When lawns become forests

– How natural/forest-like vegetation can better human health and well-being in urban areas.

Elin Fänge

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Abstract

For a long time, lawns have dominated urban areas but are they good for human health and well-being? This study investigates how natural/forest-like vegetation affects human health and well-being and discusses why static lawns still dominate areas today even though there is much research on the positive benefits of natural/forest-like vegetation. The study has three main methods; 1 - A literature study that looks into what Swedish state-owned organizations, global organization, and research studies write on the subject of human health and well-being connected to human visits in natural/forest-like vegetation. 2 - A observational study conducted in a town of Viken, Scania, Sweden looking what inhabitants do in a forest compared to a lawn. Also, a bird recording was done to count how many birds sing in the areas of the forest and lawn. 3 - An ArcGIS, Service Area analysis was done to calculate how many inhabitants today have access to the forest and lawn areas in the district of Svanebäck, Viken. The results present a compelling argument for why decision-makers need to start looking into changing existing lawn areas to natural/forest-like vegetation. This study also presents the consequences of not having daily access to natural/forest-like vegetation.

Keywords: Biodiversity, lawn, dynamic vegetation, forest, grass, human health, human well-being, green spaces, monoculture, phycological, physical, well-being, natural forests, natural/forest-like vegetation.

Foreword

I wish to thank my brother, Peter Fänge for not only correcting my spelling mistakes but teaching me how to become a better writer. Anders Larsson, my supervisor for patience and wonderful guidance in finding the red thread in writing a paper. Pär Ragvald (Urban Environment Manager, Stadsmiljöchef) for giving me a connection to Höganäs municipality and letting me access the data to perform my GIS calculations. Lastly, I want to thank Brian Hjort Nielsen, GIS Engineer at Höganäs municipality for help getting the Service Area result.

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Introduction

Background

The choice of how green spaces in urban areas were once designed and how they look today is a large subject. The public grass lawns that run through the communities today are dominated by monoculture lawns. The common practice of keeping green spaces that contain predominantly monoculture biomes gives little variation of functional use to inhabitants (Hartig, Evans, Jamner, Davis, & Gärling, 2003; Lucas & Dyment, 2010) and are having a detrimental effect on biodiversity (Borman, Balmori, & Geballe, 2001). Municipalities, politics and other state institutions are aware that inhabitants have increased well-being and feel mentally healthier when spending time outside in green spaces with natural settings (Boverket, 2007; Höganäs Kommun, 2019; Höganäs Kommun, 2020; Folkhälsomyndigheten, 2021; Folkhälsomyndigheten, 2020; Johansson, Kollberg, & Bergström, 2009). Today many people face both physiological and psychological problems that stem from the modern way of life living in urban settings with little and low-quality green spaces and are often at a far distance. Some of the problem's inhabitants can suffer from are; Stress, mental fatigue, cancer, obesity and/or unequal gender equality. Many different green spaces allow for different activities which open up for more opportunities to spend time outside (Stigsdotter, et al, 2010). Studies have shown that when offered higher quality and closer proximity to green spaces people's lives do improve (Grahn & Stigsdotter, 2003; Stigsdotter, et al, 2010). Even natural environments close to home have been shown to have a positive effect on children. (Dyment, 2005; Jansson, 2008; Jansson, Gunnarsson, Mårtensson, & Andersson, 2014; Lucas & Dyment, 2010) Natural forests are important for inhabitants, which makes this paper important for municipalities and politicianss to read and take it into consideration when planning green spaces. Municipalities and politics also need to take more action to help fight climate change and one way of doing this is to plant more natural forests and other ecosystems that bind carbon dioxide (SCA, u.d.). By making a green space that can hold the values presented could be a solution for the municipalities to have more multi-purpose green space in a village such as Viken. This study looks at a district, Svanebäck in the town of Viken which lies along the West coast of the province Scania in southern Sweden. The areas of interest in Svanebäck hold 19,361 m^2 forests with tree coverage and 33,865 m^2 of monoculture lawn areas.

Aim and Purpose

The aim of this study is to explore if the green spaces in a district, which are lawn dominated need be changed to more natural/forest-like vegetation to improve the inhabitant's health and well-being.
The purpose is to give municipalities and politics a guidance to change their monoculture dominant lawns to more green spaces with natural- forests/vegetation with tree canopy coverage. The district of Svanebäck in Viken was chosen to serve as an example for how this method can be applied to a broad range of communities with static green spaces lacking in forests.

Question

The questions are; What benefits both psychological and/or physiological would the inhabitants have if the public lawns were to change to a natural/forest-like vegetation.
When observed, what do inhabitants do in the green spaces, natural forest and open lawn areas? Is there a need to change the dominating public lawns?
How many inhabitants have access to the forest area today and how many would have access to the forest and the lawn area combined?

Would the inhabitants psychological and/or physiological well-being improve if the lawns were to change into more natural vegetation?

Hypothesis

The hypothesis is that inhabitant health and wellbeing would improve if the monoculture lawns were to change to parts of natural/forests-like vegetation with tree canopy coverage.

Definitions

Green space:
"Greenspace refers to small urban parks, including public parks, street verges, cemeteries, and sports grounds. The greenspaces have an area of 2 ha or less. The greenspace is located on public land that is maintained by the local government or council." (Taylor & Hochuli, 2017)

Nature:
In their publication "Bostadsnära natur", Boverket (2007) refers to nature in an urban context and attributes it to a broad definition which includes the natural and cultural landscape, landscaped and managed green areas, and residential courtyards and parks. The definition also includes the greenery of vegetation, water, mountains, beach and the wildlife. Oxford Learner's Dictionary defines the word Nature; "Nature [uncountable] all the plants, animals, and things that exist in the universe that are not made by people." And
"Nature [uncountable] the way that things happen in the physical world when it is not controlled by people". (nature, u.d.)

Lawn:
"An area of ground covered in short grass in a yard of park." (lawn, u.d.)

Monoculture:
"A culture that lacks diversity" (monoculture, u.d.)

Health:
"A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (Constitution, u.d.)

Well-being:
" Well-being is how we are experiencing our health in any given moment and extends to include our satisfaction with life, having a sense of purpose or meaning. Ideally, we strive for positive well-being." (The IWC Group, u.d.)

Material and method

The three methods mentioned below will be discussed between each other to see what changes can be made to improve the inhabitant's health and wellbeing.

Literature and references

Literary studies were found through the university's library services, Google Scholar, recommendations from teachers at SLU Alnarp, Höganäs municipality and reports produced by the nations different organizations on what can better human health and well-being in relation to community green spaces.

Observational and sound study

An observation study of park visitors will be conducted mainly based on a modified version of SOPARC (The System for Observing Play and Recreation in Communities) and Jenny Veitch et al (2015) way of using the SOPARC method. The tool is used to assess the physical activity in a community's setting such as parks. The observational study will observe what activities inhabitants do when visiting the areas of a natural forests and open lawn areas. Additionally, a sound observation will be conducted to hear the difference in bird songs as sounds of nature are also linked to human health and well-being. The two areas that will be observed are on weekdays and at two different times of the day, 6:30 – 8:00 before people go to work and 16:30-18 after people have come home from work. They will be done on weekdays because the time to conduct this observational study is limited.

ArcGIS, Services Area analysis

Further, ArcGIS (Geographic information system) will be used to do a Service Area analysis and to calculate the areas of interest. Two Service Area analyses will be done, the first calculates how many inhabitants within 300m of walking distance have access to today's forests (tree coverage). The second will be done the same way but the lawn areas will be included. The choice of the distance is explained further down in "Residential nature – Accessibility" (Boverket, 2007).

Limitations

As this is a large topic, the study has been limited mainly to what raises human health and well-being and how natural/forest-like green spaces in urban areas play a vital role in that success.
This study does not look into the following aspects;

- Values of biodiversity related to inhabitant health and well-being.
- All factors of how a forest affects the psychological and/or physiological of an inhabitant.
- Inhabitants' movement patterns throughout the day.
- Costs of establishment
- Costs of future management
- Who decides how areas are designed?
- Perceived safety
- Other green spaces such as semi-open green spaces

Literature study

Residential Nature in Sweden

The publication “Residential Nature” (Bostadsnära natur) was written by The National Board of Housing, Building and Planning (Boverket, 2007) and was ordered by the government in 2006 to develop and guide municipalities and politics across the nation and is referenced by the Public Health Agency in Sweden (Johansson, Kollberg, & Bergström, 2009). It is a guide for the municipalities to plan green spaces that are easily accessible to inhabitants. It also explains how they can design these places to help inhabitants with their physiological and psychological health. It also brings attention to that a variation of nature and structured vegetation is important for inhabitants and they have different meanings for them. (Boverket, 2007)
According to The Swedish Environmental Code an Environmental Impact Assessment (EIA) of an urban area should include both the physical and psychological impact when creating green spaces today. Sadly, in reality it is normal that the psychological impact is left out, an example is where MKB (Malmö Municipal Housing) only describes the physical impact (Boverket, 2007).

The publication mentions that there are three main aspects to take into consideration when planning a green space in a residential area. Whether the area is newly built or an already existing residential area:
Asset - What type of asset a residential green space is.
Accessibility– How accessible the residential green space is to the inhabitants
Quality - The size, content and values of the residential green space.
(Boverket, 2007)

Asset

Having nature close to home creates the opportunity for inhabitants to interact with it on a daily basis. This in turn creates places for play, solitude, togetherness, inspiration, daydreaming and to broaden the understanding of nature, ecology and its resources. That is why it is important to have different types of nature for the inhabitants in the residential area. (Boverket, 2007) Nature in the residential area should be preserved as reachable to inhabitants. Living close to a variety of green space within 300m of the home increases the inhabitant’s well-being, mental and physical health. It can also lead to less stress, more creativity at the workplace, better motor systems and concentration in children. (Boverket, 2007)

Accessibility

How inhabitants can access the green spaces is an important aspect as they have to know how to get there. Making paths and planning the green spaces in suitable places within the residential areas contributes to healthier living. The green spaces in the residential area should be open to the public to use and should not be fenced off. They should also be accessible to inhabitants with neurodiversity and children, who should not need to crossroads with traffic. Children's freedom to move around a community is strongly influenced by the design of the buildings. Their living environment is determined on how the houses are located, roads and streets drawn as parks and playgrounds are built. This is why areas for play should be planned, traffic regulated, and barriers bridged. The guideline from Boverket (2007) for the distance an inhabitant should have to a residential nature area is 300m.
(Boverket, 2007)

Quality

The quality of the green spaces in the residential areas is important. Different varieties of green spaces are also important because if everything were to look the same, for example only having lawns cover all the green spaces it would be perceived as a static landscape. Studies have shown that living in the vicinity of high-quality nature makes it attractive to buyers. Municipalities are seen as attractive when having attractive nature. Boverket (2007) says it is important to start implementing attractive plantings today in order to secure a high quality for future residential areas. Without qualities that give experience-, utility-, ecological- or cultural-historical values there will never be a support to have nature with quality in it.
(Boverket, 2007)

Healing power of the forest

Biophilia hypothesis

The term *biophilia* originated in 1973 and is described as "the passionate love of life and of all that is alive" (Rogers, 2019). Wilson's (1984) hypothesis says that humans have a kind of desire to look at other life forms. This should then actively demonstrate that humans tend to seek nature and with that meaning that nature may benefit human health (Frumkin, 2001). As it is becoming more acknowledged that natural environments such as forests contribute to human health, well-being (Kaplan & Kaplan, 1989), architectonics (Ulrich, 1984), forestry (Park B. , et al, 2008; Park B. J., et al, 2007), immunology (Maas, Verheij, Groenewegen, de Vries, & Spreeuwenberg, 2006; Li, et al, 2007, 2008a, b) and preventive medicine (Frumkin, 2001). The International Union of Forest Research Organizations (IUFRO, u.d.) found that human health and well-being can not only be solved by medication and that natural environments such as forests and trees provide better results for inhabitants.

Forest bathing (Shinrin-yoku)

The term *Shinrin-yoku* (forest-air bathing and walking) or so-called Forest Bathing originated from Japan and has been used as a natural healing for many years. It works as a climate- and aromatherapy when people walk in a forest with a canopy. Walking in a forest and breathing in the forest air makes it a pleasurable and refreshing experience. Studies have shown that the chemicals produced and excreted by the trees into the air (Li, et al, 2007, 2008a & b) can cause various biological effects and/or cause changes in physiological functions in humans such as stress and/or the feeling of well-being. (Miyazaki and Moto Hashi, 1996 see Ohtsuka, Yabunaka, & Takayama, 1998)

Natural killer activity

Li, et al (2007) & Li, et al (2008a, b) were three studies that were conducted one after the other, where the first one researched the effects of natural cancer killing cells when visiting a forest or a city and the other researched how long the activity of the same cells lasted 7-30 days after the study was conducted. Two of the studies had 12 males and one with 13 females that were chosen from the age of 37-55 years and worked full time jobs in three large companies in Tokyo, Japan. "The subjects experienced a three-day/two-night trip in three different forest fields. On the first day, subjects walked for two hours in the afternoon in a forest field; and on the second day, they walked for two hours in the morning and afternoon, respectively, in two different forest fields." (Li, et al 2007, p1) On the second- and third-days blood samples were taken to measure the activity of the natural cancer killing cells. These measurements were used to be compared with the participants before they went on their trips.

Li, et al (2007 & 2008b), investigated how that cell activity produced by the human's (values in the blood to measure natural cancer killing cells) would change when exposed to being in a forest (*shinrin-yoku*) or in the city. Results showed in both men and women that practicing *shinrin-yoku* could enhance the immune response as measured by the cell activity and also the percentage of the absolute numbers of those cells. Patients showed an increase of about 50 percent of the cells after the visits to the forests. This actively demonstrates that when natural cancer killing cells increases, that bodies could fight off cancer after having spent time in a forest.

Li, et al (2008a, b) measured the same as the previous studies blood levels to determine how long natural cancer killing cells lasted in the patients after the time the study was conducted. The patients had returned to their normal lives and blood samples were taken and they had a questionnaire to fill out. Results show that the cells were still at a higher level 7 days (but lower than day three) after the participants visited the forest. Even 30 days after the visit to the forest natural killer activity was still active.

Human health

Decreased stress in natural environments

The WHO (World Health Organization) published a report in 2009 showing the top 10 leading risk factor causes of deaths in 2004. In the group of high-income countries 1.4 million people died due to high blood pressure, 0.7 million to being overweight and obesity, 0.6 million to physical inactivity and 0.5 million to high cholesterol. (World Health Organization (WHO), 2009)
Studies have shown that cardiovascular disease and mental disorders are linked to stress and they have also shown that stress has a physiological impact on organisms and humans (Gémes, Ahnve, & Janszky, 2007; Herbert & Cohen, 1993; McEwen, 1998; Selye, 1936, 1946)

Studies have shown that access to natural environments are good for inhabitants as it helps reduce stress in their daily lives. Both being outside in a natural environment (Beil & Hanes, 2013; Hartig, Evans, Jamner, Davis, & Gärling, 2003; Q, Park, Tsunetsugu, Kagawa, & Miyazaki, 2009; Stigsdotter, et al, 2010) and/or auditory and/or virtual stimulation of nature (Alvarsson, Wiens, & Nilsson, 2010; Annerstedt, et al, 2013; Jiang, Chang, & Sullivan, 2014) bring down stress in inhabitants.

In a pilot study by Beil & Hanes (2013) 14 participants (7 male and 7 female) were subjected to four different environments of varying natural surroundings and their saliva was measured for variations in chemicals that indicate a person's level of stress. For 20 minutes on four separate days the participants spent time in one of four settings: very natural, mostly natural, mostly built, and very built. The study didn't show any differences between the stress levels in the natural settings. However, there was a significant difference between the male and female participants where the latter had lower levels of the chemicals in their saliva and thus also had more reduced levels of stress when exposed to the natural environments. Their pilot study concluded that the visits should have been longer than 20 minutes for the results to show significant differences.

A study by Hartig, Evans, Jamner, Davis, & Gärling (2003) compared how participants (112 participants, 56 female and 56 male) that were students would react to a natural or an urban environment. They would start by being seated indoors and then walk outdoors. One group would view trees from a room and afterwards walk outdoors in a nature reserve for 50 min. The other group would sit in a room without views and then walk in an urban environment for 50 min. Blood pressure was taken every 10 minutes during the walks to measure the participants' stress levels. Results showed that participants of the urban group were reported to feel on average

more anger and aggressiveness than the nature reserve group. Overall, the results showed that walking in the natural environment gave the participants lower stress levels. An additional test showed that the nature reserve group had improved their level of attention. The positive effects showed after 20 minutes into the walk and stayed till the end of the 50 min.

Lee, Park, Tsunetsugu, Kagawa, & Miyazaki (2009) conducted a study with 12 male Japanese participants where over three days physiological and psychological data was taken four times a day. Their saliva was measured for variations in chemicals, diastolic blood pressure, and pulse rate to see how they would be affected by spending time in a forest compared to an urban setting. Tests were also taken to ask how they felt throughout the day. The saliva analysis showed to be significantly lower during and after having been in the forest landscape compared to the urban landscape, meaning that stress levels went down. Significant differences of the subject's physiological data showed that they felt more comfortable, soothed, and had a refreshed feeling after being in the forest landscape. Pulse rate and blood pressure did not show significant results between the two different landscapes.

Stigsdotter et al (2010) wanted to see how the people living in Copenhagen, Denmark were affected by living close to or far away from green spaces. Their health, health-related quality of life and stress, respectively was evaluated. The green spaces that were included were forest; park, green space; beach, sea, lake; and other green space. The participants were asked to report the main reason for visiting the green space and were given a few options to choose from: "enjoy the weather and get fresh air"; "follow the seasons, flora and fauna"; "reduce stress, relax"; "exercise, keep in shape"; "do something together with friends/family"; "obtain peace and quiet without noise"; and "other reasons and never get to green space". Other questions were also asked, such as asking them how they felt mentally. The results showed that respondents living 1km or further away from a green space always reported lower mean scores on well-being and mental health. Respondents who visit green spaces more often report lower levels of stress. Also visiting green spaces to view the flora and fauna was reported as one of the main reasons for visiting that green space by both stressed and unstressed individuals. The study concluded that the more often Danes visit green spaces the less stress they experience. Also, Grahn & Stigsdotter (2003) found that when asking Swedish citizens what they would recommend a friend to do if they were feeling stressed or worried it would be to take a walk in the forest.

Lower stress with sounds of nature and/or virtual natural environments.
Alvarsson, Wiens & Nilsson (2010) studied how 42 participants (24 female and 18 male) reacted to being exposed to sounds from nature or too noisy environments for a time-lapse of 35 minutes. The sounds of nature included tweeting from birds and splashing water from a fountain at an average sound pressure level that was set to 50 dB (decibel). Three different analysis methods were used to determine if the sounds would reduce their stress levels. Alvarsson, Wiens & Nilsson (2010) results showed that the group that was exposed to sounds of nature had lower stress levels than those of a non-nature sound. Also, Annerstedt et al (2013) studied how the stress levels of 30 males (10 in each group) changed while being exposed to different visual stress tests lasting 15 minutes. The visual stress tests included two different virtual natural environments (with and without sounds of nature, the natural environment consisting of trees in a forest surrounded with a path leading to a stream of water, reminiscent of a natural setting in Scandinavia) and in one control condition (with no virtual forest or sounds). Cardiovascular data and saliva cortisol were collected to determine how the patients stress levels reacted to the different tests. The results showed stress levels were lowest in the participants that viewed virtual environments with sounds of nature (Annerstedt, et al, 2013).

A study conducted by Jiang, Chang & Sullivan (2014) had 142 participants (71 female and 71 male) view six minute 3-D videos of three different streets in a neighborhood. The three streets had either a full covering canopy of trees with complete shade, smaller trees with half shading, or no vegetation at all but grass. Salivary cortisol and skin conductance levels were taken to determine the patient's stress. The results in this study showed that only the men displayed less stress when viewing the half-shaded street. The study concluded that the time spent viewing the videos could have been too short and therefore not giving the patients enough time to have an effect on salivary cortisol and skin conductance levels.

To sum up what has been stated above; Moving in a forest the senses of smell, sight, hearing and touch are important for a visitor. As studies have shown chemicals produced and excreted by the trees into the air (Li, et al, 2007, 2008a & b) can cause various biological effects and/or cause changes in physiological functions in humans such as stress and/or the feeling of well-being. (Miyazaki and Moto Hashi, 1996 see Ohtsuka, Yabunaka, & Takayama, 1998) Observing nature is beneficial for human health and well-being, as shown by the studies on people visiting forest settings (Beil & Hanes, 2013; Hartig, Evans, Jamner, Davis, & Gärling, 2003; Jiang, Chang, & Sullivan, 2014; Kaplan & Kaplan, 1989; Lee et.al., 2009; Miyazaki and Moto Hashi, 1996 see Ohtsuka, Yabunaka, & Takayama, 1998; Li, et al, 2007 & 2008a, b; Stigsdotter et al, 2010). Also, Annerstedt, et al, (2013) concluded that sight and sound through virtual reality lowered the patients stress levels but it is then hard to prove if it was due to sound, sight or both together that gave positive results.

Children

There is a requirement that when developing or improving outdoor environments today that they should be fitted to a child's needs. The Swedish national public health goals (Folkhälsomyndigheten, 2020) say that children are an important group to take into consideration, they also say that more green spaces are needed in order for physical activity and recreation to increase. The Convention on the Rights of the Child "UNICEF" (UNICEF, u.d.) take up these relevant points about children's rights: Article 2 says that there should be no discrimination of any kind that being for example the sex of a child. Article 12 states that children have the right to have their voice heard and Article 31 states that a child should be able to participate in recreational and leisure activity. In addition, natural environments close to home have shown to have a positive effect on children as well. Things such as increased concentration, learning ability, activity, gender equality play, and less frustration. (Dyment, 2005; Jansson, 2008; Jansson, Gunnarsson, Mårtensson, & Andersson, 2014; Lucas & Dyment, 2010)

Märit Jansson (2008) interviewed 141 children aged 6-11 from two communities to find out how they perceive the public playgrounds close to where they live. Two places were in focus; one in the forest and one on open arable ground. Results showed that children preferred playgrounds that were within or close to a forest because the children could use the vegetation to climb on and use dead debris to build things with. The children expressed that they felt frustrated in the open arable playgrounds and they expressed that the arable playgrounds were usually taken by other children, this then led to that there was nowhere for them to go as there was not much to do on the lawn surrounding the playgrounds. The children who played in the forest experienced that there was enough room to play in the forest for all the children and that decreased their frustration.

Relevant ages of inhabitants in this study

Relevant ages to document were 0-10 and 11+, this because under the age of 10 it is a generalization from The National Society for Road Safety that a child should not move around a moderately to heavily trafficked road without an adult (NTF, n.d.). This in turn affects the children under the age of 10 that have to walk along or cross those roads in order to get to the tree coverage areas.

Who to include in the decision-making process?
Studies recommend including inhabitants in the planning process of urban green areas as it increases the chances of it becoming a successful green area (Boverket, 2007). Whereas Hofmann, Westermann, Kowarik, & van der Meer (2012) found that preference for dense vegetation is preferred by professionals in the field, for example by landscape designers, however it is not preferred by the general public. Hofmann et al. (2012) points out that people with the knowledge about the benefits of dense vegetation which links to higher biological values show a higher preference for that type of landscape.

Example site, Viken, Höganäs

History of Viken

The area that holds the most monoculture green lawns were built between the 1960s to 1970s. The pressure on housing was high at the time because the baby boom children that were born just after World War 2 needed housing. A large-scale exploitation was set in place to be built. In Viken many houses were built and the stress of producing so much housing caused the planners to come up with simple solutions and one was to draw lawns at the time instead of parks with elements in them. Also, at that time it was new to have green spaces free from traffic and that is why the houses were built around the green spaces with roads leading to the houses from the outside. This made it easier for people and children to walk and bike in the green spaces safely as they were undisturbed by cars. (Rådberg & Friberg, 1996) The law lacks clear formulated requirements as to what an appropriate outdoor environment must contain. This in turn can lead to a lack of quality in outdoor environments. (Boverket, 2007)

Today

Viken lies in the northern province in Scania, Sweden and holds 4553 inhabitants (2371 female and 2182 male). It has approximately the size of 1,7 by 2,8 km. The area used in this study (Svanebäck) holds 1396 inhabitants (715 female and 681 male) and is approximately 0,9 by 1,4 km at its widest. Housing here consists mainly of villas and townhouses with their own private garden area. To the west of the district lies a stretch of ocean that is a natural reserve and to get there a 70km/h road needs to be crossed. To the north/east lies mainly agricultural land with a few more houses and 50km/h road to the south/east. Toward the south can be found the town center as well as two grocery stores, a health center, the local school, daycare centers and more.

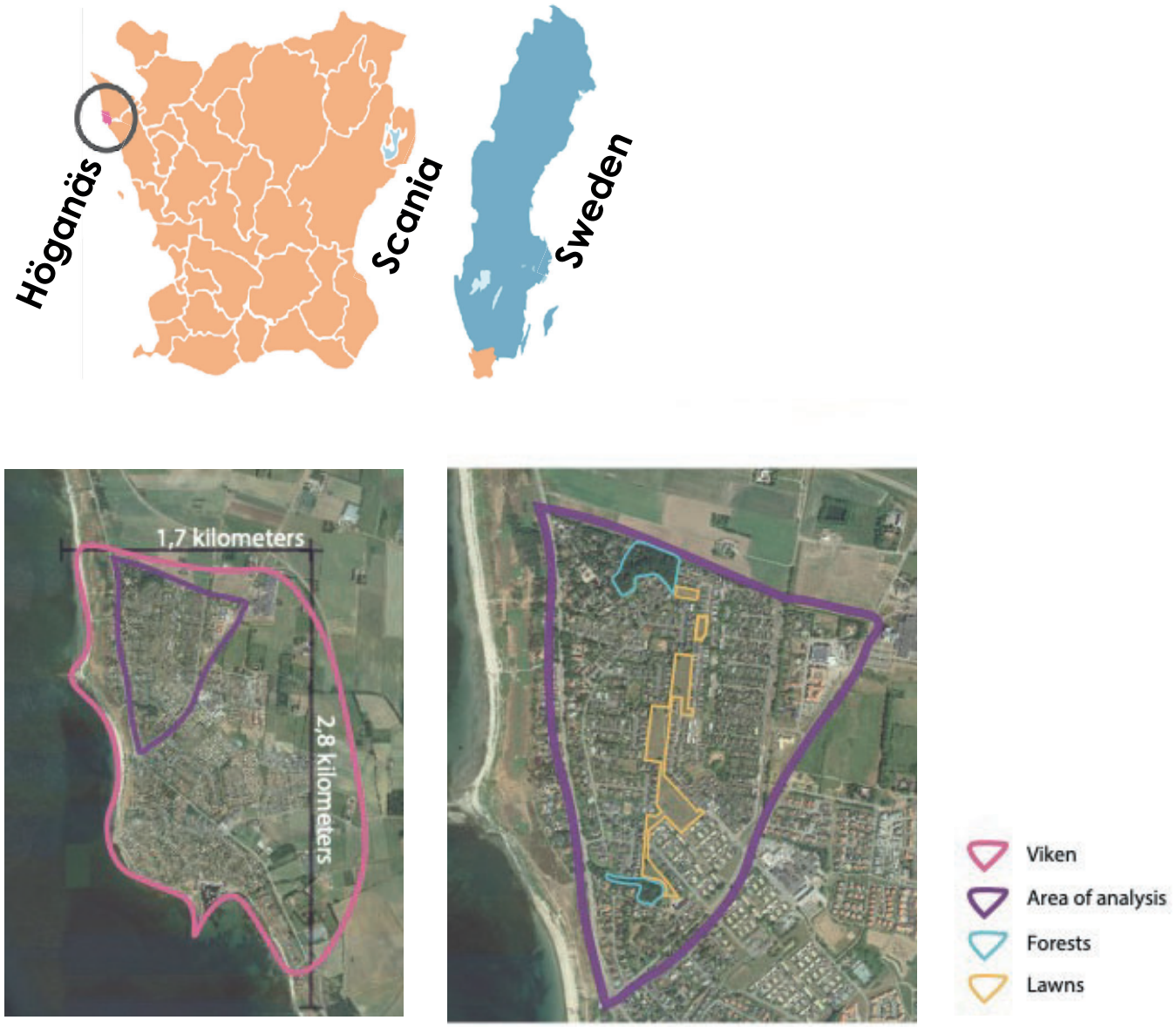

Figure 1: Map explaining location. Viken, Höganäs municipality (Fänge 2021)

Google Maps, ©2021. Viken 56.151729, 12.577731, [online] Available through: <https://www.google.se/maps/@56.1519812,12.5747142,2972m/data=!3m1!1e3> [Accessed 31 August 2011].

Potential

The area in this town was chosen because it holds a large stretch of monoculture lawn which mentioned before does not hold as many values in human health, well-being and biodiversity as continuously visiting a forest or natural vegetation setting does.

As the forests today are seen as an asset according to Boverket (2017), they also say that living within 300m of a green space which contains variation increases the inhabitant's well-being, mental and physical health. They also state that values of play, solitude, togetherness, inspiration, daydreaming and broadening one's

understanding of nature, ecology and its resources. Furthermore, it can also lead to less stress, more creativity at the workplace, better motor systems and children's concentration. (Boverket, 2007)
Accessibility is important to younger children who should not move long trafficked roads. Safe pathways need to exist so that all ages have access to the forest areas. As mentioned earlier children under the age of 10 should not move around on roads which are moderately to heavily trafficked without an adult (NTF, n.d). They also write that it is important to have green spaces with natural settings that feel untouched and that they should have a coverage rate of 300 to 400 m^2 per inhabitant. (Boverket, 2007)
The quality of green spaces is also important according to Boverket (2007) and that only having lawns is not considered as high-quality nature.

Höganäs municipality's green plan states that the forests to the north and south are high in both biodiversity and social values. It also states that the monoculture lawn areas in between the two forests are low in biodiversity and hold a medium in social values. In the future the municipality wants the lawns to have a more natural looking vegetation in the area and they also see that the monoculture lawn areas in this area have the potential to make connecting green space. (Höganäs Kommun, 2021)

More detailed descriptions of both green spaces are as follows;

Northern forest

Natural land, 13 637 m^2 (ArcGIS data)

Southern forest

Green space, 5 724 m^2 (ArcGIS data)

Biological values that are high;
Coarse trees
Broadleaved deciduous trees
Flowering trees
Bushes
Perennials
Tree continuity
Dead wood
Rare and endangered species

Social values that are medium to high;
Species richness
Culture
Tranquility
Space
Be there
Wilderness
Quality
Northern - The forest is one of the oldest in Viken and has a strong characteristic of a forest and space.
Southern - A forest-like character with a central location in Viken.

Areas of lawn

Green spaces, 33,865 m^2 (ArcGIS data)

Biological values that are low;
Flowering and fruit bearing trees, bushes and perennials.

Social values that are low to medium;
Common space (allmäning)
Space
Tranquility
Presence
Some green spaces do not meet any of the park characteristics.
Quality
A large space that is safe from car traffic and noise pollution. The areas of lawn are connected with each other and therefore hold a value in creating a connecting green area (grönstråk).
One of the smaller areas to the north has small bending roads to teach children traffic rules.

(Höganäs Kommun, 2021)

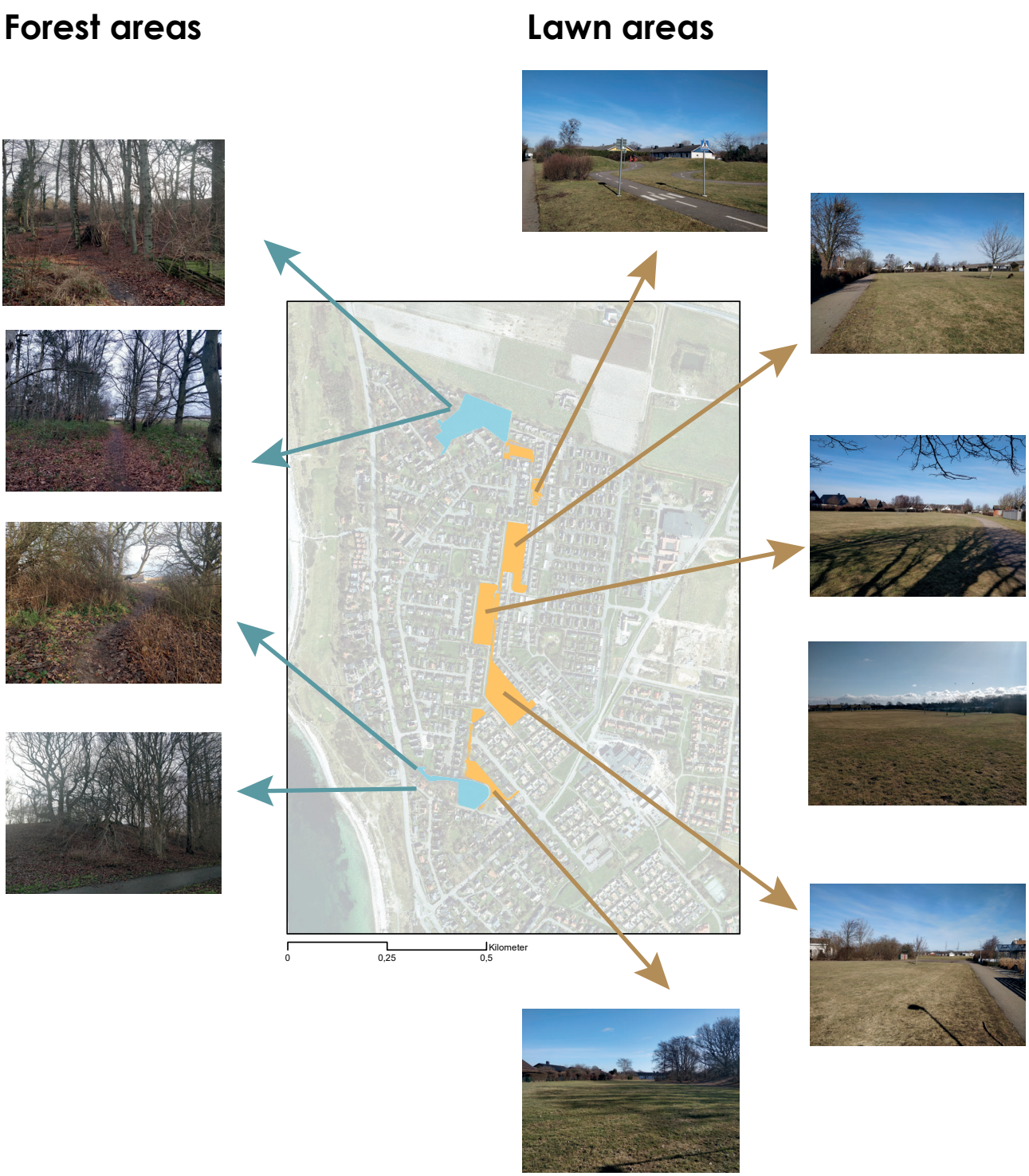

Figure 2: Map and images explaining areas. (Fänge 2021)

Google Maps, ©2021. Viken 56.151729, 12.577731, [online] Available through: <https://www.google.se/maps/@56.1519812,12.5747142,2972m/data=!3m1!1e3> [Accessed 31 August 2011].

Observational and sound study

Observational study

The purpose of this observational and sound study is to see which type of green space is more attractive to inhabitants (tree coverage, forest or monoculture, lawn) and what they do when visiting the two. The sound recordings are to see if an area has more sounds of nature than the other. It is also conducted to compare it with the literature study. At two locations, one observer will conduct observations of two areas in Svanebäck, Viken. The first area is one of the biggest grass fields in Svanebäck which holds football goals and a walk and bike path with an area of 7850 m^2. The other, a forest that lies to the north with an area of 13637 m^2 which is chosen instead of the one in the south because it lies on a hill which would make it harder for disabled people to reach (see Figure 2). The observations took place two days on a weekday before inhabitants went to work/school that day. The times were 6:30-9:00 before work or when schools start and 15:30-18:00 after work or school ends.

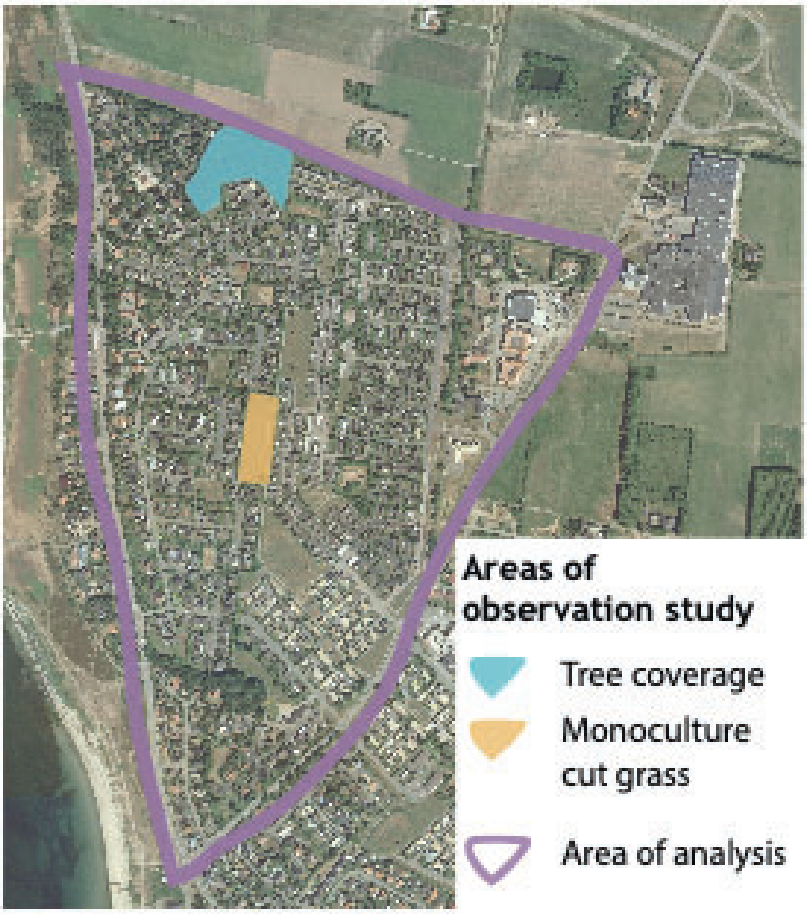

Figure 3: Areas included in observation study. (Fänge 2021)

Google Maps, ©2021. Viken 56.151729, 12.577731, [online] Available through: <https://www.google.se/maps/@56.1519812,12.5747142,2972m/data=!3m1!1e3> [Accessed 31 August 2011].

To motivate why this observational and sound study is to be conducted is because of the following; The act of Forest bathing with countless other studies show positive effects on stress, health and/or the feeling of well-being (Beil & Hanes, 2013; Hartig, Evans, Jamner, Davis, & Gärling, 2003; Jiang, Chang, & Sullivan, 2014; Lee, Park, Tsunetsugu, Kagawa, & Miyazaki, 2009; Miyazaki and Moto Hashi, 1996 see Ohtsuka, Yabunaka, & Takayama, 1998; Li, et al, 2007 & 2008a,b; Stigsdotter et al, 2010). The observation study also looked at what inhabitants do on grass fields versus a vegetative forest with tree coverage and natural looking vegetation. As Jansson (2008) concluded, children enjoy natural vegetation more than lawn fields. The result can also maybe support/not support those assets of green space are an important factor to inhabitants.

Observation method

The observation study of park visitors is conducted mainly based on a modified version of SOPARC (The System for Observing Play and Recreation in Communities and Jenny Veitch et al (2015) way of using the SOPARC method. The tool is used to assess the physical activity in a community's setting such as parks.

See the table that was used below;

§ **Table 1** Park visitor characteristics

Park visitor characteristics	N (total n=XXXX) Forest (F)	N (total n=XXXX) Lawn (L)	Percent F and	between both, L
TOTAL	_____	_____	_____	
Sex				
Male	_____	_____	_____	_____
Female	_____	_____	_____	_____
Unknown	_____	_____	_____	_____
Age				
Child (0-10 years)	_____	_____	_____	_____
Teen (11-20 years)	_____	_____	_____	_____
Adult (21-65 years)	_____	_____	_____	_____
Senior (66+ years)	_____	_____	_____	_____
Occupation				
Sitting	_____	_____	_____	_____
Walking	_____	_____	_____	_____
Playing	_____	_____	_____	_____
Training	_____	_____	_____	_____
Biking	_____	_____	_____	_____
Using natural material to play with	_____	_____	_____	_____
Playing with bought material	_____	_____	_____	_____
Period of day				
Morning	_____	_____	_____	_____
Afternoon	_____	_____	_____	_____

Sounds recordings

As concluded by Alvarsson, Wiens, & Nilsson (2010) sounds of nature create less stress and by recording each area to see the difference in what sounds are heard and how high those sounds go is a good way to see if the sounds of nature are higher in the forest or lawn area. A recording of the bird song will be recorded for one minute in the same forest and lawn as the observation study. Google chrome's extension "Sound Meter" was used to calculate the decibel. The bird songs will be sketched as they are heard inorder to identify the different songs.

ArcGIS, Services Area analysis

Natural environments close to home have shown to have a positive effect on children as well. Things such as increased concentration, increased learning ability, gender equality play, less frustration and increased activity. (Dyment, 2005; Jansson M., 2008; Jansson, Gunnarsson, Mårtensson, & Andersson, 2014; Lucas & Dyment, 2010) Stigsdotter et al (2010) also concluded that living close to green spaces is important as people tend to use them more often. This is why it would be interesting to calculate how many people have access to the forest area today and if the municipality were to change the appearance of the lawn fields, how many people would then have access to more natural/forest-like vegetation.

Calculating the Service area analysis

ArcGIS (Geographic information system) will be used to do a Service Area analysis and to calculate the areas of interest. Two Service Area analysis will be done, the first to calculate how many inhabitants today within a 300m distance have access to the forest areas. The second, will be done the same way but the monoculture lawn areas will be included (see Figure 4 for how the analysis was done). The choice of these distances and calculations of area are explained earlier in "Residential nature in Sweden – Accessibility" (Boverket, 2007). Also, areas (m^2) of the forests and lawns will be calculated.

The data needed to conduct this analysis on ArcGIS;
Data from Höganäs municipality:
Inhabitants point data - latest updated inhabitant point data was from 2017 by SCB (Statistics Sweden through Höganäs municipality, 2021)

The results of the inhabitant point data will depend on how the addresses are written in the properties tables. This will affect the percentage of how many inhabitants are placed at their correct addresses.

Paths
Path networks line data written through site visits so that hidden paths could be included.

Path networks chosen

Pathways included	Pathways not included
Walking paths	Zebra crossings
Biking paths	Not raised sidewalks
Raised sidewalks	Roads with vehicle traffic
Dead end roads with 8 houses minimum.	

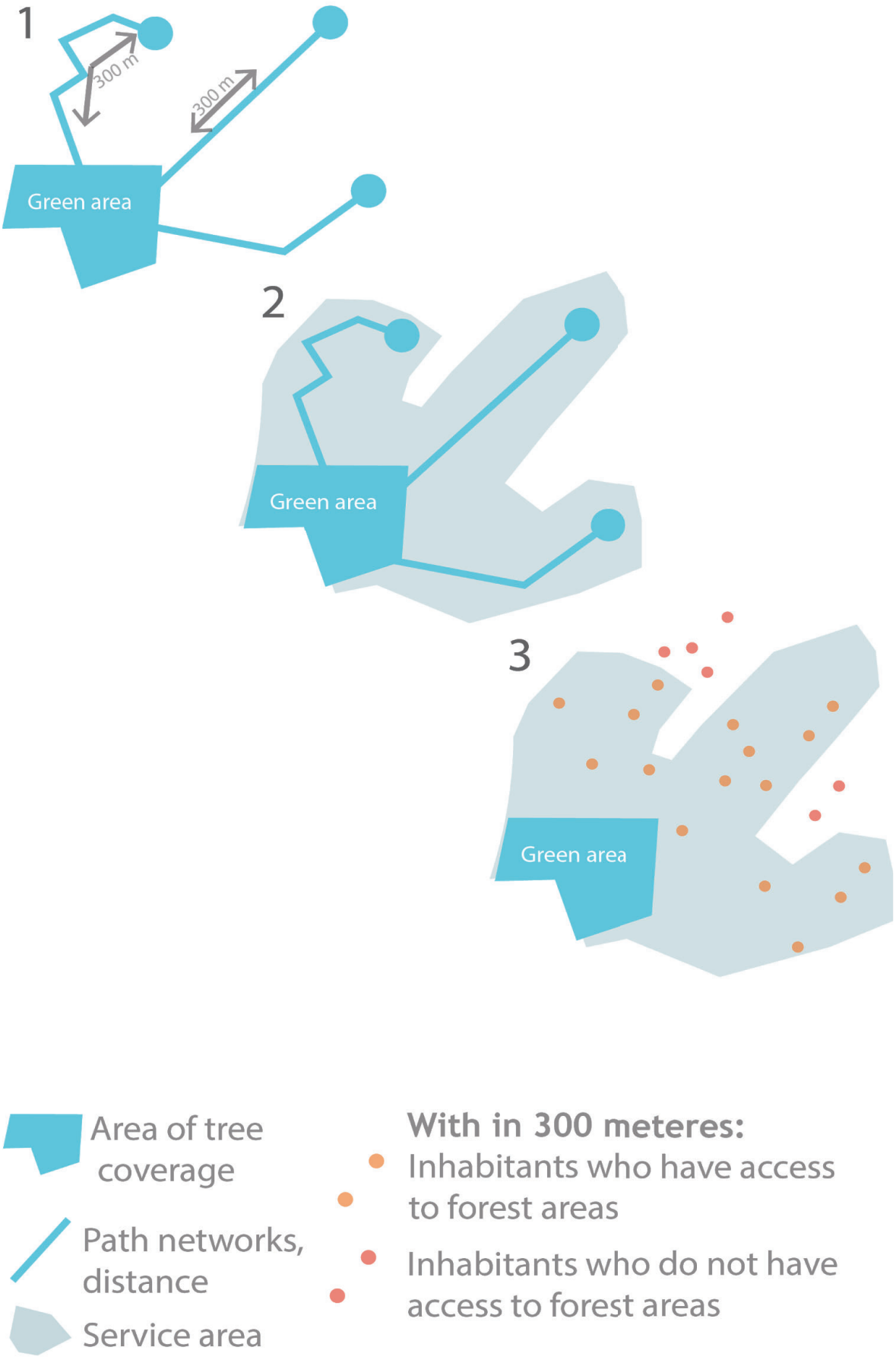

Figure 4: Principle of service area results. (Fänge 2021)

Results

Observational and sound study

Observation

The observational study was conducted during the 8th and 9th of March 2021. The weather was sunny with winds between 4-7 km/h and a temperature around 3-7 degrees Celsius.

§ **Table 2** Park visitor characteristics of both days

Park visitor characteristics	N (total n=288) Forest (F)	N (total n=230) Lawn (L)	Percent F and	between both, L
TOTAL	288	230	518 in	total
Sex				
Male	132	121	25%	23%
Female	156	104	30%	20%
Unknown	-	5		1%
Age				
Child (0-10 years)	42	24	8%	5%
Teen (11-20 years)	52	80	10%	15%
Adult (21-65 years)	172	52	33%	10%
Senior (66+ years)	22	74	4%	14%
Occupation				
Sitting	12	4	2%	1%
Walking	172	184	33%	36%
Playing	32	12	6%	2%
Training	14	6	3%	1%
Biking	58	24	11%	5%
Playing with natural material	28	-	87% ↑↓	0% ↑↓
Playing with bought material	4	12	12%	100%
Period of day				
Morning	104	90	20%	17%
Afternoon	184	140	36%	27%

Sex

The results from the observational study show that in total 288 inhabitants (55%) visited the forest and 233 (45%) visited the lawn and an equal amount of male (48%) and female (50%). There was a 10% difference in females visiting the forest (30%) with the lawn (20%) but none with the males (25 to 23%)

Age
The biggest difference was with the adults (ages 21-65) with 172 (33%) being present in the forest compared to 52 (10%) being on the lawn. Ages 11-20 were mainly by themselves and 52 (10%) were in the forest and 80 were on the lawn and the ones on the lawn were mainly seen with a football or biking. Also, the seniors showed a difference but with opposite presence 22 inhabitants (4%) were present in the forest and 72 (14%) on the lawn. The number of children (ages 1-10) visiting the forest was 42 (8%) compared to 24 (5%) to the lawn which could indicate that more children go to the forest and they were also always being taken care of by a parent.

Occupation and material they played with
The main form of occupation in the two areas was walking where 172 (33%) walked in the forest and 184 (36%) on the lawn. After that was biking with 58 inhabitants (11%) in the forest and 24 (5%) on the lawn. Play was higher in the forest with 32 inhabitants (6%) and also showed that of all 28 (87%) inhabitants out of the 32 played with natural material and 4 (12%) with bought material. It shows that of all the 12 inhabitants (100%) that played on the lawn, they all played with bought material.

Period of day
In general, inhabitants were more likely to visit the forest and the lawns in the afternoon.

Sounds recordings

Sounds of forest
One minute recording the 16th of March 2021, 14:20

Figure 5: Sound waves of birds in forest recording from Iphone. (Fänge 2021)

Figure 6: Handwritten sounds waves of different bird songs in forest. (Fänge 2021)

Listening to the recording there was presence of six different bird songs and the motorway. See handwritten sketches of the different perceived bird songs. (Figure 6)

Sounds of lawn

One minute recording the 16th of March 2021, 14:35

Figure 7: Sound waves of birds in lawn recording from Iphone. (Fänge 2021)

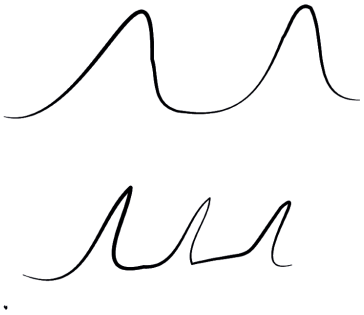

Figure 8: Handwritten sounds waves of different bird songs in lawn. (Fänge 2021)

Listening to the recording there was presence of two different bird songs and the motorway. See handwritten sketches of the different perceived bird songs. (Figure 8)

Calculating green spaces

Population		*Ages*		*Areas*
Svanebäck	- 1396	0-10	- 170	Lawns - 33865 m^2
Male	- 681	11-20	-184	Forests - 19361m^2
Female	- 715	21-65	-642	
		65+	- 40	

The results from the ArcGIS Network Analysis show that 23% (321 out of 1396) of the inhabitants today have access to the forest area. 76% (1056 out of 1396) of inhabitants have access to a green space whether that is a forest or lawn, which is a 53% difference to the inhabitants that have access to the forest areas. The rise in the inhabitants age category has also stayed stable when the lawn area was added to the analysis, which means that the age categories are evenly spread out throughout the buffered area. (see Figure 9)

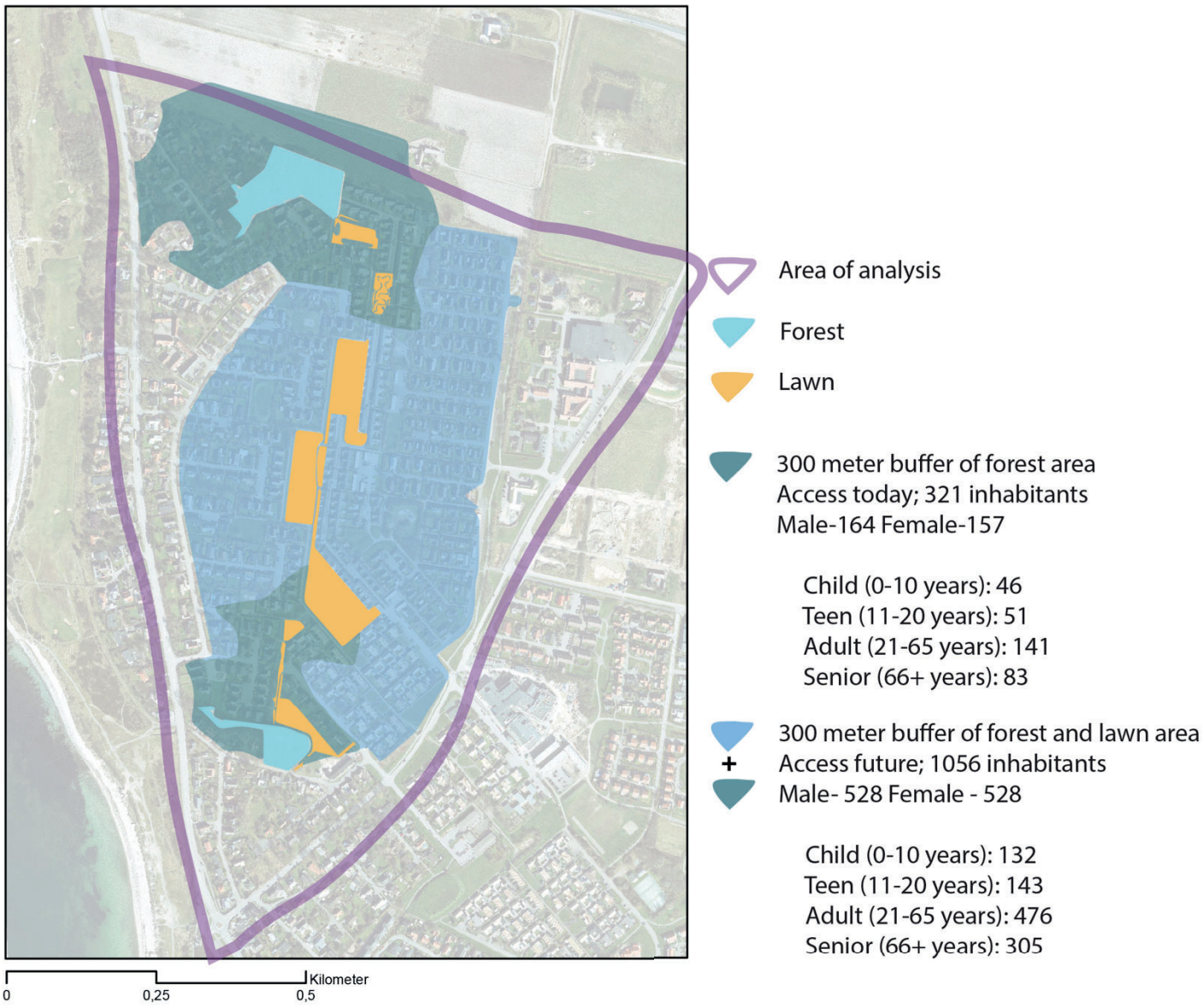

Figure 9: GIS Service area analysis - Results. (Fänge 2021)

Google Maps, ©2021. Viken 56.151729, 12.577731, [online] Available through: <https://www.google.se/maps/@56.1519812,12.5747142,2972m/data=!3m1!1e3> [Accessed 31 August 2011].

Discussion

Observational study

In total 288 inhabitants (55%) visited the forest and 230 (44%) the lawn area which does not give much of a difference. What is interesting is that even though the forest which located on the northern edge of Svanebäck, it still had more inhabitants visiting (288 in total) compared to the lawn (230).

How the inhabitants used the two different green spaces was in some cases mostly equal and some not. The biggest difference was with the adults (ages 21-65) with 172 (33%) being present in the forest compared to 52 (10%) being on the lawn. Also, the seniors showed to be more present on the lawn, 72 (14%) compared to the forest with 22 inhabitants (4%). This could be because older people do not walk longer distances and when they choose to walk, they want to walk on steady ground, so they do not trip and fall. The number of children (ages 1-10) visiting the forest was 42 (8%) compared to 24 (5%) to the lawn could indicate that more children go to the forest and they were also always being taken care of by a parent. A reason for the low difference in percentage could be because children in that age cannot walk as far.

Interesting was the difference in what females preferred where 10% more females visited the forest (30%) compared to the lawn (20%). The preference among men showed little difference (25% forest to 23% lawn). It is interesting to compare these results to Beil & Hanes (2013) pilot study where they concluded that only the females showed reduced levels of stress when being exposed to natural environments. This could actively demonstrate that females are drawn to natural environments since they feel the result of decreased stress after walking in a forest. Even Grahn & Stigsdotter (2003) concluded that people seek forests when feeling stressed. Another interesting result was that seniors use the lawns more, but this could be because the forests are too far away or that the paths in the forest are not stable enough for them to walk on (see figure 2, for path in forest).

The observation showed that walking was the main form of recreation in both the forest and lawn area. 172 (33%) walked in the forest and 184 (36%) on the lawn. Many of the studies from the literature study were conducted with participants walking through a natural forest (Grahn & Stigsdotter, 2003; Hartig et. al., 2003;) which resulted in the participants feeling less stressed, as well as less angry and aggressive. Studies have shown that the chemicals produced and excreted by the trees into the air (Li, et al, 2007, 2008a & b) can cause various biological effects (such as an increased amount of natural cancer killing cells in human bodies) and/or cause changes in physiological functions in humans such as stress and/or the feeling of well-being (Miyazaki and Moto Hashi, 1996 see Ohtsuka, Yabunaka, & Takayama, 1998) This should actively demonstrate that by walking in a forest that the facts stated above will improve inhabitant health and well-being. An interesting thing would be to look at if regular access to forests would result in fewer cancer cases.

The other forms of recreation (biking forest “F”:11%, lawn “L”:5%; playing, F:6%, L:2%; training F:3%, L:1%; and sitting F:2%, L:1%) were much lower than walking but they were all higher in the forest. What is interesting is the difference in preference between the forest and lawn results as the forest results show to be 68-75% higher than the lawn. As this observational study was only conducted over two days it would be interesting to see it be documented over a longer period and different seasons.

This survey showed that for children the forest was a more popular location for recreation, with 73% preferring the forest over the lawns. Out of the children that played in the forest 28 children (87%) played with natural material and 4 (12%) bought material. This actively demonstrates that children prefer to play in a natural environment and want to play there. The literature shows that children prefer to climb on branches and use dead material to build with (Märit Jansson, 2008). Also, the 87% children visiting the forest will have better motor systems, concentration, increased learning ability, gender equality play, less frustration and increased activity (Boverket, 2007; Dyment, 2005; Jansson, 2008; Jansson et.al., 2014; Lucas & Dyment, 2010). Shouldn't then all children have a forest to play in close to home?

Period of day
In general, inhabitants were more likely to visit the forest 184 (36%) and lawn 140 (27%) in the afternoon. Whereas in the morning 104 inhabitants (20%) in the forest and 90 (17%) on the lawn were lower. The results are not necessarily needed for the purpose of this study, but it came with the table model that Veitch, et al (2015) had based on the SOPARC.

The sound recording from the forest had four more birds singing than the recording from the lawn (F - 6 and L - 2). The sounds from the forest had more variety in bird songs and sang constantly throughout the recording compared to the static but also quiet pauses of sound coming from the two birds in the lawn area. This then supports that hearing birds in a forest help reduce stress for the inhabitants (Alvarsson, Wiens, & Nilsson, 2010; Annerstedt, et al; 2013).

Lawns to forests?

The discussion about whether there is a need to change the dominating public lawns is a large discussion but an interesting one. In general, human health and well-being does increase when inhabitants visit green areas with natural/forest-like vegetation. The observation study shows that there is a higher preference to visit the forest and according to Grahn & Stigsdotter (2003), inhabitants recommend others to visit a forest when feeling stressed. Also, monoculture lawns give little variation of functional use to inhabitants (Hartig, Evans, Jamner, Davis, & Gärling, 2003; Lucas & Dyment, 2010) as proven by the literature and observational study conducted in the study. The literature study shows that natural/forest-like vegetation increases well-being and that people feel mentally healthier when spending time outside in green spaces with natural settings (Boverket, 2007; Höganäs Kommun, 2019; Höganäs Kommun, 2020; Folkhälsomyndigheten, 2021; Folkhälsomyndigheten, 2020; Johansson, Kollberg, & Bergström, 2009). So if stress decreases when being in a forest, and stress is linked to causes of death (WHO, 2009) then why are not more forests included in urban designs? But just walking into a forest is not enough nor is the size so what should municipalities reflect upon when knowing a forest gives the health benefits presented above?

Time spent in a forest has shown to be an important factor as too little time has shown to not help. It has shown that what most of these studies have in common is that time spent under a tree canopy needs to be longer than 20 minutes and needs to happen frequently on a day-to-day basis for it to achieve positive health and well-being benefits (Beil & Hanes, 2013; Hartig, et al., 2003; Li, et al., 2007, 2008a, b). So, whether it is a corridor or hard area of tree coverage canopy it does not matter as long as the inhabitants spend more than 20 minutes there. But how often does an inhabitant have to be in the forest?

If people spend more time visiting natural green spaces regularly the greater the benefit they will have (Dyment, 2005; Jansson M., 2008; Jansson, Gunnarsson, Mårtensson, & Andersson, 2014; Li, et al, 2008a, b; Lucas & Dyment, 2010; Stigsdotter et al., 2010) and this is connected to Boverket (2007) who say that access is important for inhabitants in urban areas. Also, looking at the results from the observational study (see table 2) that showed that more children played in the forest compared to the lawn. That in turn means that a green space that should be visited often needs to be accessible. Boverkets (2007) guideline writes that an inhabitant should have a natural green space within 300 meters of their resident. If the inhabitants in this study showed more interest in the forest, then how come we do not see more natural/forest-like vegetation in urban areas?

A 53% increase to accessible natural/forest-like vegetation

The Service area analysis shows today that 23% (321 out of 1396) of the inhabitants in Svanebäck have access to a forest, and 76% (1075 out of 1396) of inhabitants would have access if the lawns were to change to a natural/forest-like vegetation. This would further lead to improved health and well-being of 53% of the inhabitants as well as offering other positive benefits. The problem is when they walk in an area that only contains a lawn the inhabitants can only look at either the lawn or hedges/houses/buildings surrounding the lawns that create a static green area. (Beil & Hanes, 2013; Hartig et al., 2003; Jiang, Chang, & Sullivan, 2014; Lee et.al., 2009; Miyazaki and Moto Hashi, 1996 see Ohtsuka, Yabunaka, & Takayama, 1998; Kaplan & Kaplan, 1989; Li, et al, 2007 & 2008a, b; Stigsdotter et al, 2010)

A solution?

A possible solution would be to plant a natural/forest-like vegetation on the grass fields in order to make a continuous tree cover canopy. It takes approximately 20 minutes to walk from the north forest to south forest meaning 40 minutes there and back would give inhabitants a good chance to increase their health and well-being and more will have accessibility to forest areas. (see Figure10)

The benefits of changing the lawns to a natural forest corridor would be the following;
Boverkets (2007) recommendations on how green space should be formed will be met. The forest as an asset will lead to more people having access to a good quality green spaces within 300m of their residences. Improved accessibility will help people who normally have a hard time moving on unstable grounds will than have a chance to more in a forest. This in turn will increase the value of houses in the area and will improve the inhabitant's economy, additionally the municipality will become a more attractive place to live, and finally biological values will increase.

Such a solution would lead to many benefits as pointed out in the literature studies. People's health and well-being will improve (Kaplan & Kaplan, 1989; Maas et al., 2006), they will experience less mental fatigue (Ulrich, 1984), natural cancer killing cells in visitors will increase (Li et al, 2007 & 2008a&b), and in turn people will use less medication (Frumkin, 2001) and death rates will go down (WHO, 2009). Even the children will have their voices heard (Jansson, 2008; Jansson et al., 2014; Lucas & Dyment, 2010; UNICEF, u.d.) as they prefer to play in vegetation.

Figure 10. Suggestion over new forest corridor. (Fänge 2021)

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How could this be done?

Why do municipalities and/or politics not design for human health and well-being today? They have access to the same knowledge that was used to conduct this paper. Could answering this question help us figure out why static green spaces are still constructed today? Could this be due to a lack of knowledge from the side of the municipalities and politicians?

If municipalities and politicians were to change their lawn areas to more natural/forest-like vegetation it would be in agreement with what the publication "Residential Nature" (Bostadsnära natur) (Boverket, 2007) has to say about green areas. By looking at the pictures on figure 2 it shows that the lawns are static, whereas the forest

offers a nature-like free growing vegetation. Then why are green space still primarily open green lawns? Could the lack of change be because Boverket (2007) recommends that they should ask their inhabitants what they want? The problem with this is that when the choice is left to people who do not have the knowledge or expertise within the relevant field, decisions often fall to personal preference which can vary depending on the persons background (Hofmann et al., 2012). One can even take this discussion one step further and ask if politicians should decide how our green spaces should look like. Should politicians have the right to shape people's health and well-being in outdoor environments since they do not all have the relevant expertise?

Conclusion

Looking at the results presented there seems to be a need to change static lawn areas to more natural/forest-like vegetation in urban areas today as they do not contribute much to human health, well-being or biodiversity.

It has shown that human health and well-being increase in inhabitants when they walk in a forest and this study supports that people prefer to walk in the forest. The size of the natural/forest-like vegetation, as well as the distance to it have also been shown to be important. Furthermore, time spent (more than 20 minutes) and the frequency (close to home) of which an inhabitant spends in the forest gives higher benefits compared to if they were to visit it once a week. Access to natural environments is good for inhabitants and reduces stress, which in turn will lead to fewer deaths linked to stress. Even natural environments close to home have been shown to have a positive effect on children and lead to such improvements as increased concentration, increased learning ability, gender equality play, less frustration and increased activity. Children in this study preferred to play in the forest and use natural material. As natural material is free compared to, for example, a football that is bought then this directly implies that equality of play comes in as all children no matter economic background can play with natural material.

If the lawns were to change to a more natural/forest-like vegetation 76% (1075 out of 1396) of Svanebäcks inhabitants would have access to forest-like areas within 300m of their houses, an increase of 53%. If the municipality would change their lawns, it would improve people's health and well-being, improve the immune system, stress recovery, increase natural cancer killing cells in visitors, and in turn help people use less medication, as well as have a positive effect on species richness. It is difficult to draw any broader conclusion from this, but this could further lead to improved health and well-being of 53% of the inhabitants as well as offering other positive effects.

To sum up everything that has been stated there is a strong case for the development of the dominating public lawns into continuous areas of tree canopy coverage with natural/forest-like vegetation. The green corridor will offer a place for inhabitants to walk under a tree canopy for up to 20 minutes or more. The improved variety of vegetation will also in turn help biodiversity in species numbers increase.

However, a difficulty in developing areas into natural/forest-like vegetation is the power people without relevant expertise have in the decision-making process. Perhaps leaving these decisions to experts would lead to a better outcome, in this case, all the benefits previously mentioned.

Flaws

As this subject is very large it has led to this paper becoming very limited in what other aspects have effect on this subject. The boundaries that were set at the beginning of this paper would have been relevant to discuss but as the time left to write this paper was limited it was felt out.

Flaws in observational study

As the time was limited it also affected the observational study and recording, as more time in both would have left better results. The observational study was only conducted over two days in the month of March 2021. Sweden at this time is cold but it would have been better to have the observational study take place throughout a whole year to see if the preferences in the forest or lawn area would change. The study was conducted during the time of the Covid19 outbreak and that in turn could affect the results of the observational study

Another thing that would have been interesting to note was how the people moved in the areas. When conducting the observational study, I noticed that people in the forest had more of a tendency to stop and look at things when walking through. Some even took a smaller pathway that was longer than the fastest path through the area. In contrast, the inhabitants who walked on the lawn chose not to stop but instead took the shortest route through the area. That brings me to the thought that the people passing by the lawn areas had to pass through as it was the quickest route to their destination. A questionnaire would have been interesting to conduct to see what people were thinking when visiting the forest or lawn areas.

Flaws in recording

The recording was only taken under one minute and that is a weak result in general but as time was limited it was hard to. Also, the analysis of determining the bird songs was done by me (Elin Fänge) but would have been better if a bird professional had done it.

Flaws in calculations of green spaces

Some addresses of inhabitants in the data collected from the SCB (Statistics Sweden) database had to be manually rewritten to fit the ArcGIS systems in order to place the point data. Due to time shortage 0.03% out of 1396 inhabitants meaning that 41 inhabitants were not counted for.
Not all urban areas are formed as Svanebäck, Viken and that in turn can make it hard to apply this method to all urban areas but this should still be seen as a strong case to overlook areas with static lawns.

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