Perception of urban blue-green infrastructure during winter in Gothenburg

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Abstract

Life in urban settlements is often associated with insufficient physical activity and continuous stress. By implementing blue-green infrastructure (BGI) consisting of parks, trees, ponds, and rain gardens, amongst others, recreational values can be provided for the residents. This in terms of opportunities for physical activities (active recreation), relaxation, and socialising (passive recreation), as well as visual appeal (aesthetics). To create appealing and functional outdoor environments, awareness of public perceptions is of great importance. Several studies have looked upon how greenery in general is perceived, both in terms of contribution to recreation and differences in perception between groups of people. However, an examination of how different types of BGI elements are perceived has not been well established, and above all, not during wintertime. In this thesis, a web-based questionnaire is conducted to investigate how greenery is visually perceived by residents of Gothenburg in Sweden, in terms of contribution to recreational values in winter in relation to summer, and how 20 BGI elements and related qualities are perceived during winter in terms of contribution to recreational values.

Based on 298 replies, the results showed that greenery is perceived to contribute to recreational values in winter, however, to a less extent than in summer. The impact of gender and age shows that women tend to perceive BGI's contribution to recreational values higher than men and that older adults perceive the contribution higher than younger adults, which is in line with previous research. In a comparison of 20 different BGI elements, it was seen that large park was perceived to contribute the most, followed by urban and peri-urban forests and green areas, small green space, and watercourse, whilst ditch was perceived to contribute the least, followed by porous pavement, small/immature single tree, green roof, and small/immature street tree. Qualities that generated high recreational values were larger areas, several elements together, and several layers of greenery. This in contrast to fragmented single or smaller types in connection to buildings or grey infrastructure. Water was seen to have a great impact on aesthetics. Findings from this study conclude that BGI contributes to recreational values in winter and that certain qualities of BGI elements are perceived to contribute more to recreation than others. These findings can have implications for urban planning in terms of knowledge that can be used for prioritisation and enhancement of BGI elements and qualities that contribute to recreational values in winter, thus, favour and are appreciated by residents.

Keywords - perception, greenery, water, urban environment, recreation

Acknowledges

After five years of studying the subject of Geography, I´m glad to be able to present this 30 credits-thesis written on a topic I have found particularly interesting during my studies. Despite ups and downs during this period, this has resulted in a wealth of new knowledge and insights that I will take with me into the future.

I would first like to thank all the involved lecturers, professors, and course managers during the masters who have contributed to my learning and continued curiosity in the subject of Geography. I would like to a give a major thanks to my supervisors Professor Sofia Thorsson at the University of Gothenburg and Joanna Friberg at Göteborgsregionen, for your valuable guidance and contribution of knowledge during the master´s thesis. Finally, I would like to express my gratitude towards my fellow Geography classmates, and a particular thanks to Rebecca Johansson and Sandra Lujic for all your support and encouragement during the master´s thesis, but also throughout the whole master´s period.

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1. Introduction

Historically it has been shown that nature-related settings, such as landscaped yards, untouched forests, or areas containing elements of living systems, have been associated with a high quality of living (Davydenko & Peetz, 2017; Knez, Sang, Gunnarsson & Hedblom, 2018). A restorative potential of nature has been looked upon for a long time, as well as involvement of humans to seek connections with nature. According to this, nature-related settings have been associated with positive effects on humankind, both in terms of physiological, psychological, and social variables (Knez et al., 2018; Atiqul Haq, Islam, Siddhanta, Ahmed, & Chowdhury, 2021). On the contrary, living in urban settlements is often associated with insufficient physical activity and continuous stress, amongst others (Atiqul Haq et al., 2021). An increase in the urban population has consequently resulted in competition for land, where room for nature is limited (Cox, Shanahan, Hudson, Fuller & Gaston, 2018). One measure that has been found to reduce the negative impacts associated with the urban environment is to implement blue-green infrastructure (BGI) consisting of BGI elements such as street trees, ponds, rain gardens and parks amongst others, which further can provide the residents with multiple benefits. One of these benefits is recreation in various forms, such as opportunities for relaxation, physical activities, and visual appeal (Veerkamp, Shipper, Hedlund, Lazarova, Nordin & Hanson, 2021). Having a comprehensive awareness of how the public perceives blue-green spaces can have great implications for urban planning and design (Atiqul Haq et al., 2021). By doing so, BGI elements implemented in the urban environment can meet the needs of the intended users, thus, fulfilling its purpose and being appreciated by the residents (Kimic & Ostrysz, 2021).

Several studies have looked at how greenery in general is perceived (Ode Sang, Knez, Gunnarsson & Hedblom, 2016), both in terms of its contribution to recreational values and differences in perception between groups of people. BGI elements exist in the urban environment all year round, yet most studies have focused on people's perception after leaves emergence, i.e., during spring or summer. Consequently, leaving people's perception during colder seasons unnoticed (Duan & Li, 2022). The focus of many previous studies has also been on site-specific urban greenery and water in terms of aspects such as availability and proximity, and not looked at elements independent of their geographical location within the urban environment. Furthermore, not many studies have focused on comparing several different types of BGI elements.

1.1 Aim & research questions

The aim of this study is to investigate how residents visually perceive urban greenery in winter in relation to summer and how different BGI elements and related qualities are perceived to contribute to recreational values in winter. This will be carried out through a quantitative approach using a web-based questionnaire in spring 2023 in Gothenburg, Sweden. The following research questions will be answered to fulfil the aim:

- How is urban greenery perceived to contribute to passive recreation, active recreation and aesthetics in winter in relation to summer, and how does the perception differentiate between people based on gender and age?

- How are different BGI elements perceived to contribute to passive recreation, active recreation, and aesthetics in winter?

- How do different qualities of BGI elements influence the perception in terms of contribution to passive recreation, active recreation, and aesthetics in winter?

The concept of perception and the different recreational values – passive recreation, active recreation, and aesthetics will be defined and further explained in part *2. Theory* under section *2.1 Human's relationship to natural environments* and *2.3 Recreation of blue-green infrastructure*, respectively. Furthermore, the term qualities will be clarified in section *2.3*.

2. Theory

2.1 Human's relationship to natural environments

Historically it has been shown that nature-related settings such as landscaped yards, untouched forests, or areas containing elements of living systems, have been associated with a high quality of living (Davydenko & Peetz, 2017; Knez et al., 2018). A restorative potential of nature has been looked upon for a long time, as well as the involvement of humans to seek connections with nature. According to this, nature-related settings have been associated with positive effects on humankind, both in terms of feelings of solitude, aesthetical values, and a sense of timelessness (Knez et al., 2018; Völker & Kistemann, 2011), as well as positive effects on physiological, psychological, and social variables (Atiqul Haq et al., 2021). How one interprets or judges the surrounding environment, such as nature-related settings can be described by the act of perception, which can be defined as a cognitive and moral act uptaken by the senses (Marques, Ursi, Silva & Katon, 2020). Perception can be studied from several aspects, which among others include from self-perception (interior world) to environmental perception (exterior world) and - by the factors that influence that perception, both external (such as intensity, contrast, and movement) and internal (motivation, experience, and culture). Our minds organise and represent what is captured by our senses, often with our vision as the dominant sense, complemented by smell, taste, touch, and hearing (ibid).

2.2 Urban blue-green infrastructure (BGI)

Dissimilar to natural settings, the urban environment is characterised by hard impermeable surfaces and shortage of greens spaces (Almaaitah, Appleby, Rosenblat, Drake & Joksimovic, 2021), which consequently is associated with insufficient physical activity and continuous stress, amongst others (Atiqul Haq et al., 2021). A measure to counteract the negative impacts that the urban environment has on human health and instead deliver a wide range of ecosystem services such as opportunities for recreation, support of biodiversity and adapt to climate change, is to implement blue-green infrastructure (BGI) (Veerkamp et al., 2021). BGI is a collective term for a strategically planned network of natural and semi-natural systems that mimic the natural hydrology, regulates surface energy processes through shadowing and evaporation, as well as natural and artificial formations of water that slows runoff by providing temporary and permanently storage (Veerkamp et al, 2021; Almaaitah et al, 2021). BGI consists of several different elements of vegetation and water, such as ponds, trees, parks,

shrubs, and lawns. Implementation of BGI elements can occur at several geographical scales, from an individual building scale (such as green walls) to neighbourhoods (such as street trees) to whole districts (such as bigger parks) (Veerkamp et al., 2021; Willems, Kuitert & Van Buuren, 2022).

2.3 Recreation of blue-green infrastructure

BGI can help improve both mental and physical health among urban residents (Atiqul Haq et al., 2021). By providing the residents with green and blue spaces such as residential greenery, parks, and playgrounds, an opportunity is created for different types of recreation (Gungor & Tugrul, 2018), which includes passive and active recreation, as well as aesthetics. Passive recreation refers to activities that promote relaxation, stress relief, and social interaction, such as reading, writing, nature observing, and social meetings (Atiqul Haq et al., 2021; Park- och naturförvaltningen, 2014). Active recreation refers to physical activities, such as walking, running, cycling, or playing ball games (Mytton, Townsend, Rutter & Foster, 2012). Aesthetics refers to an appreciation of the visual appearance or beauty (Brielmann & Pelli, 2018) of BGI.

2.3.1 Passive recreation

Exposure to natural urban settings such as blue and green spaces can contribute to stress reduction and positive changes in mood and lower heartbeat rates, in comparison to built-up settings (Arnberger & Eder, 2015; Lee, Jordan & Horsley, 2015; Knez et al., 2018; Völker & Kistemann, 2011). Urban green and blue spaces provide opportunities for social interactions which could reduce social isolation and lead to greater personal wellbeing and resilience (Lee et al., 2015; Völker & Kistemann, 2011). Furthermore, it can have positive restorative effects on mental health and provide a buffer against stressful life events (ibid). While it has been shown that larger areas of greenery promote physical activities, smaller spaces are primarily used for socialising and rest (Lee et al., 2015).

2.3.2 Active recreation

Stimulation of physical activity can be derived from urban green space and water (Park - och naturförvaltningen, 2014), which in turn gives rise to improved mental health, long-lasting psychological benefits, functioning and wellbeing, as well as a reduction of risk of cardiovascular diseases, diabetes, fall-related injuries, and depression, amongst others (Lee & Maheswaran, 2011). Leslie, Cerin & Kremer (2010) suggest that perceptions of local environments could be associated with increased or decreased physical activity engagement.

They continue to argue that the use of parks, for instance, may not only be related to proximity but also to perceived environmental characteristics, such as enjoyable scenery (ibid). One characteristic that has been found to heavily affect the promotion of physical activity is the size of green areas (Wood, Hooper, Foster & Bull, 2017). According to Coombes, Jones & Hillson (2010), areas smaller than 2 hectares are not suitable for physical activities. In a study conducted by Schipperijn et al. (2012), it was shown that many trees and water (lakes, streams, and canals) were of importance in encouraging physical activity. Urban green spaces with a high perceived naturalness have a greater value for activity, experience, and wellbeing compared to those with low perceived naturalness (Ode Sang et al., 2016; White & Gatersleben, 2011). This corresponds to literature on landscape preferences, which indicated a strong relationship between the degree of naturalness and landscape preference (Ode Sang et al., 2016).

2.3.3 Aesthetics

The aesthetic value of BGI elements has a great influence on how well they will receive positive or negative reception and acceptance from the residents (Kimic & Ostrysz, 2021). According to Smardon (1988), it has been shown that, at a general level, the presence of vegetation has positive effects on aesthetic preferences in urban areas. A previous study conducted by Wang, Zhao & Liu (2016) investigated the consensus of visual preferences of four different landscape types, where it was found that consensus increased when a landscape was well maintained and had greater vegetation coverage. Furthermore, landscapes that contain a balance between water and vegetation elements have been shown to generate high appreciation (Polat & Akay, 2015). Access to water has been shown to be important as a view (Park- och naturförvaltningen, 2014), and water connected with naturalness has also been seen to increase the visual appeal (Völker & Kistemann, 2011).

2.4 Perception of different groups of people

Different people may perceive the same sensory information in radically different ways since perception is an active, creative process in which raw sensory data are organised and given meaning (Marques et al., 2020; Passer & Smith, 2007). Polat & Akay (2015) claims that it is not solely the features of the landscape that affect aesthetic perceptions but also the characteristics of the observer. There seems to be consensus over the general perception of greenery in terms of its aesthetic, affective, and restorative qualities. However, greenery encompasses many types of vegetation, and it is therefore unlikely that all people will perceive

these in the same way (White & Gatersleben, 2011). It was found in a study conducted by Ode Sang et al. (2016) that women tend to use urban green spaces more than men, as well as rating their aesthetic values higher. In terms of age, it was also seen that older residents pursue a greater number of nature-related activities than young residents and too rated a higher aesthetical value than the young. However, the older the respondent, the less use of green spaces for more physical activities such as running, and cycling followed (ibid).

2.5 Seasonal differences of perception of blue-green infrastructure

It has been shown that the appearance of green space may vary to a great extent along with changes in seasons, thus affecting people´s perceptions (Duan & Li, 2022). Previous studies with a focus on green spaces' impact on human health have mainly introduced participants to landscapes in warm seasons such as spring and summer. Thus, leaving people's views during wintertime unnoticed (ibid). Roberts, Sadler & Chapman (2017) raise the issue of the lack of attention on the effect of seasonality and weather conditions, claiming that these are still largely overlooked as a potential determinant of outdoor physical activity. Although health benefits associated with natural exposure have been established, it is still unclear if these findings can be obtained even in colder seasons (Duan & Li, 2022). The climate which typically represents winter, is generally associated with restrictions of people's outdoor activities, resulting in a gradual decline in the level of public sports activities. However, people's need for both physical and mental health does not decline in this season (ibid). In a study conducted by Roberts, Sadler & Chapman (2017), it was found that people use parks more for physical activities during summer compared to winter. They argue that this can be explained by poor weather conditions, which have effects on individuals' desire and motivation to engage in physical activity. In a previous study, it was shown that trees were perceived as dull and grey in winter compared to other seasons, which indicates that perceived aesthetical appeal changes with seasons (Nordström & Nilborn, 2017).

2.6 Implications for urban planning

A consequence of an increased urban population is the competition for space within the urban environment. By this means, the room for nature is limited (Cox et al., 2018). There is a continuous increase in documented evidence of BGI: s social, health, and environmental benefits (Kimic & Ostrysz, 2021). The quality of the environments in which people live constitutes an important aspect of their quality of life (Van Kamp, Leidelmeijer, Marsman &

Hollander, 2003). Understanding the nature of the person-environment relationship is a central interest within the discipline of geography, which in an urban context, can be interpreted as a concern between city residents and their urban surroundings (Pacione, 2003). A necessity to obtain a proper understanding of urban environmental quality is to address both objective and subjective evaluations. As Pacione (2003) suggests, one must consider both the *city on the ground* and the *city in the mind*. Having a comprehensive awareness of public perceptions can have great implications for urban planning (Atiqul Haq et al., 2021), since this can enable urban development that meets the needs of the residents (Van Kamp et al., 2003). Ho & Au (2020) agrees that understanding human perceptions of public spaces is vital in urban studies. Involvement of the public is therefore essential in the planning and design of public spaces to make sure these are appreciated and accepted by intended users (Lee et al., 2015; Van Kamp et al., 2003; Kimic & Ostrysz, 2021).

3. Study area

3.1 Urban area of Gothenburg

Gothenburg municipality is located on the west coast of Sweden, which includes approximately 270 km² of land that is defined as urban area (Figure 1) and with a population of approximately 693,00 residents (Göteborgs stad, n.d.b; Statistics Sweden, 2020). Gothenburg city (57420N, 11580E), which is the second largest city in Sweden (Göteborgs stad, n.d.b), accounts for the largest part of the urban area within the municipality (Statistics Sweden, 2020).

Gothenburg's location on the west coast with closeness to the Atlantic Ocean gives the area a maritime temperate climate with moderately cool summers and mild winters for the latitude (SMHI, 2022; Klingberg, Konarska, Lindberg, Johansson & Thorsson, 2017). Gothenburg's location in Götaland belongs to the warm-temperate zone with deciduous forest as the natural dominant nature type. Its location implies a fairly rainy climate with 1000-1300 mm of precipitation per year. The mean temperature is 18°C in July and 1-2°C in January (SMHI, 2022).

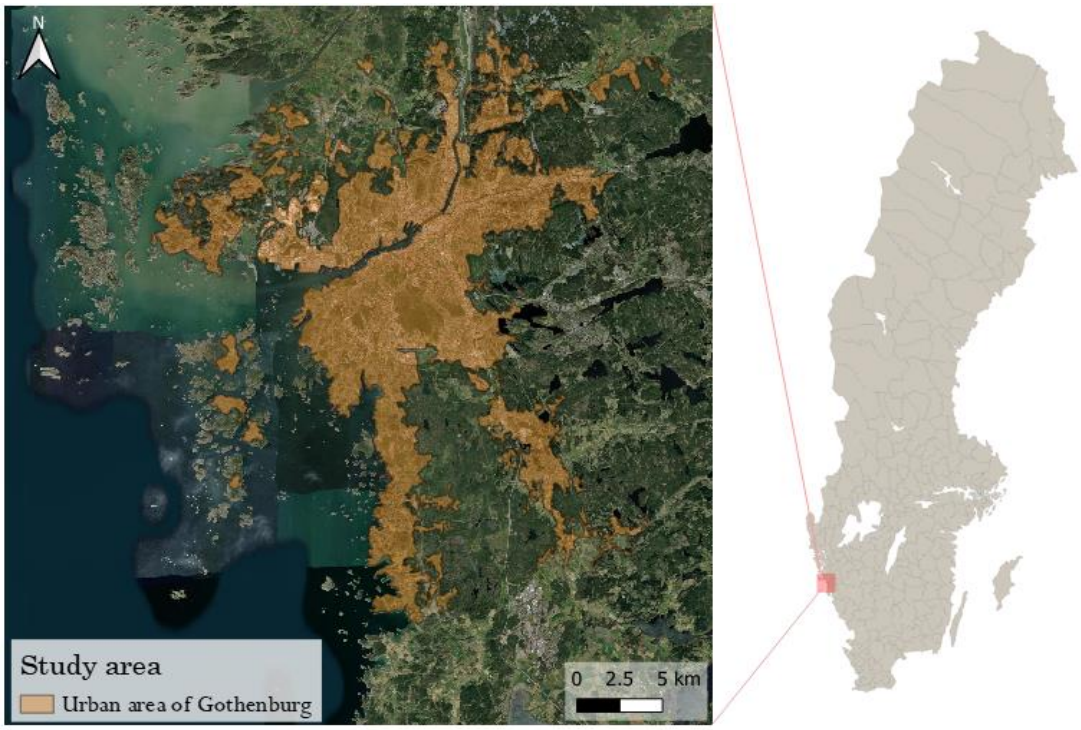

Figure 1: Geographical localisation of study area, the urban area of Gothenburg in Sweden. According to Statistics Sweden (2020), an urban area is defined as a contiguous settlement with at least 200 inhabitants. The urban area of Gothenburg municipality shown in the map includes Partille and Mölndal, however these are not included in this study. Source: Statistics Sweden (n.d.b), ESRI Satellite.

3.2 Blue-green infrastructure in Gothenburg

Gothenburg has a varied nature consisting of coast, forests, mountains, valleys, and lakes (Göteborgs stad, n.d.a), and is a relatively green city (Klingberg et al., 2017). Gothenburg's parks, green areas, and tree plantations have emerged under different eras, and its different characters in terms of design varies depending on the art and architecture of its time (Park- och naturförvaltningen, 2014). They serve as a historical reference, whilst simultaneously creating variation in the cityscape. There are several bigger parks within the urban environment, such as the Garden Society, Slottsskogen, and the Botanic Garden (Göteborgs stad, n.d.a). Besides bigger green spaces, several elements on streets and squares can be found, such as green walls, green roofs, trees, plantations, and flower urns, amongst others (Park- och naturförvaltningen, 2014).

3.3 Green strategy - "a close and green city"

One municipal document formulated on behalf of the Parks and Nature board is "Green Strategy ", which aims to show how Gothenburg can remain and further develop into a city with great green qualities, looking from both a social and ecological perspective whilst simultaneously densifying the city. The document consists of two main goals where one of these is a social that states - "Gothenburg is a dense and green city where the public places contribute to a rich and healthy urban life" (Park- och naturförvaltningen, 2014).

The goal describes how greenery in various forms is an important part to include in the development of the city to promote wellbeing for the residents (park- och naturförvaltningen, 2014). It states that Gothenburg must have attractive and varied green public spaces that promote meetings between people. These public spaces should be created for everyone, with different content and activities, since different groups of people have different views on what is considered as attractive areas. To meet the needs and ensure everyone's wellbeing, participation in planning is essential (ibid).

4. Methodology

4.1 Study design

A quantitative research method and statistical analysis have been used in this study, which according to Apuke (2017), allows questions like who, how much, what, where, how many, and how to be answered. Survey research in the format of a questionnaire was carried out to gather primary data. This method has been used for a long time in the discipline of geography to explore people's perceptions, experiences, behaviours, attitudes, and spatial interactions in diverse geographical contexts (ibid), thus seen as an appropriate method to detect patterns and draw generalisations about the study's population. The data was processed, analysed, and visualised by the software Statistical Package for the Social Sciences (SPSS) and Excel.

4.2 Questionnaire

4.2.1 Sample strategy

The sample in this study was desired to represent residents of Gothenburg as the population. Criteria included to achieve this were: age ≥18 and currently a resident of Gothenburg municipality. In this study, the distribution and collection of data were carried out by a survey company named Enkätfabriken. The strategy used was based on a non-probabilistic sample, where the respondents were contacted through a web panel with stated criteria. The collection occurred between the 7th-24th of February 2023. 298 answers were obtained: 50.7 % women, 48.7 % men, 0.3 % other, and 0.3 % don't want to state, which were distributed across the ages 18-86.

4.2.2 Design and questions

Initially, a short introduction was provided to make the respondents aware of the content. The respondents were assured anonymity since name or personal information was not considered important to share. Firstly, the questionnaire consisted of one introductory part with questions about demographic variables. Secondly, one part where the respondents were asked to take a stand on how they perceive greenery´s contribution to passive (relaxation, socialising such as having a coffee), active (exercise/physical activities such as walking or jogging) recreation, and aesthetics (beautiful to look at) in winter and in summer. Thirdly, one part where the respondents were asked to take a stand on how they perceive different BGI elements contribution to passive recreation, active recreation, and aesthetics in winter. Lastly, the

respondents were asked to take a stand on how they perceive qualities of BGI elements to contribute to a positive perception. See Appendix 1 for the full questionnaire.

The questions were followed by predetermined answer options, which according to Clifford et al. (2010), is beneficial, firstly because it works as a guide for the respondents to easily answer the questions, and secondly, because the responses are easier to analyse and interpret since they fall into a limited set of categories. One should always strive to make the answer options comprehensive and mutually exclusive, meaning that it should not be difficult for the respondent to decide which option they should choose (Esaiasson et al., 2017; Statistics Sweden, 2016). A "Likert scale" was used which presents a range of responses anchored by two extremes (Clifford et al., 2010), in this case, "Not at all" and "To a great extent". A range of 1-5 was used, which according to Esaiasson et al. (2017), is one of the more common ones when using scales and numerical values. Additionally, an option of "Do not know" was added if the respondents were unsure how to answer (ibid). An open-answered question was added at the end, where the respondents could freely share further thoughts and opinions if so wanted. All questions with predetermined answer options were marked as mandatory to answer.

Throughout the questionnaire, consistency of phrases and questions was applied, and terms that could be considered complicated or hard to understand were simplified. The same applies to the choice of structure, where the questions came in an order that made it simple to follow. This was important to consider since it has been shown that the layout, both in terms of design and words, can have a significant effect on the answers obtained (Statistics Sweden, 2016). Images were provided in conjunction with the first question in the questionnaire, where the respondents' perceptions of greenery in winter and in summer were asked (Figure 2). Images of the different types of BGI elements in winter were provided in conjunction with the second question in the questionnaire (Table 1). All images of BGI elements in winter were taken on the 22nd & 24th of January 2023 in the areas of Guldheden, Kvillebäcken, Munkebäck, and the city centre of Gothenburg. Images of greenery in summer were taken 12th of September 2022 in Munkebäck.

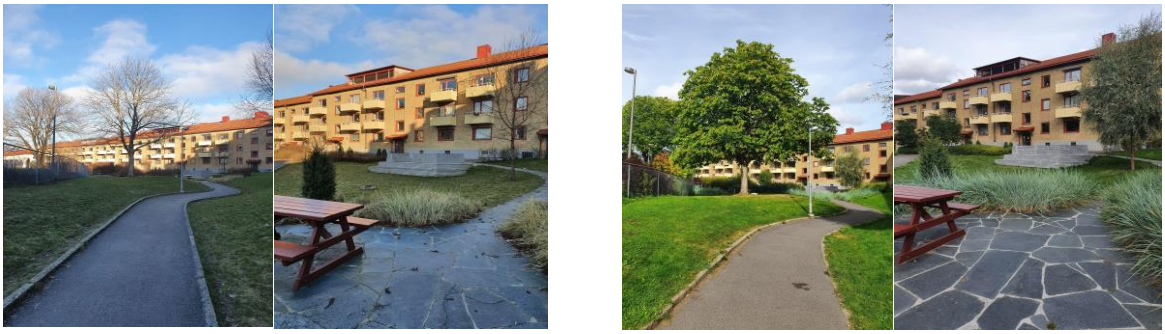

Figure 2: Images provided in the questionnaire, in conjunction with the first question where the respondents were asked to take a stand on their perception of greenery in general in winter and in summer. The two left images present a small green space in winter, and the two right images present the same small green space in summer. Images by: Mikaela Torell

Prior to the publication and distribution of the questionnaire, it was tested on several people, which Clifford et al. (2010) claim to be a final and critical step in questionnaire construction. This applied to both people with academic knowledge of the topic as well as external people without any deeper knowledge of the topic. This to avoid unclear questions or formulations that could negatively affect people's attitudes toward participating.

4.3 Collected data

4.3.1 Categorisation

Prior to analysis, the data was processed to simplify calculations. This meant that variables were categorised into new groups. The two demographic independent variables, gender and age, were categorised according to the following: x2 gender (women 51 %, and men 49%), x3 age (younger = ≤25–35 (29.2%), middle-aged = 36-55 (30.2%), and older = 56-66+ (40.6%)). The categorisation of gender was based on groups that included at least 30 units, which Harris & Jarvis (2013) claims to be a rule of thumb for a sample size to analyse one geographical population. The categorisation of age, which from the start ranged from 18-86, was categorised according to a similar study conducted by Ode Sang et al. (2016). Responses received in the answer-option “Do not know” were considered as missing data and consequently removed from the dataset.

To answer the third research question about how qualities of BGI have influenced the perception, elaboration of different categorisations of the elements was made which resulted in the qualities - BGI feature, BGI type, size, degree of naturalness, layers of greenery, and

numbers of elements. These qualities were partly based on the qualities which the respondents were asked to take a stand on in the questionnaire: “colour”, “variation of colour”, “greater garden look”, “greater naturalness”, “size”, “greenery at different height levels” and “amount”. Further elaboration resulted in additional qualities. The elements were categorised into new groups according to their different qualities.

Table 1 shows how the BGI elements have been categorised according to the different qualities. Categorisation of the quality “BGI feature” was based on a predetermined categorisation conducted by Thorsson et al. (2023). The elements were categorised according to the groups “green”, “blue”, “bluegreen”, and “greengrey”. Categorisation of the quality “BGI type” was based on a predetermined categorisation conducted by Thorsson et al. (2023). The elements were categorised according to the groups “building GI”, “yard BGI”, “BGI in connection to grey infrastructure”, “water areas”, and “green areas”. Categorisation of the quality “size” was based on elements that were defined as “small” or “large” in the questionnaire. The elements trees and parks were categorised according to the groups “small” or “large”. Categorisation of the quality “naturalness” was based on a predetermined categorisation conducted by Thorsson et al. (2023), with a modification. The elements were categorised according to the groups “high” or “low” degree of naturalness. Elements that got categorised as “high” degree of naturalness were determined by their requirement of low costs for maintenance, whilst elements that got categorised as “low” degree of naturalness were determined by their requirement of high costs for maintenance. Exceptionally, elements on facades or on buildings were categorised as “low” degree of naturalness. Categorisation of the quality “layers of greenery” was based on if the subtype included single or several layers of greenery according to the definition of vegetative stratification (Oxford reference, 2023), which includes a canopy layer, a shrub layer, and a ground layer. Categorisation of the quality “number of elements” was based on if the elements included one or several elements. For example, a lawn consists of grass (one element), whilst a park consists of a lawn, trees, and shrubs (several elements). The elements were categorised to the groups “single element” or “several elements”.

*Table 1: Images in conjunction to the second question in the questionnaire presenting the different BGI elements followed by a description and classification according to the different qualities - naturalness, size, layers of greenery, number of elements, BGI feature and BGI type. Source: Descriptions according to Thorsson et al (2023) with a modification. Images by: Mikaela Torell. * BGI GRI is an abbreviation of "BGI in connection to grey infrastructure".*

BGI element	Description	Naturalness	Size	Layers of greenery	Number of elements	BGI Feature	BGI Type
Green wall 	Building-integrated vegetation, wall completely or fully covered.	Low	-	Single	Single	Green	Building GI
Green roof 	Building-integrated vegetation, roof completely or fully covered.	Low	-	Single	Single	Green	Building GI
Lawn 	Grass cut shortly, highly maintained.	Low	-	Single	Single	Green	Yard BGI
Meadow 	Infrequently cut grass, usually herbs and other non-woody plants.	High	-	Single	Single	Green	Yard BGI
Shrub/hedge 	Low-high woody plants with multiple stems that arise at or near ground without a main trunk.	Low	-	Single	Single	Green	Yard BGI

Flower bed/planting  An area where low to medium-high vegetation grows. Usually a long narrow soil layer for ornamental plants.	Low	-	Single	Single	Green	Yard BGI
Rain garden  A permeable plant bed/planting where stormwater is led to.	Low	-	Single	Single	Blue-green	Yard BGI
Road verge  Strip of land in the immediate vicinity of roads, commonly habitats such as grass and/or plants, shrubs, and trees.	High	-	Single	Single	Green	*BGI GRI
Small/immature single tree  Usually deciduous trees with a height between 2-6 m. Good growing conditions such as good access to water, space, and light.	High	Small	Single	Single	Green	Yard BGI
Large/mature single tree  Usually deciduous trees with a height > 6m. Good growing conditions such as good access to water, space, and light.	High	Large	Single	Single	Green	Yard BGI

Small/immature street tree  Usually deciduous trees with a height between 2-6 m. Poor growing conditions such as limited access to water, nutrition, and space.	Low	Small	Single	Single	Green	*BGI GRI
Large/mature street tree  Usually deciduous trees with a height > 6 m. Poor growing conditions such as limited access to water, nutrition, and space.	Low	Large	Single	Single	Green	*BGI GRI
Ditch  Shallow depression designed to manage water from hardened environments.	High	-	Single	Single	Blue-green	*BGI GRI
Porous pavement  Porous material that enables stormwater to infiltrate, such as grass, gravel, and hollow stone in concrete.	Low	-	Single	Single	Green-grey	*BGI GRI

Watercourse  Collective term for currents with surface water, such as stream, river, and canal.	High	-	Single	Single	Blue	Water areas
Pond  Natural or artificial waterbody, permanent or temporary.	High	-	Single	Single	Blue	Water areas
Grove of trees  Smaller collection of small and large trees of the same or different species. Other vegetation such as shrubs can be included.	High	-	Several	Single	Green	Yard BGI
Small green space  Smaller green area of at least 0.2 hectares, such as community garden or small park, consisting of several elements (e.g., trees, lawn, and flower bed).	Low	Small	Several	Several	Green	*BGI GRI
Large park  Larger area of at least 2 hectares consisting of several elements such as trees, water surface, porous pavement.	Low	Large	Several	Several	Green	Green areas

Urban and peri-urban forests and green areas  Self-organised forest vegetation such as trees, shrubs and/or grasslands.	High	-	Several	Several	Green	Green areas

4.3.2 Analysis of variables

Since all respondents were asked the same questions, analysis of the collected data to find patterns and answer the study's research questions was enabled. To achieve summarised descriptions of the residents' perceptions, a descriptive analysis was applied (Esaiasson et al., 2017). Mean was used as a measure of central tendency, which was seen as a suitable measure since this allowed greater variations of how the different elements were perceived. The mean is a measure appropriate to use when the data does not consist of extreme values (Harris & Jarvis, 2013), hence applicable to this study that consists of a range of 1-5. The mean value for how all respondents answered regarding the perception of greenery in winter in relation to summer, perception of different types of BGI elements in winter, as well as the impact of qualities on the perception during winter were calculated using SPSS and Excel, where the results were presented in tables and bar charts.

To analyse if there were any relationships between the dependent variable perception of greenery in winter in relation to summer, and between the independent variables season, age and gender, inferential statistics were applied. This type of analysis can provide information of the population from which the data were sampled (Harris & Jarvis, 2012). This analysis was only applied to the first research question since it was of interest to compare this specific question with previous findings from similar studies. A Paired-Samples T–Test was used to see if there were any statistical significance between the means of the same participants in the two different seasons (winter and summer), meaning an ascertainment of that an observed relationship was not arisen by chance (Bryman & Cramer, 2011). The advantage of using a paired t-test is that by using the same participants the amount of error deriving from differences between participants is reduced. A statistical significance was confirmed in this study at a probability level (p-value) at or below 0.05, which is commonly used in social sciences (ibid).

One-way analysis of variance (ANOVA) was used as a test to examine if there was a statistical significance between the mean of the independent variables (age and gender) and the dependent variable (perception of greenery in winter in relation to summer). To analyse the impact of age, a Bonferroni test was added to ANOVA since Bonferroni modifies the significance to consider the fact that more than one comparison is made (younger, middle-aged, and older). This provides information of where the differences occur (ibid). Outputs from every test can be seen in Appendix 2.

5. Results

5.1 Perception of greenery in winter in relation to summer

Respondents perceive greenery to contribute to recreational values in winter, however, to a less extent than in summer (Figure 3). Strong significant differences (p = < 0.001) could be seen between all types of recreation in winter in relation to summer. The greatest difference was seen in passive recreation, followed by aesthetics and active recreation. As seen in the figure, the respondents' answers deviated greater from the mean value in all three types of recreation in the winter compared to the summer.

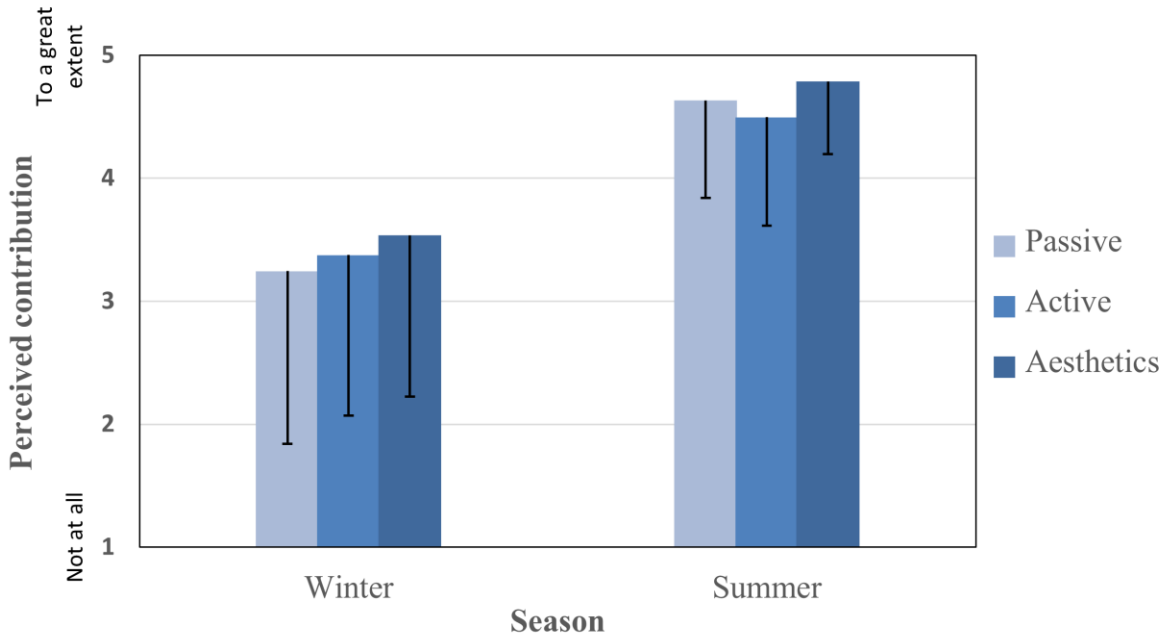

Figure 3: Mean value of greenery's perceived contribution to passive recreation, active recreation, and aesthetics in winter and in summer. Error bars represent standard deviation.

Women perceived greenery's contribution to recreational values higher both in winter and in summer compared to men. This applies to all three types of recreation. ANOVA showed a significant difference (p = 0.007) in active recreation with a mean value of 0.2 higher for women (4.6) than men (4.4), and a significant difference (p = 0.004) in passive recreation with a mean value of 0.3 higher for women (4.8) than men (4.5) in summer. No significant differences could be seen between men and women in winter.

Older adults perceived greenery's contribution to recreational values higher than younger and middle-aged adults. This applies to all three types of recreation. ANOVA (Bonferroni) showed a significant difference ($p = 0.025$) in aesthetics, with a mean value of 0.2 higher for middle-aged adults (4.8) than younger (4.6). A significant difference ($p = < 0.001$) in aesthetics, with a mean value of 0.3 higher for older adults (4.9) than younger (4.6). A significant difference ($p = 0.013$) in passive recreation, with a mean value of 0.3 higher for older adults (4.8) than younger (4.5) in summer. No significant differences could be seen between the age groups in the winter.

5.2 Recreational values of BGI elements in winter

All BGI elements were perceived to contribute relatively much to recreation (Table 2). Large park (3.8) was perceived to contribute the most, followed by urban and peri-urban forests and green areas (3.7), small green space, watercourse (3.6), and pond (3.5). Ditch was perceived to contribute the least (2.6) to recreation, followed by porous pavement (2.7), small/immature single tree (2.8), green roof (2.8), and small/immature street tree (2.8).

Of the different types of recreation, the BGI elements contributed the most to aesthetics. Large park (4.0), urban and peri-urban forests and green areas (3.9), watercourse (3.9), and pond (3.9), were all perceived high in terms of aesthetics. Passive and active recreation received more similar values. The greatest difference that was seen within the different types of recreation, were how the elements watercourse and pond were perceived to contribute noticeable higher to aesthetics (3.9, 3.9) compared to passive (3.3, 3.2) and active (3.4, 3.3) recreation.

Table 2: *Mean value of BGI elements' perceived contribution to passive recreation, active recreation, aesthetics, and aggregated recreation. Colour gradient shows degree of perceived contribution, where light green indicates low perceived contribution and dark green indicates high perceived contribution.*

BGI element	Passive	Active	Aesthetics	Aggregated recreation
Large park	3.7	3.8	4.0	3.8
Urban and peri-urban forest and green areas	3.5	3.8	3.9	3.7
Small green space	3.5	3.5	3.7	3.6
Watercourse (stream, river, canel)	3.3	3.4	3.9	3.6
Pond	3.2	3.3	3.9	3.5
Grove of trees	3.2	3.3	3.5	3.3
Large/mature single tree	2.9	3.0	3.7	3.2
Large/mature street tree	2.9	3.0	3.5	3.1
Road verge	2.8	3.0	3.2	3.0
Meadow	2.8	3.0	3.3	3.0
Lawn	2.8	3.0	3.3	3.0
Rain garden	2.7	2.8	3.3	2.9
Shrub/hedge	2.7	2.8	3.2	2.9
Flower bed/planting	2.7	2.8	3.2	2.9
Green wall	2.7	2.7	3.2	2.9
Small/immature street tree	2.6	2.8	3.2	2.8
Green roof	2.6	2.7	3.1	2.8
Small/immature single tree	2.6	2.7	3.1	2.8
Porous pavement	2.6	2.7	2.8	2.7
Ditch	2.5	2.5	2.7	2.6

5.3 Qualities of BGI elements during winter

5.3.1 BGI feature

Respondents perceived blue elements, such as pond and watercourse to contribute most to all types of recreation, whereas the greengrey element porous pavement contributed the least (Figure 4). The greatest difference could be seen in aesthetics, followed by passive and active recreation. Green elements such as large park, meadow, and grove of trees were also perceived to contribute to quite a large extent to all types of recreation, whereas bluegreen elements such as raingarden and ditch were perceived to contribute less.

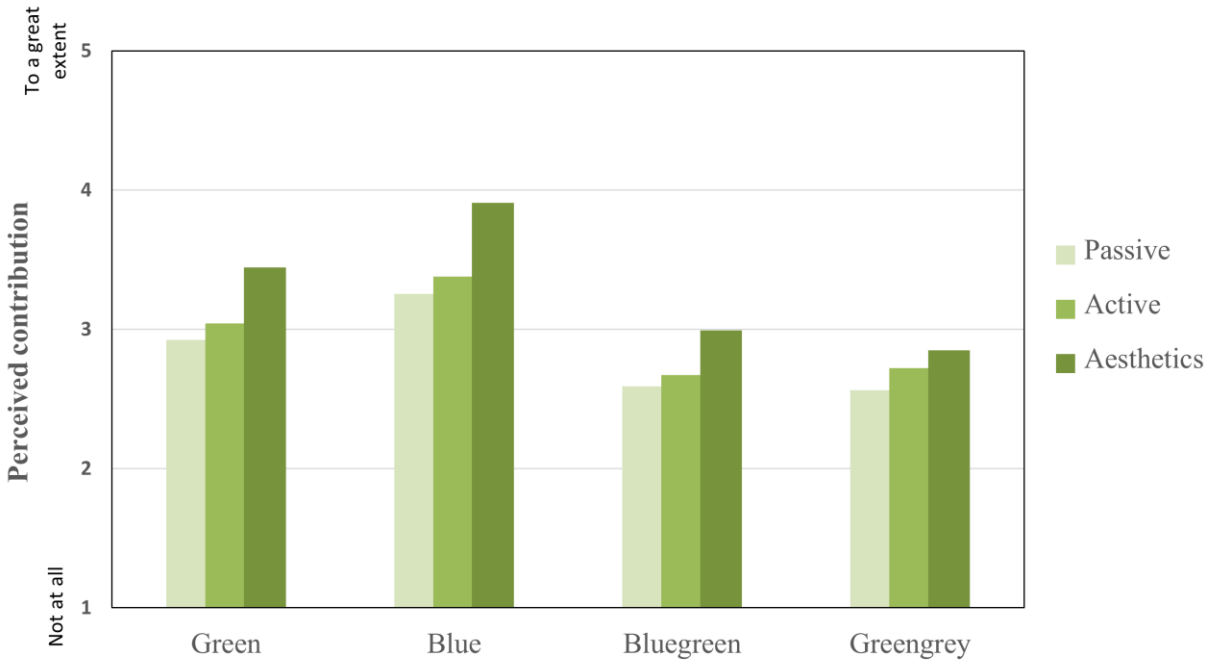

Figure 4: Mean value of BGI elements perceived contribution to passive recreation, active recreation and aesthetics categorised into blue, green, bluegreen and greengrey.

5.3.2 BGI type

Respondents perceived green areas such as large park and urban and peri-urban forest and green areas to contribute most to all types of recreation, whereas building GI elements such as green roof and green wall contributed the least (Figure 5). The greatest difference could be seen in active recreation, followed by passive recreation and aesthetics between these two categories. Elements categorised as water areas such as watercourse and pond were also seen to contribute greatly to aesthetics.

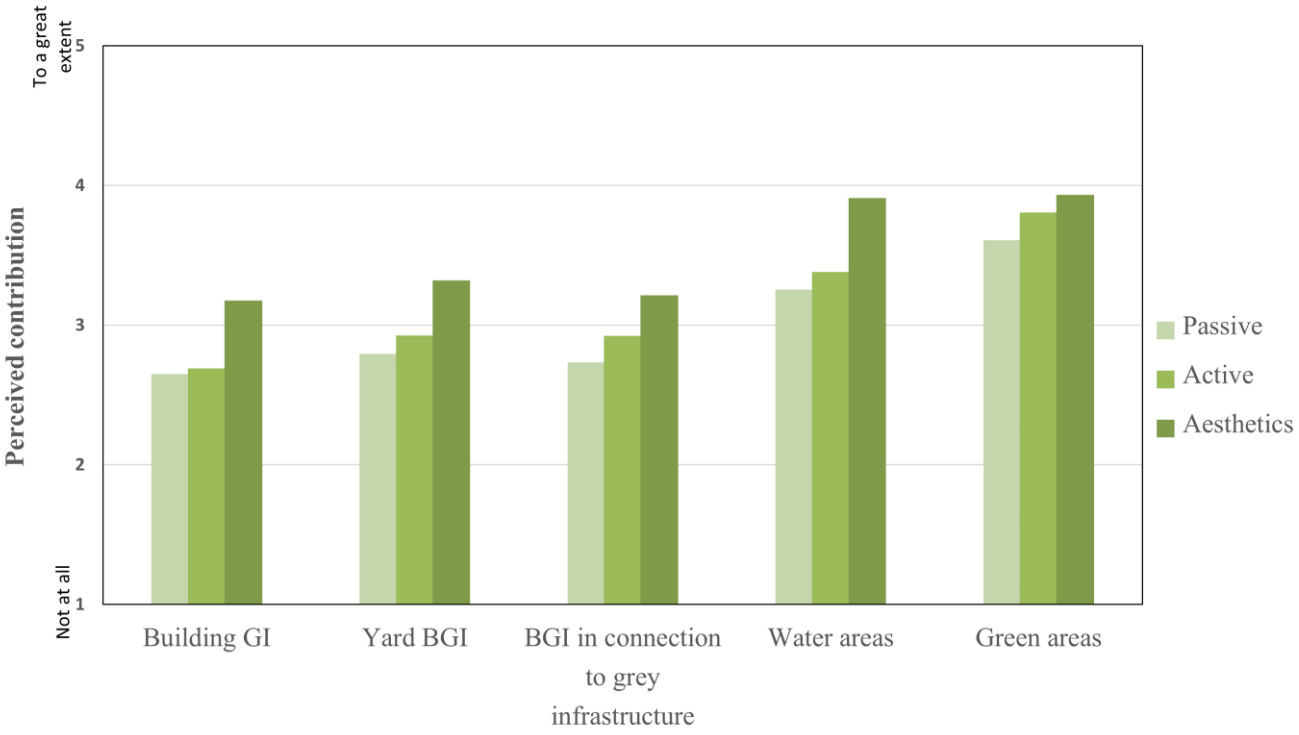

Figure 5: Mean value of BGI elements perceived contribution to passive recreation, active recreation and aesthetics categorised into building GI (Green infrastructure), yard BGI, BGI in connection to grey infrastructure, water areas and green areas.

5.3.3 Degree of naturalness

Respondents perceived high naturalness elements such as watercourse, meadow, and large/mature single tree to contribute slightly more to all types of recreation than low naturalness elements such as small green space, lawn, and large/mature street tree (Figure 6).

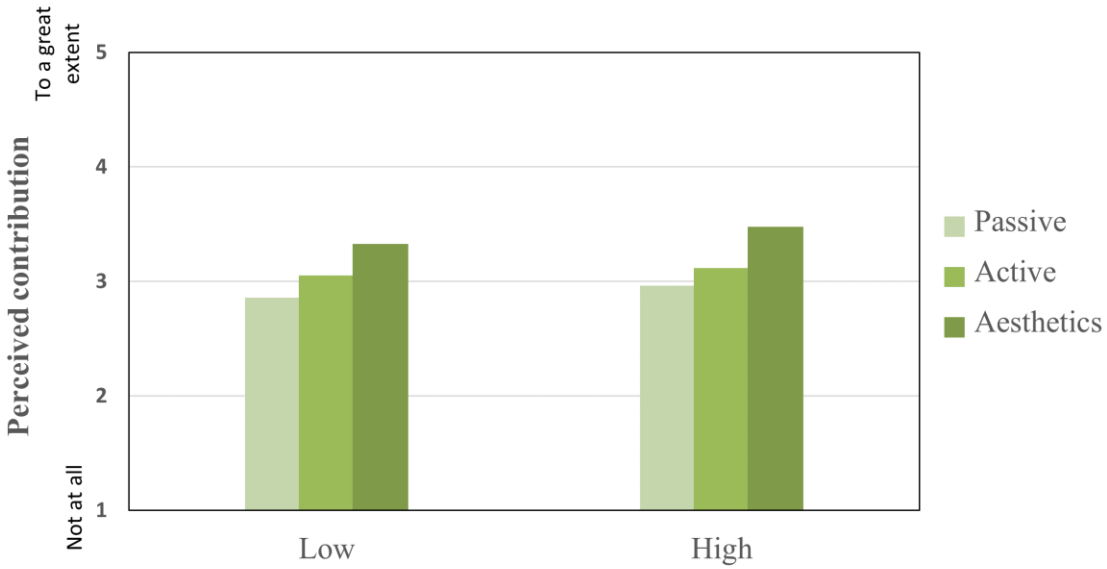

Figure 6: Mean value of BGI elements perceived contribution to passive recreation, active recreation and aesthetics categorised into low or high naturalness.

5.3.4 Size

Respondents perceived large trees and parks to contribute more to all types of recreation than small trees and parks (Figure 7). The greatest difference within the element trees were seen in aesthetics, and the greatest difference within the element park were seen in active recreation and aesthetics.

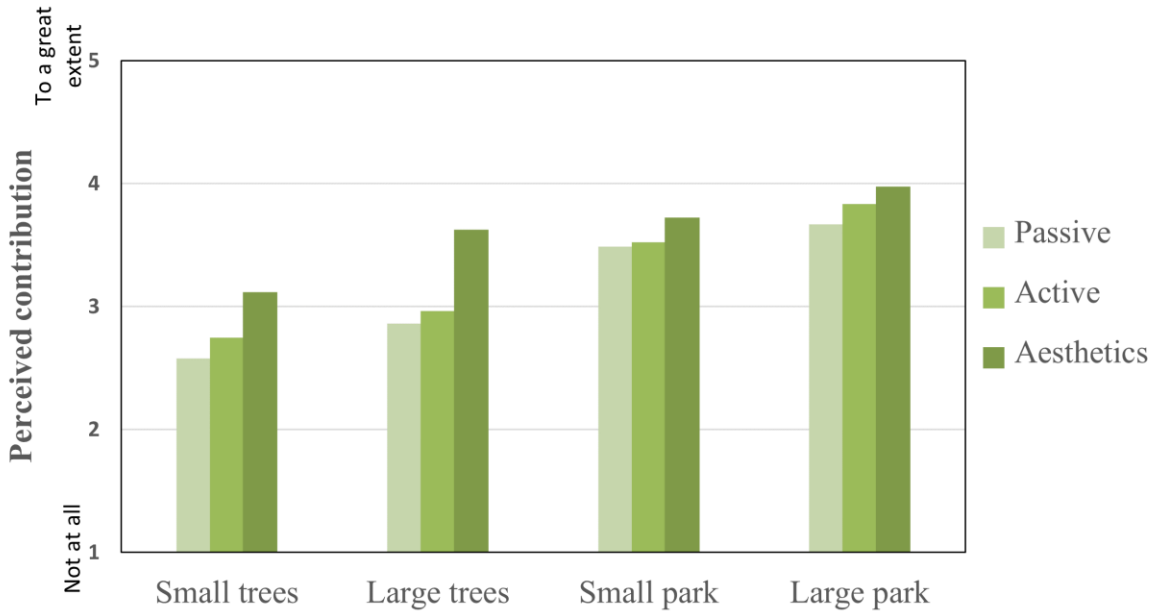

Figure 7: Mean value of BGI elements perceived contribution to passive recreation, active recreation and aesthetics categorised into small and large park and trees.

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5.3.5 Number of elements

Respondents perceived elements consisting of several elements such as grove of trees, large park, and small green space to contribute more to all types of recreation than elements that only consist of one element such as pond, flower bed/planting and ditch (Figure 8). The greatest difference can be seen in passive and active recreation, followed by aesthetics.

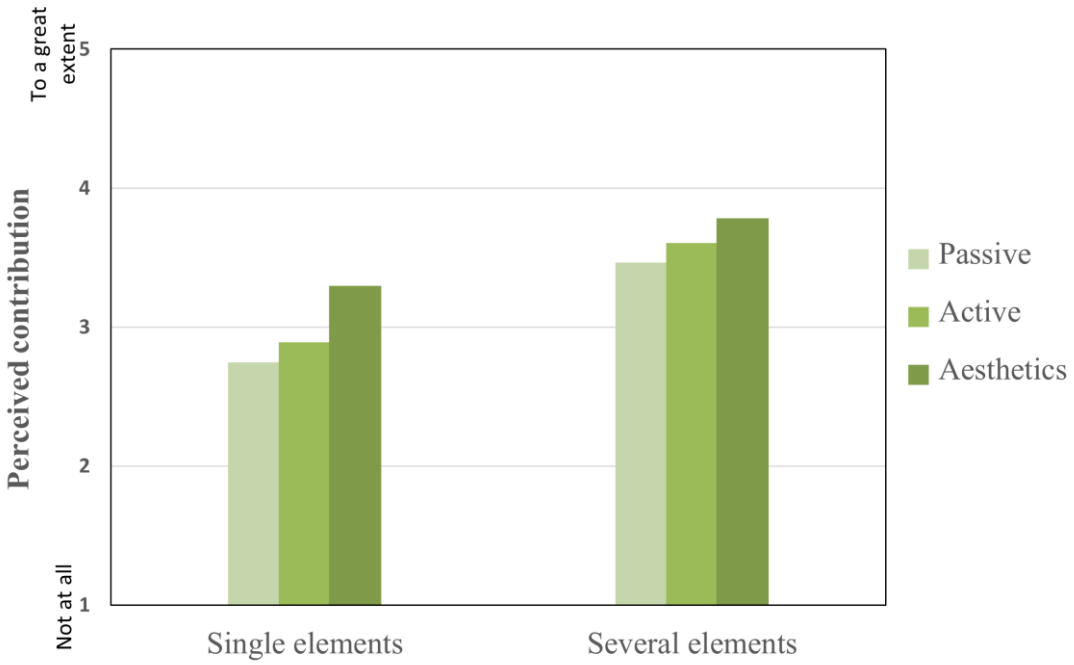

Figure 8: Mean value of BGI elements perceived contribution to passive recreation, active recreation and aesthetics categorised into single or several elements.

5.3.6 Layers of greenery

Respondents perceived elements consisting of several layers of greenery such as small green space, grove of trees, and urban and peri-urban forest and green areas to contribute more to all types of recreation than elements that only consist of one layer of greenery such as road verge, green wall, and shrub/hedge (Figure 9). The greatest difference can be seen in passive and active recreation, followed by aesthetics.

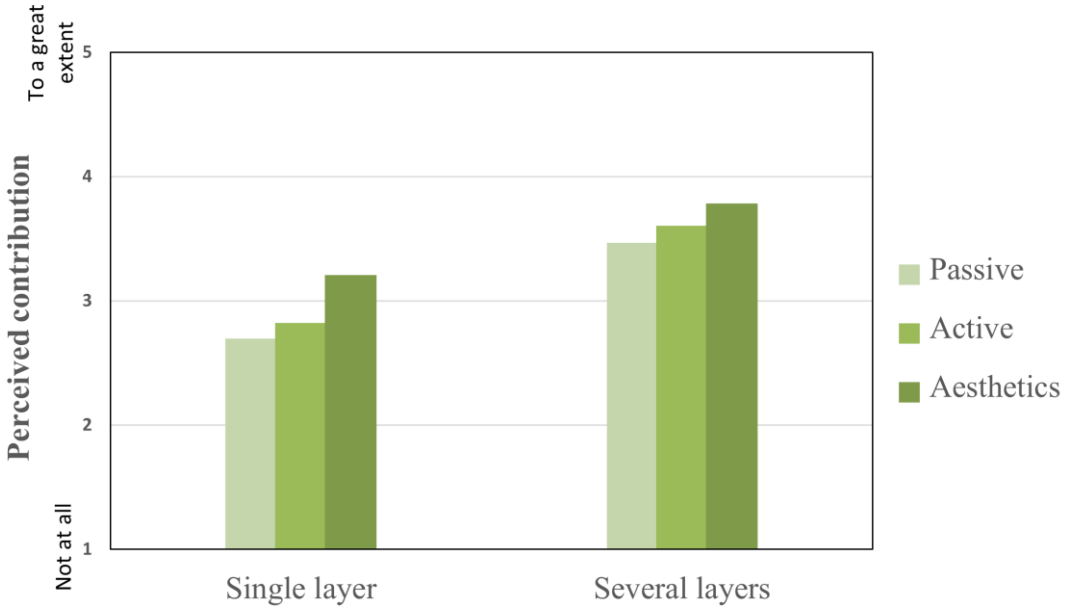

Figure 9: Mean value of BGI elements perceived contribution to passive recreation, active recreation and aesthetics categorised into single or several layers of greenery.

6. Discussion

6.1 Results

Greenery is generally perceived to contribute to recreational values during winter, however, to a less extent than in summer (Figure 3). The greatest difference between the seasons could be seen in passive recreation, followed by aesthetics and active recreation. That the appearance of green space can vary greatly between seasons has been discussed in previous research (Duan & Li, 2022). The results regarding the residents' perceptions from this study are in line with findings from previous studies that green areas are used less for physical activities and are perceived as less aesthetically beautiful in winter compared to other seasons (Roberts, Sadler & Chapman, 2017; Nordström & Nilborn, 2017). Since the differences occurred in all types of recreation, it can be assumed that the degree of greenery and its appearance was the key influence on the perception between the seasons.

Women perceive greenery's contribution to recreational values higher in winter as well as in summer in relation to men, which are in line with previous studies (Ode Sang et al., 2016). Significant differences between women and men were also seen in summer in terms of active and passive recreation, whilst no significant differences could be seen in winter. Furthermore, older adults perceive greenery's contribution to recreational values higher in winter as well as in summer in relation to younger and middle-aged adults. Significant differences between older adults and younger were also seen in summer in terms of aesthetics and passive recreation. This result also corresponds with previous studies that have shown that the elderly tend to use green areas for more physical activities and rate aesthetic values higher than young people. However, in one study, it was found that the older a respondent was, the more the use of green spaces for physical activities decreased (ibid). The degree of physical activity or different types of activities were not examined in this study, nor range of age within the older adults category, which makes it difficult to compare. However, it can be reasoned that this might have caused the lack of significant difference in active recreation when it comes to the how the elderly perceived greenery's contribution to that type of recreation.

The higher variation of the respondent's answers during winter compared to summer (Figure 3) implies that people were not as unanimous about the contribution of greenery to recreational values in winter as they were in summer. It can be argued that most people perceive greenery as beautiful during summer, whilst people have more spread opinions of its appearance during

winter, i.e., some think it is beautiful whilst some think it is ugly. It can also be reasoned that the restrictions of outdoor activities that a winter climate is associated with (Duan & Li, 2022), might cause a decrease in how one reflects on one's surroundings, thus not being as certain how to take a stand on the statements in the questionnaire in terms of winter.

In general, the BGI elements contributed relatively much to recreational values during winter, and the range between the elements with lowest and highest perceived contribution was fairly large. The BGI elements were perceived to contribute most to aesthetics, followed by active and passive recreation (Table 2). It can be reasoned that how the elements were perceived is associated with different qualities. The main finding is how elements that cover larger areas and include a larger amount of blue and green spaces, such as large park, urban and peri-urban forests and green areas, and small green space, were perceived to contribute greatly to recreational values. This can be confirmed by the mean values within the qualities BGI type, size, numbers of elements, and several layers of greenery (Figures 5, 7, 8 & 9). On the contrary, smaller, single, and scattered elements such as ditch, porous pavement, small/immature single tree, green roof, and small/immature street tree were perceived to contribute to a less extent.

As mentioned, one quality that was seen to have a great impact on recreational values was size, which was particularly clear in terms of active recreation. In a comparison between small and large parks, large park was perceived to contribute greater than small parks (Figure 7). This corresponds to previous findings that have shown that the size of green areas is a characteristic that has a great impact on the promotion of physical activity (Wood et al., 2017). Other qualities that included categories with differences in size also showed that elements of greater size were perceived to contribute more. Great differences were, for instance, seen in the quality BGI type (Figure 5), where green areas got noticeably higher mean values than building GI. The highest perceived contribution was also seen in active recreation, which once again confirms that the size of green areas heavily impacts the contribution to this form of recreation.

The influence of water (Figures 4 & 5) showed that the categories "blue" and "water areas" received noticeably higher perceived contribution to aesthetics in relation to passive and active recreation. This indicates that water elements such as watercourses and ponds are greatly appreciated by the residents in terms of their visual appeal and that integration of water, therefore, can be an approach to focus on if one strives to make the built-up environment more aesthetically appealing. The degree of naturalness (Figure 6) was also seen to influence the perception, where a high degree was considered as favourable to contribute to recreational

values. That the degree of naturalness affects the perception related to preferences of greenery has been seen in previous studies. The results correspond to findings from Knez et al. (2018) that state that high perceived naturalness has a greater value of activity and experience compared to urban green space with low perceived naturalness. The same applies to blue spaces (Völker & Kistemann, 2011). That certain attributes or characteristics of the urban environment influence the perception has been established by many previous studies (Schipperijn et al., 2012; Leslie et al., 2010), which are in line with the results of this study.

How the respondents chose to take a stand on how they perceive the various elements contribution to the various recreational values may well have been influenced by what they themselves associate the various types with. Own interpretations of what constitutes aesthetics, passive and active recreation, can certainly vary between respondents. It can be reasoned that aesthetics is easier to take a stand on since it is something everyone can see and have an opinion about, unlike active recreation, if one does not use greenery and water for physical activities. In this case, it might be harder to determine if the elements contribute to it or not. What is worth discussing are the different recreational values and their influence on each other. Although this study separates them, it can also be discussed that they influence each other. Aesthetics has been valued highest for all elements, but that in turn, may have also affected how they are perceived to contribute to passive and active recreation. The different types of recreation can thus be tied to each other to a certain extent.

6.2 Methods

Through a quantitative approach using a questionnaire, a greater number of responses were collected on how residents of Gothenburg perceive BGI, which favoured analysis to detect patterns and draw generalisations. However, the downside of using a questionnaire with predetermined answer options is that such responses tend to lack details, richness, and personal viewpoints, which can be gained from open-ended questions (Clifford, 2010). If there would have been more time available, a complementary method such as in-depth interviews could have been used. This would allow a collection of nuances and follow-up questions that could have led to a better insight into people's perceptions. However, in this study it was of greater importance to collect a larger number of responses, which could tell more about how people in general perceive BGI in Gothenburg.

In terms of construction of the questionnaire a couple of aspects should be discussed. It was of great importance to consider the content and structure of the questionnaire since it has been proved to affect people's way of responding (Statistics Sweden, 2016). One aspect that should be brought forward is the arrangement in which the BGI elements were presented to the respondents. The arrangement of the 20 different BGI elements could have affected the respondents responses in the sense that they might have compared with how they responded in the previous BGI element presented. One can also argue that there is a risk that the respondents put more time and consideration towards the first elements presented, consequently less time for the last ones. This could have been solved by the use of a randomised arrangement, so that every respondent would have been given different arrangements. The choice of images included in the questionnaire is further one aspect to adress. The images were desired to be as representative as possible of the different BGI elements located in the urban area of Gothenburg. One must though be aware of that there is a variation of how the BGI elements could look like, which consequently makes it problematic to only choose one image. In order to achieve a more representative idea of the BGI elements appearance, several different images could have been provided of the same BGI element. However, due to the great amount of different BGI elements included in this study, it was not possible to include such a variation of each individual BGI element without not letting the questionnaire be too extensive.

Since the respondents answering the questionnaire were based on a non-probabilistic sample contacted through a web panel, a few aspects should be addressed. One can argue that since the panellist could choose between different questionnaires, there is a risk that the people answering this one generally had a greater interest in this topic. This could have biased the result since the sample might be over or under representative of a certain group of people, thus not fully representative of the general population of Gothenburg. People younger than 18 years old were not included in the sample. Their perceptions should also be considered, but since this method did not allow the inclusion of respondents under the age of 18, this was accepted as a disappearance of the sample. Despite the discussed disadvantages, this method was still seen as the most convenient method in terms of time efficiency and collection of desired sample size.

One should also mention that the geographical location where the respondents live might also have influenced the responses. Since the sample included residents living in the municipality of Gothenburg and not solely in the urban environment of Gothenburg, it could have influenced

how people living in more peripheral areas answered. Although it was stated in the introduction text of the questionnaire that this study solely investigates the built-up area, people might have thought about more natural areas when answering the questions. With this in mind, there is a risk that people have originated their answers based on greenery and water seen elsewhere that do not represent elements in an urban context.

6.3 Implications for urban planning

The results showed that BGI contributes to recreational values in winter, although these were lower than in summer, which confirms that a perspective on winter is vital to ensure that the greenery and water implemented in the urban environment are pleasant and appreciated by the residents even during this time of the year. Especially since Gothenburg's geographical location in the northern hemisphere consists of long winters. Since nature-related settings have been proven to contribute greatly to various forms of recreation, it is of great importance to consider which BGI to implement in the urban environment that will provide urban residents with opportunities for recreation that are similar to those provided by natural-settings. To do so, inclusion of the public is vital, which is in line with statements in Green strategy for the development of Gothenburg (Park – och naturförvaltningen, 2014) and in numerous previous studies (Atiqul Haq et al., 2021; Lee et al., 2015; Van Kamp et al., 2003). It can therefore be reasoned that to achieve an understanding of what people prefer in terms of their surrounding environments, subjective perceptions must be considered.

Findings from this study have strengthened that seasonal differences exist in how urban BGI is perceived and varies between groups of people. But above all, it has shown that BGI contributes to recreational values in winter. Furthermore, the study has broadened the knowledge of individual BGI elements contribution to recreational values during winter and what qualities that have the greatest influence on the perceptions. Findings also showed that even the BGI elements with lowest mean values did contribute to recreational values, which means that they still fulfill a function. This study, therefore, contributes to knowledge that can support urban planners to create functional and aesthetical urban environments in terms of selection and prioritisation of optimal BGI elements and enhancement of certain qualities that favour and are appreciated by users. Although findings from this study are connected to the urban environment of Gothenburg, it can be reasoned that the results can be generalised to the urban environment in a wider context, thus, applicable to cities and built-up areas in general.

6.4 Further studies

This thesis has contributed with insights of how urban blue-green infrastructure is perceived and contributes to recreational values during winter. However, there are still several aspects that would be of interest to look further into.

It would be of interest to conduct the same study and switch focus to other seasons to see if and how the perception of the different BGI elements and qualities changes compared to the results presented in this study. It would further be interesting to include other aspects that could influence the perception, such as the diversity of plants, different colours, and their location within the urban environment. Since it was found that the perception differed between men and women, and between age groups in terms of greenery's contribution to recreation, it would also be interesting to look further into differences in terms of the individual BGI elements and qualities. When investigating different qualities, this study only focused on visual perception. This is far from the only sense that affects our perception of surrounding environments. Therefore, for further studies, it would be of interest to include other senses, such as smell and hearing, to see how qualities in terms of these senses affect the perception of urban BGI.

7. Concluding remarks

Residents of Gothenburg generally perceive greenery to contribute to recreational values in winter, however, to a less extent than in summer. Women tend to perceive greenery's contribution to recreational values higher than men, and the value of greenery increases with age, which is in line with previous research. In terms of perception of different BGI elements, large park, urban and peri-urban forests and green areas, small green space and watercourse were seen to contribute the most to recreational values, whilst ditch, porous pavement, small/immature single tree, green roof, and small/immature street tree contributed the least. Of all three recreation types, the BGI elements were perceived to contribute most to aesthetics.

Qualities that had a great influence on a positive perception were when the elements covered larger areas and included several elements or several layers of greenery. This in contrast to fragmented single or smaller types in connection to buildings or grey infrastructure, which were perceived to contribute less to recreational values. This applies to all three types of recreation. However, it was seen that water has a great impact on aesthetics. Findings from this study conclude that BGI contributes to recreational values in winter and depending on what type of recreation one strives to integrate, there are variations to some extent of what qualities that are to be preferred to enhance. Furthermore, these findings can have implications for urban planning in terms of knowledge that can be used for prioritisation and enhancement of BGI elements and qualities that will provide urban residents with opportunities for recreation during winter.

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Appendix 1 - Questionnaire

Perception of greenery and water in the urban environment during winter

Different types of greenery and water areas contribute to several services for the city´s residents. Examples of such services are water and air purification, flood management, cooling during hot and sunny summer days, as well as recreation. The purpose of this study is to investigate how residents perceive different types of greenery and water in the urban environment during winter and which qualities that contribute to a positive perception. Knowledge that will be used to value the ability of greenery and water to be aesthetically appealing (beautiful), promote recreation and social interaction, i.e. be attractive places for the city´s residents to use even during winter.

This survey is in collaboration with the University of Gothenburg, Göteborgsregionen and is financed by FORMAS and VINNOVA.

The survey is anonymous and is estimated to take about 10 minutes to complete. Your answer is important!

Thank you in advance for your participation!

GÖTEBORGS REGIONEN

GÖTEBORGS UNIVERSITET

1. Age: _____

2. Gender:

☐ Woman ☐ Man ☐ Other ☐ Don´t want to state

3. Occupation:

☐ Working ☐ Retired

☐ Student ☐ Currently at home (for example sick leave, parental leave, unemployed)

☐ Other (specify) _____

4. Postal code: _____

Perception of greenery in winter and in summer

The pictures below show examples of how a small park can look during winter and summer, i.e. before and after leaves emergence. As an initial part, please tick how you feel that greenery (in the example images no water is shown) generally contributes to different recreational values during winter and summer respectively.

Winter

Summer

5. *I perceive that greenery in general...*

	is beautiful to look at Not at all 1 2 3 4 5 To a great extent Don't know	contribute to exercise/physical activities such as walks, jogging Not at all 1 2 3 4 5 To a great extent Don't know	contribute to relaxation/socialising. such as having a coffee, relaxing Not at all 1 2 3 4 5 To a great extent Don't know
During winter	☐ ☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐ ☐
During summer	☐ ☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐ ☐

Examples of different types of greenery and water – wintertime

Small/immature single tree

Large/mature single tree

Small/immature street tree

Large/mature street tree

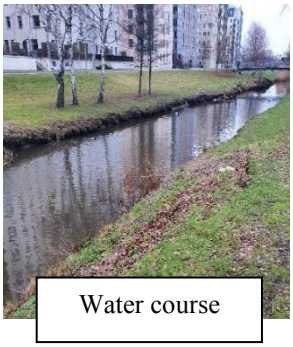
Lawn

Meadow

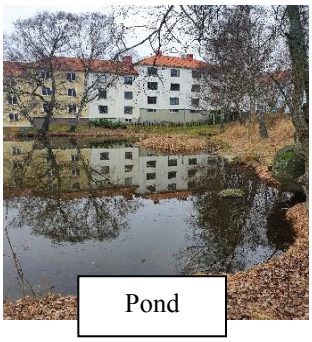
Rain garden

Flower bed/planting

Shrub/hedge



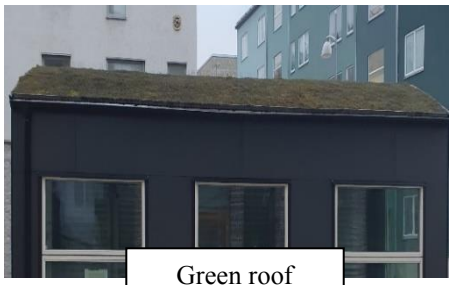
Water course



Pond

Ditch

Green wall



Green roof

Porous pavement

Road verge

Groove of trees

Small green space (small park, public garden, green playground/schoolyard)

Large park

Urban and peri-urban forests and green areas

Please fill in how you perceive that the different types of greenery and water contributes to recreational values during winter.

6. *During **winter**, I perceive that …*

	is beautiful to look at						contributes to exercise/physical activities such as walks, jogging						contributes to relaxation/socialising such as having a coffee, relaxing					
	Not at all				To a great extent		Not at all				To a great extent		Not at all				To a great extent	
	1	2	3	4	5	Don´t know	1	2	3	4	5	Don´t know	1	2	3	4	5	Don´t know
a small/immature single tree...	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
a large/mature single tree…	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
a large/mature street tree…	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
a small/immature street tree…	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
a lawn…	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
a meadow…	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
a raingarden…	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
a flower bed/planting…	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
a shrub/hedge…	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
a water course…	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
a pond…	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
a ditch…	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
a green wall…	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
a green roof…	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
a porous pavement…	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
road verge…	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
a grove of trees…	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
a small green space (small park, public garden, green playground /schoolyard) …	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
a large park…	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
urban and peri-urban forests and green areas …	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Qualities that influence the perception of greenery and water in the urban environment during winter

Greenery and water have different qualities that can affect how we perceive them. It could be the case, for example, that a large variety of different types of greenery and water affects the perception, or that the size and colour of these have an impact on the perception.

7. *I agree that the following qualities of greenery and water generally contributes to a **positive** perception in **winter**?*

Qualities – greenery/water	**Extent**					
	Not at all				To a great extent	
	1	2	3	4	5	Don´t know
Great amount (if it is a great amount greenery and water, cover larger areas)	☐	☐	☐	☐	☐	☐
Size (for example a small or large tree, a small or large pond, small or large lawn)	☐	☐	☐	☐	☐	☐
Variation of blue/green types (mix of greenery and/or water, for example a pond, a tree and shrubs at the same place)	☐	☐	☐	☐	☐	☐
Greenery in layers (greenery in layers, consisting of a groundlayer, plants/herbs, shrubs and a tree layer)	☐	☐	☐	☐	☐	☐
Colour (if the colour has an impact, for example if it has an impact if a planting contains green or brown leaves)	☐	☐	☐	☐	☐	☐
Variation of colours (if it matters if there is a variation of colours to get a positive perception, for example a mix of red/brown/green leaves in a planting)	☐	☐	☐	☐	☐	☐
More natural (high degree of naturalness, wild, natural)	☐	☐	☐	☐	☐	☐
Garden look (maintained, not natural)	☐	☐	☐	☐	☐	☐

Feel free to comment if you have any other views or experiences of how you perceive greenery and water in the urban environment during the winter.

_____
_____
_____
_____
_____
_____
_____
_____

Thank you very much for your participation in this questionnaire!

Appendix 2 - Outputs statistical tests

Paired Samples T -Test (winter and summer)

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	[Under vintern] Jag upplever att grönska generellt är vackert att titta på	3,53	292	1,312	,077
	[Under sommaren] Jag upplever att grönska generellt är vackert att titta på	4,78	292	,596	,035
Pair 2	[Under vintern] Jag upplever att grönska generellt bidrar till motion/fysiska aktiviteter exempelvis promenader, jogging	3,38	289	1,307	,077
	[Under sommaren] Jag upplever att grönska generellt bidrar till motion/fysiska aktiviteter exempelvis promenader, jogging	4,49	289	,886	,052
Pair 3	[Under vintern] Jag upplever att grönska generellt bidrar till avkoppling/socialisering exempelvis fika, socialt umgänge	3,25	289	1,400	,082
	[Under sommaren] Jag upplever att grönska generellt bidrar till avkoppling/socialisering exempelvis fika, socialt umgänge	4,63	289	,799	,047

Paired Samples Test

		Paired Differences					t	df	Significance	
					95% Confidence Interval of the Difference					
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			One-Sided p	Two-Sided p
Pair 1	[Under vintern] Jag upplever att grönska generellt är vackert att titta på - [Under sommaren] Jag upplever att grönska generellt är vackert att titta på	-1,253	1,384	,081	-1,413	-1,094	-15,478	291	<.001	<.001
Pair 2	[Under vintern] Jag upplever att grönska generellt bidrar till motion/fysiska aktiviteter exempelvis promenader, jogging - [Under sommaren] Jag upplever att grönska generellt bidrar till motion/fysiska aktiviteter exempelvis promenader, jogging	-1,114	1,306	,077	-1,265	-,963	-14,503	288	<.001	<.001
Pair 3	[Under vintern] Jag upplever att grönska generellt bidrar till avkoppling/socialisering exempelvis fika, socialt umgänge - [Under sommaren] Jag upplever att grönska generellt bidrar till avkoppling/socialisering exempelvis fika, socialt umgänge	-1,374	1,493	,088	-1,547	-1,201	-15,646	288	<.001	<.001

ANOVA - gender

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
[Under vintern] Jag upplever att grönska generellt är vackert att titta på	Between Groups	1,031	1	1,031	,599	,440
	Within Groups	497,525	289	1,722		
	Total	498,557	290			
[Under sommaren] Jag upplever att grönska generellt är vackert att titta på	Between Groups	1,341	1	1,341	3,834	,051
	Within Groups	102,159	292	,350		
	Total	103,500	293			
[Under vintern] Jag upplever att grönska generellt bidrar till motion/fysiska aktiviteter exempelvis promenader, jogging	Between Groups	1,681	1	1,681	,986	,321
	Within Groups	487,306	286	1,704		
	Total	488,986	287			
[Under sommaren] Jag upplever att grönska generellt bidrar till motion/fysiska aktiviteter exempelvis promenader, jogging	Between Groups	5,639	1	5,639	7,371	,007
	Within Groups	221,089	289	,765		
	Total	226,729	290			
[Under vintern] Jag upplever att grönska generellt bidrar till avkoppling/socialisering exempelvis fika, socialt umgänge	Between Groups	,049	1	,049	,025	,875
	Within Groups	565,951	287	1,972		
	Total	566,000	288			
[Under sommaren] Jag upplever att grönska generellt bidrar till avkoppling/socialisering exempelvis fika, socialt umgänge	Between Groups	5,258	1	5,258	8,505	,004
	Within Groups	178,660	289	,618		
	Total	183,918	290			

ANOVA (Bonferroni) - Age groups

Multiple Comparisons

Bonferroni

Dependent Variable	(I) Age_groups	(J) Age_groups	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
[Under vintern] Jag upplever att grönska generellt är vackert att titta på	Younger	Middle-aged	,013	,197	1,000	-,46	,49
		Older	-,387	,185	,110	-,83	,06
	Middle-aged	Younger	-,013	,197	1,000	-,49	,46
		Older	-,400	,183	,088	-,84	,04
	Older	Younger	,387	,185	,110	-,06	,83
		Middle-aged	,400	,183	,088	-,04	,84
[Under sommaren] Jag upplever att grönska generellt är vackert att titta på	Younger	Middle-aged	-,230*	,087	,025	-,44	-,02
		Older	-,364*	,081	<.001	-,56	-,17
	Middle-aged	Younger	,230*	,087	,025	,02	,44
		Older	-,133	,080	,293	-,33	,06
	Older	Younger	,364*	,081	<.001	,17	,56
		Middle-aged	,133	,080	,293	-,06	,33
[Under vintern] Jag upplever att grönska generellt bidrar till motion/fysiska aktiviteter exempelvis promenader, jogging	Younger	Middle-aged	-,114	,198	1,000	-,59	,36
		Older	-,294	,186	,347	-,74	,15
	Middle-aged	Younger	,114	,198	1,000	-,36	,59
		Older	-,180	,184	,982	-,62	,26
	Older	Younger	,294	,186	,347	-,15	,74
		Middle-aged	,180	,184	,982	-,26	,62
[Under sommaren] Jag upplever att grönska generellt bidrar till motion/fysiska aktiviteter exempelvis promenader, jogging	Younger	Middle-aged	-,187	,133	,486	-,51	,13
		Older	-,239	,125	,171	-,54	,06
	Middle-aged	Younger	,187	,133	,486	-,13	,51
		Older	-,052	,123	1,000	-,35	,25
	Older	Younger	,239	,125	,171	-,06	,54
		Middle-aged	,052	,123	1,000	-,25	,35
[Under vintern] Jag upplever att grönska generellt bidrar till avkoppling/socialisering exempelvis fika, socialt umgänge	Younger	Middle-aged	-,011	,214	1,000	-,53	,50
		Older	-,094	,201	1,000	-,58	,39
	Middle-aged	Younger	,011	,214	1,000	-,50	,53
		Older	-,083	,197	1,000	-,56	,39
	Older	Younger	,094	,201	1,000	-,39	,58
		Middle-aged	,083	,197	1,000	-,39	,56
[Under sommaren] Jag upplever att grönska generellt bidrar till avkoppling/socialisering exempelvis fika, socialt umgänge	Younger	Middle-aged	-,102	,119	1,000	-,39	,18
		Older	-,319*	,111	,013	-,59	-,05
	Middle-aged	Younger	,102	,119	1,000	-,18	,39
		Older	-,217	,110	,149	-,48	,05
	Older	Younger	,319*	,111	,013	,05	,59
		Middle-aged	,217	,110	,149	-,05	,48

*. The mean difference is significant at the 0.05 level.