Green and Just?
Assessing the Socio-Spatial Distribution of Green Areas in Malmö

by Laura Wascher

Master Thesis in Built Environment (15 credits)

Spring Semester 2012

Tutor: Dr. Karin Grundström

Malmö University
Faculty of Culture and Society
Department of Urban Studies
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Tutor: Dr. Karin Grundström
Examiner: Dr. Mats Persson

Malmö University
Faculty of Culture and Society
Department of Urban Studies

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Cover Page: Green and Just? - A pocket park in Copenhagen 2011
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Summary

Malmö strives to become an attractive and sustainable city by 2030. Continued population growth is a major reason for the need to densify within the existing urban structures. But more inhabitants will also increase pressure on usage and demand for green spaces in the city. Green space is of importance for human well-being and health, especially in urban environments. However the importance of green space is being marginalised in current debate and urban planning, due to the intensive focus on densification. The relevance of green space as an environmental quality has neither been recognised sufficiently in discussions on environmental justice. Previous policy and research has not integrated the socioeconomic dimension when assessing green space distribution. Hence this case study aimed to investigate the socio-spatial distribution of green areas in Malmö.

A theoretical framework was compiled including concepts on environmental justice, i.e. the equal distribution of environmental qualities among different social groups. Moreover concepts regarding access (public/private), distance (walkability) and size (utilisation) of green areas were considered. A quantitative analysis was conducted with secondary data. As no comprehensive data set covered more recent years, census data and spatial data from 2005 was used for further analysis. The data was processed and analysed with the help of a geographic information system (GIS). With this approach green space and green areas could be identified. Green areas were categorised according to the level of public access, the size and the respective recommended distances to homes. In addition several socioeconomic factors were extracted from the census data and visualised in GIS.

Thus the least advantaged neighbourhoods that lacked various public green areas could be located. On the city level it could be identified that only 13% of the total land area were covered with public green areas, resulting in 46 sq m per inhabitant in 2005. In April 2011 the population of Malmö passed the threshold of 300 000. Assuming that the amount of green areas had not changed since 2005 (unlikely), every inhabitant would have had 38 sq m of public green area in 2011. Considering these numbers in a Swedish context reveals that Malmö is on the bottom line of green area provision. On the neighbourhood level the greatest deficit was found in the eastern parts of central Malmö (e.g. Östervårn), covering a network of neighbourhoods further south (Norra Sofielund, Södra Sofielund, Almhög, Gullviksborg). In total 32 neighbourhoods were characterised by above average percentage of children, elderly, foreign born or population density. Moreover almost all neighbourhoods lacking green areas were characterised by below average income. The results showed evidence for inequalities in the distribution of green areas between different social groups.

This poses an incentive for further investigations in the field of environmental justice and sustainable urban development. Issues like actual walking distance, barriers and safety, qualities of green spaces and user experiences should be investigated in future research. Noting that the data used in this study was from 2005, it is crucial to update and determine shifts in socio-spatial distribution of green areas in the city today. Whilst the population is still increasing, it is likely that even more green space has vanished in the 7 years since 2005. All these issues are essential for a good knowledge based planning of the green and just future of Malmö.

Key words: urban green space, accessibility, environmental justice, sustainable urban development, geographic information systems (GIS), Sweden
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1 INTRODUCTION

“Benefits of urban green spaces range from physical and psychological health to social cohesion, ecosystem service provision and biodiversity conservation. Green space coverage differs enormously among cities, yet little is known about the correlates or geography of this variation. This is important because urbanization is accelerating and the consequences for green space are unclear” (Fuller and Gaston, 2009, p.352).

It is a matter of common knowledge that green space contributes to human well-being and better health. This is especially important for urban inhabitants who need not only visual access but easy pedestrian access to green space to produce preventive benefits (Hartig et al., 2003). “Due to increasing urbanization, combined with a spatial planning policy of densification, more people face the prospect of living in less green residential environments. Especially groups with a low economic status, who do not have the resources to move to greener areas outside the cities, will be affected by these developments. This may lead to environmental injustice with regard to the distribution of (access) to public green space” (Groenewegen et al., 2006, p.8).

The issue of densifying existing urban areas has become increasingly important for the city of Malmö in recent years, due to a steadily growing population. A study by Statistics Sweden (SCB) showed a decline in green spaces in the 10 largest Swedish cities between 2000-2005 (SCB, 2010a). The decline was substantial in Malmö, were the ratio of green spaces towards inhabitants was also the lowest. Currently new housing and infrastructure construction is planned or underway in Malmö, for example in Hylle and Norra Sorgenfri (Stadsbyggnadskontor, 2011b). Previous research from Skarbäck and Rydell-Andersson (2010) considered open and green spaces in Malmö, mostly by analysing different types of characters and qualities. These studies did not include socioeconomic considerations or an up-to-date investigation of the distribution of green spaces. A study from Berlin considered the socioeconomic perspective with regard to environmental justice. It included benefits and amenities like green space provision, and compared these to the socioeconomic situation of residential areas. In Stockholm a very detailed analysis was undertaken to assess public space regarding user experience and accessibility in a so-called sociotope-map.

The valid green plan for Malmö from 2003 utilized data from 1999, which can be considered outdated. Hence there is a lack of knowledge on todays distribution and accessibility of green spaces in Malmö. Sustainable urban development should take environmental and social justice into account, when regarding green urban infrastructure with all its benefits.

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1The term green space refers to the Swedish term of grönttor, which can be directly translated into green surfaces. Generally most literature uses the term green space to describe any kind of surface vegetation in the physical urban environment. The term green area refers to the Swedish term grönområde instead, i.e. a larger (min. 1ha) coherent surface of vegetation, like parks (SCB, 2010a).

2Statistiska centralbyrån
1.1 Problem, Aim and Question

Malmö strives to become an attractive and sustainable city by 2030. It aims to integrate social, ecological and economical sustainability in that process and become and a best practice example. The population will grow and needs housing and employment which challenges the densification of the existing urban environment. This will increase pressure on usage and demand for green spaces in the city. It is generally known that Malmö is a segregated city, with the affluent in the west and the less affluent in the east. Previous policy and research has however not integrated the socioeconomic dimension in green space distribution. Due to environmental and health benefits green space must be assessed independently from other types of open space. Moreover the division of private and public green has not been sufficiently analysed, and the valid green plan from 2003 was based on data from 1999. Hence there is a need for an updated assessment of the situation in Malmö today. The future development of Malmö is currently being discussed. However the importance of green space is being marginalised in current debate and urban planning, due to the intensive focus on densification.

On these grounds this studies serves multiple purposes. The first aim of this study is to advocate the wider discussion of environmental justice in a Swedish context. The study will focus on environmental qualities and benefits in the form of green spaces. Secondly, the study aims to contribute to a better understanding of the green space distribution and accessibility in Malmö. Hence it seeks to support the identification of the dispersion of inequalities within the city. This information is important and needed to plan for a more sustainable future of Malmö, where environmental benefits are equally distributed among its increasing population. Lastly the study intends to give insights to planners and policy makers driving sustainable urban development. Environmental justice issues need to be brought onto the agenda and investigated further to promote a just and sustainable society.

Hence the overarching question of this study considers how green space as an environmental quality is distributed among different social groups and generations in Malmö. Consequently the following subquestions will be investigated:

• What constitutes green space in the urban environment and how can it be categorized?

• What size and proximity is needed to experience green space as healthy environments?

• Which neighbourhoods are disadvantaged both in terms of their socioeconomic situation and access to green areas?
1.2 State of the Art: Research and Policy

Several policy documents and research articles on environmental justice and issues of green space have been reviewed during this study and influenced its process. The most important documents depicting tools and approaches for the assessment of green space are presented in a short form in the following part. At first the European scope will be illustrated, followed by examples of Berlin, London and Stockholm. The second part focuses on Malmö delineating existing policy and current research. The research themes presented in this section cover issues of green space provision in cities, in terms of accessibility, size and function. In addition research on issues of qualities of green spaces and user experiences are presented.

The Scaling of Green Space Coverage in European Cities

The study by Fuller and Gaston (2009) compared data from 2001 across 386 European cities. They determined the relation between urban green space coverage, city area and population size. An overview map of the results can be found in the appendix A.1 on page 44. The results show that the percentage green space coverage on the total city area varied greatly between 1.9% to 46% with an average of 18.6%. An interesting point depicted by Fuller and Gaston was the fact that proportional green space coverage increased by latitude, i.e. there was generally a lower percentage in the south than in the north of Europe. The per capita green space provision showed similar patterns, increasing towards north northeast (up to 300 sq m per person). In southern countries it was around 3-4 sq m per person (Fuller and Gaston, 2009). From the European perspective onwards the three following reviews present a more detailed examination on the city level of Berlin, London and Stockholm.

Socio-Spatial Distribution of Green Spaces in Berlin

This study was part of a best practice project which examined environmental justice in Berlin. The focus was on the analysis of the socio-spatial distribution of health-related environmental burdens and benefits in the city (Bunge and Gebuhr, 2011). This was made possible due to an ample amount of collected data on environmental and socioeconomic factors and an annual urban monitoring program of the whole city. The study presented separate discussions of certain aspects like the socio-spatial distribution of noise exposure, bioclimatic conditions, and green spaces (Bunge and Gebuhr, 2011). Kleinschmit et al. investigated the socio-spatial distribution of green spaces in Berlin. As green space they defined a surface in the urban environment that has a high amount of vegetation and is not built-up. To be effective for recreational purposes the green space needs to be publicly accessible and have various functions. According to the authors this applies to parks, graveyards, sports facilities, and even town squares, agricultural areas and nurseries. In addition the size of a green space should at least be 0.5 ha and it should lie within 500 m from a residence. The applied green space provision analysis included issues concerning size, form and accessibility, but excluded the issue of quality. A valid guideline for Berlin also suggests that every resident should have access to 6 sq m green space close to their residence. Hence the categorization of green space provision can be seen in table 1.1 (Kleinschmit et al., 2011). As a next step the data on green space provision was combined with the Berlin’s own development index. This index was derived from 12 socioeconomic factors, 6 describing the status (e.g. unemployment rate, population

<table>
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<th>Assessment</th>
<th>Green Space [m²/resident]</th>
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<td>1</td>
<td>high / well served</td>
<td>&gt; 6.0</td>
</tr>
<tr>
<td>2</td>
<td>middle / underserved</td>
<td>6.0 - 3.0</td>
</tr>
<tr>
<td>3</td>
<td>low / poorly served</td>
<td>3.0 - 0.1</td>
</tr>
<tr>
<td>4</td>
<td>very low / not served</td>
<td>&lt; 0.1</td>
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Table 1.1: Categorisation of green space provision (own translation after Kleinschmit et al., 2011, p.36)
with migration background), and 6 describing change (e.g. migration balance, change of unemployment rate etc.) (Bunge and Gebuhr, 2011). The study depicted the connection between the socioeconomic situation and green space provision on the level of different planning areas. The results showed that generally the dense inner city had a deficit in green space provision, as well as some planning areas further south with a lower development index. The suburbs were usually well served with green spaces and scored high on the development index. An exception were the large housing developments at the outskirts of the city, that had a low development index (Marzahn in Berlin comparable to Rosengård in Malmö). All in all the results show that areas with a higher development index are rather well served with green spaces. In contrast 51% of the planning areas with a low development index, are poorly or not served at all. Looking at the whole city indicates that there is a slight inequality in the distribution of green spaces (Kleinschmit et al., 2011). The study could identify areas of low development index that are simultaneously characterized by an under-supply of green spaces.

OPEN SPACE STRATEGIES - BEST PRACTICE GUIDANCE - LONDON
This is a very comprehensive policy document that is meant to be a guide for open space planning in England, with a best practice example of London and other case studies. It sets the frame for identifying supply and demand of open space, to identify deficiencies and improve management and monitoring. An interesting point is the recommendation to consider all types of open spaces (except private gardens) irrespective of ownership and public access. GIS is identified as a valuable tool for recording and analysing data on open space. A reference is made to the GiGL (Greenspace Information for Greater London) which manages local and regional datasets with data on e.g. public open space hierarchy and associated deficiencies. The open space hierarchy can be seen in A.1 on page 45. It depicts different sizes of open and green spaces, related to respective distances from homes and functions (CABE, 2009). This is a more detailed categorization of distance and size of green space than the one presented by Kleinschmit et al. (2011) for Berlin.

SOCIOTYPE-MAP FOR PARKS AND OTHER OPEN SPACES IN STOCKHOLM
This document presents the comprehensive work on the sociotope-map as part of the greenmap of Stockholm. The other two parts deal with the biotope-map and the life-cycle-map. It is acknowledged that an assessment of green structure and open space is needed from the social and cultural perspective. The term sociotope is a transformation of the term biotope which refers to the ecological character of an open space (e.g. sandy beach). Sociotope instead describes the human experience and used place of a specific culture (e.g. bathing beach). The questions asked are by whom and for what the open space is used. This is described in qualitative terms, regarding the quality, experience value, meaning, character and function of an open space. The maps were created based on dialog with inhabitants and new tools developed with GIS. The maps then depict valuable open space with its respective value, the accessibility within the built environment and development areas. Open space was defined in the study as not built-up areas, including not only green spaces but also squares and pedestrian streets. A typology of different types was presented, starting from a size of 0,5 ha up to city parks above 5 ha, parts of it can be seen in 2.1 on page 14 (Ståhle and Sandberg, 2002).

The focus of this study lay more on qualities and people’s experience of open space, in comparison to strictly quantitative methods focusing on provision and functions mentioned before.

Malmö GREEN PLAN 2003
This is a very comprehensive document presenting the situation of green spaces in Malmö. The current green plan was developed starting in 1996 and came into effect in 2003. It was based on data from 1999. It had a focus on recreational and biological importance of green space in the city. It also

3“Many alternative definitions of GIS have been suggested, but a simple definition is that a GIS is a computer-based system for the capture, storage, retrieval, analysis and display of spatial data” (Skidmore, 2002, p.4).
included a biotope-map, like the one in Stockholm. Green space was here foremost referred to as not built-up green land, excluding farm and pasture land. The strategic plan was built up on the so called green model, which included a deficiency analysis and a structure analysis of green areas and green paths. The classification that was used was very detailed according to the land use, the level of public access and the size and can be seen in figure A.2 on page 46. The recommendations on distance were made regarding the actual distance when walking trough the urban fabric, including reference to traffic barriers. Because of measuring difficulties the linear distance method was still used for measurement in the end, i.e. acknowledging that the actual deficit might be greater. The size categories of publicly accessible green space can be seen in figure A.2 on page 46, the distance are defined as 300m (0,2-1ha), 500m (1-5ha), 1000m (5-10ha), 2000m (above 10ha) and 3000m (above 35ha). Boverket (2007) revised the Green plan and pointed out that it included considerably longer distances then the national recommendations (for comparison see table 2.1 on page 14). It was argued that being a dense city in the flat coastal land of Scania, Malmö had different requirements when compared to other Swedish cities that are often surrounded by natural forest. The green plan recognized that the amount of publicly accessible green space\(^4\) per inhabitant was rather low with 33 sq m compared to the national standard of 100 sq m. A summary of the five deficiency analyses showed that the greatest deficit of green space was found in central parts of the city, as well as in Tygelsjö, Limhamn and the harbour areas.

THE COMPREHENSIVE PLAN FOR MALMÖ 2012

The city of Malmö is currently in a process of developing a new comprehensive plan which will delineating the development for the next 20 years. The bottom line describes future Malmö as an attractive and socially, ecologically and economically sustainable city. It is estimated that Malmö will grow with an additional 100 000 inhabitants, resulting in a need for more housing and employment. The aim is to create a resilient and forward-looking planning for the urban structure, to improve the attractiveness and existing qualities. Malmö wants to be a leading city when it comes to sustainable urban development. Challenges are thus to create a social balance within the city and reach environmental goals. One strategy is to densify the existing urban area, and limit expansion and development to the outer ring road, not exploiting valuable agricultural land. More people should be able to live and work in the city, mixing functions within neighbourhoods and decreasing the need for commuting. The planning should fulfill demands and special needs for children and elderly, considering safety and accessibility issues. It is acknowledged that the city currently has a relatively limited amount of green space, and should work on fulfilling it’s epithet as “the city of parks”. This is planned to be strengthened by implementing the new botanical garden in Lindängelund and the relatively new Varvspark in the Western Harbour. The additional amount of inhabitants is also identified as an issue, demanding new green spaces and the improvement of existing ones as well as their equal distribution within the city. The aim is to create access to green space in proximity irrespective of social groups, districts or forms of housing. The quality, supply, proximity, accessibility and location are considered as important as the quantity. References to current research name many benefits of green spaces that were mentioned earlier. There is also a reference to the plan of developing a sociotope-map for Malmö, relating issues to distance and quality like the study on Stockholm.

CHANGES IN GREEN SPACE, WITHIN THE TEN LARGEST LOCALITIES 2000-2005

Statistics Sweden made this study to compare the changes in degree of vegetation and green space in the ten largest cities in Sweden. It refers to cities rather in the term of localities, which describes the urbanized part more properly, and does not include places below a certain population density. The

\(^4\)According to the green plan this excludes allotments, sports facilities, golf courses, graveyards, gardens and courtyards.
study showed a decrease in vegetation in all localities. It also determined the percentage of green space towards the total localities area, which turned out that Stockholm had 74% and Malmö only 55%. Malmö was the cities with the lowest amount of green space per person, with 154 sq m in 2005. The study concludes that most green areas have been decreased in size due to construction of buildings or infrastructure in the immediate proximity (SCB, 2010a).

**MALMÖ-RESIDENTS EXPERIENCE OF FIVE OUTDOOR CHARACTERS**

This study is based on previous research, that was undertaken at SLU Alnarp and used GIS to define 8 characters of outdoor environments. The 8 characters are quietness, wildness, biodiversity, natural space, public, play, celebrations, cultural history. They were defined from the human ecology perspective of the attractiveness of open space to people. This study was based on a public health questionnaire and data on the urban environment of Malmö from Gatukontoret and Stadsbyggnadskontoret. It focused on improving the previous method/model and make it more applicable to the rest of the country, by increasing the significance of classification towards the answers of inhabitants. The classification of the characters was based on 39 different variables, including for example size of parks, park type, grass or scrubs type, noise, age of buildings. The analysis included 5 of the 8 different characters that could be determined with the given data on Malmö. The experience of a combination of variables within 300m (5-10min walking) of residents was assessed. The visualization in maps and the choice of uncommon city border were not further explained in the study, and can be seen in figure A.3 on page 46. To keep the model as general as possible, it was decided not to include sociodemographic factors, such as age, type of housing, education or ethnicity, however it is acknowledged to influence residents experience of green qualities. The overall result showed that 50% feel they have a peaceful environment within 5-10 minutes walk from their residence, 9% are experiencing wildness, 22% had biodiversity, 58% experience space and 23% experience cultural history within a 5-10 minute walk from their residence. The authors state that it is remarkable that the size has a great importance for inhabitants experience. Parks from the size of 5-10, and above 10ha were experienced positively related to quietness, biodiversity, space and cultural history. In contrast greenery (0,2-0,6ha) was experienced as negatively related to biodiversity, quietness and wildness. Considering noise, even parks of the size 1-5ha were experienced negatively. The authors therefore ask if a the size of 1-5ha might be too small for a park. This study reinforces other studies in the conclusion that the size of a park is one of its most important qualities (Stoltz et al., 2012).

### 1.3 Disposition

The following chapter will introduce the theoretical framework and present key concepts about environmental justice and green spaces. In chapter 3 the research design and methods for processing the quantitative data will be illustrated in detail. After this the socio-spatial analysis will present a brief account on Malmö and the results, followed by a more in-depth description of implications of the results for the most disadvantaged parts of the city. Chapter 5 concludes with a summary and reflections on the study and a discussion about future research subjects.

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5own approximate translation of the swedish definition: det rofyllda, det vilda, det artrika, en rymd för tanke och vederkvickelse, allmäningen, lustgården, centrum/festen, kulturen
2 GREEN AND JUST FRAMEWORK

To be able to answer the research question it is essential to define the underlying theories of environmental justice and green space distribution. This section will highlight relevant theories and concepts to be discussed later.

2.1 Environmental Justice

For a better understanding of the concept of environmental justice the following section will depict the origin of the term and its relevance for sustainable urban development.

2.1.1 Defining Environmental Justice

The roots of environmental justice (EJ) can be traced back to the US in the 1980’s, where a movement started to address the distribution of pollution and toxic waste mostly affecting people of colour and poor neighbourhoods (Agyeman et al., 2002). Consequently the Environmental Protection Agency (EPA) formulated the following definition: “Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. [...] this goal [...] will be achieved when everyone enjoys the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work” (EPA, 2012). In general environmental justice comprises of the fact that people should have an influence on environmental decision making, and that benefits and burdens are fairly distributed. Thus in discussions on the subject it is often distinguished between the so called procedural environmental justice (influence on decision making) and the distributive environmental justice (fair distribution of benefits and burdens). In this study the distributive type will be the focus. Therefore questions arise concerning what is to be distributed, and who is the recipient (Caney, 2007). Recently the emphasis in the discussion of EJ and environmental benefits has shifted to a focus on the general idea of environmental qualities and the possibility to experience these, e.g. green spaces and the countryside. “The principle of distribution is that everyone has a right to a certain minimum standard but beyond that standard there is room for variation” (Caney, 2007). Cutts et al. (2009) state that environmental benefits are often an overlooked element of environmental justice.

2.1.2 Environmental Justice, Sustainability and Segregation

Since the beginning in the US the concept has spread widely and was discussed on various national levels as well as the global level (Bradley et al., 2008; Geißler and et al., 2010; Fairburn et al., 2005; Anand, 2004). Many parallels can be drawn from national EJ cases to the international environmental politics between the global North and South. Discussions and oppositions have addressed many international global agreements since they did not equitably reflect the interests of countries in the global South (Anand, 2004). “But, while justice between the global North and South is generally acknowledged in Sweden, promoting justice among different groups within the national boundaries has not been emphasized in the national sustainability debate” (Bradley et al., 2008, p.70). Haughton illustrates that the discourse of sustainable development has enlarged the consideration of rights by identifying the rights of future generations and of present-day socially marginalized groups, thus relating it to environmental justice issues. “The need to ensure that public policy—environmental or
otherwise—does not disproportionately disadvantage any particular social group must be a precon-
dition for a just and sustainable society” (Agyeman et al., 2002, p.88). Bradley et al. highlight that
urban regions in Sweden and most other European countries, are becoming progressively diverse in
terms of culture, lifestyles, socio-economic conditions, and gender roles. However Bradley (2009)
also points out that current socioeconomic structures and sustainability politics can benefit certain so-
cietal groups and marginalise others. A study on EJ in Berlin revealed a disproportional distribution
of environmental burdens and benefits on planning areas with different socioeconomic status in the
metropolitan area (Kleinschmit et al., 2011). The different environmental justice factors investigated
were noise exposure, air pollution, bioclimatic conditions and green space distribution (Bunge and
Gebuhr, 2011). From an international perspective, Chaix et al. (2006) considered it important to find
out if environmental injustice may actually exist in a country with one of the most advanced welfare
states and lowest inequalities in income, i.e. Sweden. In their study on children’s exposure to air
pollution in Malmö, they found evidence for environmental injustice connected to social segregation.
They concluded that the “Enforcement of environmental regulations may be necessary to achieve a
higher level of environmental equity” (Chaix et al., 2006, p.234). In a study on infrastructure im-
pacts in Stockholm Bradley et al. (2008) revealed that the environmental justice consequences are
as obvious today as in the 1990s, but that the issues remain unaddressed in the general policy de-
bate. “Also, there is a need for mapping the environmental justice situation, even in welfare cities
like Stockholm” (Gunnarsson-Östling and Höjer, 2011, p.1064). Brulle and Pellow argue that resi-
dential segregation is a major mechanism that contributes to environmental inequality, poverty, and
health disparities. Discussions on segregation often distinguish between three types: socioeconomic,
ethnic and demographic. Demographic segregation depicts differences in spatial distributions by age,
gender and household types. The socioeconomic segregation describes the distribution of the popu-
lation according to class and resource differences. Ethnic segregation implies that people who share
certain ethnic, religious or physical characteristics tend to congregate, i.e. gathered and segregated
from those with other such attributes (Andersson et al., 2007). “A truly sustainable society is one
where wider questions of social needs and welfare, and economic opportunity, are integrally related
to environmental limits imposed by supporting ecosystems” (Agyeman et al., 2002, p.78).

2.2 Green space

Considering EJ from the perspective of environmental benefits and qualities draws focus on the distri-
bution of green spaces. As this study will investigate green areas in the urban environment of Malmö,
it is important to define this concept clearly.

2.2.1 Defining Green Space and Green Areas

In the general discussion the term green space is frequently used to describe forms of urban vegetation
(e.g. Sotoudehnia and Comber, 2010; Kleinschmit et al., 2011; Gidlow and Ellis, 2011; Groenewegen
et al., 2006). According to studies undertaken by SCB green space is defined as all kinds of surfaces
with vegetation inside the urban environment, e.g. public parks, lawns, other tree- or grass-covered
surfaces (including leftovers after construction), private gardens, green between apartment blocks
and industrial buildings, and even open vegetated spaces between roads (SCB, 2010a). The degree
of vegetation may vary, so that a small percentage of sealed surfaces may be included (SCB, 2008,
2002). In the studies undertaken by SCB the minimum accounting unit of green spaces is specified as
0.01 hectares, i.e. 100 square meters.
In contrast to this green areas are defined as larger undeveloped (no buildings) green spaces with a
2.2 Green space

size of at least 1 hectare, i.e. 10000 square meters. In some studies pastureland\(^6\) was considered a green area, but no agricultural land (e.g. SCB, 2010a; Skärbäck et al., 2009).

In most studies on urban areas, agriculture and pastureland are not mentioned, as they logically are considered a part of rural and not urban areas.

### 2.2.2 Relevance of Green Space in the Urban Environment

The importance of urban green spaces can be related to the affiliation of humans to nature and biodiversity, which was defined by E.O. Wilson as the biophilia hypothesis (Kellert et al., 1995). The concept suggests a biologically based, innate human need to incorporate all lifelike things. The opposite concept is that of biophobia, proposing that nature can also be seen as a danger, creating fear and avoidance (Tzoulas et al., 2007). “These studies suggest that a complete Green Infrastructure may have a considerable potential for improving the health of urban residents” (Tzoulas et al., 2007, p.171). Besides, reliable scientific research proved that there is a strong linkage between longevity and access to green spaces. Tzoulas et al. also argue, that there is sufficient evidence prevailing to conclude that green infrastructure is a significant public health factor.

“Access to green space in urban areas is important because of the contributing role of the areas in the quality of life and improving human health and wellbeing” (Sotoudehnia and Comber, 2010, p.1). Groenewegen et al. points out the fact that the notion of beneficial effects of nearby green space have persisted throughout history. “Health benefits arise both from directly taking exercise within these areas, and also indirectly through the visual amenity in terms of mental well being” (Fairburn et al., 2005, p.26). This can also be related to the benefit of green in the urban environment as it fosters biodiversity, and helps to regulate climate on different levels, like temperatures, ventilation and precipitation. Vegetation in the city influences air temperatures, and can create shade in hot environments, which benefits urban population (Bunge and Gebuhr, 2011).

These benefits will become even more relevant and needed with ongoing climate change (Rockström et al., 2009). Groenewegen et al. argue that due to the pressure of densification, urban residents face the risk of living in less green and overused environments. Fuller and Gaston state that urbanisation is accelerating and the consequences for green space are unclear. “However, our analyses suggest that access to green space could decline rapidly as cities grow, increasing the geographical isolation of people from opportunities to experience nature. More generally, contact with urban biodiversity can be interpreted as a quality of life indicator distinct from the biological value of an area” (Fuller and Gaston, 2009, p.354). Above that the restorative effect of green spaces is based on experiencing quietness and the sounds of nature, instead of urban traffic and noise (Ericsson et al., 2009; Stoltz et al., 2012).

Hence the question of distribution and access to public green space becomes more relevant in the EJ perspective. This is crucial especially for less-affluent residents, and less mobile ones like children and elderly, as they have fewer possibilities of leaving their living environment to explore nature outside of the city. Thus within growing cities green spaces become more important and valuable for physical and mental well-being, health, stress recovery, activity and even social cohesion (Groenewegen et al., 2006; Sotoudehnia and Comber, 2010; Fuller and Gaston, 2009). Research has also identified that the availability of nature in outdoor public spaces attracts different social groups and increases opportunities for positive social interaction (Coley et al., 1997). Moreover there is considerable evidence that the use of green space is highly differentiated between different social groups and generations (Sotoudehnia and Comber, 2010; Cutts et al., 2009; Ericsson et al., 2009; Fairburn

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\(^6\)Pastureland within semi-urban environment consists of mostly small fenced in plots with open soil and grass, it is thus as inaccessible as agricultural land for recreational purposes (Skärbäck et al., 2009).
et al., 2005). This issue might correlate with the fact that green space increases the value of adjacent properties, resulting in a need for higher income to live close to green space (Fairburn et al., 2005).

2.2.3 Distribution and Accessibility

To be effective for recreational purposes green space needs to be publicly accessible and have various functions (Kleinschmit et al., 2011). Many of the larger scale studies do not differentiate between private/public but rather consider land cover (e.g. water, forest) and categorise by land use (e.g. industrial, residential) or by urban structure (e.g. detached housing area, no buildings) (SCB, 2002; Attwell, 2000; Hanski and et al., 2012; Fuller and Gaston, 2009). Studies regarding the city scale often understand green space as a public good, and hence publicly accessible (Cutts et al., 2009; Gidlow and Ellis, 2011; Sotoudehnia and Comber, 2010). Ståhle (2010) depicts a definition of open space that includes public and private land, including gardens and courtyards. This issue can be related to the club theory as defined by Buchanan. “The study of clubs was intended to bridge the gap between private and pure public goods” (Sandler and Tschirhart, 1997, p.336). This means that club goods represent a class of public goods, which are excludable and subject to some rivalry in the form of congestion. Club theory has been applied to a variety of problems, including recreational facilities, national parks and wilderness areas (Sandler and Tschirhart, 1997). In that sense it can be linked to categorizing green space into public, semi-public and private space (Boverket, 2007). Hence semi-public green space (as a club good) can be related to some sort of excludability or requirement of membership, i.e. sports facilities, allotments, school yards (Boverket, 2007; Sandler and Tschirhart, 1997).

A major issue of access is also that green spaces are usually reached by foot, which makes poor access, walkability and safety issues critical to the usage of available green spaces (Fairburn et al., 2005; Cutts et al., 2009). The distance from residence to green space is a crucial factor for the frequency of visits. Many people have stress-related problems, and the distance to green space actually influences how many days a year people feel stressed and tired (Stoltz et al., 2012). Close by green areas have the most impact on health and behavior, as they are presumably more frequently visited due to the easy of access and incidentally through daily movements. Proximity to green space is assumed to be especially important for elderly, young children and less mobile adults whose movements out of the living area might be more limited (Gidlow and Ellis, 2011). Studies have also shown various health related issues for groups with migration background, low income, elderly and children concerning the proximity to green space and its connection to recovery, obesity, allergies, and stress (Ericsson et al., 2009; Cutts et al., 2009; Hanski and et al., 2012; Gidlow and Ellis, 2011; Groenewegen et al., 2006). Ståhle (2010) described one of the earliest accessibility standards set by the Stockholm General Plan already in 1952. It was based on a questionnaire from kindergartens, and set 300 meters as the maximum distance to playgrounds. The value of 300 meters is the most frequent distance used for defining access to green space in current discussions, as it represents the maximum distance most people are willing to walk to reach a green space (e.g. Stoltz et al., 2012; Ståhle, 2010; Sotoudehnia and Comber, 2010; Gidlow and Ellis, 2011; Ericsson et al., 2009; Björk et al., 2008). This is based on an estimate of 5 min walking (Sotoudehnia and Comber, 2010). Current research shows that the frequency of visits and time spent in green spaces is decreasing by increasing distance (Ståhle, 2005; Stoltz et al., 2012; Ericsson et al., 2009). Hence an increase in stress levels and decrease in visiting frequency can already be observed between close by green space and a distance of 50m (Stoltz et al., 2012). Great discomfort (tiredness, headache, stress) was observed for people living 1000m away from green space, these discomforts decreased between 300m and even further for 50m distance.

13
2.2 Green space

Green space

<table>
<thead>
<tr>
<th>Green space type</th>
<th>Min. size (ha)</th>
<th>Max. distance (m)</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pocket parks</td>
<td></td>
<td>&lt;50</td>
<td>Green space</td>
</tr>
<tr>
<td>Local parks</td>
<td>&gt;0.3–0.6</td>
<td>&lt;200</td>
<td>Green space, play area</td>
</tr>
<tr>
<td>District parks</td>
<td>&gt;10–20</td>
<td>&lt;500–800</td>
<td>Green space, play area, peace &amp; quite, recreational activities</td>
</tr>
<tr>
<td>Nature areas</td>
<td>&gt;1000</td>
<td>&lt;1000</td>
<td>Wilderness, play area, peace and quite, recreational activities</td>
</tr>
</tbody>
</table>

Table 2.1: Tables showing guidelines from Boverket and Stockholm on minimum size and maximum distance (Ståhle, 2010, p.59)

There are obvious differences even regarding shorter distances of 50m, 100m and 300m. Ericsson et al. puts it into a simple rule, if the green space is close we visit it more often and we experience less stress. This means that green space is needed as close as possible to the residence (Ericsson et al., 2009). An overview of Swedish guidelines was compiled and translated by Ståhle (2010), see table 2.1.

Another big issue regarding the distance are physical barriers, like traffic infrastructure. Many studies show that these are very important factors influencing the frequency of visits. “Poor access may keep people away from their local parks because they do not feel safe enough to journey to them on foot” (Fairburn et al., 2005, p.25). This is linked to the problem that green spaces are often too far or difficult to reach for children, resulting in the fact that they are often not allowed to go on their own, again decreasing the frequency of visits (Fairburn et al., 2005). Many studies refer to the fact that green space is reached by foot, i.e. to a maximum distance of 300m or even 500m (Cutts et al., 2009; Kleinschmit et al., 2011). Green spaces that are further away are usually reached by other means of transport e.g. bikes, cars or public transport. This of course requires access to those means, linking it to affordability and income Sotoudehnia and Comber; Fairburn et al.; Cutts et al.. The issue of income and transport choice is also related to minorities, e.g. people of foreign origin, who usually have a low income and are more dependent on walking and public transport (Bradley et al., 2008; Cutts et al., 2009; Sotoudehnia and Comber, 2010; Fairburn et al., 2005). In most studies a linear distance measure was applied, but it shows that other tools for actual distance within the urban fabric might be more effective to relate issues to frequency of visits (Ståhle, 2010).

A factor influencing the potential for green space to be useful for recreational purposes is noise. Noise from traffic is something a person does not simply get used to, but it is a major influence on stress, health and well-being. Noise and traffic dominate urban environments making quietness a rare amenity. For a green space to be relatively quiet in comparison to the noisy surroundings requires a certain size. Stoltz et al. (2012) found out that green space with the size of 1-5 ha was negatively related to quietness. In contrast a positive relation was observed when the green space had a size of 5-10ha. The authors therefore questioned if a green space (1-5ha) might be too small, or even one that is under 1ha in the context of Malmö (Stoltz et al., 2012). Small green spaces were not of importance
to most factors. They could even be a problem, when they were wild and with scrubs, as they were
experienced as unsafe (Stoltz et al., 2012; Bergström, 2012). Even usually quiet places like grave-
yards were related to negatively when they were close to noise sources like large roads or railroads
(Stoltz et al., 2012; Bergström, 2012). In addition the size often influences what kind of amenities can
be found within the green space, e.g. playgrounds, sports facilities, wilderness see table 2.1 (Stoltz
et al., 2012; Ståhle, 2010; Gidlow and Ellis, 2011).

Considering population density as an issue concerning green space distribution, it is important that
green spaces are close to where people live (Ericsson et al., 2009). As the provision of green space
is often measured in square meters per inhabitant, it seems natural that a low populated areas scores
higher on this measure compared to a highly populated area with the same amount of green space. But
as Ståhle (2010) discussed in his study, high spatial integration of inner city parks means that they
are probably more effectively used by relatively more stakeholders, when compared to same sized
parks in the suburbs. This is linked to the fact the they are within the daily movements of people,
and that they are highly visible, whereas parks in the suburbs have a more segregating character of
being green belts. A study on the European level showed that green space per capita varied between
3-4 square meters in Spain and up to 300 square meters in Finland. On a city level green space is
often measured as percentage towards the total land area, not detailing the actual distribution (Ståhle,
2010). On a European level Fuller and Gaston investigated 386 cities, and found that the average
green space coverage was 18,6 %, and a maximum of 46% as depicted in A.1 on page 44.

In summary the conceptual frame for this thesis consists of the main theories on environmental justice
and equal distribution of environmental goods among different social groups. In these terms the con-
cept of green space and green areas is considered with the related benefits for human well-being in
urban environments. This is based on further theories and concepts concerning access (public/private),
distance (walkability) and size (utilization) of green areas.
3 METHODOLOGY

This part describes the choice and procedure of the study. As the research design a case study approach was chosen. The quantitative analysis was based on secondary data, i.e. census data and spatial information retrieved from different trusted sources. The data was screened and has been processed for further analysis in GIS which will be described more in-depth in the following. Further elaborations on limitations of the study and its reliability and validity will conclude this section.

3.1 Research Design

As the research design for this thesis the case study approach was chosen, providing the proper framework for collection and analysis of data (Bryman, 2008). The Research design links the data to be collected and conclusions to be drawn to the initial research questions of the study (Yin, 2009). Hence for this study, data on green space and socioeconomic factors has been collected and related to the research questions concerning distributive EJ. This is appropriate as the case (being an empirical inquiry) investigates a contemporary phenomenon within a real-life context which is associated to a certain location, i.e. Malmö. Malmö was chosen as the case study object, since it represents an interesting example in the Swedish context. It is a unique city in Sweden when regarding its location and surroundings as well as its young and multicultural population (Pålsson, 2011). The case study research relies on multiple sources of evidence and comprises of a detailed and intensive analysis of a single case (Yin, 2009). A quantitative research method can be found within this case study (Bryman, 2008). The quantitative analysis deals with census data and spatial data that was brought together in a geographic information system (GIS) on the scale of Malmö city (Skidmore, 2002; Mitchell, 2009). The author has conducted case study research before and has gained in-depth knowledge about the field of research and several methods (Wascher, 2010, 2012).

3.2 Quantitative Data Collection

Given the research questions the focus lay on finding reliable data to describe the socioeconomic situation of neighbourhoods and spatial information on green spaces in Malmö. In addition literature was reviewed to gain more knowledge on previous research methods and guidelines in the field. An overview was compiled on State of the Art: Research and Policy in section 1.2 on page 6. Given the character of spatial analysis the focus lay on collecting different forms of spatial data (e.g. shapefiles\(^7\) and satellite images) and census data (excel tables) that could be added to GIS. The data was retrieved through reliable sources, like government agencies, municipal administrations and universities. The author has thorough experience of quantitative analysis and the utilization of GIS, as well as local knowledge of the city of Malmö (Wascher, 2010, 2012). Methods and tools previously used by the author in the bachelor thesis and other research were extended in the analysis of this study. The following part will describe the data and how it was processed in the analysis.

\(^7\)A shapefile is a geospatial vector data format for geographic information systems software (GIS). “A shapefile is a simple, nontopological format for storing the geometric location and attribute information of geographic features. Geographic features in a shapefile can be represented by points, lines, or polygons. The workspace containing shapefiles may also contain dBASE tables, which can store additional attributes that can be joined to a shapefile’s features” (Esri, 2011).
3.2.1 Socioeconomic Situation

The most detailed set of census data for Malmö is called områdesfakta, i.e. area information, on the level of the 10 city districts and the 134 neighbourhoods (Malmö, 2012). The content of this dataset with the main categories can be seen in table A.2 on page 47, it does not include the various subcategories listed in the excel files. Census data has not been collected in this form after 2008, but certain factors like income statistics from 2009 and statistics on population with migration background from 2011 was obtained from Malmö Stadskontor, Avdelning för Samhällsplanering (Stadskontor, 2012a,b). The complete set of area information from 2005 and 2008 was received from Malmö University, Department for Urban Studies (US, 2012a,b). Most of the included data in the area information is derived from SCB, e.g. income and education (Malmö, 2012). Given the coherent data of the last two data sets, and the later described spatial information, the time frame of the year 2005 was chosen to be the focus of analysis. The spatial data is sorted according to the neighbourhoods given theirs names, this made it possible to sort the census data and integrate it with existing files of the spatial data. Some irregularities were found, like the change of name from Sorgenfri industriområde to Norra Sorgenfri, indicating that the industrial area is transformed into a new residential neighbourhood (Stadsbyggnadskontor, 2011b). These irregularities were aligned with the spatial data, to identify the right neighbourhood in the resulting maps, adding zero values for neighbourhoods that did not exist in 2005 yet (i.e. Fortuna Hemgården, Svägertorp). Hence 2005 data on the distribution of population density, migration background and income on the neighbourhood level was chosen as socioeconomic factors based on examples from previous research (Kleinschmit et al., 2011; Sotoudehnia and Comber, 2010; Gidlow and Ellis, 2011; Groenewegen et al., 2006; Cutts et al., 2009).

These factors were then integrated into GIS by adding it to the existing data layer including the neighbourhood areas of Malmö (US, 2012a,b,c). The data was visualized using descriptive methods for better interpretation (Rogerson, 2006). For further statistical processing, the 30 out of 120 neighbourhoods with a population under 100 inhabitants were taken out of calculations. This left 90 neighbourhoods for the analysis (after cutting the neighbourhood borders to the investigation area, further explanation see 3.2.2 on the next page). For each factor, the mean value was determined, see table 3.1 (Rogerson, 2006; Mitchell, 2009). The focus for further analysis was on below average income (all under 256 000 SEK), whilst all other factors were assessed base on above average (e.g. foreign born percentage of total population over 24%). The factors were displayed in a map. The threshold for further considerations lay on at least 3 out of 5 factors above/below average to be fulfilled by a neighbourhood. These neighbourhoods were identified as less advantaged, and therefore considered to have a greater need for publicly accessible green areas in proximity.

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>MEAN VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean disposable income per family/year in SEK</td>
<td>256 000</td>
</tr>
<tr>
<td>population density in inhabitants/ha</td>
<td>70</td>
</tr>
<tr>
<td>population age 0-5 in % of total population</td>
<td>6</td>
</tr>
<tr>
<td>population age 65-79 in % of total population</td>
<td>12</td>
</tr>
<tr>
<td>foreign born population in % of total population</td>
<td>24</td>
</tr>
</tbody>
</table>

Table 3.1: Socioeconomic factors and respective mean values from 89 neighbourhoods in Malmö 2005 (after data from US, 2012a,b)
3.2 Quantitative Data Collection

3.2.2 Spatial Information on Green Spaces

“The spatial data in GIS databases are predominantly generated from remote sensing through the direct import of images and classified images, but also through the generation of conventional maps (e.g. topographic maps) using photogrammetry” (Skidmore, 2002, p.4). To cover the need for spatial data various sources have been taken into account. As mentioned before a dataset including spatial information on the neighbourhood and district level of Malmö was obtained from Malmö University, Department of Urban Studies (US, 2012c). Furthermore various shapefiles on the urban structure of Malmö were obtained from Gatukontoret11 (Gatukontoret, 2003). In addition satellite images from 2005, 2010 and 2011 was downloaded from Lantmäteriets12 free service SAP (http://saccess.lantmateriet.se/) in original colour and infrared (Lantmäteriet, 2012). Malmö’s city map is available online and was used for visual comparison to other data (Stadsbyggnadskontor, 2011a). The data that was used for the SCB study mentioned before was obtained from Metria13 (Metria, 2012a,b). Several of the data included different information on green space. The aim was to find data on green space, that really represented vegetated areas, and that could be categorized according to size and access type (see later table 3.3 and 3.4). All the data was processed in GIS and examined in detail. A green space layer could be extracted from Gatukontoret’s data, but showed inconsistency regarding actual vegetation cover, and was already inapplicably categorized. In addition it was uncertain how that data was audited and how green spaces were identified and updated.

The data set by Metria was well documented, with several publications by SCB on how the statistics and data was created and processed (SCB, 1996, 2002, 2008, 2010a,b). Hence the Metria data set was chosen for further processing, as it additionally fulfilled the demand of showing real vegetation cover and was best to categorize further. Moreover it represented a good basis for comparison with the original statistics calculated by SCB (2010a).

The dataset delivered by Metria, did not cover the official city limits of Malmö. This issue relates to the modifiable areal unit problem in spatial analysis (Rogerson, 2006). “The modifiable areal unit problem refers to the fact that results of statistical analyses are sensitive to the zoning system used to report aggregated data” (Rogerson, 2006, p.16). This means that statistical analysis tools produce different results when different zoning systems are used. In figure 3.1 the dataset covered by Metria is shown by the gray area including the buffer zone and the locality (white), which is not congruent with the municipal city border (red). Hence the differences in zoning systems, i.e.

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11 Malmö City Streets and Parks Department
12 National Land Survey
13 Metria AB is a consultancy in the field of geographical information
municipal city limits and SCB’s own city limit tätort or locality became visible. SCB describes the difference as follows: “A locality consists of a group of buildings normally not more than 200 metres apart from each other, and has to fulfill a minimum criterion of having at least 200 inhabitants. In Sweden, localities are defined as urban, and all areas outside the localities as rural. Since the municipalities in Sweden usually are large and include both urban and rural territory, the concept of locality is used for analyses of urban and rural development. The localities have no administrative status and thus have to be redefined as built-up areas grow” (SCB, 1996, p.4). Hence it is not immediately possible to compare the census data aggregated on the zoning of the municipal level of Malmö with the data from Metria / SCB on the locality. Therefore the the limits of the analysis needed to be adjusted to a more congruent section of data. The limits of the locality are almost congruent with a part of neighbourhood borders within the limit of the outer ring road, see figure 3.1. Moreover the city of Malmö is aiming to densify within the existing urban area limited by the outer ring road (Stadsbyggnadskontor, 2011b). The landscape outside the outer ring road is mostly agricultural and can be defined as rural after SCB’s definition (SCB, 1996). Thus for this analysis the outer ring road was chosen as a limit and the dataset from Metria and the neighbourhood areas were cut according to the respective neighbourhood borders in GIS. The resulting area is depicted with yellow neighbourhood borders in figure 3.1, and is henceforth referred to as the investigation area including 120 of 136 neighbourhoods of Malmö.

"Remote sensing data, such as satellite images and aerial photos allow us to map the variation in terrain properties, such as vegetation, water, and geology, both in space and time. Satellite images give a synoptic overview and provide very useful environmental information for a wide range of scales, from entire continents to details of a metre” (Skidmore, 2002, p.4). What Skidmore describes here, is one method that Metria used to create its data set on land cover / land use (hence referred to as land cover). The land cover data for the locality (urban environment) was classified by the degree of vegetation

Table 3.2: Classification used by SCB and by Metria, with translation. The Metria classification (column 2) was used in the spatial data and is therefore used for reference to different classes (SCB, 2008; Metria, 2012b; SCB, 2010a).
and different forms of urban structure, see table 3.2. Initially the different class IDs / descriptions used by SCB in various publications caused confusion, but turned out to be congruent after testing and verification from Metria (Wiman, 2012). Table 3.2 shows the classes sorted by description, the green text represents classes that were used to calculate green spaces, the bold green text represents classes that were used to calculate green areas (SCB, 2008, 2010a). The smallest accounting unit was 0,01 ha, i.e. 100 square meters. One problem with this data set was class 22, bar åkermark (bare farm land, hence referred to as farm land) which could include construction sites, parts of golf courses or simply bare soil and other surfaces (Wiman, 2012). Otherwise there was no separate class for farm land, which turned out to be a problem when examining the data further. Comparing the land cover layer from Metria to other data, like satellite images (Lantmäteriet, 2012), and Malmö city map (Stadsbyggnadskontor, 2011a) revealed a problem with farm land and pasture that was classified as no buildings with vegetation (16,18). This makes of course sense given the amount of vegetation, but for this study pastureland is on par with agricultural land. Both are not to be included in calculations on urban green space, and had to be excluded first. A layer with data on farm land was included in the data set from Gatukontoret, but did not fit properly with the other layers, which is why it could only be used as an overview reference (Gatukontoret, 2012). Therefore a detailed examination of the land cover layer was done, to redefine pasture and agricultural land and classify it from vegetation (16,18) to class 22 farm land. During this process other areas like commercial orchards, greenhouses, construction sites and brown fields were found that were falsely classified as vegetation (16,18). Hence all of these areas were re-classified to class 22 as no further differentiation was needed. Thus they were not be included in the classes containing green spaces. Consequently large areas, foremost on the border to the outer ring road, were redefined to allow a correct examination of green spaces and green areas which followed. One example is the vast construction site of Hyllie, due to slight vegetation most of it was classified from the satellite image as class 16 (some vegetation, no buildings). This would have falsely been added to a calculation of green spaces, if no further examination had taken place. To determine the amount of green space the classes 7,8,9,10,11,12,16,18,20,21 were taken into considerations. Accordingly only class 16 and 18 were chosen to determine the amount of green areas (SCB, 2010a). Considering the boundary problems described by Rogerson, both size and shape of areas affect measurements and interpretation. Hence the polygons of class 16 and 18 were grouped when adjacent and belonging to one coherent green area, according to the method described by SCB (2010b, p.41-42). This process was supported again by satellite imagery depicting vegetation in red, and Malmö city map, to determine the right extent of green areas. Simultaneously the green areas were categorized according to the level of access\textsuperscript{14}. The categorization can be seen in table 3.3 and was defined by the author based on previous research and policy documents (Ståhle, 2005; Kleinschmit et al., 2011; Fairburn et al., 2005; CABE, 2009). In some cases the polygons had

\begin{table}
\centering
\begin{tabular}{|l|c|c|}
\hline
\textbf{Type} & \textbf{Access} & \textbf{Example} \\
\hline
1 & public & park, nature area, churchyard, open sports ground, hospital park \\
2 & semi-public & allotment, fenced in sports ground, golf club, horse racecourse, school yards \\
3 & private & private property (e.g. residential, commercial), farmstead \\
4 & uncertain & construction site, industrial site, in between/close to traffic infrastructure \\
\hline
\end{tabular}
\caption{Classification of access types for green areas with a minimum size 1 ha and several examples.}
\end{table}

\textsuperscript{14}The category 4 uncertain was chosen to include all areas that were deemed not accessible, not permanent and not usable in terms of recreational purposes.
3 METHODOLOGY

3.3 Limitations

Table 3.4: Categorisation of green areas towards size and maximum physical distance from residence

to be adjusted after grouping. This was the case when they were too fragmented, which meant that they had to be merged. Or the polygons were cut, when they included other areas, like allotments or golf clubs that belonged to a different access type (e.g. 2). All green spaces that did not reach up to 1ha after grouping and careful adjustments, were not considered as green area and therefore excluded from further calculations.

The public and semi-public green areas where then categorized further regarding their size and distance based on comparison of various research and policy documents (Fairburn et al., 2005; Kleinschmit et al., 2011; Ståhle, 2005; Boverket, 2007; Ericsson et al., 2009; Sotoudehnia and Comber, 2010; Cutts et al., 2009; Gidlow and Ellis, 2011; CABE, 2009). As none of the existing determinations seemed to be proper for the case of Malmö, a new list was compiled, see table 3.4. Multiple buffer zones depicting the categorized distances considering the respective green area size were created. The 100m buffer was applied to all size categories, as larger green areas can compensate for smaller green areas. Logically smaller areas can not compensate for larger areas, which is why the buffers of 300m were for example not applied to green areas the size of 1-2ha.

This data was brought together with layers of socioeconomic factors mentioned in 3.2.1 to facilitate the assessment of determining the least advantaged neighbourhoods that were lacking supply of public green areas. This was determined on the neighbourhood level assessment differentiating between not served at all (no distance buffer included) or mostly not served (max. 50% of the total neighbourhood area not included in a buffer zone).

3.3 Limitations

The spatial data gave reason to limit the area of analysis to the main urban core of Malmö, the investigation area. The time and workload for this thesis did not allow further qualitative research which was planned initially in the form of observations as a second analysis unit, to determine aspects of usage and users of green areas. This was dismissed during the working process as the actual workload became more obvious. Initially the study was planned to cover the change in green space from 2005 to 2012, to compare with results from SCB (2010a). Due to the lack of reliable spatial data and census data for the years 2006-2012, the investigation period was later on adjusted the time frame of 2005, since the data was comprehensive for that particular year. A more detailed technical explanation describing the processing of data in GIS, would have exceed time and page limits. Considering the type of census data (aggregated over neighbourhood zones) it was not possible to exactly determine the number of inhabitants not being served with green areas, when a neighbourhood was partly covered by a distance buffer zone. Other studies (e.g. Stoltz et al., 2012) utilized geocoded address data instead, which was not available for this study. Time and analysis tools restricted the distance analysis to linear measures, see for comparison figure A.4 on page 47. More sophisticated methods for measuring actual distance were used by Ståhle (2010), but proper data and tools were not available for this study.
3.4 Reliability, Validity and Ethical Considerations

The author has collected the data in a responsible manner with regard to ethical obligations in research. Bryman demonstrates that ethics in research also include issue of politics, therefore it should be pointed out that this study was made independently, and not in collaboration with a municipality or company. However the secondary data can be obtained at any point through the various sources specified earlier, i.e. the data has a high external reliability. Given the detailed descriptions about methodology, would support replication of this study. However getting spatial data from different sources, always carries the risk of slight differences that have been made during the creation of e.g. shapefiles. This is also possible due to the application of various GIS programs and data formats. These differences result in problems when combining layers, and may therefore inhibit a coherent analysis. The data was checked on differences, and efforts where made to make the data more congruent (like change of projection). In some cases this did not solve the problem, so that the incompatible shapefiles were left out of the final analysis and were only used for visual comparison. The data was processed carefully, and every step of adjustment was monitored in detail and tested throughout the process. This was supported by several satellite images (from different vegetation periods) and Malmö city map, which made the process more secure. The calculations have been double checked, and tried towards other measurement tools, e.g. the ones available in Malmö city map. Nevertheless, regarding the reliability of the data (derived from satellite image interpretation) and its verification (by the author), Campbell (2007) asserted that all classification is subject to misjudgment and errors and even an experienced analyst would not classify the same way from one day to the other. Hence the processing of data does not have a high external reliability, given the fact of just one researcher, and the issue of different classifying approaches by different researchers as pointed out by Campbell. Considering the investigation on previous research and the theoretical framework the internal validity can be assess as rather high. As this is a single case that has been studied on the example of Malmö, the external validity can not be judged as high. However the results can be utilized for comparison with other Swedish or European cities, or they can be a reference for the initiation of more detailed studies on the issue EJ and distribution of environmental qualities.
4 Socio-Spatial Analysis

The following part depicts and describes the results of the socio-spatial analysis. At first the city of Malmö will be presented shortly. Afterwards a brief description of the main results of the socio-economic and green space investigation will be provided. The analysis sought out to locate the least advantaged neighbourhoods that lacked access to public green areas in Malmö. The section will be concluded with a discourse on what the results actually add up to for some affected neighbourhoods.

4.1 Presentation of Malmö

Figure 4.1: Malmö with urban and rural areas and the outer ring road E20 (OpenStreetMap, 2012)

Malmö is the third largest city in Sweden after Stockholm and Gothenburg. It is located in Scania in southern Sweden and the Øresund bridge connects it to Denmark’s capital Copenhagen (Pålsson, 2011). Scania consists of flat coastal zones and plains that have the most fertile soils in Sweden. It is of great national importance being Sweden’s chief food producer, with its extensive agricultural land. The typical swedish coniferous forest can only be found in the north of Scania (EB, 2012). As of April 2011 Malmö had 300 000 inhabitants and estimates state it will be 325 000 in 2017. Today residents come from 175 different countries, and 30% of the total population are foreign born. It is a young city with an average age of 36 years compared to all of Sweden with 41 years. 82% of all dwelling units can be found in apartment blocks and 18% in detached housing. Every day 61 000 commuters travel to Malmö for work. 62% of the age group 20-64 are employed. The unemployment in Malmö is around 5.9% compared to the national average of 3.5%. The maximum distance between the city center and the city limit is 10km. Malmö has 10 city districts, Centrum, Fosie, Limhamn-Bunkeflo, Södra Innerstaden, Västra Innerstaden, Hyllie, Rosengård, Husie, Kirseberg and Oxie, see figure 4.1 (Pålsson, 2011). The 10 city districts include 136 neighbourhoods which are depicted in A.5 on page 48 (US, 2012b).
4.2 Socioeconomic Results

The data on each of the five socioeconomic factors was independently illustrated in maps, as depicted in A.3.1 on page 49. The population density was highest in the center of the city with 188 inhabitants/ha in Möllevången, followed by Fågelbacken (180), Ribersborg (172), Davidshall (163), Persborg (154) and Lugnet (150), see figure A.6 on page 49. The more affluent neighborhoods of Malmö are concentrated in the west whilst the lowest mean disposable income (SEK) was registered in Flensborg (123476), followed by Södervärn (138737), Katrinelund (139606), Lönngården (143261), Heleneholm (144801) and Södra Sofielund (146672) in the east of the center, see figure A.7 on page 49. The highest percentage of children aged 0-5 was registered in Herrgården (15), followed by Vintrie (15), Törnrosen (13), Valdemarsro (13), Örtagården (12) and Hermods-dal/Kryddgården/Holma (10). The percentage of children is related to the total amount of population of a neighborhood which is illustrated in figure A.8 on page 50. Presenting solely the percentage would not account for the actual large differences in the total amount of population. For comparison, Vintrie has 403 inhabitants whereof 60 are children (15%), but in contrast Herrgården has 4812 inhabitants whereof 730 are children (also 15%). The same issue applies to the population age 65-79 and foreign born. The highest percentage of population age 65-79 was found in Borgmästaregården (32), followed by Södertorp (30), Jägersro Villastad (27), Kronprinsen (23), Gröndal (23) and Höja (21). The concentration of higher percentage of older population is mostly on the outskirts of the center, with lower amounts of total population as depicted in figure A.9. The highest percentages of foreign born population are registered south east of central Malmö in high density neighborhoods. With 68% Herrgården has the highest percentage of foreign born population, followed by Törnrosen (63), Örtagården (59), Kryddgården (59), Apelgården (55) and Holma (51), see figure A.10 on page 52. Bringing together all socioeconomic factors revealed that 40\(^{15}\) out of 90 neighborhoods fulfilled at least 3 out of 5 thresholds (below average income and above average of all other factors). A map depicting an overview on all factors combined can be seen in figure 4.2 on the next page.

4.3 Green Space Results

The investigation area included 120 neighborhoods of Malmö, which amounted to a total land area of 8851ha and a total population of 245751 inhabitants. The total amount of green space that was mapped through the described methods resulted in 4315ha, which is 49% of the total amount of land in the investigation area and this adds up to 176 sq m of green space per person. Figure A.11 depicts green space, bigger than 0,01ha. Figure A.12 shows green spaces only contained in class 16 and 18 no buildings with/with some vegetation. This map does not depict green areas, rather just vegetated surface with a minimum size of 0,01ha (100 sq m). Moreover it still includes small uncertain vegetated spots, like industrial sites, construction, green between roads, pasture and agriculture to a limited extent. In contrast figure 4.3 shows all green areas, i.e. green space larger than 1ha. The total amount of green areas is 1715ha, which covers 19% of the total investigation area. This means there were 70 sq m of green area per inhabitant. But only 66% of these green areas area publicly accessible, i.e. 1138ha. Hence only 13% of total land area are covered with public green areas, reducing the amount of sq m per inhabitant to 46.


24
4.3 Green Space Results

Figure 4.2: Socioeconomic factors combined on 90 neighbourhoods of Malmö 2005, depicting below average income and above average of the other factors (after data from Metria, 2012b; US, 2012a,b,c)

Legend
- mean disposable income per family/year in SEK
  - 123476 - 256000
- population age 65-79 in % of total population
  - 12 - 31
- population age 0-5 in % of total population
  - 6 - 15
- foreign born in % of total population
  - 24 - 68
- population density in inhabitants/ha
  - 70 - 188
- neighbourhood borders
Another 21% of green areas belong to the category semi-public, i.e. 355ha. In addition 1.5% of green areas were categorised as private and 11% as uncertain green areas, i.e. 26ha and 194ha.

Figure 4.3 shows all green areas in Malmö with a differentiation regarding the type of access. Figure A.13 shows the result of categorizing all public and semi-public green areas by size. Figure 4.4 shows all public green areas by size and the respective distance recommended by various research. A map including semi-public green areas and their respective size and distances can be seen in figure A.14 on page 56.

The most abundant amount of single green areas can be found in the group local green, with a size of 2-5ha. However there are only 4 larger municipal green areas in Malmö. The only large park is Bulltofta Rekreationsområde with 89ha. Second largest is the former limestone quarry Kalkbrottet with 87ha, see figure 4.10. The third is the beach area called Ribersborg with 86ha.

A comparison of the results with statistics from SCB can be found in table 4.1. It shows that the area SCB determined was smaller, although it did contain the urban area of Burlöv in the north east of Malmö (see figure 3.1 on page 18). As Burlöv was excluded from the investigation area, this probably resulted in the decreased amount of population and population density. As the investigation area was generally larger and included semi-urban to agricultural areas, this probably resulted in a larger amount of green spaces. Generally the results seem logical and comparable to SCBs own statistic.

<table>
<thead>
<tr>
<th>Features</th>
<th>SCB</th>
<th>Investigation Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>total area</td>
<td>7243 ha</td>
<td>8851 ha</td>
</tr>
<tr>
<td>population</td>
<td>258 020</td>
<td>245 751</td>
</tr>
<tr>
<td>population density</td>
<td>3596 ppl/km²</td>
<td>2777 ppl/km²</td>
</tr>
<tr>
<td>amount of green space</td>
<td>3952 ha</td>
<td>4315 ha</td>
</tr>
<tr>
<td>green space within total area</td>
<td>55 %</td>
<td>49%</td>
</tr>
<tr>
<td>green space per person</td>
<td>153 m²</td>
<td>176 m²</td>
</tr>
<tr>
<td>amount of green areas</td>
<td>1248 ha</td>
<td>1715 ha</td>
</tr>
<tr>
<td>green areas within total area</td>
<td>17 %</td>
<td>19%</td>
</tr>
<tr>
<td>green areas per person</td>
<td>48 m²</td>
<td>70 m²</td>
</tr>
<tr>
<td>amount of green areas with public access</td>
<td>--</td>
<td>1138 ha</td>
</tr>
<tr>
<td>green areas (public) within total area</td>
<td>--</td>
<td>13%</td>
</tr>
<tr>
<td>green areas (public) per person</td>
<td>--</td>
<td>46 m²</td>
</tr>
</tbody>
</table>

Table 4.1: Comparison of data from SCB and results from new calculations on the investigation area (own table after data from SCB, 2010a, tables p.6-8)
4.3 Green Space Results

Figure 4.3: Green areas (minimum size 1ha) in Malmö 2005, depicting the different access types (after data from Metria, 2012a; US, 2012c)
4.3 Green Space Results

Figure 4.4: Public green areas by size and the respective distances (after data from Metria, 2012b; US, 2012c)
4.4 Socio-spatial Distribution of Green Areas

Figure 4.5: Map showing pocket green with a distance of 100m towards socioeconomic factors Malmö 2005 (after data from US, 2012a,c)

Bringing together the information on socioeconomic factors and the distribution and distances to green areas, helps to identify areas of special importance. Regarding the shortest distance of 100m to pocket parks, special interest lay on less mobile groups like children and elderly. The situation for children in Norra Sofielund was the most disadvantaged as there was no green area within 100m in this neighbourhood. Other neighbourhoods that are mostly not served, and have above average percentage of children are mainly in the district Fosie and Södra Innerstaden. These include the neighbourhoods Södra Sofielund, Hindby, Almhög, Kroksbäck, Östervärn, Rörsjöstad, Gullviksborg, Holma, Törnrosen, Persborg and Herrgården. For elderly the situation is worst in Lugnet, with no green areas within 100m distance. Other neighbourhoods with above average population age 65-79 which are mostly not served with green areas within 100m distance. Other neighbourhoods with above average population age 65-79 which are mostly not served with green areas are Hindby, Almhög, Ribersborg, Katrinelund, Kroksbäck, and Dammfri. These results can be retraced in figure 4.5. The next category was local green and the most common distance of 300m (ca. 5-10min walk). It showed that there was a complete lack in the neighbourhoods Slussen, Lönngården, and Augustenborg. Mostly not served with green the size of 2-5ha (local green) were the neighbourhoods of Södra Sofielund, Hindby, Almhög, Lugnet, Gullviksborg and Västra Söderkulla, which can be retraced in figure 4.6. District parks (5-10ha) are the most important source for quietness due to the large size excluding most traffic noise in the surroundings,
4.4 Socio-spatial Distribution of Green Areas

which is why these areas can be regarded as healthy environments within the city. The deficit in district green was far-reaching.

Figure 4.6: Map showing local green with a distance of 300m towards socioeconomic factors Malmö 2005 (after data from US, 2012a,c)

Not served at all were Norra Sofielund, Södra Sofielund, Augustenborg, Almhög, Persborg, Lönngården, Nydala, and Östervärn. To a large extent not served were Södervärn, Mölevängen, Slussen, Annelund and to a lesser extent not served were Gullviksborg and others. This can be retraced in figure A.15 on page 58. It is highly unlikely that inhabitants travel by foot to a green area that is 1000m (linear distance) away. Hence the factor of income becomes relevant considering that public transport, owning a bike or taking a car all require the means to afford them. City green with the size of 10-50ha is not reachable within 1000m from the neighbourhoods Slussen, Östervärn, Augustenborg, Almhög, and Lönngården. Mostly not served are Rörsjöstaden, Norra Sofielund, Södra Sofielund and Persborg. All of these neighbourhoods have below average income, which can be retraced in figure A.16 on page 58. The same issue is true for municipal green (50-100ha) which should be reachable within 2000m from the residence. The issue of income can also be connected to foreign born, who are often less affluent. Hence green areas within proximity and walking distance become more important for this group of the population. Most parts of the districts Fosie and

\[16\] Hindby, Västra Söderkulla, Katrinelund, Lugnet, Dammfri, Örtagården, Törnrosen
Hyllie are not served by municipal green, see figure A.17 on page 59. Not at all served and characterized by above average foreign born population are the neighbourhoods Holma, Östra Söderkulla, Västra Söderkulla, Nydala, Hermodsdal, Gullviksborg, Almvik and Lindängen. Partly not served are Borgmästaregården, Södertorp and Gröndal.

Summing up, 32 out of 40 neighbourhoods lacked at least one category of green area, complete or mostly. The greatest complete deficit of 3 categories was observed in Augustenborg. A complete lack of 2 categories could be identified for Slussen, Lönngården, Nydala, Östervärn and Norra Sofielund. Mostly lacking green areas out of four categories is the case for Södra Sofielund, Norra Sofielund, Östervärn, Gullviksborg and Almhög. An overview can be found in table A.4 on page 57.

Some neighbourhoods have a lack of more than one category of green area (see A.3). A map overview is depicted in figure 4.7, showing neighbourhoods that lack 4 out of 5 categories in bright red. The neighbourhoods lacking only one category are yellow.

Figure 4.7: Map showing the neighbourhoods that lack access to 1-4 categories of green areas (after data from US, 2012a,c)
4.5 Environmental Justice Considerations

This part will give an insight on the consequences of an unequal distribution of green areas in Malmö. Various examples from the most disadvantaged neighbourhoods will be illustrated relating them to the different categories of green areas in terms of size and proximity.

Pocket Green  Considering the population age 65-79 a complete lack of pocket green can be observed in Lugnet. Within 200m walking distance a pocket green (Magistratsparken) can be reached from the closest house on the southern edge of Lugnet, but there are large roads to be crossed that increase noise level in the green area. Just 160m from the closest house in the northern edge of Lugnet, the local green (Gamla Begravningsplats) can be reached. Nevertheless a major road needs to be crossed (Regementsgatan) and the area is fenced in, leaving only one access point close by. This can pose special difficulties for people with walking disabilities, which makes a short and barrier-free travel path highly important. Moreover the green (a graveyard) is next to Gustavs Adolfs Torg, a square with a main bus station, probably increasing noise levels. It is likely that safety issues impede less mobile older people to enjoy this green area. In addition is is questionable if a graveyard just by connotation might affect well-being of older people. Considering the study by Stoltz et al. (2012), graveyards are not always perceived as quiet and safe. In contrast they might be affected by large traffic infrastructure (roads, railroads) which concerns many graveyards in Malmö, and makes them more noisy. This can also be related to the generally lower degree of actual sound damping vegetation, and a higher degree of soil sealing in comparison to parks. Furthermore it can be questioned whether graveyards per se should be considered as public green area, since there can be certain restrictions to usage, access points and opening hours. It is highly unlikely that residents would use a graveyard for other activities than taking a stroll or resting on a bench. For example sunbathing, jogging, or playing football are highly inappropriate given the connotation of a graveyard.

When examining the population age 0-5 more in detail, Norra Sofielund and Östervärn stand out. Östervärn is bordering the neighbourhood Slussen, and both are directly influenced by the railroad, the harbour industry and the highway coming into the city from the north. Östervärn lacks green areas in four categories. A green area of the type uncertain turned out to be the new shopping center Entré. Just a green stripe is left around the center, called Hornsparken. It is framed by the major road Hornsgatan, one of the most trafficated places in Malmö due to the strategic location at the northern entrance of the city, with nearly constant noise and air pollution. Figure A.19 on page 60 shows these parts of Östervärn, and the red dot indicates an observation of two children that were using the well-kept grass in Hornsparken for recreational purposes, probably not benefiting their health. Norra Sofielund shows a complete lack of green areas within the distance of 100m, which is particularly relevant to small children. For example, a local green (Enskifte-shage) can be found just a 120m from the closest house in Norra Sofielund. The center of the green area appears sheltered from larger traffic disturbance, and it provides interesting playgrounds and sports facilities. But the extra 20m to the local green consist of a five lane major road (Lantmannagatan), which presents a critical traffic barrier. Moreover the surroundings of the green area are all fenced in, leaving only one access point close to the street. It can be assumed that it is highly unlikely that many children under 5 are allowed by their parents to go to this place on their own. This probably reduces the frequency of visits and chances for physical activity and learning in a larger green environment. However a school yard with sports facilities and little green can be found in Norra Sofielund, but it is questionable if this place is accessible to everyone at all times.
Assuming the children in the statistics from 2005 are now age 7 to 12, they might prefer larger areas and probably even use their bikes to get there. Still in walking distance of 200m form Norra Sofielund is Folkets park in Möllevången. It is a local green with a high amount of sealed soil, playgrounds, buildings and entertainment facilities. That local green (Folkets park) is the only green area in Möllevången, with 27000 sq m (2.7ha) of green space (not including the large sealed surfaces). The amount of children age 0-5 in this neighbourhood was 573 (5.7% of the total population) in 2005. Now imagining all children up to five years were in the local green at the same time in 2005, would have resulted in 0.02 sq m green space per child. This of course still excludes children older than 5, and others who are probably also frequent users of the green area. Consequently it can be assumed that there is a major pressure on the usage of Folkets park and it could arguably be experienced as overcrowded at times. Of course it could still be pointed out that green courtyards with playgrounds represent additional space for children. But as Ericsson et al. (2009) summarized, children need a variety of environments to play freely and develop motor and cognitive skills. Natural environments play a big roll, and noise, air pollution and high amounts of traffic all impact the built environment to a large extent. These factors influence stress and health especially of children. This correlates to the fact that Möllevången, Norra and Södra Sofielund were identified as the neighbourhoods with the highest levels of air pollution and clusters of children with low socioeconomic status in Malmö (Chaix et al., 2006).

**Local Green** The most common maximum walking distance to a green area is 300m. Slussen and Augustenborg show a complete lack of service in that category. Slussen is located in the north east of central Malmö, directly bordering on the railroad infrastructure and the vast industrious harbour area. Only inhabitants in the southern edge of Slussen can reach a pocket green within 100m. The closest local green is St. Pauli Norra kyrkgård, a graveyard more than 400m away. Second is a local green, not a park but rather unused land (partly fenced in) with a high amount of vegetation that has been appropriated by residents. It is close to the railroad and Ellstorp park, but 700m walking distance from Slussen. Hence it is probably highly unlikely that inhabitants of Slussen visit this area frequently, as there are also many large traffic barriers on the way. Additionally the attractiveness of the green area is questionable.

There is a general lack of green areas in Slussen, and a high amount of concrete structures surrounding it, e.g. major roads, railroads and industry. These high amounts of sealed soil could pose serious problems for the inhabitants of Slussen during hot summer periods, which will probably increase with climate change. Most likely the thermal comfort will be stressed due to higher temperatures, and in case of decreased ventilation (wind) the situation can become intolerable. This is especially influencing the well-being of children, weak and older people. But the issue could also be related to income, considering who can regularly afford to leave the area, e.g. going to the beach or summer house outside of the city were the situation is more enjoyable.
An example for a neighbourhood that is not at all served in three categories is Augustenborg. Its a neighbourhood that is located south of the city center. Augustenborg also has the by-name Ecocity, as it was redeveloped the past years gaining international recognition as a best practice example for ecologically sustainable urban development (Stadsbyggnadskontor, 2011b). A new open storm water management system was installed, as well as a botanical roof garden and it is still a testbed for life-cycle technology (ibid.). The outdoor environment was remodeled into green structures with nice backyards, water channels and ponds, see figure 4.8. This helped eliminate frequent flooding of cellars after great precipitation events. The flooding was probably also related to a generally high amount of concrete in the surroundings, not permitting rain water to penetrate into the soil. Augustenborg is enclosed by the railroad in the east, and three major roads in the north, south and west, see figure A.20 on page 60. This traffic infrastructure creates barriers, air pollution, and noise. One large crossing borders on to the pocket green area Augustenborgs parken, which also has the function as a water retention field (see A.20). It is close to the school and has a playground, which probably benefits school children as well as residents. The smaller green courtyards between apartment blocks seem attractive, as depicted in figure 4.8. However as the background shows they are mostly open facing the major roads, which probably causes visual stress and does not prevent noise exposure. This could mean that they are not experienced as very recreational or benefiting recovery and stress prevention. To experience quietness, which is most likely to occur in a green area from at least 5-10ha, residents of Augustenborg would have to travel 1300m (linear distance). This would require other means of transport, like bikes, buses or cars, depending on what is affordable. The residents could chose to reach either Östra Kyrkogården (54ha) or Pildammsparken (36ha), which is one of the largest city parks (see figure A.21).

**District Green** As some studies refer to 500m being the maximum walking distance it can be determined that there are 8 neighbourhoods lacking green areas within this distance. A city green with the size of 5-10ha seems to be the minimum size to experience quietness and the sounds of nature, hence increasing the restorative effect. Those 8 neighbourhoods amount to a total of 25219 inhabitants, which was approximately 10% of Malmö’s population in 2005. It can be assumed that these residents lived in rather noisy and polluted environments and have a great need to gain access to restorative settings closer to their homes. In contrast to this housing development is ongoing at Kalkbrottet, the second largest municipal green in Malmö (87ha see figure 4.10). The pristine nature thats has developed there after closing of the vast mine, is a great source for recreation and quietness. However it can be assumed that property prices only permit affluent residents to settle down close by. The issue of income related choice of housing, is often connected to the supply of green areas.

Another example is that the neighbourhoods with the highest average income are close the Ribersborg beach along the beautiful coastline, whilst the lowest income areas are kilometers away in the dense urban environment.

**City Green and Municipal Green** Green areas with a distance of 1000m or 2000m are not considered to be reached by walking for the majority of urban inhabitants. However these important areas are providing a variety of different landscapes, recreational facilities and entertainment events. Happenings like Walpurgnis night are widely celebrated and bring together different social groups
and generations as for example in Beijers Park, Kirsebergstaden depicted in figure A.22 on page 61. This is an example for how social cohesion is created and maintained with the help of green areas. Another common activity contributing to social cohesion is having barbecue with friends or family in a public park. This opportunity is especially important for residents of apartment blocks that do not own their private garden. A variety of opportunities for physical activity outside of sports clubs is also very important, regarding access, income issues and fees. It can be pointed out here that there is a variety of golf courses and even a horse training track\textsuperscript{17} within the investigation area. These take up a vast amount of green area (176ha), but being very exclusive do not permit access to the general public. Contrary to this is the public disc golf course at Bulltofta rekreationsområde, which is accessible to all and only requires having a frisbee (see figure 4.9). It can be played in groups or individually, but it demands a large amount of space, and sometimes negotiation with other park users. All these activities require certain services and facilities that need to be maintained in public green areas. If the opportunities and attractiveness of a green area is therefore high, it can be assumed that people would even travel longer distances to reach them and visit more frequently, which would have positive effects on well-being.

In summary it can be observed that the greatest deficits correlate with the most disadvantaged neighbourhoods in Malmö. Inequalities in the distribution of green areas could be identified, see figure 4.7. The greatest deficit can be found in the eastern parts of central Malmö (e.g. Östervärn), stretching further south of the central city (e.g. Gullviksborg). It can be noticed that there are three exceptions in the western part of central Malmö, which are characterized by above average older population. The eastern neighbourhoods are clustered and built a network stretching from north to south. They are mainly characterized by above average percentage of children, foreign born and population density. Moreover all neighbourhoods are characterized by below average income.

In April 2011 the population of Malmö passed the threshold of 300 000. Assuming that the amount of green areas has not changed since 2005 (unlikely), every inhabitant would have had 38 sq m of public green area 2011.

\textsuperscript{17}Kvarnby golf, Hylliekrokens golfbana, Malmö golfbana, Jägersro travbana (Elisedal)
5 DISCUSSION AND CONCLUSION

This study presented a contribution to the discussion of environmental justice and distribution of environmental qualities in a Swedish context. It added new knowledge for a better understanding of green space distribution and accessibility in Malmö. The overarching research question could be answered to the extent of green areas and the chosen socioeconomic factors. The investigation area was delineated and green space was mapped and categorised (size, access, distance) according to the theoretical framework. The result shows evidence for inequalities in the distribution of green areas between different social groups. The main focus was to identify the least advantaged areas with the greatest deficit of green areas. To assess the different social groups and generations several respective socioeconomic factors were chosen and combined. Arguably there are diverse concepts of how to determine socioeconomic status, disadvantaged or deprived areas, but no study has focused on the issues linking them to environmental benefits in Malmö yet. Therefore this study contributed to the research field with new knowledge resulting from a combined socio-spatial analysis of Malmö.

The results of green spaces and green areas were comparable to previous research made by SCB. Nevertheless this raised the theoretical question on how to define green space, and what kind of areas can be considered (e.g. graveyards, agriculture, pasture) as well as what limits should be drawn when considering urban environments. SCB included pasture, but delineated the urban area also very strict to the built environment. The analysis included a larger investigation area, with partly rural character, resulting in a higher percentage of green areas as compared to SCB (SCB, 2010a). The result of 46 sq m per inhabitant can also be linked to the 33 sq m public green areas mentioned in the Green Plan from 2003 (Gatukontoret, 2003). The difference can be based on different classifications as to which areas are publicly accessible and to the exclusion of some recreational facilities and all graveyards in this number, whereas the results of this study included graveyards. All numbers are different, but have in common that compared to other Swedish cities, Malmö always scores lowest on the amount of green area per person. In a European context the number from 2011, 38 sq m per person, is in accordance with the average amount of 386 cities investigated by Fuller and Gaston (see figure A.1 on page 44), but depicts the major difference to other cities in Scandinavia. Nevertheless Berlin, with its recommendation of 6 sq m per person, scores far lower than Malmö in the European context. But all these cities differ greatly in land area, population and surroundings, and definitions of green space. As Boverket stated Malmö had different requirements than other Swedish cities, which is why it chose longer distances to green areas in the Green Plan 2003 than the national recommendations (Boverket, 2007). However it could be argued that the reasons given (agriculture, coastal zone, no natural forest) for accepting longer distances, can be seen contrary. Given the fact that there is virtually no natural forest and no mountains around or in Malmö remarkably increases the importance of green spaces inside the city. As inhabitants do not have alternatives right outside the city, it is of great concern that they can easily reach green space inside the urban area. The importance of these issues was depicted in the analysis, and illustrates that small green areas cannot provide restorative effects in a highly urbanised city. Even physical activity and social interaction benefits from larger green areas. An overview showing the potential of public and semi-public green areas within 300m distance can be found in figure A.18 on page 59. It can be assumed that semi-public areas also play a large role for more advantaged groups, who are able to afford membership in sports clubs or an allotment garden. Especially the latter contributes to social cohesion, well-being and even food security. In a recent article a resident of Malmö stated that the municipality should plan green spaces as the city grows. He pointed out the importance of allotments, saying they are there for everyone, and should be accessible by bike (Niwén, 2012). The queue time to a get an allotment in Malmö can take up several years, due to increasing interest (ibid.). Here further research could help to identify potential
of new semi-public green areas like allotments and concepts like shared community gardens. Those could be established in green spaces around buildings, or even on roofs, like the botanical roof garden in Augustenborg. Although With regard to the ongoing creation of the new comprehensive Plan for Malmö the question of densifying within the existing city is widely debated. The Western Harbour will be built out further towards the center (Varvsstaden), and Norra Sorgenfri is also going to be planned as a dense residential area. Further investigations are looking into possibilities of transforming Frihamnen into a dense area, close to the central Station. And possibilities of densifying in some of the million programme housing areas (e.g. Rosengård) are discussed (Stadsbyggnadskontor, 2011b). All the mentioned places would be highly sensitive regarding green space provision and densification, as there are general lacks in these areas. Careful considerations would require to plan for larger green areas (5-10ha) in these development sites. Especially on sites with high soil sealing i.e. around the central station and the harbour areas (Frihamnen, Varvsstaden). Problems and risks involved in not integrating large green are likely to be comparable to problems illustrated on the example of Slussen in 4.5 on page 32. Moreover a large green area in Norra Sorgenfri (adjacent to St. Pauli södra kyrkogård), would benefit neighbouring areas like Östervärm and Katrinelund (see figure A.5 on page 48 and 4.7 on page 31). Considering the plan to establish a botanical garden in Lindängelund (Lindången) actually adds another municipal green to the city with approximately 54ha. This would fill the large gap in supply of municipal green (distance 2000m) in Fosie and Hyllie in southern Malmö (see figures A.17 on page 59 and 4.1). A great potential for creating more green areas, are also to a certain extent the 24% of semi-public green areas. Opening up sports facilities to nonmembers could be one concept, or creating open community gardens and using synergies with school yards. Another 11% of green areas were categorised as uncertain, e.g. green between traffic infrastructure. Many of these potential areas are close to roads, but could also be connected to other green areas and made more accessible. In a future vision for Malmö, car traffic has decreased and vehicles are not emitting noise or pollution. Moreover plans are made to transform large roads into pedestrian friendly streets, to overcome barriers between neighbourhoods. This could open up the potential of suitable green areas along roads, to become more useful to a certain extent. However traffic safety issues should not be neglected.

Generally more research is needed on the subject of the actual distances residents have to green areas. This needs to be complemented with more detailed studies on safety and barrier issues. In addition it is important to find out more about how residents experience certain green areas in the city, and determine causalties for the frequency of visits. Moreover it is relevant to find out were improvements need to be made to increase the usage of green areas, and the access for all social groups and generations. Noting that the data used in this study was from 2005, it is crucial to update and determine shifts in socio-spatial distribution of green areas in the city today. Whilst the population is still increasing, it is likely that even more green space has vanished in the 7 years since the last study from SCB. All these issues are essential for a good knowledge based planning of the green and just future of Malmö.
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A Appendix

A.1 State of the Art: Research and Policy

Figure A.1: “Urban green space coverage in Europe. Points representing cities are coloured according to proportional coverage by urban green space within the city. Country polygons are coloured according to per capita green space provision for its urban inhabitants. Data unavailable for countries shaded gray” (Fuller and Gaston, 2009, p.353)
### Table A.1: London’s public open space hierarchy (CABE, 2009, p.24)

<table>
<thead>
<tr>
<th>Open space categorisation</th>
<th>Size guideline</th>
<th>Distances from homes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Regional parks</strong></td>
<td>400 hectares</td>
<td>3.2 to 8 kilometres</td>
</tr>
<tr>
<td>Large areas, corridors or networks of open space, the majority of which will be publicly accessible and provide a range of facilities and features offering recreational, ecological, landscape, cultural or green infrastructure benefits. Offer a combination of facilities and features that are unique within London, are readily accessible by public transport and are managed to meet best practice quality standards.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Metropolitan parks</strong></td>
<td>60 hectares</td>
<td>3.2 kilometres</td>
</tr>
<tr>
<td>Large areas of open space that provide a similar range of benefits to regional parks and offer a combination of facilities and features at the sub-regional level, are readily accessible by public transport and are managed to meet best practice quality standards.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>District parks</strong></td>
<td>20 hectares</td>
<td>1.2 kilometres</td>
</tr>
<tr>
<td>Large areas of open space that provide a landscape setting with a variety of natural features providing for a wide range of activities, including outdoor sports facilities and playing fields, children’s play for different age groups and informal recreation pursuits.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Local parks and open spaces</strong></td>
<td>2 hectares</td>
<td>400 metres</td>
</tr>
<tr>
<td>Providing for court games, children’s play, sitting-out areas and nature conservation areas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Small open spaces</strong></td>
<td>Under 2 hectares</td>
<td>Less than 400 metres</td>
</tr>
<tr>
<td>Gardens, sitting-out areas, children’s play spaces or other areas of a specialist nature, including nature conservation areas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pocket parks</strong></td>
<td>Under 0.4ha</td>
<td>Less than 400 metres</td>
</tr>
<tr>
<td>Small areas of open space that provide natural surfaces and shaded areas for informal play and passive recreation and that sometimes have seating and play equipment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Linear open spaces</strong></td>
<td>Variable</td>
<td>Wherever feasible</td>
</tr>
<tr>
<td>Open spaces and towpaths alongside the Thames, canals and other waterways, paths, disused railways, nature conservation areas, and other routes that provide opportunities for informal recreation. Often characterised by features or attractive areas that are not fully accessible to the public but contribute to the enjoyment of the space.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure A.2: Map from Malmö Green plan showing the various classes of the green model (Gatukontoret, 2003, p.15)

Figure A.3: The map shows percentage of the respondents who live within 300 m from an area experiencing character (quietness) within 5-10 minutes (Stoltz et al., 2012, p.12)
A.2 Methodology

<table>
<thead>
<tr>
<th>Innehåll av områdesfakta</th>
<th>Socioeconomic Factors</th>
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<tr>
<td>Åldersfördelning</td>
<td>Age composition</td>
</tr>
<tr>
<td>Flyttningar</td>
<td>Relocation</td>
</tr>
<tr>
<td>Areal</td>
<td>Area</td>
</tr>
<tr>
<td>Prognos</td>
<td>(population) Forecast</td>
</tr>
<tr>
<td>Folkmängd, tidsserie</td>
<td>Population, time series</td>
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<tr>
<td>Personer utländsk bakgrund</td>
<td>People of foreign origin</td>
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<td>Förvärvsarbetande</td>
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<tr>
<td>Utbildning</td>
<td>Education</td>
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<td>Arbetslöshet</td>
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<td>Val</td>
<td>Election</td>
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<td>Income</td>
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<tr>
<td>Försörjningsstöd</td>
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<tr>
<td>Bilinnehav</td>
<td>Car ownership</td>
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</table>

Table A.2: List of socioeconomic factors in the area information (own translation after Malmö, 2012)

Figure A.4: Comparison of linear distance measure (left, blue line 1.5 km), and actual distance measure for pedestrians (right, blue line 2.4 km ca. 30min) (left Stadsbyggnadskontor, 2011a)(right Neis, 2012)
Figure A.5: Overview of all neighbourhoods in the investigation area, the numbered neighbourhoods name did not fit into the its respective borders (after data from US, 2012c)
A.3.1 Socioeconomic Results

Figure A.6: Population density of 90 neighbourhoods in Malmö 2005 (after data from US, 2012a,c)

Figure A.7: Mean disposable income of 90 neighbourhoods in Malmö 2005 (after data from US, 2012b,c)
Figure A.8: Percentage of population age 0-5 towards total population, the circle represents the actual amount of inhabitants for each neighbourhood in Malmö 2005 (after data from US, 2012a,c)
Figure A.9: Percentage of population age 65-79 towards total population, the circle represents the actual amount of inhabitants for each neighbourhood in Malmö 2005 (after data from US, 2012a,c)
Figure A.10: Percentage of foreign born population towards total population, the circle represents the actual amount of inhabitants for each neighbourhood in Malmö 2005 (after data from US, 2012a,c)
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Figure A.12: Green spaces with minimum size of 0.01ha from classes 16 and 18, Malmö 2005 (after data from Metria, 2012a; US, 2012c)
Figure A.13: Public and semi-public green areas by size (after data from US, 2012c; Metria, 2012b)
Figure A.14: Public and semi-public green areas by size with respective distances (after data from US, 2012c; Metria, 2012b)
A.3.3 Socio-spatial Distribution of Green Areas

<table>
<thead>
<tr>
<th>TYPE</th>
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<tr>
<td>pocket green</td>
<td>1-2 ha</td>
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<td>local green</td>
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<td>district green</td>
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<td>city green</td>
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<td>municipal green</td>
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Table A.3: Type, size and amount of single green areas that are publicly accessible in Malmö 2005

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Table A.4: List of neighbourhoods lacking access to green area categories, completely (O) and mostly (x), purple highlights the ones lacking 4 categories out of 5
Figure A.15: Map showing district green with a distance of 500m towards socioeconomic factors Malmö 2005 (after data from US, 2012a,c)

Figure A.16: Map showing city green with a distance of 1000m towards socioeconomic factors Malmö 2005 (after data from US, 2012a,c)
Appendix A.3 Socio-spatial Analysis

Figure A.17: Map showing municipal green with a distance of 2000m towards socioeconomic factors Malmö 2005 (after data from US, 2012a,c)

Figure A.18: Distance of 300 m from all green areas (type 1-4) in relation to the socioeconomic factors
Figure A.19: Östervärn with the shopping center Entré and Hornsparken, the red dot indicates the location of children using the space for recreational purposes (Stadsbyggnadskontor, 2011a, plus own explanation)

Figure A.20: Aerial photo showing the traffic infrastructure and Augustenborgs parken. The red dot indicates where the picture of the courtyard was taken, see 4.8 (Stadsbyggnadskontor, 2011a, plus own explanation)
Figure A.21: View through Pildammsparken to the east

Figure A.22: Walpurgis night in Beijers Park, Kirsebergsstaden - an example for creating and maintaining social cohesion