AN INTEGRATIVE CONCEPT FOR VISITOR MONITORING IN A HEAVILY USED CONSERVATION AREA IN THE VICINITY OF A LARGE CITY: THE DANUBE FLOODPLAINS NATIONAL PARK, VIENNA

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Abstract: The Danube Floodplains National Park, Vienna, Austria is used predominantly by the Viennese population for daily recreation purposes. Different methods were applied for the monitoring of visitor activities in the National Park (long-term video monitoring, short-term visitor observation, interviews and route registration). The results show that only a combination of monitoring and survey data obtained by various methods allows a thorough analysis of visitor activities as a basis for the ecologically and economically sustainable management of recreation and conservation areas.

Introduction

Wildland recreation areas in close proximity to large conurbations present managers and researchers with a variety of challenging problems, due to the high number of visitors and the multifaceted visitor structure. 'Often times the activities and behaviors engaged in by urban visitors do not fit traditional conceptions of wildland recreation' (Heywood, 1993). Therefore, successful management requires an extensive recording of the uses visitors make of these areas.

The Danube Floodplains National Park has a rather unique position among the National Parks of Europe. The Park is situated in the east of Vienna, the capital city of Austria, with a population of 1.7 million. A large percentage of the national park's area, the so-called Lobau, actually lies within the city boundaries of Vienna (XXIIth district) and within the boundaries of Groß-Enzersdorf, a small municipality in Lower Austria. Settlements and areas of intensive agriculture surround the park (Figure 1).

For decades, the Lobau with an area of 24 km^2 (9.3 square miles) has been mainly used by the Viennese and the residents of Groß-Enzersdorf as a regional recreation area,

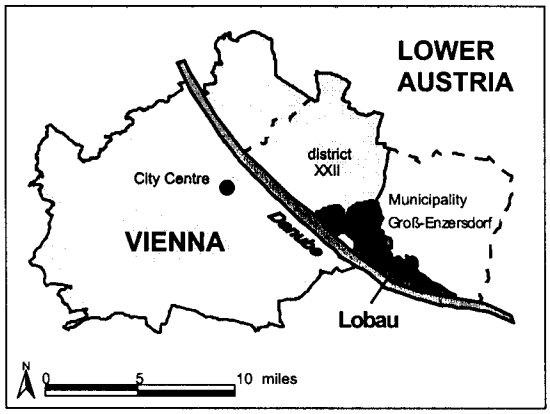

Figure 1. Study area: Lobau, the Viennese Part of the Danube Floodplains National Park (Hinterberger, 2000, modified)

as it serves as a residential environment. In 1996, the Danube Floodplains were declared a National Park, and in 1997 they received international recognition, IUCN category II. Therefore, the protection of the floodplains gained in importance compared to the use as recreation area, which for decades had been the major focus.

Park management now has the task to fulfil both the demands posed by intensive daily recreational use and by the need to protect the floodplains' forested landscape. To deal effectively with the high number of visitors, management requires more detailed information about user behavior. The visitor monitoring project of the Institute for Landscape Architecture and Landscape Management at the University of Agricultural Sciences, Vienna (Arnberger et al., 2000a) contributes significantly to this knowledge gap. This study was commissioned by the Department of Forestry of the City Council of Vienna.

Methods

As illustrated in Figure 2, the following methods for visitor monitoring were used:

- *Permanent time-lapse video recording:*
  Video-cameras were installed at several entrance points to monitor recreational activities (see Leatherberry & Lime, 1981) year round, from dawn to dusk. For the analysis, only 15 minutes of observations per hour were taken into account, but this had no negative impact upon the significance of the results (Brandenburg, Muhar & Zemann, 1996; Muhar, Zemann & Lengauer, 1995). Given the type of video system installed, it is not possible to identify individual persons, so anonymity can be guaranteed.

- *Interviews and personal observation:*
  At the 12 main entrance points into the park visitors were counted and interviewed about their motives, activities, expectations etc. on four days; the counting and the interviews took place on a Thursday and the

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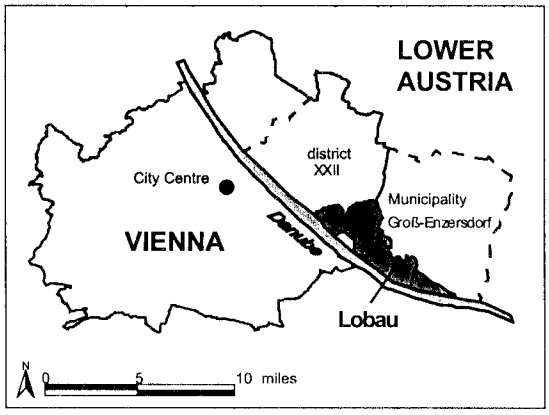

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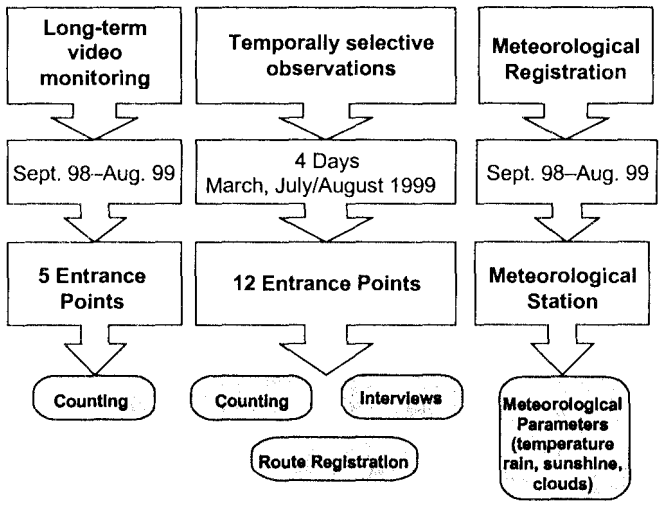

Figure 2. Methods of Data Gathering

immediately following Sunday, once in spring and once in summer. The survey was conducted on days of fine weather, to be able to collect as many data as possible. The total sample size for this study was 780. This temporally selective counting can be combined with video data for extrapolating to the total number of visitors per year.

- *Analysis of the routes taken on the basis of the results of the survey (frequency maps):*
  As part of the survey, visitors were asked to mark the route through the Lobau which they took or planned to take in a simple map. By linking the data from the interviews with the help of an Access database, an analysis by topic was possible and the respective routes could be made visible via GIS (ArcView) (see Hinterberger, 2000; Arnberger et al., 2000b).

Interviews

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. The Lobau can therefore be called the "green living room" for a large number of Vienna's inhabitants. An analysis of the visitor 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 kilometers away from entry point, very high frequency of visits (at least once a week), short length of stay in the park (up to 2 hours); the motive for the visit is the proximity to the Lobau and the opportunities offered for sporting and recreational activities (e.g. jogging).
- Occasional recreational visitors from other parts of the city and Lower Austria: home more than two kilometers away from entry point, go there frequently (at least once a month), but stay for more than 2 hours and are motivated to visit the landscape.
- National park visitors: home further away from the Lobau, low frequency of visits, the motive for the visit is the wish to see the National Park. This type accounts only for 2 percent of the total number of visitors.

Analysis of routes

The frequency maps developed on the basis of the survey present the distribution of visitors within the observed area by type of user, catchment area, park entrances, length of stay, frequency of visits, days of the week, seasons etc. as basis for further interpretation. In addition, the path length could be compared by kind of use, season and other variables. Given the information provided in the interviews about the home of the visitors, it was possible to divide the catchment area into three zones (Figure 3). When one compares the routes chosen by visitors from the three zones, it becomes obvious that people coming from the residential area adjacent to the Lobau (zone 1, up to about 2 kilometers away from the Lobau) tended to stay in those parts of the Lobau close to the residential area.

Counting

Long-term video monitoring lead to the following information:

- Chronological distribution of the visitors: number of visitors over the entire year, by month or by season; daily visits, daily visits by season, peak days, minimum and average number of visitors per day, total number of hours visitors spend in the park.

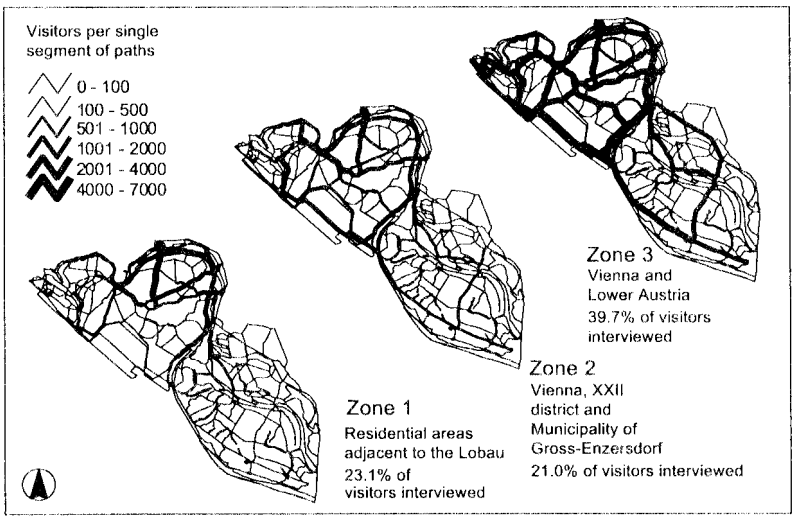

Figure 3. Routes Depending on Catchment Area (Hinterberger, 2000, modified)

- Spatial distribution of visitors: number of visitors at various entrance points, choice of direction at the intersection of paths etc.
- Linking of chronological and spatial data: number of visitors at a certain entrance point at a certain time, average duration of visits.
- Quantification of user groups: cyclists and their distribution in space and time etc.
- Recording and quantification of behavior not wanted by the management: dogs not kept on leash etc.
- Correlation of visitor numbers with meteorological data, such as temperature or rain.
- Prognostic models: the data provide a basis for the development of prognostic models to predict visitor loads.

The Lobau is used by about 600,000 people per year. The main users of the Lobau enjoy biking and hiking, while a minority is jogging (3%) and swimming (1%). The main period of visitation is between March and October with highest frequencies being observed in May and on Sunday afternoons, when all types of visitors can be found in the Lobau (Figure 4).

The main visiting period for bikers is the summer, for pedestrians it is spring (Figure 5). Joggers do not peak as drastically during the summer, but larger number of visits on their part can be observed during the shoulder seasons (March, April and September, October).

The pattern of visitation on working days differs considerably from the situation on weekends (Figure 6). On working days, the overall number of visitors is obviously lower, and grows steadily to a small peak in the early afternoon, while over the weekend and on public holidays a significant peak can be observed in the afternoon. On average, at 2 p.m. on weekends, four times as many visitors can be observed per hour than at the same time on a working day. The number of visitors leaving the

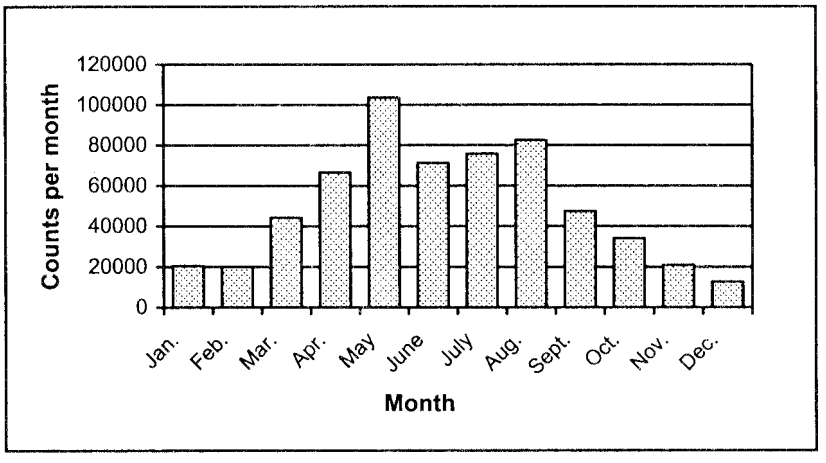

Figure 4. Visits per Month over the Year

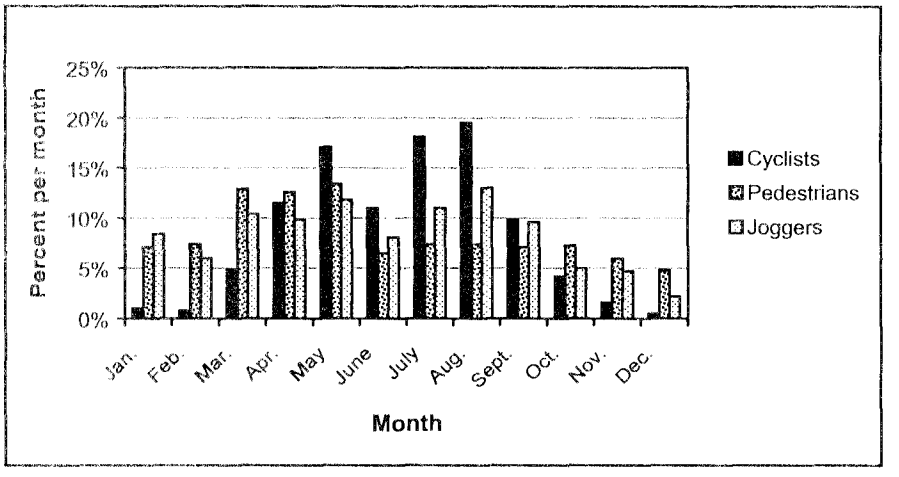

Figure 5. Relative Seasonal Distribution of User Groups

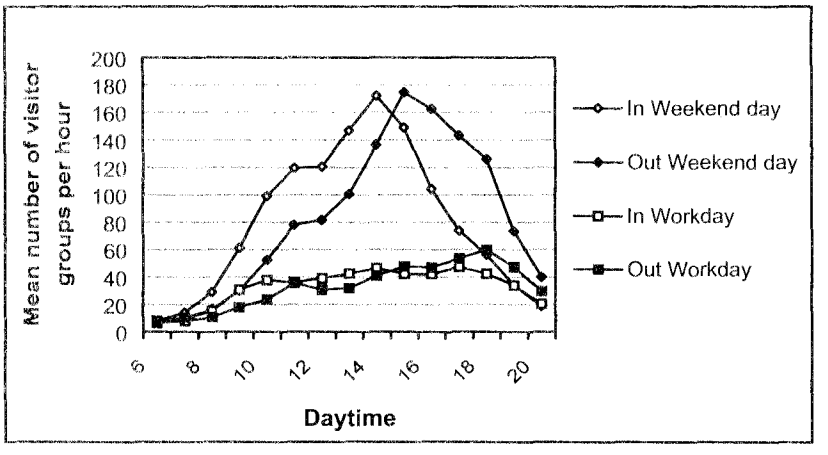

Figure 6. Hourly Visitor Rates Depending on Day of the Week over the Year

Lobau is roughly the same as the number of people entering the Lobau, but there is a time delay by about one to two hours. On working days, a comparatively high number of people enter the Lobau late in the afternoon or early in the evening, while over the weekend the number of visitors entering the Lobau already starts to decrease significantly from 2 p.m. onward.

Model to Predict Visitor Loads

The second focus of this project was the investigation and modelling of relationships between the number of visitors and external factors such as weather, season and day of the week (Brandenburg, 2001). Reliable models can be calibrated for the total number of visitors per day as well as for specific user groups with high numbers (i.e. pedestrians and cyclists). A Univariate Analysis of Variance was used. The model allows the prediction of visitor loads for a specific day (Figure 7).

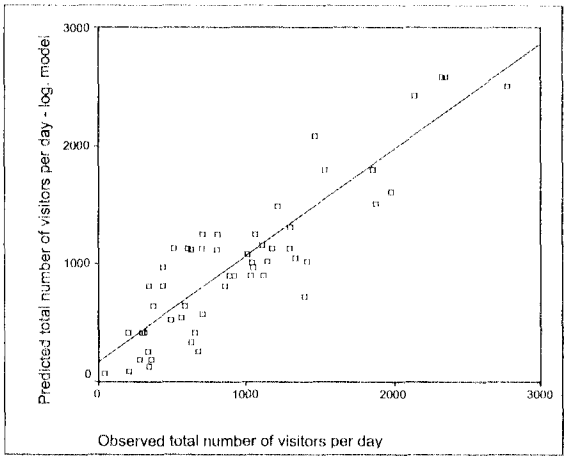

Figure 7. Model for the total number of visitors per day (adjusted $R^2 = .834$)

The day of the week has the greatest influence upon the total number of visitors as well as for user groups (Table 1). Temperature as a meteorological feature appears in the models indirectly through the scale indices of thermal comfort and the development of the temperature during the day. The Physiological Equivalent Temperature (PET) has a major impact upon the number of visitors per day, in particular on cyclists and pedestrians. 'PET is defined as the air temperature at which in a typical indoor setting (without wind and solar radiation) the heat budget of the human body is balanced with the same core and skin temperature as under the complex outdoor conditions to be assessed' (Höppe, 1999). The usage patterns of joggers and dog owners were more complex to model, as they apparently are less dependent on weather related factors. The development of the weather is integrated into the model via the development of the temperature and cloud cover in the preceding seven days. However, the overall effect of these factors is small.

Use of the Visitor Analysis Data for the Management of the Park

The results of the visitor analysis can be used for the planning and management in and around the national park (Table 2). For example:

- Areas of origin, particularly the residential areas close to the national park: improvements to residential areas.
- Wildland/urban interface: design and sizing of park entrances.
- National park: ecological and visitor management in the national park.

Conclusions and Outlook

The quality of data collected in short-term monitoring campaigns is heavily affected by statistical variations. Thus, long-term monitoring can be a very important complement to short-term in-depth visitor observation and interviews. (See Figure 8.) Due to the density and structure

Table 1. Explanatory Value of the Total Number of Visitors per Day and the User Groups Cyclists, Pedestrians, Joggers and Dog Owners (Brandenburg, 2001)

Extent of interference	Total number of visitors	Cyclists	Pedestrians	Joggers	Dog owners
Workday, Weekend and holiday	high	high	high	small	moderate
Rain	moderate	moderate	small	extant	extant
PET	high	high	moderate		extant
Clouds	moderate	moderate	small		small
Interaction between weekday and PET	moderate		small		extant
Cloud coverage of the last 7 days			very small	extant	extant
Temperature of the last 7 days		moderate	very small		
Value of model	adj. R^2=.834	adj. R^2=.844	adj. R^2=.744	adj. R^2=.291	adj. R^2=.440

Table 2. Application of Visitor Analysis Data

Areas of origin, particularly residential areas close to the national park	Wildland/urban interface (park entrances)	National park
• Improvements in the residential areas close to the Lobau (green connections, parks) • Better co-ordination of time tables of public transport to the National park Connection to other foot paths and cycle lanes • Contribution to development plans for the area close to the National park • Contribution to marketing strategies to promote the National parks • Signposting of the paths in the National park on the basis of the interview results	• Location, dimension and design of new entrance and information points (size of visitor rooms, number of parking spaces, management of the parking lot, architectural design) • Schedules for the personnel at information points (when, where, for how long) • Type of information required and best way to convey it depending on the kind of visitors at various entrance points	• Refined distribution of zones: marking of rest or recreational areas in connection with a certain guidance of visitors in time and space • Kind of facilities needed in recreational areas • Paths: making some more attractive and giving up others, path design (for example, choice of surface) depending on kind of use • Schedules for the personnel of the park who look after visitors, organize walks etc. (in time and space) and the management of resources • Targeted measures to address observed, undesirable behavior (for example, dogs not kept on leashes) • Basic data for further research projects

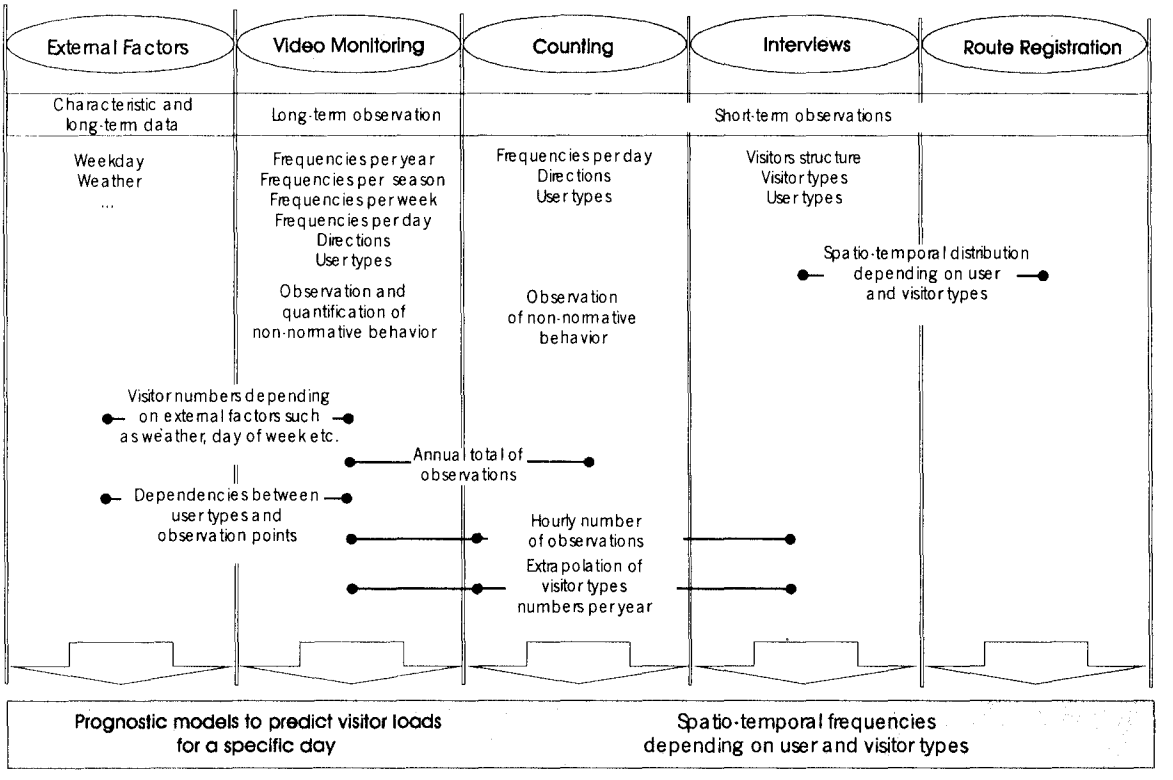

Figure 8: Methods for an Integrative Concept for Visitor Monitoring – Overview (Brandenburg, 2001, modified)

of the data collected, long-term monitoring offers remarkable advantages for a more in-depth evaluation. However, the overall expenses are rather high. However, when considering the proportional costs per registration day and monitoring point, long-term video monitoring fares very well because of the relatively low installation costs for each unit.

Consequently, this research project lead to the result that only the combination of monitoring and survey data gained by different methods allows a thorough analysis of visitor activities as a basis for the ecologically and economically sustainable management of recreation and conservation areas. Only on this basis, a precise description of the use people make of a particular recreation area can be provided.

Planned are an improvement of computer simulation modelling and research on the social carrying capacity as well as on crowding issues (Shelby & Heberlein, 1986; Manning, 1999) based on types of visitors and in combination with long-term video data.

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