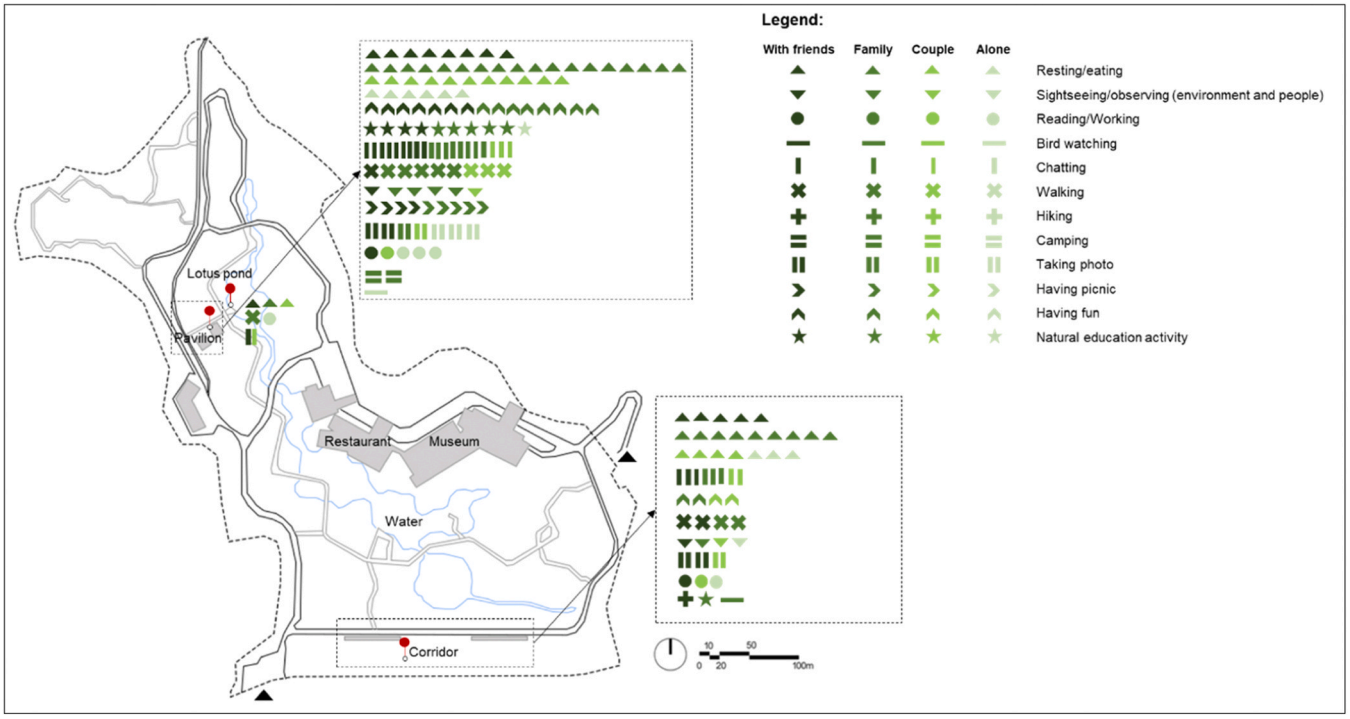


Fig. 6. Behaviour mapping of different visitor groups.

whereas visitors who visited with their families and friends or others engaged in 83.3% of the total types of activities.

4. Discussion

This study primarily investigated three issues utilizing a combination of a questionnaire, mental mapping, and environmental observation as supplementary data sources. First, it explored how individuals perceive urban wilderness areas that were intentionally designed. Second, this study investigated how their visiting experience and environmental attributes contribute to their perceptions. Finally, the study delved into how visitors comprehend and interact within an urban wilderness.

Significantly, the findings uncovered that visitors' perceptual environmental attributes and their actual visiting experience both correlated with visitors' perception of an urban wilderness and showed a strong impact on the level of urban wilderness perception. In contrast, cognitive environmental attributes showed a weaker correlation and less influence on visitors' urban wilderness perception. These findings provide

Table 6
Composition of visitors' activities.

		Alone	Couple	Family	Friend/Other	Total	Percentage
Social Activities	Resting/eating	3	32	100	49	184	18.4%
	Reading/working	6	6	-	8	20	2.0%
	Chatting	-	10	31	65	106	10.6%
	Having fun	-	2	40	58	100	10.0%
Natural Activities	Sightseeing/observing	1	2	15	2	20	2.0%
	Bird watching	1	-	3	-	4	0.4%
	Hiking	-	-	-	17	17	1.7%
	Camping	-	-	15	-	15	1.5%
	Natural education	1	-	14	216	231	23.1%
Activities in Between	Taking photo	3	8	3	15	29	2.9%
	Walking	-	6	22	21	49	4.9%
	Picnicking	-	-	23	201	224	22.4%
Total		15	66	266	652	-	
Percentage		1.5%	6.6%	26.6%	65.3%		

valuable insights for future planning and management of urban wilderness.

4.1. How visitors perceive and comprehend urban wilderness

Our study revealed that wilderness in high-density cities is widely comprehended and appreciated by most participants. While previous research has shown that city residents tend to harbour negative emotions, such as fear and insecurity, when encountering desolate wilderness (Jorgensen et al., 2007), urban wilderness with adequate human intervention, as a selected case in this study, could offer users a sense of security. Consequently, this type of urban wilderness is generally well-perceived and easily understood by users, echoing findings from precedent research. For example, E.P. Zefferman et al. (2018) conducted a public survey in the United States to evaluate the public's attitude toward Knoxville's urban wilderness, and participants' responses showed their appreciation toward the wild nature in urban settings. Our work extends these precedent studies by employing a detailed assessment of the public's perceptions and preferences toward diverse environmental attributes in an urban wilderness. Moreover, prior research has discussed the potential differences in environmental aesthetics between professionals and non-professionals (e.g., Gobster, 2010). Nevertheless, our questionnaire responses showed that most participants had no specific interest in natural knowledge and ecological parks. Despite the lack of interest, most respondents exhibited a positive experience during their visit to the site, perceiving it as an urban wilderness space.

Text labelling on the mental maps provided insights into the participants' level of familiarity with the routes and spatial layout of the site. Additionally, observation records indicated that most visitors' behaviours and conducted activities aligned with the site's design intent. For example, natural education, picnicking, and resting/eating appeared to be the most common behaviours of visitors during observation, demonstrating the compatibility between visitors' demands and the shelter and resting facilities provided by the environment. These findings indicate the participants' profound comprehension of the ecological values, restoration, and recreation benefits of urban wilderness. Furthermore, many visitors showed exploratory tendencies during their visit, conducting activities such as climbing the mountain on the site, insect observation, and bird-watching. These observations echo Kaplan and Kaplan's (2004; 2003 and, 2000) contention that the legibility and mystery variables in the environmental preference matrix.

How participants sketched their maps and the sequence in which they drew elements revealed how they understood the physical settings in an urban wilderness. The vegetation and waterbodies in the site were the most prominent or impressive natural elements or nodes depicted by the participants, which aligned with the questionnaire response. This finding is also supported by numerous precedent research. For example, Yuan et al. (2023) found that large waterbodies were critical when assessing participants' audio-visual experience and preference in 360° videos of landscape environments. According to Liang et al. (2023), the water biotope was the most preferred among different biotopes in urban green spaces. The restorative benefits of water and plants for visitors' perception were assessed by Deng et al.(2020) using physiological and psychological indicators. A study in Guyana indicated that visitors regarded spaces with a higher proportion of vegetation and waterbodies as more natural, showing more restorative and wellbeing benefits (Fisher et al., 2021).

Our study highlights a pronounced interest in the site's wildlife, including insects, birds, and reed beds, as depicted in numerous mental maps. Correspondingly, questionnaire responses underscored a prevalent motivation for visiting the site, namely, the desire to 'get close to wild nature in an urban setting'. During environmental observation, natural education emerged as the predominant visitor activity. These findings revealed the distinctive ecological significance of urban wilderness spaces, setting them apart from conventional urban parks. This aligns with Yuan et al.'s (2023) study, which emphasizes the pivotal role of the natural environment sensation, e.g., the sound of insects and birds, in shaping visitors' landscape preferences.

4.2. What contributes to perceptions of urban wilderness

Environmental cognition is a knowledge-based component. Its multiple attributes have been associated with environmental awareness, perception, and aesthetics disciplines. This study revealed that visitors' previous cognition attributes of urban wilderness environments do not necessarily influence visitors' on-site perceptions of urban wilderness, while strong associations were found between visitors' urban wilderness perception and their on-site perceived attributes and actual experiences.

Compared to the knowledge-based cognitive attributes, the on-site experience of environmental attributes appeared more influential. The better people experience the environment, the higher their level of perceptions of the site as an urban wilderness. The diversity of plant groups and density of vegetation as environmental attributes showed a significant effect on urban wilderness perceptions, echoing Grahn's (1991) assertion that a wide variety of species in a limited landscape space profoundly impacts visitors' preferences, and Mathey et al. (2018)'s contention that the density of vegetation in different succession periods significantly influenced visitors' perceptions and aesthetics. Furthermore, the study revealed the importance of water quality in shaping urban wilderness perceptions.

The questionnaire responses and mental maps revealed the vital role that natural elements and the unique traits of wilderness play in shaping people's comprehension and perception of the overall atmosphere of an urban wilderness. Natural elements tend to be more integrated into the visitor's impression of the environmental experience and wilderness ambience than distinctly remembered and recognized as landmarks. In contrast, human-made elements stand out more straightforwardly and

prominently.

According to the mapping results, the most frequently mentioned elements included artificial facilities and structures, such as a set of large buildings depicted in the site layout (see Fig. 1). However, different responses and attitudes were found in the questionnaire. When participants were asked about the various environmental attributes that form their urban wilderness perception, 'facility' emerged as the least chosen element. This finding implies the invisibility and unimportance of facilities when urban green spaces are perceived as urban wilderness, whereas they become more prominent and relevant when urban wilderness serves as urban green spaces.

4.3. Implications for urban wilderness planning and management

It has been proved that intentionally planned and designed urban wilderness parks positively impact the urban environment and its dwellers from an ecological (e.g., Jorgensen and Tylecote, 2007; E.P. Zefferman et al., 2018), social, and economic (e.g., Welch et al., 2022) point of view. The landscape and urban planning field faces both opportunities and challenges in operationalizing the concept of urban wilderness in the urban planning and design context. Simultaneously, the environment of an urban wilderness is constantly changing, so feedback and suggestions from a wide range of stakeholders, including users, on how to enhance the environment should not be disregarded after the construction phase. It is thus essential to incorporate visitors' perceptions and preferences into the planning process, thereby providing practical strategies for designing urban wilderness from users' perspectives.

Our findings imply for urban planners and landscape architects that more wilderness should be preserved and designed in an urban setting to fulfil the public's growing appreciation and demand for natural environments. Additionally, it was proved in our study that the allocation and characteristics of specific physical environmental attributes significantly contribute to the urban wilderness perception of visitors, e.g., the diversity and density of vegetation and the waterbodies, adequate maintenance and management, etc. So, strong emphasis could be placed on considering these physical attributes during the planning and design process to create an authentic "wild atmosphere" and visitor experience. Importantly, native species preservation and plant design, especially regarding species diversity, relatively higher vegetation density compared to ordinary urban parks, and the provision of high-quality waterbodies should receive adequate attention from spatial planners and designers.

Besides, our study aids in determining how urban wilderness is distinct from other urban green places in terms of visitors' comprehension and on-site experience, highlighting how the environmental features affect and support users' on-site behaviour. In an intentionally planned and designed wilderness landscape in urban settings, one of the concerns was how to preserve the wilderness quality while avoiding the potentially negative experience in the primary wilderness through design action. From the results of our study, natural education proved to be the most common activity visitors employed, and facilities for wildlife observing and bird watching appeared to be the most expected facility in the questionnaire responses, even though related facilities were relatively scarce on the site. This implies that during the planning and design of an urban wilderness, an appropriate proportion of artificial facilities and buildings are essential for providing spaces and support for visitors' demands. The results of the mental maps also revealed that large complexes of buildings may leave visitors with a strong impression or are perceived as spatial landmarks but do not significantly contribute to urban wilderness perception. Therefore, the number of artificial facilities and building mass in the urban wilderness must be carefully controlled, creating an adequate nature-culture balance that enhances the visitors' urban wilderness experience and allows urban residents to get close to nature in urbanization.

4.4. Limitations and future steps

It was difficult to interpret people's subjective perceptions and interactions with the environment comprehensively from the perspective of landscape planning and design. Our study provided a mixed-method analysis of people's environmental perception and comprehension of intentional urban wilderness from diverse dimensions of landscape environmental attributes. However, we recognize that even though multi-dimensions have been considered, the selection of a specific case rather than conducting a universal study using multiple cases might cause insufficient data and bias in this study. Therefore, one possible limitation would be selecting a single case from a specific cultural context. Furthermore, the multi-methods approach should recruit the same group of participants to join in both the questionnaire, mental maps, and observation to improve the reliability and solidity of the result. The research should consider the different seasons and other environmental factors that could affect the number and perception of visitors. Besides, as the experimental site is located in the non-central area of the West Lake Scenic, and its entrance is not located on the main road of the city, which leads to the relative lack of accessibility of the selected case compared to other parks in West Lake. A significant number of visitors from other cities, therefore, may not choose to visit Jiangyangfan Ecological Park, resulting in the majority of participants being locals and nearby residents. This could lead to an insufficient sample size for accurate and reliable data collection. Although the forty mental maps can capture considerable information regarding participants' perceptions and awareness of urban wilderness landscape spaces, additional mental maps are required to ascertain the results. The current sample size of participants is restricted without further differentiation of participants' profiles (e.g., income, social status, etc.), and the maps are drawn in unevenly distributed locations. To obtain more comprehensive and meaningful data in future studies, increasing the size and bias of participant sampling is necessary.

Besides, the manner in which participants drew their maps is closely tied to their backgrounds, such as occupation, age, and gender. For instance, one participant observed the drainage system of a park, as his occupation involved managing public water systems. On the other hand, some younger participants focused more on a lower line of sight of the landscape or more microscopic aspects when viewing the scenery. When children were invited to draw their mental maps, they drew details such as the wild animals and vegetation they had observed. Most individual participants conveyed more space-related details and information on their maps when compared to those who visited the park with others. These findings provided insights for future steps to investigate the urban wilderness perception in different groups of people with different profiles.

Furthermore, even though our results indicate a great willingness to experience and admire the urban wilderness, the attributes that most contribute to visitors' perceptions show limited distinctions between the characteristics of common urban green spaces, e.g., vegetation density and species diversity or the visibility of waterbodies, and wilderness-related environmental attributes such as encounters with wildlife and the sensation of nature which have been proven as beneficial for people's perceptions in precedent research (e.g., Grahn and Stigsdotter, 2010). The latter showed a relatively lower impact on visitors' perceptions when compared to the physical elements in our study. This finding may be due to the city-centre location and the medium-scale of the selected case, which limit the wild atmosphere visitors could experience and might, therefore, make the wilderness-related attributes less prominent than common environmental attributes. Consequently, an investigation of the differences in visitors' urban wilderness perceptions of urban wilderness spaces versus common urban green spaces is lacking. Therefore, valuable studies exploring the uniqueness of urban wilderness perception are essential in future research.

5. Conclusion

In the rapid development of urbanization, it is increasingly challenging to preserve the pristine nature in urban settings and to conduct planning and design processes to balance the ecological succession of the space and the public's demand within it. This study selected a high-density Asian city as the case and validated how residents perceive and understand natural wilderness spaces in urban centres and how they interact with the environment. Numerous studies have previously examined the diverse values of urban wilderness (e.g., Cao et al., 2019). In the selected case, despite its limited accessibility compared to other urban parks in Hangzhou, the park's high ecological value contributed to attracting urban residents longing for natural experiences. Apart from groups of nature enthusiasts and children, the selected site as an urban wilderness was planned and designed to include a wide range of other target groups.

This study demonstrated that most users perceived and comprehended the nature and distinctive characteristics of urban wilderness environments. They also exhibited a strong willingness to revisit the site despite lacking a general understanding of the specific categories of urban wilderness parks. While previous research has found that the general public might harbour negative emotions such as fear and insecurity towards pristine wilderness areas (e.g., Jorgensen and Tylecote, 2007), this study has revealed that urban wilderness environments with sufficient and adequate human intervention can offer a sense of relaxation and are consequently well-accepted and understood by users.

Moreover, the public's previous visit experience and environmental awareness were important, as claimed by existing studies (e.g., Ittelson, 1973; Kowarik, 2018), but the on-site perception of surroundings and their experience tended to pose a more substantial impact on their urban wilderness perceptions according to our findings. Among the various environmental attributes that influence the visitors, the vegetation, and more specifically the richness and density of the species, shows the most prominent impact on shaping visitors' perceptions. These findings align with previous research and indicate the significant influence of environmental attributes and actual experience on people's environmental perception, as well as the non-negligible role of plants as a crucial component of environmental attributes and landscape elements in shaping users' spatial perception and experience.

Notably, this study proposed a novel approach by combining different layers of attributes to assess an individual's environmental perception from a landscape planning and design perspective, namely natural, cultural, and social layers. Simultaneously, a mixed-method approach was employed throughout the study to gather comprehensive data, thoroughly exploring participants' perceptions and understanding of an urban wilderness.

Significant insights for planners and designers were provided in the findings, highlighting the importance of preserving the rare wilderness space in the limited urban space through adequate planning and design and incorporating visitors' perceptions and preferences into the planning process, thereby providing practical strategies for designing urban wilderness from users' perspectives. This approach allows the public to fully perceive and experience the intrinsic value of intentionally designed urban wilderness areas. According to our findings, the physical environmental attributes and characteristics such as dense vegetation, high-quality waterbodies, and opportunities to encounter wild animals should be provided in an urban wilderness. Besides, planning and design must include an appropriate proportion of artificial facilities and management to support visitors' demands, even though large artificial buildings should be adequately controlled to maintain a balanced natural-cultural atmosphere. In this process, urban wilderness functions as a category of green space within urban settings and as a tranquil oasis distinct from the bustling urban surroundings.

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.

Acknowledgements

This research is funded by the China Scholarship Council (CSC·NO.202107720042).

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.ufug.2024.128319.

References

Botzat, A., Fischer, L.K., Kowarik, I., 2016. Unexploited opportunities in understanding liveable and biodiverse cities. A review on urban biodiversity perception and valuation. Glob. Environ. Change-Hum. Policy Dimens. *39*, 220–233. https://doi.org/10.1016/j.gloenvcha.2016.04.008.

Cao, Y., Martin, V.G., Yang, R., 2019. Urban Wildness: protection and creation of wild nature in urban areas. Landsc. Architec. 26, 20–24.

De Sousa, C.A., 2003. Turning brownfields into green space in the City of Toronto. Landsc. Urban Plan. 62 (4), 181–198. https://doi.org/10.1016/s0169-2046(02)00149-4.

Deming, M.E., & Swaffield, S. (2011). Landscape Architecture Research: Inquiry, Strategy, Design. John Wiley & Sons, Ltd. ⟨http://www.mendeley.com/research/landscape-architecture-research-inquiry-strategy-design-14⟩.

Deng, L., Li, X., Luo, H., Fu, E.-K., Ma, J., Sun, L.-X., Huang, Z., Cai, S.-Z., Jia, Y., 2020. Empirical study of landscape types, landscape elements and landscape components of the urban park promoting physiological and psychological restoration. Urban For. Urban Green. 48, 126488.

Downs, R.M., Stea, D., 1977. Maps in minds. Reflections on Cognitive Mapping. Harper & Row, Publishers, *New York*. ISBN 10: 0060417331.

Fisher, J.C., Irvine, K.N., Bicknell, J.E., Hayes, W.M., Fernandes, D., Mistry, J., Davies, Z. G., 2021. Perceived biodiversity, sound, naturalness and safety enhance the restorative quality and wellbeing benefits of green and blue space in a neotropical city. Part 2, 143095, ISSN 0048-9697 Sci. Total Environ. Volume 755. https://doi.org/10.1016/j.scitotenv.2020.143095.

Gieseking, J.J. (2013). Where We Go From Here: The Mental Sketch Mapping Method and Its Analytic Components [post-print]. *Qualitative Inquiry*. Retrieved from ⟨https://digitalrepository.trincoll.edu/facpub/148/⟩.

Gobster, P., 2010. Development of Ecological Aesthetics in the West: A Landscape Perception and Assessment Perspective. In: Academic Research (China), 2010, pp. 2–12.

Gould, P., White, R., 1986. Mental Maps. Routledge.

Grace, M., Dickie, J., Brown, C., Bartie, P., Oliver, D., 2024. Using solicited research diaries to assess the restorative potential of exposure to inland blue space across time. ISSN 0169-2046 Landsc. Urban Plan. Volume 241, 104904. https://doi.org/10.1016/j.landurbplan.2023.104904.

Grahn, P., 1991. Landscapes in our minds: people's choice of recreative places in towns. Landsc. Res. 16, 11–19. https://doi.org/10.1080/01426399108706326.

Grahn, P., K., Stigsdotter, U., 2010. The relation between perceived sensory dimensions of urban green space and stress restoration. Issues 3–4, Pages 264-275, ISSN 0169-2046 Landsc. Urban Plan. Volume 94. https://doi.org/10.1016/j.landurbplan.2009.10.012.

Harper, N.J., Mott, A.J., Obee, P., 2019. Client perspectives on wilderness therapy as a component of adolescent residential treatment for problematic substance use and mental health issues. Child. Youth Serv. Rev. 105, 104450 https://doi.org/10.1016/j.childyouth.2019.104450.

Hester, R.T., Blazej, N.J., Moore, I.S., 1999. Whose Wild? Resolving Cultural and Biological Diversity Conflicts in Urban Wilderness. Landsc. J. 18 (2), 137–146 http://www.jstor.org/stable/43324354.

Ittelson, W.H., 1973. Environment and Cognition. Seminar Press, New York.

Jorgensen, A., Anthopoulou, A., 2007. Enjoyment and fear in urban woodlands – Does age make a difference? Urban For. Urban Green. 6 (4), 267–278. https://doi.org/10.1016/j.ufug.2007.05.004.

Jorgensen, A., Tylecote, M., 2007. Ambivalent landscapes—wilderness in the urban interstices. Landsc. Res. 32 (4), 443–462. https://doi.org/10.1080/01426390701449802.

Jorgensen, A., & Keenan, R. (Eds.). (2011). Urban Wildscapes (1st ed.). Routledge. https://doi.org/10.4324/9780203807545.

Jorgensen, A., Hitchmough, J., Dunnett, N., 2007. Woodland as a setting for housing appreciation and fear and the contribution to residential satisfaction and place identity in Warrington New Town, UK. Landsc. Urban Plan. 79 (3–4), 273–287. https://doi.org/10.1016/j.landurbplan.2006.02.015.

Kaplan, R. and Kaplan, S. 1990: The experience of nature: a psychological perspective. Cambridge: Cambridge University Press.

Kaplan, S., 2000. Human nature and environmentally responsible behaviour. J. Soc. Issues 56 (3), 491–508.
Kaplan, S. (2004). Some Hidden Benefits of the Urban Forest. In Forestry Serving Urbanised Societies. Cecil C. Konijnendijk, Jasper Schipperijn, and Karen H. Hoyer, eds. Pp. 221–231. Vienna, Austria: International Union of Forest Research Organizations.
Kaplan, S., Kaplan, R., 2003. Health, supportive environments, and the reasonable person model. Am. J. Public Health 93 (9), 1484–1489.
Kendal, D., Williams, K.R., Armstrong, L., 2008. Preference for and performance of some Australian native plants grown as hedges. Urban For. Urban Green. 7 (2), 93–106. https://doi.org/10.1016/j.ufug.2008.02.002.
Kliskey, A., 1994. Mapping multiple perceptions of wilderness in southern New Zealand, II: an alternative multivariate approach. Appl. Geogr. 14 (4), 308–326. https://doi.org/10.1016/0143-6228(94)90025-6.
Kowarik, I., 2011. Novel urban ecosystems, biodiversity, and conservation. ISSN 0269-7491 Environ. Pollut. Volume 159 (Issues 8–9), 1974–1983. https://doi.org/10.1016/j.envpol.2011.02.022.
Kowarik, I., 2013. Cities and wilderness. A new perspective. Int. J. Wilderness 19, 32–36.
Kowarik, I. (2018). Urban wilderness: Supply, demand, and access, Urban Forestry & Urban Greening, Volume 29, 2018, Pages 336-347, ISSN 1618-8667, https://doi.org/10.1016/j.ufug.2017.05.017.
Kowarik, I. (2005). Wild Urban Woodlands: Towards a Conceptual Framework. In: Kowarik, I., Körner, S. (eds) Wild Urban Woodlands. Springer, Berlin, Heidelberg. https://doi.org/10.1007/3-540-26859-6_1.
Lev, E., Kahn, P.H., Chen, H., Esperum, G., 2020. Relatively Wild Urban Parks Can Promote Human Resilience and Flourishing: a case study of Discovery Park, Seattle, Washington. Front. Sustain. Cities 2. https://doi.org/10.3389/frsc.2020.00002.
Li, X., Fan, S., Kühn, N., Dong, L., Hao, P., 2019. Residents' ecological and aesthetical perceptions toward spontaneous vegetation in urban parks in China. Urban For. Urban Green. 44, 126397 https://doi.org/10.1016/j.ufug.2019.126397.
Liang, H., Lin, Y., Chen, Y., Hao, X., Gao, D., Yu, N., Li, Y., Qiu, L., Gao, T., 2023. The relationships among biodiversity, perceived biodiversity and recreational preference in urban green spaces-A case study in Xianyang, China. Ecol. Indic. 146, 109916.
Lutz, A.R., Simpson-Housley, P., Man, A.F., De, 1999. Wilderness is rural and urban attitudes and perceptions. Environ. Behav. 31, 259–266. https://doi.org/10.1177/00139169921972092.
Macháč, J., Brabec, J., Arnberger, A., 2022. Exploring public preferences and preference heterogeneity for green and blue infrastructure in urban green spaces. Urban For. Urban Green. 75, 127695 https://doi.org/10.1016/j.ufug.2022.127695.
Marques, Valéria, Ursi, Suzana, Silva, Edneusa, Katon, Geisly, 2020. Environmental perception: Notes on transdisciplinary approach. Sci. J. Biol. Life Sci. 1, 1–9. https://doi.org/10.33552/SJBLS.2020.01.000511.
Martin, V.G., Hill, M., 2021. Urban Wildness — A More Correct Term Than " Urban Wilderness ". Landsc. Architec. Front. 9, 80–91.
Mathey, J., Arndt, T., Banse, J., Rink, D., 2018. Public perception of spontaneous vegetation on brownfields in urban areas—Results from surveys in Dresden and Leipzig (Germany). Urban For. Urban Green. 29, 384–392. https://doi.org/10.1016/j.ufug.2016.10.007.
Müller, A., Bøcher, P.K., Fischer, C., Svenning, J., 2018. Wild' in the city context: do relative wild areas offer opportunities for urban biodiversity? Landsc. Urban Plan. 170, 256–265. https://doi.org/10.1016/j.landurbplan.2017.09.027.
Rupprecht, C.D.D., Byrne, J., 2014a. Informal urban greenspace: a typology and trilingual systematic review of its role for urban residents and trends in the literature. Urban For. Urban Green. 13 (4), 597–611. https://doi.org/10.1016/j.ufug.2014.09.002.
Rupprecht, C.D.D., Byrne, J., 2014b. Informal Urban Green-Space: Comparison of Quantity and Characteristics in Brisbane, Australia and Sapporo, Japan. PLOS ONE 9 (6), e99784. https://doi.org/10.1371/journal.pone.0099784.
Stea, D.(1969b).The measurement of mental maps: An experimental model for studying conceptual spaces. *Studies in Geography,17:Behaviourl Problems in Geography*. A symposium. NorthwesternUniversity.
Sui, M., Cai, J., (2021). Wilderness Therapy and Its Inspiration to the Therapeutic Recreation Use of Natural Protected Areas in China. *World Forestry Research* , 34(4). DOI：10.13348/j.cnki.sjlyyj.2021.0016.y.
Tate, A. (2001). Great City Parks. Retrieved from ⟨https://ci.nii.ac.jp/ncid/BA70611217⟩.
TEEB (2010) The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions, and recommendations of TEEB.
Threlfall, C.G., Kendal, D., 2018. The distinct ecological and social roles that wild spaces play in urban ecosystems. Urban Forestry & Urban Greening. 29, 348–356. https://doi.org/10.1016/j.ufug.2017.05.012.
Threlfall, C.G., Ossola, A., Hahs, A.K., Williams, N.S., Wilson, L.D., Livesley, S.J., 2016. Variation in Vegetation Structure and Composition across Urban Green Space Types. Front. Ecol. Evol. 4 https://doi.org/10.3389/fevo.2016.00066.
Tuan, Y., 1990. Topophilia: A Study of Environmental Perceptions. Attitudes, and Values. Columbia University Press.
Tyrväinen, L., Mäkinen, K., Schipperijn, J., 2007. Tools for mapping social values of urban woodlands and other green areas. ISSN 0169-2046 Landsc. Urban Plan. Volume 79 (Issue 1), 5–19. https://doi.org/10.1016/j.landurbplan.2006.03.003.
Ulrich, R.K. (1983). Aesthetic and Affective Response to Natural Environment. In Springer eBooks (pp. 85–125). https://doi.org/10.1007/978-1-4613-3539-9_4.
Wang, X., Lin, Q., 2011. The Story of the Design of Hangzhou Jiangyangfan Ecological Park. Landsc. Architec. 1, 14. https://doi.org/10.14085/j.fjyl.2011.01.019).
Welch, J.G., Sims, C.B., McKinney, M.L., 2022. Does an urban wilderness promote gentrification? a case study from knoxville, Tennessee, USA. Sustainability 14, 973. https://doi.org/10.3390/su14020973.
Yuan, S., Browning, M.H.E.M., McAnirlin, O., Sindelar, K., Shin, S., Drong, G., Hoptman, D., Heller, W., 2023. A virtual reality investigation of factors influencing landscape preferences: natural elements, emotions, and media creation. ISSN 0169-2046 Landsc. Urban Plan. Volume 230, 104616. https://doi.org/10.1016/j.landurbplan.2022.104616.
Zefferman, E.P., McKinney, M.L., Cianciolo, T., Fritz, B.I., 2018. Knoxville's urban wilderness: Moving toward sustainable multifunctional management. ISSN 1618-8667 Urban For. Urban Green. Volume 29, 357–366. https://doi.org/10.1016/j.ufug.2017.09.002.
Zhang, J., Tan, P.Y., 2019. Demand for parks and perceived accessibility as key determinants of urban park use behavior. Urban Forestry & Urban Greening 44, 126420. https://doi.org/10.1016/j.ufug.2019.126420.