Measurement and analysis of congestion at the traditional Japanese garden "Korakuen"

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Abstract: Nature and greenery spaces are especially required in the high-density residential areas of Megalopolis in Japan. People are looking for rich greenery spaces and they are requiring for the preservation of the greenery space in redeveloping areas. But people have recently found that parks often were too crowded, when they visited them for enjoying a quiet greenery environment. Almost all old Japanese cities have parks in traditional garden style, which have been opened to the public since Meiji revolution, i.e. a hundred years ago. Originally, the gardens were possession of the Daimyo, i.e. the feudal lord, and they were enjoyed privately. Recent increase in visitors destroyed the original use pattern and the unique atmosphere, and this, of course, confused the management of the park administration. The administration and the users therefore encouraged investigations concerning the appropriate management of park as a pleasant environment.

To find a preferable carrying capacity of green spaces, the impression of congestion and quietness was analyzed in a traditional Japanese garden, using the number of visitors as an indicator. The following results were obtained.

The impression of congestion is significantly correlated with the number of visitors in the park, and 700 persons on 7 hectares generates the impression of congestion for a half of visitors.

To satisfy the impression of quietness for more than a half of visitors, their numbers must be reduced to less than 400 persons for 7 hectares.

The decreasing in number of visitors provides a more efficient impression of congestion than that of increasing.

INTRODUCTION

Generally, an increasing number of visitors in the park suggests a strong needs for greenery spaces and natural areas. In Japan, the number of visitors has heavily increased in natural parks in the last 50 years. The annual usage of the natural park has been estimated to be more than 900 million people since 1990 (Nature Conservation Bureau 1999). The most rapid increase was observed from 1965 to 1975 and the number of visitors has grown twice in this decade compared to the 10 percent increase of the total population. The demand was formed by the rapid urbanization, i.e. by the strong immigration to urban areas. This sprawl in high-density areas had isolated the residents from natural areas and prevented them form enjoyment in natural spaces. In the enlarged urban areas, the few existing green spaces were scarcely developed and people lost the chance of enjoyment of rich greenery. As a consequence, they rushed into the greenery areas left in the city center to enjoy the precious nature. Since the Meiji revolution, Tokyo has designated the private gardens of the Daimyo, i.e. the then feudal lord, to the public. But they had never established large parks in the city for the residents, as it was the case in European cities. Furthermore, the Tokyo Metropolitan Government had once opened the gardens free of charge to the public. But as it turns out, park use has become too strong to maintain the gardens in a pleasant environment. For the present, they tried to impose the entrance fee again to control the visitors' number. But they don't know the suitable or pleasant carrying capacity of the gardens (Aoki 1984).

Park use must be controlled now to fit the mass of visitors into the traditional style of Japanese Garden. This paper aims to find reasonable carrying capacity of the traditional Japanese Garden at Koishikawa Korakuen Garden by carrying through the inquiries concerning the visitors’ congestion impressions.
recent studies

An investigation method was developed by Kirchner (1970) for the visitors' numbers of the urban parks in Vienna. Thayer (1979) developed an estimation method of park use by a multiple regression model. Cooper (1981) surveyed tourist behavior at Jersey Island, and Dwyer (1988) studied the prediction of daily use of urban forest at Chicago. Aoki (1988) studied sampling schemes for counting the daily number of visitors. Tooko and Baker (1996) investigated the effect of film on the visitors' number. Aoki and Fujinuma (1996) analyzed the effects of weather conditions and social aspects on the daily use of parking lots at the Nikko National Park, and Loomis (2000) proposed the Long-Term Monitoring for the recreational use. The investigation of park use was firstly carried out in 1923 (Yoshida 1934) and is continuing until now in Japan.


But the studies on this subject have not been frequently done in this realm (Greiner und Helmut 1975, Aoki 1999). And there are no studies on the congestion and the quietness of the park environment related to the number of park visitors.

study area

Koishikawa Korakuen was planned in 1625 in Edo era by the gardener Sahyoe Daitokuji for the first feudal lord of Mito Tokugawa family (Yoshikawa 1981). The garden comprised 7 hectares and was designed as a typical traditional Japanese garden in Kaiyushiki style, e.g. enjoy walking around ponds, and has 3 ponds, the main, the west and the east (Tamura 1929). Nowadays, people normally enter from the gate of southwest, called Kantokutei Gate, then the tour on the west side of the garden. They walk at first through an open lawn area and then cross over the west pond. The pond is established as a miniature of Lake Shifu, in the South of China, which is appreciated as a beautiful landscape in China. Then people arrive to a small bridge, called Togetsu Bridge, from where they may look to the famous bank, called Sotei, which is again a miniature of the original Sotei Bank at lake Shifu. On the other side of the bridge, people find a small waterfall. After that they come up to a mountain, where they may enjoy an overview of the main area of the garden. Continuing the path, they walk up and down a mountain and come across the Engetsu Bridge. This bridge was constructed by the Shogun Mitsukuni under the guidance of the Chinese scholar Shunsui. They then come up and down a hill and enjoy Iris fields. These Iris fields are very beautiful in May and June because of the colorful flowers. After that people stop at Kyuhachiya cottage looking at the main pond on their right side. The fascinating trail then leads the visitors into a clad, beyond which they pass through the ruin of Karamon Gate. They now enter the inner garden, which they may enjoy by a round trip. Back to the gate, they walk to the westward along a narrow trail like in the mountains. Behind a deep forest, they can find light impression of a maple wood. For the wood is not densely planted and kept clear by the harvesting. In autumn, especially in late November, people can enjoy beautiful colored leaves there. From the area, they also can see the island in the main pond. The island, called Horaijima, symbolizes a kind of paradise. Over a bridge the visitors finally come back to the lawn field at the beginning of the tour.

The garden captures an area of about 7 hectares and the walk takes almost an hour. The garden is maintained by the local Government of Tokyo since 1936. They once the garden opened to the public without entrance fee. But because of the constructions and the growing congestions in the garden, only one entrance is available and it requires an entrance fee of 300 yen per adult, at present. Several members of the managing staffs and part-timers have maintained the garden, so far. But now gardening is put out to contract to the professionals of maintenance companies. The garden has a Japanese style restaurant, which provides food and meeting rooms. People use the restaurant for the tea ceremony, Haiku meeting and so on. At present the annual visitors are estimated as to some 200,000 persons, constantly.
The most congested month is April and the most congested day is normally 5. of May (Aoki 1984). The largest visitor number of the day was estimated about 7,000 persons.

INVESTIGATION

Visitors' number has been studied from 1970 to 1991 (Table 1). Several questionnaire surveys were conducted and we focused the survey of 5. of May 1974, in which the maximum number of the visitors' residence was observed. The questionnaire was distributed to the every 10th visitors and collected at the entrance. The fact that only one gate was available, is useful for this kind of investigation. 91% of the people cooperated with us and 268 samples were obtained. The respondents drew their behavior in the map and responded the question of feelings about congestion and quietness. Simultaneously the number of visitors in the garden was also counted at the entrance. The responses were accumulated in each period of time and the subjective impressions of congestion and quietness were calculated. The investigation gathered the answer of the visitors' behavior in the garden on the map in which they lined the trails walked and marked places stopped (Fig 1 and 2). The weather of the day was cloudy and pleasant. The temperature of noon was 22 degrees (Celsius) the humidity was 59% and the wind was 4.4m/s at the observation tower of Meteorological Agency located at Otemachi, 2 km away from the garden. The total number of visitors of the day was 2922 and the peak of the simultaneous stay was estimated at 929 persons. During the whole day, 46% of the visitors have a feeling of congestion. The highest ratio of impression of congestion amounted to 60% of people at 14 o'clock in the afternoon.

RESULTS

The answers, which indicated the behavior of the respondents, were overlaid and totaled at each route and place. The largest number of the passengers was observed at the path along the Tatsuta River (Fig. 1). And the largest number of the stops could be found at the open area in front of the Kuhachiya cottage (Fig. 2). More than 10% of spent some time even in peripheral areas of the garden. So more than 100 groups visited whole area of the garden on that day.
Figure 1: Ratio of passengers on 5 May 1974 (%)

Figure 2: Numbers of visitors stopped at the site (Upper: %, Lower: persons)
Factors | coefficients | T-value
---|---|---
Distance from the entrance | -0.099 | -1.6
Area of site (m2) | 0.4 | 5.2**
Canopy closed | 0.59 | 0.6
Gradient of ground(%) | -1.55 | -1.9
Object grade A (1,0) | 5.46 | 4.0**
Object grade B (1,0) | 4.61 | 4.5**
Object grade C (1,0) | 2.36 | 2.7**
Constant | 1.84 | 0.9

Corrected correlation coefficient was 0.89.

Table 2: Effective factors to visit the sites of garden (Analysis by multiple regression equation)

The use of peripheral areas showed a full of visitors at the peak use.

The frequencies were analyzed by the multiple regression equation to find the effective factors for visitation to the local sites. The width of site and interesting objects affected to the frequency with the statistical significance level of 0.01 (Table 2), i.e. they are effective factors to visit for the respondents.

The number of the visitors in the garden was increasing in the morning and at noon (Fig. 3), it decreased after 13:30 o’clock. The impression of congestion increased slowly related to the number of visitors. And the impression was decreasing rapidly after 14:00 o’clock.

Analysis of regression equation was applied (Fig. 4) for testing the relationship between impression of congestion and number of visitors. The results satisfied the significant statistical level of 0.01.

But the efficiencies of the regression equations were not the same in case of increasing and decreasing of the visitors’ number. The data obtained at the increasing of congestion fluctuated more gently than the decreasing. It was assumed that different psychological effects had happened in the density of increasing and decreasing.

This analysis reveals that the impression of congestion was related strongly to the number of visitors in the garden. It was shown that more than 700 persons in the garden arises the feeling of overcrowding in more than half of the respondents.

The analysis of regression equation was tried (Fig. 5) for the impression of quietness, too. The regression showed a statistically efficient result in relation to the decrease of the visitors and less than 400 persons simultaneously in the garden provided the impression of quietness for more than half of the visitors.

To propose a carrying capacity for this garden, the maximum number of the residence was generally estimated around 30% to the total visitors of the day (Table 1). According to this proportion, the daily number of visitors should be controlled less than 2100, to prevent from the congested impression of more than 50% of visitors. And if the daily number will be kept under 1200 persons, the criteria of quietness will also be satisfied.

With these criteria, we estimated the number of congested days within 6 months of this fiscal year of 2001, i.e. from April to September. The result showed 8 days overcrowded and 22 days unsatisfied quietness.

**DISCUSSION**

The carrying capacity of the Koishikawa-Korakuen was estimated at 700 persons. But this was not preferred density of the users. Quietness requires more rigid control of the visitors’ number: it has to be kept under 400 persons in the most congested period.

In historical times, when the feudal lord used the garden, his guests and their subordinates, only, the maximum number of people entering the garden simultaneously may be estimated at approximately 20 persons. Ono (2000) reported that the largest number of the visitors at Rikugien Japanese Garden, which comprises 10 hectares, amounted up to 50 persons in Edo era (ca. 1780). Then the density planned was seemed much lower than our result.

For example, the imperial gardens office of Kyoto has controlled the maximum guests under 40 persons simultaneously for 5 hectares of Katsurairikyu garden and 50 persons for 54 hectares of Shugakuinrikyu garden. We had better to propose more strict use capacity for the traditional Japanese gardens.

As for the entrance fee, this garden requires 300 yen per adult. But the garden of Saihoji temple, a moss garden, is reported to require about 3000 yen per adult (Dodd and Richmond 1999). Regarding better maintenance of the garden we can suggest much higher entrance fees.
Fig. 3 Fluctuation of visitors' density

Fig. 4 Relation between congestion and visitors' density

\[ y = 0.0383x + 22.2 \]

\[ R^2 = 0.883 \]

Fig. 5 Relation between quietness and visitors' density

\[ y = -0.042x + 67.8 \]

\[ R^2 = 0.792 \]
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Public Use of the Public Parks and Protected Areas of Budapest

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Abstract: Based on the series of studies investigating the public uses of various public parks and nature conservation areas of Budapest, a comparative evaluation was prepared which allowed us to quantify the actual recreational role of these two types of green areas in the green area system of large cities. The approach involved on-site interviews with questionnaires and on-site monitoring, with additional urban planning analyses. The results provided direct help in the development of green area management guidelines for cities and in the preparation of future management plans for protected areas. In addition, the results allowed us to develop planning guidelines and a basis for developing new means of environmental awareness raising and education.

INTRODUCTION

Park use studies in Budapest have been prepared regularly since 1986. Of great importance was 1994 because a comprehensive, simultaneous investigation was done in various types of public parks. In the last couple of years, public uses of public parks in Budapest were individually studied in connection with investment projects or city development plans. The data gathered throughout these years are now also suitable for assessing changes or trends in such uses.

In Hungary, the exact evaluation of the visitedness and public uses of protected areas has been brought into focus only for about 1 or 2 years. A series of similar, all-round-year comparative studies on the locally protected areas of Budapest were prepared for the first time in 2000.

Primarily, this study presents the results of the studies of 1994 on park uses and those of the studies of 2000 on protected areas (Nagy, 1997, Kellner, Nagy, 2001). The large number of data obtained during these two series of studies is suitable for comparative evaluation.

OBJECTIVES

The assessment of both public parks and protected areas had a number of objectives.

Evaluation of the data obtained provided direct help to the practical job in, for example, the maintenance of green areas, the design of playgrounds, the installation of additional pieces of furniture, reconstruction of some parts of parks according to new needs, the development of annual management plans and the design of educational pathways (Kellner, Nagy 2001).

In addition, the results form the comparative studies assisted both the planner and the decision-maker in the preparation of city development plans and conceptions, and as a basis for justifying individual plans and actions (Nagy, Pinter, Wettstein, 1998, Nagy, Szilagyi, 1998).

Furthermore, the information gained from these studies were essential in developing planning guidelines, green area development strategies and design indices (Nagy, 1997).

METHODS

The primary means for data collection included on-site interviews with questionnaires, structured, on-site monitoring (personal observation) and visitor flow counting, combining at least two of these approaches in each case. Depending on the topic, this was supplemented by demographic analyses, deep interviews, targeted "traffic" counting and city development investigations (evaluation of land use, traffic, parking, institutions, surrounding residential areas, etc.).

Normally, a dBase-based inquiry system was used to reveal the relationships between the test data.

In 1994 and 2000, on-site questionnaires were used in combination with on-site monitoring using "tables". The questionnaire included questions focusing on visiting habits (e.g. frequency, use of public transport), purpose of the visits, duration of the visits, determination of the extent of the catchment area and assessment of new needs.

On-site monitoring was done using previously compiled, matrix type tables to record the number, age and activity of the people staying in the park or in a part thereof.

STUDY LOCATIONS

During the studies, data were collected in a total of 8 locations in 5 parks. One of the criteria for selecting study locations aimed at selecting locations different in type and size (0.5 ha-100 ha) so as to
represent the diversity of the parks in Budapest. Thus, two large city parks on the east (Pest) side (Városliget, Népliget), one park in a blockhouse area (in Kelenföld, Buda side) and two downtown public gardens (Károlyi Garden, Hild Square) were selected.

Similar criteria were used in selecting the locations for the assessment of protected areas.

The study locations included:
- **Apáthy Cliff**: part of the protected forest area of Buda and a traditional target for excursions in Budapest.
- **Rupp Hill**: located in the outskirts, adjacent to areas of intensive residential development zones,
- **Róka Hill**: former limestone quarry near to a blockhouse area,
- **Kis-Sváb Hill**: located nearest to the inner city, an island-like hill wedged in a family house zone,
- **Lake Naplás**: located in the outskirts of the east side (Pest), in a plain area, and includes a huge secondary lake, a creek and a forest area.

**DATE AND DURATION OF THE STUDIES**

Sampling for the park use studies were done in two phases, between 1 June, 1994 and 30 September, 1994, and between 1 October, 1994 and 15 December, 1994.

In the protected areas, data collection occurred continuously in three phases between April and December, 2000.

Samples were taken at predetermined points in time, representing both weekdays and weekends, at various parts of the day and under various weather conditions.

**AMOUNT OF DATA**

The comparative studies on parks involved 1500 questionnaires and 128 targeted monitoring events in 5 parks.

In the protected areas data from a total of 750 questionnaires were processed. As a result of on-site monitoring, 220 data tables were evaluated.

In addition to the quantifiable data, subjective opinions of the visitors were also recorded. Thus, an additional job was to classify and evaluate such opinions.

**MAIN RESULTS**

**Characteristics of the uses of parks in Budapest**

- 60% of the visitors visit their favourite park every day.
- Among park users, the ratio of regular visitors is increasing.
- The catchment area of parks consists of the residential areas within 15 minutes distance, i.e. 75% of the visitors live within this area.

**Significant differences were observed between the catchment area of the two large (100 ha) parks. The popularity of Városliget and the surrounding town-like residential areas make it attractive to visitors form larger distances than Népliget, which is of similar size but of lower prestige and surrounded by industrial areas.**

- On average, visitors spend 1-2 hours in the parks during one visit. The time spent on visiting parks have been dramatically decreased over the past years.
On average, visitors of public parks changes six times per day. This daily "turnover" shows an increasing tendency (in the 70's the average turnover was four times according to certain studies).

The percentage of visitors above 30 years of age, including pensioners, is much lower than the average in Budapest, and this tendency is augmenting. Those in the active age (i.e. in the working age) would go to parks at an increasingly lower frequency. Most probably, this is due to the permanent time pressure. On the other hand, pensioners would justify their absence by public safety reasons.

Today, park users would mostly pursue moderately active (e.g. walking, playing) and inactive (sitting, sunbathing) activities. Active activities involving a lot of exercises are almost exclusively typical to those below 20 years of age.

The percentage of those walking with dogs is increasing at a very high speed and this is a source of conflict in the parks of Budapest. (In a 10 ha park located in an intensively developed, small house residential area, almost half of the visitors were walking with dogs!)

Downtown gardens are more visited during the weekdays than in the weekends.

The recreational role of public parks in Budapest is lower in the weekends than during the weekdays. That is, parks are more intensively used during the weekdays.

Public parks and gardens are more like a neutral meeting points, with increasing agora character.

Results of the studies in protected areas (nature conservation areas)

Mostly, the purpose of the visits is to spend one's leisure time outdoors, in good air and natural environment. The ratio of visitors specifically visiting these places to see the natural values is less than expected (12%). Every fifth visitor uses the protected areas as a place for jogging or cycling. A part of the young would regularly meet friends. Many come to walk their dogs.

Protected areas located in the traditional excursion targets are more visited in spring and fall, i.e. during the excursion season.

The island-like areas, which are surrounded by residential zones, are almost only known to and visited by those living in the neighbourhood.

Most of the visitors of protected areas are regular visitors, some areas have almost like a clientele. Almost half of the visitors visit the specified area on a weekly basis. Mainly in the case of island-like areas (surrounded by residential areas), the percentage of regular visitors can be as high as 80% (dog owners!).

On the basis of the time spent to arrive to the specified area, 60% of the visitors of protected areas live within a distance of 15 minutes. Apáthy Cliff, which is also an excursion target, and Lake Naplás are visited form larger distances, too.
On average, every second visitor arrives on foot, and 14% comes by bicycle. In the case of Lake Naplás, which is located at a larger distance from residential areas and is difficult to reach by public transport, 70% of the visitors arrive by car.

Most of the visitors visit the protected areas in the weekend, in the afternoon period. The number of visitors to island-like areas is considerable during the weekdays, too.

The biggest problem in almost all locations is litter and periodic abuses. In addition, in places where many walk with dogs (Kis-Sváb Hill) or rides a bicycle (Apáthy Cliff), or where parking places are not available (Lake Naplás) public use may also create direct damages to habitats (soil compaction, treading, erosion).

The level of education among visitors to protected areas is much higher than the average in Budapest, and is also slightly above the average of public park visitors.

People living in family houses with gardens are more bound to protected areas, and would visit such places at a higher frequency than those living in blockhouse areas of in the inner city.

The protected areas of Budapest are not completely known even to the visitors. On average, 80% of the visitors were aware to be in a protected area. Most of them had this information form the local signs. Most of the children heard about protected areas in the school or from the parents. The adult population would gather information mostly form local newspapers. However, a remarkable number of people believed that all the large parks in Budapest are protected areas.

COMPARISON OF THE VISITING HABITS IN THE PUBLIC PARKS AND IN THE PROTECTED AREAS OF BUDAPEST

Based on the investigations, protected areas are also used as places to spend leisure time and play an important role in public recreation. One of the reasons is that Budapest has few green areas in the direct neighbourhood of residential areas, and the overall size of green area per person is also low (as low as 10 m² per person, even if the forest zones are also included).

In the areas where public parks are missing, the use of protected areas (i.e. frequency and intensity of visiting, characteristics of the daily turnover, etc.) is similar to that of public parks. Similarly, the percentage of those walking with dogs is high, as is in the public parks of Budapest. In other protected areas the uses are typical of a park forest. The varied cliff configurations and geological formations attract the young mostly as playgrounds for adventure types of activities.

However, there is a significant difference between the motivation of visitors to public parks and protected areas. Many people like to go to protected areas because, in contrast to public parks, the vegetation is natural, and these are the only areas in a city where nature can be enjoyed in its original state. In general, visitors to protected areas are also more bound to public parks. However, many of the park users only know and visit "their own" nearest park.

Also, assessment of crowdedness is different in the protected areas. Visitors would already complain about crowdedness if more than 2 or 3 groups (families) are within eyeshot, simultaneously in the same part of the area. In the case of public parks the feeling of crowdedness depends on the size of the park. In the case of small public gardens, intensive use is better tolerated, whereas in large city parks, visitors would feel much comfortable in a quiet, less
intensively used part of the park, with the exception of walkways, playgrounds and sports fields.

With respect to the percentage of cyclists, there is a surprising difference between public parks and protected areas. The results show that the average ratio of cyclists is only 4% in public parks, but is as high as 13% in protected areas, although cycling is forbidden in certain parts of such protected areas. More than twice as many people go to protected areas by bicycle than to public parks. However, there is an interesting similarity in that the percentage of those arriving on foot is exactly the same, i.e. 48% for both types of green areas. Visitors of the parks and gardens much more frequently arrive by public transport, whereas almost one fourth of the visitors of protected areas arrive by car due to the larger distances and the difficulties with public transport.

Much similarly to public parks, most of the protected areas have regular visitors, some of them even have a clientele. Only 30% of the visitors of protected areas is occasional visitor and the rest visit these places on a weekly basis.

The primary catchment area for both parks and protected areas consists of the surrounding residential zones within a distance of 15 minutes. In spring and fall, i.e. during the excursion season, protected areas have a slightly larger catchment area with every fifth visitor travelling more than 30 minutes to arrive.

Age distribution of the visitors is similar in parks and protected areas. The percentage of those between 31 and 60 years of age is higher, but the percentage of those younger than 6 and older than 60 is lower in protected areas than in public parks. The percentage of those in the school years and of the youth is almost the same.

Distribution according to the level of education is the same for both types of areas. The results demonstrate that the green areas of Budapest, both natural and near natural, are visited by the more educated, with an outstandingly high percentage of people with college/university level education.

**PRACTICAL USE OF THE RESULTS**

Primarily, park use studies are prepared for the purpose of planning in the best accordance with public needs and of developing planning and management guidelines. In addition, the evaluation of these results creates a basis for recommendations that we prepare with regard to developing green area policy guidelines, and justifying and supporting municipality decisions. Investigations in the protected areas serve as a basis for the assessment of recreational loadability and for the identification of the public role of these areas within the green area system of Budapest.

The study results have been used for the following specific objectives so far:

- Defining the main function for proposed future public parks (e.g. sports park, events park).
- Preparing guidelines for green area planning.
- Identifying the green area development objectives of development programs and regulation plans.
- Measure and design of parking places based on actual demand.
- Measure and design of playgrounds.
- Identifying buffer zones for protected areas.
- Recommendations on the assignment of the most loadable visitors' zones in protected areas.
- Preparation of recommendations to improve education and awareness raising with regard to nature conservation.

**SUMMARY, CONCLUSIONS**

The present series of studies indicated that such data collection methods resulted in a database (not available from other sources) that, when evaluated and analysed for potential relationships, provides practical assistance in the development of green areas and in the management – in the good sense – of the natural values of Budapest.

Quantified results demonstrated that protection of the nature conservation areas in a city with a population of 1.8 million should not involve hermetic, reservation type of protection, i.e. absolute elimination of visitors. In large cities where the number of public parks is low or the availability of green areas is scarce, protected areas have an additional, special recreational role.

At the same time, island-like protected areas (i.e. those surrounded by residential areas) compensate for the missing public parks in a given zone, therefore their use is similar to that of a park.

Such recreational load should be considered in the management of protected areas. Protection of the endangered, sensitive habitats and zones is only possible if the intensive uses may be canalised to other parts of the area. These would be the locations for the "equipment, and furniture" for raising attention, offering interactive programs or interesting information, which can provide long term and valuable assistance in public education and awareness raising with regard to nature conservation.

**REFERENCES**

A Survey of Recreation Interests in Urban Forests, the Influence of Travel Distance

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Abstract: The forest complex of Heverlee-Meerdaal, which consists of two forest parts, is located on a gradient from a rural region to an expanding urban area. By means of counts an interpretation on congestion and on spreading of visitors in time and space in the area was made. On the basis of these counts questionnaires were carried out in the forest throughout the whole year and among all activity groups. The questionnaires dealt with socio-demographical characteristics of the visitors, preferences and perceptions of the respective activity groups and their interpretation of the forest area concerning structure and infrastructure. According to this study, the geographical distribution of the visitors in the forest is highly determined by the position of the forest along a gradient relative to the conurbation.

INTRODUCTION

The region of Flanders (northern part of Belgium) has a long history of intense agricultural exploitation and high population densities, which resulted in a complex cultural landscape with a dense urban and infrastructural network. Forest cover is limited to 10%. The last decades there has been an increasing demand for outdoor recreation areas and particularly for afforestation in an urban environment. To ensure proper design of urban forests, more research needs to be done on visitors’ perceptions, preferences and expectations (Rydberg & Falck, 2000). Little is known in depth about the interaction between the structural characteristics of the recreation site and recreation patterns in particular. However, much information has accumulated empirically by landscape architects in order to offer optimal planning, design and management solutions at particular sites for specific types of outdoor recreation (Bell, 1997). In sociological research a lot of attention is paid to the link between visitor characteristics and their behaviour in a broad spectrum of recreation activities (Tarrant & Green, 1999). An appreciation of visitor demands on natural resources and man-made facilities is required to identify the key issues that can be useful in decision-making and management. The recreation function of forests has been highlighted (Anon., 1993), but it is a task for the manager to integrate this function with all others, including nature conservation and silvicultural goals. As with most aspects of outdoor leisure, an attractive physical environment is demanded. The choice of a recreation site in a particular geographical area is influenced by site attributes (Clark & Downing, 1984) e.g. size, desolation, infrastructure, ...

An important factor for extensive recreational activity is the travel distance to the area (Lindhagen, 1996). This is of crucial interest for the design and establishment of new urban forests. The position of the two studied sites, situated at unlike distances to the city of Leuven, is an unique opportunity to study how recreation varies with the gradient from a more rural to a highly urbanized landscape. Next to socio-demographical characteristics of the visitors also their recreation preferences and forest perceptions are examined. We further analysed the demographical patterns of transport towards the forest complex and the interactions with visit typology.

METHODS

Study area

The forest complex of Heverlee-Meerdaal consists of two forest parts and is located in a gradient from 5 to 10 km south of the city of Leuven (Figure 1). It covers a total area of approximately 1890 ha and is the second largest forest complex in Flanders. The complex is a remnant of a vast forest that once covered central Belgium (Tack et al., 1993).

Because of the relative position of the forest complex to the agglomeration of Leuven (88.500 inhabitants), the adjacent parishes (50.000 inhabitants in total) and the public access an intensely practised recreation occurs throughout the whole year at fairly high densities. Therefore it can be considered to be an urban forest. A main road from Leuven to Namur forms a direct connection between the city center and the two forest parts. The forest is state property (Flemish region) and managed by the division of Forest & Green
focussing on three main functions: leasure, wood production and ecological conservation. The latter are detailed and integrated in a forest zonation plan. Management gives priority to a sustainable wood production and an application for FSC (Forest Stewardship Council)-labelling is accepted. Access is restricted to forest roads and paths, with a clear regulation in function of the type of recreation (walking, biking, horse riding, driving…). In contrast with many other Belgian forests plant biodiversity is exceptionally high, because of the limited fragmentation and the large habitat diversity on a variety of soil and topographic conditions. The forest stands consist mainly (65%) of deciduous tree species like oak \((Quercus\ spp.\ L.;\ 25\%)\), Beech \((Fagus\ sylvatica\ L.;\ 30\%)\), Hornbeam \((Carpinus\ betulus\ L.)\) and Birch \((Betula\ pendula\ Roth)\). About 35% is covered with coniferous species like Pine \((Pinus\ sylvestris\ L.,\ Pinus\ nigra\ subsp.\ laricio\ Maire;\ 30\%)\).

Counts and data sampling

The counts \((n=5972)\) had the purpose of giving a solid impression of the distribution of visitors throughout the total forest area. They were executed at nine predetermined locations (four in Heverlee (HF) and five in Meerdaal forest (MF), distributed over the total area but preferentially at paths used by all recreation types (Figure 1). This was done every season during the weekend as well as during the week between 7.00h and 21.00h. These data are not proper for simulating the total visitor in- and outflux but for each recreation type a reliable minimum of respondents per recreation type could be determined. The counts were used further for controlling the proportional representativity of interviewees compared to visually observed visitors, in respect of preventing over- or underestimation of certain groups (cf. Jansen et al., 1994; Kroon, 1994).

Visitor information was collected by means of a questionnaire, administered through personal interviews in the period between the summer of 1998 and spring 1999, at the same positions where counts took place. The questionnaire was tested preliminary and then amended and made more complete. Visitors were interviewed by the ‘next-to-past’ technique (cf. Sgeren & Visschedijk, 1997), the sequential interview of a person or groups passing by. The first person taking the floor was considered being the respondent for the complete questionnaire. Initially a quota of 450 questionnaires was taken because of statistical integrity. By planning and observation these were distributed proportionally over all seasons and recreation types. Finally 526 detailed questionnaires were completed and 606 of an earlier and more incomplete test version.

The questionnaire focussed on visitor profile and origin, complaints and preferences in activity, forest structure and infrastructure. Response formats were either closed (dichotomous, multiple choice) or in ranking scale (cf. Jensen & Koch, 1998). Where needed, questions were clarified by photos. The oral questionnaire gave the possibility of clarifying the questions by direct interaction between interviewer and interviewee, enhancing the reliability of the answers. The interviews were conducted by a professional polling firm.

Data analysis

The data were analysed using categorical data processing methods (Agresti, 1990) such as Pearson \(\chi^2\)-testing (cross tabulation) and nonparametric statistical tests (Siegel & Castellan, 1988). For all statistical analyses SPSS was used (SPSS 10.0, 1999). Analysis of the data concentrated on the differences between the two forest parts in relation to a distance gradient towards the city of Leuven and a possible influence of this on visiting patterns. Key issues are the distance covered reaching the forest and the transport means used. Another important item is visitor behaviour including the type of activity, group size, visit duration and frequency. The calculation of georeferential data (covered distances and time during journey) was executed using Geographic Information Systems (GIS), more specific with databases like Streetnet Flanders (TeleAtlas) and Route 66 (Copyright Route 66 GIS B.V.) (Moons et al., 2000). Items of interest are also the preferences for forest type and structure, topography and path structure.
SOME RESULTS

Visiting patterns in time and space

The counts give evidence to the fact that recreation appears to be most intense in autumn (28%), immediately followed by summer (26%). 45% of all visits happens in the weekend. There seems to be a preference of some activity groups for certain seasons. Walkers prefer autumn (57%), while joggers (52%) and bikers (41%) mostly come by in spring.

Social characteristics of the visitors

Most respondents (n= 1132) are male (71%), which can be considered to be an undistorted measurement because in the independent visitor counts male were 67% part of the visitors’ party. The largest group of respondents is the 31-45 age group (37.8%), with second in line that under 30 years (27.9%). The mean and median age are respectively 42 (sd= 16) and 40 years. The visitors in HF mostly belong to the youngest or oldest age group, while visitors of MF are rather middle aged. It can be observed that walkers appear more than expected in the oldest age groups, while joggers mainly are between the age of 36 and 45. Biking as well as horse riding are dominated by the youngest age groups.

As far as the educational status is concerned, 50% of the respondents (n= 526) has a high level of formal education (higher level -3 years- or university education). Minimum 30% of the others has finished secondary school. 60% works as employee or skilled worker. Retired people and students count respectively 13% and 11% of the respondents.

Most of the visitors are married or live together (63%) and have a family of maximum three persons (60%). About 23% has children older than 15 years. Singles represent 30% of the total group. A minor group (7%) consists of divorcé(e)s and widow(er)s. Each of these groups consists of approximately 2/3 men and 1/3 women, as was also earlier observed in the counts.

Recreation activities

Interviewees were asked for the main reason of their visit and were asked also to ordeny several pre-listed reasons, based on the preliminary questionnaire. Most visitors (48%) came for a walk. There is a pronounced difference (χ²= 27.159; P<0.001) between the two forest parts concerning the main activity. Joggers clearly prefer HF and bikers do the same with MF (Figure 2).

In general, biking (29%) is the second most practiced activity, followed successively by jogging (16%) and horse riding (7%). Mostly confirmed additional reasons for visiting the forest complex are health reasons (64%), relaxation (47%) and enjoyment of nature (36%).

Figure 2: Distribution of the activities per forest part (n= 526); * significance of difference (P< 0.05) between forest parts

For all activities, except for walking, a group size of one person is the most given answer (χ²= 66.570; P<0.001). Almost 50% of the interviewees visit the forest on their own. This is even much more for joggers (68%) and horse riders (63%). Walkers have a maximum score by a group size of two persons (48%). Relative frequency declines when group size increases. In MF visitors appear more in group than in HF (χ²= 19.214; P=0.023), matching a different spectrum of visitor activities.

Visitor arrival is maximal in two periods. One peak occurs from 9.00h till 11.00h and the other from 14.00h till 15.00h. The time of peak departure is postponed for about two hours in comparison with arrival (Figure 3). Arrival, as well as departure intensity, drops during noon. The maximum visitor congestion is reached around 11.00h, but there is a nearly stable congestion period between 10.00h and 19.00h. The mean length of a visit to the forest complex is 103 minutes (sd= 73).

Figure 3: Cumulative percentage of visitors’ arrival and departure time (n= 526)

Almost 80% of all interviewees stays between half an hour and three hours. There are some unexpected differences in visit duration between activities (χ²= 55.810; P<0.001) as well as between forest parts (χ²= 42.298; P<0.001). Explicit maxima in duration are observed for joggers, horse riders and bikers, varying respectively in length between
half an hour and three hours. In HF most visitors stay between half an hour and two hours (median= 75 min), while there is a peak duration in MF between two and three hours (median= 120 min).

Most of the total number (HF and MF together) of respondents (58.6%) visit the forest at least once a week. 16.7% does so at least once a month and 24.1% less. In MF the peak visit frequency is one time a week. In both forest parts a small peak (10.1%) is noticed at a frequency of two or three times a year. The most intensively visited forest is HF ($\chi^2 = 42.014; P < 0.001$). This is clearly reflected in the counts ($n = 5972$) indicating that 68% of all visitors go to HF and also that forest recreation is most intense in weekends (45%), spring (36%) and autumn (43%).

Visit duration is significantly correlated with visit frequency ($r_s = -0.261; P < 0.001$). So visitors that come more often, stay less long. People coming only a few times a year and making longer distances stay relatively longer.

**Travel distance**

Mean distances covered to both forest parts differ significantly from each other (Mann-Whitney: $Z = -6.963; P < 0.001$). People visiting HF cover a mean distance of 6.6 km ($sd = 8.9$), while visitors of MF do so in 8.8 km ($sd = 8.8$). Travel distance and time (minutes) to reach the forest proved to be strongly correlated ($r_s = 0.964; P < 0.001$). There is also a significant difference between the distances covered by different activity groups ($\chi^2 = 17.967; P = 0.036$). Joggers mainly cover short distances, while horse riders make no complaint travelling longer distances. This also explains the strong difference ($\chi^2 = 35.288; P < 0.001$) in covered distance between the two forest parts (Figure 4). As expected, similar patterns can be observed for the travel time to the forest. Both differences between forest parts ($\chi^2 = 19.863; P = 0.001$) and activity groups ($\chi^2 = 32.386; P = 0.006$) are significant.

Most visitors ($n = 1132$) use the car for transport to the forest complex (55%). 27% comes by bike and 15% on foot. Differences between activity groups are significant ($\chi^2 = 219.212; P < 0.001$). The car is most popular, except for bikers, of which 60% arrives by bike. Approximately 30% of all walkers comes on foot. There also is a significant difference between the transport used for both forest parts ($\chi^2 = 33.459; P < 0.001$). Both are reached mostly by car, but the difference in frequency measures 25%. Accessibility (45%) is the most given argument if asked ($n = 526$) why people enter the forest at a specific location, followed by the presence of a well indicated parking area (13%).

There is an interaction between the distance visitors have to cover reaching the forest complex and the way the visit occurs. Visit duration is positively correlated with covered distance ($r_s = 0.111; P = 0.015$), whereas visit frequency and covered distance are less clearly related.

**Visitors’ expectations in forest structure and infrastructure**

All activity groups were asked to answer multiple choice questions about preferred forest composition and structure. First they had to answer which forest type is preferential, either deciduous, mixed or coniferous ($n = 246$). Most respondents (59%) explicitly prefer mixed forest ($\chi^2 = 109.780; P < 0.001$). Walkers react negatively against coniferous tree species and horse riders explicitly prefer mixed forest. Concerning forest structure, 78.9% of the respondents ($n = 199$) prefer (little or strong) variation in forest layers ($\chi^2 = 14.0; P = 0.001$). Sloping grounds are preferred over flat terrain ($\chi^2 = 112.154; P < 0.001$). 84.6% of the respondents ($n = 234$), distributed over all activity groups, has a strong preference for topographical variation. All activity groups together ($n = 223$) have a weak but significant preference for wide forest paths ($\chi^2 = 3.771; P = 0.05$). But only the group of joggers ($n = 37$) shows a clear ($\chi^2 = 7.811; P = 0.005$) preference for wide forest paths.

Visitors ($n = 526$) were also asked to confirm whether certain infrastructure should be present in the forest. Litter bins (88%) are confirmed most, catering facilities least (18%). As expected the group of walkers, joggers and bikers give priority to organised routes for their activity, while non-hardened paths are important for horse-riders.

**DISCUSSION**

Visitor characteristics are important variables explaining recreation activity. Personal characteristics, combined with those of family status and the specific work and living situation determine recreation activity responses (Katteler et al., 1975). Knowledge about these characteristics is essential to focus on the totality of the visitor population and their inherent demands and needs. We have found that forest visit is related to higher educational levels, which was also suggested by
Loesch (1980) and Jansen et al. (1994). Perhaps it may be explained by the fact that these people need more active relaxation in quiet surroundings. The 31-45 age group is strongly represented, as was earlier detected by Baillon (1975); this group includes mostly working people actively expanding their career and also having created a family or a cohabitation situation (AMINAL, 1993). These groups forms about 24% of the total population of Leuven. Unlike other studies that demarcate the underpresentation of singles (Meeles, 1982), in our results singels form 30% of all visitors. Recreational activities have mainly followed the increasing individualisation of society.

Walking is internationally the most important activity in forest recreation (Germany: Roznay, 1972; Flanders: Gillis & Lust, 1976; Vanderlinden & Lust, 1998; Sweden: Lindhagen, 1996; Switzerland: Gasser, 1997; Ireland: Guyer & Pollard, 1997). The other main pastimes like biking and jogging are a more energetic activity in comparison with the main reason in England, which is walking the dog (Hanley & Ruffell, 1992). In modern society there is a tendency to more active recreation. Horse riding is encouraged by the establishment of several maneges at the outskirts of the forest complex. It is remarkable that 64% of all respondents consider their outdoor activity as being important for their health (cf. Kaplan & Kaplan, 1989).

Compared to earlier European studies (Schmithüsen & Wild-Eck, 2000) the visit frequency is relatively high. It is presumed that distance is a crucial factor influencing the visit frequency of urban forests (Lindhagen, 1996). Small forests at a short distance from conurbation are more intensely frequented than large remote forests (Visschedijk, 1987; Hekhuis & Peltzer, 1995). This pattern is clearly confirmed by the location of Heverlee and Meerdaal forest. People living at a short distance from the forest travel limited time and thereby a visit happens more frequently, but the length is also much shorter. Critical distances, if shown consideration for travel time, are between 0 and 3 km for pedestrians, between 0 and 10 km for bikers and less than 25 km for car transportation (De Nil, 1973; Roggeman, 1982). A journey time of five minutes is already stated to be critical (Coles & Bussey, 2000), which is even more extreme, but relevant in interpreting the visitor proportion of Oud-Heverlee in the study. A total of 60 % of the forest visitors travels a maximum time of 15 minutes, comparable to the results of Elsaesser (1996), who computed a total of 75 % travelling less than 20 minutes. The mean visit duration in the forest complex is restricted to approximately 100 minutes, explaining the peak arrival in late morning and afternoon, while there is a decline of activity during noon. This matches well former results observed in Flanders and the Netherlands (Gillis & Lust, 1976; Peltzer, 1993; Hoogstra & Van Kerkhove, 1995; Vanderlinden & Lust, 1998; Visschedijk, 1999). However there also is an difference between the two parts of the forest complex. Visitors having the intention of staying a longer time take more effort covering the distance to the larger and more distant forest of Meerdaal. The percentage of visitors in this forest part travelling by car is likely much higher, even so being everywhere the most popular transport (AMINAL, 1993; Peltzer, 1993; Schmithüsen & Wild-Eck, 2000), and these visitors stay significantly longer. For the same reason joggers, a lot of them also running toward the forest, are significantly more represented in Heverlee forest. In comparison, bikers have a smaller functional area in HF and benefit a longer travel time being compensated by a larger forest area. The benefit of transportation time is determined by a combination of both the type of recreation and the desired duration of the recreation activity. It is remarkable that more than 50% of all visitors comes minimum ones a week to the forest complex. However comparable high rates were observed in Finland (van de Ven & Konijnenburg, 1994) and Germany (Volk, 1992). Walkers come most frequently, followed by joggers and horse riders. Bikers stay behind in mean visit frequency. The same tendency has been observed in the Netherlands (Segeren & Visschedijk, 1997).

Concerning visitor preferences for forest structure, there is an explicit preference for mixed forest types and strong variation in forest structure and topography. This is in agreement with the hypothesis that diversity and variation makes a forest acceptable for recreation (Coeterier, 1992). Coniferous forests are not popular because of the association with uniform forest stands without variation in tree and brushwood, as they appear in many plantations of northern Belgium. But coniferous trees are quite appreciated in mixed forest because they create variation in winter time (Veer & Boerwinkel, 1998). A preference for wide forest paths is probably the consequence of the fact that one can choose his own way avoiding muddy tracks and a higher safety feeling is sensed.

Visitors give priority to infrastructure minimizing the impact effects of recreation. In particular the occurrence of litter is considered to be disturbing. Organised routes are appreciated by the respective target groups. In contrast with its visit frequency, Heverlee forest is appreciated less than Meerdaal forest. This could be due to the increased visitor congestion (Jensen & Koch, 1998) - even though this is not expressed in the responses -, the noise nuisance caused by the highway crossing the northern part of Heverlee forest or the less expressed variation in forest structure and topography.

CONCLUSION

In this study the recreative use of the forest complex of Heverlee-Meerdaal by the population
was investigated. The visit typology can be approached throughout preferences and demands of the visitors themselves, as well by the location and the characteristics of the forest. Counts delivered quantitative data about forest congestion and subsequent questionnaires gave qualitative data concerning motives, perceptions and preferences of the visitors. The average visitor is a middle-aged person with higher formal education and living in a family or cohabitation situation, mostly male.

The preferred activity is walking, followed by biking and jogging. Most of the people visit the area on their own. Visit frequency and are negatively correlated and strongly determined by the covered distance from the residence to the forest.

This distance effect is described by a transport pattern of a gradient from an urbanised to a rural landscape. The dominant visitor group consists of locals and inhabitants of the city. Neverlee and Meerdaal forest attract a different type of visitor, influenced by the size of the forest area, the desired recreation activity and the distance to the forest part. Approximately 70% of the visitors are inhabitants of the city of Leuven and the adjacent conurbation, confirming the urban character of the forest complex.

A preference is given to mixed forest types with variation in structure and topography. Most respondents give a positive response to additional infrastructure, giving absolute priority to the appearance of litter bins. The overall forest area is evaluated very positively.

These data indicate the importance of visitor demands in respect of their interests for outdoor recreation activity. They provide essential information for decision-making concerning forest management in terms of silvicultural practices, infrastructure and the establishment of new urban forests.

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Recent Trends of Park Use at Tokyo Metropolitan Area

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Abstract: Tokyo Metropolitan Government has studying its urban parks since 1982. Several parks are selected in each year, and the parks under study are increasing. The cost has already amounted more than 10 million yen. At 69 parks, the government counted the visitors’ number of the monitoring day and interviewed age of visitors, their way of access, purposes of visit, their impressions of the parks and the requirements of the park management. The results were totaled at each park category. The categories were: A, famous park well facilitated; B, city park with wide, grassy open space; C, sports parks; D, natural forest parks in hilly area; E, historic garden parks with admission; and F, small parks. The density of visitors ranged from 1-200 persons per hectare, and 80% of parks had a density below 50 persons per hectare. The inducement sphere, 80% of visitors accessible, was ranged from 1-50km; the widest radius was observed at the parks with admission and the park at the city center. A frequent arrival of the visitors was observed 1-2 p.m. and the exit was 2-3 p.m. at the historical gardens (E type). The parks, less than 20 hectare, showed the increase in visitor numbers in proportion to the park area. B type park showed the increase of residence time in relation to the park area. Congestion had a bipolar effect on visitors’ satisfaction: each park has its own comfortable visitor density.

INTRODUCTION

Since 1966 Tokyo Metropolitan Government has conducted studies of recreational use of parks in coordination with a nationwide survey carried out by the Ministry of Construction. The studies have been carried out by the Metropolitan Government assisted by the private companies since 1982. To assess trends of park use in Tokyo metropolitan area, the annual results were summarized and analyzed in 1989 and 1994. This paper reviews the trends of studies of recreational use of urban parks in Tokyo since 1982 and shows the results of the analysis conducted in 1994.

TRENDS OF STUDIES ON PARK USE

Table 1 shows the history of park studies conducted since 1982 until 1998. A total of 69 metropolitan parks were investigated and more than a half of them were already investigated twice. Since 1990, we surveyed 6-10 parks in each year and per year and paid more than ten million yen including contract cost.

We investigated the number of visitors at the park entrances, which ranged a few to many depending to the park type, and interviewed a questionnaire in the park. The former task employed 60-310 individuals and the later employed 20-130.

The visitors were counted on a holiday in October since 1990 compared to two separate days, one weekday and one holiday, from 1982-1989. The annual visitors were estimated on the basis of the survey results in proportion to the data of the charged parks where we counted the exact visitors’ numbers through the year.

The interview was conducted on a holiday in October. We asked age of respondents, group composition of visitors, means of transportation to access, time duration to reach the park, frequency of visits, reason for choice the park, purpose of visit, facilities used, impression of the park, and requirement of facilities and their image of the park.

RESULTS OF ANALYSIS

The analysis used the results of 46 parks surveyed from 1990-94. We summarize the some trends of park use in Tokyo metropolitan area.

The parks were categorized into six groups according to the factors, as the reason of establishment, park facilities, users’ behavior and inducement spheres.

Type A involves well-known major parks with well facilitated (e.g., Hibiya Park, Ueno Park).

Type B involves multipurpose parks and scenic parks which have a large grassy open spaces or a wide recreational areas (e.g., Shakujii Park, Nogawa Park).
Type C involves sports parks with various sporting facilities (e.g., Komazawa Olympic Park).
Type D involves hilly parks and natural parks (e.g., Sakuragaoka Park).
Type E involves historical parks and Japanese-style gardens (Koishikawa-Korakuen Gardens).
Type F involves small parks (e.g., Aoyama Park, Nakagawa Park).

Density of visitors
Density of visitors was calculated as the average density of visitors per park area at each hour. This indicates the congestion of the park of the day. As in Figure 1, 80% of parks showed a visitor density of under 50 persons/ha. Zoological park, botanical gardens and parks with cultural installation or sporting facilities showed much higher densities.

Conversely, as in Figure 2, the lower density was observed at Type D, hilly parks with large forest.

Inducement sphere
The inducement sphere was estimated by the radius of the area where 80% of respondents lived in and the induced distance was calculated as the average radius of the sphere.
Induced distance of each park is shown in Figure 3. Tokyo metropolitan parks had the distance ranged from 1 km to 50 km. The large inducement spheres were observed at the charged parks or park located in the city center. Figure 4 shows the frequency distribution of the inducement sphere of each park type. Type E parks, historical parks and Japanese gardens, had a larger inducement sphere, while other types had a sphere of less than 10 km.

Fluctuation of visitors’ arrival, leaving and residence in the park
Figures 5-7 illustrate fluctuation of visitors entering, leaving and residence of each park type.
Type E displayed high concentrations of arrival during 13-14 o’clock and departure during 14-15 o’clock. In contrast, Type C, sports parks, showed a relatively gentle fluctuation for both arrival and departure due to the capacities of the facilities and also showed the gentle peak by the constant use.

Effect of park area to the visitors’ number
Figure 8 shows the correlation between the annual number of visitors and park areas.
The greater annual number of visitors was observed at the larger park (Aoki 1984).
However, the large park, e.g. over 20 ha, especially well-known, major parks of Type A showed the inconsistent results. Because these parks were affected by the invents held at the park and the location of the park on the annual visitors. And type D, hilly parks, showed the smaller number of visitors compared to the park area. As for the smaller parks, i.e. less than 20 ha, the annual number of the visitors was related to the park area. (Fig.9)

Effect of park area to residence time
Figure 10 reveals a weak correlation between the average residence time of visitors and the park area. And Figure 11 demonstrates, different residence time at each park type.
Sports parks and gardens showed similar residence time in the park category, because of the similar behaviors at the park. Type B, multipurpose or scenic parks, showed the effect of park area on the residence time, because of the variety of visiting purposes. (Fig.12)

Relation of satisfaction and congestion
Satisfaction ratio was calculated as the percentage of respondents who stated satisfactions in the questionnaire. Congestion ratio was calculated as the percentage of respondents who stated the park to be congested. The level of satisfaction decreased at the weak congestion and at the overcrowded. The highest satisfaction was observed at 15% the congestion ratio. (Fig.13)
This suggests that some visitors are seeking tranquillity and relaxation, and some are enjoying a crowd.

REFERENCES (IN JAPANESE)
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<td>Akita Park</td>
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<td>Shinshu Park</td>
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<td>56</td>
<td>Hashimoto-Kamimura Park</td>
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<tr>
<td>57</td>
<td>Kita Park</td>
<td>243</td>
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<td>Belvedere Park</td>
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<td>59</td>
<td>Komagome Park</td>
<td>7.3</td>
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</tbody>
</table>

Number of investigated parks: 69

Investigated area (in 1000 yds²):

<table>
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<tr>
<th></th>
<th></th>
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<th></th>
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<th></th>
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<td>104.1</td>
<td>89.0</td>
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<td>45.8</td>
<td>57.2</td>
<td>89.1</td>
<td>80.8</td>
<td>133.5</td>
<td>189.7</td>
<td>219.9</td>
<td>239.6</td>
<td>234.9</td>
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</table>

Number of investigators:

- Questionnaire survey: 31, 110, 44, 35, 24, 26, 24, 27, 58, 52, 61, 102, 81, 128, 106, 34, 47

Number of interviews:

- Counting survey: 2, 5, 4, 3, 2, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
- Questionnaire survey: 286, 242, 1626, 1446, 1139, 1139, 1145, 1077, 2265, 2228, 2286, 2227, 2225, 2028, 2589, 1888, 1343, 1580

Cost (million Yen):

- Counting survey: 3, 5, 4, 4, 3, 2, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0
- Questionnaire survey: 286, 242, 1626, 1446, 1139, 1139, 1145, 1077, 2265, 2228, 2286, 2227, 2225, 2028, 2589, 1888, 1343, 1580
Fig. 5 Fluctuation of visitors’ arrival

Fig. 6 Fluctuation of visitors’ leaving

Fig. 7 Fluctuation of park visitors

Fig. 8 Relationship between visitors’ number and park area

---

*Fig. 5 Fluctuation of visitors’ arrival*

*Fig. 6 Fluctuation of visitors’ leaving*

*Fig. 7 Fluctuation of park visitors*

*Fig. 8 Relationship between visitors’ number and park area*

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SUMIYOSHI, UCHIYAMA: RECENT TRENDS OF PARK USE AT TOKYO METROPOLITAN AREA
Fig. 9 Correlation between visitors’ number and park area (smaller than 20ha)

\[ y = 90.946x - 255.58 \]
\[ R = 0.636 \]
\[ T = 4.439 \]

Fig. 10 Relationship between average residence time and park area

\[ y = 2.3379x + 19.131 \]
\[ R = 0.673 \]
\[ T = 3.151 \]

Fig. 11 Average residence time by park type

Fig. 12 Correlation between average residence time and park area (type B park)

Fig. 13 Relationship between satisfaction of visitor and congestion
The Planning of User Flows in Istanbul Groves for Sustainability in Natural Structure

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Email: aduzun@istanbul.edu.tr

Abstract: The greenness of Istanbul Bosphorus, except its natural vegetation, is gathered in its parks, gardens and groves. The greenness of the Bosphorus identifies itself with the groves that also have great monumental value. Today, in Istanbul, there is a great number of groves that belong to either governmental or private institutions. Recently, these groves have experienced increasing pressure from the great number of visitors and their potential use. The latest inventories indicate that existing use patterns of the natural resources of groves affect the trees and plant diversity negatively. Overuse of specific sites causes damage to vegetation especially for exotic plant species that are rarely found in Istanbul. This paper is aimed to describe progress on a system that enables optimal dispersion of use patterns and sustainable use of the groves for future protection. The “User Inventory for Istanbul Groves” was developed to include periodic user observation and user survey in order to maintain groves effectively. For this reason, the computer technology is used as an evaluation tool for examining the user survey results and physical data of the groves that concentrate especially on Yildiz Grove. For the purpose of the study, Yildiz Grove is divided into different zones based on the physical conditions and potential use patterns of the grove and a system is developed that depends on sensitivity for usage.

INTRODUCTION

The metropolis of Istanbul is located in the northwestern part of Turkey. The Bosphorus that divides the city into two parts lets the European and Asian continents meet together.

Istanbul comprises the 9.7 % of the country’s total land surface and it has significant importance on presence of the population. According to the year of 2000 population census, the total of the city’s population reached to 10 041 477 and the annual increase is estimated to be 0.035 (Anonymous, 2000).

The amount of the active green space of Istanbul is 1.9 m²/per person including playgrounds, sport areas, public groves, forest and picnic areas. The amount of the passive green space is 3.1 m²/per person including afforested areas, nurseries and forests, green spaces with scenic values, public squares, refuges, cemeteries, etc. based on the 2000 census (Aksoy, Y. 2001).

According to this situation the total amount of the green space for per person is 5.2 m² in the city and there are certain efforts to raise this number of urban open spaces. But because Istanbul has always led in urbanization in the region, high immigration and the density of construction in the city center have limited these efforts.

The vegetation formation of Istanbul summarized maquis that represents the Mediterranean along the slopes and ridge of the Bosphorus and islands of Istanbul, and this vegetation type forms very dense and high vegetation cover in non-damaged areas. The other vegetation covers of Istanbul that form the green space of the city are comprised of groves, parks and residential gardens. Especially the Istanbul groves represent the greenness of the Bosphorus with natural appearance and monumental value.

In this study, the Yildiz Grove is selected as a sample area in the Besiktas District that has dense population and movement. The amount of the green space is 5.5m²/per person for the Besiktas district. In spite of the fact that the number is higher than the city average, the amount is accepted as “lower” because of the size of the population during day times.

The reasons for the selection of Yildiz Grove as a sample area for this research are its charming potential for the people with the magnificent Bosphorus view, its historical importance and the monumental trees that the grove has.

After examining the physical data of the Grove, questionnaire surveys named “User Inventory for Istanbul Groves” have been distributed to the user groups of the area.

In the light of this inventory, the Yildiz grove was evaluated depending on its sensitive structure, using style and density, and certain decisions were...
made for keeping its sustainability in a natural structure.

**ISTANBUL GROVES**

The word “grove” is described as a small wood, a big group of trees or forested area located in or near the city.

Today, in Istanbul, there are a great number of groves that belong to either governmental or private institutions. And they have a very important role in the city because of their recreational capacities and potential of green spaces. (Table 1).

<table>
<thead>
<tr>
<th>Grove Name</th>
<th>Area (ha)</th>
<th>Main characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cubuklu</td>
<td>23</td>
<td>Old garden of Ottoman Pavillion</td>
</tr>
<tr>
<td>Buyukcamlica</td>
<td>12.4</td>
<td>&quot;</td>
</tr>
<tr>
<td>kucukcamlica</td>
<td>24.8</td>
<td>&quot;</td>
</tr>
<tr>
<td>Abrahampasa</td>
<td>27.9</td>
<td>&quot;</td>
</tr>
<tr>
<td>Fethipasa</td>
<td>16</td>
<td>&quot;</td>
</tr>
<tr>
<td>Harem</td>
<td>3.2</td>
<td>Natural grown urban forest</td>
</tr>
<tr>
<td>Yildiz</td>
<td>46.7</td>
<td>Old Garden of Ottoman Pavillion</td>
</tr>
<tr>
<td>Emirgan</td>
<td>47.3</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

*Table 1. The important Groves belong to governmental Institutions*

Recently, these groves have experienced increasing pressure because of overuse of these areas. In the last few decades, there have been certain damages, especially on vegetation, depending on the overuse. Parallel to this dense usage, compaction occurred on the soil coverage of these areas and knocking down of trees, drying or dying of trees or growing problems were determined. There is no chance for natural succession like in the forest in these areas and it necessitates usage sensitivity and protection.

**THE CHARACTERISTICS OF THE RESEARCH AREA**

The most important one of all these groves is Yildiz grove in the Bosphorus area because of the natural structure and historical value. The ownership of the grove is the Istanbul municipality and it covers an area of 46.7 hectares. Opened to the public in 1950, the grove was restored and the historical Malta and Cadir Kiosks were opened for public use in 1979. The historical ceramic factory has also been run in the area (Yaltirik, Efe, Uzun, 1997).

The grove has very important potential for attracting people with its magnificent view open to the Bosphorus and Marmara Sea, cafés, sitting places, ornamental ponds, small lakes and monumental trees.

According to our study of the natural structure, 120 natural and exotic woody plant species were determined to be in the area. With natural vegetation structure in non-damaged areas, the grove has an important value for the protection of biological diversity in the city.

The user density of the area is very high because of district of Besiktas where the grove is located is very populated. Especially on spring and autumn days, the weekend use of the area has reached as high as 10,000 people. The area has two entrances and the one at the south is the most popular one. The daily average of cars that prefer the main entrance on summer season weekdays is 150 and this number can reach 1200 on weekends. During the winter season, the daily average of cars at the main entrance is around 100, but this number exceeds 400 during weekends. The number of the cars at the east entrance is more than 1/3 times bigger than the one at the south entrance. According to official recording and counting of the cars between January 1st and October 31st the total number of the cars is 53 000 in the year of 2001. There is no entrance fee for pedestrians but cars must pay a fee.

**THE CASE STUDY OF THE RESEARCH AREA**

The fieldworks of the area have been subjected to a detailed study. All the physical data related to the area have been transferred to the computer in order to reach efficient and easy results for further studies.

Classification of various forest covers defined as individual inventory units were realised by using analogue topographic maps, the orthophotos having 1/5000 scale. First of all, the analogue data were transformed to the digital form by means of a wide-
Figure 2. The vegetation map of the Yildiz Grove
format scanner and a large-format digitiser. The cadastral boundaries of each planning unit were transferred onto the digital orthophotos, which were overlapped onto the topographic maps by using GIS software package NETCAD. Compartment boundaries were drawn first based on the roads, streams and mean ridges of the hills as a first step, and then the inventory units were placed into compartments (Yesil, et.al.,2001) (Figure 2).

After examining the physical data of the Grove via prepared maps, the area was evaluated based on the interferences and changes caused by land-use differences until today. According to natural data and land use relationships of the Yildiz Grove, the area is divided into four sections showing different characteristics.

- Maximum Interferenced Areas (Management Building and surroundings, nursery-garden and greenhouses, historical ceramic factory, Fire Department Building)
- Interferenced Areas (Malta and Cadır kiosks and surroundings, the pond and the surroundings)
- Minimum interferenced areas (the trees are protected but natural ground cover removed for the intensively cultivated areas with lawn)
- Protected Areas (the trees are healthy and protected, the natural ground cover is somewhat damaged but easily renewable)

THE PREPARATION AND APPLICATION OF THE DATA GATHERING

The methods of data gathering for the Yildiz grove were formed with long-term visitor observation, selective questionnaire conduction and official car registration and counting. After long-term observation of the area between May 2000 and September 2001, the important sub-groups and the relevant ratios between them were determined as following in order to determine the sample size for the questionnaire.

i. Main Entrance at South: East Entrance.  2:1
ii. Male: Female 1:1
iii. Pedestrians: Car Drivers
   Main Entrance 2:1     East Entrance 1:1

TOTAL SAMPLE (240)

<table>
<thead>
<tr>
<th>MAIN ENTRANCE AT SOUTH(160)</th>
<th>EAST ENTRANCE (80)</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
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<td>FOOTH(20)</td>
</tr>
<tr>
<td>CAR(20)</td>
<td>CAR(20)</td>
</tr>
</tbody>
</table>

Figure 3. Determining sampling size

The primary purpose of the questionnaire was to explore the relationship between the area resources and usage of people. For the planning of user flows in Yildiz Grove to sustain its natural structure, visitors to the area were chosen by a systematic sampling method to complete an on-site questionnaire. These surveys included questions meant to determine reasons in choosing to come to the area, including what they prefer to do in the area and which part of the area they prefer to be in. Additional items included on the surface related to the area quality and the problems that need to be solved.

The questionnaire was given to 240 people with 16 questions. And for the data analysis of the questionnaire, the SPSS Statistical package and excel programs were used.

THE OBJECTIVES OF THE QUESTIONNAIRE

The objectives of the questionnaire can be summarized in five subjects as following:

- The characteristics of the grove and the user groups
- The relationships of the grove and the user groups
- The density of the crowd according to seasonal change, the main form of transport that the visitors prefer to use to get to the area, the time they spent at the area, which region they live in Istanbul and the well-known characteristics and their view of the grove.
- The using type and the facilities of the grove
- Expectations of the users
- Expectations of the nature scientists

The improvements or new developments that the users would like to see in the grove or their suggestions to protect the area that have very important and sensitive issues that relate to the area

QUESTIONNAIRE RESULTS

After evaluation of the data received from the questionnaire, the findings could be summarized as follows:

Between the people visiting the area, 82.5 % of the respondents’ have been the area before and 67.5% of the total think that the area needs some improvements and new developments especially on outdoor and parking facilities and educational provisions.

Respondents’experience about the reason for choosing to visit the grove and the activities that they prefer to perform at the area are summarized at the following tables.
Because there is a need to change existing use patterns for sustainability in natural structure, we suggest the voluntary dispersal through either information programs or changes in physical design of the setting. Compared to permit or regulation enforcement, make some changes in the physical design of setting and educational programs are non-confrontational. Limiting parking space, make some changes in road access, close to some areas to the vehicle traffic and pedestrianized. The road access passing through the protected areas will be controlled and redirected in the interferenced areas of the grove. The sitting and gathering places will be designed in short-time service.

The decisions related to planning of the grove

The operation and further development of the facilities and their functions and objectives will be determined one by one. The carrying capacity of each grove will be determined and concentrated on nature friendly usage. The parking problems adjacent to entrance points will be solved and the entire grove will be closed to vehicle traffic and pedestrianized. The road access passing through the protected areas will be controlled and redirected in the interferenced areas of the grove. The sitting and gathering places will be designed in short-time service.

The decisions related to visitor management

The management system needs to be developed considering user demands and it also will be supported by public relations efforts. Especially at the entrance points, the users need to be informed about some restrictions of using the area.
- An efficient signage system and directions at certain points will enable people to get oriented to the area.
- There must be some restrictions about the time that the people spend at certain points and some places need to be protected from overuse.
- People who prefer to have a traditional picnic in the area need to be directed away from the groves.
- The number of the personnel who work in the groves ought to be increased dependent on the area of the grove, usage density and land-use behaviours.
- Education programs for users ought to be held in order to make users conscious of the natural structure of groves and such topics as how to act in the area and how to benefit from the area.
- The user groups need to be informed via communication devices about the groves before visiting the areas.

In order to plan the user flows in Yildiz grove for sustainability in its natural structure, the grove was grouped as subsections based on the evaluation of land-use behaviours and recent use of the sections before conducting the questionnaire.

After examining the questionnaire results, the grove was divided into different zones based on the evaluation of land-use behaviours and recent use of the sections before conducting the questionnaire.

The decisions related to urban planning

In order to control the visitor crowd, the planning needs to be considered in an urban planning scale. The renovation and improvements of the district parks adjacent to the grove will decrease the demand for the grove especially with children and teenagers.
ZONE 1. Having an average of 60-70 % slope, this area is maintaining a collection of mature trees and intensely cultivated areas with lawns. Building a natural history and information centre provides information and includes educational exhibits in this area. This will be a helpful decision in order to publicize the biological diversity and richness of the area. Additionally, the usage of this zone must be under control and the information about every plant and natural object will be presented. The existing pond in the zone has an advantage of increasing the biological diversity.

ZONE 2. In this zone, the needle-shaped trees form the dominating vegetation and the ground cover is intensely cultivated with lawns. The usage of this zone needs to be considered as follow up of zone 1. The area has a potential for plant shows.

ZONE 3. This area, including the historical Malta and Cadir kiosks serving as a restaurant today, reaches the highest visitor potential with its unique scene. Especially on upper slopes, the undergrowths were damaged and somewhere natural ground cover replaced with lawns. This zone is mostly preferred by picnic users and it needs to be controlled and planning for short time usage will be promoted.

ZONE 4.1. The Istanbul Municipality, Chapter of Parks and Gardens Management Building and greenhouses that serve the plant requirements for the grove are located in this zone. The greenhouses need to be improved with modern technologies and should serve as demonstration houses. The greenhouses could be transferred into educational centres that provide information about plant growing techniques and nature.

ZONE 4.2. The historical ceramic factory is located in this zone and it ought to be protected and renovated. The existing sale pavilions should also be supported and improved for continuity.

REFERENCES
Recreation in Urban Forests: Monitoring Specific User Groups and Identifying their Needs with Video and GIS-support

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Abstract: In the urban forest of Stuttgart the forest roads are used by a growing number of people looking for recreation for their leisure activities. To manage and channel the different user groups within an optimized forest road network needs a lot of information: Number and composition of visitors, demands of different user groups concerning standard of roads and trails they use for their activities, conflicts that may rise between different users using the same road at the same time, dedication of roads to special activities (e.g. fitness trail, hiking trail...). Personal interviews with “experts” were made to obtain information about the specific demands of the different user groups, a new method of video monitoring was used to collect longtime information about number and composition of visitors, and analysis of road network was done with the help of GIS. The results show that these tools complement one another quite well and the combination of obtained data may help to channel visitor flows and to minimize conflicts between different user groups.

INTRODUCTION

Forest roads, in former times planned and constructed for the needs of wood harvesting and transport, are the key factor for recreational access to and activities in forests. Leisure activities in urban forest include hiking, biking, horse-riding, jogging and inline-skating. The different user groups may have different demands and impacts on the roads they use for their activities and on the surrounding environment. Using the same roads at the same time may lead to increasing conflicts between the different users. Managing the increasing number of visitors in urban forests needs information about the number, composition and temporal distribution of visitors as well as a profound knowledge of their demands. These information may help to channel visitor flows and to minimize conflicts between users by establishing roads that meet the special requirements of the different user groups.

This paper discusses some methodical aspects and results of an investigation dealing with the analysis and optimization of a multiple use forest road network in the urban forest of Stuttgart (v. Janowsky, 2001). This forest is managed as a multifunctional forest. The objectives are to produce wood for industrial use in an efficient and sustainable way, and to provide opportunities for all kind of recreational activities and outdoor use for the more than 500,000 inhabitants of the town and the region. The objective of this study is to derive an optimized forest road network that meets the requirements of forest management as well as the needs of recreation and outdoor use most effectively. Compared to the status quo, this optimized forest road network should also be characterized by lower maintenance costs and reduced impact on the forest ecosystem. For analyzing the status quo as basis of further optimization the following methodical tools were used (see also fig. 1):

- Video monitoring
- Personal interviews
- Geographic Information Systems (GIS)

![Figure 1: Methodical tools for optimization of multi-use forest network](image-url)
METHODS

Collecting data about number, composition and time schedules of visitors by video monitoring

Some areas of the urban forest of Stuttgart show a heavy frequecntion by the city-dwellers, but up to now actual and exact numbers of long-range studies do not exist. In former counts around Stuttgart visitors were counted only on single days by a couple of people (e.g. school classes) standing at different points - mostly entrances – in the forest. Because of the serious disadvantages of that method – high manpower resulting in data for only a few days that can’t be extended for a longer period– a new method was developed and tested: an automatic video-supported long-range study of visitor number and composition.

This method should fulfill the following technical requirements:

- limited need for service
- no waste of videotapes by recording at times when nobody comes by
- enclosed information about date and time of recording
- no personal related information as faces or number plates of cars
- small and inconspicuous camera for outdoor use (i.e. water resistant and shockproof) that can be fastened easily at different points

Based on these preconditions a system of several electronic components was composed: A water resistant case contains the hen’s egg sized camera and a radio transmitter. Operation power of the camera is ensured by a car battery. The camera sends a radio signal to the receiver which is attached to a movement registering sensor. A signal of this sensor activates the recording control station and the video recorder starts recording for a defined period of time (5 seconds). A time-date generator inserts time and date of the recording. Collecting of personal information is excluded by the focal length of the camera.

By this setting continuing recordings up to one week without need for change of videotape become possible. The necessary service and control measures is limited to check the operation of the system and the regularly change of car battery (once a week) and videotapes (depending on frequention every 2 to 6 days).

The recording unit is not powered by battery, it has to be connected to the electricity mains. This limits the position of the recording set and so the camera can only be installed at spots within a distance up to 50 meters (range of radio signal) to electric cables.

In this research two such camera systems were posted at four different spots. One camera should provide data for a long-range study and therefore stayed at the same spot for one year, while the other camera was set up at three different spots for shorter times (6 weeks to 3 months).

Personal interviews to identify the needs of specific user groups and conflicts between them

Based on the video recording data and on discussion with the local forest management, following user groups could be identified:

- “traditional” cyclists
- mountain-bike-cyclists
- jogger (using fitness trails as well as normal roads and trails)
- walkers
- hiker
- horse-rider
- forest operations

For forest roads which are constructed and used for the purpose of forest operations as wood harvesting and transport, precise standards for technical design are established. Similar standards for recreation trails are lacking in most cases. To obtain a better knowledge and understanding of the demands of the different user groups and the conflicts that may arise between them using the same roads and trails at the same time for their activities, personal interviews with a panel of experts were made. Because of their specific experience these experts represent the opinion and express the demands of many other people of their user group (Atteslander & Bender, 1993). A total number of 13 experts were chosen, for example leader of jogging groups or riding schools and other representatives and stake holders.

The oral interviews based on a written questionnaire which served as a guideline. The questions are open questions, that means they have no fixed categories for answering but the asked person may articulate her point of view oneself. The order of the questions depends on the course of the interview, often some of the planned questions don’t have to be asked expressively, because the answers were already given before.

Regarding the content, the interview guideline is structured in three parts. The first part is dealing with general questions about the position of the interviewed person, about the type and size of the user group he represents and about the frequency and time of activities in the urban forest of Stuttgart. The second part contains the questions about recreation road standard and road density, and the third part deals with possibilities and limitations of overlapping use of different user groups.

Interviews lasted about 90 minutes each and were documented by notes during the interview that were worked out to a detailed protocol afterwards.

Use of GIS for visualisation of roads and trails

The visualisation and analysis of the overlapping use of the roads and trails by the different user groups can be done most effectively by the use of Geographic Information Systems.

Geometry of roads, trails and forest districts was digitized in the Software package ArcView 3.2. For roads and trails information about their length, type
(logging road=1, skidding trail=2, footpath=3) and their dedication to recreational activities were added.

Additionally, the forest roads which are necessary for wood harvesting and transport were marked as dedication to logging.

Each dedication to a special activity was saved in a single column of the database (see table 1). This data structure makes it much easier to locate road segments with high potential for conflicts, because every combination of the different activities can be used for a query.

<table>
<thead>
<tr>
<th>type</th>
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<th>hike</th>
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<th>ride</th>
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<tbody>
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<td>12</td>
<td>y</td>
<td>n</td>
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<td>Y</td>
</tr>
<tr>
<td>2</td>
<td>25.6</td>
<td>n</td>
<td>y</td>
<td>y</td>
<td>n</td>
<td>n</td>
<td>n</td>
</tr>
<tr>
<td>3</td>
<td>18.9</td>
<td>y</td>
<td>n</td>
<td>n</td>
<td>y</td>
<td>y</td>
<td>n</td>
</tr>
</tbody>
</table>

Table 1: Example for attribute table of feature theme “roads”.

RESULTS

Video monitoring

The results presented in this paper do primarily refer to technical / methodical aspects of the video surveillance. For a close look at the results of the statistical analysis of the data see Mutz et al. (2001).

The used method of video monitoring enables management of recreational areas to count visitors over a long period of time with limited input of manpower and costs. Statistical analysis of this data shows cyclical patterns and determinants of visitor behavior that may serve as an input for statistical simulation of visitor flow (Mutz et al, 2001).

Although the main methodical requirements pointed out above are fulfilled, the method still has some disadvantages and weak points that should be mentioned and discussed in the following:

To ensure a continuous operation with low failure times of the system in outdoor use the single components of the system have to be coordinated very well. Failure times may be caused by technical reasons (functional disorder of video camera or connected components) or by delayed change of video tapes or battery. The ratio between days without any failure times and total number of recording days varies at the different spots between 28 % and 80 %. The lowest availability value of 28 % is probably caused by interference to the radio signal at this special location. Frequent monitoring of the video tapes during the first days of recording may show such problems early.

While the data capture on video tapes can be done automatically and therefore is very easy, the analysis of the tapes requires a lot of time. Automatic movement / picture analysis seems to be possible but has not been applied until now. Visual analysis takes – depending on the frequency of use of the roads – between 18 and 210 minutes per recording day (daily recording times from 6 a.m. to 10 p.m.). A simplification of visual analysis was tried by determining the number of movements that trigger recording by the parameters recording time per day and time of a single record (5 seconds). The number of events can be calculated this way, but unfortunately, this leads to a significant loss of information: the object that triggered recording can’t be identified. It could have been a single person as well as a group of people of two or more persons or a logging truck. Recording can also be triggered by the change of light and shadow (e.g. caused by wind moving twigs) because the movement registering sensors react on differences in brightness. This loss of qualitative information makes it impossible to differentiate the user groups and to make statements about the exact number of visitors. So that kind of simplification of data analysis had to be dropped.

Because of the geomorphology of the forests of Stuttgart, a statistical valid sampling of all visitors of a given area over time requires a systematic counting at many spots.

Caused by

- the recording unit’s dependency on electricity mains, which makes only a limited number of locations available for video surveillance
- the high costs of the recording system (5,000-7,000 DM) and
- the time consuming visual analysis of video tapes

only a few camera sets can be used at the same time. This makes the setting of a systematic sample survey for a complete registration of visitors in a defined area quite difficult or impossible.

So this kind of video monitoring is up to now suitable for correct determination of the frequentation of single roads, but it can not be used to obtain a correct spatial distribution of all visitors. Further development in technical means that ensure more independence of electricity and in analysis methods – e.g. using picture analysis software based on identification of patterns - may allow to obtain results about spatial distribution by a flexible spatial-temporal change of recording locations.

Personal interviews

The interviews were suitable to obtain precise information about standards for recreation trails and about possible conflicts between the different user groups.
<table>
<thead>
<tr>
<th></th>
<th>Horse-rider</th>
<th>Hiker</th>
<th>Walker</th>
<th>Jogger</th>
<th>Keep-fit trail</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Road length</strong></td>
<td>10-20 km</td>
<td>no statement</td>
<td>1-5 km</td>
<td>12-25 km</td>
<td>3.5-6 km</td>
</tr>
<tr>
<td><strong>Width</strong></td>
<td>&gt; 3 m</td>
<td>&lt; 2 m</td>
<td>&gt; 3 m</td>
<td>&gt;1.50 m, better &gt; 3 m</td>
<td>&gt; 1.50 m</td>
</tr>
<tr>
<td><strong>Surface</strong></td>
<td>reinforced for go at walk or trot, not reinforced for gallop</td>
<td>not reinforced</td>
<td>reinforced, asphalt if possible</td>
<td>reinforced, no asphalt</td>
<td>reinforced</td>
</tr>
<tr>
<td><strong>Condition</strong></td>
<td>good</td>
<td>walkable</td>
<td>very good</td>
<td>good</td>
<td>good</td>
</tr>
<tr>
<td><strong>Grade</strong></td>
<td>in general up to 6 %, sections up to 10 %</td>
<td>rough terrain, no maximum gradient</td>
<td>flat, max. 5 %</td>
<td>slightly rough terrain, max. 15 % (60-80 m)</td>
<td>1.5 km flat, slightly rough terrain, max. 20 % (50-100 m)</td>
</tr>
<tr>
<td><strong>Route</strong></td>
<td>circular route, not along roads, motorways or tramlines</td>
<td>with regard to scenery, along meadows and vantage points, no roads / cars</td>
<td>towards vantage points or restaurants, sufficient resting benches (every 100 m), starting from parking lots</td>
<td>no steps, starting from parking lots, circular route, signs</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>“Normal” cyclists</th>
<th>Mountain-bike cyclists (competitions)</th>
<th>Mountain-bike cyclists (leisure time)</th>
<th>Forest company</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Road length</strong></td>
<td>no statement</td>
<td>4.5-6 km</td>
<td></td>
<td>45 – 50 m/ha</td>
</tr>
<tr>
<td><strong>Width</strong></td>
<td>&gt; 3 m</td>
<td>&lt; 2 m</td>
<td>predominantly &gt; 3 m</td>
<td>3.50 m</td>
</tr>
<tr>
<td><strong>Surface</strong></td>
<td>reinforced, asphalt or fine crushed gravel</td>
<td>max. 15 % asphalt 95 % without asphalt, natural or artificial obstacles</td>
<td>mostly reinforced with some not reinforced sections</td>
<td>reinforced, subgrade and pavement</td>
</tr>
<tr>
<td><strong>Condition</strong></td>
<td>good</td>
<td>no long, very muddy sections</td>
<td>good / passable</td>
<td>good</td>
</tr>
<tr>
<td><strong>Grade</strong></td>
<td>max. 6 %</td>
<td>no maximum gradient, difference in altitude: 130 – 140 m on the whole distance</td>
<td>rough terrain with different levels blue: up to 6 % red: 6-15 % black: &gt;15%</td>
<td>2-8 (10) %</td>
</tr>
<tr>
<td><strong>Route</strong></td>
<td>with regard to scenery, along meadows or vantage points</td>
<td>circular route, Single trails have to be cut free</td>
<td>avoiding sensitive areas and popular hiking trails</td>
<td>max. opening-op effect, regarding terrain, curve radius: 50 m plain country 20 m mountainous country 12 m serpentines</td>
</tr>
</tbody>
</table>

*Table 1: demands of different user groups*
The standards for different kinds of recreation trails concerning width, surface, condition, grade and route are listed in table 2. A normal logging road is suitable for most of the leisure activities. Some logging trails and footpaths should as well be dedicated to special user groups to ensure attractiveness also for these user groups that prefer that kind of roads for their activities.

In principle a parallel use of different user groups seems to be possible at least on logging roads wider than 3 m. On more narrow roads and trails the conflicts may increase. Especially mountain-bikers show a high potential for conflicts. This is mostly caused by their relatively high speed and their nearly noiseless moving resulting in sudden appearance in front of other people.

Theoretically the user group of the horse-riders shows a similar potential for conflicts. Because of the legal requirements in Baden-Württemberg that limit riding on specially dedicated trails, other users can avoid this trails and so much less conflicts do arise. Quite conflict-free user groups appear to be the joggers and the walkers and hikers as long as they don’t have unleaded dogs with them. Figure 2 shows the potential for conflicts between the different user groups as it is seen by the interviewed people.

![Figure 2: conflicts between user groups](image)

The personal interviews do not only result in general statements about demands and conflicts but may also address specific local problems. Furthermore, the integration of local protagonists leads to a better acceptance of management measures.

### Analysis of the road network with Geographic Information Systems (GIS)

Based on the results of the interviews it is possible to locate road segments that have a high probability for conflicts. In this context not only the overlapping use of different leisure activities but also the type of the road / trail have to be taken into account. Logging roads that are usually wider than 3 m can be dedicated to different leisure activities without causing heavy conflicts, while on small footpaths multi-use dedication should be handled very carefully.

A simple query in the GIS-database may show for example all footpaths that are dedicated for riding and as fitness trail. If this multi-use is assessed as not acceptable, one of the special dedications has to be shifted to nearby roads, taking into account the demands cited by the experts in the interviews. This shifting can be done easily in the GIS by changing the attributes in the attribute table. The more information about the road sections (concerning parameters as grade, surface, etc.) are stored in the database, the better the demands of the different user groups can be met.

### CONCLUSIONS AND OUTLOOK

The use of Geographic Information Systems, video monitoring and personal interviews for monitoring different user groups may be very promising because these tools can be used in combination and are complementary to each other.

The Geographic Information System contains not only the information about the location of the forest roads. Additional attribute information as a dedication to certain activities, grade of the road, width, surface, etc. enable the management to compare the actual status of the road network with the demands of the different user groups, which were articulated by the experts in the personal interviews. The more information about the roads are available, the better the requirements of the users can be met.

Improved information could be gained of the GIS by adding information about terrain, i.e. by a digital terrain model.

It was shown that dedication of roads and trails to special activities which fulfill the requirements of the specific user groups in combination with the technical design and condition of the single roads seems to be a suitable way to channel visitor flows and to minimize conflicts between different user groups.

As the interviews showed, many people avoid forest roads that don’ t meet their demands, so a “bad” condition of a road may be understood as an intentional instrument to keep certain types of visitors apart from this special road. A parallel dedication of roads as alternatives for the specific user groups is necessary to obtain this effect. As results from other investigations (Wöhrstein, 1998)
and experiences with new dedicated mountain-bike routes show, a dedication of suitable roads to a special activity leads to decreasing conflicts.

A further development of the methodology of video surveillance in the direction pointed above resulting in the possibility to obtain statistically valid data of spatial distribution of visitors in time may link the results of this surveillance with the GIS. The spatial distribution of the visitors could then be visualized and analyzed in the GIS.

REFERENCES


Recreational Forest Management: Sustainably Protecting and Improving the Recreational Function of the Vienna Woods

Herbert Weidinger
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The City of Vienna stretches from 16°11'13" to 16°34'43" Eastern longitude, and from 48°07'06" to 48°19'23" Northern latitude, covering a territory of 41,495 hectares. At an altitude of 150 to 580 metres above sea level, Vienna is traversed by the Danube river for a length of over 20 km.

URBAN TERRITORY BROKEN DOWN BY UTILISATION


Today, Vienna is an environmental model town that offers its people a high quality of living, thanks to its location on the eastern fringe of an extensive forest range known as the Vienna Woods.

VIENNA WOODS

Geographical extension
- More than 135,000 hectares to the west of Vienna (only a small part 6 % is located on actual Viennese territory).

Geology
- 52% of the region Vienna Woods is covered by forest.
- Two rock types can be distinguished: Flysch (sandstone);
- Extends over most of the Vienna Woods in the northern and western parts.
- Marl, clay slate and sandstone, heavy and deep soil.
- Gently rolling hills with elevations of not more than 500 metres.
- Terraces descending towards Vienna, characterised by the deposits and erosions of the Danube.
- Vegetation: Deciduous forest (oak & hornbeam, beech & fir, red beech).

Limestone:
- In the south.
- Limestone or dolomite rock, dry, oligotrophic soil.
- Precipitous rock faces, hills with elevations of up to 900 metres.

- Prominent timber: Austrian pine (Pinus nigra; planted in the 18th and 19th century to obtain resin).
- Vegetation: Austrian pine & hornbeam, Austrian pine & beech, downy oak, sessile oak & hornbeam, red beach.

Climate
- Western part: Atlantic climate (precipitation: c. 1000 mm, cool summers).
- Eastern part: continental climate (precipitation up to 600 mm, hot summers).

CITY OF VIENNA FOREST MANAGEMENT

One fifth of the areas managed by the Municipal Department 49 (Forestry Office) of the City of Vienna is located within the conurbation (8,230 hectares of mostly forested areas).
- Management of the city forests.
- Ongoing participation in urban development, by planning, designing and maintaining attractive green spaces.
- Preservation and maintenance of recreational areas and facilities (hiking paths, benches, grill spots, cycling and walking paths, etc.) in Vienna.
- Afforestation for the public benefit.
- Maintenance and preservation of meadows.
- Layout of ecological zones and wind screens.
- Information for forest visitors.
- Maintenance of paths and roads in the Forestry Office’s administrative territory.
- Upkeep of the buildings of the Forestry Office.
- Activities to control game population.
- Timber sale.
OWNERSHIP STRUCTURE

Most of the forests in Vienna (about 72%) are owned by the Municipality. The Austrian Federal Forests hold about 13%; church forests make up some 8%, and about 5% are in private hands and in the hands of the Federal Republic of Austria.

URBAN FOREST MANAGEMENT

The forests of Vienna are the “green lung” of the city, an ecological compensation and important recreational space for the population of Vienna. Measures taken in and for the recreational forests aim to preserve and improve existing forest stands, based on the following principles:

- no clear felling, only spot clearing;
- regeneration through seeding by the trees;
- rare tree species of ecological value (e.g. Sorbus torminalis, Sorbus domestica) are encouraged;
- space set aside for special habitats (wetlands, dry meadows and grasslands);
- ban on chemicals (artificial fertilisers, herbicides, insecticides);
- visitor flows are directed to suitable paths and recreational facilities to protect ecologically valuable forests;
- old forest stands, trees and deadwood are not removed unless they constitute a danger to visitors;
- natural forest reserves are set up in near-nature forests.

Recreational facilities: Suitable recreational infrastructure needs to be provided for the hikers and strollers. The Forestry Office cares for more than 50 playgrounds in the forests and adjoining open spaces, large picnic meadows, three observation towers, five grill spots, several thousands of benches, garbage bins, signposts, information signs and two animal enclosures.

The newly popular sports of running, mountain biking and walking have conquered the forests, and runners and walkers can use the extensive network of paths without friction. For the mountain bikers, separate cycling paths, which quickly get them from the more urban parts of the forests to the quieter sections of the Vienna Woods, had to be laid out in the forests to avoid conflict with other users. The network of cycling paths was developed jointly with the Province of Lower Austria, the Austrian Federal Forests and the neighbouring communities in 1998.

Nature protection: Vienna owns more than 2,800 hectares of national park, of which more than 2,500 hectares are set aside as a nature reserve within the boundaries of Vienna. The other parts of the Vienna Woods and the vineyards are mostly dedicated as protected areas. Nature protection in Vienna nevertheless is not limited to areas specifically designated for protection, but encompasses all habitats including those in the core of the city, and it spans efforts to raise awareness of the concept in the population.

Soil protection: The City of Vienna has planted more than 50 km of wind breaks within the territory of Vienna to shelter agricultural land, which are managed by the Forestry Office of the Municipal Department 49. By introducing these screens, an additional valuable component has been created in an urban environment which offers recreational space next to residential areas.

Timbering is fostered by the rigorous implementation of a concept to regenerate near-nature forest stands. Utility forests make up 7,800 hectares in Vienna, producing a timber stock of 311 cubic metres per hectare, an annual growth of 6.3 cubic metres per hectare and an annual utilisation of 3.8 cubic metres per hectare. Some near-nature stands (about 160 hectares in Vienna) are completely banned from timbering due to their scientific importance of being a natural forest reserve.

VIENNA WOODS MANAGEMENT – FOCUS ON RECREATIONAL FUNCTIONS

Recreational areas in the immediate vicinity of a conurbation such as Vienna are expected to cover a number of requirements. Forests and open spaces contribute more than their share in terms of recreation, supply of fresh air and protection of

<table>
<thead>
<tr>
<th></th>
<th>hectares</th>
<th>percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building space</td>
<td>13,600</td>
<td>33</td>
</tr>
<tr>
<td>Green space</td>
<td>20,250</td>
<td>49</td>
</tr>
<tr>
<td>of which:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>forest</td>
<td>7,840</td>
<td>18</td>
</tr>
<tr>
<td>agriculturally used</td>
<td>6,800</td>
<td>16</td>
</tr>
<tr>
<td>parkland</td>
<td>1,620</td>
<td>4</td>
</tr>
<tr>
<td>meadows</td>
<td>2,290</td>
<td>5</td>
</tr>
<tr>
<td>private gardens</td>
<td>1,270</td>
<td>3</td>
</tr>
<tr>
<td>sports grounds</td>
<td>770</td>
<td>2</td>
</tr>
<tr>
<td>Water</td>
<td>1,930</td>
<td>4</td>
</tr>
<tr>
<td>Traffic space</td>
<td>5,700</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>41,495</td>
<td>100</td>
</tr>
</tbody>
</table>
hobbies. In view of the large number of (potential) users, it is necessary to identify and allocate individual interests while at the same time ensuring that the parks and green areas can still function as a high-quality recreational space, suppliers of fresh air, air filters and water reservoirs.

In terms of managing urban recreational areas, be they in Budapest, Vienna, Athens or elsewhere, similar approaches are used. An international comparison can analyse various strategies, from which solutions can be adapted for other regions.

In order to evaluate the current use of recreational forests in Vienna, a survey and analysis was made of their condition and infrastructure. Over one hundred square kilometres

New offers of infrastructure and information are developed from suggestions and requests made by visitors through direct contacts or surveys. In addition, emerging conflicts may call for the need to find particular solutions. Rapid action is required in such cases and experience from other urban forests can be put to good use.

The findings obtained from this urban forest analysis and comparison between cities are intended to facilitate harmonious (conflict-free) utilisation of recreational forests and to explore further ways and means to utilise unused potentials. Special attention is being given to target-group specific information programmes and timely educational efforts.

EDUCATIONAL FACILITIES OFFERED BY THE FOREST OFFICE OF THE MUNICIPAL DEPARTMENT 49: APPRECIATION IS THE FIRST STEP TOWARDS PROTECTING OUR NATURAL ENVIRONMENT

Forest school: experience the forest with all your senses

The Vienna forest school offers school children an opportunity to relate to nature by using their senses. Opened in 1998, it welcomes more than 5,000 children per year, who, from 9 am to 4 pm on a “forest day”, learn to feel trees, taste plants, smell soil, hear animals and open their eyes to discover their surroundings by experiencing nature with all their senses. They obtain their information directly from the forest ranger who is the epitome of a person of acknowledged environmental competence. http://www.wien.gv.at/ma49/

The Lainz game preserve is a nature preserve of some 2,500 hectares in size which counts more than half a million visitors a year. One of its major attractions is the Hermesvilla once used by Empress Elisabeth and now the site of art exhibitions. In spring 2000, a visitor information centre was built at the main entrance to the preserve, which offers basic insights into this natural habitat. The preserve organises guided tours for groups specialising in a number of subjects, as well as guided forest tours for school classes and groups.

Nature trails: learning under the open sky

The Vienna Forest Office has laid out nature trails and “forest classrooms” in all forests of the city to furnish nature heritage information that can be freely used by all comers at all times or alternatively included specifically in a half-day guided tour with the forest ranger.

National Park: a pristine forest at the boundaries of a capital city

In addition to the Vienna Woods, the City of Vienna can also boast of its riverine forests along the Danube to add to its green spaces. These forests became part of the Donauauen National Park in 1996. In view of its great potential as a nature preserve, the National Park features a number of visitor attractions, such as a boat trip from the centre of the city to the Park, followed by a guided tour. Green Tours – a walking experience in the National Park.

National Park camp: a school under the stars

As the owner of the National Park, the Vienna Forest Office opened a youth camp at the edge of the National Park in early 2000, organising camp stays for children and youths for several weeks. During school holidays, the camp is also open to family and youth groups.

With ever changing and growing demands and focal points of environmental interest, the Municipality is constantly faced with new challenges in identifying targets and objectives in environmental education. In order to respond to new trends in the public interest in the environment, concepts are already being developed for new ecological education programmes.

SUMMARY

Management of urban recreational forests

Forests located in the vicinity of cities should cover a number of requirements: they must offer a great variety of complex services, such as supplying fresh air, meeting recreational needs and protecting habitats. Considering that many different interests are involved in the use of forests, it is imperative to prioritise conflicting interests and to ensure that the forest’s main functions as a supplier of fresh air, air filter and water storage medium will not be impaired in their quality.

Regarding the size and geographical distribution of forests and their usefulness, Vienna and Budapest show quite similar forest structures. The Natural Resources Project, which focuses on the afforestation of patches in the Pannonian region with a sparse wood cover, offers an opportunity to compare conflict solving strategies at an international level, and thus to address principles of recreational forest management in urban environments. The Management of Recreational Forests includes an analysis of how the recreational potential is utilised, a study of the network of forest paths, information facilities and transport systems. The conflict analysis will be used in the
management plan to identify parameters of relevance to the recreational value of forests. The findings will facilitate conflict-free utilisation of forests and identify potential usage gaps. Conflict resolution will also be helped by information and awareness-raising programmes as well as efforts to educate children and young people on the benefits of forests.