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Exploring Spatial Behaviour of Visitors in Peri-Urban Recreational Areas - Multi-attribute Analysis of Individual Route Profiles

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ABSTRACT

Understanding human spatial behaviour in natural settings is a critical issue when working out sustainable strategies in the field of social and ecological management for heavily used peri-urban recreational areas. The aim of this study is to characterize spatial behaviour of individual recreationists by exploring attributes of their spatially manifested acts. The case study area – Lobau is situated east of Vienna, Austria and is part of the Danube Floodplains National Park. It is characterised by high use levels impacting wildlife and causing conflicts with conservation goals. On-site visitors (N=511) were interviewed about the route that they took on one of the sampling days. Attributes of the routes comprising physical features of the environment, route geometry and topology as well as spatial information provided on site, were analysed in order to identify the types of routes. Finally, route profiles were linked to visitor characteristics. For data storage and analyses GIS, database management and statistical packages were used. Outcomes of the study deliver practical information on spatial requirements and the demand for outdoor recreational activities, as well as about obeying site regulations by visitors. The results might be also very useful for creating, testing and calibrating recreational behavior models and simulations.

1 INTRODUCTION

1.1 Motivation

Assuring sustainable urban development and at the same time providing high quality of life for city inhabitants belong to the most challenging issues in the field of spatial planning nowadays. High standard recreational opportunities and appealing open spaces contribute to the improvement of wellbeing of citizens (Cox, 1972; Rogerson et al., 1988; Kendle & Forbes, 1997).

As the populations of most Western countries become more urbanized, and as work becomes less and less connected with the land, many more people are seeking to regain a connection with nature and with wild landscapes. Urban forests, increasingly common in Europe and North America, can provide opportunities for solitude and quietness well within the city limits (Bell, 1997).

These areas, due to the intensive level of recreational use, often face problems of balancing visitor needs and site capacities (Arnberger, 2003). Planning sustainable recreation requires satisfying visitors' expectations on the one hand, and protecting values of natural resources on the other one. There is a need for greater commitment to resolve problems through management, through environmental education, and by strategic planning of the means of access in terms of roads, parking facilities and footpaths (Bell, 1997).

Comprehensive understanding of recreational use is necessary for effective management of natural areas (Heywood, 1993). Investigating spatio-temporal patterns of recreational activities as well as deepening knowledge on human-environment interactions are particularly important from the spatial planning perspective. The need for systematic monitoring and management of visitor flows was strongly emphasised during the Conference on Monitoring and Management of Visitor Flows in Recreational and Protected Areas in 2002 (Arnberger et al., 2002).

There are two major ways to analyse spatio-temporal data of recreational use: an aggregate and individual-oriented one. The aggregate approach supports analysis of use intensity (e.g. number of people visiting particular destination or using certain facility, visitor load per trail segment). Such information is often used as background for habitat disturbance analyses. It might be helpful for identifying conflict areas, evaluating effectiveness of management measures, analysing effects of infrastructure changes, considering potential locations for new facilities, etc. An individual-oriented approach delivers information on how a particular visitor or group of visitors use the recreational space. Data of this type might be used to analyse spatial requirements for performing different types of activities, analyses of people's recreational needs and preferences as well as other aspects of human-environment interactions.

1.2 Aim & Scope of the Study

The aim of this study is to characterize spatial behaviour of individual recreationists. The term spatial behaviour refers to spatially manifested and overt acts of people performing a range of daily or other episodic activities (e.g., journey to work, shopping, recreation, education, etc.). These acts yield data such as distance and direction of movement, directional bias, trip frequency, episodic interval, and repetitiveness, and are represented and analysed as occurrences in space (Golledge, 2001; Golledge & Stimson, 1997) Another term, namely behaviour in space involves investigating choices underlying spatially manifested acts. This aspect, however, is not the subject of our study. The paper focuses on the characteristics of routes, based on individual visitor trip reports, integrating route geometry, topology and physical features of the environment.

2 CASE STUDY AREA

The case study area – Lobau is situated east of Vienna, Austria, and is part of the Danube Floodplains National Park (Figure 1). It lies within the city boundaries and is a traditional local recreational site. In 1996 the Danube Floodplains were declared a National Park which in 1997 received international recognition – IUCN category II. This obligates the park management to fulfil both the demands posed by intensive daily recreational use and by the need to protect the floodplains' ecosystem (Brandenburg, 2001). A long-term monitoring of visitor flows in the Lobau allowed to identify spatio-temporal patterns of recreational use as well as to characterize the visitors. This relatively small area (approx. 10 km long and on average 2 km wide) attracted 600 000 visitors in 1999. Dominating recreational activities here are biking and hiking. Minority of visitors is jogging (3%) and swimming (1%) (Arnberger et al., 2000).

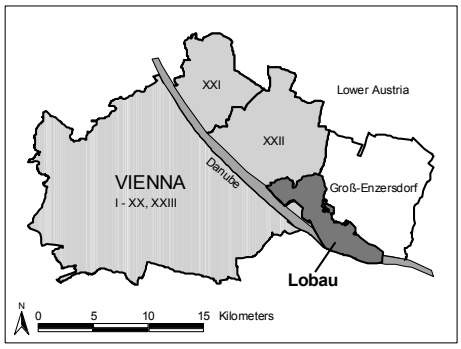


Figure 1 Case study area – Lobau

(Source: Hinterberger, 2000)

3 METHODS

In order to investigate the spatial distribution of visitors, a survey on recreational use, comprising visitor characteristics and a short trip report, was conducted (Arnberger et al. 2000). Additionally, detailed data covering attributes of the Lobau physical environment have been collected. Spatial and statistical analyses were used to explore attributes of routes. Figure 2 illustrates methodology used in this study.

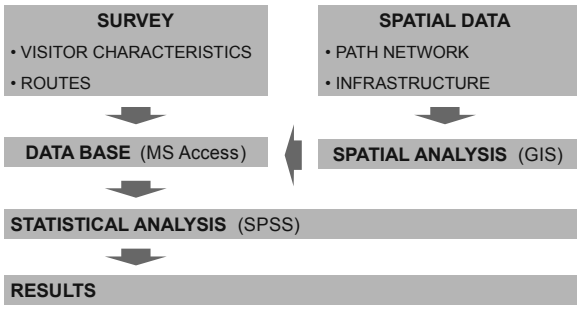


Figure 9 Methods used for analysing route profiles

3.1 Data Collection

On-site visitors were interviewed about their outdoor activities, visiting motives, length of stay, local knowledge, etc., at main entrance or intersection points at randomly selected days. As part of the interviews, respondents were asked to mark on a map (1:25.000) the route that they took or planed to take on that day. The sample size was 511 for complete surveys comprising route and visitor characteristics. Additional 21 visitors reported about their route only.

Based on the Austrian topographic map 1:50.000 and field work the trail network was digitised. Next, the route information from the interviews was spatially referenced and stored into a database. All records have been checked for topologic consistency, e.g. contiguous route segments (Hinterberger et al., 2002).

Additionally, as a part of the field work, environmental and infrastructure data have been collected. Information on physical features of the area such as type of surface, width of trail, landcover along paths, views, accompanying tourist infrastructure, locations of information boards and signs were collected.

3.2 Input Data Structure

Various types of data have been used in this study. Table 1 illustrates the structure of input data covering visitor characteristics, routes, network of trails, environmental features along path segments and at node points. All the data were stored in a database (data model: Hinterberger, 2000; Taczanowska, 2004). MS Access and ArcGIS geodatabase were both considered as possible frameworks for data storage and data preparation for final analysis. Eventually, MS Access package was used, due to the ease of establishing relations between different entities and extensive possibilities of performing SQL queries.

Input data	Source	Type	Input for final analysis
Visitor characteristics	Survey	Non-spatial	**=> visitor characteristics**
Routes	Survey (trip report)	Spatially referenced	
Trail network	Map & field study	Spatially referenced	**=> route characteristics**

Environment characteristics	Field study	Spatially referenced

Table 1. Structure of input data

3.3 Generating Route Attributes

The characteristics of routes are the main subject of final analysis. The presented above 'raw' input data do not deliver route attributes directly. Those must be additionally generated with the help of SQL queries. Table 2 summarizes route attributes covering physical appearance of trails, encountered tourist infrastructure, route geometry and topology.

Attribute class	Description / measures
Length	Total sum of used path segments (m)
Shape	Loop/traverse (category); level of retracing paths (%)
Signage	Marked trail; marked multi-use trail (m); share of marked and not marked trails (%)
Surface	Asphalt; gravel; unpaved track; grass; other (m); share of different surface types (%)
Width	Width classes: >4 m; 3-4 m; 2-3 m; 1,5m; <1m (m); share of different width classes (%)
Landscape type	Riverine forest; pine forest; bushes; meadows; agriculture; water, industry, building (m); share of different landscapes types (%)
Infrastructure	Number of benches per trail km (count)
Attractions	Picnic spot; restaurant; museum; (category)

Table 2. The summary of route attributes

3.4 Statistical Analysis

Exploratory methods were applied to investigate spatial behaviour of individual recreationists. In an exploratory data analysis process many variables are taken into account and are compared, using a variety of analysis techniques in the search for systematic patterns. Basic statistical methods were used in this study. Distributions of the variables, correlation matrices and multi-way frequency tables were analysed. Additionally, some a priori hypotheses were tested. The analyses of route attributes were performed with the help of SPSS statistical package.

4 RESULTS

4.1 Visitors Characteristics

More than 90 percent of the visitors interviewed reside in Vienna. A high frequency of visits could be observed; more than 60 percent of interviewees visit the Lobau at least once a week. An analysis of visitors surveys lead to the differentiation between three types of visitors, characterized primarily by their residential address, the frequency of their visits and their motivation for visiting the Lobau. The visitor types are:

Regular recreational visitors from a residential environment: home less than two kilometres away from entry point, very high frequency of visits (at least once a week), short length of stay in the park (less than two hours); the motive for the visit is the proximity to the Lobau and the opportunities offered for sporting and recreation.

Occasional recreational visitors from other parts of Vienna and Lower Austria: home more than two kilometres away from entry point, go there frequently (a least once a month), but stay for more than two hours and are motivated to visit the landscape

National Park visitors: home further away from the Lobau, low frequency of visits, the motive for a visit is the whish to see the National Park. This type accounts only for 2 percent of the total number of visitors.

(Arnberger et al., 2001)

4.2 Characteristics of the Lobau Trail Network

Recreational use in the Lobau area concentrates along the trails. Therefore description of the physical environment was based on the path segments characteristics. The trail layout in the Lobau is a complex network offering extensive opportunities for performing various types of activities (Fig. 3). The paths are very diverse and comprise paved as well as natural surfaces of different width, marked and not marked paths accompanied by a range of landscape types and infrastructure along trails. The tables below present general spatial characteristics (Table 3) and selected attributes of the trail network (Table 4).

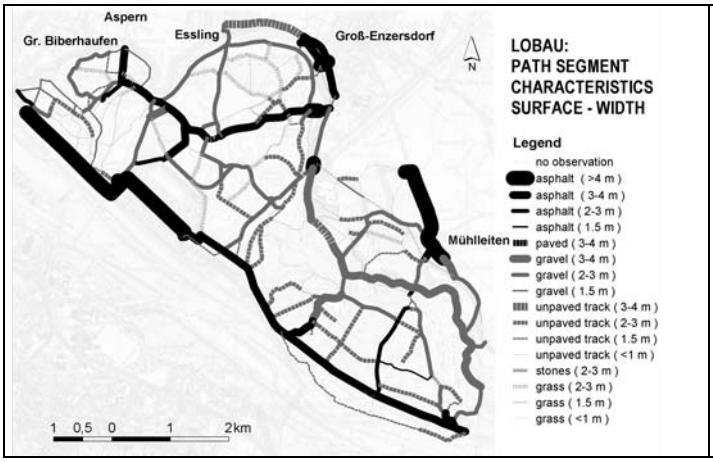


Figure 3. Lobau recreational area - layout, surface and width of trails

Network characteristics	Quantity
Area (km^2)	20
Number of links	349
Number of nodes	225
Length of trails (km)	132.6
Average density of trails (km/km^2)	6.6

Table 3. Spatial characteristics of trail network

Class	All	Surface				Width of path					Signage		
Attribute		Asphalt	Gravel	Unpaved	Grass	>4m	3-4m	2-3m	1,5m	<1m	Marked	Marked Multi-use	Not marked
Length (km)	132.6	24.6	36.3	53.4	16.7	5.5	21.3	60.3	24.2	21.3	61.8	27.1	71.1
Share (%)													
	100	18.6	27.4	40.3	12.6	4.1	16.1	45.5	18.3	16.1	46.6	20.4	53.6

Table 4. Summary of the selected trail network attributes.

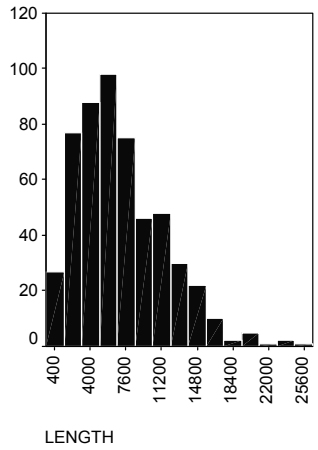
4.3 Exploring Selected Attributes of Route Profiles

Exploring the attributes of route profiles combined with visitor characteristics delivers practical information on how different people use the suburban recreational setting. Selected attributes describing length of routes, shape, signage, type of surface and width of trails are presented below. Further analyses of landscape characteristics and infrastructure such as type of vegetation, presence of water, sun exposure, views as well as locations of picnic spots, restaurants, view platforms, etc. are currently in progress and were not included in this paper.

4.3.1 Length of Routes

The length of route is one of the most important attributes delivering knowledge on how much space is needed to perform recreational activities. Visitors to the Lobau vary a lot in terms of distances travelled. The shortest route reported in the Lobau was only 163 meters long, leading from the entrance point to the lake and return. The longest one (25.7 km) was reported by a biker, spending his time in the Lobau on a Sunday in spring (Hinterberger et al., 2002). The mean value of route length was 7.0 km (Figure 4).

Significant variations between different user groups were observed (Figure 5). Bikers tend to perform the longest distances, followed by joggers and hikers. However, if considering the maximum lengths of routes, some hikers took longer trips than joggers. As there were no significant differences in the duration of stay between the activity groups, it can be assumed that the variation of route lengths was caused by the speed of movement.



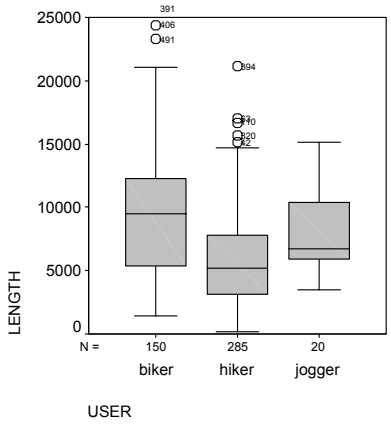


Figure 5. Distribution of route lengths among user groups

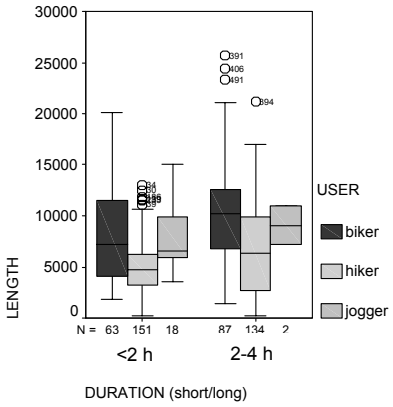


Figure 6. Distribution of route lengths grouped by duration of stay and type of activity

Time budget had a significant influence on distances (Figure 6). Generally, the length of routes raised while the duration of visit increased. However, stays exceeding four hours demonstrated higher variance of distances than one- to two-hour visits. This measure implicates that a high share of long-term visitors was more passive. This group of visitors (mostly hikers) made longer stops, while performing their recreational activities. Short-term visits seem to be more 'effective' in terms of movement across the recreational space.

Slightly seasonal variations of the route length were also observed. Summer visitors tended to be less active than spring visitors. In summertime a large number of people hiked or biked only for a short distance in order to get to their favourite swimming spot (Hinterberger et al., 2002).

4.3.2 Shape of Routes

From the recreation planning and infrastructure design perspective the shape of route belongs to one of the most important measurements. In highly diverse and dense trail networks, in areas without any particular point attractions (the whole site may be regarded as attraction), people can choose among different combinations of paths. Such network is an ideal area to investigate the spatial behaviour. Figure 7 illustrates examples of routes taken by the Lobau visitors. Consequently, in this study two measures were considered to describe the shape: the distance between start and end points, and the share of repeating the paths (retrace).

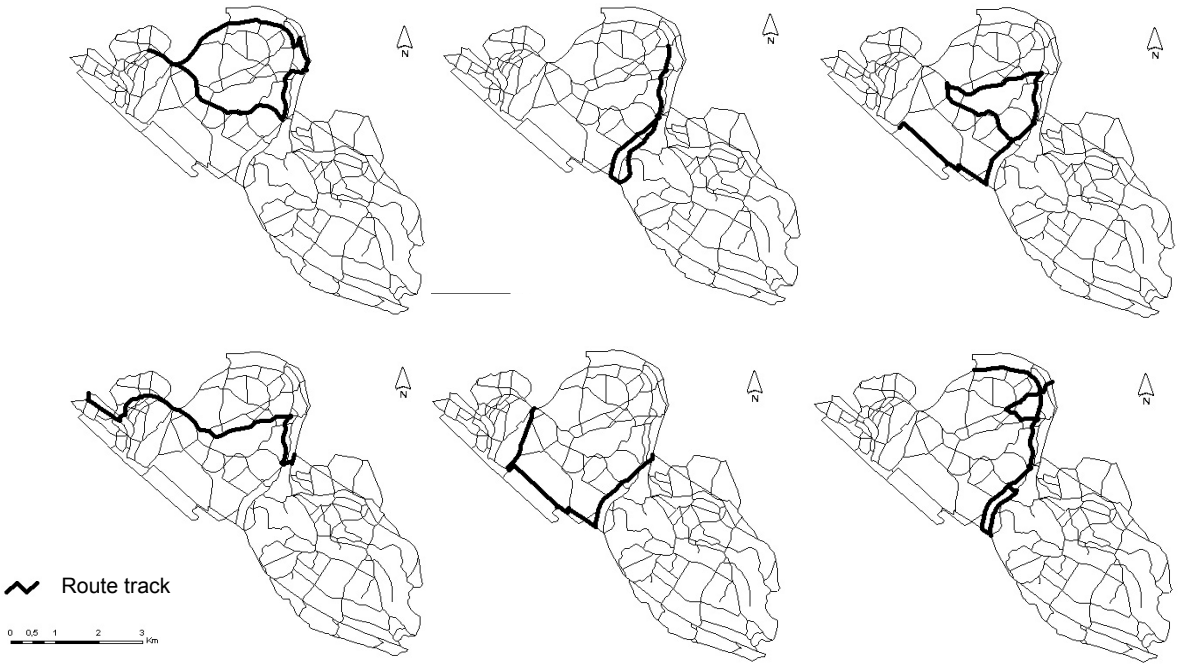


Figure 7. Examples of routes reported by the visitors. Lobau recreational area

Generally, two types of route shapes could be distinguished: a loop and traverse. The large majority of the respondents made loops (80%), getting back to their starting location. This result can be explained by the fact that many visitors reached the recreational site by car. People living close to the Lobau also tended to make loops. One quarter of the interviewed visitors traveresed the area (Fig. 8). Many bikers cross the Lobau as leg of a longer trip towards the eastern part of the Danube Floodplains National Park or as part of larger loops in the surrounding area.

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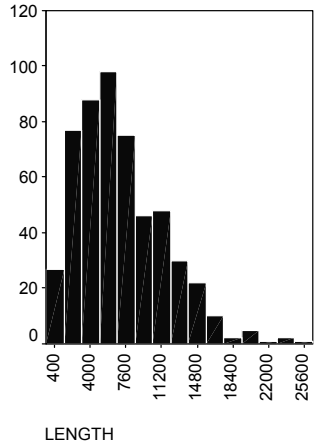

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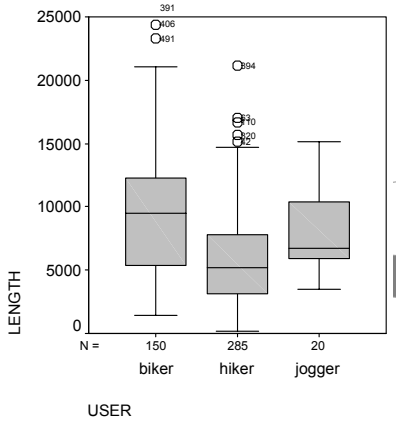

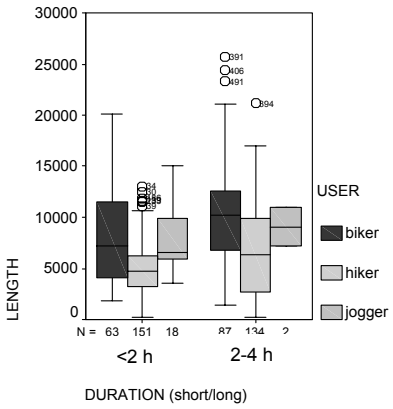

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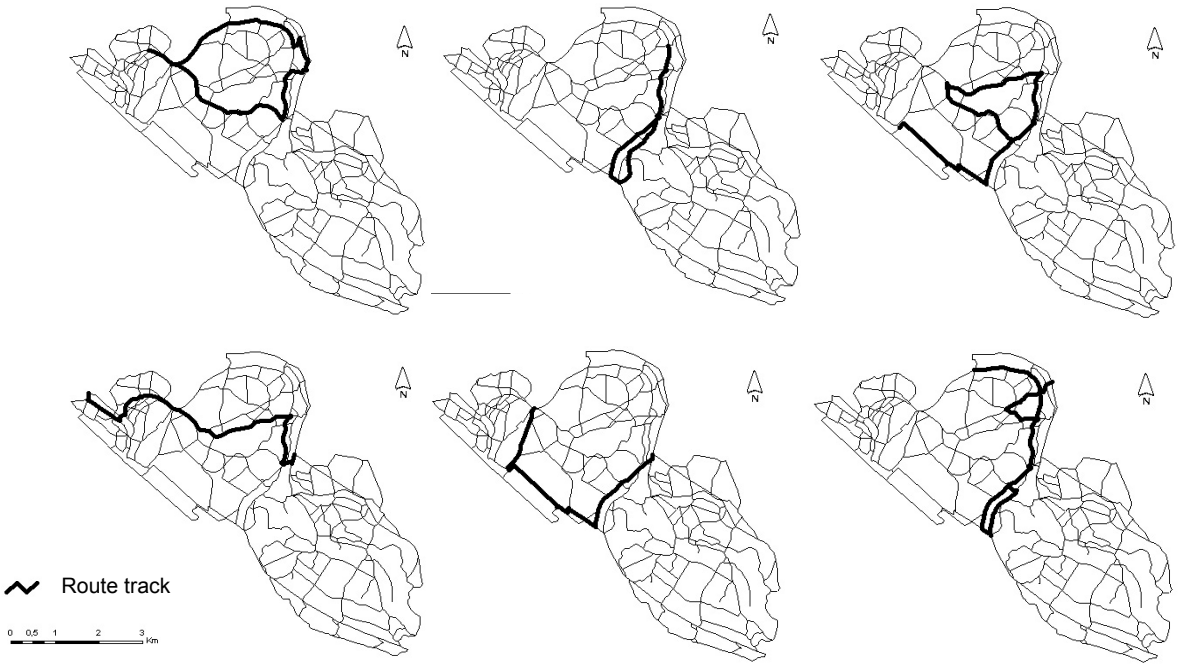

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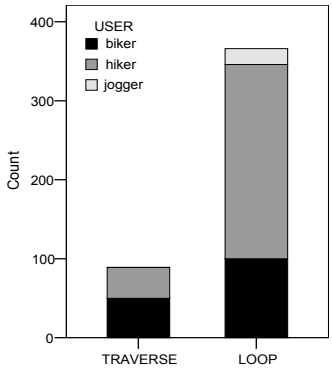

Figure 8. Proportion of non-natural trail surfaces used across user groups

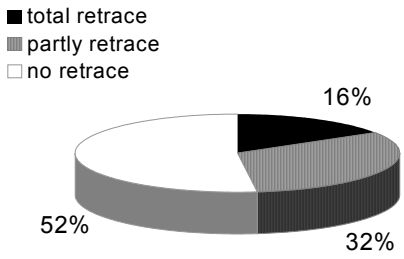

Figure 9. Distribution of grass trails used, clustered by user groups

5 DISCUSSION & CONCLUSIONS

This study delivered practical information on how individuals use a recreational setting. The outcomes may be very useful for planning and management purposes, especially in terms of provision and allocation of recreational infrastructure. Strategic planning of the access to natural areas and visitor flow management are powerful tools for assuring sustainability of suburban natural sites. Studies of this kind may be very helpful for verifying a priori assumptions concerning distribution of individual visitors in the outdoors. Exploring this subject seems to be critical, while developing visitor guidance strategies and attempting to provide high quality recreational opportunities for city inhabitants. So far, investigation on human spatial behaviour at individual scale belongs to the underreported fields in outdoor recreation research.

The results demonstrate great diversity of routes respondents took or planned to take during their visit to the Lobau. Reported trips ranged from long-distance loops, following marked and well paved trails, up to the destination-oriented shortcuts leading from a parking place to the nearest picnic or swimming spot. Analysed routes differ considerably in terms of length, type of surface, width, shape and signage. However, those large spatial differences can not be easily explained by visitor characteristics. It implicates that spatial behaviour should be considered as additional feature for defining visitor profiles and building recreationists typologies. Such comprehensive 'picture' of a visitor, covering demographical data, recreational behaviour characteristics and spatial dimension of his or her acts, would be of great value for visitor flow management purposes.

Results of empirical studies can support developing guidelines for planning areas of a comparable kind. This investigation demonstrated several spatio-temporal similarities of recreational use with other urban areas in Europe. These analogies refer particularly to the quantities of route lengths and duration of stay (Zundel & Völksen, 2002). Layout of trail system, design of recreational infrastructure and provision of information affect the distribution and experiences of visitors (Barth, 1982; Bell, 1997; Job, 1991). Feeling secure, without the danger of getting lost is necessary when spending time in outdoor leisure areas (Findlay & Southwell, 2004). Results of this study also confirm these findings. Visitors to the Lobau generally use well-defined paths and follow marked trails. Nevertheless, our investigation revealed a group of visitors who does not follow the site regulations. Particularly bikers tend to use all possible trail combinations, not considering any limitations for this type of activity. The number of off-trail users is an important measure from the nature protection point of view, as this way of exploring the outdoors is regarded to strongly impact wildlife (Job, 1991). Spatial behaviour delivers information on the effectiveness of management strategies and actions.

Access to a recreational setting and mode of transport used to reach the site determine much of the spatial behaviour pattern. Parking places encourage car born visits and consequently promote the 'loop' type of trips. Public transport could enable traversing the area, without the need to finish a trip in a starting point. Closer cooperation between recreational site managers and public transportation providers would be desirable to address these issues (Sammer, 2005). Minimising the level of retracing paths could be achieved by designing attractive loop trails of different lengths and by providing adequate information.

Additionally, social context is regarded as an important factor influencing recreational experience (Arnberger, 2003; Manning, 1999; Cessford, 2002). Investigating perception of crowding and conflicts between different users contributes to better understanding the spatial patterns observed in recreational settings. Including these aspects into the analysis of human spatial behaviour could be considered for future studies.

The findings of this exploratory study were the first step to understand spatial behaviour of visitors in a recreational setting. In the next stage, multivariate techniques will be used to identify different groups of spatial behaviour and to build on the typology of visitors based on their spatially manifested acts.

As the current technologies enable modelling complex phenomena, such as people's movement across urban space, the need for detailed real-world data became an emerging topic in the field of spatial planning. Modern decision support tools, such as traffic or visitor flows simulations allow to evaluate alternative management scenarios in order to apply strategies that work (Gimblett, 2002; Itami & Gimblett, 2002). Agent-based modelling technique is extensively used for this kind of simulations. Artificial individuals (agents) interact with surrounding environment according to predefined rules of behaviour. However, when expecting plausible results that mirror actual human behaviour, reliable input is a must. Comprehensive empirical data and studies of this kind contribute to better understanding of complex phenomena of human spatial behaviour. The findings of our study might be a valuable basis for creating, testing and calibrating models of recreational use.

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