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Indicators for Socially Sustainable Park Use – Results from a Case Study

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1 INTRODUCTION

This paper presents selected elements of a recently concluded case study (Ostermann and Timpf 2007). The key aims were to develop criteria and indicators for socially sustainable park use, to improve knowledge about individual and aggregated human appropriation of public park space, and subsequently identify key factors to improve the design and management of parks. The methodology employed was based on observations and quantitative spatial analysis (Ostermann and Timpf in press).

The next section presents the indicators for sustainable park appropriation and use which were used throughout the study. The third section describes the case study that this research was embedded in, before the fourth section briefly outlines the spatio-temporal analysis methods employed. The fifth section shows exemplary results for one park and discusses them, before the final section concludes with this research's implications.

2 SOCIALLY SUSTAINABLE APPROPRIATION OF URBAN PUBLIC PARKS

Urban public parks offer a great potential to raise the quality of life for urban citizens, while at the same time their creation and maintenance requires substantial amounts of money. Surveys have shown that citizens consider parks to be an important element for their well-being, even if used only occasionally (Solecki and Welch 1995; Thompson 2002; Tinsley and Croskeys 2002; Chiesura 2004; Krenichyn 2004; GrünStadtZürich 2006; StadtZürich 2006). By offering opportunities for equal participation irrespective of gender, age, nationality or social-economic status, parks also enhance social sustainability. These two key terms (public access and social sustainability) are described in the following paragraphs.

Contrary to the other two pillars of sustainability (economical and ecological), social sustainability has evaded a concise and generally adapted definition. A general normative principle is that of social justice, expressed by chances of equal participation in public life (Mitchell 1995; Jörissen, Kopfmüller et al. 1999; Empacher and Wehling 2002; Littig and Griessler 2004), which is adopted in this research. This paper adheres to the categories from MONET (Bundesamt für Statistik, BFS et al. 2003), and interprets them such that each potential visitor should have equal chance to access and use the public resource of parks. This means that an appropriation of public parks is the more sustainable, the fewer processes of exclusion exist, and the greater the diversity of visitors and activities is.

This approach agrees with the generally accepted consensus in western society that a space is public when it is accessible to everyone, and no one is barred from its use based on some a-priori defined social or ethnic affiliation (Mitchell 1995; Paravicini 2002; Mitchell 2003). Conflicting interests of use are to be solved by consensus. However, this ideal is the exception in reality. Nevertheless, research not systematically broached the issue of social sustainability and public spaces, often limiting the scope to issues of security and order (Ruhne 2003; Sauter and Hüttenmoser 2006).

Patterns of design and management (Low, Taplin et al. 2005) and informal processes of exclusion and domination can oppose general access and equal participation in public parks (Manning and Valliere 2001; Chiesura 2004). Thereby, they reduce diversity and endanger social sustainability (Paravicini 2002; Thompson 2002; Brandenburg, Arnberger et al. 2006). In the research literature, processes of exclusion and domination are described as the results of adaptive behavior in order to cope with exceeded social carrying capacities, resulting in stimulus overload and social interference (Gramann 1982; Kuentzel and Heberlein 1992; Manning and Valliere 2001; Ostermann 2009). Exclusion and domination happen on two different scales: Exclusion is the cause of inter-site displacement, and domination the cause of intra-site discplacement.

Thus, processes of displacement can manifest themselves on two levels: The meso-scale of a neighbourhood, and on the micro-scale of single park usage. A comparison of the age and gender structure of the visitor sample with those of the neighborhood population allows detecting processes of exclusion. A statistically significant difference would be an indicator for non-sustainable appropriation of park space. Similarly, a significant clustering of visitors and activities within a park can be an indicator of domination.

On both levels, the indicators alone cannot prove any exclusion of domination. However, they give hints in which direction to pursue further research activities. At the same time, they can give leads as to which design and management strategies foster socially sustainable park use.

This research assumes that the specific behavior settings of parks (Schoggen 1989; Ostermann 2009) and management strategies (Kaplan, Kaplan et al. 1998) strongly affect visitors' behavior by affording certain activities while discouraging others. Thus, both the design and the management can contribute to minimize usage conflicts and ensure social sustainability. Consequently, the design and management of public parks and recreation areas have attracted a substantial amount of interest. Academical research ranges from technical aspects of counting visitors (Arnberger, Brandenburg et al. 2006), the usage of parks (Brandenburg, Arnberger et al. 2006), a focus on gender issues (Paravicini 2002) to more conceptual and theoretical publications on the social construction of public space and its appropriation (Löw 2001). On a more administrative level, the postulates of social sustainability and intensive usage of public parks are integrated into the agenda of the city of Zurich, for example (GrünStadtZürich 2006). In order to identify suitable strategies of design and management, one needs more knowledge about the actual usage and appropriation of parks. Relevant studies have been mostly in the form of off-site surveys, neglecting direct observations (GrünStadtZürich 2005; Fischer, Stamm et al. 2006). The spatial distribution of park usage has already been observed in Basel (Baur, Zemp et al. 2000), although the resolution is coarse. The case study presented in the next section goes into more detail.

3 SET-UP AND SCOPE OF THE ZURICH CASE STUDY

An important aspect of this work is its empirical foundation of direct observations. The case study was undertaken in close collaboration with the administrative department responsible for the design and maintenance of public parks, GrünStadtZürich. The three parks to be observed were selected on the basis of four criteria:

- Their function in the city context as neighborhood parks
- Their age (established vs. new)
- Their style of design
- Their suitability for observations (size, visibility).

The Wahlenpark in Neu-Oerlikon is an example for a relatively young park (opened 2004), with a modern, regular design. The Bäckeranlage as an example of one of the oldest parks in Zurich, located in a densely built neighborhood with a potentially precarious social constellation of low income and ethnically diverse population (Berger, Hildenbrand et al. 2002). Finally, the Savera-Areal as an example for a park close to the lakeshore in a middle-class residential neighborhood, with very limited infrastructure.

Due to the limited space available in this paper, only the last park is described in more detail. The Savera-Areal is located in a neighborhood with a comparatively high proportion of children and elderly citizens. It is located at the western lakeshore, i.e. its eastern borders are actually beaches or waterfront. The park was handed over to the public in spring 1989. The design concept aimed for a simple landscape, preserving natural morphology, using only natural materials and native vegetation, but provide possibility for a multi-functional use (Stadtkanzlei Zürich 1989). This design can be interpreted as an implementation of landscape park and natural garden style. It consists of low stone benches that descend towards the water, becoming a narrow stretch of coarse sand beach. In the southwestern corner, a public toilet is located. Directly adjacent to the park at the southern end is a community center, providing a kiosk, volleyball field, and playgrounds. At the western and northern side are a large car sales and dockyards, respectively, although hidden behind large trees. Thus, access to the Savera-Areal is limited to a walkway skirting the dockyards, a subterranean passage near the car sales property, and a narrow path along the lakeshore southwards.

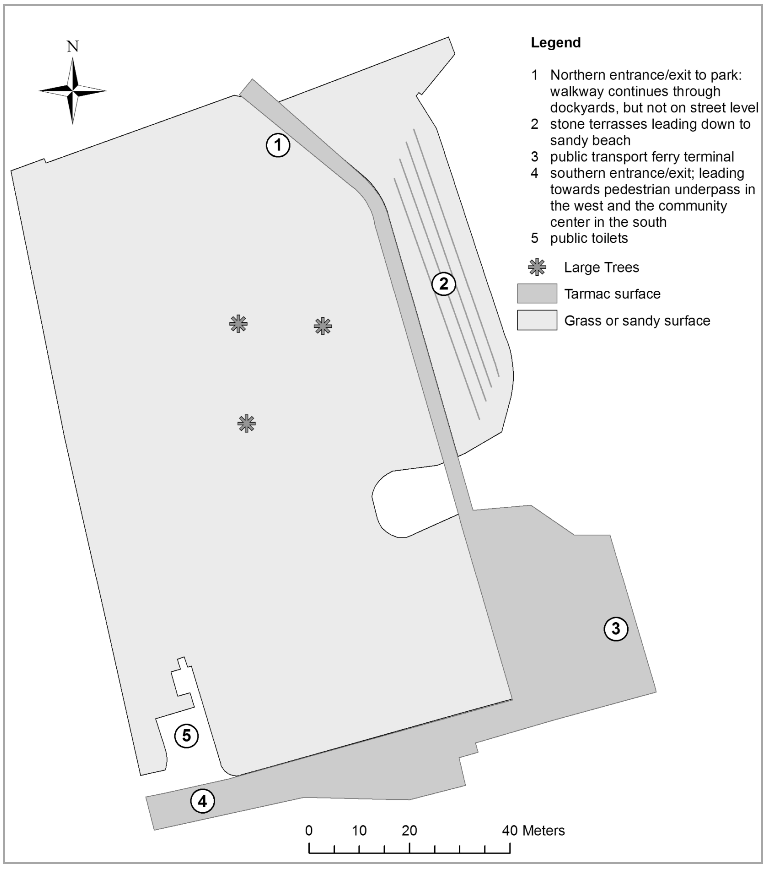

Figure 1: Map of the Savera-Areal; source GrünStadtZürich, edited by Timpf, Sabine and Ostermann, Frank

A crucial requirement of the observations as main empirical method was their ability to record detailed, individual data with a spatial and temporal component. The aim was a fully structured, non-participating, covert observation procedure, in order to record representative, consistent and un-biased data. Obviously, the observer's presence constitutes a participation to some degree. However, the general disinterest shown towards the observers, and their low numbers (maximum of 3 versus dozens of park visitors), support the assumption, that their influence on the results of the study is negligible. The observations build on principles formulated by Meier-Kruker (Meier-Kruker and Rauh 2005), i.e. clearly formulated research question, systematic planning, systematic collection of data, and repeated evaluation.

Resulting from the conceptualization of social sustainability presented in the preceding section, the observations recorded individual visitors, their age, gender, time, location and type of activities, and group affiliation (not in the sense of socio-economic or other groups, but groups of park visitors that know each other and spend their stay together). Age was classified into the broad groups of children, teenagers, adults and elderly (retired). The activities were grouped into Static Solitary (e.g. reading, sleeping), Static Interactive (communicating), Eat/Drink, Dynamic Irregular (e.g. running around), Dynamic Regular (some kind of playing field, e.g. football), Playgrounds and Water. In case of multiple or quickly alternating activities, a hierarchical approach was used, with dynamic activities recorded first, then eating or drinking, and static activities for the rest.

The observations were realized over a period of three years, including a pilot study. Each of the three parks was observed on 7-14 days for 2-4 hours. As two parks were observed on consecutive years, this amounts to almost 150 hours of observations with over 8000 park visitors recorded. The schedule for the Savera-Areal was as follows:

Date	Day	12-14	14-16	16-18	18-20
05.06.	Tuesday		x	x	
06.06.	Wednesday			x	x
14.06.	Thursday			x	x
16.06.	Saturday		x	x	

20.06.	Wednesday	x	x		
01.07.	Sunday	x	x		
03.09.	Wednesday	x			

Table 1: Observation Sessions Savera-Areal 2007; source: the author

A newly developed, digital observation method allowed the direct encoding of the observational data using TabletPCs and standard GIS software.

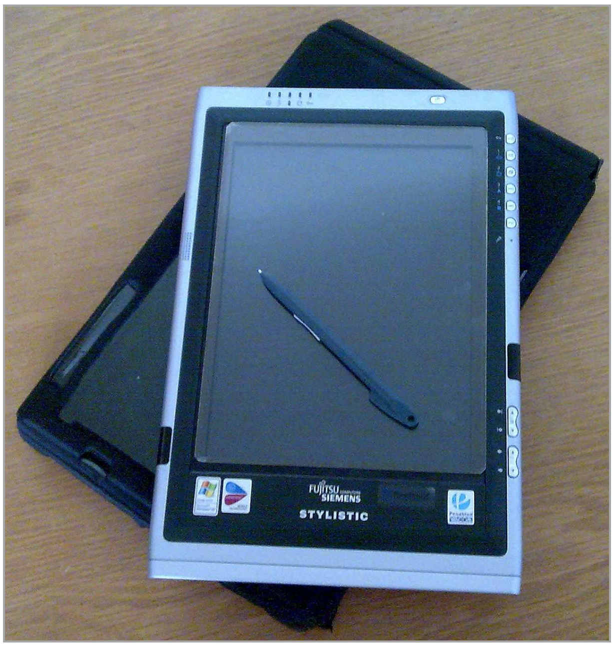

Figure 2: TabletPC used for observations; source: the author

Although the interface of the GIS software had been customized for this particular purpose, the numbers of visitors sometimes exceeded the cognitive limits of the observers. While more observers were not possible due to limited resources, their influence on the visitor behavior would have been problematic to take into account. Video recording was not possible because of privacy issues.

Therefore, the observation team developed an aggregated method, which would still allow the analysis at the meso-scale of neighborhood park usage. It only recorded three age classes and gender, and only rough spatial and temporal resolution. Nevertheless, the detailed observation method was employed when possible, with great care being taken in producing a representative sample.

4 SPATIO-TEMPORAL ANALYSIS METHODS

The observations provided a large data set and the subsequent analysis a wealth of information on park use. The analysis can be grouped into three phases: First, the preparation of the raw data. Second, the explorative visualization and analysis. Third, geostatistical quantitative analysis and visual qualitative interpretation. Concerning the preparation of the data, some obvious errors were eliminated, the datasets merged, some attributes partially reclassified, and some derived values such as duration of stay where computed. Finally, all data was available in aggregated form. The explorative analysis consisted mainly of a visual interpretation of the activity data mapped as dots and classified for age, and/or gender. A large number of spatial and temporal analysis methods were reviewed for their suitability for the third phase. Within the scope of this contribution, it is only possible to highlight some results.

4.1 Analysis at the micro-scale

On the micro-scale of parks, the analysis of the original discrete point data is possible with established spatial analysis methods: Mean centers, standard deviational ellipses, nearest neighbor index and kernel density estimates are straightforward and provided meaningful results on several scales. The temporal analysis methods consisted of statistical analysis of time series and qualitative visual examination of mapped output.

Mean Center: The mean center has as its coordinates the average of all x-coordinates and y-coordinates of all the features in the study area. If computed separately for different values of an attribute, the mean center can hint at different distributions, e.g. of male and female visitors.

Standard Deviational Ellipse: The Standard Deviational Ellipse (SDE, or Directional Distribution) measures the compactness of features and the general direction or orientation of the distribution. In order to measure the compactness, the standard distance in the x- and y-axis is calculated in a similar manner as the standard deviation for a set of data values. The standard distance is the average difference in distance between the features and the mean center of the distribution. In contrast to a standard distance circle, the x- and y-values are calculated separately. The mean x- or y-coordinate value is subtracted from the x- or y-coordinate value of each point, then each difference is squared, then summed, before finally the square root of the resulting value is taken. The ellipse is centered on the mean center and rotated until the sum of the squares of the distance between the features and the axes is minimized.

Kernel Density Estimations: KDE have been used on crime data at an aggregate meso/macro scale in the search for hot spots. The observation data is very similar to crime data, where incidents usually are recorded as points that have several attributes such as type of crime, time, and many others (Kwan and Lee 2003; Levine 2006; Brunsdon, Corcoran et al. 2007). The population parameter weighs the points (events) based on an attribute value, which was the duration of the activity at that location. In this way, all visitors are weighted according to their time spent in the park. This measure was necessary in order to minimize observer effect and bias: During the measurement (i.e. the observations), the observers placed a new dot (event) when there was a significant, permanent relocation of activities. This means that park visitors who are involved in static activities but relocate these activities several times (such as moving with the shadow of a tree, for example) are weighted more than those who stay in the same place for hours, or those who move around a lot but do not change the center of their activities. In addition, there is an observer bias introduced, because it is left to the observer’s judgment when a notable relocation has taken place. Although extensive training of the observers should have minimized this effect, its influence might still be significant. For each observation season, kernel density estimations were performed for all visitors grouped for gender and activities. A relative density of gender was calculated by subtracting the values of male density from those of female density, resulting in map showing the relative “surplus” of each gender. The activities were grouped into general static ones (Static Solitary and Interactive, Eating) and general dynamic activities (Dynamic Irregular and Regular, Playgrounds, and Water). The parameters were as follows: Cell size was one meter, output units were square meters, population was the calculated duration, and search radius 10 meters. As with the results of the field-based computation, the density results are shown in isarithmic representations. Note that the absolute values differ significantly. They are dimensionless but listed to enable comparisons.

Temporal Analysis: The Knox Index would have to be calculated for every observation session in order to check for temporal clustering/segregation of certain attributes (e.g. gender). Otherwise, the observation schedule and different park locations introduce an artificial clustering effect. The resulting large number of datasets and the manual processing (again no programming interface was available) precludes the use of the Knox index here. In theory, one could also compute the mean center and SDE for each moment of the observed time. The nature of the data precludes this, since there are periods when only a very limited number of visitors were present in the parks. It is not advisable to calculate the measures of mean center and SDE with such small samples, because outliers could distort the result severely and not be representative.

Cluster Analysis: The use of spatial clustering algorithms is also problematic for similar reasons. For example, the K-function is dependent on each singular situation observed in the parks. Therefore, it cannot be used for temporally aggregated data. On the other hand, if the K-function would be applied for each activity type for each temporal state in each park, the problem of a small sample size would arise. The Nearest Neighbor Hierarchical Clustering Index (NNHI) has the challenge of critical but user defined-parameters: Threshold distance and minimum cluster size. Levine (2006) gives impressive examples of the variance introduced through slightly different variable values. Since no rules-of-thumb or inductively gained values are yet known for the observational data, a great deal of uncertainty would be introduced with this analysis method. The results would have to be tested thoroughly for robustness.

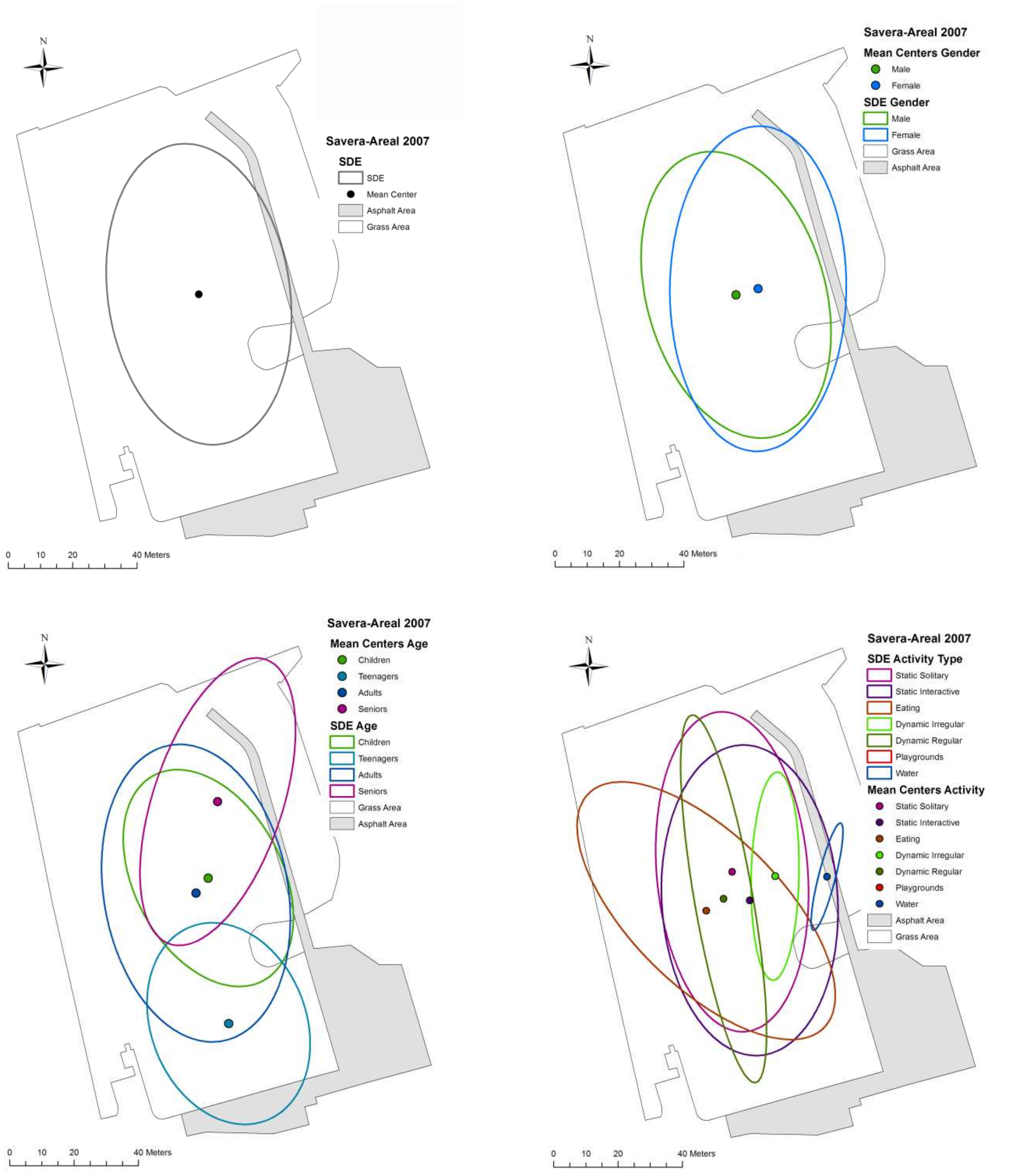

Figure 3: Mean Center and SDE Savera Areal 2007; all visitor data (top left), gender (top right), age groups (lower left), and activity types (lower right); source: own design

The senior visitors do not have many benches to sit upon, but concentrate at the quieter northern end. The teenagers clearly cluster in the southern end, while the children are again closer to the water, and adults are shifted towards open space. There seems to be a correlation between female SDEs and children's SDE (both are closer to the water than the rest). Since children do only have limited influence on the gendered SDEs (about 17% of visitors are children), this could be attributed to female visitors attending to the children. The elongated SDEs for dynamic activities hint at the fact that most took place at both ends of the park, while the other activities are more centered.

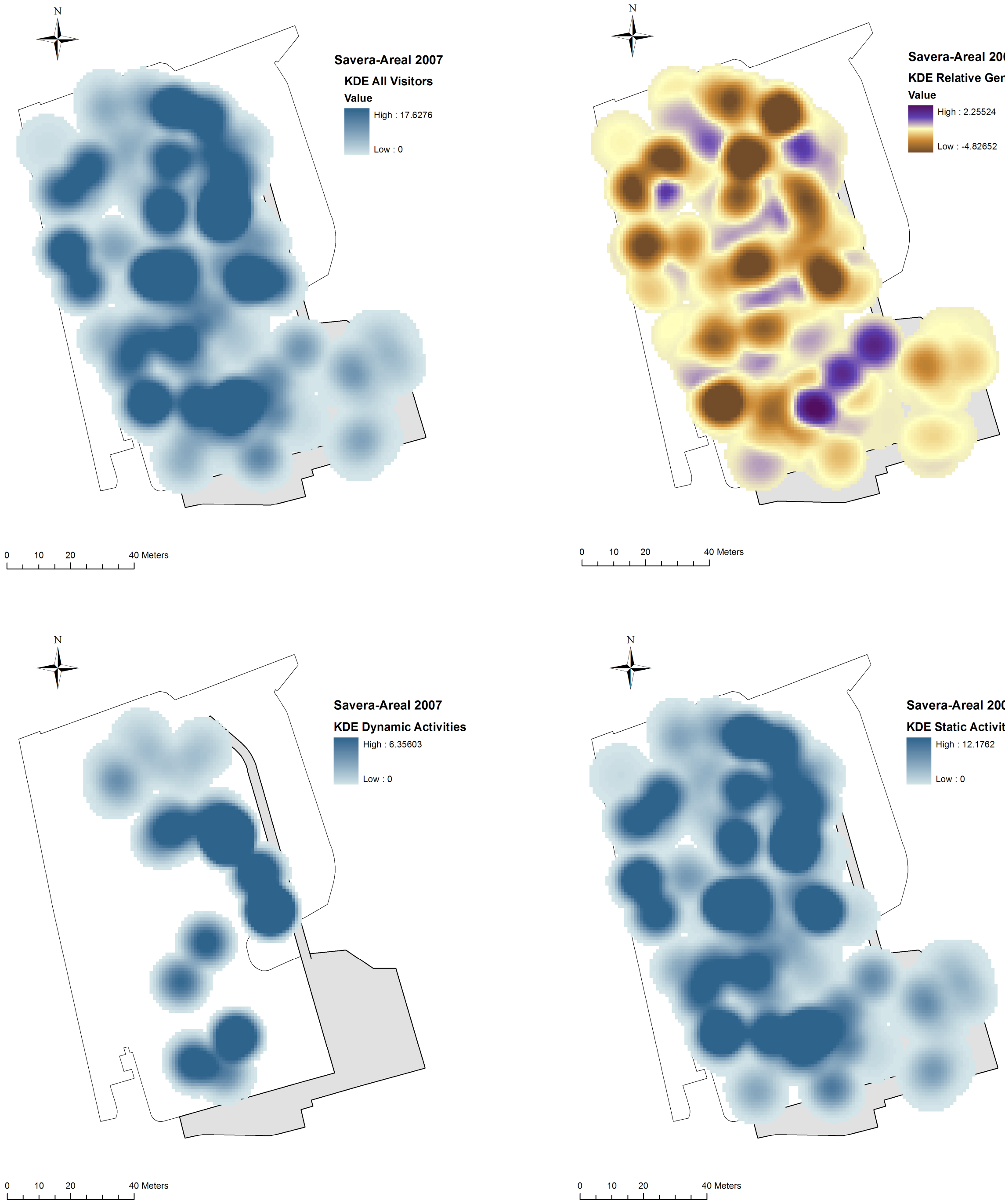

Figure 4: KDE Savera-Areal 2007; all visitors (top left), relative gender (top right), dynamic activities (lower left), and static activities (lower right); source: own design; Source: own design

The absolute densities of male and female visitors are comparable. The density of female visitors is higher towards the lakeshore to the east, while male visitors seem to be located more towards the western areas of the park. The whole area is more or less evenly used. The dynamic activities are located rather at the periphery or towards the lakeshore, while the static activities dominate the central open grass area.

4.2 Analysis at the meso-scale

On the meso-scale of neighborhoods, the composition of the visitor sample was also compared to the neighborhood population by employing Chi-Square-Tests.

The data was normalized to a hypothetical visitor count and neighborhood population of 100 each (i.e. effectively using percentages). This was for two reasons: One, to make the data more easily comparable. Two, in order to avoid a problem of the Chi-Square-Test with high population values. Since the values are squared during the calculation, small differences between observed and expected values have a strong impact at high numbers and lead to low confidence levels for falsely rejecting the null hypothesis. The following table shows the percentages of observed and expected visitor gender and age. The expected values are derived from the neighborhood population as per official statistic (Zürich 2008):

	Male	Female	p Gender	Children	Adults	Seniors	p Age
Observed	51.4	48.6	0.62	17.9	76.1	5.95	< 0.00
Expected	53.9	46.1		16.1	61.9	22	

Table 2: Savera-Areal 2007 Chi-Square Test, source: the author

The data shows that with regard to the age structure, the sample population in the parks is significantly different from that of the surrounding neighborhood. One can reject the null hypothesis within a confidence level of less than 0.01 in all cases.

The frequency of the gender distribution is nowhere significantly different in the sample population from the surrounding neighborhood at the standard confidence level of 0.05. It depends on the judgment of an analyst, whether a higher confidence level (such as 0.1 or even 0.2) would be acceptable.

5 RESULTS

5.1 Discussion of Results

The nature of the observations and the resources at hand clearly indicate that representative results cannot to be expected at all temporal granularities. At the level of specific days of the week, the sample would be too small. However, at the level of observations seasons, the data is sufficiently representative for a statistical analysis. The same is true for the spatial distribution of visitors. For this reason, the park usage was not analyzed at this scale or finer. Concerning the representation of activities, it is likely that the impact of dynamic activities on the park usage and appropriation might be underestimated or underrepresented. Although several measures (including weighing by duration of stay and disaggregate analysis) counter the effect of the observation method's bias towards static activities, activities involving constant movement in a larger area might be inadequately represented.

Concerning the data quality, the careful classification, pre-tests and repeated instructions and evaluations showed a low error. One can consider the quality of the raw data as adequate for the representation of human space use and appropriation in public parks. Improvements to the data capture technique could include video observations, although this could introduce ethical issues of privacy and control of personal data. The need for the development of an automated digitization technique would also arise, although some advanced methods of automated movement tracking exist.

5.2 Social Sustainability

This section looks at the implications of the analysis for the evaluation of social sustainability in the observed park(s). For a more detailed treatment, see Ostermann (2009).

5.2.1 Exclusion at the Meso-Scale of Neighborhoods

In all parks, senior citizens are highly significantly underrepresented. The Savera-Areal data shows this exemplary: On average, 76% of the visitors in the Savera-Areal are adults, 18 % children, and 6% seniors. This could be due to the few infrastructure elements that cater to the needs of the elderly. There is the possibility that seniors use the parks outside of the observation periods, i.e. mainly in the mornings. However, a non-representative unstructured observation sample taken during the morning hours showed not many seniors visiting the parks. Instead, there are more children in the park than in the neighborhood population. This is all the more interesting, since the nearby community centre and its playground attract even more children.

5.2.2 Domination at the Micro-Scale of single Parks

It proved to be not feasible to use standard clustering methods, since the variables to be analyzed are nominal in scale in the case of the original point data. To use clustering analysis on the results of the kernel density estimations is not feasible either, because a certain amount of clustering is to be expected as a result of the park infrastructure. Any value used as a threshold would be highly arbitrary. Therefore, the analysis of the second indicator was in the form of an interpretative synthesis, relying mostly on a visual qualitative analysis of the multiple results of the quantitative spatial analysis.

The spatial distribution of gender shows some clusters, but these are intermingled and spread out through the whole park area. Therefore, a general inter-site displacement process through domination is highly unlikely. Concerning the age groups, seniors and teenagers are clearly spatially separated. However, since in their case the data for age groups is based on a very small sample and might not be representative. In addition, even if showing a general pattern, this spatial separation is probably no hint at inter-site displacement, since both groups are spaced out in “their” respective parts of the park. Instead, it might represent an institutionalized use pattern, serving to the advantage of needs both groups. However, their low absolute numbers could be a sign of exclusion from the park altogether (see section above).

In all parks, there is a high diversity of activities, with static activities dominating throughout all parks. There are pockets of dynamic activities, usually close to some infrastructure such as playgrounds, or in the periphery of the parks. Mostly children use the parks actively and dynamically. Even the large patches of grass mostly used for static activities such as chatting or pick-nicking.

6 CONCLUSIONS & IMPLICATIONS

In summary, while some activity patterns resemble expected patterns, others contradict observations reported in the literature by other research projects. For example, the results showed no indication of a potential domination at the micro scale: Space-consuming, dynamic male activities did not dominate the central open spaces as suggested elsewhere (Paravicini 2002). To the contrary, the dynamic activities were located at the periphery of the open spaces in all parks. Generally, the different activities existed peacefully next to each other, a result that is confirmed by other studies (Landolt and Schneider 2006). At the meso-scale, elderly visitors are statistically significant under-represented. Besides this interesting fact, no processes of exclusion were detectable.

Clearly, each user group seems to have certain preferences with regard to the park infrastructure. Therefore, a diverse infrastructure gives the heterogeneous user groups the possibility to participate. From a managerial perspective, it could be advantageous to concentrate on few types of usages and discourage antagonistic activities. However, this depends on the intention of the planners how public open space is supposed to be used. If public open spaces are understood as places where participation and negotiation are desirable, then a heterogeneous mix of usages should be the objective. The examples from the Savera-Areal shows that open, unstructured spaces tend to develop an institutionalized patter of use. However, these patterns might not be stable and subject to change. A repeated evaluation of park use through direct observations is a valid and necessary management strategy.

7 ACKNOWLEDGEMENTS

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