IS BIODIVERSITY ATTRACTIVE?

On-site perception of recreational and biodiversity values in urban green space

Stefan Lindberg

SLU

Swedish University of Agricultural Sciences
Faculty of Landscape Planning, Horticulture and Agricultural Sciences
Department of Landscape Architecture

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ÄR BIODIVERSITET VACKERT?
Platsbaserad uppfattning av rekreations- och biodiversitetsvärden i urban grönmiljö

Stefan Lindberg

Supervisor: Anders Busse Nielsen, SLU, Department of Landscape Management, Design and Construction
Examiner: Mats Gyllin, SLU, Department of Work Science, Business Economics and Environmental Psychology
Assistant examiner: Christine Haaland, SLU, Department of Landscape Architecture
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SLU, Swedish University of Agricultural Sciences
Faculty of Landscape Planning, Horticulture and Agricultural Sciences
Department of Landscape Architecture

ABSTRACT

Urban and near-urban green spaces tend to be the main venues for human leisure and recreational activities, given their multifunctional potential, restorative effect and proximity to large numbers of people. Urban green spaces also provide significant ecological resources, not only in contrast to the rest of the urban matrix, but also as a unique part of a greater network of ecosystems. Urban areas have been proven to harbor large numbers of plant and animal species and green spaces are their primary habitats. As global biodiversity is declining and urban populations are growing, urban green spaces play an important role in promoting both biodiversity and human recreation, thus raising the question of how to best combine these functions. It is therefore crucial to understand if and how humans perceive and appreciate biodiversity in a recreational context.

Three different types of on-site studies were conducted in an urban park with a wide range of green space typologies. The first study was an inventory and assessment of biodiversity values at the study site, which resulted in a number of zones of varying habitat quality. The other two studies were perception studies, each employing one group of laypersons and one group of landscape/ecology experts. In one of these studies, the participants were asked to photograph features that they liked and disliked along a marked trail. In the other study, the participants instead photographed features of high and low perceived species richness. The photographs and accompanying written motivations were then analyzed based on their spatial distribution and on thematic categories developed from photograph content and motivations. The relationship between the three studies is the primary focus of the thesis.

The results suggest a general ability among both experts and laypersons to perceive differences in habitat quality, although their preferences do not necessarily relate positively to high biodiversity values. Further is indicated a strong influence of individual green space elements and details on both species richness perception and preference. The participants appeared to find the study site especially sensitive to human-related elements, which had a significant impact on preference.

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Stefan Lindberg
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Contact:
stf.lin@gmail.com
+46(0)704907560

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INTRODUCTION

Human leisure and recreation are, when possible, primarily outdoor activities. Urban and near-urban green spaces tend to be the main venues for these activities, given their multifunctional potential and proximity to large numbers of people. In addition, green areas have also proven to have restorative effects on human beings (e.g. Nordh, Hartig et al. 2009, p.226; Grahn and Stigsdotter 2010, p.264), why these spaces deserve attention through protection and promotion.

At the same time, urban areas and urban green spaces in particular can, despite their lack of natural, untouched environments, serve as important habitats for large numbers of plant and animal species (e.g. Cornelis and Hermy 2004; Elmqvist, Colding et al. 2004). Urban green spaces are a significant ecological resource, not only in contrast to the rest of the urban matrix, but indeed as a unique part of a greater network of ecosystems extending well beyond the cities (Farinha-Marques, Lameiras et al. 2011, p.250). As primary habitats for many species, urban green spaces are key components in preserving and promoting urban biodiversity and ecology, which provide many different services.

Urban green spaces are thus arenas which must harbor and increase biodiversity while they simultaneously service human recreational activities as well as everyday life. The importance of both functions is constantly increasing as global biodiversity is declining (Alvey 2006, p.195) and urban populations are growing (UN-HABITAT 2008, p.IX). The pressure on urban green spaces to service both biodiversity and human recreation is consequently greater than ever, which raises the question: To what extent are these functions compatible?

There is a large body of knowledge on landscape preference and perception, but the research rarely considers biodiversity as a factor. In my thesis, I wish to approach a greater understanding of how people perceive and appreciate urban green spaces in relation to biodiversity.

PURPOSE AND OBJECTIVES

Research context

The relationship between biodiversity and recreational values is an important question to be addressed as urban areas tend to grow both bigger and denser. To fully understand how to combine these two interests, more knowledge is needed on how people use and perceive green environments. Konijnendijk (1999, p.145) stresses in particular a lack of knowledge on how people perceive and interact with urban forests. An American study by Montgomery (2002) measured people's attitudes towards different benefits of biodiversity. In the study, recreational and aesthetical benefits were ranked relatively low compared to ecological benefits. Consequently, people would prefer ecological values over recreational in a given setting. It is highly relevant, however, to test whether these benefits are compatible and to determine whether people actually recognize and appreciate ecologically rich environments when exposed to them as part of a recreational green space setting.

Most recreational activities in urban green space seem to be of informal character, such as walking, dog-walking or relaxing (Tzoulas and James 2010, p.121), why it can be assumed that these environments are experienced primarily on foot, as a sequence of views and features along the way. There is a lack of knowledge on what is appreciated and what is not when urban green spaces are experienced in this (typical) way.

In my opinion, many of the classic preference studies, assessing scenic beauty, have had a one-sided focus on scenic compositions, or spatial configurations, as Kaplan and Kaplan might call them. Kaplan and Kaplan (1989, p.40-49) differentiate between our perception of spatial configurations and content-based attributes, claiming that one can dominate the visual impression over the other. Although standardized photographs might provide true enough representations of reality, they do not provide the same range of objects, details and scenic compositions as does a live visit. When experienced live, any environment provides a multitude of impressions, many of which are probable to be induced by individual objects or ephemeral events, visible or not on a standardized photograph. The same is true for scenic views, which can differ strongly depending on a range of factors. The relative importance of such content-based attributes and spatial configurations during on-site visits is under-researched and will be addressed in the present study. For green space design and planning purposes, it would be beneficial to know more about the relative influence of content and spatiality on people's preference and perception of biodiversity values.

Purpose

Both humans and an abundance of species co-exist in urban green spaces. It is therefore crucial to understand if and how humans perceive and appreciate biodiversity. Increasing this knowledge could contribute to improved ways of designing and managing these spaces for the enjoyment of *all* species, human beings included.

Main objective

- To explore the relationship between *preferences*, *actual biodiversity* and *perceived biodiversity values* within urban green space.

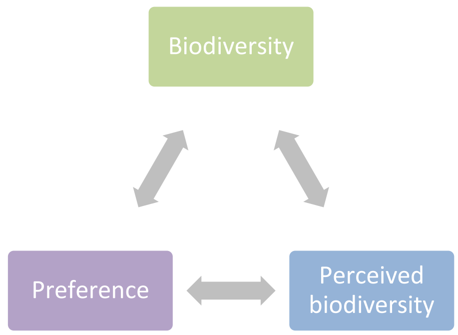


Figure 1: Triangular relationship between the three factors of the present study.

Research questions

- What features in an urban green space trigger people's preference and perception of species richness, and how can these be explained?

- Can conflicts or synergies be found between biodiversity values and perceived recreational values in urban green space environments?

- Does ecological education influence people's preference and ability to assess ecological values in urban green space?

- In the appraisal of preference and perceived species richness, what is the relative importance of spatial configurations and content-based attributes?

The findings of the study should be relevant to anyone involved in urban green space/woodland design, promotion or management, and also to policy-makers for outdoor recreation or urban ecology.

Limitations

Both landscape perception/preference and urban ecology are vast research subjects, although relatively new. Much of the literature and available examples are international or based mainly in the US or Europe. I have therefore chosen to keep an international approach in my references, even though the present survey was conducted in a Swedish context. This choice is motivated both by the lack of relevant literature from Sweden or the Nordic countries and by the international mix of informants used in the survey. Also, many of the principles and conclusions of the two subjects can be expected to be universal, especially in the case of urban ecology.

Since urban green spaces, as opposed to natural areas, are unique in their function, design, ecology, management etc., the focus of the thesis is always on urban conditions. Much of the existing research and literature, however, does not have an exclusively urban focus. When this kind of literature is referenced, caution has been taken not to exaggerate their importance within the urban green space context. I am confident that this is clear where it occurs.

Climatic, environmental, economic and similar benefits of green space and urban ecology will not be addressed as they fall outside the aim of the thesis.

Terminology

A few key expressions should be clarified to avoid misunderstandings or ambiguous interpretations:

- *Anthropic* adj. – "of or relating to human beings" (Thefreedictionary.com)
- *Biodiversity* n. – ""Biological diversity" means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."(UN/UNEP 1993)
- *Motif* n. – "A recurrent thematic element in an artistic or literary work." (Thefreedictionary.com)

Thesis outline

- Chapter 1: The first part of the thesis will be a literature review of present knowledge within green space recreation, urban ecology and landscape perception and preference research. The scope will be general introductions to each subject and specific research connected to the study conducted within the thesis.

- Chapter 2: A thorough description of the survey methods and materials will constitute the second part of the thesis. The survey procedure is briefly described below.

  Three different types of on-site studies were conducted. Two of them were perception studies, each employing one group of laypersons and one group of landscape/ecology experts. In one of the studies, the participants were asked to photograph features that they liked and disliked along a marked trail in an urban park. In the other study, the participants walked the same trail, but instead photographing features of high and low perceived species richness. The photographs and accompanying comments were later digitized and analyzed using categories based on picture content and written motivations. The third type of study was an inventory and assessment of biodiversity values at the study site. The relationship between the three studies is the primary focus of the thesis.

- Chapter 3: Presentation and analysis of the results. First, the individual results from each field survey will be presented, followed by the combined results.

- Chapter 4: The last part will be a discussion of the study results.

Methods

The methods applied in the thesis will be presented at the beginning of their corresponding chapters to increase readability.

CHAPTER 1: LITERATURE REVIEW

This chapter will provide the reader with a knowledge base which will serve as an introduction to the topic of the present survey. Some key concepts within urban green space, urban ecology and landscape perception/preference are presented in relation to the stated objective. The literature review will demonstrate current knowledge and hopefully aid in answering the research questions and approaching the aim of the thesis.

LITERATURE REVIEW METHOD

The choice of literature developed during the process of the thesis, but a general idea of the most relevant authors was conceived after an initial period of broad literature-search within the landscape perception field. Various authors were found through reading the works of others. The main part of the scientific literature was found through database queries using predominantly Scopus Search. Keywords were defined by the topic of each thematic section of the thesis. Books, dissertations, electronic publications etc. were mainly found through reviewing the reference lists of found literature.

Throughout the thesis, I have referenced author, year and page number where I quote or refer to specific sections of a publication. Where I refer only to authors or publications in general, I have excluded page number from the reference.

HUMAN BEINGS IN URBAN GREEN SPACE

Green concepts

The many words and expressions referring to green areas of various character and size can be confusing and contradictory. Therefore a short list of the most commonly used expressions will follow, together with definitions of how they will be used in this particular thesis. Please keep in mind that these expressions are used in different ways by different authors appearing in the thesis. The present definitions are based mainly on Bell, Blom et al. (2005, p.149-153).

A garden – is a private plot of land not accessible to the public. Its main surface is typically covered with vegetation and can be of more or less ornamental character, often containing vegetables, fruits and exotic species and horticultural varieties.

A park – is a publically accessible space of more or less open character set aside for recreational purposes of all sorts. It contains an important portion of trees, often together with grass, shrubs, water and paths or roads. The design of a park can be of many different sizes and characters, ranging from strict ornamental to wild-like, but always aiming at providing recreational and/or aesthetic values for the visitor. Additional values such as ecological ones can also be important purposes of parks.

Urban woodland – is a "forested ecosystem of natural, semi-natural or man-made origin, used for a variety of purposes including recreation, nature protection and, in exceptional circumstances, wood production" (Bell, Blom et al. 2005, p.150). Elements such as water, paths and open spaces are common, although trees are the main feature of the area. Urban means that the woodland is located in or near a major human settlement.

The urban forest – is an expression not used in the present thesis but it appears in some of the literature. It refers to the total vegetation structure found in an urban area, including street trees, parks, private gardens, urban woodlands, spontaneous vegetation on derelict land, etc. Several authors might refer to the above definition of urban woodland when they use the expression *urban forest*, and the difference can be worth keeping in mind when references are compared.

Forest – is a general description of all kinds of forested areas anywhere in the man-made or natural landscape and includes major mono-culture woodlands for wood production, among all other types.

Green space – is perhaps the most ambivalent yet well-used of these expressions, but will in general include the whole range of spatially defined, continuous areas dominated by vegetation. Typically, it will refer to parks, urban woodlands and vegetation-covered remnants of land in the urban fabric. With that said, I believe that the term will appear self-explanatory in each context where the expression *green space* is used.

Nature/Natural area – is an expression which, despite what it seems, is just as man-made as the ones above. Surely there are as many definitions as there are authors, but a general approximation would probably read: Non-urban area that is not, or to a minimum extent, exploited by humans, or that at least has a long continuity of free development or gentle human management. In some contexts, however, nature/natural will probably refer also to some culturally influenced areas of long continuity, such as meadows and planted forests.

A (very) brief history of urban green space

The concept of leisure, at least in the sense of recreation for the general public, has its origin in 19th century industrialization, when the conservation and establishment of green areas became a means to curb the discontent among the growing urban working class due to poor working and living conditions (Konijnendijk 1999, p.11). Of course, green spaces within the cities were not a new phenomenon, but they had in general been parks exclusively for the nobility or the bourgeoisie. As urbanization augmented and cities grew bigger, distances to natural green areas outside the cities increased (Konijnendijk 1999, p.12). At the same time, city growth has sometimes led to the incorporation of green areas previously located outside the city, which in turn has influenced the establishment of parkways and greenbelts in the outskirts of urban areas as a design concept (Bell, Blom et al. 2005, p.156). Modern modes of transportation have shortened the distances to these areas while an increasing urban population intensifies the pressure on available green space within cities.

Direct benefits of urban green space for human beings

This section will focus on the benefits that are directly experienced for a user of urban green spaces. Many other benefits for humans can be derived from urban green space, such as climatic, environmental and economic benefits, but these will not be addressed in the thesis. Instead, the focus will be on urban green space as temporary habitats for human beings and hence on the direct benefits thereof.

Recreational values – how are green spaces used?

The urban environment is generally not adapted to recreational needs specifically. Still, public open space is the foundation for outdoor recreation and leisure activities and these spaces range from simple sidewalks via squares, plazas and public parks to extensive urban or rural green areas. Urban green spaces do however play a unique role in outdoor recreation, considering their close proximity to large numbers of people and also considering the fact that parks and green areas often are the only spaces specifically dedicated to outdoor recreation within the urban perimeter. Adding to this is the unique qualities that urban green spaces provide by offering urban citizens direct contact with species habitats resembling those in natural or rural areas. Urban green spaces are thereby important facilities for contact with flora and fauna but do also satisfy other recreational needs, which we will see shortly.

According to Bell, Blom et al.(2005), there are three aspects that can be included in what they call *the social dimension* of urban green space. The first is *escape*, which refers to people's need to get away from the urban environment in search of relaxation and stress reduction (p.159). Smaller parks or even street trees can probably contribute to such recreational benefits (Nordh, Hartig et al. 2009, p.226), but bigger parks and woodlands have greater potential to create a feeling of physical distance to the urban environment. Also Chiesura (2004) mentions "escape from the city" (p.133) as a common motive for visiting parks. In her study from a park in Amsterdam, about a third of the interviewees stated this as one of their motives for visiting the park. Over half of the respondents stated the similar motive "to be in nature" (p.133) and over 70 per cent stated "to relax" (p.132) as a motive, which was the most frequently stated reason.

The second aspect put forward by Bell, Blom et al. is *social activities*. Urban green spaces provide the settings for a wide range of activities that are not as suitable within the built environment. As examples, the authors mention walking, looking at views, playing sports, having picnics, spending time with family and friends. Shaded squares and street trees can also be of value for outdoor activities and social interaction, especially in warmer countries. (Bell, Blom et al. 2005, p.160)

The last aspect of the social dimension is *safety and security*. The attitude towards spending time in parks and woodlands differ among individuals but also between countries. In the Nordic and Central European countries people may feel more comfortable in forest settings than would, for example, people from the Mediterranean countries. Being attacked or getting lost can be among the worries people might have, along with issues such as accessibility or hurting oneself. At the same time, many people seek out areas of dense or mature vegetation to find solitude or excitement. (Bell, Blom et al. 2005, p.160)

The sense of security can be assumed to relate mainly to the presence or absence of other people. Chiesura (2004) puts forward that urban green space provides both the possibility of being on your own and of socializing, as it is visited for different reasons, such as "to be with children", to contemplate and meditate", "to meet others" and "to get artistic inspiration" (p.133).

Availability and accessibility of green space

Most urban green areas are part of the public space and should therefore be at the service of all citizens. In practice, though, not all green spaces are adapted to the needs of everyone.

Accessibility is an aspect which does not only concern disabled people but also children, elderly persons and people from certain socio-economic or ethnic groups. These are all important users who should be considered in the design of urban green space, along with users with different recreational interests. However, accessibility measures must always be weighed against aesthetic qualities to some extent, so as not to compromise the very purpose of the green space. (Bell, Blom et al. 2005, p.162)

The number of people a specific green area can host is determined by its *carrying capacity*. The *physical* carrying capacity can be limited by soil erosion on paths or damage to vegetation. The size of the green space and the straightness of paths within woodlands are examples of factors influencing the *visual* carrying capacity. (Bell, Blom et al. 2005, p.162)

Different types and sizes of green spaces can be assumed to have different attraction potential and carrying capacity for different kinds of recreation. Distance to various kinds of green space will thus influence the frequency of visits and will hence affect people's recreation possibilities. The UK government agency English Nature recommends a maximum distance of 300 m to the nearest accessible natural green space from each urban resident's home (Barbosa, Tratalos et al. 2007, p.188). As a comparison, also The Swedish National Board of Housing, Building and Planning (Boverket, 2007, p.14) recommends this distance, adding that urban green space should fulfill the following criteria: availability, accessibility, and quality (p.11). Barbosa, Tratalos et al. (2007, p.187-188) writes that 15 min walking distance to the nearest green space is the maximum recommended by the European Environment Agency.

Availability of green space has sometimes been calculated using so called green space factors based on vegetation, openness and permeability of ground surface(e.g. The city of Malmö, Malmö Stadsbyggnadskontor 1999). Critique against employing similar (rather ecologically focused) methods for recreational or social planning purposes is brought forward by Ståhle (2005, p.58), who points at these methods' lack of such variables as usage, use value and micro climate. Ståhle instead proposes a different measure to calculate green space accessibility which "considers range (1000 m), orientation (axial line distance), green space size (sqm) and number of use values" (Ståhle 2010, p.47). He claims that this method relates considerably better to people's actual use and need of urban green space (see also Ståhle 2005). Bell, Blom et al. argue that the *climate* strongly influences how green spaces are utilized and designed. However, the effect of strong, cold winds in some countries can be reduced through well-placed vegetation, while warmer climatic regions might benefit from summer breezes. The search for sun or for shade in summer time is also heavily affected by the local climate, and puts demands on the design of urban greenery. (Bell, Blom et al. 2005, p.163)

Investigating accessibility of forested areas, Hörnsten (2000) reports that an overwhelming majority (85%) of Swedish respondents preferred a distance of 1 km or less to the nearest recreational forest, while 40% stated that they lived too far from such a forest. For recreational forests, Hörnsten also finds distance to become a strong barrier when it exceeds 2 km. She partly explains this by the Swedes' unwillingness to drive a car when going on forest visits. As complementary data (although old), an equal part (47%) of trips to Swedish forests was made by car and on foot/bicycle according to a 1974 survey (cited in Finnish Forest Research Institute 1995, p.258).

The general conclusion that can be drawn from these data is that urban and near-urban green spaces are highly important recreational amenities for the ever-growing urban population.

Health benefits

The city has been considered a center of disease and depression during different eras – from the medieval cities with its muddy streets and epidemic outbreaks, via the overcrowded dwellings of industrialism's London, to modern marginalized slums and anonymous and stressed business districts. Nature or natural elements have often been considered the counterpart, or even remedy, at least ever since Ebenezer Howard's Garden City became an ideal. Perhaps more than ever, green space in urban environments is considered crucial for public health and well-being.

Various studies have shown a positive relationship between the amount of green space available and *self-perceived* health (e.g. Maas, Verheij et al. 2006; Mitchell and Popham 2007). Others have shown correlations between green space availability and reduced mortality from, among others, cardiovascular disease (Richardson and Mitchell 2010), while Hartig, Evans et al. (2003) reported quicker decline in blood pressure for subjects resting with a view of trees after being exposed to psychophysiological stress.

It is a difficult task, however, to establish the actual effect of green space on people's physical and mental health. *Presence* of green space might be associated with, for example, affluence of the residential area or the level of urbanity – factors which in themselves may influence people's health. In similar fashion, the *amount* of green space does not necessarily relate to the level of usage, which can differ significantly between, for example, men and women (Hutchison 1994; Cohen, McKenzie et al. 2007). Nor does green space quantity reflect the recreational *quality* of such spaces, a much more complex factor to consider. Also, if positive health effects are measured, it must be determined whether they appear because of the *activities* performed while in green space or because of the exposure to greenery itself, as claimed by some authors (e.g. Ulrich, Simons et al. 1991). Compensation and control of such factors can, of course, only be done to some degree in any given study.

The complexity of this type of investigation is addressed by Lee and Maheswaran (2011) in a review of research papers investigating the urban green space-health relationship. The authors did find a general consensus on the positive health benefits of urban green space among the papers. The same conclusion is drawn by Grahn and Stigsdotter in their review (2010, p.266). Nevertheless, the review by Lee and Maheswaran also demonstrated weak evidence bases among the studies due to poor study design, failure to exclude confounding, bias etc.

Regarding the specific effect of *biodiversity* on human health, Dean, van Dooren et al. (2011) found in their review only one study (namely, Fuller, Irvine et al. 2007) investigating a direct relationship between biodiversity *per se* and mental health. Although Fuller, Irvine et al. reported a positive such correlation, a larger evidence base is clearly needed to draw any universal conclusions.

Aesthetic, cultural and spiritual benefits

Urban green spaces are not only places for leisure and restoration, but they also serve as cultural expressions, historic footprints and reminders of nature.

The aesthetic experience of green areas can differ from the rest of the urban environment, heightening people's sensory impressions. As a contrast to the calculated and fashion-influenced built environment, the natural forms of vegetation, its seasonal changes and the cycle of life and death can enhance the experience of all urban environments. (Bell, Blom et al. 2005, p.161) It is not only the mere visual appreciation of green areas that motivate people to go there, but also deeper emotional experiences. Chiesura's study from Amsterdam showed, for example, that among the asked park visitors, "unity with nature" was a frequent response to the question: "Which feeling does nature evoke you?"(Chiesura 2004, p.134). Also "Unity with myself"(Chiesura 2004, p.134) was a common spiritual motivation in the study, indicating that green areas can have profound impacts on people's emotional life. The presence of animals is another factor contributing to the unique aesthetics of urban green space. According to Bjerke, Østdahl et al., "observing wildlife is one often-mentioned motive for recreational activities in urban natural areas"(2006, p.38).

Bell, Blom et al. also promote urban vegetation and green space as a link between the built city and nature – a sort of stepping-stone. Whether represented through a single tree or through a naturalistic urban woodland, nature can remind us of its presence in the city. (Bell, Blom et al. 2005, p.162)

Just like architecture, green space design becomes part of our cultural heritage. City parks and other green areas display design ideals of different eras, for example the "naturalistic" tendencies of the last few decades (Özgüner and Kendle 2006, p.140). The range of design traditions is an important part of the diversity and qualities of urban areas, although green space design should be executed with some caution. Planted areas and elements take long time to mature and are therefore sensitive to overly contemporary design styles (Bell, Blom et al. 2005, p.161). A park or woodland must and should reflect current norms to some extent, adding to the diverse urban mesh. The gradient from formal to natural on the design scale also plays a role in the visitors' experience, providing them with a sense of human presence, wilderness, peace etc. (p.161)

Figure 2: Urban green spaces can function as important venues for cultural events.

FLORA AND FAUNA IN URBAN GREEN SPACE

Ecology and biodiversity of urban areas

Urban ecology

Ecology is a vast subject describing highly complex systems interacting in countless ways. *Urban ecology* is not detached from the laws of general ecology, but it does describe a system highly affected by both human agents and natural processes (Alberti 2009, p.93). It will not be possible to explore the whole range of these vast fields within the scope of the thesis. Here will be, however, presented an overview of the most relevant aspects of urban ecology and biodiversity in order to approach a better understanding of their importance and unique characteristics.

Biodiversity, or biological diversity, as defined in the introduction, refers to variability within species, between species and of ecosystems. In an urban context this is just as true as elsewhere, but the urban ecology is a special one with unique and important characteristics which need to be understood to fully comprehend the benefits of urban biodiversity. It is the appearance and function of urban areas that create this unique ecology. Farinha-Marques, Lameiras et al. (2011, p.248) point out the following characteristics:

- Urban areas have distinctive physical attributes and ecological conditions
- Habitats are separated into heterogeneous, small-scale mosaics
- Local and introduced species are combined, which creates unique habitats
- Urban areas contain habitat types and biological communities that differ from others elsewhere

Alberti (2009), in turn, highlights the differences between urban and natural ecology through their "climate, soil, hydrology, species composition, population dynamics and flows of energy and matter" (p.1). Specifically, the city is highly dependent on *outside* sources of energy and materials, but also on an ability to absorb emissions and waste (p.62). Moreover, "humans create distinctive ecological patterns, processes, disturbances, and subtle effects" (p.1).

Scale

When considering urban biodiversity, two levels of organization should be included (Farinha-Marques, Lameiras et al. 2011, p.250):

- The landscape level: This level can be regarded as a gradient between local and regional scale. It includes the range from neighborhoods via the city/town itself and its suburbs to the urbanized surrounding areas.
- The habitat level: This comprises the meso to micro scale from neighborhood and land-use type to individual urban habitats of several square meters.

Following landscape ecology terminology, the habitat level could be considered as patches within the matrix of the landscape level (which in turn contains even bigger patches), although the relationship between matrix and patches can be regarded in various ways. A positive relationship between patch size and biodiversity has been reported by, among others, Cornelis and Hermy (2004), who suggest surface area to be the main indicator of biodiversity levels in urban and suburban parks. Other factors are also important for the preservation and promotion of urban biodiversity. For example, well-distributed urban green spaces and green elements such as street trees may increase habitat connectivity, which affects the "movement of resources and organisms among natural patches" (Alberti 2009, p.83).

To illustrate the urban matrix in another way, it may also be described as a weave of *grey structures*, which are the built and impermeable surfaces; *green structures*, which comprise all thinkable vegetation, both horizontal and vertical; *blue structures*, represented by both natural and artificial water surfaces; and *brown fields*, which are abandoned or derelict land (Farinha-Marques, Lameiras et al. 2011, p.251).

Importance of urban biodiversity

High biodiversity does not in itself guarantee or equal ecosystem health, but it is indeed a critical factor in the ecosystem functions. Biodiversity highly influences a number of important indicators for the health of an ecosystem: *resilience* (the capacity to absorb stressors), *organization* (the diversity and number of interactions between different parts of the system) and *vigor* (the activity and productivity of an area) (Dean, van Dooren et al. 2011, p.878).

The study of urban biodiversity has been widely adopted relatively recently and available research is therefore limited. There are increasing data, however, indicating that urban and suburban areas can possess relatively high levels of biodiversity (Alvey 2006, p.196). Possible reasons for such levels of biodiversity within some cities are connected to previous local and natural conditions: Cities often contain remnants of natural habitats, such as rivers or forests, as well as habitats under cultural influence such as meadows and arable land; also, cities were often established on the border between ecosystems, for example at estuaries or on hills, which typically are places with elevated biodiversity (Kühn, Brandl et al. 2004 in; Farinha-Marques, Lameiras et al. 2011, p.248). A study from Flanders, Belgium, shows that a city's parks can jointly contain up to 30-60% of wild species present in the region (Cornelis and Hermy 2004, p.391). In several instances, urbanized areas can even possess higher species richness than the natural areas they have replaced, especially when it comes to plants (McKinney 2008, p.167). A consensus exists, though, that the urban core generally harbors far less species, especially natives, than do rural areas (Alvey 2006, p.197) due to habitat fragmentation and the harsh living conditions for many species. This fact may be all the more reason to acknowledge and promote the flora and fauna in fact present in the urban environment, considering the many benefits they provide.

As part of an ecosystem, urban green spaces and vegetation can contribute to several different services positive for human life and well-being. Dean, van Dooren et al. (2011, p.878) organize these benefits into *provisioning services* (locally produced food and fresh water, etc.), *regulating services* (improving urban hydrology, air quality, temperature regulation, etc.) and *culturally enriching services* (recreation, education, aesthetic values, cultural heritage, etc.). It is not only humans that benefit from the preservation of other species, though. Dearborn and Kark (2010) motivate the importance of urban biodiversity conservation using seven key arguments ranging from ecologic to anthropic benefits:

- *Preserve local biodiversity in an urbanizing environment and protect important populations or rare species;*
- *create stepping stones or corridors for natural populations;*
- *understand and facilitate responses to environmental changes;*
- *connect people with nature and provide environmental education;*
- *provide ecosystem services;*
- *fulfill ethical responsibilities* and;
- *improve human well-being* (p.434).

On a global scale, great numbers of both habitats and species are disappearing and the loss of half of the world's current species is anticipated (Sax and Gaines 2003, p.561). The two major reasons for species extinction are *elimination/fragmentation of habitats* for endemic species; and *introduction of exotic species*, which lead to the decline or disappearance of native species (Sax and Gaines 2003, p.561). This projection obviously puts emphasis on preserving existing natural and man-made habitats world-wide that contain important species populations. As shown above, urban environments *can* possess such habitats and these are often located to urban green spaces.

Urban green space as habitat

Habitat qualities of urban green space

The survey conducted within this thesis is located to an urban park mainly for two reasons: Urban green spaces are the primary facilities for outdoor recreation and; urban green spaces are the primary species habitats within the urban environment. Since the objective of the present study is to compare aesthetic and recreational values with biodiversity values within the same environment, an urban green space results to be the ideal setting for such a survey. Some aspects and qualities of urban green space as habitat will therefore be presented next.

The existence or diversity of plant and animal species has been investigated on many occasions and locations. It is not common practice, though, that *all* species present at a site are counted and reported. Instead, different indicator species or taxa are monitored to approximate the occurrence of other species. Among plants, vascular plants are often used since they make up the bulk of the vegetation structure and are hence the primary source of food and shelter for animals (Farinha-Marques, Lameiras et al. 2011, p.257). Sensitive plant types, such as lichens, can instead be used when the effect of pollution or climate change is measured (e.g. Käffer, Martins et al. 2011). Within fauna, birds are most commonly used, followed by arthropods (butterflies, bees, beetles, spiders, etc.), because of their sensitivity to habitat change, their taxonomic diversity and the relative ease of inventory (Farinha-Marques, Lameiras et al. 2011, p.257). Mammals, reptiles and amphibians are not so commonly used due to the difficulty of sampling (p.257).

A Czech study (Konvicka and Kadlec 2011) on the presence of butterflies and moths in urban green space found the city periphery to contain a significantly higher number of species compared with the more central green spaces. The authors believe that increasing the area of grasslands with less intensive mowing schemes in urban green space could benefit several butterfly and moth species in the city core. The importance of habitats in early successional stage is supported by the results of a Swedish study in Malmö (Öckinger, Dannestam et al. 2009) where ruderal sites within the urban area were found to contain almost as many species, including one red-listed species, as semi-natural grasslands in the rural surroundings (p.36).

A similar conclusion is drawn regarding bees in a Chicago study (Tonietto, Fant et al. 2011) where green roofs were compared with natural parks and prairies. Bee richness increased when a natural green area was present within 500 m, but the opposite was true when the green area was mainly turf grass. The study also found green roofs to harbor increasingly more bee species when the number of native, blooming plant species increased. Urban green roofs may provide important habitats for pollinators as natural habitats are replaced or disturbed by human activity, according to the authors (p.107).

In a study from London (Chamberlain, Gough et al. 2007), bird species richness was found to increase with the size of urban green space. Also, adjacent private gardens increased species richness for small green spaces (<1 ha), as these form part of a larger habitat (p.93). The presence of rough grass, including weed and nettle beds, also correlated significantly to higher bird species diversity. Rough grass is assumed to function as food source, providing seeds and invertebrate prey for many birds, rather than as nesting resource (p.93). Water bodies were shown to increase the number of water dwelling bird species, but showed no effect on terrestrial species. An Iranian study (Hemami and Zaeri Amirani 2011) also showed bird species richness to increase with the size of urban parks. Additionally, high disturbance (i.e. large number of park visitors) negatively influenced bird species richness. An Indian study conducted in Delhi (Khera, Mehta et al. 2009) suggested green space size and structural diversity to be beneficial for bird diversity, which increased with, in particular, shrub diversity and density.

The activity of bats along a gradient of natural to urbanized areas was measured in Quebec, Canada (Fabianek, Gagnon et al. 2011). In general, more bat species were active in less urbanized areas, although this was species-dependent. However, spatial habitat factors (such as percentage of forest cover, lawns, open water, buildings, etc.) at local scale (100-500 m radius) had the strongest influence on bat species activity in the study (p.15). The authors stress the importance of preserving natural habitats within urban areas for bat species diversity.

A study conducted in several Central European cities (Lososová, Horsák et al. 2011) demonstrated that urban habitat type had stronger effect on the composition of non-planted vascular plant species than did climatic factors, such as temperature and precipitation. A comparison between domestic gardens in a number of UK cities also found geographical and climatic factors to be of little influence on plant species richness, while management and economic status proved to be more important (Loram, Thompson et al. 2008). Also, Lososová, Horsák et al. showed residential areas and urban peripheries to have higher species richness than city squares and boulevards. The authors conclude that urban habitat complexity is important for plant species diversity. In comparison, a Beijing study (Li, Ouyang et al. 2006) found urban park age and design to be more significant than park area size regarding plant species composition. For herbaceous species, however, park size was more important.

Urban influence

According to Cornelis and Hermy (2004), it is the diversity of habitats (i.e. vegetation regimes) which can be found in many parks that is the main reason for the high species richness often recorded there. Another contributing reason is the wide range of cultivated and exotic species, which are typically included in the inventories (p.398).

Since urban areas are often under transition or expanding, biodiversity is often measured along an urban-rural gradient, in order to demonstrate the effects of different land uses on species presence (Farinha-Marques, Lameiras et al. 2011, p.256). This method has shown the effect of urbanization to depend on the studied species or taxa, as seen above in the Canadian study on bats. For example, birds and plants seem to benefit from the habitat complexity of suburban areas and intermediate urbanization levels, while highly urbanized environments have a negative effect on vertebrate and plant species richness (p.256). Another example is given by Palomino and Carrascal, who found in their Spanish study (2007) the presence of raptors (birds of prey) to be negatively affected by urban development in general, although some species were benefitted.

Other studies have found socio-economic status of urban neighborhoods to be a strong predictor of species richness of, for example, birds and plants (e.g. Kinzig, Warren et al. 2005). Although the dependability must be tested in different cities and cultures, socio-economic status could provide an indicator which includes several complex factors, such as green space area, number and diversity of planted species, management level, etc.

Exotic species

According to a comprehensive collection of data on alien plants in Europe (Lambdon, Pysek et al. 2008), 6 new plant species with the capability to naturalize arrive to Europe each year. A majority of naturalized plant species in Europe was intentionally introduced and most of these have escaped from ornamental or horticultural cultivation. A clear majority of unintentional, naturalized introductions stems from contamination of seed batches, transports of minerals (e.g. soil or rock) or other commodities. Industrial habitats, parks, gardens and arable land are the environments where most naturalized aliens occur. However, grasslands and woodlands are also highly susceptible to plant invasion.

As we can see, urban and suburban environments are the primary habitats for alien plant species, both cultivated and naturalized (wild) ones. In a review of studies of biodiversity in private gardens (Goddard, Dougill et al. 2010), exotic plant species appear to provide adequate habitats for some animal taxa, such as various invertebrates, while pollinating insects and birds tend to prefer native species (p.92). Considering, for example, the previously mentioned UK study (Loram, Thompson et al. 2008), which found 70% of domestic garden plant species to be of alien origin, habitat quality of exotic species becomes a highly relevant issue. Also in many other highly suburbanized cities, domestic gardens will surely make up an important part of the urban habitats.

LANDSCAPE PERCEPTION AND PREFERENCE

Introduction to landscape perception theory

Landscape perception and preference has been researched increasingly since the 1960s (Zube, Sell et al. 1982, p.12) and has become a large field with various methods and theoretic directions. Zube, Sell et al. (1982) categorize landscape preference research into four approaches depending on the theoretical base of each work: *the psychophysical*, *the cognitive, the experiential,* and *the expert approach*. Lothian (1999) has further organized these approaches into two contrasting paradigms: *the subjectivist* and *the objectivist paradigm*.

Lothian makes a historical review of the philosophy of beauty and aesthetics and traces the objectivist paradigm back to classical philosophers such as Socrates, Plato and Aristotle. Common to all objectivist theory is that beauty is inherent in the object (or landscape) and can thus be assessed and appreciated objectively by the observer. This view was prevalent within philosophy until the appearance of the English philosophers of Locke, Hume and Burke (17^{th} - 18^{th} century) who introduced the notion of beauty as something "of the mind" (Lothian 1999, p.184) rather than of the object. The most influential individual in contributing to the subjectivist paradigm, however, was the German philosopher Kant (18^{th}century). He considered beauty to lie in the eye of the beholder and found that "the aesthetic experience is the mind's representation of the object and, experienced with disinterest, is pure and is wholly subjective" (Lothian 1999, p.186), *disinterest* meaning without desire to have (p.185).

According to Lothian, Kant preceded evolutionary theorists such as Darwin, but also landscape preference theorists such as the Kaplans, Appleton and Ulrich (who will all be addressed further on), in recognizing "the mind's representation of the environment rather than the environment per se" (Lothian 1999, p.193). In these authors' theories, understanding and interpreting threats and opportunities have been abilities essential for human survival.

Subjectivist landscape preference research has indeed been the prevailing paradigm in modern times (Zube, Sell et al. 1982, p.12), and it will also form the basis for the present study. The objectivist research does however have merits which can provide insights in subjectivist research analysis and discussion.

Objectivist (physical) paradigm

According to Lothian, the objectivist paradigm regards landscape quality as "inherent in the physical landscape" (1999, p.177). As mentioned above, this is a position held by aesthetics philosophers for a long time, and these landscape qualities where supposed to affect each and every person equally. Lothian claims, however, that the paradigm is actually not objective at all since it is often based on the assessment performed by one or very few (professional) individuals and that it is non-replicable, among other reasons (1999, p.180). Within modern landscape perception studies this paradigm is represented by what Zube, Sell et al. (1982) refer to as the *expert* approach, which in turn can be divided into the categories *formal aesthetic* and *ecological aesthetic* (Ode 2003, p.13).

Although the objectivist paradigm may be less employed and less suitable for landscape preference research compared to the subjectivist (as expressed by, respectively Zube, Sell et al. 1982; Lothian 1999), I believe there are aspects of it that can be useful in a discussion of the outcome of the present study.

Expert approach

Formal aesthetic

The *formal aesthetic* is based on design theory, aesthetic philosophy and art, employing terms and concepts developed within these on landscape, with the purpose of providing a language describing its aesthetic qualities (Ode 2003, p.15). The formal aesthetic identifies visual landscape characteristics and their interrelationship, as exemplified in Table 1, and this information can be used within e.g. design and planning.

Physical attributes	Form/shape Texture	Line Size	Color
Interrelationship	Diversity/variety Shape Unity/Harmony Continuity	Spirit of place Visual force Strength Rhythm	Scale Harmony Contrast Symmetry

Table 1: Some formal aesthetic concepts (after Ode 2003, p.15).

The formal aesthetic concepts have been used for management and design recommendations by, for example, Lucas (1991) and Bell, Blom et al. (2005), where they are mainly applied to landscapes as experienced from a large distance. It is possible that the method has greater applicability in those situations, compared to when the landscape is experienced from within, so to speak. It is clear, however, that the approach requires specific knowledge from the observer, which is seldom found among the general public. This is a problem which manifests itself through low reliability in comparative tests (Daniel 2001, in Ode 2003, p.15). It has been argued, though, that coherence among observers could be obtained through training (Bell 1998, in Ode 2003, p.16). Simplified, the formal aesthetic approach to landscape can be regarded as not necessarily aiming for consensus in landscape preference, but rather as aiming for a landscape that "looks right" on an intuitive level.

To visualize this approach, we can easily agree that the physical elements around us can be divided into four basic types of units: *volume*, *plane*, *line* and *point*. Any object or scene can be described using combinations of these units. According to Lucas (1991, p.8), these basic elements appear in different manners depending on variables such as *number, position, direction, size, shape, texture, color, visual force,* etc. *Shape* is considered to be the strongest variable of all, dominating the visual impression of any composition (p.8). Geometric shapes are instantly recognized by the human mind, especially when they appear in natural settings, compared to organic shapes. Another important variable in landscape design, according to Lucas, is *visual force*, which is the "illusion of energy or movement" (p.13) which can be experienced when regarding a static image. The phenomenon can appear due to individual shapes (e.g. the arrow), the interaction between shapes (e.g. plough lines responding to a slope), etc., and is considered to affect the attention or eye-movement of the observer (p.15).

The basic elements and their variables do not appear individually, but are also organized on different levels. Structural organization can be experienced as *scale, rhythm, balance* and *tension*, while elements can be grouped based on *nearness* or *similarity* (Lucas 1991, p.7). *Scale* is particularly important for our perception and does of course vary depending on distance (p.19). Other organizational concepts are *diversity* and *unity* (p.7), which are strongly connected to *complexity* and *coherence* – concepts frequently used within subjectivist theory (see below). The *Genius loci* (spirit of place) concerns the uniqueness of a landscape and the meaning which can be extracted from it (p.39). Visual elements that detract from the overall atmosphere of a place can easily ruin the unique visual experience of that location.

Some of the visual concepts presented here are not easily defined or explained. But although a layperson would probably not be able to utilize all of these concepts when describing or evaluating a landscape or scene, she/he may very well notice and react to them on a sub-conscious level. This question needs more research but there are examples of visual concepts being tested as predictors for preference (e.g. Tveit 2009).

Ecological aesthetic

The *ecological aesthetic* is an approach which proposes preference to be related to ethical and ecological concern and knowledge (Ode 2003, p.16). The acceptance of, and even the preference for, "messy" natural environments of high ecological value are here assumed to increase with knowledge of ecological function, as mentioned by, for example, Sheppard (2000, p.158) and Tyrväinen, Silvennoinen et al. (2003, p.136). Some studies have been made testing differences in preference based on value orientation regarding ecology (e.g. Kaltenborn and Bjerke 2002), while others have interviewed landscape professionals vs. laypersons (e.g. Dandy and Van Der Wal 2011). We also know that additional information regarding ecological aspects of forest scenes affects the ratings of these (e.g. Ribe 1989; Gundersen and Frivold 2011). For the study in this thesis the question whether knowledge in ecology and biodiversity affects preference is highly relevant, although the question will possibly remain whether biodiversity is at all recognized or not. The present study might shed some light on this. Montgomery comments on the same issue:

> "Because people may not understand the role that any particular species plays in an ecosystem, they may be unable to express the importance to them of the less apparent ecological benefits of wildlife in the context of a list of named species. Instead, they may only be capable of revealing preferences for those benefits that they do understand – benefits that are immediately apparent, such as aesthetic uniqueness or commercial value." (Montgomery 2002, p.323)

Although Montgomery refers to a written questionnaire on species benefits, rather than to preference, it may very well also apply to visual experience of species. The ecological aesthetic theory assumes people to accept landscape change and to recognize healthy ecosystems if the right knowledge is apprehended among the public (Sheppard 2000, p.158). Certain authors believe however, that we need to change the very way we interact with, and affect, the landscape, rather than just inform the public of ecological principles. Some of these opinions are presented below.

Care and stewardship

"Perception of human intention may be the difference between a nature preserve and a dumping ground", Nassauer writes (2002, p.199), saying that people's understanding of nature as positive often depends on visible signs of intended preservation, as opposed to land being ignored. The crucial problem, according to Nassauer, is that ecologically important environments do not necessarily look aesthetically pleasing to (modern) human beings, who tend to find such sites "messy" (p.196). Conversely, attractive environments are not necessarily ecologically beneficial. The reason, Nassauer claims, is that the concept of nature is culturally colored to such a degree, that picturesque conventions "are mistaken for ecological quality" (p.197). People's picturesque notion of nature is a landscape that looks *tended*, rather than *wild*, e.g. cleared of deadwood, inaccessible marshes and brushy understory vegetation (p.200).

The appearance of landscapes tends to be seen as reflections of the landowner's or the manager's personal traits, provoking approval or dissatisfaction among visitors, neighbors, citizens or whomever regards or judges the landscape (pp.198, 203). If nature in some sense belongs to us all, then we expect it to display the same level of care as our own front yards do – Nassauer seems to say – fitting nature to "cultural expectations" (p.200). However, such a care will probably be at the cost of ecological health. In order to create and preserve ecological function and human aesthetic affection simultaneously, landscape ecology and design is thus a matter of framing true ecological function with culturally accepted expressions of nature (p.197). The trick to achieve this balance, according to Nassauer, is by providing "cues to care" (p.203), which are details or practices that indicate human presence and management, but that do not interfere with or reduce the ecological quality. Cues to care might differ between cultural contexts, but examples are paths of mowed grass (as opposed to entirely mowed lawns), excessive flowering within more modest restorations, linear planting designs or pruned shrubs (pp.203, 204). As landscapes are naturally changing, landscape designs or preservations do not need to be static, but, as Nassauer says, they are "expected to exhibit the signs that well-intentioned people are watching over that change" (1997, p.74).

A similar theory of *visible stewardship* has been developed by Sheppard (2000), who builds on the work of Nassauer and Gobster, among others. Sheppard argues for a locally anchored forestry, which, if integrated properly with the local community, would be at the same time ecologically, aesthetically and economically feasible. He identifies the public's distrust of the logging industry, which often is seen as "taking without giving" (p.161). According to Sheppard, we find it difficult to compare forestry with other harvesting industries, such as traditional farming, since loggers are not connected to, and dependent on, the land they harvest in the same way as farmers are (or rather, our romanticized image of them). Also, the rotation of planting and harvest is in the span of a life-time, compared to the seasonal variations of a crop field, which makes it hard for people to perceive the clear-cuts as anything but permanent damages to natural environments (p.160).

Sheppard motivates this visible stewardship as: "other things being equal, we find aesthetic those things that clearly show people's care for and attachment to a particular landscape; in other words, that we like man-modified landscapes that clearly demonstrate respect for nature in a certain place and context" (p.159). To achieve this, forest companies and their activities should be more visible, engaging ecologists and landscape architects to be an active part of the community and to participate in public discussions, also considering subjective opinions (p.167).

Forestry representatives should be locally connected, devoted to individual landscape units, and the community needs to see the short- and long-term benefits of the industry (p.167). Management, Sheppard says, must show continuity, rather than discontinuity, and show a "clear fit with nature and culture" (p.168).

Figure 3: Some authors stress the importance of visible human care for landscapes.

Subjectivist (psychological) paradigm

Lothian describes this paradigm as regarding landscape quality as "a product of the mind – eye of the beholder" (1999, p.177) and it contains *the psychophysical*, *the cognitive* and *the experiential* approach. The common precondition for these is that preference is ultimately a personal and individual experience which can be altered by different factors.

Experiential/Phenomenological approach

This approach appears to be the least used within preference research and theory and relevant literature has therefore proven itself scarce. Zube (1982) summarizes it as considering "landscape values to be based on the experience of the human-landscape interaction, whereby both are shaping and being shaped in the interactive process." (p.8). According to Ode (2003, pp.13-14), the experiential approach has a weaker link to the visual qualities of the landscape, compared to the psychophysical and cognitive approaches, why it may not be as widely applicable.

As the observer is also an active participant, this approach focuses on the realm of everyday experience, such as familiarity, social space and landscape style (Zube, Sell et al. 1982, p.9). As an example of this interaction between human beings and landscapes, one might consider the experience of aesthetic landscapes in the light of the aesthetic creations they inspire (Zube, Sell et al. 1982, p.20) – a landscape as beautiful because it makes us create beautiful things (e.g. art, poetry).

Psychophysical approach

This approach focuses on measuring people's affection for landscape scenes or components, which can be expressed by interviewees as ratings. The method assumes landscape properties to act as stimuli on humans, provoking responses in form of evaluation or behavior (Zube, Sell et al. 1982, p.8). Research within this field is generally based on visual input, why photography elicitation is widely used, for example through the scenic beauty estimation (SBE) method, as mentioned earlier.

The psychophysical approach is empirical and focuses on finding out which landscape features people actually claim to prefer or not. It does not necessarily seek to explain the results with theories of, say, spatial arrangement (Ode 2003, p.14). It does, however, often consider differences in participant attributes, such as age, sex, education level, profession etc. in order to predict and compensate for inter-group biases. Preference studies in the Nordic countries have mainly been conducted using this approach (e.g. Hultman 1983; Tyrväinen, Silvennoinen et al. 2003; Gundersen and Frivold 2011) and have for example contributed to management recommendations for recreational forests (Hörnsten 2000, p.12).

Cognitive/Psychological approach

The interest within the cognitive approach is not people's preference *per se*, but rather the underlying meanings for humans in landscapes and landscape properties (Zube, Sell et al. 1982, p.8). This meaning is shaped by past experience, future expectation and sociocultural conditioning. Interpreting the information we collect from our surrounding correctly has according to this theory been a precondition for survival (Ode 2003, p.14).

The preference matrix

Just like the psychophysical approach, the cognitive is strongly based on visual impressions and the empirical methodology is essentially similar to that of the former approach. According to the procedure proposed in *The Experience of Nature* (Kaplan and Kaplan 1989), however, the subsequent analysis of the results is different since it does not just consider the scenes as such, but organizes the scenes into categories based on the content and spatial layout of the scenes. Common preferences for different categories can thus be identified. For example, settings with visible human influence seem to affect ratings negatively compared to natural settings (Kaplan and Kaplan 1989, p.43) and half-open or savanna-like configurations are generally preferred to very open or dense scenes (Kaplan and Kaplan 1989, p.48), as we will see later on.

The cognitive approach theory does not end there, however. Very influential in the explaining of preference has been the *preference matrix* introduced by the Kaplans (Kaplan and Kaplan 1989). They did not find content and spatial layout to sufficiently explain differences in preference between scenes, since these factors are appreciated differently depending on the context (Kaplan and Kaplan 1989, p.50). Also, the Kaplans found other similarities within preferred and un-preferred scenes explained by neither content nor spatial configuration.

		Informational needs	
		Understanding	Exploration
Availability of information	Immediate	Coherence	Complexity
	Inferred, predicted	Legibility	Mystery

Table 2: The Preference Matrix (after Kaplan and Kaplan 1989, p.53)

The basis for the preference matrix, then, is *environmental information* – what we need to know and how easily we extract that information. The matrix divides the informational needs into *understanding* and *exploration*. The frustration of not understanding is easily recognized by any of us, regardless of the immediate importance of the information (Kaplan and Kaplan 1989, p.51). Additionally, the ability to understand and make sense of the surrounding environment is affected by previous experience (p.51) and hence is individual. The need to explore, in turn, drives us to gather more information and knowledge from the surrounding and thus increases our capacity to understand unknown environments and to extract deeper meanings from familiar situations (p.51-52).

The extraction of information (the availability) is divided into *immediately* available information and *inferred* (predicted) information. Immediate availability can be visualized as the information which can be extracted from a scene when regarded through a window. This information is instantly available and rapidly processed (Kaplan and Kaplan 1989, p.52). We do have the ability, however, to imagine ourselves on the other side of the glass, entering the scene, discovering partly obscured features, depth and distances between objects. This ability requires a higher level of interpretation or processing, a greater *inference* (p.52).

When combining each of the categories of informational needs and information availability with the other, four different concepts emerge:

Complexity, defined as "the number of different visual elements in a scene; how intricate the scene is; its richness" (p.53). High complexity means more things to recognize and consider.

Coherence "helps in providing a sense of order and in directing attention. A coherent scene is orderly; it hangs together" (p.54). Coherence depends upon features which organize the scene into units, e.g. repetition or uniformity.

The *legibility* of a place affects our ability to understand and to remember it and a legible space is "well-structured … with distinctive elements" (p.55), which will help orientation. Landmarks and other identifiable elements will increase comprehension of and movement through a specific setting (p.55).

Mystery provides "an opportunity to learn something that is not immediately apparent from the original vantage point" (p.55). Partial obstruction, landform changes and path bends are examples of features that imply further information in a scene (p.56).

The different pieces of the preference matrix can be seen as predictors of landscape preference, or as explanatory devices for analyzing a certain study outcome. Although the matrix may not cover all possible landscape preferences, as the Kaplans point out, the strength of it is that it considers "several factors as well as their combination" (p.58), a system which has a greater explanatory potential than a simple continuum ranging from "unity to diversity" (p.58).

Psycho-evolutionary theories

Emotional response

Ulrich argued (e.g. Ulrich, Simons et al. 1991) that human emotional responses to nature are immediate and subconscious, automatically triggered by contact with natural content (p.207). Several emotions, such as fear, anger, sadness, are claimed to be provoked in this manner (p.207). Aesthetic preference is thus merely one of many subconsciously induced reactions. According to Ulrich, when necessary, these immediate emotional responses call for instant physiological behavior, such as avoidance (in the case of perceived danger) (p.208). These behaviors are performed immediately, without, or with a minimum of, previous cognitive processing. Depending on the setting, the individual's response can range from stress to restoration. Restoration, Ulrich says, can be the result of an environment to which the responses are, for instance, attention accompanied by liking, reduced fear and physiological arousal (p.208). Depending on the stress intensity, such restorative responses should occur in a matter of minutes (p.208). Ulrich's theory states that

> "modern humans might have a biologically prepared readiness to quickly and readily acquire restorative responses with respect to many unthreatening natural settings, but have no such preparedness for most urban or built contents and configurations."
> (Ulrich, Simons et al. 1991, p.208)

In short, natural environments suitable for sustaining human life should have a rapidly noticeable positive effect on human well-being, following a period of stress.

Prospect-refuge theory

Appleton's prospect-refuge theory has been widely influential in landscape design and in studies of landscape perception and preference. Appleton wanted to explain landscape preference using biological and behavioral sciences (Hudson 1992, p.54). According to *habitat theory* (or *habitat selection*), landscape preference is linked to those spatial arrangements, colors, shapes or other visual features that resemble beneficial environments and hence evoke spontaneous aesthetic satisfaction in the observer (Hudson 1992, p.54). More specifically, the prospect-refuge theory refers to the advantageous position of being sheltered or hidden, while having a clear field of vision, beneficial for both humans and animals. In Appleton's own words, "the ability to see without being seen is conducive to the exploitation of environmental conditions favourable to biological survival and is therefore a source of pleasure" (Appleton 1975, p.270 in; Hudson 1992, p.54). According to Hudson, it is not necessarily the act of hunting and hiding from dangerous animals – a well-used argument for Appleton's theory – which has provided us with such an aesthetic inclination, but rather the need for shelter against weather, a safe place for socializing and an overview for planning purposes (p.56).

Savanna hypothesis

The idea of an inherent, human preference for savanna-like landscapes was developed particularly by Orians (1986). According to this *savanna hypothesis*, an innate preference for open fields with big, scattered trees emerged during the early stages of human development. This type of environment provided food, shelter and long views, but it was also the environment where savanna trees - acacia trees - thrived and gained the big, spreading canopies which people still tend to prefer before other tree shapes (Lohr 2007, p.84). Other features, such as vegetation color, are also claimed to be inherently preferred, demonstrating healthy vegetation and landscapes of long survival-potential (p.84).

Figure 4: Landscapes reminding of the African savanna are often considered to be inherently preferred by human beings.

Some findings from perception and preference studies of urban green space

In this section, some specific findings will be presented to work as references in the analysis of the present study. Preference research on specifically *urban* green space is not abundant, while the more is available on forests and natural or cultivated green areas. However, since urban green spaces can be said to resemble excerpts from, or representations of, natural or cultivated environments, many conclusions from general preference research, regarding density, scale, influence of water etc., ought to be applicable also to urban green space. However, parks and gardens often have highly ornamental designs and many man-made elements which make them different from natural environments. The close distance to residents and the unique recreational functions of urban green space also contribute to this differentiation. Some findings can however be summarized and applied to urban green space. Keep in mind, though, that the examples are taken from various different locations and context, and cultural differences might reduce the geographical generality of these findings. Also, many studies on landscape perception and preference investigate differences between societal groups and can be difficult to generalize for whole populations. The findings presented here are loosely organized by two themes: *Influence of green space design and vegetation structure*; and *Influence of previous ecological knowledge on landscape preference.*

Influence of green space design and vegetation structure

Within the built-up, hard-surface urban environment, any existing vegetation elements will have a significant effect on people's outdoor experience. It is apparent, though, that the design style and vegetation structure of urban green space are highly influential on the preference and use of these spaces.

The famous work of Kaplan and Kaplan (1989) shows vast, open areas without distinctive foreground objects to be generally low in preference, which is also the case of visually blocked scenes with dense vegetation (pp.45-47). The highest rated landscapes are those with accessible ground surface and scattered trees, resembling the well-known *savanna* landscape (p.48). In a Norwegian study comparing appropriateness for recreation depending on density, Bjerke, Østdahl et al. (2006, p.40) found a moderately dense park scene to be more preferred than very open or very dense park scenes (although all were considered appropriate for recreation). Also in forest environments, a dense under-story tend to reduce preference (Tyrväinen, Silvennoinen et al. 2003).

The level of density or management can be appreciated differently by different age groups. Youth has been found to enjoy wild, dense and hidden forests to a greater extent than adults and children (Tyrväinen, Silvennoinen et al. 2003, p.146). Also sense of security has been found to be influenced by vegetation density, according to Bjerke, Østdahl et al. (2006, p.36). Although this relationship may depend on context, a dense under-story typically generates decreased perceived safety (p.36). Jorgensen, Hitchmough et al. (2002) found dense understory and natural woodland edges to decrease both preference and sense of safety compared to the less dense alternatives in a photo simulation for park development scenarios. The authors claim, however, that spatial arrangement and vegetation type cannot be considered isolated, as is often the case.

A British study (Özgüner and Kendle 2006), comparing public preference between ornamental and naturalistic parks, found both design regimes to have their own, distinct merits. Feelings of naturalness and freedom were more easily experienced in a naturalistic landscape, which also was claimed to be more suitable for social activities. A formal design, on the other hand, not only had a positive influence on the sense of safety, but it was also experienced as more peaceful and calming, better for stress-relief and renewal (p.154). Another interesting finding of the study was the fact that people seem to view any green space (both formal and naturalistic designs) as "nature" or "natural" when contrasted to the built-up city landscape, while they are also able to distinguish "naturalistic" as a contrast to "formal" use of plants. Also, it appeared that a majority of the participants welcomed a larger naturalistic component in urban parks (p.154).

Such a preference is supported by a review by Arnberger and Eder (2011), who investigated trail preferences in urban green space. Here, previous research indicated that "trail environments characterised by high numbers of trees and shrubs, water resources and rolling topography are preferred, while built environments and streets detract from enjoyment" (p.892). We might assume that people in general tend to prefer natural-looking forests, since they are coherent with people's image of the forest as being ‘natural’. Still, Finnish studies have shown that managed forests are more popular among local residents, but only if the management is natural-looking or “without visible traces of human activity (Tyrväinen, Silvennoinen et al. 2003, p.136). Arnberger and Eder's review shows that trails in bad condition are disliked, as are surroundings that are overgrown or show little sign of maintenance. They also found trail surface material to have an influence on preference, but this typically depends on the activity. The review also shows litter, graffiti and vandalism to have a strong negative influence on trail preference for recreation. Additionally, conflicts sometimes appear due to incompatibility of multiple uses, such as bicycling or walking unleashed dogs (Arnberger and Eder 2011p.892).

In a Detroit study (Nassauer, Wang et al. 2009) on exurban (beyond the suburbs) homeowners’ attitudes towards front yard designs containing native plants and nature-inspired plantings, the homeowners were found to prefer this kind of design if, and only if, most of their neighbors’ front yards had such designs. In more conventional-looking neighborhoods (predominantly cut lawns and occasional trees), homeowners preferred conventional designs. The result implies that, in this context, attitudes towards designs contributing to biodiversity depend more on "what the neighbors appear to prefer" (p.290) than on broad cultural norms. This could suggest that preference for a certain green space design can change with increased familiarity, although the study does not tell whether the homeowners chose to move to their neighborhoods because of the local design customs or if they changed their opinion over time.

As described earlier, green environments seem to have a restorative and beneficial effect on people's stress levels. There also appears to be a strong link between perceived restorative qualities and aesthetic preference (van den Berg, Hartig et al. 2007, p.85; Nordh, Hartig et al. 2009). This link could have one of two origins: either we tend to like the environments that make us feel better, or we feel better by being in environments that we like. A biological explanation could be *habitat selection*, which is a tendency among vertebrates to prefer environments in which their species prospers (Kaplan and Kaplan 1989, p.69) (see also the section above on prospect-refuge theory).

Influence of previous ecological knowledge on landscape preference

Several studies on landscape preference (although predominantly on forest preference specifically) suggest that people's preference for different environments or landscape features can be affected by their previous knowledge or by knowledge provided to them when interviewed. Tyrväinen, Silvennoinen et al. (2003) summarize this theory:

> "Much of the existing psychological research regarding human landscape preferences has been based on a 'rational' model that emphasizes logical and knowledge-based decision making processes ... This approach suggests that preferences should be strongly influenced by ecological knowledge. People with a greater knowledge of ecosystems, for example, should be more likely to prefer ecologically sustainable landscapes ..." (p.136)

For example, the presence of deadwood is often considered to detract from landscape preference. Gundersen and Frivold (2011) tested this using images from a boreal forest accompanied by information about the benefits of natural downed wood. The authors found, however, that knowledge about the ecological benefit of deadwood in a scene did increase people's preference for it. Gundersen and Frivold believe that the general aversion for deadwood might be related to the physical obstacle it creates or to the seeming lack of care that it displays (p.113). Research has indeed shown an aversion among the general public towards deadwood (Ribe 1989; Tyrväinen, Silvennoinen et al. 2003; Gundersen and Frivold 2011). Natural downed wood, however, seem to be more acceptable than slash (Ribe 1989, p.63). As a contrast to above mentioned findings, Dandy and van der Wal, who performed a visitor-employed photography study (2011), found that

> ”Moss, fungi and deadwood were clearly amongst the most valuable elements of the woodland site with a sparse understorey – again across groups [professionals vs. laypersons] – although less prominent at the other sites. The presence of deadwood was considered positive, and linked explicitly to decay, regeneration and life-cycles” (p.47).

A clear explanation of this outcome is not readily available, but ecologic knowledge is likely to have influenced the participants' preference, since “the perceived benefit of deadwood as supporting wildlife was a particularly consistent and prominent theme in both societal groups” (Dandy and Van Der Wal 2011, p.47). However, the result might also have been affected by the participants' attributes and interests (they were, for example, all from the same rural area), the on-site experience, or a range of other reasons. The influence of on-site experience for landscape preference is, of course, tested in the survey of the present thesis, and the representativeness of photo-elicitation has been questioned by other authors, e.g. Özgüner and Kendle (2006):

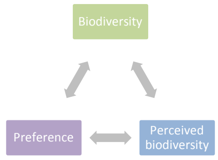
> "there is a growing debate regarding the use of photo-questionnaires in landscape perception and preference studies as they are unlikely to assess the respondents‘ actual experiences made in real places ... Perceptions and preferences expressed on the basis of two-dimensional photographs are different to those, which might be made in real places" (p.155)

In any case, preconceptions about the place that is being rated also seem to influence preference. Ribe (1989, p.59) has reviewed research showing that scenes are rated more beautiful if they are labeled as wilderness or national park, while timberland labels decreased the rating. The reputation or public knowledge of a location would thus be of importance for perception and preference.

Regarding species composition in forests, Ribe (1989, p.62) comes to the conclusion that species preference is difficult to generalize, as it seems to be influenced by, for example, cultural and regional expectations. Instead he proposes that the structure of the forest stand and the visual diversity of species would play a more important role. One might expect people without silvicultural or biological education to be less attentive to species diversity, rather noticing structural or color attributes. This hypothesis is partly supported by Dandy and van der Wal (2011, p.47) who reported a three times higher use of species common names among woodland professionals than among lay-people when discussing a shared woodland excursion.

Summary of green space preference

At this point in the thesis, we have seen several examples of people's perception and preference of the physical environment in general and of green space in particular. We have also seen several examples of how different kinds of urban green spaces affect biodiversity. Let us therefore recall the main objective of the thesis:



> "To explore the relationship between *preferences*, *actual biodiversity* and *perceived biodiversity values* within urban green space."

This objective will hopefully be approached in Chapter 3, but we can already now review the knowledge acquired so far by making a short summary. This will serve as a prediction of the outcome of the study.

- People will in general dislike the presence of coarse deadwood
- People will in general dislike dense understories and inaccessible ground cover
- People will in general dislike the presence of trash, intrusive human influence and signs of damage or lack of care
- People will in general appreciate highly maintained areas, although the maintenance should not be visible as such in naturalistic areas
- People will in general appreciate visually open green areas with scattered trees, resembling a savanna
- People will in general react more to content-based attributes than to spatial configurations, at least in woodland settings
- People will in general be sensitive to visible human influence in natural-looking areas
- Landscape/ecology experts will more accurately recognize areas of high species richness
- Landscape/ecology experts will be more tolerant or positive to management practices promoting biodiversity, compared to the general public

CHAPTER 2: SURVEY

In this chapter are presented detailed descriptions of the study site and survey procedure and method. Since the study is experimental in its character, effort has been made to explain the procedure as clearly as possible.

NOTE: The survey was prepared and conducted in collaboration with postgraduate student Ling Qiu, who is also to use the results for her own research at SLU Alnarp.

SURVEY METHOD

Choosing between on-site or off-site investigation

On-site photo investigation is hardly the most common practice when assessing landscape preference, which is more commonly assessed through off-site photo elicitation. As we will see below, standardized photographs are often considered to be a good representation of reality, which would make on-site research methods redundant. What the present study intents to demonstrate, however, is not that on-site methods are more representative than off-site ones. Rather, the study aims to investigate the relative importance of details and scenic compositions when a person experiences the landscape as a sequence, which indeed is the only way one experiences a landscape in practice. To shed some light on the differences between on-site and off-site methods of assessing landscape perception, I will summarize a short review made by Gyllin (2004), in which he compiles the main arguments in scientific literature:

- Physical effort of on-site investigation may affect judgments. Also, great individual differences may be cancelled out in group averages.
- The photographs used in off-site investigations are supposed to represent distant objects, while the photographs themselves are objects with their own aesthetic qualities. Hence there is a risk of the photo being judged, rather than the represented landscape.
- The experience of movement through an environment and the possibility of viewing an object from different angles provide significantly more information and sensations than the static image of a photograph.
- Many authors consider photos to elicit judgments equivalent or even better to those of on-site experiences, arguing that on-site methods provide too much disturbing information.

- Both on-site and off-site methods might generate erroneous results, depending on the choice of informants. Judgments may differ significantly between laypersons and people who are experts in some sense.

(Gyllin 2004, pp.2-3)

Within the realm of landscape preference research, there is already a large percentage of studies employing off-site methods such as landscape photography elicitation (e.g. Steinitz 1990; van den Berg, Vlek et al. 1998; García Pérez 2002; Tveit 2009). The most widespread method to estimate preference is the scenic beauty estimation (SBE) method, endorsed primarily by Daniel and Boster (1976), in which respondents rate the perceived beauty in landscape photographs (Ribe 1989).

What these studies might fail to take into account is the respondent's composite experience of being on the site, putting the image in a context and experiencing the landscape through all senses, not just the visual. The method is also heavily dependent on the researcher's choice of photographic objects, leaving little room for participants to elaborate on their own, personal preferences. Surely photo elicitation can represent the on-site experience accurately enough for a number of purposes, at least when asking about the specific content of each image. It does, however, strongly guide the viewer's attention towards certain aspects of the environment in question, rather comparing views than investigating the relative importance of different qualities.

By letting participants choose freely among the motifs within a live setting, a deeper understanding might be approached of what visual elements actually attract visitors' attention in urban green spaces. In addition, indicators of high biodiversity may be highly specific and small in size. Since a partial goal of the study is to investigate whether people detect biodiversity in urban green space, photography elicitation might not provide sufficient information for conclusions to be drawn regarding biodiversity.

Visitor-employed photography

A survey method alternative to presenting previously selected photographs to the informants is to let them take their own photographs in the field – so called visitor-employed photography (VEP) – a technique introduced by Cherem in the 1970s (Heyman 2011). Its participatory dimension was considered one of the method's main strengths at the time (Dandy and Van Der Wal 2011, p.44). Moreover, a VEP approach has the potential to register a wider set of factors and elements, such as smells, sounds, views and surfaces, which may all positively or negatively influence the actual experience (Dorwart, Moore et al. 2010). For example, the high complexity and reduced field of vision within a woodland stand could be assumed to demand *in situ* investigation in order to demonstrate the relative importance of context-based factors in landscape preference and perception. This assumption is supported by Nielsen et al. (2012), who's study suggests a higher relative importance of content-based properties within woodland stands compared to more open landscapes, where scenic attributes play a bigger role in respondents' perception.

As mentioned by Oku and Fukamachi (2006), visitor-employed photography "allows participants an immediate and easy way to express their environment visually, without a need for specific skills, time or labor" (p.36), which can be argued to better represent the actual experience than would a previously taken photograph. Also, a real landscape scene is rarely, if ever, the only available view (one can always choose to look elsewhere). It can especially be argued that the experience of a location or an object is relative to the context in which these are experienced. In other words, by letting participants choose what is important to them in a specific context, previously overlooked qualities and inadequacies of a setting can be discovered. In my particular study, the abundance of information provided by the physical environment, both in details and in the spatial compositions, can be expected to play a key role in the perception of biodiversity, which is built on various scales.

My study will be a continuation of, and to some extent a repetition of, two parallel studies (Heyman, 2011; Nielsen, Heyman et al. 2012) conducted using an adapted version of the VEP method in a recreational forest area in Gothenburg, Sweden. Since comparative studies are essential to support or contradict the results of previous work, I will employ a similar structure and methodology in my own study, with some adjustments. Compared to these previous studies, I will cross-check the participants' preferences with perceived species richness. I will also investigate the relative influence of expert knowledge on the result. Finally, I will include a broader spectrum of green space typologies or biotopes available in the urban environment.

Due to the relatively low number of participants, but high number of inputs (photos), the study is both qualitative and quantitative in its nature. The complexity and individuality of the material obtained from the participants requires interpretation and comparison and cannot be directly quantifiable through previously used methods. The unique qualities of the study site also contribute to the need for careful examination. The data is, however, used quantitatively to extract statistical relationships, but always in combination with qualitative analysis. Where this has been done, I believe that the transparency is sufficient for the reader to judge the results objectively.

Serial vision

Although *The Concise Townscape* (Cullen 1971) was written very specifically to comment on the *urban* environment and how we interact with it, I would like to use a few of Cullen's words to describe the special experience of moving through a physical environment. The study presented in this thesis was conducted in a predominantly green, vegetation-covered space. But like the townscape, this landscape is also built up by ground-planes, walls, ceilings and varying topography, although the building blocks in this case are not of brick and stone. The participants of this VEP-study experienced the different parts of the park in a fixed order, defined by us, the study designers. Cullen describes this way of discovering an environment as *serial vision* – the scenery as "revealed in a series of jerks or revelations" (p.9). When defining the trail that the participants were to walk, we kept this in mind in order to provide a diverse experience. In the urban context, Cullen writes:

> "A long straight road has little impact because the initial view is soon digested and becomes monotonous. The human mind reacts to a contrast, to the difference between things, and when two pictures … are in the mind at the same time, a vivid contrast is felt and the town becomes visible in a deeper sense. It comes alive through the drama of juxtaposition. Unless this happens the town will slip past us featureless and inert." (Cullen 1971, p.9)

Also in a green space context, this interplay of different physically and visually defined spaces might have importance in understanding what and where the participants choose to photograph. Returning to the one of the thesis' research questions, – "*In the appraisal of preference and perceived species richness, what is the relative importance of spatial configurations and content-based attributes?*" –, it is tempting to think that the visual experience of contrasting physical realms has the power to direct people's attention *to or from* content-based and spatial configuration attributes. The study might shed some light on whether indeed it is so.

SURVEY MATERIAL

Study site

Site criteria

A suitable site to conduct the survey was located through aerial/satellite photography and field visits. The site was expected to be an urban or near-urban green area, regularly visited for recreational purposes. It should include several clearly distinguishable vegetation characters and a high number of biotopes of different ecological importance. Additionally, the characters should include a range from park-like to nature-like (ornamental to wild). Finally, these different units should be possible to traverse on a walkable trail, about 2 km long.

Helsingborg was originally selected as general study area in order to take advantage of previous research conducted there by collaborator Ling Qiu. In the end, we chose to work in an area that was not part of her previous material, but since Helsingborg has many parks and major green areas within the urban perimeter, the city was still suitable for the study. A first selection of possible sites was made through aerial photography analysis, focusing on size, shape, location, diversity and composition of vegetation structures, number of management regimes and, vegetation continuity. Vegetation continuity was identified through comparing recent aerial photographs with ones taken around World War II. Five initial locations were selected and visited in March, 2012. Out of these five, Ramlösa Brunnspark was finally selected, on the basis of the following criteria:

- Commonly used as recreational area
- Includes a variety of environments, ranging from seemingly high levels of species richness to low levels (based on this criterion, the site was also recommended by the municipality’s ecologist)
- Includes a variety of design/management schemes, ranging from highly ornamental to wild-like
- Includes a variety of design/management schemes, ranging from very open to very dense vegetation structure
- A trail could easily be established that would traverse all characteristic environments of the park

A detailed inventory of the site was performed to identify the different biotopes, and the relative biodiversity was estimated for each of them, as presented later on.

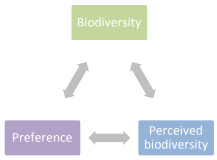
Site conditions and history

Ramlösa Brunnspark is located in the southern part of the city of Helsingborg, on the southwestern coast of Sweden. The park was inaugurated in 1707 and used as a place for curation and recreation after the discovery of a natural spring of mineral-enriched water (The city of Helsingborg's homepage). Two major parts of the park can be distinguished. The southern part is inspired mainly by the English landscape parks, dominated by mown lawn and scattered trees and shrubs. Several well-preserved 19th century wooden buildings, still in use, also lie scattered in this part and since 1973 the whole park is protected by law under the Heritage Conservation Act (The city of Helsingborg's homepage). The northern part of the park is beech-dominated woodland, which covers the ravine where the creek *Lussebäcken* runs. The ravine has occasionally very steep slopes, many of which are heavily eroded. Relevant vegetation structures are described in the section *Definition of units/biotopes*. A system of paths and trails is laid out over the whole area and certain sections are provided with electrical light after sunset. Stairs and small bridges are installed where the topographic conditions so require. The park is closely surrounded by mainly single-family houses, some of them from before the 1940s. A road and parallel railroad are prominent features bordering the south side of the park.

The bedrock is Lower Jurassic sedimentary with some outcrops of Rhaetic-Liassic bedrock along the ravine. The quaternary deposits are mainly boulder clay or till (silty to fine sandy), except for the valley bottom and southernmost part of the park, which have alluvial deposits (fine sandy – sandy). (Sveriges Geologiska Undersökning 1974)

Figure 5: Aerial photograph of Ramlösa Brunnspark (used with permission).

Field surveys



The present study aims to investigate the triangular relationship between three aspects of urban green space and therefore three different surveys were conducted. Next are presented the procedures for each of these three field surveys:

- *biodiversity assessment;*
- *perceived species richness* and; *preference*

Biodiversity assessment

Precedents
Once the study site was established, it was desirable to define areas of higher and lower biodiversity within the total, continuous green space. A review of methods for assessing the biodiversity of the different zones was therefore performed. The review unveiled two problems, related to each other. Firstly, following the definition of *biodiversity* as presented in the introduction, one must consider not only diversity of species, but also diversity of habitats, why a strict biodiversity grading of zones, already divided by habitat type, cannot be done (this is also the reason why finally the participants were asked to consider *species richness* instead of biodiversity). Secondly, available reference studies do not compare individual habitats within the same green spaces, but rather they compare entire green spaces with each other.

Nevertheless, a search was performed, looking for a relatively quick and easy method for assessing biodiversity in urban green spaces. Due to the lengthy character of the review, it can be found in Appendix I. It lists and evaluates the methods by order of publication year.

No method could be found, as mentioned, that assessed biodiversity for different habitats within individual green areas. Some of the methods were also highly time consuming or costly. The reviewed studies did, however, provide partially useful methodologies which inspired the method applied in the present study. The objective was to find a method which would assign a score or an index to each habitat type within the green space. Still, no one provided a rapid and directly applicable biodiversity score for individual habitat types (although the study by Gao, Qiu et al. approached this).

For the purpose of the thesis, the aim of the method applied here will be a so-called biodiversity score or *biodiversity level* that is an approximation which considers commonly used parameters that can be easily measured or appreciated. Hopefully the transparency of the method will compensate for its experimental character.

Zoning of the study site

Following the study design, the participants should experience a variety of vegetation structures and biodiversity levels as they walked along the trail. They should also be exposed to a variety of design/management regimes, ranging from highly ornamental to wild-like, in order to experience the full range of urban green space qualities. The study site was therefore divided into a number of zones and sub-zones, based on the above mentioned factors. A trail was then established that would pass through as many of these zones as possible and resulted in a winding, 1.6 km long route. The zones and sub-zones are shown in Figure 6, together with the trail layout and important features visible from the trail. Each 25 m stretch of the trail is numbered from 1 to 65.

Figure 6: Division of zones based on vegetation structure and design/management regime.

Below is found panoramic photos from each of the zones and sub-zones, together with a short description.

Figure 7: Zone 1 – Ornamental park with lawn, some trees, exotic species

Figure 8: Zone 2 – Abrupt transition: residential gardens meet woodland

Figure 9: Zone 3a – Forested valley with sparse understory, moist

Figure 10: Zone 3b – Forested valley with dense understory, swampy

Figure 11: Zone 4 – Beech-dominated woodland, no understory, no ground cover

Figure 12: Zone 5 – Public lawn in residential area with bordering woodland

Figure 13: Zone 6a – Woodland with dense understory

Figure 14: Zone 6b – Woodland with sparse understory and ground cover, a lot of deadwood

Figure 15: Zone 6c – Straight path with bordering woodlands, lamp posts

Figure 16: Zone 7 (first part) – Ornamental park in valley, open lawn, exotic species

Figure 17: Zone 7 (second part) – Ornamental park in valley, open lawn, exotic species

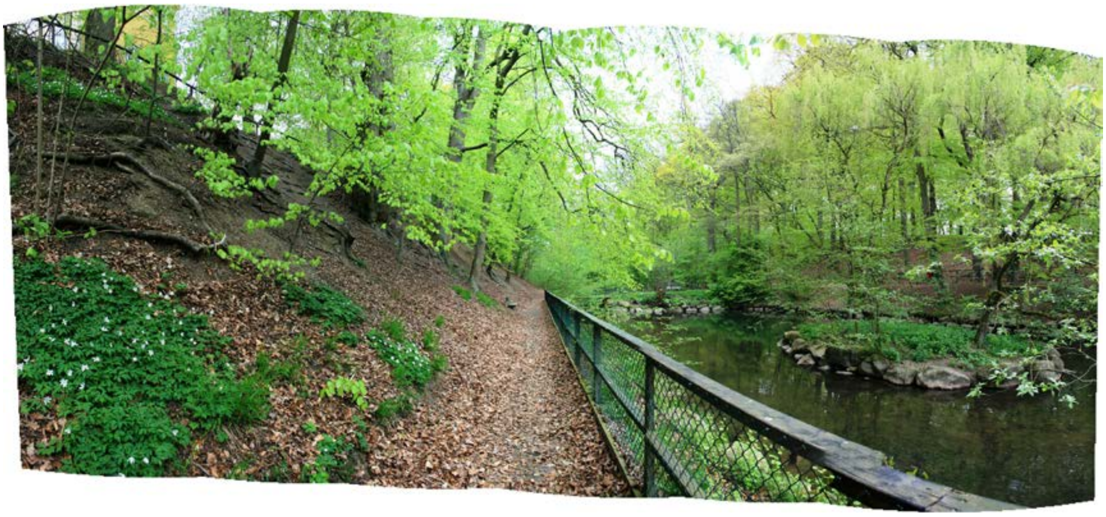


Figure 18: Zone 8a – Pond in valley, fenced, sound of running water, foul odor

Figure 19: Zone 8b – Forested valley with sparse understory, dry

Biodiversity assessment parameters
Six parameters were finally chosen to influence the biodiversity level which was assigned to each main zone:

- Total number of species found in the zone
- Percentage of alien species among total number
- Number of found indicator species (AWI, Ancient Woodland Indicator) according to list compiled by Gao, Qiu et al. (2012).
- Length of trail segment
- Intensity of management
- Complexity of habitat structure

Each parameter was graded into three levels, representing 1, 2 or 3 points, where 3 is the highest level. Since the assessment method lacks precedent, all six parameters were weighed equally to maximize transparency.

Score	Biodiversity level
6-9	Low
10-14	Medium
15-18	High

This system resulted in a scale from 6 to 18, which was divided into three so-called *biodiversity levels*: Low (6-9), Medium (10-14) and High (15-18). Needless to say, this method considers the different zones in comparison to *each other*, not to an established index of general biodiversity. Still, for the purpose of the study, it serves better since the participants also judge the zones compared to each other, not in relation to other areas. It should also be mentioned that the grading was performed for the main zones in their entirety, knowing that some of the sub-zones were rather different for some of the parameters. This was however the only reasonable assessment, since the species inventory was performed only considering main zones (see below).

Species richness inventory
The one parameter (except segment length) which could accurately be measured on site was the species richness of each zone. The most commonly used taxa for species richness assessment are vascular plant species, which is time and effort efficient.

The inventory of vascular plant species was made for each of the eight main zones of the area. The number of vascular plant species was counted within a 30 m wide strip on each side of the established trail (or up to the neighboring zone's limit, whichever came first). This procedure obviously resulted in different sample area sizes for each zone depending on the length of each trail segment. In retrospect, a comparison of the zones might have gained from an inventory performed in equally sized sample plots or transects. However, adding trail segment length to the biodiversity score parameters will hopefully compensate for this possible bias. After the inventory was completed, the found species were divided into native and alien species, as well as into indicator species. The outcome of the inventory and biodiversity assessment is presented in Chapter 3: Results.

Perceived species richness and preference

Survey conditions

For practical reasons (i.e. seasonal conditions), the first survey could not be conducted until mid-May when the leaves had burst and the vegetation could be appreciated in its full glory. Finally, the survey was conducted at three different occasions between May 8th and June 3rd 2012, but always within the time span of 13-17 o'clock. The weather conditions were similar at all three occasions – sunny to cloudy and a bit windy. Of course, the vegetation had changed somewhat between the first and the last occasion, but in relation to the clear differences in permanent vegetation structure between the various parts of the park, the seasonal differences can be considered relatively small.

Participants

The survey was performed using four different groups of 14-22 persons each (two persons were later excluded from the data set, due to inconsistencies in their data). Two of the groups consisted of laypersons – current or previous students, several international, recruited from the local campuses in Helsingborg and Lund and through personal contacts. The other two groups consisted of international and Swedish graduate students (from the University of Agricultural Sciences, Alnarp), at the time participating in an advanced level course about vegetation design and dynamics, landscape ecology and similar subjects. In the particular context of the study, these students were considered ecosystem/landscape experts.

Based on the abundant research showing significant differences in landscape perception and preference among societal groups (e.g. age, sex, profession, education), it might be argued that university students are not representative of a whole population. With this, I do agree. I argue, however, that for this particular study design, it was more important to find laypersons that were highly comparable to the experts. For practical reasons, the two expert groups had to set the standard, since we could not within reasonable time and effort put together expert groups representative of a whole population. Hence, the laypersons were recruited so as to most closely resemble the experts, apart from the latter's ecological expertise.

Survey procedure

The common procedure for all four groups was a brief instruction about the survey procedure to each group separately, followed by a guided walk around the previously established trail, marked with a numbered tag each 25 m. Each group was then given detailed instructions about the task and then the participants were sent off individually with a gap of approx. one and a half minute, bringing their digital camera and a photo-log, which they were instructed to fill out during the walk. All participants were instructed to take a total of 10 photographs and to make a short comment on each in the photo-log.

One of the laypersons groups and one of the expert groups were given the instruction to take five pictures of things (objects, scenes or events) that the participant *liked* and five pictures of things she/he *did not like* as part of the walk around the park.

The other laypersons group and expert group were given the instruction to take five pictures of places or things that they believed represent *high species richness* and five pictures that they believed represent *low species richness*.

Upon the immediate return of each participant, her/his photographs were downloaded to a PC and saved in a folder with the participant's assigned number. After downloading their pictures, each participant was asked to fill out a short questionnaire (see Appendix V), which requested some personal information and an ecology quiz, which aimed to test and indicate their prior knowledge on ecology.

The data was later digitized and categorized, as described in the following section.

Expert preference group	Expert species richness group
14 participants (12 female + 2 male) Age 22-39 (mean 27) All current or previous university students Mean quiz score 5.6 / 7	18 participants (12 female + 6 male) Age 22-40 (mean 27) All current or previous university students Mean quiz score 6.1 / 7
Layperson preference group	**Layperson species richness group**
14 participants (10 female + 4 male) Age 22-43 (mean 28) All current or previous university students Mean quiz score 2.9 / 7	21 participants (12 female + 9 male) Age 24-31 (mean 26) All current or previous university students Mean quiz score 3.3 / 7

Table 3: The four groups of participants.

Data handling

The significant amount of data (670 pictures/comments) required a clear system for handling and interpretation. Once all photos and comments were downloaded and digitized in an Excel worksheet, each photo/comment was therefore put into one or several categories based on the picture motif and the written motivation. All categorizations were made based on a combination of picture motif and motivation, which made the process of categorizing a highly qualitative task. Some comments were simple in structure and could directly be categorized, while others required interpretation and comparison. Since the participants' comments and choices of motifs could not be predicted, the categories (especially the sub-categories) were created on the basis of the data input. Naturally, the categories were chosen also on the basis of the study aims and planned subsequent analyses. Some guidance could be drawn from Nielsen, Heyman et al. (2012), although their study design and aim was only partially similar to the present one. In order to create as general categories as possible that would be able to hold as many pictures as possible, the category definitions were made value neutral, being open to both positive and negative pictures. The categories also had to relate, on equal terms, to both the preference study and to the perceived species richness study. The final categories used in the study can be found in Table 4.

The photos/comments were analyzed and discussed several times by the two study designers and the categories were tested and developed during this process. When disagreement occurred in the final categorization, a third party was consulted.

Is should be mentioned that the participants were from many different countries, none with English as mother tongue. Yet, the study was conducted in English and the participants wrote their comments in English. This undoubtedly affected the accuracy and length of descriptions and motivations and did certainly leave the reader some room for interpretation. Nevertheless, in combination with the photographs, all photos/comments could after careful interpretation be put into either one of the spatial or content-based categories.

Categorization

The primary categorization that was performed divided all pictures into either one of the categories *Spatial configuration* and *Content-based attribute*. This division is based on the categorization made by Kaplan and Kaplan (1989, pp.42-49), but the definition is not identical to the Kaplans', nor does it intend to be. The importance of these categories has been discussed earlier in the thesis, and they will in this study constitute the main classification.

Some categories, then, had to be of strictly spatial configuration character and others of strictly content-based character. Hence, the same photo/comment could never appear in both a spatial configuration category and in a content-based category, but would always belong to one of them (with exception for *Auxiliary motivations*, see below). All categories used in the analysis can be found in Table 4.

Content-based categories

As *content-based attribute* is here considered:

- a photo/motivation which refers to individual objects or landscape elements (areal, lineal or punctual), temporary events, subtle details or signs of activity.

"An oak, an old oak has a very high value for biodiversity."

"Stone with PEAB and orange color."

"People are taking care of this lawn. They probably don't allow too much variation of species here."

Figures 20-22: Examples of content-based photos/motivations.

The content-based categories were divided into the main categories *Natural elements*, *Anthropic elements* (elements relating to humans) and *Combined elements*, keeping in mind that the whole green space was indeed established by humans. Natural elements therefore refer to such features which can be found in natural environments, although they may have been introduced or altered by humans in this particular green space. Since urban green spaces can be said to be representations of natural areas within built-up settings, the division into these two categories seemed logical. Additionally, man-made content has been shown to affect people's preference of nature-like areas (Kaplan and Kaplan 1989, pp.43-44), why the interaction of these elements is an interesting subject. The Combined elements category contains content-based pictures that could not fit exclusively into a single sub-category.

Examples of Natural elements motivations:
- *"Water is always a great source of life."*
- *"Artificial hill which seems be too artificial and like a barrier."*
- *"Dead tree with fungi on it (insects)."*

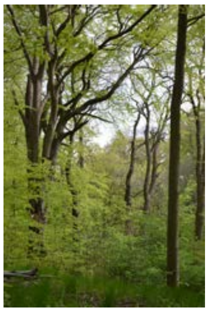
Examples of Anthropic elements motivations:
- *"The football goal is ugly."*
- *"Blue paint on trunk."*
- *"Road created by humans. Represents destroyed nature for the sake of functionality."*

Examples of Combined elements motivations:
- *"Humans and animals are there."*
- *"It's so cute, the tree and the art."*
- *"Magnolia and bare soil."*

Spatial configuration categories
As *spatial configuration* is here considered:
- a photo/motivation which refers to the arrangement of elements in a scene, the sensation of a spatially defined room, the landscape type or the conditions of a place.

"The contrast between nature and more man-made artificial landscape with sweeping lines."

"Path does not feel very inviting, feels half private…"



"Elevation effect, you get a sense of the massiveness ..."

Figures 23-25: Examples of spatial configuration photos/motivations.

The spatial configuration categories were divided according to which elements the spatial setting was made up of – hence the two main categories: *Setting of natural elements* and *Setting of natural and anthropic elements*. Since the whole study area consisted of a park and, to some extent, villas with gardens, no settings of purely Anthropic elements were recorded by the participants.

Examples of Setting of natural elements motivations:
- *"Multilayered forest with deadwood."*
- *"It is quiet and beautiful."*
- *"Park with many different species from soil to tree tops. Different plant communities."*

Examples of Setting of natural and anthropic elements motivations:
- *"Grass, several trees. In front of a house."*
- *"Flowers, trees, buildings, beautiful and make me want to have a rest."*
- *"Way into the wilderness, view on the stream, bridge."*

Auxiliary motivations categories

In many comments, however, the motivations were not of strictly descriptive character, but rather contained personal reflections, feelings, guesses and similar additional information. These pictures/comments were therefore first put into either one of the spatial or content-based categories, but also into a category of *Auxiliary motivations*. This category was further divided into *Human influence* and *Reflections*. The *Human influence* category relates to perceivable effects of human activities, such as trampling or traffic-noise. *Reflections* contain a number of value neutral sub-categories which, to varying extent, related to both of the study themes. Comments in this category expressed emotions, knowledge, opinions, feelings etc. The *Auxiliary motivations* may relate to both content-based photos and to those of spatial configurations.

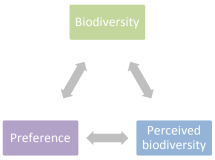
Examples of Human influence motivations:
- *"Bare soil, hard trampling."*
- *"Solitary bush stand weeded to promote monoculture."*
- *"The sound and sight of traffic."*

Examples of Reflections motivations:
- *"The bridge doesn't fit to the place."*
- *"Hollow tree, looks scary."*
- *"Wet old tree trunk can be home of ants, insects, mushrooms…"*

Spatial / Content	1st order categories	2nd order categories	3rd order categories
Spatial	**Landscape settings**	**Settings of natural elements** - type, style, character or arrangement of natural elements	
		Settings of natural + anthropic elements - type, style, character or arrangement of natural elements in combination with anthropic elements	
Content	**Natural elements** - naturally occurring elements (may have been introduced or affected by humans)	**Vegetation** - presence or character of plants or plant communities	**Living vegetation** - trees, shrubs, herbs or other plants
			Deadwood - standing or lying dead trees, trunks, stubs or larger branches
		Water - presence or character of water features	**Water bodies** - ponds or pools, brooks or creeks
			Surface water - ground water and surface water conditions
		Ground - presence or character of ground conditions	**Topography** - height differences and inclinations
			Rocks and soil - rocky outcrops, eroded slopes, boulders or large stones, mounds, soil, dead leaves on the ground
		Animals - physical presence of wild or domesticated fauna (incl. insects, birds, mammals, pets etc.)	**Visible**
			Audible
	Anthropic elements - buildings, infrastructure or facilities constructed by humans	**Architecture** - presence or character of buildings	**Buildings and houses**
		Infrastructure - presence or character of permanent human constructions or artifacts	**Roads, streets, constructed paths and parking lots (incl. parked cars) etc.**
			Stairs, bridges, hand rails etc.
			Fences, walls, gates etc.
			Lighting systems, light poles etc.
			Outdoor furniture, waste bins, playgrounds etc.
			Wells, sewage systems, pump houses etc.
		Small or temporary signs of human presence - small or temporary signs of human activity	**Graffiti, spontaneous art, tree carvings etc.**
			Trash/Waste/Litter
			Signs, rat traps etc.
		People–visible human beings	**People**
	Combined elements	**Combined elements –** more than one elements depicted that could not fit into the same element category	
Spatial / Content	**Auxiliary motivations**	**Human influence** - perceivable effects of human activity	**Trampling, biking, etc.**
			Signs of park management - choice or execution of management regime
			Sound of human activity - e.g. traffic
		Reflections - emotions, knowledge, opinions, feelings or beliefs	**Aesthetics** - perceived beauty, ugliness etc.
			Management - perceived park management practice
			Accessibility - perceived locomotive or visual accessibility
			Safety - perceived safety, security or danger
			Tranquility - perceived peace, calm or disturbance
			Activity - perceived possibility, will or inability to engage in activities
			Scale - perceived scale or spatial conditions, feelings of massiveness etc.
			Coherence - perceived naturalness, artificiality, design style etc.
			Microclimate - perception of lighting conditions, shade, temperature, etc.
			Species richness - presumed presence or absence of species
			Habitat indicator - presumed favorable or unfavorable conditions indicated by e.g. deadwood, single trees etc.
			Other - other feelings or motivations, e.g. sense of history, sadness, inspiration etc.

Table 4: Hierarchy and definitions of categories.

CHAPTER 3: RESULTS



As expressed in previous chapter, the present study aims to explore the triangular relationship between *biodiversity*, *perceived species richness* and *preference*. The results of the study will therefore be presented in that same order – first by individual survey, then combined and compared:

- **Biodiversity assessment**
  Species inventory
  Assessment of biodiversity level for each zone

- **Perceived species richness**
  Results by category
  Results by distribution

- **Preference**
  Results by category
  Results by distribution

- **Triangular relationship**
  Category comparison
  Distribution comparison

BIODIVERSITY ASSESSMENT

Species inventory

The inventory yielded a total of 158 species distributed over 115 genera. The number of alien species was 55 (35%) and the number of indicator species 10. The distribution of species over the zones can be seen in Table 5.

Vascular plant species in each zone of the study area

	Total	Native		Alien		Indicator species
Zone 1	78	51	65%	28	35%	1
Zone 2	59	31	53%	28	47%	1
Zone 3	41	38	93%	3	7%	5
Zone 4	21	19	90%	2	10%	3
Zone 5	36	22	61%	14	39%	0
Zone 6	38	34	89%	4	11%	7
Zone 7	25	15	60%	10	40%	1
Zone 8	41	38	93%	3	7%	6

Table 5: Distribution of vascular plant species over the zones of the study area.

The eight zones obviously shared many of the species and the uniqueness of species can be seen in Table 6. It shows that ¾ of the species were found in only one or two of the zones – 48% in just one zone and 27% in two zones. This can be partly explained by the strong horticultural influence in some of the zones, considering that 33 of the 76 species found in only one zone were alien, as were 15 of the 43 species found in two zones. In comparison, only 3 of the 13 species found in three zones and 2 of the species found in four zones were alien. Gardens and ornamental parks can be expected to contain a large portion of alien plant species, which is supported by the native/alien ratio for the corresponding zones No. 1, 2, 5 and 7, as seen in Table 5. A complete list of species can be found in Appendix II.

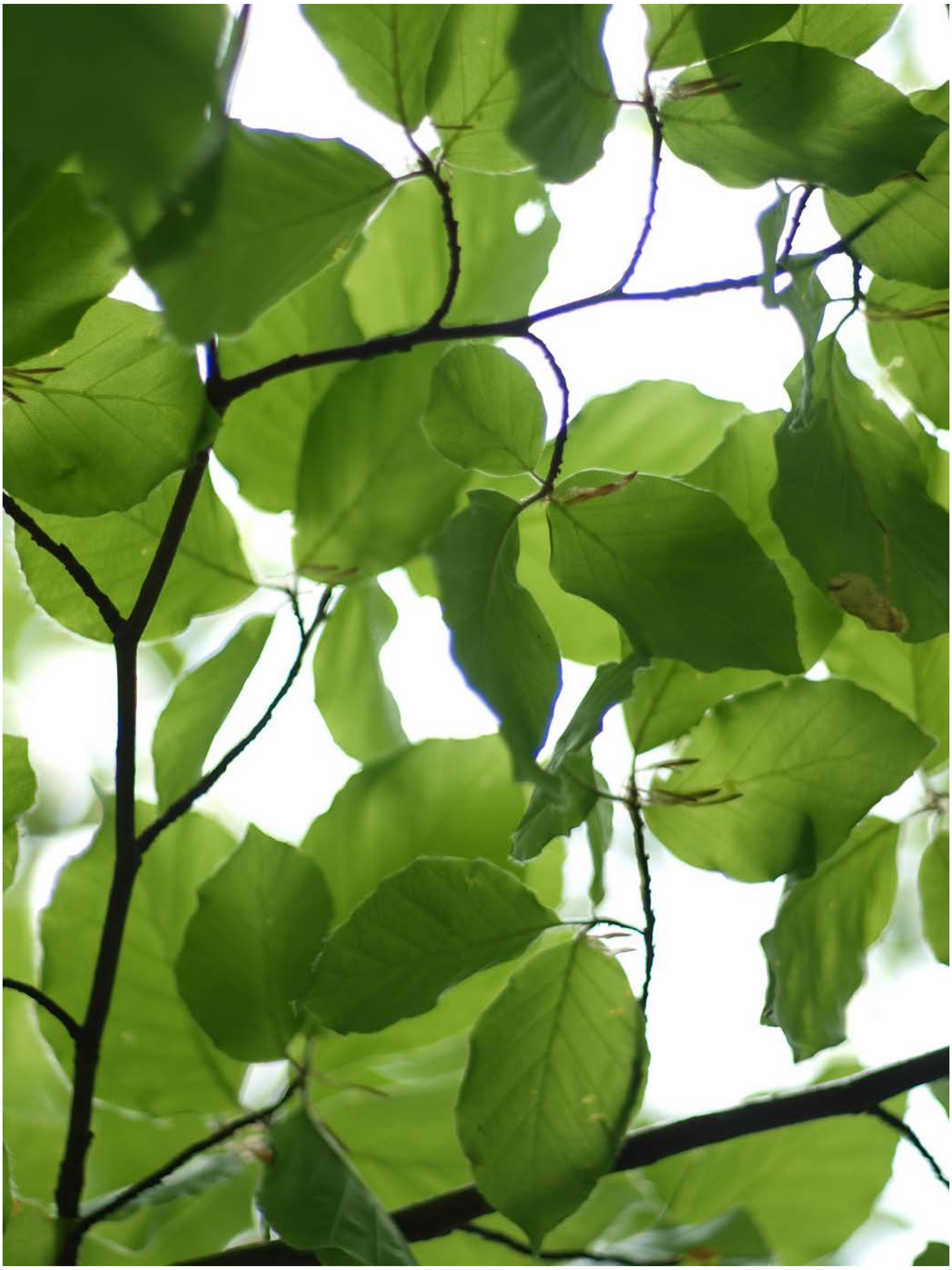


Figure 26: Beech (Fagus sylvatica) – by far the most common tree species at Ramlösa Brunnspark.

Number of species found in number of zones									
Nr. of zones	8 zones	7 zones	6 zones	5 zones	4 zones	3 zones	2 zones	1 zone	**Total**
Nr. of species	3	4	3	4	12	13	43	76	**158**

Table 6: Occurrence of species over the zones of the study area.

Assessment of biodiversity level for each zone

The biodiversity assessment was performed for each of the eight main zones and the calculations can be found in Table 8. Since some of the zones were in fact similar to each other, the eight main zones were also clustered into four habitat types in order to permit analyses on multiple levels:

- Type A – ornamental park;
- Type B – residential/woodland transition;
- Type C – moist multi-story woodland in valley and;
- Type D – dry simple woodland on ridge.

The biodiversity score (and level) for these four habitat types are – keep in mind – merely averages of their comprising zones. Individual assessments of the habitat types might have resulted in slightly different levels. The grading criteria for the different parameters can be found in Table 7.

Total number of species	Percent alien species	Number of indicator species (AWI)	Trail segment length	Intensity of management	Habitat structure complexity	Partial score	Biodiversity level grading
10-30	100-31%	0	350-275 m	High	Mostly cut lawn, occasional trees and shrubs, built constructions / infrastructure.	1	Low: 6-9
31-50	30-16%	1-4	250-175 m	Medium	Partly wooded area with built constructions / infrastructure or; woodland of simple structure.	2	Medium: 10-14
51-	15-0%	5-	215-75 m	Low	Woodland of complex structure, presence of water.	3	High: 15-18

Table 7: Grading criteria for biodiversity parameters.

Zone No. / Habitat type	Species	Alien	AWI	Length	Management	Complexity	Total biodiversity score	Biodiversity level
Zone 1	3	1	2	2	1	1	**10**	Medium
Zone 7	1	1	2	2	1	1	**8**	Low
Type A	-	-	-	-	-	-	**(9)**	Low
Zone 2	3	1	2	3	2	2	**13**	Medium
Zone 5	2	1	1	3	1	2	**10**	Medium
Type B	-	-	-	-	-	-	**(11.5)**	Medium
Zone 3a	-	-	-	-	-	-	-	-
Zone 3b	-	-	-	-	-	-	**-**	-
Zone 3	2	3	3	1	3	3	**15**	High
Zone 8a	-	-	-	-	-	-	-	-
Zone 8b	-	-	-	-	-	-	**-**	-
Zone 8	2	3	3	2	2	3	**15**	High
Type C	-	-	-	-	-	-	**(15)**	High
Zone 4	1	3	2	3	2	2	**13**	Medium
Zone 6a	-	-	-	-	-	-	-	-
Zone 6b	-	-	-	-	-	-	-	-
Zone 6c	-	-	-	-	-	-	**-**	-
Zone 6	2	3	3	1	2	2	**13**	Medium
Type D	-	-	-	-	-	-	**(13)**	Medium

Table 8: Biodiversity score table for each main zone and habitat type (sub-zones are not rated since species inventories were not performed for these exclusively).

Habitat type A (Zone 1 & 7): Ornamental park

The two zones comprising the ornamental park type were both considered to have equal complexity and management intensity. They also had similar trail segment lengths and numbers of indicator species. The main, and only, difference was the number of species found, which was significantly higher in Zone 1. Of all the zones, Zone 1 was actually the one with the highest number of species, which was rather surprising. One possible explanation is the long continuity of this zone. Of course, a large percentage was exotic and ornamental species and many were common generalists. Still, the species richness was enough to bump up Zone 1 to a Medium level, compared to Zone 7 which was the only Low level zone in the study area.

	Score	Biodiversity level
1	10	Medium
7	8	Low
A	(9)	Low

Habitat type B (Zone 2 & 5): Residential/woodland transition

Both Zones 2 and 5 showed rather high numbers of species, despite their short lengths. Of the total amount of species, however, a large percent was alien, as expected in areas of villa gardens. The higher number of both total and indicator species in Zone 2 could possibly be explained by the south-facing, free-growing edge bordering the valley woodland (Zone 3). The gardens' closeness to the path in Zone 2 also motivated us to include all garden species identifiable from the trail, compared to only the edge species in Zone 5. Adding the two zones' medium complexity, they both resulted to beat Medium biodiversity level.

	Score	Biodiversity level
2	13	Medium
5	10	Medium
B	(11.5)	Medium

Habitat type C (Zone 3 & 8): Moist multi-story woodland in valley

The two zones in the valley, 3 and 8, were essentially two parts of the same habitat and therefore received similar scores, the difference being only length and management intensity. In both zones were found medium amounts of species but, compared to habitat types A and B, only a minor part was of alien origin. Also a large number of indicator species were found here. The habitat structure complexity was considered high due to the shifting topography, the multi-story woodland and the presence of water. Both the zones and the habitat type hence received High biodiversity levels.

	Score	Biodiversity level
3	15	High
8	15	High
C	(15)	High

Habitat type D (Zone 4 & 6): Dry simple woodland on ridge

The sub-zones of Zone 6 were perhaps the most shifting of the sub-zones, but on the whole, the zone was considered as having medium habitat structure complexity. This was also the case for Zone 4, although this zone contained relatively few species. It did however contain a medium amount of indicator species, while Zone 6 contained the highest amount of all zones: seven indicator species. Both zones were in general nature-like woodlands, but the relatively strong human influence resulted in medium levels of management intensity. The two dry woodland zones received equal scores, placing them into Medium biodiversity level.

	Score	Biodiversity level
4	13	Medium
6	13	Medium
D	(13)	Medium

PERCEIVED SPECIES RICHNESS

Results by category

NOTE: The percentages used for the category sections always refer to the percent of pictures out of the *total number* of pictures taken in *each group*. In some instances, the total percentage might differ from the sum of its parts (with a maximum difference of 1%). This is due to the exclusion of decimals which I believe would have made the overview difficult. I assume these minor alterations will not affect the reading.

The two groups that received the task of assessing species richness showed similar results regarding the main categories, including the positive/negative relationships. The result is displayed by group and main category in Table 9.

	EXPERT GROUP			LAYPERSONS GROUP		
	POS	NEG	**TOT**	POS	NEG	**TOT**
Setting of natural elements	14%	8%	**22%**	18%	8%	**26%**
Setting of natural/anthropic elements	1%	0%	**1%**	4%	2%	**6%**
TOTAL SPATIAL CONFIGURATION	14%	8%	**22%**	22%	10%	**32%**
Natural elements	27%	38%	**65%**	26%	32%	**58%**
Anthropic elements	0%	2%	**2%**	0%	6%	**6%**
Element combo	9%	2%	**11%**	2%	2%	**4%**
TOTAL CONTENT-BASED	36%	42%	**78%**	28%	40%	**68%**
TOTAL	**50%**	**50%**	**100%**	**50%**	**50%**	**100%**
Auxiliary motivations: Human influence	1%	10%	**11%**	0%	5%	**6%**
Auxiliary motivations: Reflections	39%	10%	**49%**	21%	11%	**32%**

Table 9: Perceived species richness by group and theme.

The participants put a strong overall focus on elements (content-based), as compared to settings (spatial configurations). The expert group and layperson group motivated their photos using elements in, respectively, 78% and 68% of the cases. Within the elements, as might be expected, both groups put an overwhelming focus on natural elements, both in the positive and in the negative motivations but with slightly more pictures in the negative column. The main part of the element pictures concerned vegetation (mostly living vegetation), followed by the rocks-and-soil category. This last category contained almost exclusively negative comments about bare ground, erosion or lack of field layer. While deadwood was considered exclusively positive within the expert group, some of the laypersons' comments on deadwood were negative. The most interesting category, however, was living vegetation which came to be the single biggest sub-category for both groups – 41% (19% pos. and 21%neg.) and 29% (11% pos. and 18% neg.) for the expert and laypersons group respectively. The expert group showed great consistency in their motivations, stating specifically edge zones as positive, together with several comments regarding gardens or old individual trees. As negative vegetation features, they stated particularly cut lawns but also other types of monocultures. The laypersons group was more inconsistent in their positive motivations, mentioning plant diversity or just presence of different kinds of vegetation, among other things. As negative features, also they stated cut lawns and other monocultures, among other features.

"Tree log. No sign of life."

" Trampling, biking, shadow – soil too much compacted."

"Edge zone of the forest with mixture in tree and field layer."

Figures 27-29: Typical examples from the Natural elements category.

Also for the motivations based on spatially configured settings, the main focus was on purely natural elements. The photographed settings were regarded positive for species richness to a greater extent than negative. Among the experts, most of the positive settings pictures regarded multi-layered woodlands, several containing deadwood. Also the laypersons took their positive pictures in woodlands, especially when close to water. The negative comments in this category concerned primarily single-layered beech stands among the experts and simple or monotonous woodlands/tree structures in general among the laypersons.

"Multilayered forest with deadwood – diverse habitats."

" Water. Trees. Rich soil. Birds."

"Beech, almost monoculture, no field layer."

Figures 30-32: Typical examples from the Settings of natural elements category.

Auxiliary motivations, which are always supplementary to the spatial configuration/content-based motivations, appeared in at least half of the photos in the expert group and in about a third of the photos in the laypersons group. A minor percent of the total pictures concerned *Human influence*, almost exclusively in the negative column. Of these, about half were motivated by trampling and half by park maintenance. Typical examples from Human influence: "*Trampled area, path, compacted, often used, continuous disturbance.", "Newly planted garden. Hard surface = less attractive for other species. Low varieties of plants."*

The reflections, which appeared in respectively 49% and 32% of the two groups' pictures, regarded predominantly positive motivations. The main focus for both groups in this category was their perception of elements as indicators of beneficial or detrimental habitats, followed by assumed presence or absence of species, and reflections about microclimatic conditions. Indicator motivations were predominantly positive in both groups and half of the experts' comments in this frequently used category (34%) concerned deadwood as habitat for insects and fungi. Also the laypersons mentioned deadwood in several instances. Additionally, water and special vegetation was mentioned in both groups. Motivations regarding presumed presence or absence of species were mainly positive and concerned different kinds of woodland.

Typical examples from the Reflections category:

- *"Deadwood – good for fauna."*
- *"Almost dead tree. Probably lots of insects."*
- *"River valley, many ecological niches to be filled."*
- *"Bumble bees. Indication of variety of species!"*
- *"Many trees, a river with many animals filled. Water can afford many species."*

Results by picture distribution

In a visually diverse environment such as Ramlösa Brunnspark, one can expect people to react on features along the whole trail. The area was, however, divided into zones, mainly by habitat type. Some of these zones were similar in structure, although located at different points along the trail. Additionally, the distribution of pictures along the trail was assumed to differ depending on the resolution of analysis. Therefore, the distribution will be presented in four different ways: by habitat type; by zone; by sub-zone and; by tag number.

Due to the difference in numbers of participants between groups and in segment length between zones, the distributions will be shown as relative each other. The amount of pictures is presented as the *mean percentage of positive or negative pictures per 25m in each zone or habitat type* (25 m was chosen as arbitrary minimum unit since it was the distance between tags). While this somewhat decreases transparency, it makes possible a necessary comparison between groups and between zones.

Each main zone and habitat type was assigned a 3-level rating: Negative, Opposing or Positive. This rating will be used to compare the results to the preference groups' result and to the previously mentioned *biodiversity level*. The levels were defined as follows (Table 10):

Difference: positive minus negative pictures	Perceived species richness level	
< -1.00%	Negative*	*Only if dominating percentage (+/-) is >1.06%. Otherwise Average level.
= -1.00% - 1.00%	Average**	**Only if at least one of the (+/-) percentages is >1.06%. Otherwise unsatisfied (no level).
> 1.00%	Positive*	

Table 10: Definition of perceived species richness levels (preference levels are the same).

As reference level was chosen 1.56%, since this is the mean percentage for each 25 m, had all pictures been distributed over the whole trail (1600 m). A moderate amount of positive or negative photos was thus considered to be between 1.06% and 2.06% (i.e. a span of 1.00%). A dominating category (Positive or Negative) is therefore always at least within the moderate amount. The Average level implies contradictory amounts of positive and negative pictures. The distribution of pictures and rating of zones can be found in Table 11.

	EXPERTS PERCEIVED SPECIES RICHNESS				LAYPERSONS PERCEIVED SPECIES RICHNESS			
Zone No.	% pos. per 25 m	% neg. per 25 m	Difference pos. - neg.	Perceived level	% pos. per 25 m	% neg. per 25 m	Difference pos. – neg.	Perceived level
1	2,22%	2,67%	-0,44%	Average	1,14%	2,57%	-1,43%	Negative
7	0,37%	2,10%	-1,73%	Negative	1,48%	0,63%	0,85%	Average
A	1,35%	2,40%	-1,05%	Negative	1,30%	1,65%	-0,35%	Average
2	4,07%	1,85%	2,22%	Positive	1,59%	1,27%	0,32%	Average
5	1,78%	1,11%	0,67%	Average	0,95%	1,14%	-0,19%	Average
B	2,64%	1,39%	1,25%	Positive	1,19%	1,19%	0,00%	Average
3a	4,81%	1,30%	3,52%	Positive	5,24%	2,06%	3,17%	Positive
3b	1,11%	1,11%	0,00%	Average	1,71%	2,29%	-0,57%	Average
3	3,13%	1,21%	1,92%	Positive	3,64%	2,16%	1,47%	Positive
8a	0,00%	0,56%	-0,56%	-	1,43%	0,00%	1,43%	Positive
8b	0,74%	0,19%	0,56%	-	1,27%	0,00%	1,27%	Positive
8	0,56%	0,28%	0,28%	-	1,31%	0,00%	1,31%	Positive
C	2,05%	0,82%	1,23%	Positive	2,66%	1,25%	1,40%	Positive
4	1,39%	3,06%	-1,67%	Negative	1,43%	3,81%	-2,38%	Negative
6a	0,74%	0,56%	0,19%	-	0,95%	2,22%	-1,27%	Negative
6b	0,74%	1,48%	-0,74%	Average	0,32%	1,59%	-1,27%	Negative
6c	0,44%	1,56%	-1,11%	Negative	0,57%	0,38%	0,19%	-
6	0,63%	1,11%	-0,48%	Average	0,68%	1,43%	-0,75%	Average
D	0,80%	1,54%	-0,74%	Average	0,85%	1,96%	-1,11%	Negative

Table 11: Distribution of perceived species richness pictures and rating of zones (sub-zones are only shown as additional data, since they cannot be compared to biodiversity level).

Picture distribution by habitat type

The eight main zones were clustered into four habitat types: type A – ornamental park; type B - residential/woodland transition; type C – moist multi-story woodland in valley and; type D – dry simple woodland on ridge.

When clustering the zones into habitat types, the expert group showed a high percentage of positive photos in habitat type B and, with somewhat lower level, type C. The remaining types A and D received moderate and low levels of positive pictures. For the laypersons group, only habitat type C received high levels of positive pictures, while type A and B got moderate and D got low levels. The highest percentage of negative pictures was for the experts in type A – ornamental park – and the lowest percentage was in type C – complex woodland. Within the laypersons group, the differences between habitat types were not very noteworthy for negative pictures, but the highest level was recorded in type D.

Picture distribution by main zone

As we break down the habitat types into the main zones, we see that the majority of positive pictures in the ornamental park type appear in Zone 1 for the expert group but more evenly split between Zone 1 and 7 for the laypersons. The negative pictures, on the other hand, are many in both zones for the experts but only in Zone 1 for the laypersons.

The residential/woodland transition, which received the most positive pictures by the experts, shows a clear majority in Zone 2, while Zone 5 received a moderate level. The negative pictures were of moderate level in both zones and this was true also for both positive and negative pictures among the laypersons.

The moist, complex woodland, which received the most positive pictures by the laypersons and a large part by the experts, clearly shows a stronger influence in Zone 3 than in Zone 8 for both positive and negative pictures. Considering the similarity of environments in these zones, one possible explanation might be that the participants found Zone 8 to be a repetition of Zone 3 and therefore did not photograph it as much.

The simple structure woodland type as a whole received low percentages of positive pictures and moderate percentages of negative by both groups. When separated into zones, this habitat type shows somewhat more positive pictures in Zone 4 than in Zone 6, while the negative pictures are heavily dominated by Zone 4 – a woodland of tall beeches virtually without field or shrub layer.

Picture distribution by sub-zone

Since no more than three of the main zones were divided into sub-zones, only these will be addressed here.

Zone 3 as a whole received high levels of positive pictures by both groups. Yet we find the overwhelming majority of these to be in Zone 3a and only a moderate level in Zone 3b. The negative pictures, which show high levels only among the laypersons, are evenly split between the two sub-zones for both groups.

Zone 6 did not receive much attention as a whole and neither one of the three sub-zones received notable percentages, at least not by the expert group, although 6b and 6c got somewhat more negative photos than 6a. Among the laypersons could be mentioned a domination of negative pictures in Zone 6a, a moderate level in 6b and a low level in 6c.

Zone 8 was the least photographed main zone among the experts, who took no positive pictures at all in Zone 8a and only one picture in 8b. The laypersons group showed an even distribution of positive photos between 8a and 8b, while they took no negative photos at all in these sub-zones.

Picture distribution by tag number

The graphs below show the distribution of positive and negative pictures by tag number. Here, the pictures are represented in absolute numbers, not as percentages or in relation to trail segment length. Note also that the total number of pictures may differ from one group to another. However, the scale of each y-axis has been chosen in relation to total picture number in each group. The relative importance of each bar can therefore be compared between groups.

As we can see, both of the species richness groups took pictures along the whole trail, although the majority was taken within the first half. The most important recurring features have been marked in the graphs and are presented as photos and written motivations for each group.

The experts found especially deadwood and an old tree in the first two zones to be positive and also the woodland edge in Zone 2. The most important negative features were the grass lawn in Zone 1 and the bare ground of the beech woodland in Zone 4. Also the trampled soil in Zone 6b and the low species diversity of Zone 7 were mentioned several times.

The laypersons focused especially on the benefits of the creek and its surrounding in Zone 3a, but also on the pond in 8a. The woodland structure of 6a and the open character of Zone 7 were other prominent positive features. The emptiness and lack of diversity in Zone 1 are highlighted as negative features and the laypersons agreed with the experts on the negative effect of bare ground in Zone 4. They did, however, take several pictures regarding the lack of diversity in Zone 6a and Zone 7, which several had stated as positive.

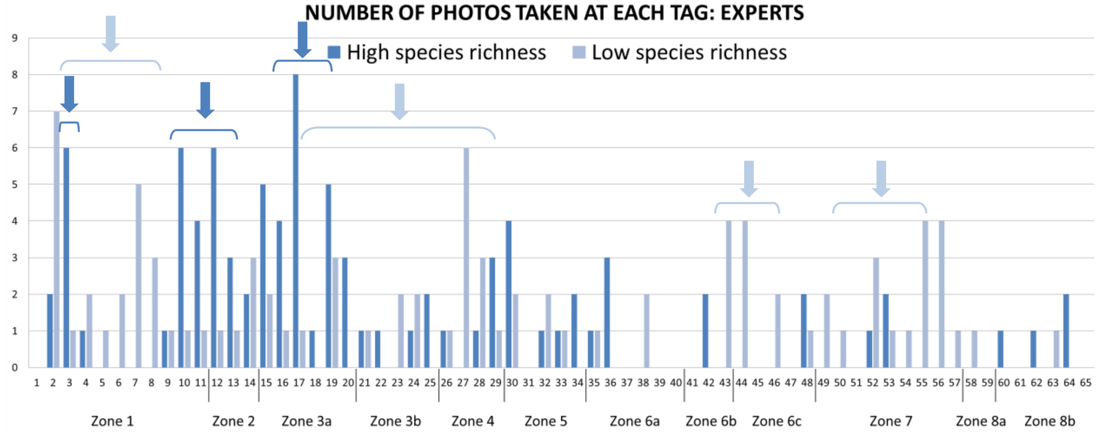


Figure 33: Picture distribution by tag number for expert species richness group.

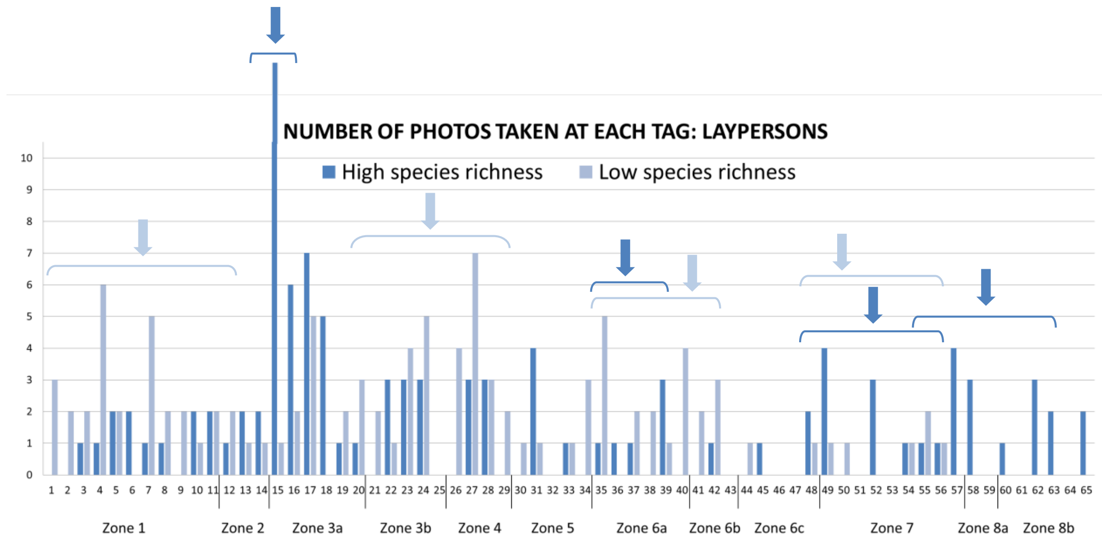


Figure 34: Picture distribution by tag number for layperson species richness group.

Tag No. 3

"Hole in a tree, protected micro climate for e.g. bugs."

"Almost dead tree. Probably lots of insects."

"Many bugs, bacterias, fungi etc. in deadwood."

"Pterocarya + undergrowth."

"Old trees contain lots of insects, mosses, lichens, bird nest, bat nests."

"Insect fauna."

Tag No. 10-13

"Grove, many different species."

"Edge, nice habitat."

"Edge, looks natural."

"Forest edge meets lawn."

"Edge zone of the forest with mixture in tree and field layer."

"Mixed species + mixed ages."

"Edge to a slope, different flowers and complex structure."

"The edge of the forest."

"South-facing edge zone = higher diversity."

"Edges, holds[?] both species who need light but also species who need shade."

Tag No. 16-19

"Deadwood + nice field layer."

"Water animals, insects, deadwood."

"Left trunks and branches from cutting."

"Rich field layer, deadwood, birds."

"Deadwood + rich field layer."

"Deadwood – good for fauna."

"Deadwood. High, middle and field layer."

"Multilayered forest with deadwood."

"Deadwood, good for high biodiversity."

"Deadwood – insects! Light forest, field layer."

"Multilayered forest with deadwood – diverse habitats."

"Mixed vegetation (deadwood in the mix), lots of birds, tree species and field layer species."

Tag No. 3-8

"Grass lawn."

"Cut lawn, not so many species."
"Seeded grass with few herbs."

"Cut lawn, grass largely favoured."
"Single tree in mowed lawn with no ground cover. Typical garden solution that could be more interesting."
"Lawn, monoculture, high maintenance."
"Lawn – other species surpressed."

"Grass lawn with few trees."
"Lawn and bare soil plant beds, not many possibilities for natural establishing."
"Mowed lawns are fertilized to promote only grasses."

Tag No. 17-29

"The Fagus create dense shadow and sour soil."

"Beech stand without ground vegetation."

"Beech forest floor."

"Beech stand, monoculture, almost no field layer."

"Mostly Fagus sylvatica."
"Fagus stand, not too many species can grow under a Fagus canopy."

"Beech pillar hall without any other plants than beech."

"Beech stand, bare soil, acid soil and few species."

"Monoculture of beeches."

"Beech forest with young trees."

"Only beeches."

"Beech monoculture with no field layer."

"Beech, almost monoculture, no field layer."

"Young beech trees (no other species) with no field layer."

"Old Fagus sylvatica stand = low species richness."

"No plants growing at all – shadow... (beech!)."
"One species dominant, shades, makes pH different and sets the stage."

"Beech forest floor, dark, pH: few species."

Tag No. 43-46

"Acer + no field layer + disturbances from visitors."
"Trampled area, path, compacted, often used, continuous disturbance."

"Trampling, biking, shadow – soil too much compacted."

"Compacted path – nothing can grow here."

"Bare soil, soil compacted."

"Earth bank where people walk."

"Heavily trampled soil."

"Slope only covered with soil."

Tag No. 50-56

"A cultivated landscape with Rhododendrons on cut lawn with monoculture field flora towards the edge – no room for more species."

"Monoculture."

"Rhododendron, kills all else."
"Solitary bush stand weeded to promote monoculture."
"Monoculture of Rhododendron."
"Monoculture fieldlayer, almost."
"Parksallat [Cicerbita macrophylla], too invasive."

"Rhododendron + Cicerbita."
"Parksallat [Cicerbita macrophylla] monoculture."
"Monoculture of "Parksallat" [Cicerbita macrophylla]."
"Field layer outcompeting everything else."
"One field layer species takes it all over."

Figures 35-41: Most recurrent positive/negative features in expert species richness group.

Tag No. 14-16

"Water, lots of green, lively."
"Many trees, a river with many animals filled. Water can afford many species."
"Trees along the river, close to water. Not quite close to the area where people live."
"River = a lot of different species!! Filled with life!"
"Clear water, duck and plants."
"Water will provide environment/conditions for many living things."
"Water. Trees. Rich soil. Birds."
"A small river with some trees."
"The water is flowing and there are a variety of species in the pond, such as ducks, fishes etc."
"Water is always a great source of life."
"Water is the source of all life and open water adds an area for new species."

Tag No. 35-39

"The forest. Represents a natural and protected environment for many species."
"Many trees and grasses."

"Many small plants. They're quite mixed."

"Untouched path."

"Many different kinds of plants."

"It's a forest, not just trees."

"Standard forest's characteristics, with young trees, leaves on ground."

Tag No. 48-56

"Trees, flowers, resting place, squirrel, territory diversity."

"Up and down."

"Grass habitat for many insects."

"Grassland with flowers and trees."

"A lot of sunlight and flowers."

"Spring time. Trees have surrounded the flowers."

"Grass, flowers, trees. Open field with careful protection."

Tag No. 55-63

"The lake. Water, animals, trees around together they make species rich."
"Water, animal, trees, flowers."

"Pond filled with life!!"

"Water with different animals and plants around."
"Water, different plants."

"Small pond with trees and grass, it should have many species."
"Small island in the middle of small river."
"The river. Water gives life for different species."
"By the river. Water, trees around."

Tag No. 1-12

"Same type."
"It's empty and not so many trees and animals."
"Grass and cars = not much life."
"Field and grass. Guessing it doesn't contain as many species as naturally grown fields."
"Same color."
"Very empty, only few trees."
"Only soil with few species."
"No people, no animals, no flowers."
"The lawn is cut regularly. Not so many trees, bushes around."
"Only grass field, looks artificial."
"People are taking care of this lawn. They probably don't allow too much variation of species here."
"No diversity."
"Same type."
"Grass along the road. It's for single species."
"Just grass."

Tag No. 20-29

"Trees with few small plants. Field covered by trees, lack of sunshine."
"Not much grass on the slope."
"Sands with few species."
"Only grass and dead leaves."
"Not much grass on the slope."
"Roots under the ground or over the ground?"
"Looks dead and dry."
"Grass with low density."
"Not enough bushes."
"No plants on ground."
"Same tree, no plant on the earth."
"Soils with few grass."
"Sands with died leaves."
"The dirt ground. I didn't see many species around."
"Sands with died leaves."
"Looks poor and dry."

Tag No. 35-42

"Nothing but several small trees."

"Huge tree with few grass. Nutrition and sunshine is taken by the tree."
"Single plant."

"Only 1 species."

"Looks like only small trees."

"Soils with few species."

"Same kind of tree."

"Trees. Only one kind."

Tag No. 48-56

"Nice color but few species."

"Only grass, artificial."

"Only the grass field, not so many animals nearby."

"Hill up to house = only 1 kind of species!"

"No sunshine, no other species."

"Same kind of grass."

"Many species of one kind in one area. Diversity would lead to increased richness."

Figures 42-49: Most recurrent pos./neg. features in layperson species richness group.

Summary of perceived species richness picture distribution

	Exp.	Lay.
1	Average	Negative
7	Negative	Average
A	Negative	Average

Habitat type A (Zone 1 & 7): Ornamental park
The ornamental park type generated inconsistent results, both between zones and between groups. Experts found many negative aspects of both zones, while laypersons found them mostly in Zone 1. Still, experts found many positive aspects of Zone 1 but very few ones in Zone 7. Laypersons found moderate levels of positive aspects in both zones.

	Exp.	Lay.
2	Positive	Average
5	Average	Average
B	Positive	Average

Habitat type B (Zone 2 & 5): Residential/woodland transition
As a whole, the habitat type which was the border between villa gardens and woodland showed moderate levels of both positive and negative pictures, except for a high level of positive pictures among experts. This peak is due to a very high level in Zone 2. Apart from that, both groups found moderate levels of both positive and negative aspects in the two zones, although slightly higher in Zone 2.

	Exp.	Lay.
3	Positive	Positive
8	-	Positive
C	Positive	Positive

Habitat type C (Zone 3 & 8): Moist multi-story woodland in valley
The multi-story woodland in the valley received, as a whole, high levels of positive pictures from both groups. However, despite the apparent visual similarities between Zone 3 and 8, Zone 3 received the vast majority of positive pictures and of these, Zone 3a received the great bulk. Both Zone 8a (the pond) and 8b received very little attention from experts, while laypersons took moderate levels of positive pictures and no negative ones at all in these sub-zones.

	Exp.	Lay.
4	Negative	Negative
6	Average	Average
D	Average	Negative

Habitat type D (Zone 4 & 6): Dry simple woodland on ridge
The simple, beech-dominated woodland generated a low level of positive pictures among both groups. Of these pictures, a moderate amount was taken in Zone 4 and a low amount in Zone 6. The negative pictures, which amounted to moderate levels for the habitat type as a whole, showed strikingly high levels in Zone 4 while only moderate levels in Zone 6. The three sub-zones of Zone 6 all got low levels of positive pictures, while the negative ones appeared more in Zone 6b and 6c among the experts and more in 6a and 6b among the laypersons.

PREFERENCE

Results by category

The distribution of pictures over the main categories was relatively similar between the two preference groups, as seen in Table 12. One difference that can be noted is the stronger tendency of choosing content-based motifs among the laypersons group, although the tendency was strong for both groups.

	EXPERT GROUP			LAYPERSONS GROUP		
	POS	NEG	**TOT**	POS	NEG	**TOT**
Setting of natural elements	20%	6%	**26%**	12%	2%	**14%**
Setting of natural/anthropic elements	10%	6%	**16%**	7%	1%	**8%**
TOTAL SPATIAL CONFIG.	30%	11%	**41%**	19%	3%	**22%**
Natural elements	14%	9%	**23%**	17%	19%	**36%**
Anthropic elements	4%	27%	**31%**	12%	29%	**41%**
Element combo	2%	2%	**4%**	1%	0%	**1%**
TOTAL CONTENT-BASED	20%	39%	**59%**	31%	47%	**78%**
TOTAL	**50%**	**50%**	**100%**	**50%**	**50%**	**100%**
Auxiliary motivations: Human influence	1%	1%	**2%**	1%	7%	**9%**
Auxiliary motivations: Reflections	29%	30%	**59%**	31%	36%	**67%**

Table 12: Preference by group and theme.

As just said, both groups focused on content-based motifs, which were distributed mainly between *Natural* and *Anthropic elements*, with somewhat more pictures in the Anthropic elements category. However, while the positive/negative distribution was quite even in the natural elements category, the anthropic elements were considered predominantly negative, suggesting sensitivity to individual human-related elements among the participants. A closer look at the sub-categories shows that the negative Anthropic elements were mainly different kinds of *Infrastructure*, such as fences and walls, lighting systems, outdoor furniture etc., and *Small or temporary signs of human presence*, such as graffiti or litter.

"Light with all wires."

" White rhododendron."

"The fence is dirty and not pleasing to the eye."

Figures 50-52: Typical examples from the Anthropic elements and the Natural elements categories.

In the spatial configuration categories we find that both groups focused more on settings of purely natural elements than on mixed settings. What is worth highlighting, however, is the overall predominance of positively motivated pictures in both settings categories. Looking at these pictures/comments, a few recurring themes appear: the openness and composition of Zone 7 (and also of Zone 1) was mentioned several times in both groups. Also the structure of the woodlands on the north ridge was appreciated, especially within the expert group, while the area around the pond and creek was mentioned as positive in various instances among the laypersons group. Another specific feature with several positive comments was the view down to the water from the path along Zone 2.

"I like the grassplot, enjoy the sunshine here."

" Woodland structure and color: openness and light."

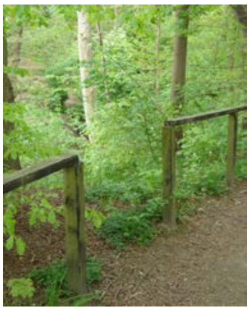
"Steep hill, clear view to water."

Figures 53-55: Typical examples from the Setting of natural elements category.

Within the Auxiliary motivations, few comments regarded *Human influence* and of these, most were negative, referring to e.g. traffic noise, trampling, broken handrails and the only recurring theme among the laypersons – tree stumps and deadwood. *Reflections* appeared in about two thirds of both groups' motivations, evenly distributed between positive and negative pictures. Among the Reflections, the *Coherence* category was the most common, containing predominantly negative motivations regarding artificiality or bad fit. Also *Aesthetics* was a commonly used sub-category, containing very diverse motifs, both positive and negative ones. For the rest of the reflection sub-categories – although they were not so commonly used (0-10% of total amount) – the two groups differed somewhat. Several comments in the expert group concerned *Scale* while the same was true for *Tranquility* in the laypersons group. Both groups made comments about *Accessibility* – mainly negative – and the laypersons also made several negative comments on *Safety* issues and perceived maintenance issues.

"The shape of the island is very unnatural."

" The house with the trees. It's beautiful."



"Old, not safe."

Figures 56-58: Typical examples from the Auxiliary motivations category.

Results by picture distribution

The definition of preference level is the same as for the perceived species richness (see previous section), and will therefore not be repeated here. The preference picture distribution can be found in Table 13.

	EXPERTS PREFERENCE				LAYPERSONS PREFERENCE			
Zone No.	**% pos. per 25 m**	**% neg. per 25 m**	**Difference pos. - neg.**	**Preference level**	**% pos. per 25 m**	**% neg. per 25 m**	**Difference pos. – neg.**	**Preference level**
1	2,71%	2,14%	0,57%	Average	2,86%	1,29%	1,57%	Positive
7	1,90%	0,32%	1,59%	Positive	2,06%	0,63%	1,43%	Positive
A	2,33%	1,28%	1,05%	Positive	2,48%	0,98%	1,50%	Positive
2	2,38%	2,38%	0,00%	Average	0,48%	1,90%	-1,43%	Negative
5	0,29%	1,71%	-1,43%	Negative	1,14%	0,86%	0,29%	Average
B	1,07%	1,96%	-0,89%	Average	0,89%	1,25%	-0,36%	Average
3a	2,38%	0,71%	1,67%	Positive	1,67%	2,62%	-0,95%	Average
3b	0,86%	2,57%	-1,71%	Negative	1,71%	2,29%	-0,57%	Average
3	1,69%	1,56%	0,13%	Average	1,69%	2,47%	-0,78%	Average
8a	0,71%	5,71%	-5,00%	Negative	1,43%	4,29%	-2,86%	Negative
8b	0,95%	1,43%	-0,48%	Average	1,43%	2,38%	-0,95%	Average
8	0,89%	2,50%	-1,61%	Negative	1,43%	2,86%	-1,43%	Negative
C	1,35%	1,95%	-0,60%	Average	1,58%	2,63%	-1,05%	Negative
4	1,43%	2,14%	-0,71%	Average	2,14%	1,43%	0,71%	Average
6a	1,19%	0,71%	0,48%	Average	0,48%	0,48%	0,00%	-
6b	1,43%	1,43%	0,00%	Average	0,48%	4,29%	-3,81%	Negative
6c	0,86%	1,14%	-0,29%	Average	0,57%	0,00%	0,57%	-
6	1,12%	1,02%	0,10%	Average	0,51%	1,12%	-0,61%	Average
D	1,19%	1,27%	-0,08%	Average	0,87%	1,19%	-0,32%	Average

Table 13: Distribution of preference pictures and rating of zones (sub-zones are only shown as additional data, since they cannot be compared to biodiversity level).

Picture distribution by habitat type

The eight main zones were clustered into four habitat types: type A – ornamental Park; type B - residential/woodland transition; type C – moist multi-story woodland in valley and; type D – dry simple woodland on ridge.

When clustered, type A received the highest relative percentage of positive pictures in both the expert group and the laypersons group. The rest of the positive pictures are quite evenly distributed between the other habitat types in the expert group, while type C received a larger portion of pictures in the laypersons group.

The negative pictures dominated type B and C in the expert group but showed a very strong predominance in type C for the laypersons. For both groups, the habitat type with the most positive pictures (A) received relatively few negative pictures. Similarly, the habitat types with the least positive pictures (B and D) received relatively many negative pictures. However, type C does not follow this pattern for any of the groups. Instead, this habitat type received relatively many both positive *and* negative pictures, especially in the laypersons group. We will look closer at this relationship in the following sections.

Picture distribution by zone

When the distribution is broken down into the eight main zones, we can see that the high percentage of positive pictures in the ornamental park type (for both groups) corresponds to high percentages in both Zone 1 and 7, although highest in Zone 1. The negative pictures taken in these ornamental and highly maintained zones, however, were mostly located in Zone 1 – especially for the expert group – which suggests many, or strongly, disturbing features in an otherwise appreciated area of the park.

The residential/woodland transitions, on the other hand, were not as consistent. While the experts took a high percentage of positive pictures in Zone 2 and a very low percentage in Zone 5, the laypersons took a very low percentage of positive pictures in Zone 2 and a moderate percentage in Zone 5. The negative pictures for these zones appeared in Zone 2 to a larger extent than in Zone 5, which is noteworthy at least for the expert group, who took as many negative as positive pictures in Zone 2. A preliminary guess is that the positive and negative pictures were taken on each side of the transition, respectively.

The complex woodland habitat type (C) received a moderate level of positive pictures in both zones 3 and 8 from both groups, except for Zone 8, which received a relatively low level from the experts. The negative pictures, however, were notably high in Zone 8 for both groups and in Zone 3 for the laypersons, while they were only moderate for the experts.

Zone 4, which belonged to the simple, dry woodland, received moderate to high percentages of both positive and negative photos, although the negative dominated the expert group while the opposite was true for the laypersons. Zone 6 appears to have passed relatively unnoticed by both groups as it got only low to moderate levels, especially low positive level for the laypersons.

Picture distribution by sub-zone

Since no more than three of the main zones were divided into sub-zones, only these will be addressed here.

As the picture distribution is broken down into sub-zones, the experts' seemingly even relation between positive and negative pictures in Zone 3 shows a clear difference between zones 3a and 3b, with a strong preference for 3a and an equally strong aversion for 3b. For the laypersons group, the positive/negative relation in Zone 3 as a whole was uniformly reflected in the two sub-zones. Here, the main difference between the groups was the low percentage of negative photos in Zone 3a among the experts and the high percentage among the laypersons.

Zone 6, which as a whole received low to moderate levels by the experts, showed a relatively even distribution of both positive and negative pictures between its three, visually rather different, sub-zones. For the laypersons, on the other hand, the few positive pictures were also here evenly spread over the sub-zones, but Zone 6b (one of the shortest trail segments) displayed a proportionally huge percentage of negative pictures (9 pictures in 75 m).

Both groups took low to moderate levels of positive pictures and high levels of negative pictures in Zone 8 as a whole. As sub-zones, 8a and 8b received even distributions of positive pictures, but Zone 8a possessed an overwhelming majority of the negative percentage, especially among the experts. Keep in mind that all percentages are related to the corresponding trail segment length. For example, there were more negative pictures in Zone 8b than in 8a among the laypersons. Still, in the table, Zone 8a displays a much higher percentage than Zone 8b due to the difference in segment length (50 and 150 m, respectively).

Picture distribution by tag number

The graphs below show the distribution of positive and negative pictures by tag number. Here, the pictures are represented in absolute numbers, not as percentages or in relation to trail segment length. Note also that the total number of pictures may differ from one group to another. However, the scale of each y-axis has been chosen in relation to total picture number in each group. The relative importance of each bar can therefore be compared between groups.

The graphs show that both of the preference groups took pictures along the whole trail, suggesting an even distribution. The peaks do not necessarily indicate a specific feature, but are often photos of varying content. Therefore, the most important clusters of specific, recurrent features are marked and presented with photos and written motivations in the following pages. It becomes clear that the expert group was significantly more homogeneous in their choices of motifs, both positive and negative, than was the layperson group, which demonstrated only one recurrent feature.

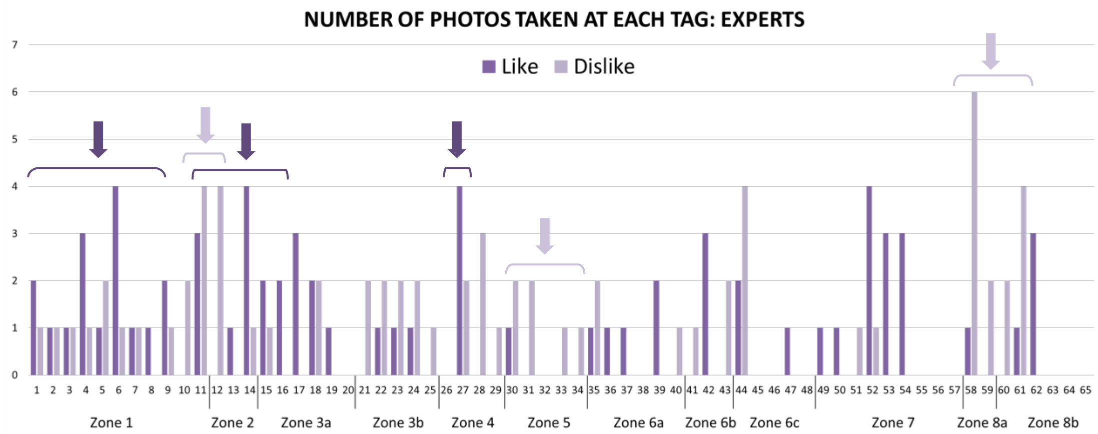


Figure 59: Experts distribution of preference pictures by tag number.

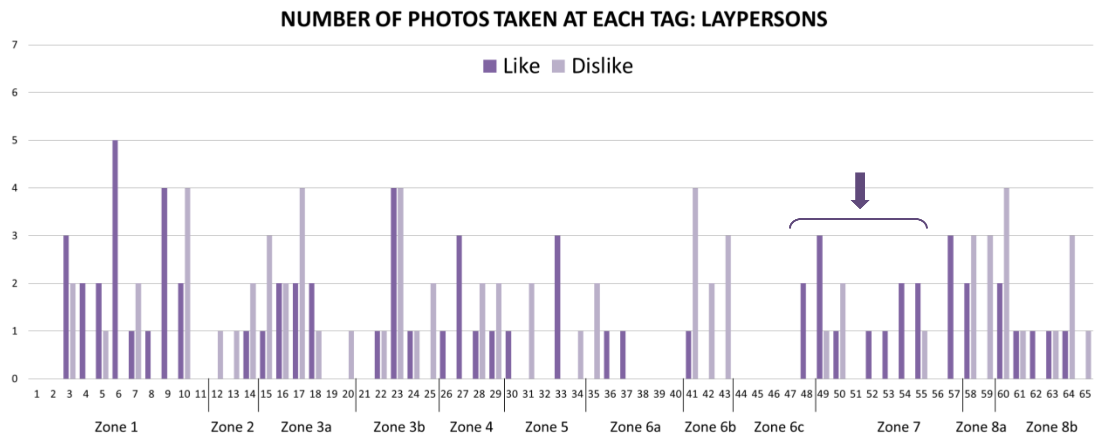
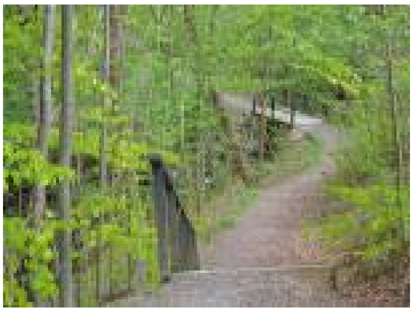


Figure 60: Laypersons distribution of preference pictures by tag number.

Tag No. 1-9

"View to several nice buildings."
"It reminds me of the old traditional spa."
"Combination of housing in park environment + majestic trees."
"Architecture (nice houses)."
"The houses and their framing is very characteristic. I like how one is used as kindergarten - lively, good interaction."
"Balance between building and park"
"Beautiful house and maple."
"Building in itself."
"Old gardening style + architecture inspiring."
"Beautiful house."

Tag No. 11-16



"Interesting steep view, water in the bottom."
"View down on stairs and water."
"Steep hill, clear view to water."
"Feeling of the space and the trees."
"Way into the wilderness, view on the stream, bridge."
"Entrance, views, covered."
"It looks wild, and because of the stream."
"The river and the vegetation around the river magical. And to be down in the valley, good climate!"
"Impression of wild river, sound of running water, birdsong."

Tag No. 18-27

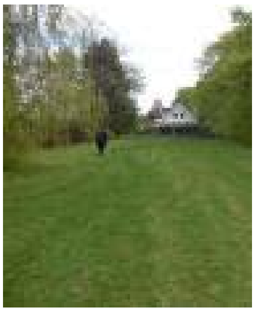
"Trunks in contrast to leaves."
"Great volumes impress."
"Incredibly nice green foliage moving in the wind."
"The slope with the Fagus, amazing, respectful."
"Woodland structure and color: openness and light."
"Because of the shade and feeling about old Fagus trees."
"The height differences. Being among the tree crowns and stand on a plateau under another tree crown level."
"The height difference - being up in the crowns."

Figures 61-63: Most recurrent positive features in the expert preference group.

Tag No. 10-12

"Stone with PEAB [a construction company] and orange color."
""Interruption" of the path."
"Disturbing elements like neon/concrete thing, buildings not fitting in."
"The character of the house doesn't fit to the surrounding park area."
"Disturbing and unsuitable objects in an otherwise quite nice place."
"Superimposed feeling."
"The meeting between the house and nature - "gunnebostaket" [common green wire fence]."
"Path does not feel very inviting, feels half private…"
"The fence and the corner of the path - barriers, not too friendly."

Tag No. 30-34



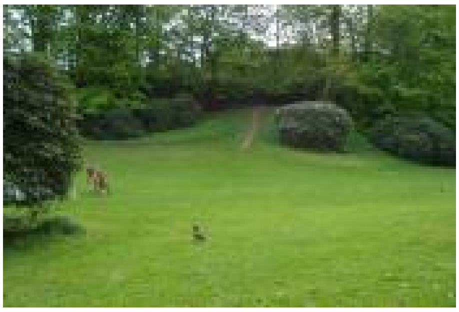
"The form of the lawn."
"Boring exit. Would be great to just plant a tree either at the start of the passage, or end to frame it for example."
"Boring part compared to rest of the walk."
"Berberis."
"Ugly materials, roadblock, the edge disappears."
"Repelling (right now) connection housing < > green area."
"Concrete wall."

Tag No. 58-61

"The arrangement of stones is not attractive at all (would nicer with scattered ones)."
"Pond surrounded by stones and island like floating pancake"
"The shape of the island is very unnatural."
"View of duck pond from bench. Placing of bench bad, path and pond dull. "
"The bridge doesn't fit to the place."
"…the river and looking artificial."

Figures 64-66: Most recurrent negative features in the expert preference group.

Tag No. 48-55



"The trees and grass, gorgeous! Let's have a picnic!"
"Duck, green, sunshine, relax."
"I like the grassplot, enjoy the sunshine here."
"A place to sunbathe/have a picnic, rest, etc."
"Rest in nature."
"Nice meeting point/green spot. Lots of people hanging here."
"It is quiet and beautiful."
"Hilly/wavy grass area."

Figures 67-68: Most recurrent positive feature in the layperson preference group.

Summary of preference picture distribution

	Exp.	Lay.
1	Average	Positive
7	Positive	Positive
A	Positive	Positive

Habitat type A (Zone 1 & 7): Ornamental park
The classic park type with cut lawn and scattered trees and bushes generated the most positive pictures, consistently for both groups. Of the two park zones, both generated many positive pictures, but Zone 1 more so than Zone 7. However, Zone 7 received low levels of negative pictures, while Zone 1 received a high level among experts and moderate level among laypersons.

	Exp.	Lay.
2	Average	Negative
5	Negative	Average
B	Average	Average

Habitat type B (Zone 2 & 5): Residential/woodland transition
The transition between residential gardens and park woodland generated inconsistent results between groups and between zones. Zone 5, which had a cut lawn between the gardens and the woodland, showed similar low to moderate levels of positive and negative pictures among the laypersons. The experts, on the other hand, showed a clear difference between positive and negative levels, with very few positive pictures and a (strong) moderate amount of negative. An identical pattern was displayed by the laypersons for Zone 2, while the experts showed high levels of both positive and negative pictures in this zone.

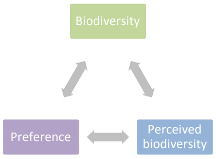
	Exp.	Lay.
3	Average	Average
8	Negative	Negative
C	Average	Negative

Habitat type C (Zone 3 & 8): Moist multi-story woodland in valley
The complex woodland type generated moderate levels of positive pictures in both groups and also moderate level of negatives in the expert group. However, the laypersons displayed a very high percentage of negative pictures for this habitat type. When looking on zone level, the experts display moderate levels of both positive and negative pictures in Zone 3, but the sub-levels show that most positive ones were taken in Zone 3a and most negative ones in 3b. The laypersons, who displayed moderate amount of positive pictures and high amount of negative in Zone 3, showed the same distribution also in the two sub-zones. The low to moderate amount of positive pictures taken in Zone 8 were quite evenly distributed between Zone 8a and 8b for both groups. The amount of negative pictures, on the other hand, was high in Zone 8 as a whole, but the overwhelming part was found in Zone 8a.

	Exp.	Lay.
4	Average	Average
6	Average	Average
D	Average	Average

Habitat type D (Zone 4 & 6): Dry simple woodland on ridge
The simple-structured woodland type generated moderate to low levels of photographs. Both main zones received moderate amount of positive pictures by the experts and the ones in Zone 6 were relatively evenly spread over the three sub-zones although lowest in 6c. For the laypersons, Zone 4 got a high level of positive pictures, while all three sub-zones in Zone 6 got low levels. Looking at the negative pictures, Zone 4 generated relatively high amount among the experts and moderate amount among the laypersons. Zone 6 generated (weak) moderate levels among both groups, but while the experts' pictures were relatively evenly spread over the sub-zones, the laypersons' negative pictures were almost exclusively in Zone 6b – the woodland with very dense shrub layer.

TRIANGULAR RELATIONSHIP



So far, we have seen the individual results for each of the three parts of the triangular relationship that is the backbone of the study aim. In this section, the results from the three surveys will be put together and compared, first by category, then by spatial distribution (zones and habitat types).

Category comparison

Since the category data is only designed and available for the preference and perceived species richness, the category comparison will only be performed between these two. The two themes will then be compared to the biodiversity score in the next section – *Distribution comparison*.

As a first comparison, it can be noted that in both themes – preference and perceived species richness – the content-based motivations dominated. This was true for both experts and laypersons.

The positive pictures were in general motivated by natural elements or settings in both the preference and perceived species richness theme. There were some differences, though. While both species richness groups focused mainly on natural elements and to a lesser extent on natural settings, the expert preference group focused mainly on natural settings, followed by natural elements and settings of mixed elements. Among the layperson preference group, positive motivations mainly concerned natural elements followed by anthropic elements and settings of natural elements.

The negative pictures differed more between the two themes. Among both groups, negative preference motivations concerned mainly anthropic elements (i.e. infrastructure and small or temporary signs of human presence) and to a lesser extent natural elements. Natural elements, and to some extent natural settings, were instead the most common negative motif in the species richness theme.

Distribution comparison

Each of the three factors of the triangular analysis – assessed biodiversity level, perceived species richness, and preference – have been assigned a 3-level rating for each of the eight main zones and for the four habitat types. In some cases, also the sub-zones have been rated and can provide additional information. The combined ratings presented in Table 14 are, as mentioned before, based on the relative amount of positive and negative pictures in each zone and are related to trail segment length. The ratings are thus the result of the chosen methodology and will be analyzed knowing that they represent a synthesis and generalization of the participants' opinions.

Zone No. / Habitat type	Biodiversity level	Experts perceived species richness	Laypersons perceived species richness	Experts preference	Laypersons preference
Zone 1	Medium	Average	Negative	Average	Positive
Zone 7	Low	Negative	Average	Positive	Positive
Type A	Low	Negative	Average	Positive	Positive
Zone 2	Medium	Positive	Average	Average	Negative
Zone 5	Medium	Average	Average	Negative	Average
Type B	Medium	Positive	Average	Average	Average
Zone 3a	-	Positive	Positive	Positive	Average
Zone 3b	-	Average	Average	Negative	Average
Zone 3	High	Positive	Positive	Average	Average
Zone 8a	-	-	Positive	Negative	Negative
Zone 8b	-	-	Positive	Average	Average
Zone 8	High	-	Positive	Negative	Negative
Type C	High	Positive	Positive	Average	Negative
Zone 4	Medium	Negative	Negative	Average	Average
Zone 6a	-	-	Negative	Average	-
Zone 6b	-	Average	Negative	Average	Negative
Zone 6c	-	Negative	-	Average	-
Zone 6	Medium	Average	Average	Average	Average
Type D	Medium	Average	Negative	Average	Average

Table 14: Combined ratings of zones and habitat types.

Habitat type A (Zone 1 & 7): Ornamental park

In the preference groups, the experts matched their Average species richness rating for Zone 1, while the laypersons generated a Positive preference rating which should be compared to their Negative species richness rating. About Zone 1 in general can be said that it generated a wide range of motivations and motifs within both themes.

For Zone 7, which was the only zone with Low biodiversity level, both preference groups agreed and showed Positive preference. In Zone 7, the two layperson groups gave similar motivations, concerning mostly positive pictures of the character of the open lawn, the rhododendrons and the animals that could be seen there. Also the expert preference group gave motivations similar to this, but the expert species richness group instead gave negative comments about the lawn and rhododendrons and also about the invasive *Cicerbita macrophylla*.

It is interesting to compare the results for the ornamental park type since the participants' opinions seem to follow the diverse and mixed character of it, at least in Zone 1. This habitat type was indeed the most popular one, judging by the large number of positive pictures, both relative its length and in absolute numbers. But Zone 1 also generated significantly more disliked photos than the structurally similar Zone 7.

The cluttered character of Zone 1 might also help to explain the inconsistency of the species richness groups, who photographed many negative features in Zone 1 but displayed diverging results in all other aspects. For example, several positive photos in the expert group depicted old tree trunks and a woodland edge – very specific elements that are not always found in a habitat type like this. The laypersons did not react notably to these features. Between the two species richness groups, the experts were somewhat more accurate than the laypersons in judging Zone 1 and 7, resulting in Average and Negative ratings, respectively.

Zone 1 and 7 were indeed the only main zones that got Positive preference ratings (besides sub-zone 3a), making *ornamental park* the most popular of the four habitat types.

Habitat type B (Zone 2 & 5): Residential/woodland transition

The transitional zones between villa gardens and woodlands were of Medium biodiversity level and the species richness groups mostly agreed with this (Average), although the experts found Zone 2 to be of Positive level for species richness, which also affected the rating of the habitat type as a whole. On habitat type level, type B thus generated mostly Average levels for both assessed biodiversity and preference.

It appears as if the narrow path between the gardens and the woodland in Zone 2 made the preference groups focus on either one of the two sides. Negative comments mostly concerned the gardens and some infrastructure, while the positives ones mostly concerned the view down into the valley. The species richness groups focused almost entirely on the woodland side of the trail, especially the experts, who found many positive aspects there.

In zone 5, however, the preference groups did not at all pay attention to the woodland edge, the experts having mostly negative comments about the character of the place and the laypersons having mostly positive. The species richness groups also paid little attention to the woodland in Zone 5, giving mixed motivations concerning mostly the gardens and the grass field. In the preference groups, experts found Zone 5 to be Negative and laypersons thought the same about Zone 2.

Habitat type C (Zone 3 & 8): Moist multi-story woodland in valley

Zone 3 and 8 were the only zones, and therefore the only habitat type, which received High biodiversity levels in the assessment. Both species richness groups accurately found mainly positive aspects of this habitat type, although the experts did not take enough photos in Zone 8 for it to be rated. Preference ratings, on the other hand, ranged from negative to Average. Habitat type C was indeed the only habitat type that received at least one Negative preference rating (for the whole type), which indicates a conflict with both assessed and perceived biodiversity/species richness. Additionally, the pictures taken in the multi-story woodland in the valley suggest a need to consider the area as sub-zones rather than looking at these clustered, as we will see.

Although zones 3 and 8 indeed are similar habitat types, clear differences appear in the results. Zone 3a generated high to moderate amounts of positive pictures among all four groups, though some negative comments about infrastructure appeared among the laypeople. In comparison, Zone 8b, which is essentially identical to 3a, generated several negative comments in the preference groups. At closer examination, these comments regarded exclusively human interventions such as infrastructure, design or graffiti. It is also interesting that the species richness groups took so few positive pictures in Zone 8b compared to in 3a. The disturbing human interventions mentioned by the preference groups might be one possible reason to why the species richness in 8b was not so highly considered. Another explanation could be the effect of repetition or that most pictures already were taken by the time the participants got to 8b. A third guess could be the difference in e.g. field layer or presence of deadwood close to the path.

Zone 3b generated rather inconsistent results, but still received mostly negative preference pictures. The slope with exposed beech tree roots was appreciated by several participants, while infrastructure was disliked by several experts and the swamp was disliked by several laypersons. Actually, while both 3a and 3b got Average preference ratings by the laypersons, they got two completely opposite preference ratings by the experts, clearly liking Zone 3a and clearly disliking 3b. The two species richness groups found 3a to be significantly more interesting than 3b, indicating clear local differences in their perception of positive habitats.

Zone 8a, the study area's only pond, generated very consistent results. Within the species richness groups it was barely noticed, although there were three positive comments about the water among the laypersons. The preference groups, however, found a proportionally very large amount of negative aspects along this very short trail segment. These negative comments regarded almost exclusively human interventions such as the fence around the pond, rat poison and the unfitting design of the pond's edges. The strong negative preference for 8a actually resulted in Negative ratings for Zone 8 as a whole, despite Average preference levels in Zone 8b.

Habitat type D (Zone 4 & 6): Dry simple woodland on ridge

The zones and sub-zones in the dry woodland habitat type were the only ones that did not get any High or Positive ratings at all. The assessed biodiversity level was Medium for both Zone 4 and Zone 6, which were very simply structured woodlands, often lacking field layer. Basically all zones and sub-zones in this habitat type received Average preference ratings, except for 6b, where the laypersons found several disturbing elements. The species richness ratings showed a negative tendency.

Among the preference groups, Zone 4 generated mixed results with positive pictures mostly regarding the woodland structure or similar aspects, and negative pictures mostly regarding a very noticeable graffiti on a log. Despite moderate amounts of positive pictures, the species richness groups took predominantly negative pictures in Zone 4, which they found inhospitably shady and empty, remarking the lack of field layer in this zone. Worth noticing is how they expressed this in the comments and in their choice of motifs. While the expert group highlighted the shade-giving beech trees, the laypersons focused on the ground and the bare soil.

All groups generated Average ratings for Zone 6, although there were some Negative ratings in the sub-zones. Sub-zone 6a, a woodland with dense shrub layer, generated comments mostly about vegetation and vegetation details in all four groups, but did not generate significantly Negative preference, as previous research might have predicted. Zone 6b, which was similar to Zone 4 with the addition of large trunks of deadwood on the ground, generated quite mixed comments in all groups and concerned vegetation, deadwood, road noise, trampling etc. The negative peak which appears in the laypeople preference group was mainly due to different sorts of human interventions. Zone 6c, which was a straight road through the woodland down to the open lawn, generated some negative comments among the species richness groups about bad growing conditions and some mixed comments in the expert preference group.

CHAPTER 4: DISCUSSION

Can conflicts or synergies be found between biodiversity values and perceived recreational values in urban green space environments?

One of the first conclusion do be drawn from the triangular analysis is that the species richness ratings corresponded rather well to the assessed biodiversity level, or at least they never showed opposite ratings. This speaks for a general ability among the participants to perceive green environments of high ecological value. I will return to this aspect in a later section.

It is also interesting to see how the preferences related to the biodiversity levels. In fact, the most positive preference ratings corresponded to the lowest biodiversity level, while the most negative preference ratings corresponded to the highest biodiversity level. This indeed puts an extra question mark behind the question: Is biodiversity attractive? For the ornamental park zones (1 and 7), this result was perhaps not so unexpected since previous research has shown a strong general preference for this type of landscapes. Still, I would claim that the participants' perceptions of these two zones were quite different. Zone 1 was indeed a lot more "cluttered" with a wide range of things: buildings of varying architectural styles, kindergartens, parking lots etc. Such things thus appeared more in the comments from Zone 1, which had a higher level of negative photos, than from Zone 7, which was clearly more spatially defined and ordered. Applying Kaplan and Kaplan's preference matrix, this zone satisfies the needs of both coherence and legibility, which might help to explain its popularity. The legibility, and to some extent also the possibility to explore, was perhaps further emphasized by the fact that the trail surrounded this zone – a bowl-shaped, open lawn, surrounded by woodlands – making overview clear and easy. The possibility of seeing a place from different directions may very well have had an effect on the participants' perception, compared to when they were led along a more or less straight line, leaving behind the things they pass.

The differences in perception between the two ornamental park zones show that the amount and character of content in this type of area had a clear impact on the participants. While the more clearly defined Zone 7 seemed to be popular among both preference groups, the expert species richness group saw negative monotony but the laypersons saw positive diversity. In Zone 1, the diversity of features generated positive and negative pictures in all groups, making it difficult to extract clear conclusions. It is also possible that Zone 1 received so many pictures simply because it was the first one the participants passed. I would argue, though, that this factor should have a minor effect, considering that all participants had walked the whole trail once before taking their pictures.

What features in an urban green space trigger people's preference and perception of species richness, and how can these be explained?

Resolution and zoning

There are at least a few aspects that might have generated the different results in the two residential/woodland transition zones. The obvious is the fact that Zone 5 contains a grass lawn, dividing the gardens and the woodland, making it an open space, rather than a narrow path. The lawn did in fact motivate some pictures. It is not certain, however, that it is decisive. While Zone 2 offered a view down on a water stream in the valley, where the participants were soon to enter, Zone 5 offered a plain, north-facing woodland from which the participants just came out. In the latter, the mystery and eager to explore the woodland was quite probably lost, and the focus shifted instead to what else was around. Interesting is also the different reactions to Zone 5 by the experts and laypersons. While laypersons saw the possibility to play on and enjoy the grass next to the houses, the landscape experts could not accept its plain design.

Within some of the habitat types, clear differences in rating appeared both between main zones and between sub-zones, which proposes that the habitat type scale is not always sufficient to predict preference or perceived species richness. In some cases, this was true also for the main zone level. Especially in the valley woodland habitat type, the resolution of analysis proved itself highly relevant – Zone 3a got higher ratings than 3b for both preference and species richness. Knowing the conditions in the two sub-zones, this can perhaps be explained. In Zone 3b the trail is further away from the creek and instead an inaccessible swamp is visible, which some people reacted against. Also, in 3b there was more infrastructure present, which again added negatively to this otherwise nature-like area.

In the dry ridge woodland, one perhaps cannot draw general conclusions from the fact that the dense understory in Zone 6a did not induce a general disliking, as previous research predicts. It is tempting to argue, though, that the live experience of passing through such an environment is significantly different from, for example, seeing it on a photograph. Other factors will of course influence as well, such as species or size of the woodland, but most of the comments did concern vegetation details that would not be visible or salient in a photograph capturing a typical view. Although all sub-zones in this habitat type had a similar canopy layer, the arrangement of vegetation and anthropic elements seem to have had an influence on the participants' perception and preference.

Human interventions

The relatively low general preference for the woodland in the valley, zones 3 and 8, was quite surprising. In many aspects, this environment ought to be the ideal woodland for recreation. It contains a water course, a pond, delicate field layer and semi-dense canopies, among other things. As stated before, however, infrastructure and other human interventions seem to have affected the preference for this area negatively. The strong negative preference for the pond and its immediate surrounding was especially surprising, as similar duck ponds are such an archetypical feature in (older) parks and since previous research has shown water to generally have a clear positive impact on preference. For this particular water body, however, the design and certain elements seem to have ruined the positive experience. It is possible that the low preference for this traditional park feature is connected to the participants' age or education. Still, opinions regarding artificiality of design or small, disturbing details might not have many forums outside this study, thus being previously unheard. I also believe that the location of the clearly human-influenced water features in an otherwise very nature-like part of the park had a strong influence on reactions. Considering the apparent influence of human interventions in this sub-zone, one must ask what the outcome would have been, had the pond been integrated differently into the surrounding environment.

Also the negative preference comments in Zone 8b clearly suggest a strong negative impact of human interventions on natural-looking environments. It is not impossible that these features also had an impact on the perception of species richness, considering for example the more artificial look of the creek in 8b compared to in 3a.

Interesting is also how the preference groups reacted to buildings. While negative motivations to a great extent regarded infrastructure and signs of human influence, many buildings received great praise. There were some obvious differences, though. The residential houses immediately adjacent to the park in zones 2 and 5 were generally not appreciated. The old, wooden houses inside the park, on the other hand, were considered as displaying a "nice balance between buildings and park", or simply "beautiful house" or "architecture (nice houses)". This shows that built features, regardless how intrusive their size, can be both accepted and appreciated in a green space setting, given that they are well integrated. In this particular case, the buildings were old, well-preserved and in some way authentic and coherent with the style of the park. The question remains, then, whether new constructions could be appreciated in a park setting in the same way, unless they are obvious pastiches of a previous era.

Auxiliary motivations

Many of the comments in the study did not include more than a short description of what was shown on the corresponding picture. In the preference groups, though, more than half of the comments included some kind of expressed or implied auxiliary motivation. The most commonly used sub-category – Coherence – says a lot about what people react to. It contained mostly negative comments in which different things were expressed as artificial or not fitting in. Features seem to be judged in relation to the context – how they fit into the surrounding. All features that are not expected in a given context will be noticed and thereafter judged based on their appearance. In a sense, this is what some theorists refer to as *Genius loci*, the spirit of place. The stronger the spirit, the more sensitive is the place. Thus people would react more negatively to disturbing elements the more they liked the place as a whole, resulting in negative ratings for a positive environment. An interesting further analysis of the data would be to investigate the distribution over zones of these comments about coherence, to see if indeed some zones appear to be more sensitive than others.

The aesthetics category contained equal amounts of positive and negative pictures with very diverse motifs. These were motivations such as "beautiful", "cool", "ugly", "unattractive", "romantic" etc.

For the species richness groups, the auxiliary motivations were predominantly connected with assumed species presence, habitat indicators and microclimate. The focus on these aspects is hardly surprising, but it might be worth noticing both groups' tendency to draw from their own knowledge or to at least make guesses, as compared to making plain observations (which they also did, of course).

Does ecological education influence people's preference and ability to assess ecological values in urban green space?

Influence on perceived species richness

Looking at the final ratings of assessed biodiversity level and perceived species richness, both experts and laypersons appear to identify the habitat quality of the different areas rather correctly. Compared to the *biodiversity level* of each zone and habitat type, the experts deviate a little less than the laypersons, but the error margins of the study might be too thin to draw conclusions based on that. In any case, the areas of highest assessed biodiversity (3, 8, C) did in fact generate the most positive ratings among both groups. The areas of lowest assessed biodiversity (7, A) generated also the most negative ratings, at least among the experts. Here, the laypersons perception of species richness was perhaps influenced by their personal preferences, or perhaps they interpreted the task differently from the experts. For none of the areas, however, the ratings were completely opposite those of the biodiversity assessment.

The ratings thus did not indicate any major differences between ecology experts and laypeople in their ability to recognize habitat quality. The category analysis does not reveal any significant differences between the two groups either. The distribution of positive and negative pictures between categories is rather similar between experts and laypersons. At closer examination of the individual comments and motifs, though, certain differences do appear. The experts display much greater consistency in their choice of motifs and in their motivations. As mentioned earlier, woodland edges, deadwood, old trees and monocultures were examples of motifs which the experts motivated in very similar fashion. It is my guess that the university course that they were all currently taking had a certain influence on their homogeneity. Still, they mentioned indicators of habitat quality twice as often as the laypersons and did in general choose more advanced motifs. In that respect, the laypersons focused a lot more on *visual* diversity (or lack thereof) of vegetation or vegetation structures, in line with "Many different colors" or similar comments. They also to a greater extent pointed out individual plants or animals, merely because of their presence. In this sense, the experts used their knowledge to find less obvious examples, such as ecotones. Thus the two groups' perception of species richness captured to some extent different ranges of diversity. As Montgomery proposes (see *Ecological aesthetic* section), people in general may only appreciate benefits that are "immediately apparent, such as aesthetic uniqueness" (Montgomery 2002, p.323).

The presence of deadwood was highly recognized by the expert group and was unanimously considered ecologically beneficial. The laypersons also gave rather a lot of comments on deadwood, but in their case the comments were not always positive, especially not in the preference group. Several participants did however recognize the benefit for insects and fungi, while others saw deadwood as "nature being disturbed" – a negative human influence. The negative influence of deadwood on preference is well-established in previous research, but this study also supports those showing that ecological knowledge can have a positive influence on preference for certain woodland features.

One could perhaps question just how representative the distribution of photos is in relation to the participants' composite opinions about the different zones or habitats. All groups focused more on content-based motifs and might therefore have identified elements of high or low value regardless of the quality of the surrounding environment. Especially the laypersons showed several examples of pointing out e.g. individual birds, insects or plants that not necessarily indicated a positive or negative quality of the whole local environment, but rather had their own values. Even so, I believe that the analysis procedure compensated for this quite well, since zones of very contradictory comments resulted in Average ratings. As a possible future use of the data, the distribution analysis could thus be done for the spatial configuration photos only, in order to investigate the importance of general zone character/typology.

Influence on preference

The preference ratings do not show any directly opposing levels between experts and laypeople. Where differences occur, one of the ratings is always Average, which suggests inconsistent opinions. Both groups agree on the preference for Zone 7 and habitat type A, which both received only Positive ratings. Zone 1 also got Positive rating by the laypeople but merely Average by the experts. It should be noted, though, that this zone got high amounts of positive pictures also by the experts, and that most of their negative comments regarded features which ruined the positive character, in line with "Parking lots are visible (not so attractive).", "Tree ring - feels out of place.", "Disturbing elements like neon/concrete thing, buildings not fitting in." or "Disturbing and unsuitable objects in an otherwise quite nice place.". This suggests that also the experts appreciated the overall character of Zone 1.

The categories did not add any significant differences between the two preference groups, although the expert had a stronger focus on spatial configurations than the laypersons. In general, the two groups seem to show relatively similar preferences for this particular green space. The laypersons did, however, comment more on safety issues and had more opinions about how the park should be maintained. Though it cannot be extracted from the statistics, it is my personal judgment that the experts had more opinions than the laypersons about design and execution of the different parts of the park, especially negative ones.

In the appraisal of preference and perceived species richness, what is the relative importance of spatial configurations and content-based attributes?

It appears that for both themes – preference and perceived species richness – the content-based photos/motivations dominated. This was somewhat surprising since the landscape/ecology experts were expected to hold a more holistic point of view when regarding the surroundings and thus focus more on spatial configurations. The expert preference group did, however, photograph spatial configurations twice as much as the laypersons did. The expert species richness group, on the other hand, did this to a lesser extent than the laypersons species richness group. If we would accept that experts prefer spatial configurations to a greater extent than laypersons, then their strong focus on content in the species richness group might be explained by their tendency to identify indicators of habitat quality, which was a common category among the experts.

Whether the strong focus on content-based motivations was due to the study design or to other circumstances is difficult to assess, but the results do support the study by Nielsen, Heyman et al. (2012), who also found a predominance of content-based photos. Additionally, the two studies support each other in that the content-based motivations were predominantly negative, while the motivations of spatial configuration were predominantly positive. This relationship was stronger in the preference theme than in the species richness theme, but valid for all four groups.

Why is this? If I allow myself to speculate, I believe that it has partly to do with what we expect from our surrounding environment. It is difficult for any person to explain how a positive scene would be composed, be it about preference or species richness. In the same way, it is difficult to motivate why one considers a given scene to be positive. Thus, the positive spatial configurations present themselves in the moment we see them, unexpectedly. Negative scenes, I believe, are easier to both give examples of and to motivate, since the harmony is easily disrupted by individual features. When walking through a park, then, we expect a certain order of things – a certain standard of naturalness or tidiness, depending on which kind of park it is. Since this is the order we expect, it requires significant additions to heighten the quality of a scene, while it is easily impoverished by disturbing details.

The clear influence of content suggests that details and individual elements play an important role in how urban green spaces are perceived.

Presentation hierarchy

As I started looking at the results of the study and trying to put them into words, the difficulty of finding a suitable hierarchy became apparent. The data can be organized on several different levels: by preference or species richness theme; by experts or laypersons; by positive or negative; by spatial configuration or content-based attribute; by tag number, sub-zone, zone or habitat type. None of the parameters is logically more important than the others but they all depend upon each other. I chose to always present the experts and laypersons next to each other and to present each theme in its entirety, since I believed it would have been difficult to follow the reasoning had they appeared separately. In general, I presented the results first by individual theme and then combining them. Each theme was presented by habitat type and zone/sub-zone and, to some extent, by positive and negative. To me, this was the most interesting and useful classification, which allowed the reader to compare the different environments to each other. It did, however, imply some repetition, as the habitat types were described over and over, each time with new additions. I believe, though, that this sort of repetition would have been necessary either way, since the complexity of the data would have been too much to handle had the results been presented all at once. And after all, they do say that "repetition is the mother of knowledge".

Research method

As for the decision of conducting an on-site investigation compared to e.g. photo-elicitation, I believe that both the photographs and the motivations that were collected from the participants indicate a strong influence of features and perspectives that would not be salient in an off-site situation. The high number of content-based photos is one of the reasons, but it is also about how the participants chose to use their cameras, how they approached the motifs. The data retrieved from the two VEP-surveys was perhaps better adapted for the preference theme than for the perceived species richness theme. To me, the analysis of the preference material seemed somewhat more logical and applicable than the other half. A future study of perceived ecological values should perhaps be modified to provide a stronger connection to the geographical units of the site.

Although the results from on-site perception studies, as compared to off-site studies, are more complex and difficult to analyze or generalize, I believe that there is great value in investigating landscape perception in a site context. The objective should not be to surpass off-site methods, but to add other dimensions. The present study has revealed that people have a wide range of opinions about green space features, more complex than just simple ratings.

Participants

The choice of participants has already been motivated in Chapter 2, but I will mention a few aspects about the practical matters. One thing that became painfully clear during the preparations of the study was the difficulty in finding laypeople that were willing to participate. The original plan was to recruit only students from the campus in Helsingborg, which was attempted using email send-outs, information posters and flyers, handed out in great amounts at the university and the student housings. Despite the promised compensation, the response rate was very low. It is still unclear whether this was due to a general disinterest, our choice of information method, the time and location of the study, or due to something else. In any case, our personal networks had to be used in order to find the sufficient number of participants. In the end, though, the study probably benefitted from this, since the number of international participants more closely matched the number in the expert groups. As explained earlier, also age and education background matched very well between the four groups.

Site

When I presented the preliminary results to the expert group I received some comments regarding the choice of study site. The site was supposed to represent an *urban* green space, while some opinions claimed it to be too wild-like or *suburban* or not even urban at all, thus not being representative for the study purpose. In response to similar critique I would argue that, first of all, Swedish cities (and many others too) are generally highly suburbanized, having only minor dense city centers. In that respect, I believe the location of the park to be fully representative. Secondly, no park can effectively represent all parks. Of the nine green areas in Helsingborg that were originally considered, and of the five that were later visited, Ramlösa was the one that held the widest range of habitats, design schemes and management regimes. It was also highly frequented by runners, dog-walkers, parents with strollers etc., which speaks for the park being used for everyday recreation. I would, however, agree that the choice of study site has a great influence on the result. For example, the categories used in the study were not standard categories, but based on which motifs and motivations appeared in this particular study. Also, the proportion of different habitats/environments certainly affected the participants. The important thing then, I believe, is to carefully consider the results in relation to this particular site and to not dive headfirst into drawing universal conclusions.

Possible use of the data

Given the tremendous amount of data collected in this study, many possible ways to use the information or modify the study obviously remain. Some suggestions:

- Spatial/content relation to zones: A distribution analysis of spatial configurations and content-based attributes could be performed for each zone and habitat type. This could indicate the relative influence of habitat typology (spatial configuration) on preference and species richness perception.
- Demographic bias control: apart from sex, age and education background, the participants also stated their childhood environment and recreational habits. The demographic information could be used to control for possible biases.
- Other societal groups: the study could be repeated employing e.g. children, elderly, disabled people, other professions etc., in order to broaden the applicability of the results.
- Reversed order: the influence of experiencing a fixed sequence of scenes has not been thoroughly investigated. The study could be repeated in reversed trail direction to indicate the influence of spatial contrasts or repetition of habitat types.

CONCLUSIONS

The study suggests a general ability among both experts and laypersons to perceive differences in habitat quality within an urban green space. Primarily landscape elements and vegetation are used as indicators of species richness. Some differences were found between experts and laypersons in their photograph motivations.

The results of the study further suggest that knowledge or perception of an area's species richness does not necessarily relate positively to people's preference for it. In fact, a negative correlation between assessed biodiversity and preference was indicated by the study results.

The study also suggests a strong influence of individual (landscape) elements and content-based features in general on people's perception of urban green spaces. In particular the presence or character of vegetation seems to play a major role in the perception of habitat quality, whereas human-related elements or signs of human activities influence preference. The design and location of infrastructure appears to be particularly sensitive to negative perceptions, while the study also showed several examples of human constructions which were considered well integrated in the park environment. This fact points to the importance of design and execution of human interventions in green recreational areas.

Finally, the study suggests that neither the overall habitat type, nor a coarse dividing of a green space into vegetation/design characters, is always a sufficient scale to predict visitors' preference or their perception of species richness. Local differences within the scale of 0-100 m have shown to have significant impact on both perception and preference. Also minor details and variations will influence, suggesting on-site investigation to be an important complement to traditional research methods.

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APPENDICES

APPENDIX I: ASSESSMENT METHODS REVIEW

Hermy and Cornelis (2000): "Towards a monitoring method and a number of multifaceted and hierarchical biodiversity indicators for urban and suburban parks."

The method measures diversity of both habitats and species and was originally developed for urban and suburban parks in Belgium.

The habitat unit diversity is calculated using a list of 56 different habitat units which can be found in parks. The units are organized into planar, linear and punctual elements (e.g. lawn, hedge, single tree), which are expressed in area, length and number, respectively. When all the units of a park have been counted and measured using aerial photos and field visits, an index is calculated and weighted, giving the park a certain habitat diversity score.

The species diversity is assessed using four different indicator species groups: *vascular plants*, *butterflies*, *breeding birds* and *amphibians*. Plant species are counted in representative plots, once in spring and once in summer, and an index is calculated. Number of butterfly species is counted, but not individuals. Breeding birds and amphibians are assessed in a similar way, adding information from local ornithologists or nature organizations, if available. Indices for the animal species groups are then calculated, providing information can be found on the total number of species recorded in parks of the region.

Pros of the method:
- Detailed scale and accuracy
- Useful division of habitat units (high structure resolution)
- Assesses both plant and animal diversity

Cons:
- Only provides a total biodiversity index for the whole park, not for the individual units
- Needs comparison with other parks
- Time consuming if done thoroughly (33 days/25 ha, according to the authors)
- Difficult to conduct animal inventory

Löfvenhaft, Björn et al. (2002): "Biotope patterns in urban areas: A conceptual model integrating biodiversity issues in spatial planning."

The authors aim to create "a model that considers the spatial aspects of biodiversity in urban planning" (Löfvenhaft, Björn et al. 2002, p.223), creating a tool especially for spatial planning. The study area was located to Stockholm, Sweden.

The method consists of seven main steps (p.227):

- Development of a classification system
- Data collection by stereographic interpretation of color infrared aerial photographs
- Evaluation of classification accuracy by using field controls
- Development of a digital data base
- Landscape ecological analyses
- Choice of presentation strategies
- Implementation of the results in the local comprehensive spatial planning

A list of biotopes similar to that of Hermy and Cornelis was established (using aerial photographs) comprising a total of 78 biotope classes, also here divided into areal, linear and point elements. Species inventory focused on amphibians and insects living on deadwood, the latter category relying on existing data. The species groups were chosen for representing both species dependent on various different biotopes and species dependent on specific features.

The case study area was analyzed and divided into four zone types: *core areas*, *connectivity zones*, *buffer zones* and *green development areas,* in order to be useful in a planning context. The zones were in the size range of 100-4000 m.

Pros of the method:
- Useful division of biotope classes
- Does not (seem to) need comparison with other areas

Cons:
- Does not provide a biodiversity score for individual biotopes
- Does not consider plant diversity (other than biotope class)
- Not created especially for biodiversity assessment
- Difficult to conduct animal inventory

Li, Ouyang et al. (2006): "Plant species composition in relation to green cover configuration and function of urban parks in Beijing, China"

The authors of this study compared the vascular plant richness of 24 urban parks in Beijing, China, as part of a bigger biodiversity study.

The inventoried parks were divided into new parks (established after 1950) and old parks. Both categories were separated into green space-dominant and architecture-dominant parks, to indicate the degree of vegetated surface. The plant inventory method does not offer an original method for biodiversity assessment, but it does however provide an example of plant inventory methodology.

Plants were recorded using sample plots, randomly located within each park, with the number of plots proportional to the park area. Plot sizes were 10m x 10m, 2m x 2m, and 1m x 1m for tree, shrub and herbaceous species, respectively (similar plot sizes were used by Hermy and Cornelis, namely 10m x 10m and 2m x 2m for trees/shrubs and herbaceous species, respectively). Tree species were measured in number, height, trunk and canopy diameter. For shrubs and herbaceous species, number, height and ground cover was recorded. A diversity index was then calculated for each park.

Pros of the method: - Easy to use and relatively fast
- Well-defined inventory methodology

Cons: - Does not provide a biodiversity score for individual biotopes, only for whole parks
- Does not consider animal diversity or indicator species
- Low resolution in biotope units (uses very few categories)

Tzoulas and James (2010): "Making biodiversity measures accessible to non-specialists: an innovative method for rapid assessment of urban biodiversity"

The method is created to offer a fast and reliable biodiversity inventory that can be easily understood by a general public. Vegetation structure is used as biodiversity indicator, since habitat composition and complexity is considered to represent overall biodiversity well.

Three stages are performed:

- First, a checklist is developed for recording *urban habitat type* (e.g. cemetery, industrial, urban park), *vegetation structure* (height and domination value) and *vascular plant genera diversity* (both natives and exotics; list of genera occurring in the region is obtained from available inventories).
- Second, the checklist is filled in during field work. Urban habitats are considered at sizes larger than one hectare. For the plant sampling, plots of 65m radius are employed. The number of plots is chosen so that the total sampling area represents more than 10% of the study area and includes a variety of habitat types. The proportion of different vegetation structures is visually estimated using a known procedure. The plant genera-recording is performed along four 10m wide radii within the sampling plots.
- Third, the recorded data are combined into an overall biodiversity score using a point assigning protocol, considering the three categories of the checklist.

Pros of the method:
- Easy to use and relatively fast
- Well-defined inventory methodology
- Considers both habitat type, vegetation structure and plant genera diversity
- Provides a diversity score *partly* applicable to individual biotope units

Cons:
- Does not provide a clear biodiversity score for individual biotopes, only for whole parks
- Does not consider animal diversity or indicator species
- Low resolution in vegetation structure units (uses few categories)
- Measures plant genera diversity *across* different habitat types instead of *within*

Gao, Qiu et al. (2012): "The Importance of Temporal and Spatial Vegetation Structure Information in Biotope Mapping Schemes: A Case Study in Helsingborg, Sweden"

The study investigates factors of biotope mapping in urban green spaces. Biotopes are identified using four parameters of vegetation structure: *continuity of forest cover, age of dominant trees, horizontal structure*, and *vertical structure*. Identification of biotopes is made using aerial photos and the combinations of parameters add up to approximately 172 possible biotope types.

To assess the species richness and diversity of biotopes, Ancient Woodland Indicator (AWI) species are used as indicators of vegetation continuity along with a species inventory made through linear measurement in woodlands of long and short continuity, respectively. Three 60-m stretches are used in each sample plot and vascular plants are counted along 2 m stretches at 4-m intervals. A diversity index is then calculated for each sample plot. Also animal species richness is controlled for, identifying birds and mammals along parallel lines. Animals are recorded when spotted within 3 minutes of observation at each observation point (every 30 m of the observation lines).

Pros of the method:
- Easy to use
- Useful division of habitat units (high structure resolution)
- Considers both habitat type, vegetation structure and plant and animal species diversity
- Provides a diversity index for each biotope

Cons:
- Is designed primarily for comparing woodlands of different continuity
- Time consuming if done thoroughly

APPENDIX II: COMPLETE SPECIES LIST

Vascular plant species inventory in Ramlösa Brunnspark, Helsingborg 2012-04-23

Scientific name	Swedish common name	Occurrence of species in each main zone (1-8)								Alien sp.	AWI sp.
		1	2	3	4	5	6	7	8		
Acer platanoides	Skogslönn	1		1							
Acer pseudoplatanus	Tysklönn	1	1	1			1		1	1	
Acer sp.	Lönn					1		1			
Aegopodium podagraria	Kirskål	1		1					1		
Aesculus hippocastanum	Hästkastanj	1				1	1			1	
Agrostis capillaris	Rödven					1					
Alchemilla mollis	Jättedaggkåpa		1							1	
Alliaria petiolata	Löktrav	1	1		1	1	1		1		
Alnus glutinosa	Klibbal			1					1		
Alium oleraceum	Ängslök	1									
Anemone nemorosa	Vitsippa	1	1	1	1		1	1	1		1
Anemone ranunculoides	Gulsippa			1					1		1
Anthriscus sylvestris	Hundkäx						1		1		
Aquilegia vulgaris	Akleja		1							1	
Arctium lappa	Storkardborre								1		
Bambusa sp.	Bergbambu		1			1				1	
Bellis perennis	Tusensköna	1					1				
Berberis vulgaris	Berberis					1				1	
Bergenia cordifolia	Bergenia	1	1							1	
Betula pendula	Vårtbjörk	1			1						
Betula utilis	Himalayabjörk							1		1	
Buddleja davidii	Fjärilsbuske		1							1	
Buxus sp.	Buxbom		1							1	
Campanula persicifolia	Storblåklocka		1								
Cardamine pratensis	Ängsbräsma	1									

Carex acuta	Vasstarr			1							
Carex sylvatica	Skogsstarr			1							1
Carpinus betulus	Avenbok	1					1		1		
Cerastium fontanum var. vulgare	Hönsarv	1									
Chionodoxa forbesii	Vårstjärna	1	1			1		1		1	
Cornus sp.	Kornell	1								1	
Cornus sp. alba sibirica	Korallkornell					1				1	
Cornus sanguinea	Skogskornell		1	1							
Corylus avellana	Hassel	1	1	1					1		
Crataegus monogyna	Trubbhagtorn	1	1	1			1		1		
Crocus vernus	Vårkrokus	1								1	
Dactylis glomerata ssp. Glomerata	Hundäxing	1	1			1			1		
Deschampsia cespitosa	Tuvtåtel		1								
Deschampsia flexuosa	Kruståtel				1						
Epilobium angustifolium	Mjölkört								1		
Epilobium montanum	Bergdunört			1							
Epilobium roseum	Rosendunört			1							
Equisetum arvense	Åkerfräken			1					1		
Erythronium sp.	Hundtandslilja	1								1	
Euonymus sp.	Benved	1								1	
Fagus sylvatica	Bok	1	1	1	1		1	1	1		
Festuca rubra ssp. Rubra	Rödsvingel	1	1			1		1			
Filipendula ulmaria	Älggräs			1					1		
Forsythia sp.	Forsytia		1			1				1	
Fragaria moschata	Parksmultron	1									
Fragaria sp.			1								
Fragaria vesca	Smultron		1			1					
Fraxinus excelsior	Ask	1		1	1	1	1	1	1		
Gagea lutea	Vårlök	1				1		1	1		
Galanthus nivalis	Snödroppe	1								1	
Galium apparine	Snärjmåra		1								
Galium sp.	Måra		1								

Geranium robertianum var. robertianum	Stinknäva						1				
Geum rivale	Humleblomster			1							
Geum urbanum	Nejlikrot	1	1	1	1	1	1	1	1		
Ginkgo biloba	Ginkgo	1								1	
Hedera helix	Murgröna		1						1		
Heleboruis sp.	Julros		1							1	
Hemerocallis vulgaris	Daglilja		1							1	
Hieracium subsect. Sylvaticiformae	Skogsfibbla				1		1				
Hortensia	Klätterhortensia		1							1	
Hyacinthus orientale	Hyacint	1	1			1				1	
Lavandula officinalis	Lavendel		1								
Illex aquifolium	Järnek				1					1	
Juglans sp.	Valnöt	1						1		1	
Laburnun	Gullregnssläktet	1								1	
Cicerbita macrophylla	Parksallat							1		1	
Lamium album	Vitplister		1								
Lathraea squamaria	Vätteros						1		1		1
Ligustrum vulgare	Liguster	1									
Lonicera periclymenum	Vildkaprifol								1		
Lonicera tatarica	Rosentry	1	1							1	
Lonicera xylosteum	Skogstry	1									
Lychnis coronaria	Purpurklätt					1				1	
Magnolia sp.	Magnolia	1							1	1	
Mahonia aquifolium	Mahonia	1				1				1	
Maianthemum bifolium	Ekorrbär				1		1				
Malus sp.	Apel	1				1					
Malus sylvestris	Vildapel			1							
Melica uniflora	Lundslok				1		1		1		1
Mercurialisperennis	Skogsbingel		1			1		1			1
Milium effusum	Hässlebrodd				1		1				1
Muscari botryoides	Pärlhyacint	1	1							1	
Narcissus sp.	Påsk-/Pingstlilja	1	1							1	

Oxalis acetosella	Harsyra						1		1		1
Paeonia sp.	Bondpion		1							1	
Pyracantha sp.	Eldtorn		1							1	
Pinus nigra	Svarttall					1				1	
Platanus sp.	Platan	1								1	
Plantago lanceolata	Svartkämpar	1				1					
Plantago major	Groblad	1						1			
Picea breweriana	Slöjgran							1		1	
Poa annua	Vitgröe						1	1			
Poa nemoralis	Lundgröe	1		1	1		1		1		
Poa pratensis ssp. Pratensis	Ängsgröe	1	1					1			
Prunella vulgaris	Brunört	1									
Prunus avium	Fågelbär		1		1		1		1		
Prunus cerasifera	Körsbärsplommon		1							1	
Prunus padus	Hägg			1	1		1		1		
Prunus sp.	Körsbär	1				1					
Pterocarya fraxinifolia	Kaukasiskvingnöt	1								1	
Puschkinia scilloides	Porslinshyacint	1								1	
Quercus robur	Skogsek	1		1	1		1		1		
Quercus rubra	Rödek					1		1		1	
Ranunculus auricomus	Majsmörblomma			1							1
Ranunculus ficaria	Svalört	1									
Ranunculus ficaria ssp. Bulbilifera	Svalört	1	1	1		1		1	1		
Ranunculus repens	Revsmörblomma	1		1		1		1			
Rhododendron sp.	Rhododendron	1	1	1				1		1	
Rhus typhina	Rönnsumak		1							1	
Ribes alpinum	Måbär	1	1								
Ribes rubrum	Vinbär	1									
Ribes uva-crispa	Krusbär						1				
Rosa sp.	Ros	1	1								
Rubus idaeus	Hallon			1	1	1	1				
Rubus nessensis	Skogsbjörnbär			1			1				
Rumex crispus	Krusskräppa	1		1		1	1				
Rumex longifolius	Gårdsskräppa								1		
Rumex obtusifolius	Tomtskräppa								1		
Salix alba	Vitpil					1					

Salix caprea	Sälg		1	1					1		
Salix sp.	Hängsälg		1	1							
Sambucus nigra	Fläder	1		1			1				
Scilla bifolia	Tidigblåstjärna							1		1	
Scilla siberica	Ryskblåstjärna	1	1					1		1	
Sedum telephium	Kärleksört	1	1								
Sorbus aucuparia	Rönn				1	1	1		1		
Sorbus sp.	Rönn	1									
Spiraea sp.	Spirea	1				1				1	
Stachys sylvatica	Stinksyska						1				1
Stellaria media	Våtarv	1									
Syringa sp.	Syrén	1	1							1	
Syringa vulgaris	Syrén	1	1			1					
Taraxacum sect. Ruderalia	Ogräsmaskrosor			1							
Taraxacum sp.	Maskros-art	1	1	1	1	1	1	1	1		
Taxodium ditstichum	Sumpcypress	1								1	
Taxus baccata	Idegran	1	1	1	1	1	1	1	1	1	
Thuja sp.	Tuja		1			1				1	
Tilia cordata	Lind	1							1		
Trifolium repens	Vitklöver	1									
Tulipa gesneniana	Tulpan	1	1							1	
Tulipa humilis	Violtulpan	1								1	
Tulipa tarda	Flocktulpan		1				1			1	
Ulmus glabra	Alm	1	1	1	1		1		1		
Urtica dioica var. dioica	Brännässla	1	1	1		1	1	1	1		
Veronica arvensis	Fältveronika	1									
Veronica chamaedrys	Teveronika	1	1	1							
Veronica officinalis	Ärenpris						1				
Viburnum sp.	Olvon		1							1	
Vicia sp.	Vicker					1					
Vicia sepium	Häckvicker						1				
Viola odorata	Luktviol	1		1					1		
Unidentified shrub	-							1		1	

APPENDIX III: SPECIES RICHNESS PHOTO-LOG (EXCERPT)

Faculty of Landscape Planning, Horticulture and Agricultural Sciences
Swedish University of Agricultural Sciences

Participant No. _____

Instructions: Take a total of 10 photographs, five of which show places or attributes you think represent <u>high species richness</u> and five that show places or attributes you think represent <u>low species richness</u>. For each picture, fill out the corresponding fields below. Please complete all fields.

Pic.1:

1. Property represented

☐*high species richness* ☐*low species richness*

2. Mark the position where the picture was taken by writing the number of the tag closest to you

☐*Tag No.*________

3. Shortly explain what the picture shows and why you photographed this attribute

☐ ____

Pic.2:

1. Property represented

☐*high species richness* ☐*low species richness*

2. Mark the position where the picture was taken by writing the number of the tag closest to you

☐*Tag No.*________

3. Shortly explain what the picture shows and why you photographed this attribute

☐ ____

APPENDIX IV: PREFERENCE PHOTO-LOG (EXCERPT)

Faculty of Landscape Planning, Horticulture and Agricultural Sciences
Swedish University of Agricultural Sciences

Participant No. _____

Instructions: Take a total of 10 photographs, five of which show the scenes or attributes you most liked and five that show the scenes or attributes you most disliked. For each picture, fill out the corresponding fields below. Please complete all fields.

Pic.1:

1. Attribute represented

☐*like* ☐*dislike*

2. Mark the position where the picture was taken by writing the number of the tag closest to you

☐*Tag No.*________

3. Shortly explain what the picture shows and why you photographed this attribute

☐ ____

Pic.2:

1. Attribute represented

☐*like* ☐*dislike*

2. Mark the position where the picture was taken by writing the number of the tag closest to you

☐*Tag No.*________

3. Shortly explain what the picture shows and why you photographed this attribute

☐____

APPENDIX V: QUESTIONNAIRE

Faculty of Landscape Planning, Horticulture and Agricultural Sciences
Swedish University of Agricultural Sciences

Part 1: Personal information **Participant No. _____**

1. Sex:
□ *male* □ *female*
2. Age:
□ ___________
3. Education background:
□ High school □ University/College (bachelor level)
□ University/College (master level) □ Vocational education (Swedish: KY/fhsk)
4. Which type of environment would you say best describes where you spent the main part of your childhood?
□ *countryside (agricultural)* □ *countryside (forest)* □ *suburb or small town* □ *city*
5. How often do you spend time in green areas (parks, fields, forests, etc.)?
□ *almost never* □ *once per month* □ *once a week* □ *several times per week*
6. How did you find out about our research study?
□ ____

Part 2: We are interested in whether knowledge about ecology affects how people experience green spaces. Therefore, we would like you to answer a short quiz. Only one answer per question is correct. Please do not hesitate to mark "*I don't know*", if you are unsure.

1. A 'habitat' is:
A. □ The same as an ecosystem
B. □ The number of different organisms living in a specific area
C. □ A particular area inhabited by plants and animals
D. □ An animal's nest
E. □ I don't know

2. Fertilizers used in farming can be washed into rivers by the rain. This can cause:
A. □ Corrosion of drainage pipes
B. □ Accumulation of algae

C. □ Erosion of river banks
D. □ Extermination of phytoplankton
E. □ I don’t know

3. Plants need all of the things listed below to survive, but when there is not enough the plants must compete with each other. Which of these things is <u>not</u> competed for by plants?

A. □ Light
B. □ Nutrients
C. □ Warmth
D. □ Water
E. □ I don’t know

4. Which chemical element is fixed by bacteria in the roots of some plant species, such as alder tree (Swedish: al) and clover (Swedish: klöver)?

A. □ Carbon (Swedish:kol)
B. □ Phosphorus (Swedish:fosfor)
C. □ Water (Swedish:vatten)
D. □ Nitrogen (Swedish:kväve)
E. □ I don’t know

5. What is/was the chemical substance DDT used as?

A. □ Plant fertilizer
B. □ Insect extermination
C. □ Water purification
D. □ Weed extermination
E. □ I don’t know

6. What is humus (Swedish: humus)?

A. □ A disease affecting plant roots
B. □ The inner layer of a tree’s bark
C. □ A soil rich in mineral nutrients
D. □ Partially decomposed organic matter
E. □ I don’t know

7. What is likely to happen if you stop mowing a lawn completely?

A. □ Trees and shrubs will eventually cover the lawn
B. □ The grass will soon die if you don’t mow it
C. □ The grass will grow high, but nothing else will happen
D. □ Rabbits will not be able to eat the grass
E. □ I don’t know

Thank you for participating!

APPENDIX VI: INFORMATION SHEET

SLU | Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

PARTICIPATE IN AN OUTDOOR RESEARCH STUDY!

At SLU, we are conducting a research study on landscape perception – how people experience the physical world around them – and we are currently looking for participants. Would you like to spend an afternoon in a park in Helsingborg, taking photographs? Then you should participate! All participants will be compensated with a cinema ticket.

What will you do?
The study will take place at Ramlösa Brunnspark in Helsingborg. Participants will be guided through a marked route (1-2 km) around the park. They will then walk the same route individually with their digital camera, taking pictures of sceneries and features they experience along the way. **No previous knowledge or experience is required** and we will not judge the quality of the photographs. Detailed instructions will be given before the study takes place.

When and where?
We meet up on **Tuesday May 15th** at **14:00** outside the main building at **Ramlösa Brunnspark**, and we cancel only in case of rain. The study will take about 1-3 hours and coffee and a light snack will be offered. We kindly ask you to bring and use your own, fully charged digital camera. If you do not have a digital camera, please inform us and we will try to provide one. Equipment for picture downloading will be available at the site.

Interested?
Send an email to **stli0001@stud.slu.se** and write your first name, email address and telephone number, saying that you want to participate (using Swedish is fine). Questions can be sent to the same email address. Please let us know as soon as possible, but no later than **May 7th**, if you want to participate. The number of places is limited.

Kind regards,

Ling Qiu, PhD candidate & Stefan Lindberg, Graduate student,
Swedish University of Agricultural Sciences, SLU, Alnarp

SLU
Swedish University of Agricultural Sciences
Faculty of Landscape Planning, Horticulture and Agricultural Sciences
Department of Landscape Architecture