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Detecting user patterns in public green space
A GPS based survey of visitor behavior and movement patterns in a
park in Denmark

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Extended abstract

INTRODUCTION

Since park and recreational planning first developed as a part of town planning tradition, issues about people's needs, commodities and preferences for the role of the green and recreational spaces, has been a major contributor to the development of social, collective and established institutions in society, as well as democratic values.

Take these fine values from the established park tradition in to consideration and addressing new questions about what kind of user needs, design and planning tasks, the next generation of park design have to for fill, other oppressing needs for further documentation for spending budget and economy, health issues and specific and individual user needs, the overall task that occurs

and that are already on the agenda, forms altogether the main driving force for the further development of new and further methods, addresses specific tasks and issues that could gain and required knowledge about the areas, the design and there by addressing the right solutions of how to elaborate with these new demands.

Detecting user pattern in urban green spaces, takes this task to a new level and generation of possible questions asked and answered concerning park demand and supply: By detecting and visualizing the different patterns and making the unknown or "thought" user patterns concrete, the new knowledge makes new elaborations occur and opens up for deeper insight within the context, so that the revealed pattern together with the practical knowledge, facilitates the planners to direct the right questions and possible task of demand.

The quantification of the user pattern and spatial movements, sets out a new research agenda about concerns for the used green space and the connected elaboration of the spatial patterns in green spaces to for fill design criteria, connecting neighborhoods with everyday recreational needs and addressing functional solutions to the health issues and problems that are existing and that green spaces and areas can help answer: All together establish the new agenda of how to use this knowledge in the design process of existing, new and intentional spaces and values of green spaces.

History

GPS tracking and spatial analysis of people's behaviour in parks is relative new but extremely promising research field. Due to the rapid developed of the GPS technology and falling price on the GPS units it is now possible, easy, and with low costs to track the location of people's behaviour and movement patterns with great accuracy when they are using parks and other types of urban environments. The geographical precision of the data and the combination of spatial relations and time use allows new types of analysis and inference for the improvement of site surveys and planning.

Very few GPS based dataset have been collected in parks worldwide, and maybe the first in Japan as late as 2005 (Yamamoto, Y et. al., 2005) and the paper therefore briefly gives a short historical overview covering other earlier survey methods developed and used to document people's behaviour and movement patterns in parks (Goličnika, B et. al, 2010).

Taking a point of departure in a brief overview over selected references and in a unique dataset based on GPS registration and questionnaires from the Skanseparken survey in Aalborg, Denmark, autumn 2007 the paper present different types of GIS based analyses of the GPS data and discusses their application Rendtlew et. al. (2007), The Skanseparken survey included all 298 people visiting the Skanseparken over two days in 2007. 156 respondents answered the questionnaire based survey while 132 respondents carried a GPS device for registration of their itinerary and time spent during their visit to the park.

The survey and its analysis allows the researchers and the city of Aalborg to answer questions such as - What are people doing in a public park like Skanseparken? Where are the people in the park? How long time do people use in the different areas of the park? - Thus giving comprehensive geographically detailed evidence on park use for the average user as well as for subgroups – and allowing that a geographical component be included in the analysis of what makes a park attractive? And what makes people use the park the way they do? (Harder, et al. 2008)

Introduction

Detecting user patterns in urban green space are closely related to the behaviour of the users of the urban green area. The behaviour of users using the parks, are often divided between physical activity and the use of the green space. The use of Green space together with the physical green area are often closely connected to provide outcomes such as physical health benefits, psychological health benefits, social benefits, economic benefits and environmental benefits (Bendino-Rung et. al. 2005). The behaviour of the users in the green area, are then again often related and interrelated with and defined by the I. user characteristics and II. The characteristic of the urban green space (Bendino-Rung et. al.).

The overall use of a Urban green space could be determined by its attractiveness, location and as well as distance to and the nearby neighbourhoods; divided in to two categories of user patterns: the patterns defined by use of the green space related to external factors (outside the park), and patterns related to internal factors (inside the park). The two different user patterns are then directly interconnected with the context the green urban area are located in, as well as the social demographic the single user or user groups and the parks characteristics.

This paper focuses on the tradition to detect the internal factors of the connected patterns. J. Shipperin (Shipperin 2010) makes an overview of the research tradition the last 10 years in Denmark to consist of the methodology that are only looking at the interior factor in the park and therefore are not confronting the question of why or the essential question of how to connect the park to its surroundings, connecting the park with new potential users groups that are not coming in the park today, but also to understand that the internal user pattern are and should be understood by the context from its surroundings and as well as to relate the specific approach to park design and planning, how to interconnect an existing park or potential new park with new user groups through new planning traditions and methods (Ministry of Social Affairs).

THE PAPER ADRESS THE FOLLOWING QUESTIONS:

How do we assign meaning to the revealed pattern between interior and external factors?

Can we make environmental assessment on parks so that they have to for fill a Health standard and recreational perspectives (as well as aesthetic)?

How can we set the internal factors forward together with a design tradition with human need, health and democratic values once again, reinventing the “playground”?

How do we relate maintenance questions to the detected user pattern?

What role does the user pattern and attractiveness of parks play in a increasing awareness of better health effects?

Can we relate questions from the overall benefits of urban green space by the technological step?

In this paper data based on a case methodology developed through empirical research in 4 parks in Aalborg, concerns and questions about maintenance, management and political interest at the satisfactory level and gaining knowledge about the actually use of parks was a major driver to the Municipality of Aalborg to conduct the surveys.

Background

The design tradition in a Danish historical context has used at least two different methodological approaches to gain knowledge about user groups and the outcome of the overall benefits during time. Taking its starting point from the need for knowing the spatial behaviour of user groups from the garden design and planning tradition, C. Th. Sørensen knew to provide the need of the users (A. W. Spirn in Andersson et. al.):

“Sørensen’s work is profoundly humane. They are comfortable. The needs of people are not neglected for the ends of art. Often what first appears as a rigid geometric structure is actually quite flexible in use (Kampmann, Kalundborg and Nærum). Even his most monumental projects, such as Kongens hus Mindepark, do not dwarf the human, but keep the human at the center”.

Sørensens intentions in these cases where for the people to enlivened and transform the places and the concern for people and larger social issues. His intentions only to create a framework for people to fill out for themselves, was taken to its most with an area, the Playground at Emdrup, Skrammellegepladsen. The intentions where to give the children a place of their own and space where they could feel the sun and move them out of the dark shaded backyard and environment to open and free sunny surroundings. The area should only be in-placed in a short distance from the living quarters as for a playground and its functions. But the idea where to create the free space for a pedagogical development and to stimulate fantasy, freedom and to shape an ideal for adulthood (Andersson et. al.).

Seen in Danish traditions Sørensen way of designing was not unique. He and others worked the same way: Intentions in the design of a green area where detected in the design and design tradition, where the landscape architects created the scheme for an area by the choice of plant materials, functions and

outline by the landscape plan and possibilities that each area was designed for in size and functionality. The users intentions (or a program describing the intentions) were then embedded in the design to create and fulfil the needs for the users, values of society and transformation of society through the plant material and aesthetics by the tradition and values of landscape art and culture.

Hauxner (Hauxner, 2002) outlines the Danish landscape and garden design tradition and the different values and aspects and indicate that different themes have transformed green spaces in the Danish tradition based on different norms and values of society during time. The resistance of the *“outlaid design”* and values in the design tradition came to a confrontation in the society after the Second World War. Norms of behaviour changed, grass where to be laid on and spaces for people to fill out for themselves, breaking old norms by changing behaviour in society and definitions of needs was defined and taken into action by the users themselves. Hauxner puts it this way:

“By the end of the student and youth resistance in the 70'ties and the next decade, gardens and parks where disappeared from reality and language, and the quality of the “open space” (friarealer), as the prompt was now changed to, was directly proportional with the absence of human efforts” (Hauxner, 2002).

A way to perspective the development where, that there were other aspects of the Danish society that needed the attention from the landscape architects and planners than the traditional garden and park design and planning and old values was set aside. The design tradition has since then undergone a methodological lift followed the footsteps by its earlier traditions in the developed method by Hauxner(Hauxner, 2007).

Not many new parks are designed or planed in a Danish context today anno 2010. Focus is today on operating or running existing parks and this creates a new rising interest for understanding the need for and use of urban green space such as parks in municipalities again initiated by the increased focus on health issues nationwide and rising issues due to limitation of economy in maintenance in the municipality responsible for the operation of the parks.

Especially the development at the management and planning level in the municipality has been focusing on building an organisation structures, as well as technical aspects, in servicing the different user groups and citizen's satisfaction levels and needs in park supply and demand. The needs are met by concrete design, planning and maintenance actions often based on an evaluation among different user groups in prioritising of means and economy.

Incorporating user needs are also developed in urban planning tradition by user involvement in the planning processes. Another approach has been to detect the use of urban green space, as a part of outlining the service level in the concrete park to detect the supply and demand of benched, dustbins, walking patterns on grass and paving, as well as frequency of servicing the needs of sanity and clean surrounding.

The health issues relates questions of the numbers of users, user frequency, and time spent in urban green space to detect the role of the urban spaces

recreational values and how to facilitated a better product in the more varied terms of diverse users and user needs understood by individual, physical activities and cultural aspects.

The developing research area of user needs and use of green open spaces for the last 10 years are divided in to 3 categories by Shippering (2010):

I. Research that is carried out on site by surveys or observation using selected urban green spaces as case studies.

II. A group of research studies has the current users and potential users targeting by randomly selecting residents that live in the vicinity of a selected green space and including them in a postal or telephone survey.

III. Studies that look at the use of all green spaces close to a respondents home in one or more cities or neighbourhoods by conducting a telephone survey targeting randomly selected citizens.

And adding an IV. category detecting user pattern by positioning technology and therefore relating new types of questions to be revealed from the positivistic detection of movements:

Very few GPS based dataset have been collected in parks worldwide, and maybe the first in Japan as late as 2005 (Yamamoto et. al., 2005) and the paper therefore only a pinpoints few earlier similar survey methods developed and used to document people's behaviour and movement patterns in parks etc. see Goličnika (Goličnika, B et. al, 2010) and (Ostermann, F. (2009)) but there are others in the GPS tracking field (Shoval, N. et. al. 2007) (Nielsen, TAS et. al. 2004).

The case and survey setup used in Skanseparken in Aalborg

The Aalborg GPS-Park survey is the most recent and most comprehensive of the finished explorative Park GPS based surveys conducted by DUS Research Project from Aalborg University developed together with the Municipality of Aalborg. The Aalborg GPS-Park survey was conducted in Aalborg (Denmark) in august 2007 and consisted of surveys in four public parks (N = 4.462). This paper discusses the results from one of the four park surveys: Mølleparken, Søheltens Have, Kildeparken and Skanseparken. The data from these four parks were collected using an identical survey setup. In this paper data from Skanseparken, 67.000 m² is presented. A map showing Skanseparken and surroundings can be seen on Figure 1.

Skanseparken is placed in the Danish city Aalborg, in the northern part of the Aalborg urban area called "Nørresundby" and consist of several smaller areas design for use with different purposes e.g. gardens, tennis court and small woodland. From parts of the park it is possible to enjoy the view of the most of the southern part of Aalborg. The park is located in an older detached house area and is used as a place to stay or as a supplementary garden. The average income of the area is about the level of the average income in the municipality of Aalborg.



Figure 1 Map showing Skanseparken and parts of Aalborg and Nørresundby

In the following the results will be further described and elaborated. It should be noted that the conducted surveys and the gathered data are not statistically representative for the life in the park over a 12 month period but can be characterize as an empirical case (Yin 2003). The survey and the gathered data however gives a good and adequate overview of what takes place in Skanseparken on a day in a typical month of august.

The practical setup:

According to prearrangements with the municipality of Aalborg a number of survey representatives were placed at the park entrances in Skanseparken on every survey day. According to the agreed survey set-up the survey representatives at the chosen entrances contacted all visitors entering the park. They invited the visitors to participate in a survey carried out by Aalborg University in co-operation with the municipality of Aalborg. In case the visitor agreed to participate a questionnaire was done, and at the end it was asked if the visitor (now a respondent) would like to carry a GPS during his or her stay in the Skansepark. If the visitor did not want to take part in the survey at all, the survey representative tried to carry out a refusal survey consisting of very few questions. The questionnaire part of the survey was based on a total of 156 respondents, while the GPS-tracking conducted was based on 132 respondents. A total of 41 visitors answered the refusal-questionnaires and 101 visitors did not wish to participate in the refusal-survey. None of the people in the two last-mentioned groups are part of the further analysis. A total of 301 visitors were registered on the two survey days. Wednesday august 22nd 68 respondents answered the questionnaires that were handed out and GPS-tracking of 58 respondents was conducted. Saturday august 25th 88 respondents answered the questionnaires that were handed out and GPS-tracking of 74 respondents was conducted. The Total number of filled out questionnaires or participated in the GPS tracking can be seen on Figure 2.

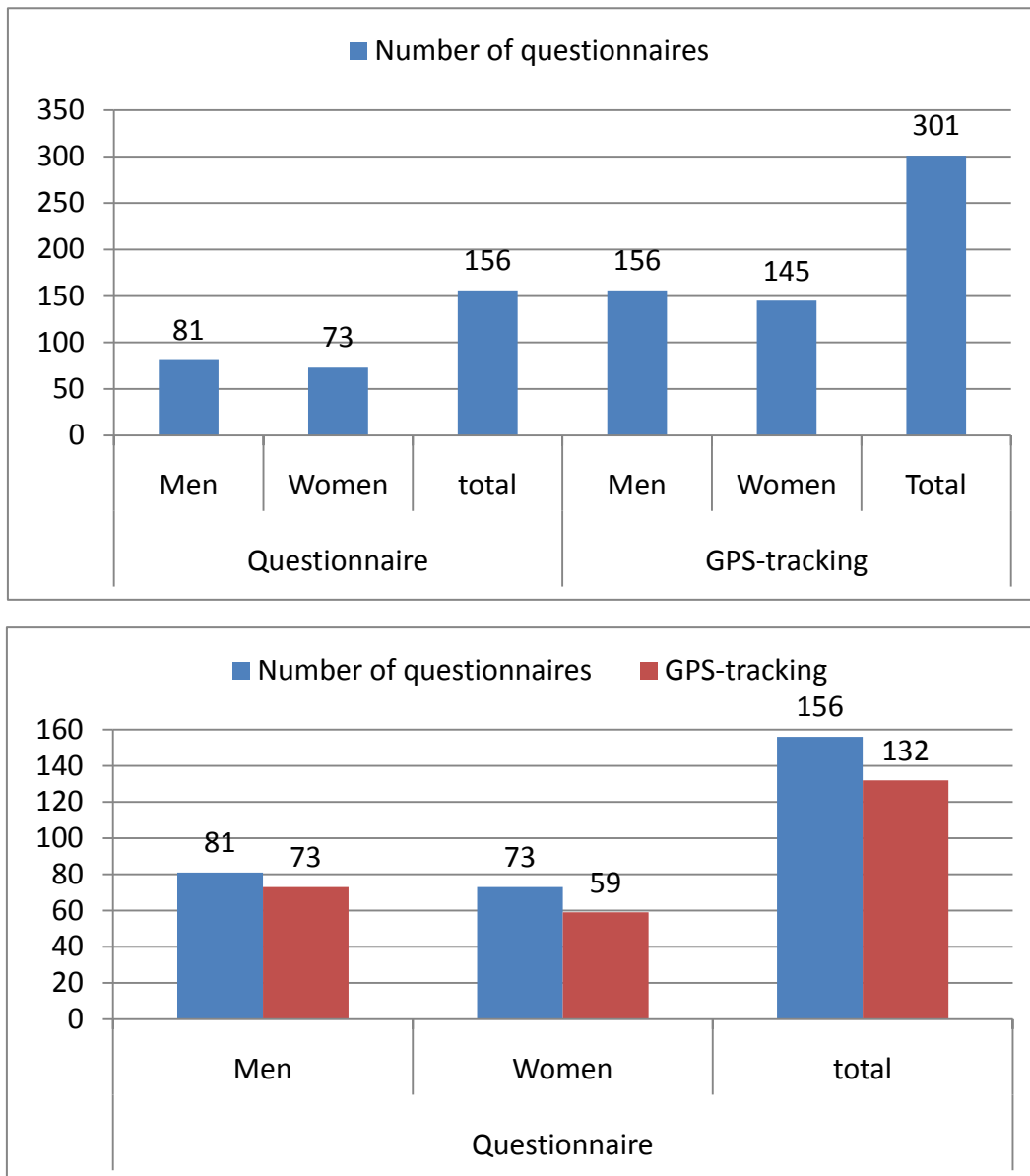


Figure 2 Total number of filled out questionnaires, as well as the number of GPS-trackings distributed on gender and total in Skanseparken (N=156).

The weather conditions:

Former practical Danish experiences Jensen, F. S., et. al. (2004) and Jensen, F. S (2003) / with park surveys shows that the weather conditions play an important role in connection with the use of parks in Denmark. If there is sunshine during the surveys day, more people will be outside and especially recreational activities are transferred to the parks. Whereas very good weather such as bright sunshine means that for example the beach or other locations further from the residence can become more attractive options than parks. In case of persistent full-day rain, wind of gale strength etc. the evident tendency is that people do not turn up in the parks. Furthermore, according to experience, the number of visitors in the individual park varies depending on if larger events or the like are taking place other places in the city. For all these circumstances however regional variations can occur.

Confer the above-mentioned the surveys were conducted on days, where there were no larger events or the like, as well as on days, where the weather conditions were not "extreme". By appointment with Aalborg municipality the survey was conducted on Wednesday August 22nd and Saturday August 25th respectively. The weather was generally good on the two days of the survey with temperatures of up to 22 degrees Celsius. There was no precipitation, but it was lightly overcast at times both on the Wednesday and on the Saturday.

Results from the questionnaire based survey

Since not all citizens, who utilized Skanseparken on the days of the survey, wanted to participate in the survey, it was tried to distinguish between the ones who were part of the survey and the ones who weren't. Using the term "visitor" is in this paper a common term for everyone in the park, both people who refused all contact and those who came in/out of the entrances, where there were no survey representatives, as well as the people who filled out the "refusal-questionnaire". The word: "respondents" is used about the people, who chose to participate in the questionnaire part of the survey.

Overall characteristics of the visitors and respondents:

In the two days, set aside for this survey, a total of 298 visitors were registered; 156 of these chose to participate in the survey and were then converted to "respondents". The average age of the respondents in the park over the two days were 39 years (156), were the women (73) age was 37.3 years and was a bit lower than the average age of the men of 40.8 years.

The respondents who used the park, were coming from up to about 2 kilometers from the park to utilize the park. 75% of the respondents however were coming from within a radius of about 350 meters distance from the park. The park was best visited in the stretch of time between 13:00 – 18:00 with a maximum number of registered respondents of 29 within an hour. The purpose for the majority of the respondents was to utilize the parks facilities to: "get fresh air". Furthermore the majority of the respondents "choice of activities" was characterized by primarily being undertaken alone. The respondents preferred activities in the park was thus: "taking a walk" and: "dog walking". The respondents were generally "very content" or "content" with the maintenance and caretaking of the park as a whole, but especially the main elements: "grass", "trees and bushes", "flowers", "pathways and squares".

To the question concerning the importance of the elements of the park the green elements such as "grass covered areas", "flowers" and "trees and bushes" were ranked high too in the survey by the respondents. So it is clear that the elements the respondents find important are attached to their use of the park in that the respondents primarily used the park for walks and getting fresh air. The facilities as for instance playgrounds were of importance to the respondents in Skanseparken too. The explanation might be found in that the age-group 1-20 year olds made up 24, 4 % and it most often being children and young people utilizing this type of facilities.

Time-span for stays in the park:

The graph (Figure 3) shows within which time-span most respondents did use the park. The park was, as the graph shows, most used in the time-span from 13:00 to 18:00 o'clock with a maximum number of respondents of 29 in the park from 17:00 to 18:00 o'clock. See appendix for map over Skanseparken with the marked entries.

The total number of recorded persons that have left the park is 154. The total number of recorded person entering the park is 152. There are several sources of error in this connection. The reason that data were missing on exits and entries can be that the respondent did not fill out this part of the questionnaire. Furthermore several of the respondents did not know exactly when they entered the park. The total number of respondents in the park in a given time-span only reflects the fully filled out questionnaires by which 2% of the 156 respondents are not shown on the graph. Furthermore there is an unknown number of visitors that entered the park at other places than through the entries which were manned with survey representatives. The respondents who did enter and exit can be seen on Figure 3.

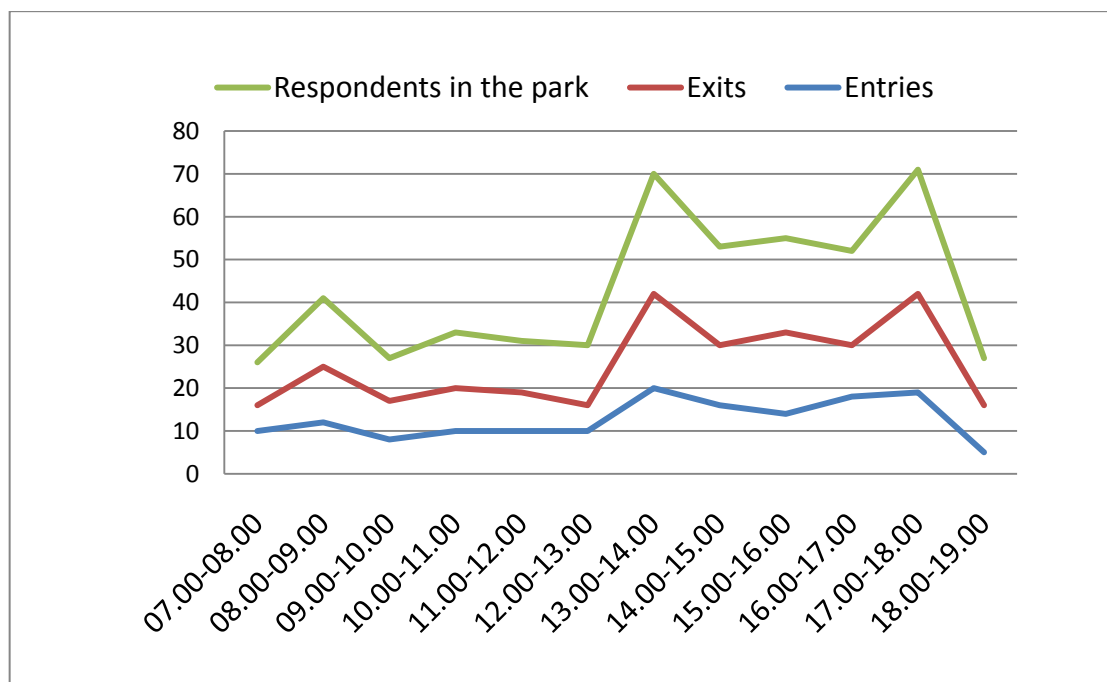


Figure 3 The number of respondents who, in the interval between 07:00-19:00, did enter and exit the park, as well as the total number of respondents in the park. (N=152 number are the number of respondents entering the park, N=154 number of respondents exiting the park from exits, N=152 number of people in the park). *This is the time that the respondents have noted as entry time and not the time when the GPS is first moved.

Purpose of stay and activities in the park:

The respondents were asked of their purpose with visiting the park. The respondents purpose with staying in the park mainly distributed among five main purposes: The five main purposes were: "getting fresh air", "experience nature", "get peace and calm", "get in a better mood" and "to improve my fitness". The five purposes with staying in the park were characterized by that the activities could be fulfilled alone, but also in smaller or larger groups. While the

purposes that was less represented were: "meeting other people", "for the family to be able to do something together" and "to be with my friends" which involves at least one other person. The respondent's purpose with staying in the park can be seen on Figure 4.

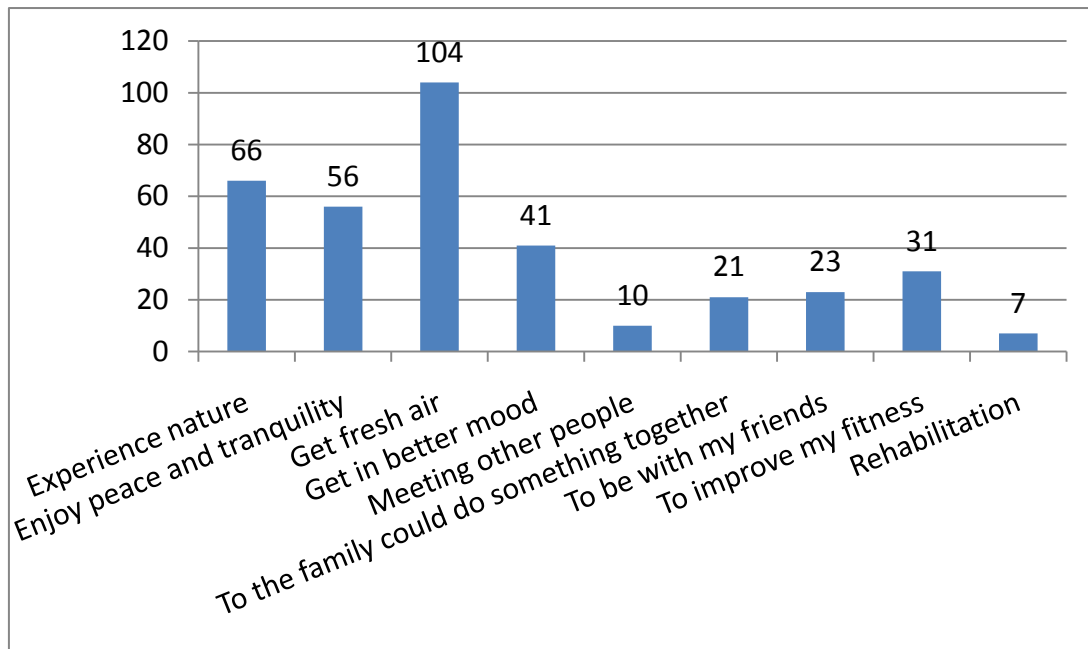


Figure 4 The respondents purpose with staying in Skanseparken (N=146). The respondents can name several purposes.

Activities in the park:

The respondents were furthermore asked about the activities they carried out in the park. Of the respondents answers it was evident that the respondents especially used the park for the activities such as: "gone for a walk" and "dog walking" and "used the park as a shortcut". The respondent's distribution of activities can be seen on Figure 5.

Other activities indicated by the respondents included "collecting chestnuts", "enjoy the view", "collecting mushrooms" and "picking grass for the rabbits". These were activities, the respondents had carried out other than the ones pre-selected and printed in the questionnaire. About 21% of the respondents "used the park as a shortcut" and thus this group stands out from the rest of the respondents by not having an actual purpose with being in the park.

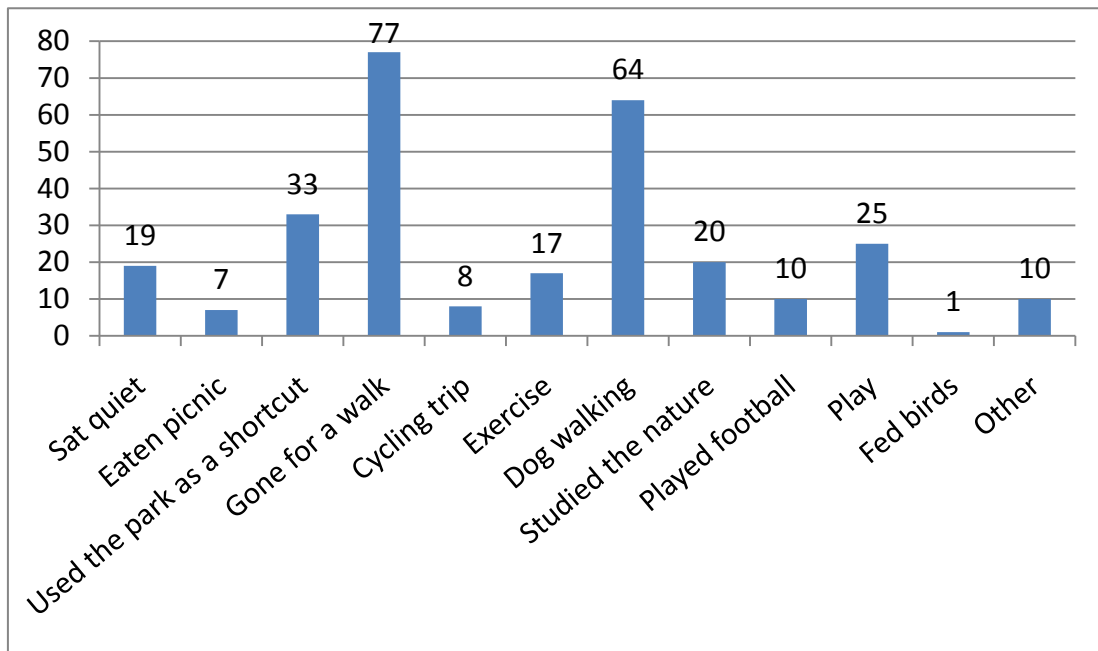


Figure 5 Distribution of respondents activities. The respondents had the possibility of naming several activities in Skanseparken (N=155)

GPS based mapping of user patterns in Skanseparken

The use of GPS tracking as survey instrument allows a range of analysis that may shed new light on visitor-environment interactions and provide inputs to user-oriented design. Additionally GIS processing and mapping of the spatially explicit user data can facilitate the communication of results to practitioners as well as to stakeholders more widely. In the following data from 121 GPS tracked respondents (N=132) is presented.

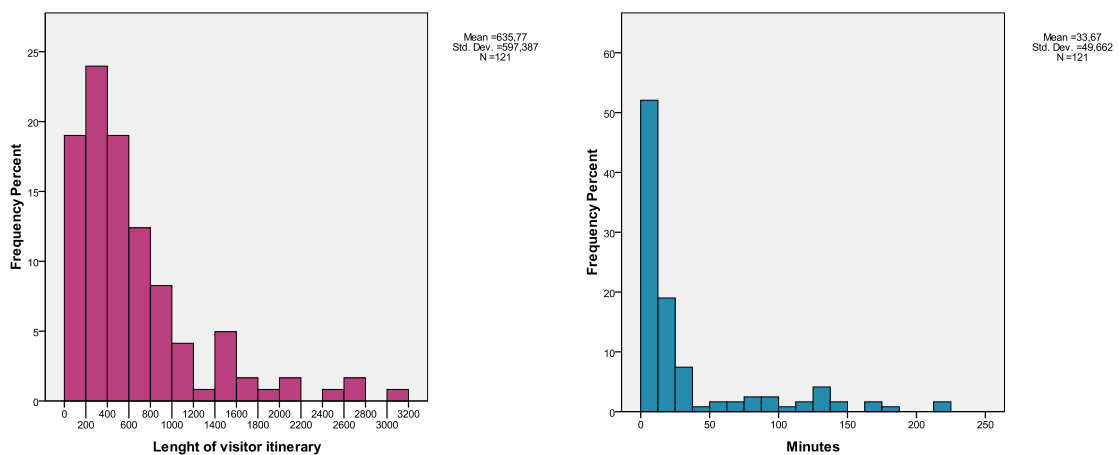


Figure 6 The respondents frequency distribution within length of visitor itinerary in the park (left) and duration of stays in the park (right). Both measures were derived from GPS trackloos (N=121).

The GPS Unit:

The GPS Unit chosen was GPRS based hardware unit (Flextrack Lommy©) with a built-in GPS was chosen to the completion of the Aalborg GPS-park survey: firstly the design of the unit was simple, the unit was light and small (it only weighs 99 gram, and the dimensions were 74x61x23 mm), and it had only one small red on/off button. Secondly the choice of this GPS unit gave the opportunity to follow the GPS unit online and in real time so that respondents leaving the park without having passed survey representatives at the chosen entrances could be tracked and caught up with.

The Precision of the GPS and GPRS units which were used in Aalborg GPS-Park survey was tested in a park environment (Skanseparken) and had a deviation of up to 6 meters. Big trees and single-storied buildings caused a minor systematic error while tall buildings caused a considerable systematic error in a narrow street with tall buildings on each side¹.

The 'backbone' in GPS logging is a continuous registration of device, coordinates and time. This provides for reconstruction of itineraries and time spent during a visit to the park. It also opens for mapping and analysis of variations in use over time, for summary and 'ranking' of places inside the park, as well as for segmentation and analysis of user patterns of subgroups. One the following pages GPS based maps of variations in time, places in the park, as well as the use pattern of two subgroups are presented.

The GPS survey part and user frequency and itineraries in the park:

Figure 7-10 display the differences in user frequency and itineraries when comparing four time intervals within the period surveyed (07:00-20:00). The itineraries of the individual users have been drawn from GPS registrations and give an indication of connections and flows as well as areas of intensified use. The park is clearly used at the highest frequency and geographically most widely in the afternoon and in the evening. The directions and paths of flows going through the park are generally the same at all times, but at different magnitudes. However, especially the afternoon and evening use pattern introduces some areas of intensified use that were previously inactive.

¹ The accuracy of the GPS part of the hardware unit is based on a 16 Channel parallel Very High Sensitivity receiver with a sensitivity tracking: -158 dBm / -188 dBW and a high efficiency Helix antenna (Simonsen, A. K. et al. (2007))



Figure 7 Itineraries of visitors between 07:00 and 09:00 drawn from GPS log points. Individual visitors are marked with individual colours.

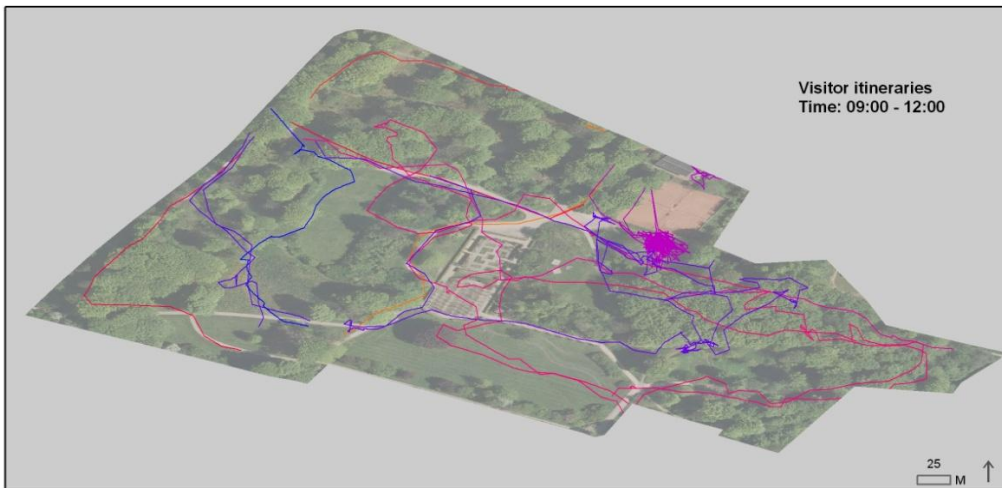


Figure 8 Itineraries of visitors between 09:00 and 12:00 drawn from GPS log points. Individual visitors are marked with individual colours.

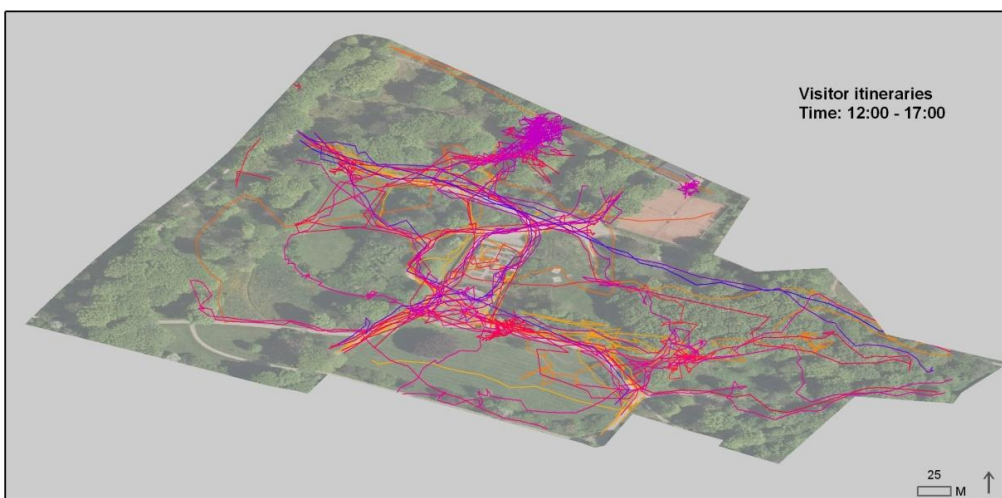


Figure 9 Itineraries of visitors between 12:00 and 17:00 drawn from GPS log points. Individual visitors are marked with individual colours.

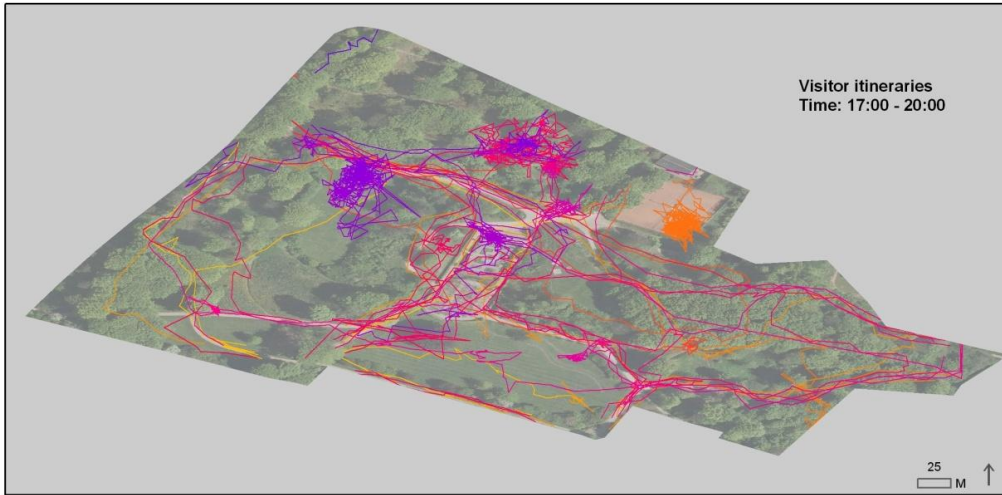


Figure 10 Itineraries of visitors between 17:00 and 20:00 drawn from GPS log points. Individual visitors are marked with individual colours.

GPS based classification of the use of the park

Figure 11-14 classifies the space of the park used based on a 5x5 meter grid. For each grid cell the GPS data has been used to calculate the number of visitors passing through the cell (Figure 11), the total time use (spent) in the cell (Figure 12), the average time spent per visitor in the cell (Figure 13), and finally the movement intensity of the cell (Figure 14).

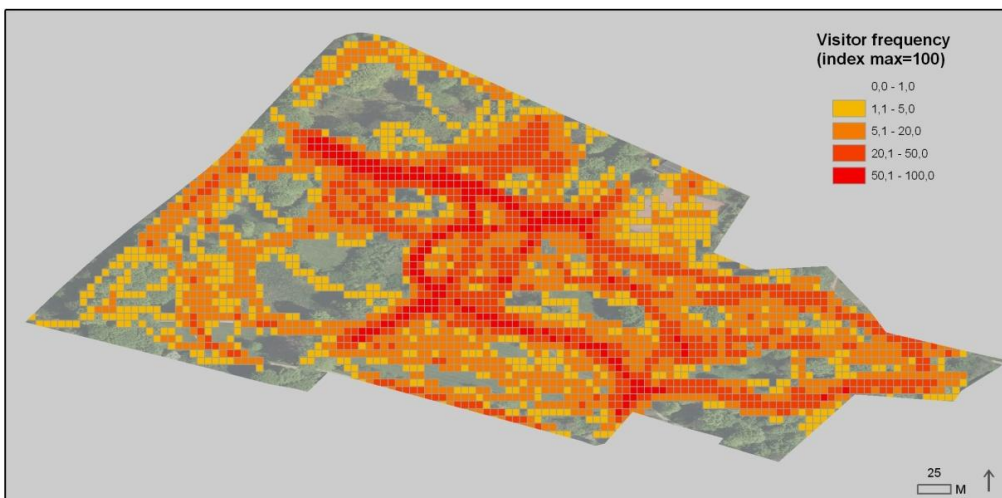


Figure 11 Visitor frequency for 5 m grid cells displayed as index where the highest frequency=100.



Figure 12 Total time use by all visitors for 5 m grid cells displayed as index where the highest time use=100.

Movement intensity is calculated as an index from the product of total movement (distance) within the cell and the number of entries to the cell as judged/calculated from the GPS data. The map of visitor frequency (Figure 11) indicates that there are a number of main paths that are used by many, but also that visitors circulate widely in the small park. The map of time spent (Figure 12) indicate that the stationary activities are much more confined and clustered around a few location connected to the most 'central' part of the path system and



Figure 13 Average time use per visitor for 5 m grid cells displayed as index where the highest average time use for a cell=100.



Figure 14 Movement intensity for 5 m grid cells displayed as index where the highest movement intensity for a cell=100.

visitor flow. High average time use per visitor (Figure 13) is connected to the same locations. Facility wise high time use is clearly linked to sports facilities, flower garden or central ‘multi purpose’ locations centrally located in the north-west end of the park.

Spatial distribution of short and long duration visitors

Figure 15 and 16 display frequency distributions of visitors by duration of stay in the park and length an itinerary ‘recorded’ during the visit to the park.

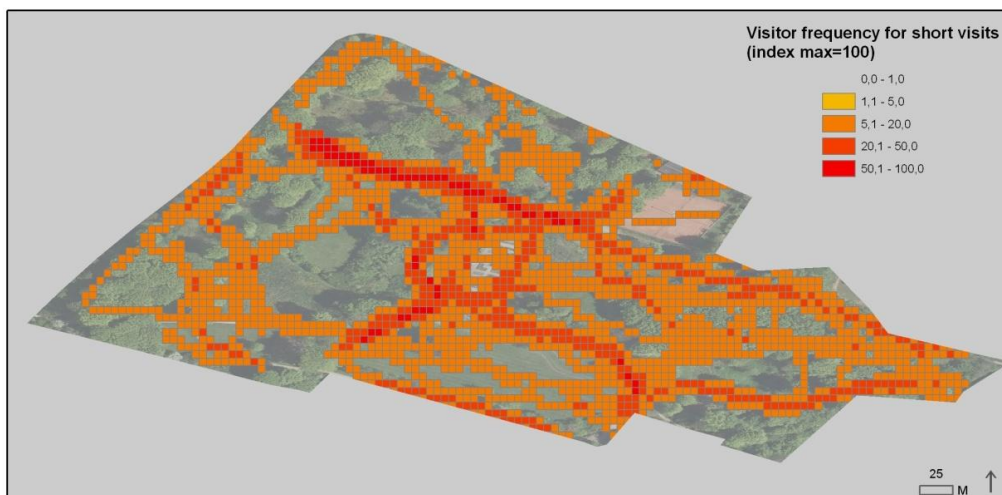


Figure 15 Visitor frequency for 5 m grid cells, for short visits <20 minutes, displayed as index where the highest frequency=100.

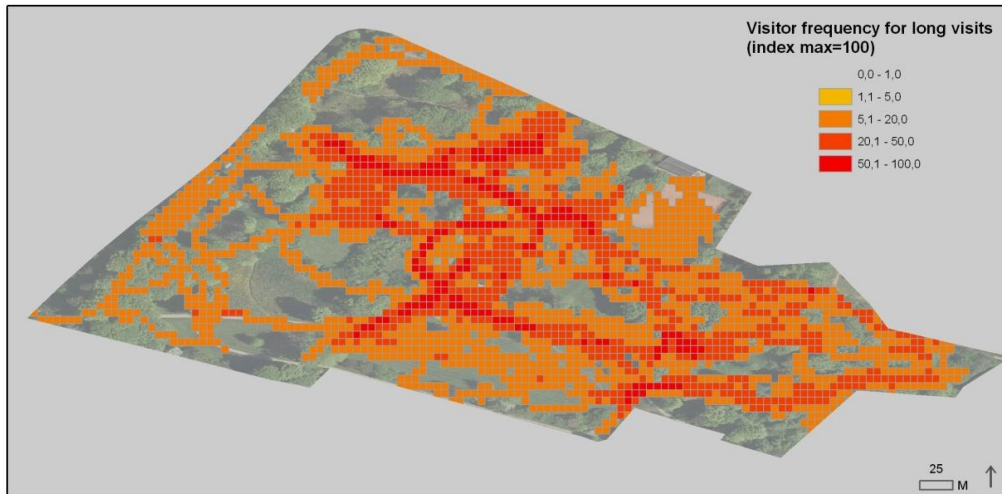


Figure 16 Visitor frequency for 5 m grid cells, for long visits > 20 minutes, displayed as index where the highest frequency=100.

Average duration is 33 minutes and average distance covered in the park is 636 meters. A very large proportion of short stays is characteristic of the time use frequency distribution. 50% of the visitors to the park did not spend more than 11 minutes in the park, while 2/3 did not spend more than 20 minutes. The figures 15 and 16 apply a 20 minutes threshold and display maps of visitor frequencies by 5 meter grid cells for short duration visitors and long duration visitors.

The short duration visitor mainly uses the path network of the park. The long duration visitor uses the path network as well as a wider field of activity spaces in the centre and North-West corner of the park. The short duration visitors tend to use the edges of the park comparatively more than long duration visitors. The use of the park among the short duration visitors seems to consist of 'walk-through' and 'walk-in-walk-out' visits; whereas the long duration visitors consist of 'walk-rounds', as well as intensive use of various facilities and activity spaces in the park (tennis court, flower garden, open grass/law etc.).

Different age groups and different time patterns and use of the park

It can GPS tracking combined with the GIS analyses also makes it possible to register different ages groups time patterns. In this case the age group 7 – 20 used 1.238 minutes (mean 38 minutes) in the park and the age group 21 - 60 uses 2.638 minutes) (mean 34 minutes) x and the age group 26 - 85 used 198 minutes (mean 20 minutes). The 121 respondents tracked in this data group in average used 4.074minutes in Skanseparken.

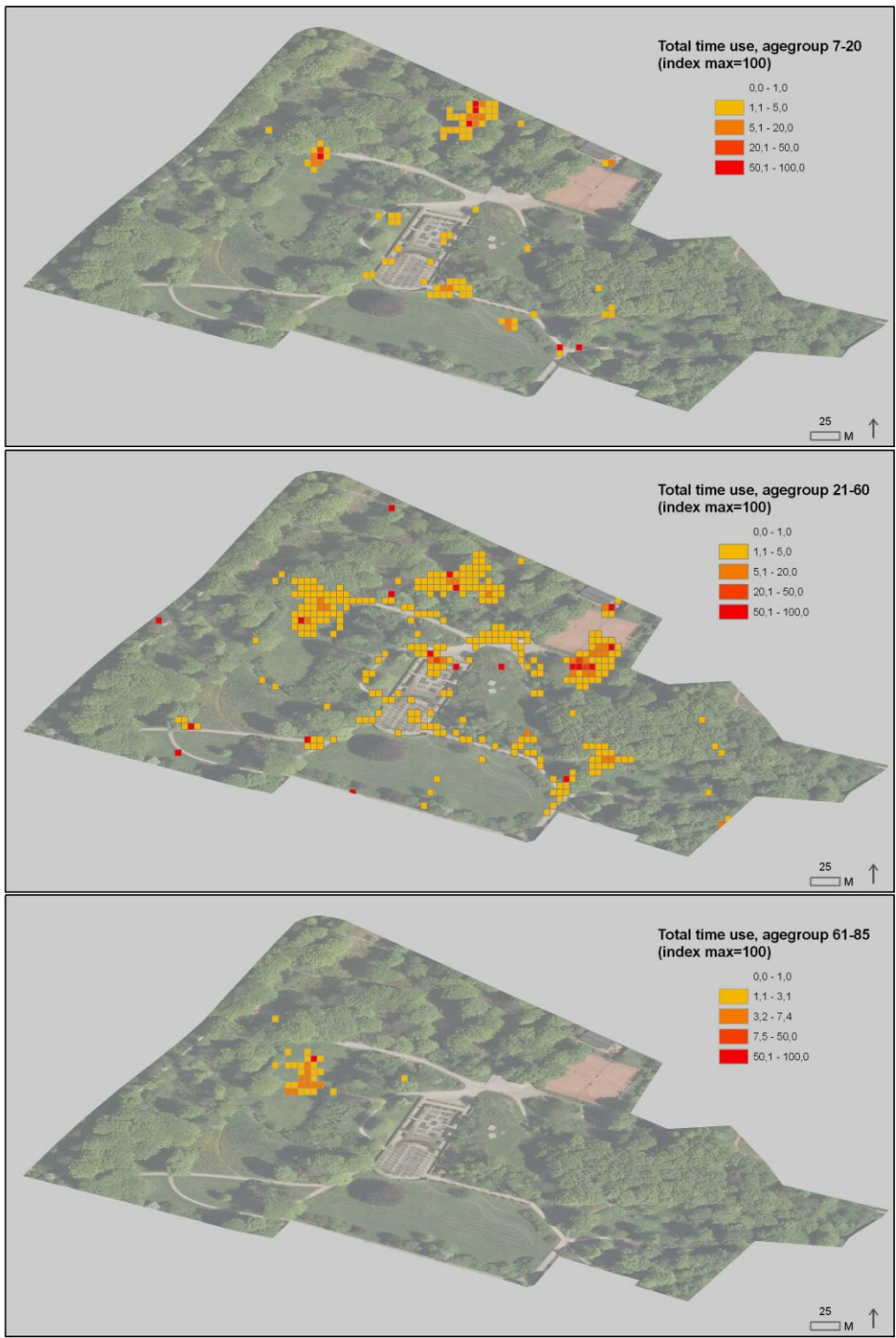


Figure 17 Age group and time used

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Appendix

